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PRELIMINARY DATA EVALUATION AND PATHWAY ANALYSES REPORT FOR CONSENT DECREE PCB SITES

Indiana State Department of Health
Environmental Epidemiology Section

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Indiana State Department of Health

PRELIMINARY DATA EVALUATION AND PATHWAY ANALYSES REPORT

FOR

CONSENT DECREE PCB SITES

BLOOMINGTON, MONROE COUNTY, INDIANA
SPENCER, OWEN COUNTY, INDIANA

ANDERSON ROAD LANDFILL (BLOOMINGTON)
BENNETT STONE QUARRY (BLOOMINGTON) - IND006418651
LEMON LANE LANDFILL (BLOOMINGTON) - IND980794341
NEAL'S DUMP (SPENCER) - IND980794549
NEAL'S LANDFILL (BLOOMINGTON) - IND980614556
WINSTON-THOMAS SEWAGE TREATMENT PLANT (BLOOMINGTON)

DECEMBER 1992

NOVEMBER 1993

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SUMMARY

Based on the environmental data reviewed by the Indiana State Department of Health (ISDH) staff, the six PCB sites discussed in this report posed a past public health hazard to specific subpopulations in Owen and Monroe Counties, who were exposed to site-related PCBs through completed pathways. Evidence indicates that humans were exposed in the past, at the six Consent Decree sites, to PCBs and other contaminants in the environment at concentrations that, if exposures were long-term (greater than 1 year), could cause adverse health effects.

Estimated ingestion doses for soil and fish taken from site-related streams and creeks exceeded the minimal risk level (MRL) for chronic exposure. Various PCB-specific epidemiologic studies have been performed on the Bloomington community. These studies did not reveal an excess number of medical problems or conditions in members of the affected community compared with members of comparison communities who were not exposed.

A review of the health outcome data for Monroe and Owen Counties did not indicate that the sites have adversely affected the health of the general population. Specific subgroups in those counties, however, may have signs and symptoms of adverse health outcomes related to exposures at the site that would not be identified through analysis of county-wide databases.

These six sites pose an indeterminate public health hazard because groundwater in the area is used as a source of potable water, and because PCBs have been found in private wells, although not at high levels. Private well sampling data for chemicals other than PCBs were available only for Neal's Landfill. Because groundwater under the sites is known to be contaminated, the potential for contamination of private wells remains.

High levels of PCB contamination formerly were found in land depressions and springs associated with the six sites. No data were available at the time of the writing of this report to indicate that the springs, ditches, and depressions associated with the Lemon Lane Landfill and Neal's Dump have been remediated, or that provisions have been made to ensure that humans are not exposed to significant concentrations of PCBs or other hazardous substances.

In accordance with past guidelines of the Agency for Toxic Substances and Disease Registry (ATSDR), the ISDH has recommended the following actions: 1) monitoring of all sites for contaminants of concern present in and transported into private wells, 2) remedial actions be taken to ensure that humans are not exposed to significant concentrations of hazardous substances potentially found in the streams (Lemon Lane) and depressions (Lemon Lane), 3) continued monitoring of fish taken from waterways associated with the six sites, 4) reevaluation of the surface water collection system at Neal's Landfill to ensure protection of human and environmental health, 5) continued communication with the Indiana Department of Transportation (INDOT) to ensure that human health is not at risk because of the proposed interchange for State Routes 37 and 46 near Bennett Stone Quarry, 6) washing and peeling

(before eating) of all root crop vegetables grown in sewage sludge-treated gardens, 7) development of health professional education programs for nurses and primary care physicians, 8) surface soil sampling by state and federal environmental agencies at the approximately 180 other PCB-contaminated sites to establish priorities for cleanup, 9) congener-specific serum PCB analyses of people whose blood has previously been tested for PCBs, 10) a study of contaminant levels within the ABB Corporation (formerly Westinghouse Corporation) plant and their effect on the health of workers, and 11) reevaluation of former Westinghouse workers.

EXECUTIVE SUMMARY

A Consent Decree was signed on May 25, 1985, by Westinghouse Electric Corporation, the U.S. Environmental Protection Agency (EPA), the Indiana Department of Environmental Management (IDEM), the City of Bloomington, and Monroe County. Westinghouse is required to remove an estimated 650,000 cubic yards of polychlorinated biphenyl (PCB) contaminated soils, sludge, solid waste, and stream sediments from six sites located in the Bloomington, Indiana area. (U.S. District Court. Consent Decree. 1985)

The Consent Decree PCB sites are the Anderson Road Landfill, Bennett Stone Quarry, Lemon Lane Landfill, Neal's Dump, Neal's Landfill, and the Winston-Thomas Sewage Treatment Plant. Two of the sites, Anderson Road Landfill and the Winston-Thomas Sewage Treatment Plant, are Consent Decree enforced cleanup sites; the others are all on the National Priorities List (NPL).

The Agency for Toxic Substances and Disease Registry (ATSDR), a federal public health agency, has undertaken a multi-phase project to address concerns related to the impact of the six Consent Decree sites on public health.

This project has three purposes: 1) to conduct a comprehensive evaluation of the public health impact of the six Consent Decree sites in Monroe and Owen Counties, 2) to determine the public health implications of incinerating the PCB-contaminated soil, and 3) to identify and evaluate the pertinent public health considerations of technically feasible alternatives.

Four tasks will be performed concurrently by ATSDR to fulfill these goals:

A report will be written describing a comprehensive evaluation of all past, present, and future human exposure pathways, available health outcome data, all previous health studies, and community health concerns associated with the six Consent Decree sites. This report is task number one and will be incorporated into the final ATSDR public health assessment of the six PCB Consent Decree sites.

Expert panels will be formed to address issues associated with incinerating PCB-contaminated soils. Tasks to be performed by the panels include:

- a comprehensive review of site-specific PCB-related health studies;
- an evaluation of the public health implications of incinerating the PCB-contaminated soil; and
- an evaluation of the public health implications of other technically feasible treatment strategies.

BACKGROUND

Staff from the Indiana State Department of Health (ISDH), the Indiana Department of Environmental Management (IDEM), and Westinghouse conducted a site visit at the six Consent Decree sites on January 28, 1993. Access to all sites except the Anderson Road Landfill was restricted by locked, chain-link fences posted with warning signs. Anderson Road Landfill is accessible since this is still an operating solid waste landfill. The Interim Storage Facility is at the Winston-Thomas Sewage Treatment Plant. A plastic liner had been placed on top of the contaminated soil inside the on-site Interim Storage Facility (an aluminum, steel-supported building). A concrete floor and liner prevents contaminated, excavated soil from entering the soil under the storage facility.

Anderson Road Landfill

The Anderson Road Landfill, currently operated as the Monroe County Landfill, is a sanitary landfill approximately 11 miles northeast of Bloomington in Monroe County, Indiana.

The Anderson Road Landfill site is in a sparsely populated area of Monroe County. Land use around the site is mainly for farming. Residences in the area surrounding the site use private groundwater wells for all domestic purposes. The population within a ½-mile radius of Anderson Road Landfill consists of approximately 30-45 people. Residences closest to the site are east and north within a ¼- to ½-mile radius. All interim remedial measures were completed in 1987.

Bennett Stone Quarry

The Bennett Stone Quarry site, also known as Bennett's Dump, is in central Monroe County about 2½ miles northwest of Bloomington. The site was an industrial waste dump from 1966 to 1980. Stout's Creek runs north along the western side of the site. Private groundwater wells are used for all domestic purposes. Stout's Creek formerly was used for watering cattle. It was also used for mud baths by a few local residents who would also swim and bathe in the quarries.

The Bennett Stone Quarry site is in a sparsely populated area. Fewer than 10 people live within a ½-mile radius of the site. Land near the site has been used for quarry operations. Properties west and northwest are cattle farms. A residential development has been proposed for the area across from the site, immediately west of Stout's Creek.

Lemon Lane Landfill

Lemon Lane Landfill is a landfill covering approximately 10 acres on the northwest side of the City of Bloomington in Monroe County, Indiana. This site was a municipal dump from 1930 to 1964. The site is adjacent to a residential neighborhood to the east and within 1,000 feet of a residential neighborhood to the southwest. A railroad line and a cemetery are adjacent to the site on the south.

Approximately 300 residences are within 2,000 feet of the site. Residences and businesses in the immediate vicinity and downgradient of the site are served by a municipal water supply.

Neal's Dump

Neal's Dump is in Owen County, Indiana. It served as the municipal dump from 1968 to 1972. The actual old fill area is relatively small in comparison with the other Consent Decree sites. Spencer, Indiana, which has a population of 2,609, is approximately 4 miles north of the site. Private residences are within 1,000 feet of the site; the nearest residence is within 50 feet. Private wells are used for potable water. It has been estimated that 954 people live within a 3-mile radius of the site, and that 65 people live within a ¼-mile radius of the site. The primary land use in the site area is agricultural. A preliminary health assessment of the site was conducted by the ISDH in September 1991.

Neal's Landfill

Neal's Landfill is in a rural area of Monroe County, Indiana. The site was a municipal dump from 1949 to 1972. The main fill area covers approximately 150 by 300 yards. Between 30 and 40 people live within a ½-mile radius of the site.

Land use near the site includes 10 to 20 residences approximately ½ mile west and ½ mile north of the site. Wooded lands immediately adjacent to the site do not appear to be used. There is a municipal water service to the immediate area surrounding the site; however, some residences in the vicinity of the site still rely on private groundwater wells.

Winston-Thomas Sewage Treatment Plant

The Winston-Thomas facility is an inactive sewage treatment plant owned by the City of Bloomington, Indiana, and located on the southwestern side of the City of Bloomington. In November 1975, Westinghouse advised the City of Bloomington that they had been discharging PCBs into the city sewer system. PCBs were then sampled for and confirmed at high concentrations in sewage, Tertiary Lagoon clay and sludge, and in the trickling filter at the plant.

In July 1986, the Bloomington City Utilities Board approved temporary storage of wastes on city property at the Winston-Thomas site. After the approval and receipt of all necessary permits needed for construction, Westinghouse built the Interim Storage Facility before remediation began at the other sites as outlined in the Consent Decree.

Approximately 500 people live within a 1-mile radius of the site. The site is surrounded by residential areas to the west and south, and by commercial developments to the north and east. A residential area is west of the site beyond Clear Creek and the Illinois Central Railroad tracks. The municipal water supply serves the area in the vicinity of the site. The current status of residential well use in the area is unknown.

The site history, all remedial measures undertaken, the former contaminant levels, and the completed and potential exposure pathways for these sites are shown in the following tables.

ANDERSON ROAD LANDFILL SUMMARY

History	Remedial Measures	Former Contaminant Levels		Exposure Pathways	
		On-Site	Off-Site	Completed	Potential
0.75-acre site Industrial Dump 1960-1970 4,487 tons PCB-contaminated waste	Surface capacitors and stained soils removed On-site pond drained Regrading and backfilling Installation of clay cap All interim remedial measures completed in 1987	**Surface Soil** 3,600 ppm PCBs **Groundwater** < 1 ppb PCBs 5-27 ppt dioxin/furan **Soil Gas** 3-2,100 ppm VOCs		**Past** On-site Ambient Air **Past** On-site Surface Soil	**Past, Present, & Future** Off-site Groundwater **Past** Off-site Surface Water

BENNETT STONE QUARRY SUMMARY

History	Remedial Measures	Former Contaminant Levels		Exposure Pathways	
		On-Site	Off-Site	Completed	Potential
4-acre site Industrial waste dump 1966-1980 Limestone quarry 55,000 cubic yards of PCB-contaminated soils	chain-link fence installed site capped surface capacitors removed sediments removed from Stout's Creek	**Surface Soil** 380,000 ppm PCBs **Surface Water** 7 ppb PCBs **Sediment** 5 - 102 ppm PCBs **Groundwater** 1,100,000 ppb PCBs	**Residential Wells** ND-<1 ppb PCBs **Surface Water** ND PCBs **Fish** 6.5 ppm PCBs	**Past** On-site Ambient Air **Past** Off-site Surface Water **Past** Off-site Sediment	**Past** On-site Surface Water **Past, Present, Future** Off-site Groundwater

ND = non-detect

LEMON LANE LANDFILL SUMMARY

History	Remedial Measures	Former Contaminant Levels		Exposure Pathways	
		On-Site	Off-Site	Completed	Potential
10-acre site Municipal dump 1930s-1964 Compound sinkhole 176,000 cubic yards PCB-contaminated waste	Chain-link fence installed Surface water erosion control Surface capacitor removal Landfill clearing and grading Gas venting system Synthetic membrane cap installed	**Ambient Air** 0.6-194 $\mu g/m^3$ PCBs **Surface Soil** 330,000 ppm PCBs **Subsurface Soil** < 1-22 ppm PCBs, 0.001-0.002 ppm dioxins/furans **Soil Gas** ND for VOCs **Groundwater** 2.41 ppb PCBs	**Ambient Air** 1-30 $\mu g/m^3$ PCBs **Soil Boring** 0.0001-0.005 ppm dioxins/furans **Subsurface Soil** 0.2-360,000 ppm PCBs **Groundwater** < 1 ppb PCBs **Residential Wells** non-detect - < 1 ppb PCBs **Surface Water** ND for PCBs **Spring Water** 2-12 ppb PCB **SD** 1,000 ppm PCB	**Past** On-site Ambient Air **Past** On-site Surface Soil **Past, Present, and Future** On- and Off-site Wild Game	**Past** Off-site Groundwater **Past, Present, and Future** Off-site Surface Water

ND = non-detect

NEAL'S DUMP SUMMARY

History	Remedial Measures	Former Contaminant Levels		Exposure Pathways	
		On-Site	Off-Site	Completed	Potential
0.5-acre site Municipal dump 1968-1972 Excavation pit Volume - 14,000 cubic yards	Chain-link fence installed Surface capacitors and stained soils removed Erosion control fences installed	**Ambient Air** 1-61 $\mu g/m^3$ PCBs **Subsurface Soil** 88,000 ppm PCBs **Surface Soil** 220,000 ppm **Groundwater** 31 ppb PCBs 11 ppb VOCs 8 ppb pesticides 2,600 ppb metals **Sediment** 275 ppm PCBs	**Ambient Air** <1 $\mu g/m^3$ PCBs **Surface Soil** <0.001 ppm PCBs **Residential Wells** BDL **Spring Sediment** ND	**Past** On-site Surface Soil	**Present & Future** Off-site Groundwater **Past** Off-site Sediment **Past** Off-site Surface Water

BDL = below detection limit

ND = non detect

NEAL'S LANDFILL SUMMARY

History	Remedial Measures	Former Contaminant Levels		Exposure Pathways	
		On-Site	Off-Site	Completed	Potential
17.6-acre site Municipal dump 1949-1972 Low area between two ridges Volume - 325,000 cubic yards	Chain-link fence installed Erosion control fences installed Regraded and capped portions of the site Site drainage re-routed Spring treatment facility installed Sediment collection traps installed Surface capacitors and stained soils removed Sediment in Conard's Branch removed Sediment in Richland Creek removed	**Surface Soil** 219,000 ppm PCBs **Groundwater** 9.6 ppb PCBs **Surface Water** 9.8 ppb PCBs **Spring Sediment** 1,700 ppm PCBs **Fish** 279 ppm PCBs	**Residential Wells** ND-7 ppt PCBs **Surface Water** 6 ppb PCBs 184,000 ppb metals **Spring Surface Water** 3-7 ppb PCBs 0.1-56 ppb VOCs 40,000 ppb metals **Sediment** 68 ppb PCBs **Fish** 8 ppm PCBs **Vegetables** 1,100 ppm PCBs	**Past** On- and Off-site Ambient Air **Past** On-site Sediment **Past** On- & Off-site Wild Game **Past, Present, & Future** Off-site Surface Water and Sediment **Past** Off-site Fish **Past** On-site Surface Soil	**Present & Future** Off-site Groundwater **Present & Future** Off-site Surface Water and Sediment **Future** Unknown Fish

ND = non-detect

WINSTON-THOMAS SEWAGE TREATMENT PLANT SUMMARY

History	Remedial Measures	Former Contaminant Levels		Exposure Pathways	
		On-Site	Off-Site	Completed	Potential
26-acre site Sewage treatment plant 1933-1982 Volume - Tertiary Lagoon 55,000 cubic yards - trickling filter rocks 20,000 cubic yards - stored sludge 4,000 cubic yards - digester sludge 5,500 cubic yards - drying bed media 4,400 cubic yards - abandoned lagoons 5,000 cubic yards	Chain-link fence installed Removed sediments from Clear Creek adjacent to the site Work on digester lids and water trickling filter	**Ambient Air** BDL for PCBs **Ahandoned lagoon** 700 ppm **Groundwater** 7 ppb PCBs **Tertiary Lagoon borings** 660 ppm PCBs **Tertiary Lagoon clay** 15 ppm PCBs **Tertiary Lagoon core sludge** 4,400 ppm PCBs **Tertiary Lagoon sludge** 2,400 ppm PCBs **Trickling filter** 22.1 ppb PCBs	**Residential Wells** ND-98 ppb PCBs **Surface Water** ND-0.9 ppb PCBs **Sediment** ND-1,300 ppm PCBs **Fish** ND-85 ppm PCBs	**Past, Present, & Future** Off-site Fish **Past, Present, & Future** Off-site sewage sludge **Past, Present, & Future** On- & Off-site wildlife	**Past** Off- and On-site Ambient Air **Past & Future** On-site Surface Water **Past** Off-site Surface Water and Sediment **Past, Present, & Future** Off-site Groundwater **Past** Off-site Cattle

BDL = below detection limit
ND = non-detect

ENVIRONMENTAL CONTAMINATION

A summary of all chemicals of concern is shown by site and media in the table below. Other chemicals found were not at levels of health concern.

Summary of Chemicals of Concern by Site and Media

Site	Chemicals of Concern and Affected Media
Anderson Road Landfill	PCBs: On-site subsurface soil On-site groundwater Hepta-chlorodibenzofuran: On-site pond surface water
Bennett Stone Quarry	PCBs: On-site soil On-site pond sediment On-site groundwater
Clear Creek	PCBs: Fish tissue
Lemon Lane Landfill	Aluminum: Off-site springs surface water Cadmium: Off-site groundwater Off-site springs and streams surface water Naphthalene/2-methylnaphthalene: Off-site spring sediment PCBs: On-site groundwater On-site subsurface soil Off-site sediment Off-site surface water Sodium: Off-site stream surface water Tetrachloroethene: Off-site springs surface water Trichloroethylene: Off-site groundwater Off-site springs surface water
Neal's Dump	PCBs: On-site subsurface soil On-site groundwater

Site	Chemicals of Concern and Affected Media
Neal's Landfill	Aluminum: Off-site stream surface water Arsenic: Off-site stream surface water Boron: Off-site stream surface water Chromium: Off-site springs surface water Chloroethane: On-site groundwater Cobalt: Off-site stream surface water Dioxins: On-site soil borings Dioxins & Furans: On-site surface soil Heptachlor: Off-site spring surface water Lead: Off-site stream surface water PCBs: On-site ambient air On-site groundwater On-site sediment On-site surface water Off-site surface water Off-site sediment Sodium: Off-site stream surface water 1,1,1-Trichloroethane: On-site groundwater Trichloroethylene: On-site groundwater Off-site streams surface water Vanadium: Off-site streams surface water Vinyl Chloride: On-site groundwater Zinc: Off-site streams surface water
Winston-Thomas Facility	PCBs: On-site groundwater On-site surface water On-site sludge (Tertiary Lagoon) Off-site sediment

Based on the environmental data reviewed, the six PCB sites discussed in this report were deemed by the ISDH to pose a past public health hazard to specific subpopulations in Owen and Monroe Counties. People who participated in the following activities have past completed exposure pathways:

- scavengers;
- people who ate fish from Richland Creek, Conard's Branch, and Clear Creek;
- trespassers;
- children who played on the landfills;
- people who ate wild game that roamed or lived on the landfills;
- people who participated in recreational activities at the quarries, Stout's Creek, Richland Creek, and Conard's Branch;
- people who ate vegetables from gardens where PCB-contaminated sewage sludge was applied; and
- landfill workers.

Information on these exposed populations was gathered through the 1986 Exposure Assessment Study conducted on the population surrounding the six PCB Consent Decree sites (Stehr et al. 1986).

Present and future potential exposure pathways exist for the following people from various routes of exposure:

- people who use private wells for potable water;
- people who have contact with springs associated with the Lemon Lane Landfill; and
- people who participate in recreational activities at Richland Creek and Conard's Branch.

The MRL for chronic exposure was exceeded for estimated ingestion doses for contaminated soil, groundwater, sediment, surface water, and consumption of PCB-contaminated fish taken from Richland Creek, Conard's Branch, and Clear Creek. Various PCB-specific epidemiologic studies (see following list) have been conducted on the Bloomington community. These studies did not reveal an excess number of medical problems or conditions in members of affected communities compared with members of comparison communities who were not exposed. Specific increases in disease outcomes and certain types of cancers have been seen in occupationally exposed people.

- Centers for Disease Control (CDC) study of the health effects of individuals who used PCB-contaminated sewage sludge on their gardens (Baker et al. 1980)

- National Institute of Occupational Safety and Health (NIOSH) study of the metabolic and health consequences of occupational exposures to PCBs (Smith et al. 1982)

- CDC/ISDH studies of PCB exposures of residents near three waste sites (Lemon Lane Landfill, Neal's Landfill, and Bennett Stone Quarry)

  - Health effects associated with serum PCB levels (Stehr et al. 1986)
  - Serum PCB levels in people at high risk of exposure in residential and occupational environments (Stehr et al. 1986)
  - Effects of PCBs and lipemia on serum analysis (Steinberg et al. 1986)

- Study of higher and lower chlorinated serum PCB congeners in individuals who used PCB-contaminated sludge in their gardens and capacitor manufacturing workers (Steele et al. 1986)

- NIOSH/ISDH follow-up health study of workers occupationally exposed to PCBs (NIOSH. HETA 84-339. 1990)

- ISDH/NIOSH study to evaluate the mortality experiences of a cohort of Westinghouse Electric Corporation workers occupationally exposed to PCBs (NIOSH. HETA 89-116-2094. 1991)

- ISDH/NIOSH study of proportional hazards model to examine the variations between cumulative PCB exposure and site-specific cancer mortality (Sinks et al. 1992)

- CDC/ISDH study to evaluate the potential for using domestic animals in the surveillance of environmental exposures (Schilling et al. 1988)

- ISDH/ATSDR study to evaluate the health implications of general community exposures to PCBs (Steele and Richter. 1992)

- NIOSH study of serum PCB concentrations in 50 workers at the Westinghouse plant (Phillips et al. 1989)

A review of the health outcome data for Monroe and Owen counties did not indicate that the sites have had an adverse health impact on the general population. White females were the only population that showed statistically significant increases in cancer (ovaries, cervix, and uterus). The data reviewed did not suggest an environmental component to these cancers since there was no consistent increase in any one particular type. (EPA, U.S. Cancer Mortality Rates and Trends 1959-1979). Data of all fetal deaths in Monroe and Owen Counties were reviewed. The ISDH Birth Problems Registry is relatively new; thus, the information it contains cannot yet be analyzed for significant trends or problems that may result from exposure to site-related chemicals.

The table below lists the multi-media PCB ingestion exposure doses and cancer risk summaries for all of the Consent Decree sites. To evaluate health effects, ATSDR has developed a Minimal Risk Level (MRL) for chemicals commonly found at hazardous waste sites. The MRL is an estimate of daily human exposure to a chemical below which non-cancer, adverse health effects are unlikely to occur. MRLs are developed for each route of exposure such as ingestion and inhalation, and for the length of exposure such as acute (less than 14 days), intermediate (15-364 days), and chronic (greater than 365 days). ATSDR presents these MRLs in toxicological profiles. These chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status. In the following discussion, wherever possible, ATSDR Toxicological Profiles have been used for the chemical evaluation.

Table of PCB Multi-Media Ingestion Exposure Doses and Cancer Risk Summaries for All of the Consent Decree Sites

SITE	MEDIA	IED* ABOVE MRL	CANCER RISK
Anderson Road Landfill	subsurface soil (on-site)	yes	low increase
	groundwater (on-site)	yes	no apparent
Bennett Stone Quarry	surface soil (on-site)	yes	very high
	pond sediment (on-site)	yes	no apparent
	groundwater (on-site)	yes	moderate increase
Lemon Lane Landfill	groundwater (on-site)	yes	low increase
	subsurface soil (on-site)	yes	high increase
	sediment (off-site)	yes	moderate increase
Neal's Dump	subsurface soil (on-site)	yes	moderate increase
	groundwater (on-site)	yes	very high increase
Neal's Landfill	groundwater (on-site)	yes	low increase
	surface water (off-site)	yes	low increase
Winston-Thomas Facility	groundwater (on-site)	yes	low increase
	surface water (on-site)	yes	low increase
	sediment (off-site)	yes	high increase

* Ingestion Exposure Dose

The six Consent Decree PCB sites pose an indeterminate public health hazard because groundwater is used as a source of potable water. Data on the sampling of private wells for chemicals other than PCBs are available only for Neal's Landfill.

On-site monitoring wells at Anderson Road Landfill and Bennett's Stone Quarry show contamination with dioxins and furans. Community members near these two landfills all use water from private wells. On-site monitoring wells show trichloroethylene (TCE) and dioxin contamination at Lemon Lane Landfill. Private wells around this site have been sampled for PCBs. During the dye tracer studies for Lemon Lane Landfill and Neal's Landfill, when dye was found in a residential well, EPA sampled for priority pollutants including dioxins and furans. Private wells in the communities surrounding Neal's Dump, Neal's Landfill, and the Winston-Thomas Sewage Treatment Plant have not shown levels of PCB contamination greater than 1 part per billion (ppb). The on-site groundwater PCB contamination indicates that there is a potential for these wells to become contaminated.

Community health concerns were derived from several sources, including meetings with local residents, and county and city officials. Their concerns are listed below.

- Will the health study point out correlations such as cancer and miscarriages due to PCBs?

- Are their physicians aware of the literature regarding the toxicity of exposure to PCBs?

- What about former and current workers at the Westinghouse/ABB plant. Many of the former workers have stated that they feel their health is deteriorating. Current workers are concerned that they are still being exposed to PCBs (from residual contamination) while working in the plant.

- How will the study show a true picture of the health effects when it is limited to only the Consent Decree sites? What about ABB (formerly Westinghouse) and Fell Iron & Metal Inc., which are in heavily populated areas?

Based on the evaluation of the environmental data, exposure pathways, health outcome data, health studies, and estimated exposure doses, the ISDH recommends the following:

1. monitor all sites for the presence in and transport into private wells of TCE, dioxins and furans, PCBs and any other site-related contaminants of concern;

2. take remedial actions to ensure that people are not exposed to significant concentrations of cadmium, tetrachloroethene, trichloroethylene, naphthalene/2-methyl naphthalene, and PCBs potentially found in the springs and streams associated with the Lemon Lane Landfill;

3. continue to monitor fish from Clear Creek, Richland Creek, and Conard's Branch for PCB contamination;

4. reevaluate the surface water treatment collection system at Neal's Landfill by regulating the National Pollutant Discharge Elimination Level to a level that is protective of human and environmental health to ensure that the sediments in Richland Creek and Conard's Branch are not re-contaminated;

5. continue communications with the Indiana Department of Transportation, the Monroe County Health Department, and the Indiana Department of Environmental Management to ensure that human health is not at risk from the proposed interchange for State Routes 37 and 46 near Bennett Stone Quarry;

6. wash and peel all root crop vegetables grown in sewage sludge-treated gardens before cooking or consumption; studies show that PCB uptake in plants is limited, and contamination primarily occurs through adhesion to the soil on the exterior of vegetables (Sommers LE. July 7, 1976);

7. develop education programs for nurses and primary care physicians to address community concerns that local health professionals may not be familiar with the signs and symptoms of health effects caused by exposures to PCB-contaminated media;

8. state and federal environmental agencies sample surface soil at the approximately 180 other PCB-contaminated sites to establish priorities for cleanup; and

9. conduct studies as listed below in follow-up to the previous studies conducted on the Bloomington population and to address community concerns:

   - a study to determine congener-specific serum PCBs of people who have previously had their blood tested for PCBs;

   - a study of contaminant levels within the ABB Corporation (formerly Westinghouse Corporation) plant and their effects on the health of workers; and

   - reevaluate the health of former Westinghouse workers exposed to PCBs.

INTRODUCTION

This report contains an evaluation of data and information on the release of hazardous substances into the environment and the pathways by which the surrounding community may be exposed. This information will be grouped into Background, Environmental Contamination and Other Hazards, and Pathways Analyses sections for each individual site. A description of these sections is given below.

BACKGROUND

The background section of this report contains information on the history and description of a site which includes but is not limited to:

- types of activities carried out at the site
- duration of commercial and industrial activities
- the length of time contamination has been present at the site
- changes in size or development of the site
- current and planned remedial activities

This section also contains a "Site Visit" report which is an essential element of the report process. The site visit allows a firsthand observation of the current conditions at the site.

GENERAL OVERVIEW

A Consent Decree was signed on May 25, 1985, by the Westinghouse Electric Corporation, the U.S. Environmental Protection Agency (EPA), the Indiana Department of Environmental Management (IDEM), the City of Bloomington, and Monroe County. Westinghouse is required to remove an estimated 650,000 cubic yards of polychlorinated biphenyl (PCB) contaminated soils, sludge, solid waste, and stream sediments from six sites located in the Bloomington, Indiana area. (U.S. District Court. Consent Decree. 1985)

The Agency for Toxic Substances and Disease Registry (ATSDR), a federal public health agency, has undertaken a multi-phase project to address concerns related to the impact on public health resulting from exposures to PCB-contaminated media at these six Consent Decree sites.

This project has three purposes: 1) to conduct a comprehensive evaluation of the public health impact of the six Consent Decree sites located in Monroe and Owen counties, 2) to determine the public health implications of incinerating the PCB-contaminated soil, and 3) to identify and evaluate the pertinent public health considerations of technically feasible cleanup alternatives.

The Consent Decree PCB-related sites (see Figure 1) are listed below, and are the only sites addressed at this time in this report. The ABB Corporation (formerly Westinghouse Corporation) and Fell Iron & Metal Inc. are not a part of this report, but may be addressed in the future.

Site	Status	Location
Anderson Road Landfill	EPA/State Enf. 8/85	Monroe County
Bennett Stone Quarry	NPL 9/84	Monroe County
Lemon Lane Landfill	NPL 9/83	Monroe County
Neal's Dump	NPL 6/86	Owen County
Neal's Landfill	NPL 9/83	Monroe County
Winston-Thomas Sewage Treatment Plant	EPA/State Enf. 8/85	Monroe County

Four of these sites (Bennett Stone Quarry, Lemon Lane Landfill, Neal's Landfill, and Neal's Dump) are listed on the EPA National Priorities List (NPL) of sites targeted for cleanup under the Comprehensive Environmental Response Compensation and Liabilities Act (CERCLA) as Superfund sites. Anderson Road Landfill and the Winston-Thomas Sewage Treatment Plant are not listed on the NPL as Superfund sites, but were made part of the comprehensive cleanup defined in the Consent Decree.

The first phase of the Consent Decree cleanup involves removal and remedial measures to contain the six sites until the extensive excavation of PCB-contaminated materials begins. Soil samples for cleanup levels were not performed. A thorough discussion of site-specific prior remediation can be found under the Site Description and History subsection for each site. An interim storage facility was constructed by Westinghouse in 1986 at the former Winston-Thomas Sewage Treatment Plant to store excavated PCB-contaminated materials until the high-temperature PCB incinerator is constructed. Groundwater investigations have also been initiated at five of the sites. The sixth site (Anderson Road Landfill) was completely remediated in 1987 by excavating and hauling all PCB-contaminated materials from this site to the interim storage facility.

The second phase of the Consent Decree cleanup involves the permitting, construction, and operation of a municipal solid waste fueled, high-temperature incinerator which will incinerate the PCB-contaminated materials excavated from all the Consent Decree sites.

Westinghouse submitted permit applications for the PCB incinerator on July 30, 1991. These applications included:

1. Toxic Substances Control Act (TSCA) and Resource Conservation and Recovery Act (RCRA) incinerator application;

2. Prevention of Significant Deterioration (PSD) Air Quality application; and

3. Certificate of Environmental Compatibility (CEC) application.

On August 22, 1991, Westinghouse submitted the RCRA landfill application for the incinerator ash landfill, and on September 30, 1992, the CEC application for the ash landfill was submitted to the Indiana Hazardous Waste Facility Site Approval Authority.
The board membership of the Indiana Hazardous Waste Facility Approval Authority is appointed by the governor, and is not a part of the IDEM. The IDEM as a party to the Consent Decree, however, is presently prohibited from reviewing these permit applications pursuant to Senate Enrolled Act 649, which requires IDEM to conduct a study of "alternative PCB technologies" before considering permit applications related to the proposed PCB incinerator.

Legislation was also passed [House Enrolled Act 1298] prohibiting the Indiana Hazardous Waste Facility Site Approval Authority from issuing Certificates of Environmental Compatibility for the incinerator and ash landfill sites before IDEM completes this study. This study was to be concluded by July 1, 1993, but has been delayed. The study must now be concluded by July 1, 1995.

Westinghouse has the responsibility of regrading, capping, and revegetating all sites after removal measures are completed. Once all Consent Decree sites have been remediated, Westinghouse will continue groundwater monitoring and site maintenance through a post-closure period of up to 30 years.

Current Status

HEA 1429 also required incinerators using solid waste as fuel to be included in the local Solid Waste Management District Plan (which is approved by IDEM) before they can be constructed. The Monroe County Solid Waste Management District Board submitted their plan to IDEM on June 30, 1992. The plan does not include incineration but does state that the plan will be revised if the PCB incinerator is built. IDEM has approved the Monroe County Solid Waste Management District Solid Waste Plan.

The Coalition Opposed to PCB Ash in Monroe County, Inc. (COPA), a local anti-incinerator group, was awarded a $200,000 EPA Technical Assistance Grant (TAG) in June 1992. This grant will allow COPA to hire expert advisors to study and interpret the EPA's investigation of the four Westinghouse NPL sites. (IDEM. General Overview of Consent Decree Sites. July 1992.)

This report is written with the intent to further characterize and evaluate all past, present, and future human exposure pathways, available health outcome data (including all previously conducted health studies of human exposure to PCBs), and community health concerns associated with the six Consent Decree sites. This report will be incorporated into the final ATSDR Public Health Assessment of these six sites.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

The tables in this section list the contaminants of concern. All data for the Consent Decree PCB sites may not be listed in this report. This report has been written from information provided to the ISDH by various individuals and agencies. Environmental data have been collected for many years. There is no one single source for the results of all the environmental sampling that has been performed by all the concerned parties. Some data were provided without summary sheets and laboratory quality assurance or controls. Quality assurance/quality control (QA/QC) is provided only wherein it was available. The ISDH relies on the information provided in the referenced documents and assumes that adequate QA/QC measures were followed with regard to chain of custody, laboratory procedures, and data reporting. This type of data was evaluated and then incorporated using professional judgment. As pertinent information becomes available, it will be incorporated in the this report, and the conclusions and recommendations will be adjusted whenever warranted. All chemical concentrations have been rounded when appropriate.

Normally, surface soil samples are considered to be taken from the surface to a maximum depth of 3 inches. Any samples taken below 3 inches are usually considered to be a subsurface soil sample. When the depth of the soil sample is unknown, the sample is considered to be a subsurface soil sample. When PCBs are spilled onto the ground, the soil will absorb the PCBs until it is saturated, with any residual PCB continuing to migrate further into the soil. Soil samples identifying PCB contamination at subsurface levels would also have corresponding surface soil contamination at equal or greater concentrations. Therefore, for those samples where sample depths are unknown, or where the sample depth may be deeper than what is normally considered for surface soil samples, these types of samples will be categorized as surface samples. This will also allow these samples to be used as worst-case scenarios to evaluate the potential for adverse health outcomes resulting from human exposure.

The contaminants of concern in the subsequent sections of this report are evaluated, and then, it is determined whether exposure to them has public health significance. The ISDH selects and discusses a chemical as a contaminant of concern based upon the following factors:

1. the chemical has no comparison value and/or may be toxic to humans at specified levels;

2. the comparison of on-site and off-site concentrations with public health assessment comparison values for (1) noncarcinogenic endpoints and (2) carcinogenic endpoints; and

3. an evaluation of the field data quality, laboratory data quality, and sample design;

4. community health concerns related to a particular chemical.

In the data tables that follow under the On-site Contamination and Off-site Contamination subsections, the listed chemical does not mean that it will cause adverse health effects from exposures. Instead, the list indicates which chemicals will be evaluated further in the report.

Comparison values for this report are contaminant concentrations in specific media that are used to select contaminants for further evaluation.

The comparison value for PCBs in groundwater is 0.05 ppb. In many instances, the level of detection determined and used by the laboratory is 0.01 ppb. A laboratory test for PCBs in the water supply could show non-detect and still be above the comparison value. We therefore consider groundwater to be a potential route of exposure where private wells are being used as a source of potable water.

The data tables include the following acronyms:

- **CREG** = Cancer Risk Evaluation Guide. CREGs are estimated contaminant concentrations based on a one excess cancer in a million persons exposed over a lifetime. They are calculated from EPA's cancer slope factors.

- **EMEG** = Environmental Media Evaluation Guide. EMEGs are media-specific comparison values that are used to select chemicals of concern at hazardous waste sites. They are derived from the minimal risk level.

- **FDA** = Food and Drug Administration

- **LTHA** = Lifetime Health Advisory (for drinking water). The LTHA is derived from the Drinking Water Equivalent Levels (DWEL) for noncarcinogens. For noncarcinogenic organic and inorganic compounds, LTHAs are 20% and 10% respectively of the DWEL. For possible carcinogens, the LTHA is divided by an additional factor of 10.

- **MCL** = Maximum Contaminant Level (for drinking water). MCLs represent contaminant concentrations that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an exposure rate of 2 liters of water per day. While MCLs are regulatory concentrations, Proposed Maximum Contaminant Level Goals and Maximum contaminant Level Goals are not.

- **NAS** = National Academy of Sciences. It has been suggested by the NAS, that where water supplies contain more than 20 ppm of sodium, dietary restriction to less than 1 g of sodium is difficult to achieve and maintain.

- **ppm** = Parts per million

- **ppb** = Parts per billion

- **ppt** = Parts per trillion

- **RMEG** = Reference Dose Media Evaluation Guide. RMEGs are media-specific comparison values that are used to select chemicals of concern at hazardous waste sites. They are derived from the reference dose level.

Toxic Chemical Release Inventory

The Toxic Chemical Release Inventory (TRI) is an EPA database that contains information on chemical releases of industries in the United States. It is used to determine the potential sources of contamination near NPL sites. The TRI includes only chemical releases that have been reported since the database was initiated in 1987. The utility of this database is limited in this report as the sites in question have undergone remediation prior to 1987. A computer search was conducted by county of all available toxic release inventory (TRI 87-90) data to determine the number of industries in Monroe and Owen Counties that potentially emit chemicals into the environment which are in common with the Bloomington PCB sites.

The TRI listed six facilities in Monroe County which emit the following chemicals into the air: xylene, toluene, methanol, methyl ethyl ketone, dichloromethane, n-butyl alcohol, and nitric acid. There were no water or land emissions reported for these chemicals. Please note that these emissions are quite possibly within a facility's emission rate limits.

No TRI data were found for Owen County.

PATHWAYS ANALYSES

To determine whether nearby residents are exposed to contaminants migrating from the site, and if former non-remediation workers were exposed to contaminants on the site, the ISDH evaluates the environmental and human components that lead to human exposure. These pathways analyses consist of five elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and an exposed population.

The ISDH categorizes an exposure pathway as a completed or potential exposure pathway if the exposure pathway cannot be eliminated. Completed pathways require that the five elements exist and indicate that exposure to a contaminant has occurred in the past, is currently occurring, or will occur in the future. Potential pathways, however, require that at least one of the five elements is missing, but could exist. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present.

Separate tables identify the completed and potential exposure pathways for each site. The discussion that precedes these tables incorporates only those pathways that are important and relevant to the site. Scavenging and trespassing are treated as having past completed exposure pathways to contaminants due to past visible evidence of these activities, as well as reports from local officials regarding these activities. It is impossible to estimate the actual number of individuals who may have trespassed on these sites, particularly where the capacitors were deposited. Information was also provided by approximately 50 individuals on the location and number of times that scavenging for metal from discarded capacitors took place. Most scavengers performed activities at most, if not all, of the six Consent Decree sites resulting in multiple exposures. Other documented activities included swimming in the quarries located around the Bennett Stone Quarry, and children playing on the sites (Stehr et al. 1986). Some of the exposure pathways that have been eliminated are also discussed.

ANDERSON ROAD LANDFILL (Monroe County)

<u>BACKGROUND</u>

A. Site Description and History

The Anderson Road Landfill, currently operated as the Monroe County Landfill, is a sanitary landfill approximately 11 miles northeast of Bloomington in Monroe County, Indiana (see Figure 1). An approximate 3/4-acre area at this landfill was used by the Westinghouse Electric Corporation in the 1960s and early 1970s for disposal of PCB-contaminated capacitors and materials. Only the portion of the site where PCB-contaminated materials were disposed has been remediated under the Consent Decree (U.S. District Court for the

Southern District of Indiana. Consent Decree. 1985). Contaminated soil removed from the site (1987) was transported to the Interim Storage Facility of the Winston-Thomas Sewage Treatment Plant. There was also a pond on-site which was drained and the water and silt were transported to the Winston-Thomas Sewage Treatment Plant's Tertiary Lagoon and Interim Storage Facility, respectively. (IDEM. General Overview of Consent Decree Sites. July 1992.)

Interim Measures

All interim measures required under the Consent Decree for this site were completed by Westinghouse in 1987. These measures included:

1. the excavation and transportation of 4,847 tons of PCB-contaminated capacitors, soil, and materials to the Interim Storage Facility;

2. the removal and transportation of all water and silt from an on-site pond to the Winston-Thomas Tertiary Lagoon and Interim Storage Facility, respectively;

3. the regrading and backfilling of all excavated areas; and

4. the placement of a soil cover capable of supporting vegetation on top of the final clay cap installed by Monroe County.

Closure

In 1989, the IDEM approved a request from Monroe County to use the remediated Anderson Road Landfill site for future solid waste disposal as part of the Monroe County Landfill operation.

Current Status

As of July 1992, there was no change in status.

B. Site Visit

On January 28, 1993, Ms. Dollis Wright and Mr. Garry Mills of the ISDH, and staff from the IDEM and Westinghouse visited the Consent Decree sites. Observances made during the site visit to the Anderson Road Landfill site are listed below.

1. The site is accessible from the north.

2. The Anderson Road Landfill is now operating as the Monroe County Landfill.

3. The area on the back side where the Anderson Road Landfill was formerly located has been regraded.

4. There were residences located east and west within a ¼- to ½-mile radius of the landfill.

C. Demographics, Land Use, Natural Resource Use, and Environmental Setting

Demographics

The Anderson Road Landfill site is in a sparsely populated area of Monroe County. The population within a ½-mile radius of Anderson Road Landfill consists of approximately 30-45 people. The population in the area is predominantly white. There are no sensitive populations (schools, nursing homes, parks, hospitals) in the immediate vicinity of the site. Residences closest to the site are located east and west within a ¼- to ½-mile radius.

Land Use

The area around the Anderson Road Landfill site is mainly farm land.

Natural Resource Use

Residences in the area surrounding the site use private groundwater wells for all domestic purposes.

Environmental Setting

Information on the hydrogeology of Anderson Road Landfill was not found in the reviewed data.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-site Contamination

Ambient Air

Air sampling for PCBs was conducted at the Anderson Road Landfill site by Westinghouse during September of 1986, and May through August of 1987. No PCBs were detected in any samples (Gulf Coast Laboratories Inc. Analytical Report).

Surface Soil

Soil samples were collected by EPA at six locations at the Anderson Road Landfill site in March 1987. Sample locations and depths are unknown due to the absence of a summary sheet and a site map being attached to the raw data. Samples were analyzed for solvents, total PCBs, and pesticides. Seven solvents and total PCBs were detected. Pesticide levels were below detection limits. PCBs shown in Table 1 were the only chemicals of concern.

Table 1. On-Site Surface Soil Sample Results for Anderson Road Landfill, March 1987

Chemical	Sample ID	Concentration Range (ppm)	Comparison Value	
			ppm	Source
PCBs (total)	S40-S36	<1-9D	0.01	EMEG

D - Results are on a dry weight basis

Subsurface Soil

In November 1981 a soil investigation study for PCBs was conducted by a private contractor for the City of Bloomington (see Figure 2). The scope of the study included the investigations of four areas at the site property. At each location a core soil sample from the ground surface to a depth of 2 feet was collected. (A-1 Disposal Corporation. Letter to Monroe County Commissioner regarding PCB Contamination, Monroe County Landfill.)

Area A - The temporary storage area for open and leaking capacitors and soil. Soil samples were collected at five locations (A-1,-2,-3,-4,-5,) within this area. At the center of this area, an additional soil sample was collected from 2 to 3 feet. PCBs were detected from 2,400 - 3,600 ppm.

Area B - This area was possibly contaminated as a result of movement of the capacitors and soils to Area A. Soil samples were collected at six locations (B-6 - 11) within this area. PCBs were detected at 60 ppm (B-10).

Area C - This area was possibly contaminated due to vehicular traffic. Soil samples were collected at ten locations (C-12 - 21) within this area. PCBs were detected at 50 ppm (C-19).

Area D - This is the original dump site. Soil samples were collected at 16 locations (D-22 - 37) within this area. At four locations, an additional core soil sample from 2 to 4 feet was collected. PCBs were detected at 180 ppm (D-26).

Soil Gas

Soil gas sampling at the Anderson Road Landfill was conducted by Westinghouse in May 1987. Eighteen samples (SG51 - 68) were collected, plus one blank sample, and analyzed for volatile organic chemicals(VOCs) only. Sample depths are unknown due to the absence of information detailing the procedures used. A total of 13 VOCs were detected during sampling. Chemicals of concern in soil gas sampling are shown in Table 2.

Table 2. On-Site Soil Gas Organic Sample Results for Anderson Road Landfill, May 1987

Chemical	Sample Number	Concentration Range (ppm)	Comparison Value	
			ppm	Source
1,1-dichloroethane	SG58-SG62	3-16	*	
trans-1,2-dichloroethene	SG60-SG55	6-53	10	CREG
fluorotrichloromethane	SG65-SG67	2-2,100	*	
vinyl chloride	SG59-SG65	46-180	2 ppb	EMEG
xylene	SG64-SG65	10-700	*	

* No comparison value available

Groundwater - Monitoring Wells

Groundwater samples were collected for PCB analysis from three monitoring wells (MW-1, -2, -3) by the Monroe County Solid Waste Management District in May and August of 1985, and March, May, August, and November of 1987. Sampling also included one background sample. All samples analyzed detected PCBs at less than 1 ppb.

In July 1986, on-site groundwater samples were collected by a private contractor for Westinghouse at the site. These samples were taken from two locations and analyzed for total PCBs and cyanide. Sample results for total PCBs and cyanide ranged from non-detect to less than 1 ppb.

In January 1987, a private contractor for the City of Bloomington collected water samples for dioxin and furan congener groups at the Anderson Road Landfill site. Samples were collected at two locations.

Congeners are chemical compounds that are closely related to one another by virtue of their chemical makeup and the effects they exert on each other as well as other chemicals. As certain chemicals show similar properties, they are assumed to produce similar health effects. A toxic equivalency factor is a number that has been assigned to a chemical that represents its relative degree of toxicity. This number is then multiplied by the comparison value of its chemical congener. The product is the toxic equivalency factor concentrations for 2,3,7,8-tetrachlorodibenzo-p-dioxin. Three congeners, heptachloro-dioxin at 27 ppt, hepatachloro-dibenzofuran at 5 ppt, and octachloro-dioxin at 74 ppt were detected. Heptachloro-dibenzofuran and heptachloro-dioxin were the only congeners found at a level of concern. (Analytical Services Inc. Analysis of Samples for Dioxins and Furans Tetrachloro through Octachloro Congener Groups, Water Samples #S-1 and S-2. January 16, 1987.; Monroe County Health Department. Letter to Mr. Lamb regarding Consent Decree; Monroe County Solid Waste Management District. Groundwater data at the Monroe County Landfill. March 1993.) Chemicals of concern in groundwater monitoring well samples are shown in Table 3.

Table 3. On-Site Groundwater Sample Results for Dioxin and Furan at Anderson Road Landfill, January 1987

Chemical	Maximum Concentration (ppt)	*TEFC (ppt)	**2,3,7,8-TCDD Comparison Value	
			ppt	Source
heptachloro-dibenzofurans	5	0.05	0.04	EMEG
heptachloro-dioxin	27	0.3	0.04	EMEG

* Toxic equivalency factor concentration
** 2,3,7,8-tetrachloro-dibenzo-p-dioxin

B. Off-Site Contamination

No data were found at the time of the writing of this report for off-site contamination at Anderson Road Landfill.

C. Quality Assurance and Quality Control

Acetone and methylene chloride were detected in the blank, as well as the soil samples collected in March 1987. These two chemicals are present in all laboratories. Low levels of these contaminants in the blanks as well as the unknown samples indicate a possible/probable blank contamination.

D. Physical and Other Hazards

This site is accessible on the northside. Per the site visit on January 28, 1993, however, there were no apparent physical hazards. The buildup of methane gas in the soil can be a problem at municipal solid waste landfills. No information was found at the time of the writing of the report on methane gas sampling.

PATHWAYS ANALYSES

A. Completed Exposure Pathways

On-site Ambient Air

Prior to the remediation of this site, capacitors and related debris were located in areas of Anderson Road Landfill. Landfill workers and scavengers for capacitor metals and trespassers could potentially have been exposed to air contaminated with PCBs. PCBs can be released into the environment from poorly maintained hazardous waste sites. PCBs in air can be present as both airborne solid and liquid particles, and vapor that eventually returns to the land and water by settling snow, and rainwater.

Air is a past completed exposure pathway for individuals who scavenged capacitors and trespassed on the Anderson Road Landfill.

On-site Surface Soil

Before the remediation of Anderson Road Landfill, PCB-contaminated capacitors, soil, and materials were located on this site. As the site was accessible, on-site scavenging of PCB capacitors and general trespassing occurred. Surface soil is a past completed exposure pathway for landfill workers, scavengers, and trespassers through ingestion and dermal contact.

The landfill is currently accessible on the north side. All remedial measures required under the Consent Decree were completed in 1987. The site has been capped with clay, and soil has been placed on top of the cap to support vegetation. This remediation measure eliminates surface soil as an exposure pathway.

Table 4. Completed Exposure Pathways for Anderson Road Landfill

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
On-site Ambient Air	Anderson Road Landfill	Ambient Air	Anderson Road Landfill	Inhalation	Trespassers Scavengers Landfill workers	Unknown *50 2-3	Past
On-site Surface Soil	Anderson Road Landfill	Soil	Anderson Road Landfill	Ingestion Dermal contact	Trespassers Scavengers Landfill workers	Unknown *50 2-3	Past

* Possibly exposed at all Consent Decree sites

B. Potential Exposure Pathways

Off-site Groundwater - Private Wells

At the time of the writing of this report, although data may exist, no data were found for off-site groundwater or private well sampling. In addition, no information was found on the direction of groundwater flow or hydrogeology of this site. The closest residence is about ½ mile from the site. All on-site groundwater samples were non-detect to less than 1 ppb for PCBs. Volatile chemicals were found in the soil gas analysis; however, residential wells have not been sampled for these volatile organic chemicals. For individuals who live downgradient from the site, there is a potential exposure pathway through the ingestion of private well water.

On-site Surface Water

The on-site pond contained PCB-contaminated debris, and capacitors. This pond was not supportive of aquatic life. Photographs revealed a murky, uninviting pond of water. It is assumed that no one would want to wade in this water. On-site activities of scavengers and trespassers may have involved dermal contact with the water in this pond. PCBs do not readily evaporate; they bind very strongly to soil particles and can become airborne as a result of blowing dust. PCBs in air can be present as both airborne solid and liquid particles, and vapor that eventually returns to the land and water by settling snow, and rainwater.

The water and silt from this pond was removed during the remediation of this site and placed in the Winston-Thomas Tertiary Lagoon and Interim Storage Facility respectively. The surface water in this pond is a past potential exposure pathway for inhalation of contaminated liquid and particles due to off-gassing of the pond, and incidental dermal contact.

Table 5. Potential Exposure Pathways for Anderson Road Landfill

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
Off-site Groundwater	Anderson Road Landfill	Groundwater	Private Wells	Ingestion Inhalation Dermal contact	Residents who use private wells	Unknown	Past Present Future
On-site Surface Water	Anderson Road Landfill	Water	Anderson Road Landfill	Inhalation Dermal contact	Trespassers Scavengers	Unknown *50	Past

* Possibly exposed at all Consent Decree sites

BENNETT STONE QUARRY (Monroe County)

BACKGROUND

A. Site Description and History

The Bennett Stone Quarry site, also known as Bennett's Dump, is in central Monroe County, Indiana about 2½ miles northwest of Bloomington (see Figure 1). The dump is adjacent to Star Quarry, an active limestone quarry, and consists of a 3½-acre main site, an adjacent smaller ½-acre site, and a very small area to the north of the two main fill areas. Stout's Creek runs north along the west side of the site. Stout's Creek formerly was used for the watering of cattle as well as being used for mud baths by several of the local residents who would go to this area to swim and bathe in the quarries. This site was used for the dumping and scavenging of PCB-contaminated electrical capacitors manufactured by Westinghouse and was discovered in 1983 through a citizen complaint to the Monroe County Board of Health. A site assessment was made by the EPA in May 1983 which resulted in a Federal Emergency Cleanup Action in June 1983. At the time of the site assessment, surface samples were contaminated with PCBs at concentrations ranging from non-detectable levels to 380,000 ppm. Formerly, there was a small pond on the site. The pond water and pond sediments were also contaminated at concentrations of 7 ppb and 102 ppm respectively. Stream sediment samples taken from Stout's Creek had concentrations of PCBs ranging up to 5 ppm. This site was subsequently listed on the NPL in September 1984. (IDEM. General Overview of Consent Decree Sites. July 1992.)

Federal Immediate Action Cleanup

The EPA conducted an Immediate Removal Action at the Bennett Stone Quarry site in June and July 1983. This action included:

1. removal of 252 visible capacitors and grossly contaminated soils;
2. aerial photographic, geophysical, and soil sampling surveys to determine the extent of PCB contamination;
3. installation of a 14- to 16-inch clay cap and 6-inch top soil cover over the site; and
4. construction of security fencing around the contaminated areas.

Interim Removal and Remedial Measures

Pursuant to the Interim Remedial Measures defined in the Consent Decree, Westinghouse has complied with the posting of PCB warning signs along the length of Stout's Creek bordering the Bennett Stone Quarry, and has maintained the integrity of the clay and vegetative cap over this site. During the preliminary remediation of the sites, in order to facilitate the fencing of the site, areas with stands of trees were included. Open areas, where significant contamination existed, were covered with a clay cap. The cap was subsequently seeded. Currently the site is covered with grass. Also required under the Consent Decree was the removal of PCB-contaminated stream sediments from Stout's Creek. A Westinghouse contractor hydro-vacuumed stream sediment from 1,600 linear feet of Stout's Creek in 1987 and transported this material to the Interim Storage Facility to await incineration. Westinghouse must also monitor stream sediments in Stout's Creek for PCB contamination during the excavation of the Bennett Stone Quarry. In order to establish pre-closure baseline PCB data, Westinghouse conducted PCB sampling of indicator sediment areas in Stout's Creek in June 1988.

Final Removal Measures

An estimated 55,000 cubic yards of material will be excavated for incineration by Westinghouse. This will include all solid waste plus an additional 2-foot depth of soil to bedrock as a buffer zone.

Current Status

The Indiana Department of Transportation (INDOT) is considering a new proposal for the construction of an interchange for State Roads 46 and 37 in Monroe County. This project is part of a proposal for improvements to State Road 46 between Bloomington and Ellettsville that will traverse within about 250 feet of the Bennett Stone Quarry site.

This new proposal being studied includes the construction of an underpass below State Road 37, which will require the removal of 600,000 cubic yards of material over an old quarry known as Mule Hole #2. This quarry is an alleged Westinghouse PCB dump site and is listed on the Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS) list. In January and March 1991, IDEM and the EPA, respectively notified INDOT of their agencies' general concerns about this new proposal. Both agencies have asked for more information and plans so that detailed comments can be provided.

The Monroe County Health Department submitted a letter to INDOT on June 4, 1993 regarding this problem. Their recommendation to INDOT was to conduct an environmental impact statement for this project, paying close attention to groundwater contamination, the presence of products of incomplete combustion, and other contaminants besides PCBs.

The IDEM did receive additional information on the INDOT project after completion of the data gathering phase of this report. No report evaluating additions/deletions, or modifications to the INDOT project have been prepared by IDEM; nor has a report been prepared as to the potential human exposures.

B. Site Visit

On January 28, 1993, Ms. Dollis Wright and Mr. Garry Mills of the ISDH, and staff from IDEM and Westinghouse visited the Consent Decree sites. Observances made during the site visit to the Bennett Stone Quarry site are listed below.

1. Access to the site is restricted by a locked chain-link fence with posted warning signs.
2. The site has a clay cap with vegetation and trees on it. There are also areas within the boundaries of the site, adjacent to the cap, where trees are growing.
3. There was an active stone-cutting operation (Star Quarry) near Stout's Creek, which is located southwest of the site.
4. The closest residence, which may be vacant, is located ¼ mile northwest of the site.
5. A quarry adjacent to the site (east) is partially fenced with posted warning signs. It was reported that this quarry was used in the past for swimming by students.

C. Demographics, Land Use, Natural Resource Use, and Environmental Setting

Demographics

The Bennett Stone Quarry site is in a sparsely populated area. Less than 10 people live within a ½-mile radius of the site. Sensitive population areas (high school) are within a ½- to 2-mile radius of the site. The population in the site area is predominantly white.

Land Use

Historically, land in the vicinity of the site has been used for quarry operations. There is an active stone mill within 50 feet of the southwest corner of the site. Properties to the west and northwest are farms raising beef cattle. There is a quarry immediately east of the site that has been used occasionally by local residents for swimming and hiking. Warning signs prohibiting swimming are posted. Light manufacturing and some retail business are also in the area. A residential development has been proposed in the area immediately west of Stout's Creek across from the site.

Natural Resource Use

Stout Creek flows north along the west side boundary and ultimately empties into Bean Blossom Creek 4 miles to the north. Water from Stout Creek was and may be used by cattle raised on the farm to the west and northwest of the site. According to county health officials, residents to the north along Stout Creek are not currently serviced by public water supplies and use groundwater wells. There are still an unknown number of residential wells being used in the immediate vicinity of the site.

Environmental Setting

The Bennett Stone Quarry is on relatively flat terrain with moderate slopes. Underneath the soil layer there are three different types of rock. The first rock layer is limestone. The second layer is a fine grain calcite; and the third layer, which is less than 3-feet thick, is grey/black shale.

On-site groundwater is 2.5 to 14 feet below the soil surface. Recharge to the groundwater occurs through the quarries located around the site. The number and depth of aquifers below the site were not provided in the reviewed data. The major origin of water in the quarries is believed to be through groundwater. The major discharge for site groundwater is believed to be Stout Creek. Two seeps within the main fill are also discharge points. Groundwater flow at this site is west-northwest toward Stout Creek.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-site Contamination

On May 12, 1983, the Monroe County Health Department, the ISDH, and the EPA conducted a site assessment tour of the Bennett Stone Quarry. The inspection team collected a total of nine multi-media samples for PCB analysis. All collections of soil, water, and creek sediments (Table 6) were grab samples (see Figure 3). (EPA. Site Assessment and Emergency Action Plan for Bennett's Quarry. May 1983.)

Table 6. On-Site Multi-Media Sample Results from Bennett Stone Quarry, May 1983

Media	Location	PCB Concentration (ppm)	Comparison Value	
			ppm	Source
Soil*	S-01	263,000	0.01	EMEG
Soil*	S-02	380,000	0.01	EMEG
Soil*	S-03	353,000	0.01	EMEG
Water	S-04	7 (ppb)	0.05 (ppb)	EMEG
Pond Sediments	S-05	102	0.01	EMEG
Creek Sediments	S-06	<5	0.01	EMEG
Creek Sediments	S-07	<5	0.01	EMEG
Surface Soil	S-08	31	0.01	EMEG
Creek Sediments	S-09	<5	0.01	EMEG

* Depth not specified

Surface Soil

Two soil samples were collected in October 1984 by EPA for dioxins and dibenzofurans from east/northeast of the former fill area. These two samples are considered surface soil samples as depths are unknown. A background sample was collected from a nearby city park for baseline data comparison.

Sample results show that two separate dioxin isomers (hepta and octa) are present in the soils at the Bennett Stone Quarry site. The higher chlorinated isomers, in particular the octa form, were more prevalent. The octa isomer was also present in the background sample from the park. (EPA. Final report on Bennett Stone Quarry dioxin sampling. March 1986)

In May 1992, Westinghouse collected soil samples for PCB analysis on-site along the security fence of the satellite area of Bennett's Dump. All samples were non-detect for PCBs.

Subsurface Soil

In June 1983, EPA collected 60 soil borings from this site. PCBs in soils ranged from 0 to 52,332 ppm. No site sampling map was provided with this information.

In May 1984, Westinghouse collected 27 soil boring samples throughout the site. No map was provided with this information. Boring depths ranged from 0 to 12 inches with a concentration of < 1 ppm. The higher concentrations were found in 0 to 6-inch samples (< 1-3 ppm). At boring depths of 0 to 3 inches, PCBs were found at < 1 to 3 ppm. PCBs in select samples ranged from 1 to 3 ppm. (Westinghouse. Phase I Progress Report on Winston-Thomas Facility and Bennett's Dump. January 1987.)

The EPA conducted sampling activities at the Bennett Stone Quarry in November 1984. The primary objective of the work was to obtain representative soil samples to be analyzed for dioxins and dibenzofurans (results not reported in document). Auger cuttings from the borehole contained evidence of likely PCB-contaminated refuse, including pieces of capacitors, capacitor binding, insulation, pieces of brown ceramic insulators, and oil. PCBs were found in this debris at a concentration range of non-detect to 3.3 ppm. No split spoon samples could be retrieved below 4 feet due to the debris encountered.

Groundwater - Monitoring Wells

Four quarterly groundwater sampling events were conducted at the site during the period from March to December 1988. Analyses of the samples were performed by EMS Laboratories, Inc. Groundwater sampling events are presented in Figure 4.

All wells installed at the Bennett Stone Quarry, except for Well MW-5, were sampled during each sampling round. Well MW-5 was not sampled during the August and December sampling rounds because oil was observed in this well during the March 1988 first quarterly event. The top of the water column in this well was examined and found to exhibit an oily sheen; however, no product layer of globules was noted in a sample that was withdrawn for closer visual examination. The PCB levels of concern from the groundwater monitoring well samples are listed in Table 7. (Westinghouse Environmental Services. Quarterly Groundwater Sampling Results, December 5-7, 1988, for Bennett's Dump and Winston-Thomas Facility Supplemental Hydrogeologic Investigation, Bloomington, Indiana. January 1989.)

Table 7. On-Site Groundwater PCB Sample Results for Bennett Stone Quarry, 1988

Location	Latest PCB Concentration December 1988 (ppb)	Concentration Range March - December 1988 (ppb)	Comparison Value	
			ppb	Source
MW-3	ND	ND-0.1	0.05	EMEG
MW-5	NS	03/9/88 1,100,000	0.05	EMEG
MW-6I	21	2-21	0.05	EMEG
MW-61 Duplicate	27	1-27	0.05	EMEG
MW-6D	2	0.3-7	0.05	EMEG

NS = not sampled
ND = non-detect

B. Off-site Contamination

Groundwater - Residential Wells

In June 1983, residential water sampling was done in homes surrounding the Bennett Stone Quarry site (see Figure 5). The selection process for these homes was not provided. These samples were taken from yard faucets and cold-water taps in garages. PCBs were detected at concentrations from non-detect to less than 1 ppb.

In November 1986, the Indiana University School of Public and Environmental Affairs in Bloomington conducted a well user survey of approximately 70 residential wells within 5,000 feet of the Bennett Stone Quarry site. Samples were collected at faucets nearest to the well head for drinking water and were analyzed for PCBs. Documentation for the well user survey did not include a location map of the residences sampled. PCBs were detected from non-detect to less than 1 ppb. (Indiana University. Collection and Analysis of Drinking Water Well Samples for PCB Content. November 1986.)

In August 1988, the residential wells sampled in 1983 were sampled again. PCBs were the only parameter analyzed. All samples had a PCB concentration of less than 1 ppb.

Surface Water - Stout's Creek

Stream samples for PCB analysis were collected by IDEM and Westinghouse in June 1988. These samples were taken to determine baseline PCB concentrations prior to any excavation activities. The area sampled at Stout's Creek was just downstream of the site. Five samples were taken upstream, and five samples were taken downstream. All samples were non-detect. (IDEM. Memorandum to Westinghouse CERCLA File regarding indicator stream area sampling, Bennett's Dump - Stout's Creek. June 30, 1988.)

Sediment - Stout's Creek

On June 21, 1988, IDEM and Westinghouse sampled indicator sediment areas as designated by the state and required by the Consent Decree. All samples were taken at or below the water line on the north bank. All samples were non-detect. (IDEM. Memorandum to Westinghouse CERCLA File regarding PCB sampling of Stout's Creek. June 30, 1988.)

Fish

Fish sampling of Stout's Creek consisted of eleven creek chubs (5-7" long) and was conducted at Acuff Road downstream of the Bennett Stone Quarry site and Bean Blossom Creek. The PCB concentration detected (6.5 ppm) was above the Food and Drug Administration (FDA) action level of 2 ppm and is indicative of contamination (Table 8). Fish from the Bean Blossom Creek sample had low levels of PCBs and are not indicative of serious contamination from Stout's Creek. (Indiana State Board of Health Memorandum, March 5, 1984)

Table 8. Off-Site Fish PCB Sample Results, Bennett Stone Quarry, March 1984

Sample Location	Species	PCB Concentration Range (ppm)	Comparison Value	
			ppm	Source
Stout's Creek at Acuff Road	creek chub	7	2	FDA
Bean Blossom Creek at Mel Curry Road above Stout's Creek	carp crappie, bluegill, longear sunfish	0.1-0.5	2	FDA
Bean Blossom Creek at Moon Road below Stout's Creek	channel catfish, pumpkin seed, longear and green sunfish, smallmouth bass	0.4-0.9	2	FDA

Concentrations listed as one number indicate only a single sample at that location.

C. Quality Assurance and Quality Control

Data from the groundwater residential well samples collected in August 1988 were reviewed and fulfilled all requirements for QA/QC. All duplicates (field and lab), blanks (field and lab), reference standards, associated retention times, matrix spike and matrix spike duplicates, and surrogates detection limits were met.

A review of the 1984 data from the soil samples collected for dioxin and dibenzofuran analysis revealed the tetra isomer as an estimate only, not a true detection level. All other samples were deemed acceptable for use.

Invalid data were found in the March 1988 groundwater monitoring well sample results and are listed as non-detect in the data range as there was suspected cross contamination caused from well MW-5 at the site.

D. Physical and Other Hazards

Per the site visit on January 28, 1993, there were no apparent physical hazards. This site is accessible only by key.

PATHWAYS ANALYSES

A. Completed Exposure Pathways

On-site Ambient Air

PCBs can be released into the environment from poorly maintained hazardous waste sites that contain PCBs. PCBs in air can be present as both airborne solid and liquid particles, and vapor that eventually return to the land and water by settling, snow, and rainwater.

Before June 1983 (interim remediation) there were areas at Bennett Stone Quarry where the soils were visibly stained with PCB oils. Burning of PCB-contaminated debris was also reported. There is no documentation of the degree of ambient air contamination on the site. Due to the stained soil, as well as the burning, there is a past completed exposure pathway through ambient air for landfill workers, scavengers, and trespassers.

A 14- to 16-inch clay cap and 6 inches of top soil were placed on Bennett Stone Quarry. This interim remedial measure removes the potential for volatilization of PCBs from contaminated soil to the air.

Off-site Surface Water - Stout's Creek/Quarries

Swimming was reported to have occurred in the quarries (Stehr et al. 1986). It is possible that the quarries northwest of Bennett Stone Quarry may have PCB contamination due to groundwater being the primary origin of water. These quarries are considered to be past completed exposure pathways for anyone coming into contact with the waters.

As previously mentioned, groundwater from Bennett Stone Quarry discharges directly into Stout's Creek. Sediments at the bottom of a body of water like Stout's Creek or the quarries generally act as a reservoir from which PCBs may be slowly released over a long period of time into the water. The latest water sampling performed at Stout's Creek (June 1988) was non-detect for PCBs. Surface water is a past completed exposure pathway for individuals participating in recreational activities in Stout's Creek through dermal contact and incidental ingestion.

Off-site Sediment

The sediment route of entry to the human body would be through incidental or accidental ingestion of stream water and/or absorption of the chemicals through the skin. It is important to note that these chemicals are bound to soil particles, considerably reducing the amount of human skin and stomach absorption. Swimmers, especially young children, could swallow water containing these sediments. The amount of sediment ingested during swimming, wading, and mud bathing is expected to be minimal.

The primary discharge of groundwater from Bennett Stone Quarry is to Stout's Creek. Recharge to the groundwater occurs through the quarries located around the site.

Sediments were removed from a 1,600-foot section of Stout's Creek. Stream sediment samples taken from Stout's Creek had PCB concentrations ranging up to 5 ppm. The latest stream sediment sampling data (June 1988) showed all samples were non-detect for PCBs. Sediments found in Stout's Creek presented a past completed exposure pathway for individuals who participated in recreational activities in Stout's Creek and the quarries.

Table 9. Completed Exposure Pathways for Bennett Stone Quarry

PATHWAY NAME	EXPOSURE PATHWAY						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
On-site Ambient Air	Bennett Stone Quarry	Ambient Air	Bennett Stone Quarry	Inhalation	Trespassers Landfill workers Scavengers	Unknown 2-3 *50	Past
Off-site Surface Water	Bennett Stone Quarry	Water	Stout's Creek, Quarries	Incidental ingestion, Dermal contact	Mud Baths, Wading, Recreational users of Stout's Creek and the quarries (swimmers)	50-100	Past
Off-Site Sediment	Bennett Stone Quarry	Sediment	Stout's Creek	Incidental Ingestion, Dermal contact	Mud baths, wading Recreational Users of Quarries and Stout's Creek	50-100	Past

* Possibly exposed at all Consent Decree sites

B. Potential Exposure Pathways

On-site Surface Water

Based on photographs of the site prior to the interim remediation, there were areas of the site where water pooled and formed a sludge. These areas appeared to be in locations where there was a lack of, or distressed, vegetation possibly due to PCB contamination. Because of the scavenger and trespasser activities on the site, surface water is a past exposure pathway through dermal contact. The site is currently capped, removing on-site surface water as an exposure pathway.

Off-Site Groundwater

Based on the 1986 well users survey performed on a 5,000-foot radius of Bennett Stone Quarry, there are approximately 75 private wells in use. Presently, municipal water is supplied to the general area, but there are an unknown number of individuals continuing to use private wells for potable water.

Groundwater flow is west-northwest toward Stout's Creek. The primary discharge of groundwater is to Stout's Creek, with some discharge to two seeps within the main fill area. The number and depth of aquifers below the site were not provided in the reviewed data. There is a past, present, and future potential for private wells that are west and northwest of Bennett Stone Quarry to be contaminated by on-site PCB-contaminated groundwater. Off-site groundwater is a past, present, and future potential pathway for individuals using private wells for potable water.

Table 10. Potential Exposure Pathways for Bennett Stone Quarry

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
On-site Surface Water	Bennett Stone Quarry	Water	Pooled on-site water	Dermal contact	Trespassers Scavengers	Unknown *50	Past
Off-site Groundwater	Bennett Stone Quarry	Groundwater	Private Wells	Ingestion, Inhalation, Dermal contact	Residents who use private wells (3-mile radius)	245	Past Present Future

* Possibly exposed at all Consent Decree sites

LEMON LANE LANDFILL (Monroe County)

BACKGROUND

A. Site Description and History

Lemon Lane Landfill is an approximate 10-acre landfill located on the northwest side of the City of Bloomington in Monroe County, Indiana (see Figure 1). The site is adjacent to a residential neighborhood to the east and within 1,000 feet of a residential neighborhood to the southwest. A railroad line and a cemetery are adjacent to the site on the south. The City of Bloomington operated the landfill from 1950 to 1964 as a municipal waste landfill and accepted PCB-contaminated electrical capacitors from Westinghouse from 1957 to 1964. Lemon Lane Landfill was opened in 1933 as a refuse dump in a large elongated compound sinkhole and valley approximately 30 feet deep. No records of types or quantities of wastes disposed at this site were kept during its operation. In addition to the original compound sinkhole, other Karst and surface water features identified around Lemon Lane Landfill include numerous smaller sinkholes, a few caves, three creeks, 14 perennial springs, 14 intermittent springs, and one sinking stream. (IDEM. General Overview of Consent Decree Sites. July 1992.)

Immediate and Interim Removal and Remedial Measures

The EPA contracted for the installation of a security fence around the perimeter of the site in June 1983. Following the approval of the Lemon Lane Grading Plan pursuant to the Consent Decree, interim removal and remedial measures began in May 1987. The site was first cleared of all trees and vegetation, and all exposed capacitors were removed and transported to the Interim Storage Facility. Once the eroded south slope was stabilized with a clay cap, the entire site was covered with a synthetic liner (TYPAR), followed by 30,000 tons of clean fill and a 36 mil plastic membrane (HYPALON) cover. Gas collection and filter systems were installed on top of the 488,000 square feet of HYPALON cover to complete the immediate and interim removal measures in September 1987.

Westinghouse began hydrogeological investigations in the summer of 1987 as part of the interim remedial measures. These investigations resulted in the installation of three new on-site groundwater monitoring wells and two additional off-site monitoring wells. Westinghouse conducted a high-flow dye trace study in April 1989, which revealed that during high-flow conditions, there are hydrologic connections between Lemon Lane Landfill and about a dozen springs that discharge within 6,000 feet of the landfill. Based on this dye trace study, Westinghouse determined the original tier-level monitoring well plan outlined under the Consent Decree to be inadequate to detect PCB contaminant migration from this site. To further characterize the groundwater flow around this site and to determine the possible impact on area residential water wells, a second dye trace study was conducted in the summer of 1990. The tracer dye was injected into three monitoring wells around the landfill and then the springs, and approximately 80 residential wells were monitored for eight weeks for the presence of dye. When dye was found, EPA sampled for priority pollutants including dioxins and furans. Only two abandoned residential wells were found to contain the dye in addition to several springs. This study revealed that 97% of the dye recovered from the Lemon Lane Landfill discharged at Quarry Spring southeast of the landfill.

Currently, IDEM staff are working with the EPA and Westinghouse to draft a new spring-based monitoring plan for the Lemon Lane Landfill site.

Adjacent to the site was a former farm where cattle were raised. A small pond was on the farm near the site and was used as a source of drinking water for the cattle. Westinghouse purchased this property prior to the implementation of the interim removal measures.

Final Removal Measures

Ultimately, approximately 176,000 cubic yards of materials will be excavated for incineration by Westinghouse. This will include excavation of refuse to the pre-Westinghouse landfilling depths plus a 3-foot buffer zone of soil.

B. Site Visit

On January 28, 1993, Ms. Dollis Wright and Mr. Garry Mills of the ISDH, and staff from IDEM and Westinghouse visited the Consent Decree sites. Observances made during the site visit to the Lemon Lane Landfill site are listed below.

1. Access to the site is restricted by a locked 6-foot chain-link fence with posted warning signs.

2. A synthetic membrane cap covers the entire site. In addition, there is a clay cover on the south slope underneath the membrane cap.

3. There was a gas venting system for the site.

4. The sampling locations at Quarry Springs A, B, and C southwest of the site near railroad tracks were identified.

5. Coyotes were seen off-site to the south.

6. The closest residences in the area are located adjacent to the site. Businesses are also within ½- to 1-mile of the site.

7. An off-site fenced farm pond that was formerly used as a source of drinking water for cattle was seen to the northwest.

C. Demographics, Land Use, Natural Resource Use, and Environmental Setting

Demographics

The Lemon Lane Landfill site is adjacent to a residential neighborhood to the east and within 1,000 feet of a residential neighborhood to the southwest. Approximately 300 residences are within 2,000 feet of the site. Sensitive population areas (students at schools) are located within a 1- to 1½- mile radius of the site. Indiana University is located 2 miles east of the site. The population in the site area is predominantly white.

Groundwater flow within the shallow zone during low-flow conditions is interpreted to flow to the southeast and eventually drain at a series of springs. A minor amount of groundwater from beneath the site is believed to flow to the northwest and discharge at the following springs: Slaughterhouse, Packing House Road, Packing House Culvert, and to other headwaters of Clear Creek. During low-flow periods, groundwater flow in the deeper, lower zone beneath the site is generally to the north/northwest. During high-flow periods, the groundwater flow in the lower zone is interpreted as being to the east.

Land Use

Within several hundred feet to the west of the site is undeveloped land owned by Westinghouse. Other properties in the area include a commercial area and a cemetery south of the site. The Bennett Stone Quarry Superfund site lies approximately ¾ mile northwest of the site.

Natural Resource Use

Residences and businesses within the immediate vicinity and downgradient of the site are served by a municipal water supply. There is only one residential well still in operation in the area. This well is on the east side of the site. Testing has indicated that no PCBs are present in this well. The owner of this well had declined to be connected to the municipal water supply. As of April 19, 1993, ISDH representatives were informed this individual has agreed to have his residence connected to the municipal water.

Environmental Setting

The soils at the Lemon Lane Landfill consist of fill material and native soils ranging in depth from 10.5 to 43 feet. The soil under the fill is made up of indigenous red clay. Two different types of sedimentary rock underlie the soil, St. Louis Limestone and Salem Limestone. St. Louis Limestone is composed of gray to yellow-brown limestone, dolostone, and shale, with a water-bearing zone. Salem Limestone is composed of light grayish and yellow to gray, thick cross-bedded calcarenite (Indiana Limestone). The bedrock at this site dips west to southwest at approximately 30 feet per mile.

The primary recharge to the groundwater flow system occurs through sinkholes and swallowholes. Some recharge does occur via rain percolation through the soils adjacent to the landfill.

Two aquifers exist below the site. The shallow aquifer is located at approximately 11 to 22 feet below the surface with the deep aquifer occurring at 28 to 38 feet below the soil surface. The shallow aquifer flows to the southeast and drains at a series of springs during low-flow periods. During high-flow periods, water from the shallow aquifer flows to the northwest discharging at the slaughterhouse, Packinghouse Road, Packinghouse Culvert, springs, and to other springs of Clear Creek.

Based on hydraulic testing, the deeper zone is less transmissive than the shallow zone. During low-flow periods, the deep aquifer flows to the north and northwest. During high-flow periods, the flow is to the east.

Springs and surface streams associated with this site include, but are not limited to the following:

Slaughterhouse	ICG-2	Pumping Station
Packinghouse Road	ICG-3	17th Street
Packinghouse Culvert	Fell Iron Spring	Urban
Illinois Central	Crestmont	Snoddy A
Quarry	WN-1	Snoddy B
Sargent's Pond	WS-2	Hinkle
Clear Creek	Stony East	Abrams
Stout's Creek	Stony West	Walcott A
Griffy Creek	Detmer A	Walcott B
ICG-1	Detmer B	Robertson

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-site Contamination

Ambient Air

During June and July 1983, EPA conducted a pre-cleanup on-site air monitoring study for PCBs at the Lemon Lane Landfill site (see Figure 6). Airborne PCB measurements were collected at three on-site locations (A, B, & C). Locations A and B were atop a large bank of capacitors which extended along the southern edge of the site. Location C was alongside the west boundary toward the south end of the site.

Battery operated, personal-type pump systems were used to sample during 8-hour, low-volume daytime periods at a fixed height above the sample locations. High-volume systems were employed to sample for 24-hour periods.

Sample location A, for the 8-hour low-volume period, had a concentration detection range of 30-89 $\mu g/m^3$ (micrograms per cubic meter); B showed 60-194 $\mu g/m^3$; and C showed 6-20 $\mu g/m^3$.

Sample location A, for the 24-hour high-volume period, had a concentration detection range of 43-45 $\mu g/m^3$; B showed none; and C showed 13-34 $\mu g/m^3$.

The levels of PCBs found in the ambient air at this site are considered to be of concern as there is no health-based comparison value for PCBs in air.

Soil Borings

In March 1984, soil samples were collected by Westinghouse from three boring locations (B-1,-2,-3) in the fill material of the Lemon Lane Landfill site and were analyzed for PCBs. A total of eight samples were collected at depths ranging from 12 to 24 feet at B-1, 4 to 32 feet at B-2, and 6 to 12 feet at B-3. PCBs were detected (Table 11) at all three boring locations with a concentration range of less than 1 to 22 ppm (4 to 6 feet).

Table 11. On-Site Soil Boring PCB Sample Results for Lemon Lane Landfill, March 1984

Soil Boring Number	PCB Concentration Range (ppm)	Comparison Value	
		ppm	Source
B-1	<1-2	0.01	EMEG
B-2	<1-22	0.01	EMEG
B-3	<1-3	0.01	EMEG

In early October 1984, two on-site soil samples were collected by EPA at the site, and were analyzed for dioxins and dibenzofurans (see Table 12). The samples collected by EPA were documented as surface soil. Polychlorinated-dibenzodioxins and furans were detected in only one of the samples at 0.002 ppm and 0.001 ppm respectively.

In late October 1984, additional on-site sampling was conducted by EPA at the site. Three samples were collected from two different boreholes. Sampling also included one blank sample (E-26). All six samples were analyzed for dioxins and dibenzofurans (see Table 12). Dioxins were detected in one sample at 0.002 ppm. Dibenzofurans were detected in three other samples with a concentration range of 0.0002 to 0.002 ppm.

As certain chemicals show similar properties, they are assumed to produce similar health effects. A toxic equivalency factor is a number that has been assigned to a chemical that represents its relative degree of toxicity. This number is then multiplied by the comparison value of its chemical congener. The product is the toxic equivalency factor concentrations for 2,3,7,8-tetrachlorodibenzo-p-dioxin. Based on the respective toxic equivalency factor for dioxins and furans, the levels found are lower than the comparison value for 2,3,7,8-tetrachlorodibenzo-p-dioxin ($2E^{-6}$ ppm). These chemicals are therefore not considered to be at a level of health concern.

Table 12. On-Site Surface Soil/Boring Sample Results for Dioxins and Furans, October 1984

Chemical	Sample Period	Maximum Concentration (ppm)	TEFC*	2,3,7,8-Tetrachloro-dibenzo-p-dioxin	
				ppm	Source
octachloro dioxin (surface soil)	Early October 1984	0.002	$2E^{-7}$	$2E^{-6}$	EMEG
octachloro dibenzofuran (surface soil)	Early October 1984	0.001	$1E^{-7}$	$2E^{-6}$	EMEG
octachloro dioxin (soil boring)	Late October 1984	0.002	$2E^{-7}$	$2E^{-6}$	EMEG
octachloro dibenzofuran (soil boring)	Late October 1984	0.002	$2E^{-7}$	$2E^{-6}$	EMEG

*TEFC = Toxic Equivalency Factor Concentration

Subsurface Soil

On-site subsurface soil was collected at the site by the ISDH and the City of Bloomington in June 1981. Because the sample depths ranged from surface to 5 feet, all samples are considered subsurface. Samples contained PCBs ranging from 1,700 to 330,000 ppm (Table 13).

Table 13. On-Site Subsurface Soil Total PCB Sample Results for Lemon Lane Landfill, June 1981

Sampled By	Sample Date	Sample Location	Concentration Range (ppm)	Comparison Value	
				ppm	Source
ISDH	6/81	I-B - I-A	1,700-330,000	0.01	EMEG
City of Bloomington	6/81	B-2 - B-1	28,118-69,160	0.01	EMEG

In June/July 1981, on-site soil samples were collected by EPA at the site and were analyzed for PCBs, VOCs, SVOCs, and pesticides (see Figure 7). Soil samples were collected from nine locations (81CL06S01 -81CL06S09) with a sample depth range of surface to 5 feet. Therefore, all soils will be considered subsurface, unless otherwise indicated. Two sample locations (81CL06S08 and 81CL06S09) were capacitor areas.

PCBs were detected at all nine locations with a concentration range of 0.1 to 57,000 ppm (Table 14). No other chemicals were reported at detectable levels. (EPA. Memorandum to chief of Water and Hazardous Materials Enforcement Branch regarding data results from Lemon Lane Landfill in Bloomington, Indiana. September 9, 1981.)

Table 14. EPA On-Site Subsurface Soil PCB Sample Results for Lemon Lane Landfill, June/July 1981

Sample Number	Sample Depth (feet)	Concentration Range (ppm)	Comparison Value	
			ppm	Source
81CL06S01	Surface	6	0.01	EMEG
81CL06S02	1	0.4	0.01	EMEG
81CL06S03	3	0.4	0.01	EMEG
81CL06S04	5	0.1	0.01	EMEG
81CL06S05	1	3	0.01	EMEG
81CL06S06	3	0.1	0.01	EMEG
81CL06S07	5	0.8	0.01	EMEG
81CL06S08	Soil around capacitors, south side	1,550	0.01	EMEG
81CL06S09	Soil around capacitors, west side	57,000	0.01	EMEG

Soil Gas

On-site soil gas sampling was conducted at the site in April 1987 (see Figure 8). The purpose of the sampling was to detect and characterize vapors in the soil pore space at the site. The results were analyzed for VOCs. A total of 23 samples were collected from 15 locations. VOCs were not detected in any samples. (Westinghouse. Letter to EPA, 1987).

Groundwater - Monitoring Wells

Between December 1982 and January 1983, on-site groundwater samples were collected by Westinghouse at the site (see Figure 9). Samples were collected for PCB analysis at four locations: MW-3, -4 (shallow), -4 (intermediate), and -4 (deep). Sample depths ranged from 105 feet in MW-3, 80 feet in MW-4 (shallow), and 99 feet in MW-4 (intermediate, and in excess of 123 feet in MW-4 (deep).

Total PCBs were detected in all wells except MW-4 (intermediate) with a concentration range of 1 ppb in MW-3 and MW-4 (shallow) to 2 ppb in MW-4 (deep).

In February 1983, on-site groundwater samples were collected by Westinghouse at the site. Samples were collected at MW-3, MW-4 (shallow, intermediate, and deep), and were analyzed for total PCBs. Total PCBs were detected in MW-4 (intermediate) at 2 ppb. All other samples were detected at less than 1 ppb.

Sediment

In March 1987, on-site sediment samples were collected by EPA from 18 locations at the site and analyzed for total PCBs, VOCs, and SVOCs.

A total of 22 solvents and 17 PCBs (total) were detected in March 1987. Chemicals of concern in sediment samples are shown in Table 15. (EPA. Letter to Westinghouse Bloomington Project Manager regarding analytical data for Anderson Road Landfill and sulfide data from Lemon Lane Landfill. April 10, 1987.)

Table 15. On-Site Sediment Sample Results for Lemon Lane Landfill, March 1987

Chemical	Concentration Range (ppm)	Comparison Value	
		ppm	Source
benzo(b)fluoranthene** and benzo(k)fluoranthene**	0.7-2	*	
benzo(a)pyrene	1	0.1	CREG
chrysene* and benzo(a)anthracene	1-2	*	
dibenzofuran	0.5	*	
2-methylnaphthalene	1	*	
naphthalene	1	*	
PCB (total)	13-4,300	0.01	EMEG
phenanthrene	0.7-1	*	

Concentrations listed as one number indicate only a single sample at that location.
* No comparison value available
** These two parameters are reported as a total

B. Off-site Contamination

Ambient Air

During June and July 1983, EPA conducted a pre-cleanup off-site air monitoring study for PCBs at the Lemon Lane Landfill site. Airborne PCB measurements were collected at three off-site locations upwind and downwind (locations 1 and 2, see Figure 6). Downwind locations 1 and 2 were situated in the yards of residences that border the north side of the site. The upwind monitoring location was located at a cemetery behind a mausoleum near the southern edge of the site boundary.

Battery-operated, personal pump systems were used to sample during 8-hour, low-volume daytime periods. High-volume systems were employed to sample for 24-hour periods. Sample locations upwind for the sample type 8-hour low-volume period showed a concentration range detection of less than 1 $\mu g/m^3$. No 8-hour low-volume period measurement was taken for the downwind locations.

The upwind location for the sample type 24-hour high-volume period also had a concentration range of less than 1 $\mu g/m^3$; downwind locations 1 and 2 for the sample type 24-hour high-volume period had a concentration range of less than 0.3 - 1 $\mu g/m^3$.

Ambient air monitoring samples were collected by personal and perimeter air monitoring at the site by Westinghouse from June to September 1987. All samples were analyzed for PCBs. Concentration ranges detected in June and September 1987 for personal air monitors were 30 $\mu g/m^3$ in June to 1 $\mu g/m^3$ in September. Concentration ranges detected from June-September 1987 for the perimeter air monitoring were 1 $\mu g/m^3$ (July 1987, east) to 21 $\mu g/m^3$ (August 1987, west).

Surface Soil

Surface soil samples were collected by the City of Bloomington at a private residence in June 1981 and in a wooded depression area in February 1982. One of the two samples from the private residence detected PCBs at 3,500 ppm. This sample was collected from a junk disposal site north of the residence. Five samples were taken in the wooded depressions southeast of the site. These depressions flood during periods of wet weather resulting from a combination of surface runoff and spring flow. All samples detected PCBs ranging from 0.2 to 360,000 ppm.

Concurrent with the spring water sampling in June 1983, soil samples were obtained from points north and south of the railroad embankment adjacent to Illinois Central Spring. The north sample was taken at the inlet where flow from the spring passes under the embankment; the second soil sample was taken at the spring outlet south of the embankment. Soil samples were analyzed for PCBs and VOCs. PCBs were detected at a concentration range of 2.5 ppm in the second sample to 5.8 ppm in the north sample. Methylene chloride was detected at a concentration range of 0.07 ppm at the spring outlet to 0.1 ppm at the north sampling location.

In early October 1984, six off-site soil samples were collected by EPA from residences in the immediate neighborhood of the site, and were analyzed for dioxins and dibenzofurans. The samples collected by EPA were documented as surface soil; depths were not listed. Dioxins were detected in all six samples with a concentration range of 0.0001 to 0.005 ppm. Dibenzofurans were detected in one sample at less than 0.00002 ppm. Based on the respective toxic equivalency factor for dioxins and furans, the levels found are lower than the comparison value for 2,3,7,8-tetrachlorodibenzo-p-dioxin ($2E^{-6}$ ppm). These chemicals are therefore not considered to be at a level of health concern.

Groundwater - Monitoring Wells

Between December 1982 and January 1983, off-site groundwater samples were collected by Westinghouse for the Lemon Lane Landfill site (see Figure 9).

Samples were collected for total PCB analysis at nine locations: MW-1 (shallow), MW-1 (deep), MW-2, -5, -6, -7, -8 (shallow), and -9. Sample depths ranged from in excess of 49 feet in MW-1 (shallow), 65 feet in MW-1 (deep), in excess of 121 feet in MW-5, 69 feet in MW-6, in excess of 66 feet in MW-7, 60 feet in MW-8 (shallow), 91 feet in MW-8 (deep), and 107 feet in MW-9. All samples detected total PCBs at less than 1 ppb.

In February 1983, off-site groundwater samples were collected for PCB analysis by Westinghouse at the site. Samples were collected at nine locations: MW-1 (shallow), -1 (deep), -2, -5, -6, -7, -8 (shallow), -8 (deep), -9, plus two duplicates at MW-1 (deep) and -5. All samples detected total PCBs at less than 1 ppb.

Between October 1982 and June 1983, off-site groundwater samples were collected by EPA from around the periphery of the site (see Figure 10). Samples were collected at five locations: MW-B1, -B2, -B3, and -B4, plus a pond on private property (now owned by Westinghouse) directly northwest of the site. These samples were analyzed for VOCs, SVOCs, metals, and cyanide. Sample depths ranged from excess of 47 feet in MW-B1, in excess of 57 feet in MW-B2, in excess of 52 feet in MW-B3, and in excess of 47 feet in MW-B4. Due to a partially clogged screen, MW-B3 contained only enough water for a VOC sample. In addition, the sampling included one duplicate (MW-B4) and one blank. A total of 12 VOCs/SVOCs and six metals were detected with no cyanide in October 1982.

In June 1983, off-site groundwater samples were collected by EPA at MW-B1, -B2, -B3, and -B4. These samples were only analyzed for VOCs/SVOCs and total PCBs. No PCBs were detected, but VOCs/SVOCs and heavy metals were detected in June 1983. Chemicals of concern in groundwater monitoring well samples are shown in Table 16. (Westinghouse. Phase I Report Supplemental Hydrogeologic Investigation, Lemon Lane Landfill. November 1989; Westinghouse. 1990 Lemon Lane High Flow Tracer Test Report. March 1991.)

Table 16. Off-Site Groundwater Monitoring Well Sample Results for Lemon Lane Landfill, October 1982 and June 1983

Chemical	October 1982 Sampling		June 1983 Sampling		Comparison Value	
	Sample Point	Concentration Range (ppb)	Sample Point	Concentration Range (ppb)	ppb	Source
cadmium	B-2 & B-4 - B-1	3-8	-	-	2	EMEG
iron	B-4 - B-2	75-103	-	-	*	
trichloroethylene	B-1	61	B-1	11	3	CREG

Concentrations listed as one number indicate only a single sample at that location.
* No comparison value available

Groundwater - Residential Wells

In June 1981, groundwater samples were collected in the site area by the City of Bloomington Utilities Lab and were analyzed for PCBs (see Figure 10). A total of 17 residences were sampled. All sample results were non-detect. (City of Bloomington Utilities Lab. Laboratory report on surface water and residential well water samples for Lemon Lane Landfill site. June 1981.)

Between June and July 1981, residential well samples were collected by EPA at three residences (samples 81CL06512 to 14) in the site area and were analyzed for PCBs (see Figure 7). All samples were non-detect. The residential well samples collected were part of a soil sampling event in June/July 1981 by EPA. (EPA. Letter to Chief of Water and Hazardous Materials Enforcement Branch regarding data results for Lemon Lane Landfill. September 9, 1981.)

As an addendum to the dioxin soil sampling conducted by EPA in early October 1984, EPA was asked to sample a residential well (junkyard property) near Vernal Pike for PCBs and pesticides. Sample results were non-detect. (EPA. Memorandum to File, December 11, 1983; EPA, Draft Remedial Action Master Plan, June 6, 1983; Indiana University. Collection and Analysis of Drinking Water Well Samples for PCB Content. November 1986.)

In November 1986, the Indiana University School of Public and Environmental Affairs in Bloomington conducted a well user survey of approximately 13 residential wells within 5,000 feet of the site. Samples were collected at faucets (used for drinking water) nearest to the well head. All samples were analyzed for PCBs. Documentation for the well user survey did not include a location map of the residences sampled. Samples detecting PCBs had a concentration range of non-detect to less than 1 ppb. (Indiana University. Collection and Analysis of Drinking Water Well Samples for PCB Content. November 1986.)

Surface Water

In June 1981, off-site surface water samples were collected by the City of Bloomington Utilities Lab in the Lemon Lane Landfill area, and were analyzed for PCBs. Two surface water samples (#1 and #2) were collected from private ponds on the north and northwest side of the site, plus a surface water sample from Hensenberg Creek. The sampling event was conducted in relation to the residential well samples collected in June 1981. All sample results showed non-detect. (City of Bloomington Utilities Lab. Laboratory report on surface water and residential well water samples for Lemon Lane Landfill site. June 1981.)

Between June and July 1981, off-site surface water samples were collected by EPA at the Lemon Lane Landfill area, and were analyzed for PCBs. As part of the EPA soil sampling event in June/July 1981, one surface water sample (81CL06S10) was collected from a private pond 25 yards west of the northwest corner of the site, along with one blank sample. PCBs were detected at 0.9 ppb in the pond water (see Figure 7). (EPA. Letter to Chief of Water and Hazardous Materials Enforcement Branch regarding data results from Lemon Lane Landfill. September 9, 1981.)

Spring Water

In July 1982 nine springs in the vicinity of the site were sampled by EPA (see Figure 11). These sample points were identified as: Stoney Spring East (#1), Stoney Spring West (#2), Illinois Central Spring (#4), Snoddy Spring (#6), Robertson Spring (#8), Packinghouse Road Spring (#9), Slaughter House Spring (#10), Packing Plant Spring (#11), and Detmer Spring (#7). Two additional points, Quarry Spring (#3) and Hinkle W-W Rise (#5), were to be sampled, but were found to be dry. The sampling also included two blank samples.

Samples collected were analyzed for VOCs, semi-volatile organic compounds (SVOCs), inorganic chemicals and PCBs/pesticides. A total of seven VOCs and eight inorganic chemicals were detected. No PCB/pesticides were detected in July 1982. EPA requested a second set of spring samples in December 1982. Quarry Spring and Hinkle W-W Rise were sampled after flow was observed at their originating points. The other nine spring samples were also again sampled. All samples were analyzed for VOCs, SVOCs, PCB/pesticides, inorganic chemicals, and cyanide. Sampling included two blank samples plus a duplicate (Packing Plant Spring). A total of 13 VOCs/SVOCs, one PCB, and 11 inorganic chemicals were detected. No cyanide was detected during sampling. Chemicals of concern in spring water samples are listed in Table 17.

Table 17. Off-Site Spring Surface Water Sample Results for Lemon Lane Landfill, July/December 1982

Chemical	July 1982 Sampling		December 1982 Sampling		Comparison Value	
	Sample #	Concentration Range (ppb)	Sample #	Concentration Range (ppb)	ppb	Source
PCB-1248	-	-	1,4	2-12	0.05	EMEG
tetrachloro-ethylene	7	32	7	7	0.7	EMEG
1,2-trans-dichloroethylene	4,7	31-206	7,4	6-7	*	
trichloroethylene	7	45	7,4	8-41	3	CREG

Concentrations listed as one number indicate only a single sample at that location.
* No comparison value available

In June 1983, the four springs closest to the site (Stoney Spring East and West, Quarry Spring, and Illinois Central Spring) were sampled for VOCs only. The Hinkle W-W Rise Spring was to be included in this group, but was not flowing at sampling time. Only VOCs, acetone (#2) at 14 ppb and trichloroethylene (#3 & #4) at 12-24 ppb, were detected during sampling.

Springs and Streams

In November 1991, water samples were collected by EPA from various springs and streams associated with the Lemon Lane Landfill site (see Figure 12). The IDEM collected sediment samples (see sediment section). This project was designed by EPA in conjunction with the

IDEM to determine whether PCBs were present in the springs and streams that were believed to possibly be in contact with PCB-contaminated material buried at the Lemon Lane Landfill site.

The collection of stream samples began at the most downstream location to minimize the possibility of cross contamination. When possible, water samples were collected prior to collection of the sediment samples. At some locations it was apparent IDEM would have to try several locations along the stream bed in order to find a sufficient quantity of fine-grained silt. For these locations, IDEM first collected the sediment sample. The water sample was then collected immediately upstream of these locations while IDEM was sampling, or at the location after the water had cleared following the sampling.

The EPA samples 1 through 6 were submitted for analyses of VOCs, SVOCs, pesticides, PCBs, and metals. These six samples included a duplicate from the Swallow Hole (sample 3), a background sample collected from Oard Spring at Oard Road Bridge (sample 5), and a field blank prepared with distilled water (sample 6).

Fifteen additional samples (including three duplicate samples, although duplicates are not listed in the table) were found to contain PCBs. Thus, 14 of the 33 locations sampled (also not including the background sample from Oard Spring) contained detectable levels of PCBs. Fifteen of these locations are from Quarry Springs (including the Illinois Central Springs) or the Quarry Springs Branch.

No VOCs, SVOCs, or pesticides were detected during this sampling. A total of seven metals were detected during sampling at the locations (01, 04, & 05) with a concentration range of 6 ppb (cadmium) to 78,300 ppb (calcium). Chemicals of concern in surface water samples are listed in Table 18.

Table 18. Off-Site Springs & Streams Surface Water PCB Sample Results from Lemon Lane Landfill, November 1991

Chemical	Sample Number	Concentration Range - ppb	Comparison Value	
			ppb	Source
PCBs (total)	1	12	0.05	EMEG
	2	9		
	3	10		
	4	8		
	20	1		
	24	8		
	26	9		
	27	8		
	28	8		
	29	0.4		
	31	13		
	32	11		
	33	12		
aluminum	1 - 5	410-2,300	*	
cadmium	1 - 4	6-9	2	EMEG

Concentrations listed as one number indicate only a single sample at that location.
* No comparison value available

Sediment

In June/July 1981, off-site sediment samples were collected by EPA in the Lemon Lane Landfill area and were analyzed for PCBs. As part of an EPA soil sampling event in June/July 1981, one sediment sample (81CL06S11) was collected from a private pond 25 yards west of the northwest corner of the site, along with one blank sample. PCBs were detected at 0.52 ppm in the pond. (EPA. Letter to Chief of Water and Hazardous Materials Enforcement Branch regarding data results from Lemon Lane Landfill. September 9, 1981.)

In October 1981, off-site sediment samples were collected by EPA at four locations: 1) Stout's Creek, 2) Quarry Spring, 3) Stoney Springs East, and 4) Stoney Springs West. All samples were analyzed for total PCBs and were below the detection limit.

The IDEM conducted two sediment sampling events for total PCB analysis in June 1991 (see Figure 13) and November 1991 (see Figure 14) from various springs and streams associated with the Lemon Lane Landfill site. In June 1991 a total of 15 locations were sampled. Sampling in June 1991 included two duplicate sample locations, both at Illinois Central

Spring - midstream. Total PCBs were detected in 11 samples (Table 19) with a maximum concentration of 22 ppm (IDEM. Memorandum. September 23, 1991; IDEM. Memorandum. February 25, 1992).

Table 19. Off-Site Sediment Total PCB Sample Results for Lemon Lane Landfill, June 1991

Sample Location	Maximum Concentration (ppm)	Comparison Value	
		ppm	Source
Quarry Spring - North Seep	2	0.01	EMEG
Quarry Spring - South Seep	0.7		
Quarry Spring Weir	5		
Illinois Central Spring - Midstream	8		
Illinois Central Spring - Midstream	11		
Illinois Central Spring - Composite	22		
Illinois Central Swallowhole	17		
Slaughterhouse Spring	0.6		
Robertson Spring	0.2		
Detmer (B) Spring	0.2		
Detmer (A) Spring	0.7		

In November 1991, sediment samples were collected from various springs and streams associated with the Lemon Lane Landfill site. The IDEM sediment samples were coordinated with the EPA water samples (see Off-Site Springs and Streams subsection). Five IDEM samples were analyzed for PCBs, VOCs, SVOCs, and metals. Lead was the only metal found at a level of concern. No SVOCs were found, and methyl ethyl ketone at very low levels was the only VOC found. All other samples were analyzed for PCBs only. A background sample taken from a spring (Oard Spring at Oard Road Bridge) in the area, that presently has not been linked to any site in this area, was also taken. This sample indicates the ambient levels of naturally occurring analytes.

The highest concentrations of PCBs were detected at the Illinois Central Springs samples (5.8 ppm). At the Illinois Central bridge north of Allen Street, only one sample had detectable levels of PCBs at 1 ppm. PCBs were indicated both north and south of this junction. Nine samples for PCBs were below the detection limit.

C. Quality Assurance and Quality Control

All chemicals with estimated detection levels were not used. The July 1982 spring water inorganic sampling results were of questionable validity and were not used. In the March

1987 sediment samples, bis(2-ethylhexyl)phthalate was a suspected laboratory contaminant and therefore not used. All samples detected below the quantifiable detection limit were not included.

D. Physical and Other Hazards

Per the site visit on January 28, 1993, there were no apparent physical hazards present on this site.

PATHWAYS ANALYSES

A. Completed Exposure Pathways

On-site Ambient Air

On-site burning of capacitors and PCB-contaminated materials was reported to health officials by nearby residents, and by anecdotal reports from scavengers. Landfill workers, scavengers, trespassers, and individuals living around the site had past completed exposures to PCB-contaminated ambient air through inhalation. Sampling of the ambient air was not done during this time. Ambient air on and around the Lemon Lane Landfill is considered to be a past completed exposure pathway. The latest air monitoring of this site was non-detect.

On-Site Surface Soil

PCB oil-stained dirt was excavated from this site and moved to the Interim Storage Facility. Before this and other remediation measures were undertaken, this site was accessible to the general public. There were reports of individuals pouring the PCB oils out of capacitors and scavenging them for metal. Surface soil is a past completed exposure pathway for landfill workers, trespassers, and scavengers through dermal contact, and incidental ingestion. Because children have more hand-to-mouth activities than adults, they are of particular concern for this past completed exposure pathway.

On- & Off-site Wild Game

Based on a pilot study on the use of animal sentinels in environmental health, dogs that roamed these Consent Decree sites had elevated PCB serum levels (Schillig et al. 1988). Excretion of PCBs is slow, so accumulation occurs even at low exposure levels. The higher the chlorination, the longer it takes to be excreted by the body. If wild game forage in the brush on the site, or in the springs and/or depressions that are associated with this site, the accumulation of PCBs is very likely. Consumption of game such as rabbit, raccoon, and squirrel that roamed the Lemon Lane Landfill and/or its associated springs and depressions are past completed exposure pathways for people who eat them.

Table 20. Completed Exposure Pathways for Lemon Lane Landfill

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
On-site Ambient Air	Lemon Lane Landfill	Air	Lemon Lane Landfill	Inhalation	Landfill workers Scavengers Trespassers Nearby Residents	2-3 *50 100 750	Past
On-site Surface Soil	Lemon Lane Landfill	Surface Soil	Lemon Lane Landfill	Ingestion Inhalation Dermal Contact	Trespassers Scavengers Landfill workers	100 *50 2-3	Past
On- & Off-site Wild Game	Lemon Lane Landfill	Rabbits Squirrels Raccoon	Lemon Lane Landfill and surrounding streams and springs	Ingestion	People who eat game that roamed on-site and around the site associated springs and streams	100-150	Past

* Possibly exposed at all Consent Decree sites

B. Potential Exposure Pathways

Off-Site Groundwater

Dye tracer tests were performed at the Lemon Lane Landfill. Two aquifers exist below the site. The shallow aquifer ordinarily flows southeast and drains at a series of springs. During heavy rainfalls, however, the flow is to the northwest toward the site-related springs. The deep aquifer flows northwest ordinarily, but during heavy rainfall flows to the east. The groundwater flow system occurs primarily through sinkholes and swallow holes, and to a lesser extent, by rain percolation through the soils adjacent to the landfill.

The thirteen residential wells that were tested by Indiana University in 1986 were all non-detect or below 0.01 ppb for PCBs. All residents surrounding the site are on municipal water. Off-site groundwater is a past potential exposure pathway for individuals using private wells for potable water.

Off-Site Surface Water/Sediment

The highest reported detection of PCBs in surface water was at the Illinois Central Spring. A fence with warning signs had been constructed around this spring; however, it is in a state of disrepair. There is some potential for downstream transport of PCBs. Sampling results indicate that PCB levels in surface water are non-detect in downstream samples taken below Third Street. PCBs bind tighter to sediment than to water. Sediment PCB levels were in general less than 1 ppm in samples taken downstream from the site. Surface water and sediment from Lemon Lane Landfill is a past, present, and future potential exposure pathway through dermal contact for children who play and adults who may fish in and around the springs associated with this site.

Table 21. Potential Exposure Pathways for Lemon Lane Landfill

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
Off-site Groundwater	Lemon Lane Landfill	Groundwater	Private Wells	Ingestion, Inhalation, Dermal contact	Residents who use private wells (3-mile radius)	40	Past
Off-site Surface Water	Lemon Lane Landfill	Surface Water	Springs	Ingestion Dermal contact	Nearby residents	300	Past Present Future
Off-site Sediment	Lemon Lane Landfill	Sediment	Springs	Dermal contact Incidental ingestion	Nearby residents children	300	Past Present Future

NEAL'S DUMP (Owen County)

BACKGROUND

A. Site Description and History

Neal's Dump is in Owen County, Indiana (see Figure 1). The actual old fill area is relatively small in comparison with the other Consent Decree sites, being approximately 1/2 acre in area and 20 feet deep. The site served as a dumping ground by Westinghouse for capacitors, contaminated rags, and sawdust from 1966 to 1971. A preliminary health assessment was performed on this site by the ISDH in September of 1991. (IDEM. General Overview of Consent Decree Sites. July 1992.)

Interim Removal and Remedial Measures

In December 1983, Westinghouse removed surface capacitors and installed a clay cap and security fence as part of the Preliminary Remedial Action Settlement for Neal's Dump. During the preliminary remediation of the sites, in order to facilitate the fencing of the site, areas with stands of trees were included. Open areas where significant contamination existed were covered with a clay cap. The cap was subsequently seeded. Currently the site is covered with grass. Maintenance of the interim measures already in place, including surface drainage control and monitoring, are required of Westinghouse until removal and incineration.

At Neal's Dump, Westinghouse will excavate all solid waste plus an additional 2-foot buffer zone, which according to the Consent Decree will be incinerated.

Current Status

As of July 1992 there was no change in status.

B. Site Visit

On January 28, 1993, Ms. Dollis Wright and Mr. Garry Mills of the ISDH, and staff from IDEM and Westinghouse visited the Consent Decree sites. Observances made during the site visit to the Neal's Dump site are listed below.

1. Access to the site is restricted by a locked 6-foot chain-link fence, and warning signs are posted.

2. The site has a clay cap with vegetation. There are also areas within the boundaries of the site, adjacent to the cap, where trees are growing. An erosion control fence is also in place around the site.

3. The site has an accumulation of refuse (old appliances) throughout, probably from past illegal dumping. We were informed that this dumping occurred after the interim remedial measures were completed, but before the 6-foot chain-link fence was in place.

4. Five to six residences are located at the site boundary.

5. There is no gas venting on-site.

6. On-site monitoring wells were observed.

C. Demographics, Land Use, Natural Resource Use, and Environmental Setting

Demographics

Spencer, Indiana is approximately 4 miles north of the site with a population of 2,609. Private residences are within 1,000 feet of the site with the nearest residence being within 50 feet. An estimated population of 954 is within a 3-mile radius of the site, and approximately 65 individuals reside within a ¼-mile radius of the site. The population in the site area is predominantly white.

Groundwater flow in the upper sandy silt unit is interpreted to be toward the northwest. Regional flow in the deeper sand aquifer is believed to be toward the west, and the White River is interpreted to be the discharge boundary for this unit.

Land Use

Neal's Dump is in a rural location. The primary land use in the area of the site is agricultural, although the site is located in a small residential area. The nearest commercial/industrial area is more than 1 mile away, and the nearest recreational area is more than 2 miles from the site. The area around the site supports raccoons, opossum, white-tailed deer, squirrels, woodchucks, and rabbits.

Natural Resource Use

About 1,000 people within 3 miles of the site use well water. No municipal water source is available. There are 49 wells within 1 mile of the site. When the site was ranked in 1984, the closest residential well to the site was 750 feet. Currently, the closest private well is within 50 feet of the site.

Surface water runoff from the site and surrounding area flows in intermittent streams toward the west/northwest and drains into the floodplain prior to reaching the White River less than ¼ mile west of the site.

Environmental Setting

Neal's Dump is located on the top of a hill which slopes west toward the floodplain of the White River. Intermittent drainage ways are north and south of the site and flow west-southwest toward the White River.

There are three aquifers beneath the site. A shallow unconfined aquifer exists in the uppermost sandy silt unit at 12 to 15 feet below the soil surface. This aquifer flows from the site by the northern drainage ditch toward the northwest. The middle aquifer is located in the deeper sand unit at 37 to 45 feet below the soil surface. The deep aquifer is found in the last sand layer. The groundwater flow in the deepest aquifer is west toward the White River.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-site Contamination

Ambient Air

Between June and July 1983, EPA conducted a pre-cleanup on-site air monitoring study for PCBs at Neal's Dump (see Figure 15). Airborne PCB measurements were collected at two hot spot locations (A & B) where leaking capacitors were evident.

Battery operated, personal pump systems were used to sample during 8-hour, low-volume daytime periods at a fixed height above the hot spots and upwind locations. High-volume systems were employed to sample for 24-hour periods at the upwind and downwind locations.

The 8-hour low-volume period sample locations (A and B) detected a PCB concentration range of 1 to 61 $\mu g/m^3$. The 24-hour high-volume samples detected a PCB concentration of 23-61 $\mu g/m^3$.

In July 1984, EPA conducted an on-site post-cleanup air monitoring study for PCBs at the site. Airborne PCB measurements were collected at location A.

An 8-hour low-volume daytime and a 24-hour high-volume sampling period were conducted at location A. The 8-hour period detected a PCB concentration of 1 $\mu g/m^3$. The 24-hour period detected a PCB concentration of 3 $\mu g/m^3$. (EPA. Draft Final Report on Ambient Monitoring for PCB Near Three Landfills in Bloomington, Indiana Area. June 1983.)

<u>Surface/Subsurface Soil</u>

In June 1976 one on-site soil sample was collected by the ISDH near an exposed capacitor on the Neal's Dump site, and was analyzed for PCBs (see Table 22). Soil depths were not given; therefore, the samples are considered surface soil. PCBs were detected at 12,500 ppm.

In November 1980, the EPA collected soil samples at Neal's Dump for total PCBs (see Table 22). Sampling was conducted around exposed capacitors, some of which had obvious PCB stained soils on the ground. Subsurface soil depths ranged from surface to in excess of 8 feet; or, intervals of 5 feet. Concentrations detected ranged from 8,000 ppm to 88,000 ppm (Westinghouse Electric Corporation, Pennsylvania. Bloomington Sites Soils Information. June 1986.; Westinghouse Electric Corporation, Pennsylvania. Surface Water and Ground-Water Analytical Information, Bloomington Sites, 1976-1983. October 1986.)

In May 1982, the EPA collected six samples at the site which were analyzed for PCBs, VOCs, and SVOCs (see Table 22). Three samples were collected from the corners of the site, while the remaining three were collected from the central exposed area of the site. (EPA. Draft Preliminary Report on Extent of Contamination at Neal's Dump. November 1982.)

Concentrations of total PCBs were detected throughout all the soil samples. Concentrations ranged from 4 to 19,000 ppm. Pyrene at a concentration of 0.3 ppm, and 2,4-dichlorophenol at 0.3 ppm were also detected. The concentration of pyrene and 2,4-dichlorophenol are below their respective comparison values. They are not considered to be contaminants of concern. All other chemicals detected were below the quantitation limit. (Westinghouse Electric Corporation, Pennsylvania. Bloomington Sites Soils Information. June 1986.; Westinghouse Electric Corporation, Pennsylvania. Surface Water and Ground-Water Analytical Information, Bloomington Sites, 1976-1983. October 1986.)

In April 1984, EPA conducted on-site post remediation soil borings at Neal's Dump for total PCBs (see Table 22). Discreet samples were taken from the following depth ranges: 0-21 feet, 0-15 feet, and 0-18 feet. All sample results showed PCBs at less than 1 ppm.

Table 22. On-Site PCB Soil Sample Results for Neal's Dump

Sample Date	PCB Concentration Range (ppm)	Comparison Value	
		ppm	Source
June 1976 (surface)	12,500	0.001	EMEG
November 1980	8,000-88,000	0.001	EMEG
May 1982	4-19,000	0.001	EMEG
April 1984	<0.001	0.001	EMEG

Concentrations listed as one number indicate only a single sample at that location.

Groundwater - Monitoring Wells

Initial groundwater sampling was conducted by EPA at Neal's Dump in August 1982 (see Figure 16). Samples were analyzed for PCBs, VOCs, SVOCs, pesticides, and inorganic chemicals from the installation of seven monitoring wells (1 through 4). Wells 1 through 3 were installed in a nest of shallow and deep wells. Well 4 was installed as a deep well. Well depths ranged from in excess of 15 feet to in excess of 55 feet. All monitoring wells except 1 (shallow) are located downgradient of the site.

Sample results showed total PCBs at 31 ppb; bis(2-ethylhexyl)phthalate, at 11 ppb; endosulfan sulfate at 8 ppb; and zinc at 2,600 ppb. All were detected in well number 1 (shallow).

For verification of the August 1982 groundwater sampling of monitoring wells, samples were collected by EPA in September 1982 and analyzed for PCBs (see Figure 16). PCBs at 23 ppb were detected twice at shallow monitoring well location 1. All other monitoring well results were less than 1 ppb. (O'Brien & Gere. Report on Neal's Dump and Neal's Landfill Investigation. December 1982)

The sampling of on-site monitoring wells from May 1987 through November 1992 was performed semi-annually by Westinghouse as required by the Consent Decree to establish baseline PCB concentrations (see Figure 17). Four shallow wells (ND-1S, -2S, -5S, and -6B) and four deep wells (ND-1D, -2D, -4D, and -5D) comprise the monitoring network. As recommended in the Report of Investigations - Neal's Dump, Owen County, Indiana, April 1992, three (deep) additional monitoring well locations (EPA-B1 and -B2, ND-3D) were added to the existing well network from which samples are collected. The three additional monitoring well locations were included in the semi-annual sampling schedule. Well depths ranged from in excess of 17 feet to in excess of 55 feet. The shallow wells are screened in the upper unconfined sandy-silt aquifer zone, and the deep wells are screened in the lower confined sand aquifer zone. The groundwater flow direction in the upper unconfined sandy-silt aquifer zone is toward the west and northwest. The flow direction of groundwater in the lower confined sand aquifer zone is believed to be in this direction as well.

The environmental data for the on-site monitoring wells reflect the concentrations of PCBs detected from May 1987 through May 1993 (Table 23). All samples collected from the three additional deep monitoring wells (B1, B2, & 3D) were below the detection limit.

Table 23. On-Site Groundwater Monitoring Well PCB Sample Results for Neal's Dump, May 1987 - May 1993

Month & Year	PCB Concentration (ppb)								Comparison Value	
	Well 1S	Well 1D	Well 2D	Well 2S	Well 5S	Well 4D	Well 5D	Well EPA 6B	ppb	Source
May 1987	5.4	ND	ND	ND	210.0	ND	0.5	ND	0.05	EMEG
May 1989	0.25	ND	ND	ND	22.0	ND	ND	ND	0.05	EMEG
November 1989	0.26	BDL	BDL	BDL	89.0	BDL	BDL	BDL	0.05	EMEG
May 1990	BDL	BDL	BDL	BDL	180.0	BDL	BDL	BDL	0.05	EMEG
November 1990	BDL	BDL	BDL	BDL	69.0	BDL	BDL	N/A	0.05	EMEG
May 1991	1.0	0.28	0.43	BDL	93.0	0.63	0.11	0.12	0.05	EMEG
June 1991	BDL	BDL	BDL	BDL	47.0	0.16	0.11	N/A	0.05	EMEG
July 1991	0.18	0.11	0.22	0.14	180	0.11	BDL	N/A	0.05	EMEG
August 1991	0.98	BDL	BDL	BDL	84.0	BDL	BDL	N/A	0.05	EMEG
September 1991	N/A	BDL	BDL	BDL	N/A	BDL	BDL	N/A	0.05	EMEG
October 1991	N/A	BDL	BDL	0.33	N/A	0.69	0.35	N/A	0.05	EMEG
November 1991	N/A	BDL	BDL	BDL	N/A	BDL	BDL	N/A	0.05	EMEG
May 1992	0.40	BDL	BDL	BDL	240	BDL	0.14	BDL	0.05	EMEG
November 1992	0.29	BDL	BDL	BDL	67.0	BDL	BDL	N/A	0.05	EMEG
May 1993	0.19/ 0.16*	BDL	BDL	BDL	97	BDL	0.17	BDL	0.05	EMEG

BDL = below detection limit of 0.1 ppb
ND = not detected at a level of 0.1 ppb
N/A = not applicable (well dry)
* = duplicate

Stream Sediment

In June 1976, one on-site stream sediment sample was collected by the ISDH from the bottom of a ditch leaving (north-northwest) Neal's Dump, and was analyzed for PCBs. PCBs were detected at 275 ppm. (Westinghouse Electric Corporation, Pennsylvania. Bloomington Sites Soils Information. June 1986.; Westinghouse Electric Corporation, Pennsylvania. Surface Water and Ground-Water Analytical Information, Bloomington Sites, 1976-1983. October 1986.)

B. Off-site Contamination

Ambient Air

Between June and July 1983, EPA conducted an off-site pre-cleanup air monitoring study for PCBs at the Neal's Dump site vicinity. PCB measurements were collected at two sample locations: 1) upwind near a mobile home south of the site area, and 2) downwind near a mobile home east of the of the site area. Battery operated, personal pump systems were used to sample during 8-hour low-volume daytime and 24-hour high-volume periods. The upwind, 8-hour sampling period detected a PCB concentration of less than 1 $\mu g/m^3$. The upwind and downwind 24-hour sampling periods detected a PCB concentration of less than 1 $\mu g/m^3$.

In July 1984, EPA conducted an off-site post-cleanup air monitoring study for PCBs at the site. PCB measurements were collected at two locations: 1) upwind near a mobile home south of the site area, and 2) downwind near a mobile home east of the site area. Sampling was conducted for 24-hour high-volume periods at both locations. The 24-hour upwind and downwind sample locations both detected a PCB concentration of less than 1 $\mu g/m^3$. (EPA. Draft Final Report on Ambient Monitoring for PCB Near Three Landfills in Bloomington, Indiana Area. June 1983; EPA. Ambient Monitoring for PCB after Remedial Cleanup of Two Landfills in the Bloomington, Indiana Area. March 1986.)

Surface Soil

In January 1976, four off-site soil samples were collected by EPA at the Neal's Dump site, and were analyzed for total PCBs. All sample results were detected at less than 0.001 ppm (Westinghouse Electric Corporation, Pennsylvania. Bloomington Sites Soils Information. June 1986.; Westinghouse Electric Corporation, Pennsylvania. Surface Water and Ground-Water Analytical Information, Bloomington Sites, 1976-1983. October 1986.).

In October 1981, EPA conducted follow-up sampling off-site to the on-site soil sampling in November 1980. No PCBs were detected. (EPA. Draft Preliminary Report on Extent of Contamination at Neal's Dump. November 1982.)

Groundwater - Residential Wells

In July 1991 (see Figure 18) and November 1992 (two wells only shown in Figure 19), Westinghouse collected water samples from 13 residential wells around Neal's Dump. A residential well sampling program was initiated because PCBs were found for the first time in seven of eight groundwater monitoring well samples obtained during the semi-annual groundwater monitoring sampling at Neal's Dump in May 1991. Additional follow-up samples confirmed the PCB contamination in the groundwater monitoring wells. (Westinghouse. Letter regarding residential well sampling. August 8, 1991.; Westinghouse. Ground Water Monitoring Report, Neal's Dump. December 1992.)

All residential well sample results, however, were below the detection limit of 0.1 ppb for PCBs.

Stream Sediment

In January 1983, EPA conducted stream sediment sampling of the north-northwest ravine stream for total PCBs. Samples were collected at 12 locations (#20-31); no PCBs were detected (Westinghouse Electric Corporation, Pennsylvania. Surface Water and Ground-Water Analytical Information, Bloomington Sites, 1976-1983. October 1986.).

C. Quality Assurance and Quality Control

The surface soil samples taken in 1982 showed inconsistent concentrations of methylene chloride and phthalates. These inconsistent concentrations were directly attributed to either field, bottle, or lab contamination; thus, those concentrations were not used.

D. Physical and Other Hazards

Per the site visit on January 28, 1993, Neal's Dump has refuse on-site which appears to be from past illegal dumping. The site does not pose a physical hazard and access is limited by the chain-link fence and a locked front gate.

PATHWAYS ANALYSES

A. Completed Exposure Pathways

On-Site Surface Soil

Before the interim remediation of Neal's Dump, soils on this site were visibly stained with PCBs. The site was accessible and active scavenging of scrap metal from PCB capacitors occurred on a regular basis. (Stehr et al. 1986) The on-site surface soil is a past completed exposure pathway for landfill workers, scavengers, and trespassers through incidental ingestion of contaminated soil, inhalation of contaminated air particles due to off-gassing of soils, and by dermal contact with PCB-contaminated soils during on-site activities.

Presently, surface soil is not a pathway for contaminants to enter the body. Much of the contaminated soil and all the capacitors have been removed. Erosion and surface soil runoff is currently controlled by a clay cap and silt curtains inside the fence line along the north, east, and west perimeters of the site. The site is not accessible due to an 8-foot high fence with barbed wire.

Table 24. Completed Exposure Pathways for Neal's Dump

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
On-site Surface Soil	Neal's Dump	Soil	Neal's Dump	Ingestion Inhalation Dermal Contact	Trespassers Scavengers Landfill workers	Unknown *50 2-3	Past

* Possibly exposed at all Consent Decree sites

B. Potential Exposure Pathways

Off-Site Groundwater

There is no municipal water supply to the area surrounding the site. All potable water is obtained from private wells. There are two aquifers below the site. Groundwater flow in the shallow aquifer is interpreted to be toward the northwest toward the northern unnamed drainage area. The deep aquifer is believed to flow toward the west and the White River. All private wells are located in the deep aquifer.

Samples from on-site monitoring wells from the deep aquifer have all had PCB levels below the EPA Public Drinking Water Standard of 0.5 ppb. Private wells have been monitored once a year from 1987 to the present. All samples have been below 0.5 ppb.

PCBs have been detected in the shallow aquifer at very high levels (240 ppb). Because of the high levels detected and the type of soils (silt and fine sand) present at the site, the presence of other organic chemicals in these soils could facilitate migration of contamination from the shallow to the deep aquifer. Off-site groundwater is a present and future potential exposure pathway for individuals using private wells for a potable water source.

Off-Site Surface Water/Sediment

Surface water drains west-southwest through a ravine and toward the White River, with some intermittent water drainage running north and south of Neal's Dump. The maximum concentration of PCBs found in samples taken from these ravines prior to any remediation was <1 ppm in the west-southwest drainage ditch and 275 ppm in the north-northwest drainage ditch.

The potential for surface water and sediment to be a pathway of exposure is decreased since the interim remediation. The implementation of erosion and surface soil controls by the placement of silt curtains inside the fence line, and a clay cap, reduces the potential for surface soil and sediment to migrate off-site. Surface water and sediment in the north-northwest and west-southwest ravines are past potential exposure pathways for hikers primarily through incidental dermal contact.

Table 25. Potential Exposure Pathways for Neal's Dump

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
Off-site Groundwater	Neal's Dump	Groundwater	Private wells	Ingestion, Inhalation, Dermal contact	Residents who use private wells (3 mile radius)	40	Present Future
Off-site Sediment	Neal's Dump	Sediment	North-northwest & west-southwest ravine drainage ditches	Dermal contact	Hikers	10-50	Past
Off-site Surface water	Neal's Dump	Water	North-northwest & west-southwest ravine drainage ditches	Dermal contact	Hikers	10-50	Past

NEAL'S LANDFILL (Monroe County)

BACKGROUND

A. Site Description and History

Neal's Landfill is in Monroe County, Indiana (see Figure 1). The site is approximately 18 acres in an area which was used as an industrial and municipal waste landfill from 1950 to 1972. The main fill area is approximately 150 by 300 yards. (IDEM. General Overview of Consent Decree Sites. July 1992.) The site was scored and included on the NPL in September 1983.

Interim Removal and Remedial Measures

In December 1983, Westinghouse removed surface capacitors and installed a clay cap, erosion control fences, a security fence, and drainage control trenches as part of the Preliminary Remedial Action Settlement for Neal's Dump and Neal's Landfill. During the preliminary remediation of the sites, in order to facilitate the fencing of the site, areas with stands of trees were included. Open areas where significant contamination existed were covered with a clay cap. The cap was subsequently seeded. Currently, the site is covered with grass. Maintenance of these measures are required of Westinghouse in addition to a sediment collection system for Conard's Branch, installation of additional erosion control fences, and posting of warning signs along Conard's Branch and Richland Creek.

Due to known VOCs existing in Neal's Landfill, IDEM conducted an area water well user survey to assure drinking water integrity. The wells involved in the survey and subsequent sampling were within a 5,000-foot radius of Neal's Landfill. The sample results showed no contamination of wells.

Westinghouse completed construction and began operation of the Neal's Landfill Spring Treatment System in February 1990. This water treatment facility was required under the terms of the Consent Decree to treat PCB-contaminated water discharging from three springs around Neal's Landfill into the Conard's Branch stream. Westinghouse was issued a National Pollutant Discharge Elimination System (NPDES) permit on July 1, 1988, by IDEM. This permit requires Westinghouse to operate a spring treatment facility, to sample the spring treatment facility influent and effluent twice a month, and to submit monitoring reports once a month.

The PCB discharge limit for this facility was set at 1 ppb pursuant to the Consent Decree. The owners of the property that the discharge stream crosses challenged this permit limit in court in May 1989 based on the current NPDES PCB discharge limit of 0.1 ppb. In April

1991, a Jackson Circuit Court judge ruled that IDEM is not bound by the PCB discharge limit set in the Consent Decree and ordered IDEM to reissue the NPDES permit following a new public hearing. Westinghouse appealed this decision in May 1991. On August 2, 1991, the Circuit Court judge ordered IDEM to reconsider the NPDES permit standards and to hold a public hearing while the Westinghouse appeal is being decided.

The IDEM conducted the NPDES public hearing in Bloomington on November 25, 1991. At the public hearing, a staff member of the U.S. Fish and Wildlife Service submitted a biological report entitled "PCBs in Richland Creek Downstream from Neal's Landfill, April 1991". This report summarizes the Service's cursory fish and sediment sampling effort in Richland Creek and Conard's Branch downstream of the Spring Treatment Plant.

The Fish and Wildlife Service report implies that human health and the environment are not being adequately protected under the current NPDES permit limits and makes several recommendations for stricter NPDES permit limits. This report also recommends that IDEM implement a fish consumption study on Richland Creek downstream from Neal's Landfill.

On April 14, 1992, the Court of Appeals of Indiana denied the Westinghouse appeal of Judge Curry's decision. The IDEM must now issue a new NPDES permit that is not bound by the PCB limit set in the Consent Decree.

Westinghouse is also required to perform groundwater monitoring activities at Neal's Landfill to refine the knowledge of hydrogeologic conditions, to monitor the groundwater for PCBs, and to confirm remediation efforts. In January 1992 Westinghouse, in cooperation with all the Consent Decree parties, initiated a dye tracer study of the Karst aquifer at this site to determine groundwater flow patterns and if residential wells in the area are hydrologically connected to the site. Preliminary results indicate the largest amount of dye was recovered at North Spring and South Spring, which are part of the Neal's Landfill Spring Treatment System. Only one residential well of the approximate 39 monitored was found to have a possible hydrologic connection to the site. The EPA sampled this well for all priority pollutants including dioxins and furans. The IDEM is currently waiting for the final results of this study to be released.

The Indiana Supreme Court ruled in May 1993 that the 1 ppb PCB limit set in the Consent Decree is binding on IDEM.

Removal Measures

An estimated 320,000 cubic yards of material will be excavated for incineration by Westinghouse. Excavation at the headwaters of Conard's Branch began in the summer of 1987. The Stream Bank and Stream Sediment Removal Project was completed in October

1988. Following the excavation project, sediment samples were taken above and below Conard's Branch in the Richland Creek stream bed. The analysis of these samples did not detect any PCBs.

Current Status

The IDEM staff requested the Biological Section of the Office of Water Management to review the Fish and Wildlife report and to conduct fish tissue sampling in Conard's Branch and Richland Creek downstream of Neal's Landfill to assess the possible human health risks associated with the consumption of fish from these areas.

The IDEM Superfund Section staff, in cooperation with the EPA, are evaluating the need to conduct additional sediment sampling in Conard's Branch and Richland Creek to assess whether or not these waterways have been re-contaminated by PCB-contaminated spring waters bypassing the spring treatment facility.

B. Site Visit

On January 28, 1993, Ms. Dollis Wright and Mr. Garry Mills of the ISDH, and staff from IDEM and Westinghouse visited the Consent Decree sites. Observances made during the site visit to the Neal's Landfill site are listed below.

1. Access to the site is restricted by a locked chain-link fence, and warning signs are posted.

2. The site has a clay cap with vegetation. There are also areas within the boundaries of the site, adjacent to the cap, where trees are growing. An erosion control fence is also in place around the site.

3. There was a surface water runoff collection system near the southwest surface water seep area. Per a conversation with Westinghouse staff, this system has underground pipes and a tank.

4. Several areas throughout the site had refuse on them (i.e., old appliances, tires).

5. Deteriorated and open former operations buildings had refuse inside.

6. Surface water areas at the Southwest Seep, North and South Springs, and Conard's Branch, including the spring treatment facility were seen.

7. The injection point locations for on-site dye testing were seen.

8. A white-tail deer was seen near the southwest seep area.

9. There were residences within ¼ to ½ mile of the site.

C. Demographics, Land Use, Natural Resource Use, and Environmental Setting

Demographics

Neal's Landfill is in a rural area. The population in the site area is predominantly white. Approximately 30-40 people live within a ½-mile radius of the site.

Land Use

Land use in the vicinity of the site includes 10-20 nearby residences approximately ¼ mile west and ½ mile north (hog farm) of the site. There is no apparent use of the wooded lands immediately adjacent to the site.

Natural Resource Use

There is no municipal water service to the immediate area surrounding the site; however, some residences in the vicinity of the site rely on residential groundwater well supplies. The hog farm north of the site receives water drainage (Conard's Branch) from Neal's Landfill.

Environmental Setting

Richland Creek is 1½ miles northwest of the site. The southwest seep branch and Conard's branch are two tributaries which flow from the site. Conard's Branch flows from the north and joins with the creek ¾ miles downstream. The southwest seep branch joins Richland Creek approximately 2 miles west of the landfill from the south.

The soils at Neal's Landfill consist of refuse, fill material, and silty clay ranging in depths from 0 to 31 feet. St. Genevieve Limestone formations underlie the soil. This limestone has the following features: sinkholes, swallowholes, solution cavities, caves, sinking or disappearing streams, and springs. It is composed of shale interbeds and chert beds. The bedrock at this site dips northwest which is contrary to the southwest regional trend. The water table is located at depths as low as 65 feet. The number and depths of aquifers below the site were not indicated in the data.

Groundwater recharge is through sinkholes, swallowholes, joint sets, and solution cavities that intersect the land surface in the area surrounding the site. Groundwater flow beneath the site discharges to the surface at springs located within valleys northwest and southwest of the site. The South and North Springs of Conard's Branch are resurgence points for groundwater originating at the site.

Discharges from the North and South Springs, and Southwest Seep are handled by the Westinghouse Spring Treatment facility during low-flow periods. During high-flow conditions (when combined, the total flow from the three springs exceeds 1 cubic foot per second); however, the overflow from the North and South Springs goes directly to Conard's Branch, and overflow from the Southwest Seep goes directly to the Southwest seep branch.

SITE ASSOCIATED SPRINGS AND SEEPS

- North and South Springs (NW)
- Southwest Seep (southern perimeter)
- Taylor and Branham Springs (SW)

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-site Contamination

Multi-Media Contamination

In July of 1983 an evaluation of alternative remedial actions for PCB contamination at Neal's Landfill was prepared by EPA.

Before beginning the study, EPA undertook certain initial remedial measures to limit exposure or threat of exposure to public health or the environment. Remediation was initiated based on the observations listed below.

- There was an actual or direct potential contact with the PCB contaminant by the nearby population and local animal life.

- There was no effective drainage control system to prevent the runoff of PCB contaminants.

- Visible PCB-laden capacitors and capacitor paper, and PCB stained soils were present on the landfill site, at or above ground surface, which posed a serious threat to the public health and the environment.

- Conditions were such that normal rainfall events upon the landfill could cause the PCBs to migrate from the site and pose a threat to the public health and environment.

The results of the study are as follows:

- Monitoring wells adjacent to site showed PCBs at 9.8 ppb.
- Soil samples collected on-site showed PCBs at 219 ppm.
- Stream sediment PCB levels in Conard's Branch and Richland Creek ranged from 0.002 to 0.07 ppm. PCB levels in water samples from Conard's Branch approached 1 ppb (excluding springs).
- Samples of aquatic life from Conard's Branch and Richland Creek exhibited PCB levels as high as 1,118 ppm.

No Laboratory QA/QC data summary sheets or maps were attached to this information. (EPA. Remedial Alternative Assessment for Neal's Landfill. July 1983.)

Surface Soil

On November 3, 1980, the Environmental Emergency and Investigation Branch of EPA collected two soil samples. Samples were analyzed for PCBs.

The soil samples were taken around leaking capacitors. The depth of these samples was not reported. These samples are therefore considered surface soil samples. The PCB concentration range found in these two samples was 79,000 - 136,000 ppm. The data met all QA/QC laboratory requirements. A map was not provided with these data. (EPA. Letter From Phyllis A. Reed regarding data results for Neal's Landfill, Environmental Emergency Investigation Branch. February 24, 1981.)

On February 18, 1981, EPA conducted an inspection of Neal's Landfill. A survey of the area revealed PCB-filled capacitors, which represented an environmental threat to both surface and subsurface waters. No indication of any surface runoff was present in the area of the dump; the soil in the area consisted mainly of sand. Soil samples taken at the site showed PCB levels greater than 1,000 ppm (assumed to be surface samples as no depth was given). No laboratory data sheets or map were provided. (EPA. Memorandum to Ross Powers. February 19, 1981.)

On September 8, 1983, EPA collected six soil samples at Neal's Landfill for dioxin and dibenzofuran analysis. The first two soil samples were collected from the surface, and the remaining four were collected by digging a hole to a depth of approximately 8-12 inches. The last two samples were taken from areas of discolored, possibly charred, material/soil. All samples are considered to be surface soil samples as it was not possible to distinguish which samples were surface or subsurface. Congeners are chemical compounds that are closely related to one another by virtue of their chemical makeup and the effects they exert on each other as well as other chemicals. As certain chemicals share similar properties, they are assumed to produce similar health effects. A toxic equivalency factor is a number that has been assigned to a chemical that represents its relative degree of toxicity. This number is then multiplied by the comparison value of its chemical congener. The product is the toxic equivalency factor. Concentrations for dioxins and furans are reported as toxic equivalency factor concentrations for 2,3,7,8-tetrachlorodibenzo-p-dioxin. The chemicals of concern in these soil samples are listed in Table 26. No map was provided with this information. (EPA. Transmitted information to H. Beard regarding field data, October 1984.)

Table 26. On-Site Surface Soil Sample Results for Dioxin and Furan Congeners, Neal's Landfill, September 8, 1983

Congener	Concentration (ppb)	*TEFC (ppb)	**2,3,7,8-TCDD Comparison Value	
			ppb	Source
hepta-dioxin	0.01-0.9	0.0001-0.009	0.002	EMEG
tetra-furan	0.02-0.13	0.01-0.07	0.002	EMEG
hepta-furan	0.51 - 11	0.005-0.11	0.002	EMEG

ND = non-detect
* Toxic equivalency factor concentration
** 2,3,7,8-tetrachlorodibenzo-p-dioxin

Subsurface Soil

On October 30, 1984, EPA collected an additional six soil samples at Neal's Landfill (see Figure 20) to determine dioxin and dibenzofuran contamination. Three samples were taken from the landfill (E09-E11) and a background sample (E12) was taken from a city park for baseline data comparison. Data are presented in Table 27.

In addition to the soil samples, three composite samples (E15 to E17) were collected from a borehole situated in the southeast portion of the fill area, approximately 150 feet south of the on-site road. Sample E15 comprised of soil from the upper 13 feet of the borehole, with no definite ash layers or burned material observed in any of the six split-spoon samples. Samples E16 and E17 were composites from materials collected from 13-28½ feet in nine separate split spoon samples. The boring was terminated at a depth of 28½ feet due to hitting the upper surface of the bedrock.

Three dioxin congeners were detected in these samples (Table 27): hepta, octa, and penta. Dibenzofurans were not detected in the soil boring samples. Background sample E12 did not detect any furans or dioxins. (EPA. Final report on dioxin sampling at Neal's Landfill and Lemon Lane Landfill. April 1986.)

Table 27. On-Site Soil Boring Sample Results for Dioxin, Neal's Landfill, October 30, 1984

Sample Number	Dioxin Concentration (ppb)	*TEFC (ppb)	**2,3,7,8-TCDD Comparison Value	
			ppb	Source
E-09	hepta - 0.2 octa - 6	0.002 0.06	0.002	EMEG
E-17	penta - 0.8	0.8	0.002	EMEG

* Toxic equivalency factor concentration
** 2,3,7,8-tetrachlorodibenzo-p-dioxin

Ambient Air

Ambient air monitoring was performed at Neal's landfill prior to the on-site interim remediation.

PCB levels (Table 28) were measured at locations where capacitors were leaking PCB fluid onto the ground. The air levels measured on the landfill exceeded the upwind background levels indicating that PCBs were being emitted into the air. The level of PCB identified in the air generally correlated with the number of exposed leaking capacitors. The higher concentrations were measured at locations where more capacitors were visible. PCB concentrations were also observed at sampling locations downwind of the landfill.

The airborne PCB concentrations varied with height; levels at 2 cm above the ground were 40 to 100 times higher than the levels at an elevation of 180 cm.

The sampling took place during unseasonably warm, dry weather which probably maximized PCB emissions. Thus, the levels observed during this study may represent the "upper limit" of values. (EPA. Ambient monitoring for PCBs near three landfills in the Bloomington, Indiana area. June 1983.)

The EPA performed ambient air monitoring at Neal's Landfill after the interim remediation (see Figure 21). This monitoring program was conducted to determine PCB levels in ambient air on and in the vicinity of the site. The sampling locations and methods used were the same as employed in the interim remediation of the site conducted during June and July of 1983.

Sampling data from former hot spots were considerably lower than pre-remediation levels. PCB concentrations downwind of the site were comparable to pre-remediation levels. The results (Table 28) indicate the interim remedial cleanup reduced ambient PCB levels at former hot spots on the site. (EPA. Draft project summary - ambient monitoring for PCBs after remedial cleanup of two landfills in the Bloomington, Indiana area. 1985.)

Table 28. PCB Air Monitoring Data Pre- (1983) and Post-Cleanup (1985) for Neal's Landfill

Sampling Location	Type of Sampling	Pre-Cleanup Concentration Range mg/m^3	Post-Cleanup Concentration Range mg/m^3	Comparison Value	
				mg/m^3	Source
A	8hr LV	5-11	0.4-1	*	
	2 cm	550-1050	2-3		
	30 cm	56-120	1-2		
	60 cm	30-49	0.9-1		
	120 cm	10-23	0.7-1		
	180 cm	6-13	0.4-0.6		
C	8hr LV	5-12	2-3		
	24hr LV	5-14	3-5		
	2 cm	941-1108	12-21		
	30 cm	111-157	4-6		
	60 cm	40-62	2-5		
	120 cm	15-21	2-3		
	180 cm	9-16	2-3		
	8hr LV				
E		7-18	ND-<0.04		
D-2	24hr HV	0.8-2	1-1.4	*	
D-3	24hr HV	0.8-2	0.8-1.2		
D-4	24hr HV	0.3-0.7	0.4-0.6		
U	24hr HV	0.08-0.09	0.2-0.3	*	

LV = low volume
HV = high volume
* No comparison value available

Groundwater

From the fall of 1982 to the summer of 1983 groundwater sampling took place at Neal's Landfill for PCBs and other organic chemicals.

Monitoring wells were installed by both EPA and Westinghouse for the purpose of collecting geologic and groundwater quality data and for measuring groundwater elevations from the limestone bedrock aquifer. The data results for both the EPA and Westinghouse wells are not truly comparable. This could be due to slightly differing depths, the wells being sampled at different times, or the samples being analyzed by different laboratories. Non-detect sample and not sampled readings were left in the tables for completeness of information. Table 29 lists the PCB sample results and Table 30 lists the maximum concentrations of specified organic chemicals. All sample locations are shown in Figure 22. (Westinghouse. On-site Groundwater Monitoring Plan, Neal's Landfill. August 1987.)

Table 29. On-Site Groundwater PCB Sample Results for Neal's Landfill, 1982-83

Sample Location	PCB Concentration Range (ppb)		Comparison Value	
	1982 Samples	1983 Samples	ppb	Source
EPA 1AA	NS	ND	0.05	EMEG
MW-1	0.01-1	NS	0.05	EMEG
EPA 2A	ND	ND-0.6	0.05	EMEG
MW-2	0.01	NS	0.05	EMEG
EPA 2SS	NS	ND	0.05	EMEG
EPA 3A	0.3-4	0-2	0.05	EMEG
MW-3	0.01-0.1	NS	0.05	EMEG
EPA 4A	ND-0.8	ND-1	0.05	EMEG
MW-4	0.6-2	NS	0.05	EMEG
EPA 5A	ND	3-7	0.05	EMEG
EPA 5SS	ND	ND	0.05	EMEG
MW-5	0.04-0.2	NS	0.05	EMEG
EPA 6A	ND-2	ND-4	0.05	EMEG
8A	ND	ND	0.05	EMEG
EPA 9A	ND	ND	0.05	EMEG
EPA 10 S	0.4	ND	0.05	EMEG
11	NS	1-3	0.05	EMEG

ND = non-detect
NS = not sampled

Table 30. On-Site Groundwater Sample Results for Neal's Landfill, 1982-1983

Organic Chemical	Sample Location Number of Maximum Concentration	Maximum Concentration (ppb)	Comparison Value	
			ppb	Source
bis(2-ethylhexyl)phthalate	10S	38	3	CREG
chloroethane	5S	5.2	*	
tetrachloroethylene	5A	490	0.7	CREG
trans-1,2-dichloroethylene	11	2840	200	RMEG
1,1,1-trichloroethane	5A	890	200	LTHA
trichloroethylene	5A	25,700	3	CREG
vinyl chloride	3A	2,360	0.2	EMEG

* No comparison value available

Surface Water

The EPA and Westinghouse have investigated surface water features on and surrounding the Neal's Landfill site, including North and South Springs (groundwater resurgence points), and the overflow springs of South Spring and Southwest Seep. Surface water was sampled and analyzed by both Westinghouse and the EPA in 1982 and 1983 for PCBs (Table 31) and other organic chemicals. The surface water channel that flows from Southwest Seep is known as Southwest Seep Branch. Both Conard's Branch and Southwest Seep Branch flow into Richland Creek. Samples were taken from all locations listed on the table including a sample taken 500 feet upstream which was non-detect for PCBs (see Figure 23).

Other organic chemicals were detected at two surface water sample locations. Diethyl phthalate was found at 20 ppb at the north flume. N-nitrosodi-n-propyl was found at the Southwest Seep at 120 ppb. The analytical results for n-nitrosodi-n-propyl were not reproducible. It is therefore not considered as a chemical of concern. All other sampling locations were non-detect for organic chemicals.

PCBs were found in the North and South Springs in low levels ranging from 1 to 10 ppb. Water samples collected from Conard's Branch and the seep areas contain detectable levels of PCBs ranging from 0.1 to 7 ppb. (Westinghouse. On-site Groundwater Monitoring Plan, Neal's Landfill. August 1987.)

Table 31. On-Site Surface Water PCB Sample Results for Neal's Landfill, 1982-83

Sample Location	PCB Concentration (ppb)		Comparison Value	
	1982 Samples	1983 Samples	ppb	Source
Southwest Seep	0.6	0.1 - 3	0.05	EMEG
South Spring	4 - 7	1 - 10	0.05	EMEG
North Spring	1 - 4	4	0.05	EMEG
South Spring overflows	0.7	2	0.05	EMEG
South Flume	3	2	0.05	EMEG
North Flume	4	2	0.05	EMEG
Northeast Seep	NS	2	0.05	EMEG
On-site Pond	0.5	3	0.05	EMEG
Conard's Branch Headwaters	7	ND	0.05	EMEG
Conard's Branch midpoint	5	NS	0.05	EMEG
Conard's Branch near end	NS	ND	0.05	EMEG
Richland Creek below confluence	0.4	NS	0.05	EMEG
Runoff near 6A	0.1	NS	0.05	EMEG
Runoff between 8 and 9	1	NS	0.05	EMEG

Concentrations listed as one number indicate only a single sample at that location.
ND = non-detect
NS = not sampled

Stream Sediment Sampling

Westinghouse performed a stream sediment sampling and analysis program for the tributaries of Richland Creek, Conard's Branch, and Southwest Seep Branch in January and June 1983. PCBs were found above 1 ppm in 86 percent of the sediment samples from Conard's Branch and in 49 percent of the sediment samples from Southwest Seep Branch.

B. Off-site Contamination

Groundwater - Residential Wells

In November 1986, the Indiana University School of Public and Environmental Affairs in Bloomington conducted a well user survey of approximately 43 residential wells within 5,000 feet of the Neal's Landfill site. Samples were collected at faucets nearest to the well head for drinking water and were analyzed for PCBs. Documentation for the well user survey did not include a location map of the residences sampled. Samples had a concentration range of non-detect to 7 ppt. (Indiana University. Collection and Analysis of Drinking Water Well Samples for PCB Content. November 1986.)

Surface Water

On November 3, 1980, a sampling inspection was conducted by the EPA Environmental Emergency and Inspection Branch. All samples were analyzed for organic and inorganic chemicals, and PCBs. Sample results were all non-detect for organic chemicals. PCBs were present in two spring samples and one leachate sample at 3, 6, and 4 ppb respectively. The inorganic chemical sample results are listed in Table 32. The data met all QA/QC laboratory requirements. A map was not provided with this information. (Environmental Protection Agency. Letter From Phyllis A. Reed regarding data results for Neal's Landfill, Environmental Emergency Investigation Branch. February 24, 1981.)

Table 32. Off-Site Stream Surface Water Inorganic Sample Results, Neal's Landfill, November 3, 1980

Chemical	Concentration (ppb)	Comparison Value	
		ppb	Source
aluminum	<50 - 49,200	*	
arsenic	<10 - 31	.02	CREG
boron	<10 - 9,400	100	EMEG
calcium	<1 - 197,000	*	
chromium	<10 - 76	50	RMEG
cobalt	<10 - 22	*	
iron	<20- 184,000	*	
lead	<40 - 122	50	MCL
magnesium	<20 - 37,700	*	
manganese	<10 - 1,390	50	RMEG
sodium	<20 - 165,000	20,000	NAS
vanadium	<10 - 21,500	20	LTHA
zinc	<10 - 112,000	3000	RMEG

* No comparison value available

In July of 1982, a field investigation was conducted by the EPA for Neal's Landfill. The purpose of this investigation was to determine the extent of groundwater contamination, the hydrogeology, and the extent of buried materials at Neal's Landfill.

On July 28-29, 1982, six spring samples were collected (see Figure 24). All samples were analyzed by West Coast Technical Services and California Analytical Service for organic and inorganic chemicals (Table 33). PCBs were detected ranging from 3 to 7 ppb. Trichloroethylene was also found at concentrations ranging from 34 to 56 ppb. (EPA. Field Investigations of Uncontrolled Hazardous Waste Sites Task Report. November 1982.)

Table 33. Off-Site Spring Surface Water Organic and Inorganic Sample Results, Neal's Landfill, July 28 & 29, 1982

Chemical	Sample Location	Concentration Range (ppb)	Comparison Value	
			ppb	Source
Organic Chemicals				
trichloroethylene	18	34-56	3	CREG
heptachlor	18	0.1	0.008	CREG
PCB 1242	18	3-7	0.05	EMEG
Inorganic Chemicals				
aluminum	18	<200-600	*	
boron	13	<100-300	100	EMEG
chloride	18	<1,000-40,000	*	
manganese	15	<15-5,000	50	RMEG

Concentrations listed as one number indicate only a single sample at that location.
* No comparison value available

Sediment

On December 11, 1980, EPA collected an additional sediment sample for PCB analysis at the site from the stream bed of the Northwest Spring, approximately 20 feet downstream from where the spring flow originates. The sample showed PCBs at 68 ppm. This data met all QA/QC requirements. No map was provided with this data. (Environmental Protection Agency. Memorandum from Phyllis A. Reed, Environmental Emergency Investigation Branch. February 24, 1981.)

On October 26, 1992, the IDEM and Westinghouse collected sediment samples from Richland Creek and Conard's Branch for PCB analysis (Westinghouse. Memorandum to M. Pompelia regarding IDEM sediment sample results from Richland Creek and Conard's Branch. December 7, 1992). The IDEM samples showed PCBs ranging from below the detection limit to 12 ppm. The Westinghouse PCB analysis results ranged from below the detection limit to 21 ppm. No map or QA/QC was provided with these data. Results are shown in Table 34.

Table 34. Off-Site Sediment Sample Results for Richland Creek & Conard's Branch, October 26, 1992

Sample Location	PCB Concentration (ppm)		Comparison Value	
	IDEM Samples	Westinghouse Samples	ppm	Source
New Spring N of EPA #35	BDL	BDL	0.01	EMEG
EPA #35	7.5	6.7	0.01	EMEG
EPA #36	2.3	10	0.01	EMEG
EPA #37	12	6.6	0.01	EMEG
South Spring	7.7	7.1	0.01	EMEG
Conard's Branch - upstream of STF effluent	0.8-1.2	BDL-21	0.01	EMEG
Conard's Branch - just downstream of STF effluent	0.78	3.3	0.01	EMEG
North Spring	0.23	BDL	0.01	EMEG
Conard's Branch - Taylor property line	0.51	BDL	0.01	EMEG
Conard Branch on Conard's property	0.9-1.8	BDL-2.4	0.01	EMEG
Confluence of Conard's at Richland Creek	0.4-6	BDL-2	0.01	EMEG

BDL = below detection limit
Concentrations listed as one number indicate only a single sample at that location.

Fish

In 1982, samples were collected about 3 miles downstream of the site in Richland Creek at the S.R. 43 bridge in Owen County, and also near the S.R. 54 bridge east of Bloomfield in Green County. The stream in the immediate vicinity of Neal's Landfill is quite small, and with the low-flow conditions at the time of the survey, it was not possible to collect fish tissue samples in Monroe County.

The results show abnormally high PCB levels (Table 35), especially at the upper station S.R. 43 bridge. The levels encountered were often in excess of the FDA action level of 2 ppm for the edible portion of fish.

Fish samples in Indiana are routinely sampled for at least 20 parameters, PCBs, pesticides, and mercury. All other parameters were at normal low levels and did not represent a cause for concern at the time. (ISDH. Memorandum from C.L. Bridges to D. Lamm regarding Richland Creek Fish Survey. January 1982.)

Table 35. Off-Site Fish PCB Sample Results, Neal's Landfill, January 20, 1982

Location	Species	PCB Concentration (ppm)
Richland Creek S.R. 43	yellow bull head	6
	northern hogsucker white sucker	8
	longear and green sunfish	6
	striped shiner	2
S.R. 54	northern hogsucker	0.1

In February of 1983, an analysis of aquatic life found in Neal's Landfill drainage was performed. Fish samples were analyzed as whole fish or edible portions with heads, scales, and internal organs removed. Concentrations in sediments are reported on a dry weight basis (Table 36). All aquatic life PCB concentrations (except for snapping turtles) are listed under fish.

Corresponding water samples were taken for each fish and sediment sample (Table 36). PCBs ranged from 0.1 to 8 ppb for all water samples. Two samples were taken at the Salt Lick location of Richland Creek. PCB concentrations ranged from 3 to 5 ppm. PCB concentrations in sediment samples ranged from non-detect to 320 ppm, and fish samples had PCB concentrations of non-detect to 280 ppm. The PCB concentration found in snapping turtles was 3 to 17 ppm. (U.S. Fish & Wildlife. Analyses of PCBs in Neal's Landfill drainage, Richland Creek, Fish, Snapping Turtles, plants, and caged fish. 1983.)

Table 36. Off-Site Drainage PCB Analyses Results for Neal's Landfill, February 2, 1983

Location	Fish			Sediment		
	PCB Concentration Range (ppm)	Comparison Value		PCB Concentration Range (ppm)	Comparison Value	
		ppm	Source		ppm	Source
Headwaters	55-96	2	FDA	36-38	0.01	EMEG
Mid point	49-280	2	FDA	13-24	0.01	EMEG
Above confluence	21-81 snapping turtle 3-7	2	FDA	3-320	0.01	EMEG
200 yards above confluence	-	2	FDA	ND-0.9	0.01	EMEG
1.3 miles above confluence	ND-0.8	2	FDA	-	0.01	EMEG
Richland Creek downstream	2-19	2	FDA	2-2	0.01	EMEG
Richland Creek 1 mile downstream	0.8-2	2	FDA	0.3-0.3	0.01	EMEG
Richland Creek 2 miles downstream	0.5-18	2	FDA	-	0.01	EMEG
Richland Creek 5 miles downstream	0.1-4	2	FDA	-	0.01	EMEG
Richland Creek 10 miles downstream	ND-5 snapping turtle 17	2	FDA	-	0.01	EMEG
Richland Creek 33 miles downstream	ND-0.4	2	FDA	ND	0.01	EMEG

ND = Non-detect

A caged fish study was performed by the U.S. Fish and Wildlife agency in September of 1982 (U.S. Fish & Wildlife. Analyses of PCBs in Neal's Landfill drainage, Richland Creek, Fish, Snapping Turtles, plants, and caged fish. 1983.). The upper cage was initially stocked with 16 channel catfish, 25 longear sunfish, 11 creek chubs, and on one white sucker. The lower cage was stocked with 16 channel catfish, 25 longear sunfish, and 12 creek chubs. Only fish exposed in the cages for 28 days were analyzed for PCBs (Table 37).

Table 37. Caged Fish Stock PCB Sample Results, Neal's Landfill, September 1982

Species	PCB Concentration Range (ppm)	Comparison Value	
		ppm	Source
Longear Sunfish	30 - 46	2	FDA
Channel Catfish	46 -84	2	FDA
Creek Chub	71-208	2	FDA
White Sucker	203	2	FDA

In 1992 the fish advisory for Richland Creek was lifted. An advisory is lifted from a body of water when two data samples show that the level of contamination is below the FDA guideline.

Vegetation

In February of 1982, vegetation samples were taken at Neal's Landfill. These samples were considered deer browse. All samples were analyzed for PCBs. Controls were taken from areas other than Neal's Landfill and were all non-detect (Table 38). No map was provided with this information. (U.S. Fish and Wildlife. 1983. PCBs in Neal's Landfill Plants.)

Table 38. On-Site Vegetation PCB Sample Results for Neal's Landfill, February 1, 1982

Sample Type	PCB Concentration (ppm)	Comparison Value	
		ppm	Source
herbaceous grass other than grass	0.7-25	0.01	EMEG
shrub	0.5-5	0.01	EMEG
grass	0.7-1,100	0.01	EMEG

C. Quality Assurance and Quality Control

The groundwater and surface water organic chemical results showed the presence of heptachlor, n-nitrosodi-n-propylamine, carbon tetrachloride, 1,1 dichloroethane, trichlorofluoromethane, 1,1,-dichloroethylene, benzene, toluene, chloroform, ethylbenzene, and endosulfan sulphate; however, in most cases the concentrations are less than 100 ppb, and the analytical results were not always reproducible. Methylene chloride and acetone were field and laboratory contaminants. The data on these chemicals were deemed unacceptable for use in this report.

The field blank for the Neal's Landfill sampling for dioxin and furans (October 1984) showed contamination with hepta dibenzodioxins and hepta dibenzofurans. The contamination was attributed to possible use of dirty glassware. Sampled data were considered not affected, and blank subtraction was not recommended. The samples for tetra dibenzodioxin samples should not be used as there was no corresponding spiked sample. All other samples were considered valid.

The methodology employed to measure PCB levels in the ambient air during the 1983 sampling event performed well. The QA data gathered during the study demonstrate that both the low- and high-volume methods yielded reliable, reproducible data, and that comparable results are obtained by the two methods.

D. Physical and Other Hazards

Per the site visit on January 28, 1993, this site has several open, dilapidated structures and refuse on-site. This site is not accessible without a key to the front gate. There are no physical hazards accessible to the public.

PATHWAYS ANALYSES

A. Completed Exposure Pathways

On-site/Off-site Ambient Air

Nearby residents and scavengers reported open burning of trash and PCB-contaminated materials at this site. Air sampling was not done during these burn periods at the site. Prior to the on-site interim remediation of this site, PCB levels were measured at locations where capacitors were leaking PCB fluids onto the ground. The level of PCBs identified in the air generally correlated with the number of exposed leaking capacitors. Air sampling downwind of the landfill revealed PCB concentrations. Ambient air contamination by leaking capacitors and open burning is considered to be a completed exposure pathway through the inhalation route for landfill workers, scavengers, trespassers, and nearby residents.

On-Site Surface Soil

Before the interim remediation began, Neal's Landfill was accessible. Scavenging and trespassing did occur at this site (Stehr et al. 1986). PCB-stained soils were removed from the site during the interim remediation. There is a past completed pathway for landfill workers, scavengers, and trespassers through incidental ingestion and dermal contact with PCB-contaminated soil particles. This pathway does not presently exist due to the 2-foot thick clay cap in the primary fill areas and the vegetation that has covered the site.

On-Site Sediment

Before the interim remediation of Neal's Landfill, PCBs were found in sediment samples at concentrations greater than 1 ppm. Sediments are materials that settle to the bottom of, or are suspended in, a liquid. PCBs bind tightly to soil particles, thus its concentration can accumulate over time in sediment samples.

During scavenging activities or trespassing, individuals had dermal contact with PCB-contaminated sediment (Stehr et al. 1986). Sediments in the streams found on Neal's Landfill are considered to be past completed exposure pathways.

On- & Off-site Wild Game

Excretion of PCBs is slow, so accumulation occurs even at low exposure levels. The higher the chlorination, the longer it takes to be excreted by the body. Wild game forage in the brush on the site. Accumulation of PCBs in their systems is very likely through ingestion of PCB-contaminated soil or water and/or animals. A study of dogs that roamed the Consent Decree sites documented elevated serum PCBs in animals having contact with these sites. (Schillig et al. 1988).

Reports were made to the Monroe County Health Department regarding the illegal poaching of deer at the site. It was alleged that these deer were subsequently sold to local restaurants. Bio-accumulation of PCBs in these animals was very likely. Consumption of game such as deer, rabbit, raccoon, and squirrel that roamed Neal's Landfill are considered to be past completed exposure pathways.

<u>Off-Site Surface Water/Sediment</u>

Off-site sediment is a past potential exposure pathway for individuals participating in recreational activities in Richland Creek and Conard's Branch. Sediment samples taken from these areas prior to the interim remediation showed a maximum PCB contamination of 38 ppm. The sediment route of entry to the human body would be through incidental or accidental ingestion of stream sediment laden water and/or absorption of the chemicals through the skin.

Swimmers, especially young children, could swallow water containing these sediments. Fish caught and eaten from these waters may contain contaminated sediments (see Off-site Fish in Completed and Potential Exposure Pathways). It is important to note that these chemicals are bound to soil particles reducing the amount of human skin and stomach absorption considerably. The amount of sediment ingested during swimming is expected to be minimal.

<u>Off-site Fish</u>

PCBs bind tightly to soil particles, thus its concentration can accumulate over time in sediment samples. Bottom feeders or scavengers such as catfish or carp, due to their rummaging behavior, bioaccumulate contaminants through sediments over time.

In 1991, a level 2 fish advisory was issued by the ISDH on all fish in Richland Creek. PCBs were found in high enough concentrations in fish to cause concern to the local and state public health officials. The standard consumption limitation for a level 2 fish advisory of no more than ½ pound of fish per week was encouraged for adult males and women not considering pregnancy; and women of child bearing age and children under the age of 18 were warned not to eat any of the fish taken from Richland Creek. There is a past completed exposure pathway for all individuals eating fish caught in Richland Creek prior to the fish advisory, or for individuals who ignored the fish advisory.

Richland Creek is no longer on the fish advisory because the fish currently do not show contamination above the FDA action level.

Table 39. Completed Exposure Pathways for Neal's Landfill

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
On-site/Off-site Ambient Air	Neal's Landfill	Ambient Air	Neal's Landfill	Inhalation	Landfill workers Trespassers Scavengers Nearby residents	2-3 1-50 *50 30-40	Past
On-site Sediment	Neal's Landfill	Sediment	Streams	Dermal Contact	Trespassers	1-50	Past
On- & Off-site Wild Game	Neal's Landfill	Deer, Rabbits, Squirrels, Raccoons	Area around Neal's Landfill	Ingestion	Individuals eating wild game taken from Neal's Landfill	60-75	Past
Off-Site Surface Water/Sediment	Neal's Landfill	Surface Water/Sediment	Conard's Branch, Richland Creek	Dermal Contact	Individuals participating in recreational activities along Conard's Branch and Richland Creek	Unknown	Past Present Future
Off-site Fish	Neal's Landfill	Fish	Conard's Branch, Richland Creek	Ingestion	Individuals eating fish from Richland Creek and Conard's Branch	170-200	Past
On-site Surface Soil	Neal's Landfill	Soil	Neal's Landfill	Ingestion Dermal contact	Landfill workers Scavengers Trespassers	2-3 *50 1-50	Past

* Possibly exposed at all Consent Decree sites

B. Potential Exposure Pathways

Off-Site Groundwater

Many private residences within a 5,000-foot radius of the site rely on private wells for their potable water. On-site monitoring wells showed PCB concentrations of up to 9.8 ppb during the 1992 sampling event. The nearest residential well is within a ½-mile radius of the site. The depths of the residential wells near the site, and the number and depths of aquifers below the site, were not provided in the reviewed data. Continuous overburdening of the water treatment system by heavy rainfall could potentially result in contamination of private wells in the area.

Groundwater underlying the site flows to the northwest and re-surges at the South Spring/North Spring area. It also discharges to the southwest of the site at the Southwest Seep, and Taylor and Branham Springs. The treatment water system at the site collects and treats water from the North Spring, South Spring, and Southwest Seep. This system is capable of reducing or eliminating the levels of PCBs in the groundwater before the water leaves the site under base flow conditions. During heavy rainfalls, there is a potential for the amount of PCBs leaving the site to be greater than the allowable level of less than 1 ppb, since the spring water treatment system is not able to handle the amount of water flowing during these conditions. It is important to note, however, that the maximum detected amount in the effluent of the treatment plant has been 0.22 ppb (sample taken 11/21/92), and PCBs have not been detected above the drinking water standard (0.5 ppb) for any private well sampling event.

Off-site groundwater is a present and future potential exposure pathway for all private well users through ingestion, inhalation, and dermal contact. PCBs have not been detected, however, above the drinking water standard (0.5 ppb) for any sampling event.

Off-Site Surface Water/Sediment

Sediments are materials that settle to the bottom of, or are suspended in, a liquid. PCBs have been found at 7.7 ppb in sediment samples taken from the overflow basin of the spring treatment plant. This basin is within the confines of the fenced area. During heavy rainfalls, the spring water treatment system is not able to handle the amount of water flowing from the site.

Contaminated sediments are formed when chemicals bind to soil particles. PCBs bind tightly to soil particles, thus its concentration can accumulate over time in sediment samples.

The sediment route of entry to the human body would be through incidental or accidental ingestion of stream water and/or absorption of the chemicals through the skin. Swimmers, especially young children, could swallow water containing these sediments. Fish caught and eaten from these waters may contain contaminated sediments (see Off-site Fish in Completed and Potential Exposure Pathways). It is important to note that these chemicals are bound to soil particles reducing the amount of human skin and stomach absorption considerably. The amount of sediment ingested during swimming is expected to be minimal.

Surface water and sediment are present and future potential exposure pathways for individuals participating in recreational activities in Conard's Branch and/or Richland Creek.

Off-site Fish

Fish species differ in diet, habitat, growth rate, and physiology. They also accumulate chemicals at different rates. White suckers and catfish generally contain the highest concentrations of contaminants. This is due to their bottom feeding, scavenging habits. Certain fish in Richland Creek may be contaminated with PCBs due to the accumulation of contaminants in the sediments.

In 1991, a level 2 fish advisory was issued by the ISDH on all fish in Richland Creek. Consumption of no more than ½ pound of fish per week was encouraged for adult males and women not contemplating pregnancy. All other adults and children should not consume these fish. This advisory was lifted by the ISDH in 1992 due to a decrease in PCB levels found in fish tissues. There is a future potential exposure pathway for all individuals eating fish caught in Richland Creek if the sediments were to become re-contaminated due to overburdening of the spring water treatment system.

Table 40. Potential Exposure Pathways for Neal's Landfill

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
Off-site Groundwater	Neal's Landfill	Groundwater	Private wells	Ingestion, Inhalation, Dermal contact	Residents who use private wells (3 mile radius)	120	Present Future
Off-site Surface Water/Sediment	Neal's Landfill	Surface water/Sediment	Conard's Branch, Richland Creek	Dermal contact	Individuals participating in recreational activities along Conard's Branch and Richland Creek	Unknown	Present Future
Off-site Fish	Neal's Landfill	Fish	Conard's Branch, Richland Creek	Ingestion	Individuals eating fish from Conard's Branch or Richland Creek	Unknown	Future

WINSTON-THOMAS FACILITY (Monroe County)

BACKGROUND

A. Site Description and History

The Winston-Thomas facility is an inactive sewage treatment plant owned by the City of Bloomington, Indiana, and located on the southwest side of the City of Bloomington (see Figure 1). The facility operated from 1933 until 1982. In November of 1975, Westinghouse advised the City of Bloomington that they had been discharging PCBs into the city sewer system. PCBs were then sampled for and confirmed at high concentrations in sewage, Tertiary Lagoon clay and sludge, and in the trickling filter at the plant.

The facility was made part of a comprehensive cleanup as defined in the Consent Decree. This site was not on the NPL at the time of the Consent Decree settlement in 1983, nor is it currently on the NPL. (IDEM. General Overview of Consent Decree Sites. July 1992.)

Interim Measures

The Winston-Thomas facility was shut down in 1982 and a new sewage treatment plant was opened at the Dillman Road site southwest of Bloomington.

In July 1986, the Bloomington Cities Utilities Board approved temporary storage of wastes on city property at the Winston-Thomas site. After this approval and receipt of all necessary permits needed for construction, Westinghouse constructed the Interim Storage Facility prior to commencement of remediation at the other sites as outlined in the Consent Decree.

In May of 1987, the first excavated materials from Anderson Road Landfill were taken to the facility for storage. Excavated materials also began arriving from the stream sites designated for cleanup. A total of 205, 55-gallon drums filled with capacitors and capacitor parts from Anderson Road Landfill and Lemon Lane Landfill were taken to the site and properly stored. A total of 391 cubic yards of stream sediment are stored at the facility along with a total of 706 loads of excavated materials from Anderson Road Landfill weighing 4,847 tons. The Conard's Branch excavation project, which ended in October 1988, generated a total of 1,877 tons of excavated bank material and 2,748 tons of stream bed sediment, all of which is being stored at the facility. In September 1990, APTUS, a wholly owned subsidiary of Westinghouse, drummed PCB-contaminated trash from other containers, labeled all 377 drums stored at the Interim Storage Facility, and transported them to Coffeyville, Kansas for incineration. This material consisted of protective clothing, rags, filters, etc. that had accumulated during routine maintenance and inspections of the Consent Decree sites. In December 1990, APTUS removed 605 capacitors being stored on the site for incineration in Coffeyville.

In November 1990, Westinghouse notified the Consent Decree parties that water had accumulated over the years in three digester tanks on-site and was close to overflowing. With the approval of all the Consent Decree parties, Westinghouse decontaminated 410,000 gallons of water from the three digesters. Hydrogeological investigations were also begun on-site in August of 1987.

PCB Sampling of Indicator Sediment Areas of Clear Creek

In June 1988, the IDEM oversaw the PCB sampling by Westinghouse of two sediment areas along Clear Creek as required by the Consent Decree.

Current Status

Westinghouse conducts monthly inspections of the Interim Storage Facility and submits inspection reports to the EPA, IDEM, and the City of Bloomington.

The City of Bloomington utilities has contracted for the removal of muskrats at the Winston-Thomas Tertiary Lagoon because of the concern they may undermine the dike and allow PCB-contaminated water to escape. Some of the muskrats that are removed will be submitted to the U.S. Fish & Wildlife Service for PCB tissue analysis.

The City of Bloomington has contracted with an environmental firm to assess the degree, if any, of microbial degradation of the PCB-contaminated sewage sludge.

B. Site Visit

On January 28, 1993, Ms. Dollis Wright and Mr. Garry Mills of the ISDH, and staff from IDEM and Westinghouse visited the Consent Decree sites. Observances made during the site visit to the Winston-Thomas facility are listed below.

1. Access to the site is restricted by a locked chain-link fence.

2. Ducks were seen swimming on the Tertiary Lagoon.

3. Inside the on-site Interim Storage Facility (an aluminum, steel support building) a plastic liner had been placed on top of the contaminated soil. A concrete floor and liner prevents contamination from excavated soil from entering the soil under the storage facility.

4. There was a protective clothing and decontamination area in the Interim Storage Facility which included two above-ground storage tanks that are used for cleaning equipment.

5. The Winston-Thomas Sewage Treatment Plant is located in a mixed business/residential area.

C. Demographics, Land Use, Natural Resource Use, and Environmental Setting

Demographics

The Winston-Thomas Sewage Treatment Plant site area has high schools within a ½- to 1½-mile radius of the site. The population in the site area is predominantly white. Approximately 500 people live within a 1-mile radius of the site.

Land Use and Natural Resource Use

The site is surrounded by residential areas to the west and south, and by commercial developments to the north and east. A residential area lies west of the site beyond Clear Creek and the Illinois Central Railroad tracks. The municipal water supply serves the area in the vicinity of the site. The current status of residential well use in the area is unknown.

Environmental Setting

The site is located in the north to south trending valley of Clear Creek on a nearly level to moderately sloping plateau. Steep slopes are located along the berm edges of the Tertiary Lagoon. Clear Creek was at one time where the Tertiary Lagoon is presently located. Before the Tertiary Lagoon was made, Clear Creek was re-routed to the western edge of the site flowing south.

There are two layers of bedrock under the soil layer. Grey limestone and shale ranging in depths from 22-36 feet thick, make up the first layer. The second layer is made up of a water-holding, dark gray, silty shale with pyrite specks.

Groundwater flow is interpreted to flow generally to the southwest toward Clear Creek, which appears to be the discharge point. In the northern portion of the site, the groundwater flow direction trends more west-southwest, and in the central and southern areas of the site, it trends south-southwest.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-site Contamination

Ambient Air

As part of Section 7.4 of the Westinghouse Project Safety Plan, April 1987, air monitoring for VOCs, and other chemicals that might be detected, is conducted on a quarterly basis for the Interim Storage Facility at the Winston-Thomas Sewage Treatment Plant site.

Monitoring results for VOCs and PCBs conducted by Westinghouse from April 1988 through February 1993 have shown the samples to be below detectable limits. (Westinghouse. Quarterly inactive status air sample results for the Interim Storage Facility, 1988-1992.)

Abandoned Lagoon Borings

Between March and April 1984, on-site boring samples were collected by EPA at two abandoned lagoons at the Winston-Thomas Sewage Treatment Plant site (see Figure 25). The former lagoons are located south of the Tertiary Lagoon near the sludge drying beds. Samples were collected at ten locations (B-1 - B-10) and analyzed for total PCBs. Sample depths ranged from 0 inches to 9 feet 4 inches (B-6). PCBs in the abandoned lagoon boring samples (Table 41) had a concentration range of less than 1 to 700 ppm (B-4). (Westinghouse. Phase I Progress Report on Winston-Thomas Facility and Bennett's Dump. January 1987.)

Table 41. On-Site Abandoned Lagoon Total PCB Sample Results for Winston-Thomas Facility, March/April 1984

Boring Number	Sample Depth Feet (') Inches (")	PCB Concentration Range (Dry Weight) (ppm)	Comparison Value	
			ppm	Source
1	4"-5" 2'4"-2'6" 2'11"-3'	150 120 <1	0.01	EMEG
2	6"-8" 2'11"-3' 3'3"-3'4"	<1 <1 <1	0.01	EMEG
3	0"-6" 9"-10" 6'6"-6'7" 6'7"-6'8" 6'8"-6'9"	82 190 <1 <1 <1	0.01	EMEG
4	11"-1'7" 4'-4'1" 4'11"-5'	700 270 3	0.01	EMEG
5	4"-5" 2'9"-2'10" 4'3"-4'4"	36 150 <1	0.01	EMEG
6	7"-8" 5'8"-5'9" 8'1"-8'2" 8'2"-8'3" 8'3"-9'4"	160 290 <1 5 3	0.01	EMEG
7	1'-1'6" 4'6"-5'	19 <1	0.01	EMEG
8	2'11"-3' 5'9"-5'10"	120 <1	0.01	EMEG
9	11"-1'2" 4'4"-4'5" 7'3"-7'4" 7'4"-7'5" 7'5"-7'6"	6 <1 <1 <1 <1	0.01	EMEG
10	1'-1'1" 2'6"-3'2" 4'7"-4'8"	20 140 3	0.01	EMEG

Tertiary Lagoon Borings

In May 1984, Tertiary Lagoon boring samples were collected by EPA for PCB analysis from six locations (B-11 - B-16) at the Winston-Thomas Sewage Treatment Plant site (see Figure 25). The Tertiary Lagoon is 17 acres in size and maintains a water depth of 18 inches. The sample depth involving a clay surface was 0-3 inches. Sample results ranged from 2 ppm in sample B-16 to 660 ppm in sample B-14. (Westinghouse. Phase I Progress Report on Winston-Thomas Facility and Bennett's Dump. January 1987.)

Tertiary Lagoon Sludge

In July 1982, sludge samples were collected by the City of Bloomington and analyzed for PCBs (see Figure 26). A total of 11 sample points (#1-11) were involved with an average depth in excess of 55 inches. Liquid and sludge were identified at approximately 55 feet. For sludge only, the average depth was in excess of 23 inches. PCBs were detected at all 11 sample points (Table 42). (Grodner & Fore Atty. Letter regarding Winston-Thomas Sewage Treatment Plant Lagoon Samples. November 10, 1982.)

Table 42. On-Site Tertiary Lagoon Sludge PCB Sample Results, Winston-Thomas Facility, July 1982

Sample Point Number	PCB Concentration (ppm)	Comparison Value	
		ppm	Source
1	718	0.01	EMEG
2	275	0.01	EMEG
3	119	0.01	EMEG
4	1,750	0.01	EMEG
5	993	0.01	EMEG
6	527	0.01	EMEG
7	1,990	0.01	EMEG
8	2,400	0.01	EMEG
9	2,000	0.01	EMEG
10	1,137	0.01	EMEG
11	148	0.01	EMEG

Tertiary Lagoon Core Sludge

In the early 1980s, tertiary core sludge samples were collected at the site and analyzed for PCBs (see Figure 27).

Two sets of data are presented in this subsection. The documentation of samples and data for the first set have no author listed. The second set of data were collected by a private contractor (sampling date unknown) for the City of Bloomington, and were documented by City of Bloomington correspondence dated February 1983.

A total of ten sample locations (B-top, middle, bottom, D, E, G, J, L, M, O), plus one duplicate (B-middle), were analyzed in both sets of data. Samples taken from the top to the bottom of the core section were analyzed. PCBs were detected at all ten locations for Tertiary Lagoon sludge. Results from both sets of data are presented in Table 43. (Grodner & Fore Atty. Letter to O'Brien & Gere Engineers Inc. regarding Winston-Thomas Treatment Plant core sludge sample results. February 3, 1983.)

Table 43. On-Site Tertiary Lagoon Core Sludge Total PCB Sample Results, Winston-Thomas Facility

Sample Location	Core Section	Mid 1980s Sampling PCB Concentration Range (ppm)	Comparison Value	
			ppm	Source
B	Top	150-220	0.01	EMEG
B	Middle	1,000-1,400	0.01	EMEG
B	Bottom	3,100-4,400	0.01	EMEG
D	Entire	770-1,450	0.01	EMEG
E	Entire	2,000-2,400	0.01	EMEG
G	Entire	600-1,170	0.01	EMEG
J	Entire	1,000-1,200	0.01	EMEG
L	Entire	241-530	0.01	EMEG
M	Entire	2,500-3,700	0.01	EMEG
O	Entire	1,400-2,600	0.01	EMEG

Tertiary Lagoon Core Sludge and Clay

In June 1983, EPA correspondence documented that previous core sludge and clay samples had been collected and analyzed for total PCBs (see Figure 28). A total of eight core locations, plus one duplicate, were sampled. The average length of the sludge and clay in cores was in excess of 21 inches each. Samples taken from the top to the bottom of the core section were analyzed. PCBs were detected at all eight core sludge locations, while PCBs in the core clay were detected at three locations (E,G,M). PCB analyses results for lagoon core sludge and clay are shown in Table 44. (O'Brien & Gere. Letter to Blasland regarding Winston-Thomas Tertiary Lagoon sludge and clay core sample results. June 23, 1983.)

Table 44. On-Site Tertiary Lagoon Core Sludge & Clay PCB Sample Results, Winston-Thomas Facility, June 1983

Core Location	Core Section	PCB Concentration (ppm)	Comparison Value	
			ppm	Source
B	Top Middle Bottom	220 1,400 4,400	0.01	EMEG
D	Entire	770	0.01	EMEG
E	Entire	(sludge) 2,000 (clay) 15	0.01	EMEG
G	Entire	(sludge) 600 (clay) 9	0.01	EMEG
J	Entire	1,000	0.01	EMEG
L	Entire	241	0.01	EMEG
M	Entire	(sludge) 2,500 (clay) 3	0.01	EMEG
O	Entire	1,400	0.01	EMEG

Groundwater - Monitoring Wells

Ten bedrock monitoring wells were installed in September and October 1987 around the perimeter of the Winston-Thomas facility (see Figure 29). One monitoring well, MW-3S, was installed in the unconsolidated material in July 1987. The monitoring wells were designated as MW-1, -2, -3S, -3I, -3D, -4, -5I, -5D, -6, -7, and -8 (S = shallow, I = intermediate, & D = deep). Eight wells are located hydraulically downgradient, while three wells are located upgradient. Four rounds of groundwater sampling for PCBs were performed by Westinghouse beginning in March 1988 and were completed in December 1988. Monitoring well depths ranged from in excess of 40 feet to in excess of 55 feet.

With respect to the valid sampling events, PCBs were not detected in the groundwater samples obtained from wells MW-1, -2, -3D, -4, -5I, -6, and -8. PCBs were detected in two of the four representative groundwater samples obtained from wells MW-3I and -5D; in all three samples obtained from well MW-7 (and in the duplicate sample from well MW-7); and in all four samples obtained from well MW-3S. PCB sample results are shown in Table 45. (Westinghouse. Quarterly Groundwater Sampling Results, Bennett's Dump and Winston-Thomas Facility Supplemental Hydrogeologic Investigation, December 5-7, 1988. January 1989.)

Table 45. On-Site Monitoring Well PCB Sample Results for Winston-Thomas Facility, March-December 1988

Location	PCB Concentration Range (ppb)	Comparison Value	
		ppb	Source
MW-3S	2-7	0.05	CREG
MW-3I	0.4-1	0.05	CREG
MW-5D	0.3	0.05	CREG
MW-7	1-2	0.05	CREG

Concentrations listed as one number indicate only a single sample at that location.

B. Off-site Contamination

Groundwater - Residential Wells

In November 1986, the Indiana University School of Public and Environmental Affairs in Bloomington conducted a well user survey of approximately 30 residential wells within 5,000 feet of the Winston-Thomas Sewage Treatment Plant site. Samples were collected at faucets nearest to the well head for drinking water and were analyzed for PCBs. Documentation for the well user survey did not include a location map of the residences sampled. Samples detected for PCBs had a concentration range of non-detect to 98 ppt. (Indiana University. Collection and Analysis of Drinking Water Well Samples for PCB Content. November 1986.)

Surface Water

Between March 1976, September 1977, and June/July 1980, off-site surface water samples were collected (see Figure 30) by the ISDH and analyzed for total PCBs at ten sample locations: Clear Creek (CC-1 & -3), Salt Creek (SC-2,-3,-5), Pleasant Run (PR-1), and East Fork of the White River (EW-3,-4,-5,-6) (Indiana State Department of Health. Memorandum from C. Bridges to O. Hert regarding PCB levels in water sediment and fish from Clear Creek, Salt Creek, Pleasant Run, and the East Fork of White River (Monroe and Lawrence Counties, Indiana) in 1980. February 23, 1981.)

All sample results are reported as total PCBs whether or not the samples collected detected one or more PCB types. Total PCBs detected in the off-site surface water samples had a concentration range of non-detect to 0.9 ppb (CC-1).

Sediment

Between March 1976, September 1977, and June/July 1980, off-site sediment samples were collected (see Figure 30) by the ISDH and analyzed for total PCBs at ten sample locations: Clear Creek (CC-1 & -3), Salt Creek (SC-2,-3,-5), Pleasant Run (PR-1), and East Fork of the White River (EW-3,-4,-5,-6). PCB analyses results are shown in Table 46. The Consent Decree requires Westinghouse to sample from these areas. (ISBH. Memorandum to Water and Sewage Laboratory. February 1981.)

All sample results are reported as total PCBs whether or not the samples collected detected one or more PCB types. Total PCBs detected in the off-site sediment samples had a concentration range of non-detect to 1,300 ppm (PR-1).

Between June and July 1988, sediment samples were collected from two indicator areas for PCBs along Clear Creek, near Gordon Pike and the town of Harrodsburg. Sampling was overseen by IDEM. These samples were taken after hydrovacuuming of Clear Creek had been performed by Westinghouse.

The first indicator area was designated within 300 feet downstream of Gordon Pike. Ten sampling locations were selected; no PCBs were detected.

The second indicator area for PCB sampling along Clear Creek is approximately 12 miles south of the first indicator area, Gordon Pike. This area was designated as within 200 feet upstream of Old State Road 37 near Harrodsburg, Indiana. Ten sampling locations were selected. Except for one detection of 12 ppm, all other samples were non-detect.

As part of the sediment sampling conducted at the Lemon Lane Landfill by IDEM in November 1991 (RK6320-RK6324), sediment samples were also collected off-site near the Winston-Thomas Sewage Treatment Plant site (IDEM. Memorandum. February 25, 1992). These samples were only analyzed for PCBs (1248).

Table 46. Off-Site Surface Water and Sediment Total PCB Sample Results for Winston-Thomas Facility

Station or Sample Number	Location	Sample Date	Water Samples			Sediment Samples		
			Concentration Range (ppb)	Comparison Value		Concentration Range (dry weight) (ppm)	Comparison Value	
				ppb	Source		ppm	Source
CC-1	Clear Creek north of Harrodsburg	3/11/76 6/19/80	ND-0.9 <0.1-0.2	0.05	EMEG	ND <200-2,200	0.01	EMEG
CC-3	Clear Creek 1 mile up from mouth Clear Creek 100 yds. up from mouth	9/27/77 7/1/80	ND-0.2 ND-0.3	0.05	EMEG	<100-<100 ND-540	0.01	EMEG
SC-2	Salt Creek just below Monroe Dam	3/11/76 7/1/80	ND-<0.1 ND-<0.1	0.05	EMEG	ND ND-150	0.01	EMEG
SC-3	Salt Creek below Clear Creek near Logan	3/11/76 9/27/77 7/1/80	ND-0.1 ND-0.2 ND-<0.1	0.05	EMEG	ND 100-1,600 ND-2,200	0.01	EMEG
PR-1	Pleasant Run at Peerless Road	9/27/77 6/19/80	0.4-12 0.1-9	0.05	EMEG	ND-1,300,000 <200-315,000	0.01	EMEG
SC-5	Salt Creek, 0.25 mile above mouth	9/28/77 7/2/80	ND-0.6 ND-<0.1	0.05	EMEG	<100-1,500 ND-2,100	0.01	EMEG
EW-3	E. Fork White River just above Salt Creek	6/17/80	<0.1-0.1	0.05	EMEG	<200-<250	0.01	EMEG
EW-4	E. Fork White River just below Salt Creek	9/28/77 6/18/80	ND-<0.1 <0.1-0.2	0.05	EMEG	150-610 410-1,100	0.01	EMEG
EW-5	E. Fork White River above Williams Dam	6/18/80	<0.1-<0.1	0.05	EMEG	<200-<250	0.01	EMEG
EW-6	E. Fork White River below Williams Dam	9/28/77 6/18/80	ND-<0.1 <0.1-<0.1	0.05	EMEG	<100-120 <200-<250	0.01	EMEG
RK6320	Clear Creek at Gordon Pike Bridge	11/91	-	-	-	0.19	0.01	EMEG
RK6321	Clear Creek at drain tile under Winston-Thomas	11/91	-	-	-	0.13	0.01	EMEG
RK6322	Swampy area northwest of Winston-Thomas lagoon	11/91	-	-	-	BDL	0.01	EMEG
RK6323	Clear Creek north of Winston-Thomas	11/91	-	-	-	0.19	0.01	EMEG
RK6324	Clear Creek north of Country Club Road	11/91	-	-	-	0.50	0.01	EMEG

ND = non-detect
Concentrations listed as one number indicate only a single sample at that location.

Fish

Between March 1976, September 1977 and 1979, and June/July 1980, fish samples were collected (see Figure 30) by the ISDH and analyzed for total PCBs at ten sample locations: Clear Creek (CC-1 & -3), Salt Creek (SL-2,-3,-5), Pleasant Run (PR-1), and East Fork of the White River (EW-3,-4,-5,-6). (ISBH. Memorandum to Water and Sewage Laboratory. February 1981.)

All sample results in Table 47 are reported as total PCBs whether or not the samples collected detected one or more PCB types. Total PCBs detected in the fish data (whole fish basis) had a concentration range of non-detect to 85 ppm (CC-3).

Table 47. Off-Site Fish PCB Sample Results for Winston-Thomas Facility

Station	Date	Type of Fish	PCB Concentration (Whole Fish Basis) (ppm)	Comparison Value	
				ppm	Source
CC-1	1976	Creek Chub	66	2	FDA
	1980	Creek Chub	20		
	1980	Bluegill Sunfish	1		
	1980	Longear Sunfish	25		
	1980	Largemouth Bass	5		
CC-3	1976	Yellow Bass	20	2	FDA
		Bluegill Sunfish	12		
		Longear Sunfish	85		
	1977	Longear Sunfish	ND		
		Largemouth Bass	ND		
	1980	Northern Pike	ND		
		Largemouth Bass	ND		
		Bluegill Sunfish	20		
		Longear Sunfish	16		
SC-2	1976	Bluegill Sunfish	9	2	FDA
		Longear Sunfish	1		
	1980	Striped Bass (Morone sp.)	0.1		
		Bluegill Sunfish	4		
		Longear Sunfish	8		
SC-3	1976	Largemouth Bass	7	2	FDA
		Longear Sunfish	10		
	1977	Longear Sunfish	ND		
		Spotted Bass	ND		
	1980	Largemouth Bass	ND		
		Largemouth Bass	7		
		Longear Sunfish	11		
		Longear Sunfish	9		
SC-5	1976	Largemouth Bass	28	2	FDA
	1977	Largemouth Bass	ND		
		Longear Sunfish	ND		
	1980	Largemouth Bass	ND		
		Largemouth Bass	ND		
		Longear Sunfish	ND		

Station	Date	Type of Fish	PCB Concentration (Whole Fish Basis) (ppm)	Comparison Value	
				ppm	Source
EW-3	1976	Spotted Bass	12	2	FDA
		Channel Catfish	5		
		Bluegill Sunfish	10		
		Longear Sunfish	13		
	1980	Spotted Bass	ND		
		Channel Catfish	ND		
		Flathead Catfish	ND		
		Sunfishes (Lepomis spp.)	ND		
EW-4	1976	Longear Sunfish	10	2	FDA
		Flathead Catfish	3		
	1977	Bluegill Sunfish	ND		
		White Crappie	ND		
	1980	White Crappie	ND		
		Longear Sunfish	19		
		Channel Catfish	ND		
		Channel Catfish	ND		
		Channel Catfish	ND		
EW-5	1976	Spotted Bass	2	2	FDA
		Bluegill Sunfish	2		
		Longear Sunfish	13		
	1979	Longear Sunfish	ND		
	1980	Largemouth Bass	ND		
		Longear Sunfish	ND		
		Longear Sunfish	ND		
		Channel Catfish	ND		
EW-6	1976	Largemouth Bass	3	2	FDA
		Longear Sunfish	8		
	1977	Largemouth Bass	ND		
		Longear Sunfish	ND		
		Bluegill Sunfish	ND		
	1980	Longear Sunfish	ND		
		Bluegill Sunfish	ND		
		Largemouth Bass	ND		

C. Quality Assurance and Quality Control

For the first groundwater sampling event (March 1988), the PCB analytical data are invalid for wells MW-1, -2, -4, -6, -7, and -8. The data are invalid because the pump utilized for sampling contained residual PCBs from sampling well MW-5 at the Bennett Stone Quarry site. A PCB concentration of 6 ppb was detected in the methods blank QA sample obtained from the pump. The PCB analytical data for the last three quarterly sampling events (June, September, and December 1988) are valid for the aforementioned wells, except for well MW-6 in the June 1988 sampling event. PCBs were apparently still present in this well from the March 1988 sampling event. The PCB analytical data are valid for wells MW-3S, -3I, -3D, -5I, and -5D for all four quarterly events.

D. Physical and Other Hazards

This site is surrounded by a chain-link fence. Per the site visit on January 28, 1993, there were no apparent physical hazards present on this site.

PATHWAYS ANALYSES

A. Completed Exposure Pathways

Off-site Fish

Fish sampling of Clear Creek indicates that they are contaminated with PCBs. As PCBs bind tightly to sediment particles and bio-concentrates easily, it is assumed that fish in Clear Creek bioaccumulated PCBs through contaminated water and ingestion of contaminated sediments. A level 2 fish advisory has been issued by the ISDH on Clear Creek since 1988 to the present.

A level 2 fish advisory means that women of child bearing age and children under the age of 18 should not consume any of the fish listed in the advisory for the named waterway. All other individuals should limit their consumption of those designated fish species to no more than one meal per week.

Fish in Clear Creek present a past, present, and future exposure pathway for human exposure to PCBs.

Off-site Sewage Sludge

Sludge was used by various individuals in the Bloomington area for gardening. From 1972 through 1976, approximately 500 to 1,000 persons had obtained sludge at the Westinghouse plant for organic gardening. Vegetables from gardens which had PCB-contaminated sludge are a past completed exposure pathway (Baker et al. 1980). It is important to note that studies of PCB uptake in plants indicate that PCBs may be taken up by the root system of plants. It is possible, however, that contamination of plants may be due to wind-blown dust versus the root uptake system (Sommers. 1976).

On- and Off-site Wild Game

Even though the Tertiary Lagoon is fenced, wildlife such as ducks and muskrats have been observed on the site. During the daily activities of these animals, sludge in the lagoon could quite naturally be disturbed. It is likely that the ducks and muskrats in the Tertiary Lagoon have migrated and accumulated PCB-contaminated sludge in their bodies. Excretion of PCBs is slow, so accumulation occurs even at low exposure levels. Further, the higher the chlorination, the longer it takes to be excreted by the body. Human ingestion of these wild game is a past, present, and future pathway for PCBs to enter the body.

Table 48. Completed Exposure Pathways for Winston-Thomas Facility

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
Off-site Fish	Winston-Thomas Site	Fish	Clear Creek	Ingestion	Individuals eating fish from Clear Creek	200-230	Past Present Future
Off-site Sewage Sludge	Winston-Thomas Site	Sludge	Gardens	Ingestion Dermal Contact	Individuals eating home-grown produce, Gardeners	500	Past Present Future
On- & Off-site Wild Game	Winston-Thomas Site	Ducks Muskrats	Tertiary Lagoon	Ingestion	Individuals eating wild game that roamed the Winston-Thomas site	65-70	Past Present Future

B. Potential Exposure Pathways

On-site Ambient Air

PCBs in air can be present as both airborne solid and liquid particles, and vapor that eventually return to the land as water, snow, rain, and the settling of dust particles. During its operation, the Winston-Thomas Sewage Treatment Plant had two sludge lagoons, three areas of sludge drying beds, and the Tertiary Lagoon. PCBs were found in these areas at up to 2,500 ppm. These six areas presented the potential for contamination of ambient air.

Monitoring results for VOCs and PCBs from April 1988 through February 1993 have all been non-detect. As the site is no longer operating, air is a past potential exposure pathway.

Off-Site Sediment

Interim remediation involved the removal of 1,100 feet of sediment from Clear Creek. Before this removal, sediment was contaminated with unknown levels of PCBs. The sediment route of entry to the human body would be through incidental or accidental ingestion of stream water and/or absorption of the chemicals through the skin.

PCBs are bound to soil particles reducing the amount of human skin and stomach absorption considerably. Swimmers, especially young children, could swallow water containing these sediments. The amount of sediment ingested during swimming and wading is expected to be minimal. Sediment is a past potential exposure route for individuals participating in recreational activities at Clear Creek prior to the interim remediation.

The July 1988 sampling of Clear Creek revealed sediment samples contaminated with PCBs at 12 ppm. Because groundwater under the site discharges primarily into Clear Creek, and PCBs bioaccumulate rapidly, sediment is considered a future potential pathway for PCBs to reach the surrounding community during recreational activities by incidental ingestion and dermal contact. The last sampling of Clear Creek occurred in November 1991; all samples were non-detect for PCBs.

Off-site Surface Water

The sewage treatment plant was functional from 1933 to 1982. Clear Creek was at one time where the Tertiary Lagoon is presently located. Before the Tertiary Lagoon was made, Clear Creek was re-routed to the western edge of the site flowing south. Before the 1987 interim remedial removal of sediments from Clear Creek, surface water presented a past potential exposure pathway for individuals participating in recreational activities in Clear Creek through incidental ingestion of sediments and dermal contact.

Off-site Groundwater - Private Wells

The Indiana University School of Public and Environmental Affairs performed a well user survey in 1986 for the Winston-Thomas site. Forty private wells were located within a 5,000-foot radius of the site. Results showed all samples taken from the private wells to be non-detect to 98 ppt for PCB. Although the area is currently served by municipal water, it is unknown how many private wells are still being used for potable water.

Groundwater under the site flows generally to the south, southwest toward Clear Creek. There is a potential for private wells to be contaminated with PCBs emanating from the site. The private wells south and southwest of the site are the most likely to potentially be contaminated. The use of the private wells in the vicinity of the Winston-Thomas site is a past, present, and future potential exposure pathway for individuals using them for potable water.

Off-site Cattle

Some of the individuals that obtained sludge for organic gardening also used sludge in pastures where cattle grazed. Accumulation of PCBs in the tissues of these cattle is possible. Cattle that grazed on sludge covered fields are a past potential exposure pathway to individuals who ate this meat.

Table 49. Potential Exposure Pathways for Winston-Thomas Facility

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS						TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	NUMBER OF EXPOSED PERSONS	
On-site/Off-site Ambient Air	Winston-Thomas Site	Air	Area Around Winston-Thomas Site	Inhalation	Individuals around Winston-Thomas Site	250	Past
Off-site Surface Water/Sediment	Winston-Thomas Site	Water/Sediment	Clear Creek	Ingestion Dermal Contact	Recreational Users of Clear Creek	Unknown	Past Present Future
Off-site Groundwater	Winston-Thomas Site	Groundwater	Private Wells	Ingestion, Inhalation, Dermal Contact	Residents who use private wells (5,000 ft radius)	120	Past Present Future
Off-site Cattle	Winston-Thomas Site	Meat	Pastures with sewage sludge	Ingestion	Individuals eating meat from cattle that grazed on pastures with PCB-contaminated sludge	Unknown	Past

HEALTH OUTCOME DATA

This section identifies the relevant, available databases; their evaluation occurs in the Public Health Implications section. Cancer may be a plausible health outcome from long-term exposure to at least one of the contaminants of concern. The ISDH maintains a statewide cancer registry; however, data regarding cancer incidence by city and county are not yet available. In addition, the ISDH maintains a mortality database by county. Mortality data on Monroe and Owen Counties' cancer deaths are available (1950-1979).

This section of this report contains an evaluation of Community Health Concerns, Health Outcome Data, Health Studies, and a Toxicological Evaluation of all chemicals of concern found in completed and potential pathways. This data will be grouped together for the six Consent Decree sites under the Public Health Implication section of this report.

Several health studies have been performed on populations residing in and around the Bloomington area. The following studies will be evaluated further in the Public Health Implications section:

- Centers for Disease Control (CDC) study on the health effects of individuals who used PCB-contaminated sewage sludge on their gardens (Baker et al. 1980)
- National Institute of Occupational Safety and Health (NIOSH) study of the metabolic and health consequences of occupational exposures to PCBs (Smith et al. 1982)
- CDC/ISDH studies of exposure to PCBs by residents living near three waste sites (Lemon Lane Landfill, Neal's Landfill, and Bennett Stone Quarry)
    - Health effects associated with serum PCB levels (Stehr et al. 1986)
    - Serum PCB levels in persons at high risk of exposure in residential and occupational environments (Stehr et al. 1986)
    - Effects of PCBs and lipemia on serum analysis (Steinberg et al. 1986)
- Study of higher and lower chlorinated serum PCB congeners in individuals who use contaminated PCB sludge in their gardens and capacitor manufacturing workers (Steele et al. 1986)
- NIOSH/ISDH follow-up health study of workers occupationally exposed to PCBs (NIOSH. HETA 84-339. 1990)

- ISDH/NIOSH study to evaluate the mortality experiences of a cohort of Westinghouse Electric Corporation workers occupationally exposed to PCBs (NIOSH. HETA 89-116-2094. 1991)

- ISDH/NIOSH study of proportional hazards model to examine the variations between cumulative PCB exposure and site-specific cancer mortality (Sinks et al. 1992)

- CDC/ISDH study to evaluate the potential for using domestic animals in the surveillance of environmental exposures (Schilling et al. 1988)

- ISDH/ATSDR study to evaluate the health implications of general community exposures to PCBs (Steele & Richter. 1992)

- NIOSH study of serum PCB concentrations in 50 workers at the Westinghouse plant (Phillips et al. 1989)

COMMUNITY HEALTH CONCERNS

The community health concerns were derived from numerous interviews conducted with the Monroe and Owen County Health Departments and local residents. The most recent interviews were conducted on January 19, 1993, during a Citizens Information Committee meeting, and a Public Meeting on February 18, 1993, in Bloomington, Indiana conducted by the staff from ATSDR in Atlanta, Georgia. There were approximately 100 people present at the public meeting with 25 percent expressing the health concerns listed below. The concerns listed below are related to the possible impact on public health of PCB contamination in the Bloomington area.

1. Will the health study look at any chemicals other than PCBs? Will it look at chemicals such as dioxins, furans, and heavy metals?

2. What about other sites besides those listed in the Consent Decree?

3. Why is the health study being done now?

4. Have any studies been done before?

5. Are copies available of studies conducted at similar sites?

6. What happens after the health study and expert panels are concluded?

7. Is the purpose of the study to find out if PCBs are hazardous? What is to be gained?

8. How long with the health study go on?

9. How will the public health assessment be used? Will a risk assessment be involved? Are they the same?

10. Did the ATSDR Toxicological Profile on PCBs consider only cancer?

11. Will the health study point out correlations such as cancer and miscarriages due to PCBs?

12. Will you look at the potential health effects of the proposed ash landfill?

13. How will you get a true picture of the health effects when limited to only the Consent Decree sites? What about ABB (formerly Westinghouse) and Fell Iron & Metal Inc., which are located in heavily populated areas?

14. Will the Lemon Lane Landfill springs be looked at?

15. I am concerned that my physician is not aware of the literature regarding the toxicity of exposure to PCBs.

16. What about former and current workers at the Westinghouse/ABB plant? Many of the former workers have stated that they feel their health is deteriorating. Current workers are concerned that they are still being exposed to PCBs (from residual contamination) while working in the plant.

17. Will the public health assessment address all of the sites where scavenging of discarded capacitors occurred, or where PCB-contaminated sewage sludge was used?

In addition, community concerns were gathered from the January 19, 1993, Citizens Information Committee meeting. There were 40-50 people present. The issues discussed during this meeting were:

- the IDEM deadline to complete a written Report of Comparative PCB Technologies;
- the Dean Little Biodegradation of PCB project; and
- the proposed Westinghouse Incinerator to destroy PCB-contaminated soil.

The Monroe and Owen County Health Departments were contacted for any additional health concerns. Health officials reported cancer rates as the primary community health concern.

These concerns will be addressed in the Public Health Implication Section of the this report.

PUBLIC HEALTH IMPLICATIONS

In this section we will discuss the health effects of persons exposed to specific contaminants, evaluate state and local health databases, if available, discuss the results of numerous health studies on populations residing in and around the Bloomington area, and address any existing community health concerns.

A. Toxicological Evaluation

This subsection of the report assesses the public health implications of contaminants that are associated with an exposure pathway that have not been eliminated in the Pathways Analyses section.

Although the chemical of major interest in this document is polychlorinated biphenyls, there were other chemicals found at the six sites that are considered in this evaluation. These chemicals are aluminum, arsenic, bis(2-ethylhexyl)phthalate, boron, cadmium, chromium, chloroethane, cobalt, dioxins, heptachlor, lead, naphthalene, sodium, tetrachloroethene, 1,1,1-trichloroethene, trichloroethylene, vanadium, vinyl chloride, and zinc. Table 50 contains a list of the chemicals of concern by site, media, and location.

Table 50. Summary of Chemicals of Concern by Site and Media

Site	Chemicals of Concern and Affected Media
Anderson Road Landfill	PCBs: On-site subsurface soil On-site groundwater Hepta-chlorodibenzofuran: On-site pond surface water
Bennett Stone Quarry	PCBs: On-site soil On-site pond sediment On-site groundwater
Clear Creek	PCBs: Fish Tissue
Lemon Lane Landfill	Aluminum: Off-site springs surface water Cadmium: Off-site groundwater Off-site springs & streams surface water Naphthalene/2-methylnaphthalene: Off-site spring sediment PCBs: On-site groundwater On-site subsurface soil Off-site sediment Off-site surface water Sodium: Off-site stream surface water Tetrachloroethene: Off-site springs surface water Trichloroethylene: Off-site groundwater Off-site springs surface water
Neal's Dump	PCBs: On-site subsurface soil On-site groundwater

Site	Chemicals of Concern and Affected Media
Neal's Landfill	Aluminum: Off-site stream surface water Arsenic: Off-site stream surface water Boron: Off-site stream surface water Chromium: Off-site springs surface water Chloroethane: On-site groundwater Cobalt: Off-site stream surface water Dioxins: On-site soil borings Dioxins & Furans: On-site subsurface soil Heptachlor: Off-site spring surface water Lead: Off-site stream surface water PCBs: On-site ambient air On-site groundwater Off-site surface water On-site sediment On-site surface water Sodium: Off-site stream surface water 1,1,1-Trichloroethane: On-site groundwater Trichloroethylene: On-site groundwater Off-site streams surface water Vanadium: Off-site streams surface water Vinyl Chloride: On-site groundwater Zinc: Off-site streams surface water
Winston-Thomas Facility	PCBs: On-site groundwater On-site surface water On-site sludge (Tertiary Lagoon) Off-site sediment

To evaluate health effects, ATSDR has developed a Minimal Risk Level (MRL) for chemicals commonly found at hazardous waste sites. The MRL is an estimate of daily human exposure to a chemical below which non-cancer, adverse health effects are unlikely to occur. MRLs are developed for each route of exposure such as ingestion, inhalation, and for the length of exposure such as acute (less than 14 days), intermediate (15-364 days), and chronic (greater than 365 days). ATSDR presents these MRLs in toxicological profiles. These chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status. In the following discussion, where ever possible, ATSDR Toxicological Profiles have been used for the chemical evaluation.

The chemical profiles that follow are evaluated based on their potential, though highly unlikely, to contaminate private wells. Based on the dye tracer studies performed at Lemon Lane Landfill and Neal's Landfill, the flow of water from these two sites is primarily toward each site's associated springs or streams. Sample analysis of private wells within a 5,000-foot radius revealed no PCBs, and organic and inorganic chemicals were below the maximum contaminant level for drinking water. The chemicals detected in site associated streams or springs are therefore considered potential contaminants of private wells and are presented below along with the other chemicals of concern.

Aluminum

Aluminum is a natural element in the earth's crust. It is used in the manufacturing of deodorants, cooking and eating utensils, appliances, building materials, and for the treatment of water.

When aluminum enters the body, very little is absorbed into the bloodstream; most of it will leave the body through the feces and urine. Exposure to this chemical is usually not harmful. Large amounts of aluminum have been shown to cause harm in the unborn and developing animals. Very little aluminum enters the body through inhalation and dermal contact. (ATSDR Toxicological Profile for Aluminum)

Aluminum was found in the Lemon lane Landfill off-site springs surface water at 2,300 ppb, and the off-site stream surface water for Neal's Landfill at 49,000 ppb. Because aluminum is not readily inhaled or absorbed through the skin, the only route of exposure remaining is ingestion. This water is not used for drinking. Aluminum is a potential contaminant of private wells at both of these landfills.

Arsenic

Inorganic arsenic has been determined to be a cancer causing agent. The single most characteristic effect of long-term oral exposure to inorganic arsenic is a pattern of skin changes. This includes a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. While these skin changes are not considered to be a health concern, a small number of the corns may ultimately develop into skin cancer. Swallowing arsenic has also been reported to increase the risk of cancer in the liver, bladder, kidney, and lung. (ATSDR Draft Toxicological Profile for Arsenic)

Arsenic was found in the off-site streams surface water associated with Neal's Landfill. The estimated daily dose for arsenic potentially found in private wells was higher than the EPA Reference Dose (RfD) and the chronic oral MRL, and presents a low increased risk of cancer. No observed adverse health effects have been observed in humans exposed to arsenic at the estimated daily dose level.

Boron

Boron is a solid substance that widely occurs in nature. Boron alone does not dissolve in water. Over half of the boron taken by mouth can be found in urine within 24 hours. (ATSDR Toxicological Profile for Boron)

Boron was found in Neal's Landfill off-site stream surface water at 9,400 ppb. The estimated daily exposure dose was calculated based on the potential for private wells to be contaminated at the specified levels. The dose was higher than the RfD and the intermediate MRL for boron. The estimated daily exposure dose was lower than the level at which adverse health effects were noted in animal studies. Based on this information, adverse health effects are not expected from exposures at the detected levels.

Cadmium

Cadmium is an element that occurs naturally in the earth's crust. Pure cadmium is a soft, silver-white metal; however, cadmium is not usually found in the environment as a metal. It is found as a mineral combined with other elements such as oxygen, chlorine, or sulfur. These compounds are solids that may dissolve in water but do not evaporate or break down in the environment.

Cadmium can enter the body from food consumed or particles breathed in. Very little cadmium enters through the skin. If the body does not receive enough iron or other nutrients, it will likely take up more cadmium than usual from food. Another source of cadmium is cigarette smoke. Cadmium that enters the body stays in the liver and kidneys, and very little leaves the body. The body keeps most of the cadmium in a form that makes it not harmful, but too much of it can overload the kidneys' storage system and cause health damage. (ATSDR Draft Toxicological Profile for Cadmium)

Cadmium was found in the off-site groundwater monitoring wells at 8 ppb, and at 9 ppb in the off-site springs and streams surface water of Lemon Lane Landfill. An estimated daily dose exposure was calculated assuming the migration of contamination to the off-site private wells. The calculated exposure dose was lower than the MRL for this chemical. It was also lower than the level of lowest observed adverse health effects for less serious health effects in humans and animals. Cadmium is a potential contaminant of private residential wells. Adverse health effects are not expected at the levels detected.

Chloroethane

Chloroethane, which is also called ethyl chloride, is a colorless gas at room temperature and pressure, with a characteristic, sharp odor. Chloroethane is a manmade compound, and human activity is responsible for almost all the chloroethane released to the environment. Most chloroethane released to the environment ends up as a gas in the atmosphere, but small amounts may enter groundwater as a result of filtration through soil. Once in the atmosphere, chloroethane breaks down fairly quick by reacting with substances in the air. (ATSDR Toxicological Profile for Chloroethane).

Chloroethane will most often enter the body by being inhaled, although it may also enter the body through contaminated drinking water. Because this chemical was found at Neal's Landfill in the on-site groundwater at 5 ppb, there is a potential for private wells to be contaminated as well. The health effects resulting from long-term human exposure to water containing specific levels of chloroethane are not known. It is not known if chloroethane produces cancer in humans. There is no chronic ingestion MRL for this chemical.

Chromium

Chromium is a naturally occurring element that is found in soil and in volcanic dust and gases. Chromium compounds produced by the chemical industry are used for chrome plating, the manufacture of pigments, leather tanning, wood treatment, and water treatment.

For most persons, exposure to small amounts of chromium results from breathing air and ingesting drinking water and food containing chromium. Because small amounts of chromium occur in many foods, most chromium enters the body from dietary intake. Long-term exposure of workers to airborne levels of chromium higher than those in the natural environment has been associated with lung cancer.

There are three major forms of chromium, which differ in their effects on health; however, chromium (VI) is the form responsible for most adverse health effects. Chromium VI is irritating, and short-term high-level exposure can result in adverse effects at the site of contact, such as ulcers of the skin, irritation of the nasal mucosa and perforation of the nasal septum, and irritation of the gastrointestinal tract. It may also cause adverse effects in the kidney and liver. (ATSDR Draft Toxicological Profile for Chromium)

Chromium was found at a concentration of 76 ppb in the off-site streams surface water associated with Neal's Landfill. The estimated daily exposure dose was lower than the RfD for chromium VI. Further, the data we have are for total chromium, which is a combination of all three forms of this chemical. Adverse health effects are not expected at the detected levels.

Cobalt

Cobalt has both beneficial and harmful effects on human health. It is found in sewage sludge from cities sometimes at high levels. Cobalt is mostly used to make mixtures of metals, a drier for paint and porcelain enameling. Small amounts of cobalt are added to or naturally occur in foods.

Cobalt is part of vitamin B_{12} which is essential to maintain human health. It has been used as a treatment for anemia. It has not been found to cause cancer in humans or in animals following exposure in the air or in food or water.

The amount of cobalt that enters the body from food or water depends on many things including an individual's state of health; the amount of food or drink consumed; and the number of days, weeks, or years food or drinks containing cobalt are consumed. If there is not enough iron in the body, more cobalt is absorbed from the foods consumed. After cobalt enters the body, it can go into all tissues, but mainly the liver, kidney, and bones. Cobalt leaves the body slowly, mainly through the urine. (ATSDR Toxicological Profile for Cobalt)

Cobalt was found in the off-site streams surface water associated with Neal's Landfill. The estimated daily exposure dose, based on the assumption that this chemical could be found in private wells, was much lower than the level at which no health effects were observed in humans exposed to cobalt orally.

Dioxins

Chlorinated dibenzo-p-dioxins are a class of compounds that are referred to as dioxins. There are 75 different dioxins which are referred to as congeners. The dioxin which is most commonly found has four chlorines attached; it is 2,3,7,8-dibenzo-d-dioxin (2,3,7,8-TCDD). This chemical is a colorless solid with no known odor. It is released from herbicides, wood preservatives, pulp and paper manufacturing plants, burning wood, exhaust from automobiles, and from transformer/capacitor fires.

No studies are available on the inhalation toxicity of 2,3,7,8-TCDD. Chloracne is the only health effect shown to be produced by dioxins in humans. Dermal exposure to dioxins has been associated with an increase in soft tissue sarcomas and lymphomas. (ATSDR Toxicological Profile for 2,3,7,8-Tetrachlorodibenzo-p-dioxin)

A toxic equivalency factor is a number that has been assigned to a chemical that represents its relative degree of toxicity. This number is then multiplied by the comparison value of its chemical congener. The product is the toxic equivalency factor.

As certain chemicals share similar properties, they are assumed to produce similar health effects. Furans and dioxins are such chemicals. There is currently no health value for furans, although they appear to be less potent than 2,3,7,8-TCDD. For this report, however, the MRL for 2,3,7,8-TCDD was used for all dioxin and furan congeners. Air concentrations for dioxins and furans are reported as toxic equivalency factor concentrations for 2,3,7,8-TCDD.

Dioxins and furans were found in the on-site subsurface soil of Neal's Landfill at a maximum concentration of 0.11 ppb (TEFC). An estimated daily exposure dose was calculated using the worst-case scenario for human exposure. All exposure doses were below the MRL for 2,3,7,8-TCDD. Dioxins were found in the on-site soil boring samples at Neal's Landfill at a maximum concentration of 0.8 ppb (TEFC). The estimated daily exposure dose for scavengers and/or trespassers was above the MRL for 2,3,7,8-TCDD.

The hepta-chloro dibenzofuran congener was found in the on-site pond surface water at Anderson Road Landfill at 5 ppt in the sediment. The estimated daily exposure dose of this chemical was greater than the MRL for 2,3,7,8-TCDD. We have no information on the health effects of this chemical at the detected levels.

Heptachlor

Heptachlor is a manmade chemical that was used in the past for killing insects in homes, buildings, and on food crops. This chemical binds to soil very strongly and evaporates into the air. It does not dissolve easily in water. Heptachlor in soil can be taken up by plant roots. Animals that eat plants containing heptachlor can also absorb it. (ATSDR Toxicological Profile for Heptachlor/Heptachlor Epoxide)

Heptachlor was found in the on-site groundwater and the off-site springs surface water of Neal's Landfill at 0.1 ppb. The estimated daily exposure dose was calculated assuming off-site contamination of private wells. The dose was less than the RfD for this chemical. There is an insignificant increased risk of cancer due to exposure to this chemical at the specified levels.

Lead

Lead is found in the earth's crust as a naturally occurring metal. Due to human activities (use of leaded gasoline), lead has spread to the air, drinking water, rivers, lakes, oceans, dust, soil, and thus animals and plants. Lead can enter the body through inhalation (lead dust), ingestion (lead contaminated foods), and only small portions will absorb through the skin.

Lead is partitioned first in the soft tissues (liver, kidneys, lungs, brain, spleen, muscles, and heart). After several weeks it travels to and is stored in bone and teeth. Symptoms associated with lead exposure include possible decrease in memory; weakness in the fingers, wrists, or ankles; and anemia.

Children are more sensitive to the effects of lead than adults. Lead exposure can cause premature birth, smaller babies, decreased intelligent quotient scores (IQ) and reduced post-natal growth. High lead exposure may cause abortion and damage to the male reproductive system in adults, and brain and kidney damage in both children and adults. (ATSDR Draft Toxicological Profile for Lead)

Lead was found at 122 ppb in the off-site stream surface water associated with Neal's Landfill. ATSDR has not derived an MRL for lead. An RfD does not exist for lead because no thresholds have been demonstrated for the most sensitive effects in humans. The RfD is an estimate of daily human exposure to a contaminant for a lifetime below which noncancer health effects are unlikely to occur.

A quantitative estimate of the carcinogenic risk from oral and inhalation exposure to lead has not been determined. Quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. There is currently only a potential threat of exposure to this chemical.

Naphthalene/2-Methyl Naphthalene

Naphthalene is a white solid substance with the characteristic odor of tar or mothballs. It is released into the air from the burning of fuels such as coal and oil and from the use of naphthalene-containing mothballs. Naphthalene evaporates easily. When it is released into the air, humidity and sunlight cause it to break down within a few hours.

The primary health concern for humans exposed to naphthalene for either short or long periods of time is Hemolytic Anemia (a condition involving the breakdown of red blood cells). Other effects commonly found include nausea, vomiting, diarrhea, kidney damage, jaundice (yellowish skin or eyes), and liver damage. These effects can occur from either breathing or eating naphthalene. Cancer has not been seen in humans or animals exposed to naphthalene. (ATSDR Toxicological Profile for Naphthalene/2-Methyl Naphthalene)

Naphthalene and methylnaphthalene were found at 1 ppm in the off-site springs sediment associated with Lemon Lane Landfill. There is currently no health comparison value for both of these chemicals. Based on a calculated ingestion dose for a trespasser/scavenger exposed to these chemicals on a daily basis for a lifetime, there are no expected health effects. Animals exposed daily to similar concentrations for long or short periods of time have shown no health effects.

Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a family of 209 chemicals with varying numbers of chlorine atoms. Commercial PCB products are always mixtures of PCBs and are usually contaminated with small amounts of polychlorinated dibenzofurans (furans) or polychlorinated dibenzodioxins (dioxins). Contamination by furans is a concern because their toxicity is generally much greater than that of PCBs.

PCBs have caused elevated liver enzyme levels and chloracne in humans, and may be associated with reproductive effects. They cause cancer in animals and may cause cancer in humans. PCBs are environmentally persistent and concentrate upward in the food chain. The chemical stability of PCBs accounts for their persistence in the environment. Another important reason for their persistence is their resistance to biodegradation.

Fetuses and neonates are potentially more sensitive to PCBs than adults because of its distribution across the placenta and physiologic differences. They lack enzymes which are normally found in the liver that make the breakdown and excretion of PCBs easier.

Furthermore, PCBs accumulate in breast milk. Nursing infants are at additional risk of accumulation of PCBs because human milk contains a chemical that blocks the normal breakdown and excretion of PCBs. Excretion of PCBs is slow, so accumulation occurs even at low exposure levels. The higher the chlorination, the longer it takes to be excreted by the body. Antibiotics, tobacco smoke, and alcohol consumption increase a person's susceptibility to adverse health effects caused by PCB exposure. (ATSDR Draft Toxicological Profile for Selected PCBs)

PCBs are stored in the fat of the body. As exposure continues, PCBs can accumulate in the body. PCBs have been shown to cause elevations in blood fats such as triglycerides and cholesterol, to cause increases in certain liver and kidney enzymes, to cause irritation of the skin and eyes, and have been associated with certain types of cancers in individuals occupationally exposed.

Cancer and reproductive effects of PCBs in humans have not been adequately studied, but there is some suggestion that PCBs are associated with malignant melanoma, leukemia, and cancers of the liver, gall bladder, and biliary tract in individuals occupationally exposed. (ATSDR Draft Toxicological Profile for Selected PCBs)

Low levels of PCBs can be found throughout the world. PCBs in water or on soil surfaces evaporate and return to earth by rainfall or settling of dust particles. Because PCBs strongly adsorb to soil particles, significant leaching from soil and translocation to plants does not occur. Although PCBs are widespread in the aquatic environment, their low water solubility helps to prevent high concentrations in drinking water supplies.

Humans may be exposed to PCBs from various sources. Generally, most people are exposed either at their job through the ingestion of contaminated food stuffs, or through exposure to PCBs in the environment.

Food can be a major source of PCB exposure, usually from fish and animal fat. PCBs preferentially separate from water and adsorb to sediment. The food chain starts from small biota feeding on bottom sediments and progresses upward to increasing larger predator fish, then to the final level, which is consumption of fish by man. Individuals eating sport fish more frequently than people who occasionally eat marketed fish might be exposed to higher PCB concentrations. The FDA mandates tolerances of 0.2 to 3 ppm PCBs for all foods, with a tolerance level in fish of 2 ppm.

The ISDH advises that only limited amounts of PCB-contaminated fish be consumed. The FDA action levels are used as guidelines for developing fish consumption advisories for Indiana waters.

As noted in Table 51, the estimated daily exposure dose for individuals eating fish taken from the waterways associated with Neal's Landfill, and the Winston-Thomas facility were above the FDA permissible level. These doses were calculated for men, women, and children eating fish every day of the week, and once a week. Although the estimated daily ingestion exposure dose may not exceed the MRL, based on the methodology used to develop State fish consumption advisories, the ISDH recommends that individuals not consume fish from designated waterways with PCB levels higher than 2 ppm.

Table 51. Comparison of Estimated Exposure Dose to Health Guidelines for PCBs in Fish

Site	Health Guideline For Ingestion Mg/kg/day			
	Fish Species	Date	PCB Concentration (ppm)	Estimated Exposure Dose Exceeds FDA Level?
Bennett Stone Quarry	Creek Chub	3/84	7	no
Neal's Landfill	Northern Hogsucker	2/82	8	yes
	White Sucker Creek Chub	9/82	208	yes
Winston-Thomas Facility	Large Mouth Bass Creek Chub	2/76	66	yes

The fish advisory for Indiana waterways has been in existence since 1988. Sampling has been on-going at the mentioned sites since 1989. Since the safety of consuming contaminated fish remains unclear in some cases, the best way to protect the health of individuals is to limit the amount of fish they consume that are known to be contaminated with PCBs or other lipophilic chemicals. This risk can be reduced further by preparing fish as skinless fillets, trimming off all fat, and by baking or broiling the fish so the fat can drip off while cooking. Preparing potentially contaminated fish in this manner can reduce the amount of consumed contamination by nearly 50 percent.

A group 2 fish advisory was placed on Richland Creek and Clear Creek by the ISDH in 1991. A group 2 fish advisory means that women of child-bearing age and children under the age of 18 should not eat a particular species of fish. All other adult men and women are encouraged not to eat any more than 1 meal per week consisting of up to 1/2 pound of flesh from the designated fish species on the advisory. Currently, there is a group 2 fish advisory for Clear Creek; however, the advisory on Richland Creek was lifted as the fish did not show contamination above the FDA guideline.

Based on the molecular structure of PCBs, it can be anticipated that PCB behavior in soil would be similar to the chlorinated hydrocarbon pesticides which have been used extensively in the past for controlling soil-borne insects.

Pesticide research has shown that there is minimal uptake of these compounds by crops and little translocation of the chemical into the aerial part of the plant. The results of a study of carrots grown in PCB-contaminated soils indicate that small amounts of PCBs were found only in the peelings of the carrot and not in the interior of the root. Surface absorption appeared to be the major mechanism whereby PCBs accumulated in the crop. Analysis of leaf samples indicated that small amounts of PCBs were present, but it was not clear whether this was due to uptake and translocations of the PCBs, or merely surface contamination via dust fall on the surface of the leaves. (Sommers, LE. Memorandum to ISDH. Agronomy, Purdue University. July 7, 1976.)

PCB-contaminated sludge was spread on gardens and pasture lands in the Bloomington area. This resulted in the contamination of garden vegetables and cattle. Vegetables grown in gardens with PCB-contaminated soil should be washed thoroughly and peeled before eating as the chemical is not taken up in large amounts through the root system, but more so from dust landing on the foliage.

Aroclors (PCBs) were found at levels of health concern in groundwater, soil, sediment and surface soil. Table 52 presents the site-specific media and a comparison to the MRL for PCBs. All doses were calculated using children and daily exposure in an effort to evaluate the worst-case scenario.

Table 52. PCB Multi-Media Ingestion Exposure Dose and Cancer Risk Summary Table For All Consent Decree Sites

SITE	MEDIA	ABOVE MRL	CANCER RISK
Anderson Road Landfill	subsurface soil (on-site)	yes	low increase
	groundwater (on-site)	yes	no apparent
Bennett Stone Quarry	soil (on-site)	yes	very high
	pond sediment (on-site)	yes	no apparent
	groundwater (on-site)	yes	moderate increase
Lemon Lane Landfill	groundwater (on-site)	yes	low increase
	subsurface soil (on-site)	yes	high increase
	sediment (off-site)	yes	moderate increase
Neal's Dump	subsurface soil (on-site)	yes	moderate increase
	groundwater (on-site)	yes	very high increase
Neal's Landfill	groundwater (on-site)	yes	low increase
	surface water (off-site)	yes	low increase
Winston-Thomas Facility	groundwater (on-site)	yes	low increase
	surface water (on-site)	yes	low increase
	sediment (off-site)	yes	high increase

Scavengers and trespassers are the population most at risk of developing health effects due to their activities on these sites. Their primary route of exposure would be through dermal contact with PCB-contaminated soils and sediments. Studies have shown that such exposures do not result in increased body burdens of serum PCBs. This is probably due to the fact that PCBs have a greater affinity for organic matter found in soil than for the skin.

When we calculated the estimated cancer risk by multiple routes of exposure (i.e., incidental ingestion and dermal contact), however, the results indicated a change in the cancer risk. There is a high increased risk of cancer for individuals coming into contact with contaminated sediments associated with Neal's Dump, and a moderate to low increased risk of cancer at Bennett Stone Quarry, Neal's Landfill, and Lemon Lane Landfill.

In calculating the estimated cancer risk, we assumed that the exposed population was children and that they were exposed five days per week. We also assume that 100 percent of the contaminated sediment that is ingested is available for absorption by the gastrointestinal tract and that 100 percent of the contaminated sediments are absorbed through the skin. All cancer risks were based on the highest concentration of PCBs found in sediments at each site. These assumptions provide for the worst-case scenario and maximize the actual cancer risk.

No human and/or animal studies link dermal exposure to PCBs with the following adverse health effects: neurological, developmental, or reproductive. No animal studies link dermal exposure to PCBs with adverse health effects in the blood, liver, kidney, or the immune system. The long-term effects of human exposure to PCBs have not been fully determined. PCBs may produce harmful effects, however, if consumed over a long period of time. PCBs are currently only a potential contaminant of private wells surrounding the six sites. Recent sampling indicates that there are currently no exposures to PCBs in drinking private well water.

The other probable route of exposure for scavengers and trespassers was inhalation. Exposure scenarios used for estimated inhalation dose were scavenger exposure of 5 days per week and trespassers at 1 day per week. All exposures were assumed to be for 30 weeks per year for 10 years. Doses were calculated for children and adults. There is no inhalation MRL for PCBs. Dose levels were compared to the lowest level that adverse health effects (LOAEL) have been observed in animal studies (LOAEL = 3 $\mu g/m^3$), and the National Institute of Occupational Safety and Health (NIOSH) 10-hour time-weighted average of 1 $\mu g/m^3$. One sample of PCBs in the on-site ambient air at Lemon Lane Landfill was above the LOAEL for animals. The levels found in the on-site ambient air at Neal's Landfill were predominantly higher than the LOAEL.

It is important to note that these air samples were all taken prior to the interim remediation, which included the removal of leaking capacitors, the excavation of PCB-stained soil, the removal of PCB-contaminated water and sediments, restriction to the sites, and capping of all sites. These remediation steps reduce the risk of the surrounding community being exposed through ambient air to levels of PCBs that could be harmful to their health.

Sodium

Elevated sodium intake has been associated with the prevalence of hypertension in various populations throughout the world. Long-term ingestion of high concentrations of sodium are believed to be associated with the development of hypertension and would complicate clinical treatment of hypertensive patients on salt-restricted intakes.

Sodium was found in elevated levels in the off-site streams surface water associated with Lemon Lane Landfill and Neal's Landfill. Sodium is a potential contaminant of private wells within 5,000 feet of Lemon Lane Landfill.

Tetrachloroethene

Tetrachloroethene (PCE) is a manmade substance that is used for dry cleaning purposes, and for metal degreasing operations. It is also used as a building block in the manufacturing of other chemicals.

The levels of PCE in city or industrial areas, especially around dry cleaner shops, are higher than in rural areas. The use of products which contain PCE is another means of exposure. Products that may contain PCE include water repellents, lubricants, suede protectors, spot removers, and wood cleaners. (ATSDR Draft Toxicological Profile for Tetrachloroethylene)

PCE was found at 32 ppb in the off-site springs surface water of Lemon Lane Landfill. The most common route of exposure to this media is through dermal contact. An estimated ingestion exposure dose was calculated due to the potential for off-site private wells to be sharing the same aquifer as the springs. All doses were considerably higher than the MRL for PCE. Estimated cancer risk would be increased for children and adults if private wells were contaminated with PCE at the levels in the springs.

1,1,1-Trichloroethane

1,1,1-Trichloroethane is a colorless manmade chemical which does not occur naturally. It is often used as a solvent to dissolve other substances. It is used in homes in such products as spot cleaners, glues, and aerosol sprays. Regardless of how 1,1,1-trichloroethane enters the body, nearly all of it leaves the body through exhaled air. (ATSDR Toxicological Profile for 1,1,1-Trichloroethane)

This chemical was found in the on-site groundwater at Neal's Landfill at 890 ppb. An estimated daily exposure dose was calculated. The results were considerably less than the no observed adverse health effect level found in human research. The health effects resulting from long-term human exposure to water containing specific levels of 1,1,1-trichloroethane are not known.

Trichloroethylene

Trichloroethylene is a manmade chemical that does not occur naturally in the environment. It is a nonflammable, colorless liquid at room temperature with an odor similar to ether or chloroform. It is mainly used as a solvent to remove grease from metal parts.

Trichloroethylene can easily enter the body through ingestion, inhalation, or dermal contact. This chemical is not likely to build up in the body. Exposure to high levels of trichloroethylene in air can cause dizziness, sleepiness, and damage to some of the nerves of the face. It has caused rashes in some individuals who were exposed dermally. It is not known if this chemical causes cancer or will affect human reproduction. (ATSDR Draft Toxicological Profile for Trichloroethylene)

Trichloroethylene was found in the off-site groundwater and off-site springs surface water at Lemon Lane Landfill at 61 and 45 ppb respectively. The intermediate MRL for trichloroethylene is 100 ppb, which assumes exposure for longer than 14 days, but less than 1 year. The estimated daily ingestion dose for children and adults is considerably higher than the intermediate MRL. Using this water for drinking purposes for an extended period of time increases the risk of cancer.

The dye tracer study done on the springs at Lemon Lane Landfill suggests that water flows from under the site toward the springs instead of residential wells. It is important to note that the residential wells surrounding Lemon Lane Landfill have been tested for PCBs and priority pollutants. All wells were non-detect for PCBs and below the maximum contaminant level for all priority pollutants. This chemical currently is a potential contaminant of private drinking wells.

Trichloroethylene was found in the on-site groundwater of Neal's Landfill at 25,700 ppb, and in the off-site streams surface water associated with Neal's Landfill at 56 ppb. The estimated daily exposure dose, assuming the residential wells could potentially be contaminated, was higher than the MRL for this chemical. There is a low increase cancer risk if this chemical were to contaminate private wells at the specified levels.

Vanadium

Vanadium, a metal, is considered nontoxic. Headache, dry mouth, and irritated eyes have been seen in workers exposed to vanadium compound dust. The usual signs of exposure are irritated mucous membranes and/or lungs. (ATSDR Toxicological Profile for Vanadium)

Vanadium was found in the off-site streams surface water associated with Neal's Landfill at elevated levels. The estimated ingestion exposure dose was higher than the intermediate oral MRL for this chemical. This chemical is considered a potential contaminant of the private wells within 5,000 feet of Neal's Landfill.

Vinyl Chloride

Vinyl chloride is a colorless vapor with a mild, sweet odor. It can exist in liquid form if it is kept under high pressure. Almost all vinyl chloride is manmade, or can occur from the breakdown of TCE. Most of the vinyl chloride produced in the United States is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products including pipes, wire and cable coatings, and packaging materials. Other uses include furniture and automobile upholstery, wall coverings, housewares, and automotive parts.

The most likely way to be exposed to vinyl chloride is by breathing it. Vinyl chloride does not enter the body by passing through the skin. Most of the vinyl chloride is gone from the body a day after either breathing it in or swallowing it. The liver, however, makes some new substances that do not leave the body as rapidly. A few of these substances are more harmful than vinyl chloride because they react with chemicals inside of the body and interfere with the way the body uses or responds to these chemicals. It takes more time for the body to get rid of these changed chemicals, but eventually it will remove them as well. (ATSDR Draft Toxicological Profile for Vinyl Chloride)

Based on animal studies, it has been determined that vinyl chloride is a known carcinogen. Studies of long-term exposure in animals show that increases in cancer may occur at very low levels of vinyl chloride in the air. Vinyl Chloride was found in the on-site groundwater of Neal's Landfill at 2,360 ppb. The estimated daily ingestion dose for this chemical is higher than the MRL. This chemical is currently a potential contaminant of private wells in the Neal's Landfill area.

Zinc

Zinc is the 24th most common element in the earth's crust. It is found in air, soil, and water, and is present in all foods. Taking in too little zinc is at least as important a health problem as taking in too much zinc. Without enough zinc in the diet, individuals may experience loss of appetite, decreased sense of taste and smell, slow wound healing, and skin sores. (ATSDR Draft Toxicological Profile for Zinc)

Zinc was found in the off-site streams surface water associated with Neal's Landfill at 112,000 ppb. The estimated daily exposure was calculated assuming individuals could potentially be exposed to this chemical through private well use. The exposure dose was above the RfD for zinc. It was also higher than the LOAEL for less serious blood associated health effects in humans.

B. Health Outcome Data Evaluation

Using State health databases, it may be possible to determine whether certain health effects are observed more frequently than expected in Monroe and Owen Counties.

Data from the National Cancer Institute, CDC, and the American Cancer Society were reviewed through the State Cancer Control Map and Data Program. The data were standardized to the U.S. 1970 standard. All data were adjusted for gender, race, and age. Information was reviewed by decade for the period 1958-1987. (National Cancer Institute. State Cancer Control Map and Data Program).

Because white females were the only population that showed statistically significant increases in cancer, the discussion that follows will focus on all cancers found in white females. Table 53 contains the cancer statistics for white females who live in Monroe or Owen County. The asterisk beside the years and cancer types indicates that the specific cancer type was not due to random chance (statistically significant). All cancers statistically significant in one county were listed in the other county for comparison purposes. The rank in the State is based on there being 92 counties in Indiana with the first county being the county with the highest reported level of a specific cancer.

The standardized mortality ratio (SMR) is determined by dividing the observed number of cases by the expected number of cases. It can be used as a first cut to identify problem areas. If the SMR is 100, it indicates that the expected and observed number of cases are the same. If the SMR is less than 100, this indicates that the observed number is less than the expected. When the SMR is greater than 100, it suggests that the observed is greater than the expected. In most cases, increases in the SMR above 100 are due to chance since the number of cancer cases can fluctuate from year to year.

Table 53. Cancers (White Females) in Monroe and Owen Counties

County	Year	Cancer Type	Observed Number	Expected Number	Rank in State	SMR
Monroe	***1958-67**	**Cervix Uteri**	**31**	**18.9**	**18**	**163.8**
	1968-77		18	15.0	51	120.0
	1978-87		20	12.6	23	150.5
	1958-67	Colorectal	50	54.5	79	91.7
	1968-77		61	65.2	73	93.6
	1978-87		77	82.8	79	93.0
	1958-67	**Ovary**	20	22.5	56	89.0
	***1968-77**		**51**	**28.4**	**2**	**179.4**
	1978-87		45	34.7	12	129.7
Owen	***1958-67**	**Cervix Uteri**	**8**	**5.4**	**21**	**149.0**
	1968-77		2	3.7	89	53.7
	1978-87		2	2.9	81	68.4
	1958-67	Colorectal	32	18.8	2	170.1
	1968-77		17	19.3	58	88.3
	1978-87		16	21.9	90	73.2
	1958-67	Ovary	5	6.7	64	74.1
	1968-77		12	7.5	6	161.0
	1978-87		9	8.5	26	105.7

* = Statistically Significant

The number of women dying from ovarian cancer in Monroe County was statistically significant for the years 1958-1967. Ovarian cancer is considered a disease of older age. The actual cause of Ovarian cancer is unknown. Suggestive environmental causes of ovarian cancer are diet, occupation, alcohol, smoking, talc, and asbestos. (Daly, MB. The Epidemiology of Ovarian Cancer, August 1992.)

The mortality rate for ovarian cancer in Monroe County was similar to that observed from 1958-1987. Death records were reviewed for the period 1970-1990 for all white females in Monroe County who died of ovarian cancer. The rate of mortality did not change significantly for these years. The age adjusted incidence of ovarian cancer was also reviewed; it was lower than the national average for 1987-1990.

The number of women dying from cervical/uterine cancer in Monroe and Owen Counties was statistically significant for the years 1958-1967. These data do not suggest an environmental component to these cancers. If there was a relationship between an exposure and an increase in cancer incidence, we would expect to see a consistent increase of any one particular type of cancer. (EPA, U.S. Cancer Mortality Rates and Trends 1959-1979)

The ISDH has maintained a Birth Problems Registry from 1987-1991. This registry contains information on infants born with congenital anomaly(ies), low birth weight, and fetal deaths. The registry is categorized by race of mother, and the county and birth year of the infant. Data do exist for Monroe and Owen Counties and the State of Indiana (ISDH. Birth Problems Registry, March 1993).

A review of the data of all fetal deaths in Monroe and Owen Counties was done. The definition of a fetal death in this database is any pregnancy of five months or more. It is important to note that these data have a gap of missing information for all miscarriages occurring prior to a five-month gestation.

Statistical analysis of data for the period 1987-1991 did not show any statistical significant trends in the occurrence of miscarriages in Owen or Monroe County.

If an area has very few births, the observed birth defect rate or miscarriage rate may be very different from the true rate. Thus, if two areas are compared in a given year and one (or both) of the area's rates is based on a small number of births, it would not be unusual to find the comparison reversed the following year. (Kleinman, JC. Infant Mortality, Healthy People 2000 Statistical Notes, Vol. 1, No. 2, Winter 1991)

The ISDH Birth Problems Registry is relatively new, thus the information it contains is not capable of showing any indication of significant trends of concerns or problems that may be as a result of site-related chemicals. A large number of years and birth per years are required to determine if the occurrence of a birth defect is statistically significant (not due to random chance).

C. Health Studies

Several health studies have been performed on populations residing in and around the Bloomington area. The following is a summary of the findings from these studies. Environmental health data is presented to make the information more complete and understandable in this section. The studies are categorized as general community health studies, occupational health studies, and other health studies.

General Community Health Studies

In Bloomington, Indiana, the municipal sewage treatment plant has made sewage sludge available to local residents for use as fertilizer since the mid-1960s. Much of this sludge was used in organic gardens by persons who wished to minimize their exposure to agricultural chemicals. From 1972 through 1976, approximately 500 to 1,000 persons had obtained sludge at the plant. In the 1970s, however, Bloomington residents began to suspect that their sludge might be contaminated with waste PCB discharge into the sewage system by an electrical capacitor manufacturing plant.

The factory had been discharging waste PCBs into the Bloomington municipal sewage system throughout the 18 years of its operation. Further environmental testing through August 1976 confirmed the presence of PCBs in raw sewage, sewage sludge, sludge-treated soil, and in vegetables grown in treated soil (see Table 54). (Baker et al. 1980)

Among the toxic materials found in mixed industrial and domestic sewage have been metals including cadmium, lead, zinc, nickel, copper, molybdenum, selenium, chlorinated hydrocarbons, and pesticides. With repeated application, these materials may accumulate in soils and may have the potential to be absorbed by plants, eventually to reach foodstuffs. (Baker et al. 1980)

In 1976, then Mayor Francis X. McCloskey, asked the CDC to evaluate the health effects of exposure to PCBs in individuals who used this contaminated sludge in their gardens. (Baker et al. 1980)

PCB levels in vegetable samples (see Table 54) were generally much lower than those in the soils in which they were grown. Root crops such as beets and carrots appeared to absorb PCBs from soil more efficiently than leafy vegetables. This apparent difference may have been a result of adherence of PCB-contaminated soil to the exterior surfaces of root vegetables. (Baker et al. 1980)

In this study, mean serum PCB levels were 71.7 ppb in the 18 individuals occupationally exposed, 33.6 ppb in the 129 members of these workers' families, 17.6 ppb in 91 persons exposed to the sludge, and 23.8 ppb in 23 persons who were believed not to have any exposure to PCBs. Forty-nine percent (45) of the sludge users had less than two years of exposure to PCBs. The maximum exposure was for four years. No chloracne or systemic symptoms of PCB toxicity were noted. Serum levels of gamma-glutamyl transpeptidase (GGTP) increased with PCB concentrations. There were no other correlations found between PCB levels and tests of hepatic or renal function. Plasma triglyceride levels increased with serum PCB concentrations. The authors stated that these data suggest that PCBs may impair liver function and alter metabolism at exposures insufficient to cause overt symptoms. (Baker et al. 1980)

Table 54. PCB Concentrations in Environmental Samples Taken During 1976 Study of Sludge Users (Baker et al. 1980), Bloomington, Indiana

Sample Type	PCB Concentration Range (ppm)
capacitor plant discharge	1.3-5.5
raw sewage (influent)	0-0.5
sludge	0.1-1,700
sludge treated soil	0.1-107.3
untreated Soil	0-0.9
root vegetables	0-0.6
leaf vegetables	0-0.3

In late 1983, the ISDH asked the CDC for assistance in studying exposure to PCBs among residents living near three waste sites (Lemon Lane Landfill, Neal's Landfill, and Bennett Stone Quarry) in the Bloomington area. A pilot study was conducted to evaluate persons at high risk of exposure to these waste sites and determine if any of these individuals had abnormally elevated serum PCBs, and to determine which environmental pathways among those containing PCBs might have contributed most to producing abnormally elevated levels of PCBs in human sera. Based on the results of a screening survey of 995 individuals who lived in proximity to these three sites, a total of 114 individuals were selected to participate in the full study. Of the 20 individuals with serum PCB levels greater than 20 ppb, seven had known occupational exposures, five were in the highest risk group, and nine were from the randomly selected at risk group. Twenty percent of the 61 individuals in the highest risk group had elevated serum PCB levels while 16.3 percent of the randomly selected at risk group had elevated serum PCB levels. No specific environmental pathway, with the exception of occupational exposures and scavenging of capacitor parts, could be identified. One explanation given was that exposures in the community were actually taking place from a combination of pathways, although they could not be individually implicated. No statistically significant differences between the highest risk group and either of the two comparison groups (unexposed group and the randomly selected at risk group) were detected for any of the general specific diagnostic categories as elicited from the health effects survey questionnaire or from the clinical chemistries results. There was, however, a statistically significant dose-response relationship between serum PCB levels and the occurrence of self-reported high blood pressure; this relationship remained statistically significant when the data were controlled for the possible confounding effects of age or smoking. The authors recommended further study of the population to ascertain which exposure pathways were responsible for the increased levels of serum PCBs identified, and recommended a larger epidemiologic study investigating the effect of serum PCBs on measured blood pressure (Stehr-Green, Welty, and Steele. 1986; Stehr, Welty, Steele, and Steinberg. 1986; Steinberg et al. 1986.)

Table 55. Exposure Assessment Results, January & March 1984

Exposed Population	Number Exposed	PCB Concentration (ppb)	
		Mean	Range
Workers	58 (34 Westinghouse)	31.7	15-75
Scavengers	37	15.7	4-51
Diggers	81	11.7	4-42
Fish Eaters	352	9.1	4-18
Game Eaters	193	8.0	5-12
Playing On-site	220	8.2	5-12
Swimmers	200	11.4	3-23
Non-Exposed	263	6.3	4-13
Randomly Selected	-	11.1	2-47
Living Near Sites	-	8.6	3-13
Total	995		

Five individuals who had participated in the 1977 NIOSH study and six individuals who had participated in the sludge users study participated in the study (Stehr et al. 1986) previously mentioned. Changes in their higher and lower chlorinated serum PCB congeners were evaluated by reviewing the results of their serum PCB assays conducted in the late 1970s and comparing them to the results of their serum PCB analyzed in 1984. Assuming no continuing exposure in 1977 and a log-linear relation to serum PCB levels over time, which is consistent with first-order kinetics of PCB metabolism, the half-life for the lower chlorinated congeners was estimated to be six to seven months while the half-life for the higher chlorinated congeners was determined to be 33 to 34 months (Steele et al. 1986).

In 1987, the ISDH requested assistance from ATSDR in evaluating the health implications of exposures to PCBs. This study was a follow-up study to the study conducted by CDC and ISDH staff in 1983 and 1984. The goals of this study were to: (1) ascertain if the population in Monroe County from 18 through 65 years of age with serum PCB levels being greater than 20 ppb was similar to what was observed in other cross-sectional studies of populations putatively exposed; (2) evaluate whether there was an association between PCBs and hypertension, and if so, evaluate the strength and nature of the relationship; (3) evaluate the potential of PCBs to induce microsomal enzymes; and (4) to identify those exposure pathways which lead to elevated serum concentrations.

The mean total PCB level was 8.1 ppb for males and 7.8 ppb for females. Approximately 3.6 percent of the study population had serum PCB levels greater than 20 ppb. The range for all study participants was from approximately 1 to 76 ppb. There were statistically significant trends between increasing systolic and diastolic blood pressures and PCB levels in the univariate analyses. After adjustment for other variables in the multivariate regression analysis models, PCB exposure was not associated with either diastolic or systolic blood pressure. There was no association between high-density or low-density cholesterol levels and PCB levels. No statistically significant differences among the liver function enzymes were found with serum PCB levels greater than 20 ppb. No statistically significant associations between PCBs and gender, race, educational level, employment status, dietary consumption of games and vegetation, or recreational activities were identified. Eating homegrown vegetables, however, was the only variable associated (though not significantly) with increased concentrations of serum PCBs. The results of this study indicated that, in spite of the potential for exposure to PCB-contaminated media, individuals living in the general community were generally not at risk of exposure, based on the results of their serum PCB levels (Steele and Richter. 1992).

Occupational Health Studies

In 1975, NIOSH was in the process of identifying capacitor manufacturing facilities that could be used in an industry-wide study of PCB exposures in capacitor manufacturing workers.

The Bloomington Westinghouse plant was chosen for study because the concurrent epidemiological study by Baker investigating human exposures to PCB-contaminated sewage sludge provided background data on serum PCB concentrations. Data gathering began in 1977.

Serum PCB concentrations were many times greater among workers employed in power capacitor manufacturing than among the general population, even comparing employees never assigned to work in PCB exposed areas. Statistically significant correlations of symptoms suggestive of mucous membrane and skin irritation, of systemic malaise, and altered peripheral sensation were noted with increasing concentrations of serum PCBs. No clinical abnormalities attributable to exposure to PCBs were observed. Serum PCB concentrations were positively and significantly correlated with glutamic-oxalacetic transaminase (SGOT), serum gamma-glutamyl transpeptidase (GGTP), and plasma triglyceride, and were inversely correlated with plasma high-density lipoprotein cholesterol. The authors stated that these findings were indicative of PCBs' physiological effect on the liver, whose long-term health significance was unknown. Concerns were raised regarding the long-term cardiovascular effects of exposure to PCBs evidenced by the association of PCBs with plasma triglyceride and the negative association with plasma HDL cholesterol (Smith et al. 1982).

In May of 1984 the ISDH requested assistance from NIOSH to follow-up workers occupationally exposed to PCBs. These workers had participated in a cross-sectional medical study conducted by NIOSH in 1977. Serum log PCB concentrations were quantified as lower chlorinated biphenyls and higher chlorinated biphenyls. Workers were stratified into higher and lower exposed groups based on their 1977 serum PCB concentrations. By 1985 the concentration of the lower chlorinated congeners in the low exposure PCB group decreased by an average of 85 percent of the 1977 values. Serum PCB lower chlorinated congener concentrations in the high exposure group decreased by an average of 90 percent. By 1985 the level of higher chlorinated PCB congeners in the low exposure and the high exposure groups had decreased by 39 percent and 58 percent respectively of the 1977 values. No clinical abnormalities attributable to exposure to PCBs were observed. Serum PCB concentrations were positively and significantly correlated with triglycerides, cholesterol, total bilirubin, conjugated bilirubin, beta glucuronidase, 5-prime nucleotidase, serum apolipoprotein A1, serum apolipoprotein B, urinary creatinine, and urinary alanine aminopeptidase. When the prevalence of symptoms and overt clinical disease were investigated by exposure group, no differences between the groups could be ascertained except for a positive association with GGTP and a negative association with urinary creatinine. The authors state these findings are indicative of PCBs physiological effect on lipid metabolism, liver function, and kidney function.

Also in 1984, the ISDH and NIOSH began to evaluate the mortality experience of a cohort of Westinghouse Electric Corporation workers who were occupationally exposed to PCBs. The primary interest was to determine if this cohort had experienced any increased mortality from cancers previously associated with exposure to PCBs. These included malignant melanoma, liver and biliary tract cancer, cancer of the rectum, hematopoietic malignancies, and lung cancer. It was also intended to examine mortality as a function of job-specific exposures to PCBs and to control for other known exposures in the workplace. The cohort was comprised of 3,588 persons who had ever worked at the Westinghouse facility during the time which PCBs were used. Although overall mortality and deaths due to all cancers combined were less than expected, this study indicated that there was a moderate, though not statistically significant, increase in the risk of dying from cancer of the brain, and a significant increase in deaths due to malignant melanoma, a form of skin cancer. These findings applied to all individuals who were employed at this facility from January 1, 1957, through March 31, 1977. This study provides some evidence for an association between PCB exposure in an occupational environment and mortality from malignant melanoma. The brain cancer finding suggests that this outcome be carefully observed in further follow-up of this cohort, which is currently underway (NIOSH. HETA 89-116-2094, 1991.)

To follow-up on these findings, the authors conducted a proportional hazards model to examine the association between cumulative PCB exposure and site-specific cancer mortality. All-cause mortality and total cancer mortality were lower than expected. More deaths were observed than expected for malignant melanoma and cancer of the brain and nervous system. The average estimated cumulative dose for the cases of brain cancer was greater than for other workers, but the 95 percent confidence intervals around this difference were broad. The risk of malignant melanoma was not related to cumulative PCB exposure (Sinks et al. 1992.)

In 1977 and 1985, serum PCB concentrations were determined for 58 workers at the Westinghouse plant. Less chlorinated PCBs were quantitated as Aroclor 1242, and the more highly chlorinated PCBs were quantitated as Aroclor 1254. The median half-life was 2.6 years for Aroclor 1242 and 4.8 years for Aroclor 1254. The half-life, however, varied inversely with the initial serum concentration. This pattern may be a result of continued low-level exposure, variation in the time of exposure, or enzyme induction by PCBs. The authors recommended further studies incorporating greater numbers of data points and congener specific analyses in order to more fully understand the dynamics of PCBs in humans (Phillips et al. 1989)

Other Health Studies

In 1986 the ISDH along with the CDC decided to evaluate the potential for using domestic animals in the surveillance of environmental exposures. Dog owners who lived near the three major PCB waste sites were identified. Each dog owner was identified to obtain information on the dog's age, sex, breed, length of residence in the area, weight, height at the shoulder, confinement (indoors, yard, or leash), and activities outdoors (retrieving and digging). Whenever possible, older dogs that had lived in the area before the 1983 remedial actions limited access to the waste sites and dogs that had been allowed to run free frequently were selected. After selecting nine dogs from Monroe County, a similar questionnaire was used to identify nine comparison dogs owned by CDC employees in Atlanta. Dogs that were similar in weight, height, and age to the Monroe County dogs were selected. The results of the study indicated that canine serum PCB levels in contaminated areas tend to be greater than those in uncontaminated areas. The findings suggested that pet dogs may serve as sentinels of human exposure to PCBs (Schilling et al. 1988)

D. **Community Health Concerns Evaluation**

1. **Will the health study look at any chemicals other than PCBs? Will it look at chemicals such as dioxins, furans, and heavy metals?**

The ISDH is performing an analysis of the environmental data, and human exposure pathways. ATSDR will incorporate this report into their public health assessment at these sites. This project is not a health study. The health assessment evaluates the potential for people to be exposed to site-related contaminants and the possibility for adverse health outcomes resulting from those exposures. Generally, the public health assessment helps determine the need for a future health study; however, there have already been many health studies performed on individuals exposed to PCBs in this community.

The public health assessment will look at all site-related contaminants that are currently in the soil, air, surface water, and groundwater.

2. **What about other sites besides those listed in the Consent Decree?**

Only the six sites listed in the Consent Decree will be addressed in this report and in the public health assessment. Concerned citizens can request a health consultation or health assessment by petitioning ATSDR to perform a public health assessment at any non-Superfund site, or those sites not specifically covered by the Consent Decree.

3. **Why is the health study being done now?**

As previously stated, a public health assessment not a health study is being performed. Congress mandated that a public health assessment be performed at every Superfund site. Public health assessments are usually done on old existing sites when new site-related activities take place, or when a special need arises. In this instance, Congress asked ATSDR to specifically look at the six sites addressed by the Consent Decree and the health risks associated with the methods used to destroy the site-related contaminants.

4. **Have any studies been done before?**

Several health studies have been performed on individuals exposed to PCBs in the Bloomington area. Copies of these studies are available for your review in the Monroe County and Ellettsville Libraries, as well as the Indiana University Library. Copies of these studies can also be obtained from the Environmental Epidemiology Section of the Indiana State Department of Health.

5. **Are copies available of studies conducted at similar sites?**

Copies are available and will be placed in the repositories in the libraries mentioned above.

6. **What happens after the health study and expert panels are concluded?**

ATSDR will incorporate the findings of the expert panels into the public health assessment. The public health assessment will be discussed with the community. The final public health assessment will be provided to the community and all Consent Decree parties for their review and use.

7. **Is the purpose of the study to find out if PCBs are hazardous? What is to be gained?**

We already know that PCBs are hazardous, and additional work in this area is not needed. The purpose of the public health assessment is to determine the current potential for individuals to be exposed to site-related contaminants at these six sites and if they are exposed, what the potential is for those exposures to result in adverse health effects.

8. **How long will the health study go on?**

The entire ATSDR Bloomington PCB Project will be completed by the fall of 1994.

9. **How will the public health assessment be used? Will a risk assessment be involved? Are they the same?**

A public health assessment and a risk assessment are not the same. The public health assessment is not done to determine clean-up levels, assign risk levels associated with specific activities, or to determine violation of state and/or federal regulations. The public health assessment makes a qualitative assessment of the routes by which individuals can be exposed to site-related contaminants and whether those exposures would result in adverse health outcomes. The public health assessment can also be used to make recommendations for additional environmental sampling, as well as recommend actions to prevent human exposures. The public health assessment also helps prioritize future health related activities at the site or in the potentially affected community. A risk assessment will not be used or developed in this project.

10. Did the ATSDR Toxicological Profile on PCBs consider only cancer?

No, the ATSDR Toxicological Profile considers all potential health effects from each potential route of exposure (such as breathing PCBs, ingesting PCBs in food or water, or adsorption through the skin). The health effects included in the profile range from conditions that appear soon after high levels of exposure such as skin rashes to health conditions that appear months or years after exposure to lower levels. They involve the effects of PCBs on every organ system of the body including but not limited to cancer and reproductive effects.

11. Will the health study point out correlations such as cancer and miscarriages due to PCBs?

One section of the public health assessment involves the review of existing health outcome data. In this section, cancer mortality data as well as adverse reproduction outcomes are reviewed.

12. Will you look at the potential health effects of the proposed ash landfill?

The potential adverse health effects from the ash landfill will not be addressed in this preliminary report. As part of the Bloomington PCB project, ATSDR will evaluate the public health implications of incinerating the PCB-contaminated soil associated with these sites. In that context, potential health effects of the proposed ash landfill may be addressed.

13. How will you get a true picture of the health effects when limited to only the Consent Decree sites? What about ABB (formerly Westinghouse) and Fell Iron & Metal Inc., which are located in heavily populated areas?

It is true the public health assessment will focus on only the Consent Decree sites; however, there are ongoing studies of former and current workers at the former Westinghouse plant. Further, individuals who reside near the Fell Iron and Metal site have been included in other studies already performed prior to the discovery of this site. If additional health studies are shown to be needed by the public health assessment, ATSDR will work with the ISDH to undertake those studies.

14. Will the Lemon Lane Landfill Springs be looked at?

These springs are included in the preliminary report (see page 51).

15. **I am concerned that my physician is not aware of the literature regarding the toxicity of exposure to PCBs.**

It is difficult for physicians to keep abreast of the latest toxicity data regarding chemical exposures. We will, therefore, recommend that ATSDR develop and implement a medical education program for the local nurses and physicians.

16. **What about former and current workers at the Westinghouse/ABB plant? Many of the former workers have stated that they feel their health is deteriorating. Current workers are concerned that they are still being exposed to PCBs (from residual contamination) while working in the plant.**

Although the Westinghouse/ABB plant site is not a part of the Consent Decree, residual PCB contamination has been documented at the plant. ATSDR will notify NIOSH and the Occupational Safety and Health Administration (OSHA) of the workers' concerns and request that they look into those concerns.

17. **Will the public health assessment address all of the sites where scavenging of discarded capacitors occurred, or where PCB-contaminated sewage sludge was used?**

Although the assessment of those sites is not within the scope and purpose of this document, the ISDH is aware of the fact that capacitor scavenging and the spreading of PCB-contaminated sewage sludge in gardens and pastures occurred in approximately 180 different areas of Bloomington. The PCB soil levels have been measured at 27 percent of these sites. At the scavenge sites, where we have data, 50 percent of the sites had soil PCB levels greater than 50 ppm. At the sludge sites, only 10 percent of those sampled had soil PCB levels greater than 50 ppm. Based on these data, we will recommend that Federal and State environmental agencies continue to investigate the level of PCB contamination at these sites.

CONCLUSIONS

Anderson Road Landfill

1. Based on the environmental data reviewed, this site is judged as being a past public health hazard to trespassers and scavengers due to levels of PCBs present in the on-site soil.

2. An indeterminate health hazard is posed by private well use. These wells are the only source of potable water in this area. Private wells within 5,000 feet have been sampled for PCBs, but no other site-related contaminants. On-site monitoring wells show contamination with dioxins and furans.

3. Community-specific health outcome data do not indicate that the site has had an adverse health impact on human health. Specific sub-groups, however, may be exhibiting signs and symptoms of adverse health outcome due to site-related exposures that would not be identified through analysis of county-wide databases.

4. Sampling data for methane gas was not found in the data reviewed for this report.

Bennett Stone Quarry

1. Based on the environmental data reviewed, this site is judged as being a past public health hazard to trespassers, scavengers, subsistence fishermen, and mud bathers due to levels of PCBs that were found in on-site soil and off-site sediment samples.

2. Fish caught from Stout's Creek pose a present public health hazard if eaten on a regular basis. The levels of PCBs found in fish taken from Stout's Creek are above the FDA recommended level.

3. An indeterminate health hazard is posed by private well use. These wells are the only source of potable water in this area. Private wells within 5,000 feet have been sampled for PCBs, but no other site-related contaminants.

4. The INDOT has responded to the EPA, and IDEM's concern about the creation an interchange for S.R. 46 and S.R. 37, which will traverse within 250 feet of this site. The construction of this interchange could pose a public health hazard through the excavation of potentially PCB-contaminated soil. The INDOT has hired an environmental consultant to develop a PCB sampling plan for this project. This plan has been submitted to the IDEM and EPA for review. A report has not been prepared as to the potential human exposure.

5. Community-specific health outcome data do not indicate that the site has had an adverse impact on human health. Specific subgroups, however, may be exhibiting signs and symptoms of adverse health outcome due to site-related exposures that would not be identified through analysis of county-wide databases.

<u>Lemon Lane Landfill</u>

1. Based on the environmental data reviewed, this site is judged as being a past public health hazard to trespassers and scavengers due to levels of PCBs that were found in on-site soil.

2. There is a past indeterminate health hazard posed by past private well use. All residences have been connected to the municipal water supply. Private wells within 5,000 feet have been sampled for PCBs. Sampling data for other site-related contaminants such as TCE and dioxins were not found.

3. High levels of PCBs were found in the wooded depressions near this site. Data are not available as to whether actions have been taken to ensure that humans are not exposed to significant concentrations of PCBs found in this area.

4. Community-specific health outcome data do not indicate that the site has had an adverse impact on human health. Specific subgroups, however, may be exhibiting signs and symptoms of adverse health outcome due to site-related exposures that would not be identified through analysis of county-wide databases.

5. High levels of PCBs were found in the associated springs and streams for this site and may pose a health risk to individuals who came into contact with them primarily through dermal contact.

Neal's Dump

1. Based on the environmental data reviewed, this site is judged as being a past public health hazard to trespassers and scavengers due to levels of PCBs that were found in on-site soil.

2. An indeterminate health hazard is posed by private well use. Samples from private wells within 5,000 feet were all below the detection limit. Due to the on-site groundwater contamination, there is the potential for private wells to be contaminated.

3. High levels of PCBs were found in a ditch leaving (south-southwest) Neal's Dump. Data are not available as to whether actions have been taken to ensure that humans are not exposed to significant concentrations of PCBs found in this area.

4. Community-specific health outcome data do not indicate that the site has had an adverse impact on human health. Specific subgroups, however, may be exhibiting signs and symptoms of adverse health outcome due to site-related exposures that would not be identified through analysis of county-wide databases.

Neal's Landfill

1. Based on the environmental data reviewed, this site is judged as being a past public health hazard to trespassers, scavengers, and subsistence fishermen due to levels of PCBs found in on-site soil and off-site sediment samples.

2. This site was a public health hazard to individuals who ate more than one meal per week of fish caught in Richland Creek or Conard's Branch. The levels of PCBs found in fish taken from Richland Creek are currently below the FDA recommended level.

3. There is one private well connected hydrogeologically to the site. Although PCBs were found at very low levels, the on-site groundwater contamination presents a potential for this well to become contaminated.

4. The current National Pollutant Discharge Elimination System permit level may not be protective of human health and the environment.

5. The current collection and treatment systems may not be protective of health during high water flow conditions, thus presenting the potential for recontamination of Richland Creek.

6. Cattle drinking from Conard's Branch may become contaminated with PCBs due to the problems identified in conclusions 4 and 5 listed above. This would pose a public health hazard to individuals consuming these cattle.

7. Community-specific health outcome data do not indicate that the site has had an adverse impact on human health. Specific subgroups, however, may be exhibiting signs and symptoms of adverse health outcome due to site-related exposures that would not be identified through analysis of county-wide databases.

Winston-Thomas Facility

1. Based on the environmental data reviewed, this site is judged as being a past and present public health hazard to individuals who used sewage sludge for gardening purposes and subsistence fishermen due to levels of PCBs that were found in sewage sludge, and off-site sediment samples.

2. An indeterminate health hazard is posed by private well use. Samples from private wells within 5,000 feet were all below the detection limit of 98 ppt. Due to the on-site groundwater contamination, there is a potential for private wells to become contaminated.

3. The sediment and surface water of Clear Creek are contaminated with PCBs at levels of health concern. The levels of PCBs found in fish taken from Clear Creek are above the FDA recommended level.

4. Community-specific health outcome data do not indicate that the site has had an adverse impact on human health. Specific subgroups, however, may be exhibiting signs and symptoms of adverse health outcome due to site-related exposures that would not be identified through analysis of county-wide databases.

All Sites

1. Due to the number of sites and parties involved in sampling occurring over such a long period of time, it is possible that pertinent environmental data may have been inadvertently left out of this document.

2. Existing ATSDR toxicological profiles for aluminum, boron, chloroethane, cobalt, heptachlor, lead, 1,1,1,-trichloroethene, vanadium, and zinc lack a MRL, which would allow a better assessment of the site's public health implication. There is a need for a toxicological profile for sodium.

3. Physicians may lack information regarding the toxicity of exposure to PCBs.

4. Significant exposures may have occurred at sites of former scavenger activities and where PCB-contaminated sewage sludge was used in private gardens.

RECOMMENDATIONS

Site-specific recommendations:

Anderson Road Landfill

1. Private wells should be sampled for dioxins, furans, and other site-related contaminants.

2. Periodic private well sampling should be performed to ensure that humans are not exposed to significant concentrations of hazardous substances in the future.

3. Soil gas sampling for methane gas needs to be done.

Bennett Stone Quarry

1. The Fish Advisory for Stout's Creek should be continued.

2. Periodic private well sampling should be performed to ensure that humans are not exposed to significant concentrations of hazardous substances in the future. In addition, a well survey should be done for the area due to the unknown number of private wells still in use.

3. Communications should be maintained with the INDOT to ensure that the potential health risk involved in creating the interchange across potentially contaminated soils is addressed appropriately. Close attention should be given to groundwater contamination as well as contamination of environmental media with other chemicals.

Lemon Lane Landfill

1. Individuals using private wells for any purpose should have their well tested for PCBs and other site-related contaminants such as TCE and dioxin.

2. Information should be obtained regarding private well sampling for other chemicals besides PCBs.

3. Additional information should be obtained concerning the PCB-contaminated wooded depression area as to whether remediation has occurred in a manner protective of public health.

4. Actions should be implemented to prevent human exposures to the contaminated streams and springs associated with this site.

5. To reduce the potential for incidental ingestion and dermal exposures, children should not be allowed to play in these areas, and any persons performing activities in and around these areas should wash all exposed parts of the body as soon as possible.

Neal's Dump

1. Periodic private well sampling should be performed to ensure that humans are not exposed to significant concentrations of hazardous substances in the future.

2. Additional information should be obtained concerning the documented contaminated ditch as to whether remediation has occurred in a manner protective of public health.

3. Actions should be implemented to prevent human exposures to this area until the data gap is obtained.

Neal's Landfill

1. Periodic sampling should be performed on all private wells to ensure that humans are not exposed to significant concentrations of hazardous substances in the future.

2. A re-evaluation of the water collection and treatment system should be made to ensure that the NPDES permit level for this site is at a level which will not result in the accumulation of PCBs in aquatic species, wildlife, and domestic animals, and is also protective of public health.

3. Additional sediment sampling should be performed at Richland Creek and Conard's Branch to ensure that PCB recontamination is not occurring.

Winston-Thomas Facility

1. Periodic sampling should be performed at the private wells within 5,000 feet of the site to ensure that humans are not exposed to significant concentrations of hazardous substances in the future.

2. The Fish Advisory should be continued for Clear Creek.

3. All vegetables grown in sludge-treated gardens must be washed thoroughly and peeled before eating.

4. Actions should be implemented to prevent human exposures to the contaminated sediment and surface water found in Clear Creek.

All Sites

1. When indicated by public health needs, and as resources permit, the evaluation of additional relevant environmental data, health outcome data, and community health concerns, if available, is recommended.

2 It is also recommended that substance-specific applied research be conducted to identify a chronic MRL for ingestion exposure to aluminum, boron, chloroethane, cobalt, heptachlor, lead, 1,1,1,-trichloroethene, vanadium, and zinc. In addition, a toxicological profile should be written for sodium.

3. Community health education programs should be developed and implemented for local nurses and primary care physicians.

4. State and Federal environmental agencies should perform surface soil analysis for PCBs at sites where scavenging activities were known to occur, as well as at sites where PCB-contaminated sewage sludge was thought to have been used.

5. A full characterization of the sewage sludge taken from the Winston-Thomas Sewage Treatment Plant is needed so that calculations can be made of the potential health impact of using sludge in vegetable gardens.

Studies

The following types of studies are recommended to further evaluate the impact of PCB contamination on human health.

1. Since little information is available regarding the specific congeners present and the half-life of PCBs in human serum, it is recommended that a study of individuals in the Bloomington area who have previously had their blood tested for PCBs be used in a congener-specific serum PCB study.

2. Workers at the Westinghouse/ABB plant may currently be exposed to PCBs. Additional studies of the PCB levels present in the plant, and their effect on the health of the workers, may be warranted.

3. Former workers have expressed concerns that their health has deteriorated. Re-evaluation of these workers by NIOSH and the ISDH should be performed using the same methods as were used in earlier investigations so that changes in the signs or symptoms of disease can be determined.

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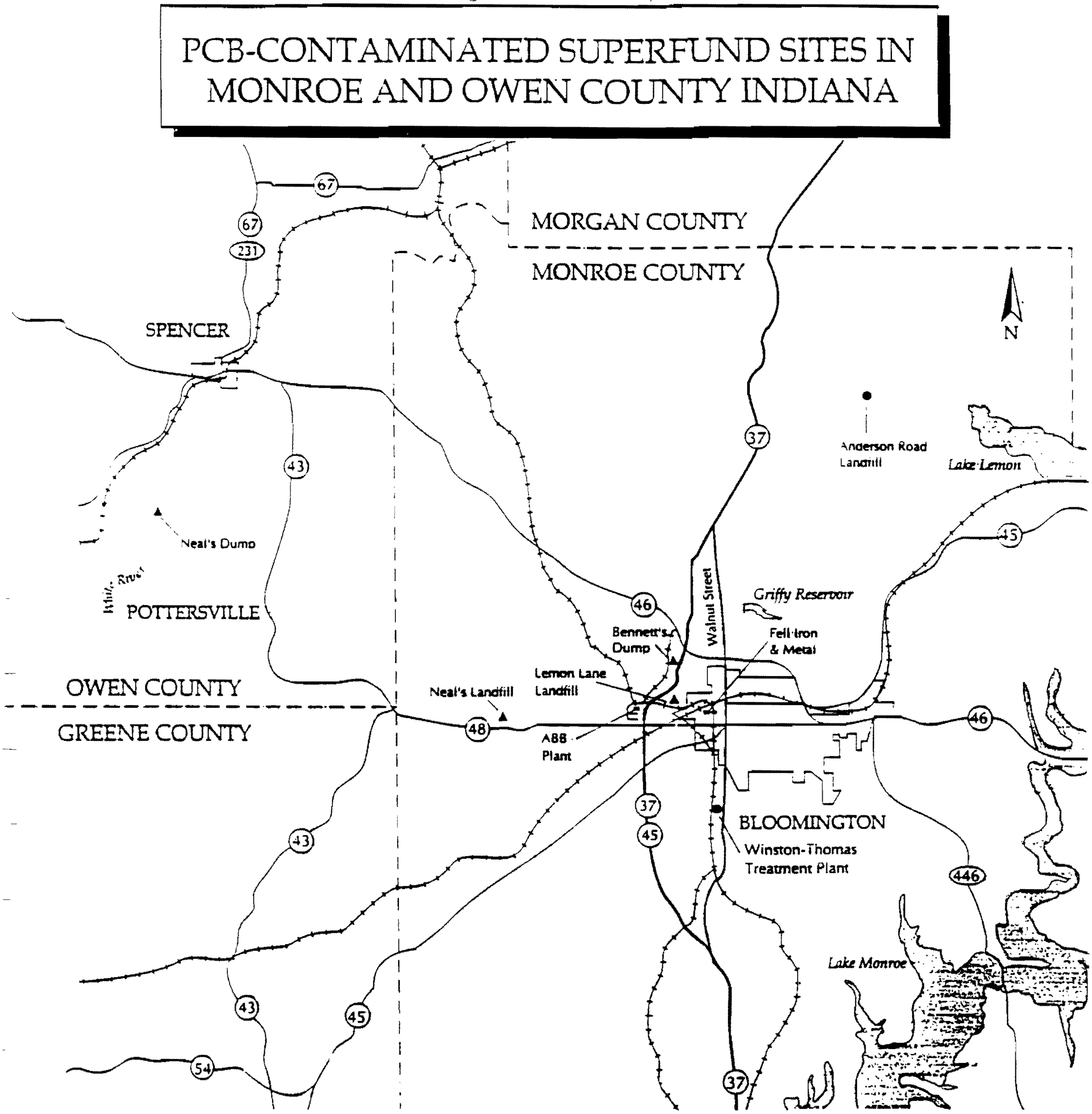
APPENDIX A

Figure 1 - site map



● Consent-Decree Sites: Anderson Rd. Landfill: 5,000 yds³* and Winston-Thomas Treatment Plant: 50,000 yds³

▲ Consent-Decree/National Priority List (NPL) Sites: Bennett's Dump: 55,000 yds³, Lemon Lane Landfill: 176,000 yds³, Neal's Dump: 14,000 yds³ and Neal's Landfill: 320,000 yds³

■ U.S. EPA Removal Sites: ABB Plant: 15,000yds³ and Fell Iron & Metal: 16,000yds³

0 2.5 5
MILES

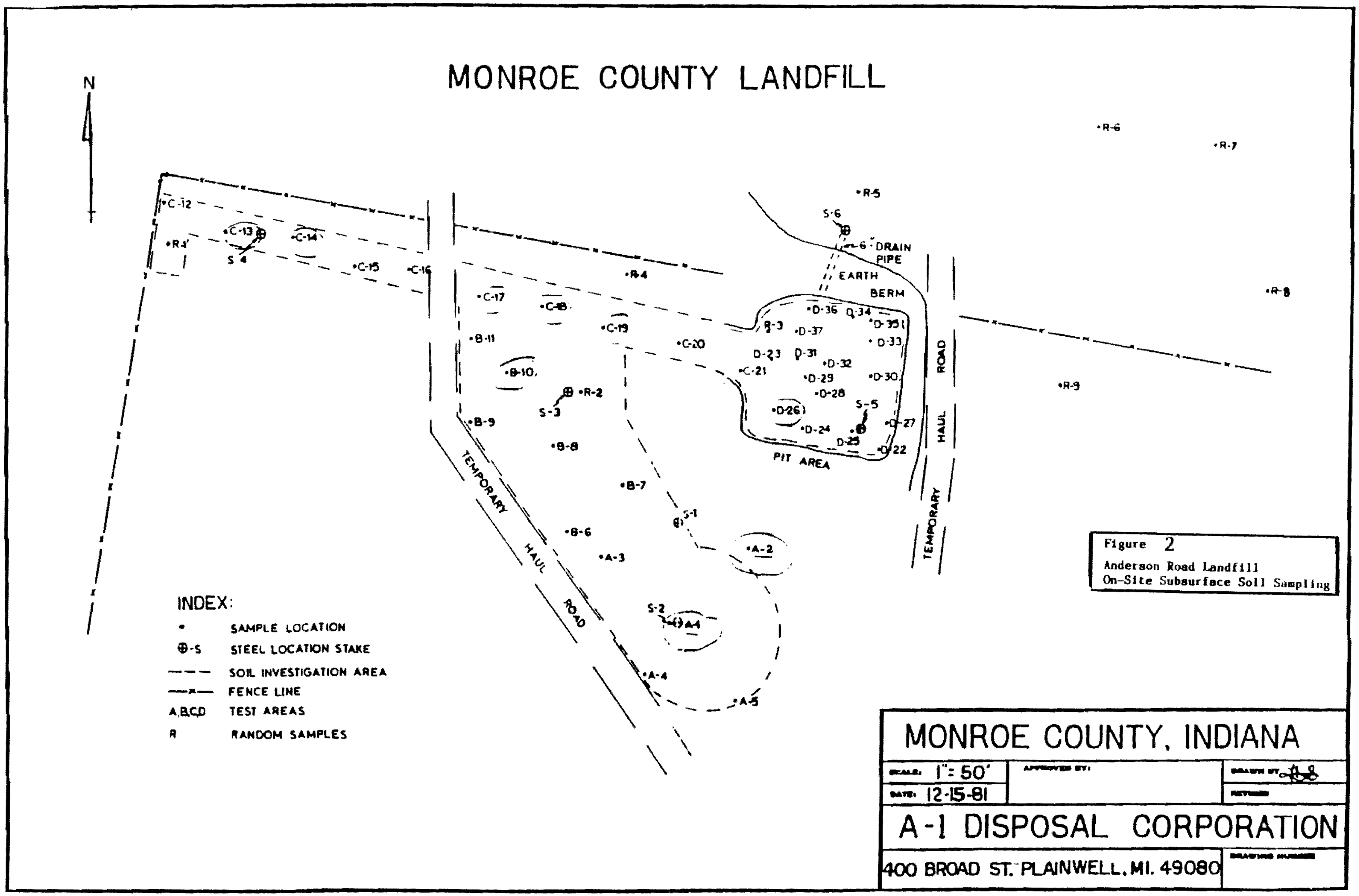
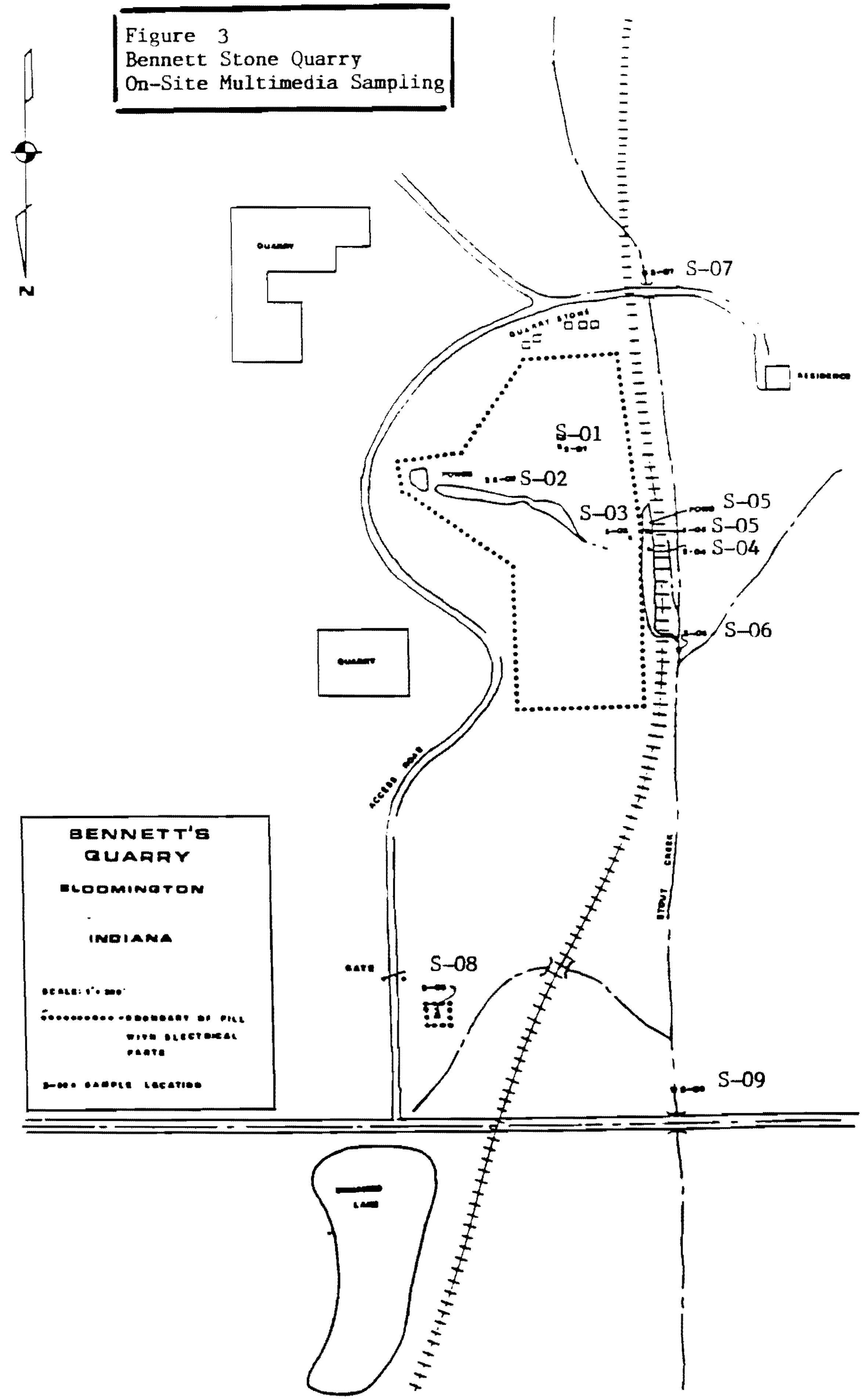

MONROE COUNTY LANDFILL
N
C-12
R-1
C-13
C-14
S-4
C-15
C-16
C-17
C-18
C-19
C-20
C-21
R-4
R-5
R-6
R-7
R-8
R-9
S-6
6" DRAIN PIPE
EARTH BERM
D-36
D-34
D-35
D-33
D-37
B-3
D-23
D-31
D-32
D-29
D-30
D-28
D-26
D-24
D-25
D-27
D-22
S-5
PIT AREA
HAUL ROAD
TEMPORARY
B-11
B-10
B-9
B-8
B-7
B-6
S-3
R-2
S-1
A-2
A-3
S-2
A-4
A-5
TEMPORARY HAUL ROAD
INDEX:
• SAMPLE LOCATION
⊕-S STEEL LOCATION STAKE
SOIL INVESTIGATION AREA
FENCE LINE
A,B,C,D TEST AREAS
R RANDOM SAMPLES
Figure 2
Anderson Road Landfill
On-Site Subsurface Soil Sampling
MONROE COUNTY, INDIANA
SCALE: 1" = 50'
DATE: 12-15-81
APPROVED BY:
DRAWN BY:
REVISED
A-1 DISPOSAL CORPORATION
400 BROAD ST. PLAINWELL, MI. 49080
DRAWING NUMBER

Figure 3
Bennett Stone Quarry
On-Site Multimedia Sampling



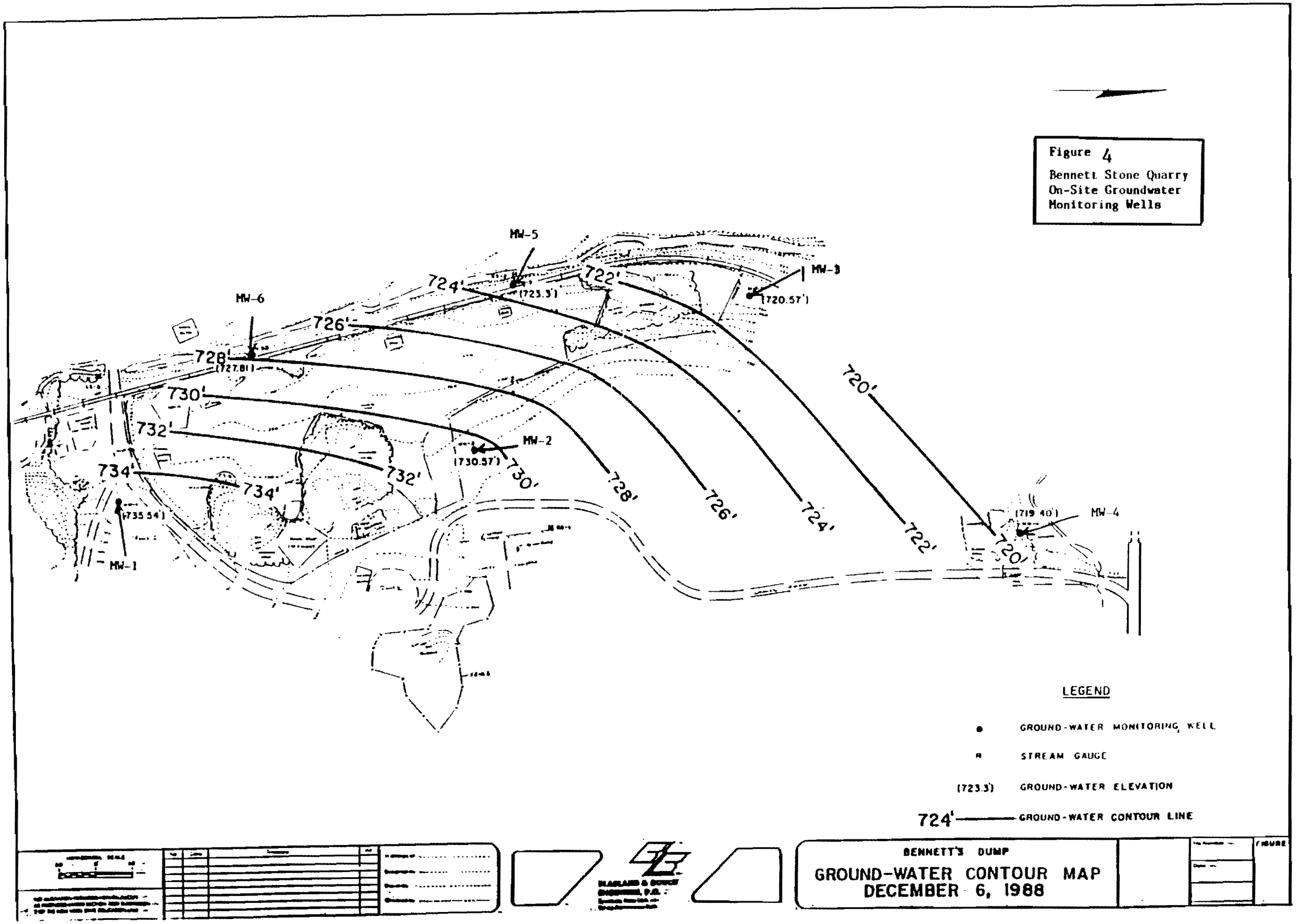
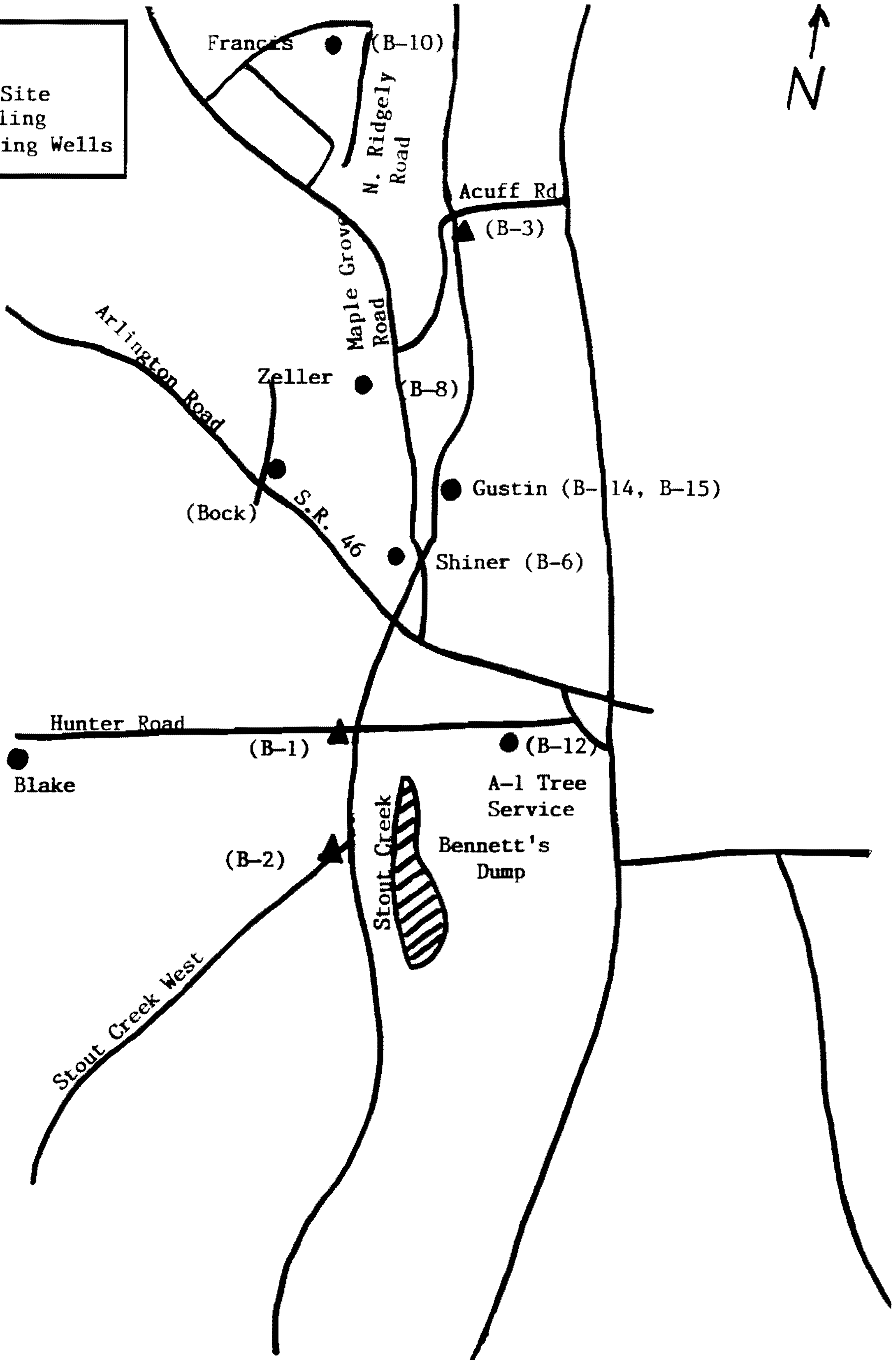


Figure 4
Bennett Stone Quarry
On-Site Groundwater
Monitoring Wells
MW-5
MW-6
MW-3
MW-2
MW-4
MW-1
(723.3')
(720.57')
(727.81')
(730.57')
(735.54')
(719.40')
734'
732'
730'
728'
726'
724'
722'
720'
LEGEND
GROUND-WATER MONITORING WELL
STREAM GAUGE
(723.3) GROUND-WATER ELEVATION
724' GROUND-WATER CONTOUR LINE
BENNETT'S DUMP
GROUND-WATER CONTOUR MAP
DECEMBER 6, 1988

Figure 5

BENNETT'S DUMP - Off-Site Residential Well Sampling Groundwater - Monitoring Wells



● = Residential Sampling Points

▲ = Surface Water Sampling Points

Not drawn to scale

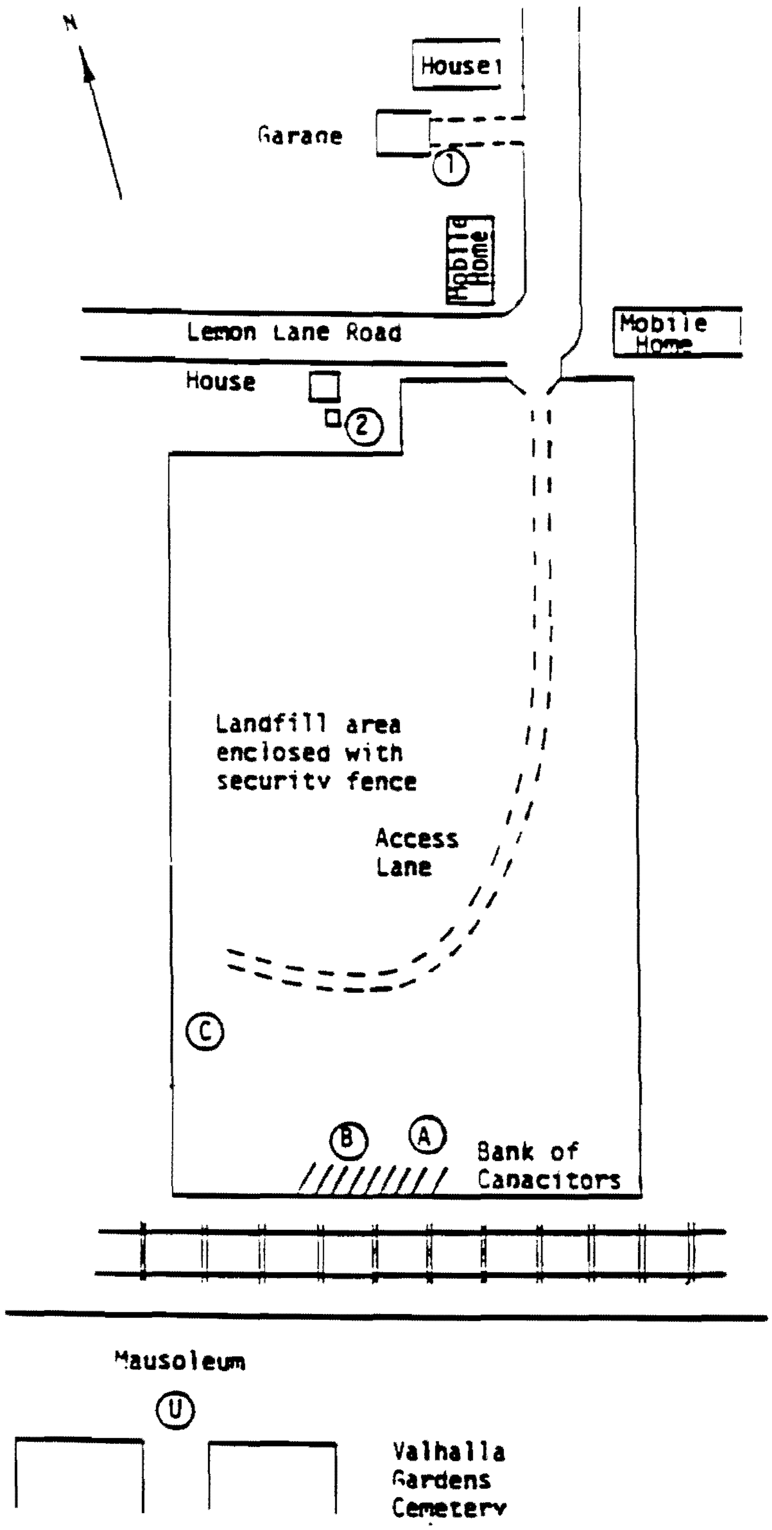
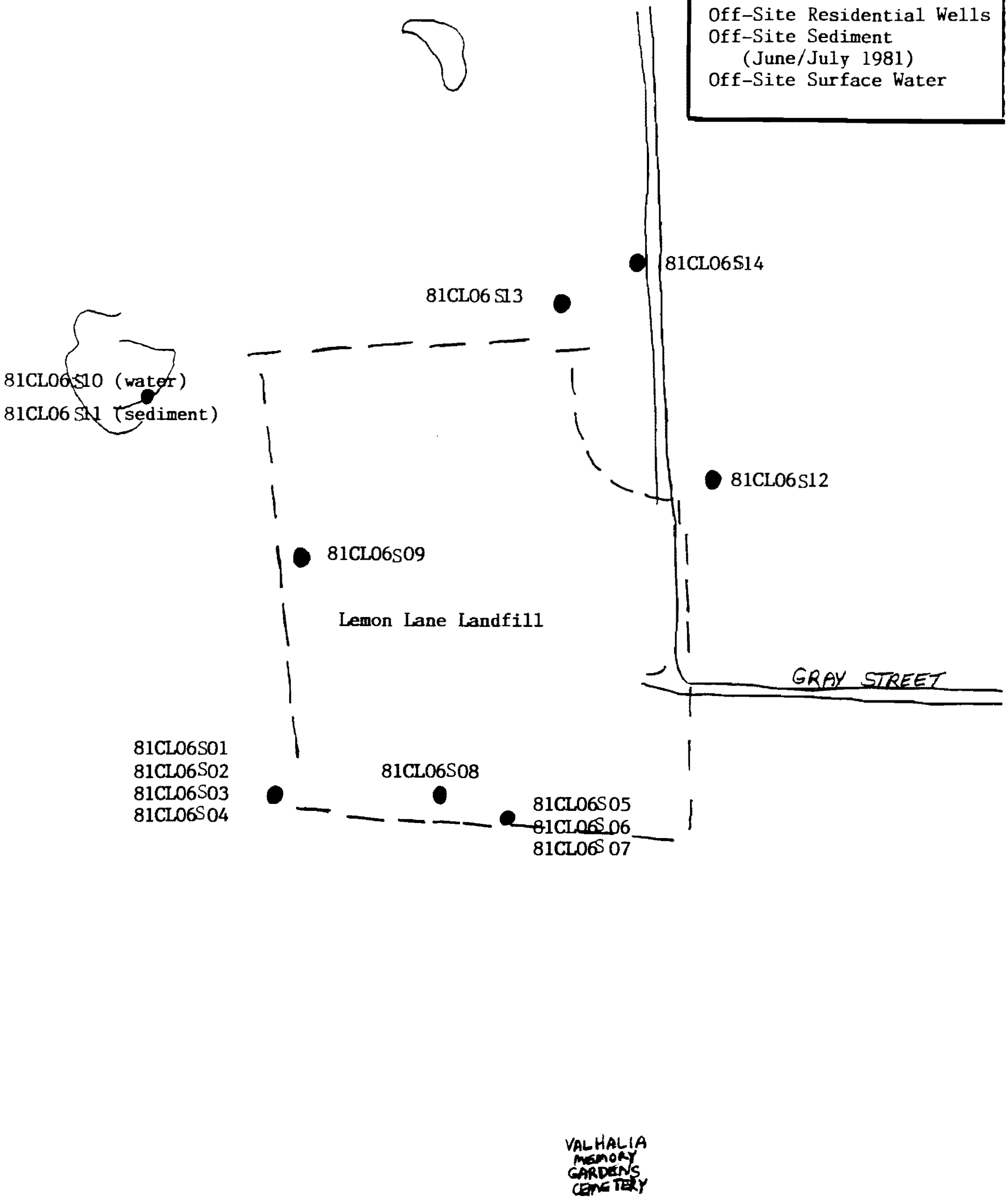


Figure 6

Lemon Lane Landfill On- & Off-Site Air Monitoring Locations

Figure 7

Lemon Lane Landfill
On-Site Subsurface Soil
(June/July 1981)
Off-site Subsurface Soil
Off-Site Residential Wells
Off-Site Sediment
(June/July 1981)
Off-Site Surface Water



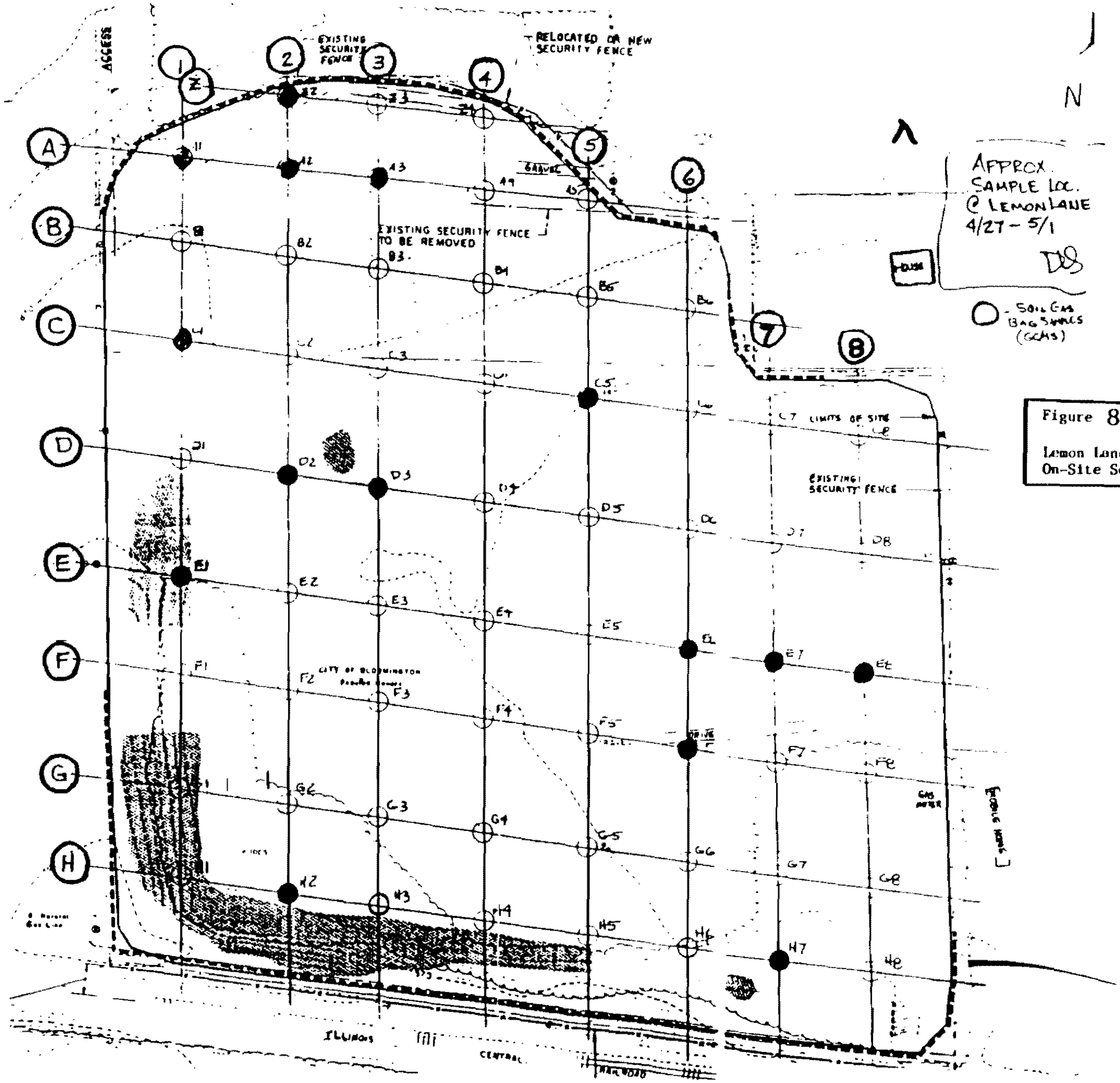
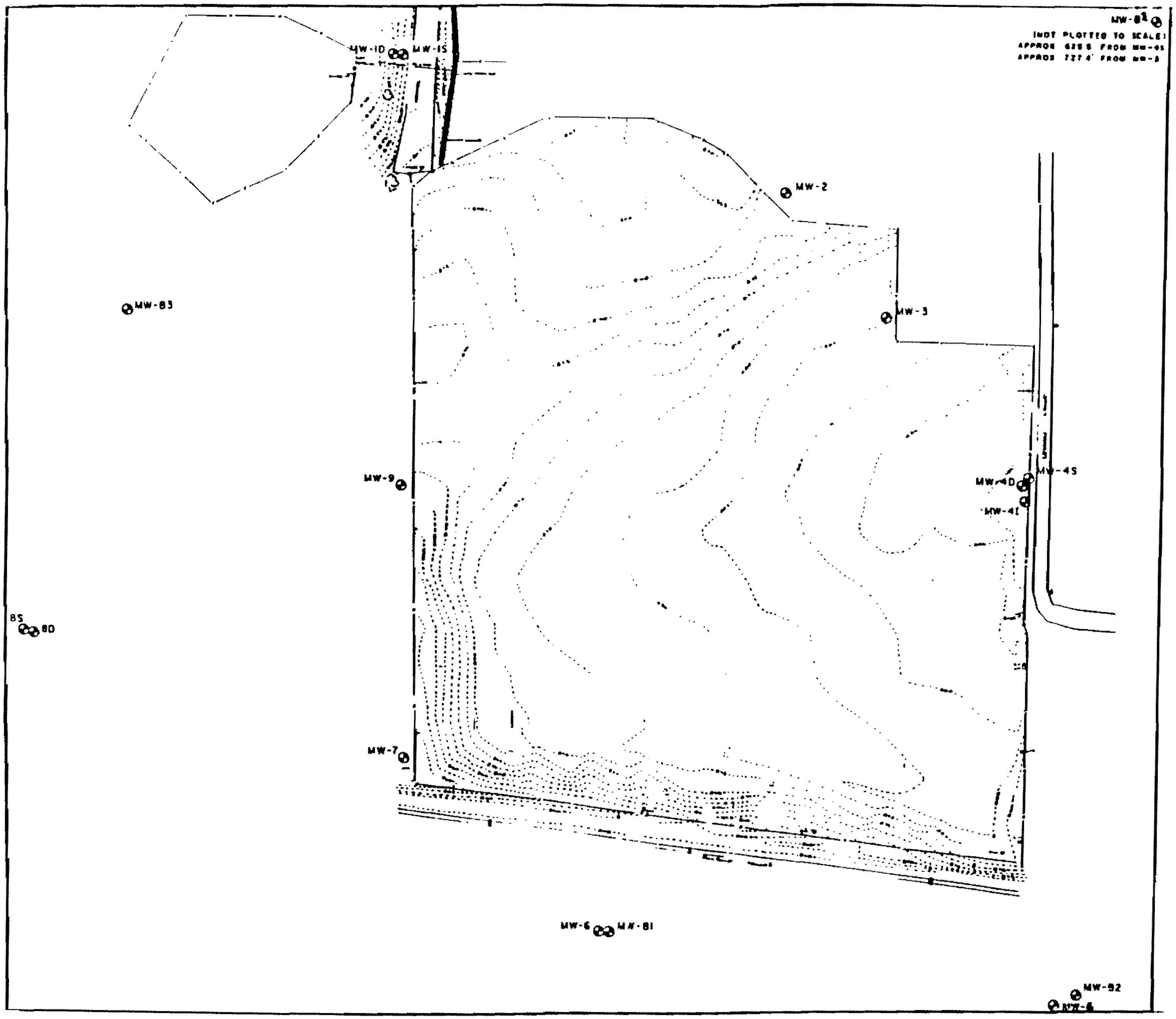


Figure 8
Lemon Lane Landfill
On-Site Soil Gas Sampling



LEGEND

MONITORING WELL

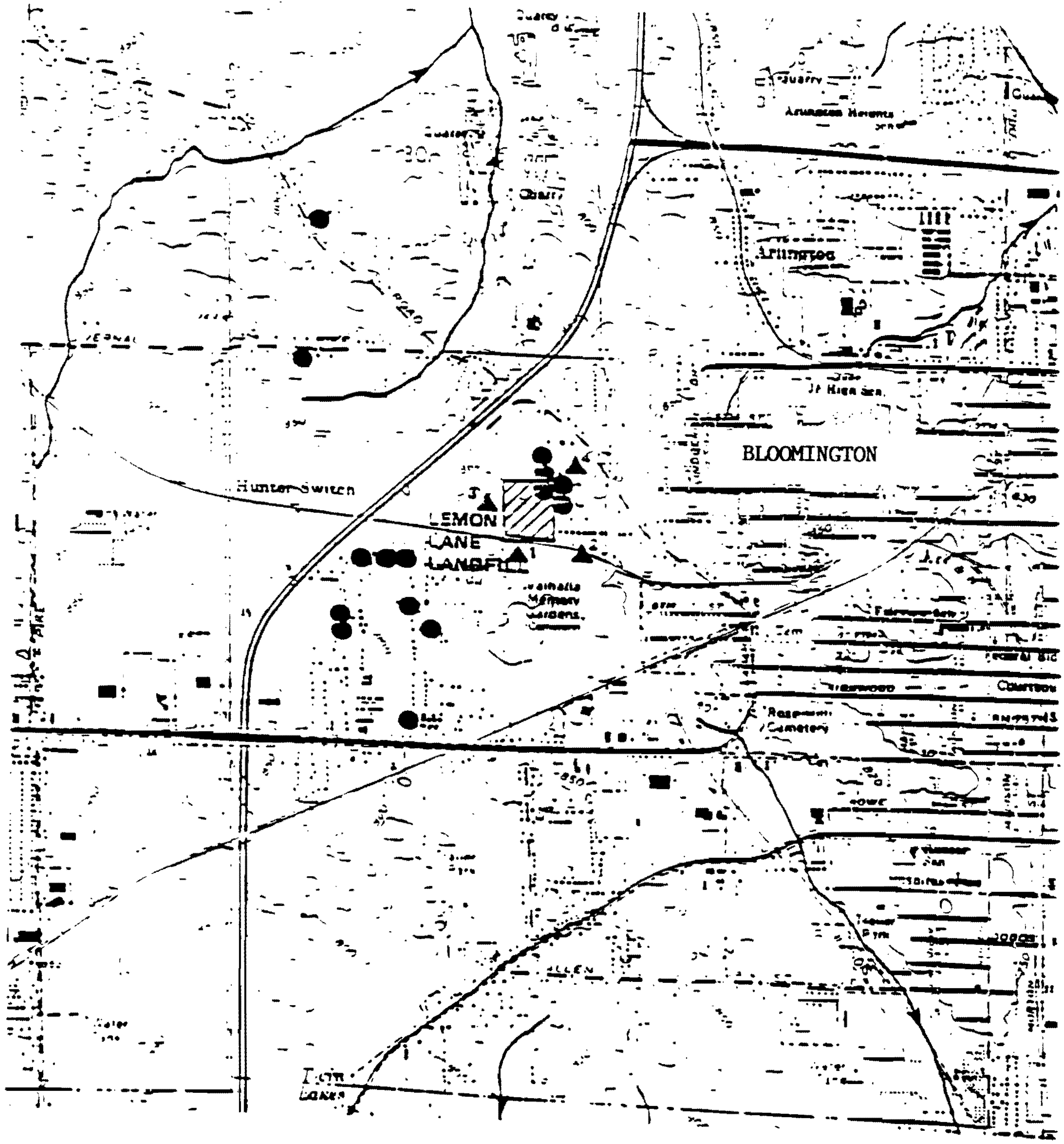
NOTE: ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929. TWO FOOT CONTOUR INTERVAL. UTILITIES NOT SHOWN.

Figure 9
Lemon Lane Landfill
On- & Off-Site Groundwater
Monitoring Wells

SAMPLING LOCATION PLAN

SCALE
0 50' 100'

BLASLAND & BOUCK ENGINEERS, P.C.



LEGEND

● RESIDENTIAL WELL

▲ MONITORING WELL

NOTE: 3 Residential wells located off this map to the northwest.

Figure 10

Lemon Lane Landfill
Off-Site Groundwater Monitoring Wells
October 1982 - June 1983
Off-Site Residential Well Sampling
June 1981

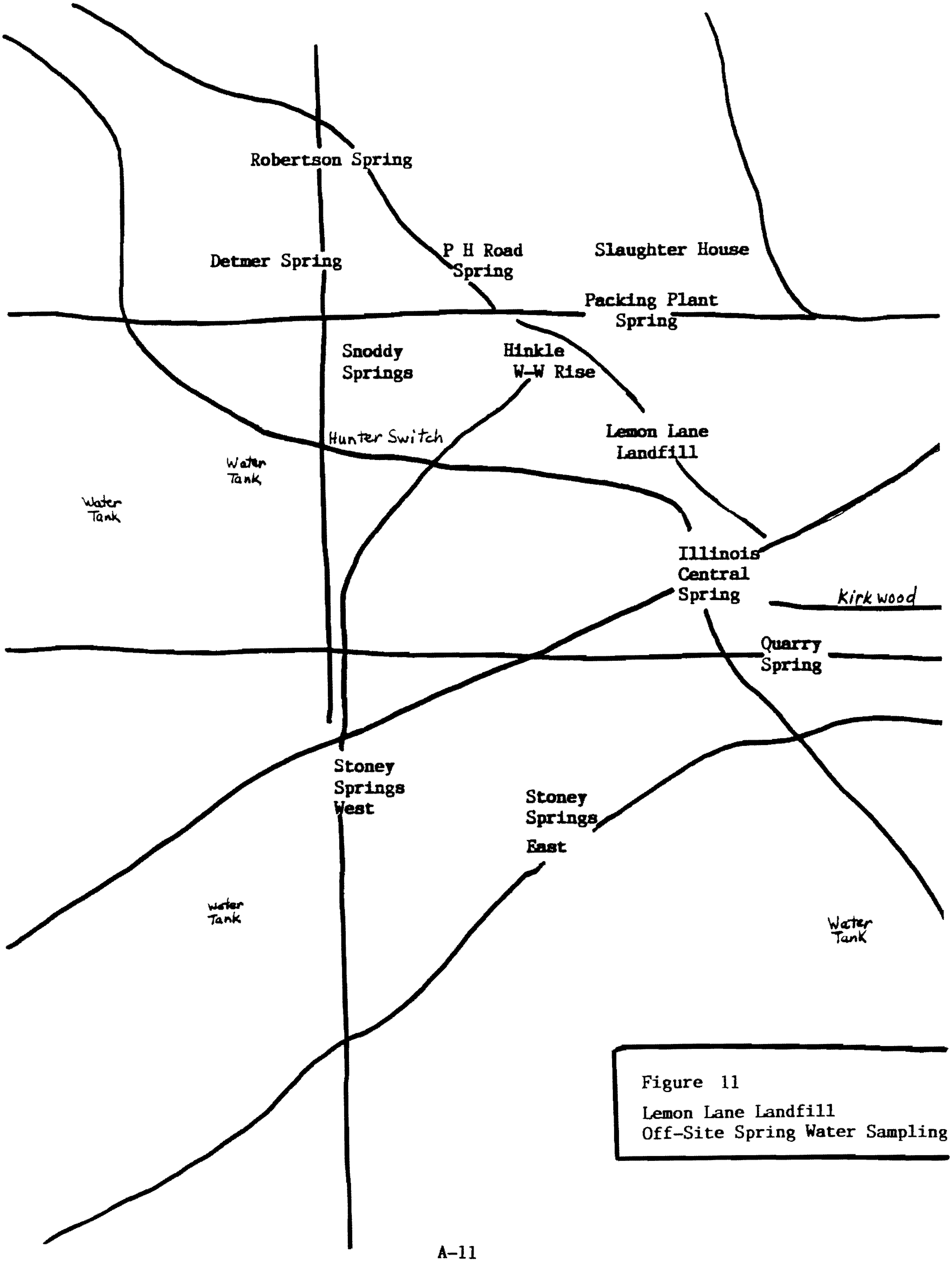
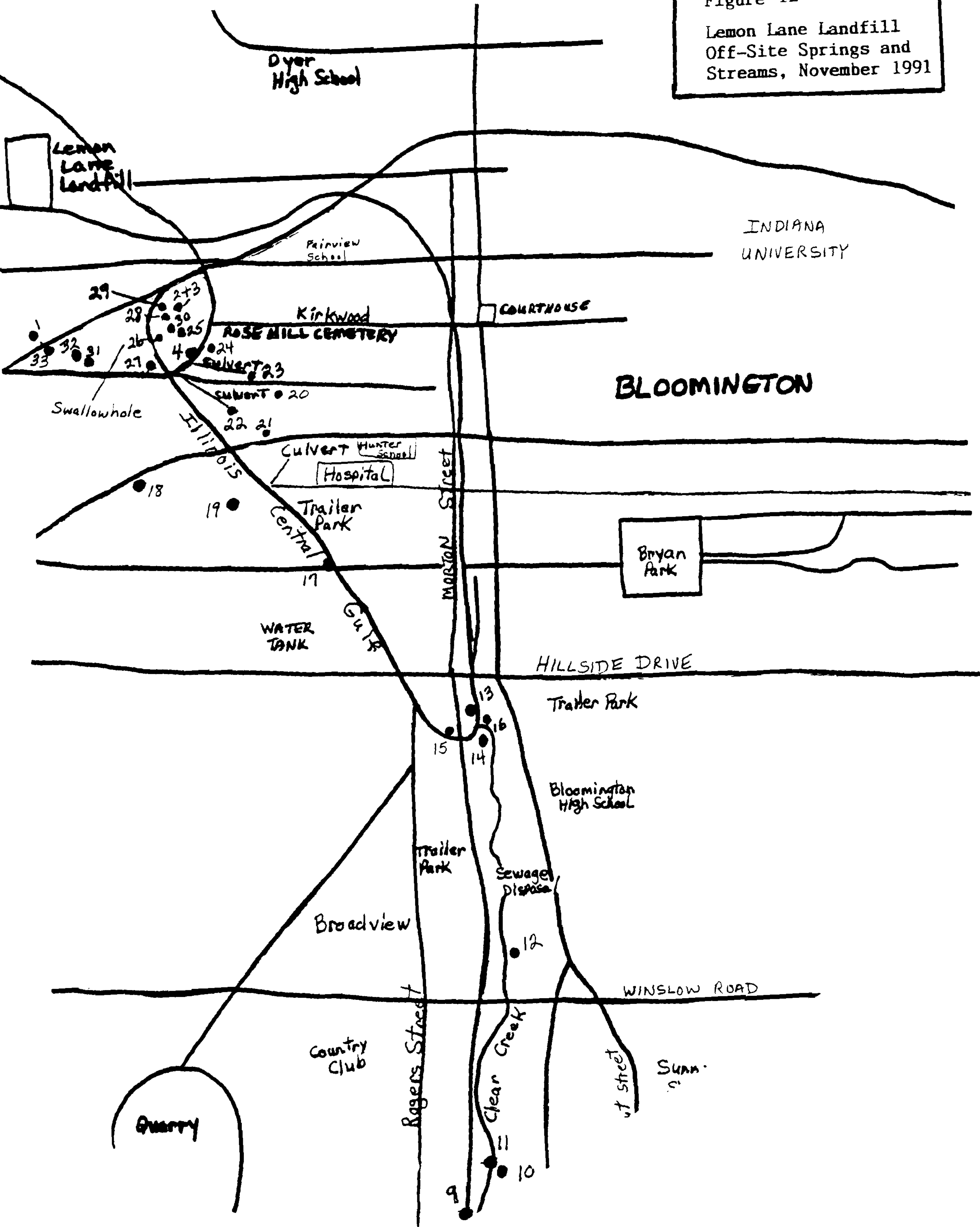


Figure 11

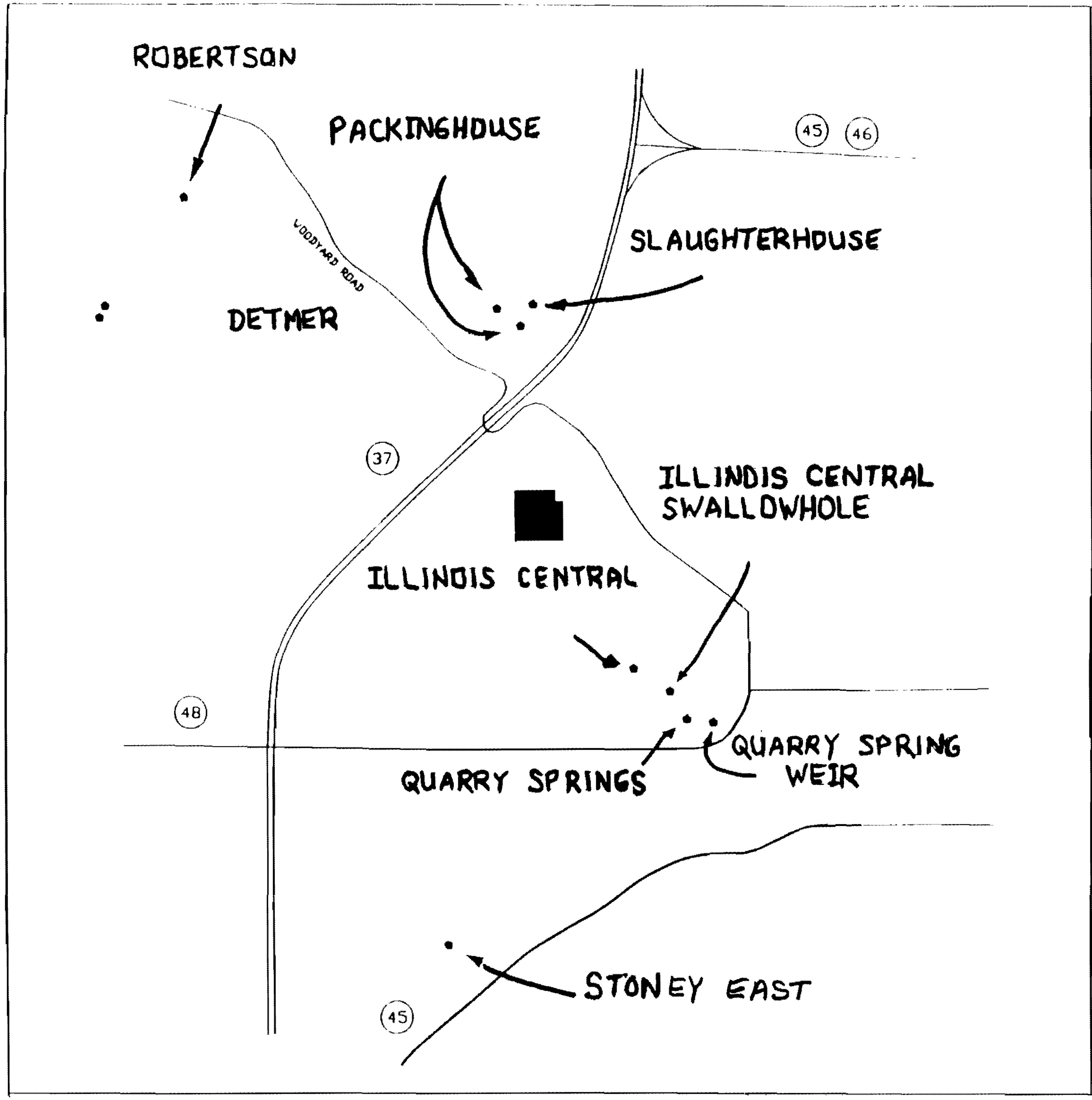
Lemon Lane Landfill
Off-Site Spring Water Sampling

Figure 12

Lemon Lane Landfill Off-Site Springs and Streams, November 1991



DISTRIBUTION OF PCB IN SPRING SEDIMENTS



LEGEND

LEMON LANE LANDFILL

SPRINGS

NOTE: SAMPLE VALUES REPORTED FOR TOTAL PCB'S, IN PARTS PER MILLION
BDL – BELOW DETECTION LIMITS

Figure 13

Lemon Lane Landfill
Off-Site Sediment Sampling
June 1991

N

SCALE IN FEET

0 1000 2000 3000

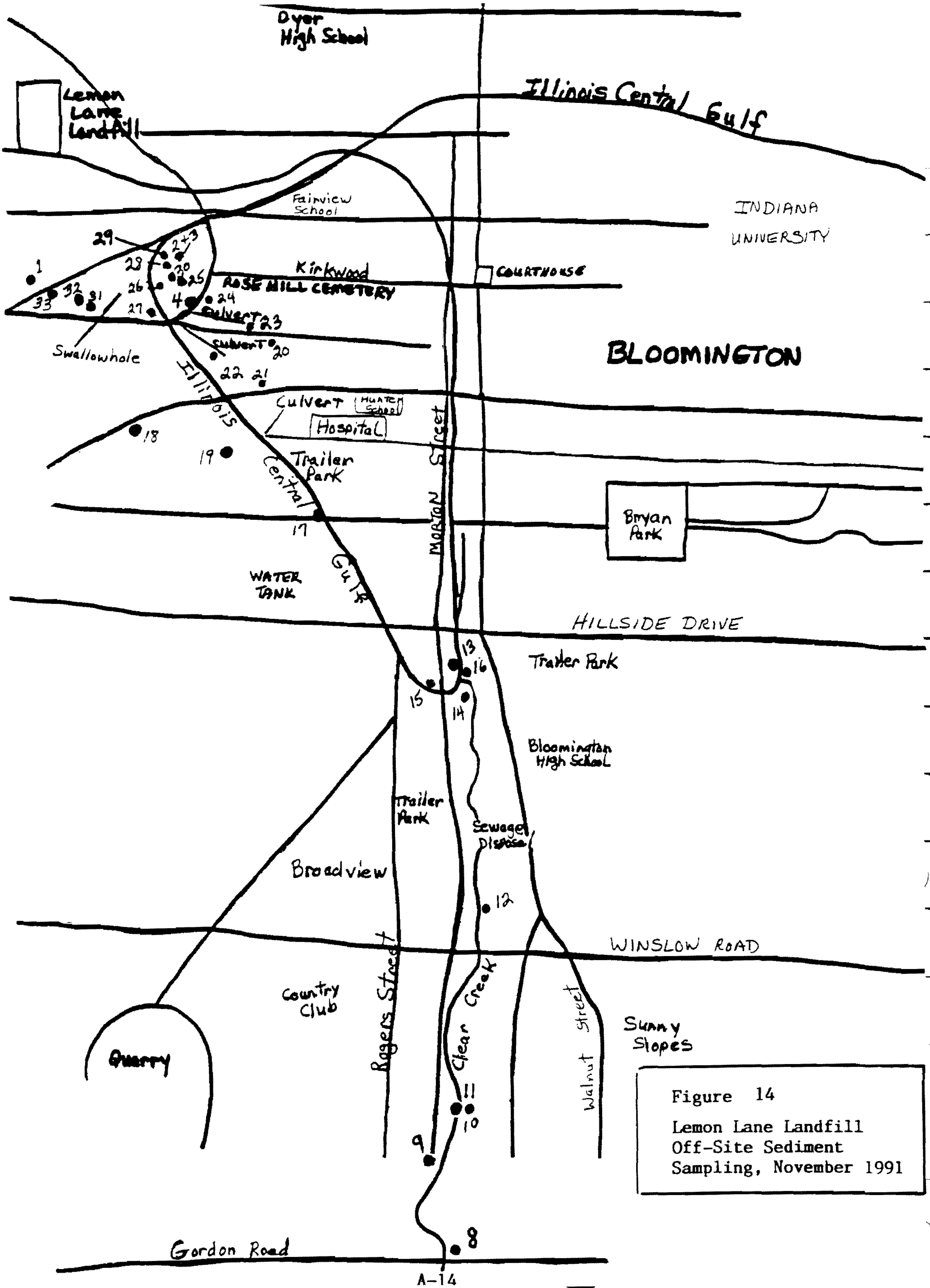


Figure 14
Lemon Lane Landfill
Off-Site Sediment
Sampling, November 1991

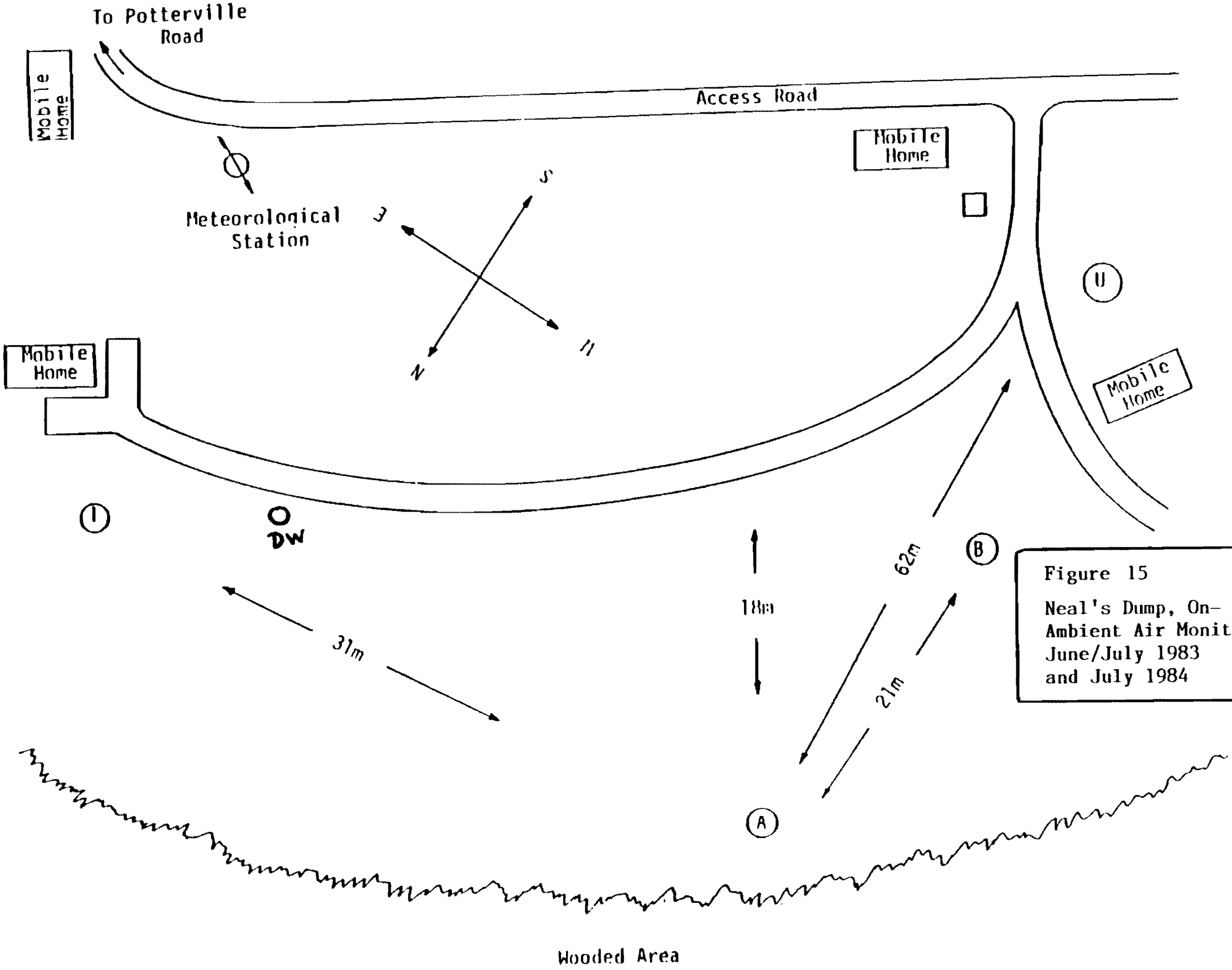
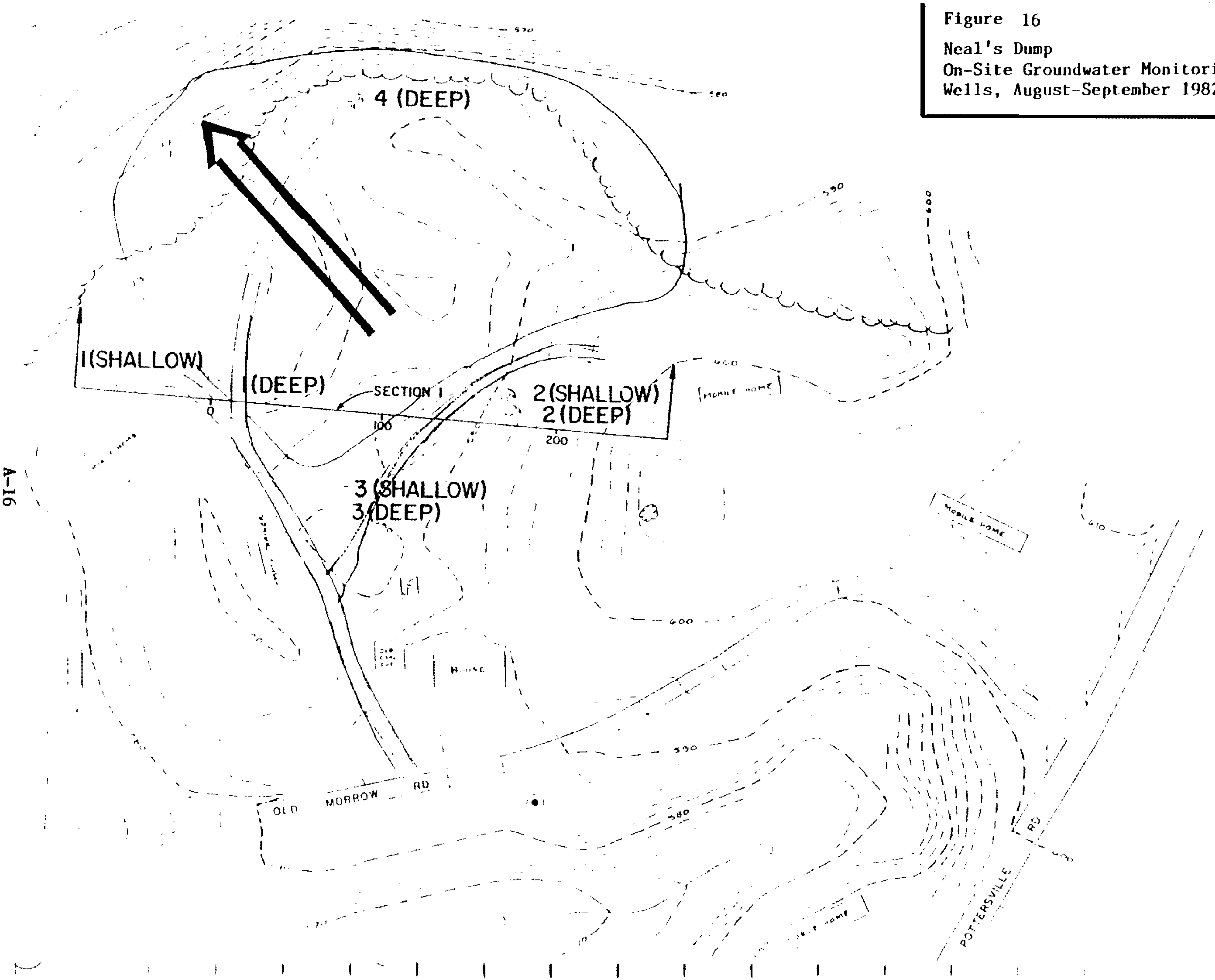


Figure 15

Neal's Dump, On- & Off-Site Ambient Air Monitoring June/July 1983 and July 1984

Figure 16

Neal's Dump
On-Site Groundwater Monitoring
Wells, August-September 1982



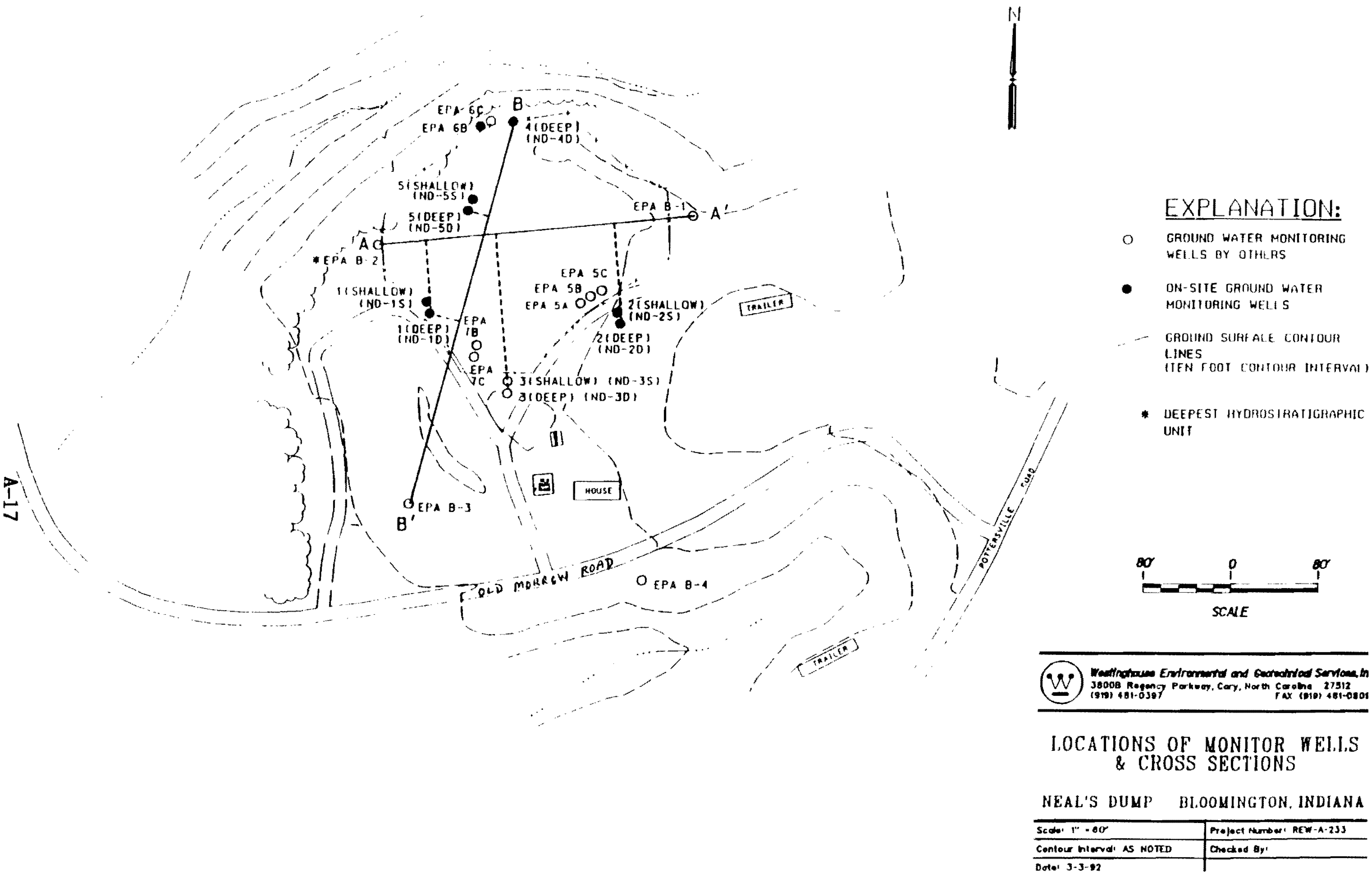
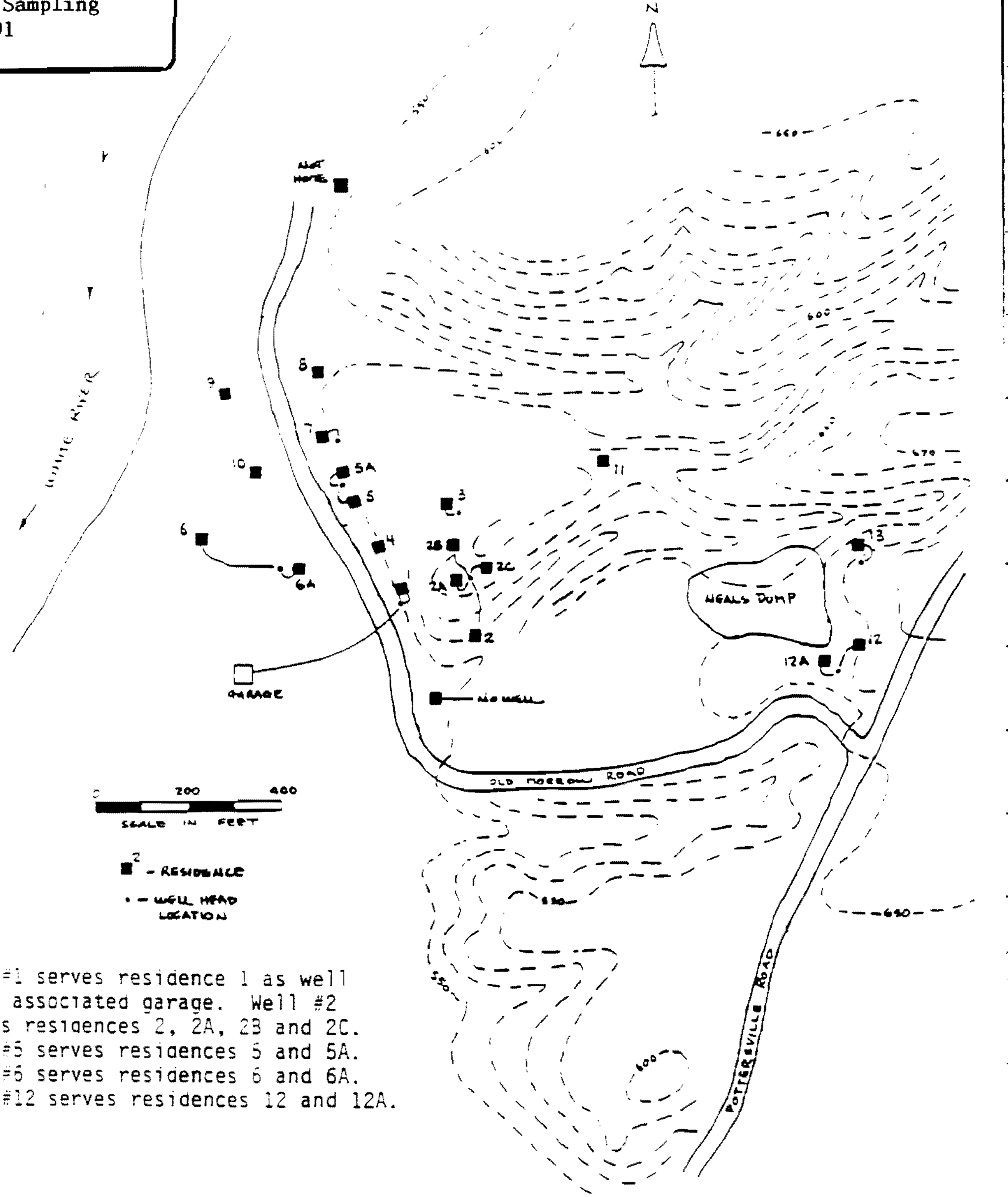


Figure 17

Neal's Dump
On-Site Groundwater Monitoring Wells
May 1987 - November 1992

Figure 18

Neal's Dump
Off-Site Residential
Well Sampling
July 1991

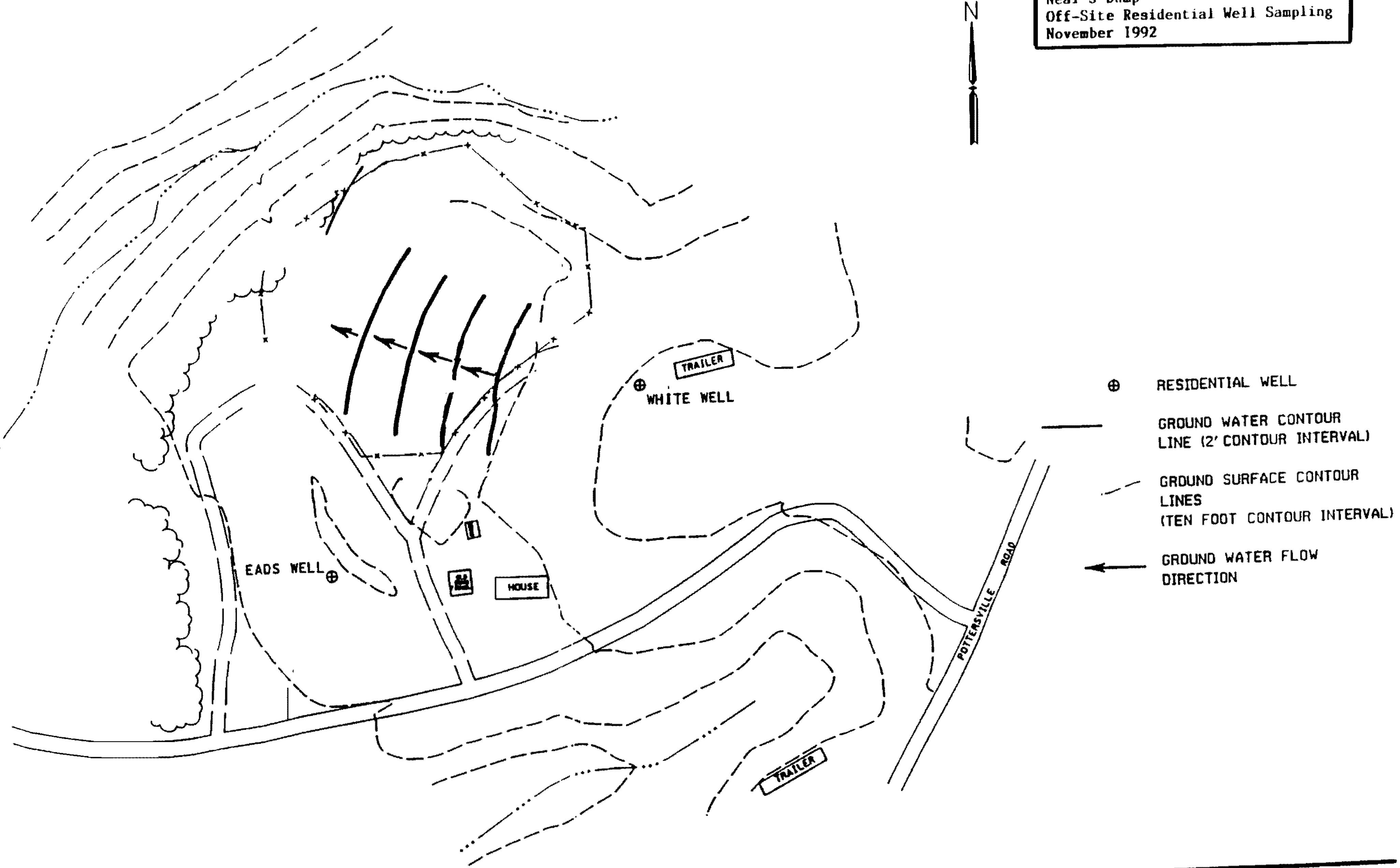


Well #1 serves residence 1 as well as an associated garage. Well #2 serves residences 2, 2A, 2B and 2C. Well #5 serves residences 5 and 5A. Well #6 serves residences 6 and 6A. Well #12 serves residences 12 and 12A.

Westinghouse Environmental And Geotechnical Services, Inc.	PROJECT TITLE: LOCATION OF RESIDENTIAL WELLS — NEAL'S DUMP — OWEN COUNTY, INDIANA	PROJECT NO.: REW-A-233	
		CHECKED BY:	SCALE: AS SHOWN
		DRAWN BY:	DATE: 3-2-92

Figure 19

Neal's Dump
Off-Site Residential Well Sampling
November 1992



SIRRINE ENVIRONMENTAL CONSULTANTS
CARY, NORTH CAROLINA

Project Title: UPPER SATURATED UNIT
GROUND WATER CONTOUR MAP - NOVEMBER 18-19,199
NEAL'S DUMP - OWEN COUNTY, INDIANA

Scale: 1" = 80'
Project Number: RE233.00

Figure 20

Neal's Landfill
On-Site Subusurface Soil Sampling
Soil Boring - Dioxin
October 30, 1984

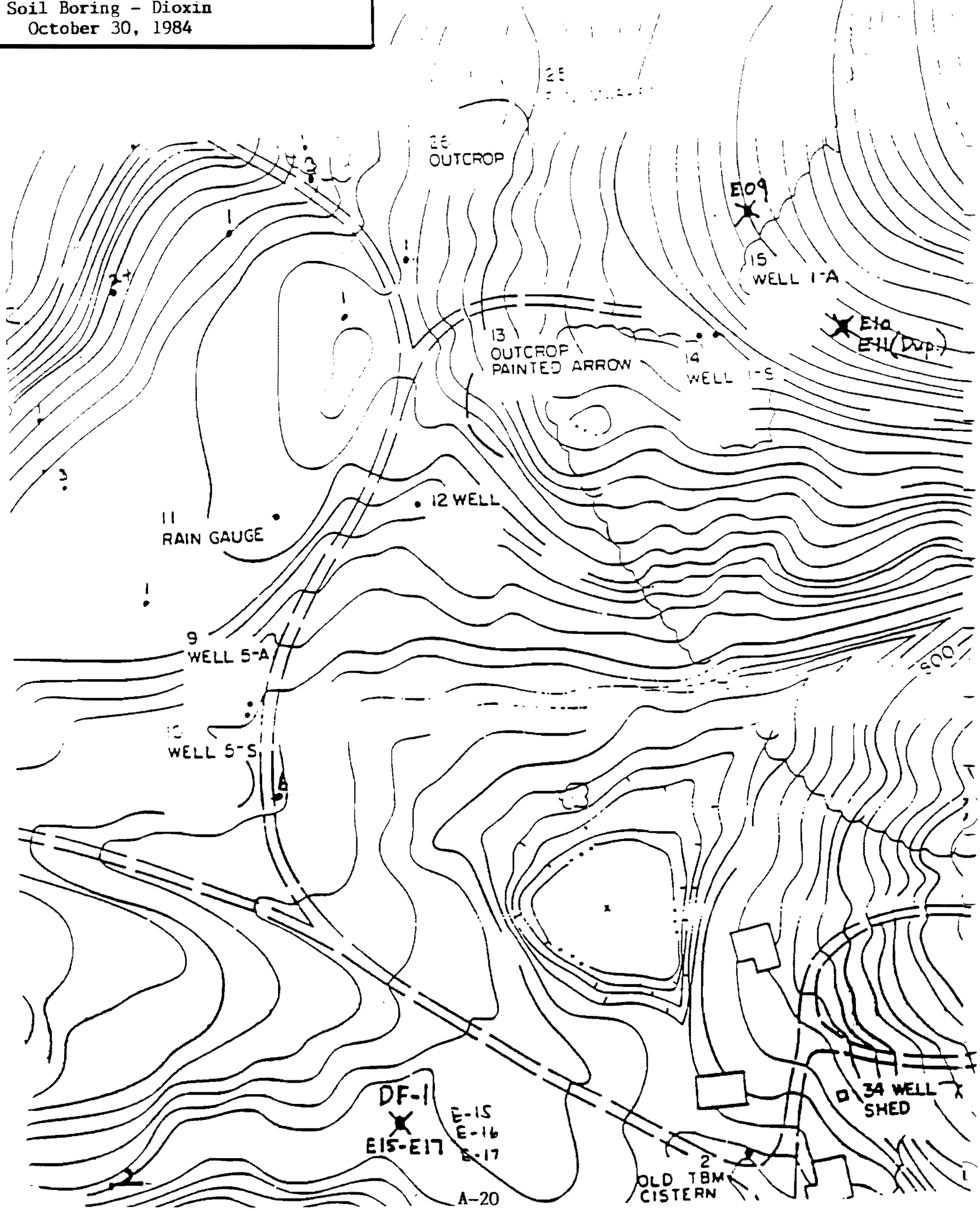
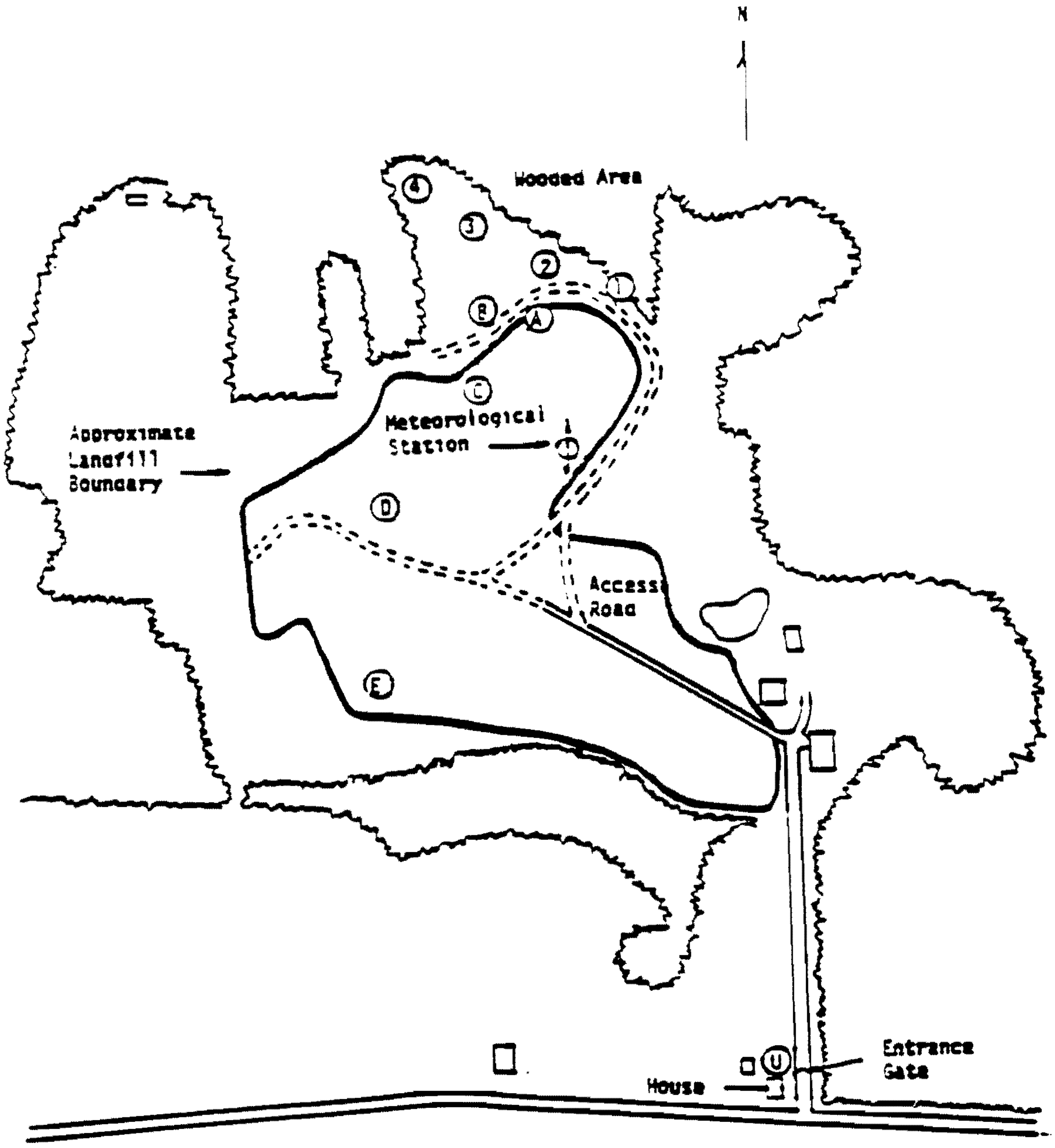


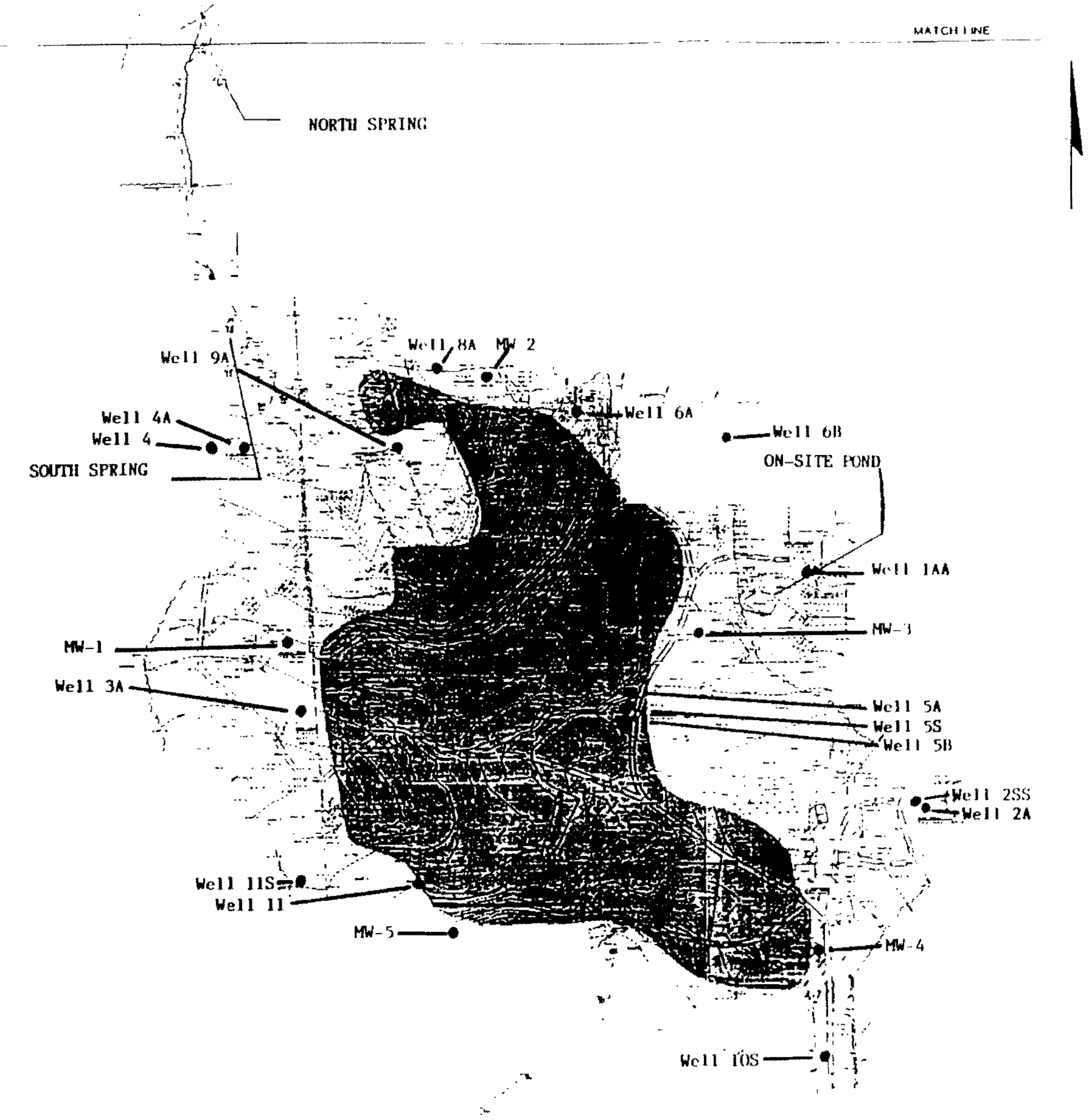
Figure 21

Neal's Landfill
On-Site Ambient Air Monitoring



Approximate Distances:

1 to 2 - 43 m	A to 2 - 12 m
2 to 3 - 46 m	C to 4 - 64 m
3 to 4 - 27 m	



NEAL'S LANDFILL

On-Site Groundwater Monitoring Wells

GOVERNMENT DATA

Figure 22

? - LOCATION APPROXIMATE

(REPRODUCTION NOT TO SCALE)

JANUARY 30 1986

Figure 23

Neal's Landfill
On-Site Surface Water Sampling

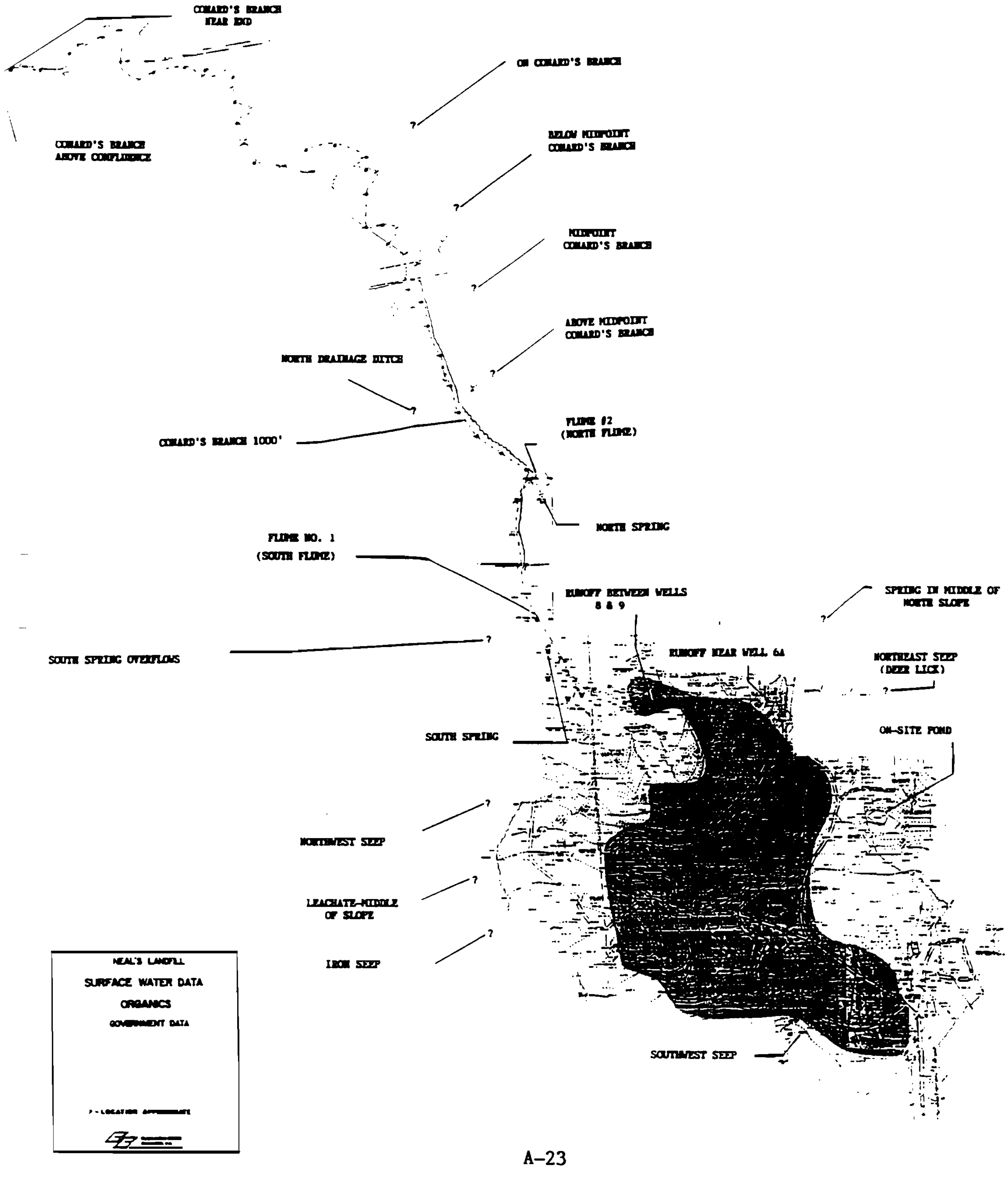
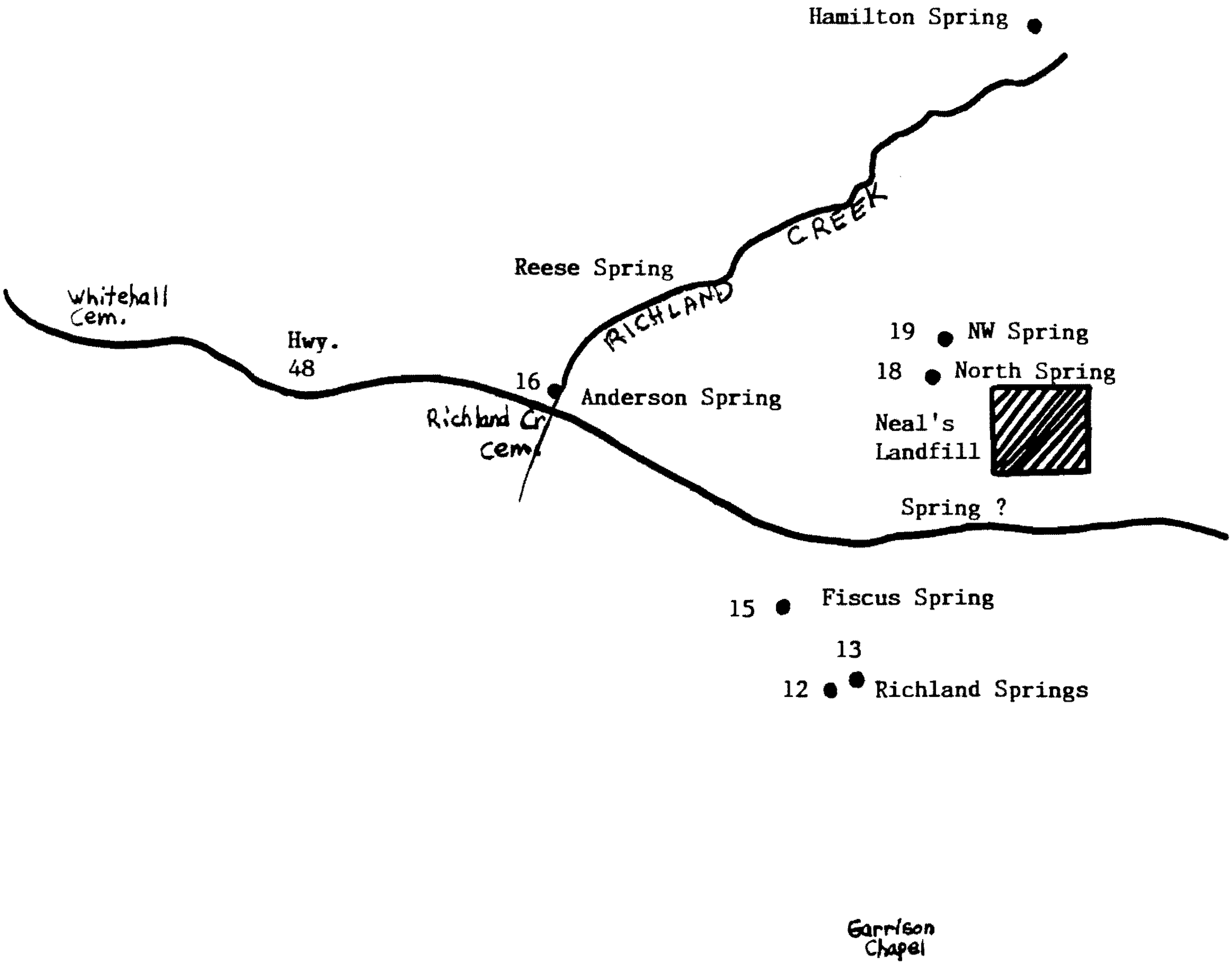


Figure 24

Neal's Landfill
Off-Site Spring Surface Water



EXHIBIT

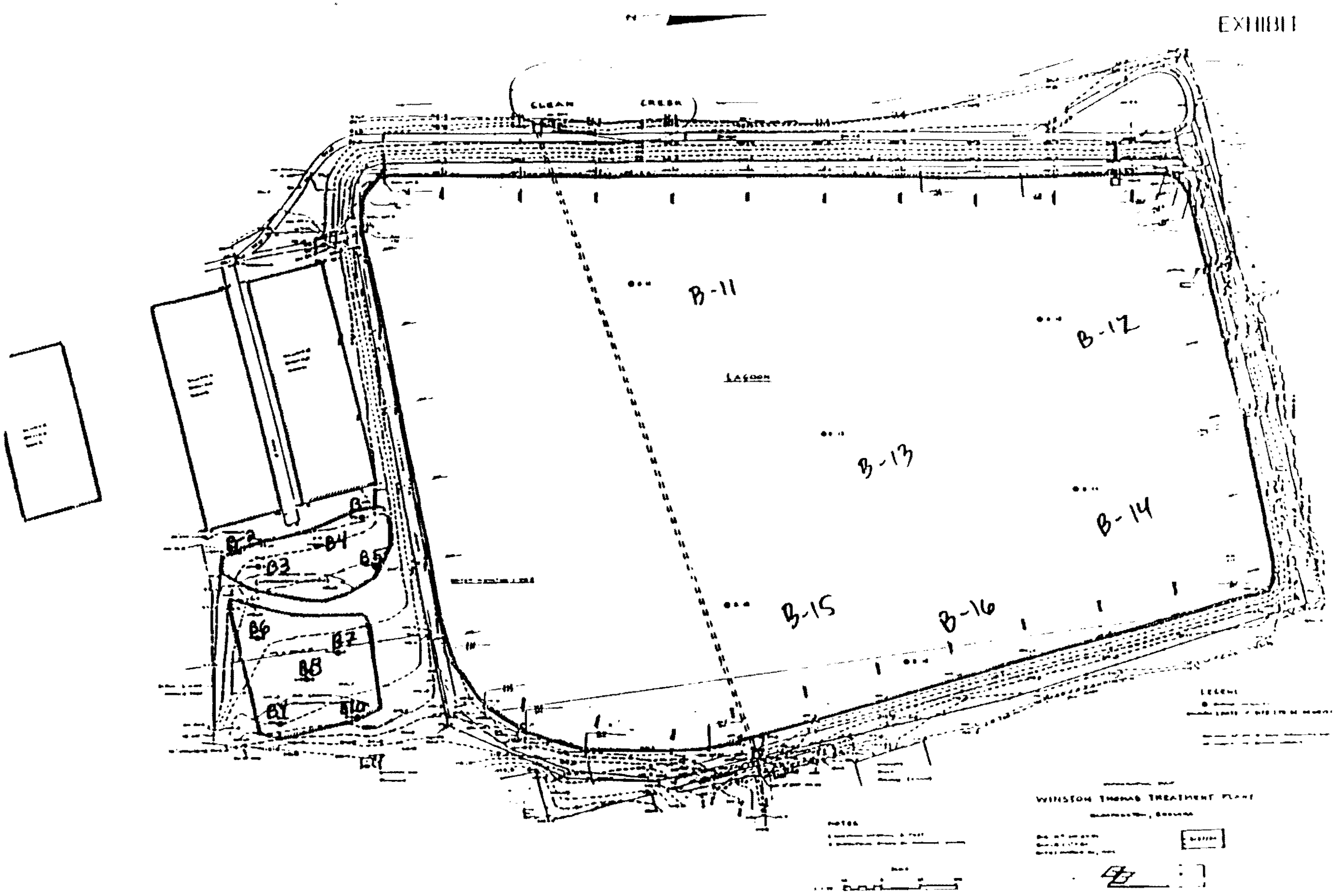


Figure 25

Winston-Thomas Sewage Treatment Plant
On-Site Abandoned Lagoon Borings
On-Site Tertiary Lagoon Borings

Figure 26

Winston-Thomas Sewage Treatment Plant
On-Site Tertiary Lagoon sludge Sampling

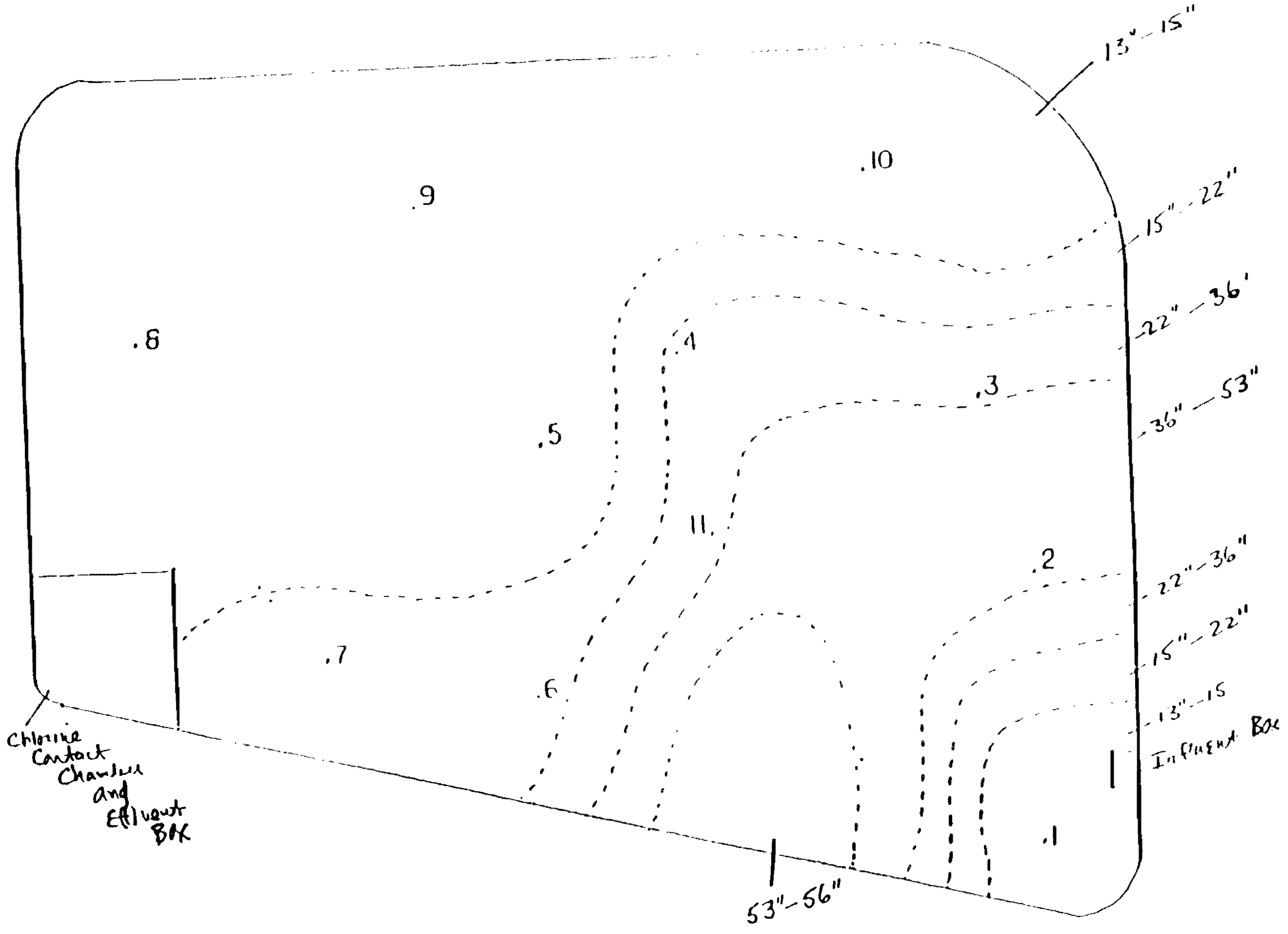
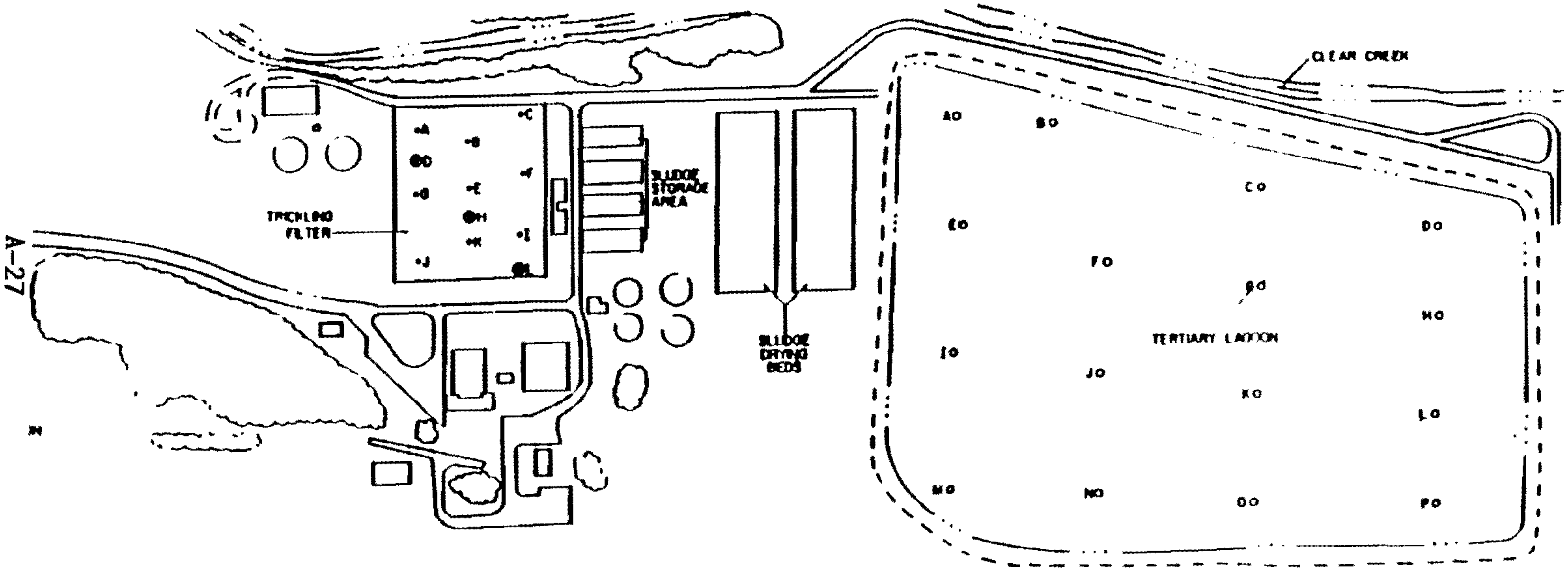


Figure 27

Winston-Thomas Sewage Treatment Plant
On-Site Tertiary Lagoon Core Sludge Sampling



PLANT LAYOUT AND SAMPLING LOCATIONS

WINSTON THOMAS TREATMENT PLANT

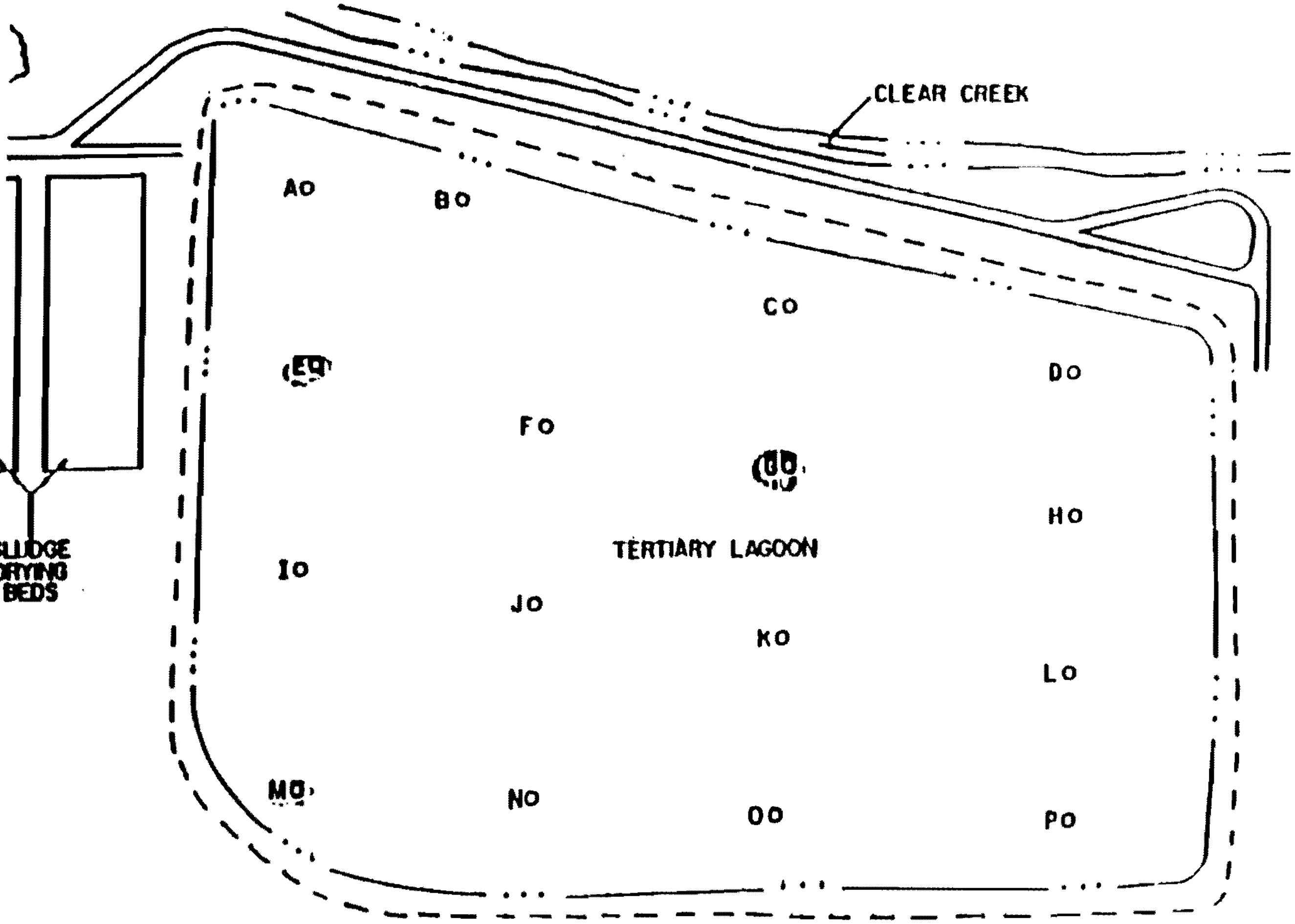
SCALE IN FEET

O'BRIEN & GERE

Figure 28

Winston-Thomas Sewage Treatment Plant
On-Site Tertiary Lagoon Core Sludge
and Clay Sampling

N



PLANT LAYOUT AND SAMPLING LOCATIONS

WINSTON THOMAS TREATMENT PLANT

SCALE IN FEET

Figure 29

Winston-Thomas Sewage Treatment Plant
On-Site Groundwater Monitoring Wells

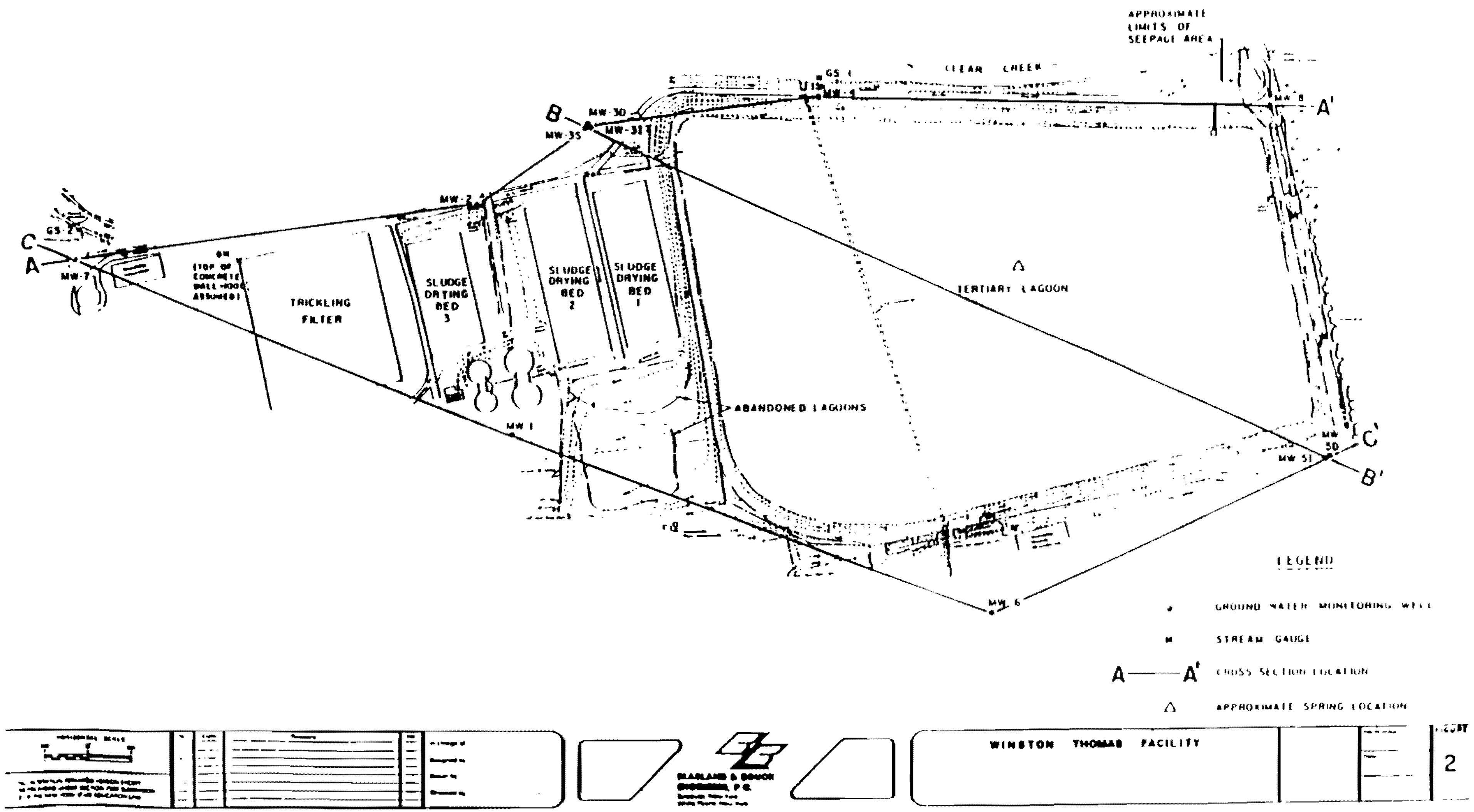


Figure 30

Winston-Thomas Sewage Treatment Plant
Off-Site Sediment Sampling
(March 1976, September 1977, and June/July 1980)
Off-Site Surface Water Sampling
Off-Site Fish Sampling