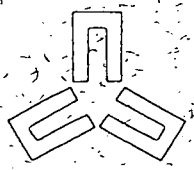
MLM-3814

EG&G MOUND-01-04-07-02-01-9612230033



EG&G
MOUND APPLIED TECHNOLOGIES

Mound Site Environmental Report for Calendar Year 1994

MOUND
is operated for the
U. S. Department of Energy
under contract No. DE-AC04-88-DP43495

Fractions and Multiples of Units

Multiple	Decimal Equivalent	Prefix	Symbol
10^{6}	1,000,000	mega	M
10^{3}	1,000	kilo	k
10^{2}	100	hecto	h
10	10	deka	da
10^{-1}	0.1	deci	d
10^{-2}	0.01	centi	c
10^{-3}	0.001	milli	m
10^{-6}	0.000001	micro	μ
10^{-9}	0.000000001	nano	n
10^{-12}	0.000000000001	pico	p
10^{-15}	0.000000000000001	femto	f
10^{-18}	0.000000000000000001	atto	a

Conversion Table

Multiply	by	to Obtain	Multiply	by	to Obtain
in	2.54	cm	cm	0.394	in
ft	0.305	m	m	3.28	ft
mi	1.61	km	km	0.621	mi
lb	0.4536	kg	kg	2.205	lb
qt (U.S.)	0.946	L	L	1.057	qt (U.S.)
ft^2	0.093	m^2	m^2	10.764	ft^2
ft^3	0.028	m^3	m^3	35.31	ft^3
L	1×10^{-3}	m^3	m^3	1000	L
Ci	3.7×10^{10}	Bq	Bq	2.7×10^{-11}	Ci
rad	0.01	Gy	Gy	100	rad
mrem	0.01	mSv	mSv	100	mrem

Mound Site Environmental Report for Calendar Year 1994

May, 1995

Prepared by the
Environmental Technology & Monitoring Section
EG&G Mound Applied Technologies
P.O. Box 3000
Miamisburg, OH 45343-3000

for the
U.S. Department of Energy
under Contract
No. DE-AC04-88DP43495

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LIST OF ACRONYMS

AIL	ALARA Investigation Level
A-I-P	Agreement-In-Principle
ALARA	As Low As Reasonably Achievable
APG	Analytical Products Group, Inc.
ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
BOD	Biological Oxygen Demand
BVA	Buried Valley Aquifer
CAA	Clean Air Act
CBOD	Carbonaceous Biochemical Oxygen Demand
CEDE	Committed Effective Dose Equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorinated Fluorocarbons
CFR	Code of Federal Regulations
COD	Chemical Oxygen Demand
CWA	Clean Water Act
DCG	Derived Concentration Guide
D&D	Decommissioning and Decontamination
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U. S. Department of Energy
DWS	Drinking Water Standard
EA	Environmental Assessment
EDE	Effective Dose Equivalent
EML	Environmental Measurements Laboratory
EPA	Environmental Protection Agency
ER	Environmental Restoration
ESA	Endangered Species Act
ES&H	Environment, Safety, and Health
FFA	Federal Facility Agreement
FFCA	Federal Facility Compliance Agreement or Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FWPCA	Federal Water Pollution Control Act
GPD	Gallons per Day
HEPA	High efficiency particulate air
HSWA	Hazardous and Solid Waste Amendments
HT	Tritium, elemental
HTO	Tritium, oxide
LDL	Lower Detection Limit
LSA	Low Specific Activity
MB	Miamisburg Area Office of the U.S. DOE
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MGD	Million Gallons per Day
MRC	Monsanto Research Corporation
NEPA	National Environmental Policy Act

NESHAPs	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NTS	Nevada Test Site
NVO	Nevada Operations Office of the U. S. DOE
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OU	Operable Unit
PCBs	Polychlorinated Biphenyls
PWA	Process Waste Assessment
QA	Quality Assurance
RAPCA	Regional Air Pollution Control Agency
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RIR	Remedial Investigation Report
RMMAs	Radioactive Materials Management Areas
RQ	Reportable Quantity
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
TSCA	Toxic Substances Control Act
TTOs	Total Toxic Organics
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
WM/PP	Waste Minimization/Pollution Prevention

CONTRIBUTORS

This report was prepared by L.R Bauer, S.A Cloud, B.M. Farmer, M.D. Gilliat, J. Guenther, J.R. Hausfeld, R.P. Paulick, and L.L. Roush of the Environmental Technology and Monitoring Section of EG&G Mound Applied Technologies. The authors note with appreciation the support of the following EG&G Mound Applied Technologies personnel:

B.J. Adams	L.C. Hopkins	R.L. Stanley
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T.D. Higgins	P.W. Seabaugh	J.J. Zahora

EXECUTIVE SUMMARY

The purpose of this report is to provides the results of Mound's effluent and environmental monitoring program in calendar year 1994. The report also contains information about the site's regulatory compliance status. Mound is a government-owned facility operated by EG&G Mound Applied Technologies for the U. S. Department of Energy (DOE). The site's historical mission included production, development, and research in support of DOE's weapon and energy related programs. The defense mission is currently being phased out. Primary Mound objectives for the future include the expansion of environmental restoration activities and the pursuit of new business opportunities for the site.

The Mound Plant, named after the Miamisburg Indian Mound adjacent to the site, comprises 120 buildings on 124 hectares (306 acres) of land in Miamisburg, Ohio, approximately 16 km (10 mi) southwest of Dayton. The Great Miami River, which flows through the city of Miamisburg, dominates the landscape of the five-county region surrounding Mound. The river valley is highly industrialized. The rest of the region is predominately farmland dotted with residential areas, small communities and light industry. Many city and township residences, five schools, the Miamisburg downtown area, and six of the city's 17 parks are located within one mile of the plant. The climate is moderate. The geologic record preserved in the rocks underlying Mound indicates that the area has been relatively stable since the beginning of the Paleozoic Era more than 500 million years ago. No buildings at Mound are located in a floodplain or in areas considered wetlands. The southwestern portion of the plant site is located over the Buried Valley Aquifer which has been designated as a sole source aquifer by the U.S. EPA.

ES.1 Perspective on Radiation

Radionuclides, radioactive species of atoms, emit ionizing radiation. Ionizing radiation is radiation possessing enough energy to remove electrons from the substances through which it passes. Most consequences to humans from exposure to radionuclides arise from the interactions of ionizing radiation with human tissue. These interactions are measured based on the amount of energy deposited in the tissue. This value is the absorbed dose. Since different types of ionizing radiation cause different degrees of biological harm, it is necessary to weight the doses to account for those differences. The unit used to make this comparison possible is the dose equivalent. The units used to report dose equivalents are the rem and the Sievert (Sv). Because doses associated with environmental exposures are typically only fractions of a rem or Sievert, it is common to report doses in terms of millirems (mrem) or millisieverts (mSv). There are 1000 mrem per rem; 1000 mSv per Sv.

Our bodies are exposed to ionizing radiation each day. Most of this radiation comes from natural sources. The average dose to a resident of the United States from natural sources is about 300 mrem (3 mSv) per year. The primary contributors to this average dose are radon, cosmic and terrestrial sources, and medical sources such as x-rays or other diagnostic exposures.

ES.2 Radionuclide Releases from Mound

Table E-1 lists the quantities of radionuclides released by Mound into the air and water during 1994. The unit used to report these quantities is the curie (Ci), a unit of radioactivity equal to 3.7×10^{10} disintegrations per second. The quantities, or activities, shown in Table E-1 were measured at the point of release.

Two specific points of interest regarding environmental monitoring in 1994 involved elevated tritium levels near SW-Building due to a water main break and elevated airborne plutonium levels associated with the Decontamination and Decommissioning (D&D) of SM Building. The water line break occurred April 18, 1994 and resulted in approximately 7 Ci of tritium being flushed from the soils surrounding SW-Building. The water line was repaired and the contaminated water was removed. Routine environmental monitoring identified elevated airborne plutonium levels near SM Building in July of 1994. As a result, D&D operations were halted until a review of the operations was performed. Techniques to reduce the plutonium levels were employed and restart of the D&D operations was approved by the EPA. The elevated plutonium levels were small fractions of the DOE Derived Concentration Guides (DCG's) and pose no significant risk.

Table E-1. Radiological Effluent Data for 1994

Radionuclide	Released to	Activity, Ci
Tritium	Air	489[a]
	Water	10.5
Plutonium-238	Air	1.5×10^{-5}
	Water	2.2×10^{-4}
Plutonium-239,240	Air	5.7×10^{-8}
	Water	8.0×10^{-6}
Radon-222	Air	2.5
Uranium-233,234	Air	9.8×10^{-9}
	Water	7.0×10^{-4}
Uranium-238	Air	5.9×10^{-9}

[a] Tritium in air consists of: Tritium oxide, 410 Ci
Elemental tritium, 79 Ci

ES.3 Dose Limits

Dose limits, or more precisely, dose equivalent limits, for members of the public are presented in Table E-2. These limits are expressed in terms of a committed effective dose equivalent (CEDE) and an effective dose equivalent (EDE) for the DOE and U. S. Environmental Protection Agency (EPA), respectively. Values shown in Table E-2 represent annual limits on dose equivalents established by the DOE and EPA.

ES.4 Doses from Mound Operations

In calculating the maximum dose received by a member of the public from Mound operations, a committed effective dose equivalent is used. The CEDEs are the doses received by a hypothetical adult individual who remained at the site boundary 24 hours per day throughout 1994. This individual was assumed to have:

- breathed only air containing the highest average radionuclide concentrations measured at an onsite or offsite air sampling station,
- drawn all of his drinking water from the offsite well with the highest average radionuclide concentration, and
- consumed produce exhibiting the average concentrations measured in the samples collected from the Miamisburg area.

The CEDEs from all of these pathways are added to obtain an estimate of a maximum CEDE received by this hypothetical individual. Table E-3 shows the results for Mound in 1994. The results are reported for tritium, plutonium-238, and plutonium-239. The absence of a radionuclide, or an exposure pathway, from Table E-3 indicates that the 1994 concentrations were below background levels or were too small to affect the overall doses reported in the table.

The data presented in Table E-3 were calculated using environmental monitoring data measured on and near Mound. Mound also evaluates doses using the EPA's computer code CAP-88. CAP-88 uses air effluent data as input to transport, dispersion, and dosimetry codes. By executing these codes, one generates an estimate of a maximum offsite dose from airborne releases. For 1994, the CAP-88-estimated maximum offsite dose was 0.03 mrem. As reported in Table E-2, the EPA's annual dose limit for airborne releases is 10 mrem. Therefore, Mound's releases in 1994 represented 0.3% of the dose limit set by the EPA.

Table E-2. Radiation Dose Limits for Protection of the Public from All Routine DOE Operations

Pathway	Regulatory Standard	Effective Dose Equivalent[a] mrem	mSv
All exposure media	DOE Order 5400.5	100	1
Air	40 CFR 61 (EPA)	10	0.1
Drinking water	40 CFR 141 (EPA)	4	0.04

[a]Evaluated based on annual exposure conditions

Table E-3. Maximum Committed Effective Dose Equivalents to a Hypothetical Individual in 1994

Radionuclide	Pathway	mrem	mSv
Tritium	Air	0.006	0.00006
	Water	0.02	0.0002
	Produce	0.0005	0.000005
	Total	0.03	0.0003
Plutonium-238	Air	1.13	0.0113
	Water	0.0002	0.000002
	Produce	0.13	0.0013
	Total	1.26	0.000002
Plutonium-239	Air	0.01	0.0001
	Water	0.00006	0.0000006
	Produce	0.0009	0.000009
	Total	0.01	0.0001
Total		1.3	0.013

CAP-88 also estimates doses to populations surrounding Mound. The population (approximately 3,035,000 persons) within a radius of 80 km (50 mi) of Mound received an estimated 1.9 person-rem from Mound operations in 1994. CAP-88 arrived at that value first by calculating doses at specific distances, and in specific compass sectors, relative to Mound. The computer code then multiplied the average dose in a given area by the number of people living there. For example, an average dose of 0.001 rem x 10,000 people in the area yields a collective dose of 10 person-rem. CAP-88 then sums up all the collective doses for the 80-km radius region and reports a single number.

Since the average dose received each year by an individual is about 300 mrem, the collective background dose for the 80-km population is approximately one million person-rem (0.3 rem x 3,035,000 persons). Mound's contribution of 1.9 person-rem represents on the order of 0.00019% of the background value.

ES.5 Environmental Monitoring Program Results

Besides setting limits on the CEDE to any member of the public, DOE has established Derived Concentration Guides (DCGs) for individual radionuclides. The DCG is defined as the concentration of a radionuclide that will result in a CEDE of 100 mrem (1 mSv) following continuous exposure for one year. The concentrations of radionuclides resulting from Mound's 1994 releases were small fractions of the appropriate DCGs.

Radiological Monitoring of the Atmosphere

Ambient air is sampled for tritium and plutonium by an onsite network of seven perimeter stations and by an offsite network of 15 stations. Ten of the offsite samplers are located in the Miamisburg area. One sampler is located far enough away to receive virtually no impact from Mound operations. This sampler serves as a reference location to establish background levels of tritium and plutonium. The amount by which a sample exceeds the background or environmental level is reported as an incremental concentration.

Incremental concentrations measured at the onsite samplers were 0.0041% and 0.16%, respectively of the DOE DCGs for tritium and plutonium-238. Average incremental concentrations at the offsite samplers for tritium and plutonium-238 were 0.0027% and 0.0066%, respectively of the DOE DCGs. Incremental plutonium-239,240 concentrations averaged 0.0034% and 0.0007% of the DOE DCGs for the onsite and offsite stations, respectively.

Radiological Monitoring of Water

Water samples were collected from locations along the banks of the Great Miami River and were analyzed for tritium, plutonium-238, plutonium-239, 240, uranium-233,234, and uranium-238. Other surface water locations were sampled for tritium and plutonium. Additionally, both river and pond sediment samples were collected and analyzed for plutonium.

River water. The average incremental concentrations of plutonium-238 and plutonium-239,240 in water from the Great Miami River were 0.0018% and 0.0006% of the DOE DCGs, respectively. Concentrations of uranium-233,234 and uranium-238 averaged 0.0132% and 0.0098% of their respective DCGs. Average tritium concentrations in the river did not exceed 0.01 % of the DOE DCG for tritium in water.

Sediment. Average concentrations of plutonium-238 in sediment samples collected from the Great Miami River suggest some accumulation of Pu-238 relative to other sampling locations. However, at such low concentrations, the error limits are quite large and the potential risks are quite small.

Radiological Monitoring of Produce and Vegetation.

Locally-grown foodstuffs, vegetation, and fish samples were collected from the surrounding area. These samples were then analyzed for tritium and/or plutonium as appropriate. Concentrations of tritium in vegetation and tomatoes were at or below environmental levels (levels established at locations not impacted by operations at Mound) in most cases. Similar results were observed for concentrations of plutonium-238 and plutonium-239 in vegetation, root crops, and fish.

Nonradiological Monitoring of Air

Particulate loadings are measured at all of the onsite and offsite air sampling locations. Particulate concentrations appeared to be independent of distance. This result suggests Mound exerts little or no influence on the levels of airborne particulates.

Nonradiological Monitoring of Water

Mound's nonradiological liquid discharges are regulated by the National Pollutant Discharge Elimination System (NPDES) permit. In 1994, 1570 samples were collected to demonstrate compliance with the NPDES permit. One exceedance did occur. On September 15, 1994, Mound exceeded the daily permit limit for total residual chlorine. Mound recorded a total residual chlorine concentration of 3.27 mg/L; the permit limit is 0.5 mg/L. The exceedance was reported to the Ohio EPA. The problem was corrected and the Ohio EPA did not issue a notice of non-compliance or violation.

ES.6 Groundwater Monitoring Program

Mound maintains an extensive network of onsite and offsite monitoring wells. In addition, a number of onsite and offsite production wells and drinking water systems are routinely monitored. Drinking water from the Miamisburg area is analyzed for tritium, plutonium, and uranium. Other regional water supplies are sampled for tritium. Samples from monitoring and production wells are analyzed for various constituents including volatile organic compounds, polychlorinated biphenyls, metals, and inorganic cations and anions. Monitoring data collected in 1994 indicate that volatile organic compounds and tritium, respectively, are the primary nonradiological and radiological contaminants of concern.

ES.7 Environmental Restoration Program

Mound was designated a Superfund site, i.e., placed on the National Priorities List, in November of 1989. A Federal Facilities Agreement (FFA) between the DOE and the U. S. EPA followed in October of 1990. The FFA was expanded to a tri-party agreement in 1993 when the Ohio EPA became a signatory. The purpose of the FFA remains unchanged; it defines the responsibilities of each party for the completion of Superfund-related (CERCLA-related) activities.

CERCLA assessments of contamination at Mound have identified approximately 345 locations of known or suspected releases. In 1994, comprehensive evaluations of these areas continued.

ES.8 Quality Assurance for Environmental Data

To ensure the reliability of environmental data, Mound maintains an internal quality assurance (QA) program that consists of running blanks, internal standards, and duplicate samples. Mound also participates in comparison exercises with external laboratories to validate further Mound's environmental results. Comparisons of Mound's performance with that of other laboratories are shown in Chapter 7 of this report. The close agreement between Mound and the external labs demonstrates that Mound's Environmental Monitoring Program generates reliable data.

1.0 INTRODUCTION

1.1 Description of Mound Plant

Location

The Mound Plant, named after the Miamisburg Indian Mound adjacent to the site, comprises 120 buildings on 124 hectares (306 acres) of land in Miamisburg, Ohio, approximately 16 km (10 mi) southwest of Dayton (Figure 1-1). The Great Miami River flows southwest through the City of Miamisburg and dominates the geography of the region surrounding Mound (Figure 1-2). The river valley is highly industrialized. The rest of the region is predominately farmland dotted with residential areas, small communities and light industry. Many city and township residences, five schools, the Miamisburg downtown area, and six of the city's 17 parks are located within one mile of the plant. The climate is moderate.

Figure 1-1. Locations of the Mound Plant and Surrounding Communities

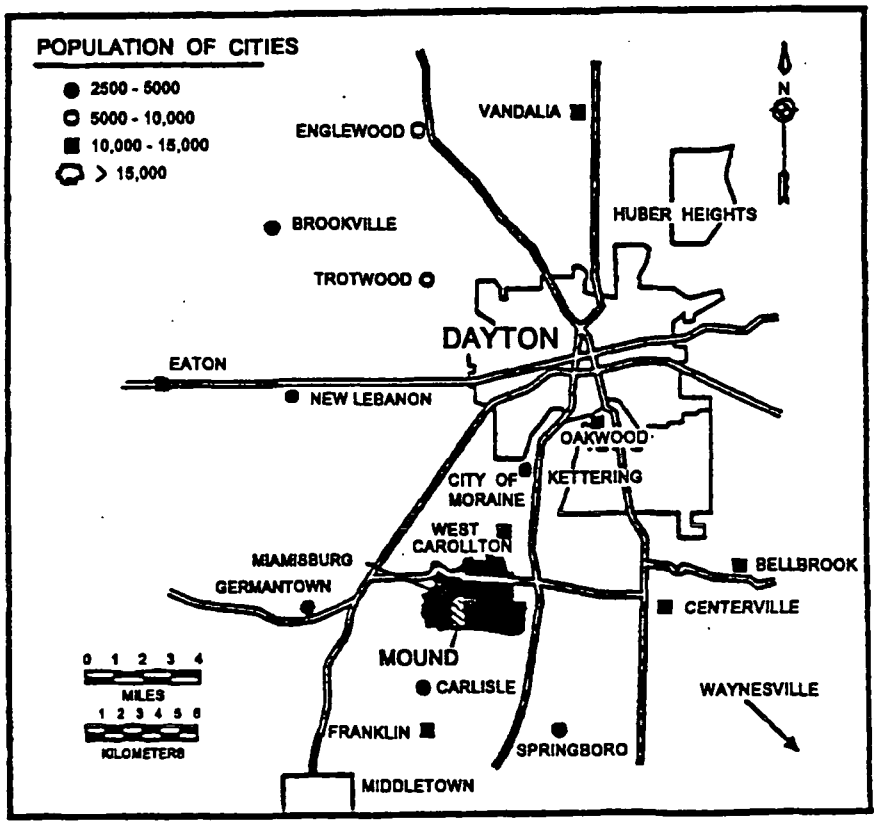
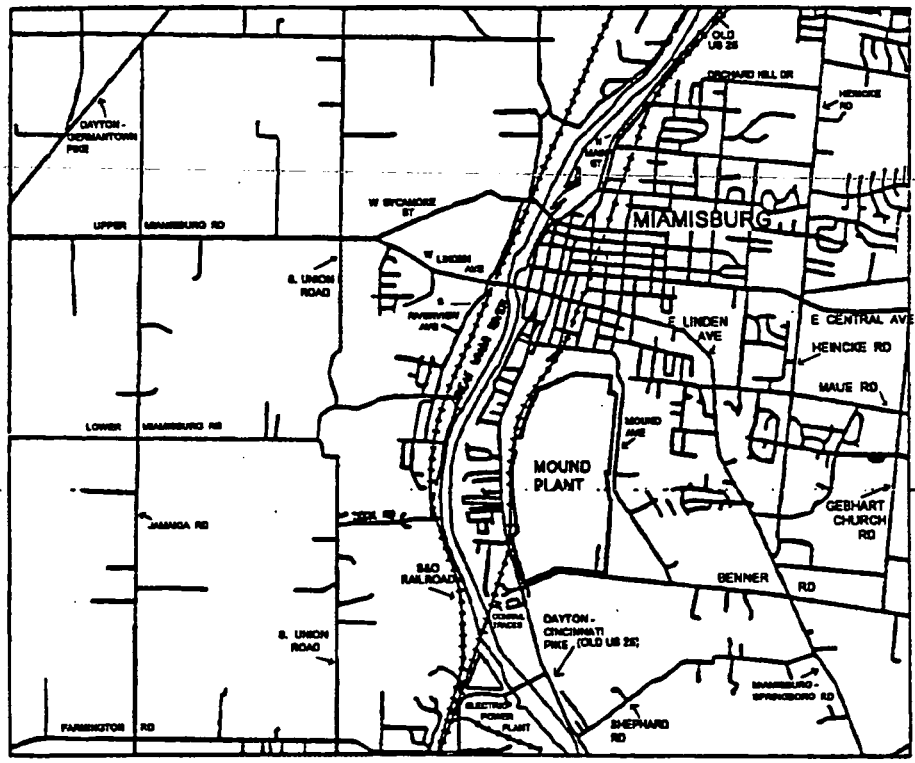


Figure 1-2. Location of the Mound Plant



Population and Land Use

Figure 1-3 shows the population distribution within 50 miles (80 km) of Mound. The population information was extracted from 1990 Census data (PL94-171) by the Ohio Department of Development. The estimated number of individuals residing within the 50-mile radius is 3,034,679 (Table 1-1). The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the agricultural land is devoted to pasturing livestock.

Table 1-1. Population Totals from the 1990 Census

Radius, miles	Total
0-10	322,876
0-20	887,114
0-30	1,477,621
0-40	2,541,609
0-50	3,034,679

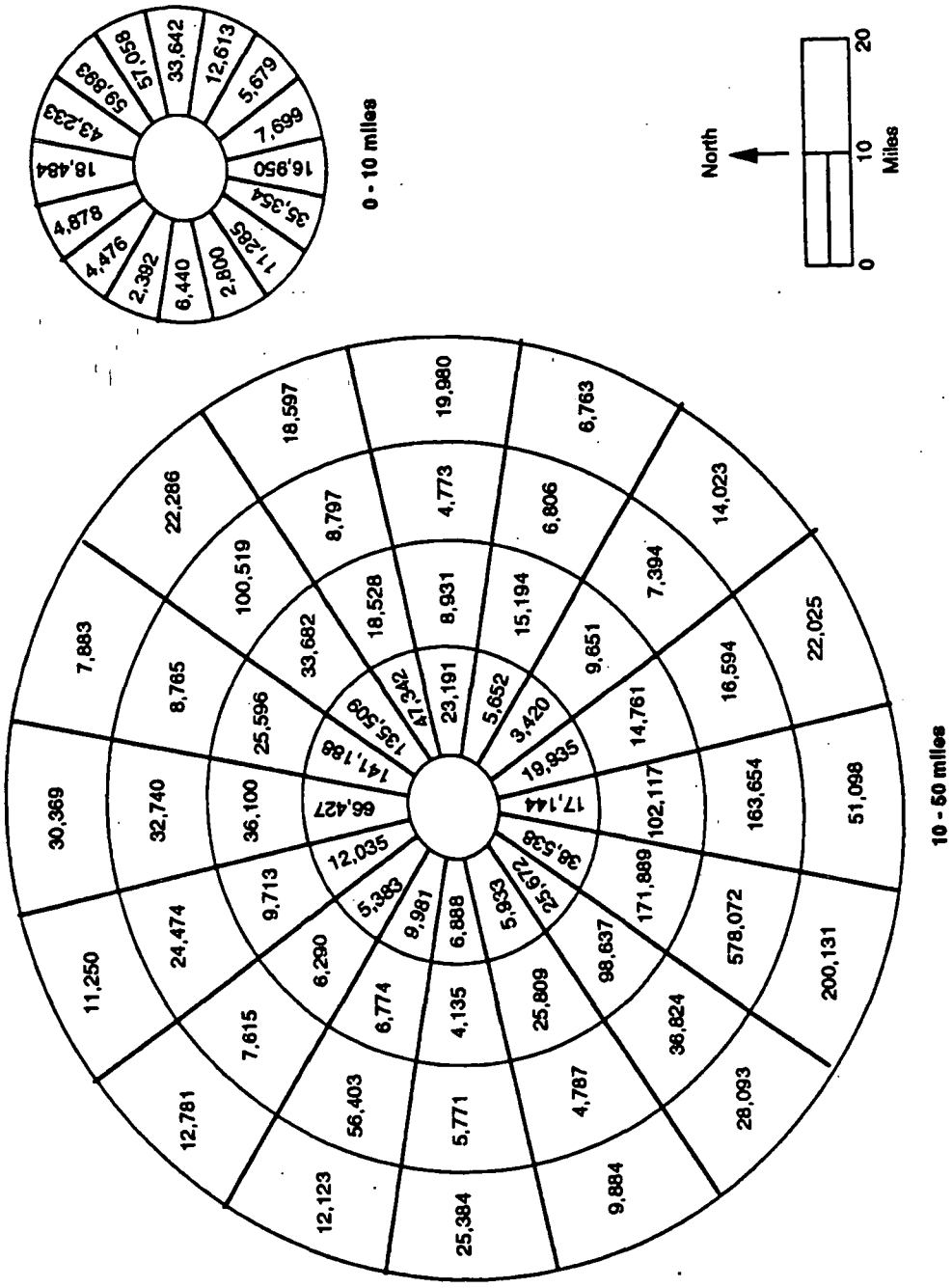


Figure 1-3. Distribution of Population within 50 mi (80 km) of Mound

Climate

The climate is moderate. The average annual precipitation rate is on the order of 91 cm (36 in) per year. As shown in Figure 1-4, the total precipitation measured at Mound in 1994 was 69.5 cm (27 in). For 1994, winds were predominately out of the south southwest (Figure 1-5). The annual average wind speed measured at Mound for 1994 was 4.8 m/s (10.7 mi/hr) (Table 1-2).

Geology

The geologic record preserved in the rocks underlying Mound indicates that the area has been relatively stable since the beginning of the Paleozoic era more than 500 million years ago. There is no evidence indicating subsurface structural folding, significant stratigraphic thinning, or subsurface faulting. Limestone strata, which are interbedded with protective shale layers at the site, show no evidence of solution activity. No evidence of solution cavities or cavern development has been observed in any borings or outcrops in the Miamisburg area.

Figure 1-4. Monthly Rainfall Measured at Mound in 1994

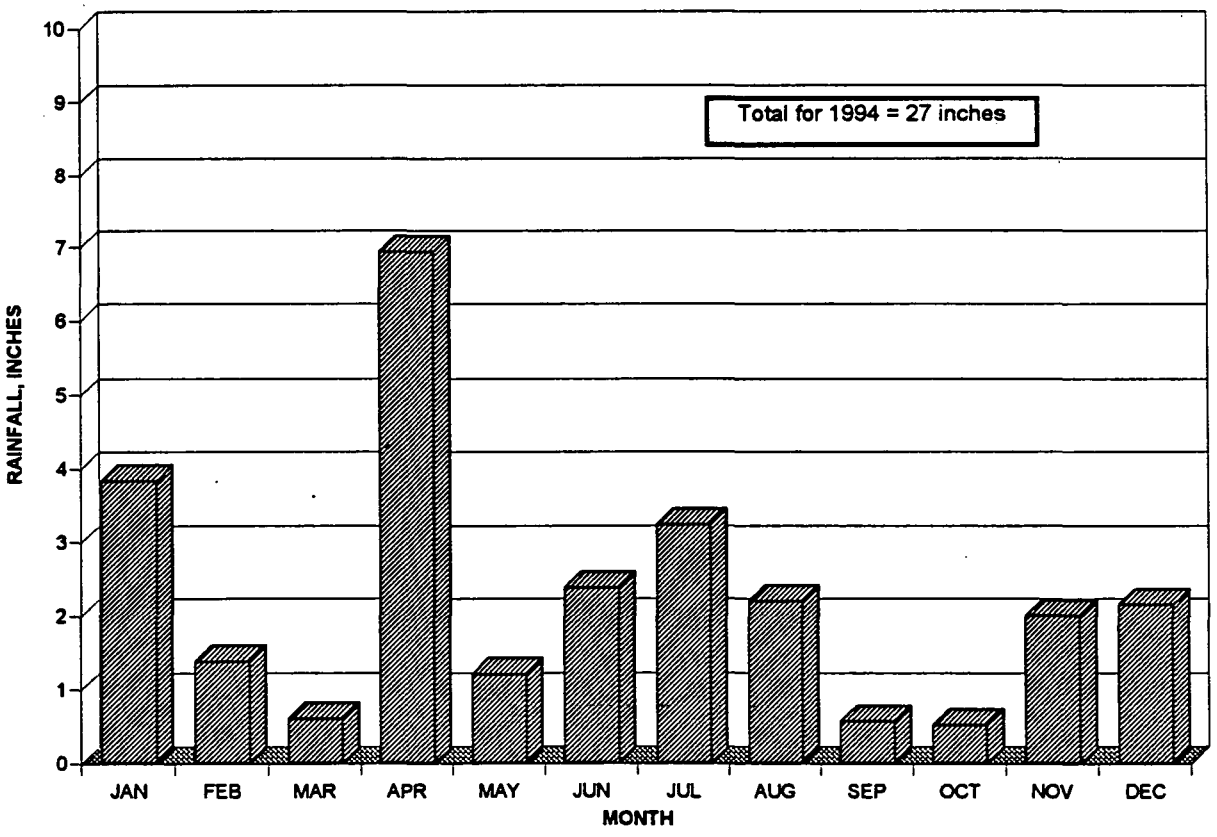
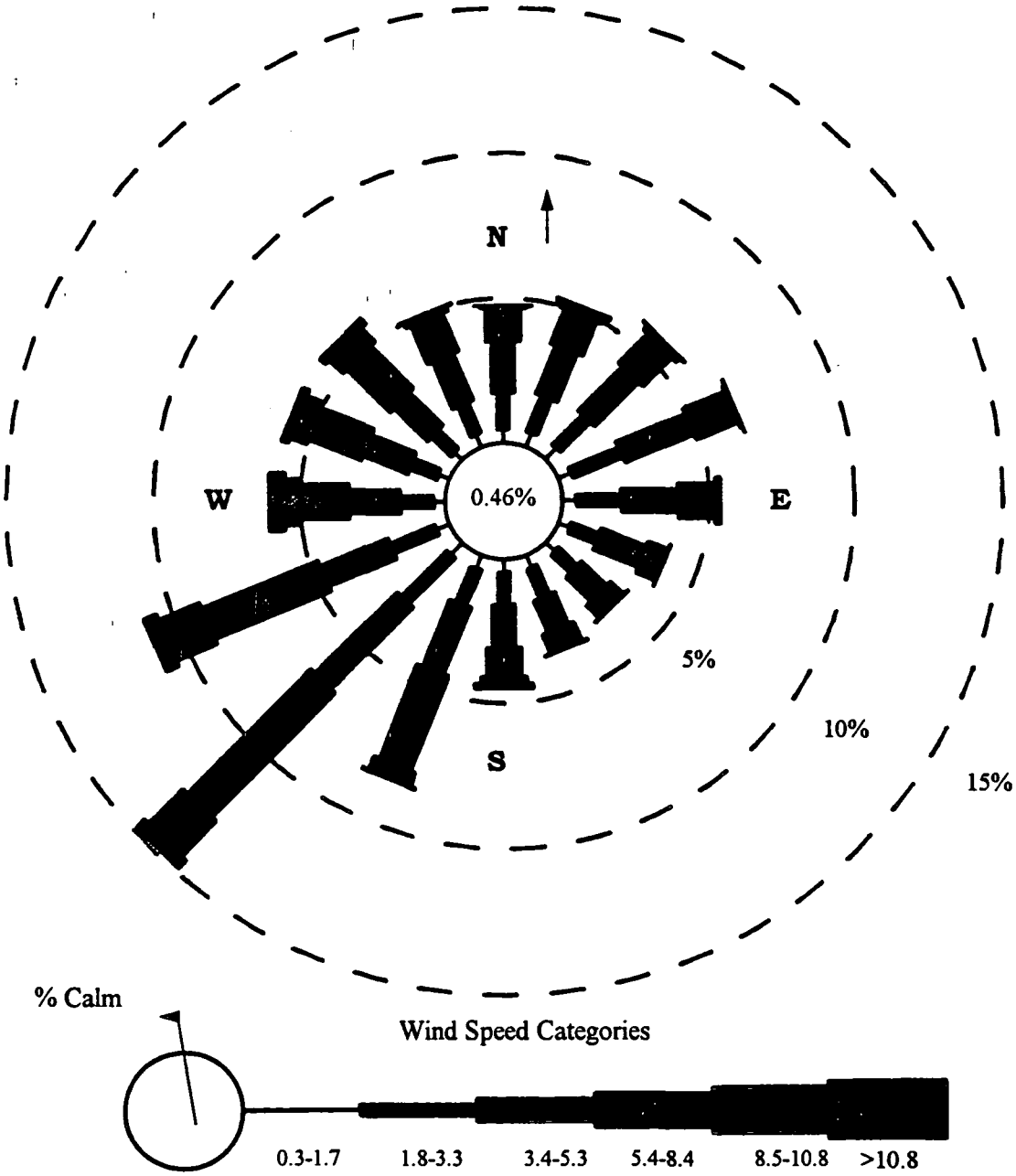


Figure 1-5. 1994 Wind Rose for the Mound Plant



(Figure indicates frequency of winds blowing *from* a given compass sector. Data set is 99.9 % complete)

Table 1-2. Percent Frequency of Wind Direction and Wind Speed from the Mound Plant 50-m Meteorological Tower for 1994

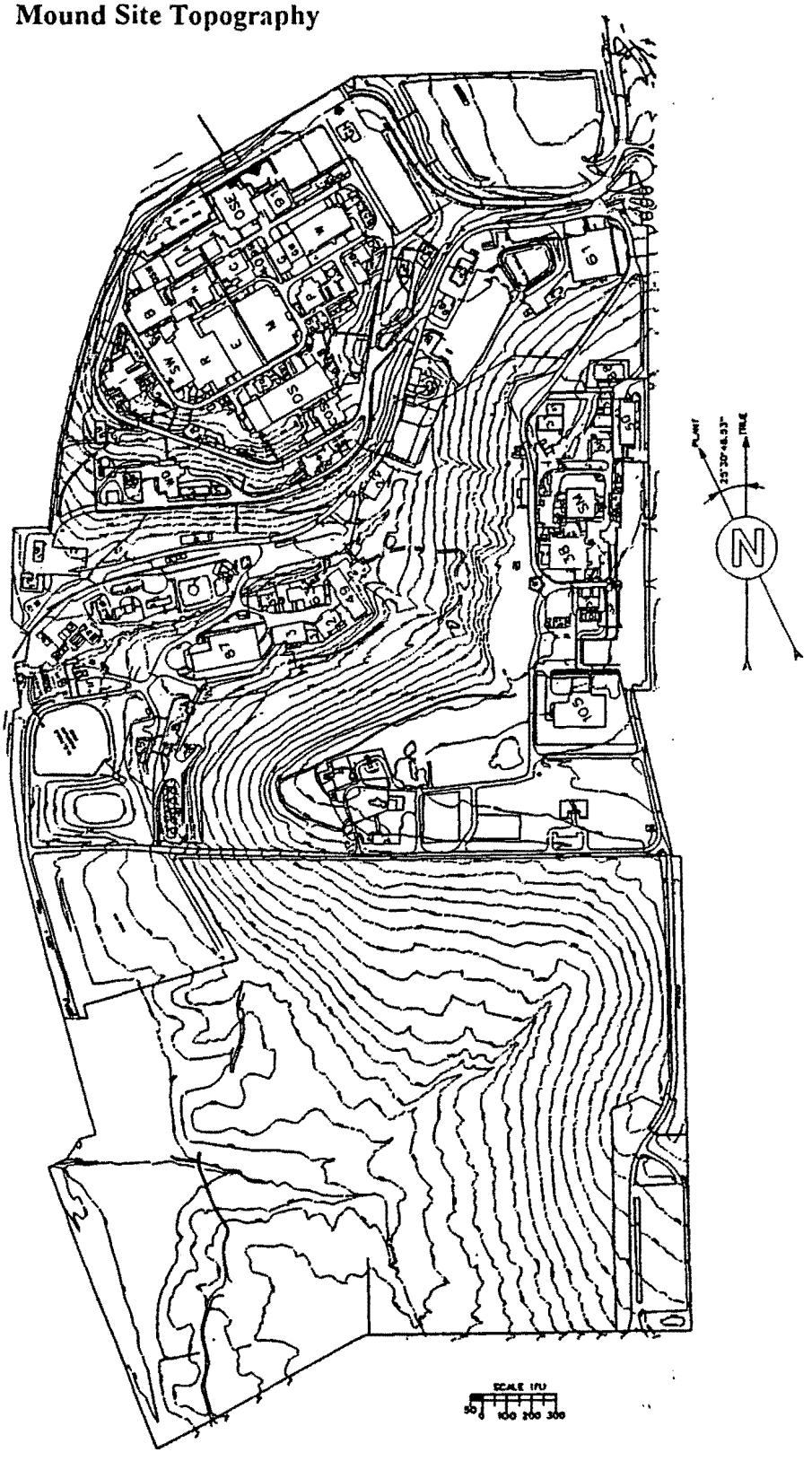
Direction	Percent	Average Speed (m/s)
N	4.7	4.2
NNE	5.2	4.5
NE	5.7	4.4
ENE	6.5	4.2
E	5.4	4.2
ESE	3.8	4.0
SE	3.2	3.8
SSE	3.5	3.9
S	4.5	4.7
SSW	8.4	5.2
SW	14.8	5.7
WSW	10.9	6.0
W	6.1	5.8
WNW	5.9	5.6
NW	5.9	5.7
NNW	5.0	4.5
		Average 4.8

Total relative frequency of calms distributed above is 0.2%

Topography

The site topography is shown in Figure 1-6. Mound site elevations vary from 216 m to 268 m (700 ft to 900 ft) above sea level; most of the Plant is above 244 m (800 ft). No building in which radioactive material is processed is located below an elevation of 241 m (790 ft). The typical nonflood stage of the Great Miami River is 208 m (682 ft). The highest flood-water levels that can be reasonably postulated for the Great Miami River basin would result in flooding to 216 m (710 ft), which is approximately the lowest elevation at the site. No buildings at Mound are located on a floodplain or in areas considered as wetlands.

Figure 1-6. Mound Site Topography



Mission and Operations

Mound has served as an integrated research, development, and production facility in support of DOE weapon and nonweapon programs, especially in the areas of chemical explosives and nuclear technology. The principal mission of the Mound Plant has been to research, develop, and manufacture non-nuclear explosive components for nuclear weapons that are assembled at another DOE site. Other major operations at Mound have included:

- Manufacture of stable (nonradioactive) nuclides for medical, industrial, and general research.
- Development and manufacture of small chemical heat sources for the national defense program.
- Recovery and purification of tritium from scrap materials generated by Mound and other DOE sites.
- Development and fabrication of radioisotopic heat sources fueled with plutonium-238 to provide power sources for such projects as lunar experiments, satellites, and spacecraft.
- Surveillance of explosive and radioactive weapons components received from other DOE sites.

As a result of the November 22, 1993, DOE decision to phase out the defense mission at Mound, activities are currently underway to transfer Mound's defense-related programs to other sites within the weapons complex.

Therefore, in addition to completing the defense mission, primary Mound objectives for the future include the expansion of environmental restoration activities and the pursuit of new business opportunities for the site.

1.2 Perspective on Radiation

This section attempts to put into perspective the potential consequences of the radionuclide releases described in subsequent sections of this report.

Most consequences to humans from radionuclides released to the environment are caused by interactions between radiation emitted by the nuclides and human tissue. These interactions involve the transfer of energy from the radiations to the tissue, a process that may damage the tissue. The radiations may come from radionuclides located outside the body (i.e., in or on environmental media and man-made objects) and from radionuclides deposited inside the body via inhalation, ingestion, or absorption through the skin. Exposure to radiation from nuclides located outside the body is called external exposure and will last only as long as the exposed person is near the external source. Exposure to radiation from radionuclides deposited inside the body is called internal exposure and will last as long as the radionuclides remain in the body.

A number of specialized units are used to characterized exposures to ionizing radiations. Because the damage associated with such exposures is due primarily to the deposition of radiant energy in tissue, these units are described in terms of the amount of energy absorbed by the tissue and the biological consequences of the absorbed energy.

Some of these units are defined below:

- **Absorbed dose** indicates the amount of energy absorbed by a material (e.g., human tissue), divided by the mass of the material. The unit of absorbed dose is the gray (Gy) or the rad (100 rads = 1 Gy).

- **Dose equivalent** indicates the biological effect of an absorbed dose on a particular organ or tissue. It equals the absorbed dose multiplied by factors that relate the absorbed dose to biological effects on that particular organ. The unit of dose equivalent is the sievert (Sv) or the rem (100 rem = 1 Sv).

- **Effective dose equivalent** indicates an individual's fatal cancer risk from an exposure to ionizing radiation. It is calculated from the weighted sum of the dose equivalents from the irradiated organs. It is also expressed in rems or Sieverts.

- **Committed effective dose equivalent** indicates the total dose over the individual's projected remaining lifetime (assumed to be 50 years) that results from an intake during one year. The committed effective dose equivalent (CEDE) expresses the dose of internal radiation received when an individual has ingested or inhaled a radionuclide that will remain inside the body for months or years. It is also expressed in rems, mrems (1000 mrems = 1 rem), or Sieverts.

- **Collective committed effective dose equivalent** indicates the sum of the committed effective dose equivalents to the individuals in a population. It gives an estimate of the expected health risk to the population from a dose of radiation. It can be used to calculate probable risks that might be too small to predict on the basis of a single individual. It is expressed in person-rems or person-Sieverts.

Sources of Radiation

Every day our bodies absorb ionizing radiation. Most of it comes from natural sources. Consumer products and medical procedures that use radiation are other common sources of ionizing radiation.

Natural Sources. Natural radiation comes from two sources-cosmic and terrestrial. Cosmic radiation results when energetic particles from outer space, traveling at nearly the speed of light, collide with nuclei in our atmosphere, creating showers of radioactive particles that fall to earth. The average annual dose equivalent received from cosmic radiation is 26 mrem (0.26 mSv) for an individual living at sea level. Because cosmic radiation dissipates as it travels through the atmosphere, individuals living at lower altitudes receive less dose from this source than those living at higher altitudes.

Terrestrial radiation results when radionuclides that are a natural part of the earth's rocks and soils emit ionizing radiation. Because the concentrations of these radionuclides vary geographically, an individual's exposure depends on his location. The average annual dose equivalent from terrestrial radiation for an individual living in the U. S. is 28 mrem (0.28 mSv).

Besides absorbing radiation from external radionuclides, we can also absorb radiation internally when we ingest radionuclides along with the food, milk, and water we ingest or along with the air

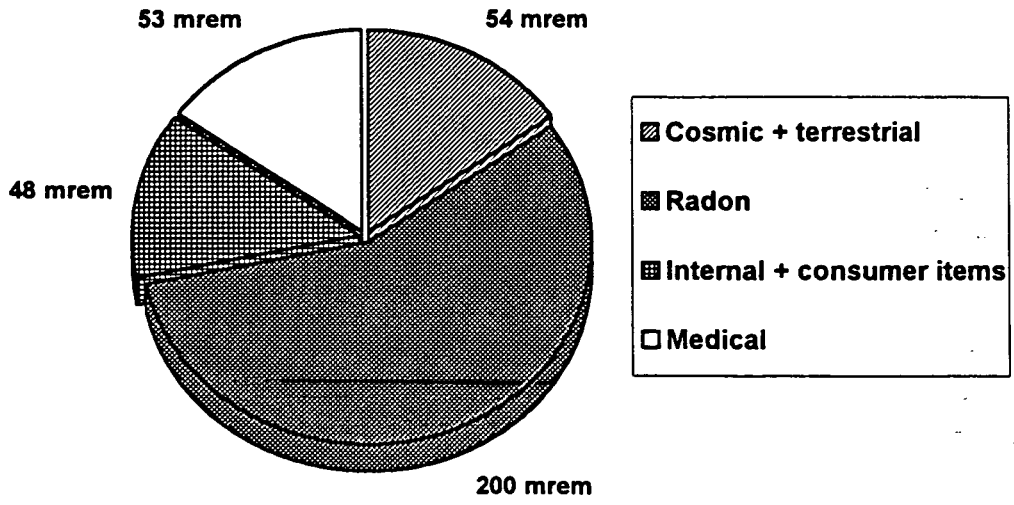
we inhale. Once in our bodies, radionuclides follow the same metabolic paths as nonradioactive forms of the same elements. The length of time a particular radionuclide remains and emits radiation depends on whether the body eliminates it quickly or stores it for a long period, and on how long it takes for the radionuclide to decay into a nonradioactive form. The principal source of internal exposure in the U. S. is believed to be radon. Inhalation of radon contributes about 200 mrem (2.0 mSv) to the average annual dose equivalent from internal radiation. Other radionuclides present in the body contribute approximately 39 mrem (0.39 mSv).

Consumer Products. Many familiar consumer products emit ionizing radiation. Some must emit radiation to perform their functions, e. g., smoke detectors and airport x-ray baggage inspection systems. Other products, e.g., TV sets, emit radiation only incidentally to performing their functions. The average annual effective dose equivalent to an individual from consumer products ranges from 6 to 12 mrem (0.06 to 0.12 mSv).

Medical Uses. Radiation is a tool for diagnosing and treating disease. The average annual dose equivalent for an individual in the U. S. from diagnostic radiation is 53 mrem (0.53 mSv). Individuals undergoing radiation therapeutic procedures may receive much higher doses.

Summary. The contributions to an average individual's annual radiation dose are shown in Figure 1-7. Mound's maximum contribution for 1994, 1.3 mrem, is too small to be included in the figure.

Figure 1-7. Average Annual Radiation Dose in the U.S. (NCRP, 1987)



2.0 COMPLIANCE SUMMARY

The Mound Plant must operate in compliance with environmental requirements established by federal, state, and local statutes and regulations. Additional requirements have been imposed by Executive Orders, U. S. Department of Energy (DOE) Orders, and a Federal Facilities Agreement (FFA). Mound's status with respect to each of those requirements is summarized below.

2.1 Major Environmental Statutes, Regulations and Orders

Clean Air Act (CAA)

Radiological emissions. Ten stacks and six building vents at Mound discharge radioactive effluents to the atmosphere. These releases are subject to the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for radionuclides. These "Radionuclide NESHAPs" regulations, 40 CFR 61, Subpart H, are components of the Clean Air Act (CAA) and are enforced by the U. S. Environmental Protection Agency (EPA).

The primary standard against which compliance with 40 CFR 61, Subpart H is measured is an annual effective dose equivalent (EDE). The regulations require that radionuclide air emissions from a given site do not exceed those amounts that would cause a member of the public to receive an annual EDE of 10 mrem (0.10 mSv). The regulations also state that each facility must determine this "maximum offsite dose" using an approved approach; the preferred approach is to use a computer code such as CAP-88.

Based on CAP-88 calculations performed for Mound's emissions in 1994, the maximum EDE received by a member of the public was 0.03 mrem. This value represents 0.3% of the dose limit and demonstrates that Mound releases for 1994 were well below allowable release levels.

The NESHAPs also define sampling and monitoring techniques which apply to stacks and vents that release radioactive materials. In July 1992, Mound submitted to the U. S. EPA, Region 5, a proposed compliance schedule to bring Mound's effluent sampling and monitoring practices into full compliance with the requirements of 40 CFR 61, Subpart H. Discussions between the U.S. EPA and DOE subsequently led to a Federal Facility Compliance Agreement (FFCA). The FFCA was signed July 7, 1994, between U. S. EPA Region 5 and the Miamisburg Area Office of DOE. The FFCA stipulates specific actions and deadlines for achieving compliance with NESHAPs requirements.

Nonradiological emissions. The Clean Air Act (CAA) of 1970, as amended in 1977, gave the EPA authority to regulate two groups of airborne pollutants: criteria pollutants and hazardous air pollutants. The CAA was again amended in 1990. The major impact of the amendments is the requirement that major emitters of pollutants obtain comprehensive air permits. Another way in which those amendments affect operations at Mound relates to the phase-out of fully halogenated chlorofluorocarbons (CFCs). The amendments of 1990 called for a phase-out of CFC's such as

freon because these chemicals are believed to be major contributors to stratospheric ozone depletion.

To evaluate Mound's compliance with the CAA and its amendments, a preliminary survey of all emission points at Mound was conducted in 1991. Based on that survey, it was shown that the amounts of criteria pollutants, hazardous air pollutants, and ozone-depleting substances discharged by the Plant are well below applicable regulatory thresholds. However, future permitting requirements and the CFC phase-out may generate new compliance issues in these areas. EG&G Mound staff members monitor federal and state CAA developments and are prepared to respond to new requirements as they arise.

Mound is also subject to state and regional air pollution regulations. Compliance with State of Ohio regulations requires that all applicable Mound operations be permitted or otherwise registered. Mound has eleven air permits from the Ohio Environmental Protection Agency (OEPA). Five other sources are registered with the Regional Air Pollution Control Agency (RAPCA). In order for a source to be considered for registration status, the source owner must demonstrate compliance with all applicable laws including employment of best available technology, maximum controlled emissions of particulate matter, sulfur dioxide, nitrogen oxides, and organic compounds cannot exceed five tons per year, and the source cannot be subject to U.S EPA new source performance standards or NESHAPs.

To ensure compliance with all state and local reporting requirements, comprehensive chemical air emission data were again collected in 1994. This information is maintained in a data base that will be updated each calendar year. In addition to providing information on release levels for materials regulated by the CAA, the data base will be used to meet the reporting requirements of other statutes such as the Emergency Planning and Community Right-to-Know Act.

Non-radioactive air release data for 1994 have been compiled (Table 5-1, page 5-1). All emissions were within required limits and no enforcement citations were received.

Clean Water Act (CWA)

The Federal Water Pollution Control Act (FWPCA) of 1972 was established to limit the types and rates of liquid effluents that may be discharged to the nation's waters. These limits are set for a specific site by the U. S. and/or state EPA using a National Pollutant Discharge Elimination System (NPDES) permit. An NPDES permit is also used to maintain compliance with more recent legislation, the Clean Water Act (CWA) of 1987.

Mound's current NPDES permit went into effect on October 1, 1992; it is valid through April 1, 1997. The permit defines discharge limits and monitoring frequencies for the Plant's liquid effluents.

On January 20, 1994, Mound applied for a modification to the existing NPDES permit with the Ohio EPA. The purpose of this modification was to authorize the discharge of an additional waste stream consisting of an aqueous liquid from Mound's groundwater monitoring program. The modification was approved on December 1, 1994. The waste stream is now directed to Mound's sanitary waste treatment plant and, after treatment, is discharged through Outfall 5601. The discharge from Outfall 5601 combines with Outfall 5602 before entering the Great Miami River. The location and descriptions of Mound's outfall system are discussed in Chapter 5 of this report.

During calendar year 1994, Mound collected 1,570 samples for analysis of NPDES parameters. One upset did occur. On September 15, 1994, Mound recorded an average concentration of total residual chlorine of 3.27 mg/L in the effluent discharged by the sewage treatment plant. The daily limit for this location is 0.5 mg/L. Additionally, the mass loading limit of 0.23 kg/day was exceeded for this occurrence. The occurrence resulted in a mass loading of 0.74 kg/day. This upset was promptly reported to the Ohio EPA. Corrective action to replace a faulty V-notch chlorination assembly was completed within four days. The Ohio EPA did not issue a notice of violation or noncompliance.

Safe Drinking Water Act (SDWA)

The Safe Drinking Water Act (SDWA) of 1974 instructed the U. S. EPA to establish a program to protect drinking water sources. To meet this goal, the EPA developed National Primary and Secondary Drinking Water Standards. These standards are applied to drinking water supplies "at the tap." Since Mound withdraws well water for use as drinking water, the Plant is subject to the requirements of the Act.

In Ohio, the SDWA is administered by the Ohio EPA. In accordance with Ohio EPA requirements, the Plant's drinking water system is routinely tested for various compounds. These analyses must be performed by a state-certified laboratory. For 1994, the analyses were performed by National Environmental Testing, Inc. (NET); no violations of standards for asbestos, bacteria, metals, nitrate, or synthetic and organic chemicals occurred.

Under the Ohio EPA's SDWA authority, Mound is also required to maintain a minimum chlorination level of 0.2 mg/L free chlorine (or 1.0 mg/L total chlorine) in the Plant's potable water system. This standard applies throughout the distribution system. Though Mound currently meets the standard, there have been isolated results indicating atypical chlorine levels at specific locations. Low chlorine levels would be a concern because they could foster bacteria growth. Continued bacterial testing of the Plant's drinking water system, however, has identified no bacteria problem. High chlorine levels, on the other hand, do not present a safe drinking water concern, but rather are an NPDES compliance issue.

A request to exempt the site from the chlorination standard is on file with the State of Ohio. The state has not acted on the exemption because the site does not meet current standards for backflow prevention and cross-connection control (Ohio Administrative Code 3745-95). On June 1, 1993, construction began to eliminate all cross-connections between potable and other water

systems such as the service and fire water systems. The project is still underway with an expected completion date in late 1995. Upon completion, Mound will be in compliance with OAC 3745-95.

Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) of 1976, as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984, established a "cradle to grave" tracking system for hazardous wastes. The Acts led to the implementation of registration and/or permit requirements for all facilities that transport, generate, treat, store, and/or dispose of hazardous wastes. For the Mound Plant, the Ohio EPA administers this program.

Mound has "interim status" as a RCRA treatment and storage facility. "Interim status" provides for the continued use of these facilities while Mound awaits a formal permit from the Ohio EPA. Mound has been seeking a permit for a number of years; the most recent permit application information was submitted on August 16, 1994.

The operations at Mound subject to RCRA and HSWA are four hazardous waste storage units and three thermal treatment units. The storage units accommodate hazardous wastes, radioactive wastes that are also regulated by RCRA (i.e., mixed wastes), and energetic materials wastes. The thermal treatment units for which Mound is seeking a permit are associated with a glass melter, open burning of explosives, and explosives retorting.

Hazardous wastes. Hazardous wastes stored and/or treated onsite are managed pursuant to RCRA regulations with regard to waste characterization, labeling, storage container integrity, facility performance criteria, and availability of protective and emergency response equipment. Those wastes not treated onsite are shipped offsite for approved treatment and/or disposal.

Mound has contracts in place for RCRA and non-RCRA waste transport and disposal. In 1994, the amounts of RCRA and non-RCRA wastes shipped offsite were 78,877 and 65,700 pounds, respectively.

Mixed wastes. Wastes regulated by RCRA, but that are also radioactive, are referred to as mixed wastes or RCRA mixed wastes. These wastes present a unique compliance issue because treatment or disposal options have not been available. For this reason, Mound continues to store mixed wastes in quantities, and for time periods, that exceed RCRA limits.

Suspect wastes. It is the policy of DOE that RCRA hazardous wastes originating in Radioactive Material Management Areas (RMMAs) be treated as "suspect" wastes, i.e., suspected of being radioactive. This precaution is necessary to ensure that hazardous waste management facilities do not receive radioactive wastes unless they are equipped and licensed to do so. As a result of this policy, in place since May of 1991, Mound is required to store wastes from RMMAs in the mixed waste storage facility. Mound has developed elaborate waste certification and characterization procedures which have allowed the Plant to dispose of stored

suspect wastes. The procedures have also helped minimize the volume of suspect wastes now generated.

Nonhazardous solid wastes. Nonhazardous solid wastes generated at Mound are disposed of in a nearby sanitary landfill that is licensed and permitted. The volume of materials requiring landfill disposal has been significantly reduced in recent years as a result of Mound's recycling programs for paper, aluminum cans, and scrap metal.

Toxic Substances Control Act (TSCA)

The goal of the Toxic Substances Control Act (TSCA) of 1976 is to protect human health and the environment from unreasonable risks associated with toxic chemical substances. The Act gave the U. S. EPA authority to govern the manufacture and use of chemicals deemed to present significant toxicity risks. Mound does not generate TSCA waste streams on a regular basis. However, efforts continue at Mound to remove TSCA wastes associated with past practices. The two primary areas comprising this category of Plant wastes are polychlorinated biphenyls (PCBs) and asbestos.

PCB's. PCB-contaminated materials that are not suspected of being radioactive are stored onsite pending their shipment to an EPA-approved facility for disposal. "Suspect" PCB wastes (those wastes originating in RMMAs) are retained onsite for waste characterization. Radioactively contaminated PCB wastes are also retained onsite. Because no disposal options are currently available for TSCA mixed wastes, they have been stored onsite in excess of the time limitations imposed by the Act. Disposal options are currently being explored for PCB contaminated mixed waste.

Asbestos. The use of asbestos in pipes, panels, and as an additive to diallyl phthalate in parts production, has been discontinued at Mound. Residual asbestos is handled, packaged, and shipped offsite to an approved disposal facility in compliance with TSCA regulations.

Asbestos removal projects continued in 1994 in connection with building renovation activities. All such projects are carefully monitored by the Industrial Hygiene Section to ensure compliance with TSCA and Mound's Safety and Hygiene Manual.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Federal Facilities Agreement (FFA)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, also known as Superfund, is the federal government's primary environmental restoration legislation. Through CERCLA, the U. S. EPA identifies sites where hazardous substance contamination may present a risk to human health and/or the environment. These sites are then placed on the National Priorities List (NPL) and subjected to a four-stage remediation process.

Mound was added to the NPL in November of 1989. A Federal Facilities Agreement (FFA) between the DOE and the U.S. EPA followed in October of 1990. The FFA defined the responsibilities of each party for the completion of CERCLA-related activities.

The FFA became a tri-party agreement on July 15, 1993, when the Ohio EPA became a signatory. The addition of the Ohio EPA did not change the general purpose of the agreement, but rather provided a mechanism for the full participation of the Ohio EPA in the CERCLA process at Mound.

Preliminary CERCLA assessment of contamination at Mound identified approximately 125 locations of actual or suspected releases. These locations were grouped into "Operable Units" (OUs) based on waste type and/or geographical proximity. Originally, Mound established nine OUs. As CERCLA activities at Mound progressed, changes to the number and composition of the OUs were warranted. Three of the original OUs, Operable Units 3, 7, and 8 have been eliminated from further consideration. This approach will save several million dollars and will expedite the cleanup process. A brief description of each operable unit can be found in Section 3.7 of this report.

In 1994, comprehensive evaluations of environmental media on and near the Plant continued. Additionally, EG&G Mound expanded its onsite soil, surface water, and well water sampling programs. Offsite characterization projects were also initiated. Mound has designed an offsite testing program which involves six types of studies to be performed throughout a 20-mile radius of the site. These study areas will focus on hydrogeology, seismic refraction, soil, wells and cisterns, surface water and sediment, and ecological assessments.

Also in 1994, the Agency for Toxic Substances and Disease Registry, ATSDR, continued its evaluation of Mound. It is a requirement of CERCLA that the ATSDR evaluate each site listed on the NPL. The Agency examines health data to seek out abnormal rates or types of illnesses. If any such problems are suspected, the Agency attempts to determine if a correlation exists between the illness and the site.

Initial ATSDR findings for the Mound Plant were published in October of 1993 as an ATSDR "Health Consultation." The consultation report indicated that plutonium-238 levels in the Mound environment are not a public health hazard. For other constituents of concern, insufficient data were available to draw public health conclusions. Therefore, a key recommendation of the report was the pursuit of additional testing. ATSDR performed soil and air sampling during 1994. Preliminary results are consistent with monitoring performed at Mound. The final report is expected to be published during 1995.

In addition to the activities described above, the Act established a list of CERCLA-regulated materials. Release of these materials to the environment is subject to certain reporting requirements. No releases of reportable quantities of CERCLA-regulated materials occurred at Mound in 1994.

Emergency Planning and Community Right-to-Know Act (SARA Title III)

The reauthorization of CERCLA came in 1986 in the form of the Superfund Amendments and Reauthorization Act (SARA). The Emergency Planning and Community Right-to-Know portion of that legislation is found in Title III of the Act. SARA Title III, Section 312, requires that sites handling "extremely hazardous" and "hazardous" substances notify regional emergency planning agencies. In compliance with the Act, Mound annually reports hazardous chemical inventory data to the State Emergency Response Commission, the Miami Valley Regional Planning Commission, and the City of Miamisburg Fire Department. The inventory information is accompanied by maps showing the specific locations of the chemicals. For 1994, Mound reported using and/or storing three "extremely hazardous" and seven "hazardous" chemicals. A listing of those chemicals is presented in Section 5.3 of this report.

SARA Title III, Section 313 mandates an annual submission of a Toxic Chemical Release Inventory report. In 1993 Mound reported that no chemicals were manufactured, processed, or otherwise used in quantities subject to the Section 313 reporting requirements. It is expected that the same results will apply for the 1994 report which will be submitted to the Ohio EPA and the Emergency Planning and Community Right-To-Know Act Reporting Center in mid-1995.

National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) of 1969 was established to ensure that consideration is given to the potential environmental impact of federal actions prior to the irretrievable commitment of resources. DOE has formalized its approach to NEPA by enacting regulations (10 CFR 1021). Mound has also formalized its approach by developing internal NEPA guidance documents.

In compliance with the National Historic Preservation Act, the State of Ohio Historic Preservation Office is consulted on issues concerning potential sites of archaeological or historic significance.

Numerous checklists and other NEPA-related documents were prepared for planned activities at Mound in 1994. In October of 1994, an Environmental Assessment for the commercialization of the Mound Plant was submitted to the DOE and to the State of Ohio.

Endangered Species Act (ESA)

Provisions of the Endangered Species Act (ESA) of 1973, as amended, prohibit federal departments such as the DOE from carrying out projects that would destroy or modify a habitat deemed critical to the survival of an endangered or threatened species.

EG&G Mound has performed a number of surveys for threatened or endangered species. Two potential ESA compliance issues have been noted. First, an endangered plant species, the Inland rush (*Juncus interior*), and an endangered bird species, the Dark-eyed junco (*Junco hyemalis*), have been observed onsite. It is not known at this time if the species are truly indigenous to the

area or were artificially transported here. More detailed studies are underway. Secondly, it has been determined that certain portions of the plant site could serve as summer habitat areas of the Indiana Bat (*Myotis sodalis*). At this point Indiana bats have not been observed onsite.

Neither the solitary sitings of the rush and the junco nor the potential habitat for the Indiana bat are expected to affect CERCLA operations onsite. However, through detailed ecological assessments, biologists will determine onsite plant and animal populations with specific emphasis on threatened and endangered species.

Federal Facility Compliance Act (FFCA)

The Federal Facility Compliance Act (FFCA) was signed into law on October 6, 1992. The FFCA required that all DOE facilities prepare an inventory of mixed wastes and mixed waste treatment capabilities. In accordance with the Act, EG&G Mound prepared a Conceptual Site Treatment Plan, which was submitted to the Ohio EPA in October of 1993. Following discussions with the Ohio EPA and public stakeholders, EG&G Mound revised the Conceptual Site Treatment Plan and submitted a Draft Site Treatment Plan to the Ohio EPA in August, 1994. The final Site Treatment Plan was submitted to DOE in March, 1995 and negotiation of an agreement with the Ohio EPA based on the plan is scheduled for October, 1995.

Executive Order 11988, "Floodplain Management"

The main plant site at Mound is not located in a floodplain. Recent investigations indicate that lower plant areas around the production wells may be in the 100-year floodplain. This finding does not significantly affect operations at Mound.

Executive Order 11990, "Protection of Wetlands"

Ecological assessments conducted during CERCLA activities for the site will ensure compliance with this Order. Biologists will conduct surveys of sensitive environments including wetlands and floodplains.

2.2 Other Key Environmental Compliance Issues

Tiger Team Action Plan

EG&G Mound continues to make improvements recommended by the 1989 DOE Tiger Team audit. The Tiger Team was an independent team of auditors, with a variety of expertise, assembled by DOE to evaluate operations at Mound. The Tiger Team recommendations are being implemented in accordance with a Corrective Action Plan developed for the Plant. As of December 31, 1994, 71 findings had been completed and 72 findings were scheduled for completion. Also as of that date, 67 closure packages for Tiger Team findings had been submitted to DOE.

Major External Environmental Audits in 1994

U. S. EPA inspection. The U.S. EPA performed an inspection of Mound on September 20 and 21. The inspection focused on TSCA and RCRA compliance issues. The audit revealed two minor findings, one related to an improperly stored waste container and another related to a record keeping error. Both findings were immediately remedied. A formal audit report from the U.S. EPA has not yet been received by EG&G Mound.

Ohio EPA inspection. The annual unannounced multi-disciplinary inspection of Mound by the Ohio EPA was conducted in May of 1994. The inspection focused on RCRA compliance issues. As a result of the inspection, the Ohio EPA found Mound to be in compliance with Ohio's hazardous waste rules and regulations.

Ohio EPA drinking water survey. On October 6, 1994, the Ohio EPA performed a sanitary survey of the Mound Plant potable water supply system. The purpose of the survey was to evaluate the capabilities of the collection, treatment, distribution, and storage facilities. The survey also reviewed the operational and managerial practices followed by EG&G Mound to ensure that safe drinking water is provided to all consumers. In the survey report, it was noted that EG&G Mound is conducting the required monitoring activities and that the water supplied by the Mound Plant complies with the state's safe drinking water laws. As a result of the survey Mound was required to prepare a contingency plan for water emergencies and to properly vent the three production wells. In addition, the Ohio EPA requested that Mound sample drinking water for tritium, gross alpha activity and gross beta activity. The activities were performed as requested.

DOE/NVO. An audit team from the Nevada Operations Office of DOE (DOE/NVO) evaluated Mound's Waste Certification Program for low-level radioactive wastes in March of 1994. The audit resulted in Mound being approved to ship low level waste to the Nevada Test Site. Approval was granted August 11, 1994.

Pending Lawsuit

A class action lawsuit was filed against the Monsanto Research Corporation (MRC) and EG&G Mound (EG&G) on December 5, 1991. The lawsuit asserts that MRC and EG&G, Mound's former and current contractor, respectively, "engaged in a continuous course of negligent...and unlawful conduct resulting in...repeated discharges of both radioactive and nonradioactive hazardous substances...into the environment surrounding the facility." The lawsuit further asserts that these actions were "concealed from the plaintiffs."

EG&G Mound strongly believes this suit is without merit. As of the publication date of this report, a class has been conditionally certified and most of the claims in the case have been dismissed. A motion to dismiss the remaining claims is pending.

Release data for Mound have been published each year in publicly distributed documents such as this report. The release data demonstrate the efforts taken by the Plant to operate within all applicable regulatory requirements and guidelines. Any individual who desires more information about operations at the Plant is encouraged to contact Mound's Public Relations Office.

2.3 Summary of Permits

Mound operates in compliance with eleven state air permits. Five additional sources of air emissions are on registration status with the State of Ohio. Liquid releases from the site are governed by an NPDES permit. Additionally, Mound operates in compliance with two permits governing water treatment processes. In the area of waste management, the Plant has filed a site-wide RCRA permit application covering four waste storage facilities and three waste treatment units. The permits and their expiration dates are shown in Table 3-3.

3.0 ENVIRONMENTAL PROGRAM INFORMATION

The principal objective of the environmental programs in place at Mound is to ensure that any threat to human health or the environment is promptly detected and mitigated. It is also Mound policy that meeting this goal be viewed as a minimum standard of practice; better performance should always be pursued. The philosophy is evident in the extent and scope of Mound's effluent and environmental monitoring programs. It is also supported by Mound's commitment to successful programs in the areas of:

- ALARA (As Low As Reasonably Achievable),
- Regulatory compliance,
- Waste minimization and pollution prevention,
- Environmental training, and
- Environmental restoration.

3.1 Effluent Monitoring

Air Emissions

All applicable stacks at Mound are sampled continuously for tritium and/or particulate radionuclides. These samples are collected to demonstrate Plant compliance with the NESHAPs for radionuclides regulations. An outline of the stack sampling program is shown in Table 3-1.

Liquid Releases

Mound's liquid discharges are also sampled continuously at their discharge points. With liquid releases, however, the key concern involves nonradiological parameters. Extensive sampling and analysis is required of the Plant to demonstrate compliance with Mound's NPDES permit. Mound also samples a number of locations prior to discharge to ensure that any unexpected constituents are quickly detected. An outline of the liquid effluent sampling program is also shown in Table 3-1.

3.2 Environmental Monitoring

Mound's environmental monitoring program involves sample collection from ambient air, regional water sources, sediments, onsite and offsite groundwater, vegetation, fish, and produce. An outline of the program is shown in Table 3-2.

Table 3-1. Effluent Monitoring at Mound

	Parameter Measured[a]	No. of Sampling Locations	Collection Frequency
Air Emissions			
	HT,HTO	7	Daily
	^{238}Pu	7	Daily
	$^{239,240}Pu$	7	Daily
	$^{233,234}U$	2	Daily
	^{238}U	2	Daily
Liquid Effluents			
	Flow rate	6	Daily 2/month as pumped
	HTO	3	Daily
	Pu	3	Daily
	U	3	Daily
	pH	6	Daily Weekly Bimonthly Monthly
	Chlorine	2	Daily Weekly
	Suspended solids	3	2/week Weekly
	COD	1	Weekly
	$CBOD_5$	1	2/week
	Fecal coliform	1	Weekly
	E. coli	1	Monthly
	Ammonia	1	2/month
	Oil and Grease	2	Monthly Quarterly

[a] HTO - Tritium oxide
HT = Elemental tritium
Pu = Plutonium
U = Uranium
$CBOD_5$ = Five day carbonaceous biochemical oxygen demand
COD = Chemical oxygen demand
VOC = Volatile Organic Compounds (beginning 12/1/94)

Table 3-1 (continued)

	Parameter Measured[a]	No. of Sampling Locations	Collection Frequency
Liquid Effluents			
	Free cyanide	1	Monthly
	Total cyanide	1	2/month
	Cadmium	3	Weekly 2/month Monthly
	Chromium	3	Monthly 2/month
	Copper	3	Weekly 2/month Monthly
	Lead	2	Monthly
	Mercury	1	2/year
	Nickel	3	Weekly 2/month Monthly
	Zinc	3	Weekly 2/month Monthly
	VOCs	1	Quarterly
	Total toxic organics	1	Quarterly
	Pentachlorophenol	1	Monthly
	Bis(2-ethylhexyl) phthalate	1	Monthly
	Toxicity testing		
	Ceriodaphnia dubia		
	acute	1	Monthly
	chronic	1	Quarterly
	Pimephales promelas		
	acute	1	Monthly
	chronic	1	Quarterly

[a] HTO - Tritium oxide
HT = Elemental tritium
Pu = Plutonium
VOC = Volatile Organic Compounds (beginning (12/1/94)
U = Uranium
$CBOD_5$ = Five day carbonaceous biochemical oxygen demand
COD = Chemical oxygen demand

Table 3-2. Environmental Surveillance at Mound

Environmental Medium	Parameter Measured[a]	No. of Sampling Locations[b]	Collection Frequency
Onsite			
Ambient Air	HTO	7	Weekly
	^{238}Pu, $^{239,240}Pu$	7	Weekly
	Particulates	7	Weekly
Drinking water	HTO	3	Weekly
	^{238}Pu, $^{239,240}Pu$	3	Monthly
	$^{233,234}U$, ^{238}U	3	Monthly
	VOCs	5	Quarterly
Monitoring wells	HTO	c	semi-annually
	VOCs	c	semi-annually
Offsite			
Ambient Air	HTO	15	Weekly
	^{238}Pu, $^{239,240}Pu$	15	Weekly
	Particulates	15	Weekly
River water	Biotoxicity	3	Monthly (acute)
			Quarterly (chronic)
	HTO	6	Weekly
	^{238}Pu, $^{239,240}Pu$	6	Monthly
	$^{233,234}U$, ^{238}U	6	Monthly
River silt	^{238}Pu, $^{239,240}Pu$	6	Quarterly
Pond water	HTO	7	Quarterly
	^{238}Pu, $^{239,240}Pu$	7	Quarterly
Pond silt	^{238}Pu, $^{239,240}Pu$	7	Quarterly

[a] HTO = Tritium oxide
Pu = Plutonium
U = Uranium
VOC = Volatile Organic Compound
[b] Includes background location when applicable
[c] Number of sampling locations varies. Locations for 1994 are specified in Chapter 6

Table 3-2 (continued)

Environmental Medium	Parameter Measured[a]	No. of Sampling Locations[b]	Collection Frequency
Drinking water	HTO	c	Monthly
	^{238}Pu, $^{239,240}Pu$	c	Monthly
	$^{233,234}U$, ^{238}U	c	Monthly
Monitoring wells	HTO	c	semi-annually
	VOCs	c	semi-annually
Vegetation	HTO	7	Quarterly
	^{238}Pu, $^{239,240}Pu$	7	Quarterly
Produce	HTO	7	Quarterly
	^{238}Pu, $^{239,240}Pu$	7	Quarterly
Fish	^{238}Pu, $^{239,240}Pu$	2	Quarterly

[a] HTO = Tritium oxide
Pu = Plutonium
U = Uranium
VOC = Volatile Organic Compound
[b] Includes background location when applicable
[c] Number of sampling locations varies. Locations for 1994 are specified in Chapter 6

Radionuclides of Concern

The principal radionuclides of concern at Mound are tritium and plutonium-238; no other radionuclides contribute significantly to the dose estimates made each year for the Plant (see Appendix). Extremely small quantities of other radionuclides, however, are (or have been) used at Mound. In cases where there is a strong probability of detecting such radionuclides in the environment, they have been added to the appropriate sampling schedule. The primary example in this case is uranium. Because U-234 is a decay product of Pu-238, U-234 is a part of Mound's routine environmental monitoring program. Mound analyzes drinking water and river water samples to monitor the ingrowth of U-234. No significant concentrations have been encountered.

Rationale

Environmental surveillance practices at Mound focus on those environmental media that are most likely to contain the radionuclide(s) of concern. For example, since Pu-238 in river water tends to accumulate in sediments, Mound evaluates plutonium concentrations in sediment samples and in bottom-feeding fish such as carp.

The same rationale has been applied to the vegetation and produce sampling programs. Grass is sampled for Pu-238 and tritium because grass can take up these radionuclides from both air and soil. Root crops such as potatoes are analyzed since the roots may come into contact with subsurface plutonium. Tomato samples, conversely, are of use due to their high water content; the high water content makes them excellent indicators of tritium uptake.

Environmental Levels

To evaluate Mound's impact on the environment, it is necessary to establish background or baseline levels of contaminants in a variety of media. Mound accomplishes this task by collecting samples at points where discharges from the Plant are not observable. These locations are usually in a direction opposite prevailing winds and at a distance too great to be impacted by the Plant. Concentrations measured at these reference locations are referred to as "environmental levels" in this report.

3.3 Effluent Treatment and Waste Management

Effluent Treatment

Air. High efficiency particulate air (HEPA) filters remove particulate radionuclides from process air emissions. Air effluents are filtered first at their point of origin (e.g., a glove box), and again just before reaching the release point (i.e., the stack or vent). The filtering system in place at each stack is composed of two banks of HEPA filters connected in series. Each filter bank has a nominal collection efficiency of 99.95% for 0.2-micron particles.

Tritium is not trapped by HEPA filters. A chemical process is used to recover tritium from waste gas streams.

Liquids. An onsite sanitary waste treatment plant manages all domestic sewage generated at Mound. An activated sludge process operated in the extended aeration mode provides the necessary treatment. The installation of a continuous backwash sandfilter in 1986 essentially upgraded the plant to tertiary treatment. The influent and effluent at the sewage treatment plant are monitored for radioactivity to ensure that radionuclides are not inadvertently discharged to the environment. All wastewater, after appropriate treatment and monitoring, is discharged from the Plant to the Great Miami River. Digested sludge from the sewage treatment plant is managed as Low Specific Activity (LSA) waste.

Waste Management

Hazardous wastes. Mound has "interim status" as a RCRA treatment and disposal facility. "Interim status" provides for the continued use of RCRA facilities while awaiting a formal permit. The operations at Mound subject to RCRA are three hazardous waste storage units and three hazardous waste treatment units. The storage units accommodate hazardous wastes, wastes that are both hazardous and radioactive, and energetic materials wastes. The thermal treatment units for which Mound seeks the permit are associated with a glass melter, open burning of explosives,

and explosives retorting. Hazardous wastes not treated onsite are shipped offsite by a waste disposal firm for treatment and/or disposal using EPA-approved procedures.

Radioactive wastes. Low-level radioactive wastes generated at Mound are typically shipped to the Nevada Test Site (NTS) for disposal. No such shipments occurred in 1993. However, in August of 1994, the Waste Management Section of EG&G Mound received approval to initiate additional shipments. For calendar year 1994, 55,400 ft^3 of low-level radioactive waste was shipped to NTS.

Nonhazardous, nonradioactive wastes. Solid wastes are disposed of according to a recycling and reclamation program whenever possible. White paper, scrap metal, and wood are sold for reclamation. General refuse is transported to a sanitary landfill approved by the county and the state.

3.4 Environmental Permits

Operations at Mound are routinely measured against the compliance requirements of state air and state water permits. Additionally, Mound's hazardous waste program operates under interim status with the state's RCRA program. A current listing of the Plant's permits is shown in Table 3-3.

3.5 Environmental Training

All Mound personnel received hazardous waste management training in 1994. Staff members with environment, safety, and health (ES&H) responsibilities received more intensive training based on their areas of responsibility. EG&G Mound environmental professionals attended numerous courses and professional society meetings in 1994.

3.6 Waste Minimization and Pollution Prevention (WM/PP)

Mound has established a Waste Minimization/Pollution Prevention Program to reduce the total volume and toxicity of Mound's hazardous, radioactive, and solid waste streams. These goals are accomplished at Mound by preventing waste generation, by recycling and reclamation, and by a variety of treatment techniques. The organizational structure of the Program is shown in Figure 3-1.

In 1994 Mound completed seven Pollution Prevention Opportunity Assessments (PPOAs), previously called Process Waste Assessments (PWAs). These ranged from simple to complex processes. Specifically, in one process a simple chemical process was replaced with a laser system thereby eliminating a chemical waste stream. At the other degree of complexity, a metal plating process was assessed and analyzed for opportunities to reduce chemical waste by recycling options.

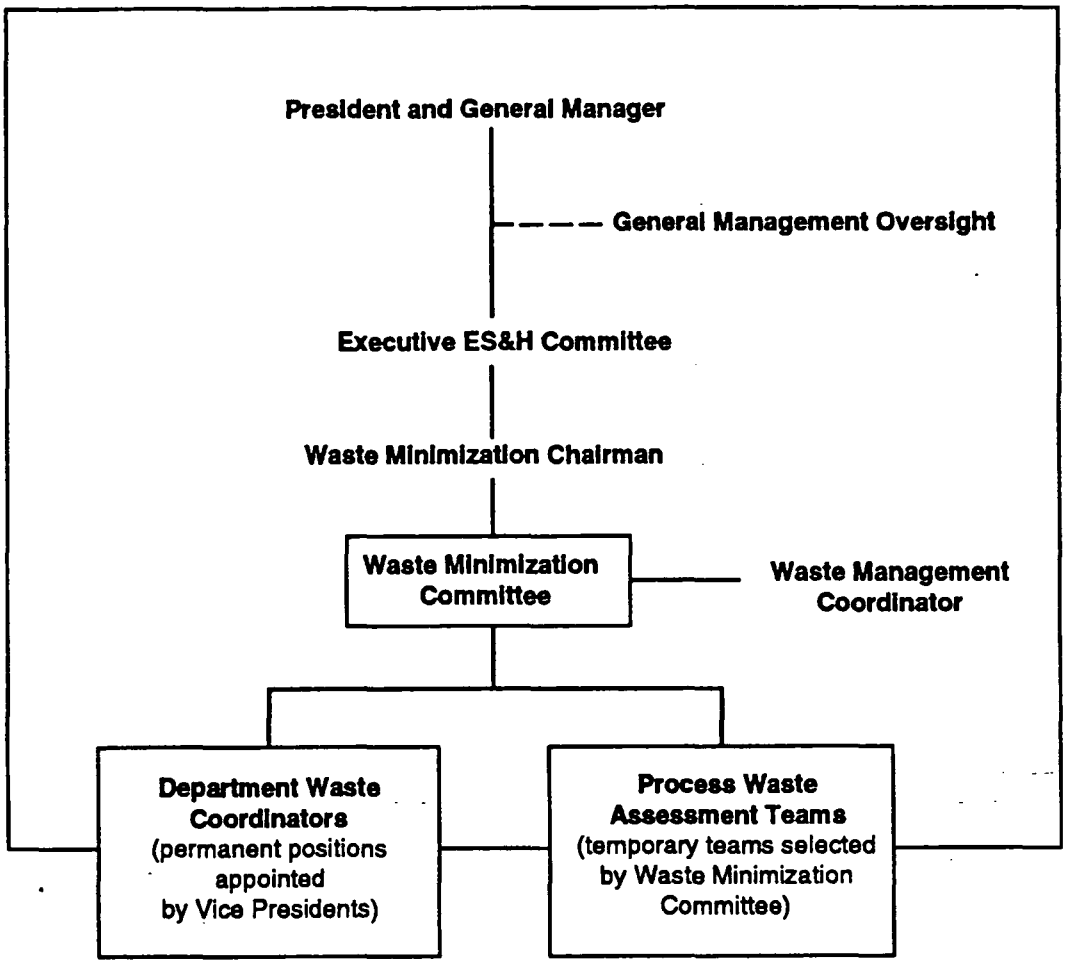
A complete Physical Chemical Inventory was completed in August, 1994 for the 73 buildings designated for safe shutdown. This inventory is being used to expedite the reuse/recycle of chemicals and dispositioning of excess chemicals.

Table 3-3. Environmental Permits Issued to Mound

Operation	Permit Type	Permit No.	Valid Through	Issuing Agency
Static screens, clarifier and sludge holding tank	water	05-5969		Ohio EPA
Open Burning (explosives disposal)	air	letter permit	11/9/95	Ohio EPA
Effluent Dechlorination	water	05-6594	9/1/95	Ohio EPA
Paint Spray Booth	air	857091196K001	11/26/95	Ohio EPA
Wastewater Discharge (NPDES)	water	1IO00005*ED[b]	3/31/97	Ohio EPA
Bd-51 PAN Process	air	85709119P024	12/1/96	Ohio EPA
E-Building	air	85709119P008	11/19/96	Ohio EPA
W-Building	air	85709119P011	11/22/96	Ohio EPA
Clay Extrusion System	air	85091196P009	2/11/97	Ohio EPA
Clay Extrusion System (Diesel Generator)	air	85709119B007	3/25/97	Ohio EPA
Bd-51 (Material Deposition)	air	857091196P020 (Registration)	permanent	Ohio EPA
ULR[a] (Diesel Generator)	air	857091196B008 (Registration)	permanent	Ohio EPA
Gas Dispensing Facility	air	857091196G001 (Registration)	permanent	Ohio EPA
Open Burning (Fire Training)	air	letter permit	permanent	Ohio EPA
Power House Boiler 1 and Boiler 2	air	857091196B001 857091196B006 (Registration)	permanent permanent	Ohio EPA
Aggregate Storage Pile	air	08-3111		Ohio EPA
Fuel Oil Storage	air	08-3149		Ohio EPA
Bd - 90 Retort	air	08-3221	1/5/96	Ohio EPA
Hazardous Waste Operations		N/A	interim status[c]	Ohio EPA

[a] ULR = Underground Line Removal.
[b] Effective 12/1/94 due to permit modification.
[c] The Mound Plant is operating under interim status. The most recent permit application was submitted on August 16, 1994.

Figure 3-1. Organizational Structure of Mound's Waste Minimization Program



Through the efforts of the WM/PP Program, Mound significantly reduces the volumes of waste solvents and low specific activity wastes generated onsite. Long-term goals for the program are to continue to:

- reduce waste generation,
- expand recycling programs,
- encourage the use of non-ozone-depleting substances, and
- ensure employee awareness of these goals.

3.7 Environmental Restoration (ER)

Mound was added to the National Priorities List (NPL) in 1989. A Federal Facilities Agreement between DOE and the U. S. EPA followed in October of 1990. The FFA defines the responsibilities of each party for the completion of CERCLA-related activities. The bipartite FFA has been renegotiated to include the Ohio EPA as a signatory. The revised Agreement was signed by the three parties on July 15, 1993.

Mound Plant Operable Units

Preliminary CERCLA (Superfund) assessments of contamination at Mound identified approximately 125 locations of actual or suspected releases. These locations were grouped into nine "Operable Units", or OUs, based on waste type and/or geographical proximity. Three of these OUs, 7, 8, and 3, are no longer necessary.

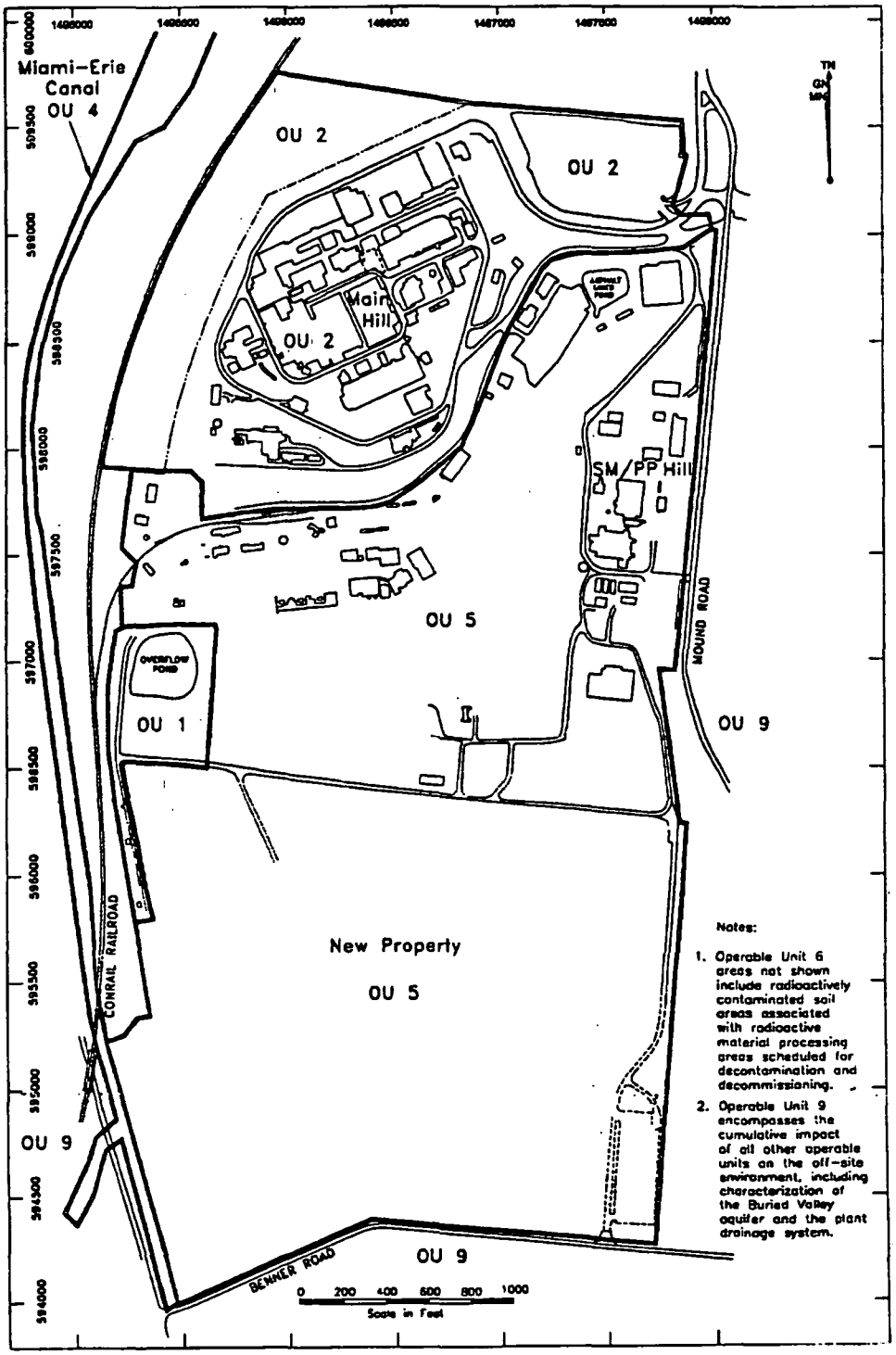
Operable Unit 7, Limited Action Sites. OU 7 was eliminated in 1990 when testing found no evidence of contamination.

Operable Unit 8, Inactive Underground Storage Tanks. OU 8 included a number of inactive underground storage tanks (USTs). Some tanks were added to geographically appropriate OUs; the remaining USTs were placed in other regulated Mound programs. OU 8 was eliminated in January of 1993.

Operable Unit 3, Miscellaneous Sites. OU 3 addressed 32 potential release sites throughout the Mound Plant for which little data were available. Testing for a variety of hazardous and radioactive constituents during 1991 and 1992 indicated that 23 of the 32 potential release sites did not need further CERCLA investigation. The remaining nine sites have been reassigned to OUs 2, 5, and 6.

The elimination of OUs 3, 7, and 8 will expedite CERCLA activities at Mound and will provide considerable cost savings. The approximate boundaries of the remaining OUs are shown in Figure 3-2. A brief description of each operable unit and its status is presented in the paragraphs that follow.

Figure 3-2. Mound Plant Operable Unit Boundaries



Operable Unit 1, Area B. OU1 addresses possible volatile organic chemical contamination of the portion of the Buried Valley Aquifer which underlies the southwest corner of the original Mound Plant. OU1 covers four acres and includes an historic landfill and an overflow pond. The main concerns at this site are volatile organic compounds that may be migrating into the groundwater. It is believed that such contamination originates from the area that was formerly used for open burning and waste disposal.

Operable Unit 2, Main Hill. OU2 addresses the source and pathways of possible contaminants on Mound's Main Hill. Off-site groundwater seeps on Mound's north hillside are also included. Historical tritium releases have been tracked since the 1970s; the extent of volatile organic compound contamination is uncertain. The Work Plan for the Remedial Investigation was completed in 1993. An Interim Response Action was initiated in 1994 to remediate soils contaminated with VOCs at the B-Building solvent shed. Soil vapor extraction was the treatment technology selected for remediation of the contaminated soils. Soil verification sampling is currently in process.

Operable Unit 4, Miami-Erie Canal. OU4 addresses contamination of the old Miami-Erie Canal bed in Miamisburg. OU4 covers the canal, the north and south pond within the park, the overflow creek from the canal to the Great Miami River, and the drainage ditch from Mound's west property line to the canal. Of concern is contamination from plutonium, which was introduced into the canal from a broken waste line and historic plant runoff. Tritium is also present in the canal as a result of past plant operations. Both the plutonium and tritium have been monitored since the 1970s and have been found to present no imminent danger to human health or the environment. Sampling of the canal to confirm the levels of these radioactive elements and analyze for chemical contamination was completed in February 1993. In January of 1994 a decision was made by DOE to perform a removal action for OU4. Design and planning activities are currently underway.

Operable Unit 5, South Property. OU5 addresses on-site soil areas in the southern portions of the Mound Plant known or suspected to contain radioactive materials. OU5 covers the SM/PP Hill, the Valley and the New Property. Available data indicate that most of OU5 is uncontaminated. However, there are areas contaminated with plutonium and thorium. The Work Plan for this OU was completed in the fall of 1993. An Interim Response Action was initiated in 1994 to remediate hydrocarbon contaminated soils associated with the former Fire Fighting Training Facility. Bioremediation was the treatment technology selected for remediation of the contaminated soils.

Operable Unit 6, D&D Sites. OU 6 verifies results of DOE's ongoing Decontamination and Decommissioning Program (D&D) at Mound. Started in 1955, the D&D Program predates CERCLA as an environmental cleanup program. Its goals are to make radiologically contaminated property available for reuse or disposal. The current D&D Program began in 1978 and concentrates on surplus plutonium facilities, underground waste pipelines, and surrounding soil areas. The D&D program functions independently of CERCLA and is not subject to EPA oversight. Upon completion of D&D activities every site will be evaluated by the CERCLA Program to ensure that EPA-regulated cleanup standards are met.

Operable Unit 9, Site -Wide and Offsite. OU 9 addresses the total environmental effects of any contamination attributable to Mound that may be found in the air, groundwater, soils, surface water, and sediments, as well as plant and animal life. OU9 covers the entire plant and the area within a 20-mile radius of the plant. Of concern is the cumulative impact of all other Operable Units onsite and in the offsite environment. Investigative field work in this OU is expected to be complete in 2000.

Though the operable units described in this section are on or near the Plant site, regional sampling activities are also underway. Mound's CERCLA program intends to investigate possible environmental impacts within a 20-mile radius of the site. Extensive groundwater, surface water, and surface and subsurface soil studies will be performed. Ecological assessments by qualified biologists are key components of the characterization efforts.

A large-scale soil sampling study was conducted in 1994. The study involved analysis of 252 soil samples collected over a 100,000-foot radius of the site. The results of the study will be published in the "Operable Unit 9, Regional Soils Investigation Report". Upon completion of regulatory reviews, the report will be available in the Public Reading Room.

ATSDR Participation

In 1994, the Agency for Toxic Substances and Disease Registry, ATSDR, continued its evaluation of Mound. It is a requirement of CERCLA that the ATSDR evaluate each site listed on the NPL. The Agency examines health data to seek out abnormal rates or types of illnesses. If any such problems are suspected, the Agency attempts to determine if a correlation exists between the illness and the site. Initial ATSDR findings for the Mound Plant were published in October of 1993 as an ATSDR "Health Consultation." The consultation report indicated that plutonium-238 levels in the Mound environment are not a public health hazard. For other constituents of concern, insufficient data were available to draw public health conclusions.

Key recommendations of the report included:

- additional testing of surface soils, surface water, and air; and
- a continuation of the existing ban on fishing in the South Pond of the Miamisburg Community Park until data from additional testing for other constituents of concern are available.

ATSDR performed soil and air sampling during 1994. Preliminary results are consistent with monitoring performed at Mound. The final report is expected to be published during 1995. ATSDR will continue to monitor CERCLA-related activities at Mound. ATSDR staff are frequent guest speakers at the CERCLA quarterly public meetings. They may also be contacted directly at their Atlanta, Georgia offices.

3.8 Agreement-In-Principle

The Agreement-In-Principle, or A-I-P, represents an added dimension to the environmental monitoring programs in place at DOE facilities in the State of Ohio. The A-I-P was signed by the U. S. Department of Energy and the State of Ohio in 1993. The Agreement establishes the framework under which the State will provide oversight and monitoring activities at the Mound

Plant, the Fernald Environmental Management Project, and the Portsmouth Gaseous Diffusion Plant.

Under the A-I-P, the Ohio EPA will review DOE environmental monitoring programs and will perform independent monitoring and data collection. The Ohio EPA's primary mission will be to ensure that cleanup activities at these sites adequately protect human health and the environment. Additional oversight by the Ohio EPA will be applied to the emergency response and public information programs in place at each site.

The A-I-P provides $11 million of support to Ohio EPA for an initial five-year period. This grant supplements the $21.5 million previously committed by the DOE to support state regulatory programs.

4.0 RADIOLOGICAL ENVIRONMENTAL PROGRAM INFORMATION

Operations at Mound result in the discharge of radioactive effluents to the air and the Great Miami River. Release limits on these discharges have been established by the Department of Energy and the U. S. EPA. Mound monitors release levels using a network of stack and water sample collection devices. In addition, Mound operates an extensive environmental surveillance program. Data generated from those programs are presented in this Chapter. As demonstrated by the data, radioactive releases from Mound in 1994 did not significantly impact human health or the environment.

4.1 Radionuclide Releases from Mound

1994 Data

Table 4-1 lists the quantities of radionuclides released by Mound into the air and water during 1994. The unit used to report these quantities is the curie (Ci), a unit of radioactivity equal to 3.7×10^{10} disintegrations per second. The quantities, or activities, shown in Table 4-1 were measured at the point of release. Information on the effluent monitors used to estimate release levels appears in Section 4.2 of this Chapter.

Table 4-1. Radiological Effluent Data for 1994

Radionuclide	Released to	Activity, Ci
Tritium	Air	489[a]
	Water	10.5
Plutonium-238	Air	1.5×10^{-5}
	Water	2.2×10^{-4}
Plutonium-239,240	Air	5.7×10^{-8}
	Water	8.0×10^{-6}
Radon-222	Air	2.5
Uranium-233,234	Air	9.8×10^{-9}
	Water	7.0×10^{-4}
Uranium-238		5.9×10^{-9}

[a] Tritium in air consists of: Tritium oxide, 410 Ci.
Elemental tritium, 79 Ci.

5-Year Trends in Radionuclide Releases

It is Mound policy and philosophy that all releases of effluents from the Plant are ALARA, that is, As Low As Reasonably Achievable. To monitor Plant performance relative to ALARA goals, ALARA Investigation Levels (AILs) are established each year for principal radionuclides. AILs are set well below applicable regulatory standards to trigger internal investigations when exceeded.

Figures 4-1 through 4-8 illustrate 5-year trends in releases of tritium, plutonium, and uranium to the air and the Great Miami River. Mound's 1994 AILs have been included on the trend charts where applicable.

Tritium. Figure 4-1 shows releases of tritium to the atmosphere. The 1994 value, 489 Ci, represents a 5-year low in release rates. Figure 4-2 shows tritium releases to the Great Miami River. The 10.5 Ci value for 1994 is approximately twice the release levels recorded over the remainder of the 5-year period shown in the figure. This increase was attributable to an April 1994 water line break which flushed approximately 7 Ci of tritium from the soils under the Main Hill into the Great Miami River. In 1994, tritium releases to the atmosphere and the Great Miami River did not approach their respective AILs.

Figure 4-1. Tritium Releases from Mound to the Atmosphere, 1990 - 1994

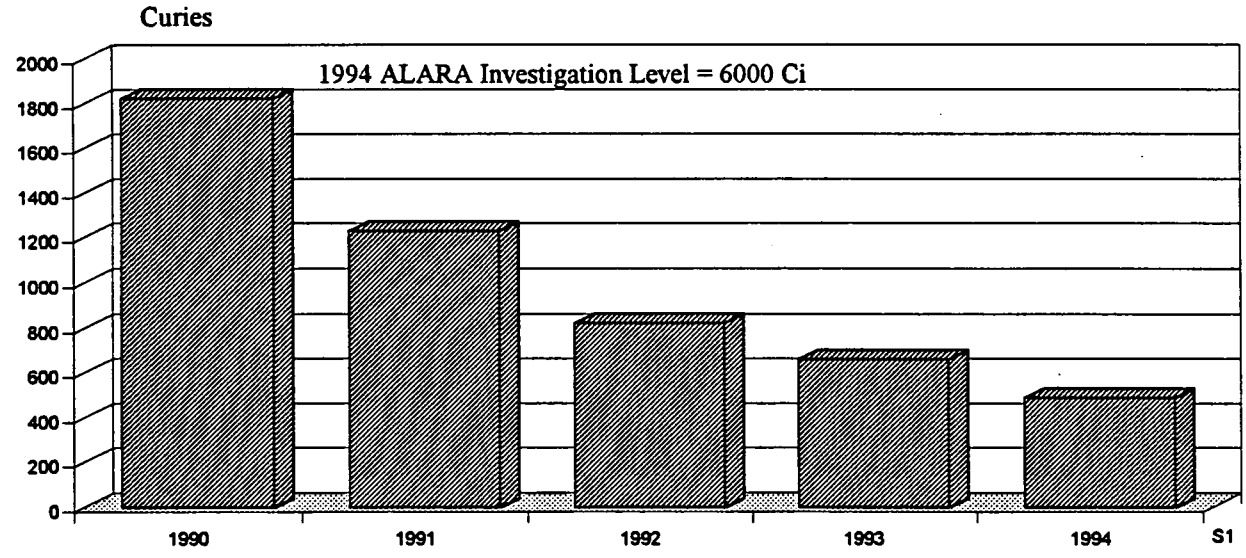
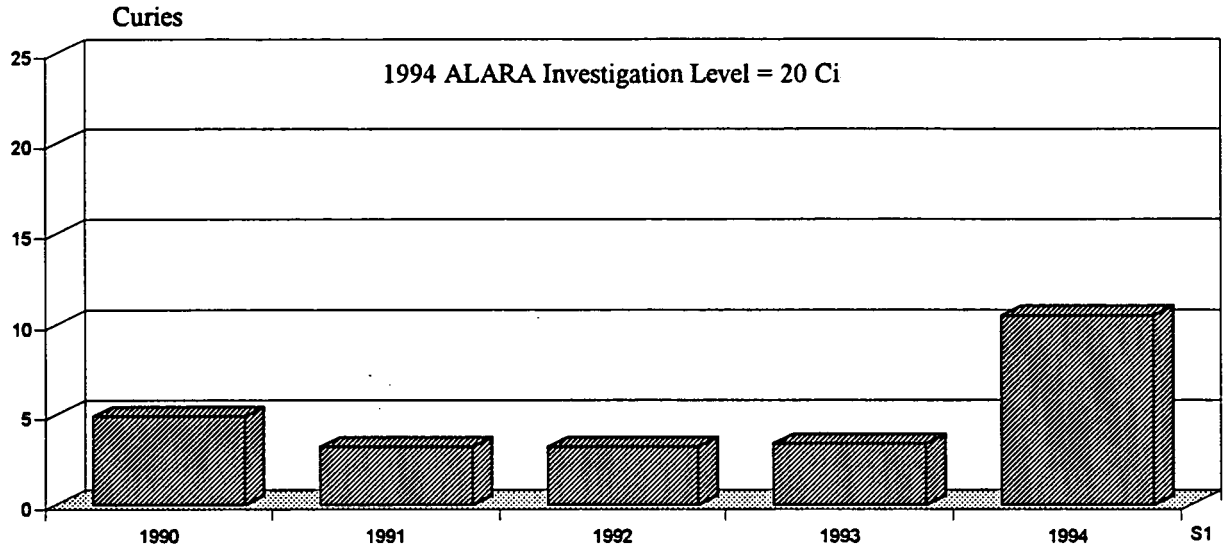


Figure 4-2. Tritium Releases from Mound to the Great Miami River, 1990 - 1994



Plutonium-238. Figures 4-3 and 4-4 show plutonium-238 releases to the atmosphere and the Great Miami River, respectively. Atmospheric release levels were higher in 1994 when compared to 1993 values; conversely, 1994 liquid release levels were lower than 1993 values. The elevated airborne plutonium levels have increased because of the SM Building D&D project. When the work is completed, the levels are expected to decline. As seen in the figures, both types of releases were small in comparison to their respective AILs.

Plutonium-239, 240. Figures 4-5 and 4-6 illustrate 5 year trends in Pu 239,240 release rates. Releases of these plutonium isotopes continue to be in the μCi and sub-μCi ranges.

Uranium. Figures 4-7 and 4-8 depict 5-year trends in uranium-233, 234 and uranium-238 release rates. Atmospheric releases of uranium are also on the sub-μCi scale. Releases of uranium-233, 234 to the Great Miami River are comparable to Pu-238 release levels for the River. As seen in Figure 4-8, uranium release rates were slightly higher in 1994 due to the previously described water line break.

Figure 4-3. Plutonium-238 Releases from Mound to the Atmosphere, 1990 - 1994

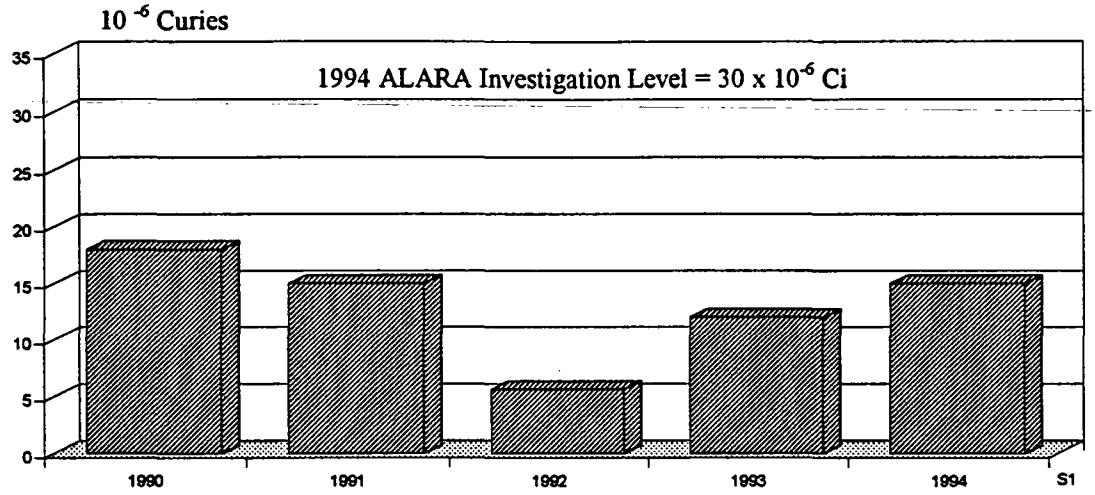


Figure 4-4. Plutonium-238 Releases from Mound to the Great Miami River, 1990 - 1994

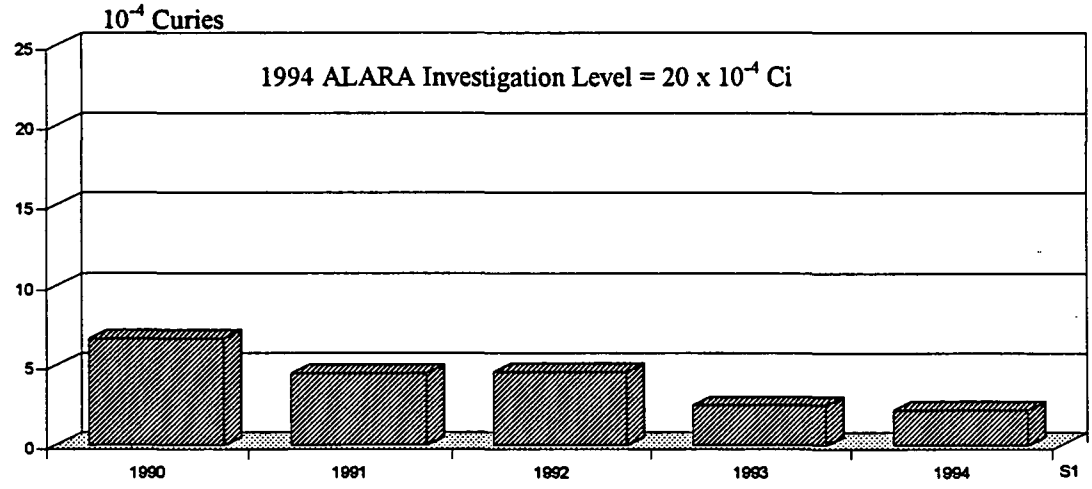


Figure 4-5. Plutonium-239,240 Releases from Mound to the Atmosphere, 1990-1994

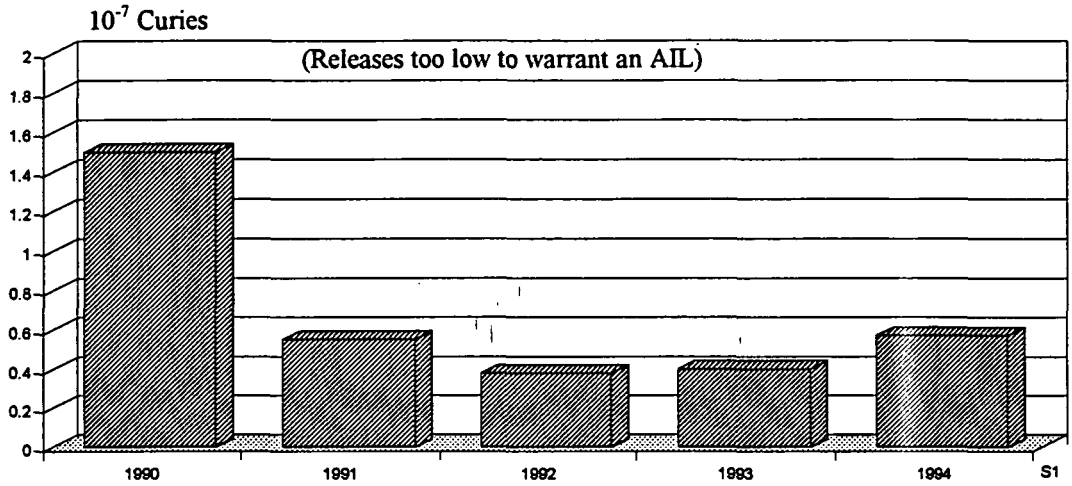


Figure 4-6. Plutonium-239,240 Releases from Mound to the Great Miami River, 1990-1994

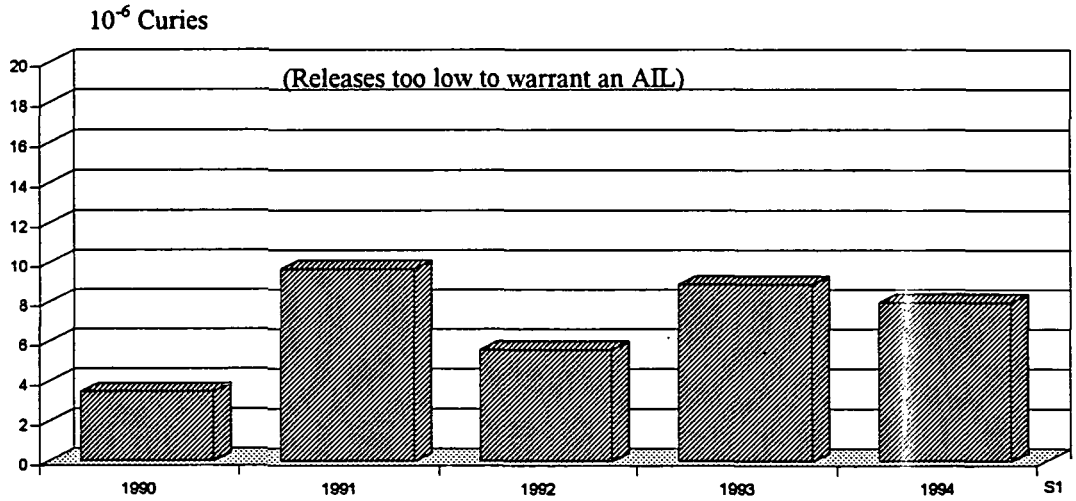


Figure 4-7. Uranium Releases from Mound to the Atmosphere, 1990-1994

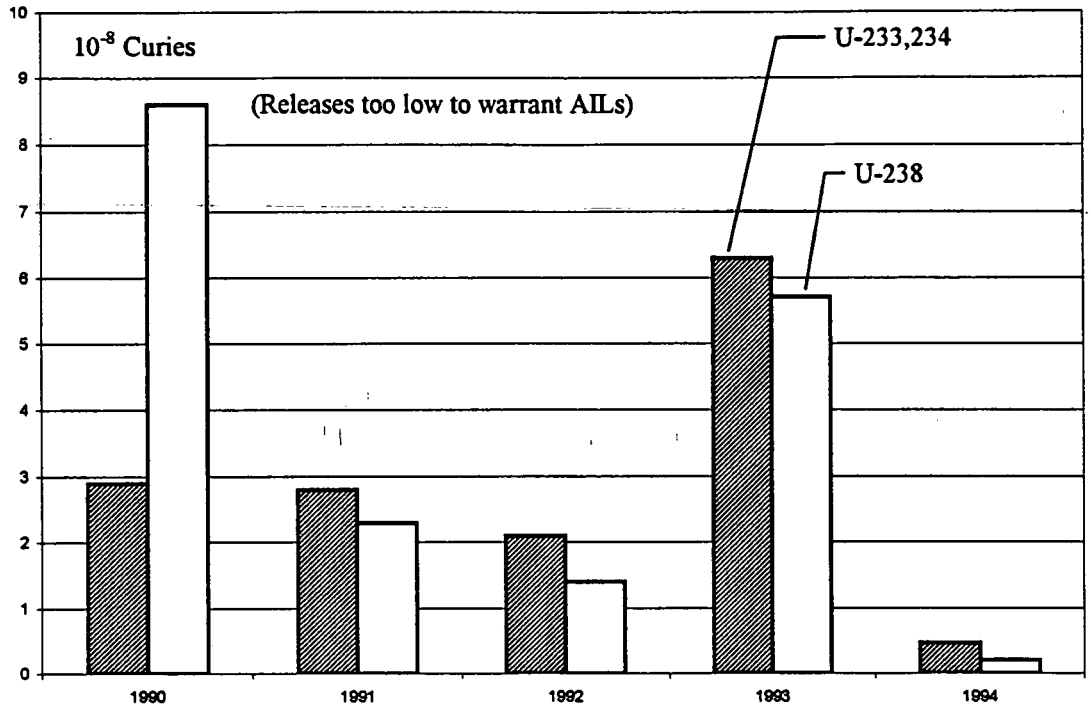
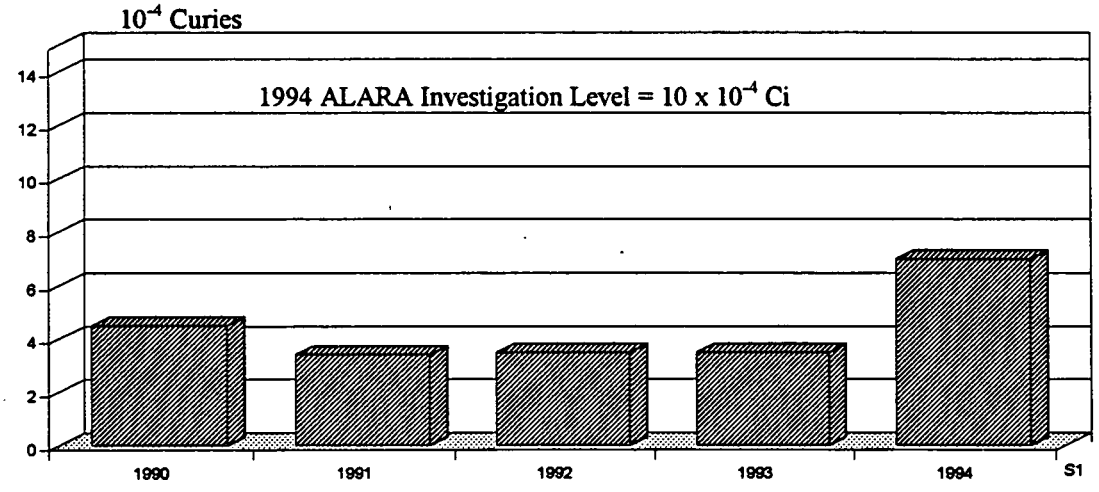


Figure 4-8. Uranium-233,234 Releases from Mound to the Great Miami River, 1990-1994



4.2 Effluent Monitoring Program

Air

Stacks through which radioactive materials are released are sampled continuously. Those areas in which a potential for unplanned releases exist are also monitored continuously.

Tritium. In operational areas where a release potential exists, room air and exhaust stacks are continuously monitored for tritium using strategically placed ionization chambers. These monitoring systems incorporate alarms and have been placed to help to locate the source if a release should occur. In most situations, an effluent removal and containment system can be relied upon to prevent or reduce the release of tritium to the atmosphere.

Plutonium and Uranium. In operational areas where a release potential exists, ventilation air passes through a minimum of two HEPA filters before being discharged to the atmosphere. Fixed continuous air samplers and continuous air monitors with alarm systems are used throughout the operational areas to detect airborne plutonium and/or uranium. These monitoring systems have been designed to ensure that prompt corrective action can be taken to reduce the number and magnitude of releases to the atmosphere.

Radon. Radon-222 from natural sources, and from past operations involving radium-226, is continually released to the atmosphere via a small roof vent. Though emission levels are negligible in comparison with natural radon emanation rates, a radon-222 release rate has been included in the 1994 effluent data (Table 4-1) in the interest of completeness. The estimated dose contribution from radon, as predicted by CAP-88, was 0.005 mrem for 1994.

Water

Sampling for radionuclides is not required by Mound's NPDES permit, however flow-proportional samples collected from NPDES Outfalls 5002, 5601, and 5602 (Figure 4-9) are analyzed for tritium, plutonium, and uranium. Samples are collected four times during Mound's four-day work week. Three 24-hour samples are collected on Tuesdays, Wednesdays, and Thursdays. One 96-hour sample is collected on Mondays. Samples are analyzed four times a week for tritium. Plutonium-238, plutonium-239, 240, and uranium-233, 234 samples are composited and analyzed every two weeks.

Average concentrations of radionuclides in effluent waters are shown in Table 4-2. These values are presented in terms of the percentage Derived Concentration Guide (DCG) they represent. DCG's for concentrations of radionuclides in water are given in DOE Order 5400.5 (DOE, 1990). These guides are based on recommendations in Publications 26 and 31 of the International Commission on Radiological Protection (ICRP 1977,1979). The DCG for a radionuclide is defined as the concentration of that radionuclide in air or water which will give a 50-year committed effective dose equivalent of 100 mrem (1 mSv) if taken into the body by inhalation or ingestion.

Release data for 1994 are shown in Table 4-1. Trend data for the 5-year period 1990-1994 appear in Figures 4-1 through 4-8.

Figure 4-9. Liquid Effluent Sampling Locations for Radionuclides

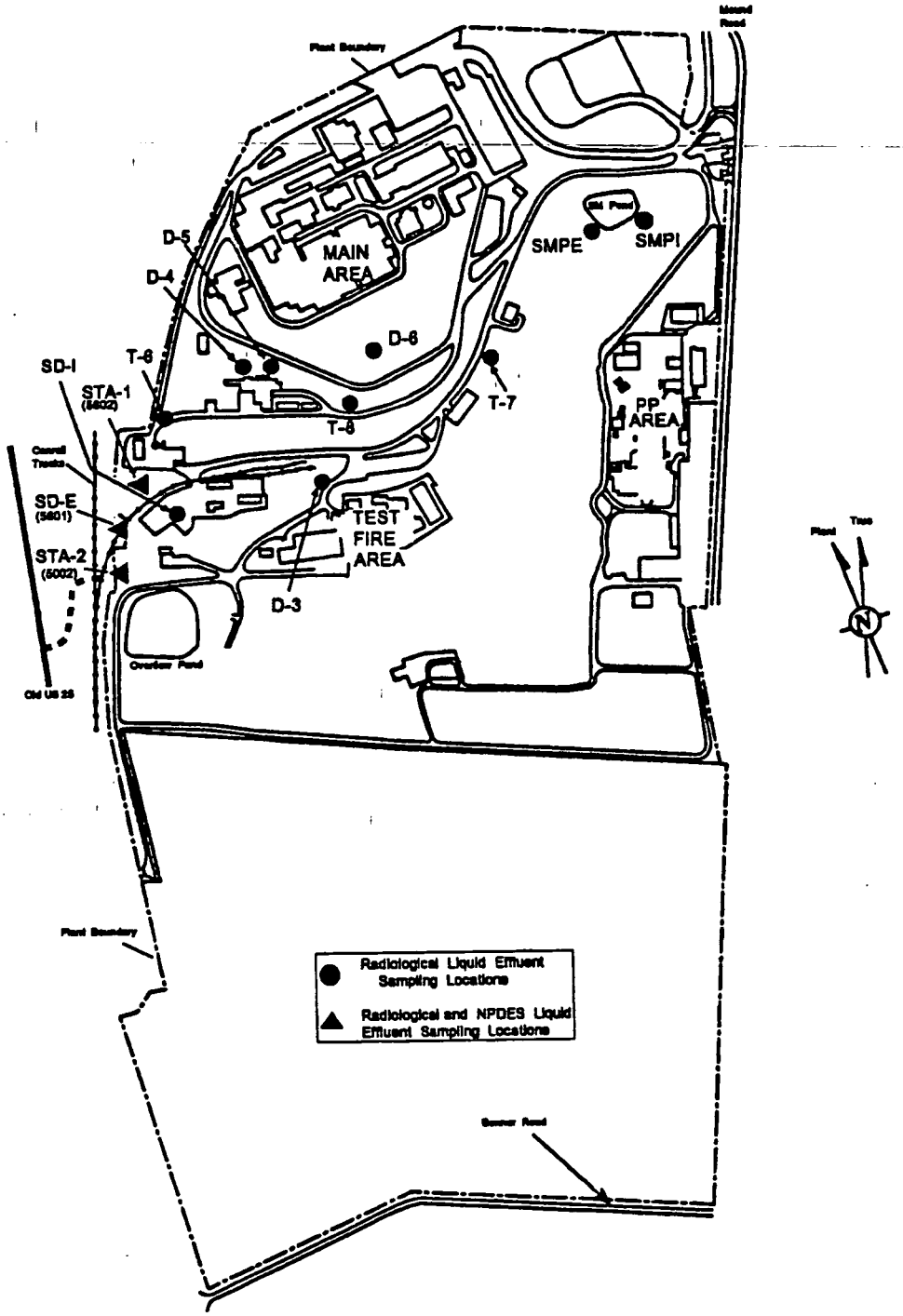


Table 4-2 .Concentrations of Radionuclides in Liquid Effluent for 1994

Outfall	Radionuclide	Average Concentration (μCi/mL)	Average as a Percent of DOE DCG[a]
Outfall 5602	Tritium	8.52×10^{-6}	0.4
	Pu-238	3.37×10^{-11}	0.1
	Pu-239	4.08×10^{-12}	0.01
	U-233,234	7.40×10^{-10}	0.1
Outfall 5002	Tritium	3.80×10^{-6}	0.2
	Pu-238	3.34×10^{-10}	0.8
	Pu-239	1.03×10^{-11}	0.03
	U-233,234	6.61×10^{-10}	0.1
Outfall 5601	Tritium	5.80×10^{-5}	2.9
	Pu-238	1.28×10^{-10}	0.3
	Pu-239	4.57×10^{-12}	0.02
	U-233,234	4.24×10^{-10}	0.1

[a] DOE DCG values in water:
Tritium 2×10^{-3} μCi/mL
Pu-238 4×10^{-8} μCi/mL
Pu-239 3×10^{-8} μCi/mL
U-233,234 5×10^{-7} μCi/mL

4.3 Environmental Surveillance

In the sections that follow, tables of environmental monitoring results are presented. The tables show:

- number of samples analyzed during the year,
- minimum concentration measured,
- maximum concentration measured,
- average value with error limits, and, when appropriate, a
- comparison to a DOE or EPA standard.

Environmental Concentrations

In a number of the tables, results are presented as "incremental concentrations". The designation indicates that an average background concentration, or "environmental" concentration, has been subtracted from those values. Therefore, incremental concentrations represent estimates of Mound's contribution to the radionuclide content of an environmental sample.

Environmental or reference locations for Mound were positioned at sites where virtually no impact from Mound could be measured. The sites are in the least prevalent wind direction and/or are at substantial distances relative to Mound. Environmental levels for radionuclides in different environment media are shown in Table 4-3.

With decreasing release rates of radioactivity, it has become increasingly difficult to observe Mound's contribution to radionuclide concentrations in the environment. For this reason, many of the tables in this Chapter report data as "below environmental levels." In those cases, it is not possible to observe an incremental concentration. In other words, the radionuclide concentration in the sample was equal to or less than the background sample.

Lower Detection Limit

All concentrations of radionuclides are determined by subtracting the instrument background and reagent blanks from the sample count. The lower detection limit (LDL) is shown for each set of data in this Chapter. The LDL is that value at which the presence of a contaminant, above that inherent in the detection method (including the reagent blank), can be inferred at the 95% confidence level. An LDL is calculated from the instrument background, the reagent blanks, and their respective estimated standard deviations. Radionuclide data throughout this report may be reported as less than the lower detection limit (LDL). Much of the data are reported as incremental values; the observed average concentration at an environmental or background location has been subtracted from results obtained from the various sampling locations to quantify Mound's impact. Low level data, after subtracting the environmental level, may fall below the LDL. In addition, measured results which are greater than the environmental blank are reported for information purposes. Data reported below the LDL are not within the 95% confidence level.

Table 4-3. Environmental Concentrations of Radionuclides in Sample Media in 1994

Radionuclide	Average Concentration[a,b]	Unit of Measure
Ambient air[c]		
Tritium oxide	3.22 ± 2.3	10^{-12} µCi/mL
Plutonium-238	0.05 ± 0.09	10^{-18} µCi/mL
Plutonium-239,240	0.07 ± 0.05	10^{-18} µCi/mL
River water[d]		
Tritium	0.02 ± 0.08	10^{-6} µCi/mL
Plutonium-238	0.97 ± 0.59	10^{-12} µCi/mL
Plutonium-239,240	0.27 ± 0.48	10^{-12} µCi/mL
Uranium-233,234	0.59 ± 0.12	10^{-9} µCi/mL
Uranium-238	0.53 ± 0.1	10^{-9} µCi/mL
Pond water[e]		
Tritium	0.07 ± 0.2	10^{-6} µCi/mL
Plutonium-238	0.25 ± 1.41	10^{-12} µCi/mL
Plutonium-239,240	N.D.	
Sediment		
Plutonium-238 in river sediment[d]	0.89 ± 0.19	10^{-9} µCi/g
Plutonium-238 in pond sediment[e]	0.37 ± 0.89	10^{-9} µCi/g
Plutonium-239,240 in river sediment[d]	3.12 ± 4.62	10^{-9} µCi/g
Plutonium-239,240 in pond sediment[e]	2.56 ± 1.25	10^{-9} µCi/g
Vegetation[f]		
Tritium in grass	0.06 ± 0.06	10^{-6} µCi/g
Plutonium-238 in grass	0.09 ± 0.09	10^{-9} µCi/g
Plutonium-239,240 in grass	0.56 ± 0.63	10^{-9} µCi/g
Foodstuffs[f]		
Tritium in tomatoes	0.03 ± 0.04	10^{-6} µCi/g
Plutonium-238 in root crops	0.003 ± .0.08	10^{-9} µCi/g
Plutonium-239,240 in root crops	0.04 ± 0.02	10^{-9} µCi/g
Plutonium-238 in fish	N.S.	
Plutonium-239,240 in fish	N.S.	

[a] Error limits are estimates of the standard error of the estimated means at the 95% confidence level.
[b] N.D. indicates concentrations below the reagent blanks.
[c] Measured 28 mi (45 km) northwest of Mound.
[d] Measured 20 mi (32 km) upstream of Mound on the Great Miami River.
[e] Measured 38 mi (61 km) southest of Mound.
[f] Measured 38 mi (61 km) west of Mound.
[g] N.S. Indicates no sample available.

4.4 Air Sampling Program

Two types of air samples are collected at each sampling location. A particulate air sample is analyzed for plutonium-238 and plutonium-239, 240. A second air sample, collected in a bubbler apparatus, is analyzed for tritium oxide. Mound operates a network of 22 stations: seven onsite and 15 offsite. The locations of the stations are shown in Figures 4-10 and 4-11, respectively.

Tritium. The air sample for tritium analysis is collected on a continuous basis. Air is bubbled through 200 mL of ethylene glycol at a flow rate of approximately 1000 cm^3/min. Ethylene glycol is used as a trapping solution because it is not subject to loss by evaporation and will not freeze when exposed to winter sampling conditions (Sheehan et al., 1975). The glycol solutions are changed weekly and represent a sample volume of approximately 10 m^3 of air. An aliquot of each glycol solution is then analyzed weekly in a liquid scintillation counter.

With this technique, tritium oxide rather than elemental tritium is collected. This approach is appropriate because tritium oxide is the more radiotoxic form of tritium. The dose that would result from a given release of tritium oxide would be 25,000 times greater than the dose from the same number of curies of elemental tritium.

Plutonium. The particulate sample for isotopic plutonium analysis is collected on a 200-mm diameter fiberglass disc by a continuously operating high-volume air sampler. The air is sampled at an average rate of 1.3 x $10^6 cm^3$/min (45 ft^3/min). The disc is changed weekly and represents a sample volume of approximately 13,000 m^3 of air. Each sampler is equipped with a flow meter so that location-specific flow rates can be calculated.

Plutonium analyses are performed on monthly composite samples for each onsite location and for the three offsite stations within 1000 m of Mound. The remaining samples are composited for quarterly analysis. The analytical protocol for plutonium incorporates the following basic steps: use of an internal tracer, chemical treatment, separation of plutonium with anion exchange resin, and alpha spectrometry.

Uranium. As seen in Table 4-1, Mound includes isotopes of uranium in the release data for air. However, because the stack emissions of uranium-233-234 and uranium-238 are so low and their dose contributions are negligible, these radionuclides are not monitored at the environmental air sampling stations.

Applicable Standards

The guides for concentrations of radionuclides in air are given in DOE Order 5400.5 (DOE, 1990). These guides are based on recommendations in Publications 26 and 30 of the International Commission on Radiological Protection (ICRP 1977, 1979). The guides for radionuclide concentrations are referred to as Derived Concentration Guides, or DCGs. The DCG for a radionuclide is defined as the concentration of that radionuclide in air or water which will give a 50-year committed effective dose equivalent of 100 mrem (1 mSv) if taken into the body by inhalation or ingestion. DCGs for tritium, plutonium-238 and plutonium-239,240 in air are listed in Tables 4-4, 4-5, and 4-6, respectively.

Figure 4-10. Onsite Air Sampling Locations

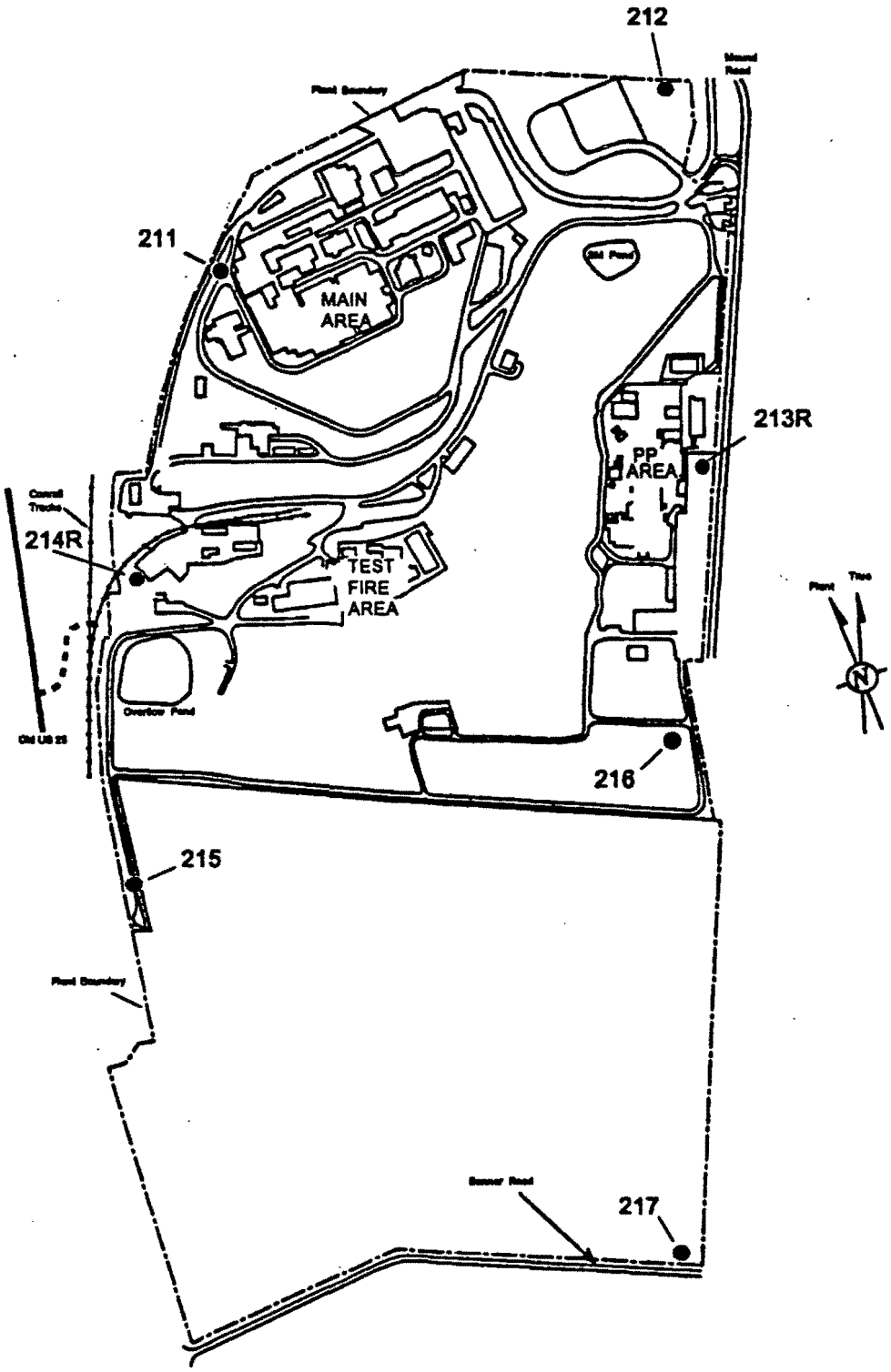
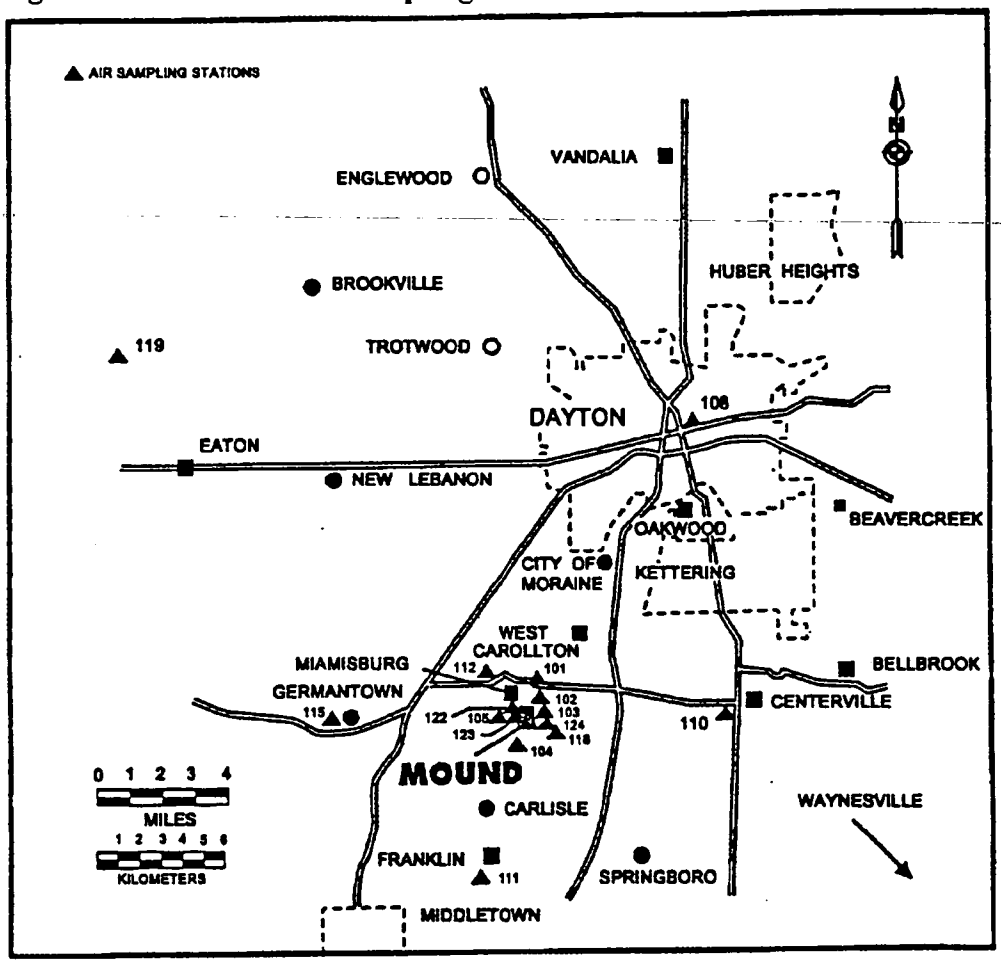


Figure 4-11. Offsite Air Sampling Locations



Results for 1994

Radionuclide concentrations measured at environmental air sampling stations in 1994 are shown in Tables 4-4, 4-5, and 4-6. The results are also presented in terms of the percentage DCG they represent. With the exception of sampling location 213R, the tables show that air concentrations of tritium and plutonium measured on and about Mound consistently averaged less than 0.01% of the DCGs established for those radionuclides.

The elevated plutonium concentrations noted at location 213R during 1994 are attributable to the D&D operation to remove the SM Building. The elevated levels are small fractions of the DOE DCG and pose no significant risk. The structure removal was completed in March of 1995.

Table 4-4. Incremental Concentrations[a] of Tritium Oxide in Air in 1994

Location*	Number of Samples	Tritium Oxide 10^{-12} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
Offsite					
101	48	e	61.51	5.96 ± 4.36	0.006
102	50	e	28.22	4.9 ± 3.68	0.005
103	50	e	26.34	2.14 ± 3.3	0.002
104	52	e	26.31	1.98 ± 3.46	0.002
105	51	e	25.35	1.25 ± 3.35	0.001
108	50	e	34.27	0.74 ± 3.42	0.0007
110	48	e	23.85	0.52 ± 3.44	0.0005
111	50	e	29.03	e	e
112	51	e	36.66	2.09 ± 3.63	0.002
115	48	e	28.99	0.75 ± 3.65	0.0008
118	51	e	28.98	0.75 ± 3.25	0.0008
122	50	e	35.15	3.37 ± 3.75	0.003
123	50	e	33.36	5.65 ± 3.54	0.006
124	50	e	40.51	8.09 ± 3.58	0.008
Onsite					
211	51	e	44.27	7.54 ± 4.61	0.008
212	50	e	47.88	4.82 ± 3.89	0.005
213R	50	e	24.29	3.55 ± 3.38	0.004
214R	48	e	30.75	4.29 ± 3.78	0.004
215	48	e	26.4	3.69 ± 3.61	0.004
216	49	e	23.71	1.97 ± 3.53	0.002
217	49	e	42.48	2.11 ± 4.06	0.002

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95% confidence interval.

[c] LDL for tritium offsite in air is 23 x 10^{-12} µCi/mL. The LDL for tritium onsite is 28 x 10^{-12} µCi/mL. The LDL for sample 211 is 35 x 10^{-12} µCi/mL.

[d] DOE DCG for tritium oxide in air is 100,000 x 10^{-12} µCi/mL.

[e] Below environmental level.

R = Relocated in 1992.

• Offsite sampling locations shown on Figure 4-11.

Onsite sampling locations shown on Figure 4-10.

Table 4-5. Incremental Concentrations[a] of Plutonium-238 in Air in 1994

Location*	Number of Samples	Plutonium-238 10^{-18} µCi/mL Minimum	Maximum	Average[b,c]	Average as a percent of DOE DCG[d]
Offsite					
101	4	0.52	1.27	0.81 ± 0.54	0.003
102	4	1.96	6.92	4.42 ± 3.23	0.01
103	4	1.68	7.63	3.6 ± 4.43	0.01
104	4	0.82	3.51	1.85 ± 1.84	0.006
105	4	0.11	0.43	0.32 ± 0.25	0.001
108	4	e	2.1	0.6 ± 1.6	0.002
110	4	e	0.34	0.07 ± 0.3	0.0002
111	4	0.11	0.2	0.16 ± 0.11	0.0005
112	4	0.16	0.39	0.26 ± 0.18	0.0009
115	4	0.05	0.14	0.1 ± 0.12	0.0003
118	4	0.66	1.1	0.86 ± 0.31	0.003
122	12	0.32	2.2	1.37 ± 0.39	0.005
123	12	1.48	8.4	4.12 ± 1.34	0.01
124	12	2.44	47.32	13.19 ± 8.39	0.04
Onsite					
211	12	2.4	23.56	8.28 ± 3.56	0.03
211T	12	1.76	15.78	6.63 ± 2.6	0.02
212	12	1.85	18.17	7.21 ± 3.13	0.02
212T	12	3.07	17.16	7.37 ± 3.05	0.02
213R	12	29.57	1994.6	354.26 ± 374.9	1.2
213RT	12	8.64	1292.16	259.65 ± 289.58	0.87
214R	12	2.52	11.22	5.55 ± 1.51	0.02
214RT	12	1.85	11.27	5.5 ± 1.89	0.02
215	12	0.2	5.2	2.56 ± 0.78	0.009
215T	12	0.85	73.19	9.17 ± 12.84	0.03
216	12	0.64	30.53	11.27 ± 6.18	0.04
216T	12	1.05	29.99	8.36 ± 5.03	0.03
217	12	0.4	6.89	2.59 ± 1.31	0.009
217T	12	0.2	21.9	4.28 ± 3.75	0.01

[a] Average environmental level shown in Table 4-3 subtracted from the data.
[b] Error limits are estimates of the standard error of the estimated means at the 95% confidence level.
[c] LDL for monthly values is 0.12 x 10^{-18} µCi/mL, for quarterly values the LDL is 0.03 x 10^{-18} µCi/mL.
[d] DOE DCG for plutonium-238 in air is 30,000 x 10^{-18} µCi/mL.
[e] Below environmental level.
R = Relocated in 1992.
T = Supplemental sampling height (2m).
• Offsite sampling locations shown on Figure 4-11.
Onsite sampling locations shown on Figure 4-10.

Table 4-6. Incremental Concentrations[a] of Plutonium-239,240 in Air in 1994

Location*	Number of Samples	Plutonium-239,240 10^{-18} µCi/mL Minimum	Maximum	Average[b,c]	Average as a percent of DOE DCG[d]
Offsite					
101	4	0.1	0.38	0.19 ± 0.22	0.001
102	4	e	0.74	0.32 ± 0.56	0.002
103	4	e	0.12	0.04 ± 0.11	0.0002
104	4	e	0.08	0.03 ± 0.09	0.0002
105	4	e	0.05	0.01± 0.08	0.00005
108	4	0.03	0.95	0.28 ± 0.71	0.001
110	4	e	0.13	0.05 ± 0.12	0.0003
111	4	e	0.6	0.18 ± 0.45	0.0009
112	4	e	0.15	0.04 ± 0.14	0.0002
115	4	e	0.16	0.05 ± 0.13	0.0003
118	4	e	0.26	0.06 ± 0.22	0.0003
122	12	e	0.32	0.11 ± 0.1	0.0006
123	12	e	0.83	0.21 ± 0.17	0.001
124	12	e	1.61	0.44 ± 0.33	0.002
Onsite					
211	12	e	1.31	0.44 ± 0.26	0.002
211T	12	e	1.47	0.34 ± 0.27	0.002
212	12	e	0.92	0.26 ± 0.21	0.001
212T	12	e	0.73	0.25 ± 0.16	0.001
213R	12	0.06	14.14	3.5 ± 2.75	0.02
213RT	12	0.47	6.71	2.14 ± 1.35	0.01
214R	12	e	1.05	0.32 ± 0.22	0.002
214RT	12	e	1.02	0.3 ± 0.21	0.002
215	12	e	0.71	0.17 ± 0.15	0.0009
215T	12	e	1.76	0.28 ± 0.32	0.001
216	12	e	1.19	0.42 ± 0.28	0.002
216T	12	e	0.92	0.35 ± 0.2	0.002
217	12	e	0.84	0.15 ± 0.19	0.0008
217T	12	e	0.3	0.1 ± 0.13	0.0005

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95% confidence level.

[c] LDL for monthly values is 0.2 x 10^{-18} µCi/mL, for quarterly values the LDL is 0.05 x 10^{-18} µCi/mL.

[d] DOE DCG for plutonium-239,240 in air is 20,000 x 10^{-18} µCi/mL.

[e] Below environmental level.

R = Relocated in 1992.

T = Supplemental sampling height (2m).

* Offsite sampling locations shown on Figure 4-11.
Onsite sampling locations shown on Figure 4-10.

4.5 Surface Water and Sediment Sampling Program

The Great Miami River and other regional surface waters are sampled routinely by Mound for tritium, isotopes of plutonium, and isotopes of uranium. Sediment samples are also collected from these locations and analyzed for plutonium isotopes. Sampling locations are shown in Figure 4-12. The analytical procedures followed for these samples are consistent with the descriptions presented in Section 4.2 of this report.

Great Miami River. River sampling locations have been selected according to guidelines published by the DOE (DOE 1991, 1992). These locations provide samples that are representative of river water after considerable mixing with Mound effluents has occurred. Tritium samples are collected and analyzed weekly; plutonium-238, plutonium-239,240, uranium-233,234, and uranium-238 samples are collected and analyzed monthly.

Regional surface waters. Seven ponds in various compass sectors relative to Mound are sampled quarterly. These samples are analyzed for tritium, plutonium-238, and plutonium-239,240.

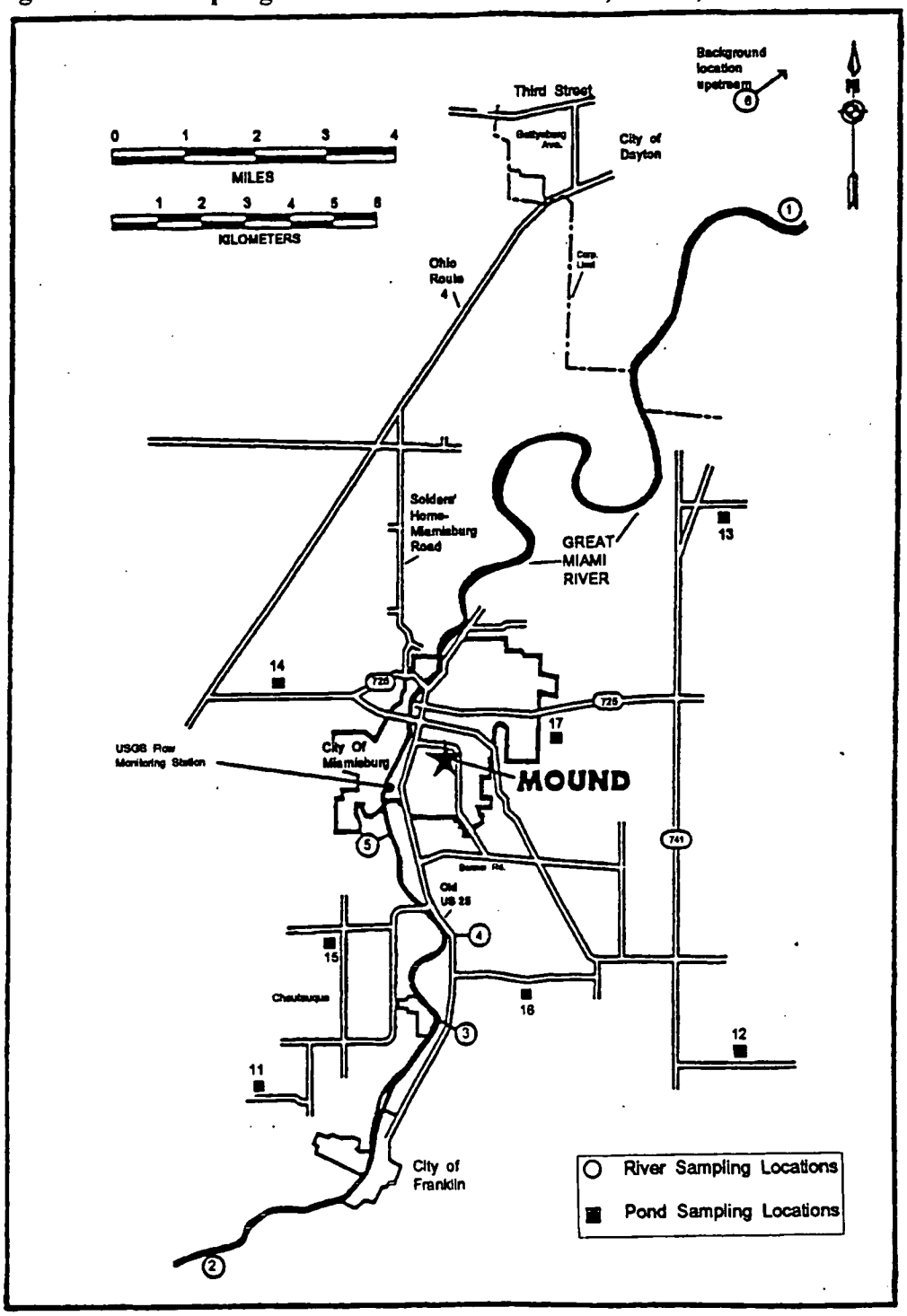
River and pond sediments. Many plutonium solutions, including those in use at Mound, are relatively insoluble in water. For this reason, they are more likely to be found in sediment than in surface water. Additionally, because of the relatively long half-lives of plutonium isotopes, they may accumulate in sediments over a number of years. Therefore, Mound samples river and pond sediments on a quarterly basis. These samples are then analyzed for plutonium-238 and plutonium-239, 240.

Applicable Standards

DOE Order 5400.5 established a radiation dose limit for the general public of 100 mrem/yr (1.0 mSv) effective dose equivalent (EDE) for all exposure pathways. To ensure that the dose standard would not be exceeded, the Order also established derived concentration guides (DCGs). DCGs are those concentrations, that under conditions of continuous exposure for one year, would result in an EDE of 100 mrem.

The primary use of DCGs for liquid releases is to control exposures received from drinking water supplies. Since neither of the Great Miami River nor any of the regional ponds are sources of drinking water, the DCGs do not apply to the environmental data reported in this section. DCGs are listed in the tables of results to help put the values in perspective. For the sediment samples, however, there are no DCGs or other applicable standards.

Figure 4-12. Sampling Locations for River Water, Ponds, and Sediment



Results for 1994

River water. Radionuclide concentrations in the Great Miami River are shown in Tables 4-7 through 4-10. Many tritium, plutonium, and uranium measurements were below their respective reagent blanks or environmental levels. Averages for 1994 were on the order of one one-hundreth of a DCG or less.

Pond water. Radionuclide concentrations measured in pond water are shown in Tables 4-11 through 4-13. As observed for the river samples, many of the pond results were below environmental levels or reagent blanks.

Sediment. Results for river and pond sediments are listed in Tables 4-14 and 4-15 for plutonium-238 and plutonium-239,240 respectively. Maximum and average concentrations of plutonium for 1994 are compared to concentrations observed in previous years. Since the plutonium isotopes are most likely found in the water bodies sediment, the concentrations of plutonium are most likely to follow localized movement of silt in those water bodies. This movement may explain the variability in plutonium concentrations at the various river and pond locations from year to year. The levels are still low and pose no significant risk, yet increased monitoring of river sampling location 4 and pond sampling location 17 may be warranted.

Table 4-7. Incremental Concentrations[a] of Tritium in the Great Miami River in 1994

Location*	Number of Samples	Tritium 10^{-6} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
1	48	e	0.13	e	e
2	48	e	10.64	0.23 ± 0.45	0.01
3	48	e	0.18	e	e
4	48	e	0.19	e	e
5	47	e	1.11	0.01 ± 0.09	0.0005

[a] Average environmental level shown in Table 4-3 subtracted from the data.
[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.
[c] LDL for tritium in water is 0.5 x 10^{-6} µCi/mL.
[d] DOE DCG for tritium in water is 2,000 x 10^{-6} µCi/mL.
[e] Below reagent blank.
* Sampling locations shown on Figure 4-12.

Table 4-8. Incremental Concentrations[a] of Plutonium-238 in the Great Miami River in 1994

Location*	Number of Samples	Plutonium-238 10^{-12} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
1	12	e	2.0	e	e
2	12	e	4.03	0.94 ± 1.29	0.002
3	12	e	6.11	1.09 ± 1.43	0.003
4	12	e	6.22	1.61 ± 1.45	0.004
5	12	e	0.58	e	e

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for plutonium-238 in river water is 5.0×10^{-12} µCi/mL.

[d] DOE DCG for plutonium-238 in water is 4×10^{-8} µCi/mL.

[e] Below reagent blank.

* Sampling locations shown on Figure 4-12.

Table 4-9. Incremental Concentrations[a] of Plutonium-239,240 in the Great Miami River in 1994

Location*	Number of Samples	Plutonium-239,240 10^{-12} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
1	12	e	2.01	0.37 ± 0.83	0.001
2	12	e	2.08	0.11 ± 0.92	0.0004
3	12	e	3.43	0.33 ± 1.03	0.001
4	12	e	1.7	0.16 ± 0.73	0.0005
5	12	e	1.18	e	e

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for plutonium-239 in river water is 3.5×10^{-12} µCi/mL.

[d] DOE DCG for plutonium-239 in water is 3×10^{-8} µCi/mL.

[e] Below reagent blank.

* Sampling locations shown on Figure 4-12.

Table 4-10. Incremental Concentrations[a] of Uranium-233,234 and Uranium-238 in the Great Miami River in 1994

Location*	Number of Samples	Uranium-233,234 10^{-9} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
1	12	e	0.51	0.13 ± 0.19	0.03
2	12	e	0.32	0.05 ± 0.15	0.01
3	12	e	0.25	0.04 ± 0.14	0.008
4	12	e	0.22	0.07 ± 0.14	0.01
5	12	e	0.32	0.04 ± 0.17	0.008

Location*	Number of Samples	Uranium-238 10^{-9} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
1	12	e	0.32	0.1 ± 0.15	0.02
2	12	e	0.23	0.04 ± 0.12	0.007
3	12	e	0.27	0.04 ± 0.13	0.007
4	12	e	0.24	0.08 ± 0.12	0.01
5	12	e	0.26	0.03 ± 0.14	0.005

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for uranium-233,234 is 0.08 x 10^{-9} µCi/mL. The LDL for uranium-238 is 0.04 x 10^{-9} µCi/mL.

[d] DOE DCG for uranium-233,234 in water is 500 x 10^{-9} µCi/mL. The DOE DCG for uranium-238 in water is 600 x 10^{-9} µCi/mL.

[e] Below reagent blank.

* Sampling locations shown on Figure 4-12.

Table 4-11. Incremental Concentrations[a] of Tritium in Pond Water in 1994

Location*	Number of Samples	Tritium 10^{-6} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
11	3	e	0.09	0.01 ± 0.37	0.0005
12	3	e	0.03	e	e
13	3	e	0.09	e	e
14	3	e	e	e	e
15	3	e	0.16	0.02 ± 0.36	0.001
17	3	e	0.18	0.07 ± 0.32	0.004

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for tritium in water is 0.4 x 10^{-6} µCi/mL.

[d] DOE DCG for tritium in water is 2,000 x 10^{-6} µCi/mL.

[e] Below environmental level.

* Sampling locations shown on Figure 4-12.

Table 4-12. Incremental Concentrations[a] of Plutonium-238 in Pond Water in 1994

Location*	Number of Samples	Plutonium-238 10^{-12} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
11	4	e	0.73	e	e
12	4	e	0.53	e	e
13	4	e	0.28	e	e
14	4	e	1.8	0.33 ± 2.13	0.0008
15	4	e	0.58	0.14 ± 1.65	0.0004
17	4	e	9.55	2.72 ± 7.39	0.007

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for plutonium-238 in water is 3.1 x 10^{-12} µCi/mL.

[d] DOE DCG for plutonium-238 in water is 4 x 10^{-8} µCi/mL.

[e] Below environmental level.

• Sampling locations shown on Figure 4-12.

Table 4-13. Incremental Concentrations[a] of Plutonium-239,240 in Pond Water in 1994

Location*	Number of Samples	Plutonium-239,240 10^{-12} µCi/mL			Average as a percent of DOE DCG[d]
		Minimum	Maximum	Average[b,c]	
11	4	e	0.79	e	e
12	4	e	0.94	e	e
13	4	e	0.96	e	e
14	4	e	1.21	e	e
15	4	e	0.96	e	e
17	4	e	1.04	e	e

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for plutonium-239,240 in pond water is 9.7 x 10^{-12} µCi/mL.

[d] DOE DCG for plutonium-239,240 in water is 30,000 x 10^{-12} µCi/mL.

[e] Below environmental level.

* Sampling locations shown on Figure 4-12.

Table 4-14. Incremental Concentrations[a] of Plutonium-238 in River and Pond Sediments in 1994

River Sediment Sampling Locations

Location*	Number of Samples	Plutonium-238 10^{-9} µCi/g Minimum	Maximum	Average[b,c]
1	4	d	0.23	d
2	4	16.31	956.92	298.01 ± 702.6
3	4	2.64	618.74	174.29 ± 472.74
4	4	16.17	3807.91	1165.97 ± 2861.36
5	4	4.69	43.69	22.71 ± 28.77

Pond Sediment Sampling Locations

Location*	Number of Samples	Plutonium-238 10^{-9} µCi/g Minimum	Maximum	Average[b,c]
11	4	d	3.73	0.84 ± 3.2
12	4	d	8.5	2.29 ± 6.77
13	4	d	1.89	0.37 ± 1.94
14	4	d	2.27	0.8 ± 1.94
15	4	d	3.22	1.16 ± 2.67
17	4	34.96	570.17	176.7 ± 417.51

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for plutonium-238 in river sediment is 0.5×10^{-9} µCi/g. The LDL for plutonium-238 in pond sediment is 1.4×10^{-9} µCi/g.

[d] Below environmental level.

* Sampling locations shown on Figure 4-12.

Table 4-15. Incremental Concentrations[a] of Plutonium-239,240 in River and Pond Sediments in 1994

River Sediment Sampling Locations

Location*	Number of Samples	Plutonium-239,240 10^{-9} µCi/g Minimum	Maximum	Average[b,c]
1	4	d	2.19	0.77 ± 5.71
2	4	d	30.56	10.62 ± 24.41
3	4	d	24.81	7.26 ± 20.73
4	4	d	18.06	10.4 ± 15.58
5	4	0.46	3.47	1.58 ± 5.09

Pond Sediment Sampling Locations

Location*	Number of Samples	Plutonium-239,240 10^{-9} µCi/g Minimum	Maximum	Average[b,c]
11	4	0.28	3.91	2.36 ± 2.89
12	4	d	17.26	4.38 ± 13.86
13	4	d	5.04	1.36 ± 4.67
14	4	d	2.96	1.07 ± 2.95
15	4	d	1.33	d
17	4	d	7.03	1.02 ± 6.35

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for plutonium-239 in river sediment is 0.7 x 10^{-9} µCi/g. The LDL for plutonium-239 in pond sediment is 0.7 x 10^{-9} µCi/g.

[d] Below environmental level.

* Sampling locations shown on Figure 4-12.

4.6 Produce and Vegetation

Various locally grown produce and vegetation samples are collected during the growing season from the surrounding area. Additionally, fish are collected from the Great Miami River. The intent of this aspect of the Environmental Monitoring Program at Mound is to determine whether significant concentrations or radionuclides are present in plant and animal life.

In 1994, samples of grass, rootcrops, and tomatoes were collected from a number of regional cities. Fish were collected from the river downstream of Mound's discharge points.

Plutonium concentrations were determined by ashing the samples, then proceeding with the technique used for plutonium analyses of air samples (Section 4.4). Tritium concentrations were determined by removing and distilling the water from the sample, then analyzing the distillate using liquid scintillation spectrometry.

Result for 1994

The results for the produce, vegetation, and fish analyses are shown in Tables 4-16 through 4-18. As seen in the tables, most of the samples were below their respective environmental levels or reagent blanks. The results demonstrate that exposure to Mound's effluents via food-related pathways is negligible.

Table 4-16. Incremental Concentrations[a] of Tritium in Vegetation and Produce in 1994

Location*	Type of Sample	Number of Samples	Number of Replicates	Tritium 10^{-6} µCi/g Minimum	Maximum	Average[b,c]
Bellbrook	Grass	1	4	d	0.04	0.01 ± 0.08
	Tomatoes	1	4	d	0.03	0.002 ± 0.07
Centerville	Grass	1	4	0.03	0.07	0.05 ± 0.07
	Tomatoes	1	4	d	d	d
Franklin	Grass	1	4	d	0.02	d
	Tomatoes	1	4	d	0.06	0.02 ± 0.07
Germantown	Grass	1	4	d	0.28	0.18 ± 0.25
	Tomatoes	1	4	d	0.04	0.01 ± 0.06
Miamisburg	Grass	1	4	d	0.02	d
	Tomatoes	1	4	0.03	0.09	0.06 ± 0.06
Trotwood	Grass	1	4	0.06	0.08	0.07 ± 0.06
	Tomatoes	1	4	d	d	d

[a] Average environmental level shown in Table 4-3 subtracted from the data.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for tritium in grass is 0.2 x 10^{-6} µCi/g. The LDL for tritium in tomatoes is 0.1 x 10^{-6} µCi/g.

[d] Below environmental level.

*Community locations shown on Figure 4-11.

Table 4-17. Incremental Concentrations[a] of Plutonium-238 in Vegetation and Produce in 1994

Location*	Type of Sample	Number of Samples	Number of Replicates	Plutonium-238 10^{-9} µCi/g Minimum	Maximum	Average[b,c]
Bellbrook	Grass	1	4	0.08	0.29	0.21 ± 0.18
	Root crops	1	4	e	0.03	d
Centerville	Grass	1	4	d	d	d
	Root crops	1	4	d	0.23	0.07 ± 0.19
Franklin	Grass	1	4	d	d	d
	Root crops	1	4	d	0.1	0.04 ± 0.1
Germantown	Grass	1	4	d	0.28	0.07 ± 0.26
	Root crops	1	4	d	0.05	0.02 ± 0.08
Miamisburg	Grass	1	4	0.04	1.18	0.52 ± 0.8
	Root crops	1	4	d	0.1	d
Trotwood	Grass	1	4	d	0.02	d
	Root crops	1	4	d	0.1	0.04 ± 0.12
Great Miami River	Fish	1	4	e	0.03	0.01 ± 0.03

[a] Average environmental level shown in Table 4-3 subtracted from the data. Environmental level fish samples were not available, therefore the fish values are not incremental.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for plutonium-238 in grass is 0.1 x 10^{-9} µCi/g. The LDL for plutonium-238 in root crops is 0.1 x 10^{-9} µCi/g. For plutonium-238 in fish the LDL is 0.1 x 10^{-9} µCi/g.

[d] Below environmental level.

*Community locations shown on Figure 4-11.

Table 4-18. Incremental Concentrations[a] of Plutonium-239,240 in Vegetation and Produce in 1994

Location*	Type of Sample	Number of Samples	Number of Replicates	Plutonium-239,240 10^{-9} µCi/g		
				Minimum	Maximum	Average[b,c]
Bellbrook	Grass	1	4	d	d	d
	Root crops	1	4	d	d	d
Centerville	Grass	1	4	d	d	d
	Root crops	1	4	d	0.04	0.002 ± 0.08
Franklin	Grass	1	4	d	d	d
	Root crops	1	4	d	d	d
Germantown	Grass	1	4	d	d	d
	Root crops	1	4	d	0.05	d
Miamisburg	Grass	1	4	d	d	d
	Root crops	1	4	d	d	d
Trotwood	Grass	1	4	d	d	d
	Root crops	1	4	d	0.02	d
Great Miami River	Fish	1	4	0.01	0.05	0.02 ± 0.04

[a] Average environmental level shown in Table 4-3 subtracted from the data. Environmental level fish samples were not available, therefore the fish values are not incremental.

[b] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[c] LDL for plutonium-239,240 in grass is 0.06 x 10^{-9} µCi/g. The LDL for plutonium-239,240 in root crops is 0.06 x 10^{-9} µCi/g.

[d] Below environmental level.

*Community locations shown on Figure 4-11.

4.7 Offsite Dose Impacts

Dose Estimates Based on Measured Concentrations

Mound used the data presented in this report to estimate maximum doses to an offsite individual. The figure-of-merit used to calculate those doses was the committed effective dose equivalent (CEDE). CEDE calculations are required of DOE facilities according to DOE Order 5400.1. These calculations are also useful in evaluating the success of ALARA (As Low As Reasonable Achievable) policies. It is the philosophy of Mound, and the DOE complex as a whole, to ensure that all doses from radiation exposure remain ALARA.

To provide an extra degree of conservatism, dose estimates are often calculated based on maximum exposure conditions. This "maximum individual", as defined for purposes of calculating CEDEs, is a hypothetical person who remained at the site boundary 24 hours per day throughout 1994. This individual was assumed to have:

- breathed only air containing the highest average radionuclide concentrations measured at an onsite or offsite air sampling station,
- drawn all of his drinking water from the offsite well with the highest average radionuclide concentration, and
- consumed produce exhibiting the average concentrations in the samples collected from the Miamisburg area.

The radionuclides and the exposure pathways which contribute to the maximum individual's CEDEs are shown in Figure 4-13. Values for the CEDEs are shown in Table 4-19. More detailed information on the CEDE calculations, including the concentration values used, is presented in the Appendix.

Dose Estimates for NESHAPs Compliance

The National Emissions Standards for Hazardous Air Pollutants (NESHAPs) radionuclide regulations (40 CFR 61, Subpart H) limit offsite doses from airborne releases to 10 mrem effective dose equivalent (EDE) per year. As specified by the EPA in 40 CFR 61, Subpart H, the preferred technique for demonstrating compliance with this dose standard is a modeled approach.

Maximum individual. Mound uses the EPA's computer code CAP-88 to evaluate doses for NESHAPs compliance. The 1994 input data for the CAP-88 calculations are listed in the Appendix. Based on the CAP-88 output, the maximum EDE from all airborne releases were 0.03 mrem. This estimate represents 0.3% of the dose standard.

Figure 4-13. Exposure Pathways for Dose Calculations Based on Measured Data for 1994

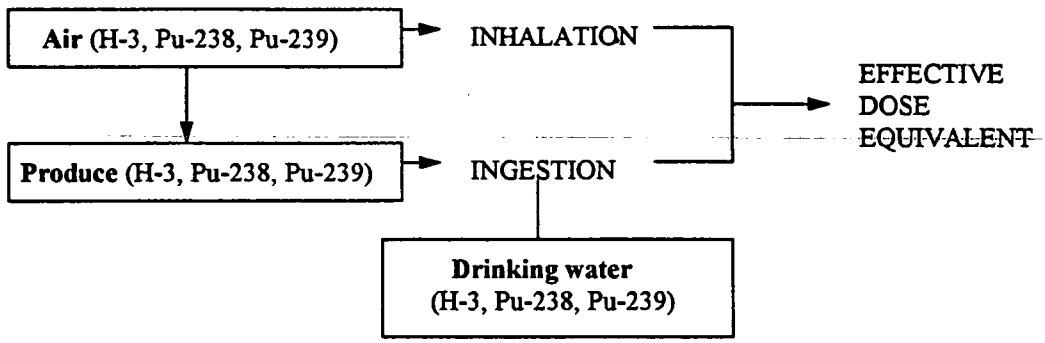


Table 4-19. Maximum Committed Effective Dose Equivalents to a Hypothetical Individual in 1994

Radionuclide	Pathway	mrem	mSv
Tritium	Air	0.006	0.00006
	Water	0.02	0.0002
	Produce	0.0005	0.000005
	Total	0.03	0.0003
Plutonium-238	Air	1.13	0.0113
	Water	0.0002	0.000002
	Produce	0.13	0.0013
	Total	1.26	0.0126
Plutonium-239	Air	0.01	0.0001
	Water	0.00006	0.0000006
	Produce	0.0009	0.000009
	Total	0.01	0.0001
Total		1.3	0.013

Population doses. CAP-88 also has the capability of estimating population doses from airborne releases. The population, approximately 3,035,000 persons, within a radius of 80 km (50 mi) of Mound received an estimated 1.9 person-rem from Plant operations in 1994. CAP-88 determined a person-rem value by calculating average doses to individuals in areas defined by their distance and compass sector relative to the release point. The dose for each area was then multiplied by the number of people living there. For example, an average dose of 0.001 rem x 10,000 persons in the area yields a 10 person-rem collective dose for that region. An additional dose contribution from drinking water is also added to the result for a total person-rem value.

Mound's dose contribution of 1.9 person-rem can be put in perspective by comparison with background doses. The average dose from background sources is 300 mrem (0.3 rem) per individual per year. A background collective dose can be estimated for the 80-km population by multiplying 0.3 rem x 3.035 million persons. The result, about one million person-rem, represents an estimate of the collective dose from all background sources of ionizing radiation. Mound's contribution, 1.9 person-rem, is approximately 0.00019% of that value.

5.0 NONRADIOLOGICAL ENVIRONMENTAL PROGRAM INFORMATION

The Mound Plant releases minor quantities of nonradiological constituents to the atmosphere. These releases are governed by State of Ohio permits. Mound monitors the impact of the Plant's nonradiological airborne releases by measuring airborne particulates at seven onsite and 15 offsite locations. Nonradiological liquid releases, however, are subject to much more extensive sampling protocols. Each year Mound collects over 1,000 water samples to demonstrate compliance with the Site's National Pollutant Discharge Elimination System (NPDES) permit.

5.1 Air Monitoring Program

The primary source of nonradiological airborne emissions at Mound is the steam power plant. The plant is normally fueled with natural gas but under certain circumstances fuel oil is used. Fuel oil with a 0.1% sulfur content is burned during unusually cold weather or if the natural gas supply to Mound is interrupted. Approximately 392,202 liters (103,614 gallons) of fuel oil were burned during 1994.

As described in Chapter 3, Mound has both air and water permits from the Ohio EPA. A number of other sources, such as the powerhouse, are registered with the Regional Air Pollution Control Agency (RAPCA).

Nonradiological airborne emissions for 1994 are summarized in Table 5-1.

Table 5-1. Nonradiological Airborne Effluent Data for 1994

Pollutant	Emission Rate (tons/yr)	Emission Threshold Limit (tons/yr)	% of Standard
Total Suspended Particulates	10.9	100	11
Sulfur oxides	0.2	250	0.10
Nitrogen oxides	20.5	100	20.5
VOCs	2.4	100	2.4
Carbon monoxide	5.2	250	2.1
Lead	0.000452	0.6	0.075

Mound evaluates particulate concentrations at seven onsite and 15 offsite locations. High-volume particulate air samples are collected weekly by flowing air through a 200-mm diameter fiberglass filter. The system operates at about 1.3×10^6 cm^3/min which represents a sample volume of 13,000 m^3 of air per week. By weighing the filter paper before and after use, it is possible to determine the mass of particulates retained by the filter. The mass loading and known air volume can then be used to generate concentration values (Table 5-2).

As the data in Tables 5-1 and 5-2 demonstrate, nonradioactive air emissions from Mound in 1994 did not significantly affect ambient air quality. All regulated releases were below permit limits, and comparisons of particulate concentrations measured onsite versus offsite suggest little or no influence by Mound. Particulate measurements for a few sampling locations exhibited periodic increases due to construction activities. These elevated air loadings were of short duration and did not significantly affect average values for 1994.

5.2 Water Monitoring Program

Mound releases wastewater to offsite surface waters via three discharge systems. In 1994, Mound discharged an average of 2.84 million liters (0.75 million gallons) of water per day to the Great Miami River. U. S. Geological Survey data indicate that the 1994 flow rate in the River averaged 1,248 million gallons per day (MGD), with a minimum and maximum flow rates of 229 MGD and 16,861 MGD, respectively. The average magnitude of the river flow rate is significantly greater than that of Mound's effluents. Therefore, releases from Mound can be expected to have minimal impact on river water quality.

Mound's discharges are regulated by a National Pollutant Discharge Elimination System (NPDES) permit. Mound's permit was renewed in October of 1992 and modified in December 1994. The permit will remain valid through March of 1997.

NPDES Monitoring Requirements

Mound's NPDES permit requires scheduled collection and analysis of Plant effluents at four onsite locations (Outfalls 5601, 5602, 5603, and 5002). Flow-weighted effluent limitations are further imposed for the combined discharges from Outfalls 5601 and 5602 (calculated Outfall 5001). Additional samples are required for one offsite Outfall (5604) and three Great Miami River locations (Outfalls 5801, 5901, and 5902). These locations are shown in Figure 5-1. The sampling requirements established for each outfall are listed in Table 5-3.

Although it is not required by Mound's NPDES permit, Plant effluent is also sampled for radionuclides. Average concentrations of radionuclides in effluent waters are shown in Table 4-2.

Outfall 5601. Outfall 5601 contains the effluent from Mound's sanitary sewage treatment plant. Flow-proportional, 24-hour composite samples and periodic grab samples are collected at this outfall. NPDES permit requirements for this location focus on conventional pollutants and heavy metals. Mound also analyzes the effluent quarterly for ten specific volatile organic compounds (effective December 1, 1994).

Table 5-2. 1994 Particulate Concentrations

Sampling Location[a]	Number of Samples	Particulate Concentration[b] ($\mu g/m^3$) Minimum	Maximum	Arithmetic Average[c] ($\mu g/m^3$)
Offsite				
101	52	22	83	47 ± 4
102	52	21	71	36 ± 3
103	52	15	46	27 ± 2
104	52	14	53	30 ± 2
105	52	17	180	42 ● 10
108	44	21	74	40 ± 3
110	52	20	60	31 ± 2
111	52	21	65	37 ± 3
112	52	11	59	29 ± 2
115	52	15	76	31 ± 4
118	52	6	43	25 ● 2
119[d]	52	12	50	25 ± 2
122	52	15	64	29 ± 3
123	52	20	58	36 ± 3
124	52	17	90	40 ± 4
Onsite				
211	52	15	61	36 ± 3
211T	50	15	58	35 ● 3
212	52	16	51	30 ± 2
212T	51	13	54	33 ± 3
213R	52	17	74	41 ● 3
213RT	51	6	63	35 ± 3
214R	50	14	64	35 ± 3
214RT	50	10	72	35 ± 3
215	52	11	45	26 ± 2
215T	51	15	55	33 ± 3
216	52	10	72	34 ± 3
216T	51	15	56	32 ± 3
217	52	17	65	35 ± 3
217T	51	7	55	31 ± 3

[a]Sampling locations shown in Figures 4-10 and 4-11 for onsite and offsite sampling stations respectively.

[b] Ohio Ambient Air Quality Standard is $50 \mu g/m^3$ (annual arithmetic mean).

[c] Values are weekly averages.

Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[d]Background location (approximately 28 miles NW of Mound).

Figure 5-1. NPDES Sampling Locations

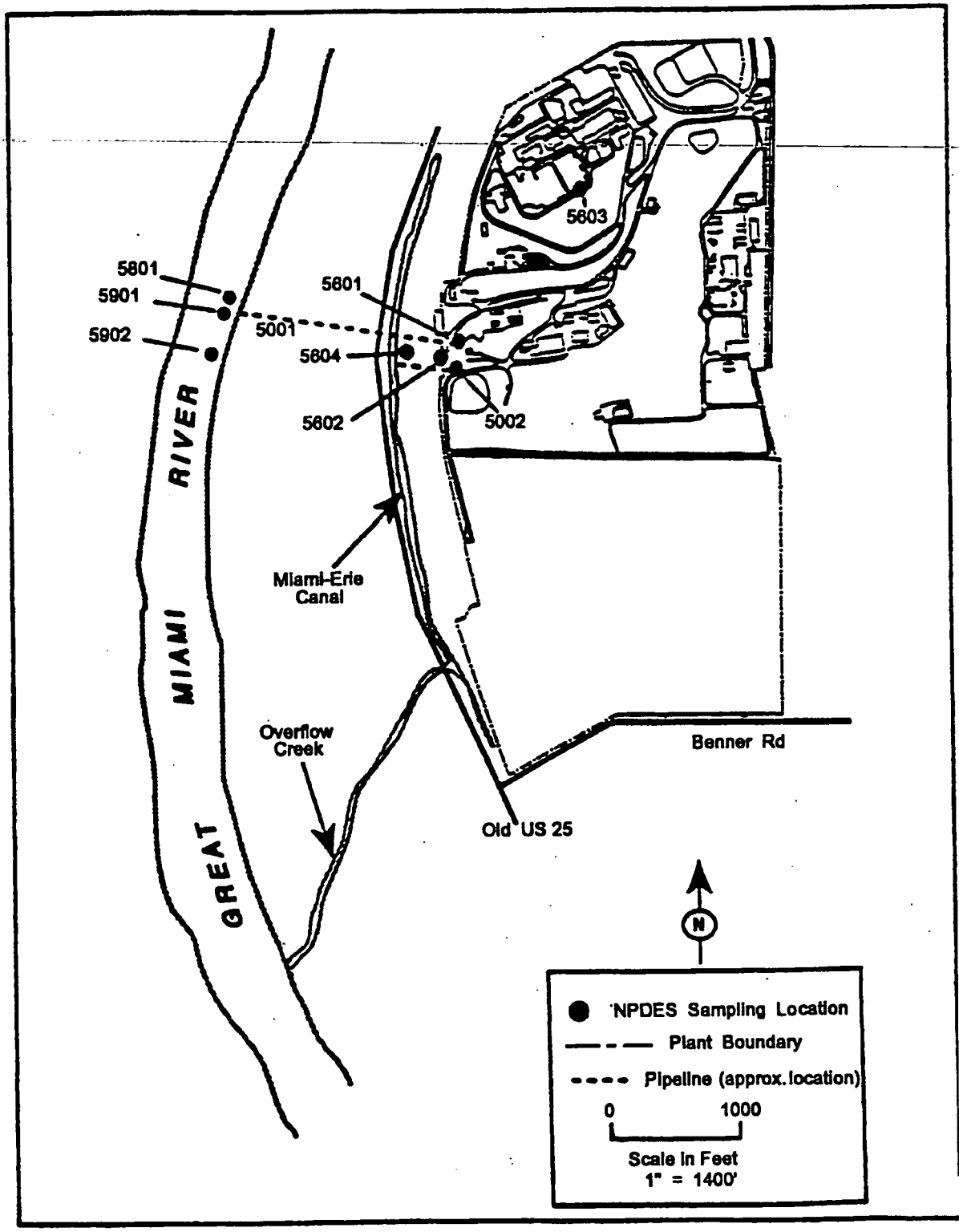


Table 5-3. National Pollutant Discharge Elimination System Data for 1994

	No. of Samples	Minimum	Maximum	Annual Average	Maximum Monthly Average	NPDES Permit Limits Daily	NPDES Permit Limits Monthly Average
Outfall 5601 Parameters							
Flow Rate, MGD	[f]	0.02	0.11	0.06	0.08	n/a	n/a
pH, s.u.	201	7.4	8.3	7.8	8.0	6.5-9.0	n/a
Chlorine: total[a], mg/L	104	0.01	3.27	0.23	0.32	0.5	n/a
Suspended Solids[b], mg/L	102	<1	17.1	1.7	5.3	30	15
Fecal coliform[a] n/100mL	27	1	1600	103	399	2000	1000
Escherichia coli[a] n/100 mL	7	3	3330	91	420	n/a	n/a
Ammonia, mg/L as N	26	0.04	2.04	0.27	1.24	n/a	n/a
Biochemical Oxygen Demand (mg/L)	102	0.1	4.3	1.2	2.1	15	10
Oil and Grease[c], mg/L	4	<1	1.2	<1	1.2	n/a	n/a
Cadmium, µg/L	12	<10	<10	<10	<10	n/a	n/a
Chromium, µg/L	12	<15	26	<15	26	n/a	n/a
Copper, µg/L	13	47	143	95	136	n/a	n/a
Nickel, µg/L	12	<15	37	<15	37	n/a	n/a
Lead, µg/L	12	<25	36	<25	36	n/a	n/a
Zinc, µg/L	12	<15	91	56	91	n/a	n/a
Mercury[d], µg/L	2	<0.2	<0.2	<0.2	<0.2	n/a	n/a
Outfall 5602 Parameters							
Flow Rate, MGD	Cont	0.04	0.88	0.26	0.31	n/a	n/a
pH, s.u.	51	7.6	8.9	8.4	8.6	6.5-9.0	n/a
Suspended solids[b], mg/L	51	<1	18.7	2.4	5.4	45	30.0
Chemical Oxygen Demand, mg/L	51	1	200	60	109	n/a	n/a
Oil and Grease, mg/L	12	<1	1.7	<1	1.7	10	n/a

[a] Summer months only (May 1 through October 31).

[b] Limits n/a when 0.25 in. of rain occurs 3 days during the week.

[c] Quarterly samples collected in Mar., Jun., Aug., Dec.

[d] Biannual samples collected in June and December.

[e] Limit not imposed until October 1, 1995.

[f] = Continuous.

[g] TU = Toxicity Units.

n/a = not applicable.

ND = Not detected

Table 5-3. (continued)

	No. of Samples	Minimum	Maximum	Annual Average	Maximum Monthly Average	NPDES Permit Limits Daily	NPDES Permit Limits Monthly Average
Outfall 5603 Parameters							
Flow Rate, MGD	6	3925	3925	3925	3925	n/a	n/a
pH, S.U.	26	7.7	8.2	8.0	8.2	6.5-9.0	n/a
Cyanide, mg/L	24	<0.1	<0.1	<0.1	<0.1	1.0	0.65
Cadmium, µg/L	24	<10	<10	<10	<10	100	n/a
Chromium, µg/L	24	<15	<15	<15	<15	500	n/a
Copper, µg/L	24	112	304	200	254	500	n/a
Nickel, µg/L	24	<15	24	<15	22	500	n/a
Zinc, µg/L	24	<15	42	<15	21	n/a	n/a
Total toxic organics[c] mg/L	4	<0.05	<0.05	<0.05	<0.05	2.13	n/a
Outfall 5002 Parameters							
Flow Rate, MGD	[f]	0	2.5	0.51	0.89	n/a	n/a
pH, S.U.	52	7.8	8.9	8.4	8.8	6.5-9.0	n/a
Suspended solids[b], mg/L	52	1.8	41.2	9.3	22.4	45	30
Outfall 5001 Parameters							
Flow Rate, MGD	[f]	0.09	0.95	0.32	0.38	n/a	n/a
pH, S.U.	26	8.0	8.4	8.2	8.4	6.5-9.0	n/a
Residual chlorine[a], mg/L	27	0.02	0.30	0.13	0.24	0.38[e]	n/a
Cyanide, mg/L	12	<0.01	<0.01	<0.01	<0.01	0.083	0.023
Pentachlorophenol, µg/L	12	<10	<10	<10	<10	n/a	n/a

[a] Summer months only (May 1 through October 31).

[b] Limits n/a when 0.25 in. of rain occurs 3 days during the week.

[c] Quarterly samples collected in Mar., Jun., Aug., Dec.

[d] Biannual samples collected in June and December.

[e] Limit not imposed until October 1, 1995.

[f] Continuous.

[g] TU = Toxicity Units.

n/a = not applicable.

ND = Not detected

Table 5-3. (continued)

	No. of Samples	Minimum	Maximum	Annual Average	Maximum Monthly Average	NPDES Permit Limits Daily	NPDES Permit Limits Monthly Average
Outfall 5001 Parameters (continued)							
Bis(2-ethylhexyl) phthalate, µg/L	12	<5	<5	<5	<5	n/a	n/a
Cadmium, µg/L	51	<10	10	<10	<10	43	n/a
Chromium, µg/L	51	<15	15	<15	<15	878	546
Copper, µg/L	51	21	110	49	70	120	n/a
Nickel, µg/L	51	<15	51	18	35	1261	760
Lead, µg/L	51	<25	112	35	56	305	191
Zinc, µg/L	51	<15	109	39	63	n/a	n/a
Ceriodaphnia dubia							
acute TU[g]	8	ND	< 10	2.0	2.0	n/a	n/a
chronic TU[g]	4	ND	2.36	1.8	1.8	n/a	n/a
Pimephales promelas							
acute TU[g]	8	ND	0.2	ND	ND	n/a	n/a
chronic TU[g]	4	ND	ND	ND	ND	n/a	n/a
Outfall 5801 Parameters							
% affected:							
Ceriodaphnia dubia							
48 hour acute	12	ND	15	3	15	n/a	n/a
Pimephales promelas							
96 hour acute	12	ND	5	ND	5	n/a	n/a

[a] Summer months only (May 1 through October 31).

[b] Limits n/a when 0.25 in. of rain occurs 3 days during the week.

[c] Quarterly samples collected in Mar., Jun., Aug., Dec.

[d] Biannual samples to be collected in June and December.

[e] limit not imposed until October 1, 1995.

[f] = Continuous.

[g] TU = Toxicity Units.

n/a = not applicable.

ND = Not detected

Table 5-3. (continued)

	No. of Samples	Minimum	Maximum	Annual Average	Maximum Monthly Average	NPDES Permit Limits Daily	NPDES Permit Limits Monthly Average
Outfall 5901 Parameters							
% affected:							
Ceriodaphnia dubia							
48 hour acute	12	ND	100	12.1	100	n/a	n/a
Pimephales promelas							
96 hour acute	12	ND	15	3.3	15	n/a	n/a
Outfall 5902 Parameters							
% affected:							
Ceriodaphnia dubia							
7 day chronic	4	ND	50	18	50	n/a	n/a
Pimephales promelas							
7 day chronic	4	2.5	10	6	10	n/a	n/a

[a] Summer months only (May 1 through October 31).

[b] Limits n/a when 0.25 in. of rain occurs 3 days during the week.

[c] Quarterly samples collected in Mar., Jun., Aug., Dec.

[d] Biannual samples to be collected in June and December.

[e] Limit not imposed until October 1, 1995.

[f] Continuous.

n/a = not applicable.

ND = Not detected

Outfall 5602. Outfall 5602 includes storm water runoff, single-pass cooling water, cooling tower blowdown, zeolite softener backwash, and effluent from the radioactive waste disposal facility. Flow-proportional, 24-hour composite samples and periodic grab samples are collected at this outfall. NPDES permit requirements for this location include chemical oxygen demand, suspended solids, and oil and grease content. Though not a condition of the permit, Mound also analyzes the effluent quarterly for total toxic organics (TTOs).

Outfall 5603. Outfall 5603 is associated with an electroplating facility operated onsite. Time-proportional composite samples and periodic grab samples are collected at this outfall. Because

the effluent is associated with the plating shop, the parameters of concern are heavy metals and cyanide. The NPDES permit also requires quarterly TTO sampling.

Outfall 5002. Discharge 5002 contains softener backwash and most of the Plant's storm water runoff. Flow-proportional, 24-hour composite samples and periodic grab samples are collected at this outfall. NPDES permit requirements for this location focus on pH and suspended solids. Though not a condition of the permit, Mound also analyzes the effluent quarterly for total toxic organics (TTOs).

Calculated Outfall 5001. Outfall 5001 represents the combined effluents of 5601 and 5602. These discharges are combined and released to the Great Miami River via a closed pipe. Since sampling the pipe is not practical, Mound's NPDES permit imposes additional limits for this outfall based on flow-weighted calculations. The concentrations of materials present in Outfalls 5601 and 5602 are used, along with their respective flow rates, to estimate concentrations in the effluent discharged through the pipe. The limits associated with Outfall 5001 are also listed in Table 5-3.

Outfall 5604. Outfall 5604 is an abandoned well located west of the plant site. In the past, Mound has purged the well, known as Miamisburg Abandoned Well No. 2, to reduce tritium concentrations. The purged water was then directed through a closed pipe to the Great Miami River. When this activity is performed, Mound's NPDES permit requires that the flow rate and pH be recorded. The well was most recently pumped in 1991.

Sampling Locations 5801, 5901, and 5902. A new requirement of Mound's NPDES permit involves toxicity testing of water samples taken from the Great Miami River. The permit specifies that monthly (for acute toxicity testing) and quarterly (for chronic toxicity testing) samples be collected from specific river locations and plant effluents (Table 5-3 and Figure 5-1). Toxicity testing consists of observing the effect that varying concentrations of sampled water has on water fleas (*Ceriodaphnia dubia*) and fathead minnows (*Pimephales promelas*). The test is intended to quantify the biological effect that a particular water sample potentially has on the aquatic environment.

Toxicity test results are presented in either toxicity units or percent of organisms affected. Results are determined by the number of observed mortalities, growth or reproductive effects, or atypical behavior of the species tested. A typical value reported in toxicity units is 2 TU (toxicity units). An ND (not detected) result indicates that the above conditions were not observed in any of the test organisms.

The three sampling locations are positioned upstream, downstream, and near the Plant's point of discharge to the Great Miami River. Results from the three sampling locations are compared to identify potential impacts that the plant effluent has in the Great Miami River.

Results

A total of 1,570 samples were analyzed for NPDES parameters in 1994. Key results are summarized in Tables 5-3 and 5-4. Analytical procedures were consistent with the methods specified in regulations of the Clean Water Act, 40 CFR 136. Sampling and analytical services were provided by Mound's Environmental Monitoring and Bioassay Labs and by outside contractors. All such procedures were required to meet Mound standards for quality assurance and quality control.

One NPDES exceedance or "upset" did occur in 1994. On September 15, 1994, Mound recorded an average concentration of residual chlorine of 3.27 mg/L in the effluent discharged by the sewage treatment plant. The daily limit for this location is 0.5 mg/L. Additionally, the mass loading limit of 0.23 kg/day was exceeded for this occurrence. The occurrence resulted in a mass loading of 0.74 kg/day. This upset was promptly reported to the Ohio EPA. Corrective action to replace a faulty V-notch valve was completed within four days. The Ohio EPA did not issue a notice of violation or noncompliance.

A review of Mound's NPDES performance over the past five years is shown in Figure 5-2. As seen in the figure, Mound recorded a total of seven NPDES upsets between 1990 and 1994. During that time period, 6,011 NPDES samples were collected.

Table 5-4. Summary of Organic Components Detected in Mound Effluents in 1994

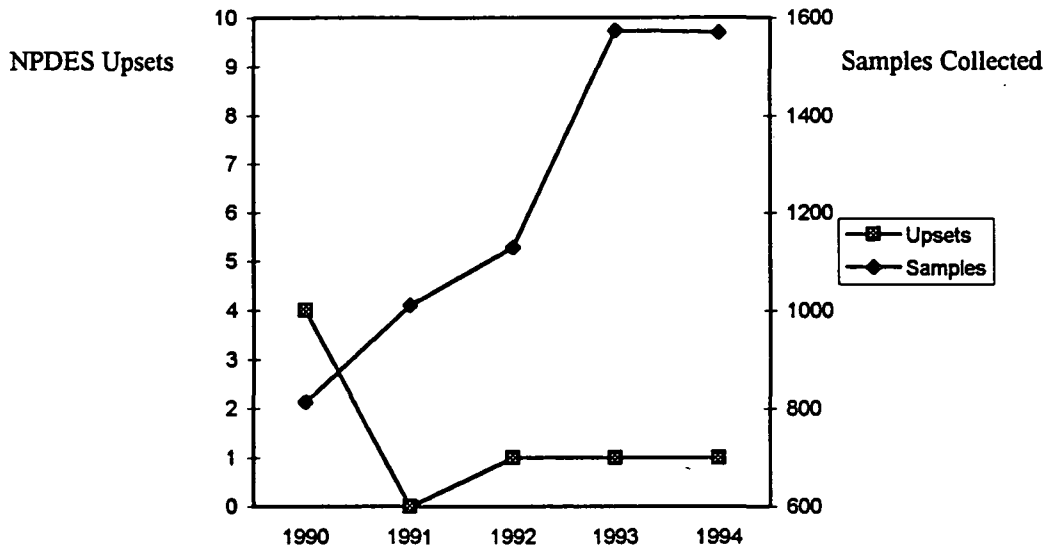
		Concentration, µg/L				
Outfall[a]	Parameter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	MDL*
5601	Bromodichloromethane	ND[b]	ND	2.1	ND	1
	Chloroform	ND	1.2	4.2	ND	1
5602	Bromoform	ND	ND	ND	1.5	1
5603	Bromoform	ND	1.3	1.4	1.8	1
	Dibromochloromethane	ND	ND	2.4	2.1	1
	Bromodichloromethane	ND	1.3	1.3	1.0	1

* MDL = Method Detection Limit.

[a] Sampling locations are shown on Figure 5-1.

[b] ND = None detected.

Figure 5-2. NPDES Sample Profile for the Five-Year Period 1990 - 1994



5.3 Submissions Under SARA Title III

Title III of the Superfund Amendments and Reauthorization Act (SARA) addresses the emergency planning and community right-to-know responsibilities of facilities handling hazardous substances. Sections 311 and 312 of Title III specify reporting requirements for the use and/or storage of "extremely hazardous" and "hazardous" substances. For facilities subject to Section 311 and 312, chemical usage, storage, and location information must be submitted to regional emergency response agencies by March 1 of each year. For 1994, Mound reported using and/or storing three extremely hazardous substances and seven hazardous substances. This information, along with site maps showing usage and storage locations, was submitted to the State Emergency Response Commission, the Miami Valley Regional Planning Commission, and the City of Miamisburg Fire Department. The ten substances handled by Mound are listed in Table 5-5.

Table 5-5. 1994 Emergency and Hazardous Chemical Data for Mound

Hazardous Substances		
Diesel Fuel	Nitrogen, liquid	Ethylene glycol
No. 2 fuel oil	Helium, liquid	
Gasoline, unleaded	Argon, liquid	
Extremely Hazardous Substances		
Chlorine	Sulfuric acid	Nitric acid

Section 313 of Title III specifies reporting requirements associated with the release of toxic chemicals. Each year Mound files a Section 313 report, Form R, for methylene chloride. (Methylene chloride usage in recent years has declined; however, the reporting requirements use 1988 as a baseline). Based on a review of chemical release data for 1994, no additional chemicals in use at Mound warrant Section 313 submissions.

5.4 Environmental Occurrences

Under CERCLA and the Clean Water Act, reportable quantity (RQ) levels have been established for designated hazardous substances. If a spill or other inadvertent release to the environment exceeds the RQ, immediate notification of the appropriate federal agencies (e.g., National Response Center, EPA, or Coast Guard) is required. No such releases occurred at Mound during 1994.

6.0 GROUNDWATER MONITORING PROGRAM

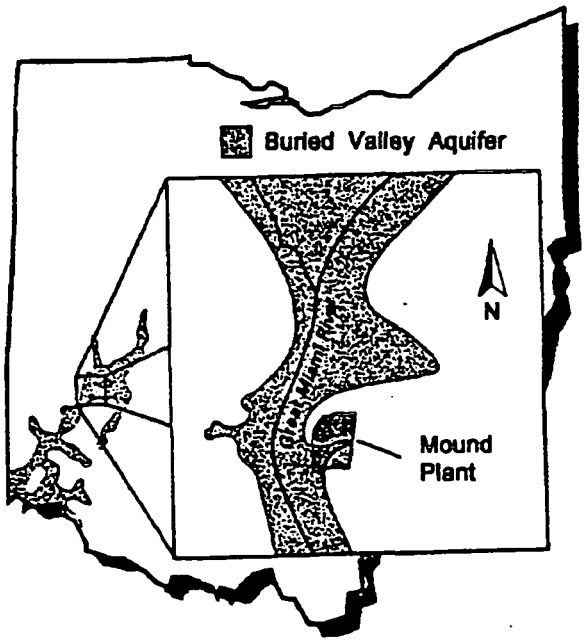
The Mound Plant site lies atop the largest of Ohio's sole-source aquifers, the Buried Valley Aquifer (BVA). The City of Miamisburg, and a number of other communities in the area, draw drinking water from the BVA. Mound also relies on the BVA for drinking and process water.

Mound has approximately 200 active groundwater monitoring sites in place onsite and offsite to characterize the impact Plant operations may have on the BVA. Included in these sites are three production wells, 126 monitoring wells, 39 piezometers, ten capture pits, nine residential wells, and 12 community wells. The groundwater monitoring program has been developed to meet the SDWA monitoring requirements, RCRA monitoring requirements as applicable or relevant and appropriate requirements (ARARs) for the CERCLA Program, and DOE-mandated practices.

6.1 Regional Geohydrology

Beneath the Miami Valley region of southwest Ohio lies the Buried Valley Aquifer (BVA). The BVA was designated a sole-source aquifer by the U.S. EPA in May, 1988. This distinction indicates that the aquifer supplies all of the drinking water to the communities above it. The approximate aerial extent of the BVA is shown in Figure 6-1.

Figure 6-1. Location and Extent of the Buried Valley Aquifer



The aquifer has a north-south orientation and reaches a maximum thickness of about 46 m (150 ft) near the Great Miami River channel. Groundwater in the area generally flows south, following the downstream course of the River. Recharge by induced stream infiltration occurs, although in this region the aquifer contains extensive layers of clayish till which impede infiltration. The BVA west of the Plant site is estimated to have calculated transmissivity values ranging from 200,000 to 430,000 gallons per day per foot. The transmissivity values are based upon hydraulic characterization data obtained from a May 1993 aquifer pump test.

The BVA is somewhat overdrawn between the cities of West Carrollton and Dayton. Practices involving relocation of well fields and artificial recharge via infiltration lagoons are in use to reduce the magnitude of the reversal. Currently, there is no evidence that the gradient reversal affects regions south of West Carrollton such as Miamisburg. At Miamisburg, pumping does not influence the natural groundwater gradient except in the immediate vicinity of individual well fields.

Uses of Groundwater in the Vicinity

There are seven municipal water supplies and numerous industrial users within an 8 km (5mi) radius of the Mound Plant. The locations of public and private water supply wells are shown in Figure 6-2 (pages 6-4 and 6-5). The only industrial user within 8 km (5 mi) downgradient is the O. H. Hutchings Power Generation Station. Industrial groundwater users located north (upgradient) of the site are isolated from Mound by hydraulic barriers.

The communities of Franklin and Carlisle are the first downgradient water supplies, but due to the extremely slow rate of groundwater movement, should not be significantly affected by Mound Plant. The City of Miamisburg owns ten wells in the BVA. At this time only the four wells located on the west side of the Great Miami River are in use. These wells are upgradient and should not be impacted by groundwater contamination from the Mound Plant. All city wells currently in service are separated from the Plant by a minimum straight-line distance of 0.8 km (0.5 mi).

In 1992, a residential well and cistern study (DOE 1993a) was conducted. A total of 216 residential wells and 14 cisterns were identified within a 2-mile radius of the Mound Plant. A representative subset of these wells will be used by Mound's ER Program to assess potential groundwater impacts of plant operations on these water sources. Results of this study are currently under regulatory review by the U.S. EPA and the Ohio EPA.

6.2 Hydrology at Mound

As seen in Figure 6-1, the "tongue" of the BVA extends onto the Mound Plant site. Within the limits of the property, the maximum known thickness of the aquifer is about 21 m (70 ft) at the extreme southwest corner of the site. Present usage of BVA water by Mound ranges from 19 to 32 liters per second (300 to 500 gallons per minute). Recharge to the portion of the BVA underlying Mound primarily arises from direct infiltration of river water, precipitation, and leakage from valley walls. These sources of recharge provide sufficient volumes of water to balance Mound's withdrawals.

Groundwater elevations are shown on groundwater contour maps (Figures 6-3 and Figure 6-4). The contour maps reflect the two sources of groundwater that are of concern to Mound, the perched water in the bedrock and the BVA. Groundwater levels vary from elevations near 670 ft to approximately 875 ft. Onsite groundwater levels generally increase with increasing ground surface elevations. (Ground surface elevations are shown on Figure 1-6.) The maximum groundwater level for the perched water in the bedrock beneath the main hill is 835 ft. The ground surface elevation for the main hill is approximately 880 ft.

Bedrock permeability. As a result of the dramatic changes in elevations associated with the Plant's topography, the site has a variety of groundwater regimes. Virtually impermeable bedrock underlies all but the first few feet of the hilltop and hillside areas at Mound. Although the rock itself is, for practical purposes, impermeable, small quantities of groundwater seep through joints and cracks. The upper 6 m (20 ft) of bedrock, where chemical weathering leads to enlargement of the cracks, is the most permeable. Permeability of the upper 6 m (20 ft) of bedrock is estimated to range from 40 to 400 L/day/m^2 (1 to 10 gal/day/ft^2). Below this depth, bedrock permeability generally ranges from 0 to 8 L/day/m^2.

Glacial till and outwash permeability. Hydraulic properties of the glacial tills that form a veneer over the site vary depending on the proportions of fine- and course-grained materials at a given location. Values of permeability normally range from 0.0041 to 0.041 L/day/m^2 (0.0001 to 0.001 gal/day/ft^2), although values up to 2.8 L/day/m^2 (0.007 gal/day ft^2) have been measured in upper weathered zones. Below the glacial till in the lower valley is a zone of glacial outwash composed of sand and gravel. The permeability of this zone is estimated to range from 40,700 to 81,000 L/day/m^2 (1,000 to 2,000 gal/day /ft^2).

Seeps

A key issue for groundwater protection at Mound is the seepage of contaminated water to the surface of the Main Hill. At points along the Plant's north hillside, bedrock is exposed and seep lines exist. A generalized cutaway depicting this phenomenon is shown in Figure 6-5. Numerous samples have been collected from the seeps and analyzed for tritium and volatile organic compounds. Results for 1994 are discussed in Section 6.4.

Surface Water Features

There are no perennial streams on the plant site. A natural drainage area exists in the deep valley separating the two main hills, but water in this area generally has a short residence time. The basin is relatively small and the slopes are relatively steep. Therefore, runoff through site drainage features is rapid.

Figure 6-2. Production and Monitoring Well Locations

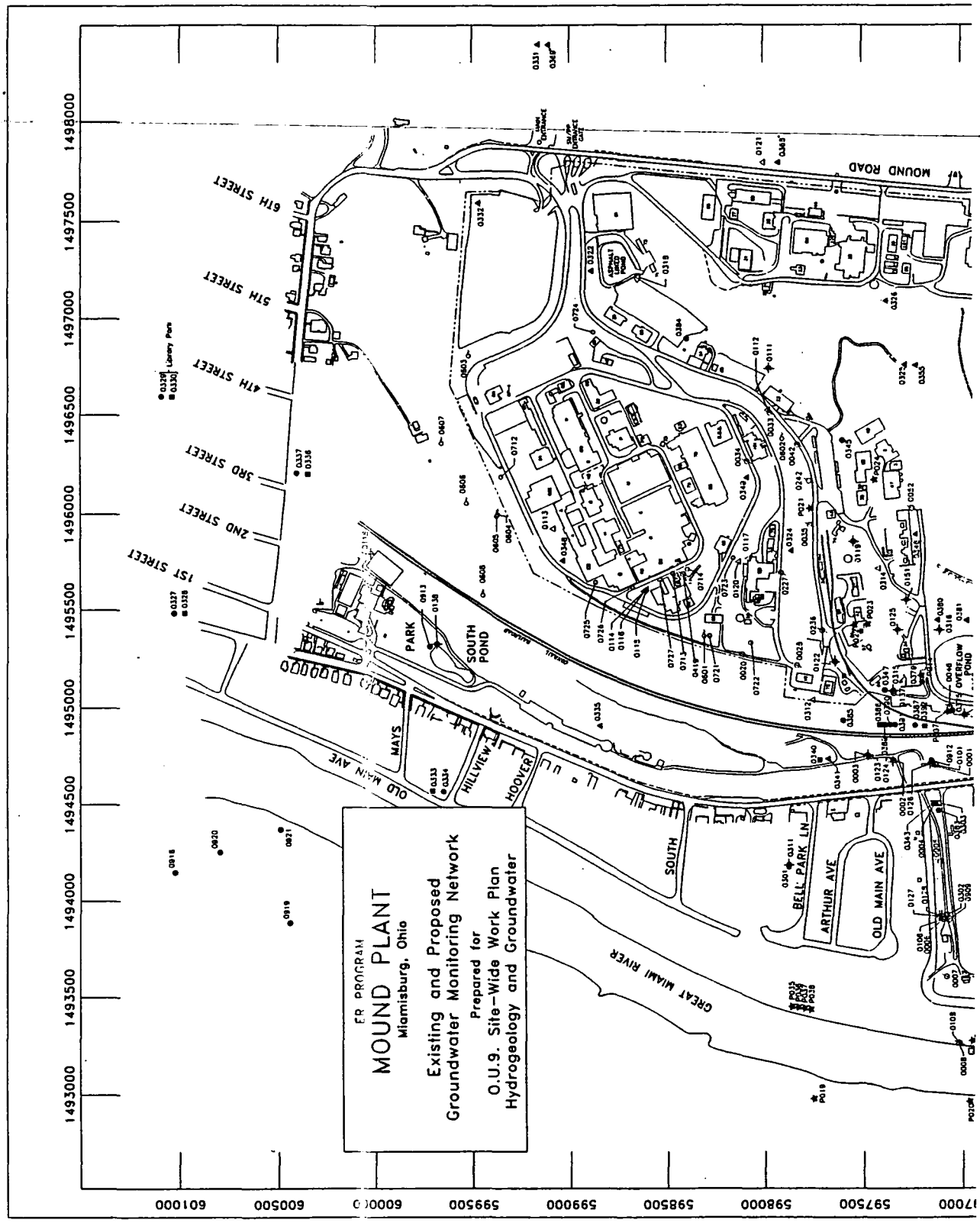


Figure 6-2. Production and Monitoring Well Locations

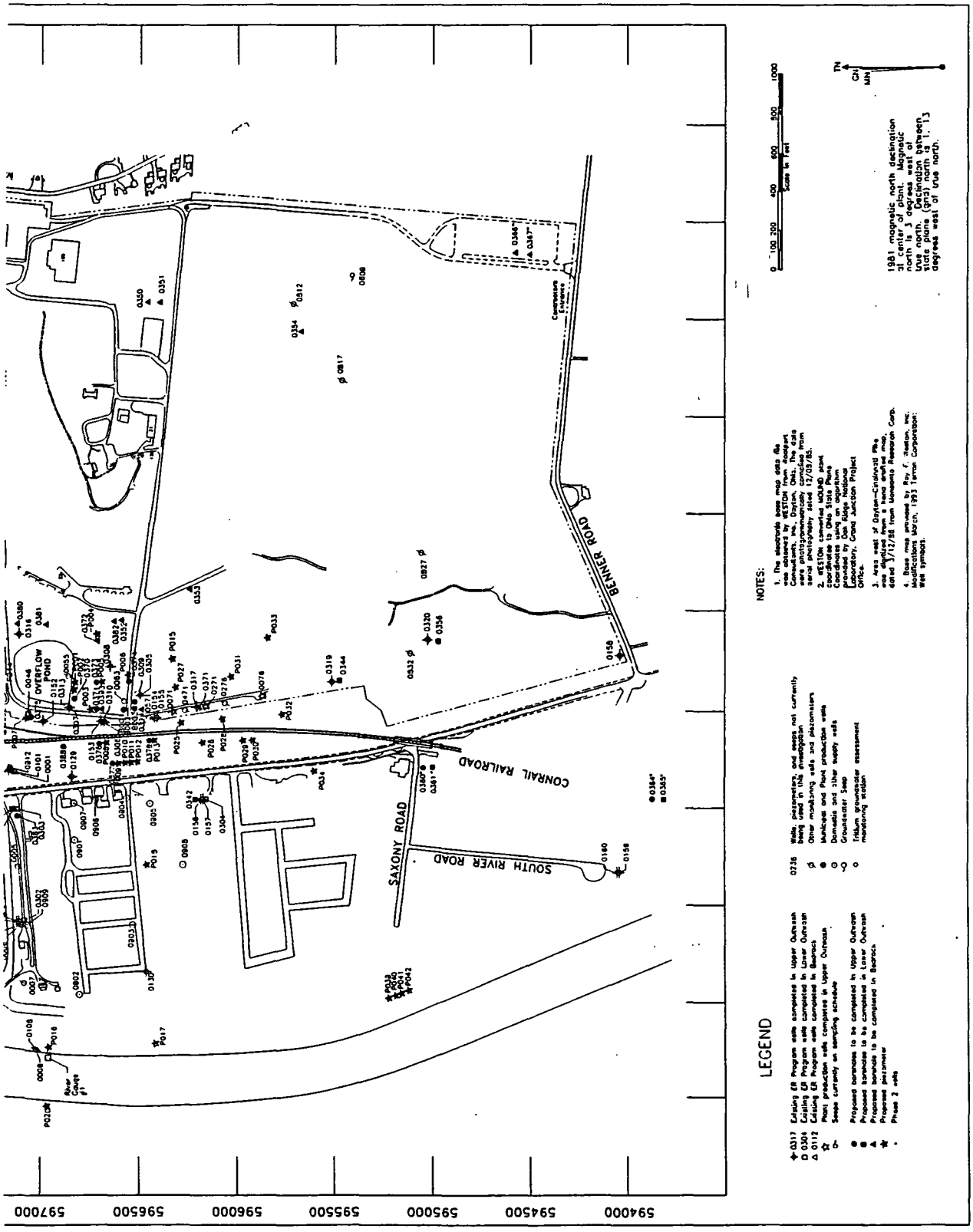


Figure 6-3. Groundwater Elevations for the Perched Water in the Bedrock

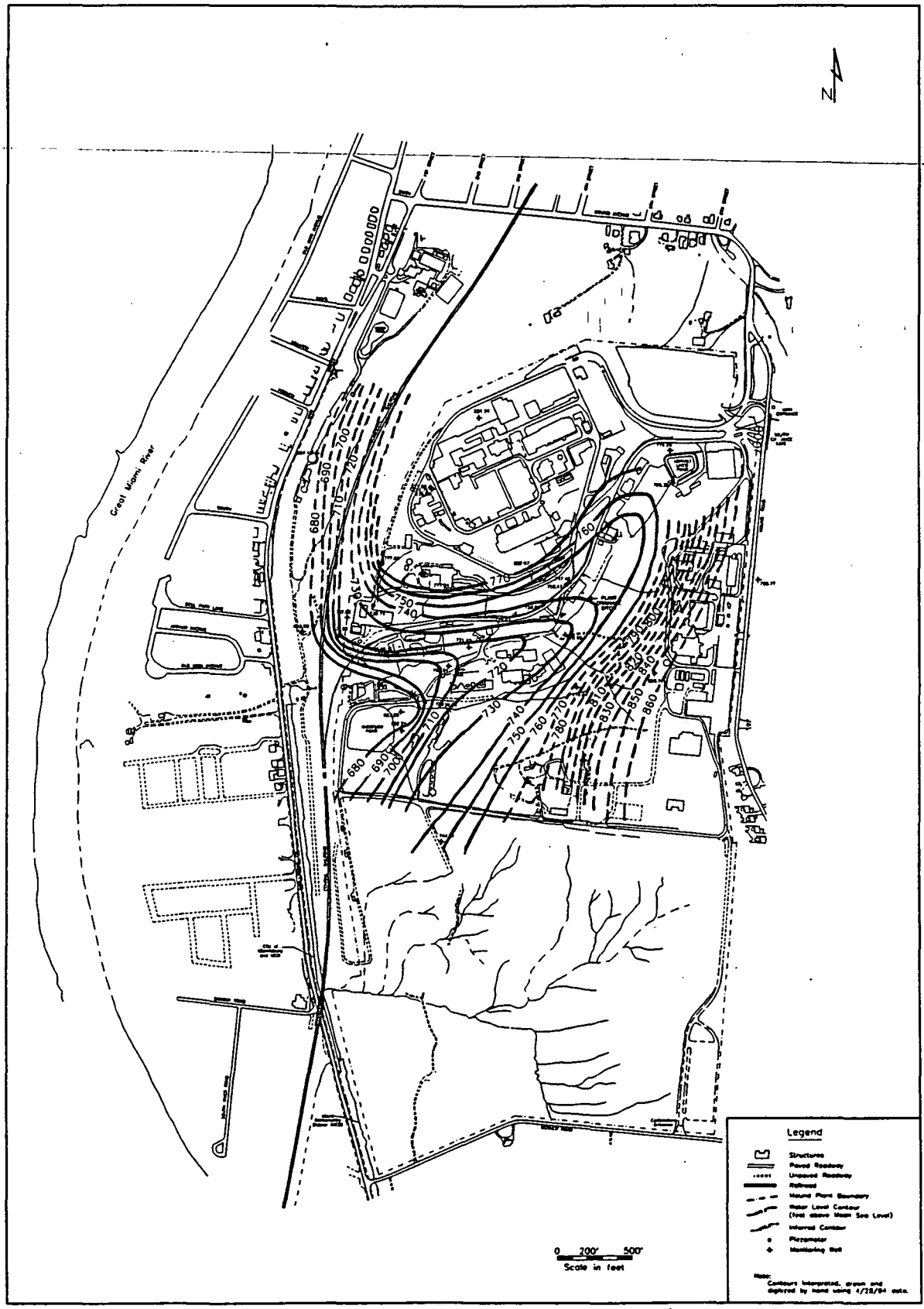


Figure 6-4. Groundwater Elevations for the Buried Valley Aquifer

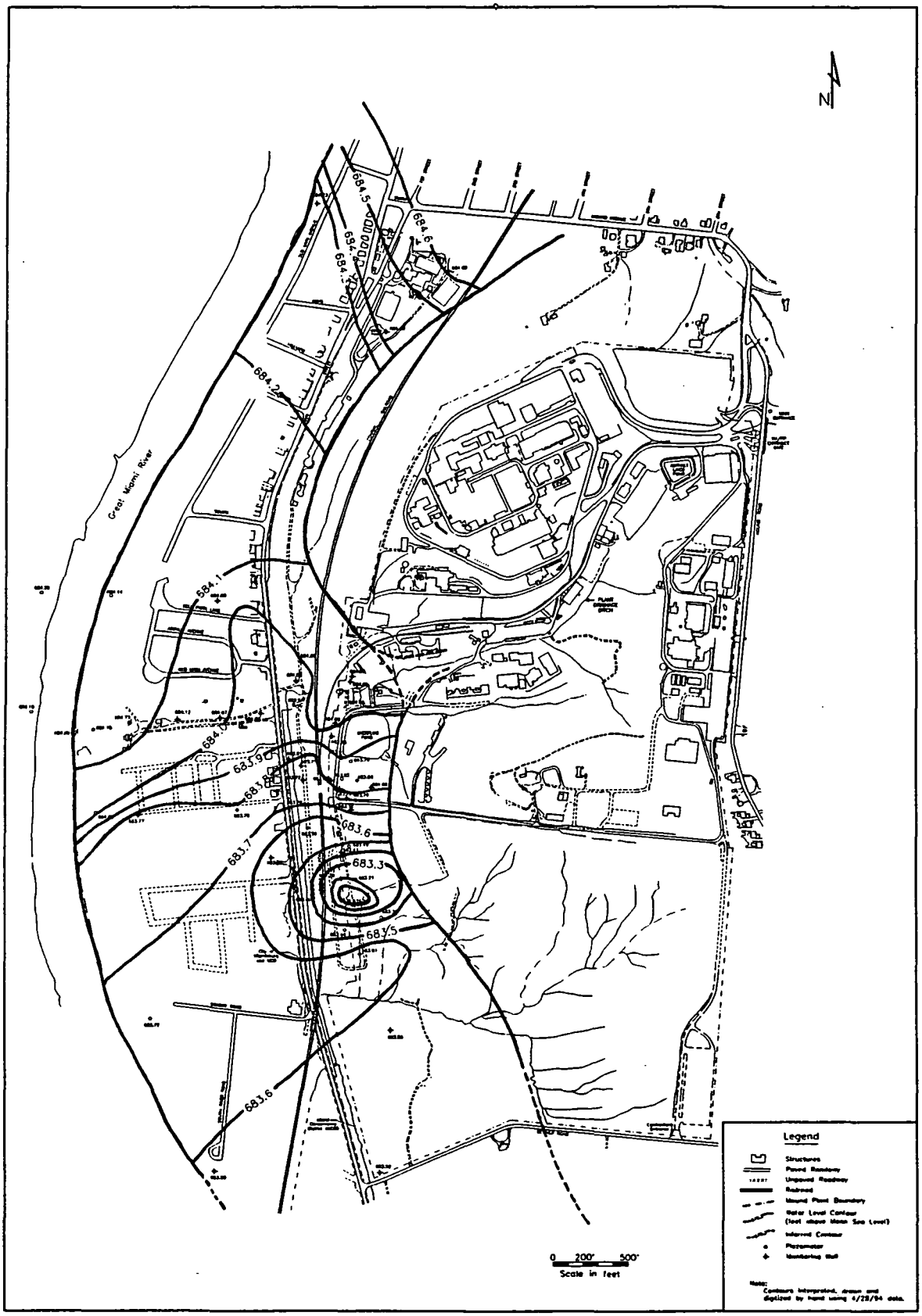
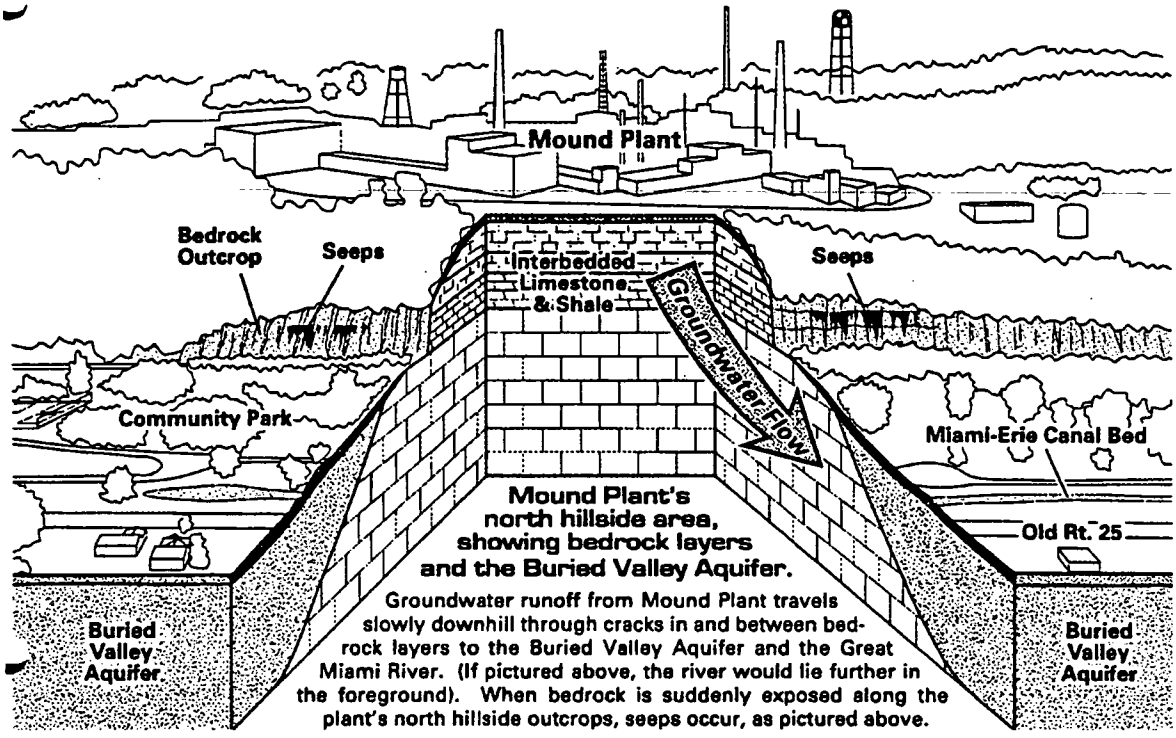


Figure 6-5. Geologic Cutaway of the Mound Plant



6.3 Offsite Groundwater Monitoring Program

The offsite groundwater monitoring program at Mound consists of routine collection of samples from production wells, private wells, regional drinking water supplies, and BVA monitoring wells. Samples are collected and analyzed primarily for radionuclides, metals, and volatile organic compounds (VOCs). Data from the groundwater analyses performed in 1994 are presented in Table 6-1. Sampling and analytical procedures used to generate these results are documented in Mound's Environmental Monitoring Plan (1994) and Mound's Groundwater Protection Management Program Plan (DOE 1993b).

Tritium in Production and Private Wells

Private wells immediately downgradient of the Plant have tritium concentrations that are above background. "Background" is established each year by collecting well water from a location unaffected by Plant operations. Those samples are collected from a well 38 km (22 mi) southeast of Mound. In 1994, tritium concentrations measured at that location were less than or equal to the reagent blanks.

Because tritium is known to have migrated from the site, downgradient wells are closely monitored for tritium. Sampling results for 1994 are shown in Table 6-1. As seen in the table, the maximum tritium concentration observed was 7.64 nCi/L. This value represents 38.2% of the

EPA's drinking water standard of 20 nCi/L. Average tritium concentrations, however, ranged from 0.17 nCi/L to 3.29 Ci/L, or 0.85% to 16.45% of the drinking water standard, respectively.

Tritium in Community Drinking Water Supplies

Tritium is the most mobile of the radionuclides released from the Plant. For this reason, Mound also monitors tritium concentrations in a number of regional groundwater supplies. The results for 1994 are presented in Table 6-2. The table shows that all of the values were near or below the lower limit of detection. However, the results reflect the pattern of tritium concentrations one would expect: higher averages near the site (Miamisburg,) and lower averages at greater distances (e.g., Middletown).

Table 6-1. Tritium Concentrations in Offsite Production and Private Wells in 1994

Well ID*	Historical Designation	Number of Samples	Tritium nCi/L			Average as a % of the EPA Standard[c]
			Minimum	Maximum	Average[a,b]	
0904	J-1	6	0.53	0.73	0.63 ± 0.07	3.15
0905	Tr-1	6	d	0.26	0.18 ± 0.10	0.90
0906	B-R	2	2.41	2.70	2.56 ± 1.84	12.8
0907	B-H	6	1.00	1.33	1.19 ± 0.13	5.95
0909	MCD	12	0.02	0.32	0.17 ± 0.05	0.85
0912	MSBG2	44	1.14	7.64	3.29 ± 0.41	16.45
0913	MSBG3	7	0.54	1.94	1.19 ± 0.49	5.95

[a] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.
[b] LDL for tritium in private well waters is 0.3 nCi/L.
[c] The EPA standard for tritium in drinking water is 20 nCi/L.
*Well locations shown on Figure 6-2.

Tritium in Offsite Monitoring Wells

To provide additional information on the extent of offsite tritium migration, Mound also collects groundwater samples from a number of offsite monitoring wells. The results for 1994 are shown in Table 6-3. (The data in Table 6-3 have not been presented as percentages of the EPA drinking water standard because these wells are used exclusively for monitoring purposes.) The 1994 data confirm that the tritium contamination is minor.

During the 1994 "spring sweep" monitoring event, 39 monitoring wells were sampled for tritium. Thirty of these wells showed tritium contamination above detection limits. The average concentration was 1.87 nCi/L, ranging from nondetectable to 10.27 nCi/L. The quantitation limits from the contract laboratory for tritium ranged from 0.2 to 0.48 nCi/L. The monitoring results indicate that tritium is more prevalent in the lower portion of the BVA than in the upper portion. These results can be reviewed in the CERCLA *Operable Unit 9, Hydrogeoligic Investigation: Groundwater Sweeps Report, Technical Memorandum* , January 1995.

Offsite Monitoring Activities for Other Radionuclides

Private well waters in the immediate vicinity of the Plant are also analyzed for plutonium-238, plutonium-239,240, uranium-233,234, and uranium-238. Results for 1994 are shown in Tables 6-4 and 6-5 for plutonium and uranium, respectively. Averages reported in both tables demonstrate that concentrations measured in 1994 were comparable to background levels for these radionuclides. (Background levels for 1994 are also listed in the tables.)

Four monitoring wells along the western boundary of the Plant were analyzed twice in 1994 for plutonium-238, plutonium-239,240, uranium-233,234, and uranium-238. The results, shown in Table 6-6, are comparable to those obtained for well 0904. Sampling of these wells provides an early indication of potential movement of plutonium and uranium towards private wells.

Table 6-2. Tritium Concentrations in Community Drinking Water Supplies in 1994

Location	Number of Samples	Tritium nCi/mL			Average as a % of the EPA of Standard[c]
		Minimum	Maximum	Average[a,b]	
Centerville	12	d	0.11	0.05 ± 0.03	0.25
Franklin	12	0.02	0.19	0.09 ± 0.03	0.45
Germantown	12	d	0.18	0.08 ± 0.04	0.4
Miamisburg	12	0.24	0.55	0.39 ± 0.07	1.95
Middletown	12	d	0.21	0.07 ± 0.05	0.35
Moraine	12	d	0.17	0.04 ± 0.04	0.2
Springboro	12	0.10	0.37	0.24 ± 0.05	1.2
W. Carrollton	12	d	0.10	0.04 ± 0.02	0.2

[a] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.
[b] LDL for tritium in community drinking water is 0.4 nCi/L.
[c] The EPA standard for tritium in drinking water is 20 nCi/L.
[d] Below reagent blank.

Table 6-3. Tritium Concentrations in Offsite Monitoring Wells in 1994

Well ID*	Number of Samples	Tritium nCi/L		
		Minimum	Maximum	Average
0005	12	0.78	1.2	0.98 ± 0.09[a]
0101	12	3.22	4.06	3.62 ± 0.15[a]
0106	12	0.12	0.62	0.25 ± 0.08[a]
0118	2	0.34	0.85	0.60 ± 0.26[a,b]
0123	2	ND[c]	0.13	0.07 ± 0.07[a,b]
0129	2	0.25	0.94	0.69 ± 0.35[a,b]
0160	2	ND[c]	0.58	0.29 ± 0.29[a,b]

[a] LDL for tritium in monitoring wells is 0.3 nCi/L (as analyzed by Mound lab).
[b] LDL for tritium in monitoring wells ranged from 0.20 nCi/L and 0.48 nCi/L (as analyzed by contract lab).
[c] ND = nondetectable values from the contract lab.
• Well locations shown on Figure 6-2.

Table 6-4. Plutonium Concentrations in Offsite Drinking Water and an Offsite Private Well in 1994

Well I.D.*	Number of Samples	Plutonium-238 10^{-12} µCi/mL			Average as a % of 0.04 x the DOE DCG[d]
		Minimum	Maximum	Average[a,b,c]	
Miamisburg water supply	12	e	2.96	0.7 ± 0.7	0.04
0904	6	e	1.0	0.13 ± 0.67	0.008

Well I.D.*	Number of Samples	Plutonium-239,240 10^{-12} µCi/mL			Average as a % of 0.04 x the DOE DCG[d]
		Minimum	Maximum	Average[a,b,c]	
Miamisburg water supply	12	e	1.74	0.04 ± 0.43	0.003
0904	6	e	3.1	0.79 ± 1.59	0.07

[a] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[b] LDL for plutonium-238 in well water is 4.5 x 10^{-12} µCi/mL. LDL for plutonium-239,240 in well water is 3.6 x 10^{-12} µCi/mL.

[c] Background concentration of plutonium-238 in 1994 averaged 0.57 ± 0.48 x 10^{-12} µCi/mL. Background concentration of plutonium-239,240 in 1994 averaged below reagent blanks.

[d] DOE DCGs correspond to doses of 100 mrem/yr. Since the EPA drinking water dose standard is 4 mrem/yr, the averages have been reported as percentages of 0.04 x DCGs. 0.04 x the DCG for plutonium-238 and 0.04 x DCG for plutonium-239,240 are 1600 x 10^{-12} µCi/mL and 1200 x 10^{-12} µCi/mL, respectively.

[e] Below reagent blank.

* Well locations are shown in Figure 6-2.

Table 6-5. Uranium Concentrations in Offsite Drinking Water and an Offsite Private Well in 1994

Well I.D.*	Number of Samples	Uranium-233,244 10^{-9} µCi/mL Minimum	Maximum	Average[a,b,c]	Average as a % of 0.04 x the DOE DCG[d]
Miamisburg water supply	12	0.33	0.47	0.4 ± 0.03	2.0
0904	6	0.08	0.17	0.14 ± 0.03	0.7

Well I.D.*	Number of Samples	Uranium-238 10^{-9} µCi/mL Minimum	Maximum	Average[a,b,c]	Average as a % of 0.04 x the DOE DCG[d]
Miamisburg water supply	12	0.27	0.43	0.36 ± 0.03	1.5
0904	6	0.1	0.15	0.13 ± 0.02	0.5

[a] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.
[b] LDL for uranium-233,234 is 0.05 x 10^{-9} µCi/mL. LDL for uranium-238 is 0.04 x 10^{-9} µCi/mL.
[c] Background concentrations of uranium-233,234 and uranium-238 in 1994 averaged 0.29 ± 0.02 x 10^{-9} µCi/mL and 0.19 ± 0.01 x 10^{-9} µCi/mL, respectively.
[d] DOE DCGs correspond to doses of 100 mrem/yr. Since the EPA drinking water dose standard is 4 mrem/yr, the averages have been reported as percentages of 0.04 x DCGs. 0.04 x the DCG for uranium-233,234 and 0.04 x DCG for uranium-238 are 20 x 10^{-9} µCi/mL and 24 x 10^{-9} µCi/mL, respectively.
* Well locations are shown in Figure 6-2.

Table 6-6. Radionuclide Concentrations in Offsite Monitoring Wells in 1994

Well ID	10^{-9} µCi/mL			
	Pu-238	Pu-239,240	U-234[e,g]	U-238[f,h]
0118				
Spring	0.0054	0.0028	0.340	0.255
Fall	LDL[a]	LDL[b]	0.260	.0260
0123				
Spring	LDL[c]	LDL[d]	0.180	0.074
Fall	LDL[a]	LDL[b]	0.120	0.040
0129				
Spring	0.0108	0.0054	0.173	0.169
Fall	0.0060	0.0010	0.150	0.140
0160				
Spring	LDL[c]	LDL[d]	0.063	0.053
Fall	LDL[a]	LDL[b]	0.020	0.040

LDL = Below the lower detection limit.
[a] LDL: for Pu-238 in the fall is 0.0063 x 10^{-9} µCi/mL.
[b] LDL: for Pu-239,240 in the fall is 0.0033 x 10^{-9} µCi/mL.
[c] LDL: for Pu-238 in the spring ranges from 0.0025 x 10^{-9} to 0.12 x 10^{-9} µCi/mL.
[d] LDL: for Pu-239,240 in the spring is 0.0027 x 10^{-9} to 0.98 x 10^{-9} µCi/mL.
[e] LDL: for U-234 in the fall is 0.06 x 10^{-9} µCi/mL.
[f] LDL: for U-238 in the fall is 0.02 x 10^{-9} µCi/mL.
[g] LDL: for U-234 in the spring is 0.021 x 10^{-9} to 0.17 x 10^{-9} µCi/mL.
[h] LDL: for U-238 in the spring is 0.021 x 10^{-9} to 0.12 x 10^{-9} µCi/mL.

In addition to the four wells monitored semiannually, thirty-nine offsite monitoring wells were sampled during the spring by the CERCLA Program. The spring sweeps revealed two anomalies. Wells 0304 and 0335 exceeded the MCL of 5 pCi/L for radium-226. The results were 5.94 and 39.47 pCi/L for wells 0304 and 0335 respectively. These wells also show evidence of thorium contamination. Thorium-228 was detected in well 0335 at 8.5 pCi/L. Neither radium-226 nor thorium-228 were detected in well 0335 during the 1993 fall sweep sampling event. However, results from the 1993 fall sweeps show that well 0304 has been consistent with respect to radium-226, thorium-228, thorium-230, and thorium-232 contamination. Results for well 0304 are shown below in Table 6-7.

Table 6-7. Radionuclide Concentrations for Monitoring Well 0304

Well ID	Radium-226 (pCi/L)	10^{-9} µCi/mL Thorium-228	Thorium-230	Thorium-232
Spring 1994	5.94	1.93	1.56	0.85
Fall 1994	12.7	4.99	3.51	3.28
Guidelines	5.0[a]	400[b]	300[b]	50[b]

[a] Ohio EPA MCL Standard.
[b] DOE DCGs correspond to doses of 100 mrem/yr. The DCG for thorium-228 is 400 x 10^{-9} µCi/mL. The DCG for thorium-230 is 300 x 10^{-9} µCi/mL. The DCG for thorium-232 is 50 x 10^{-9} µCi/mL.

VOCs in Offsite Monitoring Wells

Offsite monitoring wells are also used to evaluate concentrations of volatile organic compounds (VOCs). The wells sampled were analyzed for over 50 VOC's. Only those VOC's which were detected are discussed in this report. VOCs of concern at industrial sites are typically halogenated solvents such as 1, 1, 1-trichloroethane, trichloroethene, tetrachloroethene, and cis-1,2-dichloroethene. Concentrations of these compounds measured in offsite monitoring wells in 1994 are presented in Table 6-8. The table also lists the MCL for those compounds identified. However, MCLs are not truly applicable to these samples. MCLs are used by the EPA to ensure compliance with the Primary Drinking Water Standards. Since the samples do not represent drinking water, the MCLs should only be used to put the observed concentrations in perspective.

In the spring of 1994, the CERCLA Program conducted a sweep sampling of 39 wells for VOCs. Several wells show contamination at or above the MCL for particular VOCs. Two of these wells (0327, 0329) are upgradient from the Mound Plant. The purpose of these wells is to show background contamination in the BVA. Well 0386, located just west of the Mound Plant property line exceeded the MCL for trichloroethene. These results can be reviewed in the CERCLA *Operable Unit 9, Hydrogeologic Investigations: Groundwater Sweeps Report, Technical Memorandum*, January 1995.

Table 6-8. VOC Concentrations in Offsite Monitoring Wells in 1994

Well I.D.*	Compound	µg/L 1st Quarter	3rd Quarter	MCL[a]
0118	1,1,1-Trichloroethane	1.6	ND	200
0123	No Compounds Detected	-	-	-
0129	1,1,1-Trichloroethane	1.2	ND	200
0160	No Compounds Detected	-	-	-
0327[b]	1,1,1-Trichloroethane	1.3	NS	200
	Tetrachloroethene	11.0	NS	5
0329[b]	1,1,1-Trichloroethane	0.4	NS	200
	Tetrachloroethene	4.7	NS	5
0377[b]	1,1,1-Trichloroethane	10.0	NS	200
0378[b]	1,1,1-Trichloroethane	20.0	NS	200
0386[b]	Trichloroethene	6.8	NS	5
0389[b]	Trichloroethene	2.5	NS	5
0327[b]	Tetrachloroethene	0.4	NS	5

[a] MCL = Maximum Contaminant Level (based on EPA Primary Drinking Water Standards).

[b] Wells sampled during the spring sweeps only.

ND = not detected.

NS = not sampled.

* Well locations shown on Figure 6-2.

Metals in Offsite Monitoring Wells

The offsite monitoring wells were also used to evaluate concentrations of metallic constituents. The metals of concern are those regulated under the Safe Drinking Water Act (SDWA). Concentrations of these metals measured in offsite monitoring wells in 1994 are presented in Table 6-9. The table also lists the primary and secondary MCLs for these metals. However, MCLs are not truly applicable to these samples. MCLs are used by the EPA to ensure compliance with the Primary Drinking Water Standards. Secondary MCLs are defined as the maximum advisable limits for certain contaminants in water and are not enforceable. Since the samples do not represent drinking water, the MCLs should only be used to put the observed concentrations in perspective.

The offsite monitoring wells sampled during the spring sweep sampling event were also analyzed for metallic constituents. Several wells showed contamination at or above the MCL for particular metals. Those metals exceeding the primary MCL were arsenic, chromium, lead, and nickel. The secondary MCLs were exceeded for aluminum, chloride, iron and manganese. These results can be reviewed in the CERCLA *Operable Unit 9, Hydrogeologic Investigation: Groundwater Sweeps Report, Technical Memorandum,* January 1995.

Table 6-9. Metal Concentrations in Offsite Monitoring Wells in 1994

Well ID*	Compound	1st Quarter	3rd Quarter	MCL[a]
		µg/L		
0118	Aluminum	ND	132	50 - 200[b,c]
	Arsenic	ND	3.3	50
	Barium	90.0	98.4	2000
	Chromium	85.0	76.3	100
	Iron	1160	754	300[b]
	Lead	ND	3.2	15
	Manganese	15.7	16.7	50[b]
	Mercury	ND	0.23	2
	Nickel	52.9	37.5	100
	Selenium	2.5	5.3	50
	Silver	ND	11.1	100[b]
	Zinc	ND	3.6	5000[b]
0123	Arsenic	ND	1.4	50
	Barium	62.3	63.3	2000
	Cadmium	ND	3.9	5
	Chromium	ND	16.4	100
	Iron	ND	241	300[b]
	Lead	1.7	4.2	15
	Manganese	365	367	50[b]
	Nickel	11.5	23.6	100
	Selenium	ND	2.9	50
	Zinc	ND	2.0	5000[b]
0129	Aluminum	ND	121	50 - 200[b,c]
	Antimony	0.8	ND	6
	Barium	76.5	78.8	2000
	Chromium	ND	8.0	100
	Iron	19.4	101	300[b]
	Lead	2.0	3.0	15
	Manganese	0.8	7.5	50[b]
	Mercury	ND	0.24	2
	Nickel	42.9	26.6	100
0160	Aluminum	ND	162	50 - 200[b,c]
	Arsenic	35.2	29.3	50
	Barium	238	288	2000
	Iron	1170	1640	300[b]
	Lead	ND	9.8	15
	Manganese	144	176	50[b]
	Mercury	ND	0.24	2
	Zinc	ND	3.3	5000[b]

[a] Maximum Contaminant Level (based on EPA Primary and Secondary Drinking Water Standards).
[b] Secondary Maximum Contaminant Level.
[c] The MCL for aluminum is a range; end points have not been established for Mound.
* Well locations shown on Figure 6-2.

6.4 Onsite Groundwater Monitoring Program

The onsite groundwater monitoring program at Mound consists of routine collection of samples from production wells and BVA monitoring wells. Samples are collected and analyzed primarily for radionuclides and VOCs. Data from the groundwater analyses performed in 1994 are presented below. Sampling and analytical procedures used to generate these results are documented in Mound's Environmental Monitoring Plan (1994) and Mound's Groundwater Protection Management Program Plan (DOE 1993b).

Tritium in Mound's Production Wells

There are three production wells onsite which provide drinking water and process water for the Mound Plant. Tritium concentrations in those wells are evaluated on a monthly basis. The results for 1994 are summarized in Table 6-10. As seen in the table, minor levels of tritium are associated with the wells. However, the maximum concentrations observed, 2.4 nCi of tritium per liter of water, represents 12% of the drinking water standard.

Table 6-10. Tritium Concentrations in Onsite Production Wells in 1994

Well I.D.*	Historic Designation	Number of Samples	Tritium nCi/L			Average as a % of EPA Standard[c]
			Minimum	Maximum	Average[a,b,c]	
0071	No. 1	48	0.9	2.4	1.3 ± 0.1	6.5
0271	No. 2	49	1.1	2.3	1.9 ± 0.1	9.5
0076	No. 3	49	0.7	1.7	1.2 ± 0.05	6.0

[a] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[b] LDL for tritium in onsite well water is 0.4 nCi/L.

[c] The EPA standard for tritium in drinking water is 20 nCi/L.

* Well locations shown on Figure 6-2.

Tritium in the BVA

Mound maintains an extensive network of onsite Buried Valley Aquifer (BVA) monitoring wells (Figure 6-2). Samples from a number of these wells are collected and analyzed for tritium. The results for 1994 are listed in Table 6-11. Data from Table 6-11 and from previous years demonstrate that some degree of tritium contamination is present in the aquifer.

The maximum concentration of 19.8 nCi/L was observed in 1994 during the spring sweep sampling. The maximum concentration was located at Well 0120, which consistently yields the highest levels of tritium on site. This concentration has decreased approximately 40% since 1993. Although the wells sampled during the spring sweeps were below the drinking water standard of 20 nCi/L, several wells (0115, 0117, 0120, 0310, and 0324) were above 10 nCi/L. The average concentration for the wells sampled in the spring was 4.4 nCi/L, ranging from nondetectable to 19.8 nCi/L. These results can be reviewed in the CERCLA *Operable Unit 9, Hydrogeologic Investigation: Groundwater Sweeps Report, Technical Memorandum,* January 1995.

Tritium in the Seeps

Tritium has been recognized as a persistent contaminant in the Main Hill seeps since 1986 (DOE 1987). Since then, tritium has been the focus of extensive sampling activities in that area. Table 6-12 shows concentrations of tritium in seep samples for 1994. (Seep locations are shown on Figure 6-6). The highest tritium concentrations are clearly associated with Seep 601. This result is consistent with observations in previous years. The increase in tritium concentration is attributable to the water main break under SW-Building in April of 1994. SW-Building is the primary tritium facility onsite.

Remediation of the seeps is being addressed through Mound's CERCLA Program. The seeps are included in Operable Unit 2 of the Environmental Restoration (ER) Program established for Mound. An overview of the status of the ER Program appears in Section 3.7 of this report.

Table 6-11. Tritium Concentrations in Onsite Monitoring Wells in 1994

Well I.D.*	Tritium nCi/L	
	1st Quarter	3rd Quarter
0305	5.07	4.06
0306	5.60	6.35
0307	5.77	5.97
0313	4.98	4.05
0315	4.58	4.66

* Well locations shown on Figure 6-2.

Table 6-12. Tritium Concentrations in Seeps in 1994

Seep I.D.*	Historic Designation	Number of Samples	Tritium nCi/L Minimum	Tritium nCi/L Maximum	Tritium nCi/L Average
0601	S001	192	50.9	2917.2	344.8
0602	S002	3	0.9	4.8	3.2
0605	S005	41	29.4	117.2	74.6
0606	S005	44	5.1	81.6	39.3
0607	S007	124	0.2	108	61.3

* Seep locations are shown on Figure 6-6.

Tritium in the Capture Pits

A number of groundwater collection devices, or "capture pits", are used on the Main Hill to isolate and monitor contamination in perched groundwater. These devices have been designed to collect pockets of shallow groundwater which may have been contaminated as a result of past operational practices.

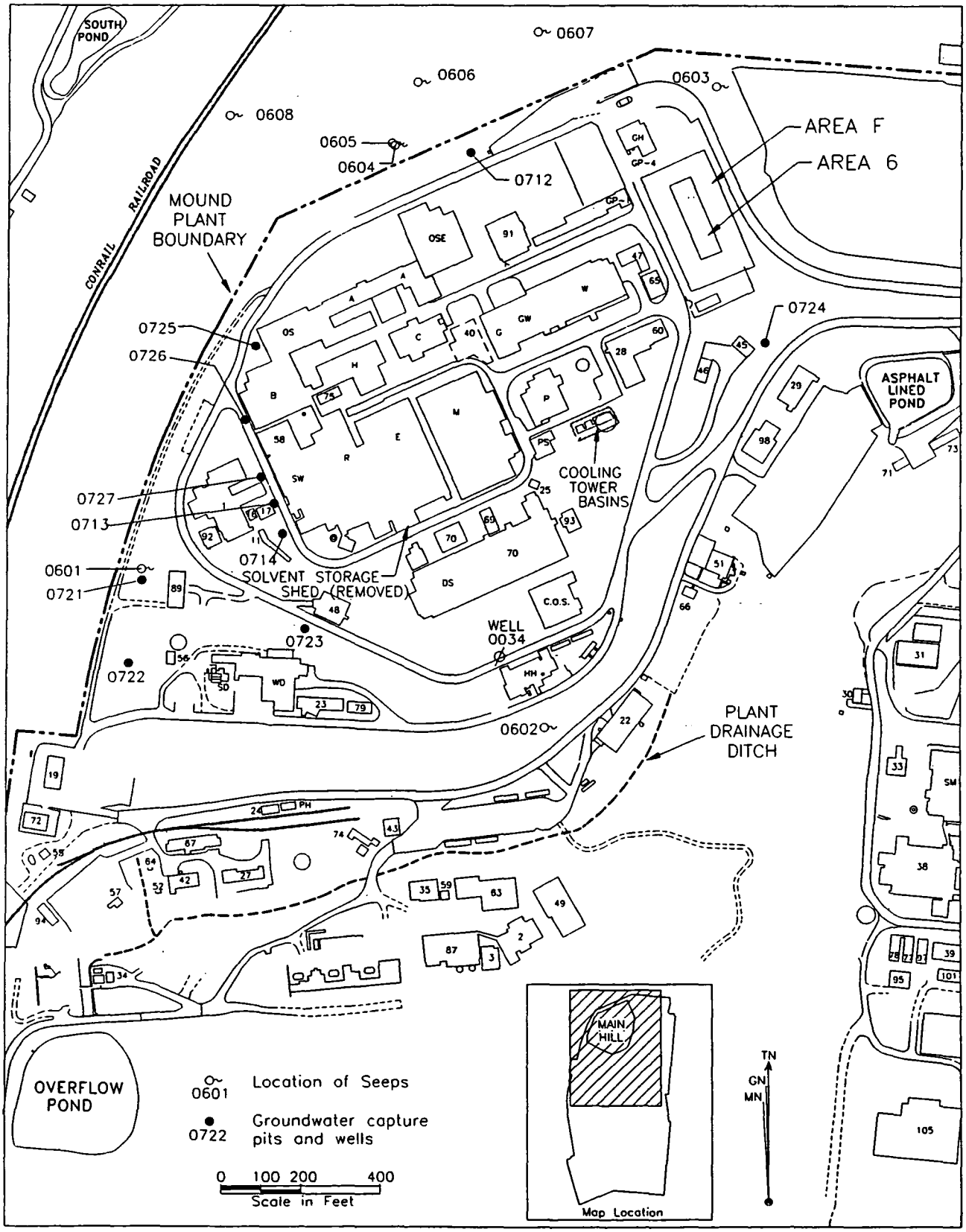
In 1994, numerous samples were collected from the pits and analyzed for tritium. The results are shown in Table 6-13. The locations of the sampling points for the capture pits are shown on Figure 6-6. The increase in tritium concentration is attributable to the water main break under SW-Building in April of 1994. SW-Building is the primary tritium facility onsite.

Table 6-13. Tritium Concentrations in the Capture Pits in 1994

Capture Pit I.D.*	Historic Designation	Number of Samples	Tritium nCi/L Minimum	Tritium nCi/L Maximum	Tritium nCi/L Average
0712	P012	28	1.2	3.5	2.2
0714	P014	70	240.3	29487.5	1235.7
0725	W005	61	1.0	31.7	5.2
0726	W006	69	3.9	2480.0	624.1
0727	W007	64	6.2	3269.5	212.9

* Capture pit locations are shown on Figure 6-6.

Figure 6-6. Seep and Capture Pit Locations



Onsite Monitoring Activities for Other Radionuclides

Samples collected from the Plant's three production wells are also analyzed for plutonium-238, plutonium-239,240, uranium-233,234, and uranium-238. Results for 1994 are shown in Tables 6-14 and 6-15 for plutonium and uranium, respectively. Values reported in both tables demonstrate that average concentrations measured in 1994 were comparable to background levels for these radionuclides (background levels for 1994 are also listed in the tables).

Table 6-14. Plutonium Concentrations in Onsite Production Wells in 1994

Well I.D.*	Historic Designation	Number of Samples	Plutonium-238 10^{-12} µCi/mL			Average as a % of 0.04 x the DOE DCG[d]
			Minimum	Maximum	Average[a,b,c]	
0071	No. 1	12	e	2.58	1.56 ± 0.53	0.1
0271	No. 2	12	e	2.18	0.85 ± 0.63	0.05
0076	No. 3	12	e	7.75	1.79 ± 1.31	0.1

Well I.D.*	Historic Designation	Number of Samples	Plutonium-239,240 10^{-12} µCi/mL			Average as a % of 0.04 x the DOE DCG[d]
			Minimum	Maximum	Average[a,b,c]	
0071	No. 1	12	e	1.35	e	e
0271	No. 2	12	e	3.85	0.04 ± 0.86	0.003
0076	No. 3	12	e	2.32	0.21 ± 0.63	0.02

[a] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[b] LDL for plutonium-238 in drinking water is 4.5 x 10^{-12} µCi/mL. LDL for plutonium-239,240 in well water is 3.6 x 10^{-12} µCi/mL.

[c] Background concentration of plutonium-238 in 1994 averaged 0.57 ± 0.48 x 10^{-12} µCi/mL. Background concentration of plutonium-239,240 in 1994 averaged below reagent blanks.

[d] DOE DCGs correspond to doses of 100 mrem/yr. Since the EPA dose standard is 4 mrem/yr, the averages have been reported as percentages of 0.04 x DCGs. 0.04 x the DCG for plutonium-238 and 0.04 x DCG for plutonium-239,240 are 1600 x 10^{-12} µCi/mL and 1200 x 10^{-12} µCi/mL, respectively.

[e] Below reagent blank.

• Well locations are shown in Figure 6-2.

Table 6-15. Uranium Concentrations in Onsite Production Wells in 1994

Well I.D.*	Historic Designation	Number of Samples	Uranium-233,234 10^{-9} µCi/mL			Average as a % of 0.04 x the DOE DCG[c]
			Minimum	Maximum	Average[a,b]	
0071	No. 1	12	0.18	0.29	0.22 ± 0.02	1.1
0271	No. 2	12	0.16	0.22	0.19 ± 0.01	1.0
0076	No. 3	12	0.2	0.28	0.23 ± 0.02	1.2

Well I.D.*	Historic Designation	Number of Samples	Uranium-238 10^{-9} µCi/mL			Average as a % of 0.04 x the DOE DCG[c]
			Minimum	Maximum	Average[a,b]	
0071	No. 1	12	0.13	0.25	0.19 ± 0.02	0.8
0271	No. 2	12	0.14	0.22	0.17 ± 0.01	0.7
0076	No. 3	12	0.16	0.24	0.21 ± 0.02	0.9

[a] Error limits are estimates of the standard error of the estimated means at the 95 % confidence level.

[b] LDL for uranium-233,234 is 0.05 x 10^{-9} µCi/mL. LDL for uranium-238 is 0.04 x 10^{-9} µCi/mL.

[c] DOE DCGs correspond to doses of 100 mrem/yr. Since the EPA dose standard is 4 mrem/yr, the averages have been reported as percentages of 0.04 x DCGs. 0.04 x the DCG for uranium-233,234 and 0.04 x DCG for uranium-238 are 20 x 10^{-9} µCi/mL and 24 x 10^{-9} µCi/mL, respectively.

* Well locations are shown in Figure 6-2.

During the spring sweep sampling event, 56 monitoring wells were sampled for radionuclides. There were several positive values for radium-226; however, none of the results exceeded the Maximum Contaminant Level (MCL). Two wells showed positive values for strontium-90. These appear to be anomalies since strontium-90 was not detected in any other wells, onsite or offsite. More information about these results can be reviewed in the CERCLA *Operable Unit 9, Hydrogeologic Investigation: Groundwater Sweeps Report, Technical Memorandum,* January 1995.

VOC Monitoring Activities

Production wells. The Plant's drinking water supply is provided by three production wells. These wells have exhibited VOC contamination in the form of halogenated solvents. The wells sampled were analyzed for over 50 VOC's. Only those VOC's detected are discussed in this report. The five halogenated solvents typically present in trace concentrations are freon-113, 1, 1, 1-trichloroethane, cis-1,2-dichloroethene, trichloroethene, and tetrachloroethene. Results for 1994 are shown in Table 6-16. The data shows the production wells to be reliably and consistently below the MCL standard for VOC contamination. (Compliance with the SDWA regulations is determined by a running annual average).

Table 6-16. VOC Concentrations in Onsite Production Wells in 1994

Well I.D.*	Compound	Number of Samples	µg/L Minimum	Maximum	Average	MCL[a]
0071	1,1,1-Trichloroethane	5	0.5	1.3	0.9 ± 0.3	200
	cis-1,2-Dichloroethene	5	1.7	5.2	3.2 ± 1.5	70
	Trichloroethene	5	1.7	4.1	3.0 ± 0.9	5
	Tetrachloroethene	5	ND	1.0	0.6 ± 0.4	5
0271	Freon 113[b]	2	2.3	2.6	2.5 ± 0.2	[c]
	1,1,1-Trichloroethane	6	1.0	1.7	1.4 ± 0.2	200
	cis-1,2-Dichloroethene	6	0.8	1.6	1.2 ± 0.3	70
	Trichloroethene	6	1.1	1.5	1.3 ± 0.1	5
	Tetrachloroethene	6	ND	0.6	0.3 ± 0.3	5
0076	1,1,1-Trichloroethane	5	0.6	1.0	0.7 ± 0.2	200
	cis-1,2-Dichloroethene	5	ND	1.0	0.6 ± 0.4	70
	Trichloroethene	5	1.6	2.1	1.8 ± 0.2	5
	Tetrachloroethene	5	ND	0.6	0.2 ± 0.3	5

[a] MCL = Maximum Contaminant Level (based on EPA Drinking Water Standards).

[b] Freon 113 = 1,1,2-trichloro-1,2,2-trifluoroethane.

[c] There is no MCL for freon 113.

ND = Not detected.

* Well locations shown on Figure 6-2.

BVA. Within the Mound Plant, numerous monitoring wells in the upper and lower units of the BVA have been sampled routinely since 1988. Results confirm the presence of VOC contamination in the aquifer. Based on routine sampling of the BVA monitoring network, the contamination appears to be greatest in the upper unit of the BVA along the western Plant boundary, immediately southwest of the Main Hill. Generally, within the boundaries of the plant, the contamination tends to decrease from west to east and from north to south.

The results for 1994 are shown in Table 6-17. Trichloroethene and tetrachloroethene are the principal contaminants which exceed the MCL for drinking water. MCLs are used as guidelines to help put observed concentrations in perspective. The MCLs are not truly applicable to these wells, since the samples do not represent drinking water.

Several onsite wells sampled during the spring sweep monitoring event show VOC contamination at or above the MCL. The MCLs were exceeded in Wells 0046, 0063, 0152, 0153, 0312, 0347, 0370, 0373, 0375, 0397, P015, and P027 by one or more of the following compounds; cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and tetrachloromethane. These results can be reviewed in the CERCLA *Operable Unit 9, Hydrogeologic Investigation: Groundwater Sweeps Report, Technical Memorandum,* January 1995.

Table 6-17. VOC Concentrations in Onsite Monitoring Wells in 1994

Well ID*	Compound	1st Quarter	3rd Quarter	MCL[a]
		µg/L		
0305	cis-1,2-Dichloroethene	13.0	ND	70
	Trichloroethene	26.0	15.0	5
	Tetrachloroethene	22.0	15.0	5
	Tetrachloromethane	1.4	2.0	5
0306	Trichloroethene	12.0	6.0	5
	Tetrachloroethene	7.9	5.0	5
0307	Trichloroethene	6.1	6.0	5
	Tetrachloroethene	10.0	ND	5
	Tetrachloromethane	1.2	1.0	5
0313	Trichloroethene	4.6	4.0	5
	Tetrachloroethene	11.0	10.0	5
	Tetrachloromethane	1.5	1.0	5
0315	Trichloroethene	7.8	7.0	5
	Tetrachloromethane	4.1	3.0	5

[a] MCL = Maximum Contaminant Level (based on EPA Primary Drinking Water Standards).
* Well Locations shown on Figure 6-2.
ND = Not detected

Seeps. Samples collected from the Main Hill in 1988 first confirmed the presence of VOCs in Seeps 0601, 0602, 0605, and 0607 (EG&G Mound, 1991). (The seep locations are shown on Figure 6-6.). The results for 1994 are shown on Table 6-18. The primary contaminants are 1,2-cis-dichloroethene and trichloroethene. Tetrachloroethene is seen only in Seep 0601, and its decline may be attributed to the Operable Unit 2 soil vapor extraction at B-Building.

Table 6-18. VOC Concentrations in Seeps in 1994

Seep I.D.*	Compound	No. of Samples	µg/L Minimum	Maximum	Average	MCL[a]
0601	Trichloromethane	22	ND	0.7	0.1± 0.3	100
	cis-1,2-Dichloroethene	22	ND	2.0	0.5 ± 0.5	70
	Trichloroethene	22	3.8	7.7	5.9 ± 1.0	5
	Tetrachloroethene	22	4.2	18.1	13.2 ± 4.3	5
0605	cis-1,2-Dichloroethene	3	ND	21	12.0 ± 8.8	70
	Trichloroethene	3	0.7	10.8	5.7 ± 4.1	5
	Chloroethene	3	ND	1.1	0.4 ± 0.5	2
0606	cis-1,2-Dichloroethene	3	ND	4.3	2.7 ± 1.9	70
	Trichloroethene	3	1.4	10.6	7.1 ± 4.0	5
0607	1,1,1-Trichloroethane	17	ND	1.3	0.1 ± 0.3	200
	cis-1,2-Dichloroethene	17	ND	3.6	2.5 ± 0.8	70
	Trichloroethene	17	2.5	5.6	4.3 ± 1.0	5
0608	cis-1,2-Dichloroethene	6	ND	1.4	0.2 ± 0.5	70
	Trichloroethene	6	2.1	5.3	3.7 ± 1.1	5
0625	1,1,1-Trichloroethene	6	ND	0.6	0.1 ± 0.2	200
	Trichloroethene	6	ND	0.6	0.2 ± 0.2	5

[a] MCL = Maximum Contaminant Level (based on EPA Drinking Water Standard).
* Seep locations are shown on Figure 6-6.
ND = Not detected
Note: Chloromethane and Dichloromethane have been identified in the above seeps. However, these VOCs may be contaminants introduced in the process of sampling and/or analyzing. Further study is required before including these contaminants as part of this report.

Monitoring Activities for Metals

Metals in Onsite Monitoring Wells. The onsite monitoring wells are also used to evaluate concentrations of metallic constituents. The metals of concern are those regulated under the Safe Drinking Water Act (SDWA). Concentrations of these metals measured in onsite monitoring wells in 1994 are presented in Table 6-19. The table also lists the primary and secondary MCL for these metals. However, MCLs are not truly applicable to these samples. MCLs are used by the EPA to ensure compliance with the Primary Drinking Water Standards. Secondary MCLs are defined as the maximum advisable limits for certain contaminants in water and are not enforceable. Since the samples do not represent drinking water, the MCLs should only be used to put the observed concentrations in perspective.

Several wells show contamination at or above the MCL for particular metals. Those metals exceeding the primary MCL were antimony, chromium, lead and nickel. The secondary MCLs were exceeded by aluminum, chloride, iron and manganese. These results can be reviewed in the CERCLA *Operable Unit 9, Hydrogeologic Investigation: Groundwater Sweeps Report, Technical Memorandum*, January 1995.

6.5 Five-Year Trends for Wells of Interest

As seen in Sections 6.1 through 6.4 of this chapter, a large volume of groundwater monitoring data is generated each year for the Mound Plant. It is important that the data be reviewed for evidence of long-term trends, especially in cases where there is some history of elevated concentrations of contaminants. In this section, five-year trends are presented for certain indicator parameters measured in wells of interest.

Trend Data for Offsite Drinking Water

A primary environmental consideration for the Mound Plant is to ensure that area drinking water supplies are not adversely affected by Plant operations. The most mobile of the constituents released to groundwater by Mound is tritium. For this reason, tritium is an excellent indicator of offsite migration. Detailed information regarding tritium levels in offsite wells was presented in Section 6.3.

Among the wells listed in those sections, two drinking water sources can be considered key receptor wells. First, the drinking water supply of the City of Miamisburg is of interest due to the proximity of the City's well fields to the Plant. And second, Well 0904, a private well, is useful as an indicator because it reflects potential impact to small drinking water systems.

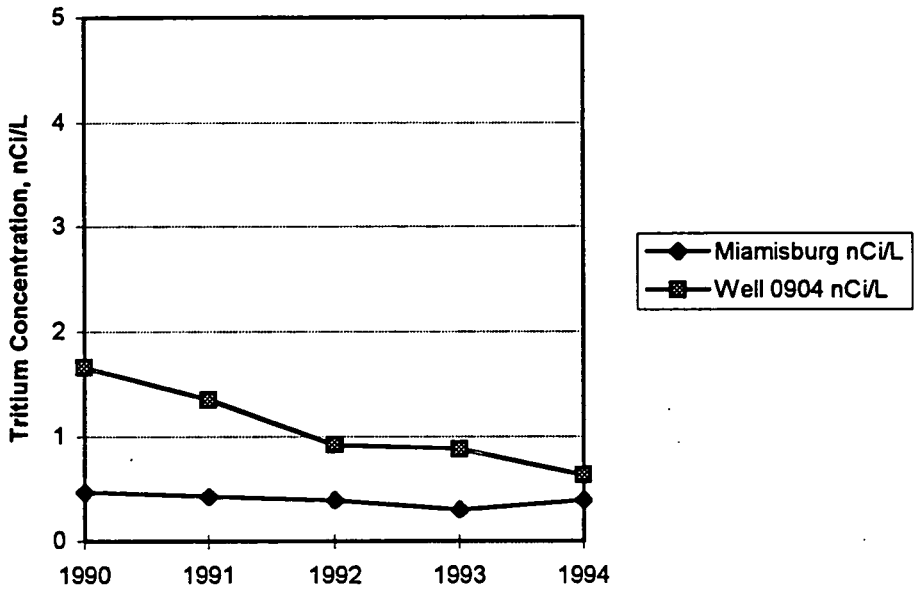
Five-year tends for tritium concentrations in the two wells described above are shown in Figure 6-7. As seen in the figure, tritium levels in the wells have exhibited little change during the period 1990 through 1994. Some evidence of a downward trend in tritium concentrations is evident for the private well, but the magnitude of change is small. All of the values shown on the graph are significantly below the drinking water standard of 20 nCi/L for tritium.

Table 6-19. Metal Concentrations in Onsite Monitoring Wells in 1994

Well ID*	Compound	1st Quarter	3rd Quarter	MCL[a]
		µg/L		
0305	Aluminum	1590	192	50 - 200[b,c]
	Antimony	2.4	ND	6
	Barium	141	157	2000
	Beryllium	0.5	ND	4
	Chromium	273	696	100
	Iron	4310	6920	300[b]
	Manganese	31.9	42.5	50[b]
	Nickel	140	193	100
0306	Aluminum	ND	111	50 - 200[b,c]
	Antimony	5.3	ND	6
	Barium	90.7	95.1	2000
	Chromium	2.0	52.7	100
	Iron	154	382	300[b]
	Lead	ND	2.9	15
	Manganese	6.5	6.1	50[b]
	Nickel	74.7	49.0	100
0307	Aluminum	ND	198	50 - 200[b,c]
	Antimony	7.3	ND	6
	Barium	124	152	2000
	Chromium	2.5	7.0	100
	Iron	224	426	300[b]
	Lead	ND	5.3	15
	Manganese	36.0	72.8	50[b]
	Mercury	ND	0.37	2
	Nickel	71.5	189	100
0313	Aluminum	1220	2340	50 - 200[b,c]
	Antimony	1.1	ND	6
	Arsenic	ND	7.0	50
	Barium	152	190	2000
	Beryllium	0.3	ND	4
	Chromium	820	2890	100
	Iron	7210	18500	300[b]
	Lead	2.6	8.3	15
	Manganese	144	222	50[b]
	Nickel	199	421	100
	Zinc	61.0	8.2	5000[b]
0315	Aluminum	ND	186	50 - 200[b,c]
	Antimony	1.2	ND	50
	Barium	166	186	2000
	Chromium	71.4	216	100
	Iron	427	5010	300[b]
	Lead	ND	2.2	15
	Manganese	11.9	111	50[b]
	Mercury	ND	0.3	2
	Nickel	72.0	190	100
	Zinc	ND	11.5	5000[b]

[a] Maximum Contaminant Level (based on EPA Primary and Secondary Drinking Water Standards).
[b] Secondary Maximum Contaminant Level.
[c] The MCL for aluminum is a range; endpoints have not been established for Mound.
• Well locations shown on Figure 6-2.

Figure 6-7. Annual Average Tritium Concentration in Offsite Drinking Water, 1990 - 1994



(Drinking water standard for tritium = 20 nCi/L)

Trend Data for Onsite Production Wells and Seeps

As previously described in this chapter, tritium and certain volatile organic compounds (VOCs) have been observed in the groundwater system underlying the plant site. As discussed in Section 6.4, VOCs of concern include trichloroethene, tetrachloroethene, and 1,2-dichloroethene. Trichloroethene is used in this section as an "indicator" VOC.

An appropriate onsite indicator well is Production Well No. 3 (also referred to as Well 0076) because it serves as the primary source of drinking water for the Plant. Another important monitoring point for the evaluation of groundwater conditions is associated with the seep sites. Data collected to date suggest Seep 0601 is an appropriate location for the observation of long-term trends.

Five-year trend data for Mound Production Well No. 3 are shown in Figures 6-8 and 6-9 for tritium and trichloroethene, respectively. Similarly, Figures 6-10 and 6-11 present five-year trend data for tritium and trichloroethene at Seep 0601.

Figure 6-8 indicates that tritium levels in Mound Well No. 3 are well below the applicable drinking water standard (20 nCi/L) and are not significantly different from the values reported for offsite drinking water systems. Some evidence of a downward trend is suggested by the data.

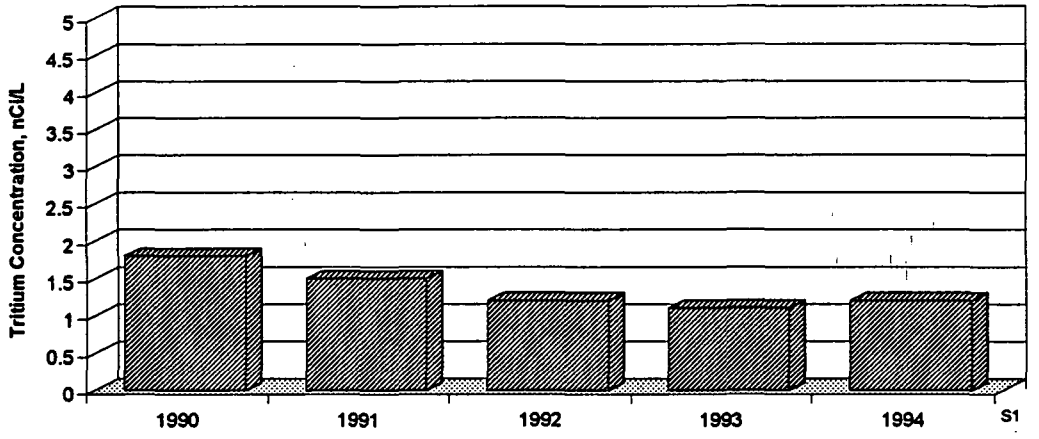
Slightly elevated concentrations of trichloroethene have been observed in Well No. 3 (Figure 6-9). However, observed concentrations have remained below the applicable MCL.

Figure 6-10 presents tritium concentration data for Seep 0601. Data for the period 1990-1994 show the yearly average for tritium concentrations ranging from approximately 100 nCi/L to 350 nCi/L. From the figure, it can be noted that average concentrations have both increased and decreased over the five-year period shown. The increase in 1994 is directly attributable to the water main break beneath SW-Building. SW-Building is the primary tritium facility onsite.

As seen in Figure 6-11, Seep 0601 is also characterized by elevated levels of trichloroethene. Additionally, though not shown in the figure, over the past few years tetrachloroethene has also emerged as a key contributor to VOC contamination in this seep.

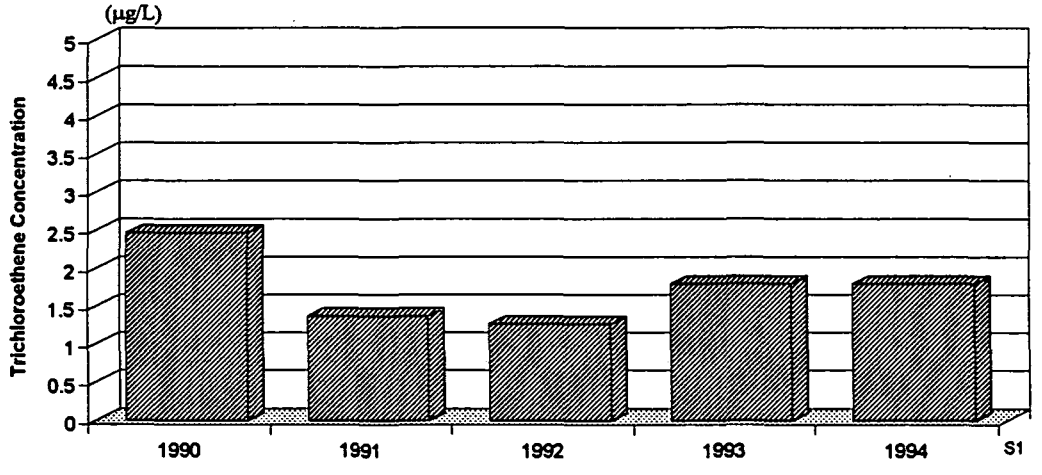
Because Mound seep sites are not sources of drinking water, tritium levels above the drinking water standard, or VOC values in excess of a maximum contaminant level, should not be interpreted as indicative of a human health concern. Mound's CERCLA Program will evaluate the risks associated with contamination in the seeps and will identify remediation actions which may be appropriate.

Figure 6-8. Annual Average Tritium Concentration in Onsite Drinking Water, 1990 - 1994



(Drinking water standard for trritium = 20 nCi/L)

Figure 6-9. Annual Average Indicator VOC Concentration in Onsite Drinking Water, 1990 - 1994



(MCL for trichloroethene = 5 µg/L)

Figure 6-10. Annual Average Tritium Concentration for Seep 0601, 1990 - 1994

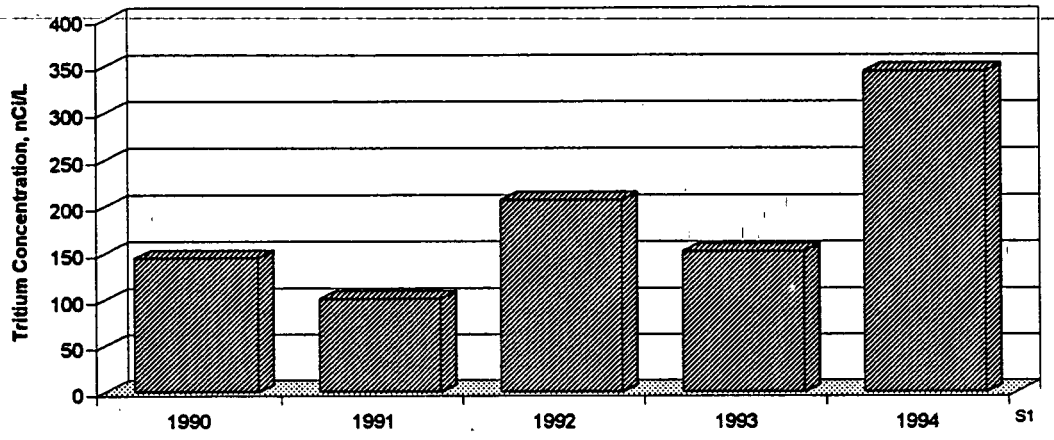
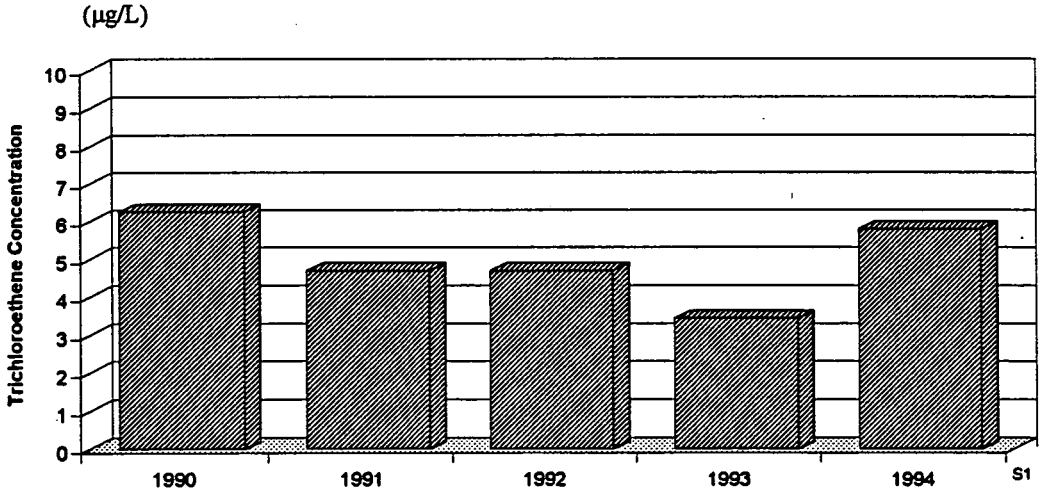


Figure 6-11. Annual Average Indicator VOC Concentration for Seep 0601, 1990 - 1994



7.0 QUALITY ASSURANCE PROGRAMS FOR ENVIRONMENTAL DATA

Mound participates in quality assurance (QA) exercises sponsored by the DOE and the EPA. Such exercises provide objective evaluations of the validity of the environmental data generated by Mound. In this Chapter, QA programs involving radiological and nonradiological analyses of a variety of environmental media are described. In addition to these external QA programs, Mound performs internal QA studies that make use of field and reagent blanks, internal standards, and duplicate samples.

EML QA Program

Twice each year, DOE's Environmental Measurements Laboratory (EML) conducts environmental sampling exercises for DOE sites. Each participating lab is given a number of samples to analyze for radiological constituents. The radionuclides are present as contaminants on air filters, or in soil, vegetation, or water. A laboratory's performance is evaluated by comparing their results with EML's reference values.

The concentrations reported by Mound for the March and September 1994 studies are shown in Table 7-1. The reference values established by EML are also shown in the table. A useful method of evaluating Mound's performance is to examine the ratio of Mound's result to the EML reference concentration for each environmental medium. This information is shown in Figure 7-1.

In 1994, EG&G Mound performed 47 multiple analyses on four environmental media. As evidenced by Table 7-1 and Figure 7-1, 25 results were within 10% of the referenced values, 13 were within 20%, 5 were within 30%, 2 were within 40 %, 1 was within 50%, and one of the results slightly exceeded the 50% range.

NPDES QA Program

National Pollutant Discharge Elimination System (NPDES) permits are used by the EPA to regulate discharges of liquid effluents. The permits limit the concentrations of certain wastewater constituents to protect the receiving body of water. To ensure that a facility does not exceed those limits, the NPDES permit imposes strict requirements for effluent characterization. The EPA requires that labs performing analyses for NPDES parameters participate in QA exercises. These exercises assure EPA that the labs are producing reliable and accurate data.

In 1994, as in previous years, Mound participated in the NDPES QA exercise. In this program, a contractor lab, ManTech Environmental Technology, Inc., prepares water samples for analysis. Labs, including Mound, analyze these samples and then submit the results to the contractor. The contractor evaluates the data based on limits for acceptability.

Table 7-1. Mound DOE Quality Assessment Program Results for 1994: Radionuclides in Environmental Samples

Sample Type	Radionuclide	Mound Result[a]	EML Reference Concentration
Air filters, pCi/filter			
March	Pu-238	10.18 ± 0.54	9.03
	Pu-239	9.01 ± 0.51	8.38
	U-234	4.9 ± 0.16	5.32
	U-238	5.22 ± 0.17	5.49
September	Pu-238	1.92 ± 0.19	1.95
	Pu-239	17.38 ± 0.59	17.51
	U-234	2.70 ± 0.22	3.03
	U-238	2.78 ± 0.22	3.03
Vegetation, pCi/kg			
March	Pu-239	89.83 ± 5.61	105.41
		92.78 ± 11.39	105.41
September	Pu-238	3.19 ± 0.84	2.49
		3.76 ± 3.08	2.49
	Pu-239	32.43 ± 2.65	33.78
		38.65 ± 9.84	33.78
Soil, pCi/kg			
March	Pu-238	307.08 ± 22.92	302.7
		303.03 ± 21.92	302.7
	Pu-239	92.78 ± 12.61	96.22
		101.97 ± 12.71	96.22
	U-234	654.47 ± 51.04	732.43
		668.59 ± 41.71	732.43
	U-238	658.62 ± 51.28	732.43
		665.09 ± 41.6	732.43
September	Pu-238	5.19 ± 1.24	8.38
		6.14 ± 6.57	8.38
		10.32 ± 8.73	8.38
	Pu-239	204.59 ± 7.95	210.27
		226.22 ± 41.08	210.27
		235.95 ± 40.81	210.27
	U-234	751.35 ± 64.86	881.08
		651.35 ± 111.89	881.08
	U-238	759.46 ± 64.05	891.89
		605.41 ± 107.57	891.89

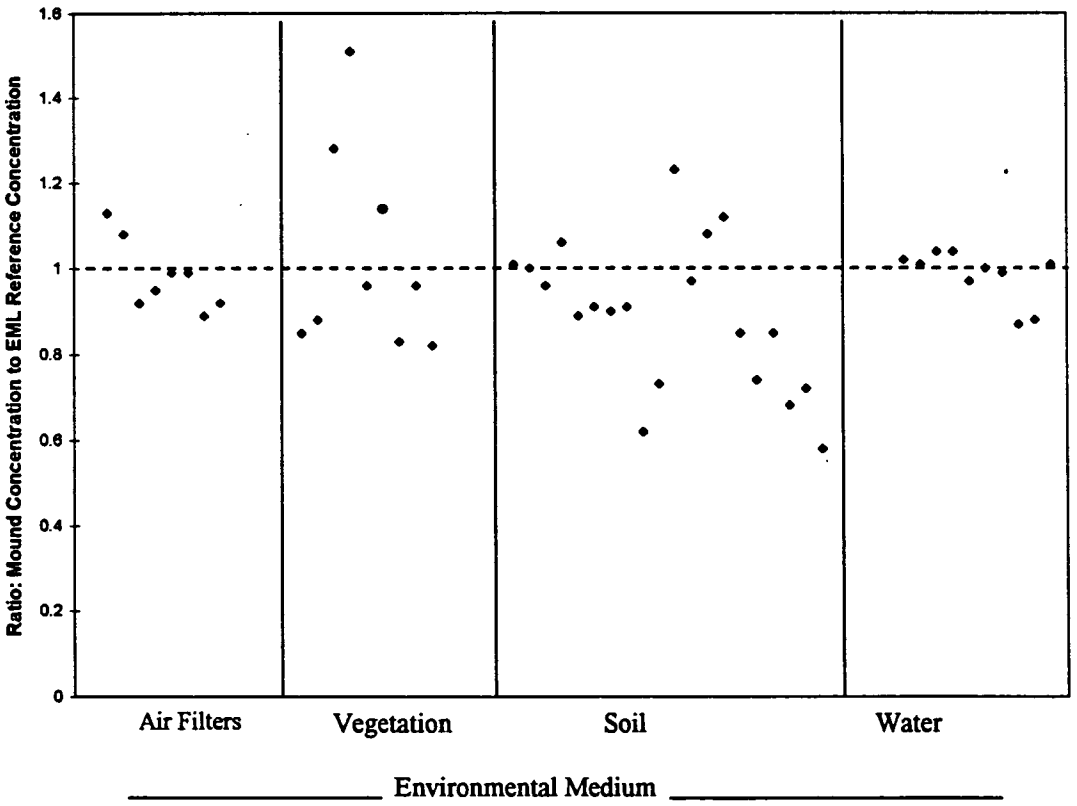
[a] The Mound error is the two-sigma error based on counting statistics or replicate analysis.

Table 7-1 (continued)

Sample Type	Radionuclide	Mound Result[a]	EML Reference Concentration
Water, pCi/L			
March	H-3	4921.16 ± 841.28	5054.05
	Pu-238	25.97 ± 1.23	25.43
	Pu-239	25.97 ± 1.23	25.84
	U-234	14.66 ± 1.54	14.05
	U-238	14.82 ± 1.54	14.27
September	H-3	3081.08 ± 278.38	3054.05
	Pu-238	28.65 ± 2.59	28.65
	Pu-239	16.05 ± 1.95	16.27
	U-234	26.05 ± 2.35	30
	U-238	26.3 ± 2.38	30

[a] The Mound error is the two-sigma error based on counting statistics or replicate analysis.

Figure 7-1. Mound's Performance in the DOE Quality Assessment Program in 1994



Mound's performance for 1994 is shown in Table 7-2. Of the 15 parameters analyzed, Mound was rated "acceptable" on 14. One not acceptable result was noted. The not acceptable result was associated with a high value for total cyanide. A review of EG&G Mound's analytical protocol revealed that the blank of 0.03 mg/L was not incorporated in the final results.

Table 7-2 also shows an evaluation of the contract lab used to perform biomonitoring studies for EG&G Mound. The lab's performance for the 1994 QA exercise resulted in eight "acceptable" ratings.

APG QA Program

As a companion to the EPA program described above, Mound also participates in another QA exercise for NPDES parameters. In this study, water samples prepared by Analytical Products Group, Inc. (APG) are analyzed in a round-robin fashion by participating labs. The studies are conducted two times per year. For each parameter of interest, APG determines the average value reported by all participants. The figure-of-merit used to evaluate a lab is the standard deviation of a result from the average for that parameter. In this fashion, a lab's performance is rated relative to the performance of all other labs.

Limits of acceptability are associated with the APG studies. There are "warning" and "not acceptable limits" for performance. Those limits have been set at 1.96 and 2.58 standard deviations from the average, respectively.

Mound participated in both APG studies for 1994. The results are shown in Figures 7-2a and 7-2b for trace metals and miscellaneous parameters, respectively. Figure 7-2a demonstrates Mound's performance for trace metal analysis in 1994. With the exception of exceeding one performance standard for lead, all other standard deviations from the averages were small and within the performance limits. Mound's performance for the miscellaneous analytes, Figure 7-2b, was satisfactory.

Mound Internal QA Program

In addition to the external programs described above, Mound performs a number of internal QA operations. Blank samples are analyzed to verify the absence of excessive instrument contamination or background. The standard deviation of the blank is then used to calculate the lower limit of detection. A quality-based approach to these data is imperative because many of the environmental samples analyzed at Mound have contaminant concentrations at or below the lower detection limit.

Mound also routinely uses duplicate sample analysis and internal standard techniques to evaluate analytical precision. Deviation from an expected value results in a comprehensive review of the analytical protocol.

Table 7-2. Mound's Performance in the NPDES Quality Assurance Program for 1994

Parameters	Mound Value	EPA Value	Acceptance Limits	Warning Limits	Mound Performance Evaluation
Trace Metals, µg/L					
Cadmium	81	78	65.8 - 91	69 - 87.9	Acceptable
Chromium	170	169	140 - 196	147 - 189	Acceptable
Copper	102	98	84.7 - 111	88 - 107	Acceptable
Lead	108	110	92.9 - 127	97.2 - 123	Acceptable
Mercury[a]	0.329	0.615	0.321 - 0.811	0.391 - 0.811	Acceptable
Nickel	670	660	587 - 732	605 -714	Acceptable
Zinc	178	171	150 - 194	156 - 188	Acceptable
Miscellaneous Analytes, mg/L					
Total Suspended Solids	47.4	50	35.5 - 53.9	37.8 - 51.6	Acceptable
Oil & Grease	12.5	12.7	5.97 - 17.3	7.40 - 15.9	Acceptable
Total Cyanide	0.091	0.065	0.036 - 0.089	0.043 - 0.083	Not Acceptable
Total Residual Chlorine	0.36	0.32	0.15 - 0.45	0.19 - 0.41	Acceptable
Ammonia as Nitrogen	12.4	12.0	9.48 - 14.3	10.1 - 13.7	Acceptable
Demands, mg/L					
CBOD[b]	75.8	64.7	32.9 - 96.5	41.3 - 88.2	Acceptable
COD[c]	122	111	84.7 - 128	90.2 - 123	Acceptable
pH (standard units)	6.20	6.20	6.05 - 6.33	6.08 - 6.30	Acceptable

[a] Mercury analysis performed for EG&G Mound by a contract laboratory.
[b] CBOD = Carbonaceous biochemical oxygen demand.
[c] COD = Chemical oxygen demand.

Table 7-2 (continued)

Parameters	Contract Lab Value[a]	EPA Value	Acceptance Limits	Warning Limits	Contract Lab Performance Evaluation
Biomonitoring Results, % of sample affected					
Pimephales promelas (Fathead minnows)					
Acute Toxicity in MHSF[b]:					
LC_{50}[c]	43.5	49.3	24.4 - 74.2	N/A	Acceptable
Chronic Toxicity:					
Survival in MHSF					
NOEC[d]	25	25	12.5 - 50	N/A	Acceptable
Growth effects in MHSF					
IC[e]	37.1	37.4	12.9 - 61.8	N/A	Acceptable
NOEC[d]	25	25	12.5 - 50	N/A	Acceptable
Ceriodaphnia dubia (Water fleas)					
Acute Toxicity in DMW[f]:					
LC_{50}[c]	46.7	44.2	20.7 - 67.8	N/A	Acceptable
Chronic Toxicity:					
Survival in DMW					
NOEC[d]	50.0	25.0	12.5 - 50.0	N/A	Acceptable
Growth effects in DMW					
IC[e]	34.5	27.5	5.33 - 49.6	N/A	Acceptable
NOEC	25.0	25.0	12.5 - 50.0	N/A	Acceptable

[a] Biomonitoring studies are performed for EG&G Mound by a contract laboratory.
[b] MHSF = moderately hard synthetic freshwater.
[c] LC_{50} = lethal concentration to 50 % of the population.
[d] NOEC = no observable effect concentration.
[e] IC = inhibition concentration.
[f] DMW = diluted mineral water.

Figure 7-2a. Mound's Performance in the APG Proficiency Environmental Testing Program for 1994: Trace Metal Analysis

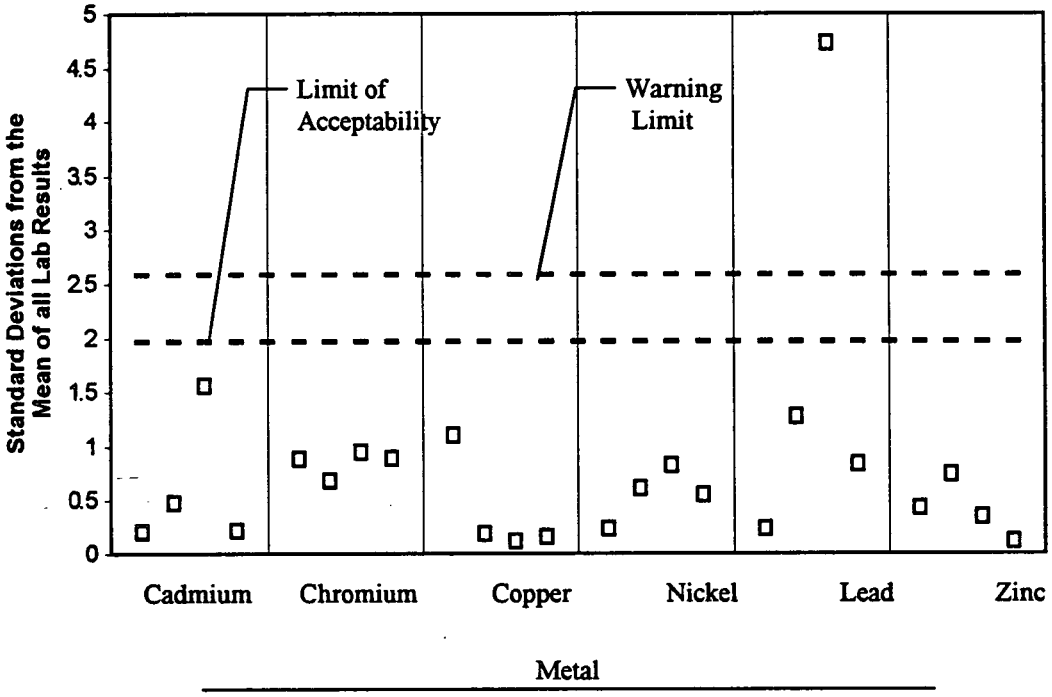
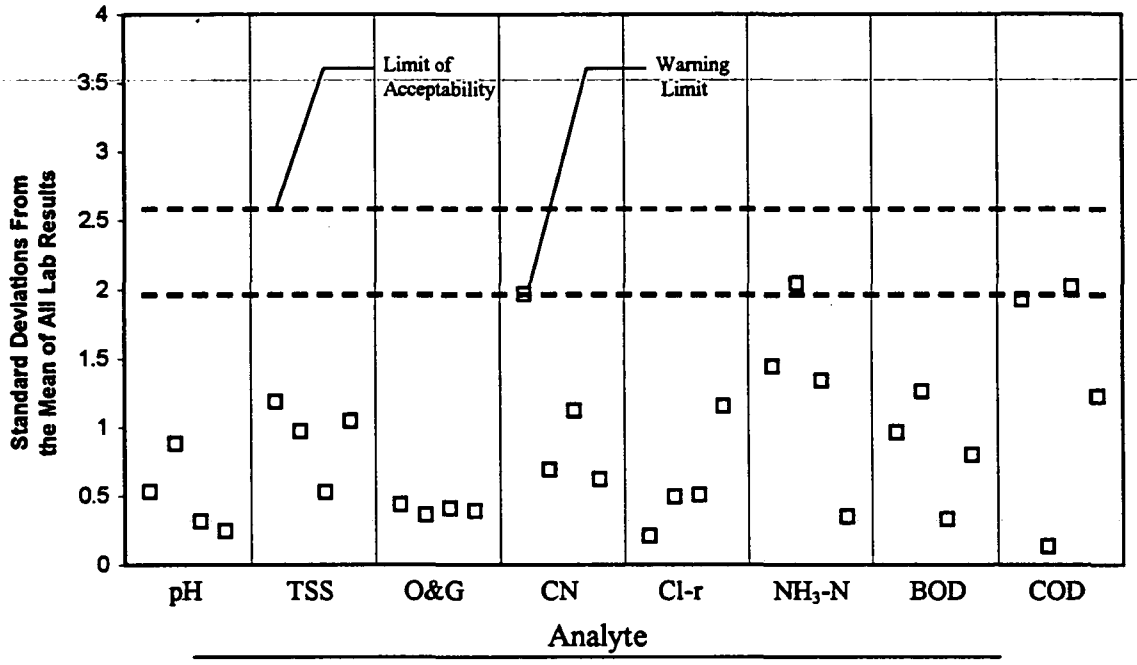


Figure 7-2b. Mound's Performance in the APG Proficiency Environmental Testing Program for 1994: Miscellaneous Parameters



LEGEND	
TSS = Total Suspended Solids	NH_3-N = Ammonia as Nitrogen
O&G = Oil and Grease	BOD = Biochemical Oxygen Demand
CN = Cyanide	COD = Chemical Oxygen Demand
Cl-r = Residual Chlorine	

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40 CFR 61, Subpart H. *National Emission Standards for Emissions of Radionuclides Other than Radon From Department of Energy Facilities.*

40 CFR 141-143. *National Primary Drinking Water Regulations Implementation and National Secondary Drinking Water Regulations.*

OAC 3745-17-10. *Restrictions on Particulate Emissions from Fuel Burning Equipment.*

OAC3745-18-63. *Montgomery County Emission Limits.*

OAC 3745-95. *Backflow Prevention and Cross-Connection Control.*

APPENDIX

A.1 Exposure Routes

Members of the public receive radiation doses via various exposure pathways. For radionuclides discharged to the atmosphere, a person may inhale or be immersed in airborne radionuclides. Other routes of airborne exposure include ground deposition of radionuclides and consumption of food products that were contaminated by airborne releases. For radionuclides released to water, a person may consume contaminated water or fish. The other potential water-based exposure pathways (e.g., swimming and boating) generally do not add significantly to the dose.

A.2 Dose Calculations Based on Measured Data

For DOE reporting requirements, doses are presented as 50-year committed effective dose equivalents (CEDEs). The CEDE is the total dose equivalent that will be received by an individual over a 50-year time period as a result of one year of exposure to ionizing radiation. The total CEDE reported is the sum of the CEDEs from the air, water, and food-related pathways.

Each year, Mound personnel calculate CEDEs for tritium, plutonium-238, plutonium-239. (Other radionuclides released by Mound were present in concentrations that were below environmental levels or were too small to affect overall dose.) The CEDEs for tritium and plutonium are evaluated using environmental monitoring data measured on and near the plant site. A CEDE for a given radionuclide is calculated as shown below. Specific input values for 1994 are shown in Table A-1.

$$CEDE = \sum_{1}^{p} C_r \bullet I_a \bullet DCF \bullet CF$$

where CEDE = total committed effective dose equivalent, mrem.

$\sum_{1}^{p}$ = summation over the exposure pathways 1 through p.

C_r = maximum average concentration of the radionuclide.

I_a = annual intake of the environmental medium.

DCF = dose conversion factor for the radionuclide and intake type.

CF = conversion factor to accommodate dose conversion factor units.

The CEDE for all radionuclides are then summed to provide a single value for reporting purposes.

Table A-1. Factors Used to Calculate 1994 CEDEs

Radionuclide	Maximum Average Concentration	Location	Dose Conversion Factor, mrem/μCi (a)
Tritium			
Air	8.09×10^{-12} μCi/mL	124	6.3×10^{-2} (b)
Drinking water	0.37×10^{-6} μCi/mL	Miamisburg	6.3×10^{-2}
Produce	0.03×10^{-6} μCi/g	Miamisburg	6.3×10^{-2}
Plutonium-238			
Air	354.26×10^{-18} μCi/mL	213R	3.8×10^{5}
Drinking water	0.13×10^{-12} μCi/mL	Miamisburg	1.9×10^{3}
Produce	0.26×10^{-9} μCi/g	Miamisburg	1.9×10^{3}
Fish	0.01×10^{-9} μCi/mL	Great Miami River	1.9×10^{3}
Plutonium-239			
Air	3.5×10^{-18} μCi/mL	213R	4.2×10^{5}
Drinking water	0.04×10^{-12} μCi/mL	Miamisburg	2.2×10^{3}
Produce	Environmental level	Miamisburg	N/A (no dose)
Fish	0.02×10^{-9} μCi/g	Great Miami River	2.2×10^{3}

Annual Intake Values

Air	8400 m^3	Produce	260 kg
Well water	730 L	Fish	21 kg

(a) Plutonium releases from Mound are believed to be insoluble (Class Y). However, to provide a reasonable degree of conservatism in the dose estimates, the Pu-238 and Pu-239 dose factors are averages of Class W and Class Y values.
(b) The dose factor is multiplied by a factor of 1.5 to include absorption of tritium through the skin.

A-3. Dose Calculations for NESHAPs Compliance

To demonstrate compliance with the requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPs, 40 CFR 61, Subpart H), Mound performs additional dose calculations each year for all airborne releases. As preferred by the EPA in 40 CFR 61, Subpart H, Mound uses the computer code CAP-88 to calculate those doses.

Whenever available, Mound uses site-specific data as input to the code. Meteorological data measured onsite are used to evaluate transport and dispersion. Stack specific release rates are used in an aggregated form as shown on the next page (Table A-2). This approach makes it possible to combine stacks with similar physical attributes. Table A-2 lists the relevant stack information used for the 1994 CAP-88 runs.

Table A-2. 1994 CAP-88 Input Data

Stack IDs	Assumed Stack Height (meters)	Assumed Stack Diameter (meters)	Exit Velocity (meters/sec)	Radionuclides	1994 Release Rate (Ci/yr)
HH	34	1.7	1.5	H-3	2.21×10^{1}
NCDPF/SW1C	44	0.8	15.2	H-3	4.55×10^{1}
				Pu-238	6.39×10^{-8}
				Pu-239	1.17×10^{-9}
				U-234	7.47×10^{-10}
				U-238	5.25×10^{-10}
HEFS	46	1.9	13.1	H-3	3.99×10^{2}
				Pu-238	5.98×10^{-8}
				Pu-239	3.55×10^{-9}
				U-234	5.09×10^{-9}
				U-238	3.76×10^{-9}
SMPP/ T West/ T East	60	2.0	10.3	H-3	2.17×10^{1}
				Pu-238	1.34×10^{-5}
				Pu-239	4.84×10^{-8}
				U-234	3.95×10^{-9}
				U-238	1.59×10^{-9}
WDALR/ WDAHR/ WDSS	12	0.6	6.8	H-3	2.0×10^{-2}
				Pu-238	1.21×10^{-6}
				Pu-239	4.15×10^{-9}

EXTERNAL

OSTI

U.S. Department of Energy

DOE/Headquarters

Michael N. Worley, EM-63

Jay Thompson, EM-60.1

Richard D. Hahn, Director, DP-64

Barry Daniel, Director, PA-1

Michael H. Kleinrock, Director, EM-22

Kathleen I. Taimi, Director, EH-22

Ralph Lightner, Director, EM-45

John P. Sand, EM-453

Rear Admiral Winford G. Ellis, USN, Deputy Assistant Secretary for Military Applications, DP-20

DOE/Albuquerque

Constance L. Soden, Director, EPD

DOE/Ohio Field Office

J. Phil Hamric, Manager

Nathaniel Brown, Jr., Assistant Manger for Compliance and Support

Robert J. Granfield III, Compliance Team Leader

Elizabeth Osheim, Chief Council

Ken Morgan, Public Affairs Officer

Anne Wickham, Assistant Manager for Planning, Technology and Economic Development

John Murphy, Technology Support Program Team Leader

Susan L. Smiley, NEPA Compliance Officer

DOE/Miamisburg Area Office

W.C. Sherard, Jr. Acting Director

Oba L. Vincent, Associate Director, Environmental Management

Dewain V. Eckman, Associate Director, Safety, Operations, and Technical Support

Michael A. Reker, Environmental Team Leader

Art W. Kleinrath, Project Engineer Team Leader

James O. Johnson, Environmental Engineer

Michael J. Merker, Environmental Specialist

Sam Cheng, D&D Team Leader

Patricia Brechlin, Environmental Protection Specialist

EG&G, Inc.

W.H. Parker, III, Director Environmental Programs

State and Federal Officials

The Honorable John Glenn
U.S. Senator

The Honorable Michael Dewine
U.S. Senator

The Honorable John Boehner
U.S. Representative

The Honorable Tony Hall
U.S. Representative

The Honorable Charles Horn
Ohio Senator

The Honorable Rhine McLin
Ohio Senator

The Honorable Robert Corbin
Ohio Representative

The Honorable J. Donald Mottley
Ohio Representative

The Honorable Lloyd Lewis, Jr.
Ohio Representative

The Honorable Tom Roberts
Ohio Representative

The Honorable Robert Netzley
Ohio Representative

The Honorable Jeff Jacobson
Ohio Representative

The Honorable George Voinovich
Governor

The Honorable Nancy Hollister
Lt. Governor

The Honorable Betty Montgomery
Attorney General

U.S. Environmental Protection Agency (U.S. EPA)

EPA Region V, Chicago IL
Jack Barnette, Chief
Radiation and Indoor Air Section

Steven Goranson, Chief
Environmental Monitoring Branch

Timothy Fischer, Remedial Project Manager

Agency for Toxic Substances and Disease Control

Dr. William Taylor
ATSDR, Atlanta, GA

State of Ohio EPA (OEPA)

OEPA Columbus
Donald Schregardus, Director

Bob Hodanbosi, Chief
Air Pollution Control

Gary Martin, Acting Chief
Surface Water

John Sadzewicz, Chief
Drinking and Ground Waters

Southwest District Office

Tom Winston, Director

Graham Mitchell

Brian Nickel

Jeff Smith

Kathy Fox

Lisa Anderson

Joseph Bartoszek

Other State Agencies

Keneth B. Cole, Chief
Technology Branch
Emergency Management Agency

State of Ohio Department of Health

Ruth Vandergrist (2)

County, City and Township Offices

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City of Miamisburg

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City of Miamisburg

Andy Alford, Councilman
City of Miamisburg

Bill Fuller, Councilman
City of Miamisburg

Paul Gutshall, Councilman
City of Miamisburg

Dan Kirchner, Councilman
City of Miamisburg

Mady Ransdell, Councilwoman
City of Miamisburg

Dave Wood, Councilman
City of Miamisburg

Shirley Omietanski, Trustee President
Miami Township

Berman Layer, Vice President
Miami Township

Doug Zink, Trustee
Miami Township

Donald Vermillion, Administrator
Montgomery County

Charles Curran, Commissioner
Montgomery County

Donald Lucas, Commissioner
Montgomery County

Vicki Pegg, Commissioner
Montgomery County

Carl Berg, Superintendent
Miamisburg City Schools

John Maletta, Member
Miamisburg Board of Education

Kathleen Bates, Member
Miamisburg Board of Education

Joseph Omietanski, Member
Miamisburg Board of Education

Cindy Heier Treiber, Vice President
Miamisburg Board of Education

Judith Peterson, Member
Miamisburg Board of Education

Media

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WKEF-TV

Mark Casey
WHIO-TV

Rob Meenie
WDTN-TV

Darrel Gray
WMMX Radio

Joyce Herring
WDAO Radio

Jim Barrett
WHIO Radio

Kim Faris
WING Radio

Charles Vansant
WLQT Radio

Bob Montgomery
WYMJ Radio

Steve Watson
WONE/WTUE Radio

Bill Nance
WFCJ Radio

Rica Duffuss
WROU Radio

Jim Pickering
Miamisburg News

Jim Hannah
Associated Press

Tim Gaffney
Dayton Daily News

Greg Stricharchuk
Dayton Daily News

Gene Fox
Dayton Business Reporter

Gabrielle Jacobs
The Business News

Steve Schelb
Small Business News

Stakeholders

Frank Winslow
Edward Howard and Company

Dan Browner
Browner Enterprises Inc.

Velma Shearer
Neighbors in Need

Gail Heller
Mound Action Committee

James Lucas
Dayton Citizens for Global Security

India Clarke
Sierra Club

Dan Grove
Mound Citizens' Action Group

Sharon Cowdrey
Miamisburg Environment, Safety and Health

Jodi Lally
Boston University School of Public Health

Peter Townsend
Hydro-Log

John Appelgate
Fernald Citizen's Task Force

Gary Nolly, President
Oil, Chemical and Atomic Worker's Union

Charles Williams, President
United Plant Guard Workers of America

Joseph Walker
Citizen's Association for the Economy

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