UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II

DATE: SEP 23 1986

40122

SUBJECT: Record of Decision for the Combe Fill South Landfill

FROM: James R. Marshall, ~~Acting Director~~
Emergency & Remedial Response Division (2ERRD)

TO: Christopher J. Daggett
Regional Administrator (2RA)

Attached for your approval is the Record of Decision (ROD) for the Combe Fill South Landfill site located in Chester and Washington Townships, New Jersey. We briefed you on the results of the remedial investigation and feasibility study for this site on September 16, 1986.

The major elements of the selected remedy include an alternate water supply for residents with potentially impacted wells, capping of the landfill including surface water controls and a gas venting system, and pumping and treatment of ground water contamination in the shallow aquifer immediately beneath the site. The need for more extensive pumping of the deeper aquifer system will be the subject of a supplemental study. The costs of the selected remedy are approximately $46 million for capital and $51 million for present worth.

The ROD has been reviewed by the appropriate program offices within Region II and the State of New Jersey and their input and comments are reflected in this document. In addition, the State has given its approval of the selected remedy.

Attachment

REGION II FORM 1320-1 (9/85)

RECORD OF DECISION

REMEDIAL ALTERNATIVE SELECTION

Site Combe Fill South Landfill, Morris County, New Jersey

Documents Reviewed

I am basing my decision on the following documents, which provide a comprehensive perspective on the Combe Fill South Landfill and a thorough analysis of the remedial alternatives considered for the site:

- Technical reports and results of investigations and sampling by the New Jersey Department of Environmental Protection over the last several years
- Final Remedial Investigation Report, Combe Fill South Landfill, prepared by Lawler, Matusky and Skelly Engineers, May 1986
- Draft Feasibility Study Report, Combe Fill South Landfill, prepared by Lawler, Matusky and Skelly Engineers, May 1986
- Evaluation of Alternate Water Supply, Combe Fill South Landfill, prepared by Lawler, Matusky and Skelly Engineers, July 1986
- Responsiveness Summary to address comments received from the public, August 1986
- Staff summaries and recommendations

Description of Selected Remedy

- An alternate water supply for affected residences
- Capping of the 65-acre landfill in accordance with Resource Conservation and Recovery Act requirements
- An active collection and treatment system for landfill gases
- Pumping and on-site treatment of shallow ground water and leachate, with discharge to Trout Brook
- Surface water controls to accommodate seasonal precipitation and storm runoff
- Security fencing to restrict site access
- Appropriate environmental monitoring to ensure the effectiveness of the remedial action
- A supplemental feasibility study to evaluate the need for remediation of the deep aquifer

Declarations

Consistent with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, and the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300), I have determined that the alternative described herein is a permanent remedy that will control the source of contamination and mitigate off-site migration of contaminants.

I have further determined that this remedy is a cost-effective alternative that is both technologically feasible and reliable. It effectively mitigates and minimizes threats to and provides adequate protection of public health and the environment. At the same time, it meets all applicable and relevant Federal and State public health and environmental requirements. Furthermore, the selected remedy is appropriate when balanced against the availability of Trust Fund monies for use at other sites.

The State of New Jersey has been consulted and agrees with the selected remedy.

September 29, 1986

Date

Christopher J. Daggett

Christopher J. Daggett
Regional Administrator

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

COMBE FILL SOUTH LANDFILL SITE

SITE LOCATION AND DESCRIPTION

The Combe Fill South Landfill site is located in Chester and Washington Townships, Morris County, New Jersey, approximately 20 miles west of Morristown (Figure 1). This inactive municipal landfill is located off Parker Road about two miles southwest of the Borough of Chester. Of the 115-acre parcel owned by the Combe Fill Corporation (CFC), the site consists of three separate fill areas covering about 65 acres. Illegal waste disposal is suspected in two fields northwest and southeast of the site proper.

Because it is situated on a hill, surface waters drain almost radially from the site. Landfill leachate, ground water, and surface runoff from the southern portion of the site constitute the headwaters of Trout Brook, which flows southeast toward the Lamington (Black) River. Southwest of the site, near the headwaters of the west branch of Trout Brook, is a hardwood wetlands. Much of the original wetlands was cleared to construct the landfill.

A series of county and state park segments, including those of the Black River County Park and Hacklebarney State Park, are located east and south of the site along the Black River (Figure 2). These parks border both sides of the Black River between Route 24 and the Hunterdon County border. Each spring, the segment of Trout Brook within Hacklebarney State Park is stocked with trout by the New Jersey Department of Environmental Protection ("NJDEP" or "the Department").

The site lies in the Piedmont Physiographic Province. In New Jersey, this province is known as "The Highlands" and consists of a 20-mile wide series of northeast-to-southwest trending ridges and valleys extending from the Hudson Highlands of New York to the Reading Prong Region of Pennsylvania. In the area, natural unconsolidated deposits of local soils and granitic saprolite overlie highly fractured granite bedrock. A shallow aquifer exists in the saprolite layer, saturating much of the waste, with a deeper aquifer in the fractured bedrock.

The deep aquifer is the major source of potable water in the vicinity of the landfill. Numerous residential wells within one mile of the site draw water from this aquifer. NJDEP records indicate that there are six public wells within two miles of the landfill, all of which tap the deep aquifer. The nearest municipal well is about one mile southwest of the site. In localized areas, the soils and saprolite overlying the bedrock are of sufficient thickness to provide domestic water supplies.

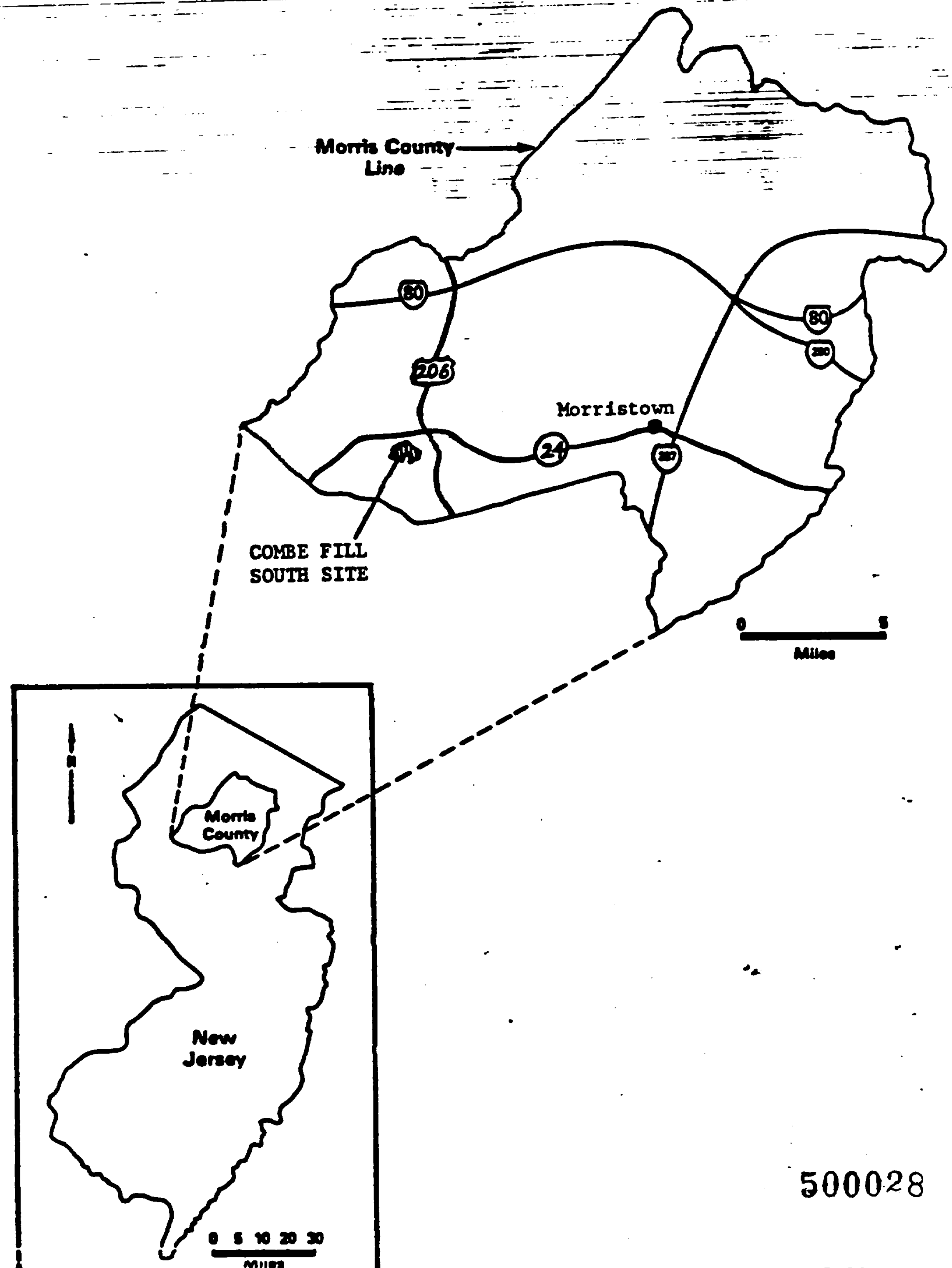

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Figure 1. General Location of Site

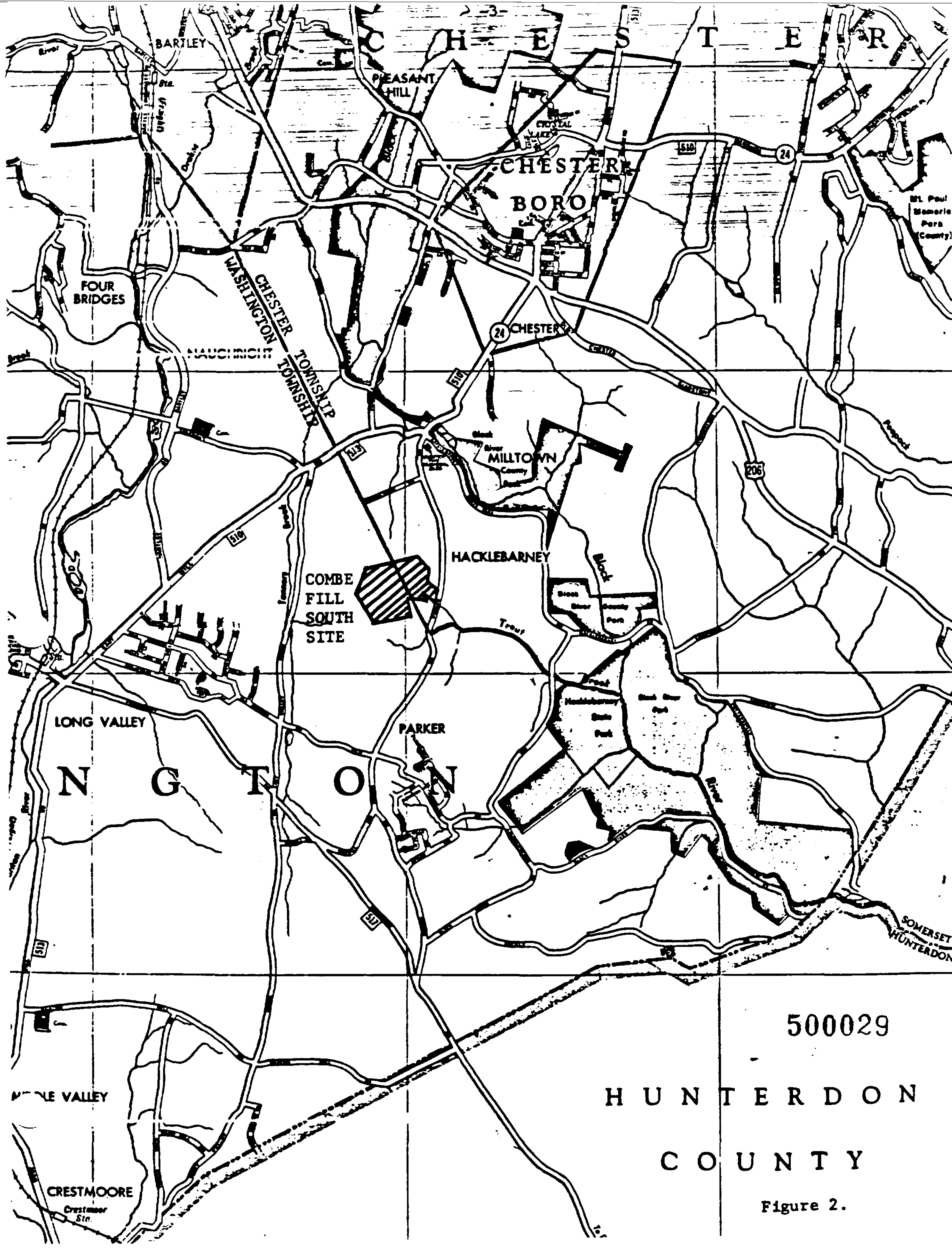

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Figure 2.

Accordingly, ground water wells often tap into the interface between the saprolite and the bedrock.

Fill height is 60-80 feet above the ground surface in the three disposal areas. These areas are punctuated with rifts and leachate seeps, which flow from the steeply graded side slopes. An abandoned workshop area strewn with empty rusty tanks, barrels, and large pieces of machinery lies next to the northern fill area, along with empty drums and loose garbage.

Existing cover at the site is poor and consists of coarse and permeable local soils and crushed rock. Erosion has occurred in many areas, exposing wastes. Severe erosion has occurred along the eastern, southern, and western slopes of the new fill areas. Major rifts exist in the northern, central, and southern portions of the site.

SITE HISTORY

The Combe Fill South Landfill was originally approved by the NJDEP for the disposal of municipal and non-hazardous industrial wastes, sewage sludge, septic tank wastes, chemicals, and waste oils, as stated in its certificate of registration. However, few data are available to document either the types or volumes of wastes actually received.

According to NJDEP files, wastes accepted at the landfill during its 40 years of operation included typical household wastes, pharmaceutical products, calcium oxide, crushed containers of paints and dyes, aerosol product canisters, industrial wastes, dead animals, sewage sludge, septic tank wastes, chemicals, waste oils, and possibly asbestos. Numerous empty 55-gallon oil drums were scattered across the landfill surface. The majority of wastes that were encountered during field reconnaissance, drilling operations, and test pit excavations included typical household wastes (garbage bags, paper, appliances, etc.) and non-hazardous industrial wastes (plastic, wire, metal frames, etc.). Refuse encountered during the drilling of a well that penetrated the center of the landfill appeared to be highly decomposed rubbish. Hazardous materials were not found at the surface of the landfill during field operations.

Based on the original landfill design drawings and records of waste volumes received on-site, approximately five million cubic yards (5,000,000 CY) of waste material are buried in the Combe Fill South Landfill. No documentation or evidence has been found to support local residents' complaints of unauthorized disposal of hazardous materials outside the site proper. The wastes present are well-mixed and no "hot spots" or localized sources of hazardous substances were detected in the landfill.

A leachate collection and recycling system was in operation from 1973 to 1976, but was not maintained nor was any treatment afforded the collected leachate. In fact, whether recycling involved recharge basins or direct discharge onto the ground is unknown, due to the scarcity of historical information on site operations. When the landfill closed in 1981, little if any final cover was applied. Subsequent severe erosion of the landfill surface contributed to the infiltration of leachate into the aquifers underlying the site.

Land use in the vicinity of the landfill is primarily low-density residential (lot sizes are generally more than two acres) amid large parcels of cleared rolling hills. Although some horse husbandry and vegetable, grain, and orchard farming are done in the area, most farmlands are now unused. A few commercial establishments and a nursery school are located on Parker Road within one mile of the landfill. The Hacklebarney iron mines, now abandoned, lie south and east of the site. High iron concentrations, which stem from natural sources, characterize the area's soils, surface waters, and ground water.

In March 1981, using the boundaries delineated in Combe Fill Corporation's (CFC's) 1972 application for registration, NJDEP identified approximately 34 acres of the Combe Fill South property as hardwood wetlands. This area constitutes the headwaters of the west branch of Trout Brook. Most of this wetland area (about 20 acres) has been sold and is no longer a part of the landfill property. The remaining wetland acreage still owned by CFC forms the western border of the site, along the west branch of Trout Brook. As mentioned above, part of the original wetlands was destroyed to construct the landfill.

CURRENT SITE STATUS

The Remedial Investigation (RI) conducted at the site revealed the presence of a wide range of contaminants, consistent with the known uses of the site and the variety of wastes accepted there. Nearly all of the chemicals of concern found at the site are volatile organic compounds (Table 1). Because the ground water represents the major exposure pathway, the substances listed are those found in significant concentrations in either the shallow or the deep aquifer. Appendices A through I list the major hazardous substances found in each of the various media: air, surface water, ground water (shallow and deep), soils (hand-auger and boring samples), and sediments.

TABLE 1

CHEMICALS OF CONCERN

COMBE FILL SOUTH LANDFILL

	Concentration Range (ppb)	
	Shallow Aquifer	Deep Aquifer
Benzene	64.7/80.2	16.9-252
Chlorobenzene	18.2-30.3	9.88/10.8
Ethylbenzene	ND or BMDL	11.7/34.2
Toluene	68.2/1370	1140
Chloroform	57.5	82.6-209
Methylene chloride	4.44-56.0	5.92-176
Trichloroethylene	4.04	2.72-56.8
Tetrachloroethylene	ND or BMDL	5.58-14.3
1,1-dichloroethane	51.4/65.2	6.41-30.2
Chloroethane	62	22.5/74.3
1,4-dichlorobenzene	10.1/39.4	14.2
1,2-dichlorobenzene	7.25/9.77	1.92/5.58
1,2-dichloroethane	6.1	4.54-40.5
Trans-1,2-dichloroethylene	8.02	5.40-47.5
Nickel (ppm)	0.02/0.03	0.02

ND = Not Detected
BMDL = Below Method Detection Limit

The overall site problems and actual or potential contaminant pathways are listed in Table 2. Public health and environmental objectives were identified for site remediation, based on the characterization of the site and the associated exposure pathways.

The RI produced three major findings:

1. The ground water beneath the site has been contaminated by hazardous substances emanating from and traceable to the site. Both the shallow (saprolite) and the deep (fractured bedrock) aquifers have been affected.

2. Potable residential wells northeast of the site, along Parker Road and Schoolhouse Lane, have already been contaminated with various chemicals that have migrated off-site.

3. Other wells farther downgradient of the site (i.e., in several different directions) are at risk due to the continued off-site migration of the contaminated ground water.

Although much of the fill material is 60-80 feet above the ground surface, the water table is also relatively high. As such, some of the waste is saturated much of the time. Contaminants from the site have moved downward into the deep aquifer and dispersed in several directions with the ground water--largely to the northeast and southwest, but also to the east and southeast (Figure 3). In the case of volatile organics, a distinct finger of the plume extends northeast parallel to Parker Road toward the western end of Schoolhouse Lane (Figure 4).

The natural soils found in the area and used to mix and cover the wastes at the site are generally well-drained, especially the Edneyville series. Overall, the underlying saprolite is highly permeable, as well. Due to the combination of leachable contaminated soil, permeable saprolite and a high water table, ground water is the primary means of contaminant migration. Figure 5 shows the stratigraphy and water table under the major (most recently used) fill area.

ENFORCEMENT

The State of New Jersey and EPA have identified numerous potentially responsible parties (PRP's), including Combe Fill Corporation (CFC) and its parent company, Combustion Equipment Associates (CEA). CFC declared bankruptcy in October 1981, one month before the landfill was officially closed. A bankruptcy hearing was held on December 22, 1982.

On October 5, 1983, Notice Letters were sent out to 97 PRP's regarding a proposed RI/FS at the site. None of the 87 acknowledged recipients offered to undertake the RI/FS.

TABLE 2

SITE PROBLEMS AND POTENTIAL PATHWAYS OF CONTAMINATION

COMBE FILL SOUTH LANDFILL

SITE PHYSICAL CONDITIONS

Exposed debris due to insufficient cover
Rifts, leachate seeps, and swampy areas
Unrestricted public access
Steep slopes with no stabilization

CONTAMINANT PATHWAYS

1. Air

   - Emissions of methane and volatile organics; dust and particulate emissions due to poor cover

2. Ground Water (Primary Pathway)

   - Ground water discharge to surface via leachate seeps

   - Ground water contamination in shallow aquifer from leachate, possibly moving off-site

   - Ground water contamination of deep aquifer, possibly moving off-site

3. Surface Water

   - Unrestricted surface water runoff moving contamination off-site

   - Discharge of leachate seeps and contaminated ground water to surface waters leaving site

4. Soils/Sediment

   - Surface water contamination of stream sediments

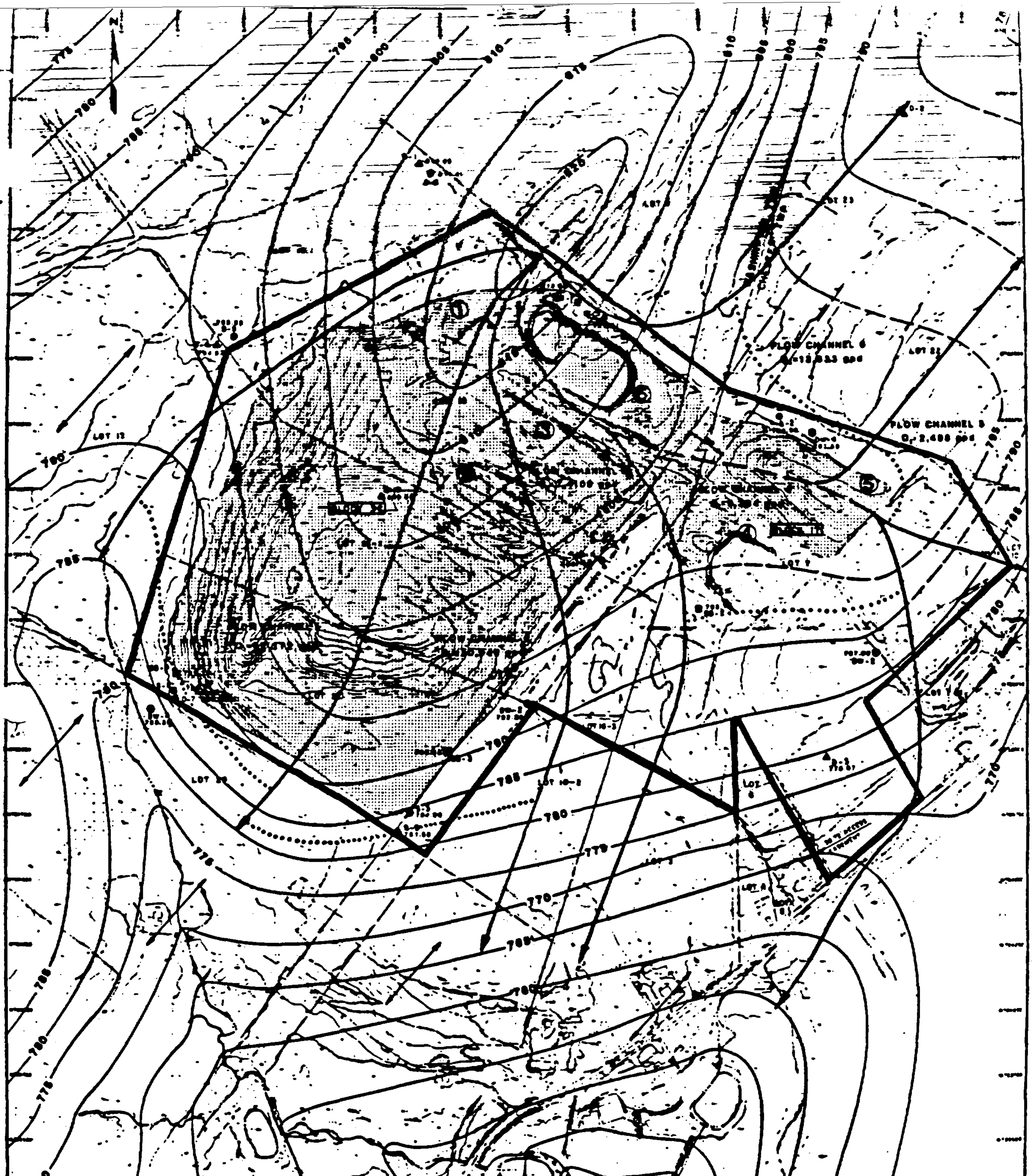

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Figure 3.

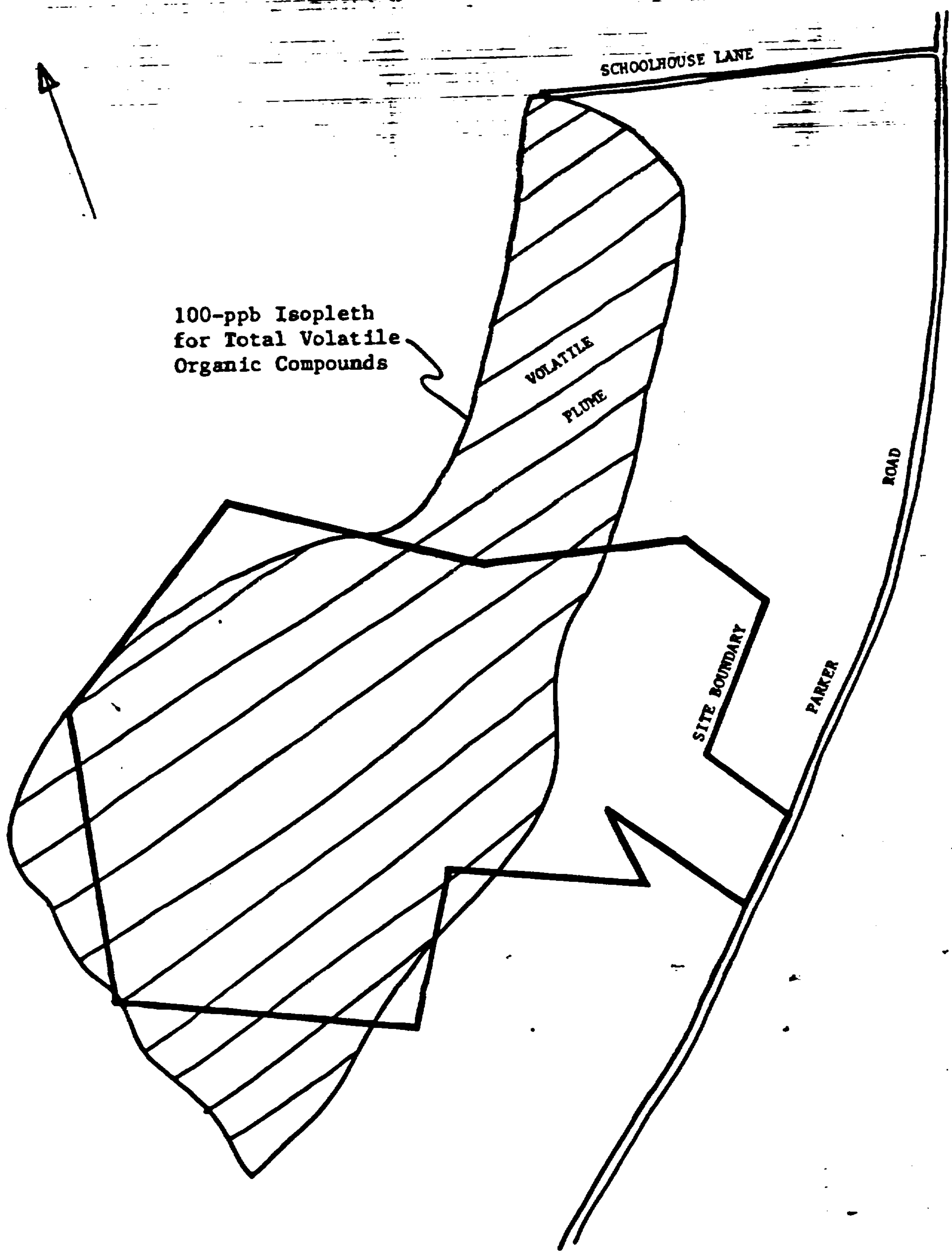
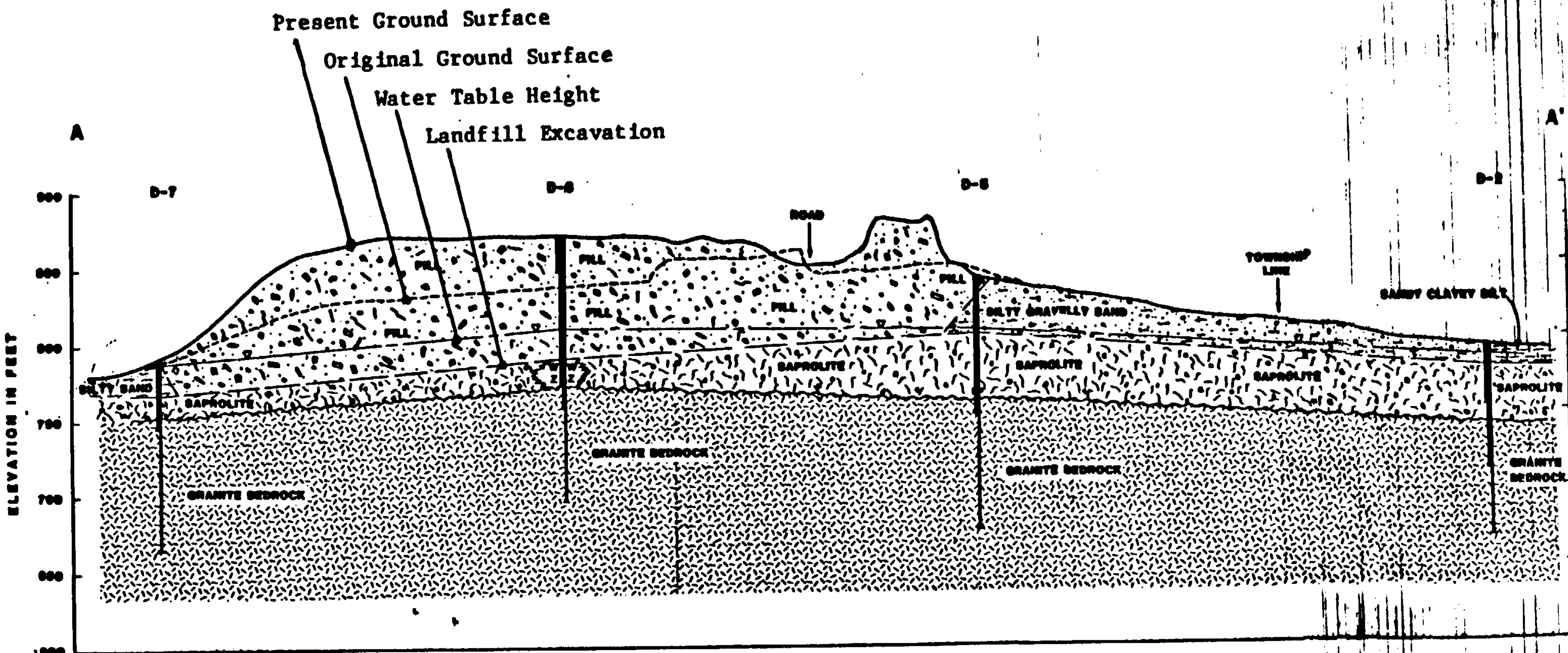

SCHOOLHOUSE LANE
100-ppb Isopleth
for Total Volatile
Organic Compounds
VOLATILE
PLUME
ROAD
SITE BOUNDARY
PARKER

Figure 4.



SECTION A-A'

Figure 5.

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On November 21, 1983, EPA entered into a Cooperative Agreement with the NJDEP making Superfund money available to conduct the RI/FS at the landfill.

On January 22, 1986, EPA filed an application in Bankruptcy Court seeking reimbursement of Superfund monies spent to date at the landfill from CFC, a debtor in Bankruptcy. Because of the limited funds remaining in the bankrupt's estate, EPA and Combe Fill Corporation reached a tentative settlement of the Superfund claims in May 1986. To date, EPA has not initiated any enforcement actions against any other potentially responsible parties, including CEA.

DEVELOPMENT OF ALTERNATIVES

The following process was used to produce the remedial alternatives considered for the Combe Fill South Landfill:

- Identify general technical response categories and determine those that are appropriate to address the public health and environmental concerns associated with a particular site;

- Develop and screen a comprehensive list of remedial technologies to select those appropriate for the site;

- Integrate successfully screened technologies into remedial components and finally into complete remedial alternatives;

- Screen alternatives according to cost, feasibility, and effectiveness.

Successfully screened alternatives were evaluated in detail to determine the most appropriate remedy for the site. This procedure is discussed in a separate section.

For the Combe Fill South site, the primary remedial objective is to control the release of contaminants from the landfill. Based on the general exposure pathways identified, more specific objectives were established:

- Mitigate off-site migration of contaminated ground water in both aquifers
- Mitigate leachate contamination of ground water
- Mitigate runoff of contaminated surface water
- Mitigate off-site dispersal of airborne contaminants
- Minimize potential for exposure to contaminants
- Restrict site access

The remedial measures developed were designed to alleviate the public health risks and potential environmental impacts associated with the landfill wastes.

The RI findings were used to develop remedial objectives dealing with both public health and the environment. Remediation of contaminated ground water protects public health directly, as potable wells tap the aquifers extending beneath the site. Restoration of Trout Brook and the surrounding hardwood wetlands is the primary environmental objective of site remediation, although the connection with other surface waters involves public health, as well.

The technical response categories identified for the Combe Fill South site are listed in Table 3. Of the categories listed, complete removal was deemed infeasible due to the large volume of landfilled wastes at the site, which has been estimated at five million cubic yards (5,000,000 CY). No approved facility currently exists that could receive such a large volume of wastes. In addition, in-situ treatment of contaminated ground water was seriously questioned due to the fractured nature of the bedrock associated with the deep aquifer. Fracturing may isolate pockets of deep ground water and preclude complete treatment of the aquifer.

A comprehensive list of remedial technologies was developed based on these response categories (Table 4) and screened to eliminate inappropriate elements. This list includes both established and innovative technologies and screening was performed in the context of developing a permanent solution to the problems at the site. Asphalt and concrete were both eliminated as capping materials due to their potential incompatibility with landfill wastes. Further, their rigidity is not suited to an unstable landfill surface. Revegetation with shrubs and trees (as opposed to ground cover alone) was also eliminated as part of a capping alternative, since the roots could eventually penetrate the cap and thus allow infiltration.

A cement/bentonite mixture was rejected for the slurry wall because the cement could actually increase the permeability of the wall. Similarly, sheet (steel) piling was dropped from further consideration because the rocky soils (especially the Parker series) and bedrock might preclude installation or damage the wall during emplacement. General operation and maintenance (O&M) problems eliminated French drains and tile drains from further consideration.

The options for removing or containing contaminated sediments were scaled down or dropped due to the small quantities of sediment involved. Various options for in-situ treatment were considered and rejected due to the fractured bedrock, as mentioned above. In general, technologies with little or no field testing to support them were eliminated, along with those that involve direct handling of the entire landfill volume.

TABLE 3

GENERAL REMEDIAL RESPONSE CATEGORIES

COMBE FILL SOUTH LANDFILL

RESPONSE CATEGORY

No or Minimal Action

Access Restrictions

Containment

Pumping

Diversion

Removal:
- Complete
- Partial

Collection and Treatment:
- On-site
- Off-site
- In-situ

Disposal:
- On-site
- Off-site

Alternative Water Supply

Relocation

TABLE 4

REMEDIAL TECHNOLOGIES

COMBE FILL SOUTH LANDFILL

1. Gas and Dust Migration Control

   A. Dust Control Measures
      1. Polymers
      2. Water

   B. Gas Collection
      1. Passive pipe vents
      2. Passive trench vents
      3. Active gas collection

   C. Capping
      1. Synthetic membrane
      2. Clay
      3. Asphalt
      4. Concrete
      5. Chemical additives/ stabilizers
      6. Multi-layered cap

   D. Vertical Barriers
      (See #3, Leachate Control, for specific technologies)

2. Surface Water Controls

   A. Capping
      (see #1, above)

   B. Grading
      1. Scarification
      2. Tracking
      3. Contour furrowing

   C. Revegetation
      1. Grasses
      2. Legumes, shrubs, trees

TABLE 4 (continued)

REMEDIAL TECHNOLOGIES

COMBE FILL SOUTH LANDFILL

D. Diversion and Collection Systems
   1. Berms
   2. Ditches, trenches and swales
   3. Terraces and benches
   4. Chutes and downpipes
   5. Seepage or recharge basins
   6. Storage ponds
   7. Levee/flood walls

3. <u>Leachate and Ground Water Controls</u>

A. Capping (see #1C)

B. Barriers
   1. Location
      a. Downgradient
      b. Upgradient
      c. Horizontal (bottom-sealing)

   2. Material/Construction
      a. Soil/bentonite slurry wall
      b. Cement/bentonite slurry wall
      c. Grout curtains
      d. Sheet piling (steel)
      e. Synthetic membrane

C. In-situ Permeable Treatment Beds

D. Ground Water Pumping
   1. Function
      a. Extraction
      b. Injection (alone or with extraction)

   2. System Options
      a. Well points
      b. Deep wells

E. Subsurface Collection System
   1. Drainage ditches/trenches
   2. French drains/tile drains
   3. Pipe drains (multimedia drains)

TABLE 4 (continued)

REMEDIAL TECHNOLOGIES

COMBE FILL SOUTH LANDFILL

4. Excavation and Removal of Waste and Soil

5. Removal/Containment of Contaminated Sediments

   A. Sediment Removal
      1. Mechanical
      2. Hydraulic
      3. Pneumatic

   B. Sediment/turbidity controls
      1. Silt curtains
      2. Cofferdams/sheet pile/ stream diversion/barriers

6. In-situ Treatment

   A. Extraction (soil flushing)

   B. Immobilization
      1. Sorption
      2. Ion exchange
      3. Precipitation

   C. Chemical Degradation
      1. Oxidation
      2. Reduction
      3. Polymerization

   D. Biodegradation

   E. Photolysis

   F. Attenuation

   G. Reduction of Volatilization

7. Waste Treatment

   A. Incineration/Destruction
      1. Rotary kiln
      2. Fluidized bed
      3. Multiple hearth
      4. Liquid injection (liquid waste)
      5. Molten salt
      6. Pyrolysis
      7. Plasma-arc pyrolysis

TABLE 4 (continued)

REMEDIAL TECHNOLOGIES

COMBE FILL SOUTH LANDFILL

B. Gaseous Waste Treatment
   1. Activated carbon
   2. Flares
   3. Afterburners
   4. Recovery/reuse

C. Liquid Waste Treatment
   1. Biological treatment
      a. Activated sludge
      b. Trickling filter
      c. Rotating biological contactor
      d. Aerated lagoons/waste stabilization ponds
      e. Anaerobic filter

   2. Chemical Treatment
      a. Precipitation
      b. Flocculation/coagulation
      c. Aeration/oxidation
      d. Neutralization (pH adjustment)
      e. Chlorination
      f. UV/ozonation

   3. Physical Treatment
      a. Flow equalization
      b. Sedimentation
      c. Activated carbon
      d. Ion exchange
      e. Reverse osmosis
      f. Liquid-liquid extraction
      g. Oil-water separator
      h. Steam distillation
      i. Filtration
      j. Air stripping
      k. Steam stripping
      l. Dissolved air flotation

   4. Discharge to publicly owned treatment works (POTW)

TABLE 4 (continued)

REMEDIAL TECHNOLOGIES

COMBE FILL SOUTH LANDFILL

- D. Sludge Handling and Treatment
  - 1. Thickening/Dewatering
    - a. Screens
    - b. Centrifuge
    - c. Gravity thickening
    - d. Flotation/thickening
    - e. Vacuum filtration
    - f. Belt filter press
    - g. Pressure filter
  - 2. Treatment
    - a. At POTW
    - b. On-site
    - c. At RCRA disposal facility
    - d. Neutralization
    - e. Incineration
    - f. Oxidation/reduction
    - g. Composting
- E. Solidification/Encapsulation
  - 1. Solidification
    - a. Cement-based
    - b. Lime-based
    - c. Thermoplastic
    - d. Organic polymers
    - e. Self-cementing
    - f. Vitrification (glassification)
  - 2. Encapsulation

8. Land Disposal/Storage

- A. Landfills
- B. Surface Impoundments
- C. Land Application
- D. Waste Piles
- E. Deep Well Injection
- F. Temporary Storage

TABLE 4 (continued)

REMEDIAL TECHNOLOGIES

COMBE FILL SOUTH LANDFILL

9. Provision of Potable Water

   A. Alternate drinking water supply
      1. Deeper wells
      2. Cisterns or tanks
      3. Municipal water system

   B. Individual Treatment Units

10. Relocation

11. Access Restriction

   A. Signs

   B. Fencing

   C. Security guards

Such large-scale operations would entail increased short-term emissions of volatile organics, temporary storage of excavated material, increased risks to on-site workers, and enormous costs. The effectiveness of any such alternative, therefore, is compromised by cost and feasibility considerations.

The successfully screened remedial technologies were used to develop an initial list of ten remedial alternatives (Table 5). Considering cost, feasibility, and effectiveness, two alternatives--off-site disposal and capping without management of migration--were dropped from further consideration.

A clay cap would provide some control of the contamination source by reducing infiltration and thus the amount of leachate generated. However, by itself, it does not mitigate the existing ground water contamination in any way, either on- or off-site, and would increase off-site migration of contaminants relative to the other alternatives considered. Thus, although cost and feasibility are both comparable to other alternatives, the lack of effectiveness rules out capping alone, as it would not adequately protect public health or the environment.

The other alternative eliminated during initial screening was off-site disposal of landfill wastes. This approach is the most effective source control remedy considered, since it physically removes the contamination to eliminate any further contact with the ground water. It is also one of the five categories that must be addressed, according to NCP requirements. The feasibility of this alternative in this case, however, is highly questionable on several counts. Excavation and transportation of such a large volume of waste material presents significant risks of exposure by both airborne dispersion and potential direct contact. These risks are aggravated by the long time required to dig up and remove all the on-site wastes. Finally, the associated cost estimate of $3.4 billion is prohibitive in light of the monies available for site remediation nationwide.

Since off-site disposal at a RCRA facility must be addressed and the original alternative is precluded by prohibitive costs and limited feasibility, a modified alternative was developed to address the intent of the NCP category requirement while providing more reasonable costs and increased feasibility. This alternative involves on-site disposal - i.e., a RCRA-approved landfill on and around the existing site. Construction of this facility entails the purchase of 135 acres of additional property next to or near the site. This approach is discussed in more detail below as Alternative 2.

TABLE 5

ALTERNATIVES DEVELOPED FOR INITIAL SCREENING

1. No Action
2A. Disposal at off-site RCRA landfill
2B. Construction of on-site RCRA landfill
3A. Cap, Treat, and Trench
3B. Cap, Treat, Trench, and Deep Pump
3C. Cap, Treat, and Shallow & Deep Pump
4. Cap, Treat, Trench, Extensive Deep Pump, and Upgradient Barrier Wall
5A. Cap, Treat, Short-Term Downgradient Pump, and Circumferential Barrier Wall
5B. Clayless Cap, Treat, and Trench
5C. Cap Only

A third modification to the alternatives listed was based on whether deep aquifer pumping would draw contaminated ground water down from the shallow aquifer. If so, this process would allow contamination to enter the fractured bedrock, where remediation would be far more difficult, if not impossible. In contrast, the shallow aquifer is more accessible and recovery pumping would be more effective. A shallow pumping system would replace the more elaborate (and much more expensive) leachate collection trench included as part of Alternatives 3A, 3B, and 4.

Given these considerations, the shallow and deep aquifer pumping components of Alternative 3C were re-examined in a different light. As a result, a phased approach was developed consisting of two separate elements. First, the shallow aquifer would be pumped to lower the water table on-site and isolate the landfilled wastes from the shallow ground water. After the water table and contaminant concentrations had been lowered to acceptable levels, the need for deep aquifer remediation could then be evaluated in a second-phase feasibility study.

As the water table is lowered and the wastes dry out, generation of methane and other gases may increase. Accordingly, the passive gas venting system was replaced with the active gas collection and treatment included as part of Alternative 4. This upgrade is considered necessary to minimize the risks of explosion, spontaneous combustion, and subsidence.

Eventually, a fourth alternative was created to incorporate these components, which is designated Alternative 3D. 20 additional ground water wells were incorporated, as well--10 to be installed in each aquifer to evaluate the effectiveness of the shallow aquifer remediation and to track contaminant migration in the deep aquifer.

<u>Alternate Water Supply</u>

In May 1986, NJDEP promised local officials that each remedial alternative considered would include a permanent alternate water supply for residents within the area of actual or potential impacts, as defined by NJDEP. Over the past several years the Department has collected well water samples at numerous residences in the vicinity of the Combe Fill South Landfill. However, it was not until the results of the August 1985 residential sampling program were reviewed that drinking water quality became a concern (i.e., concentrations of certain compounds approached the Department's Drinking Water Guidelines) for a few residences.

Based on the limited information available in December 1985, the Department identified an area of actual or potential impacts resulting from off-site migration of contaminated ground water from the landfill. Residents within this area were advised that there might be some risks associated with drinking their water, although these risks were both unconfirmed and undefined at that time. The Department also advised all residents within this area to use bottled water if they were concerned about their water quality, or if better quality water were readily available. Subsequently, claim forms for the Sanitary Landfill Closure and Contingency Fund were forwarded to these residents for future reimbursement of costs associated with the purchase of bottled water.

The decision to develop a permanent alternate water supply for affected residents was based on the hydrogeological nature of this site and the potential for contaminants to migrate off-site. This was a preventive decision, not based solely on the known potable well contamination. A briefing was given on April 31, 1986 for local, state, and federal representatives, as well as environmental groups. Based on the discussions during this meeting, the Department instructed its contractor to examine three separate options for a permanent alternate water source: creation of a new water supply, extension of the Washington Township Municipal Utilities Authority (WTMUA) supply, and extension of the Chester Township Water Company supply. Ordinarily, this study would be conducted after the Record of Decision is completed. However, because of the Department's commitment to resolve the water supply issue, the study of alternate water sources was initiated well in advance of the usual time frame.

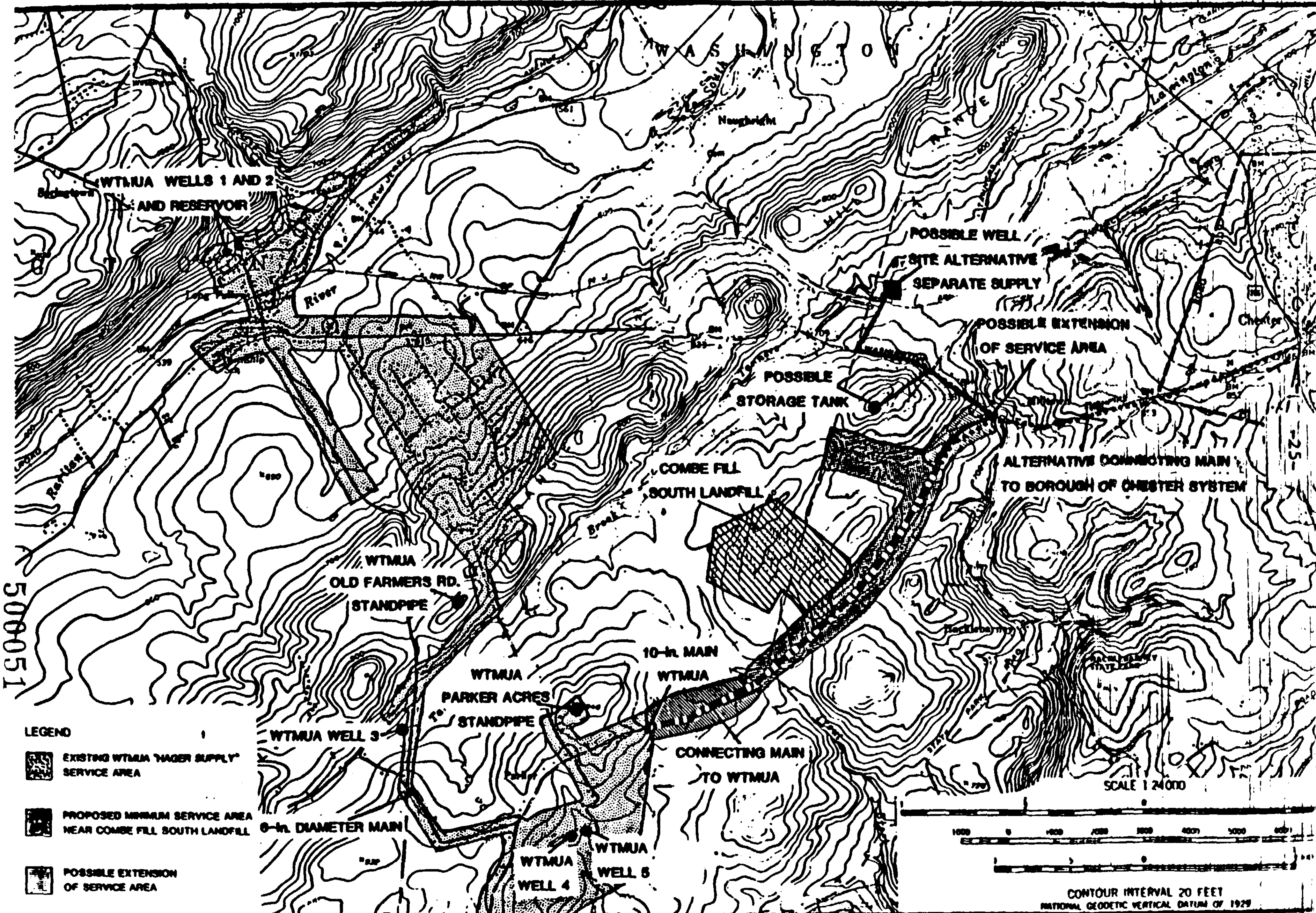
The extent of the impacted area has been outlined but the exact number of affected residences within that area has yet to be finalized (Figure 6). At the July 14, 1986 public meeting in Chester Township, NJDEP defined a core area of affected residences on Schoolhouse Lane, Parker Road and part of Old Farmers Road that will definitely receive a permanent alternate water supply. Further, NJDEP decided to sample potable wells in the surrounding area to ensure that the impacted area boundaries are accurate and sufficiently conservative to account for any further migration of contaminants.

NJDEP sampled the 39 accessible potable wells in the core area on August 19-21, 1986. As soon as the results of this sampling are reviewed, NJDEP will determine which properties are to receive the water supply. The impacted area, as described in the evaluation report, extends from the existing water main in Washington Township along Parker Road to Route 24, including Schoolhouse Lane (Figure 6). For costing purposes, this area was considered to encompass 62 homes, although the exact number will be finalized during construction.

Provision of a permanent alternate water supply to the impacted area is justifiable for several reasons. First, the residences and businesses near the site form a reasonably discrete geogra-

Fig 6.

COMBE FILL SOUTH LANDFI_ WATER SUPPLY ALTERNATIVES



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phic area. Second, the nature of the site's geology and the confirmed well contamination in the area negates any rationale for a preventive monitoring program. Third, periodic monitoring of private wells to track the contaminant plume is far more costly (and ineffective for protecting public health) than providing an alternate water supply to the affected residences. For these reasons, EPA supports the creation of an alternate water system and provision of bottled water to the affected residences in the interim.

The NJDEP intends to provide a permanent alternate water system for the affected residents by extending the Washington Township Municipal Utilities Authority (WTMUA) water main to the impacted area. This project is addressed in detail in a separate report issued by the NJDEP. As soon as the results of the August 1986 potable well sampling are available the NJDEP will initiate negotiations with the WTMUA.

Under CERCLA, federal funds can only be spent to meet the affected community's current potable water needs. This constraint excludes the costs associated with a larger diameter water main to meet fire fighting needs or future development. However, because these aspects are important in long-term planning and coordination of construction projects, the additional costs involved could be assumed by the township(s) to increase the cost-effectiveness of the system and maximize benefits to the community.

DESCRIPTIONS OF ALTERNATIVES

The nine alternatives remaining after successive screening are listed in Table 6. At least one of each of these alternatives addresses one of the five categories of site remediation in 40 CFR Part 300.68(f):

1. No action.

2. Alternatives for treatment or disposal at an off-site facility approved by EPA.

3. Alternatives that attain applicable and relevant Federal and State public health or environmental requirements.

4. Alternatives that exceed applicable and relevant Federal and State public health or environmental requirements.

TABLE 6

COMPARISON OF PRESENT WORTH FOR EACH ALTERNATIVE

ALTERNATIVE	DESCRIPTION	CAPITAL COST ($)	O&M PRESENT WORTH ($)	TOTAL PRESENT WORTH ($)
1A	No Remedial Action	317,550	1,108,603	1,426,153
1B	No Source Control Action	1,302,100	1,202,872	2,504,972
2	New RCRA Landfill	217,085,300	4,034,713	221,120,013
3A	Cap, Treat, and Trench	63,231,600	3,443,073	66,674,673
3B	Cap, Treat, Trench, and Deep Pump	63,341,800	3,584,471	66,926,271
3C	Cap, Treat, and Shallow & Deep Pump	44,616,400	4,668,518	49,284,918
3D	Cap, Treat, and Extensive Shallow Pump	46,060,700	6,091,919	52,152,619
4	Cap, Treat, Trench, Extensive Deep Pump, and NW Barrier	65,798,100	6,510,985	72,309,085
5A	Cap and Circumferential Barrier Wall	53,180,200	2,516,982	55,697,182
5B	Clayless Cap, Treat, and Trench	52,971,400	3,443,073	56,414,473

Present worth is calculated based on an interest rate of 10% and a 30 year project duration.

NOTE: The cost differential between Alternatives 1A and 1B represents the costs associated with the alternative water supply.

5. Alternatives that do not attain applicable or relevant public health or environmental requirements but will reduce the likelihood of present and future threats from hazardous substances.

The alternatives developed to address the latter three NCP categories involve both source control and management of contaminant migration. The timely installation of an alternate water supply, however, will effectively address the latter concern. Accordingly, source control becomes the more important factor in selecting a final remedy for this site.

Tables 7 and 8 list and compare the technical aspects for each alternative. As shown, every alternative includes security fencing and quarterly environmental monitoring of ground water, surface waters, and air at and near the site. Furthermore, the installation of an alternate water supply is being implemented as a separate remedial measure, as discussed above. Accordingly, the following discussion will focus on the differences between the various alternatives.

The final alternatives were numbered in the Feasibility Study (FS) according to the five NCP categories, with letters added to differentiate alternatives within a given category. This system will be used here for consistency.

1. NO ACTION

Aside from the alternate water supply, this alternative consists only of security fencing and environmental monitoring. It has an estimated present worth of $2.5 million, or $1.4 million without the alternate water supply.

A security fence would restrict unauthorized access to the site, thus reducing the potential for direct contact with the landfilled wastes. These include solid materials uncovered due to poor maintenance or erosion, leachate seeping from the side slopes, and gases released from rifts.

Installation of four ground water wells in each of the two aquifers and quarterly environmental monitoring will provide more complete information regarding contaminant migration over time. Monitoring of all the exposure pathways identified will provide an early warning system should additional wells become threatened.

TABLE 7

DESCRIPTIONS OF REMEDIAL ALTERNATIVES

Notes:

1. An alternate water supply for affected residences will be installed regardless of the specific site remedy selected and so can be considered an element of every alternative, although not listed below.

2. The components of the no-action alternative are contained within every other alternative, with minor variations in some cases.

Alternative 1 - No Action

- Installation of monitoring wells
- Quarterly environmental monitoring
- Security fencing

Alternative 2

- Creation of on-site RCRA landfill in lieu of off-site disposal

Alternatives 3A, 3B, 3C, and 3D

- Site preparation, grading, filling and access road
- Installation of multi-layered, terraced cap
- Surface water controls
- On-site ground water/leachate treatment and disposal with discharge to Trout Brook

Specific Components

Alternative 3A - Passive gas venting via trench
- Leachate collection trench

Alternative 3B - Passive gas venting via trench
- Leachate collection trench
- Localized deep pumping to northeast

Alternative 3C - Passive gas venting via pipe vents
- Shallow and deep aquifer pumping

Alternative 3D - Additional monitoring wells
- Active gas collection and treatment
- Expanded downgradient shallow pumping in lieu of leachate collection trench
- No deep aquifer pumping
- Addition of plastic liner to cap where ground surface is sufficiently level

TABLE 7 (continued)

Alternative 4

- Multi-layered, terraced cap
- Active gas collection and treatment
- Leachate collection trench
- Extensive deep pumping
- Surface water controls
- Upgradient ground water barrier wall
- Ground water treatment and disposal, with discharge to Black River

Alternatives 5A and 5B

- Multi-layered, terraced cap
- Passive gas venting
- Surface water controls

Specific Components

Alternative 5A
- Clay layer included in cap
- Gas vented via pipe vents
- Circumferential ground water barrier wall

Alternative 5B
- Clay layer not installed in cap
- Gas vented via trench
- Leachate collection trench
- Ground water/leachate treatment and disposal with discharge to Trout Brook

TABLE 8

COMPONENTS OF REMEDIAL ALTERNATIVES

COMBE FILL SOUTH LANDFILL

COMPONENT	1 NO ACTION	2 NEW RCRA LANDFILL	3 ACHIEVE A	3 FEDERAL B	3 STANDARDS C	MODIFIED C-VERSION D	4 EXCEED STANDARDS	5 ACHIEVE SOME BUT NOT ALL STANDARDS A	5 ACHIEVE SOME BUT NOT ALL STANDARDS B
1. Alternate water supply	X	X	X	X	X	X	X	X	X
2. Security fencing	X	X	X	X	X	X	X	X	X
3. Well installation	X	X	X	X	X	X	X	X	X
4. Environmental monitoring	X	X	X	X	X	X	X	X	X
5. Creation of on-site RCRA landfill		X							
6. Access road(s)		X	X	X	X	X	X	X	X
7. Grading, filling, and general site preparation		X	X	X	X	X	X	X	X
8. Multi-layered, terraced cap									
A. With clay		X	X	X	X	X	X	X	
B. No clay									X
9. Gas venting									
A. Passive									
1. Trench			X	X					X
2. Pipe vents					X			X	
B. Active		X				X	X		
10. Gas treatment		X				X	X		
11. Surface water controls		X	X	X	X	X	X	X	X
12. Leachate collection trench		X	X	X			X		X
13. Shallow aquifer pumping					X	X			
14. Deep aquifer pumping									
A. Northeast flow path				X	X				
B. All flow paths							X		
15. Ground water barrier wall									
A. Circumferential								X	
B. Upgradient							X		
16. On-site treatment and disposal of ground-water/leachate									
A. With discharge to Trout Brook			X	X	X	X			X
B. With discharge to Black River							X		

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Under this alternative, the contamination source would remain in its present state and continue to pollute the ground water. Off-site migration of contaminanted ground water would also continue, increasing so the risk of successive well contamination. Except for direct contact with wastes by persons or animals coming on-site, all exposure pathways would be left intact. Thus, the no action alternative does not address either source control or management of migration.

2. OFF-SITE DISPOSAL

Complete excavation and off-site disposal of wastes at an existing RCRA landfill is not technically, economically, or environmentally viable, as already discussed above. Given the NCP requirements, the next most appropriate alternative would be on-site disposal--i.e., the creation of a RCRA-approved landfill on and near the existing site to contain all the waste material on-site. Such a facility would accept only waste from the Combe Fill South Landfill; no hazardous wastes from any other sites would be accepted.

In addition to the measures outlined for the no action alternative, this alternative includes:

- Purchase of additional adjacent property for the construction of the facility, estimated at 135 additional acres. This expansion is necessary to spread the landfilled material over a larger area so that the slopes on-site can be reduced to between three and five percent. This is the range required for installation of a full RCRA "model" cap.

- Construction of the new RCRA landfill facility. This would be a major operation involving many tasks, including: staged excavation and temporary storage of landfill wastes, excavation of new landfill cells, installation of landfill wastes, capping of cells, and operation and maintenance of the capped facility for 30 years, along with many other activities.

An on-site RCRA landfill would provide the most effective source control of the final alternatives listed, since landfill wastes would be physically isolated from the shallow ground water. Except for problems involving transport and final disposal, however, the negative impacts of the on-site operations would be similar to those for the rejected off-site disposal alternative: increased emission of volatiles, greater exposure risks to solid material, the need for temporary on- or off-site storage for excavated material, and so on.

Neither disposal alternative would reduce existing ground water contamination, as both deal only with source control. However, the installation of the alternate water supply adequately addresses public health objectives involving management of migration.

The present worth of establishing an on-site RCRA landfill is approximately $221 million. Although far less expensive than the $3.4 billion estimated for off-site disposal, this amount is still three times the cost of the next most expensive alternative. As such, this alternative shows high effectiveness, limited feasibility, and low cost-effectiveness.

The no-action and off-site disposal alternatives represent the two extremes in site remediation in terms of both costs and complexity. The remaining candidates, which are compared in Table 9, are all containment alternatives that meet or exceed all or some of the applicable requirements. All include general site preparation, construction of an access road, and surface water controls. Each alternative also includes one of several options for capping, gas venting, and collection, treatment and disposal of ground water/leachate. The following discussions will focus on the differences in the primary remedial components of each alternative.

3. ALTERNATIVES THAT MEET APPLICABLE REQUIREMENTS

Four alternatives were developed to provide source control and management of contaminant migration, as well as some means of mitigating the adverse impacts in each of the contaminated media: ground water, surface water, air, and soils. These four alternatives differ primarily in the degree to which ground water contamination is controlled.

3A. Cap with Trench and On-Site Treatment

This alternative is designed to attain CERCLA goals of minimizing present and future migration of hazardous waste and protecting human health and the environment by remediating the major pathways of contaminant migration. The major technical components are a multi-layered, terraced cap (see Figure 7), a passive gas treatment system, a leachate collection trench, and an on-site ground water/leachate treatment system that will discharge to Trout Brook. Figure 8 shows an aerial view of this alternative.

Of the contaminant pathways listed above in Table 2--air, soil, surface water, and ground water--a multi-layered cap covering the entire site will directly address all but those involving downward and off-site migration of ground water, which are approached indirectly. While the deep aquifer is the primary pathway for the well water contamination, the installation of the alternate water supply eliminates the hazards associated with off-site migration of deep ground water. However, ground water migration still needs to be addressed by the other components of this alternative to provide a permanent remedy for the site.

Table 9

COMPARISON OF REMEDIAL COMPONENTS FOR CONTAINMENT ALTERNATIVES

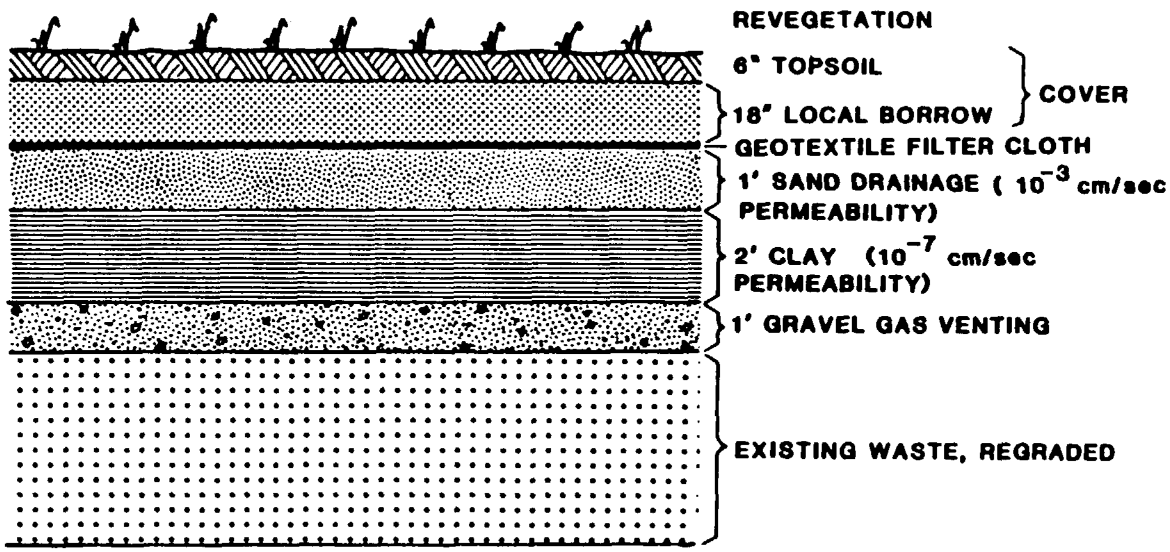
	3C	3D*	5A	5B	3A	3B	4
On-site treatment of groundwater/ leachate	+	+	-	+	+	+	+ discharged to Black River
Multi-layered cap with partial synthetic liner	+	+	+	+ w/o clay layer	+	+	+
Leachate collection trench	-	-	-	+	+	+	+
Groundwater barrier wall	-	-	+ circum-ferential	-	-	-	+ upgradient only
Shallow well system	+	+ intensive	-	-	-	-	-
Deep well system	+	-	-	-	-	+ local-ized	+ site-wide
Passive gas venting system	+ via pipe vents	-	+ via pipe vents	+ via trench	+ via trench	+ via trench	-
Active gas collection and treatment	-	+	-	-	-	-	+
Total Capital Costs:	44.6	46.1	53.2	53.0	63.2	63.3	65.8
Present Worth:	49.3	52.2	55.7	56.4	66.7	66.9	72.3

All costs shown are in millions of dollars.

* Recommended Alternative

Figure 7.

Composition of Multi-Layered Cap



Note: The plastic liner, inserted where technically feasible to comply with RCRA regulations, would be installed below the drainage layer and above the clay later.

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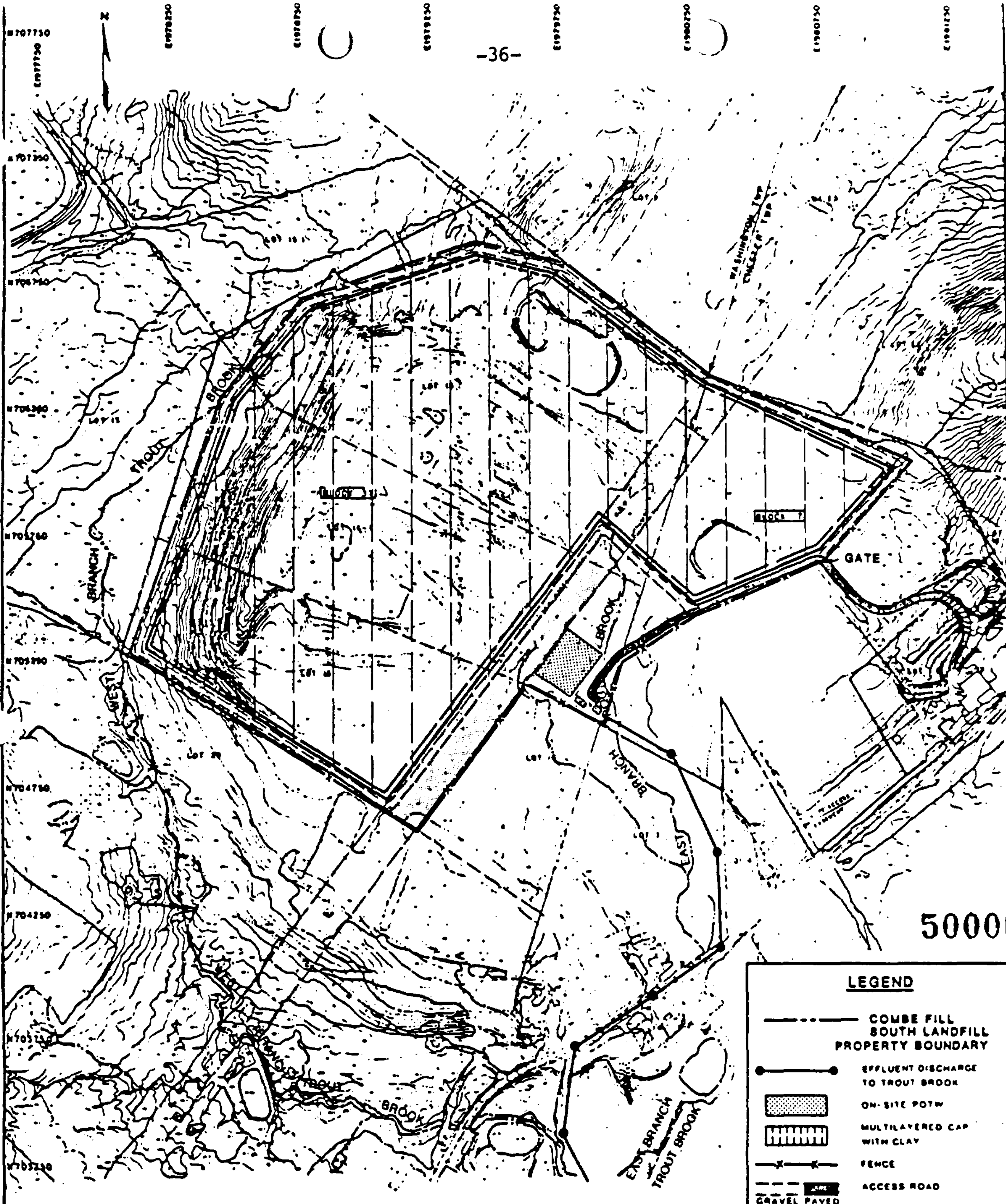

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LEGEND

- COMBE FILL SOUTH LANDFILL PROPERTY BOUNDARY
- EFFLUENT DISCHARGE TO TROUT BROOK
- ON-SITE POTW
- MULTILAYERED CAP WITH CLAY
- FENCE
- ACCESS ROAD (GRAVEL / PAVED)
- EXCAVATED WASTES MOVED TO MAIN AREAS UNDER CAP
- LEACHATE & PASSIVE GAS COLLECTION TRENCH
- PASSIVE GAS COLLECTION TRENCH

400 0 400
Scale in feet

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SCHEMATIC PLAN VIEW
ALTERNATIVE No. 3A
ACHIEVE STANDARDS WITH CAP,
TRENCH, AND TREAT

FIGURE 8

The leachate/ground water collection trench will be keyed into the bedrock, the depth of which is 40 feet on the average but is as deep as 80 feet in some areas. This trench will capture about 90 percent of the shallow ground water flowing off-site, or 102,000 gallons per day (GPD). It thus controls the migration of contaminants downward and off-site. Because capping the landfill will reduce or eliminate the infiltration and subsequent contamination of surface water and precipitation, moreover, the amount of leachate will decrease with time.

Passive gas venting will help to regulate the emission of methane and other landfill-generated gases. Otherwise, the pressure build-up could eventually disturb or rupture the cap, or even cause an explosion. This component thus provides indirect protection of public health by ensuring the integrity of the cap. Emission of volatile organics into the air will increase, however.

The perimeter of the cap will be terraced with gabions (weighted boxes of steel mesh) to accommodate the steep side slopes. The gabions will be placed on top of the clay layer to support the upper layers (sand, filter cloth, and cover). This little-used but established technology will avoid the problems involved in acquiring adjacent properties and regrading the site extensively. In addition, berms will be built above the terraces to aid in surface water control, especially storm runoff.

Typical on-site treatment methods were incorporated to facilitate costing, although the actual technologies to be applied will be finalized during remedial design. The treated water will then be discharged to Trout Brook. Again, with the cap in place and surface runoff also diverted into Trout Brook, the amount of leachate to be treated will decrease substantially with time. This reduction, from 135,000 GPD now to 20,000 GPD within 10 years, will be reflected in lowered O&M costs. Accordingly, modular treatment units will maximize the cost-effectiveness of this component.

The access roads to be constructed include a paved road to the on-site treatment facility and a gravel road around the perimeter of the cap.

This alternative reduces the volumes of uncontaminated water entering the landfill, leachate being generated, and contaminated ground water moving off-site. The alternate water supply effectively addresses the primary contaminant pathway, while the on-site components contain the waste material and reduce off-site migration of contaminants.

3B. Cap with Trench, Localized Deep Pumping, and On-site Treatment

Alternatives 3A and 3B are identical except that deep pumping is added here to collect and remediate the contaminated ground water in the deep aquifer, even though the alternate water system will ensure a safe supply of drinking water to the affected residents. Two wells will be installed northeast of the site in the path of the plume approximately 175 feet deep (Figure 9). These wells would pump an average of 920 GPD of contaminated ground water from the bedrock to the on-site treatment facility for treatment and surface discharge to Trout Brook.

This flow path accounts for only 7 percent of the deep ground water (and 0.7 percent of the total ground water) flowing under the site. Again, although it flows toward the main concentration of houses with contaminated well water and represents the most significant adverse public health impact (i.e., contaminated drinking water) associated with the landfill, the risks imposed will be eliminated by the installation of the alternate water supply.

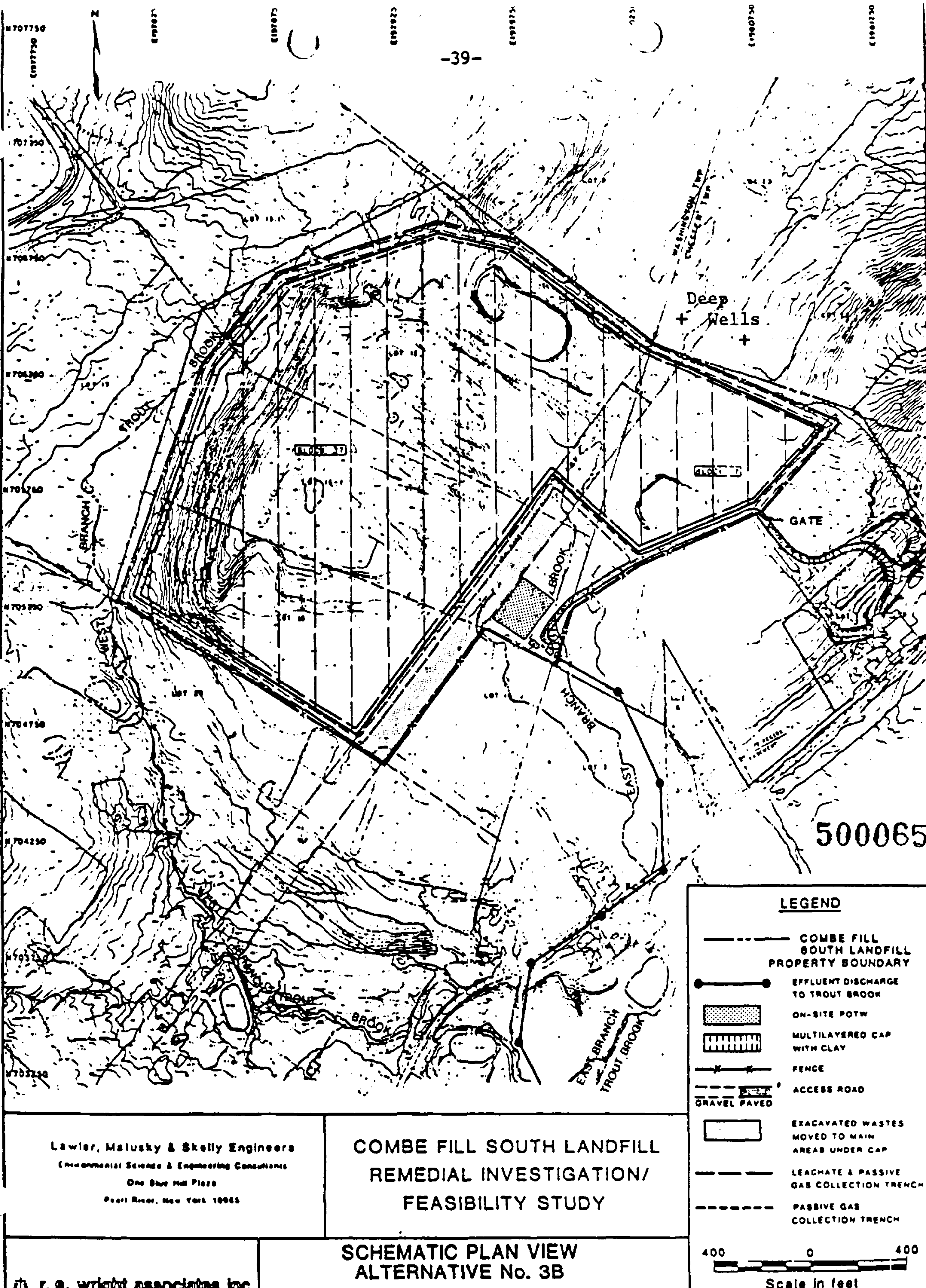
The logistics of tapping the deep aquifer present additional problems, given the fractured nature of the bedrock. However, the slight increase in collected ground water (920 GPD) associated with deep aquifer pumping should not affect the sizing of the on-site treatment facility described under Alternative 3A. Overall, this alternative is inferior to Alternative 3A in effectiveness in protecting public health and the environment, feasibility, and cost-effectiveness.

3C. Cap with Shallow and Deep Pumping and On-site Treatment

Alternative 3C is similar to Alternative 3B except that it substitutes an active technology (pumping) for a passive technology (the leachate collection trench) to remediate the shallow aquifer. Deep well pumping in the northeast flow path, previously described for Alternative 3B, is also included here and indicated in Figure 10.

The shallow pumping system to be used consists of 48 shallow wells, spaced 100 feet apart on center. This shallow aquifer pumping system substitutes for the leachate collection trench (at an enormous cost savings) in collecting and transporting the contaminated shallow ground water to the on-site treatment facility. The system will lower the water table on-site and thus isolate and dry out the wastes in the lower sections of the landfill. This process enhances the containment provided by the cap and further reduces the risks stemming from having the waste material saturated. Reduced downward migration will result in less off-site migration of contaminants, in turn.

Depending on the drawdown, these wells could dry up, which would not be a problem with the trench. However, pumping rates can be adjusted accordingly, and removal of shallow ground water may induce upward flow from the deep aquifer.



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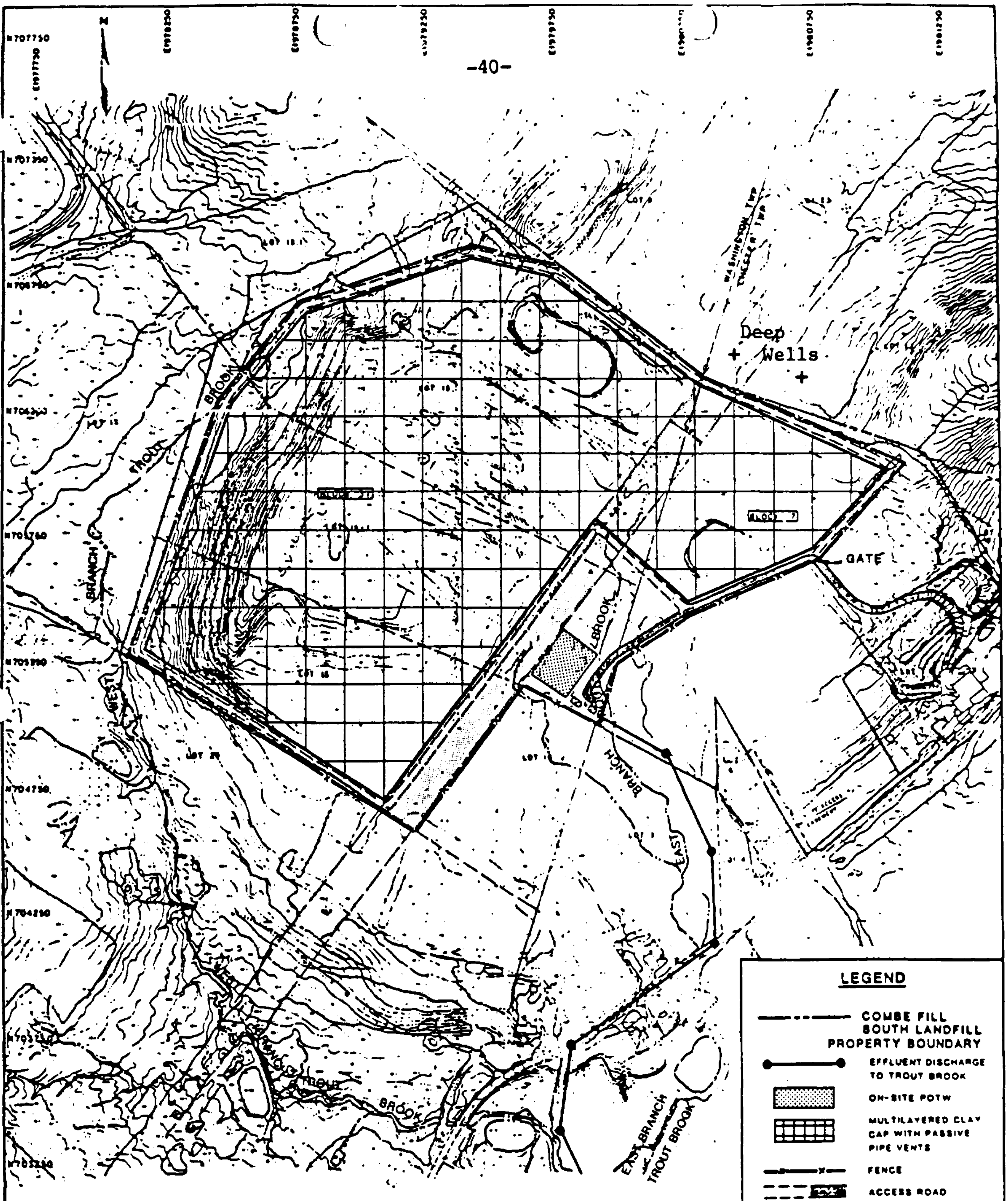
SCHEMATIC PLAN VIEW
ALTERNATIVE No. 3B
ACHIEVE STANDARDS WITH CAP,
TRENCH, DEEP PUMP, AND TREAT

FIGURE 9



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SCHEMATIC PLAN VIEW
ALTERNATIVE No. 3C
ACHIEVE STANDARDS WITH CAP,
SHALLOW AND DEEP PUMP, AND TREAT

FIGURE 10

The major portion of the peripheral passive gas venting system will be eliminated along with the leachate collection trench. An interior grid of passive gas extraction wells will be used instead. The vent pipes will extend into the waste pile and funnel gases from the waste to the surface of the cap, where they will be discharged to the air. This release will alleviate pressure build-up under the cap and is not expected to increase the risk of airborne contaminants moving off-site due to rapid diffusion.

Overall, this alternative has high cost-effectiveness and feasibilty due to the replacement of the leachate collection trench with the shallow pumping system. In addition, this approach will effectively address the remedial objectives.

3D. Cap With Extensive Shallow Pumping and On-site Treatment

As discussed earlier, this alternative is a modified form of Alternative 3C. Here, the deep pumping has been eliminated and an active gas collection and venting system, which is described in more detail under Alternative 4, replaces the passive vents. The aspects of deep pumping are discussed above for Alternatives 3B and 3C.

The active gas system was added to minimize the risks associated with the drying of the waste material under the cap. Moreover, the passive discharge of landfill-generated gases around the perimeter of the site may increase the off-site exposure risk. The active system uses a centralized blower and flaring to remove volatiles and maximize diffusion prior to migration off-site.

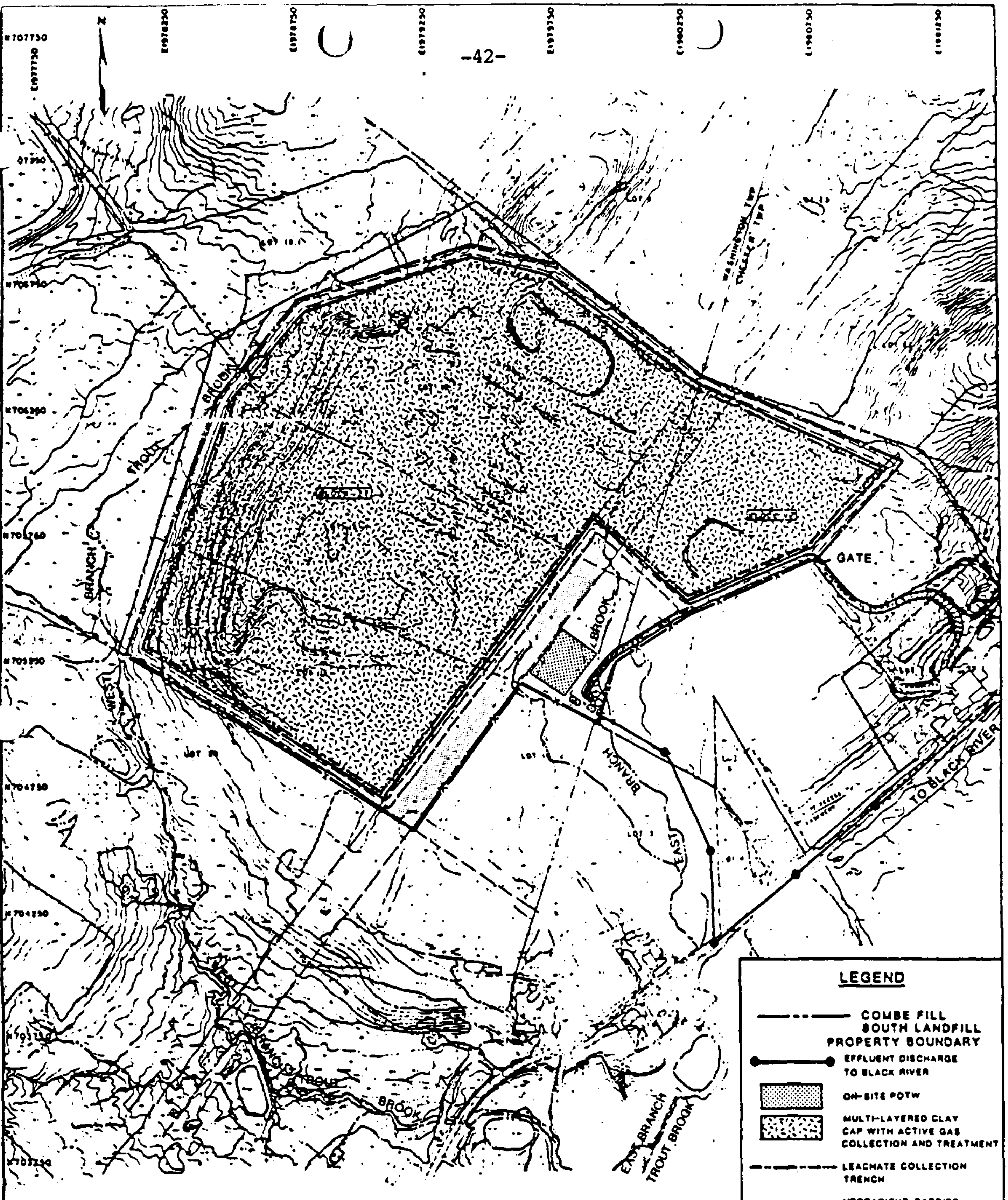
4. ALTERNATIVES THAT EXCEED FEDERAL STANDARDS

This alternative is designed to provide remediation above and beyond the goals established by applicable federal legislation. This alternative attempts to achieve this objective by the inclusion of a number of additional remedial activities beyond those described for Alternatives 3A, 3B, 3C, and 3D. It is designed specifically to control and remediate all contaminated ground water.

The components of Alternative 4 are shown in Figure 11. The additional components incorporated here are:

a. An active gas collection and treatment system, consisting of a grid of 65 gas extraction wells connected to a vacuum blower. Landfill-generated methane and some volatile organics will be removed by flaring.

b. Deep aquifer pumping beneath the site, using a series of 10 wells. The water thus produced would be treated with the leachate prior to discharge.



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SCHEMATIC PLAN VIEW
ALTERNATIVE No. 4
EXCEED STANDARDS

FIGURE 11

c. Effluent discharge to the Black ver via a one-mile pipeline to minimize future impa..s to Trout Brook and the surrounding wetlands. Extend..ng southeast of the site parallel to Trout Brook, the addi..ional pipeline would run along Parker Road about 2800 feet to the discharge point.

   The effluent requirements for this discharge location are still in the process of being determined. However, they will be similar for Black River and Trout Brook. Both are Category 1 streams, meaning that any effluent must have the same constituent concentrations as the receiving waters just upstream of the discharge point. In keeping with the objective of this alternative, the dilution of the effluent in the Black River provides additional environmental protection.

d. An upgradient barrier to prevent a small amount of ground water (1400 GPD) from moving on-site from the recharge area just north of the landfill border (see Figure 3). This barrier will help lower the water table on the site and thus reduce leachate production.

   The barrier would be a soil-bentonite slurry wall, 300 feet long and 3 feet wide, which would be constructed down to bedrock (an average depth of 40 feet). The clay cap would extend over the top of the wall to prevent desiccation and provide isolation from surface runoff.

5. ALTERNATIVES THAT ACHIEVE SOME BUT NOT ALL FEDERAL STANDARDS

The two alternatives in this category, while not attaining all applicable or relevant public health or environmental standards, substantially reduce the likelihood of present and future threats from hazardous substances.

5A. Cap and Circumferential Barrier

As seen in Figure 12, this alternative contains the site preparation and capping components previously described for Alternative 3B. However, this alternative does not provide for the collection and treatment of ground water or landfill gases. Instead, it encircles the site with a soil-bentonite slurry wall, thus preventing further off-site migration of contaminated ground water through the shallow aquifer. The 3-foot wide slurry wall will be constructed down to bedrock (an average depth of 40 feet) and will entirely encircle the waste areas (about 8000 feet around the perimeter). The clay cap will extend over the wall to prevent desiccation or infiltration.

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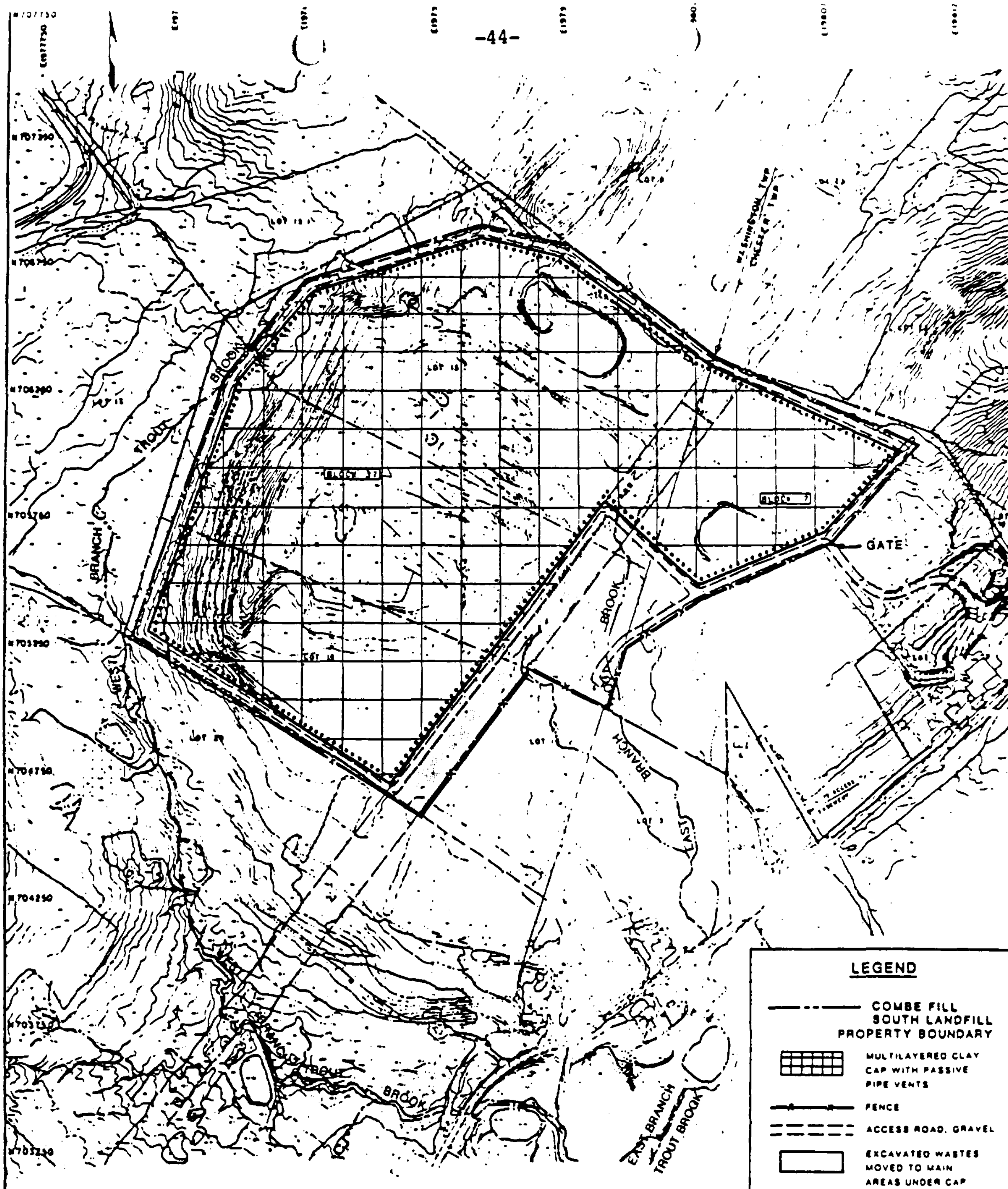
Although this alternative does not directly address the contaminated ground water in the bedrock aquifer, it will minimize both infiltration into the saprolite aquifer and lateral migration off-site of the ground water in the saprolite aquifer.



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SCHEMATIC PLAN VIEW
ALTERNATIVE No. 5A
ACHIEVE SOME BUT NOT ALL
STANDARDS WITH CAP AND
CIRCUMFERENTIAL BARRIER

FIGURE 12

Shallow well pumping may induce upward flow of the deep ground water, due to the high water table, but is not included in this alternative.

The lack of an on-site treatment facility eliminates the need for the paved access road segments previously described; a gravel road around the cap border will be adequate. Likewise, the site fencing is less extensive than in other alternatives.

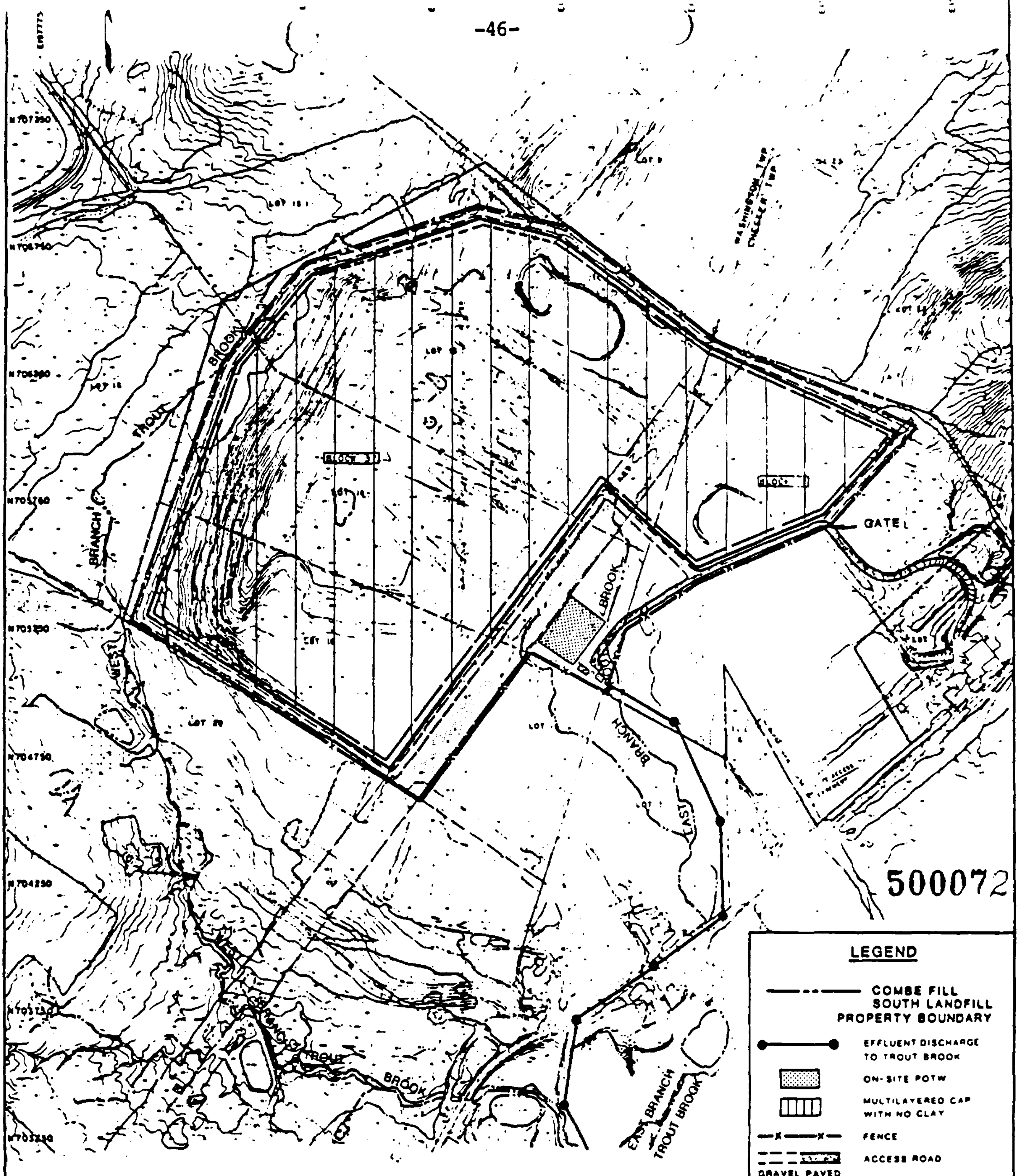
5B. Clayless Cap With Trench and On-Site Treatment

This alternative, as shown in Figure 13, is identical to Alternative 3A except that the multi-layered cap does not include a clay layer. As discussed above, the single most significant cost of the cap is the clay layer, which is necessary to achieve the required permeability of 10^{-7} cm/sec. Eliminating the clay layer in this cap will result in savings of construction time and costs, but will require the treatment of higher ground water flow at the on-site treatment facility for a greater period of time. Leachate production and ground water flow rates will not decline as rapidly as with the clay cap because of the increased permeability of the clayless cap. Thus, this alternative is less effective in dealing with the contaminant source and off-site migration than those that involve pumping or excavation.

EVALUATION OF ALTERNATIVES

Installation of an alternate water supply for the affected properties around the site will eliminate the hazards associated with off-site contaminant migration through the deep aquifer. Being the means whereby well water becomes contaminated, this migration represents the primary contaminant pathway. With management of migration adequately addressed, therefore, the focus of site remediation can shift to source control measures. In rough order of decreasing scope and effectiveness, these are: off-site removal, encapsulation, containment (both above and below the ground surface), pumping, and ground water barriers.

Off-site removal and encapsulation (e.g., in the cells of an on-site RCRA landfill) have been addressed and rejected based on cost and feasibility considerations. Physical containment by means of a circumferential barrier would control only horizontal movement of shallow ground water, even if keyed into the bedrock, since the shallow and deep aquifers are contiguous. Therefore, hydraulic containment or some other complementary measure would also be necessary to control downward migration. However, the feasibility of a slurry wall is hampered by the dimensions of the project: 8000 feet long and a maximum depth of 80 feet.



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COMBE FILL SOUTH LANDFILL
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY

r. e. wright associates, inc.
earth resources consultants

SCHEMATIC PLAN VIEW
ALTERNATIVE 5B
ACHIEVE SOME BUT NOT ALL
STANDARDS WITH CLAYLESS CAP,
TRENCH AND TREAT

FIGURE 13

Ground water pumping is feasible but requires treatment of the water produced. The shallow aquifer is readily accessible and recovery pumping would be effective in lowering the water table to isolate the wastes material and preclude contaminant migration off-site via the deep aquifer. Shallow pumping addresses the deep aquifer (and thus the primary contaminant pathway) only indirectly. However, this approach is consistent with the emphasis on source control due to the pending installation of the alternate water supply. Pumping the deep aquifer is thus less important. This aquifer is also accesible, but the effectiveness/feasibility of any recovery pumping operation is severely limited by the fractured bedrock. Even if wells can be placed so as to tap into major fractures, isolated pockets of deep ground water may be unreachable.

Both localized upgradient barriers and surface caps prevent flux of uncontaminated water, thereby reducing the amount of leachate generated. A cap also minimizes the risks of direct exposure to wastes and airborne dispersal of landfill gases, although short-term impacts may increase during construction. As with the circumferential barrier, ground water pumping would be a necessary complement to either of these components. However, both the cap and the upgradient barrier are superior to the circumferential barrier in terms of feasibility and implementabilty.

The no action alternative allows the continued migration of chemicals in the ground water, some of it toward drinking water wells. It will also allow the contamination of wetlands and Trout Brook to continue, as well as the erosion of the landfill's steeply sloped sides. Thus, while it is the least costly alternative by far, with a present worth of $2.5 million, and is technically feasible, it provides only limited protection to public health and the environment. As such, it is rejected as being ineffective in achieving CERCLA objectives.

The RCRA landfill alternative costs $150 million more than the next most expensive alternative, yet its effectiveness is not increased correspondingly. It would eventually result in total or near-total control of adverse impacts, but allows them to continue during its construction period, which will be longer than for other alternatives. Moreover, its construction-related impacts will be greater than for the other alternatives, as discussed above.

Because it prevents off-site migration of contaminated ground water, the RCRA landfill alternative provides the best isolation of wastes from the environment of all the alternatives considered. However, its technical feasibility, effectiveness, and reliability must be balanced against its extremely high cost and low implementability, both of which stem from the size and complexity of the site.

Capping controls the release of gases from the landfill and reduces infiltration. As such, its value is based on preventive maintenance and its cost must be balanced against the reduction in O&M costs due to reduced volumes of leachate.

The steep slopes bordering the landfilled areas necessitate terracing to support the continuous clay cap. Gabion terracing has been proposed, which is a less common but well-established technology. Implementability is hampered by the need to extend the cap under the 150-foot-wide right-of-way of the New Jersey Power and Light Company, which runs through the middle of the site.

The reliability of the cap will depend largely on the straightforward O&M program, which will include maintenance of the vegetative cover and any repairs, as necessary, to the cap or the gabion terraces.

COMMUNITY RELATIONS

A public meeting was held in Chester Township on July 14, 1986, at which the NJDEP presented the results of the RI/FS and the recommended remedy, including the alternate water supply.

Movement of ground water off-site is both the primary contaminant pathway identified at the Combe Fill South site and the focus of public concern, since it impacts the area's drinking water quality. Other concerns include continued leachate generation, degradation of Trout Brook, and odors emanating from the site.

Local officials, environmental groups, and residents are in agreement regarding the recommended alternative described here. The most critical issue is the time it will take to identify the impacted area and to implement the alternate water system to ensure a supply of safe drinking water. Residents strongly support the alternate water supply, although some residents are anxious over the final determination of the impacted area.

CONSISTENCY WITH OTHER ENVIRONMENTAL LAWS

The remedial alternatives developed for the Combe Fill South site involve both control of the contamination source and mitigation of contaminant migration off-site, with one exception. Alternative 2, construction of an on-site RCRA landfill, entails only source control, although with a high degree of effectiveness.

Installation of a full RCRA "model" cap would require the purchase of approximately 135 acres of surrounding property to regrade the site such that the surface slopes are reduced to three to five percent. This additional acreage could also provide temporary storage of excavated fill material during construction of the landfill. Such an extensive acquisition, however, is considered inappropriate for the site and further may pose a threat to the remaining hardwood wetlands that lie south and west of the site.

EPA has an established policy of making every effort to comply with RCRA regulations whenever appropriate and technically feasible. Without expanding and extensively regrading the site, therefore, the multi-layered cap covering the entire site could be upgraded to a full RCRA "model" cap over 16 acres (25 percent) of the landfilled area by the addition of a plastic liner. This liner can only be installed in relatively level areas to avoid slippage or subsidence of the layers above it.

The effect of the plastic liner on the cap's overall permeability has not yet been quantified. The clay layer has been designed to meet the RCRA performance criterion of 10^{-7} cm/sec permeability. However, addition of the plastic liner in the level fill areas would provide an added degree of reliability and would also satisfy the structural criteria for the RCRA "model" cap, in accordance with EPA's policy of full RCRA compliance whenever technically feasible. The present worth of the liner is $2.1 million, or four percent of the total costs. Cost-benefit will be determined more precisely during conceptual design of the selected remedy through the use of a computer similation program known as the Hydrologic Evaluation of Landfill Performance (HELP) model. This process will indicate under what conditions the landfill cap will attain full RCRA compliance.

Compliance with the RCRA performance criterion allows a clay cap to be installed without extensive regrading of fill material. As such, the purchase of adjoining properties is not necessary. This in turn minimizes the threat of landfilling to the hardwood wetland immediately southwest of the site, in accordance with Executive Order 11990 and Section 404 of the Clean Water Act. If capping is part of the selected remedy, therefore, it will be possible to comply with both RCRA and wetlands regulations.

<u>RECOMMENDED ALTERNATIVE</u>

The alternative deemed most appropriate for the Combe Fill South site is Alternative 3D. The technical components of this alternative are:

1. An alternate water supply with interim bottled water for affected residences

2. An active collection and treatment system for methane and any other landfill-generated gases

3. Expanded environmental monitoring of water, air, soils, and leachate

4. A multi-layered, terraced cap that covers the landfilled areas and extends under the utility company right-of-way

5. Pumping and on-site treatment of shallow ground water and leachate, with discharge to Trout Brook

6. Surface water controls to accommodate runoff from both normal precipitation and storms

7. Security fencing, an access road, and general site preparation

8. A second-phase feasibility study to evaluate the need for remediation of the deep aquifer

As discussed in the previous section, the multi-layered cap shown in Figure 7 is designed to meet the RCRA performance criterion of 10^{-7} cm/sec permeability. Upgrading to a full RCRA "model" cap wherever it is technically feasible is considered appropriate for this remedy as it is consistent with established EPA policy to strive to comply fully with RCRA requirements.

The main concern over pumping deep wells is the possibility of drawing contaminated ground water down from the shallow aquifer. Again, due to the fractured nature of the bedrock, patterns of vertical flow and adequacy of recovery are impossible to predict. Consequently, a more reasonable approach is to remediate the shallow aquifer to achieve the desired reduction in contaminant levels and then evaluate the need for deep aquifer pumping in a second-phase feasibility study. For the shallow pumping system, two lines of withdrawal will be installed downgradient--i.e., to the northeast and southwest along the site's perimeter. The combined actions of these two well clusters will collect any leachate produced along with the shallow ground water.

Excluding the no action and on-site disposal alternatives, the present worth estimates given in Table 6 define a substantial range of costs with reasonably discrete breaks. Alternatives 3C and 3D are the lowest cost alternatives within this range, with respective present worths of $49.3 million and $52.2 million. Because 3C was the basis for 3D, the technical justification for the additional $2.9 million has already been discussed in the description of Alternative 3D's development.

OPERATION AND MAINTENANCE (O&M)

The O&M costs for the recommended alternative are itemized in Table 10, along with the direct and indirect capital costs. Funding for O&M expenditures will be provided through New Jersey's Spill Compensation Fund. The New Jersey Department of Environmental Protection will be responsible for implementing the O&M program. EPA contributions to O&M will be as specified in CERCLA and the NCP.

SCHEDULE

The schedule for implementation of the selected remedy is as follows:

Project Milestone	Date
Approve Remedial Action	September 1986
Complete Enforcement Negotiations	
Amend Cooperative Agreement for Design	Contingent upon
Start Design	reauthorization of
Complete Design	CERCLA or State funding

FUTURE ACTIONS

Long-term O&M considerations will reflect the gradual reduction in the amount of contaminated ground water/leachate requiring treatment. As the shallow (saprolite) aquifer is remediated, the option of deep pumping will be reconsidered as a possible means of removing contaminated ground water from the bedrock aquifer. Long-term environmental monitoring, the most expensive O&M line item, is essential to evaluate the effectiveness of the implemented alternative.

Appendix A.

SUMMARY OF SHALLOW MONITORING WELLS PRIORITY POLLUTANTS

Combe Fill South Landfill

PARAMETER	S-1	S-2	S-3	S-4	S-5	S-6
DATE SAMPLED	9/4/85	9/5/85	8/29/85	9/4/85	8/28/85	8/28/85
VOLATILES, ppb						
Benzene	64.7	BM @ 4.4	80.2	BM @ 4.4	ND	BM @ 4.4
Chlorobenzene	ND	30.3	21.1	18.2	ND	ND
Chloroethane	ND	ND	BM @ 10	62.0	ND	ND
Chloroform	ND	ND	ND	ND	57.5	ND
1,1-Dichloroethane	65.2	ND	51.4	BM @ 4.7	ND	ND
1,2-Dichloroethane	ND	ND	ND	6.10	ND	ND
1,1-Dichloroethylene	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	BM @ 6	ND	ND	ND
Ethylbenzene	ND	ND	BM @ 7.2	ND	ND	ND
Methylene chloride[a]	56.0	4.44	18.4	8.2	4.67	4.67
Tetrachloroethylene	ND	ND	BM @ 4.1	ND	ND	ND
Toluene	1370	ND	68.2	ND	ND	ND
Trans-1,2-dichloroethylene	ND	ND	8.02	ND	ND	ND
Trichloroethylene	ND	ND	4.04	ND	ND	ND
Vinyl chloride	ND	ND	BM @ 10	ND	ND	ND
ACID/PHENOLICS, ppb						
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	BM @ 1.5	ND	ND

ND = Not detected.
BM = Below method detection limit.
[a]Corrected based on analysis of QA/QC samples.

Appendix A (continued)

SUMMARY OF SHALLOW MONITORING WELLS PRIORITY POLLUTANTS

Combe Fill South Landfill

PARAMETER	S-1	S-2	S-3	S-4	S-5	S-6
DATE SAMPLED	9/4/85	9/5/85	8/29/85	9/4/85	8/28/85	8/28/85
BASE/NEUTRALS, ppb						
Bis (2-chloroethyl) ether	ND	ND	ND	BM @ 5.8	ND	ND
Bis (2-ethylhexyl) phthalate	ND	BM @ 11	ND	ND	BM @ 10	ND
1,2-Dichlorobenzene	ND	9.77	ND	7.25	ND	ND
1,4-Dichlorobenzene	ND	39.4	ND	10.1	ND	ND
Di-ethyl phthalate	ND	ND	10.2	ND	ND	ND
Di-n-butyl phthalate	ND	BM @ 11	ND	BM @ 10	ND	ND
Di-n-octyl phthalate	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	3.16	ND	ND	ND
N-nitrosodiphenyl amine	ND	ND	ND	ND	ND	ND
PESTICIDES/PCBs, ppb	ND	ND	ND	ND	ND	ND
METALS, ppm						
Beryllium	ND	ND	BM @ 0.002	ND	ND	ND
Cadmium	ND	ND	ND	BM @ 0.003	ND	ND
Chromium	ND	BM @ 0.01	0.02	0.03	BM @ 0.02	ND
Copper	0.01	0.01	0.03	0.02	0.01	0.04
Lead	BM @ 0.01	0.014	0.022	0.009	0.028	0.017

ND = Not detected.
BM = Below method detection limit.

Appendix A (continued)

SUMMARY OF MONITORING WELL SAMPLES

Combe Fill South Landfill

PARAMETER	S-1	S-2	S-3	S-4	S-5	S-6
DATE SAMPLED	9/4/85	9/5/85	8/29/85	9/4/85	8/28/85	8/28/85
METALS, ppm						
Mercury	ND	ND	BM @ 0.0002	ND	BM @ 0.0002	BM @ 0.0002
Nickel	ND	BM @ 0.01	0.02	0.03	ND	BM @ 0.009
Selenium	ND	ND	ND	ND	BM @ 0.005	ND
Silver	BM @ 0.01	ND	BM @ 0.009	BM @ 0.01	ND	ND
Thallium	BM @ 0.005	ND	BM @ 0.005	ND	ND	ND
Zinc	0.05	0.10	0.24	0.04	ND	0.04
MISCELLANEOUS, ppb						
Cyanides	ND	ND	ND	ND	ND	ND
Phenols	270	ND	ND	ND	ND	ND

ND = Not detected.
BM = Below method detection limit.

Appendix B.

SUMMARY OF PRIORITY POLLUTANTS DEEP MONITORING WELLS

Combe Fill South Landfill

PARAMETER	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	DW-2	DW-4
DATE SAMPLED	8/28/85	8/28/85	9/4/85	8/28/85	8/28/85	8/29/85	9/4/85	9/4/85	9/4/85	9/5/85	9/5/85
VOLATILES, ppb											
Benzene	ND	ND	ND	ND	16.9	39.1	66.4	31.5	18.6	ND	252
Chlorobenzene	ND	ND	ND	ND	ND	BM @ 6	9.88	10.8	ND	ND	BM @ 6
Chloroethane	ND	ND	ND	ND	ND	ND	22.5	74.3	BM @ 10	ND	ND
Chloroform	ND	209	ND	82.6	ND	ND	ND	ND	ND	ND	155
1,1-Dichloroethane	ND	6.41	ND	ND	10.6	BM @ 4.7	ND	14.8	30.2	ND	ND
1,2-Dichloroethane	ND	7.98	ND	ND	40.5	37.2	ND	11.2	4.84	ND	14.2
1,1-Dichloroethylene	ND	6.41	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	BM @ 6	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	34.2	11.7	ND	ND	ND
Methylene chloride[a]	5.92	176.07	16.0	ND	9.77	ND	20.0	18.8	12.6	9.3	20.6
Tetrachloroethylene	ND	14.3	ND	ND	6.89	BM @ 4.1	ND	ND	ND	ND	5.58
Toluene	ND	ND	ND	ND	ND	ND	1140	ND	ND	ND	ND
Trans-1,2-dichloroethylene	ND	ND	ND	5.40	25.8	47.5	ND	ND	ND	ND	17.5
Trichloroethylene	ND	8.34	ND	ND	2.72	26.0	ND	ND	ND	ND	56.8
Vinyl chloride	ND	ND	ND	ND	ND	BM @ 10	ND	ND	ND	ND	BM @ 10
ACID/PHENOLICS, ppb											
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	3.12	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	BM @ 3.7	ND	ND	ND
Phenol	ND	2.35	ND	ND	2.75	ND	ND	ND	ND	ND	ND
BASE/NEUTRALS, ppb											
Bis (2-chloroethyl) ether	ND	ND	ND	ND	ND	ND	ND	BM @ 5.9	ND	ND	ND
Bis (2-ethylhexyl) phthalate	BM @ 11	ND	ND	BM @ 10	ND	BM @ 11	ND	BM @ 10	BM @ 10	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	5.58	1.92	ND	ND
1,4-Dichlorobenzene	ND	BM @ 4.6	ND	ND	BM @ 4.5	ND	ND	14.2	ND	ND	ND
Di-ethyl phthalate	ND	ND	ND	ND	BM @ 10	ND	ND	BM @ 10	ND	ND	ND
Di-n-butyl phthalate	BM @ 11	ND	ND	BM @ 10	BM @ 10	ND	ND	BM @ 10	BM @ 10	ND	BM @ 10
Di-n-octyl phthalate	BM @ 11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	21.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	3.24	ND	ND	ND
N-nitrosodiphenylamine	ND	ND	ND	ND	ND	ND	ND	BM @ 2	ND	ND	ND

[a]Corrected based on analysis of QA/QC samples.
ND = Not detected.
BM = Below method detection limit.

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Appendix B (continued)

SUMMARY OF PRIORITY POLLUTANTS
DEEP MONITORING WELLS

Combé Fill South Landfill

PARAMETER	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	DW-2	DW-4
DATE SAMPLED	8/28/85	8/28/85	9/4/85	8/28/85	8/28/85	8/29/85	9/4/86	9/4/85	9/4/85	9/5/85	9/5/85
PESTICIDES/PCBs, ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS, ppm											
Arsenic	ND	ND	ND	ND	BM @ 0.01	ND	ND	ND	ND	ND	ND
Beryllium	ND	ND	ND	ND	ND	BM @ 0.002	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	BM @ 0.01	BM @ 0.009	BM @ 0.009
Copper	0.04	0.007	0.03	BM @ 0.006	BM @ 0.006	BM @ 0.006	0.02	BM @ 0.009	BM @ 0.009	0.011	ND
Lead	0.009	BM @ 0.005	0.01	BM @ 0.005	0.008	0.008	0.007	BM @ 0.005	0.014	ND	ND
Mercury	BM @ 0.0002	0.0002	ND	BM @ 0.0002	BM @ 0.0002	BM @ 0.0002	ND	ND	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND
Selenium	ND	BM @ 0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	BM @ 0.01	BM @ 0.01	ND	BM @ 0.005	BM @ 0.005
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	0.02	0.03	BM @ 0.04	ND	0.09	0.02	0.38	BM @ 0.04	0.07		
MISCELLANEOUS, ppb											
Cyanides	ND	29.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenols	ND	ND	ND	ND	ND	ND	428	ND	ND	ND	ND

ND = Not detected.
BM = Below method detection limit.

LEACHATE SEEP QUALITY SUMMARY[a,b]

Combe Fill South Landfill

PRIORITY POLLUTANT CONTAMINANTS	LEACHATE SEEP L-1	L-2	L-3	L-6	L-7	L-8
Volatiles, ppb	69	15	162[c]	103[c]	1084[c]	137[c]
Acid/Phenolics, ppb	3	1	0	7	0	0
Base/Neutrals, ppb	19	34	48	33	2	71
Pesticides/PCBs, ppb	0	0	0	0	0	0
Metals, ppm	0.064	0.070	0.110	0.155	3.180	0.680
Cyanides, ppb	0	47	31	38	28	0
Phenols, ppb	100	0	257	247	418	254

[a]Statistical calculations assume BM = 1/2 detection limit and ND = 0.
[b]Concentrations adjusted in accordance with QA/QC review.
[c]Average of data from 13 August 1985 and 17 October 1985.

LEACHATE SOIL/SEDIMENT QUALITY SUMMARY[a,b]

Combe Fill South Landfill

PRIORITY POLLUTANT CONTAMINANTS	LEACHATE SEEP							
	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8
Volatiles, ppb	0	0	0	0	0	0	0	23
Acid/Phenolics, ppb	0	0	0	0	0	0	0	0
Base/Neutrals, ppb	288	428	1435	190	186	416	69,836	6536
Pesticides/PCBs, ppb	0	0	0	0	0	0	0	0
Metals, ppm	48.0	236.9	56.7	240.9	188.8	76.2	168.1	458.7
Cyanides, ppb	0	0	0	0	0	0	0	0
Phenols, ppb	0	0	0	0	0	0	0	0

[a]Statistical calculations assume BM = 1/2 detection limit and ND = 0.
[b]Concentrations adjusted in accordance with QA/QC review.

Appendix E.

SUMMARY OF PREVIOUS SURFACE WATER AND SEDIMENT PRIORITY POLLUTANT CHEMICAL DATA

Combe Fill South Landfill

STATION LOCATION	STATION NUMBER(S)	SAMPLE TYPE	AVERAGE TOTAL VOLATILES (ppb)	AVERAGE TOTAL ACID/PHENOLS (ppb)	AVERAGE TOTAL BASE/NEUTRALS (ppb)	AVERAGE TOTAL PESTICIDES/PCBs (ppb)	AVERAGE TOTAL METALS (ppm)
WEST BRANCH TROUT BROOK							
SE Corner of Landfill	G, H	Water	64	0	5	1	0.1025
Above Bridge	E	Water	NR	NR	NR	NR	0.0685
N of Tingue	A	Water	NR	NR	NR	NR	0.057
Upstream of Tingue	J, M, N	Water	15	0	0	0	0.0910
Tingue Driveway	Q	Water	1717	0	106	0	0.1185
		Sediment	457	0	0	0	61.050
Inflow to Pond	D	Water	NR	NR	NR	NR	0.0415
Trib. to W. Br, Upstream of Pond	P	Water	5	0	0	0	0.5779
		Sediment	75	0	15,000	5,000	171.400
EAST BRANCH TROUT BROOK							
Headwaters	F, L	Water	152	0	90	0	0.1723

NR = Not run.

Ap dix E (continued)

SUMMARY OF PREVIOUS SURFACE WATER AND SEDIMENT PRIORITY POLLUTANT CHEMICAL DATA

Combe Fill South Landfill

STATION LOCATION	STATION NUMBER(S)	SAMPLE TYPE	AVERAGE TOTAL VOLATILES (ppb)	AVERAGE TOTAL ACID/PHENOLS (ppb)	AVERAGE TOTAL BASE/NEUTRALS (ppb)	AVERAGE TOTAL PESTICIDES/PCBs (ppb)	AVE. TO. META. (ppm)
EAST BRANCH (Cont.)							
NE of Township Line	C	Water	NR	NR	NR	NR	0.054
Below Property Boundary	K	Water	131	0	0	0	0.0610
Trib. to E. Br, Above Parker Rd.	R	Water	10	0	0	0	1.1392
		Sediment	76	0	24,800	0	339.950
TROUT BROOK (MAIN SEGMENT)							
30-yd below Confluence of Branches	B	Water	NR	NR	NR	NR	0.0300
100-yd upstream of Long Hill Rd.	S	Water	0	0	0	0	0
		Sediment	23	0	41	0	157.250
50-yd upstream of Bridge at Ranger Station	T	Water	1	0	0	0	0.0040
		Sediment	8	0	19	0	111.450
100-yd upstream of Black River	U	Water	1	0	0	0	0.0025

NR = Not run.

Appendix E (continued)

SUMMARY OF PREVIOUS SURFACE WATER AND SEDIMENT PRIORITY POLLUTANT CHEMICAL DATA

Combe Fill South Landfill

STATION LOCATION	STATION NUMBER(S)	SAMPLE TYPE	AVERAGE TOTAL VOLATILES (ppb)	AVERAGE TOTAL ACID/PHENOLS (ppb)	AVERAGE TOTAL BASE/NEUTRALS (ppb)	AVERAGE TOTAL PESTICIDES/PCBs (ppb)	AVERAGE TOTAL METALS (ppm)
BLACK RIVER							
300-yd Upstream	V	Water	0	0	0	0	0.0025
of Trout Brook		Sediment	21	0	928	0	124.200
100-yd Downstream of Trout Brook	W	Water	1	0	0	0	0.0002

NR = Not run.

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Appendix F.

SUMMARY OF SOIL DATA ON HAND-AUGERED SOIL SAMPLES

Combe Fill South Landfill

PARAMETER	FIELD A 4 WHITE	FIELD A A HORIZON COMPOSITE	FIELD A B HORIZON COMPOSITE	FIELD A (LOC 5) B HORIZON	FIELD A (LOC 6) A HORIZON	FIELD B (LOC 5) B HORIZON	FIELD B (LOC 6) A HORIZON	FIELD B (LOC 3) A HORIZON	FIELD B A HORIZON COMPOSITE	FIELD B B HORIZON COMPOSITE	FIELD C A HORIZON COMPOSITE	FIELD C B HORIZON COMPOSITE
DATE SAMPLED	8/21/85	8/22/85	8/22/85	8/21/85	8/21/85	8/22/85	8/22/85	8/22/85	8/22/85	8/22/86	8/23/85	8/23/85
VOLATILES[a], ppb												
Methylene chloride	569	ND[b]	ND[b]	ND[b]	ND[b]	ND[b]	ND[b]	ND[b]	ND[b]	ND[b]	ND[b]	ND[b]
Tetrachloroethylene	ND	ND	ND	ND	5[b,c]	4[c]	3[b,c]	6[b]	3[b,c]	3[b,c]	2	1
ACID/PHENOLICS, ppb												
Pentachlorophenol	ND	150[c]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BASE/NEUTRALS, ppb												
Benzo (A) pyrene	310[c]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis (2-ethylhexyl) phthalate	1200	2200	150[c]	960	770	110[c]	110[c]	150[c]	110[c]	150[c]	330[c]	240[c]
Di-n-butyl phthalate	160[b,c]	ND	ND	ND	ND	ND	ND	ND	110[c]	ND	ND	ND
Di-n-octyl phthalate	ND	150[c]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDES/PCBs, ppb												
4,4'-DDE	ND	ND	ND	ND	11	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	17	ND	ND	ND	ND	ND	ND	ND
METALS, ppm												
Arsenic	12	18	26	29	20	26	18	18	21	23	12	9.7
Beryllium	ND	3.0	1.6	3.3	1.7	1.1	1.4	1.2	1.5	1.0	1.0	1.0
Cadmium	4.7	3.9	1.9	3.1	2.7	2.0	4.0	2.4	2.8	3.2	2.0	2.1
Chromium	33	57	50	46	25	22	22	21	21	27	12	9.1
Copper	33	57	35	74	20	40	22	26	24	22	15	7.0
Lead	37	27	14	17	2	14	25	26	29	11	16	9.7
Mercury	ND	ND	ND	ND	0.1	ND	0.1	0.1	0.1	0.1	0.2	0.1
Nickel	15	17	14	21	13	10	13	9.0	14	12	ND	ND
Silver	ND	ND	ND	ND	ND	41	ND	ND	ND	ND	ND	ND
Thallium	ND	3.6	5.1	4.5	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	48[c]	67	52	60	54	8310	62	60	62	44	46	33
MISCELLANEOUS, ppb												
Cyanides	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenols	ND	ND	ND	ND	ND	ND	1000	ND	ND	1200	ND	ND

[a]Data has been adjusted to reflect concentrations in QA/QC field and trip blank samples.
[b]Also Found in method blank.
[c]Estimated value. Value is below method detection limit.
ND = Not detected.

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Appendix [illegible]

PRIORITY POLLUTANT CHEMICAL ANALYSES OF SOIL BORING/ROCK CORING SAMPLES[a]

Combe Fill South Landfill

PARAMETERS	PIEZOMETER SB-2 SAMPLE INTERVAL (ft) 36-38	PIEZOMETER SB-2 SAMPLE INTERVAL (ft) 42-48	PIEZOMETER SB-3 SAMPLE INTERVAL (ft) 12-14	PIEZOMETER SB-3 SAMPLE INTERVAL (ft) 28-30	PIEZOMETER SB-4 SAMPLE INTERVAL (ft) 14-16	PIEZOMETER SB-4 SAMPLE INTERVAL (ft) 22-44
DATE SAMPLED	11/21/84	11/21/84	11/15/84	11/15/84	11/27/84	11/27/84
VOLATILES, ppb						
Carbon tetrachloride	ND	ND	ND	350	ND	ND
Chloroform	558	658	ND	530	5995	5595
Methylene chloride	3324	3864	ND	515	ND	ND
Tetrachloroethylene	ND	ND	805	ND	1395	ND
Toluene	395	495	955	465	2995	ND
ACID/PHENOLICS, ppb						
Pentachlorophenol	ND	BM @ 825	BM @ 825	BM @ 825	BM @ 825	ND
Phenol	ND	ND	BM @ 825	ND	ND	ND
BASE/NEUTRALS, ppb						
Butyl benzylphthalate	350	ND	ND	ND	ND	ND
Diethylphthalate	BM @ 330	ND	ND	ND	ND	ND
Di-n-buylphthalate	500	720	6000	450	560	570
Phenanthrene	Bm @ 330	ND	ND	ND	ND	ND
PESTICIDES/PCBs, ppb	ND	ND	ND	ND	ND	ND
METALS, ppm						
Arsenic	2.6	2.6	2.9	2.4	ND	ND
Cadmium	1.1	4.7	3.7	2.4	1.1	3.4
Chromium	ND	ND	ND	5.9	ND	ND
Copper	3.9	120.0	56.0	31.0	20.0	71.0
Nickel	ND	5.0	ND	ND	6.4	14.0
Zinc	16.0	61.0	91.0	ND	13.0	38.0
MISCELLANEOUS, ppb						
Cyanides	ND	ND	ND	ND	ND	ND
Phenols	ND	ND	ND	ND	ND	ND

BM = Below method detection limit.
ND = Not detected.

[a]Data have been adjusted to reflect contamination in QA/QC field and trip blank samples (see Appendix CC).

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Appendix H.

SUMMARY OF PRIORITY POLLUTANT CHEMICAL ANALYSES ON TEST PITS

Combe Fill South Landfill

PARAMETER	TP-1 COMPOSITE 0-9 ft	TP-1 DISCRETE 9-11 ft	TP-2 COMPOSITE 0-12 ft	TP-3 COMPOSITE 0-12 ft
DATE SAMPLED	8/27/85	8/27/85	8/27/85	8/27/85
VOLATILES, ppb				
Tetrachloroethylene	ND[a]	ND[a]	ND[a]	ND[a]
ACIDS/PHENOLICS, ppb	ND	ND	ND	ND
BASE/NEUTRALS, ppb				
Bis (2-ethylhexyl) phthalate	120[b]	370[b]	1300	ND
PESTICIDES/PCBs, ppb				
Aldrin	ND	ND	132	ND
Dieldrin	ND	ND	76	ND
METALS, ppm				
Arsenic	71	52	42	38
Beryllium	1.5	1.5	1.5	1.0
Cadmium	2.9	ND	13	1.3
Chromium	22	19	24	16
Copper	34	26	37	20
Lead	ND	ND	30	10
Nickel	7.7	7.2	12	7.5
Zinc	47[c]	38[c]	148[c]	50[c]
MISCELLANEOUS, ppb				
Cyanides	ND	ND	ND	ND
Phenols	ND	ND	ND	ND

[a]Data corrected based on QA/QC review.
[b]Estimated value; value is below method detection limit.
[c]Value is estimated because of interferences.
ND = Not detected.

Appendix I.

PRIORITY POLLUTANT CHEMICALS MEASURED IN AIR SAMPLES AT COMBE FILL SOUTH LANDFILL[a,b]

PRIORITY POLLUTANT CHEMICAL	UPWIND ($\mu g/m^3$)		ON-SITE ($\mu g/m^3$)		DOWNWIND ($\mu g/m^3$)	
	AVE.	RANGE	AVE.	RANGE	AVE.	RANGE
Volatiles						
Benzene	0	0	16	0-144	0	0
Ethylbenzene	6	0-10	39	0-276	8	0-13
Methylene chloride	11	0-30	9	0- 30	10	0-30
Tetrachloroethylene	4	0- 6	8	0- 30	8	0-18
Toluene	26	20-30	48	0-216	33	22-47
Trichloroethylene	<1	0- 1	5	0- 30	0	0
Base/Neutrals						
Diethyl phthalate	0.004	0.003-0.005	0.005	0-0.014	0.005	0-0.011
Di-n-butyl phthalate	0.001	0-0.003	0.0015	0-0.007	0.001	0-0.002
Metals						
Antimony	0	0	0.004	0-0.069	0.034	0-0.061
Beryllium	0.004	0.0034-0.0051	0.001	0-0.0024	0.002	0.0015-0.0029
Cadmium	0.005	0-0.0139	0.002	0-0.0089	0.002	0-0.039
Chromium	0	0	0.014	0-0.2563	0	0
Copper	0.147	0.057-0.223	0.126	0.036-0.406	0.117	0.047-0.164
Lead	0.279	0.081-0.611	0.158	0-0.438	0.293	0.181-0.448
Nickel	0.012	0-0.025	0.009	0-0.029	0.036	0.015-0.066
Zinc	9.3	8.6-9.9	1.2	0-4.5	3.3	0-7.8

[a]Contaminants found at greater than BM (i.e., greater than the detection level) at one or more stations based on QA/QC corrections. QA/QC corrections include subtracting filter blank data given on Table CC-26.

[b]Statistical averages assume BM = 1/2 the detection limit and ND = 0.