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United States Government

Department of Energy

# memorandum

DATE: SEP 7 1984

REPLY TO:  
ATTN OF: NE-20

SUBJECT: Action Description Memorandum (ADM) Review: Proposed 1984 Remedial Actions at Middlesex, New Jersey

TO: File

Department of Energy (DOE) proposes to carry out some remedial actions during 1984 at two sites in Middlesex, New Jersey. The proposed 1984 remedial actions include cleanup of radioactively contaminated materials located at the Middlesex Landfill and interim storage of these contaminated materials at DOE's Middlesex Sampling Plant site. The major proposed actions include:

- o Excavation of approximately 14,000 m<sup>3</sup> (18,000 yd<sup>3</sup>)\* of landfill materials, of which about one-third (4,600 m<sup>3</sup> (6,000 yd<sup>3</sup>))\* is expected to be radioactively contaminated. (These wastes are expected to be co-contaminated with hazardous chemicals.\*\*
- o Transport of the 4,600 m<sup>3</sup> (6,000 yd<sup>3</sup>)\* of radioactively contaminated wastes to the Sampling Plant site and placement of these materials in a new interim-storage pile on the existing asphalt storage pad.
- o Backfilling of the excavated area at the Landfill with the 9,200 m<sup>3</sup> (12,000 yd<sup>3</sup>)\* of excavated wastes that have radionuclide concentrations below the cleanup criteria, supplemented with approximately 4,600 m<sup>3</sup> (6,000 yd<sup>3</sup>)\* of clean fill materials to restore the Landfill to the original grade.
- o Construction of support facilities at the Landfill, including an access road, a vehicle decontamination area, and an area for stockpiling and drying excavated materials (as necessary) prior to transport.

The radioactively contaminated materials will be removed from the Landfill according to DOE's radiological guidelines for residual radionuclide concentrations in soil at FUSRAP sites. Following removal

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\* These volumes are being revised as detailed engineering progresses. As of April 24, 1984, the estimated total volume to be excavated has been reduced to 13,000 m<sup>3</sup> (16,000 yd<sup>3</sup>), of which 4,200 m<sup>3</sup> (5,500 yd<sup>3</sup>) is expected to be radioactively contaminated.

\*\* Because of the chemical contamination, the proposed actions have been coordinated with the U.S. Environmental Protection Agency (Attachment 1).

of the radioactively contaminated materials, DOE will make a decision regarding the future use of the property relative to the final radiological condition of the site. A decision on future use of the Landfill relative to chemical contamination is not within DOE's jurisdiction. The U.S. Environmental Protection Agency (EPA) and State and local governments have jurisdiction with respect to hazardous chemical in the Landfill and will determine the need for further remedial actions, if any.

Details and impact analysis for the activities are given in the attached ADM (Action Description Memorandum "Proposed 1984 Remedial Actions at Middlesex, New Jersey" - Attachment 2).

The proposed 1984 remedial actions are a continuation of remedial actions involving the former Middlesex Sampling Plant and vicinity properties. The current status of the Middlesex remedial action is noted in Section 2 "General Setting" on page 2-1 of the attached ADM.

After reviewing all of the pertinent facts including the attached ADM, I have determined that the remedial action described in the subject ADM is an action which in and of itself will have a clearly insignificant impact on the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA), 42 U.S.C. 4321 et seq.

Separate environmental reviews will be prepared to support future decisions on remedial action at Middlesex, New Jersey, including permanent disposition of the contaminated materials or other remedial actions that may impact the quality of the human environment within the meaning of the NEPA, 42 U.S.C. 4321 et seq.



Franklin E. Coffman, Director  
Office of Terminal Waste Disposal  
and Remedial Action  
Office of Nuclear Energy

2 Attachments

cc: w/attachs.  
S. Miller, GC-11  
S. Woodbury, PE-252

*A. Whitman*



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II  
26 FEDERAL PLAZA  
NEW YORK, NEW YORK 10278

JUL 20 1984

Mr. E.L. Keller, Director  
Technical Services Division  
U.S. Department of Energy  
Oak Ridge Operations  
P.O. Box E  
Oak Ridge, Tennessee 37831

Dear Mr. Keller:

The purpose of this letter is a follow-up to my letter of June 25, 1984 concerning the proposed remedial action at the Middlesex Landfill (ML) by the U.S. Department of Energy (DOE) under its Formerly Utilized Sites Remedial Action Program (FUSRAP).

Based on the E.P. toxicity data received from DOE for samples taken in the portion of the Middlesex Landfill subject to the proposed remedial action we concur that the material is apparently not subject to the Resource Conservation and Recovery Act (RCRA) as hazardous waste. Additionally, a review of the sampling program utilized by DOE to obtain these data was done by the U.S. Environmental Protection Agency's (EPA) Region II Office. This review did show some deficiencies in the monitoring program, specifically: 1. the lack of a sampling plan, 2. a cleaning method for split spoon core samples which is inconsistent with EPA Region II Standard Operating Procedures, and 3. the use of biased instead of random sampling. However, these deficiencies would tend to lead to more conservative results or a worst case situation.

Considering the DOE's time frame for this proposed remedial action and the fact that the data appear to support the conclusion that the material subject to the remedial action is not a RCRA hazardous waste, the EPA has no objection to the implementation of the remedial action plan as proposed by DOE in the "Work Plan For the Middlesex Municipal Landfill Site" (ORO-846).

Hopefully, this satisfies your original request of June 5, 1984.

Sincerely yours,

*for Shelley Erick Holtm*  
Conrad Simon, Director  
Air & Waste Management Division

*So 22159*

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ACTION DESCRIPTION MEMORANDUM  
PROPOSED 1984 REMEDIAL ACTIONS AT MIDDLESEX, NEW JERSEY

Prepared by  
Environmental Research Division  
Argonne National Laboratory  
Argonne, Illinois

June 8, 1984

Prepared for  
U.S. Department of Energy  
Oak Ridge Operations  
Technical Services Division  
Oak Ridge, Tennessee

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## 1. SUMMARY OF PROPOSED ACTIONS AND RELATED ACTIVITIES

Under the Formerly Utilized Sites Remedial Action Program (FUSRAP), the U.S. Department of Energy (DOE) proposes to carry out some remedial actions during 1984 at two sites in Middlesex, New Jersey (Figures 1.1 and 1.2). The proposed 1984 remedial actions include cleanup of radioactively contaminated materials located at the Middlesex Landfill and interim storage of these contaminated materials at DOE's Middlesex Sampling Plant site. The major proposed actions include:

- Excavation of approximately 14,000 m<sup>3</sup> (18,000 yd<sup>3</sup>)\* of landfill materials, of which about one-third (4,600 m<sup>3</sup> [6,000 yd<sup>3</sup>])\* is expected to be radioactively contaminated. (These wastes are expected to be co-contaminated with hazardous chemicals.\*\*)
- Transport of the 4,600 m<sup>3</sup> (6,000 yd<sup>3</sup>)\* of radioactively contaminated wastes to the Sampling Plant site and placement of these materials in a new interim-storage pile on the existing asphalt storage pad.
- Backfilling of the excavated area at the Landfill with the 9,200 m<sup>3</sup> (12,000 yd<sup>3</sup>)\* of excavated wastes that have radionuclide concentrations below the cleanup criteria, supplemented with approximately 4,600 m<sup>3</sup> (6,000 yd<sup>3</sup>)\* of clean fill materials to restore the Landfill to the original grade.
- Construction of support facilities at the Landfill, including an access road, a vehicle decontamination area, and an area for stockpiling and drying excavated materials (as necessary) prior to transport.

Details of the various proposed activities are given in Section 4 (Proposed Action and Alternatives).

The radioactively contaminated materials will be removed from the Landfill according to DOE's radiological guidelines for residual radionuclide concentrations in soil at FUSRAP sites (Appendix A). Following removal of the

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\*These volumes are being revised as detailed engineering progresses. As of April 24, 1984, the estimated total volume to be excavated has been reduced to 13,000 m<sup>3</sup> (16,000 yd<sup>3</sup>), of which 4,200 m<sup>3</sup> (5,500 yd<sup>3</sup>) is expected to be radioactively contaminated.

\*\*Because of the chemical contamination, the proposed actions are being coordinated with the U.S. Environmental Protection Agency (EPA) under a Memorandum of Understanding between DOE and EPA regarding hazardous wastes (see Section 5.2.1).

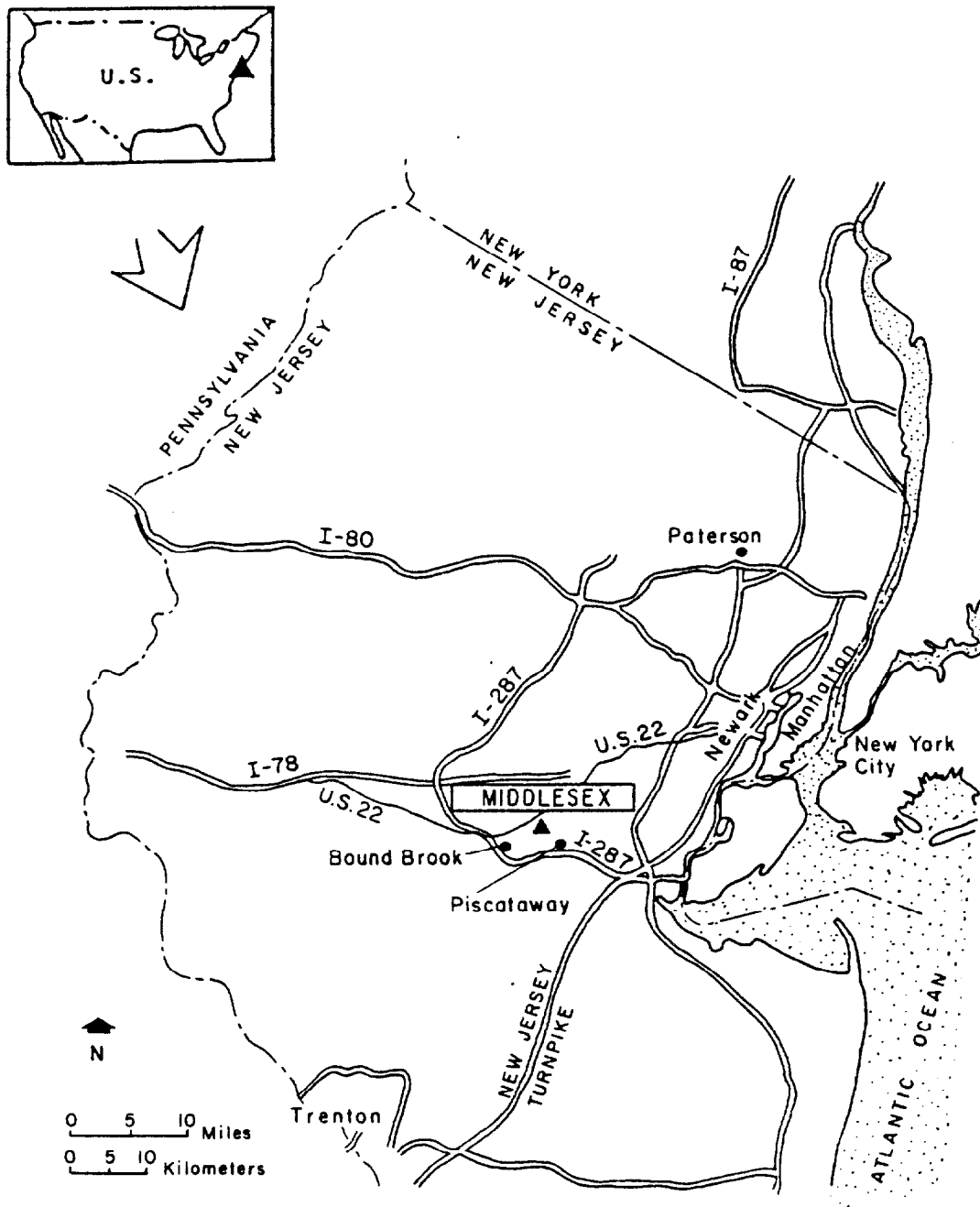


Figure 1.1. Location of Middlesex, New Jersey.



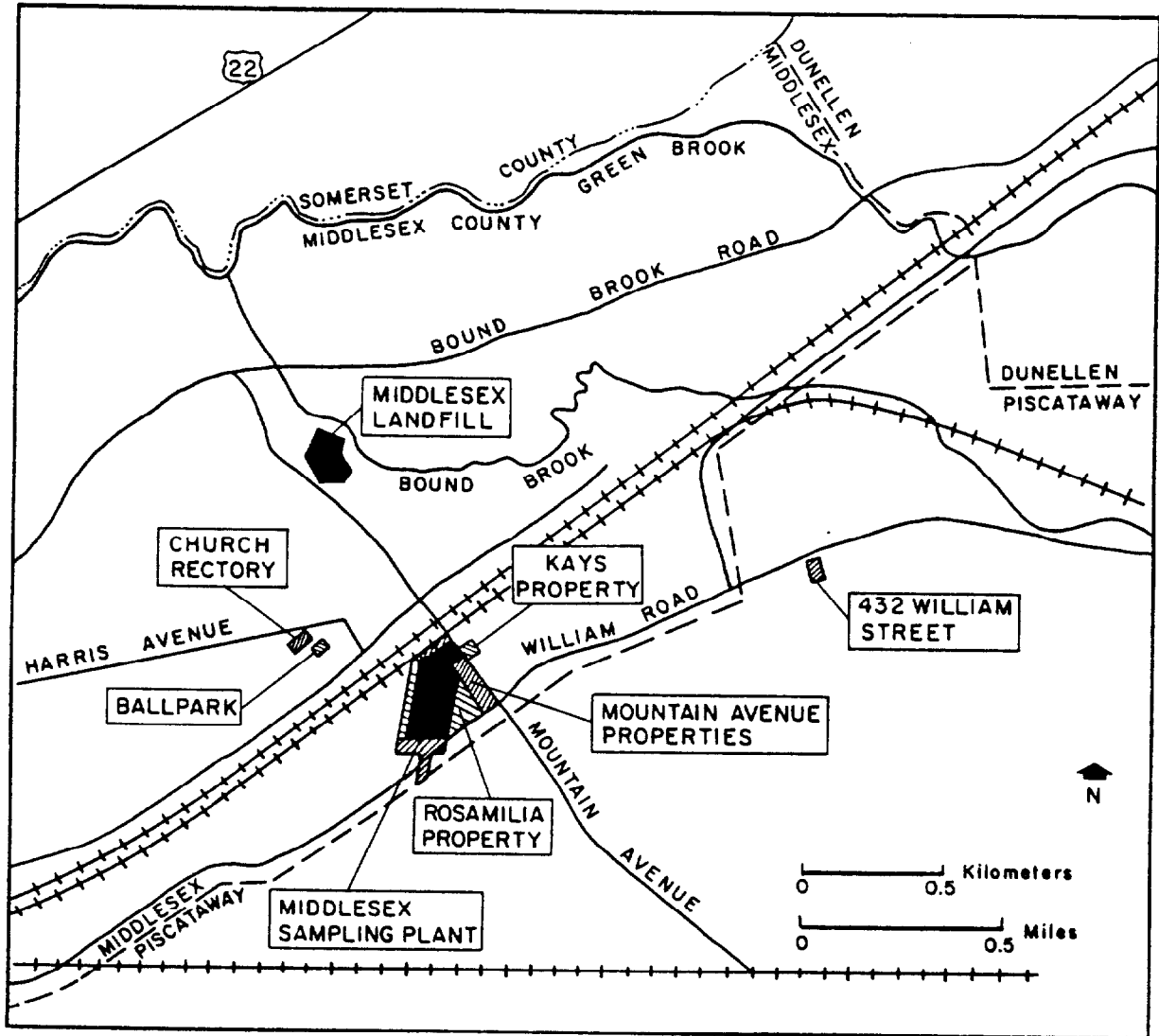


Figure 1.2. Location of the Middlesex Landfill, DOE Middlesex Sampling Plant Site, and Previously Contaminated Properties.

radioactively contaminated materials, DOE will certify the property for future use, as appropriate, relative to the radioactive condition of the site. A decision on future use of the Landfill relative to chemical contamination is not within DOE's jurisdiction. The U.S. Environmental Protection Agency (EPA) and state and local governments have jurisdiction with respect to hazardous chemicals in the Landfill and will determine the need for further remedial actions, if any.

The proposed 1984 remedial actions are a continuation of remedial actions involving cleanup of the Sampling Plant site and several vicinity properties (see Section 2.1). The decisions to be made now are whether to carry out the proposed 1984 work and, if so, in what manner. Depending on future funding (determined by the yearly Congressional appropriations), there will be separate future decisions on additional remedial actions. Because a permanent storage or disposal site is not now available, current plans call for interim storage at the Sampling Plant site. Another future decision will be made relative to permanent disposition of the contaminated materials. Separate environmental analyses will be prepared to support future decisions.

## 2. HISTORY AND NEED FOR ACTION

### 2.1 GENERAL SETTING

Middlesex, New Jersey, is located in an urban area about 35 km (22 mi) southwest of downtown Manhattan (New York City), 29 km (18 mi) southwest of Newark, New Jersey, and 48 km (30 mi) northeast of Trenton, New Jersey (Figure 1.1). There are several properties in the Borough of Middlesex and Township of Piscataway (both in Middlesex County) that have been identified as being radioactively contaminated as a result of work that was carried out on various uranium, thorium, and beryllium ores at the Middlesex Sampling Plant (Figure 1.2). Most of the contaminated properties have been cleaned up and the contaminated materials placed in a large interim-storage pile at the Sampling Plant site. These properties and their current status are listed below:

#### Phase I Remedial Actions (5 properties)

432 William Street Church rectory Playground Rosamilia property Kays property	Cleaned up in 1980; certified and released for unrestricted use (U.S. Dep. Energy 1983a)
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#### Phase II Remedial Actions (28 properties)

Mountain Avenue properties Area south of Sampling Plant site and ditch to Main Stream Periphery of Sampling Plant site Road on north side of Sampling Plant site	Cleaned up in 1981 and 1982; not yet certified
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#### Middlesex Landfill Remedial Actions

Proposed for cleanup in 1984

#### Phase III Remedial Actions

Sampling Plant site, including old processing building and interim-storage piles	To be decided in the future
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### 2.2 HISTORY

The history of the Middlesex Sampling Plant, the Middlesex Landfill, and the other properties can be found in reports by Bechtel National (1984a, 1984c), Boyer et al. (1982), Ford, Bacon & Davis (1978, 1979), and U.S. Department of Energy (1979, 1980a, 1980b). Following is a brief summary.

From 1943 to 1955, the Middlesex Sampling Plant was used to thaw, crush, dry, screen, sample, weigh, assay, store, package, and/or ship various types of uranium, thorium, and beryllium ores. This work was originally carried out under the auspices of the Manhattan Engineer District (MED) of the U.S. Army Corps of Engineers during development of the atomic bomb. The MED was succeeded by the U.S. Atomic Energy Commission (AEC), the U.S. Energy Research and Development Administration (ERDA), and finally (for certain functions) by DOE. Some of the radioactively contaminated wastes resulting from the sampling operations were containerized and disposed at sea by the U.S. Navy. From 1955 to 1967, the Sampling Plant was used mainly for storage and some sampling of thorium residues. In 1967, onsite structures were decontaminated and the site was certified and released for unrestricted use. The U.S. General Services Administration transferred the property in 1969 to the U.S. Marine Corps, who used the site for a reserve training center until 1979. Through an agreement established in 1978, DOE became custodian of the site. Currently, DOE uses the site for interim storage of radioactively contaminated materials that have been cleaned up from nearby vicinity properties and areas adjacent to the Sampling Plant site. Except for an onsite custodian, the buildings are unoccupied and the site is fenced.

The Middlesex Landfill has been in use for over 25 years. In 1948, the landfill area was a gully that extended from within 30-61 m (100-200 ft) of Mountain Avenue to Bound Brook. By 1974, the area was level to within about 30 m (100 ft) of the brook. The surface of the Landfill reportedly rose about 2.4-3.0 m (8-10 ft) from 1961 until it was closed in 1974. The Landfill is currently used as a collection point for recycling of cans, bottles, and paper.

In 1948 during some renovations at the Middlesex Sampling Plant, about 4,600 m<sup>3</sup> (6,000 yd<sup>3</sup>) of excess soil contaminated with uranium ore was transported and disposed at the Middlesex Landfill. Contaminated soil was also apparently taken to the church rectory site and the 432 William Street property (Figure 1.2) for use as fill material.

In May 1960 during a civil defense drill, elevated radiation levels were detected at the Landfill. These elevated radiation levels were confined to an area of less than 0.24 ha (0.6 acre). In 1961, the AEC removed 500 m<sup>3</sup> (650 yd<sup>3</sup>) of near-surface radioactively contaminated material and covered the area with 0.6 m (2 ft) of clean soil. The contaminated soil was removed to the AEC New Brunswick Laboratory in New Brunswick, New Jersey. Since the 1961 remedial action, about 2 ha (5 acres) of the northern portion of the Landfill site has been sold to the Middlesex Presbyterian Church and a church building has been erected.

Beginning in 1980, DOE conducted remedial actions designed to cleanup radioactively contaminated properties and to place the contaminated materials in a large storage pile at the Sampling Plant site. All vicinity properties except the Landfill have been cleaned up (see Section 2.1). About 27,000 m<sup>3</sup> (35,000 yd<sup>3</sup>) of contaminated soils are now stored on an asphalt pad under a synthetic-rubber (EPDM) cover at the southern end of the Sampling Plant site.

### 2.3 RADIOLOGICAL CONTAMINATION AND NEED FOR ACTION

The Middlesex Landfill has been surveyed several times. The two most recent and comprehensive surveys were made in 1974 and 1978.

The results of the 1974 survey (U.S. At. Energy Comm. 1974) indicated that surface gamma readings were generally in the background range of 9-11  $\mu\text{R}/\text{h}$ . At points of higher gamma readings, core samples confirmed the presence of radioactivity near the surface. Some core samples from areas that had normal background readings at the surface revealed some elevated levels of radioactivity at 0.6-1.2 m (2-4 ft) below the surface. Based on the 1974 survey, it was concluded that the radioactivity represented no measurable radiation health or safety problem relative to the use of the property at that time. If any excavation or other development at the Landfill was proposed in the future, the radiological conditions would need to be reevaluated to ensure that there was no undue risk to the public. The AEC suggested that the property record be appropriately flagged so that these limitations would be recognized in any future proposed use of the land.

The 1978 survey (U.S. Dep. Energy 1980b) was conducted to further characterize the current radiological condition of the site. Both surface and subsurface measurements were taken. This survey confirmed that there is little contamination of surface soil on the site. Average radon emanation rates, average external gamma radiation levels, and average beta-gamma dose rates on the site are near background levels. Radionuclide concentrations in water taken from Bound Brook near the site were far below allowable Nuclear Regulatory Commission limits (30,000 pCi/L for uranium and 30 pCi/L for radium-226 [10 CFR 20]). Background is reported as 0.29 pCi/L; all results in the 1978 study were reported as being <0.5 pCi/L and more recent results (Bechtel Natl. 1984a) were reported as being slightly less than background.

The 1978 measurements contain only two borings within the proposed excavation area. Several borings were taken in this area in the 1974 survey (Figure 2.1). Based on the 1974 and 1978 survey data, the concentration of radium-226 is plotted as a function of depth in the vicinity of the proposed excavation area (Figure 2.2). Based on the 1974 and 1978 survey data, the following observations can be made:

- The distribution of contaminated materials within the Landfill is very spotty, both vertically and horizontally.
- There is little or no correlation between surface radiation levels and subsurface radionuclide concentrations.
- The closely grouped samples that had concentrations in excess of DOE radiological guidelines are in the proposed excavation area, although most of the samples had radium-226 concentrations below 15 pCi/g. At the 0- to 15-cm depth, nine samples had radium concentrations above the 5 pCi/g radiological guideline (Table 2.1 and Appendix A). The 15 pCi/g guideline for radium concentration at the 15-cm to 1.5-m depth was exceeded in five cases, including two that were taken at the 0- to 15-cm depth. Radium-226 contamination below 1.5 m is not covered by existing guidelines and has to be considered on a site-specific basis. (No site-specific analysis has been conducted of contamination below 1.5 m at the Landfill.)

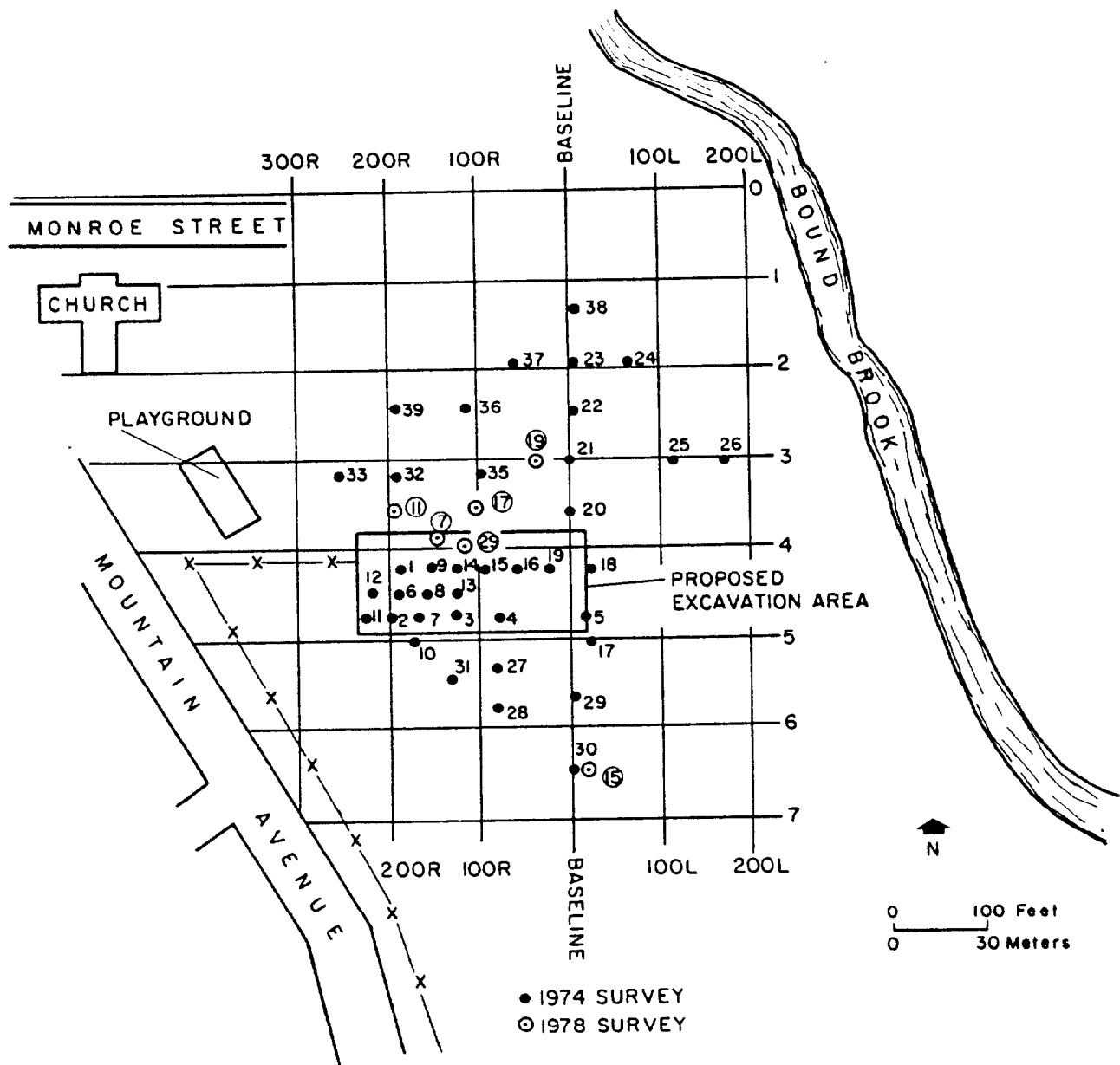
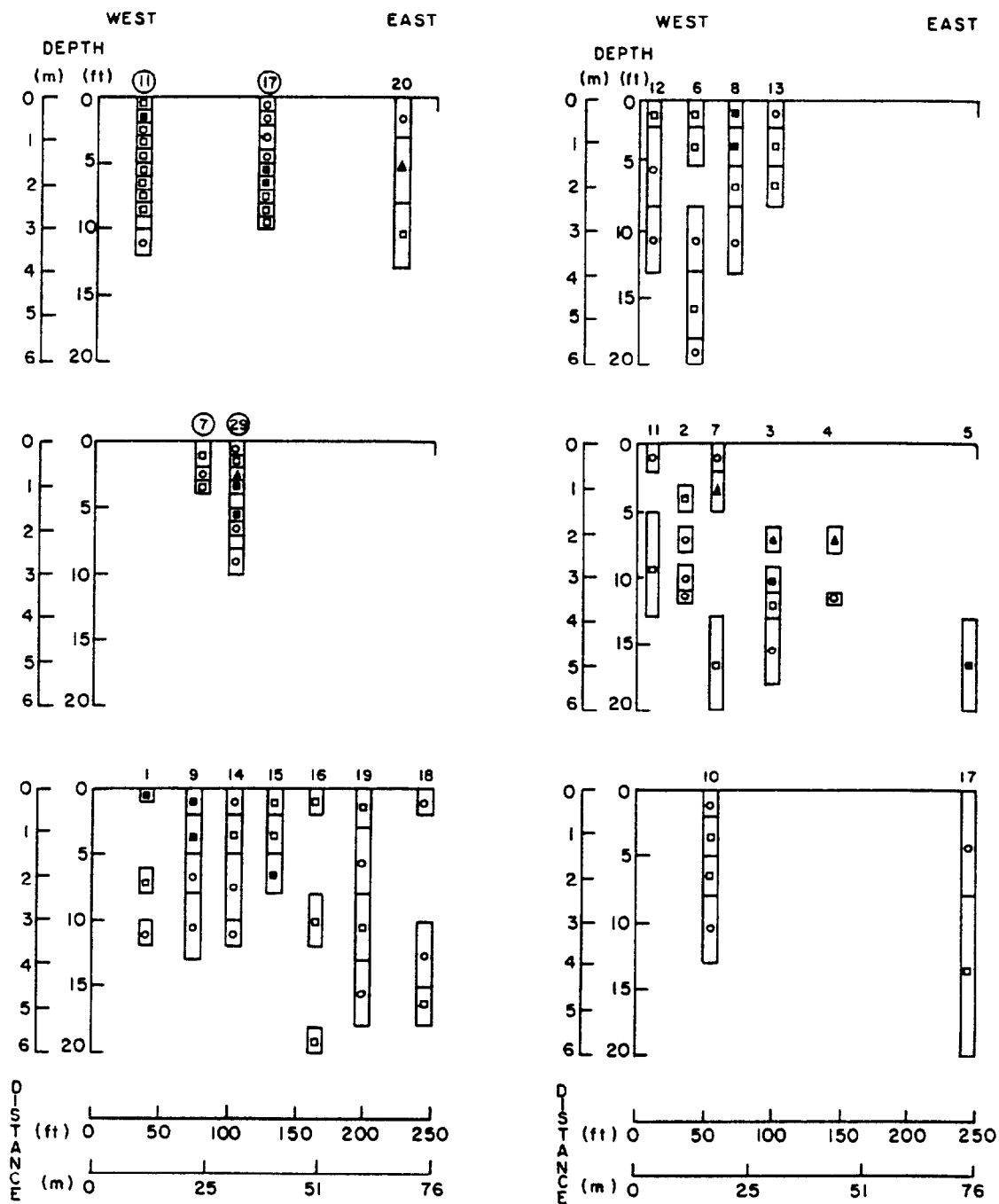


Figure 2.1. Locations of 1974 and 1978 Core Samples Relative to the Proposed Excavation Area. Source: Adapted from U.S. Atomic Energy Commission (1974).



**LEGEND:**

BOREHOLE NUMBERS CORRESPOND TO BOREHOLE LOCATIONS ON FIGURE 2.1.

RADIUM - 226 CONCENTRATION:

- <math>< 5 \text{ pCi/g}</math>
- 5-15 pCi/g
- 15-50 pCi/g
- ▲ > 50 pCi/g

Figure 2.2. Contamination of the Middlesex Municipal Landfill as a Function of Depth Below Surface. Based on data presented in reports of the U.S. Atomic Energy Commission (1974) and U.S. Department of Energy (1980b).

Table 2.1. DOE Radiological Guidelines for  
Residual Radionuclide Concentrations  
in Soil at FUSRAP Sites

Radionuclide	Allowable Concentration Above Background (pCi/g)
U-natural† <sup>1</sup>	75
U-238† <sup>2</sup>	150
Th-232	15
Ra-226	5/15† <sup>3</sup>

†<sup>1</sup> One curie of natural uranium means the sum of  $3.7 \times 10^{10}$  disintegrations/second (dis/s) over any 15-cm-thick layer from U-238 plus  $3.7 \times 10^{10}$  dis/s from U-234 plus  $1.7 \times 10^9$  dis/s from U-235.

†<sup>2</sup> Assumes no other uranium isotopes are present.

†<sup>3</sup> 5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over 15-cm-thick soil layers more than 15 cm below the surface and less than 1.5 m below the surface.

- Except for one sample at a depth of 3.6 m in Borehole 5, only two-thirds of the proposed excavation area had samples above radiological guidelines.
- There were several boreholes outside the proposed excavation area that had concentrations above guidelines: Boreholes 11, 15, 17, and 19 from the 1978 survey; and Borehole 20 from the 1974 survey.
- Based on the borehole data, it is conservatively estimated that the average concentration in the 4,600 m<sup>3</sup> (6,000 yd<sup>3</sup>) to be removed to the storage pile is about 15 pCi/g. Therefore, the total amount of radium-226 to be removed from the proposed excavation area is about 0.093 Ci.
- Assays of surface soils indicated that only one area--centered around coordinates 4 and 200R (Figure 2.1)--exceeded the uranium-238 guideline of 150 pCi/g.

Although it was determined earlier that the radioactive contamination in the Middlesex Landfill presents no immediate public health concern, local and state authorities have expressed concerns about the contamination at the Landfill. DOE therefore proposes to remove the slightly contaminated materials to the Sampling Plant site for storage until permanent disposition of the materials can be determined.



### 3. AFFECTED ENVIRONMENT

#### 3.1 GEOLOGY AND HYDROLOGY

##### 3.1.1 Middlesex Landfill Site

The Middlesex Landfill is located within the Piedmont Province of central New Jersey (Barksdale et al. 1943). The ground surface at the Landfill ranges from 11 m (35 ft) MSL near Bound Brook to about 16 m (53 ft) MSL near Mountain Avenue (Figure 3.1). Before landfill operations began in the mid 1940s, the area was a gully that extended from within 30 to 61 m (100 to 200 ft) of Mountain Avenue to the brook. As a result of filling activities, the area is now mostly level out to a steep slope within about 33 m (100 ft) of the brook.

Surface runoff flows east towards Bound Brook, which in turn flows northwest and discharges into Green Brook (Figure 3.2). Green Brook discharges into the Raritan River about 3.0 km (1.9 mi) southwest of the site (Figure 3.2). The nearest potable surface water supply (4.4 m<sup>3</sup>/s [100 mgd]) is drawn from the Raritan River at the confluence with the Millstone River, about 4.2 km (2.6 mi) upstream of the confluence of Green Brook (Cesnek 1984). A private industry (Union Carbide Corporation) withdraws a very small amount of water (0.2 m<sup>3</sup>/s [5 mgd]) from the Raritan River about 0.8 km (0.5 mi) downstream from the confluence with Green Brook.

The 100-year flood level at the Landfill is about 13 m (44 ft) MSL. Therefore, during the 100-year flood, the eastern edge of the site would be flooded about two-thirds of the way up the slope (Figure 3.1). The discharge associated with the 100-year flood is estimated to be about 115 m<sup>3</sup>/s (4050 ft<sup>3</sup>/s) at the Landfill (Swanson 1984). Based on drainage areas and stream-flow measurements on Bound Brook and Cedar Brook at South Plainfield (see gauging stations on Figure 3.2), it is estimated that the low flow of Bound Brook at the Landfill is about 0.2 m<sup>3</sup>/s (8.8 ft<sup>3</sup>/s) during the month of August (U.S. Geol. Surv. 1983).

Groundwater at the Landfill is found in both the unconsolidated overburden deposits and in the bedrock. The overburden is about 3.4 to 10 m (11 to 34 ft) thick, of which the upper 0 to 6.1 m (0 to 20 ft) consists of fill material (Ford, Bacon & Davis 1979; Bechtel Natl. 1984b). Underlying the fill material are sedimentary units of sandy clay, silt, and sand. The upper aquifer in the overburden material (including the lower part of the fill materials) is separated from the lower bedrock aquifer by a layer of lower-permeability ( $6.5 \times 10^{-6}$  to  $7.0 \times 10^{-7}$  cm/s) clay formed from weathered shale bedrock. The lower aquifer, which is the major reservoir in the region, occurs in the fractured upper surface of the Brunswick Shale Formation.

It is not known to what extent the upper and lower aquifers may be interconnected. Because the permeability of the clay layer is not extremely low and both aquifers have the same groundwater level, it is possible that the

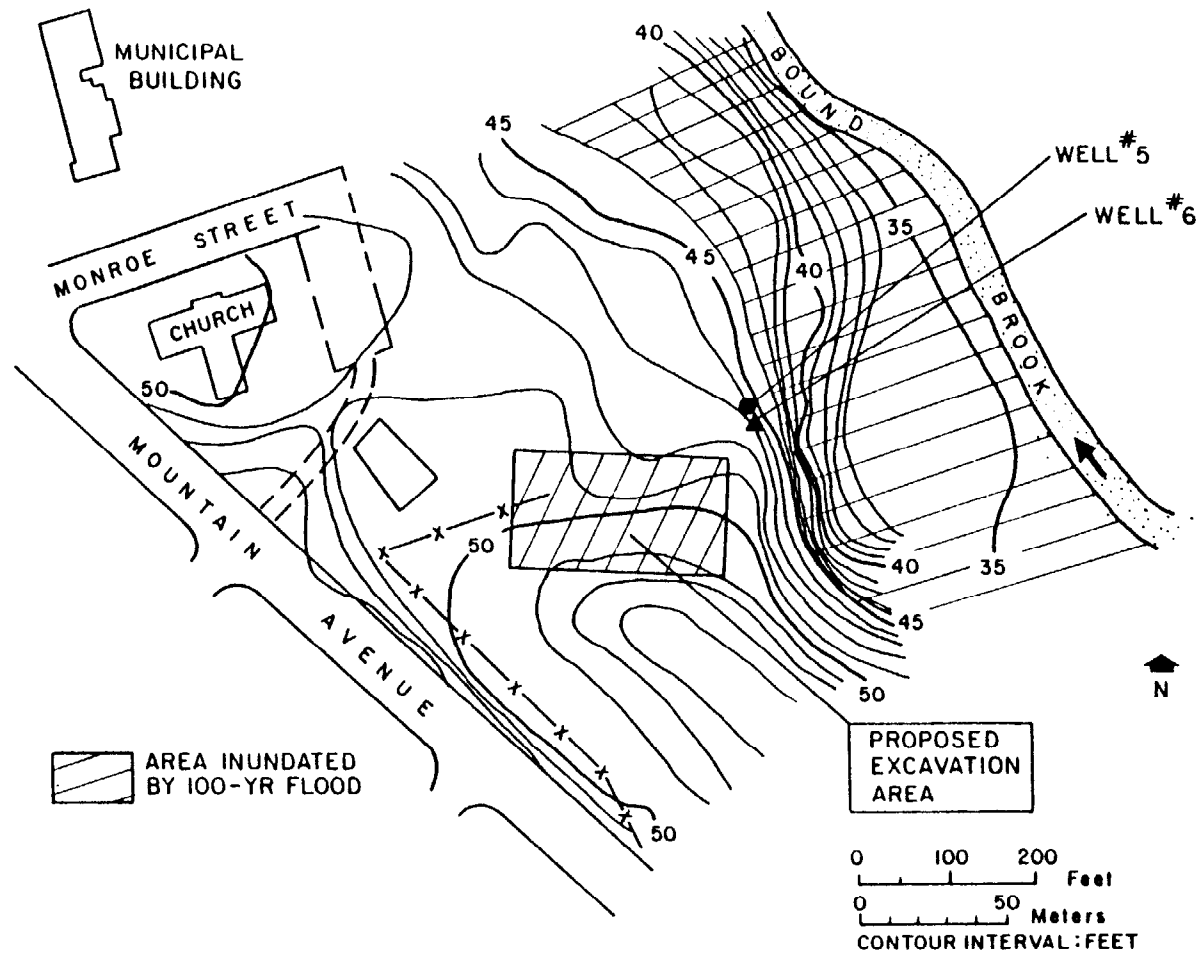


Figure 3.1. Topographic Map of the Middlesex Landfill Site.  
 Source: Adapted from Bechtel National (1984c--  
 Figure 2-4).

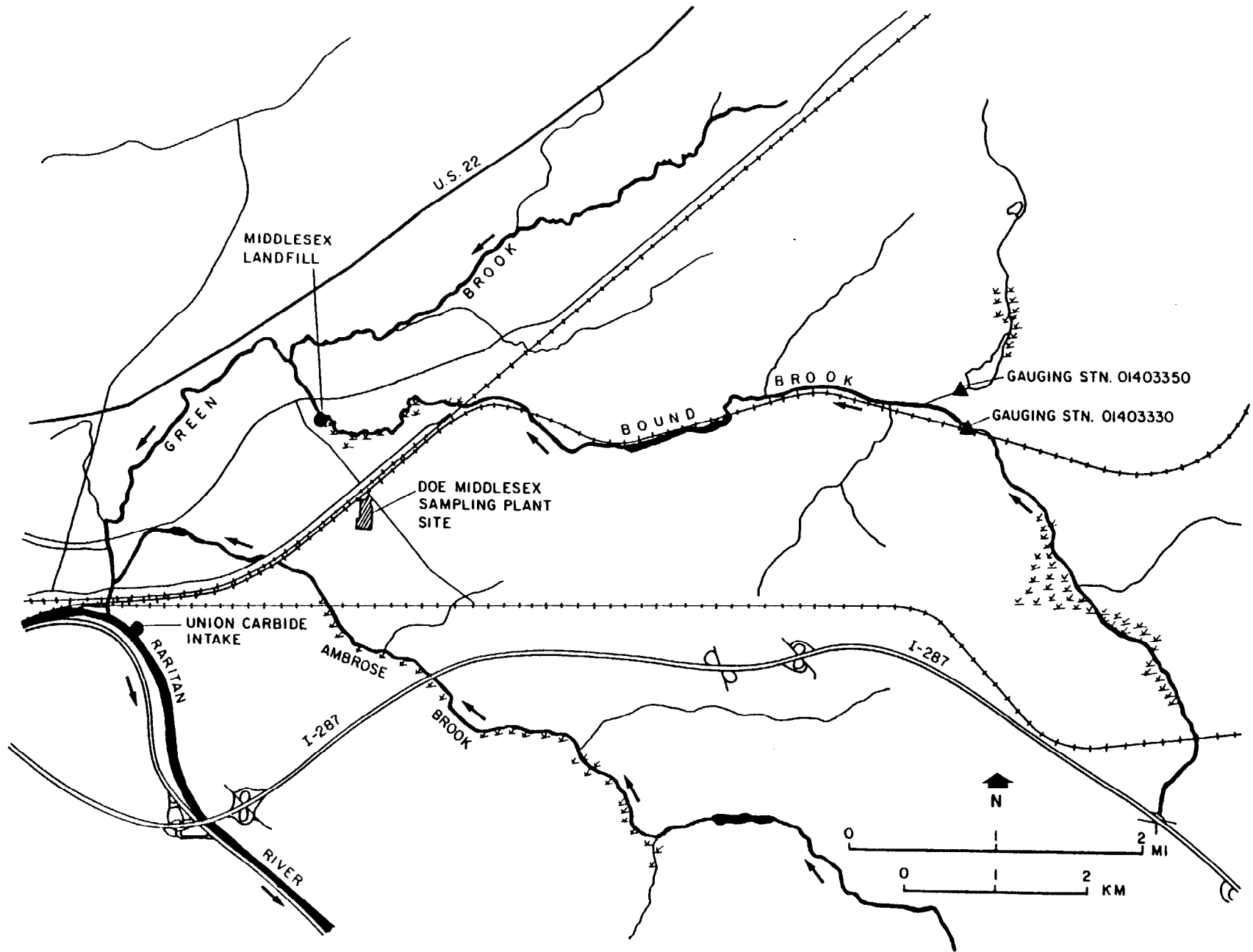


Figure 3.2. Surface Water Drainage Near the Middlesex Landfill and Sampling Plant Sites. Source: Adapted from U.S. Geological Survey (1981).

aquifers may be partially connected. On the other hand, the limited water quality data that are available for comparing the upper and lower aquifers at the Landfill (Bechtel Natl. 1984b) indicate that there may not be much exchange between the two aquifers. Comparative water temperature data are not available.

The groundwater table varies seasonally (Table 3.1). It has been reported as high as 12 m (40 ft) MSL at two wells located near the eastern edge of the proposed excavation area (Figure 3.1). Thus, groundwater may be found about 3 m (10 ft) below the surface of the Landfill in the proposed excavation area. If the groundwater table follows surface contours, water may be encountered 1.6 m (5.4 ft) below the surface in the excavation area. The general direction of groundwater flow at the Landfill is east-northeast toward Bound Brook.

Table 3.1. Selected Groundwater Elevations in Two Wells Near the Eastern Edge of the Proposed Excavation Area

Well No.	Aquifer	Surface Elevation		Date	Groundwater Elevation		Groundwater Depth	
		m MSL	ft MSL		m MSL	ft MSL	m	ft
5	Upper (overburden)	13.7	45.6	12/17/81	9.8	32.6	3.9	13.0
				2/24/82	12.1	40.2	1.6	5.4
				11/24/82	8.7	29.1	5.0	16.5
				7/13/83	10.4	34.6	3.3	11.0
6	Lower (bedrock)	13.5	45.1	12/17/81	10.5	35.0	3.0	10.1
				2/24/82	11.9	39.7	1.6	5.4
				11/24/82	12.8	42.7 <sup>†1</sup>	0.7	2.4 <sup>†1</sup>
				7/13/83	10.7	35.7	2.8	9.4

†<sup>1</sup> Results suspect.

Source: Bechtel National (1984b).

In a recent analysis of water samples from onsite wells (Eberline 1983), only one sample had a radium-226 concentration elevated above the EPA Interim Primary and Secondary Drinking Water Standard of 5 pCi/L. Total uranium concentrations were all below the EPA recommended level of 10 pCi/L. Four samples had slightly elevated concentrations of chromium, lead, and selenium (Eberline 1983; Princeton Test. Lab. 1983a). (See further discussion in Section 3.6.)

### 3.1.2 Middlesex Sampling Plant Site

The Middlesex Sampling Plant site is generally flat, with an elevation ranging from 15 to 19 m (50 to 61 ft) MSL. The dominant soil types are silty

to sandy loams with a thickness of 0.5 to 2.4 m (1.5 to 8 ft). Underlying these deposits are the shales of the Brunswick Formation (U.S. Soil Conserv. Serv. 1976).

Surface runoff from the existing storage pad (see Figure 4.3) is collected in several drains that empty into a large settling basin through an underground drainage system and then into a drainage easement ditch south of the site which runs 180 m (600 ft) south to Main Stream (Figure 3.3). Main Stream empties into Ambrose Brook, and Ambrose Brook flows into Green Brook near the confluence with the Raritan River (Figure 3.2). Neither Main Stream nor Ambrose Brook are used for water supplies.

Groundwater at the Sampling Plant site is available in surficial stratified glacial drift deposits and in the shale bedrock aquifer. The shallow unconfined groundwater in the surficial deposits flows southwest to Main Stream.

Surface water samples collected at the outfall of the settling basin and in Main Stream (Figure 3.3) during 1980, 1981, and 1982 had average uranium and radium-226 concentrations well below the DOE guidelines for uncontrolled areas (Bechtel Natl. 1984a). For soluble radium-226, only 2 of 42 samples collected at the plant outfall exceeded the DOE guideline. This was during 1980 when the pile was exposed during cleanup actions at vicinity properties. Groundwater samples taken from several wells located on the site indicated that the maximum uranium concentrations ranged from 0.005 to 0.34 mg/L, and maximum radium-226 concentrations ranged from 0.2 to 2.3 pCi/L--all within the DOE guidelines for uncontrolled areas (Bechtel Natl. 1984a).

### 3.2 METEOROLOGY

New Jersey averages about 120 days of precipitation per year, and the mean annual precipitation is about 120 cm (48 in.). August is the wettest month, with an average of 12 cm (4.8 in.) of precipitation measured at Somerville, New Jersey, about 13 km [7.8 mi] west of Middlesex (Gale Res. Co. 1980). The highest amount of precipitation recorded for a single day is 23 cm (8.9 in.), and the highest monthly total is 37 cm (14 in.). Floods accompany heavy rains, which in turn are sometimes associated with storms of tropical origin. Short droughts occur during the growing season, but prolonged droughts are rare--generally occurring only once every 15 years (Gale Res. Co. 1980). The prevailing winds are from the northwest during October through April and from the southwest during the summer months.

### 3.3 ECOLOGY

Middlesex is located within the glaciated area of the Appalachian oak forest section of the eastern deciduous forest (Bailey 1978). This forest section is characterized by oak, hickory, maple, basswood, elm, and ash--with alder, willow, ash, elm, and hygrophytic shrubs common in moist (poorly drained) habitats. However, because the Landfill is located within an urban setting and was used for disposal of wastes, little forest habitat is present.

No site-specific ecological surveys have been made at either the Landfill or the Sampling Plant Site. The following discussion is based on a site visit in March 1984 and on general literature information for the region. The flora

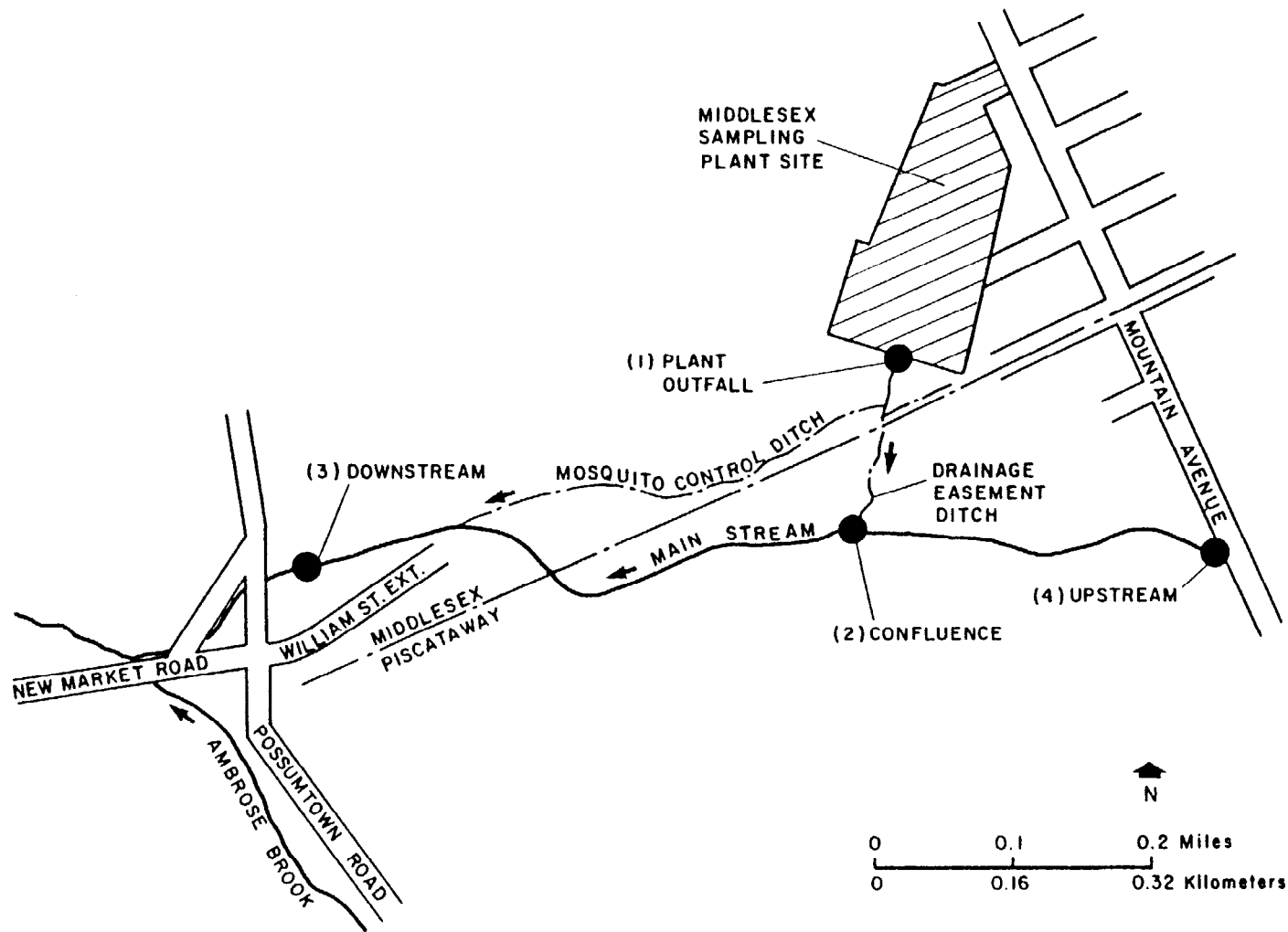


Figure 3.3. Surface Drainage Map of the Middlesex Sampling Plant Site.  
 Source: Adapted from Bechtel National (1984a).

of the Landfill site is dominated by early successional species. These include grasses and forbs (e.g., aster, fescue, plantain, goldenrod, panic-grass, clover, dandelion, smartweed, yarrow, thistle, and wild carrot) and shrubs and small trees (e.g., maple, aspen, willow, elm, cherry, and cottonwood). Mature trees are common in the floodplain of Bound Brook. The reed phragmites (*Phragmites communis*) is also common on the site, especially in the floodplain area, and occurs in small stands on the upper portion of the fill material. Phragmites is indicative of poorly drained or moist soils (e.g., marshes, pond margins, and ditches) (Galvin 1979).

The fauna is probably limited due to a lack of suitable habitat. Commonly encountered species are those that have adapted to suburban/urban encroachment. Birds include the house sparrow, starling, rock dove (pigeon), red-winged blackbird, common crow, and robin. Mammals include the Norway rat, raccoon, opossum, woodchuck, house mouse, meadow vole, white-footed mouse, deer mouse, eastern mole, eastern cottontail rabbit, striped skunk, eastern gray squirrel, and shorttail shrew. A few species of reptiles such as the eastern garter snake and American toad have partially adapted to urban habitats and can be expected to occur in the area.

Aquatic habitat is limited to Bound Brook and a pond formed by a former channel of the brook. Plant communities of Bound Brook and permanently moist areas are dominated by cattails and marsh grasses. Mosquito and midge larvae, aquatic beetles and bugs, and other aquatic invertebrates capable of rapid colonization and/or short life cycles are probably typical inhabitants of temporary water bodies found in the vicinity. Species typical of small, generally degraded streams are probably found in Bound Brook (e.g., aquatic worms, midges, snails, blackflies, beetles, bugs, minnows, and suckers).

Minimal biotic resources occur on the Middlesex Sampling Plant site because most of the site is paved. Pigeons, sparrows, rats, and mice may occur on the site, and some aquatic insects (mostly dipterans) and frogs may occur in the sedimentation basin.

Because of the highly disturbed nature of both the Landfill and Sampling Plant sites, the occurrence of any rare or endangered species on these sites is extremely unlikely.

### 3.4 LAND USE

The Middlesex Landfill site is located on property that is jointly owned by the Borough of Middlesex and the Middlesex Presbyterian Church. Until 1974, the Landfill was used for disposal of municipal wastes from other landfills, businesses, and streets. The Landfill site is no longer in active use except for a can, bottle, and paper recycling operation located near the entrance. The areas immediately east and south of the Landfill are undeveloped. The Middlesex Presbyterian Church is adjacent to the northwest side of the Landfill, and the Middlesex Municipal Building is located northwest of the church property (Figure 3.1). Mountain Avenue and residential properties are located on the west side of the Landfill.

The Landfill and adjacent properties on the north, east, and south are zoned for single-family and planned residential options (Cross Assoc. 1976). One property west of the site (across from Mountain Avenue) is mostly zoned

for a municipal center. Similar zoning--plus zoning for single-family, apartment, general business, two-family, commercial/light manufacturing/wholesale, and industrial/industrial park--are also located within several kilometers of the site.

The Middlesex Sampling Plant site currently contains abandoned buildings and a large interim-storage pile. The site is bordered to the north by the Central Railroad of New Jersey and the Lehigh Valley Railroad, to the east by an empty lot (Rosamilia property) and residential properties on Mountain Avenue, to the south by a vacant field, and to the west by industry. During the day, there is frequent heavy-truck traffic entering and leaving the access road off Mountain Avenue between the railroad and the north end of the Sampling Plant site. The site and adjacent property are zoned for industrial/industrial park, although single-family residences are located just east and southeast of the Sampling Plant site. Zoning within several kilometers of the site is similar to that previously mentioned for the Landfill.

The current land use surrounding both sites is a mosaic of residential, commercial, industrial, public, and vacant land (Ford, Bacon & Davis 1979). With the completion of Interstate 287, the area has become increasingly more attractive for development. Future activity probably will include the development of residential areas south and southeast of the site and the development of industrially zoned land from about 0.8 to 1.6 km (0.5 to 1 mi) to the south and southwest (Ford, Bacon & Davis 1979).

Future land use is not expected to change greatly from current plans and usage. The Middlesex 1976 Master Plan (Ford, Bacon & Davis 1979) calls for creating a homogeneous industrial zone along South Avenue and Lincoln Boulevard, replacing nursery and greenhouse properties with residential areas and developing vacant lands outside the flood-control areas. Moreover, plans to extend William Street across the southern portion of the site have been under consideration for many years. Such action would allow development of a large area in Piscataway.

### 3.5 SOCIOECONOMICS

Both the Landfill and Sampling Plant sites are accessible to railroad and interstate transportation systems (Figure 3.4). Several schools, hospitals, and other institutional facilities are located within 3.2 km (2 mi) of the contaminated properties (Raritan Valley Regional Chamber of Commerce, undated; League of Women Voters 1980). However, except for the Middlesex Presbyterian Church located on the north side of the Landfill, no other institutional facilities occur near the two sites or along Mountain Avenue between the sites.

There are about 15 million people residing within 80 km (50 mi) of Middlesex. The 1980 populations for Middlesex and Piscataway were 13,480 and 42,223, respectively--a change from the 1974 populations of 14,004 and 37,132 (U.S. Bur. Census 1982b; Raritan Valley Regional Chamber of Commerce, undated). Populations in both communities are projected to increase over the next 10 to 15 years (Raritan Valley Regional Chamber of Commerce, undated). Little unimproved or vacant land is available for residential development in Middlesex. However, there are several hundred acres of vacant land to the south of the Sampling Plant site in Piscataway. The Township of Piscataway recently passed



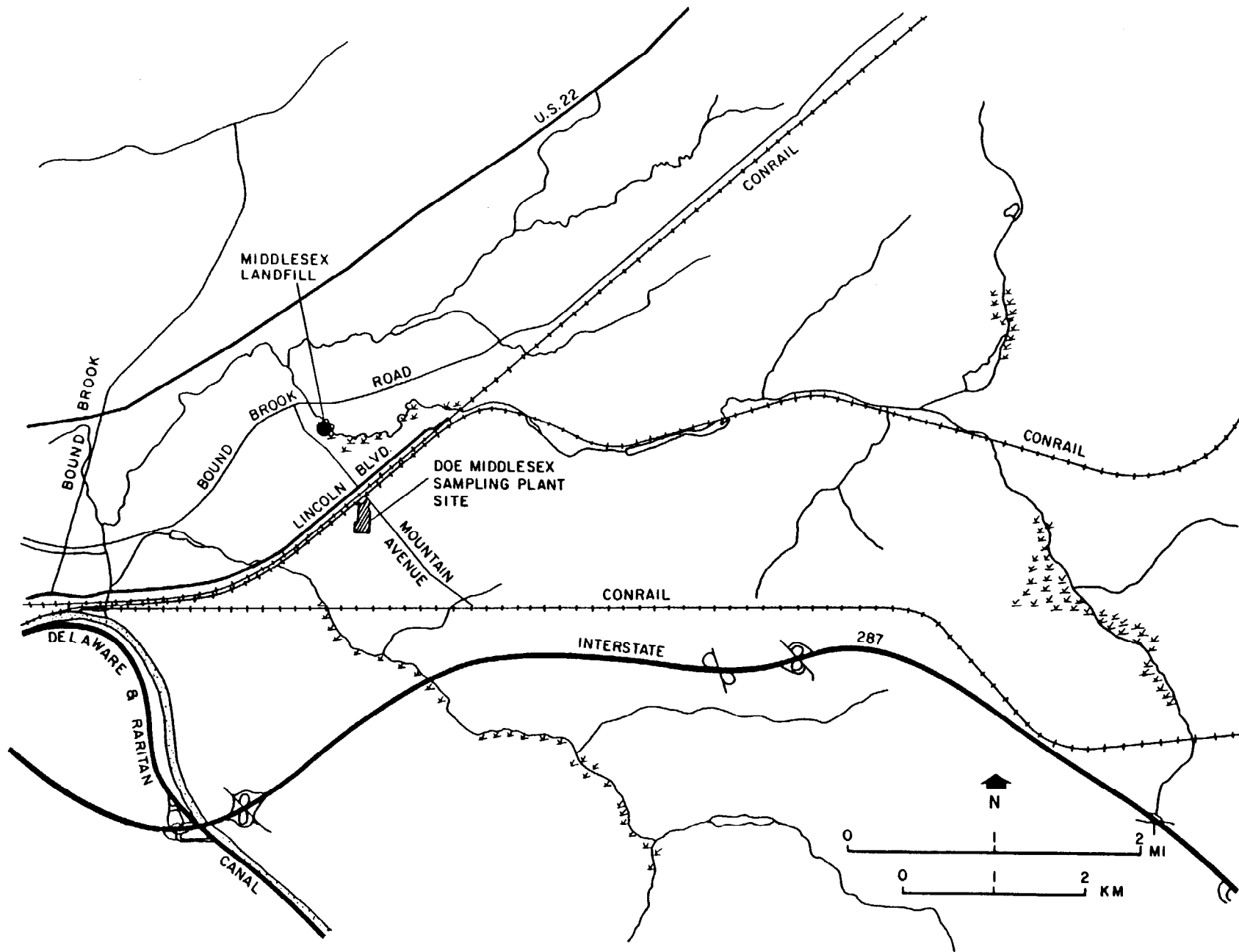


Figure 3.4. Transportation System Near Middlesex, New Jersey.  
 Source: Adapted from U.S. Geological Survey (1981).

a new master plan calling for the development of several residential areas on sections of this vacant land (Ford, Bacon & Davis 1979). If the plan is followed, the population in Piscataway within 1.6 km (1 mi) of the Sampling Plant site could increase by as much as 12,000 people.

The 1980 housing characteristics in the communities of Middlesex and Piscataway are similar. Median home values were \$60,300 for Middlesex and \$63,100 for Piscataway (U.S. Bureau of Census 1982a). Vacancy rates for home owners and rental properties were very low when compared to the patterns recorded in many other New Jersey communities.

Both Middlesex and Piscataway are comprised predominately of white, married-couple families having a median family income in 1979 of \$25,000 to \$26,000 (U.S. Bur. Census 1982b). In 1982, the average household size for the communities of Middlesex and Piscataway was 2.94 and 2.93, respectively, a number that has steadily declined since 1960 (Middlesex Co. Plan. Board 1983). The most prevalent occupations in these communities are manufacturing, professional and related services, and retail trade (U.S. Bur. Census 1982b).

Middlesex and Piscataway are located in the central subregion of Middlesex County, which attracted over 60% of the county's 1980 daily in-commuters (Middlesex Co. Plan. Board 1983). Based on 1980 census information (U.S. Bur. Census 1982b), commuting by private vehicles appears to be the preferred mode of transportation in both communities. Therefore, many of the workers who are employed within 1.6 km (1 mi) of the sites are expected to be commuting into this area from outside the county by private vehicle.

The radioactive contamination in the project area has produced some effects on the current socioeconomic setting because of local health and safety perceptions. The presence of radioactive materials on the DOE Sampling Plant site has had a bearing on the demand for the use of surrounding properties (Ford, Bacon & Davis 1978). It is not known whether or not a similar situation may also be associated with properties around the Landfill site.

### 3.6 CHEMICAL

#### 3.6.1 Landfill Materials

There is evidence which indicates that appreciable quantities of non-radiological hazardous wastes may be present in the Landfill. High concentrations of arsenic, chromium, and lead were detected in a composite soil sample analyzed from a borehole drilled in 1983 about 120 m (400 ft) north of the Landfill. Cyanide and some organics were also present (Bechtel Natl. 1984b; Fisk Assoc. 1984).

Six boreholes were drilled in January 1984 in the area to be excavated (Fisk Assoc. 1984). The presence of appreciable amounts of methane hampered drilling operations and limited sample collection. High concentrations of chromium, arsenic, and lead were found along with hazardous organics such as PCBs, benzo(a)pyrene, and naphthalene (Rudolph 1984; Keller 1984). Details of the results for all borehole analyses are given in Table 3.2. It should be emphasized that the estimated average concentrations are based on samples from only six boreholes. Based on the average concentrations, it is estimated that thousands of kilograms of chemicals may be transported to the Sampling Plant

Table 3.2. Concentrations of Hazardous Materials in Borehole Samples from the Middlesex Landfill†<sup>1</sup>

Parameter	Concentrations (ppm)			Number of Positive Results† <sup>2</sup>	Detection Limits (ppm)	
	Well 83-22	1984 Boreholes			Well 83-22	1984 Boreholes
		Average† <sup>2</sup>	Range† <sup>2</sup>			
Arsenic	330	38	0.86 - 179	6		
Beryllium	0.2	0.75	0.25 - 1.25	6		
Cadmium	27.4	5.9	0.65 - 29	6		
Chromium	155	79	18 - 71	6		
Copper	53	130	56 - 251	6		
Lead	742	367	61 - 938	6		
Mercury	0.8	0.25	0.06 - 0.52	6		
Nickel	21.5	26	18 - 36	6		
Selenium	0.4	-† <sup>3</sup>	-† <sup>3</sup>	0		0.5
Silver	1.1	3.2	2.5 - 4.5	6		
Thallium	23	-	-	0		5
Zinc	1,100	456	60 - 1,800	6		1
Cyanide	3.8	1.7	1.3 - 3.6	1	0.1	1.3
Phenols	0.4	-	-	0	0.1	0.4
Methylene chloride	0.243	-	-	0	0.001	0.05
Trichlorofluoromethane	0.053	-	-	0	0.001	0.05
1,1,1-Trichloroethane	0.085	-	-	0	0.001	0.02
Trichloroethene	0.335	-	-	0	0.001	0.02
Chlorobenzene	0.020	-	-	0	0.001	0.01
Benzene	0.005	-	-	0	0.001	0.01
Toluene	0.304	-	-	0	0.001	0.01
Ethylbenzene	0.161	-	-	0	0.001	0.01
2,4,D; methoxychlor	0.021	-	-	0	0.001	0.01
Acenaphthene	-† <sup>3</sup>	0.28	0.2 - 0.76	3	0.01	0.2
Anthracene	-	2.5	0.2 - 5.6	5	0.01	0.2
Benzo(a)anthracene	-	4.4	0.26 - 6.8	6	0.01	0.2
Benzo(a)pyrene	-	3.8	0.2 - 7.3	5	0.01	0.2
Benzo(ghi)perylene	-	0.6	0.2 - 1.4	4	0.01	0.5
Benzo(k)fluoranthene	-	3.4	0.2 - 6.2	5	0.01	0.2
Bis(2-ethylhexyl)phthalate	-	2.3	0.2 - 5.6	4	0.01	0.2
Dibenzo(a,h)anthracene	-	0.57	0.19 - 1.2	3	0.01	0.5
1,4 Dichlorobenzene	-	0.18	0.1 - 0.2	1	0.01	0.2
Di-n-butyl phthalate	-	0.98	0.2 - 2.1	5	0.01	0.2
Fluoranthene	-	2.7	0.2 - 5.9	5	0.01	0.2
Fluorene	-	0.38	0.2 - 0.73	3	0.01	0.2
Ideno(1,2,3-cd)pyrene	-	0.53	0.2 - 1.1	4	0.01	0.5
Naphthalene	-	0.57	0.2 - 1.5	4	0.01	0.2
Pyrene	-	2.3	0.2 - 4.9	5	0.01	0.2
Phenol	-	0.65	0.5 - 1.4	1	0.01	0.5
4,4 DDT	-	0.07	0.02 - 0.20	1	0.001	0.02
4,4 DDE	-	0.06	0.02 - 0.20	1	0.001	0.02
4,4 DDD	-	0.06	0.02 - 0.20	1	0.001	0.02
PCB 1254	-	2.4	0.5 - 12.0	1	0.001	0.5

†<sup>1</sup> Based on Rudolph (1984) and Bechtel National (1984a--Appendix D). Only those parameters are listed for which at least one positive result was obtained.

†<sup>2</sup> Averages and ranges were computed using detection limits as the results for those samples with negative results.

†<sup>3</sup> A dash means no positive results obtained.

site for storage. For example, 280 kg arsenic, 580 kg chromium, 950 kg copper, 2,700 kg lead, 3,300 kg zinc, 28 kg benzo( $\alpha$ )pyrene, 17 kg pyrene, and 18 kg PCB may be stored. Approximately twice as much will be placed back into the Landfill. In some respects, these amounts may be overestimates--e.g., average concentrations were estimated using detection limits at the lower end of the range in some cases; however, in other respects, the amounts may be underestimates--e.g., concentrations varied widely and the contents of any buried containers were not sampled.

Prior to drilling the boreholes, a ground penetrating radar survey was carried out to locate buried metal objects. The boreholes were then drilled to avoid known metal objects. It is not known if the objects are metal drums or containers. The presence of drums is suspected because some drums can be seen protruding from the landfill slope (Merry-Libby 1984; Glenn 1984a).

Although the available data indicate the presence of hazardous chemical substances in the Landfill, additional data are needed to sufficiently characterize the chemical condition of the Landfill (particularly in the area to be excavated) with respect to predicting potential impacts of excavation, storage, and long-term disposal of landfill materials. The 1983 borehole sample was not located in the area to be excavated, and the results of the organics analyses of the 1984 samples are quite different from those of the 1983 sample. One problem is the high detection limits associated with the 1984 data. Also, the lack of 1984 data for volatile organics is highly suspect for landfill samples, indicating possible problems with sample preservation or analytical methods. Furthermore, spatial heterogeneities may not be adequately accounted for because the 1984 boreholes are located quite far from one another (15 to 24 m [50 to 80 ft]). Finally, there may be buried drums or other containers and their contents are not known.

### 3.6.2 Groundwater

Analyses of groundwater samples taken from seven wells drilled into the upper (overburden) aquifer at the Landfill showed low levels of metals (Table 3.3). Pesticides and PCBs were not detectable at a level of 2 ppb (5 ppb for PCBs). Several other organics were detected, and concentrations in some samples exceeded regulatory limits. Those chemicals for which analysis of water samples from one or more wells gave positive results are listed in Table 3.3. Several of the chemicals (chromium, lead, and naphthalene) were close to, but below, the regulatory limits. Only selenium had an average concentration slightly above the regulatory limit.

It is difficult to know if the values given in Table 3.3 are representative of average upper aquifer concentrations. For one thing, these values refer to water samples drawn at one time in 1983. For at least part of the year the groundwater level in some of the wells sampled extends into the Landfill (Section 3.1) and concentrations of hazardous materials in the landfill materials appear to be appreciable (Section 3.6.1).

Except for chloride, sulfate, total dissolved solids (TDS), and hardness, no analyses were performed on well-water samples drawn from the bedrock aquifer. The lower bedrock and upper overburden aquifers may or may not be appreciably interconnected at the Landfill (Section 3.1).

Table 3.3. Concentrations of Chemicals in Wellwater from the Upper (Overburden) Aquifer†<sup>1</sup>

Parameter	Concentration (ppb)		Detection Limit	Number of Positive Results	Regulatory Limits
	Average† <sup>2</sup>	Range† <sup>2</sup>			
Chloride	80† <sup>3</sup>	20 - 150† <sup>3</sup>	-	7	
Sulfate	36† <sup>3</sup>	10 - 100† <sup>3</sup>	-	7	
TDS	1,400† <sup>3</sup>	680 - 4,600† <sup>3</sup>	-	7	
Hardness	380† <sup>3</sup>	250 - 600† <sup>3</sup>	-	7	
Chromium	36	20 - 87	20	3	50† <sup>4</sup>
Copper	20	20 - 22	20	1	bkgd† <sup>4</sup>
Lead	41	24 - 56	-	7	50† <sup>4</sup>
Zinc	40	14 - 120	-	7	bkgd† <sup>4</sup>
Arsenic	15	10 - 50	10	2	50† <sup>4</sup>
Silver	13	10 - 24	10	3	50† <sup>4</sup>
Selenium	12	10 - 40	10	3	10† <sup>4</sup>
Uranium	6.3	5 - 13	5	2	bkgd† <sup>4</sup>
Cyanide	10	10 - 12	10	2	bkgd† <sup>4</sup>
Phenols	100	100	100	1	bkgd† <sup>4</sup>
1,4 Dichlorobenzene	11	7 - 18	10	2	bkgd† <sup>4</sup>
Naphthalene	11	4 - 25	10	3	13† <sup>5</sup>
Benzene	2.5	1 - 5	1	5	bkgd† <sup>4</sup>
Chlorobenzene	77	1 - 430	1	4	400† <sup>5</sup>
Chloroform	5	2 - 20	2	1	bkgd† <sup>4</sup>
1,1 dichloroethane	3	1 - 10	1	1	bkgd† <sup>4</sup>
Ethylbenzene	3	1 - 10	1	1	1,400† <sup>5</sup>
Toluene	2	1 - 6	1	3	bkgd† <sup>4</sup>

†<sup>1</sup> Based on Bechtel National (1984b), Princeton Testing Lab (1983b), and Haywood (1983).

†<sup>2</sup> The seven values, one for each well into the overburden aquifer, were averaged together. The detection limit was taken as the sample value for those wells for which the presence of a parameter was not detectable. Where appropriate, this limit was included in determining the range of values.

†<sup>3</sup> Concentrations given in ppm.

†<sup>4</sup> 40 CFR 264 groundwater limits for operators of hazardous waste sites. The abbreviation "bkgd" denotes background concentrations.

†<sup>5</sup> New Jersey Pollutant Discharge Elimination System (NJPDDES) limits in effluents for toxicity protection of potable water supplies.

## 4. PROPOSED REMEDIAL ACTIONS AND ALTERNATIVES

### 4.1 PROPOSED 1984 ACTIONS

#### 4.1.1 Middlesex Landfill

The proposed actions for 1984 involve cleanup of the Middlesex Landfill and placement of radioactively contaminated materials in an interim-storage pile on the Middlesex Sampling Plant site. It is expected that approximately 14,000 m<sup>3</sup> (18,000 yd<sup>3</sup>)\* of landfill materials will be excavated, of which about one-third (4,600 m<sup>3</sup>) [6,000 yd<sup>3</sup>]\* is expected to be radioactively contaminated. The proposed excavation area is shown in Figure 4.1.

Support facilities will be constructed at the Landfill prior to excavation. Small trees and shrubs and other vegetation will be removed. A gravel access road will be constructed from the main gate off Mountain Avenue to the proposed excavation area (Figure 4.1). Because some of the excavated materials will probably be wet (see further discussion in Section 5.2), a synthetic liner will be placed on the ground north of the excavation area (Figure 4.1). This area will be used to stockpile wet wastes, allowing them to drain back into the excavation area and partially dry prior to being loaded onto trucks for transport to the Sampling Plant site.

A decontamination facility, consisting of a gravel-filled pit with a wooden ramp over the pit, will be constructed south of the excavation area (Figure 4.1). Steam and high-pressure water will be used to clean construction vehicles and any large buried objects that need to be decontaminated (see below). After collecting in the pit, the water will flow to a standpipe and will be recirculated through a sand filter to remove particulates. It is expected that the sand filters will have to be replaced about every two days; used filters will be disposed on the interim-storage pile. When the water becomes too contaminated and can no longer be recirculated, it will be transferred to a 3,800-L (1,000-gal) stationary bladder tank and will be used for dust control at the Landfill.

Excavation will be carried out similar to a strip mining operation, with minimal exposure of the open cut and backfilling completed as soon as excavation depth allows. The wastes will be excavated in strips 9-m (30-ft) wide and 34-m (110-ft) long in 0.3-m (1-ft) depth increments (Figure 4.2). The layer to be excavated will be radiologically surveyed, and materials that are

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\*These volumes are being revised as detailed engineering progresses. As of April 24, 1984, the estimated total volume to be excavated has been reduced to 13,000 m<sup>3</sup> (16,000 yd<sup>3</sup>), of which 4,200 m<sup>3</sup> (5,500 yd<sup>3</sup>) is expected to be radioactively contaminated.

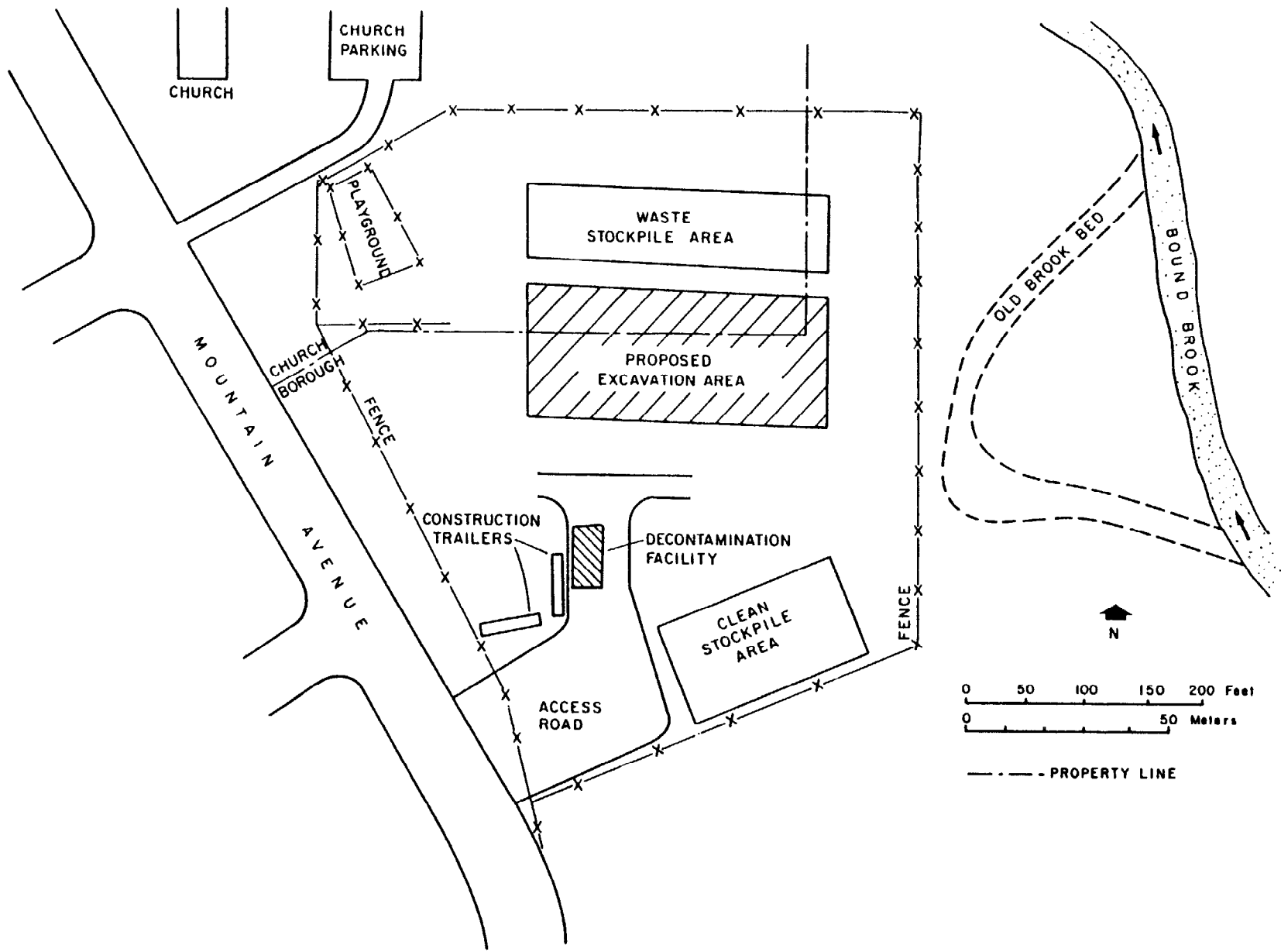


Figure 4.1. Middlesex Landfill--Proposed Cleanup Plan. Source: Preliminary drawing (1984) by Bechtel National.

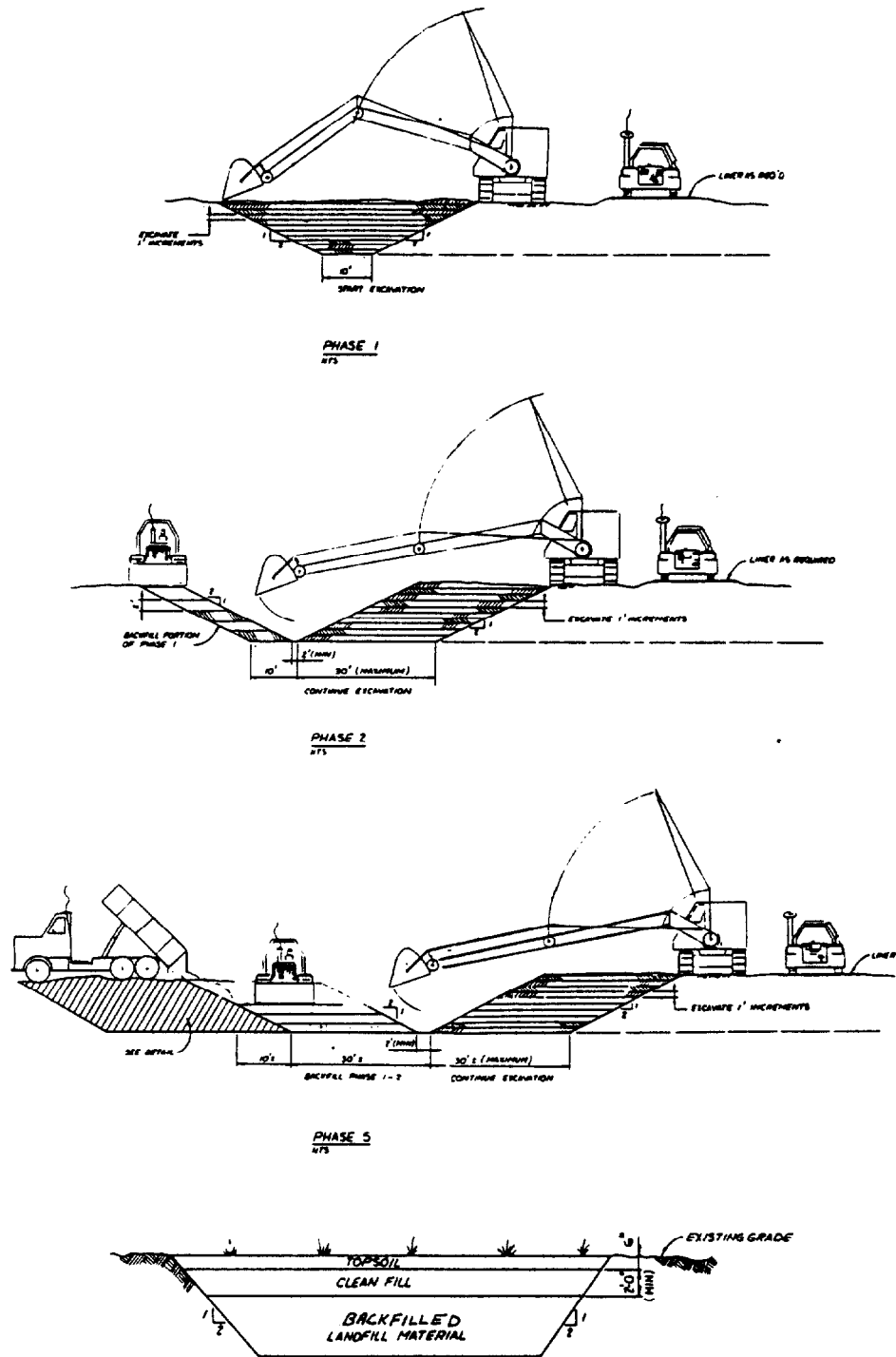


Figure 4.2. Middlesex Landfill--Sequence of Proposed Excavation and Backfill Activities. Source: Preliminary drawing (1984) by Bechtel National.



radioactively contaminated will be excavated and loaded onto trucks for delivery to the Sampling Plant site for interim storage. For the first cut, landfill material that is not radioactively contaminated will be placed in the stockpile area on the north side of the excavation area. For subsequent cuts, such material will be backfilled into the previously excavated cut.

Buried metal objects and other large pieces of wastes will be decontaminated and returned to the excavation area. Decontamination will be accomplished by mechanical cleaning (e.g., rigorously shaking off loose soil at the excavation area and, if necessary, taking the object to the onsite decontamination pad for washing down). Any objects that cannot be sufficiently decontaminated will be taken to the Sampling Plant site.

The transport distance to the Sampling Plant site is approximately 0.8 km (0.5 mi) along Mountain Avenue. The dump trucks transporting the radioactive materials will be covered with tarpaulins. The capacity of the trucks will be restricted by the applicable load limits of the roads and a railroad bridge that must be traversed. Using 10-yd<sup>3</sup> trucks and assuming an excavation time of 40 workdays, about 600 truckloads, or 15 truckloads per day, will be required.

#### 4.1.2 Sampling Plant

The northern part of the existing asphalt storage pad at the Sampling Plant site will be used for storage of the landfill wastes (Figure 4.3). In addition to the existing large pile on the south storage pad area, there is a small existing pile on the north pad area containing contaminated ashes resulting from incineration of trees and other organic matter removed from other properties during previous remedial actions. This ash pile is covered with a synthetic liner (EPDM). This pile and the area to be covered by the new storage pile (Figure 4.3) will be covered with a synthetic liner and the landfill wastes will then be placed on the liner to form one continuous new storage pile. Wastes will be laid down in layers and dried or wetted, as necessary, so that they can be compacted by a bulldozer. The pile will eventually reach a height of about 3 m (10 ft), cover an area of 1,800 m<sup>2</sup> (20,000 ft<sup>2</sup>), and have 3:1 side slopes.\* Any large objects that are removed from the Landfill and cannot be adequately decontaminated will be stored in a separate section of the pile.

It will take about 3 months to complete the pile and cover it with a synthetic cover. The synthetic liner and cover have not yet been specified. The material will be resistant to degradation by the chemical substances, particularly organics, in the landfill wastes. Both Hypalon and EPDM are currently being considered. (See further discussion in Section 5.2.)

The trucks will dump the wastes from a ramp at the storage pile in order to minimize decontamination requirements. After depositing each load at the storage pile, the trucks will be surveyed for radioactivity and decontaminated, as necessary, at the existing decontamination area in the northeast corner of

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\*The pile dimensions may change slightly if waste volumes change.

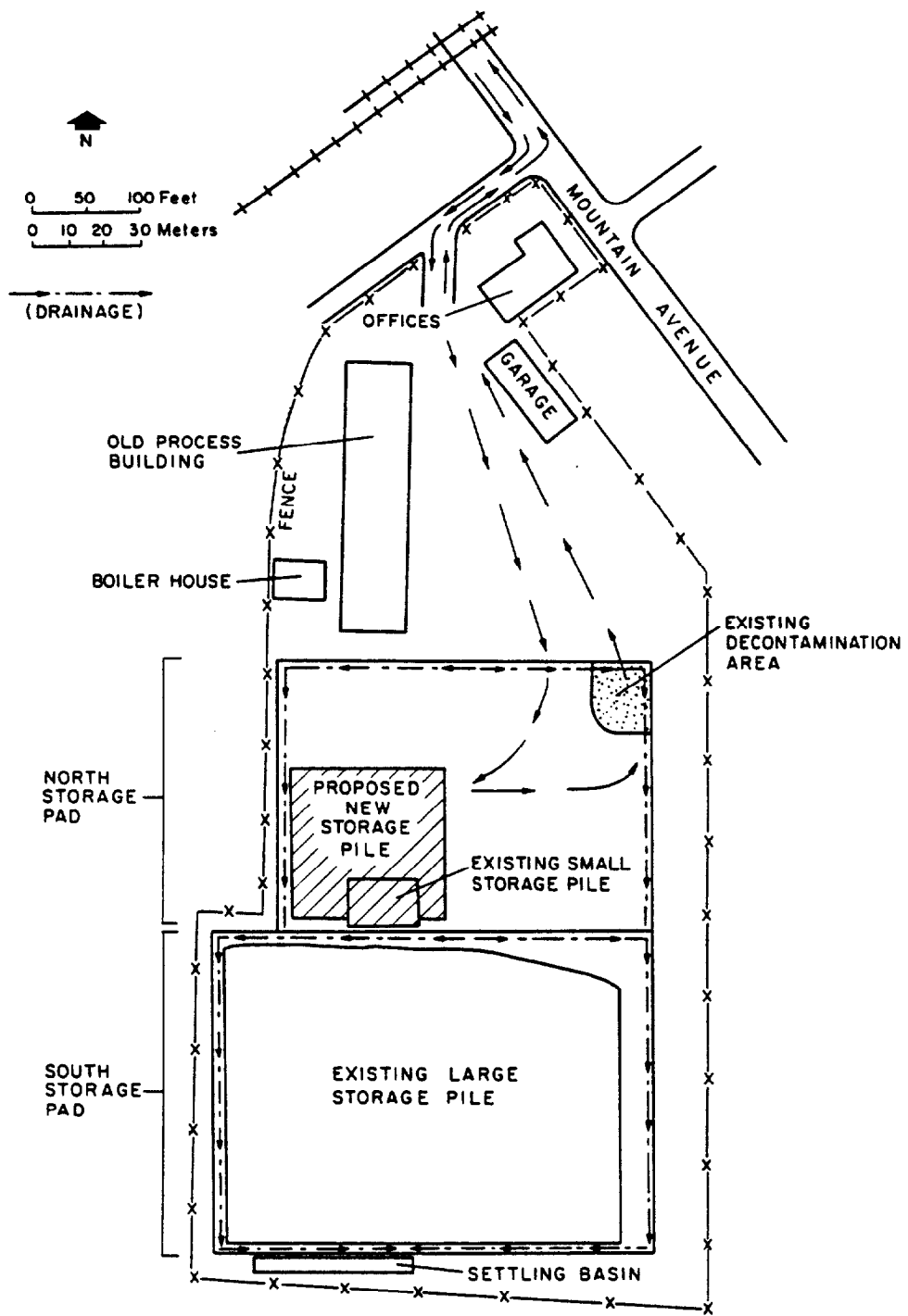


Figure 4.3. Middlesex Sampling Plant Site--Proposed Location of New Storage Pile. Source: Preliminary drawing (1984) by Bechtel National.

storage pad. This will be accomplished using a fire hose. The drainage system of the north pad area (which currently empties into the south pad drainage system and then to the settling basin and ditch) will be modified to separately collect all runoff from the north pad. The collected water will be analyzed for both radiological and chemical contaminants. If determined to be within acceptable limits, it will be released to the ditch. If contaminated, the water will be placed in storage tanks and hauled offsite to a licensed facility for treatment and disposal.

A summary of the measures to mitigate and monitor potential impacts that will be a part of the proposed actions is given in Table 4.1. Additional measures that are being considered are discussed in Section 5.

#### 4.2 ALTERNATIVES TO THE PROPOSED ACTION

Alternatives to the proposed action include:

1. TAKE NO ACTION AND CONTINUE RESTRICTIONS REGARDING USE OF THE LANDFILL. This may require formal implementation of legal and other institutional controls, such as putting restrictive covenants on deeds.
2. RELEASE THE LANDFILL FOR UNRESTRICTED USE WITH RESPECT TO RADIOLOGICAL CONDITIONS. This would require more extensive hydrological characterization of the Landfill and a pathway analysis of potential exposure of humans to the radioactivity under possible land- and water-use scenarios. The release of the Landfill with respect to hazardous chemical conditions is not under DOE's jurisdiction.
3. EXCAVATE AND STORE ONLY THE RADIOACTIVELY CONTAMINATED MATERIALS FOUND WITHIN THE UPPER 1.5 m OF THE LANDFILL. "Hot spots" would also be excavated. Following removal of the contaminated materials, DOE would certify the property for future use, as appropriate.
4. STABILIZE THE RADIOACTIVE MATERIALS IN PLACE. Such measures might include construction of a cap over the Landfill to reduce radon emissions and reduce infiltration into and subsequent seepage from the Landfill. Restrictions on future use of the Landfill may also be necessary.
5. DELAY REMEDIAL ACTION UNTIL THE CHEMICAL CONDITION OF THE LANDFILL CAN BE MORE ADEQUATELY CHARACTERIZED. If necessary, more mitigative measures could be planned with respect to hazardous chemicals. Such measures might include coordination with EPA and other authorities to either stabilize both the hazardous chemical and radioactive wastes in place or to remove both kinds of wastes together to a treatment and/or permanent disposal facility.
6. MOVE THE RADIOACTIVELY AND/OR CHEMICALLY CONTAMINATED MATERIALS DIRECTLY TO ANOTHER SITE(S) FOR LONG-TERM MANAGEMENT OR PERMANENT DISPOSAL. This alternative offers the advantage of moving the contaminated materials only once. However, a permanent disposal site has not yet been identified, and funds are currently available for excavation and interim storage.

Table 4.1. Summary of Measures to Mitigate and Monitor Potential Adverse Impacts That Will Be Part of the Proposed 1984 Actions

- 
- Controls over possible spread of radiological and chemical contamination, including: worker monitoring; decontamination of vehicles; control of runoff from the excavation and storage areas; and use of a cover and liner at the storage pile to inhibit infiltration into and seepage from the stored wastes.
  - Careful radiological surveys of each 0.3-m (1-ft) excavation layer to minimize the amount of material that has to be treated as being radioactively contaminated.
  - Erosion and dust controls, including: staged, prompt restoration/revegetation of disturbed areas and completion of work before end of growing season; temporary cover over storage pile, as necessary; watering of disturbed areas and unpaved truck routes; covering truckloads of contaminated material with tarpaulins; and spraying collected contaminated water on the storage pile during construction of the pile.
  - Drilling of ventholes and excavation in 0.3-m (1-ft) increments to allow methane gas to dissipate; provision of anti-spark devices on trucks and other construction equipment; monitoring for methane and other volatile gases.
  - Use of protective clothing and masks if hazardous chemicals are encountered.
  - Water quality monitoring, including: radiological monitoring of wells around the storage area and radiological and chemical monitoring of runoff water collected from the north storage pad area.
  - Air monitoring for radioactive gases and dust.
  - Noise mitigation, including: periodic checks of mufflers, compressors, etc.; work between 8:00 a.m. and 8:00 p.m. to minimize nuisance to nearby residents.
  - Construction of a new fence around the excavation area; prompt restoration of the original grade at the Landfill.
  - Scheduling of truck movements and provision of traffic directors, as necessary, to minimize traffic congestion.
  - Temporary relocation of the recycling center to an area behind the municipal building during the Landfill cleanup.
  - Consultation, cooperation, and coordination with local authorities and concerned citizens throughout the entire period of the action, including: regular information/coordination/planning meetings during both the cleanup and storage phases and designation of an onsite public liaison person for the cleanup phase.
  - Periodic monitoring and surveillance of the interim-storage pile, with maintenance of the cover and a pest (rodent and plant) control program, as necessary, to ensure the integrity of the pile and minimize potential offsite movement of contaminants.
-

7. REMOVE THE CONTAMINATED MATERIALS TO THE MIDDLESEX SAMPLING PLANT FOR LONG-TERM MANAGEMENT OR PERMANENT DISPOSAL. This would require additional site characterization and design engineering. In addition, such disposal would most reasonably be considered in conjunction with disposal of the wastes that are already stored in the existing interim-storage piles on the Sampling Plant site. Funds are currently not available for consideration of a permanent site. Moreover, local authorities have taken the position that they do not want the Middlesex Sampling Plant site used for permanent disposal of either radioactive materials or chemically contaminated materials.
8. DISPOSE OF THE LANDFILL WASTES IN THE OCEAN. This has previously been considered for the wastes that are already stored at the Sampling Plant site. However, this alternative has received much public opposition and the regulatory framework for taking such an action is not yet in place. Furthermore, the presence of hazardous chemicals in the Landfill wastes may preclude their disposal in the ocean.

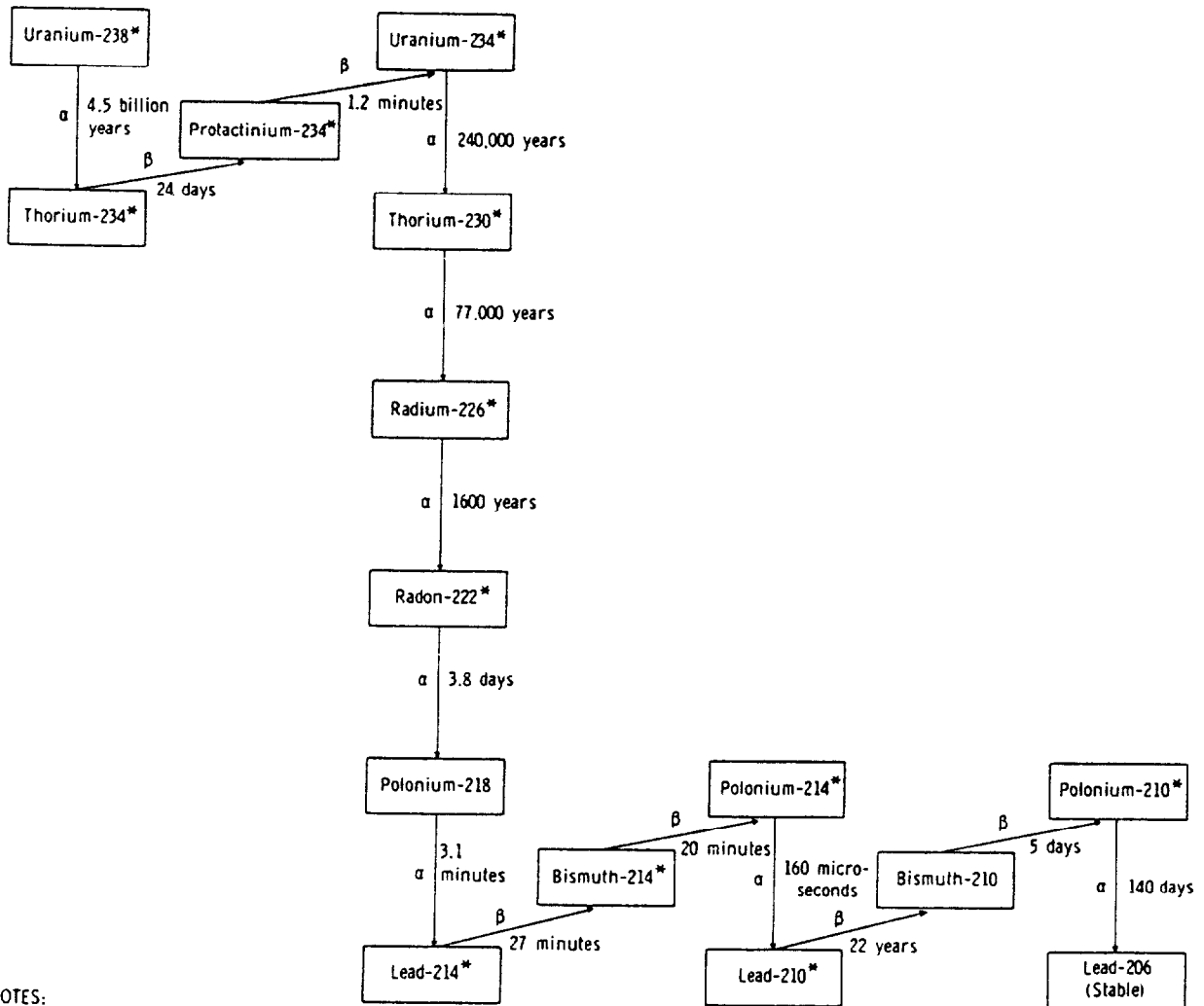
## 5. ENVIRONMENTAL CONSEQUENCES AND MITIGATION

### 5.1 RADIOLOGICAL

A major potential issue associated with the proposed remedial actions is the radiological impacts. The predominant pathways by which radionuclides could reach nearby workers and members of the general public during the proposed actions are: (1) internal dose from inhalation of radioactive products such as those from decay of radon gas (radon-222)--a radionuclide in the decay chain of uranium-238, which is found at the Middlesex Landfill site (Figure 5.1), (2) internal dose from inhalation of contaminated dust particles, (3) external dose from submersion in a cloud of contaminated dust, and (4) external dose from radioactive particles deposited on the ground. Based on analysis of similar activities (Argonne Natl. Lab. 1982), it is expected that the internal dose from ingesting contaminated food or water will be relatively insignificant.

The analysis of potential doses to nearby individuals and to the general public within an 80-km (50-mi) radius of the Landfill is based on the following:

- Radionuclides in the uranium-238 decay chain (Figures 5.1) are assumed to be present in equilibrium with the parent radionuclide.
- The average concentration of each of the radionuclides in the contaminated materials to be excavated and stored is 15 pCi/g (Section 2.3).
- The duration of the activities involving cleanup and construction of the interim-storage pile will be 3 months.
- Both gaseous and particulate releases will occur while the material is being excavated and placed on the storage pile (for 3 months), but only gaseous releases will occur thereafter because the storage pile will be covered and maintained.
- Particulate releases from the excavation activities and exposed storage pile (during the 3 months of pile construction) are assumed to be 0.14 kg/m<sup>2</sup>/mo (0.6 ton/acre/mo), which is half the rate reported for general construction activities (U.S. Environ. Prot. Agency 1977; Argonne Natl. Lab. 1982). It is expected that much of the excavated material will be wet, and dust-control measures will be used at the storage pile. Estimated radioactive particulate releases are therefore 0.000012 Ci for each of the radionuclides in the uranium-238 decay chain.
- Radon gas releases will include both "puff" releases when the contaminated materials are disturbed during excavation and "steady" releases from the storage pile. Puff releases are assumed to be 20% of the radon gas inventory (the other 80% remains trapped within the contaminated particles). Steady releases account for most of the releases and are calculated based on the assumptions that the stored material will: (a) be an average of



## NOTES:

Only the dominant decay mode is shown.  
 The times shown are half-lives.  
 The symbols  $\alpha$  and  $\beta$  indicate alpha and beta decay.  
 An asterisk indicates that the isotope is also a gamma emitter.

Figure 5.1. Uranium-238 Radioactive Decay Chain.

2.5 m (8.3 ft) in depth, (b) cover an area of 1800 m<sup>2</sup> (20,000 ft<sup>2</sup>), (c) have an average moisture content of about 13%, and (d) have a gaseous diffusion coefficient of 0.0036 cm<sup>2</sup>/s. For continued releases during interim storage, no credit is taken for retardation of radon gas by the cover. Radon fluxes are estimated to be 3.1 pCi/m<sup>2</sup>/s. These fluxes are calculated according to the method of analysis given in a report of the U.S. Nuclear Regulatory Commission (1983). Radon releases are estimated to be 0.044 Ci during the 3-month action period and 0.18 Ci/yr thereafter.

- The population distribution for the 15 million people within 80 km (50 mi) of Middlesex is estimated based on 1980 county census data.
- Meteorological conditions at Middlesex are assumed to be similar to those at Newark, New Jersey, for which meteorological data are available.
- Doses are evaluated in terms of the 100-year environmental dose commitment (EDC). The 100-year EDC is the integrated dose over 100 years resulting from continued exposure to the radionuclides released either during the 3 months of remedial actions or during each subsequent year from the storage pile.

Assuming that the mitigative measures discussed in Table 4.1 are implemented, potential doses to nearby individuals are estimated to be small (Table 5.1). The predicted whole-body doses are similar in magnitude to doses received while spending 2 minutes on a jet plane at high altitudes or spending 3 months (the time required to complete the remedial actions) at an altitude that is 2.6-m (8.7-ft) higher (Table 5.2). Specific organ doses (e.g., bone and lung) are lower than doses received from natural sources (Table 5.2).

Table 5.1. Estimated Radiological Doses to Nearby Individuals As a Result of Releases During the Proposed 1984 Remedial Actions†<sup>1</sup>

Individual/Location	Distance and Direction from Center of Storage Pile	Dose (mrem)			
		Whole Body	Bone	Average Lung	Bronchial Epithelium
Worker at Salvage Yard	50 m W	0.0083	0.22	0.24	0.29
Resident on Mountain Avenue	140 m ENE	0.011	0.29	0.32	0.39
Resident on William Street	200 m SE	0.0023	0.063	0.068	0.083

†<sup>1</sup> Bases for radiological analysis are given in the text.



Table 5.2. Comparison of Doses to Maximally Exposed Individual to Doses from Natural Background Sources

Dose from Remedial Action (values from Table 5.1)	Comparable Dose
0.011 mrem (whole body)	Equal to dose from riding about 2 minutes in a jet plane at 10,000 m (33,000 ft) because of increase in cosmic radiation with altitude,† <sup>1</sup> or  Equal to dose from staying for the same amount of time as the remedial action (3 months) at 2.6-m (8.7-ft) higher altitude† <sup>1</sup>
0.29 mrem (bone)	30 mrem received from natural radiation sources (background) over the same period of time† <sup>1</sup>
0.32 mrem (average lung)	45 mrem received from natural background radiation over the same period of time† <sup>1</sup>
0.39 mrem (bronchial epithelium)	83 to 150 mrem received from radon from natural background radiation over the same period of time† <sup>2</sup>

†<sup>1</sup> Conversion factors are given in reports of Argonne National Laboratory (1982) and National Council on Radiation Protection and Measurements (1975).

†<sup>2</sup> Based on 320 to 600 mrem/yr, assuming an outdoor radon-222 concentration of 0.3 pCi/L (Moses et al. 1963), an indoor concentration of 1 pCi/L (U.N. Sci. Comm. At. Radiat. 1977), and dose conversion factors for radon-222 of 1000 mrem/yr per pCi/L for outdoor background conditions (infinite source) and 625 mrem/yr per pCi/L for indoor conditions (50% equilibrium of radon daughters) (U.S. Nucl. Reg. Comm. 1980).

The estimated doses to several organs and the whole body for the general public are presented in Table 5.3. The general public is considered to be the population of about 15 million people (1980 census) residing within 80 km (50 mi) of the site. This population will receive doses resulting from releases during the remedial actions; and, after the remedial actions have been completed, this population will continue to be exposed to radioactive releases from the storage pile (e.g., radon gas). These doses will all be negligible compared to doses the same population will receive from natural background sources of radiation (Table 5.3).

Table 5.3. Estimated Doses to the General Public As a Result of the Proposed 1984 Remedial Actions

Tissue or Organ	Dose† <sup>1</sup> (person- or organ-rem)		
	From Releases During the 3 Months of Remedial Actions	From Natural Background Radiation During the 3 Months of Remedial Actions	Dose from Releases as Percentage of Background
Whole body	0.054	380,000	0.000014%
Bone	0.30	450,000	0.000067%
Average lung	0.30	680,000	0.000044%
Bronchial epithelium	0.12	400,000 - 2,300,000	0.0000052 - 0.000030%
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Tissue or Organ	Dose† <sup>1</sup> (person- or organ-rem/yr)		
	From Continuing Gaseous Releases from the Storage Pile	From Continuing Natural Background Radiation	Dose from Releases as Percentage of Background
Whole body	0.0052	1,500,000	0.00000035%
Bone	0.016	1,800,000	0.00000089%
Average lung	0.0046	2,700,000	0.00000017%
Bronchial epithelium	0.48	4,800,000 - 9,000,000	0.0000053 - 0.000010%

†<sup>1</sup> Reported as the 100-year environmental dose commitment to the population within 80 km (50 mi) of the Middlesex Sampling Plant site.

Doses to workers will be controlled and limited to less than those specified by DOE regulations for occupational doses (e.g., whole-body doses of 3000 mrem/quarter or 5000 mrem/year). Workers will be trained with regard to radiation risks and proper health-physics procedures.

Another potential radiological issue is whether the decontamination guidelines for the contaminated areas are considered sufficient (see Appendix A). The guidelines to be used are based on recent detailed studies (U.S. Dep. Energy 1983b; Gilbert et al. 1983). DOE believes that these guidelines are conservatively low for considering potential adverse health effects that might occur in the future from any residual contamination. All remedial actions will be conducted in a manner to minimize radiation doses to the general public and to workers in accordance with DOE's as-low-as-reasonably-achievable (ALARA) philosophy. Following removal of radioactively contaminated materials, DOE will certify the property for future use, as appropriate.

## 5.2 CHEMICAL, PHYSICAL, AND BIOLOGICAL

### 5.2.1 Chemical

#### 5.2.1.1 Landfill

There are two pathways for potential chemical impacts resulting from activities at the Landfill: (1) atmospheric transport of hazardous dusts and organic vapors, and (2) leachate and runoff entering surface water or groundwater. Atmospheric transport of hazardous dusts and organic vapors may impact people living within about one hundred meters (a few hundred feet) of the Landfill. Besides being potentially hazardous, airborne chemicals may have objectionable odors. Also, the release of methane gas may cause a potential explosion hazard. Mitigative measures will be taken, including: use of anti-spark devices on vehicles and equipment, use of an air quality monitor for volatile gases, keeping exposed surfaces moist to minimize dust generation, restricting activities when it is very windy, and following procedures to minimize the rupture of drums and containers. Workers at the Landfill will be exposed to much higher concentrations of hazardous materials than will people living nearby. Therefore, workers will wear protective clothing and masks, as necessary, and activities will be carried out in a manner that will serve to protect their health.

The activities at the Landfill may adversely impact surface water and groundwater both during and after the remedial actions. Although there currently seems to be little movement of radioactive or chemical contaminants (Sections 3.1 and 3.6), disruption of the landfill materials could result in mobilization of the hazardous chemicals. This could occur in several ways. First, it is expected that groundwater will be encountered during excavation, and the excavation itself may temporarily change local upper aquifer flow patterns so that more groundwater flows into the excavation hole from all sides. This will especially be the case if Bound Brook is at flood stage. Wet wastes excavated from the Landfill will be placed alongside the excavation and contaminated leachate will drain back into the excavation. The physical disruption and mixing of contaminants and the presence of large amounts of contaminated water may possibly increase contaminant migration into groundwater, particularly in the overburden aquifer. Contaminated surface runoff and groundwater may also reach Bound Brook, especially if a severe (e.g., 100-year) flood occurs during excavation.

There should be no little or impacts from atmospheric transport of hazardous chemicals after closure of the Landfill because the backfilled wastes will be completely covered with clean backfill. The potential impacts on surface water should also be somewhat less because of the cover. However, depending on the degree of disruption and mixing of backfilled waste material, the chemical impact on groundwater could be worse than before the excavation.

Mitigative measures at the Landfill include minimizing the amounts of contaminated leachate and wastewater generated during the activities. This can be accomplished primarily by not excavating when the groundwater level is high, usually during the summer. Besides minimizing the rupture of drums or containers, another mitigative measure that could be considered is containing and removing the contents of any ruptured drums from the landfill area for safe disposal.

A possible mitigative factor results from the fact that the total amount of backfilled contaminated material will be less than the original amount of excavated material; thus the total amount of chemical contaminants in the Landfill will be less than it was prior to the excavation activities. However, this may be partially counteracted by any increased contaminant mobilization caused by the excavation activities.

Another mitigative factor is that the overburden aquifer is not used for drinking water, at least near the site, and Bound Brook and other downstream waters are not used as a source of potable water (Section 3.1). However, the degree of interconnection between the overburden aquifer and bedrock aquifer (which is used as a public water supply) is not known (Section 3.1).

A reasonable precautionary measure that could be considered is to carry out a program of sampling and analysis for chemical parameters in both the wastes to be transported and backfilled, as well as in the water that collects in the excavated area.\* Also, further chemical characterization of the landfill materials will serve to more clearly delineate the potential for contamination of surface water, groundwater, and air and may help to define other mitigative measures.

#### 5.2.1.2 Transportation

There should be minimal potential chemical impacts from the trucks transporting the wastes from the Landfill to the Sampling Plant site. The trucks will have a water-tight bed, will be gasketed, and will be covered with tarpaulins (Bechtel Natl. 1983). Little or no releases of contaminated dust or leachate are expected during the 0.8-km (0.5-mi) trip. Also, the wastes will be drained prior to loading onto the trucks (Section 4.1.1). U.S. Environmental Protection Agency (EPA) and U.S. Department of Transportation (DOT) shipping regulations for hazardous wastes (40 CFR 263 and 49 CFR 177) require that, for shipment in hopper or dump trucks, the trucks must be free from leaks and discharge openings must be securely closed during transportation (49 CFR 173.510).

#### 5.2.1.3 Sampling Plant

The impact of dust and organic vapors entering the atmosphere from the wastes at the Sampling Plant site should be similar to those at the Landfill because dumping and forming the wastes into a pile should generate emissions in amounts similar to those generated during excavation activities. Although less material will be dumped at the Sampling Plant site than is excavated at the Landfill, the material at the Sampling Plant site will be exposed in an above-ground pile for about 3 months until it is covered.

There may be impacts on surface water and groundwater at the Sampling Plant site due to the presence of hazardous chemicals. During construction of the storage pile and during storage, all runoff from the north storage pad

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\*It is currently planned to take only 20 samples of the wastes to be transported for chemical analysis (Glenn 1984b). This corresponds to about one sample for every 30 truckloads.

area will be collected, analyzed for both radiological and chemical contaminants, and treated if necessary (Section 4.1.2). Based on a peak average monthly precipitation of 37 cm (15 in.), it is estimated that up to 27,000 L (7,000 gal) could be collected in one month.

During the storage period, there may be contamination of both surface water and groundwater if the liner and cover are seriously degraded, thereby allowing release of chemicals. Liners such as Hypalon or EPDM, which have been used previously for storage of wastes having similar radioactive contamination, are not recommended for materials containing petroleum solvents or aromatic or halogenated hydrocarbons (EPDM) or oils (Hypalon) (U.S. Environ. Prot. Agency 1980). Therefore, the selection of the special liner and cover material is being studied relative to the known chemical contaminants. Also, the wastes will be sampled during construction of the pile and analyzed relative to organics that may damage the liner and cover. There will be periodic inspection of the cover, with maintenance or replacement of the cover, as necessary. As long as the cover is maintained, infiltration into and seepage or runoff from the pile will be minimized. A mitigative measure that could be considered is periodic analysis of samples taken from the existing onsite monitoring wells for chemicals that are expected to be most mobile and/or hazardous.

#### 5.2.1.4 Regulations

According to DOE Order 5408.2 and a Memorandum of Understanding between DOE and the EPA (signed on February 22, 1984), activities at both the Landfill and the Sampling Plant site are governed by EPA requirements for hazardous waste sites. Of particular relevance are those requirements contained in 40 CFR 260-265. The specifics of any requirements relative to EPA regulations are being worked out during ongoing consultation and coordination with the EPA and the New Jersey Department of Environmental Protection.

The redeposition of nonradioactive wastes back into the Landfill may be subject to New Jersey nonhazardous waste management regulations (N.J. Dep. Environ. Prot. 1983). According to these regulations, the redeposition of all solid waste resulting from a landfill excavation shall be in conformity with all requirements for landfills. One requirement is that in order for a landfill to receive and deposit wastes, it must have a system in place for interception, collection, and treatment of any and all leachate generated at the facility. Proper approvals for such a system and for a monitoring program are also required. Such a system and monitoring program are not currently planned for the redeposited material at the Landfill. This issue will be resolved during planned coordination with the EPA and the New Jersey Department of Environmental Protection relative to the proposed remedial actions.

#### 5.2.2 Physical

Disturbed areas at the Landfill will be subject to wind and water erosion, with subsequent potential increases in turbidity, sedimentation, and dissolved solids in Bound Brook. The greatest potential for such impact will occur in the summer months during the thunderstorm season. The magnitude of this impact will depend primarily on the timing of construction and the amount of material exposed. However, because Bound Brook is located in an urbanized area and receives a number of point and nonpoint discharges, no noticeable

change in suspended solids is expected. Runoff from the storage pad at the Sampling Plant is not expected to be high in suspended solids because only the actual storage pile will be barren soil; the remainder of the site is paved with asphalt or gravel. Furthermore, a temporary cover will be placed over the pile when heavy rains are predicted, and all runoff from the north storage pad area will be collected and treated, as necessary.

Another issue may be the durability of the interim-storage pile. Frost penetrates to a depth of about 38 cm (15 in.) in the Middlesex area. Frost heave could cause the cover to rupture--resulting in infiltration of snowmelt and rainwater, saturation of the pile, and leaching to groundwater. This may be exacerbated by the relatively steep side slopes (3:1) that may lead to slumping of the stored material. However, measures will be taken to minimize this potential impact, including: compaction of the stored materials, periodic surveillance to check on the integrity of the pile and its cover, and repairs (as necessary).

Water from the local public supply system (estimated to be less than 38,000 L [10,000 gal]) will be used for equipment decontamination at both the Landfill and Sampling Plant sites. At the Landfill, a steam/high-pressure water system will be used to minimize water use, and water will be recirculated through filters as much as possible. The amount of water to be used is small relative to the available resources and local demands in Middlesex.

Construction of the access roads will require consumption of timber, sand, and gravel resources. These resources are generally available locally, and supplies will not be unduly strained by the demands of the proposed project.

### 5.2.3 Biological

Implementation of the proposed action will have only a minimal effect on the terrestrial biota in the project area. Mammals and birds currently inhabiting the area to be disturbed at the Landfill will be dispossessed (larger and/or mobile species) or destroyed (smaller, less mobile species). The vegetation will be destroyed temporarily. After backfilling is complete, disturbed areas will be seeded and vegetation should become reestablished quickly. The area is expected to be dominated by early successional species similar to those present prior to the remedial actions. The adverse effects of dust, noise, and traffic during the period of excavation and storage will be minimal due to (1) the paucity of wildlife, (2) the fact that the sites are located in an urban area where such impacts currently exist, and (3) the implementation of mitigative measures (i.e., dust suppression). No impacts to endangered or threatened biota are anticipated from the proposed actions because their habitats do not correspond to those found on the affected sites.

During the interim-storage period (designed for 25 years), animals and plants could adversely affect the durability of the interim-storage pile. Burrowing animals such as the woodchucks may invade the pile--resulting in excavation of the contaminated soils, increased water infiltration, and decreased stability of the pile (Arthur and Markham 1983). Plant roots may also intrude into the storage pile (Cline and Uresk 1979; Yamamoto 1982)--especially species that produce suckers, such as the tree-of-heaven. However, the storage pile will be located on the asphalt storage pad, which will deter

animals from inhabiting it. Also, during the interim-storage period, the cover will be maintained and a pest-control program will be implemented, if necessary (Table 4.1).

### 5.3 SOCIOECONOMIC IMPACTS

At the county and community levels, the settlement pattern should not be impacted by the proposed action. Following cleanup of contaminated soils at the Landfill site, current public and residential land uses could continue (subject to local zoning ordinances). Borough of Middlesex plans for the Landfill site are reportedly contingent on the availability of federal funds. If funds become available, a park-recreation area might be developed in the present location (U.S. Dep. Energy 1980b).

As long as the interim-storage pile remains at the Sampling Plant, the land cannot be used for other kinds of development. The federal government will maintain the storage pile. If the radioactive materials are removed from the site in the future, the assessed value of this property may increase approximately 10 times (see Ford, Bacon & Davis 1979), especially if the property is used for industrial or commercial purposes.

Cleanup activities involving excavation, movement, restoration, and storage of the contaminated soils at the Landfill could cause some localized impacts. Transport of soils to the Sampling Plant site will increase truck traffic on Mountain Avenue (about 15 trucks per day). Additional traffic may also result from movement of equipment to the job sites, transport of clean backfill materials to the Landfill, and the small work force that is expected to commute to these sites in private vehicles (Section 3.5). Transportation impacts are expected to be short-term and are likely to be associated with increased traffic congestion. It is expected that the increased traffic associated with the proposed remedial actions will be negligible compared to the traffic (including heavy trucks) that already occurs during the day on Mountain Avenue. Truck movements will be scheduled and traffic directors will be provided, as necessary.

Excavation, loading, unloading, pile construction, and site restoration activities--as well as increased traffic--are expected to temporarily increase local noise levels around both the Landfill and Sampling Plant sites. Some individuals that use the municipal building and church near the Landfill and residents on Mountain Avenue and William Street near the Sampling Plant may be annoyed. Background noise at the Sampling Plant is relatively higher than at the Landfill because of other industrial activities on nearby properties. In order to minimize noise impacts at both locations, mufflers and compressors, etc., will be periodically checked and work will be carried out only between 8:00 a.m. and 8:00 p.m. An additional mitigative measure that could be considered is scheduling work after services at the adjacent church if work at the Landfill site occurs on a Sunday.

Demographic changes from the influx of workers or the outmigration of local residents is expected to be insignificant. Some local subcontractors will be hired and a few work force in-movers with families are anticipated. Following cleanup of the Landfill, local health concerns should be reduced. Consequently, future home sales, outmovement of residents, and/or land-use changes at and near the Landfill are not anticipated at this time. However,

some degree of public concern may continue until decisions are made regarding permanent disposition of the contaminated materials to be stored on the Sampling Plant site, and future use of the Landfill and Sampling Plant sites.

Another potential adverse impact is noxious odors from the excavated Landfill materials. The mitigative measures discussed previously (Section 5.2.1) should help minimize this impact to nearby residents.

Other socioeconomic impacts, such as demands on local goods and services or effects on the local economy, are expected to be minimal for a project of this size (Argonne Natl. Lab. 1982).

In an analysis of previous remedial actions at Middlesex (Ford, Bacon & Davis 1979), the following conclusions were reached: (1) workers are likely to be drawn from both the local area and outside the vicinity, (2) the influx of workers would not stress local services, and (3) a storage pile as high as 3 m (10 ft) above ground level on the Sampling Plant site may be aesthetically displeasing. These same conclusions are also applicable to the proposed 1984 remedial actions.

Through proper planning and coordination, adverse socioeconomic impacts can be minimized. Dissemination of information to the public is an important activity needed during remedial actions (Ford, Bacon & Davis 1979; Argonne Natl. Lab. 1982). Nonradiological health and safety concerns associated with excavating and loading activities at the Landfill will be lessened by construction of a fence (Section 4.1.2) and other security measures. Radiological concerns may be lessened by providing the public with information regarding the cleanup schedule and planned monitoring procedures.



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APPENDIX A. U.S. DEPARTMENT OF ENERGY  
INTERIM RESIDUAL CONTAMINATION AND WASTE-CONTROL GUIDELINES  
FOR  
FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM (FUSRAP)  
AND  
REMOTE SURPLUS FACILITIES MANAGEMENT PROGRAM (SFMP) SITES

(April 1984)

Presented here are the residual contamination cleanup and waste-control guidelines of general applicability to the FUSRAP project and remote SFMP sites.\* A site-specific analysis will be prepared for each FUSRAP and remote SFMP site prior to determining residual contamination guidelines for a specific site. In addition, it is policy of the DOE to decontaminate sites in a manner consistent with DOE's as-low-as-reasonably-achievable (ALARA) policy. ALARA will be considered in reducing levels of residual contamination below applicable dose limits. ALARA will be implemented using cost/benefit considerations, and applied on a site-specific basis.

The soil residual contamination guidelines were developed on the basis of limiting maximum individual radiation exposure to DOE limits specified in DOE Order 5480.1A, exclusive of exposure from natural background radiation or medical procedures. The radium-226 and thorium-230 guidelines include an additional limitation for buildup of radon-222 decay products in buildings. The aggregate of the contribution from all major pathways was assumed, based on scenarios for permanent intrusion--e.g., establishing residences on the site. In most circumstances, the probability is low that such an intrusion will occur. Also, conservative assumptions were used in deriving these criteria to ensure that a particular dose limit would not be exceeded. Use of these guidelines is additionally conservative because the pathways considered in the derivation of the guidelines assume all water intake and most food intake is from the site. Also, the FUSRAP and remote SFMP sites often have limited agricultural capability and the contamination is generally not homogeneous. The combined effect of these factors is such that the probable radiation exposure to the average population on, or in the vicinity of, FUSRAP or remote SFMP sites decontaminated to these guidelines will not be appreciably different from that normally received from natural background radiation.

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\*A remote SFMP site is one that is excess to DOE programmatic needs and is located outside a major operating DOE Research and Development (R&D) or production area. Remote sites are more likely to be released to the public or excessed to other government agencies after decontamination than are sites located with major R&D or production areas.

The residual contamination guidelines for surface contamination of structures were adapted from guidelines developed by the U.S. Nuclear Regulatory Commission (1982) for decontamination of facilities and equipment prior to release for unrestricted use or termination of licenses for byproduct, source, or special nuclear material. The waste-control guidelines are consistent with DOE Orders and EPA regulations for inactive uranium milling sites, 40 CFR Part 192.

A. RESIDUAL CONTAMINATION GUIDELINES FOR FORMERLY UTILIZED SITES AND REMOTE SURPLUS FACILITIES MANAGEMENT PROGRAM SITES

The following guidelines represent the maximum residual contamination limits for unrestricted use of land and structures contaminated with radionuclides related to the nuclear fuel cycle at FUSRAP and remote SFMP sites. A site-specific analysis will be prepared for each site prior to determining residual contamination guidelines for a specific site. It is the policy of DOE to decontaminate sites to contamination levels at or below the limits and in a manner consistent with DOE's as-low-as-is-reasonably-achievable (ALARA) policy on a site-specific basis. Site-specific guidelines and ALARA policy will be determined by DOE on a site-specific basis and an ALARA report filed on completion of remedial action at a site. Existing state and federal standards will be applied for water protection. Residual contamination limits for other nuclides will be developed when required using the same methodology as was used for those represented here [described in ORO-831 (U.S. Dep. Energy 1983) and ORO-832 (Gilbert et al. 1983)].

1. Soil (Land) Guidelines (Maximum Limits for Unrestricted Use)

Radionuclide	Soil Criteria <sup>1,†2,†3</sup> (pCi/g above background)
U-Natural <sup>†4</sup>	75
U-238 <sup>†5</sup>	150
U-234 <sup>†5</sup>	150
Th-230 <sup>†6</sup>	15
Ra-226	5 pCi/g, averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over 15-cm-thick soil layers more than 15 cm below the surface and less than 1.5 m below the surface.
U-235 <sup>†5</sup>	140
Pa-231	40
Ac-227	190
Th-232	15

Am-241	60
Pu-241† <sup>7</sup>	2400
Pu-238, -239, -240	300
Cs-137	80
Sr-90	300
H-3 (pCi/mL soil moisture)	5,200

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- †<sup>1</sup> In the event of occurrence of mixtures of radionuclides, the fraction contributed by each radionuclide to its guideline shall be determined, and the sum of these fractions shall not exceed 1. There are two special cases for which this rule must be modified:
- (a) If Ra-226 is present, then the fraction for Ra-226 should not be included in the sum if the Ra-226 concentration is less than or equal to the Th-230 concentration. If the Ra-226 concentration exceeds the Th-230 concentration, then the sum shall be evaluated by replacing the Ra-226 concentration by the difference between the Ra-226 and Th-230 concentrations.
- (b) If Ac-227 is present, then the same rule given in (a) for Ra-226 relative to Th-230 applies for Ac-227 relative to Pa-231.
- †<sup>2</sup> Except for Ra-226, these guidelines represent unrestricted-use residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m<sup>2</sup> surface area. The same conditions prevail for Ra-226 except for soil layers beneath 1.5 m; beneath 1.5 m, the allowable Ra-226 concentration may be affected by site-specific conditions and must be evaluated accordingly.
- †<sup>3</sup> Localized concentrations in excess of these guidelines are allowable provided that the average over 100 m<sup>2</sup> is not exceeded. However, DOE ALARA policy will be considered on a site-specific basis when dealing with elevated localized concentrations.
- †<sup>4</sup> One curie of natural uranium means the sum of  $3.7 \times 10^{10}$  disintegrations per second (dis/s) over any 15-cm-thick layers from U-238 plus  $3.7 \times 10^{10}$  dis/s from U-234 plus  $1.7 \times 10^9$  dis/s from U-235. One curie of natural uranium is equivalent to 3,000 kilograms or 6,600 pounds of natural uranium.
- †<sup>5</sup> Assumes no other uranium isotopes are present.
- †<sup>6</sup> The Th-230 guideline is 15 pCi/g to account for ingrowth of Ra-226 as Th-230 decays. Ra-226 is a limiting radionuclide because its decay product is Rn-222 gas.
- †<sup>7</sup> The Pu-241 guideline was derived from the Am-241 concentration.

## 2. Structure Guidelines (Maximum Limits for Unrestricted Use)

### a. Indoor Radon Decay Products

A structure located on private property and intended for unrestricted use shall be subject to remedial action as necessary to ensure the annual average concentration of radon decay products is less than 0.03 WL within the structure.

b. Indoor Gamma Radiation

The indoor gamma radiation after decontamination shall not exceed 20 microroentgen per hour (20  $\mu$ R/h) above background in any occupied or habitable building.

c. Indoor/Outdoor Structure Surface Contamination

Radionuclides† <sup>2</sup>	Allowable Surface Residual Contamination (dpm/100 cm <sup>2</sup> )† <sup>1</sup>		
	Average† <sup>3</sup> ,† <sup>4</sup>	Maximum† <sup>4</sup> ,† <sup>5</sup>	Removable† <sup>4</sup> ,† <sup>6</sup>
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000 $\alpha$	15,000 $\alpha$	1,000 $\alpha$
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000 $\beta$ - $\gamma$	15,000 $\beta$ - $\gamma$	1,000 $\beta$ - $\gamma$

†<sup>1</sup> As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

†<sup>2</sup> Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides shall apply independently.

†<sup>3</sup> Measurements of average contaminant should not be averaged over more than 1 m<sup>2</sup>. For objects of less surface area, the average shall be derived for each such object.

†<sup>4</sup> The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 mg/cm<sup>2</sup> of total absorber.

†<sup>5</sup> The maximum contamination level applies to an area of not more than 100 cm<sup>2</sup>.



- †<sup>6</sup> The amount of removable radioactive material per 100 cm<sup>2</sup> of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels shall be reduced proportionately and the entire surface shall be wiped.

B. CONTROL OF RADIOACTIVE WASTES AND RESIDUES FROM FUSRAP AND REMOTE SFMP SITES

Specified here are the control requirements for radioactive wastes and residues related to the nuclear fuel cycle at FUSRAP and remote SFMP sites. It is the policy of DOE to store radioactive wastes in a manner representing sound engineering practices consistent with DOE's ALARA policy.

1. Interim Storage

All operational and control requirements specified in the following DOE Orders and other items shall apply:

- a. 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations.
- b. 5480.2, Hazardous and Radioactive Mixed Waste Management.
- c. 5483.1, Occupational Safety and Health Program for Government-Owned Contractor-Operated Facilities.
- d. 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements.
- e. 5484.2, Unusual Occurrence Reporting System.
- f. 5820, Radioactive Waste Management.
- g. Control and stabilization features will be designed to ensure, to the extent reasonably achievable, an effective life of 50 years and, in any case, at least 25 years.
- h. Rn-222 concentrations in the atmosphere above facility surfaces or openings shall not (1) exceed 100 pCi/L at any given point, or an average concentration of 30 pCi/L for the facility site, or (2) exceed an average Rn-222 concentration at or above any location outside the facility site of 3.0 pCi/L (above background).
- i. For water protection, use existing state and federal standards; apply site-specific measures where needed.

## 2. Long-Term Management

- a. All operational requirements specified for Interim Storage Facilities (B.1) will apply.
- b. Control and stabilization features will be designed to ensure, to the extent reasonably achievable, an effective life of 1,000 years and, in any case, at least 200 years. Other disposal site design features shall conform with 40 CFR Part 192 performance guidelines/requirements.
- c. Rn-222 emanation to the atmosphere from facility surfaces or openings shall not (1) exceed an average release rate of 20 pCi/m<sup>2</sup>/s, or (2) increase the annual average Rn-222 concentration at or above any location outside the facility site by more than 0.5 pCi/L.
- d. For water protection, use existing state and federal standards; apply site-specific measures where needed.
- e. Prior to placement of any potentially biodegradable contaminated wastes in a Long-Term Management Facility, such wastes will be properly conditioned to (1) ensure that the generation and escape of biogenic gases will not cause the requirement in paragraph 2.c. to be exceeded, and (2) ensure that biodegradation within the facility will not result in premature structural failure not in accordance with the requirements in paragraph 2.b. If biodegradable wastes are conditioned by incineration, incineration operations will be carried out in compliance with all applicable federal, state, and local air emission standards and requirements, including any standards for radionuclides established pursuant to 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants (NESHAPS).

## C. Exceptions

Exceptions may be made to the guidelines presented herein following analysis of the site-specific aspects of a candidate site. Specific situations that warrant consideration for modifying these guidelines are:

1. Where remedial actions would pose a clear and present risk of injury to workers or members of the public, notwithstanding reasonable measures to avoid or reduce risk.
2. Where remedial actions would produce environmental harm that is clearly excessive compared to the health benefits to persons living on or near affected sites, now or in the future, notwithstanding reasonable measures to limit damage to the environment. A clear excess of environmental harm is harm that is long-term, manifest, and grossly disproportionate to health benefits that may reasonably be anticipated.
3. Where the cost of remedial actions for contaminated soil is unreasonably high relative to long-term benefits and the residual radioactive materials do not pose a clear present or future hazard. The likelihood that buildings will be erected or that people will spend long periods

of time at such a site should be considered in evaluating this hazard. Remedial actions will generally not be necessary where residual radioactive materials have been placed semipermanently in a location where site-specific factors limit their hazard and from which they are costly or difficult to remove, or where only minor quantities of residual radioactive materials are involved. Examples are residual radioactive materials under hard-surface public roads and sidewalks, around public sewer lines, or in fence-post foundations. Supplemental standards shall not be applied at such sites, however, if individuals are likely to be exposed for long periods of time to radiation from such materials at levels above those that would prevail in Subpart A.

4. Where the cost of cleanup of a contaminated building is clearly unreasonably high relative to the benefits. Factors that shall be included in this judgment are the anticipated period of occupancy, the incremental radiation level that would be affected by remedial actions, the residual useful lifetime of the building, the potential for future construction at the site, and the applicability of less costly remedial methods than removal of residual radioactive materials.
5. Where there is no known remedial action.

D. Guideline Sources

Guideline	Source
<u>Residual Contamination Guidelines</u> <sup>†1</sup>	
Soil Guideline	DOE Order 5480.1A, 40 CFR Part 192 <sup>†2</sup>
Structure Guideline	40 CFR Part 192, U.S. Nuclear Regulatory Commission (1982)
<u>Control of Radioactive Wastes and Residues</u>	
Interim Storage	DOE Order 5480.1A
Long-Term Management	40 CFR Part 192

†<sup>1</sup> The bases of the residual contamination guidelines are developed in ORO-831 (U.S. Dep. Energy 1983) and ORO-832 (Gilbert et al. 1983).

†<sup>2</sup> Based on limiting the concentration of Rn-222 decay products to 0.03 WL within structures.

REFERENCES (Appendix A)

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