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REGIONAL AIR POLLUTION CONTROL AGENCY

POLICY

All personnel must be protected insofar as practical from breathing asbestos fibers. Only asbestos removal that can be performed in a glove bag will be allowed by Mound personnel. Other asbestos removal projects that require employees to work in an asbestos-enclosed area, will be performed by an outside contractor licensed in the removal of asbestos.

SCOPE

This procedure describes how asbestos should be handled and removed in a wet state sufficient to prevent emission of airborne fibers.

This procedure is particularly applicable to the removal or demolition of pipes, structures, or equipment covered with insulation containing asbestos.

SPECIAL REQUIREMENTS

1. Asbestos concentration in breathing air must not exceed 0.2 fibers per cubic centimeter of air during an eight-hour workday.

2. Asbestos work area should be isolated from surrounding work area.

3. Monitoring of asbestos-concentration in breathing air must always be performed.

4. All work area hazards must be identified.

5. All employees involved in the work activity must participate in a joint meeting where they are informed of the hazard of breathing asbestos fibers.

PROCEDURES

ENGINEERING/MAINTENANCE SUPERVISOR

1. Notifies Industrial Hygienist that asbestos handling work procedures are scheduled three weeks in advance.

   Schedules a meeting of all involved workers in work area to discuss and plan working procedures.

3. Provides Asbestos Removal Training (#070031) to asbestos removal personnel. Training includes reviewing the removal procedure and health hazards of asbestos. Supervisor submits to the Training office a list of trained employees. (See attached appendices for health hazard material and training record).

INDUSTRIAL HYGIENIST

4. Files a notification report with RAPCA at least two weeks prior to the asbestos removal project. (See Appendix C).

5. Insures that training has been completed.

6. Monitors area and workers performing asbestos removal.

DECONTAMINATION OR JANITORIAL PERSONNEL

7. Will prepare the work area as follows:

   - Label work area with the following danger sign:

DECONTAMINATION OR JANITORIAL PERSONNEL (Cont'd)

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA

- Provide glove bags for asbestos
- Provide 6 mil bags for disposable clothing and other asbestos contaminated waste.
- Provide spray container.
- Provide disposable clothing, half-face or full-face respirator with HEPA filter cartridges.

WORKING PERSONNEL

8. Wear disposable shoe covers, disposable paper hats, and disposable paper cover clothing over overalls while in isolated work area.

9. Place tools and equipment required for the asbestos job in the glove bag.

10. Attach glove bag to the pipe and seal all openings to assure no release of asbestos fibers during removal operation.

11. Cut a small hole in the glove bag to place the nozzle of the spray container.

12. While cutting asbestos, wet insulation to minimize airborne asbestos.

13. Gently drop asbestos insulation to the bottom of the glove bag.

WORKING PERSONNEL
(Cont'd)

14. When job is complete, wet pipe to assure all residual asbestos has been removed.

15. Clean off tools. Place tools in one arm of glove, twist glove and tape. This will isolate the contaminated tools from the work area.

16. Remove glove bag from pipe. Clean pipe again with a damp cloth to assure the pipe is now asbestos free.

17. Place contaminated rags in glove bag and seal contaminated glove bag.

18. Cut the glove that contains the tools from the bag. Seal the open end of the glove bag.

19. If no more asbestos removal is to be performed go to step 22.

20. If additional asbestos removal is necessary, place bagged tools into the bottom of the new glove bag and return to step 10.

21. Remove tools from the bagged glove and clean all tools and equipment thoroughly with a damp cloth.

22. Place contaminated rags in the 6 mil plastic bags.

23. Remove protective clothing and place in 6 mil plastic bag.

24. Remove respirator. Remove HEPA filter cartridges and place in 6 mil plastic bags.

WORKING PERSONNEL
(Cont'd)

25. Before sealing waste bags, make certain that all waste material is wet.

26. Place danger label on each waste container that states

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

27. Contact Waste Management for pickup and disposal of asbestos waste

APPENDIX A

A. HISTORICAL RECORD

1. The potential for asbestos to cause disease was recognized as early as the first century, A. D., when Pliny, the Elder, and Strabo, a Greek geographer, reported lung sickness among slaves who wove asbestos cloth.
2. The relationship between asbestos and cancer was not established until 1949, when a report was published in which an excess number of lung cancers among asbestosis victims was described.
3. Mesothelioma was first recognized as an asbestos disease in 1960, when a series of cases in South Africa was publicized.

B. GENERAL CHARACTERISTICS

1. Asbestos diseases result from the **inhalation** (breathing) of asbestos fibers.
2. Once asbestos is inhaled and enters the respiratory tract, the fibers can become embedded in the lung tissue, remaining there for long periods of time.
3. All types of asbestos fibers can cause disease.
4. Age can increase the chances of developing some asbestos-related diseases. This is due to the fact that when a person is initially exposed at a young age, two factors can be considered. 1) That person may breathe a larger quantity of fibers through continued exposure. 2) Over a period of time, greater scarring/impairment may occur.
5. To date, the way asbestos causes diseases is not known.
6. Individuals who have pre-existing lung problems are at an increased risk of developing asbestos diseases.
7. Concern over nonoccupational exposure exists due to the fact that families of asbestos workers have contracted related diseases. In addition, fibers have been found in individuals who have not been occupationally exposed to asbestos.

C. ASBESTOS DISEASES

1. Asbestosis.
   a. Asbestosis is a chronic disease during which the lungs become scarred as the result of a biological reaction to the inhalation of asbestos fibers.
   b. The disease usually results after exposure to high concentrations of fibers over a long period of time.
   c. Once asbestosis is diagnosed, the disease process continues, even after the victim is no longer exposed to asbestos.
   d. Victims experience shortness of breath and are at high risk of developing lung cancer.
   e. The latency period for asbestosis is 15 to 35 years after the first asbestos exposure.
   f. Victims usually die from heart failure.
2. Lung Cancer
   a. This disease is the greatest health risk for American asbestos workers. Lung cancer has been responsible for over half the deaths from asbestos exposure.
   b. Lung cancer results in a tumor which usually begins in the lower lobes of the lung.

APPENDIX A - Cont'd

c. The earliest symptom is the development of a persistent cough or change in a chronic cough.

d. The tumor invades other tissues and can metastasize.

e. Later symptoms include loss of appetite, weight loss, pain, general malaise, and weakness.

f. Asbestos exposure and smoking increase the risk of developing lung cancer. Smoking in addition to asbestos exposure does not increase that risk two times. The combination has a "synergistic" effect (the total is greater than the individual effects).

A one-pack-day smoker exposed to asbestos has an increased risk approximately 50 times greater than a non-smoker.

A person who smokes two to three packs a day and is exposed to asbestos is approximately 90 times more at risk than a non-smoker.

g. The risk of developing lung cancer increases with both the duration and concentration of exposure.

h. The majority of lung cancers from asbestos exposure occur after the age of 45. For lung cancer (not asbestosis), the lifetime risk caused by asbestos exposure does not depend on the age of the victim when exposed.

3. Mesothelioma.

a. This disease is a cancer of the lining of the lung (pleural) or abdominal (peritoneal) cavity.

b. Mesothelioma rarely occurs in individuals who have not been exposed to asbestos.

c. The latency period is usually at least 25 to 30 years, and some victims experience a 40 year period before symptoms appear.

d. This form of cancer is rarely curable and is usually fatal within a year after diagnosis.

e. No relationship has been shown between smoking and the risk of developing mesothelioma.

4. Other Cancers. Asbestos workers have an increased incidence of gastrointestinal cancers.

APPENDIX B

Supervisor: _____

APPENDIX B

PARTICIPANT LISTING

Course Title: ASBESTOS REMOVAL TRAINING Course Code: 070031

Date Course Completed: _____ Course Coordinator: _____

Participant	HP #	CC

Return completed form to:
Training and Development
A-145

APPENDIX C

ASBESTOS DEMOLITION/RENOVATION NOTIFICATION

1. Check one only:

   ☐ Renovation involving at least 260 linear feet or 160 square feet of friable asbestos material (Notification required as soon as possible before renovation.).

   ☐ Demolition involving at least 260 linear feet or 160 square feet of friable asbestos material (10 day notification required, except for ordered demolition.).

   ☐ Demolition involving less than 260 linear feet or 160 square feet of friable asbestos material (20 day notification required.). Complete (1) through (6) only.

2. Name of owner: Name of Operator (Contractor):

   Address:

   Phone:

3. Facility Name:
   Street Address:

4. Facility description (include size, age, and prior use):

5. Estimate of friable asbestos on pipe: _____ linear feet; on other components: _____ square feet. Explain estimation techniques if less than 260 linear feet or 160 square feet.

6. Asbestos removal starting date: _____. Completion date: _____

7. Nature of planned demolition or renovation and methods to be used:

8. Procedures to be used to insure compliance with 40 CFR Section 61.147, 61.52, and 61.1:

APPENDIX C - Cont'd

9. Name and location of approved landfill where asbestos will be deposited:

Phone:

10. If ordered demolition, the name, title, and authority of sate or local governmental representative who has ordered the demolition:

Phone: Demolition to be completed in _____ days.

11. Form completed by: _____ Date: _____

---------- OHIO EPA USE ONLY----------

Postmarked: _____
Reviewed by: _____ Delivered (date stamp)
Inspected on: _____
Inspected by: _____

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U.S. Department of Energy

Environment, Safety and Health
Office of Environmental Audit

Environmental Survey Preliminary Report

Mound Plant
Miamisburg, Ohio

March 1987

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May contain unclassified controlled nuclear information subject to Section 148 of the AEA, as amended (42 USC 2168). Approval by the Department of Energy prior to release is required.

PREFACE
TO
THE DEPARTMENT OF ENERGY
MOUND PLANT
ENVIRONMENTAL SURVEY PRELIMINARY REPORT

This report contains the preliminary findings based on the first phase of an Environmental Survey at the Department of Energy (DOE) Mound Plant, located at Miamisburg, Ohio. The Survey is being conducted by DOE's Office of Environment, Safety and Health.

The Mound Plant Survey is a portion of the larger, comprehensive DOE Environmental Survey encompassing all major operating facilities of DOE. The DOE Environmental Survey is one of a series of initiatives announced on September 18, 1985, by Secretary of Energy John S. Herrington, to strengthen the environmental, safety and health programs and activities within DOE. The purpose of the Environmental Survey is to identify, via a "no-fault" baseline Survey of all the Department's major operating facilities, environmental problems and areas of environmental risk. The identified problem areas will be prioritized on a Department-wide basis in order of importance in 1988.

The findings in this report are subject to modification based on the results from the sampling and analysis phase of the Survey. The findings are also subject to modification based on comments from the Albuquerque Operations Office concerning the technical accuracy of the findings. The modified preliminary findings and any other appropriate changes will be incorporated into an Interim Report. The Interim Report will serve as the site-specific source for environmental information generated by the Survey, and ultimately as the primary source of information for the DOE-wide prioritization of environmental problems in the final Survey report.

March 1987
Washington, D.C.

PRELIMINARY

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EXECUTIVE SUMMARY

Introduction

This report presents the preliminary findings from the first phase of the Environmental Survey of the United States Department of Energy (DOE) Mound Plant, conducted August 18 through 29, 1986.

The Survey is being conducted by an interdisciplinary team of environmental specialists, led and managed by the Office of Environment, Safety and Health's Office of Environmental Audit. Individual team components are outside experts being supplied by a private contractor. The objective of the Survey is to identify environmental problems and areas of environmental risk associated with the Mound Plant. The Survey covers all environmental media and all areas of environmental regulation. It is being performed in accordance with the DOE Environmental Survey Manual. The on-site phase of the Survey involves the review of existing site environmental data, observations of the operations carried on at the Mound Plant, and interviews with site personnel.

The Survey team developed a Sampling and Analysis Plan to assist in further assessing certain of the environmental problems identified during its on-site activites. The Sampling and Analysis Plan will be executed by Battelle Memorial Institute and a DOE National Laboratory. When completed, the results will be incorporated into the Mound Plant Environmental Survey Interim Report. The Interim Report will reflect the final determinations of the Survey for the Mound Plant.

Site Description

The Mound Plant is located on a 306 acre site in southern Montgomery County in southwestern Ohio. The Mound site is mainly within the southern city limits of Miamisburg and is about 10 miles south-southwest of the Dayton city limits. The Mound Plant is operated by Monsanto Research Corporation (MRC) under contract with DOE. The main mission of Mound is to manufacture nonnuclear components and tritium-containing components for nuclear weapons which are assembled at another site. The Mound site has been in continuous use since 1948.

In meetings with Federal and State regulators, the State regulatory agencies expressed their concern over plutonium in the soils of an abandoned canal located in a city park. They also expressed concern over Mound's continued need to pump the Buried Valley Aquifer to keep tritium levels within the Safe Drinking Water Act's concentration limits. These two issues are among those discussed in this report.

Summary of Findings

The major preliminary findings of the Environmental Survey for the Mound Plant are:

- levels of tritium in on-site and off-site groundwater exceed limits set by the Safe Drinking Water Act; the aquifer serves as a public drinking water supply; activities are being conducted to reduce the levels at the wells to within regulatory limits;

- over 200 drums of hazardous waste and chemical products are stored in an exposed manner that could result in leaks; these practices include waste drums stored in an open field and product storage drums with no diking or curbs stored near stormwater drains;

- various problems including siting, lack of calibration, unmonitored sources and deficiencies in stack sampling, were uncovered in the air monitoring program potentially affecting the accuracy of the reported dose estimates for the facility; and

- seventeen areas on-site and one off-site have varying levels of radioactive surface contamination, generally less than 100 pCi/g; additional areas represent the potential for contamination with hazardous substances.

PRELIMINARY

Overall Conclusions

The Survey found no environmental problems at the Mound Plant that represent an immediate threat to human life. The environmental problems identified at the Mound Plant by the Survey confirm that the site is confronted with a number of environmental problems which are by and large a legacy from past practices at a time when environmental problems were less well understood. These problems vary in terms of their magnitude and risk, as described in this report. Although the sampling and analysis performed by the Mound Plant Survey will assist in further identifying environmental problems at the site, a complete understanding of the significance of some of the environmental problems identified requires a level of study and characterization that is beyond the scope of the Survey. Actions currently under way or planned at the site, particularly the Phase II activities of the Comprehensive Environmental Analysis and Response Program (CEARP) as developed and implemented by the Albuquerque Operations Office, will contribute toward meeting this requirement.

Transmittal of Results

The findings of the Environmental Survey for the Mound Plant were shared with the DOE Albuquerque Operations Office, the DOE Dayton Area Office, and MRC at the Survey closeout briefing held August 29, 1986. Since that time, informal coordination with the site and with representatives of the Albuquerque Operations Office have been ongoing in an effort to keep this report current. Those problems that involve extended studies and multi-year budget commitments will be the subject of the DOE-wide Environmental Survey final report and DOE-wide prioritization.

Within the Office of Environment, Safety and Health, the Office of Environmental Guidance and Compliance has immediate responsibility for monitoring environmental compliance and the status of the Mound Plant Survey findings. The Office of Environmental Audit will continue to assess the environmental problems through the program of systematic environmental audits that will be initiated toward the conclusion of the DOE Environmental Survey in 1988.

PRELIMINARY DRAFT

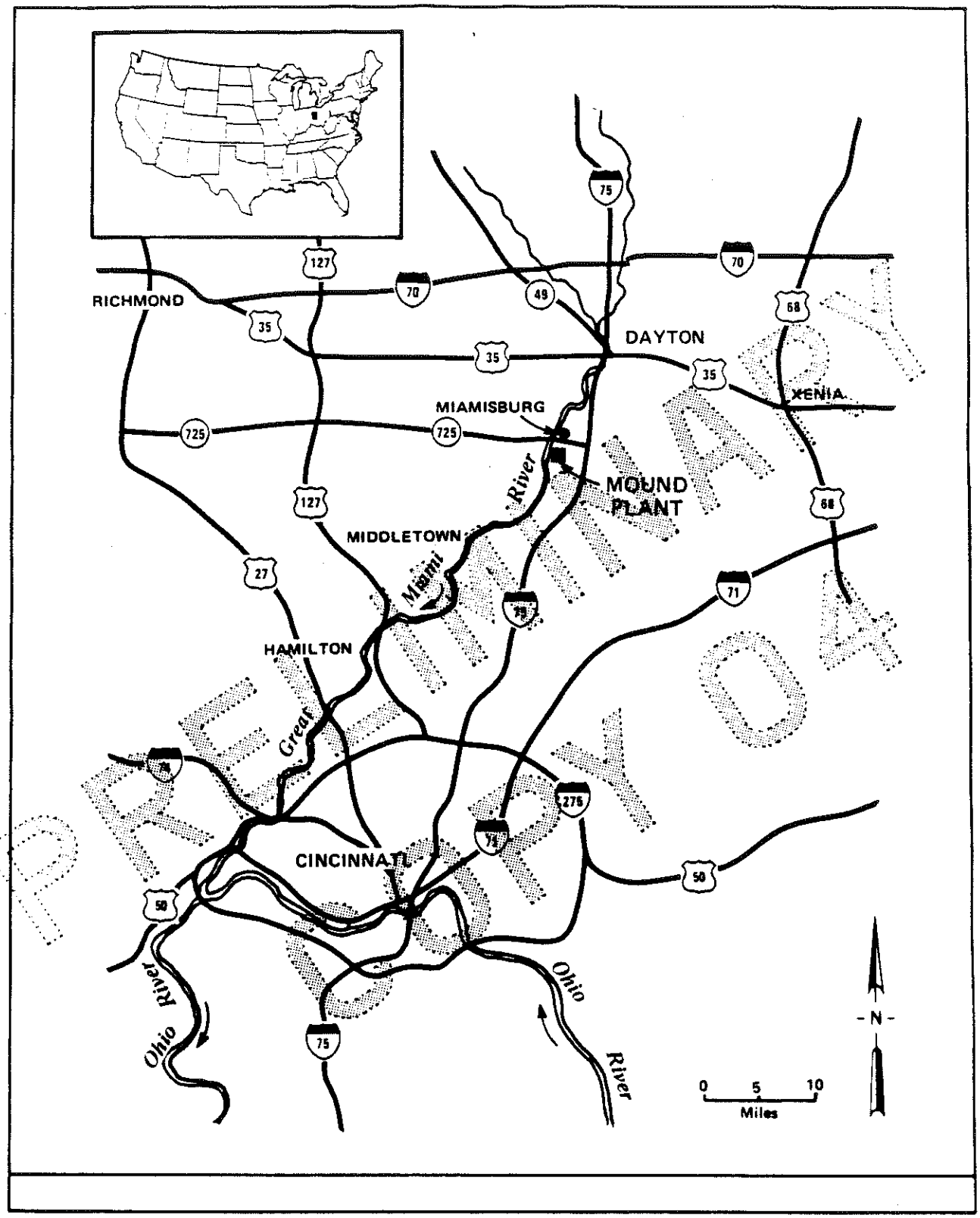
1.0 INTRODUCTION

The purpose of this report is to present the preliminary findings of an Environmental Survey conducted from August 18 through 29, 1986, at the Department of Energy's (DOE) Mound Plant, Miamisburg, Ohio (Figure 1.1-1). Mound is operated for DOE by the Monsanto Research Corporation (MRC), a subsidiary of the Monsanto Chemical Company.

The Mound Survey is part of the DOE-wide Environmental Survey announced by Secretary John S. Herrington on September 18, 1985. The purpose of the overall effort is to identify, via "no fault" baseline Surveys, existing environmental problems and areas of environmental risk at DOE facilities, and to rank them on a DOE-wide basis. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and allocate the resources necessary to correct these problems. Because the Survey is "no fault" and is not an "audit," it is not designed to identify specific isolated incidents of noncompliance or to analyze environmental management practices. Such incidents and/or management practices will, however, be used in the Survey as a means of identifying existing and potential environmental problems.

The Mound Environmental Survey was conducted by a multidisciplinary team of technical specialists headed and managed by a team leader and assistant team leader from DOE's Office of Environmental Audit. A complete list of Survey participants and their affiliations is provided in Appendix A.

The Survey team focused on all environmental media and used Federal, State, and local environmental statutes and regulations, accepted industry practices, and professional judgment to make the preliminary findings included in this report. The team carried out its activities in accordance with the guidance and protocols in the draft Environmental Survey Manual (DOE, 1986a). Substantial use of existing information, plus interviews with knowledgeable field office and site-contractor personnel, accounted for a large part of the on-site effort. A summary of the site-specific Survey activities is presented in Appendix C.



Mound Plant Location Map, Southwestern Ohio Figure 1.1-1

DOE SURVEY-MOUND
AUGUST 1986

The preliminary Survey findings are presented in Chapters 3 and 4 in the form of existing and potential environmental problems. Chapter 3 includes those findings that pertain to a specific environmental medium, e.g., air or soil, while Chapter 4 includes those that are non-media specific, e.g., waste management, direct radiation, and quality assurance. Because the findings vary greatly in terms of magnitude, risk, and characterization, and consequently require different levels of management attention and response, they are further divided into four categories within each of the sections in Chapters 3 and 4.

The criteria for placing a finding into one or more of the four categories are as follows:

Category I includes only those findings which, based upon the information available to the team leader, involve immediate threat to human life. Findings of this type shall be immediately conveyed to the responsible Environmental Safety and Health personnel at the scene or in control of the facility or location in question for action. Category I findings are those environmental problems where the potential risk is highest, the confidence in the finding, based on the information available, is the strongest, and the appropriate response to the finding is the most restrictive in terms of alternatives.

Category II findings encompass one or more of the following situations:

- Multiple or continuing exceedances, past or present, of a health-based environmental standard where there is immediate potential for human population exposure, or a one-time exceedance where residual impacts pose an immediate potential for human population exposure.

- Evidence that a health-based environmental standard may be exceeded, as discussed in the preceeding situation, within the time-frame of the DOE-wide Survey.

- Evidence that the likelihood is high for an unplanned release due to, for example, the condition or design of pollution abatement or monitoring equipment or other environmental management practices.

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- Noncompliance with significant regulatory procedures, i.e., those substantive technical regulatory procedures designed to directly or indirectly minimize or prevent risks, such as inadequate monitoring or failure to obtain required permits.

Category II findings include those environmental problems where the risk is high but the definition of risk is broader than in Category I. The information available to the team leader is adequate to identify the problem but may be insufficient to fully characterize it. Finally, in this category, more discretion is available to the operations offices and program offices as to the appropriate response; however, the need for that response is such that management should not wait for the completion of the entire DOE-wide Survey to respond. Unlike Category I findings, a sufficient near-term response by the operations office may include further characterization prior to any action taken to rectify the situation.

Category III findings encompass one or both of the following criteria:

- The existence of pollutants or hazardous materials in the air, water, groundwater, or soil resulting from DOE operations that pose or may pose a hazard to human health or the environment.

- The existence of conditions at a DOE facility that pose or may pose a hazard to human health or the environment.

Category III findings are those environmental problems for which the broadest definition of risk is used. As in Category II, the information available to the team leader may not be sufficient to fully characterize the problem. Under this category, the range of alternatives available for response, and the corresponding time-frames for response, are the greatest. Environmental problems included within this cateogory will typically require lengthy investigation and remediation phases as well as multiyear budget commitments. These problems will be included in the DOE-wide prioritization effort to ensure that DOE's limited resources are used effectively.

PRELIMINARY DRAFT

In general, the levels of pollutants or materials that constitute a hazard or potential for hazard are those that exceed some Federal, State, or local regulations for release of, contamination by, or exposure to such pollutants or materials. However, in some cases, the Survey may determine that the presence of some nonregulated material is in a concentration that presents a concern for local populations or the environment that is sufficient to be included as an environmental problem. Likewise, the presence of regulated materials in concentrations, even though below those established by regulatory authorities, that nevertheless present a potential for hazard or concern may be classified as an environmental problem. In general, however, conditions that meet regulatory or other requirements, where such exist, should not present a potential hazard and will not be identified as an environmental problem.

Conditions that pose or may pose a hazard are generally those which are violations of regulations or requirements (e.g., improper storage of hazardous chemicals in unsafe tanks). Such conditions present a potential hazardous threat to the health and the environment and should be identified as an environmental problem. Additionally, potentially hazardous conditions are those where the likelihood of the occurrence of release is high.

The definition of the term environmental problem is broad and flexible to allow for the wide differences among the DOE sites and operations. Therefore, a good deal of professional judgment must be applied to the identification of environmental problems.

Category IV findings include instances of administrative noncompliance and management practices that are indirectly related to environmental risk, but are not appropriate for inclusion in Categories I-III. Such findings can be based upon any level of information available to the team leader, including direct observations by the team members. Findings in this category are generally expected to lend themselves to relatively simple, straightforward resolution without further evaluation or analysis. These findings, although not part of the DOE-wide prioritization effort, will be passed along to the operations offices and appropriate program office for appropriate action.

Based on the professional judgment of the team leader, the findings within the categories are arranged in order of relative significance. Comparing the relative significance of one finding to another, either between categories within a section or within categories between sections, is neither appropriate nor valid. The categorization and listing of findings in order of significance within this report constitute only the first step in a multistep, iterative process to prioritize DOE's problems.

The next phase of the Mound Survey is sampling and analysis (S&A). Battelle Memorial Institute, the S&A team for Mound, will be taking samples over a 2-week period beginning May 1987. Prior to sampling, an S&A plan will be prepared by DOE and Battelle in accordance with the protocols in the draft Survey Manual. The S&A plan will be designed to fill existing data gaps or weaknesses. The results generated by the S&A effort will be used to assist the Survey team in further defining the existence and extent of potential environmental problems identified during the Survey.

An Interim Report will be prepared 4 to 6 weeks after the completion of the S&A effort. The Interim Report will incorporate the results of the S&A effort as well as any changes or comments resulting from the review of the Preliminary Report. Based on the S&A results, the preliminary findings and observations made during the on-site Survey may be modified, deleted, or moved within or between categories. The Interim Report will serve both as the site-specific repository for information generated by the Survey and, ultimately, as the site-specific source of information for the DOE-wide prioritization of environmental problems.

It is clear that certain findings and observations contained in this report, especially those in Category II, can and should be addressed in the near term, i.e., prior to the DOE-wide prioritization effort. It is also clear that the findings and observations in this report vary greatly in terms of magnitude, risk, and characterization. Consequently, the priority, magnitude, and timeliness of near-term responses will require careful planning to ensure appropriate and effective application. The information in this Preliminary Report will assist the Albuquerque Operations Office in planning these near-term responses.

2.0 GENERAL SITE INFORMATION

2.1 Site Setting

The Mound Plant is located on a 306-acre site in southern Montgomery County in southwestern Ohio (Figure 2.1-1). The Mound site is mainly within the southern city limits of Miamisburg and is about 10 miles south-southwest of the Dayton city limits.

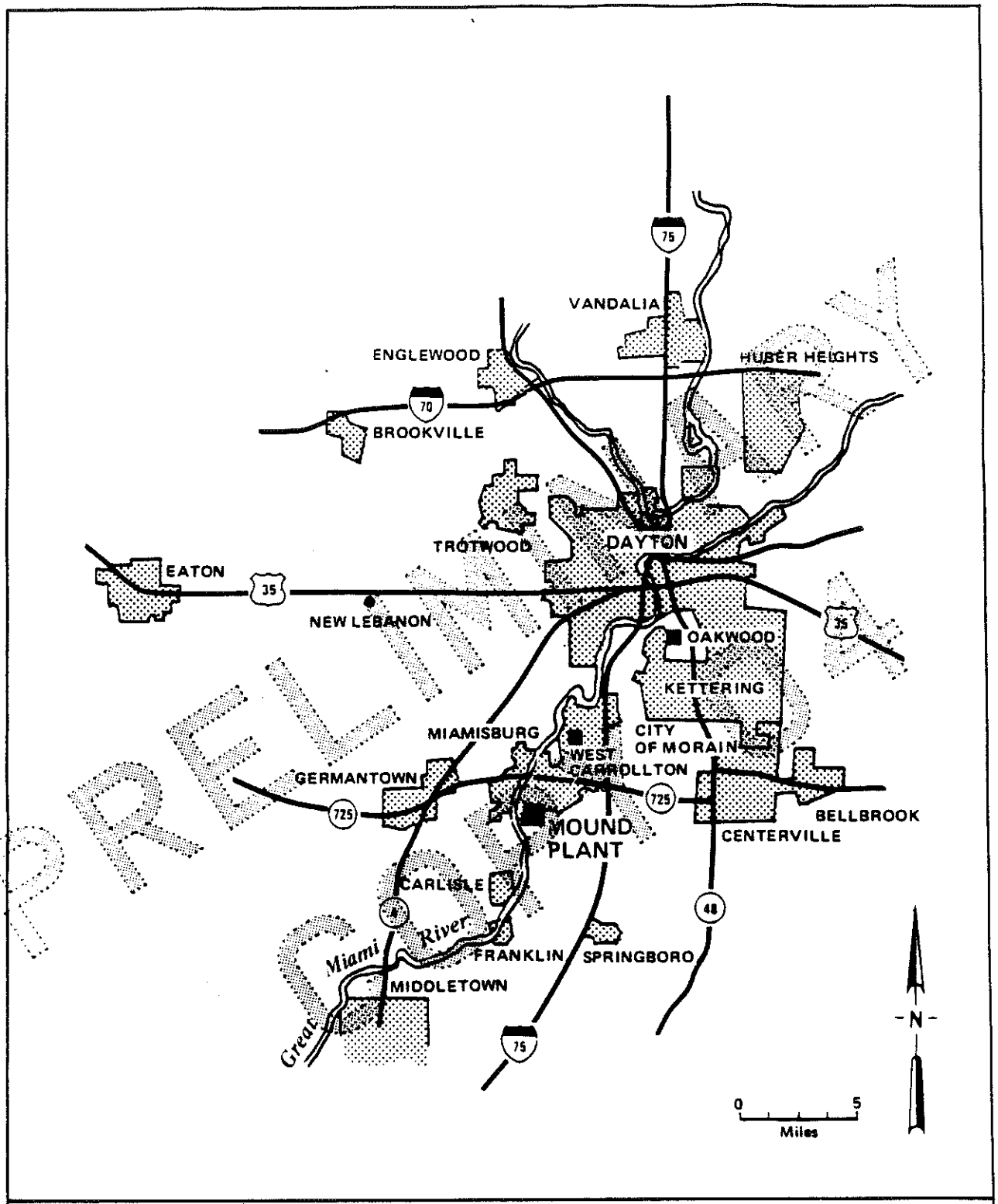
The northern boundary of the site is approximately 0.13 mile south of Mound Avenue in Miamisburg (Figure 2.1-2). Mound Avenue curves south, becomes Mound Road, and runs south along the eastern boundary of the site. The southern boundary of the site is Benner Road. Tracks of the Penn Central Railroad roughly parallel the western boundary at distances ranging from approximately 50 to 200 feet. The Great Miami River flows 1500 to 2000 feet west of the site.

The present land use within a 5-mile radius is mostly residential, with limited industrial development. Most residential, commercial, and industrial development is concentrated on the Great Miami River floodplain. The adjacent upland areas are used for residences and agriculture or are unused open spaces.

Miamisburg has 13 parks and 4 playgrounds. Mound Golf Course and Miamisburg Mound State Memorial Park, directly east of the facility across Mound Road, are heavily used during favorable weather. The Memorial Park is the site of a 68-foot-high ancient Indian mound, which is located 380 feet east-southeast of the site boundary. The other recreational areas, including the municipal swimming pool, Harmon Athletic Field, and Library Park, are extensively used in summer

The major water body in the vicinity of the plant site is the Great Miami River. It is approximately 150 to 200 feet wide in this area. There is no commercial barge traffic or commercial fishing, but some pleasure boating and sport fishing do occur, usually during the summer.

Agricultural land within a 5-mile area around the site is used primarily for corn and soybean production and for livestock grazing.



Source: Mound Final Environmental Impact Statement

Dayton/Miamisburg Area Map

Figure 2.1-1

DOE SURVEY-MOUND
AUGUST 1986

Miamisburg Street Map

Figure 2.1-2

DOE SURVEY-MOUND
AUGUST 1986

The 1980 census results show the population of Miamisburg as 15,300, Dayton as 199,540, and Montgomery County as 571,700. There is no large seasonal variation in population for the local area surrounding Mound. There are no major parks, major landmarks, or tourist attractions that draw a significant seasonal transient population to the area. There are approximately 2300 employees at the facility from 7:00 a.m. to 5:00 p.m. during the 5-day workweek. Most of these employees work in the northwest area of the facility. Approximately 100 employees work on Saturdays and 50 on Sundays and at night.

The climate of the area is continental, with moderate extremes in temperature. Summers are rather warm and humid, but temperatures rarely exceed 100°F. Winters are moderately cold, with an average of about 2 days of subzero weather and frequent periods of extensive cloudiness. Autumns are predominantly cool, dry, and invigorating. Spring is the wettest season. Severe weather usually means heavy thunderstorms resulting in damaging winds and local flash flooding. Temperatures in the Dayton area range from an average daily minimum of 23.1°F in January to an average daily maximum of 86.9°F in July.

The relative humidity in southwestern Ohio is moderately high, in correlation with precipitation patterns. Estimated average values for different times of the day at the Mound site range from 50 to 85%.

Precipitation is common in all seasons. The average annual rainfall equivalent is about 40 inches, including about 27 inches per year of snow. The maximum 24-hour rainfall recorded in Dayton is 4.68 inches.

The surface wind flow at Dayton is predominantly from the southwest quadrant. Average annual wind speeds range from 7 to 10 miles an hour (MRC, 1985a).

2.2 Overview of Major Site Operations

The main mission of Mound is to manufacture both nonnuclear and tritium-containing components for nuclear weapons which are assembled at another DOE site. The Mound site has been in continuous use since 1948.

Production activities are conducted in more than 100 buildings situated on two hills (the "Main Hill" and the "SM/PP Hill") and in the valley separating the two hills (Figure 2.1-3). As can be seen from the figure, the northern part (183 acres) of the Mound site is a heavily developed site with a high density of buildings, roads, and parking lots. The southern part (the new property, which includes 123 acres) was purchased in 1983 and has not been developed. Most of the new property is covered with trees or other vegetation. The Mound Site Development and Facilities Utilization Master Plan (MRC, 1985a) has identified the majority of the new property as suitable for future major construction projects.

Mound is also involved in a number of weapon and nonweapon programs in fulfilling its missions. A wide variety of activities are performed for the following major programs.

- Weapons Program - Activities associated with the weapons program include research, development, and production of: detonators; timers, transducers and switches; firesets; actuators; and nuclear components. Surveillance is also performed on various components of weapons taken from stockpile. In addition, 36 products on 9 different types of ordnance are procured for other sites involved in the program.

- Stable Isotope Program - Development of isotope separation methods for biomedical applications, molecular science research, isotope separation research and development, stable isotopes inventory program and worldwide sales, and isotope separation by chemical exchange are the major efforts conducted within the stable isotope program.

- Safeguards Program - Mound's safeguards programs include research and development for nuclear measurement instruments and methodology, and provide site assistance for nuclear material accountability, and calorimeter reimbursable materials.

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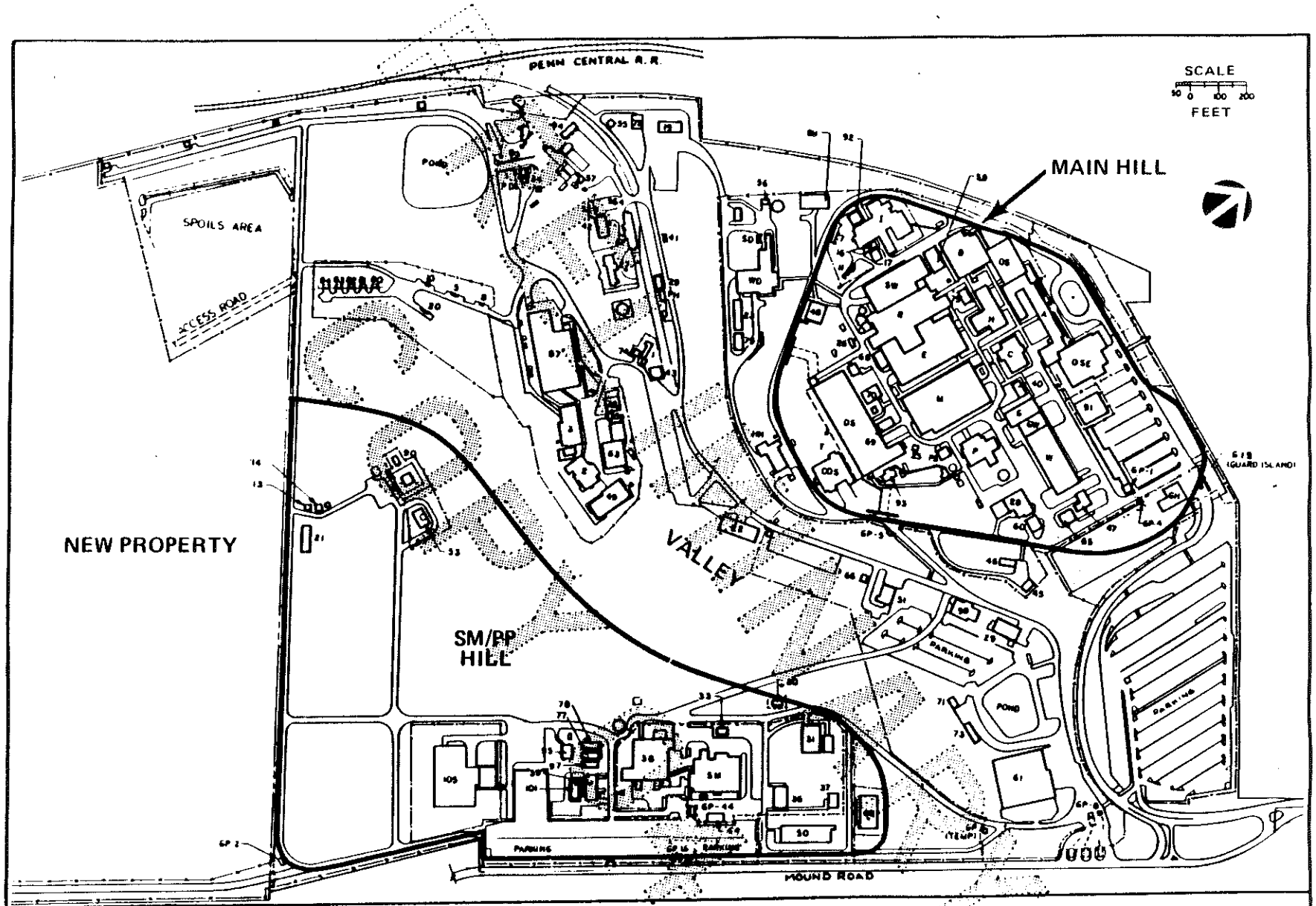

Source: MRC Drawing, April 1985: Site Plan

Figure 2.1-3

Mound Plant Building Map

DOE SURVEY-MOUND
AUGUST 1986

- o Heat Source Program - Mound's activities in the heat source program include hardware fabrication, radioactive module assembly, radioisotopic thermoelectric generator (RTG) assembly, and testing of heat sources for the production of electricity in space, in the ocean, and on land. Also associated with this program are the receipt and monitoring of spare flight RTG's after launches are completed at Kennedy Space Center.

- o Tritium Recovery Program - Mound receives scrap materials from other DOE sites and recovers and purifies the tritium for future use.

2.3 State/Federal Concerns

Representatives of the Survey team met with the U.S. Environmental Protection Agency (EPA), Region V, on July 1, 1986, and the State of Ohio environmental agencies on July 2, 1986, as part of the pre-Survey information exchange. In addition, early in the Survey, on August 19, 1986, the team met again with representatives of the State of Ohio to allow the State to set forth additional concerns. At these meetings, the Survey team representatives asked the Federal and State representatives to identify and discuss their environmental concerns about the Mound Plant so that these could be reviewed during the DOE Survey. These concerns are summarized below.

U.S. EPA's only concern was to ensure that the Survey team had a good understanding of certain aspects of the environmental regulations. The regulations of particular concern include:

- o Groundwater contamination from leaking underground storage tanks, and

- o Underground injection control.

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Ohio environmental agencies, including the Ohio EPA, the Department of Health, and the Regional Air Pollution Control Agency (RAPCA), wanted information pertaining to the following concerns:

- o The extent of tritium groundwater contamination;
- o The potential for plutonium contamination of groundwater and surface water from broken or leaky pipelines;
- o A comprehensive inventory of sources of environmental contamination from the Mound Plant;
- o The types of chemical compounds going into and out of the sanitary treatment plant, particularly methylene chloride;
- o The types and quantities of chemicals stored on-site;
- o The impact of sewer leaks;
- o The potential for plutonium detection in groundwater below the Miami-Erie Canal; and
- o The potential for surface-water contamination from biocides.

In addition, representatives of RAPCA asked the Survey team to determine if any processes in the facilities were operating in contravention of the air permit/registration requirements of the State of Ohio.

Information presented herein should be useful to the Ohio environmental agencies and RAPCA in addressing these concerns.

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3.0 MEDIA-SPECIFIC SURVEY FINDINGS AND OBSERVATIONS

The discussions in this section pertain to existing or potential environmental problems in the air, soil, water and groundwater media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team related to each medium.

3.1 Air

3.1.1 Background Environmental Information

The Mound Plant is located in the Dayton Air Quality Control Region (AQCR), which includes Clark, Darke, Greene, Montgomery, and Preble counties within the Ohio Environmental Protection Agency's (OEPA) Southwest District. Table 3.1-1 presents the National Ambient Air Quality Standards (NAAQS) pertinent to the Dayton AQCR which are designed to protect the health and welfare of the general public. RAPCA, under contract to the Montgomery County Department of Health, administers the OEPA air regulations in the Dayton AQCR. In addition, Mound is a source of radioactive and other hazardous air emissions regulated by the regional office of the U.S. Environmental Protection Agency (EPA). Because Mound is a DOE facility, the Federal regulations which are applicable to the Mound Plant are included in the National Emission Standards for Hazardous Air Pollutant (NESHAP) of Title 40, Code of Federal Regulations, Part 61, Subparts C, E, H, J, and M.

Table 3.1-2 presents the average annual wind rose from the on-site meteorological station for a 4-year period. The prevailing winds measured at the site are from the south-southwest through west-southwest sectors, occurring with an average frequency of 30.8 percent. Southwesterly winds occur most frequently. These wind directions are also associated with somewhat higher average wind speeds (5.4 meters per second), compared with the annual average of 4.4 meters per second. Winds from the north-northwest through the south-southeast occur with approximately the same frequency (4.1-4.9%), while southerly and westerly through northwestly winds occur with a somewhat higher frequency (5.3-6.0%).

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Table 3.1-1

AMBIENT AIR QUALITY STANDARDS STATE OF OHIO

Air Contaminant	Standard		Units	Averaging Period
	Primary	Secondary		
Sulfur Dioxide	80 360 --	-- -- 1300	µg/m³ µg/m³ µg/m³	Annual 24 hours 3 hours
Total Suspended Particulates	75 260	60 150	µg/m³ µg/m³	Annual 24 hours
Carbon Monoxide	10 40	60 150	µg/m³ µg/m³	8 hours 1 hour
Nitrogen Dioxide	100	Same as Primary	µg/m³	Annual
Ozone	244	Same as Primary	µg/m³	1 hour
Lead	1.5	Not Established	µg/m³	3 months

Source: 40 CFR 52.1883

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Table 3.1-2

FOUR-YEAR AVERAGE ANNUAL WIND ROSE AT MOUND PLANT

(1981 THROUGH 1984)

Direction	Frequency (Percent)	Average Wind Speed (meter/sec)
N	4.2	4.3
NNE	4.5	4.1
NE	4.9	4.0
ENE	4.9	4.0
E	4.5	4.1
ESE	4.1	3.9
SE	4.4	4.1
SSE	4.7	4.2
S	6.0	4.4
SSW	9.7	5.0
SW	12.4	5.6
WSW	8.7	5.2
W	5.4	5.0
WNW	5.3	5.1
NW	6.0	4.7
NNW	4.4	4.4
Calm	6.1	-
Average		4.4

Source: MRC, 1982 - 1984, 1985b

PRELIMINARY DRAFT

3.1.1.1 Nonradioactive Air Contaminants

The Dayton AQCR is designated an attainment area for sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2) and lead (Pb). The cities of Miamisburg and Dayton are nonattaining for the primary total suspended particulate (TSP) standards and, with the exception of Preble County, the Dayton AQCR also does not meet the primary standard for ozone (O_3).

The nonattainment status of the Dayton AQCR with respect to the primary NAAQS for TSP and ozone requires special attention to the emissions of particulate matter and hydrocarbons from the facility. The formation of ozone in the lower atmosphere occurs through a complex air chemistry that involves photochemical reactions with atmospheric hydrocarbons. Thus, the emissions of photochemically reactive hydrocarbons are considered precursors to the ambient levels of ozone in the atmosphere, and implementation plans for attainment and maintenance of the ozone NAAQS involve the control of hydrocarbons.

There is a growing environmental concern relative to the anthropogenic emissions of toxic air pollutants (TAP). At present, NAAQS have not been established for these air contaminants, but many State regulatory agencies have, or are in the process of developing, regulations governing TAPs. Table 3.1-3 lists those air emissions currently classified as toxic air pollutants in the State of Ohio (Lee, 1986). The OEPA is in the process of preparing a formal list of toxic air pollutants.

3.1.1.2 Radioactive Air Contaminants

Current activities at Mound are sources of radioactive air emissions to the atmosphere. Plutonium is used as a heat source for radioisotope thermoelectric generators manufactured at Mound for the military and civilian space programs. The normal isotopic composition of the plutonium used for this application is 80% ^{238}Pu, 17% ^{239}Pu, and 3% of the heavier isotopes (^{240}Pu, ^{241}Pu, ^{242}Pu) by weight (Dobry, 1980). Tritium (^{3}H) separation and enrichment constitute a major activity in support of the nuclear weapons program and controlled thermonuclear research and development programs. Mound also performs the separation of stable radionuclides for civilian applications.

Table 3.1-3

TOXIC AIR POLLUTANTS, STATE OF OHIO

Acetaldehyde	Ethylene
Acetonitrile	Ethylene dibromide
Acrylonitrile	Ethylene dichloride
Ammonia	Ethylene oxyde
Arsenic and compounds	Fluorine
Benzene	Formaldehyde
Benzo (a) pyrene	Hydrogen cyanide
Beryllium and compounds	Maleic anhydride
Bromine	Methyl chloride
Butadiene	Methyl methacrylate
Cadmium and compounds	Methylene chloride
Carbon disulfide	Perchloroethylene
Carbon tetrachloride	Phosgene
Chlorine	Styrene
Chlorabenzene	Titanium tetrachloride
Chloroform	Toluene
Chromium (VI) compounds	Toluene diisocyanate
Cyanide and compounds	Vinyl chloride
Dioxin	Xylene
Ethylbenzene	

Source: Lee, 1986

Although plutonium does not occur naturally, there is an anthropogenic global background level of plutonium in the environment caused by nuclear weapons testing and nuclear-powered satellite burnup during reentry. Figure 3.1-1 shows the levels of plutonium at a monitoring station about 28 miles from Mound and a general trend of overall reduction in background levels of plutonium from 1974 through 1985, not only globally but also around the Mound Plant.

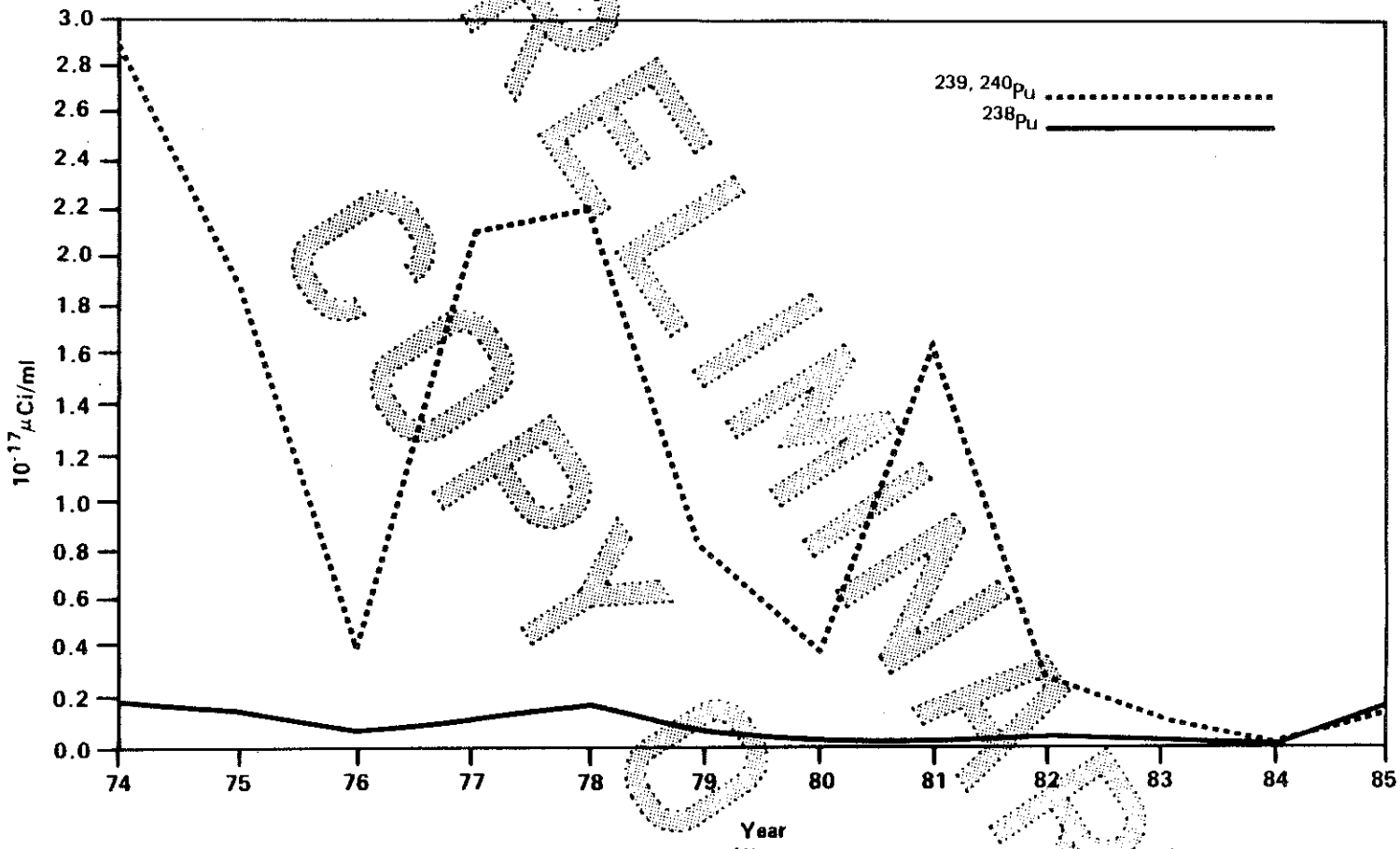
Tritium is produced by natural processes from cosmic-ray-induced transformations taking place in the atmosphere. Cosmogenic tritium production is estimated to lead to a steady state global inventory of 29 megacuries (MCi). However, anthropogenic production and release of tritium far outshadow its natural occurrence. The background concentration of tritiated water vapor measured 28 miles from Mound is shown in Figure 3.1-2 and establishes a trend of overall tritium reduction from 1974 to 1985 not only globally but also around the Mound Plant.

3.1.2 General Description of Pollution Sources/Controls

The discussion of air emissions, controls and problems at the Mound Plant is presented in terms of radioactive and nonradioactive materials. The nonradioactive emissions include a wide range of substances generated by the burning of fuel and by the research, development, and production processes conducted at the facility. The radioactive emissions, including plutonium, tritium, and possibly others, are generated by present operations and potentially by the resuspension of contaminated soils.

3.1.2.1 Nonradioactive Air Contaminant Sources

The sources and emissions of nonradioactive air contaminants generated by the Mound Plant are presented in this section. These contaminants include, in part, the criteria pollutants with established ambient air quality standards, and those air contaminants regulated under either a New Source Performance Standard (NSPS) or NESHAP. However, the Survey also considered the emissions of toxic air pollutants, whether or not they were listed by the State, and unregulated air contaminants which might pose a future problem.



Source: Mound Environmental Monitoring Reports (MRC, 1975-1984, 1985b; 1986b)

Measured Background ^{238,239}Pu Air Concentrations in Southwestern Ohio, 1974 - 1985 Figure 3.1-1

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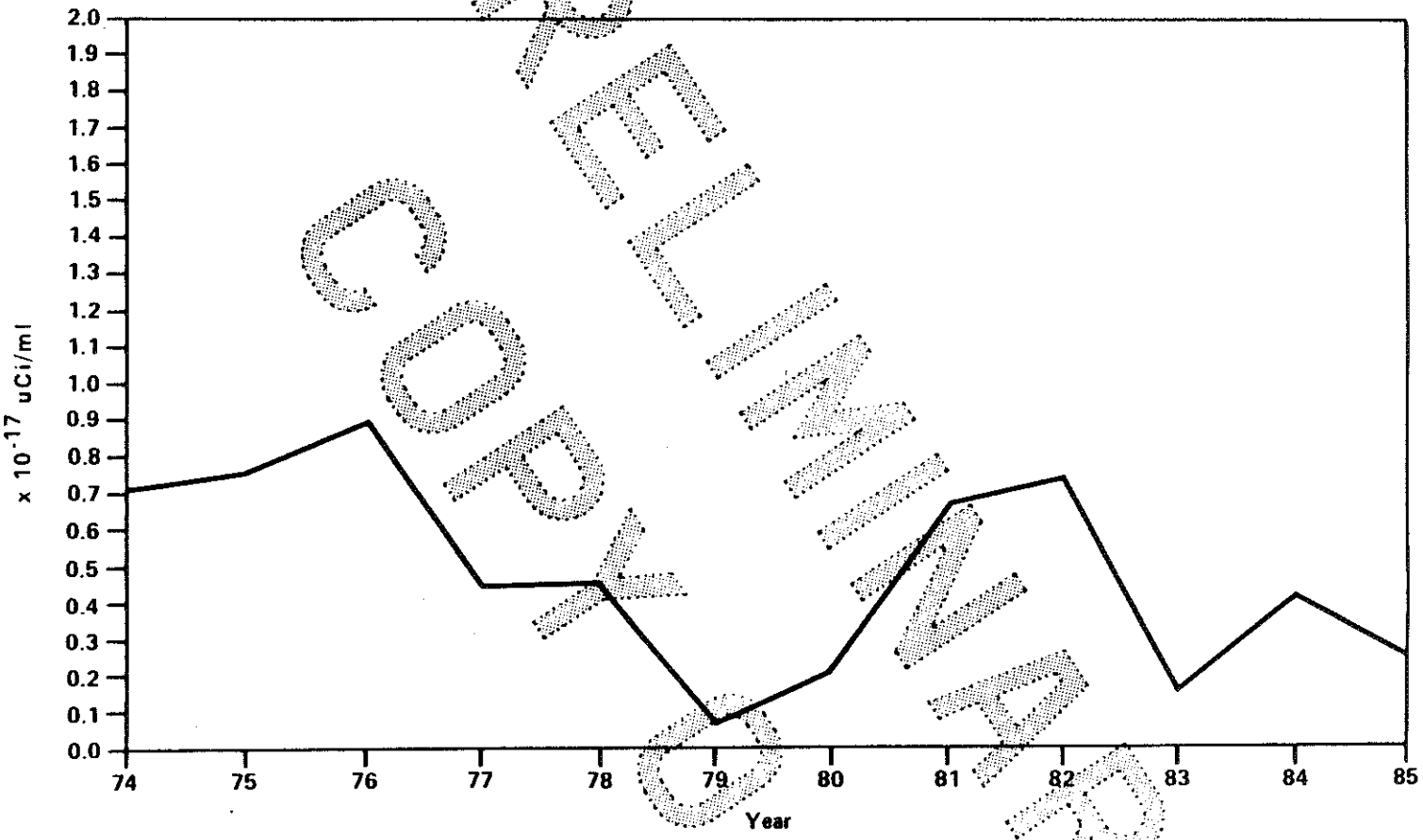

PRELIMINARY DRAFT

Source: Mound Environmental Monitoring Reports (MRC, 1975-1984, 1985b, 1986b)

Measured Background Tritium Air Concentrations in Southwestern Ohio, 1974 - 1985

Figure 3.1-2

NOT FOR PUBLIC DISSEMINATION
May contain unclassified controlled nuclear information subject to Section 148 of the AEA, as amended (42 USC 2168). Approval by the Department of Energy prior to release is required.

3.1.2.1.1 Fuel-Burning Sources and Emission Controls

There are 11 fuel-burning sources at eight locations on the Mound Plant (Figure 3.1-3). The Powerhouse (P Building) operates two boilers rated at 60,000 lbs/hr and 85,000 lbs/hr steam generation to meet the space heat and process steam demands at Mound. Maximum steam demands are about 80,000 lbs/hr so that only one boiler is in operation at a given time. Ninety-five percent of the steam generation is used for space heat, and the remaining five percent is used for process heat in the stable isotope separation processes (HH Building). The boilers operate on an interruptable natural gas supply as the primary fuel, with No. 2 grade diesel oil fired in the boilers when natural gas is unavailable. The boiler flue gases are emitted to the atmosphere from the P Building stack without emission controls. However, due to the low fuel burning rate and low sulfur content of the fuels used, there is no need to apply such controls on the boilers.

Other fuel burning equipment includes the Building 90 retort in the high-explosive burn area (propane fuel) and emergency diesel generators for use in the event of a loss of off-site power. The location and size of these emergency diesels are as follows:

Location	Rating (kw)
P Building	60
P Building	300
R Building	565
Building 2/3	25
Building 38	565
Building 56	175
Building 57	100
Building 58	565

These diesels are tested once a week to ensure their operability in the event they are needed during an emergency. They are considered very minor sources of air pollutants.

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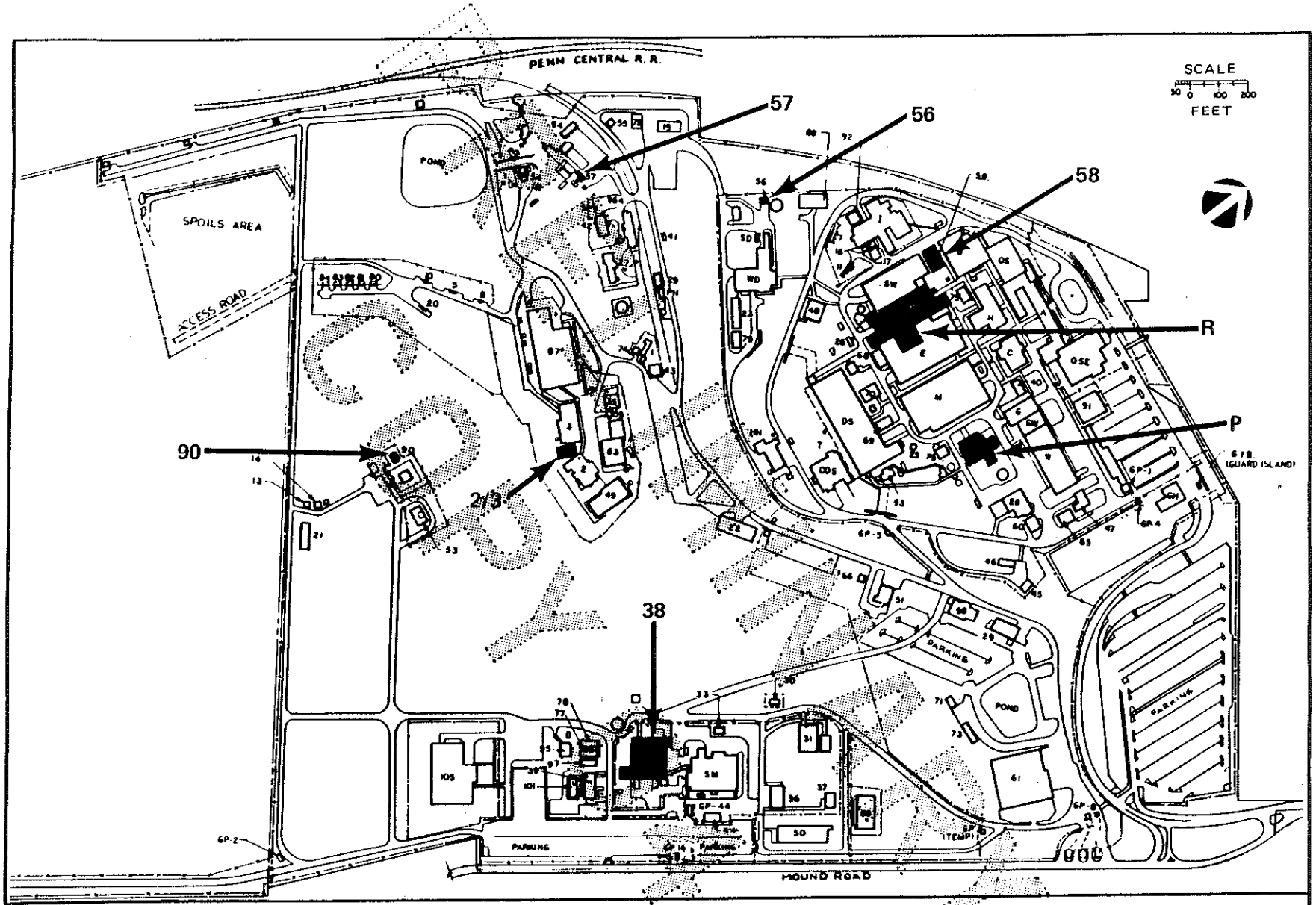

Source: MRC Drawing, April 1985: Site Plan

Location of Fuel-Burning Sources at the Mound Plant

Figure 3.1-3

3.1.2.1.2 Process Sources and Emission Controls

The production of explosive components for the nuclear weapons program is a major activity and a source of nonradioactive air emissions from Mound. However, there are also nonradioactive emissions of air contaminants from other process areas and the support services. These activities occur in a number of different buildings on the facility, and it is a difficult task to identify the individual sources and to inventory the air contaminants they emit. With a few exceptions, the research and development activities at Mound are conducted on a laboratory bench-scale basis. Mound does not have a comprehensive list of air contaminant sources or an inventory of its air emissions. This seriously complicated the work of the Survey team.

The scope of this problem can be appreciated both by the number of ventilation hoods used in the facility and by the variety of chemicals handled. A computer printout of all ventilation hoods was provided to the Survey team by the heating, air conditioning, and ventilation (HVAC) staff (MRC, 1986a). Mound has a total of 570 ventilation hoods in 34 separate buildings, as summarized in Table 3.1-4. These hoods handle a wide spectrum of hazardous and toxic materials, including acetone, acetonitrile, asbestos, benzene, carbon disulfide, chloroform, hydrochloric acid, hydrofluoric acid, mercury, methylene chloride, nitric acid, percholoroethylene, potassium cyanide, sulfuric acid, toluene, trichloroethylene, and xylene as well as radioactive materials. Numerous other organic materials are also in use. Mound's Industrial Hygiene and Engineering departments conscientiously test the ventilation rates of these hoods to ensure that they work as designed to maintain the workplace environment. However, the control of fumes and vapors in the workplace leads to their emission into the atmosphere. With a few exceptions, only small quantities of the various materials are used in each hood. As a consequence, the Survey focused on the potential emissions of toxic air pollutants and hazardous air pollutants under the NESHAPs, since even small quantities of these materials may present a problem.

Table 3.1-4

SUMMARY OF VENTILATION HOODS AT MOUND

Mound Laboratory Hoods			
Building	Number of Hoods	Building	Number of Hoods
02	1	60	6
03	8	63	1
26	3	92	3
27	1	A	1
28	13	B	41
29	12	DS	32
30	1	E	51
36	3	H	6
37	4	HH	16
38	9	I	8
40	2	M	120
42	4	PS	2
43	1	R	70
46	2	SW	58
48	1	T	37
49	23	W	21
51	1	WD	8

Source: MRC, 1986a

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During the Survey, an attempt was made to identify the emission points for each ventilation hood, the materials and amount expected in the effluent stream, and the presence of any emission control device. The HVAC staff assembled the necessary information on the air emission points, and the Purchasing Department provided a complete listing of the materials used on site. Appendix D gives a summary of the emission points for the ventilation hoods and identifies the type of emission control equipment installed on the effluent gas stream. Table 3.1-5 lists the quantities of selected materials purchased at Mound over a 7-month period and extrapolates them on an annual basis. An estimated 71,500 pounds of organic chemicals are used in the various processes throughout Mound each year. However, it was impossible to reconstruct an air emissions inventory by individual building solely from this information. In general, Mound has installed and operates control equipment on many air emission sources, but not for most ventilation hoods that emit organic substances to the atmosphere. It must be stressed that individual ventilation hoods are likely to be small sources of pollution, and unless the material is particularly toxic or hazardous there may not be a compelling reason to install individual control devices.

The use of asbestos in the diallyl phthalate (DAP) plastics process in Building 29 was one area of particular concern to the Survey team. The team found, however, that the handling and processing of asbestos at the facility were adequate to control the emission of this material into the air.

3.1.2.2 Radioactive Air Contaminant Sources

Of the chemical substances used at Mound, the air emissions of radioactive contaminants are the primary area of concern from an environmental perspective. Present operations at the facility result in release of plutonium and tritium to the atmosphere. As discussed below, Mound reported a maximum effective dose equivalent of 0.61 mrem by the air pathway from these radioactive emissions in 1985. However, the legacies of past site activities also need to be considered as potential sources of radioactive air emissions. In this category, there are at least two sources of radon emissions at Mound unrelated to the present production operations. In addition, the resuspension of soils contaminated from past practices (see Section 3.2) is a potential source of emissions of uranium, thorium, cesium,

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Table 3.1-5

ESTIMATED ANNUAL USAGE OF CHEMICALS AT MOUND

Inventory of Materials Purchased	
Material	Estimated Annual Usage: (lbs/yr)
Organics	
Acetone	8,705
Acetonitrile	42
Butyroacetone	213(1)
Benzene	42
Cyclohexane	63
Diacetone alcohol	3
Dichlorobenzene	2(1)
Ethanol	30,358
Isopropanol	14,612
Methanol	1,152
Methylene Chloride	6,403
Refrigerant	7,425
Toluene	1,192
Trichloroethane	2,560
Trichloroethylene	6,121
Xylene	11
Inorganics	
Asbestos	Could Not Be Estimated
Cyanides	Could Not Be Estimated
Hydrofluoric acid	2
Hydrochloric acid	2,532
Lead	60(1)
Mercury	233(1)
Mercury chloride	1(1)
Nitric acid	2,532
Sulfuric acid	6,507

Sources: MRC, 1986c
MRC, 1985c

(1) Estimate based on Mound Industrial Hygiene Inventory (MRC, 1985c)

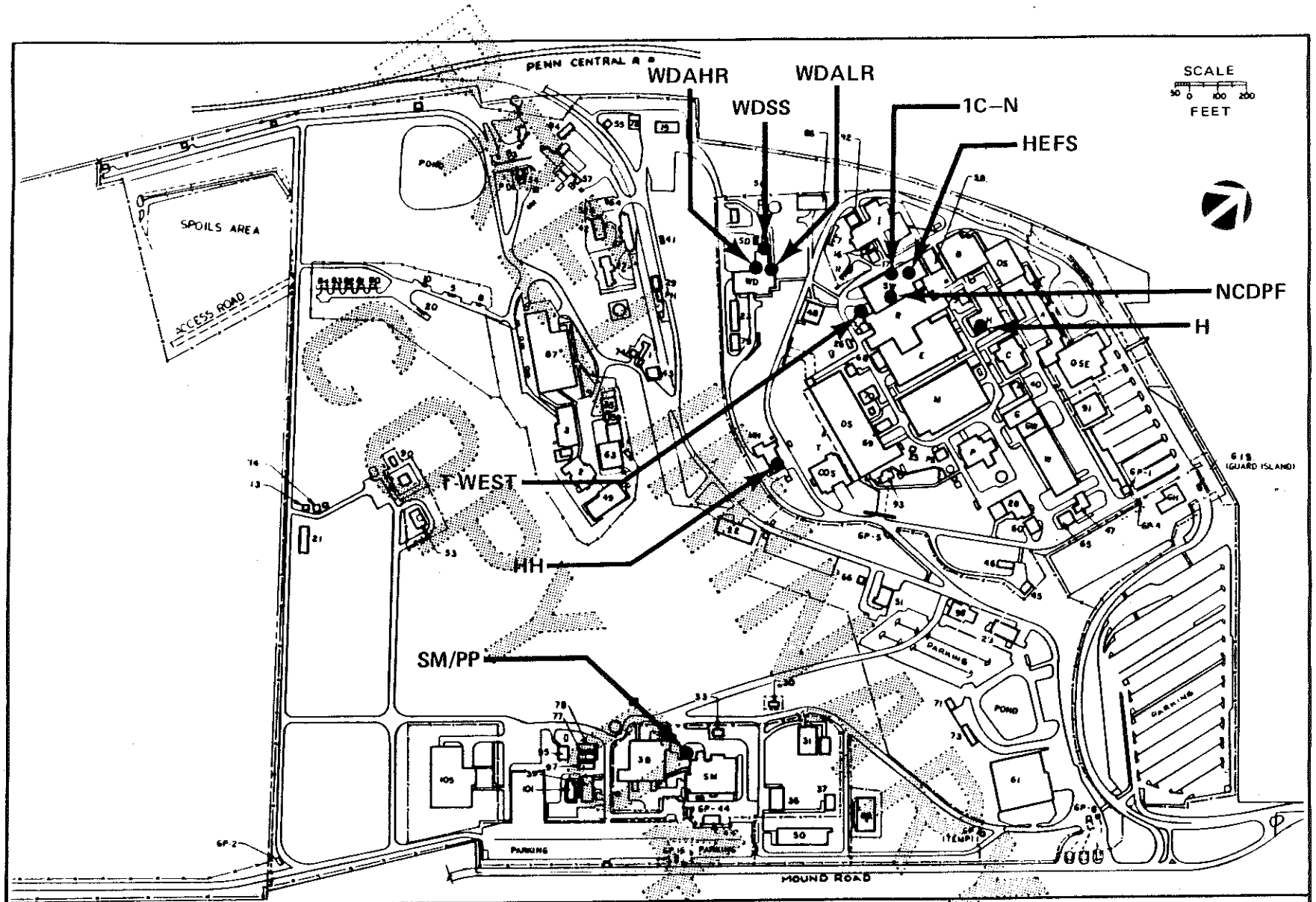
and cobalt as well as plutonium. While polonium has been handled by Mound in the past, it has a relatively short half-life of 138.4 days and has substantially decayed away.

3.1.2.2.1 Plutonium Sources and Emission Controls

With the exception of R Building, where a small amount of plutonium is stored, the major sources of plutonium air emissions are WD Building at the base of the Main Hill, H Building on the Main Hill, and SW and PP Buildings and Building 50 on the SM/PP Hill. There are also potential sources of fugitive plutonium emissions by resuspension from various on-site areas of soil contamination and off-site contamination of sediments in the North Canal (see Sections 3.2.2 and 4.5.1 for discussion of these sources).

All sources of nonfugitive plutonium air emissions at Mound are controlled by high-efficiency particulate air (HEPA) filter banks. Maintenance of the HEPA filters and prefilters is the responsibility of the Engineering Department. Mound personnel read the pressure drop across the filter bank weekly, and stack-flow measurements are conducted monthly. The filters are changed when the pressure drop approaches a predetermined value (normally 2 inches of mercury across a prefilter, but this depends on the particular filter bank). The requirement for filter change-out can be initiated by the HVAC technician, area foreman, or building manager. There are no formal procedures to identify the chain of responsibility for initiating a filter change-out, and some discretion is available to the HVAC technician.

Continuous stack monitoring is performed on all major sources of plutonium at Mound. Sample probes are mounted in the stack or ducts downstream of the HEPA filter bank. The sample stream is split and passes through two continuous alpha monitors (CAM) mounted in parallel, which are set to alarm in the event of a high alpha count. The plutonium-bearing particles are collected on filters, which are changed daily, composited, and analyzed to obtain monthly ^{238}Pu emissions. The materials handled are about 80% ^{238}Pu by weight, but Mound reports that the ^{238}Pu accounts for better than 95% of the dose. The plutonium emission sampling locations used in 1985 are listed in the following table, and Figure 3.1-4 displays their locations on the Mound site.



Source: MRC Drawing, April 1985: Site Plan

Location of Radioactive Emissions Sources at the Mound Plant

Figure 3.1-4

Plutonium Continuous Monitoring Locations

Building	Sample Probe Designation	Stack Designation
H	ADBCA 001 001	H
HH	ADBCB 002 001	HH
PP	ADBCC 003 001	SM/PP
R	ADBCD 004 001	T-West
SM	ADBCD 004 001	SM/PP
SW	ADBCF 006 003	1C-N
SW	ADBCF 006 006	HEFS
WD	ADBCH 008 002	WDSS
WD	ADBCH 008 004	WDALR
WD	ADBCI 009 001	WDALR
WD	ADBCI 009 002	WDAHR
41*	ADBCM 013 001	41
TR-15*	ADBCN 014 001	TR-15

* Building 41 and Trailer 15 emission sampling locations no longer in service.

Table 3.1-6 gives the reported total annual ^{238}Pu emissions for the latest 12 years of operation. Of the total 1985 emissions, Mound reports 77.9% were released from the SM/PP stack, 9.5% from the three WD Building stacks, 6.9% from the T-West (R Building) stack, and 2.0% from the SW Building stacks (MRC, 1985a). The accuracy of the reported emissions of plutonium is considered questionable, since the particulate sampling is not performed isokinetically and the probes are not located far enough from flow disturbances.

3.1.2.2.2 Tritium Sources and Emission Controls

The major sources of tritium air emissions are HH, SW, and T Buildings on the Main Hill. The main tritium process waste gas streams from SW and T Buildings have effluent removal systems to control the release of tritium to the atmosphere. The systems have a chiller unit to condense tritiated water vapor and organics from the stream, followed by a catalytic recombiner unit to convert elemental tritium to tritiated water vapor, and then a dryer unit to remove the tritiated water vapor. These waste streams are then emitted to the atmosphere from the three stacks on SW Building (NCDPF, HEFS and IC-North) and one on T Building (T-West).

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Table 3.1-6

REPORTED ANNUAL ^{238}Pu AND TRITIUM AIR EMISSIONS FROM MOUND PLANT, 1974-1985

Year	Annual Radioactive Emissions	
	^{238}Pu (μCi)	Tritium (Ci)
1974	28	10,000
1975	22	8,859
1976	15	6,206
1977	12	4,896
1978	14	7,346
1979	12	3,821
1980	15	3,795
1981	8	4,285
1982	21	4,283
1983	4	4,293
1984	6.5	3,430
1985	5	4,795

Source: MRC, 1975-1984, 1985b, 1986b

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Front-end and recycle tritium is used at HH Building for the separation of the stable isotope ^3He, which is the daughter formed in tritium beta decay. The waste tritium gas streams from this separation process are emitted from the HH Building stack.

Continuous tritium monitoring is performed on these tritium sources. The tritium sampling locations are presented below and on Figure 3.1-4.

Tritium Continuous Monitoring Locations

Building	Sample Probe Designation	Stack Designation
HH	ADBCB 002 001	HH
SW	ADBCF 006 003	1C-N
SW	ADBCF 008 004	NCDPF
SW	ADBCF 005 006	HEFS
T	ADBCG 007 001	T-West

The tritium samples are passed through three ethylene glycol bubblers to collect tritiated water vapor and organics in the stream. The sample is then passed through a catalytic recombiner to convert elemental tritium to tritiated water vapor and a second set of three ethylene glycol bubblers. This sample collection procedure allows the separate identification of tritiated water vapor and elemental tritium released to the atmosphere.

Table 3.1-6 also presents the tritium emissions from Mound for the last 12 years. The effort to control tritium emissions have resulted in about a 50% reduction over this period. Since 1979, these emissions have been between 4,000 and 5,000 curies per year. In 1985, the HEFS stack accounted for 88.9% of the reported tritium emissions, approximately 44% of which was tritiated water vapor. The NCDPF stack accounted for 8.6% (71% tritiated water vapor) and the 1C-N stack for 2.1% (11.7% tritiated water vapor) of the total 1985 tritium emissions. The T-West and HH stacks were minor sources by comparison (MRC, 1985d). A new tritium recovery process to treat tritiated water, scheduled to go on-line in 1987, will increase tritium emissions by approximately 10 percent.

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May contain unclassified controlled nuclear information subject to Section 148 of the AEA, as amended (42 USC 2168). Approval by the Department of Energy prior to release is required.

3.1.2.2.3 Other Sources of Radioactive Emissions

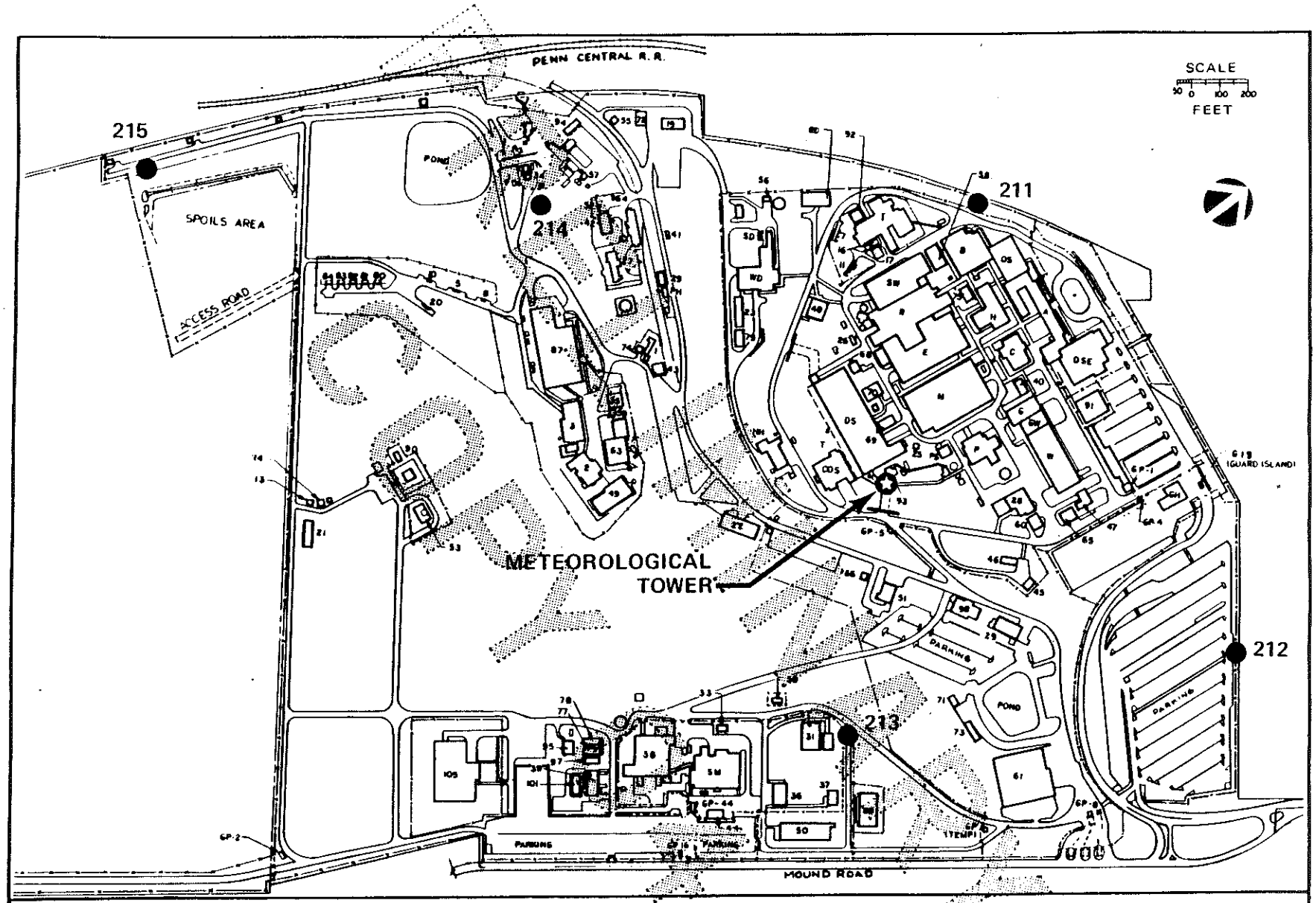
The SW Building and Building 21 are sources of radon air emissions from the facility. A stub stack on the SW Building is used to vent radon being generated from contaminated ducts in a cave area. The effluent stream to the radon stack is sampled and counted by a CAM preset with a high radiation alarm as a precautionary measure. However, the sample stream is not used to collect quantitative data to establish the emission from this radon stack.

Building 21 is used for the storage of Cotter concentrate (thorium ore) used in an earlier process. The Cotter concentrate is stored in 55-gallon drums, which were inspected and found to be in good condition. However, thorium generates radon as a daughter product in its decay chain, and the radon gas can escape from the drums into the building atmosphere. Building 21 has slit ventilation openings on top of the roof and open eaves. Thus, any radon reaching the building atmosphere would have a direct pathway to the outside environment.

Contaminated soils are a potential source of airborne radionuclides when the soil particles are resuspended by wind erosion or human activities. The contamination of soils from past operations at Mound is discussed in Section 3.2. The main radioactive materials of concern are plutonium and thorium, although some areas are known to contain uranium, cesium, and colbalt. With the exception of the North Canal area, all the contaminated soil areas are on-site. Resuspension by wind erosion is mitigated, but not eliminated, by the development of vegetative cover on the contaminated areas. The disturbance of these soils by decontamination and decommissioning (D&D) operations or other earth-moving activities may result in resuspension of radioactively contaminated soils.

3.1.3 Environmental Monitoring Program

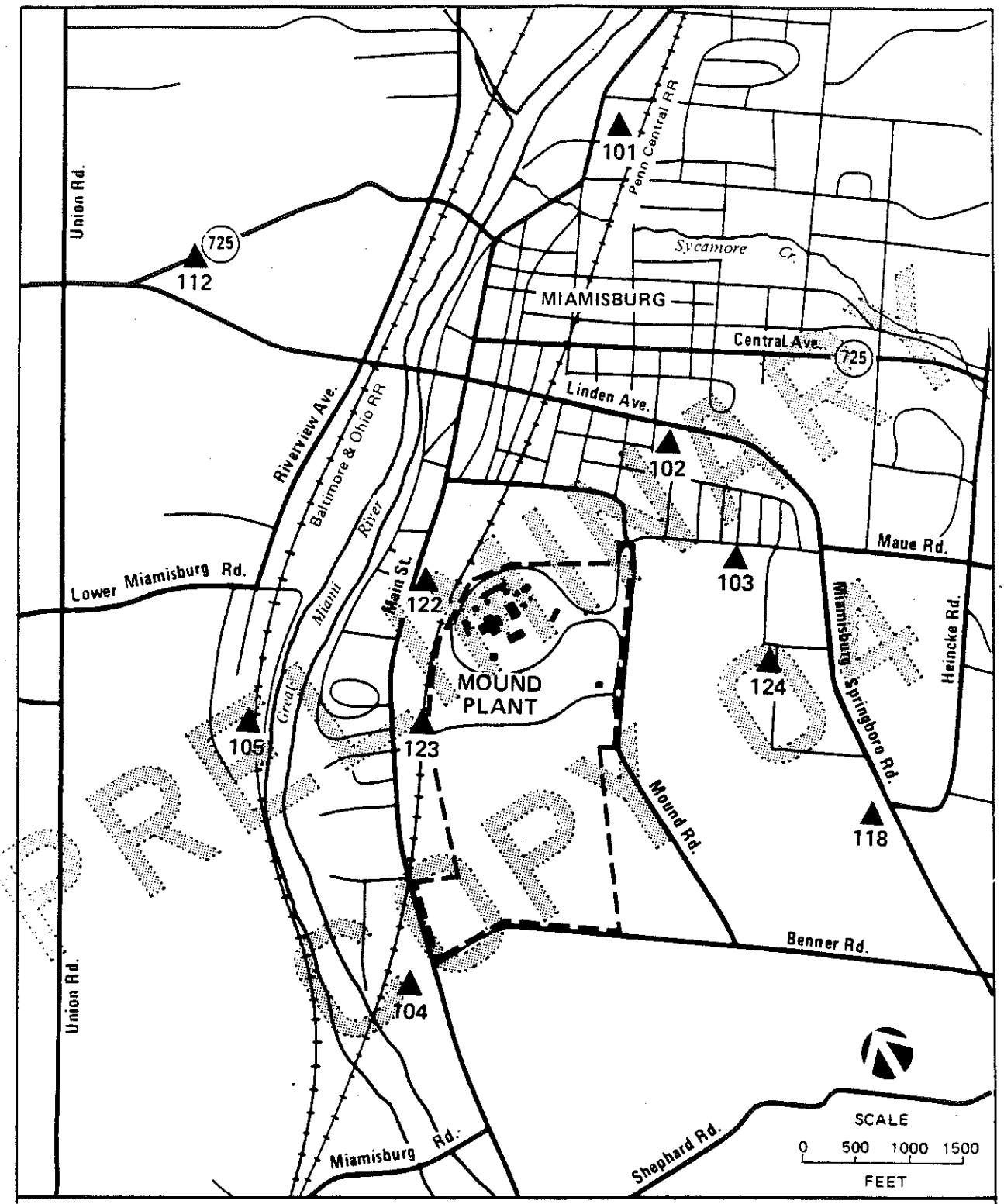
As a part of its overall environmental monitoring program, Mound operates a network of 20 ambient air monitoring stations and an on-site meteorological tower. Five of these air monitoring stations are located on-site near the existing fenceline (Figure 3.1-5). The other 15 are located off-site around the facility. Ten of the off-site air monitoring stations are within a 1-mile radius of Mound (Figure 3.1-6),



Source: MRC Drawing, April 1985: Site Plan

Location of Mound On-Site Environmental Monitoring Stations

Figure 3.1-5



Source: DOE Environmental Survey

Location of Mound Nearby Off-Site Environmental Monitoring Stations Figure 3.1-6

DOE SURVEY-MOUND
AUGUST 1986

and four are located in or near Dayton, Centerville, Franklin, and Germantown (see Figure 2.1-1). The other station, which is located about 28 miles northwest of the facility and north of Eaton, and serves as the background monitoring station for determination of the reported incremental environmental impact. Mound monitors for TSP, plutonium, and tritiated water vapor.

Each air monitoring station consists of two continuous sampling trains. The first is a high-volume TSP sampler, where air is drawn at a rate of about 45 cfm across an upfacing, 200-mm-diameter Microsorban filter disk. The integrated air volume flow rate drawn through the sampler is measured by a dry gas flow meter. The second sampling train uses an ethylene glycol bubbler for the continuous collection of tritiated water vapor and tritiated hydrocarbons. The air sample is pumped through the bubbler at a rate of about 0.45 cfm. The flow rate through the sampler is measured by a rotameter located between the pump and the bubbler. An average air flow rate through the bubbler is determined from the rotameter readings at the start and end of a sampling period.

The filters and bubblers in all the monitoring stations are changed weekly. RAPCA performs this function for Mound at the 15 off-site monitoring stations, as well as preconditioning and weighing the new filters. Mound personnel service the on-site air monitoring stations. After preconditioning, the used filters are weighed to determine the ambient TSP concentration and then are composited for the plutonium analyses. The off-site ambient TSP concentration determinations are performed by RAPCA before the filters and bubblers are returned to Mound.

Plutonium analyses of the filters from the five on-site monitoring stations and from three of the off-site monitoring stations (Stations 122, 123, and 124) are performed on a monthly composite. Analyses of the filters from the remaining 12 off-site stations are performed on quarterly composites. The procedure for plutonium analysis involves the incineration of the filters after spiking with a known quantity of ^{242}Pu, residue leaching with nitric acid, anionic exchange for plutonium separation, electrodeposition of the plutonium, and alpha spectrometry to determine the quantities of ^{238}Pu, ^{239}Pu, and ^{242}Pu. Quantitative determination of ^{242}Pu is used as a measure of the recovery efficiency of the overall analytic procedure for each sample. The reported ^{238}Pu and $^{239}Pu + ^{240}Pu$ concentrations are corrected for the measured ^{242}Pu recovery efficiency.

Weekly analyses are performed for tritium from all 20 monitoring stations. The procedure involves removing an aliquot of the ethylene glycol solution, which is then counted in a liquid scintillation spectrometer. The reported tritium concentrations are based on the laboratory analysis data corrected for evaporative losses and exchange reactions between ethylene glycol and tritiated water during the sample collection (Bishop et al., 1985). The monitoring train is designed to collect only tritiated water vapor and tritiated hydrocarbons in the atmosphere. Mound does not determine the ambient air concentration of elemental tritium, which is estimated to comprise about 30 to 40% of the total tritium air emissions. Since elemental tritium is not absorbed in the body, the omission of elemental tritium in the dose calculation introduces a negligibly small error.

3.1.3.1 Ambient TSP Concentrations

Table 3.1-7 summarizes the total suspended particulate (TSP) concentration data for the latest 5-year period. Violations of the annual average primary or secondary National Ambient Air Quality Standards (NAAQS) are marked by the superscript p or s, respectively. A similar notation is used to denote exceedances of the 24-hour average primary or secondary NAAQS based on the weekly average ambient air concentrations. Since the 24-hour average NAAQS cannot be exceeded more than once in a calendar year, these weekly averages do not constitute a violation of the standard. However, it is clear that a weekly average in excess of the 24-hour average NAAQS must have been an exceedance of the standard for at least one 24-hour period during the week.

Violations or exceedances of the NAAQS indicated for the on-site (200-series monitoring stations) stations are shown for reference only. Technically, these locations are not accessible to the general public and therefore are not subject to the NAAQS regulations. However, these locations are near the site fenceline, and where such exceedances are indicated, it can be inferred that possible exceedances also occurred beyond the fenceline. Although most of the violations occurred from 1981 to 1983, there was one measured exceedance of the 24-hour primary NAAQS at Station 104 and the annual secondary NAAQS at Station 213 during 1985.

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Table 3.1-7
AMBIENT AIR CONCENTRATION OF TOTAL SUSPENDED PARTICULATES, 1981-1985

Monitoring Station	Ambient TSP Concentration: (µg/m3) Calendar Year				
	1981	1982	1983	1984	1985
101	103P 174S	97P 202S	105P 216S	54 142	50(1) 98(2)
102	95P 307P	76P 234P	78P 165P	38 64	40 133
103	75P 227S	67P 161S	63S 115	34 95	32 61
104	95P 220S	91P 212S	86P 174S	40 105	42 286P
105	82P 275P	66S 153S	62S 116	33 65	31 47
108	111P 195S	109P 239S	98P 154S	53 95	50 86
110	70S 139	63S 170S	74S 234S	34 62	31(1) 51(2)
111	106P 191S	103P 476P	104P 394P	43 88	39 72
112	88P 172S	73S 212S	73S 180S	38 63	31 49
115	89P 267P	65S 152S	80P 229S	38 82	36 106
118	89P 194S	80P 203S	84P 145	40 82	39 96
119	79P 472P	64S 209S	57 202S	30 64	26 56
122	67S 271P	60S 183S	51 93	28 66	32(1) 69(2)
123	90P 155S	76P 185S	81P 296P	39 77	36 65
124	85P 319P	78P 228S	75P 139	38 74	34 58
211	81P 133	73S 169S	73S 339P	54 163S	50 127
212	72S 147	72S 168	67S 305	39 74	29 57
213	81 153S	86 346P	117P 265P	84P 295P	62S 108
214	59 124	60S 204S	57 136	36 129	45(1) 122(2)
215	67S 146	70S 231S	53 95	32 52	30 63

Source: MRC, 1982-1984, (1985b, 1986b)

Notes:
(1) Upper value for a monitoring station is the arithmetic annual average.
(2) Lower value for a monitoring station is the maximum weekly average.
(P) Denotes an exceedance of a primary NAAQS.
(S) Denotes an exceedance of secondary NAAQS.

3.1.3.2 Ambient Plutonium Concentrations

The measured annual average concentrations of ^{238}Pu and $^{239,240}Pu$ at the 20 ambient on and off-site monitoring stations are summarized in Table 3.1-8 for the 12-year period from 1974 to 1985.

3.1.3.2.1 Ambient ^{238}Pu Concentrations

From the data presented in Table 3.1-8, and the monitoring elevations with respect to the main ^{238}Pu discharge from the SM/PP stack, the maximum ^{238}Pu concentrations occurred on elevated terrain features (e..g, stations 213, 211, 102, 103 and 124) as opposed to stations at lower elevations (e.g., stations 212 and 214). Additionally, the maximum concentration which was measured occurred at station 213 which is located on the SM/PP hill approximately 500 feet northwest of the SM/PP stack.

There are two stations which do not fit the trend discussed above, stations 214 and 123. These stations are located in a valley 300 feet below the SM/PP Hill and have both shown relatively high concentrations of ^{238}Pu. However, the site micrometeorology and the location of an additional nearby source of ^{238}Pu at the WD building within the valley system offers a possible explanation. Since the WD building is a ^{238}Pu source located within the valley system, the emissions from the stack are transported and dispersed by the valley winds and primarily impact Stations 214 and 123.

Unpublished studies by Monsanto (Farmer, 1986a) have attempted to correlate the measured ^{238}Pu concentrations at the monitoring stations to the measured air emissions. The studies failed to observe any meaningful correlations using a linear regression analysis, and led to the tentative conclusion that the measured ^{238}Pu concentrations were dominated by a resuspension mechanism of contaminated soils rather than stack emissions. An earlier published study of the contaminated North Canal area also concluded that Stations 122 and 123 showed the effect of ^{238}Pu-contaminated sediment resuspensed from the north portion of the canal (MRC, 1978b). While resuspension by wind erosion or earth-moving activities undoubtedly contributes both to on-site and off-site stations, it is by no means clear that this represents the dominant source. If, indeed, resuspension is the dominant source of ^{238}Pu, then it should be possible to detect other long-lived radionuclide soil

Table 3.1-8

AMBIENT ANNUAL AVERAGE PLUTONIUM CONCENTRATIONS, 1974-1985, IN 10^{-17} µCi/ml

Year		Monitoring Station									
		101	102	103	104	105	108	110	111	112	115
1974	^{238}Pu	10.00M	6.00	6.40	1.30	1.20	3.20	1.30	0.78	2.00	1.00
	^{239}Pu(1)	3.10	2.80	3.20	3.30	3.40M	3.40M	1.30	3.00	2.70	3.40M
1975	^{238}Pu	2.30M	1.40	1.30	1.40	0.94	0.75	<0.23	<0.33	0.35	<0.17
	^{239}Pu	2.90M	2.90M	2.30	2.20	1.90	1.90	1.90	2.20	3.10	2.60
1976	^{238}Pu	3.90	2.60	2.90	<0.79	<0.21	0.39	<0.17	<0.17	0.26	0.21
	^{239}Pu	0.67	0.52	0.85	0.52	0.48	0.44	0.46	0.46	0.51	0.55
1977	^{238}Pu	1.00	0.81	0.62	0.37	<0.15	<0.15	<0.09	<0.21	<0.16	<0.13
	^{239}Pu	2.40	2.20	2.10	2.20	2.20	2.70	2.30	2.50	2.10	2.50
1978	^{238}Pu	0.31	0.66	3.00M	0.27	0.15	0.14	0.11	0.26	0.12	<0.08
	^{239}Pu	2.80	3.20M	2.70	2.60	2.70	3.90M	2.90	3.30	3.00	2.70
1979	^{238}Pu	0.34	0.67	0.42	0.40	0.14	0.11	0.10	0.16	0.09	0.07
	^{239}Pu	0.87	0.87	0.85	1.00	0.81	1.10	0.95	0.95	0.88	0.92
1980	^{238}Pu	0.22	0.69	0.56	0.25	0.09	0.04	0.07	0.12	0.06	0.06
	^{239}Pu	0.55	0.48	0.49	0.47	0.49	0.51M	0.51M	0.51M	0.42	0.42
1981	^{238}Pu	0.12	0.47	0.71	0.26	0.10	0.02	0.05	0.02	0.04	0.04
	^{239}Pu	1.86	1.83	1.77	1.71	1.57	2.32M	1.84	1.77	1.74	1.93
1982	^{238}Pu	0.21	0.45	0.40	0.17	0.09	0.03	0.03	0.06	0.04	0.04
	^{239}Pu	0.26	0.26	0.23	0.22	0.21	0.27M	0.20	0.26	0.25	0.20
1983	^{238}Pu	0.10	0.28	0.65	0.43	0.07	0.02	0.06	0.07	0.04	0.07
	^{239}Pu	0.29	0.24	0.25	0.23	0.25	0.19	0.21	0.19	0.25	0.22
1984	^{238}Pu	0.29	1.12	0.46	0.23	0.08	0.07	0.02	0.02	0.02	0.03
	^{239}Pu	0.06	0.06	0.05	0.04	0.03	0.05	0.03	0.05	0.04	0.04
1985	^{238}Pu	0.26	0.819	0.65	0.188	0.262	0.02	0.018	0.035	0.099	0.008
	^{239}Pu	0.025	0.027	0.039	0.017	0.017	0.033	0.016	0.021	0.022	0.023

Table 3.1-8 (continued)

AMBIENT ANNUAL AVERAGE PLUTONIUM CONCENTRATIONS, 1974-1985, IN 10^{-17} μCi/ml

Year		Monitoring Station (On-site)									
		118	119	122	123	124	211	212	213	214	215
1974	^{238}Pu	1.40	0.19	-	-	-	81.00	19.00	57.00	17.00	8.20
	^{239}Pu	3.00	2.90	-	-	-	-	-	-	-	-
1975	^{238}Pu	0.44	<0.14	1.70	-	-	21.20	5.20	103.30M	6.70	3.80
	^{239}Pu	1.80	1.90	1.60	-	-	2.20	2.10	4.10M	2.50	2.20
1976	^{238}Pu	0.65	<0.05	3.80	16.00M	-	8.70	3.50	26.70M	9.10	3.30
	^{239}Pu	0.56	0.38	0.60	0.51	-	0.59	0.54	1.30M	0.81	2.20
1977	^{238}Pu	0.75	<0.10	2.10	2.90M	1.70	5.10	2.50	8.10M	3.10	1.30
	^{239}Pu	2.50	2.10	1.60	2.10	2.40	2.00	1.90	3.10M	1.90	<1.70
1978	^{238}Pu	0.95	0.16	0.94	3.00	1.40	2.70	1.50	12.00	3.30	1.30
	^{239}Pu	3.60	2.20	2.20	3.00	3.00	2.60	2.70	2.70	2.60	2.50
1979	^{238}Pu	0.41	0.05	0.42	3.60M	1.30	2.20	1.70	19.00M	1.40	0.68
	^{239}Pu	0.99	0.78	0.74	0.96	0.98	0.84	0.83	1.10M	0.81	0.79
1980	^{238}Pu	0.12	0.02	0.28	1.40M	0.66	3.80	0.91	5.90M	0.69	0.57
	^{239}Pu	0.48	0.34	0.33	0.44	0.45	0.43	0.40	0.49M	0.31	0.37
1981	^{238}Pu	0.23	0.01	0.17	1.66M	1.59	36.40M	1.04	6.62	2.08	0.61
	^{239}Pu	2.04	1.63	1.30	1.71	1.70	1.66M	1.26	1.36	1.38	1.48
1982	^{238}Pu	0.11	0.03	0.28	1.74M	0.46	8.83M	0.88	3.86	2.42	0.55
	^{239}Pu	0.27M	0.26	0.23	0.26	0.25	0.29M	0.25	0.24	0.28	0.24
1983	^{238}Pu	0.06	0.02	0.20	1.24M	0.60	2.96	0.62	7.44M	1.34	0.29
	^{239}Pu	0.31M	0.10	0.15	0.27	0.28	0.23	0.23	0.30M	0.22	0.19
1984	^{238}Pu	0.50	0.0002	0.21	1.50	2.20M	4.19	1.71	12.60M	2.32	0.50
	^{239}Pu	0.05	0.04	0.05	0.07M	0.06	0.10	0.06	0.11M	0.07	0.06
1985	^{238}Pu	1.10	0.015	0.858	4.03M	1.38	18.20M	1.69	15.30	12.60	1.66
	^{239}Pu	0.029	0.013	0.033	0.084M	0.02	2.21M	0.31	0.99	0.74	0.37

Source: MRC, 1975-1984, 1985b, 1986b
(1) Concentration of ^{239}Pu + ^{240}Pu
(M) Maximum annual average off-site and on-site concentrations
(-) Not reported

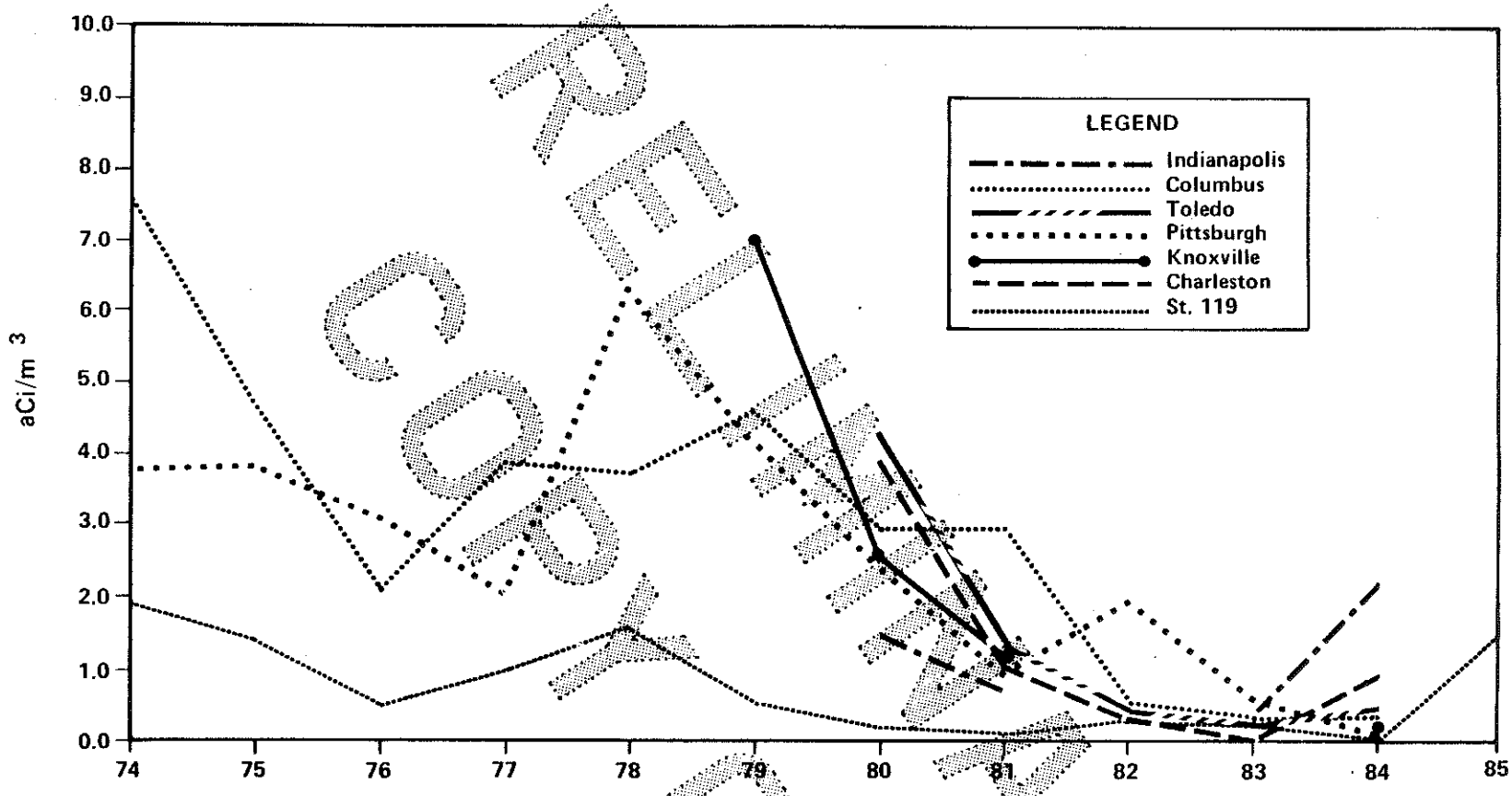
contamination (e.g., thorium) in the collected samples. Currently, Mound monitors only for plutonium. Therefore the Survey team will sample for additional radionuclides known to be present in the soils on-site.

3.1.3.2.2 Ambient $^{239,240}Pu$ Concentrations

The annual average $^{239,240}Pu$ concentrations are not expected to be correlated to Mound operations, since the primary source of these plutonium isotopes in the environment is fallout from nuclear weapons tests. The on-site and off-site $^{238,240}Pu$ concentrations are spatially uniform in any year, although there do appear to be slight increases at those monitoring stations that experienced high ^{238}Pu levels. However, there is a year-to-year variation in the $^{239,240}Pu$ concentrations observed in the ambient air monitoring data.

3.1.3.2.3 Ambient Plutonium Background Concentrations

The use of plutonium concentrations from Station 119 as background for Mound can be compared with the annual average plutonium concentrations determined from data reported by the U.S. EPA for Columbus, Ohio. The following table shows that the $^{239,240}Pu$ concentrations are reasonably similar and exhibit the same temporal trend. The high $^{239,240}Pu$ concentrations measured in 1974, 1978, and 1981 are associated with fallout from known atmospheric nuclear weapons testing by mainland China. The ^{238}Pu concentration trends in these separate sets of data are also similar, but the concentration levels in Columbus are consistently higher than those measured by Mound. The reason for the anomaly in the ^{238}Pu concentration is unclear, since there are no known sources of plutonium in the vicinity of Columbus. As shown in Figure 3.1-7, the annual average background ^{238}Pu concentrations reported by the EPA for Columbus, Toledo, Indianapolis, Knoxville, Charleston, Pittsburgh, and Station 119 are higher than the annual average ^{238}Pu concentrations measured at Monitoring Station 119.



Sources: Mound Environmental Reports (MRC, 1975-1984, 1985b, 1986b) • ORP, 1975a-1985c

Measured Midwest Background ^{238}Pu Concentrations, 1974 - 1985

Figure 3.1-7

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Plutonium Concentration: aCi/m^3

	U.S. EPA		Station 119	
	Pu-238	Pu-239,240	Pu-238	Pu-239,240
1974	7.6	42.0	1.9	29.0
1975	4.7	21.8	1.4	19.0
1976	2.1	7.3	0.5	3.8
1977	4.0	25.2	1.0	21.0
1978	3.7	33.4	1.6	22.0
1979	4.6	13.7	0.5	7.8
1980	2.9	6.8	0.2	3.4
1981	2.9	18.3	0.1	16.3
1982	0.5	3.0	0.3	2.6
1983	0.3	1.5	0.2	1.0
1984	0.5	0.4	0.02	0.4

Source: Mound Environmental Reports (MRC 1975-1984, 1985b, 1986b and ORP 1975a-1985a)

3.1.3.3 Ambient Tritium Concentrations

The annual average tritium (oxide) concentrations for the same 12-year period are presented in Table 3.1-9. All the on-site monitoring stations show impacts from the tritium releases. The highest ambient tritium concentrations are most frequently measured at Station 213, which is on the SM/PP Hill east to east-southeast of the tritium release stacks (see Figure 3.1-6). When viewed from the SM/PP Hill, the tops of the tritium stacks are not much above Station 213. However, comparable tritium concentration levels are frequently observed at Station 211 and 212. Station 212, which measured the highest annual average tritium concentration of 413 pCi/m^3 (1980) in the 12-year period, is located in the employee parking lot at the base of the Main Hill, northeast of the tritium stacks. On the other hand, Station 211 is on Main Hill just to the west and very near the base of the tritium stacks. Station 214, located in the valley near the water treatment plants, frequently measures tritium concentrations comparable to Stations 211 and 212, although it is at the base of Main Hill and south-southeast of the stacks. Finally, Station 215, approximately 1250 feet south of Station 214, also experiences tritium concentrations that are normally 68% of those at Station 214.

Unlike the ambient air concentrations for plutonium, the maximum off-site tritium concentrations tend to occur at monitoring stations located downwind of the prevailing wind directions; that is, at Stations 101, 102, 103, and 124. Lower,

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Table 3.1-9

AMBIENT ANNUAL AVERAGE TRITIUM CONCENTRATIONS, 1974 - 1985, IN 10^{-11} µCi/ml

Year	Monitoring Station									
	101	102	103	104	105	108	110	111	112	115
1974	<11.00	<14.00	<14.80	<4.90	<5.40	<1.60	<1.70	<1.10	<4.00	<1.20
1975	<1.30	<1.60M	<1.40	<0.90	<1.10	<0.78	<0.74	<0.74	<1.00	<0.75
1976	<1.30	<1.50M	<1.10	<0.94	<0.89	<0.89	<0.90	<0.81	<0.92	>0.85
1977	<0.64	<1.24M	<0.72	<0.44	<0.40	<0.37	<0.40	<0.62	<0.59	<0.56
1978	0.44	0.86M	0.52	0.34	0.20	0.17	0.14	0.30	0.29	0.07
1979(1)	0.53	1.04	0.65	0.39	0.28	0.10	0.05	0.05	0.22	0.03
1980	4.96	13.70M	6.66	1.40	0.54	0.60	0.18	0.01	0.71	EL
1981	7.02M	6.10	6.17	2.92	2.25	1.10	1.19	0.72	1.29	0.16
1982	4.70M	3.57	3.13	1.09	0.81	0.73	0.63	0.57	0.81	0.11
1983	2.53	2.60	1.97	0.78	0.77	0.45	0.24	0.46	0.73	0.02
1984	1.88M	1.72	1.15	0.87	0.50	0.26	0.09	EL	0.11	EL
1985	1.74	2.92M	1.09	0.939	0.489	0.23	0.099	EL	0.245	EL

Year	Monitoring Station									
	118	119	122	123	124	211	212	213	214	215
1974	<8.70	<0.70	-		-	<8.60	<11.00	<32.00M	<17.00	<16.00
1975	<0.89	<0.74	-	-	-	<3.10	< 3.30	< 3.10	< 3.40M	< 2.00
1976	<0.90	<0.88	-	<1.10	-	<1.80	< 2.00	< 2.80M	< 2.20	< 2.40
1977	<0.57	<0.44	-	<0.88	<0.94	<1.80	< 3.00M	< 2.00	< 1.60	< 1.60
1978	0.19	0.56	-	0.73	0.60	0.34	0.62	0.90M	0.87	0.45
1979(1)	0.29	0.06	0.62	0.76	1.10M	0.83	0.95	1.35M	0.86	0.74
1980	0.86	0.20	4.21	4.53	7.60	8.88	41.30M	21.50	8.58	3.90
1981	3.12	0.65	3.19	5.26	5.94	7.18	6.76	7.85M	4.45	3.04
1982	0.66	0.73	1.70	2.80	2.00	5.26	3.93	5.65M	3.02	2.07
1983	0.75	0.14	2.15	3.07	3.26M	3.53	3.21	4.25M	3.43	2.12
1984	0.19	0.41	1.44	1.58	1.61	2.21	2.11	2.83M	2.67	2.15
1985	0.649	0.254	1.17	2.02	1.82	3.27M	2.97	2.73	2.48	1.98

Source: Mound Environmental Monitoring Reports (MRC, 1975-1984, 1985b, 1986b)

(M) Maximum on-site and off-site concentrations

(1) Concentrations after 1978 are incremental relative to the concentration measured at Station 119

(EL) Less than background levels

(-) Not reported

but noticably elevated, concentrations of tritium are also observed at Stations 122 and 123, located on the canal to the west and southwest, respectively, of the tritium emission stacks. The tritium concentrations observed at Station 123 are, on the average, about 85 percent of the values at Station 214, which is about 750 feet further east.

3.1.3.4 On-Site Meteorology

The on-site meteorological tower is located on Main Hill (Figure 3.1-6) and was originally installed to support emergency response functions. The tower has instruments to measure wind speed and direction at the 164-foot (50-meter) level and ambient dry bulb and dew point temperatures at the lower level. Atmospheric stability is determined by wind direction variation (sigma theta method) as measured by the wind vane. The meteorological station is also equipped with a tipping bucket rain gauge.

In the past, the meteorological data collected on the tower were fed into the Lawrence Livermore National Laboratory's Accident Release Advisory Capability (ARAC) system, and the Livermore Laboratory prepared and sent out the annual data summaries used by Mound in the environmental monitoring reports. The ARAC system was modified recently to access data logged to a disk at the site; this will mean that Mound must develop the necessary postprocessing software to obtain the annual data summaries. The meteorological station continues to serve the emergency response needs of the facility. However, the annual meteorological data summaries are used only for the environmental monitoring reports, since Mound does not model the off-site dosimetric impacts from its atmospheric emissions. The reported doses to the general public are based solely on the measurements obtained from the environmental monitoring program.

3.1.4 Findings and Observations

3.1.4.1 Category I

There are no air media Category I findings.

3.1.4.2 Category II

1) Accuracy of Dose Estimates - The total dose estimates reported by Mound are considered to be questionable. Mound estimates total dose of radionuclides based on ambient air monitoring data. However, the Survey team found inadequacies in the monitoring system that bring into question the accuracy of the reported dose. These inadequacies include monitoring station siting and calibration and unmonitored radionuclides.

One third of the air monitoring stations examined during the Survey were found not to meet accepted siting criteria. The Survey team was able to inspect only 12 of the 20 ambient air monitoring stations because of time constraints. The following four of these stations were considered to be poorly sited:

Station 102: The station is atop the locker facility and covered by a tree growing between the buildings. The tree could block airborne particulates from reaching the monitor.

Station 122: The monitor is on the ground in a fenced enclosure. Decorative wooden slats are mounted on the fence and block the air flow to the monitoring train intakes.

Station 214: Located on the ground near the discharge canal in tall vegetation and near a tree.

Station 215: Located behind the pumphouse which blocks the sampler from the emission sources.

The other stations visited (Stations 101, 103, 118, 123, 124, 211, 212, and 213) were found to be in well-exposed locations.

In addition, monitoring stations are not regularly calibrated. The high-volume air sample flow rates at the on-site monitoring stations were last calibrated in July 1986. Prior to this, there had been no calibration of any on-site high-volume air sampler since 1977. The 15 off-site high-volume air samplers maintained by

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RAPCA have not been calibrated since 1977. While the most recent calibrations did not indicate any significant change in the characteristics of the critical flow orifice at five of the on-site stations, there can be no assurances that the air sample flow rates remained stable over the ten-year period between calibrations.

Radon and other unmonitored radionuclides are emitted from Mound. The unmonitored emissions result in a potential for unestimating the annual dose impact. There are two known sources of radon: SW Building and Building 21. The radon emission rates from these facilities have not been quantified by Mound. Consequently, it cannot be determined if the contribution from these sources to the indoor radon concentration at the nearest residence conforms with the recently issued U.S. EPA action guideline of 4 pCi/l. The sampling and analysis portion of the Survey will measure the radon emissions to determine if further action is necessary.

Thorium, uranium, and, to a lesser extent, cesium and cobalt are unmonitored contributions to the off-site doses, since they can become airborne by wind erosion and earth-moving activities involving soils contaminated with these radionuclides. The Soils Section (3.2) of this report contains additional information on the location of these soil areas. Sampling and analysis activities will measure the airborne concentration of these radionculides at selected monitoring stations to assess if resuspension is an important contribution to the off-site air concentrations, and to estimate the relative importance of these unmonitored radionuclides on the off-site dose.

2) <u>Accuracy of Radionuclide Emissions Measurements</u> - The reported stack emissions of ^{238}Pu and tritium from Mound are considered to be questionable and possibly understated. The sampling probes installed in the various effluent streams do not have a consistent design, and they are generally located too close to disturbed flow regions in the duct or stack to obtain a representative sample of particulate emissions.

At the request of the Survey team, seven sampling probes were pulled for inspection; an eighth sampling probe was pulled by the Mound staff and their observations were communicated to the Survey team. The R Building probe was of

an entirely different design than any of the other probes. The holes in it spiraled along the length of the tube and had decreasing hole sizes toward the effluent end of the probe. This design appeared to be an attempt to draw an isokinetic sample from along the length of the probe. The second probe pulled was the SM Building B-probe. This probe had a series of about 20 holes of equal size drilled in it, with each set of holes offset 45 degrees. An inspection of this probe found that about 40% of the holes were either completely or partially blocked by metal burrs. Mound personnel had difficulty removing the SM Building A-probe but later found that it was nothing more than a straight tube projecting about 6 inches into the large duct.

On the basis of these initial observations, all the probes were pulled in the WD Building stacks. There are two probes each in the WDAHR and WDALR stacks. The primary probes in each stack consisted of a row of holes of equal size along the length of the probe. The alignment of the holes relative to the flow would be important for the sample collected. The primary sample probe in WDALR was found to be rotated about 45 degrees from the flow. The secondary probes in WDAHR and WDALR were of a different design from the primary probes and also from each other. The secondary WDAHR probe had three groups of equal-size holes along one side of the probe, while the secondary WDALR probe had three groups of different-size holes in what appeared to be a random pattern around the circumference for each group. Again, it is considered unlikely that any of these probes draw an isokinetic sample along its length or, for that matter, at any location on the probe. The WDSS stack probe was observed to consist of a 6-inch stub tube oriented perpendicular to the flow in a 15-inch-diameter stack.

The potential inaccuracies discussed above may represent understatements of ^{238}Pu and, to a lesser extent, tritium. Monitored data tend to be higher than emissions data. Although the differences in monitored and measured Pu stack releases could be attributable to fugitive emissions, data indicate the more likely source of the difference is higher emissions levels than measured. In addition, neither the elemental tritium emissions nor the emissions from the WD Building are measured, thereby understating total tritium emissions.

There are plans to install an isokinetic probe at the 100-foot level of the SM/PP stack. However, there is a need to determine the possible inaccuracies in the reported annual emissions. This will be accomplished during the sampling and analysis portion of the Survey on the WDALR stack.

3) Unapproved Method Used to Calculate Off-Site Dose Impacts - The Mound procedures used to determine the reported off-site dose impacts may not be in conformance with regulatory requirements under NESHAP.

The ambient air monitoring data rather than atmospheric dispersion modeling of emissions are used to calculate the dose to the general public for comparison with the NESHAP standards (40 CFR 61, Subpart H). Measurements from air monitoring data can be used to demonstrate acceptable levels of environmental impact from the operation, provided U.S. EPA gives its approval. Although this resulted from a policy decision by the Albuquerque Operations Office, U.S. EPA approval of this approach could not be demonstrated. While the problems identified with the ambient monitoring program are not likely to cause a dramatic change in the reported doses, quality control and quality assurance procedures to support the data are lacking. In addition, it is difficult to demonstrate that the existing monitoring network actually detects the maximum ^{238}Pu and tritium concentrations, given the siting and calibration problems discussed in the previous findings and the inability to correlate emissions and monitoring data.

The 1985 reported dosimetric impacts from Mound operations (MRC, 1986b) are quite small, being about 1.2% of the NESHAP allowable values from all pathways. Of the 0.88 mrem dose calculated for calendar year 1985, the air pathway contributed 0.61 mrem or 69% to the total internal organ dose.

4) Lack of Organic and Toxic Emissions Inventory - The nonradioactive air emissions from Mound cannot be determined because there is no air emissions inventory. Nonradioactive air emissions occur throughout the Mound site as a result of the use of volatile organic and other chemicals in the ventilation hoods of production buildings. Appendix D lists the emission points for the ventilation hoods and identifies the type of emission control equipment installed on the effluent gas stream. Table 3.1-5 presents the quantities of selected chemical materials

purchased at Mound for a 7-month period and extrapolated to estimated annual usage. However, it was impossible to reconstruct a building-by-building air emissions inventory solely from this information. In general, Mound personnel have installed control equipment on many of the air emission sources. However, this is not the rule for most ventilation hoods that emit organic substances to the atmosphere. It must be stressed that individual ventilation hoods are likely to be small sources, and unless the material is particularly toxic or hazardous there may not be a compelling reason to install such devices. However, the lack of a comprehensive emissions inventory of organic and toxic air pollutant emissions is a potential problem, because these substances are unmonitored and the cumulative amounts emitted over the entire site may be of concern. Based on the ventilation hood inventory and the chemical usage information referenced above, there is a potential concern about the level of toxic air pollutant emissions from solvent usage and plating operations. For example, the solvents acetone, trichloroethylene, and methylene chloride are used in large quantities. The plating shop contains a vapor degreaser which uses perchloroethylene to clean components. Laboratories at Mound often evaporate small quantities of solvents in fume hoods. The Sampling and Analysis portion of the Survey will attempt to determine emissions from two processes.

3.1.4.3 Category III

1) Tritium Emissions from the WD Building - The tritium air emissions from the WD Building stacks are not measured by Mound; this results in an underestimation of the total emissions from Mound. There is evidence that tritiated water is infiltrating the abandoned alpha waste pipeline and entering the alpha waste treatment facility. This could lead to unmonitored air emissions of tritium for the WDALR and WDSS stacks and also from the building ventilation system by evaporative losses from the flocculator tanks. These potential unmonitored tritium air emissions are likely to be small, compared with the monitored tritium emission points at Mound. The sampling and analysis part of the Survey will quantify the emission rate from the WDALR stack and the tritium levels in the building area of the flocculator tanks to assess this unmonitored source of tritium.

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3.1.4.4 Category IV

There are no air media Category IV findings.

3.2 Soil

3.2.1 Background Environmental Information

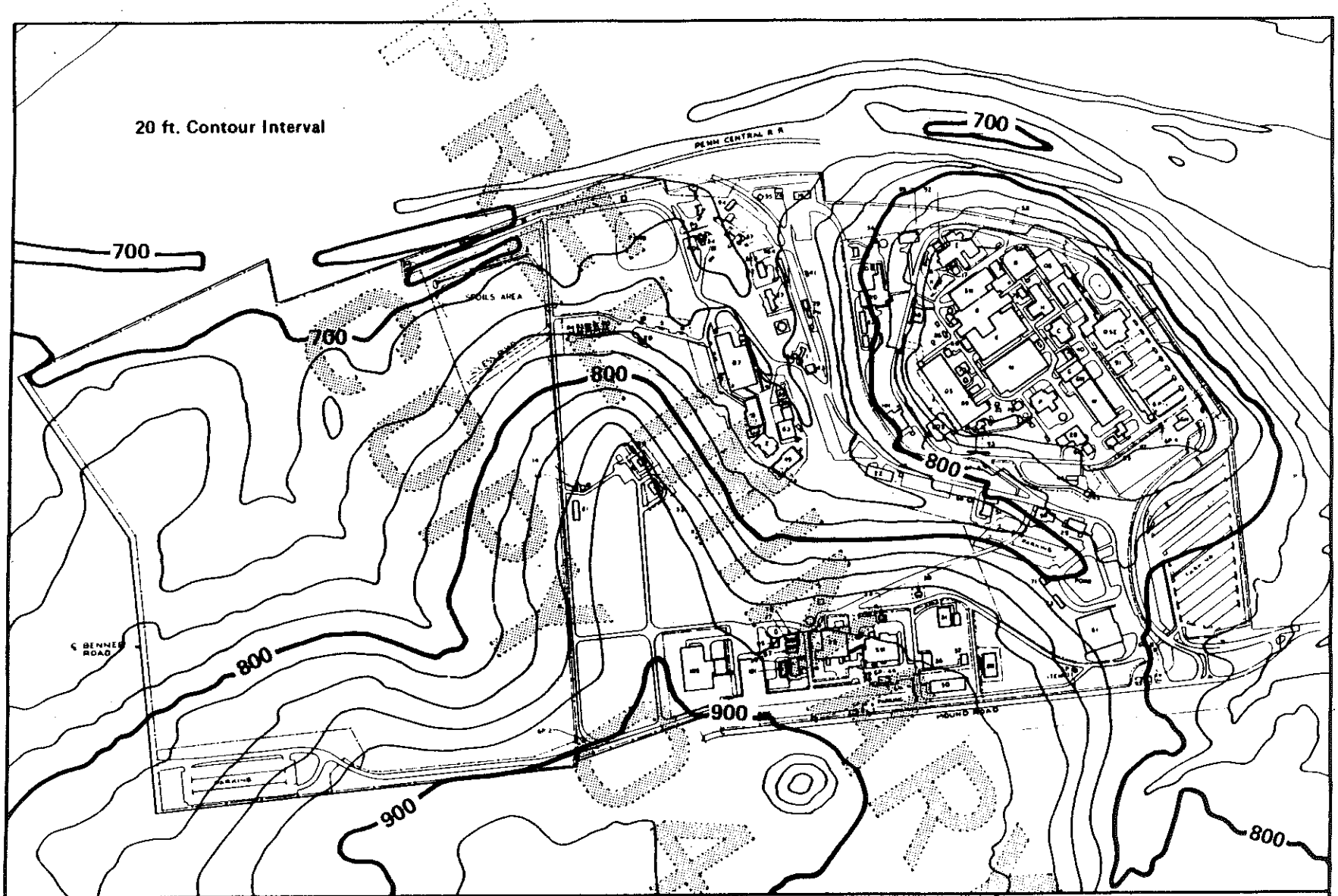
The Mound Plant is situated topographically on a high area overlooking Miamisburg and the Great Miami River and the river plain area to the west. The property is characterized by two high areas divided by a minor northeast-southwest trending valley which drains to the river (see Figure 3-2.1). Most of the buildings are located atop the northwest high area (Main Hill). A smaller group of buildings lies atop the southeast high area (SM/PP Hill), while several buildings are located in the valley and on valley slopes. Figure 3.2-1 is a topographic map showing the contours of the terrain.

The two topographically high areas are generally covered by a relatively thin layer (1 to 5 feet) of glacial till composed of silt, clay, and some fine gravel. The lower valley is filled with a wedge of glacial outwash between the upper tills and the bedrock. Hydraulic properties of the glacial till soils that form a veneer over the entire site are variable and are dependent upon the relative proportions of fine-grained material to coarse-grained material at any given location.

Below the glacial till in the lower valley area is a zone of glacial outwash composed of sand and gravel. The permeability of this zone is estimated to range from 1,000 to 2,000 gal/day/ft^2. This horizon forms the eastern edge of the Buried Valley Aquifer and extends under the Great Miami River to the west.

The Main Hill soils are comprised of soils classified as Urban land loamy material, Miamian-Urban land complex, Hennepin and Miamian silt loams, and Fairmount silty clay loam.* Urban land loamy material type occurs on uplands and is

* The descriptive data on soils in this subsecton are derived from USDA, 1976.



Source: EG&G Graphic Overview System, 1976

Mound Site Vicinity Topography

Figure 3.2-1

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underlain by glacial till or limestone bedrock. The Miamian-Urban land complex are soils which have been disturbed or buried by filling. It is generally moderately well drained and underlain by compact calcareous glacial till. The Hennepin and Miamian series consist of well-drained soils which are shallow to calcareous loam glacial till. The permeability at the surface is 0.63 to 2.0 inches per hour. The Fairmount silty clay loam is characterized by well-drained, dark-colored soils that formed in residium weathered from thin-bedded limestone and clay shale bedrock. The surface layer is about 3 to 4 inches thick with a permeability of 0.63 to 2.0 inches per hour. The subsoil is olive-brown and olive silty clay overlying interbedded limestone and clay shale bedrock at a depth of 15 inches.

The SM/PP Hill soil is comprised of Milton silt loam and Ritchey silt loam. The Milton silt loam occurs on rims of valleys cut into bedrock and on crests of bedrock-controlled hills of the till plain. It consists of well-drained soils formed in 20 to 40 inches of glacial till over limestone bedrock. The permeability at the surface is 0.63 to 2.0 inches per hour. The Ritchey silt loam occupies narrow bands on the shoulders of slopes of limestone hills. It consists of well-drained soils that are shallow to bedrock with a surface permeability of 0.63 to 2.0 inches per hour. It is found in calcareous glacial till and residium from limestone and limestone interbedded with clay shale bedrock.

The valley area soil is comprised of Miamian clay loam, Fairmount silty clay loam, and man-made land. The Miamian clay loam occurs in strips along small streams on the moraines and stream-dissected till plains. It is eroded to the point that most of the original surface layer has been lost. Miamian clay loam has permeability at the surface of 0.63 to 2.0 inches per hour. Man-made land consists of sanitary landfills. These areas contain a mixture of soil materials and underlying material.

The new property soils are also a mixture of soil types: Fairmount silty loam, Milton silty loam, Miamian silt loam, Miamian clay loam, and Ross silt loam. The Milton series consist of well-drained soils that formed in 20 to 40 inches of glacial till over limestone bedrock. The permeability at the surface is 0.63 to 2.0 inches per hour. The Miamian series consists of well-drained soils formed either wholly or partly in calcareous glacial till. The silt loam has a permeability of 0.63 to 2.0 inches per hour, while the clay loam has a permeability of 0.2 to 0.63 inch per hour. The Ross silt loam occupies broad areas of floodplains. It consists of dark-colored,

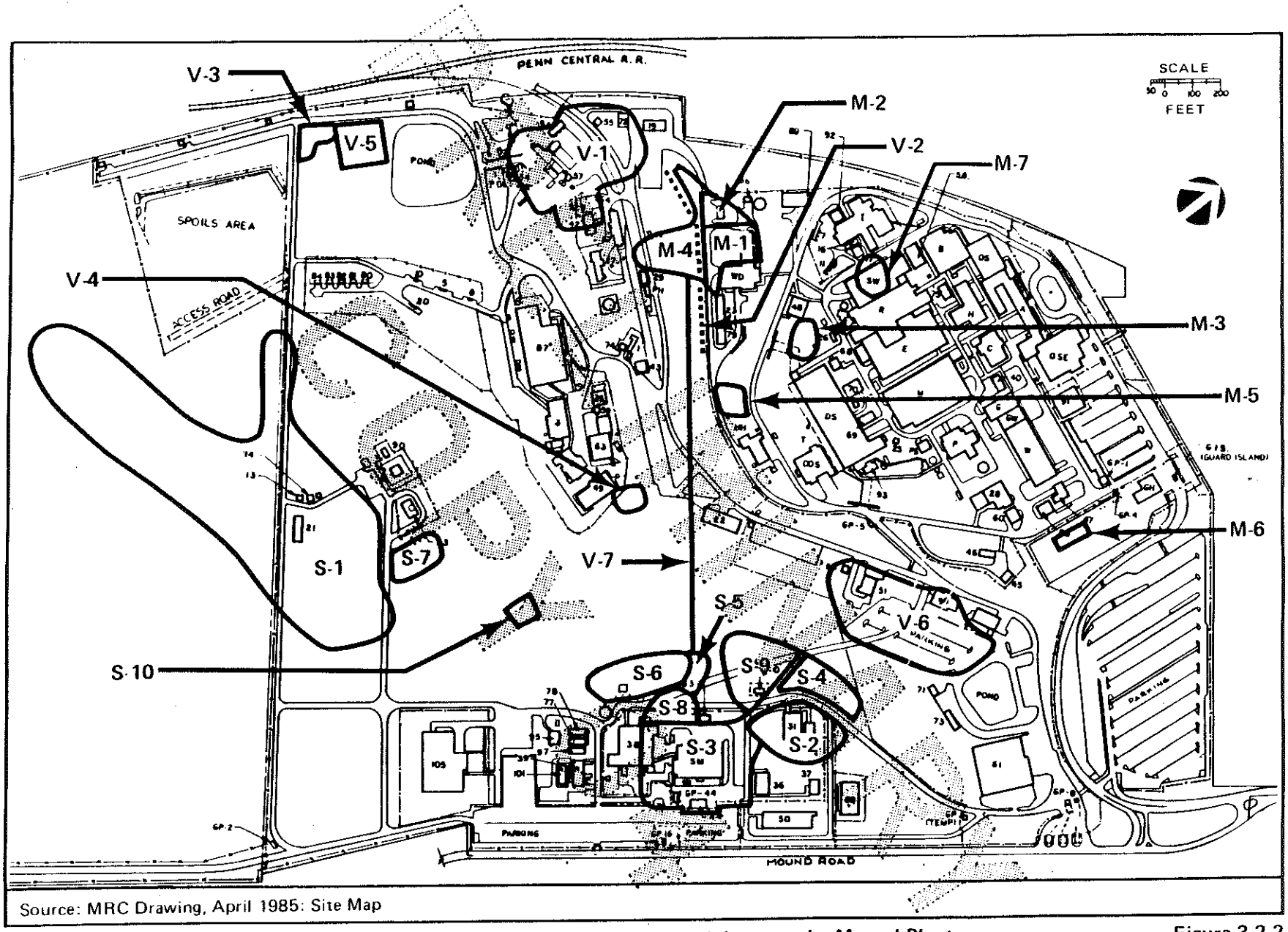
well-drained soils that formed in recent alluvium on floodplains with a permeability of 0.63 to 2.0 inches per hour. The Ross silt loam occurs in wide convex strips around the base of limestone-controlled hills. It consists of dark-colored, moderately well-drained soils that formed in calcareous loam glacial till. It has a moderately slow permeability of 0.63 to 2.0 inches per hour at the surface.

Muller et al. (1976) determined the aerial distribution of ^{238}Pu around the Mound Plant. They reported background levels of 0.06 nCi/m^2 of ^{238}Pu. Bobula and Alberts (1978), in a study to determine ratios of industrially derived ^{238}Pu and fallout of $^{239,240}Pu$, reported surface soil concentrations in the Miami River watershed soils varying from 0.97 to 1.32 pCi/kg soil of ^{238}Pu (0.00097 to 0.00132 pCi/g soil) for four locations outside the influence of atmospheric releases of Mound Plant.

3.2.2 General Description of Pollution Sources/Controls

Construction of the Mound Plant began in February 1947 and was completed in 1949. Past practices have resulted in the deposition of radioactive and chemical materials on various areas on-site and on one location off-site. This section will discuss only those areas that have or may have soils contaminated with radioactivity. Soils contaminated with nonradioactive materials and the off-site soil contamination area are discussed in Section 4.5.

There are a total of 24 radioactively contaminated soil areas on the Mound Plant. The areas have been identified by past site surveys and investigations as well as the DOE Environmental Survey. Mound personnel conducted a general soil inventory for ^{238}Pu during 1976 and 1977 and identified 16 areas of on-site soil contamination. Mound personnel undertook a more extensive sitewide survey during FY 1982-1986, a draft version of which was made available to the DOE Survey (MRC, 1986d). As a result of the study, eight additional areas of contamination were identified. The DOE Environmental Survey team then conducted an independent radiological assessment of the Mound soils and concluded that one additional area which had previously been denoted as a nonradioactive contaminated area should be considered a radioactive area (referred to as area V-2). The area is located at the southwest corner of WD Building and runs south and west across the buried pipeline from Building 41 to WD Building. Figure 3.2-2 identifies all the radioactively contaminated soil areas.



Source: MRC Drawing, April 1985: Site Map

Identified Radioactively Contaminated Areas at the Mound Plant

Figure 3.2-2

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The major potential sources of the radioactive contamination of the soil and the areas contaminated by each source are described below:

- o Airborne release from plant operations depositing on the ground.

  - As can be seen from the environmental monitoring of the soil (see Section 3.2.3) data, there is a low level of contamination caused by the release ^{238}Pu to the atmosphere and the subsequent dispersion and deposition to the area surrounding the Mound Plant.

- o Releases directly to the soil from spills. These releases include both spills of solid and/or liquid material.

  - The SM/PP Hill-1 (S-1) area is located near Building 21. Bulk transfer of thorium drums to (1964) and from (1973) storage basin (Building 21) resulted in spillage of thorium. The area (approximately 136,000 ft^2) was cleaned up in 1965 and 1973 and backfilled with clean soil. Existing information identified the new property as contaminated with ^{232}Th and also reported ^{238}Pu contamination caused by exposed storage of wooden containers and resultant surface runoff. Preliminary data indicate that peak ^{238}Pu contamination is 34,000 pCi/g. Peak ^{232}Th contamination is greater than 100 pCi/g, while the average concentration is 10 to 100 pCi/g. (MRC, 1986d).

  - The Valley-1 (V-1) area, which surrounds Buildings 72, 55, 94, and 57, was a storage and redrumming area encompassing approximately 15,000 ft^2. The area was cleaned and backfilled with clean soil in 1965. A site survey (MRC, 1986d) found no thorium; however, ^{238}Pu contamination was found which was probably the result of runoff of contamination from a Waste Transfer System (WTS) line rupture in 1969. Preliminary data indicate that the average ^{238}Pu concentration remaining is 10 to 100 pCi/g (MRC, 1986d).

  - The Main Hill-1 (M-1) area is located near the Waste Disposal (WD) Building. The area was contaminated with ^{210}Po and ^{60}Co when the WD Building influent tanks overflowed in 1965 (polonium has decayed out, leaving residual ^{60}Co). Contamination also resulted from the rupture of

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the WTS line, the same rupture noted in V-1, releasing ^{238}Pu. Preliminary data indicate that the average soil ^{238}Pu concentration ranges from 100 to 1000 pCi/g (MRC, 1986d). No estimates are available for ^{60}Co concentrations.

- The Main Hill-2 (M-2) area is near WD Building. Area M-2 is the sewage sludge disposal drying pits which were contaminated with ^{210}Po and ^{60}Co from the accident noted in M-1 above. The drying pits are part of the old SD Building located immediately adjacent to the WD Building. ^{238}Pu contamination also resulted from the WTS line rupture mentioned in V-1 above. No estimates are available for ^{60}Co and ^{238}Pu concentrations.

- The SM/PP Hill-2 (S-2) area, located near Building 31, was a storage and redrumming area which was contaminated with ^{232}Th; the area was cleaned and backfilled with clean soil in 1965. The area covers approximately 40,000 ft^2. Thorium-contaminated soil was removed to another area on-site. Preliminary data indicate that the area still has an average soil ^{232}Th concentration ranging from 1 to 10 pCi/g (MRC, 1986d).

- The SM/PP-3 (S-3) area is under and immediately adjacent to SM Building and covers approximately 40,000 ft^2. The contamination is largely the result of a heat source program which used unencapsulated ^{238}Pu during the 1960s. As a result of these activities, the area beneath this building was contaminated with ^{238}Pu. Most of this area is covered by SM Building and paved roads. Decontamination operations are currently underway to demolish SM Building and remove the contaminated soil. Preliminary data indicate that peak ^{238}Pu concentration is 16,000 pCi/g measured during operations for removal of the WTS pipeline. The average soil ^{238}Pu concentration ranged from 100 to 1000 pCi/g (MRC, 1986d).

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- The Valley-2 (V-2) area is an open drainage ditch south of WD Building that was contaminated as a result of a spill containing plutonium in 1969. The spill resulted from leakage from one or more plutonium liquid waste drums stored at the southwestern corner of the WD Building. This spill ran into a catch basin south of the loading dock area and flowed down a stone-lined open drainage culvert southwest across the buried pipeline from Building 41 to WD Building. Part of this ditch is being decontaminated along with Area M-4.

o Releases from damaged underground pipes

- The Main Hill-3 (M-3) area is located north of Building 48. A radioactive waste line containing ^{60}Co and ^{210}Po from HH Building to WD Building ruptured in 1969. Polonium has decayed out, leaving residual ^{60}Co. The area covers approximately 6,800 ft^2. Preliminary data indicate that the average soil concentrations of ^{60}Co range from 10 to 100 pCi/g (MRC, 1986d).

- The Main Hill-4 (M-4) area is southwest of WD Building. In 1969 the radioactive WTS line from SM to WD Building broke, contaminating the surrounding soil near WD Building. A total of 964 ft^3 of contaminated soil was removed and shipped off-site for burial. The area was backfilled with clean soil; 2,700 ft^3 of remaining contaminated soil were removed from the hillside, and the area was sodded. Decontamination operations are underway and are expected to be completed by the end of 1986. Preliminary data indicate that peak soil ^{238}Pu concentration is 3,500,000 pCi/g. The average ^{238}Pu concentration is in the 1,000 pCi/g range (MRC, 1986d).

- The Main Hill-5 (M-5) Area, west of HH Building, was contaminated when the radioactive waste line rupture noted in M-3 occurred. The area of contamination has not been calculated. Preliminary data indicate that the average concentration of ^{60}Co in the soil is in the range of 10 to 100 pCi/g. A site survey (1986d) reported ^{137}Cs contamination (10 to 100 pCi/g) which could not be explained.

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o Movement of contaminated material from a contaminated area to a noncontaminated area as a result of activities such as decontamination

- The Valley-3 (V-3) area lies is between the Overflow Pond and Well No. 1. This contaminated area was created when sand contaminated with ^{210}Po was disposed of here in 1965. The sand resulted from the cleaning of the metal framework from WD Building sand filters (the polonium has decayed out, leaving residual ^{60}Co). The area covers approximately 15,000 ft^2. No estimates are available for the ^{60}Co concentration.

- The Main Hill-6 (M-6) area, north of Building 76 and east of Building 65, was created when sand contaminated with polonium was disposed of here in 1964. Sand resulted from the cleaning of the metal framework of WD Building sand filters (polonium has decayed out, leaving residual ^{60}Co), as was the case with Area V-3. The area is approximately 2,100 ft^2. No estimates of the ^{60}Co concentration are available.

- The SM/PP Hill-4 (S-4) area is west of Building 30. This area in 1965 received subsurface contaminated dirt from the decontamination operations near Building 21 and Building 31. The area is approximately 25,000 ft^2. Preliminary data indicate that the average soil concentration of ^{232}Th is 10 to 100 pCi/g (MRC, 1986d).

- The SM/PP Hill-5 (S-5) area, located west of Building 30, received polonium-contaminated concrete from Unit 4 Dayton operations in 1950 (the polonium has decayed out). Unit 4 Dayton was previously owned by Mound and was decontaminated in 1950. The area covers approximately 13,000 ft^2.

- The SM/PP Hill-6 (S-6) area lies west of SM Building. Area S-6 contains buried contaminated dirt from decontamination of thorium near Building 21 (Area S-1) in 1965. The area covers approximately 19,000 ft^2. A site survey (MRC, 1986d) also found ^{238}Pu contamination which is probably the result of SM operations. Since the WTS line traversed this area, much of the contaminated soil was removed as part of that

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decontamination work. Preliminary data indicate that the average soil ^{238}Pu concentration is 10 to 100 pCi/g. The average concentration of ^{232}Th in the soil is 1 to 10 pCi/g (MRC, 1986d).

- The Valley-4 (V-4) area, northeast of Building 49, in 1950 received polonium-contaminated concrete from the Unit 4 Dayton decontamination operations noted in Area S-5. The polonium has decayed out). The area covers approximately 9,000 ft^2 (MRC, 1986d).

- The SM/PP Hill-7 (S-7) area resulted from the transfer of contaminated soil from Area M-5, near HH Building, in 1985. The area of contamination has not been calculated. Preliminary data indicate that the average concentration of ^{60}Co in the soil ranges from 10 to 100 pCi/g (MRC, 1986d).

o Disposal of liquids into leaching beds and/or retaining and settling basins

- The SM/PP Hill-8 (S-8) area is west of SM Building. Prior to 1965, area S-8 was contaminated by SM Building operations. The area covers approximately 2,600 ft^2. Preliminary data indicate that the average soil ^{238}Pu concentration is 10 to 100 pCi/g (MRC, 1986d).

- The SM/PP Hill-9 (S-9) area, west of Building 30, contained a sanitary sewage septic tank and leach basin for SM Building used from 1960 to 1965. The area is approximately 15,500 ft^2. Preliminary data indicate that the average soil ^{238}Pu concentration is 10 to 100 pCi/g (MRC, 1986d).

o Landfill operations

- The Valley-5 (V-5) area is located south of Overflow Pond. The silt and dredgings from an on-site drainage ditch were used from 1971 to 1974 as cover for certain sections of landfill. Approximately 3,200 ft^3 of silt and dredgings were spread over an area of 60,000 ft^2. A site survey (MRC, 1986d) did not find any soil ^{238}Pu contamination (0.1 to 1.0 pCi/g) on the surface or in two boreholes drilled into the cap of the landfill. However, the study recommended further sampling.

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o Storage and Disposal

- The Valley-6 (V-6) area, located southeast of Buildings 51 and 29, was thought to contain empty corroded thorium drums buried from 1954 to 1965. The area is suspected to be contaminated with ^{226}Ra, ^{227}Ac, and ^{228}Th. The area covers approximately 22,000 ft^2. A previous study (MRC, 1986d) found no ^{226}Ra, and ^{227}Ac was located in only one part of the area. In addition, a septic tank later used during construction may have been used for the burial of radioactive waste products from SW Building. This area is now a paved parking lot. Preliminary data indicate that the peak soil ^{227}Ac concentration is 1,400 pCi/g, while the average soil ^{228}Th concentration is 1 to 10 pCi/g (MRC, 1986d).

- The SM/PP Hill-10 (S-10) area is located northeast of Building 53 and west of Building 95. This was an explosives storage area during site construction (late 1940s and early 1950s) and may have been used later for storage of radioactive materials from SW Building during the 1950s and 1960s. The area of contamination has not been calculated. In addition, a small area east of this location was found to be contaminated with ^{137}Cs. Preliminary data indicate that the average concentration of ^{137}Cs in the soil ranged from 10 to 100 pCi/g. Contaminated soil was removed in 1985, and there is no further contamination (MRC, 1986d).

o Existing Buried Waste Lines

- The Valley-7 (V-7) area is the pipeline between SM/PP Hill and WD Building. This area contained a 1-1/2-inch underground line and a 2-inch underground line that were formerly used to transfer low-level and higher level ^{238}Pu contaminated liquid waste from the SM-PP area to WD Building for processing. This area has recently undergone decontamination and is now completely decontaminated (i.e., there is no further trace of radionuclides in the soil) (MRC, 1986d).

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- o Contaminated material not removed during prior decontamination activities

  - The Main Hill-7 (M-7) area is Room 219 of SW Building. The contaminated soil at this location is below an old radioactive cell that itself was contaminated in the late 1950s and never completely decontaminated because of the structures around it. The old Room 219 cave is now under a second concrete floor. The area is approximately 1,000 ft^2. The site survey team did not perform an analysis of this soil.

Radioactive contamination in the soil can result in three potential environmental problems. First, surface-deposited radioactivity poses a potential offsite hazard due to resuspension in the air. Second, the surface contamination can serve as a source of stream sediment contamination as a result of overland wash, stream convection, settling, and resuspension mechanisms. Third, it is possible for some radioactive substances to migrate through the soil to the groundwater, thereby creating the potential for ingestion.

Table 3.2-1 summarizes the current status of each of the on-site contaminated areas. Of the 24 on-site areas (one off-site area is discussed in Section 4.5) that have been identified, 16 are currently being examined in a D&D study in order to estimate the levels of effort needed for decontamination. Table 3.2-2 presents the estimated volume of soil to be removed in order to decontaminate these 16 areas. Three (M-6, V-3, and V-5) of the 24 areas have radioactive contamination, but the levels are below decontamination values and were not included in the present Mound study (MRC, 1986e). One area (V-2) was not considered for the Mound study since it was identified as a radioactive area during the DOE Survey. Several areas (S-5, V-4, and V-7) have already been decontaminated or the radioactivity has decayed away. One area, M-7, although contaminated, was not considered in the Mound decontamination study since it is beneath an active building.

3.2.3 Environmental Monitoring Program

The results of on-site soil contamination measurements where discussed in the previous Section (3.2.2). The Mound Plant measures the levels of off-site radioactive contamination in the environment by measuring the concentration of

Table 3.2-1

CURRENT STATUS OF CONTAMINATED AREAS WITHIN THE MOUND PLANT, SEPTEMBER 1986

Area Number		Current Status
DOE Survey	Mound Site Survey	
M-1	4	In Mound D&D Study(1)
M-2	4A	In Mound D&D Study
M-3	5	In Mound D&D Study
M-4	14	Currently undergoing D&D
M-5	20	In Mound D&D Study
M-6	6	Contamination less than D&D levels[1]
M-7	15	Not considered in D&D study
S-1	1	In Mound D&D Study
S-2	9	In Mound D&D Study
S-3	17	Currently undergoing D&D
S-4	8	In Mound D&D Study
S-5	10	Activity decayed out
S-6	12	In Mound D&D Study
S-7	22	In Mound D&D Study
S-8	11	In Mound D&D Study
S-9	16	In Mound D&D Study
S-10	21	In Mound D&D Study
V-1	3	In Mound D&D Study
V-2	23	Not considered in D&D study[2]
V-3	2	Contamination less than D&D levels[3]
V-4	13	Activity decayed out
V-5	18	Contamination less than D&D levels[3]
V-6	7	In Mound D&D Study
V-7	19	Decontaminated

(1) Draft Site Survey, Project Engineering Estimate dated June 4, 1986 (MRC, 1986e)
(2) A portion of V-2 is included in the D&D for M-4
(3) $^{238}Pu > 10$ pCi/g
Thorium > 2pCi/g

Table 3.2-2

SOIL VOLUMES AND ISOTOPIC INVENTORY FOR DECONTAMINATION PROJECTS ON THE MOUND PLANT

Area Number		238 Pu > 10 pCi/g		Thorium > 2 pCi/g		Total	
DOE	Mound	Soil Vol (Cu. ft)	Curie Inventory	Soil Vol (Cu. ft)	Curie Inventory	Soil Vol (Cu. ft)	Curie Inventory
M-1	4	54100	1.23E-02	0	0	54100	1.23E-02
M-2	4A	4100	9.31E-04	0	0	4100	9.31E-04
M-3	5	0	0.003 + 00	0	0	0	0
M-4	14	25400	5.77E-03	5600	1.27E-03	31000	7.04E-03
M-5	20	0	0	0	0	0	0
S-1	1	151000	3.43E-02	84000	1.91E-02	235000	5.33E-02
S-2	9	4600	1.04E-03	58500	1.33E-02	63100	1.43E-02
S-3	17	101100	2.29E-02	94000	2.13E-02	195100	4.43E-02
S-4	8	7600	1.73E-03	135400	3.07E-02	143000	3.25E-02
S-6	12	50600	1.15E-02	76000	1.73E-02	126600	2.87E-02
S-7	22	0	0	0	0	0	0
S-8	11	61300	1.39E-02	50200	1.14E-02	111500	1.53E-02
S-9	16	22600	5.13E-03	29700	6.74E-03	52300	1.19E-02
S-10	21	0	0	0	0	0	0
V-1	3	40800	9.26E-03	31100	7.06E-03	71900	1.63E-02
V-6	7	0	0.00E + 00	130900	2.97E-02	130900	2.97E-02

Source: Draft Site Survey, Project Engineering Estimate, June 4, 1986 (MRC, 1986e)

radioactivity in vegetation and foodstuffs. Mound monitors grass, potatoes, and tomatoes in the Miamisburg, Centerville, and Bellbrook areas (see Figure 2.1-1) and a control site located 28 miles west of Mound. Table 3.2-3 presents these data for the last 7 years. Figure 3.2-3 is a graphic display of the data in Table 3.2-3. These data indicate higher concentrations of tritium in grass and tomato samples near Miamisburg. The environmental monitoring program has not detected any consistent pattern of plutonium in grass and tomato samples at varying distances from Miamisburg. The quantities detected in vegetation vary from year to year but are near background concentrations (up to 3 to 8 times background).

In addition to the monitoring performed by Mound, three studies have been conducted in order to determine the levels of ^{238}Pu in the soil. Muller et al. (1976) conducted a study around the Mound Plant to determine the aerial distribution of ^{238}Pu and $^{239,240}Pu$. Figure 3.2-4 illustrates their results as a function of distance and direction from Mound. Bobula and Alberts (1978) reported surface soil ratios of industrially derived ^{238}Pu and fallout of $^{239,240}Pu$, varying from 0.97 to 1.32 pCi/kg soil of ^{238}Pu (0.00097 to 0.00132 pCi/g soil) for background levels and 147 to 3320 pCi/kg of ^{238}Pu at two locations around Mound.

These three studies indicate that ^{238}Pu released from Mound has deposited on soils surrounding the Mound Plant. It appears from the distribution of the radioactive contamination that the contamination has reached the off-site locations via atmospheric dispersion and deposition. Depending on the direction, Mueller indicates that the off-site contamination of soil is less than two orders of magnitude above background (maximum of 11 nCi/m^2).

3.2.4 Findings and Observations

3.2.4.1 Category I

There are no soil findings in Category I.

3.2.4.2 Category II

There are no soil findings in Category II.

Table 3.2-3

ENVIRONMENTAL CONCENTRATION OF RADIOISOTOPES IN VARIOUS MEDIA (10-6 μCi/g) IN PROXIMITY TO MOUND, 1979-1985

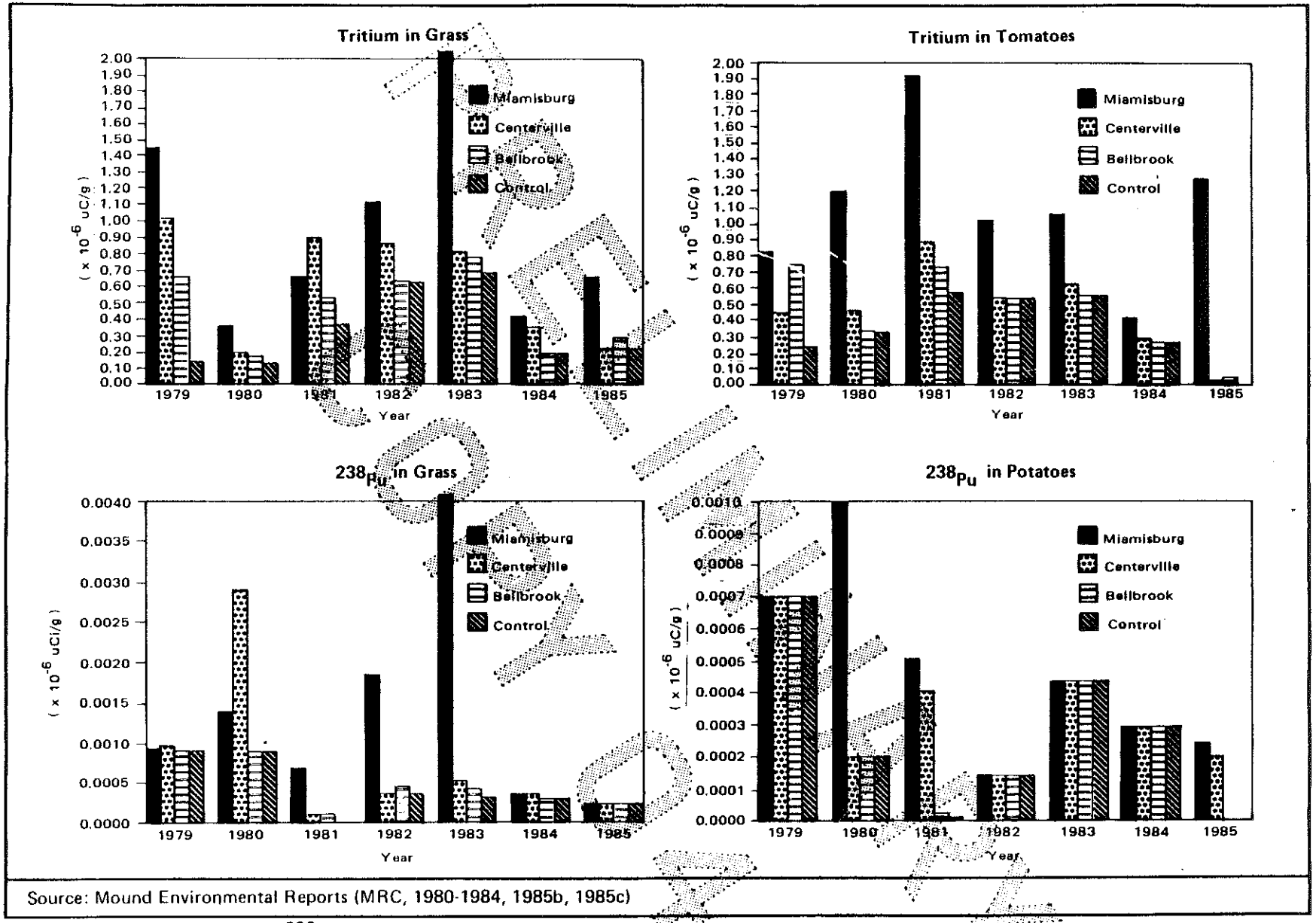
^{238}Pu Total (Incremental & Control)

	1979	1980	1981	1982	1983	1984	1985
Miamisburg							
Grass	0.00093	0.00140	0.00070	0.00186	0.01932	0.00036	0.00023
Potatoes	0.00070	0.00100	0.00051	0.00015	0.00044	0.00030	0.00025
Centerville							
Grass	0.00097	0.00290	0.00010	0.00036	0.00052	0.00036	0.00023
Potatoes	0.00070	0.00020	0.00041	0.00015	0.00044	0.00030	0.00021
Bellbrook							
Grass	0.00090	0.00090	0.00010	0.00046	0.00042	0.00030	0.00023
Potatoes	0.00070	0.00020	0.00002	0.00015	0.00044	0.00030	0.00000
Control							
Grass	0.00090	0.00090	0.00000	0.00036	0.00032	0.00030	0.00023
Potatoes	0.00070	0.00020	0.00001	0.00015	0.00044	0.00030	0.00000

Tritium Total (Incremental + Control)

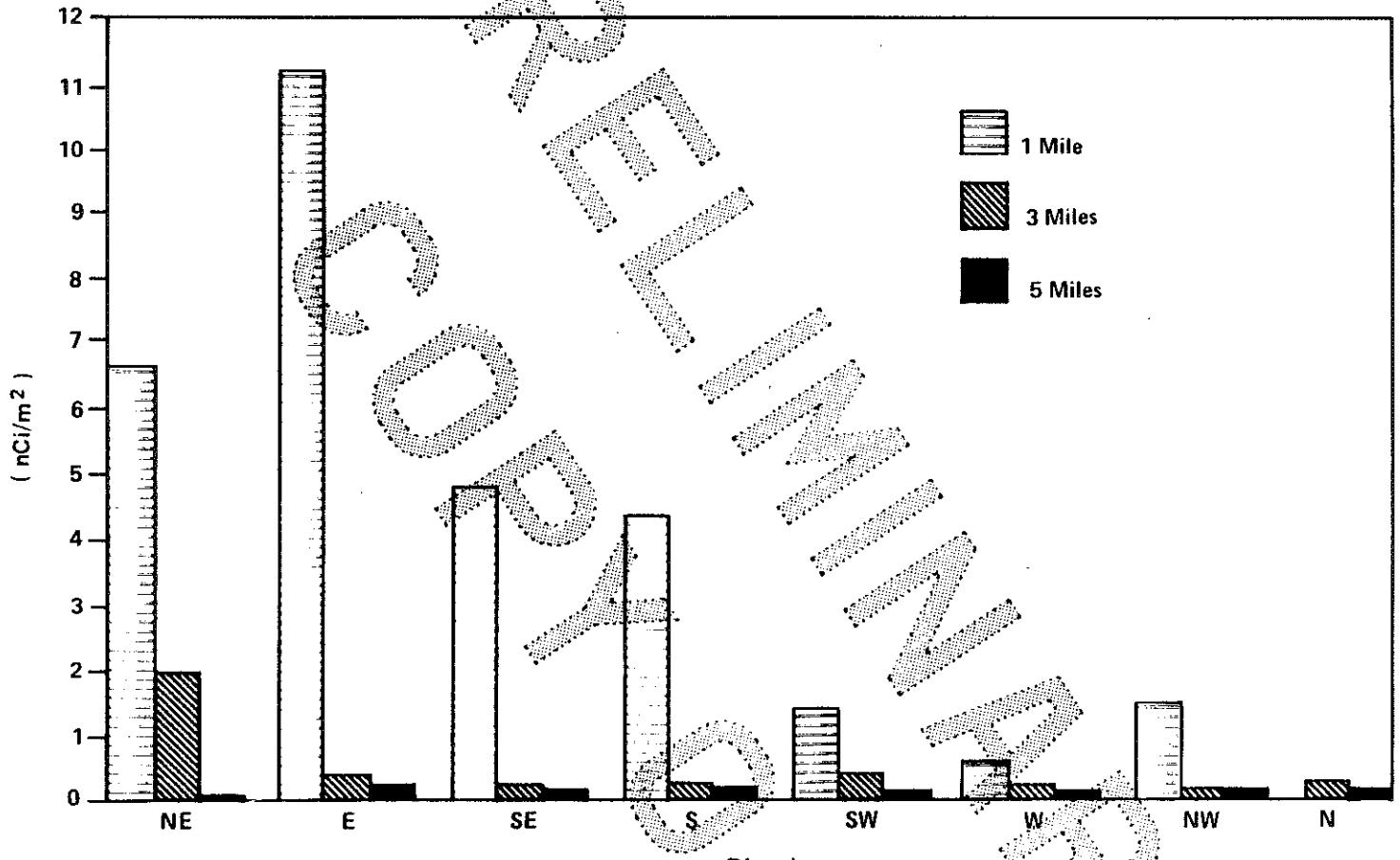
	1979	1980	1981	1982	1983	1984	1985
Miamisburg							
Grass	1.46	0.36	0.67	1.12	9.89	0.43	0.67
Tomatoes	0.83	1.20	1.93	1.03	1.07	0.43	1.30
Centerville							
Grass	1.02	0.20	0.91	0.87	0.82	0.36	0.23
Tomatoes	0.44	0.46	0.89	0.55	0.64	0.30	0.03
Bellbrook							
Grass	0.67	0.17	0.55	0.64	0.79	0.20	0.29
Tomatoes	0.75	0.33	0.74	0.55	0.57	0.28	0.04
Control							
Grass	0.14	0.13	0.38	0.63	0.69	0.20	0.23
Tomatoes	0.24	0.33	0.58	0.55	0.57	0.28	0.00

Source: Mound Environmental Reports (MRC, 1980-1984, 1985b, 1986b)



Source: Mound Environmental Reports (MRC, 1980-1984, 1985b, 1985c)

^{238}Pu and Tritium in Vegetation in Proximity to the Mound Plant, 1979-1985 Figure 3.2-3



Source: Mueller, 1976

^{238}Pu in Soils as a Function of Distance and Direction from the Mound Plant 1976

Figure 3.2-4

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May contain unclassified controlled nuclear information subject to Section 148 of the AEA, as amended (42 USC 2168). Approval by the Department of Energy prior to release is required.

3.2.4.3 Category III

1) Potential Movement of Plutonium and Thorium Contamination on the New Property - Plutonium and thorium have contaminated a drainage path on the new property, and the contamination may be moving toward Mound property boundaries. This is the area referred to in this report as Area S-1. The source of the plutonium was an incident involving the storage of plutonium-contaminated materials in wooden boxes north of Building 21.

Bulk transfer of thorium drums to and from the storage basin (Building 21) resulted in spillage of thorium. The area (approximately 136,000 ft^2) was cleaned up and backfilled with clean soil. Mound has found that an area on the new property is contaminated with ^{232}Th. ^{238}Pu contamination, which was caused by exposed storage of wooden containers and resultant surface runoff, has been found in the vicinity. Preliminary data indicate that peak ^{238}Pu contamination is 34,000 pCi/g. Peak ^{232}Th contamination is greater than 100 pCi/g (the average is 10 to 100 pCi/g). The peak ^{238}Pu soil contamination of 34,000 pCi/g is over 3400 times the D&D levels for the site. The peak ^{232}Th concentration is over 50 times the background level at Mound.

Plutonium and thorium contamination has been found on the new property, and the Survey team believes that the plume is moving. A site survey (MRC, 1986d) indicates that the ^{238}Pu and ^{232}Th have been scoured from the center line of the drainage basin. The data indicate that contamination is still present along the sides of the drainage basin. This implies that the contamination was deposited by high-volume runoff which more completely flooded the basin while smaller runoff volumes have subsequently removed soil contamination deposited along the center line farther downstream and farther along the drainage center line.

In addition to the potential for the plutonium and thorium contamination to have moved by water-borne transport of material, there is a potential for movement and dispersion due to earth-moving activities nearby. During the DOE Environmental Survey, it was noticed that earth-moving operations had occurred on the new property near the end of Area S-1. If the soil surface contamination has indeed moved since the 1982 survey, the earth-moving operations may have disrupted the plume and moved contaminated soil closer to the site boundary. Movement closer to the site boundary increases the potential for exposure to the general public.

The sampling and analysis phase of the Survey will test soils in the vicinity to determine whether movement of contamination from known locations can be detected.

2) Potential for Radionuclide Contamination of Surface Water from Runoff - Areas M-1, M-2, V-1, V-2, S-2, and S-7 have been contaminated with radionuclides. The contamination is on the surface and has the potential for movement off-site into surface waters. The sampling and analysis phase of the Survey will test water samples at the outfall of the stormwater system to determine if any contaminants can be detected. Each area is discussed below:

- Area M-1 is located near WD Building. The area around the building was contaminated with ^{210}Po and ^{60}Co when the building's influent tanks overflowed in 1965 (polonium has decayed out, leaving residual ^{60}Co). Contamination also resulted from the rupture in 1969 of the WTS line, which released ^{238}Pu. Preliminary data indicate that the average soil ^{238}Pu concentration ranges from 100 to 1000 pCi/g (MRC, 1986d). No estimates are available for ^{60}Co concentrations.

- Area M-2 is near WD Building. Area M-2 is the sewage sludge disposal drying pits which were contaminated with ^{210}Po and ^{60}Co from the accident noted in M-1 above. The drying pits are part of the old SD Building located immediately adjacent to the WD Building. ^{238}Pu contamination also resulted from the WTS line rupture mentioned in M-1 above. No estimates are available for ^{238}Pu and ^{60}Co concentrations.

- Area V-1, which surrounds Buildings 72, 55, 94, and 57, was a storage and redrumming area covering approximately 15,000 ft^2. The area was cleaned and backfilled with clean soil in 1965. Previous studies found no thorium; however, ^{238}Pu contamination was discovered which was probably the result of contamination from the WTS line rupture noted in M-1 above. Preliminary data indicate that the average ^{238}Pu concentration is 10 to 100 pCi/g (MRC, 1986d).

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- Area V-2 is an open drainage ditch which contained plutonium. Part of this ditch is being decontaminated along with Area M-4. The Pu spill may not have been accurately identified in current D&D plans resulting in the potential for less than total remediation of the area. This area was previously reported to have involved the spill of a plutonium-containing solution shown to be at the east end of WD Building. Review of interview records and conversations with a former employee revealed that this was incorrect. Ths spill involved leakage from one or more plutonium liquid waste drums stored at the southwestern corner loading area of WD Building, near where the liquid tank trucks from SM/PP area are now unloaded. This spill ran into the catch basin south of this loading dock area and flowed down a stone-lined open drainage culvert southwest across the buried pipeline from Building 41 to WD Building. More accurate location information is important, because present plans to remediate the spill do not encompass all areas contaminated by the release.

- Area S-2, located near Building 31, was a storage and redrumming area which was contaminated with ^{232}Th. The area, approximately 40,000 ft^2, was cleaned and backfilled with clean soil in 1965. Thorium-contaminated soil was removed to another area on-site. Preliminary data indicate that the area still has an average soil ^{232}Th concentration ranging from 1 to 10 pCi/g (MRC, 1986d).

- Area S-7 resulted from the transfer in 1985 of contaminated soil from Area M-5, near HH Building. The area of contamination has not been calculated. Preliminary data indicate that the average concentration of ^{60}Co in the soil ranges from 10 to 100 pCi/g (MRC, 1986d).

3) <u>Potential for Radionuclide Contamination of Groundwater</u> - Areas M-3, V-5, V-6, S-4, S-6, S-8, S-9 all have subsurface contamination only. This contamination poses some degree of threat to the groundwater exclusively. The degree of threat posed in many instances is low, due to mobility characteristics of the radionuclide. The areas are described below:

- Area M-3 is located north of Building 48. A radioactive waste line containing ^{60}Co and ^{210}Po from HH Building to WD Building ruptured in

1969. Polonium has decayed out, leaving residual ^{60}Co. The area covers approximately 6,800 ft^2. Preliminary data indicate that average soil concentrations of ^{60}Co range from 10 to 100 pCi/g (MRC, 1986d).

- Area V-5 is located south of Overflow Pond. The silt and dredgings from an on-site drainage ditch were used from 1971 to 1974 as cover for certain sections of landfill. Approximately 3,200 ft^3 of silt and dredgings were spread over an area of 60,000 ft^2. A site survey (MRC, 1986d) did not find any surface soil ^{238}Pu contamination (0.1 to 1.0 pCi/g) either at the surface or in two boreholes drilled atop the new landfill. However, the study recommended further sampling.

- Area V-6, located southeast of Buildings 51 and 29, was thought to contain empty corroded thorium drums buried from 1954 to 1965. The area, which is approximately 22,000 feet, is suspected to be contaminated with ^{226}Ra, ^{227}Ac, and ^{228}Th. A previous study (MRC, 1986d) found no ^{226}Ra, and ^{227}Ac was located in only one part of the area. In addition, a septic tank used during construction later may have been used for the burial of radioactive waste products from SW Building. This area is now a paved parking lot. Preliminary data indicate that the peak soil ^{227}Ac concentration is 1,400 pCi/g. The average soil ^{228}Th concentration is 1 to 10 pCi/g (MRC, 1986d).

- Area S-4 is west of Building 30. This area in 1965 received subsurface contaminated dirt from the decontamination operations near Building 21 and Building 31. The area is approximately 25,000 ft^2. Preliminary data indicate that the average concentration of ^{232}Th in the soil is 10 to 100 pCi/g (MRC, 1986d).

- Area S-6 is west of SM Building. Area S-6 contains buried contaminated dirt from decontamination of thorium near Building 21 (Area S-1) in 1965. The area covers approximately 19,000 ft^2. A site survey (MRC, 1986d) also found ^{238}Pu contamination which is probably the result of SM operations. Since the WTS line traversed this area, much of the contaminated soil was removed as part of that decontamination work. Preliminary data indicate

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that the average soil ^{238}Pu concentration is 10 to 100 pCi/g. Preliminary data indicate that the average soil ^{232}Th concentration is 1 to 10 pCi/g (MRC, 1986d).

- Area S-8 is west of SM Building. Prior to 1965, Area S-8 was contaminated by SM building operations. The area is approximately 2,600 ft^2. Preliminary data indicate that average soil ^{238}Pu concentration is 10 to 100 pCi/g (MRC, 1986d).

- Area S-9, west of Building 30, contained a sanitary sewage septic tank and leach basin for SM Building used from 1960 to 1965. The area is approximately 15,500 ft^2. Preliminary data indicate that the average soil ^{238}Pu concentration is 10 to 100 pCi/g (MRC, 1986d).

3.2.4.4 Category IV

1) Soil radionuclide studies. Soil radionuclide contamination data have not been correlated with previous studies to assess the potential for migration of the radionuclide contamination. For example, it might have been possible to determine if the contamination on the new property was moving based upon 1985 results if it could be compared with spring 1982 data.

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3.3 Surface Water

3.3.1 Background Environmental Information

The surface-water body of concern to the Mound Plant is the Great Miami River. The river has an average flow of 2,436 ft^3/sec for the 45 years of record at USGS gauging station 03271500 at the Route 725 bridge in Miamisburg (USGS, 1983). Other records for USGS station 03271510 at Linden Avenue in Miamisburg (0.6 mile downstream from the previous station and upstream of both Mound outfalls) show that for the water year from October 1981 through September 1982, the river had a mean pH of 8.0, with a range from 7.5 to 8.9, and a dissolved oxygen (DO) concentration mean of 8.8 mg/l, with a range from 0.4 to 20.0. However, the latter extremes occurred as diurnal fluctuations in August when algal photosynthesis and respiration can be expected to be high. The lowest monthly mean DO content was 5.5 mg/l for September. The background concentrations of some relevant radionuclides in surface waters and sediments in the region surrounding the Mound Plant are shown in Table 3.3-1.

The topography of the Mound site consists essentially of two large hills adjoining the eastern edge of the floodplain of the Great Miami River. A wide, short valley separates the two hills (Figure 3.2-1). The north hill, referred to as the Main Hill, was built up earlier and more densely than the valley and the south hill, referred to as the SM/PP Hill. With the exception of the new property and some steep hillsides, all parts of the site are now either developed or planned for development. The various drainage systems generally follow the natural ground contour, that is, down the faces of the two hills into the valley and down the valley toward the Great Miami River.

There are three principal drainage systems on the site: sanitary wastewater, stormwater (which also receives significant amounts of noncontact cooling water) depicted in Figure 3.3-1, and radioactive wastewater. Each system leads to a treatment unit before ultimately discharging the liquid effluents to the river. The units are, respectively, the sanitary wastewater treatment plant (Building 57), the stormwater retention pond, and the waste disposal (WD Building) plant. The stormwater collection system is a combination of underground pipes, concrete-lined open channels, unlined ditches, and natural stream beds. The sanitary

Table 3.3-1

BACKGROUND CONCENTRATIONS OF RADIONUCLIDES IN SURFACE WATERS IN MOUND REGION FOR 1985

Nuclide	Location			
	Great Miami River, 20 Miles Upstream of Mound		Small Headwaters Lake, 28 miles Northwest of Mound	
	Small River, fCi/ml	River Silt, fCi/gm	Surface Water, fCi/ml	Surface Water Silt, fCi/gm
^{238}Pu	$(0.25 \pm 1.03) \times 10^{-3}$	(0.65 ± 1.2)	$(6.23 \pm 16.6) \times 10^{-3}$	(0.33 ± 0.61)
^{3}H	$(0.13 \pm 0.04) \times 10^{+3}$	(2)	$(01 \pm 0.06) \times 10^{+3}$	(2)
^{233}U and ^{234}U	(0.71 ± 0.44)	(2)	(2)	(2)
^{238}U	(0.76 ± 0.06)	(2)	(2)	(2)

Source: Mound Environmental Monitoring Report for 1985 (MRC, 1986b)

(1) femto Curie = 10^{-15} Ci
(2) Nuclide not analyzed

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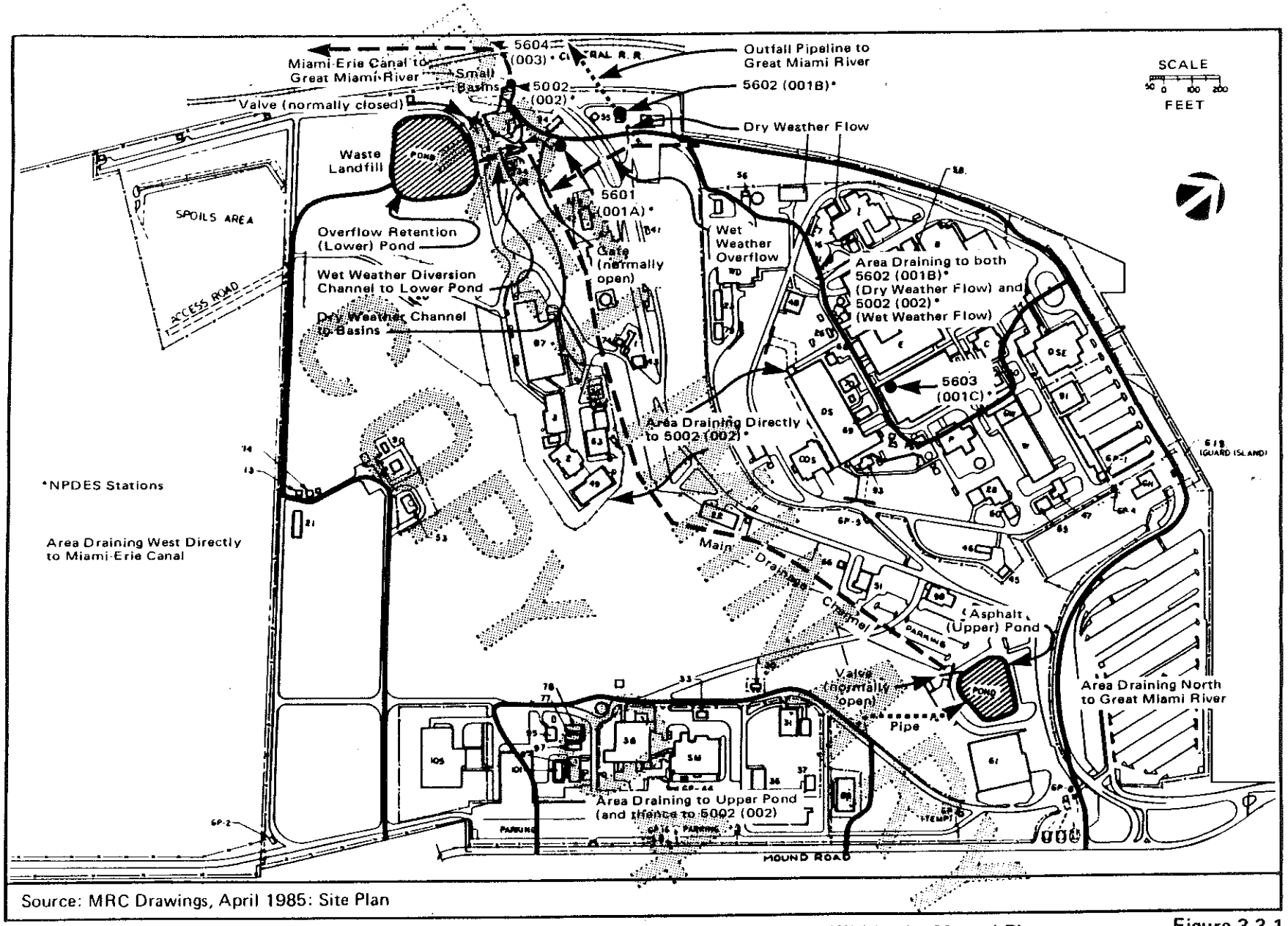

Source: MRC Drawings, April 1985: Site Plan

Storm Drainage System and NPDES Sampling Station Locations Within the Mound Plant

Figure 3.3-1

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wastewater collection system is composed entirely of underground pipes, with very few sewage ejectors and pumping stations. The radioactive waste collection system consists of an underground gravity-flow piping system now abandoned in place, and a new system of some overhead and ground-level piping, with a few sumps and steam-ejector pumping units. The wastewater sources, treatment plants, and discharge points are described in more detail in the next section. The effluents from the sanitary wastewater treatment plant and the radioactive waste treatment plant join a short distance outside the Mound property line and discharge through a 1,750-foot pipeline directly into the Great Miami River adjacent to the Mound Plant. This pipeline is listed as Outfall 5001 in the National Pollutant Discharge Elimination System (NPDES) permit (see Figure 3.3-1). The stormwater effluent discharges through a culvert under the railroad tracks into the abandoned Miami-Erie Canal; this discharge is listed as Outfall 5002 in the NPDES permit (see Figure 3.3-1). It then flows south in the old canal bed, parallel to the railroad tracks, and then diagonally southwest through a drainage ditch to enter the river about 1 mile south of the previously mentioned outfall pipeline.

A variety of piping materials is used in the above systems. The older portions of the plant, i.e., on the Main Hill, have used primarily vitrified clay underground piping for all three systems (MRC, 1986e). Newer portions of the stormwater system use concrete or reinforced concrete underground pipes, especially in the larger sizes. Some cast iron, steel, duriron, and plastic underground piping are also used where strength or corrosion-resistance are required in specific locations. The sanitary and radioactive waste effluent pipeline to the river, which is mostly vitrified clay, was slip-lined with a one-piece PVC plastic liner about 1983 to guarantee its integrity against any leaks where it crossed the alluvial floodplain between the Mound Plant and the river. The more recently installed above-ground and on-ground radioactive waste lines are one-piece ½-inch diameter to 1-inch diameter, high-density polyethylene (HDPE) pipes within 4-inch HDPE solvent-welded carrier pipes. Where the on-ground lines pass under roads, they are further encased in steel carrier pipes to resist the extra-heavy loads.

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Other water-related utility systems include a potable and process water supply system, a fire protection water system, and two separate central refrigerated brine systems for the north and south hills, respectively. The water supply for the Mound Plant is derived almost exclusively from three on-site wells at the western edge of the property, as described in detail in Section 3.4, Groundwater. The facility also has a backup connection to the Miamisburg municipal water system near Building 50, at the eastern edge of the property. The on-site supply is piped to the pump house and water treatment plant (Building 24) in the west-central part of the site, where it is chlorinated and pumped into the separate domestic and fire protection systems. There are two elevated tanks and one ground-level standpipe on the fire protection system to provide reserve water supplies. Although most of the piping in the domestic and fire protection distribution systems are cast iron, a substantial portion of the domestic system--perhaps 25%--is asbestos-cement pipe.

Both refrigerated brine loop systems are centered at, and controlled from, the powerhouse (P Building), where the refrigeration units, recirculating pumps, and brine makeup tanks are located. The distribution piping is mainly overhead between buildings. The Main Hill loop uses a calcium chloride/zinc chromate additive to form the brine, whereas the SM/PP Hill loop uses a 50% propylene glycol/50% water circulating liquid. Some isolated buildings, (e.g., in the test fire area) have local systems and cooling towers that use one or the other of the above fluids (Hoffman, 1986).

3.3.2 General Description of Pollution Sources/Controls

There are numerous sources of wastewater in the many buildings at the Mound Plant. They are summarized in Table 3.3-2 and, where they contribute to an existing or potential environmental problem, are explained in more detail in the text that follows. The following facilities and pollution sources contribute wastes to the sanitary, radioactive, and stormwater sewer systems. These systems act as pathways for environmental problems discussed in the surface-water (Section 3.3.4) and groundwater (Section 3.4.4) findings .

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Table 3.3-2

WASTEWATER SOURCES AT THE MOUND PLANT

Source	Collection/Treatment System Receiving the Flow			
	Sanitary	Stormwater	Radioactive Waste	Other (solvent disposal)
Sanitary: Toilets, lavatories, & showers	X			
Stormwater, etc.				
Stormwater runoff from roots, pavements, & ground surfaces		X		
Ground-water infiltration	X	X	X	
Process Water				
Laboratory sinks, general	X			X
Laboratory sinks, radioactive work areas			X	
Floor drains in laboratory, production, & plant services areas	X	*		X
Photographic processing units	X			
Plating shops	X			
Plant laundry			X	
Cooling water, noncontact		X		
Steam condensate, non-recycled (most is recycled)		X		
Refrigeration system cooling tower blowdowns	X			
Softener/Deionizer backwashes	X			
Radioactive wastes, reaction by-product water, contaminated cooling water, and decontamination washwater			X	

* = Information incomplete; some units may be connected to this system

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Laboratory sinks, general: There are usually one or more laboratory sinks in each of the numerous laboratories at the Mound Plant.

The principal hazardous wastes generated in the laboratories are volatile organic solvents, some strong acids and bases, and heavy metal salt solutions from etching and plating. Where significant quantities of organic solvents are used, the facility has systems for disposing of the wastes generated, as described in Section 4.1, Waste Management. Dumps of plating baths are shipped off-site to a commercial TSD facility. However, residual amounts of these materials may be discharged into the laboratory sinks leading to the sanitary sewer system. The exfiltration of these substances from the broken pipes in the sanitary sewer system may result in contamination of subsurface soil and water.

Laboratory sinks, radioactive work areas: These operations are located in Buildings T, SW, R, and PP (38), and drain to dedicated sumps in each of the buildings. The T Building sump is equipped to solidify the sump liquids. The R and SW Buildings drain to radioactive waste sumps in the SW Building basement, from which it is either pumped to WD Building or solidified within the SW Building basement. The liquid wastes from PP Building are transported in tanker trucks to WD Building for treatment and disposal.

Floor drains in laboratory, production, and plant services areas: These drains generally go to the sanitary system, with two exceptions. The first is for Buildings 1, 74, 27, and 42 in the test fire area, where the floor drains and drain channels go outside the respective buildings. These formerly drained to nearby evaporation/seepage pits but now are pumped into drums for off-site disposal. The second exception is the R Building solvent storage shed pad floor drain, which is said to terminate just below the pad in a small gravel seepage bed rather than to be connected by pipe to any wastewater collection system.

Photographic processing units: Such units were found in Buildings 40, M, E, R, DS, 2, and 35. Although there are numerous equipment configurations used, the baths may generally be classed as developer, stop bath, fixer, and rinse(s). The rinse bath frequently is allowed to run continuously and overflow to drain during equipment operation. The other baths are dumped and renewed periodically, depending on

equipment usage. Silver lost from the film during developing tends to accumulate in the first bath and can be recovered for its intrinsic value. Some of the photographic units send their silver-bearing wastes to be stored until the Mound silver recovery unit becomes operational. Other dissolved silver is disposed of in drains which go to the sewage treatment plant. The silver is likely to be precipitated into the sludge at the sewage treatment plant.

Plating shops: Two plating shops, one a production shop and the other for research and development items, are located in Building M, the first at the southwest corner of the building and the second at the northwest corner. The southerly (production) plating shop is NPDES permitted outfall #5603 (see Figure 3.3-1). It has relatively up-to-date equipment and baths for batch plating of copper, nickel, chromium, cadmium, platinum, silver, and gold and for electrophoretic coating with acrylic plastic. Some of the metal baths use cyanide to complex the metals, and others use simple metal salts. There are also aqueous cleaning baths using nitric, hydrochloric, sulfuric, and hydrofluoric acids, caustic soda, and various detergents, as well as nonaqueous cleaning units utilizing perchloroethylene, acetone, and ultrasonic energy. Plated parts, when completed, are placed successively in a set of four rinse tanks. The liquid in the rinse tanks flows countercurrent to the parts, the makeup is deionized tap water, and the overflow goes to the sanitary sewer. The northerly (R&D) plating shop has similar baths and capabilities, but has improvised and outdated equipment in poor condition. However, a replacement shop is now under construction at the other end of the building, adjacent to the southerly plating shop. Like the photographic waste discharges, the rinse waters discharged from the plating shops have the potential to contain toxic heavy metals that could exfiltrate from broken sewer pipes to contaminate subsurface soils and water prior to reaching the sewage treatment plant.

Plant laundry: This unit, located in Building H, is divided into two sections that handle smocks and other items from nonradioactive and radioactive areas, respectively. Water, detergents, and fabric softeners, but not bleach, are used; there is no dry-cleaning with perchloroethylene or other organic solvents. There are three industrial-type automatic washers and four dryers in the nonradioactive section, and one washer and one dryer in the radioactive section. However, no distinction is made between the effluents of the two sections, which both flow to a sump in the radioactive section and are then pumped through a line ultimately leading to WD Building.

Cooling water, noncontact: Substantial amounts of cooling water are used at the powerhouse, Building P, for refrigeration equipment cooling and for process unit, analytical equipment, and compressor cooling in numerous buildings, particularly T, DS, HH, and PP (38). All of this water is discharged directly into the storm sewer system and, during dry weather, constitutes the major deliberate input to it. This indirectly leads to regulatory violations of the NPDES limits for the storm water system, Outfall 5002, because the limits are set essentially for the dry weather discharge of cooling water, which are then frequently exceeded during storms because of silt pickup from soil erosion. There is a proposal for FY 1987 to remove most of the cooling water discharges from the storm sewer by installing several local closed-circuit cooling loops, each with its own cooling tower, at major cooling-water users.

Steam condensate, nonrecycled: Condensate is normally returned to the powerhouse, but in one case noted in Building HH a condensate pump was out of service and a substantial flow was being discharged through a hose leading out of the building to a storm drain inlet in the road outside.

Refrigeration System Cooling Tower Blowdowns: The cooling tower water contains additives to control algae, bacteria, and scale formation. These additives are, respectively: Algacide, 2-benzyl-chlorophenol, initial concentration = 50 ppm; microbicide, mixture of 5-chloro, 2-methyl, 4-iso-thiazolin, 3-ore, initial concentration = 1 ppm, and 2-methyl, 4-iso-thiazolin, 3-ore, initial concentration = 8.3 ppm; scale inhibitor/dispersant, sodium polyacrylate, initial concentration not given (Carfagno, 1986a). Although these materials degrade and/or are consumed, some of each are still likely to be present in the 10,000 to 30,000 gal/day collective blowdown from all the Mound cooling towers to the sanitary sewers.

Softener/deionizer backwashes: The zeolite softeners are regenerated using salt; both the backwash, which may contain an excess of calcium ions, and any surplus salt solutions are compatible with the wastewater treatment process, although they are not removed by it. The boiler feed water is further treated by reverse osmosis to remove almost all ionic and non-ionic solutes; the concentrated brine from this process is also discharged to the sanitary sewers.

Groundwater pumpage: The facility intermittently draws water from one of the wells adjacent to the site (as described in Section 3.4, Groundwater) to alter the groundwater flow pattern and thereby diminish the tritium concentration in the aquifer. The discharge is listed in the NPDES permit as sampling station 5604 (old 003). This essentially clean water (less than 20 nCi/l of tritium) is discharged into the stormwater system and ultimately into the Great Miami River.

Groundwater infiltration: Recent investigations of the storm and sanitary sewer systems have identified numerous pipe and joint cracks, breaks, misalignments, sags, and obstructions. The abandoned underground hot waste sewer system was not investigated for practical reasons, but it is likely to be in the same condition because of its similar age and conditions of service. These defects are conducive to both infiltration into the pipe and exfiltration out of it, depending on the external groundwater levels at the various points along the pipe. It is likely that there is a net additional flow into the three systems. This has been demonstrated for the abandoned radioactive waste sewer system, which has no acknowledged inputs but has a substantial output at its terminus in WD Building. It is also possible that there are losses of contaminated wastewater from these systems to the groundwater. Because there are some areas of contaminated soil on-site (see Sections 3.2 and 4.5), it is also possible that the groundwater infiltrating into these sewer systems is contaminated. Neither the amounts nor contaminant contents of this infiltration and exfiltration have been quantified. Mound has submitted a FY 1987-1988 budget request to repair the piping systems.

Runoff: As discussed in Sections 3.2 and 4.5, there are a number of areas on-site where the soils are contaminated with radioactive materials. Drainage from most of these areas would follow the normal site-drainage patterns and discharge through the stormwater collection system.

The sanitary wastewater treatment plant, the stormwater retention ponds, and the radioactive waste disposal building are used to control surface water pollution. The sanitary treatment plant discharges some 120,000 to 130,000 gal/day, or about 3,000,000 gal/month. Its process train consists of a grit collector, two aerated equalization basins, two aeration basins using the extended aeration process, two final clarifiers, two sand filters, two chlorine contact tanks, and a Parshall flume for flow measurement. The sludge removed in the final clarifiers is split, most

going to an aerobic digestor that is physically identical to the extended aeration tanks. Sludge is held in this digestor and added as needed to the incoming flow to innoculate it. Excess sludge is periodically wasted to open sand drying beds, with the filtrate being returned to the equalization tank. The dried sludge is placed in large plywood boxes, along with absorbent, and disposed of off-site as low specific activity (LSA) radioactive waste. The grit is washed in a screw conveyor type washer attached to the grit collector, with the elutriate flowing back into the grit collector. The washed grit is placed in the boxes along with the sludge for off-site disposal as LSA waste. Backwash from the sand filters is returned to the equalization tank. NPDES sampling station 5601 (old 001A) is located just upstream of the Parshall at the plant discharge.

The principal device for controlling storm-water pollution is the overflow retention pond, but three smaller basins also serve to control contaminant discharge during dry weather (Figure 3.3-1). During dry weather, the flow goes in succession only through the three smaller basins, passing from one to the next via overflow weirs that, incidentally, retain much of the sediment. The last basin discharges over a V-notch weir onto a concrete apron and thence into a short channel leading to the culverts under the railroad tracks, the canal, and ultimately the Great Miami River, as described earlier. NPDES station 5002 (old 002) is located at the V-notch weir, with the water samples being taken via a weighed tube from the bottom of a 2-foot-square by 1-foot-deep (below the concrete apron) submerged box located just downstream of the weir.

At the beginning of storms, a gate at the upper end of the first of the three small basins is closed manually, causing the flow to back up and overflow through a short channel into the overflow retention pond. The pond outlet, which is controlled by a valve that is normally closed, draws from a vertical outlet pipe in the pond, with baffled (to retain floating materials) inlet openings at several levels. The outlet pipe exits in the last of the three small basins, upstream of the V-notch weir and of the NPDES station. The diversion gate is kept closed for many hours after a storm, until the utilities supervisor sees that the incoming water is sufficiently clear for discharge directly through the three small basins. The water in the overflow retention pond is allowed to stand for several days until the suspended solids (i.e., the turbidity) have settled out. The clearer water is then bled out through the outlet pipe.

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The retention pond has a compacted clay impervious liner on the bottom and sides. There is also a paved chute that allows some surface-water runoff from the undeveloped, southerly part of the old site to drain directly into the retention pond. The leachate drainage pipes from the adjacent hazardous waste landfill also drain directly into the pond below the water surface. This feature allows pond water to back up into the landfill, perhaps allowing material to be leached out into the pond as the pond level fluctuates. This phenomenon is discussed in more detail in Section 4.5, Inactive Waste Sites and Releases. Sediment has been allowed to accumulate in the pond since its construction in 1978. The sediment depth is measured occasionally, but the sediment has not been cleaned out. Similarly, the sediment in the three small basins is measured occasionally, although it has not been cleaned out.

The upper pond, near Building 61, functions in a somewhat analogous manner to the lower pond. The storm sewers from the SM/PP Hill feed into it. There is also a controlled outlet and an emergency overflow spillway (which has never been utilized); flows for both would go to the previously described basins and lower retention pond. The upper pond is paved with asphalt on the sides and bottom. The sediment depth is measured from time to time, as is its gross activity. The sediment was cleaned out once, beginning in 1982. It was dewatered on-site on portable filter screens/beds and packaged for off-site disposal as LSA radioactive waste. Another such cleanout operation is planned for the near future.

The radioactive WD Building handles all radioactive wastewater. The alpha waste is treated by flocculation and sedimentation, followed by sand filtration of the effluent prior to its discharge to the Great Miami River via NPDES sampling point 5602 (old 001B). The sludge residuals are concentrated by batch settling and decanting off the supernatent liquid, and then solidifying and packaging the remainder for off-site disposal as LSA wastes. The beta wastes are directly solidified and packaged for off-site disposal as LSA wastes.

The reserve fuel oil storage tank is situated on the north side of the main drainage channel, east of Building 27. This 30,000-gallon tank (rated capacity; ultimate is 20% greater) is piped so that it can receive oil either by rail, via tank cars parked on the nearby railroad siding, or by truck, from tankers unloading at the

powerhouse, Building P, on the Main Hill. The oil would then be piped back to the powerhouse when needed if the main fuel supply, natural gas, was ever interrupted. The fuel oil tank is surrounded by an earthen dike, forming a secondary containment with a nominal capacity of 315,000 gallons. The sides and floor of the containment are paved with a layer of asphalt concrete, and drain to a sump just inside the midpoint of the easterly dike. A pipe from the sump leads through a normally closed valve to a seepage pit just outside the dike. This valve is open only on rare occasions when it is necessary to release excess rainwater ponding within the dike beyond that which can be safely allowed to evaporate.

Recent excavation and refilling of a trench for an electrical cable along the entire outer face of the south dike, adjacent to the main drainage channel, and down the center of the west dike from the southwest corner to the midpoint have impaired the dike in two ways. First, new low points have been created in the top of the south and west dikes, especially at the midpoint of the west dike, such that the containment would not reach its nominal capacity before overflowing. Second, improper compaction of the trench backfill in the south dike allows the loose material to be eroded by the flowing water in the adjacent stream channel. This action is undermining the dike at the southwest corner, and it may not be stable enough to retain the full depth of liquid on the containment if this were ever necessary. The quality of the electrical conduit construction work is now in litigation, and repairs to the dike will be made when the legalities are cleared up. There has never been any interruption, or threat of it, in the natural gas supply since the tank was installed, and thus the tank has never been filled or used. Construction of a replacement tank at a less vulnerable location near Building 19 is planned.

3.3.3 Environmental Monitoring Program

The Mound Environmental Monitoring Program is composed of four elements to achieve regulatory and process control objectives. The four elements are: the analysis of discharges to the Great Miami River; sampling at major points of the wastewater systems for process control and internal monitoring; testing sediments in the Great Miami River; and analyzing the potable water system.

NPDES Monitoring Program

There are two NPDES permitted outfalls to the river (5001 and 5002, see Figure 3.3-1). However, outfall #5001 has four intermediate permitted discharges, referred to as #5601, 5602, 5603, and 5604. Station #5601 receives discharge from the waste water treatment plant. Station #5602 primarily receives effluent from the WD treatment facility. The southern plating shop is permitted at #5603. Station #5604 encompasses the water pumped from Miamisburg well #2 to diminish the concentration of tritium in the aquifer.

The are two outfalls and five sampling stations involved in the monitoring for the Mound NPDES permit to discharge to the Great Miami River. Fecal coliforms, oxygen-demand, Cl_2, COD, heavy metals chromium, cadmium nickel and/or copper are analyzed at various sampling points, as shown in Figure 3.3-1, to satisfy the varying NPDES permit requirements for the different sampling points.

Most of the sampling locations are shown in Figure 3.3-1. Sampling station 5602 (old 001B) is in a manhole between Buildings 19 and 55. Stations 5601, 5602, and 5002 have small sheds nearby to house the sampling equipment. The equipment at each consists of a flow totalizer, chart recorder, and flow-to-sampling interval converter, i.e., a flow-activated sampling-cycle "trigger"; also, there are a peristaltic sampling pump and a refrigerator that holds a 10- or 20-liter plastic jug used to collect the 24-hour composite samples. Station 5603 is really two indoor stations in M Building , at the north and south plating shops, respectively. The equipment is otherwise similar to that at the other stations. The results of the two separate and parallel analyses for the two plating shops are numerically prorated and combined based on the respective daily flows, and the combined values are reported for station 5603. Station 5604 requires only a flow reading (no chemical parameters are required for the NPDES, however, ^3H is monitored at this location on a weekly basis) when the well pumps are running, and this can be obtained directly from the pump rating.

The composite sample jugs are collected daily, and liquid scintillation counting of gross beta activity (essentially tritium) and argon gas-flow proportional counting of gross alpha activity (essentially transuranics) are performed on the samples.

Mound Internal Monitoring and Control Sampling Program

Other wastewater sampling and analyses not called for by permits are conducted by Mound for internal monitoring and control purposes. These include daily sampling of "arterial" points in the stormwater system where tritiated water would be likely to show up if it were to escape into noncontact process cooling water coming primarily from Buildings T, SW, and HH. Timer-based composite samplers are used in several concrete-lined open channels, culvert headwalls, stormwater manholes, and the inlet and outlet to the upper stormwater retention pond. All are collected and analyzed daily for gross beta activity. Those from the inlet and outlet of the upper pond are also analyzed for gross alpha activity.

Great Miami River Sediment Sampling Program

Mound monitors ^{238}U, ^{234}U, ^{233}U and H_3 in the water of the Great Miami River. In addition, ^{238}Pu is sampled and analyzed in the silt of the Great Miami River. Five sampling stations are used. Starting from upstream they are: No. 1 at Carillon Park in Dayton, about 2,000 feet above the I-75 bridge; No. 5 about 500 feet above the Mound canal discharge and the Penn Central railroad bridge but below the Mound outfall pipe discharge; No. 4 about 250 feet below the electric power station diversion dam at Franklin; and No. 3 and No. 2 progressively further downstream.

Samplings at stations No. 1, 5, and 4 were observed and will be discussed here as typical of all five. Sampling of the river, which is 100-250 feet wide, is done by manually reaching out from the bank as far as possible. Liquid samples are taken by submerging a plastic jar of about 1 liter and allowing it to fill. The sample is immediately vacuum-filtered on 10-cm-diameter Whatman #2 filter paper. The filtered solids and the filter paper are discarded. Gross beta and alpha counts are run monthly at the laboratory on monthly composites of the liquid filtrate. Sediment samples of about the top ¼-inch of sediment are collected using metal discs about the size of a bottle cap. The sediments are also composited for 3 months, digested with acid, and the liquid from the digestion counted for gross alpha.

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Potable Water Sampling Program

The raw water supply comes from three wells on-site that are monitored for tritium as a groundwater contaminant, as described in Section 3.4, Groundwater. The raw water is also monitored for the list of 130 toxic heavy metals and organics mandated by regulatory requirements. Specifically, eight such scans have been run by a commercial laboratory at more or less quarterly intervals since 1985. Four of these have been complete scans, while four have covered only volatile organic chemicals (VOCs). The finished (treated) water is tested only for chlorine residuals and bacteria. Ten to fifteen samples per month are collected from many points in the potable water distribution system, especially the cafeterias, on a rotating basis.

Piping systems in new buildings are also tested for bacteria, on a one-time basis, when they are put in service. The utility department also checks chlorine residuals daily at one or two points in the distribution system. In addition, the State of Ohio requires quarterly tests by an outside laboratory for bacteria in the finished water. Testing of the finished water for trihalomethanes was recently begun for a 6-month trial period. No testing of the water for asbestos fibers is performed, even in areas of the plant with asbestos-cement water mains.

Records of the NPDES analyses demonstrate that most limits are being met regularly, with two exceptions. The first exception includes several exceedances of the coliform limit at the exit of the sanitary treatment plant, station 5601 (001A), in June of 1985 and May of 1986. It was explained that a new chlorine injector had just been installed in the latter case, and also that, because of the manual control of the chlorine dose, the dose sometimes is not adjusted fast enough to compensate for a rapid increase in chlorine demand. The second exception has historically been for suspended solids (SS) at sampling point 5002 (002). The system readily meets the SS limit during dry weather when the flow consists almost entirely of cooling water, but soil eroded during storms is picked up as SS (or "turbidity") and causes the limit to be exceeded. Construction of the stormwater ponds has helped somewhat by allowing some of the SS to settle out prior to discharge, but it was not feasible during the Survey site visit to evaluate enough of the discharge records to quantify the improvement. The FY 1987-1988 budget request includes a proposal to reduce cooling water inflows by substituting several

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local closed-loop cooling systems and towers at major points. The most recent renewal of the NPDES permit, dated September 30, 1985, addresses this issue by relaxing the SS requirement at 5002 (002) during and after carefully defined storm events and time periods.

3.3.4 Findings and Observations

3.3.4.1 Category I

There are no surface water findings in Category I.

3.3.4.2 Category II

There are no surface water findings in Category II.

3.3.4.3 Category III

1) Potential Contamination of Sediment - The sediment in the lower and upper stormwater retention ponds (and the smaller basins at NPDES Outfall 5002) may be contaminated with hazardous waste and radionuclides as a result of plant processes and runoff from contaminated areas. This could represent an environmental problem because any contamination that is in the sediment may be resuspended and released or may be transported into the soil and groundwater beneath the overflow pond.

The sediment in the lower stormwater retention pond may have received hazardous wastes which have drained from piping inside the landfill adjacent to the pond. The drain pipes inside the landfill, which were designed to drain the wastes after they were encased in clay, were installed approximately 8 feet above the clay bottom of the inside of the landfill. The wastes were wet when placed in the landfill. This elevation is believed to be as low as they could be placed and still drain by gravity into the overflow pond. It is assumed that the lower 8 feet of wastes are still saturated. Further, when the water level of the overflow pond rises 1 or 2 feet above its normally maintained depth (which it frequently does after storms, since it is used as an equalization basin), the liquid from the pond is believed to be able to flow back into the landfill wastes. This creates a constantly saturated condition in

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the lower 8 feet of the wastes and a percolator-type condition in the 8-foot to 10-foot layer. The trapped water in the lower 8 feet of the landfill may be quite concentrated in contaminants after leaching for 10 years. Eventually, it may escape through the bottom of the landfill. The percolator condition remains a potential problem, although removal or permanent blockage of the drain pipes from inside the landfill would eliminate the problem. The existing condition has the potential to be constantly adding to the contamination both of the overflow pond sediment and the stormwater discharged through the overflow pond. Moreover, the overflow/retention (lower) pond has not been cleaned of sediment since its construction in 1978. When last measured in February 1982, the sediment was 20.5 inches deep at the entrance channel in the north side, 14 inches deep at the midpoint of the south side adjacent to the hazardous waste landfill, 5 inches deep in the northwest corner at the outlet pipe, and from 5 to 8 inches deep at other points. The total volume of silt accumulated up to that time was estimated at 28,122 ft^3, with an average ^{238}Pu activity of 53,711 microcuries.

The upper pond, near Building 61, functions as a settling lagoon similar to the lower pond. The storm sewers from the SM/PP Hill feed into it. There is also a controlled outlet and an emergency overflow spillway (which has never been utilized). Flows for both would go to the previously described basins and lower retention pond. The upper pond is paved with asphalt on the sides and bottom. The sediment depth is measured from time to time, and its gross activity is also measured. The sediment was cleaned out once, beginning in 1982. It was dewatered on-site on portable filter screens/beds and packaged for off-site disposal as LSA radioactive waste. Prior to the cleanout operation, the sediment had an estimated average depth of 2 inches, and the 3,933 ft^3 of silt removed had an average ^{238}Pu activity of 678.5 pCi/gram or a total of 136,867 microcuries. Much smaller concentrations of the following nuclides were also present: 228-Th, 226-Ra, 228-Ra, 238-U, 234-U, and 210-Pb. Another cleanout operation is planned for the near future.

The upper pond sediment has the potential to act as a sink for radioactive and chemical contaminants. Plutonium, thorium, and other radionuclides may adhere to particles in the sediment. During the sampling and analysis portion of the Survey, sediments from the ponds will be tested to determine if radioactive or chemical contamination exists.

2) Potential for release of plutonium wastewater if pipeline breached - There is a potential for release from the radioactive wastewater piping between the SW and WD Buildings due to the unprotected ground-level siting of these lines.

The radioactive wastewaters (plutonium contaminated) are currently carried from the SW Building to the WD Building in small plastic pipes within larger plastic carrier pipes. Both are laid essentially on the ground in a seemingly improvised fashion, but with an additional steel protective pipe where the pipes pass under roads at shallow depths. The plastic pipes have been breached only once in approximately 7 years of operation. That incident was caused by a heavy construction backhoe which broke the outer, carrier pipe but not the inner, waste pipe. Improved protection alternatives for these waste pipes are now under study by the facility's engineering department. These alternatives include placing the coaxial plastic pipes in an open-top concrete trench set in the ground, and overhead placement on pipe bridges.

3.3.4.4 Category IV

1) Unrepresentative River Sediment Sampling - The present sampling methodology for sediment in the Great Miami River is potentially unrepresentative of the sediment across the profile of the river. Mound personnel sample river sediment by extending an arm from the bank and securing a sample. The river is between 100 and 250 feet wide, and the current method of sampling is unrepresentative.

2) Unrepresentative Effluent Flow Monitoring - Capacity limitations in the flow-metering equipment at NPDES station 5602 (001B) that slightly impair the representativeness of the water quality data and the validity of the flow data were noted during the Survey. The capacity limits of the flow indicator/recorder for station 5602 (001B) are such that during dry weather the flow barely registers on the chart, whereas during wet weather, due to the capacity limits of the equipment, it frequently registers at the upper limit of the chart and stays there.

3) Inoperative Sampling Devices - In two cases during the Survey, automatic samplers at arterial points of the stormwater system were found to be inoperative. The first case was caused by the weighted sampling tube being pushed out of the

channel by an earlier, higher storm flow (at the culvert inlet midway between Buildings 19 and 56). The second was caused by a delay in restoring electric power after some construction work (at the downstream side of the road bridge over the main drainage channel near Building 74).

4) Insufficient Dike Capacity - The storage of fuel oil at the 300,000-gallon fuel oil tank represents a potential environmental problem in the event of a catastrophic release due to insufficient dike-containment capacity. The secondary containment dike has insufficient freeboard to meet applicable spill prevention, countermeasure, and control requirements. It has been further impaired by recent defective construction work. The tank is poorly located adjacent to the main drainage channel that bisects the Mound Plant. The problem is presented as a Category IV concern because the tank is empty and has been unused in recent years, there is little prospect of its being used in the near future, and a replacement tank is already being planned for a different location.

3.4 Groundwater

3.4.1 Background Environmental Information

3.4.1.1 Regional Geology

The Mound Plant is located on the Cincinnati Arch, a platform structure in the Central Stable Province. This flat structural element is bounded by the Illinois Basin to the west, the Michigan Basin to the north, and the Appalachian Basin to the east. The region has been tectonically inactive since the Paleozoic Era and is not subject to seismic activity.

The Mound Plant is underlain by limestone and shale bedrock of Ordovician age. Along the western boundary of the site, a river valley was eroded in the bedrock during pre-Pleistocene and/or Pleistocene time. The valley was subsequently filled with glacial outwash material, consisting primarily of sands and gravels. The valley fill is approximately 150 feet thick in the center of the valley. Overlying the glacial outwash in the valley area are fine-grained riverine deposits of silts and clays.

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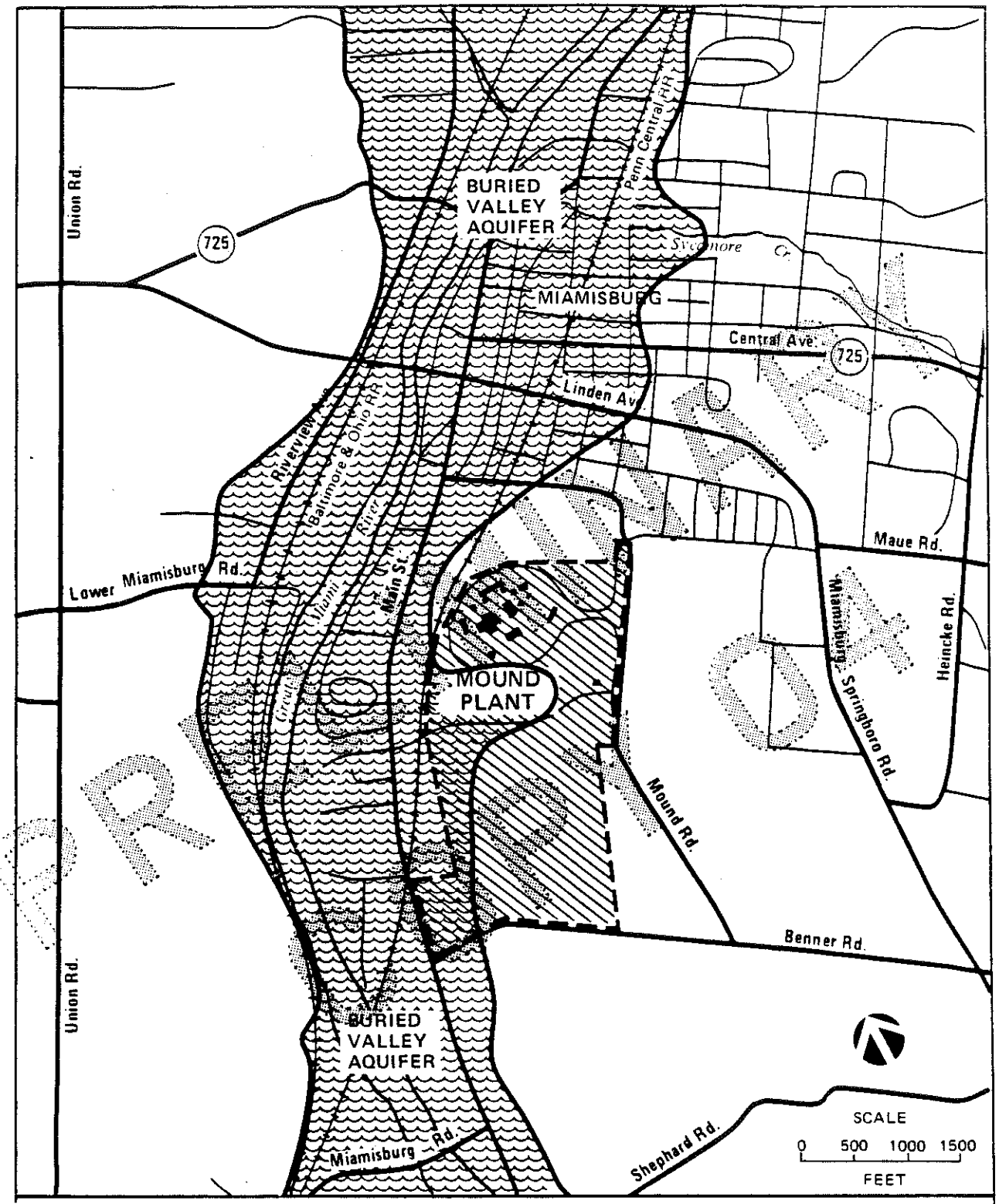
On the highland areas, the bedrock is overlain by a thin veneer of fine-grained glacial till. This till, consisting of clays, silts, and some fine gravel, is generally less than 5 feet thick at the Mound site.

3.4.1.2 Hydrogeology

Groundwater occurs in all of the geologic materials described in the previous section. Of the three units described (bedrock, glacial outwash deposits, and glacial till), only the glacial outwash deposits constitute a major aquifer in the Mound area. The bedrock, although it contains water, does not have sufficient fracture permeability to act as a reliable water supply. Reported hydraulic conductivities for the bedrock are in the range of 0 to 5×10^{-4} cm/sec (Spieker, 1968). The glacial till is too thin generally to act as a water supply, although it contains perched water zones. Hydraulic conductivities in the till range from 5×10^{-9} to 3×10^{-6} cm/sec (Spieker, 1968).

The glacial outwash deposits within the in-filled river valley are part of a major buried valley which extends from the Dayton area to the Ohio River near Cincinnati. This "Buried Valley Aquifer" has been characterized as one of the most productive sources of groundwater in the Midwestern United States (Dames & Moore, 1976a). Typically, groundwater occurs 20 to 25 feet below the ground surface within the valley. Hydraulic conductivities range from 4×10^{-2} to 9×10^{-2} cm/sec. In the site vicinity (Figure 3.4-1), the sands and gravels in the Buried Valley Aquifer are locally interspersed with clay layers which create local barriers to the vertical movement of water in the aquifer.

Under natural conditions of no groundwater withdrawal, the direction of groundwater flow is toward the southwest along the axis of the valley. Locally, flow would move from the edges of the valley toward the river. Recharge to the aquifer is from infiltration of precipitation which falls directly on the aquifer and from leakage along the valley walls. Due to municipal and industrial pumping in the area, local depressions in the water table induce infiltration from surface waters. For this reason, the Great Miami River is one of the principal sources of recharge in the vicinity of the Mound Plant.



Source: EG&G Graphic Overview System, 1976

Buried Valley Aquifer Location Map

Figure 3.4-1

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Flow of the perched water in the till at the Mound site is poorly understood. However, it is postulated that the perched water flows to the valley walls and continues along the interface to enter the Buried Valley Aquifer or flows to the surface as seeps and springs. Man-made influences on the shallow flow regime are considerable at this site. The high density of building and the paved areas on the main hill greatly reduce the amount of precipitation that is available for infiltration by collecting it into surface runoff channels. The extensive network of underground piping and utilities also alters the flow by providing highly permeable pathways in the gravel pack around pipes and cables. These pipe chases and utility trenches may provide linkage between pockets of perched water.

3.4.2 General Description of Pollution Sources/Controls

Sources of groundwater pollution at Mound consist of various known and unknown releases of contaminants over time to other media. These releases subsequently impact groundwater. Specific potential sources of groundwater contamination are discussed more completely in Section 3.4.3 and under subsections of the air, soil, surface water, waste management, toxic materials, direct radiation, and inactive waste sites sections of this report.

In general, the major sources of groundwater contamination can be identified as:

1) Historic disposal practices in the landfill area which may represent a source of organic contamination.

2) Infiltration from surface water discharges in the main drainage channel, the most likely source of the historic tritium contamination in the Buried Valley Aquifer.

3) Historic releases from operations on the Main Hill where accidental releases of tritium may have created a reservoir of contamination beneath the site which is continuing to migrate both within the site and to off-site areas.

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3.4.3 Environmental Monitoring Program

Well Locations

The groundwater monitoring program at Mound uses samples from 19 on-site wells, 19 off-site wells, and 12 municipal supply systems. All of these wells monitor the sand and gravel aquifer. There are no wells monitoring the perched zone. The on-site wells include 3 domestic supply wells and 16 monitor wells. The off-site wells include 10 monitor wells, 7 private domestic supply wells, and 2 wells that were previously part of the Miamisburg City supply. These wells are listed and identified in Table 3.4-1 and shown in Figure 3.4-2. The municipalities whose supplies are sampled are shown in Figure 3.4-3.

Well Construction

Construction details are not complete for all monitored wells. In general, depth of the well and diameter of the casing have been measured in all wells with the exception of a few private water supply wells. Other construction details such as screen length and depth, gravel pack size, and location of seals are generally not known. For some of the monitoring wells installed in 1976, this information is provided in a consultant report, but variations exist between the data on wells in the text of the report and data on boring logs in the report's appendices (Dames & Moore, 1976a).

Sampling Frequency and Monitored Parameters

Although no written schedule for well sampling was available to the Survey team, site personnel verbally provided information on sampling frequency of wells and the chemical parameters analyzed during each sampling interval. This schedule is summarized in Table 3.4-2. The Mound Plant samples for tritium and plutonium in community water supplies and some private wells. This sampling has been conducted since at least 1974 and is reported annually in the Environmental Monitoring Report Series. An examination of those reports indicates that the sampling schedule is not uniformly adhered to by site personnel. The number of samples reported for each sampling point per year can show considerable variation.

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Table 3.4-1

MOUND GROUNDWATER MONITORING SAMPLING WELL LOCATIONS

On-Site Monitor Wells	
20-1	42-2
27-2	46-1
28-1	55-1
33-1	63-1
34-1	71-3
36-2	71-4
37-1A	71-5
42-1	76-2
On-Site Domestic Supply Wells	
71-1	
71-2	
76-1	
Off-Site Monitoring Wells	
OW-1A	OW-6
OW-2	OW-6A
OW-3	OW-7
OW-4	OW-8
OW-5	OW-8A
Off-Site Private Domestic Supply Wells	
Bud's 1	Jim's
Bud's 2	Jim's Trailer
Bud's 3	
Bud's House	
Bud's Rental	
Former City Wells	
Miamisburg No. 2	Miamisburg No. 3

Sources: Mound Environmental Reports (MRC, 1975-1984, 1985b, 1986b); Carfagno, 1986b

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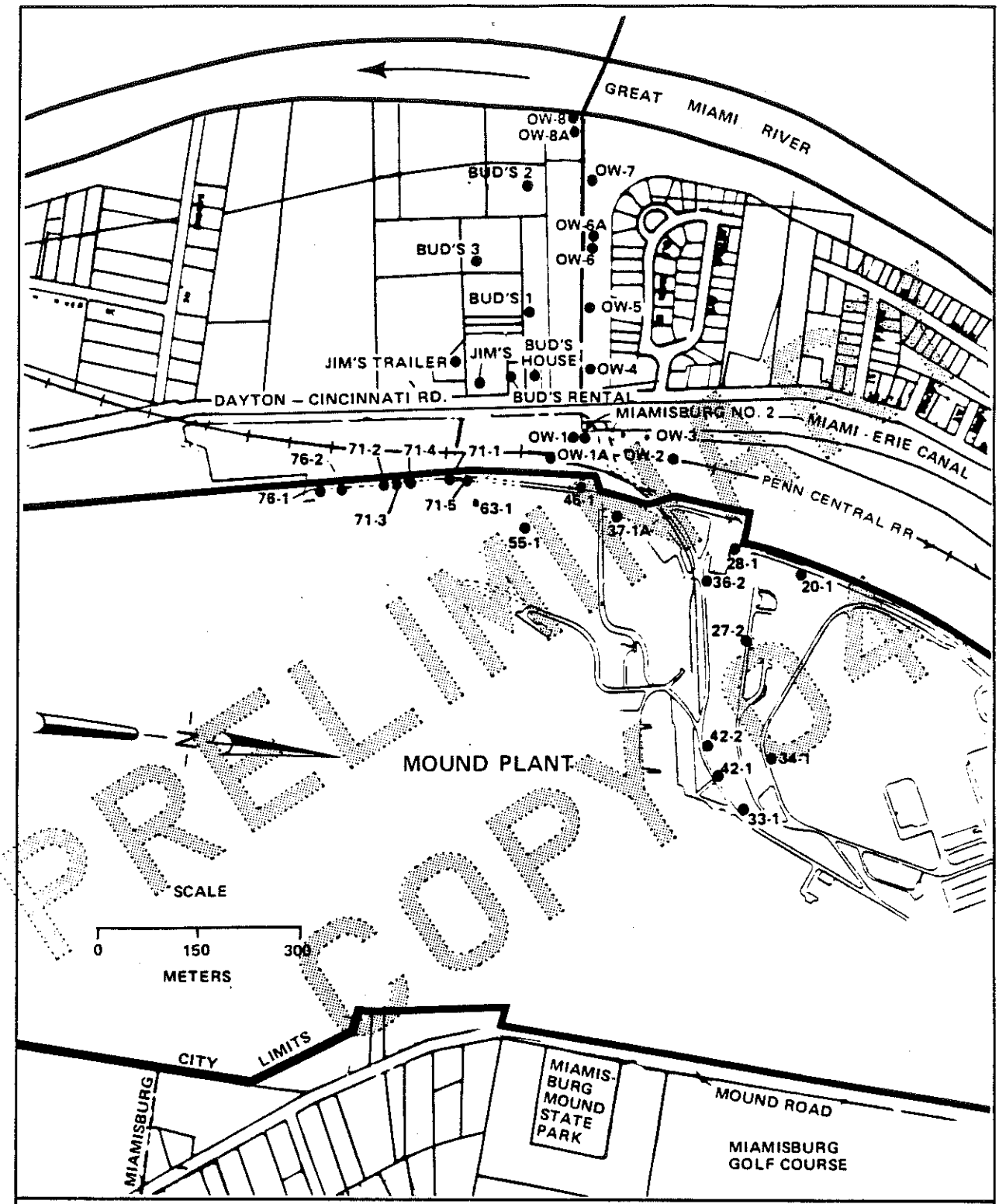

Sources: Mound Environmental Reports (MRC, 1975-1984, 1985b, 1986b) ; Carfagno, 1986b

Mound Groundwater Monitoring Sampling Well Locations Figure 3.4-2

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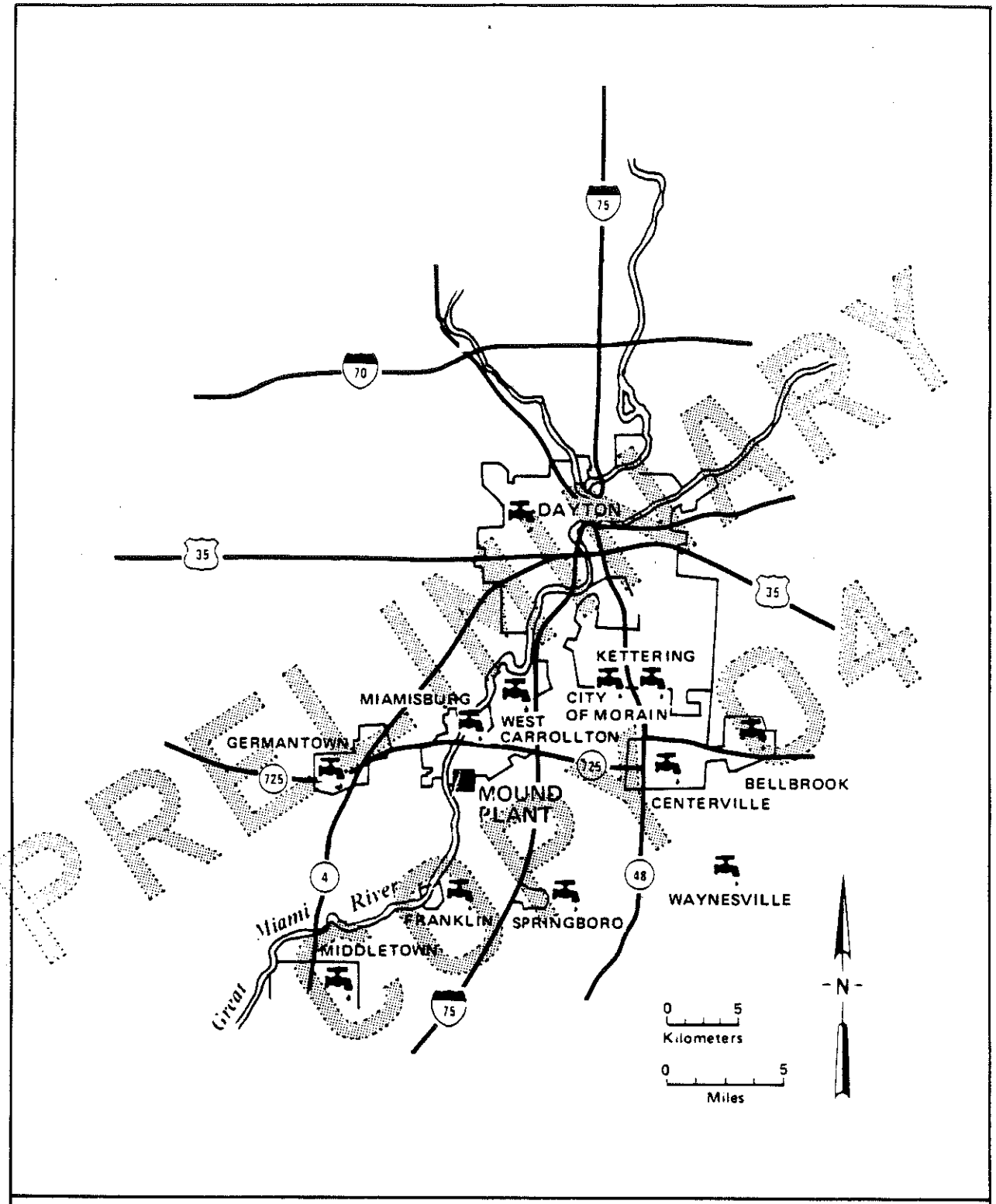

Source: EG&G Graphic Overview System, 1976

Mound Groundwater Monitoring Municipal Supply Well Locations Figure 3.4-3

Table 3.4-2

MOUND GROUNDWATER MONITORING SAMPLING SCHEDULE AND MONITORED PARAMETERS

Wells	Total Number of Wells	Sampling Interval	Monitored Parameters
Miamisburg 2, Bud's 1, 2, 3 Bud's House On-Site Wells	24	Weekly	Tritium
OW1-8 Miamisburg 3 Bud's Rental Jim's	13	Monthly	Tritium
On-Site Wells	19	Quarterly	Plutonium, Metals
Bud's 1, 2, 3 Bud's House Bud's Rental Miamisburg Municipal Supply	6*	Annual	Plutonium
37-1A, 46-1, 55-1, 63-1, Bud's 1, 71-1, 71-2, 76-1	10	Irregular	Priority Pollutants
OW-1-8, 20-1, 27-2, 28-1, 37-1A, 46-1, 55-1, 63-1, 71-3, 71-5, 76-2, 71-1, 71-2, 76-1, Bud's 1, 2, 3, Bud's House, Bud's Rental, Jim's, Jim's Trailer	31	Irregular	Volatile Organics

Source: Carfagno, 1986b

*Miamisburg uses several wells to supply the city.

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Sampling for organic compounds has been conducted on several occasions since late 1985. As yet, this is not part of the monitoring program, as only a few rounds of samples have been analyzed.

Sampling Procedures

A variety of procedures is used to collect groundwater samples at Mound. The community water supplies, the private water supply wells, the on-site water supply wells, and some on-site monitor wells are equipped with pumps. Samples from these wells are collected from taps as close to the pump discharge as possible.

A number of on-site and off-site monitor wells are equipped with dedicated bladder pumps with variable discharge rate of up to 1.3 gpm. Samples from these wells are collected from the pump discharge line. The remaining monitoring wells are sampled with either a bailer or a portable peristaltic pump. The sampling procedure for each well is identified in Table 3.4-3.

Sample Analysis

The majority of analyses performed on groundwater samples at Mound are handled by the on-site environmental laboratory. Organic analyses are performed by ETC Laboratories, Edison, N.J.

Groundwater Monitoring Results

Groundwater monitoring at the Mound Plant has been largely directed toward detection and monitoring of tritium and plutonium in the Buried Valley Aquifer. Although plutonium is detectable in some samples, it is at such extremely low levels that it is difficult to distinguish from background levels. Tritium is detectable above background, and it is evident that site activities have contributed to tritium levels in the aquifer.

A significant source of tritium to the aquifer was historical disposal practices. Prior to 1970, tritiated wastewater was diluted to below the Energy Research and Development Administration (ERDA) discharge limits and released to the main drainage channel which flowed to the Miami-Erie Canal. Infiltration from surface water into the ground resulted in elevated tritium levels in the aquifer adjacent to

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Table 3.4-3

SAMPLING METHODS FOR MONITOR WELLS IN MOUND NETWORK

WELLS	PROCEDURE
46-1, 63-1, Miamisburg No. 2 Miamisburg No. 3	Dedicated Electric Pump
71-1, 71-2, 76-1 Bud's 1, Bud's 2, Bud's 3 Bud's House, Bud's Rental Jim's, Jim's Trailer	Domestic Supply (Pumped Wells)
OW-1A, OW-2, OW-3, OW-4, 0W-5, OW-6A, OW-7, OW-8, 37-1A, 55-1, 71-5, 76-2	Well Wizards (Bladder Pump)
20-1, 27-2, 28-1, 33-1, 34-1, 36-2, 42-1, 42-2, 71-3, 71-4	Bail or Peristaltic Pump

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the site. Management decided in 1970 to reduce overall emissions to as low as practicable. Tritium wastes were transferred to the WD Building, solidified, and shipped off-site for disposal. The program was largely successful, (Dames & Moore, 1976b), as demonstrated by the reduction in releases from 1969 (2,300 Ci) to 1975 (58 Ci) (Dames & Moore, 1976b). Releases in 1985 had been reduced to less than 6 curies of tritium (MRC, 1986b). The reduction of emissions led to a gradual decline in tritium levels in the aquifer as well.

In 1974, following passage of the Safe Drinking Water Act, the Environmental Protection Agency (EPA) proposed new standards for tritium in drinking water supplies. The previous standard, set by ERDA, had been 1,000 nCi/l. The proposed EPA standard was 20 nCi/l. The management at Mound recognized that, under the new standard, a number of private wells near the site as well as the on-site water supply wells would not meet the new levels. A program was initiated to evaluate the problem and to develop plans to correct it. This "Potable Water Standards Project" (Dames & Moore, 1976b) concluded that high-volume pumping of wells near the site would induce recharge to the aquifer from the river and would effectively dilute the levels of tritium to permit achievement of compliance with the new standard. To a large degree, the groundwater monitoring program at Mound was developed to determine the effectiveness of the pumping program. Monitoring data indicate that the program was successful. All off-site wells in the area are in compliance with the drinking water standard for tritium (MRC, 1986b). Pumping continues at Miamisburg #2 on an intermittent basis to maintain compliance. In addition, site personnel continue to try to identify and eliminate any continued releases of tritium from the site. The current efforts are discussed more fully in Section 3.4.4.2.

This past spring, during routine sampling, Mound personnel observed on-site runoff with elevated levels of tritium. In an attempt to track the seepage to the source, a number of excavations have been made on the hillside and hilltop of the Main Hill. To guide the efforts to uncover the source of this contamination, Mound has formed a committee with representatives of several divisions within the facility. Mound has taken a number of samples of springs and seeps both on-site and off-site

(on the north slope of the Main Hill). The highest concentration of tritium found during this effort was in excess of 7,000 nCi/l. This sample was taken on-site on the top of the Main Hill. Analysis of samples taken from seeps and springs on the west and north slopes of the Main Hill indicate that elevated levels of tritium exist in the shallow groundwater. Of particular concern are those springs which are off-site and have flowing water. One such spring on the north slope has tritium levels in excess of 100 nCi/l. Although it is unlikely that anyone will drink from this spring, it is on public property and is unmarked. Mound is continuing its efforts to locate the source of this contamination. In addition, the Albuquerque Operations Office is conducting an investigation of the shallow groundwater system as part of the Comprehensive Environmental Assessment and Response Program (CEARP) (DOE 1986b).

3.4.4 Findings and Observations

3.4.4.1 Category I

There are no groundwater Category I findings.

3.4.4.2 Category II

1) Tritium Contamination of Groundwater - Although remedial efforts at the Mound Plant have reduced tritium levels in the Buried Valley Aquifer at the wells to within drinking water standards, the existence of tritium contamination in the groundwater on-site and in the adjacent aquifer constitutes an existing environmental problem.

While historical disposal practices, as discussed previously, were the major source of contamination of the aquifer in the past, current contamination of the groundwater both on-site and off-site is derived from past accidental releases on-site. Past on-site releases have resulted in a reservoir of contamination that is continuing to enter the groundwater. The evidence that supports this conclusion includes analyses of core samples from inside site buildings, samples of liquids in utility trenches on-site, and samples of seeps and springs both on and off-site.

As part of the Potable Water Standards Project, Dames & Moore (1976b) analyzed several core samples from beneath SW Building. Based on the sample results, they

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provided a worst case estimate of almost 1,300 curies of tritium beneath the building. A file memo (Meyer, 1963) expressed concern about contamination of the soil beneath SW Building as early as 1963, although it did not specifically mention tritium. This contamination could slowly migrate from beneath the building within the perched water zone or with water movement through utility trenches. Recent sampling efforts have confirmed that the utility trenches and gravel packs around buried pipes are acting as pathways for the migration of tritium. Samples collected from the sewer chase between Buildings SW and I have indicated tritium levels in excess of 7,000 nCi/l. Analyses of samples from seeps and springs on the west and north slopes of the Main Hill indicate that elevated levels of tritium exist in the shallow groundwater. Of particular concern are those springs which are off-site and have flowing water. One such spring on the north slope has tritium levels in excess of 100 nCi/l. Although it is unlikely that anyone will drink from this spring, it is on public property; it is not marked as undrinkable; and it contains tritium at five times the level allowed by the Safe Drinking Water Act.

The problem of continued migration of tritiated water in the shallow zones is compounded by a lack of understanding of flow mechanisms in these zones. The flow mechanisms could reasonably be expected to be complex and highly variable, and achieving a better understanding will be difficult.

Category II environmental problems are intended to identify environmental problems that require immediate management attention. To date, the management of the Mound Plant and the Albuquerque Operations Office have devoted considerable attention, manpower, and resources to this problem. Substantial effort has been expended and is continuing to reduce all emissions to "as low as reasonably achievable." To locate the source of the contaminated seepage, a committee was formed with representatives of several divisions within the facility. This committee meets weekly to determine the course of action for the week. In addition, the Albuquerque Operations Office is conducting an investigation of the shallow groundwater system as part of CEARP (DOE, 1986b).

3.4.4.3 Category III

1) Areas With the Potential to Affect Groundwater Quality Adversely - Several areas at the Mound Plant represent potential sources of contamination to the

groundwater. These areas include the old landfill, the evaporation pond behind Building 42, and the lithium carbonate and solvent disposal area. These areas are discussed in more detail in Section 4.5 and identified on Figure 4.5-1. At each of these areas, historical records indicate disposal or storage of organic chemicals. Records also indicate disposal in the landfill of drums used to store thorium. Monitor well data in the vicinity of the old landfill indicate low levels of various organic compounds in the aquifer. In each case, sampling and analysis has been scheduled to confirm the existence and potential mobility of organic compounds in these areas.

2) Broken Pipes in Wastewater Treatment Systems - The poor condition of the three sewer systems results in a potential environmental problem for groundwater. Many sections of the three sewer systems (sanitary, storm, and abandoned radioactive waste) are in very poor condition, structurally and hydraulically. This allows both infiltration and exfiltration at various points, with the attendant possibility of the exchange of conventional, hazardous, and/or radioactive contaminants between sewer systems or between any one of them and the groundwater or soil. These exchanges are both uncontrollable and unquantifiable as the sewer systems now stand.

Recent investigations of the storm and sanitary sewer systems have shown them to have numerous pipe and joint cracks, breaks, misalignments, sags, and obstructions. The abandoned underground radioactive waste sewer system was not directly investigated, but it is likely to be in similar condition because of its similar age and conditions of service. These defects are conducive to both infiltration into the pipe and exfiltration out of it, depending on the external groundwater levels at the various points along the pipe. It is likely that there is a net additional flow into the three systems. This has been demonstrated for the abandoned radioactive waste sewer system, which has no acknowledged inputs but has a substantial output at its terminus in WD Building. It is possible that there are losses of contaminated wastewater from these systems to the groundwater. Because there are some areas of contaminated soil on-site (see Sections 3.2 and 4.5), it is also possible that groundwater infiltrating into these sewer systems is contaminated. Neither the amounts nor contaminant contents of this infiltration and exfiltration have been quantified. Mound has submitted an FY 1987-1988 budget request to repair the piping systems.

3) Perched Aquifer Flow Regime Poorly Understood - At the present time, there is an incomplete understanding of the hydrogeologic transport mechanisms that affect the Mound Plant, making it difficult to identify specific sources of contamination that can be seen in springs and seeps. In addition, future groundwater quality problems may be difficult to trace to a source because of the lack of information. This is particularly true of the perched water that occurs in the vadose zone on-site. The management of the Mound Plant and the Albuquerque Operations Office recognize this problem and will be addressing it as part of the CEARP Phase 2 program.

3.4.4.4 Category IV

1) Groundwater Monitoring Program - The groundwater monitoring program has been in operation for more than 10 years and was designed to address the specific problem of tritium contamination. While the current monitoring program produces reliable and credible data, some procedural modifications could enhance their defensibility.

During the Survey, the following observations were made:

1. On-site monitor wells are not secured against tampering. Off-site monitor wells are equipped with locking caps, but several were observed to be broken. The importance of locking caps is demonstrated by the fact that several on-site wells are contaminated with oil.

2. Chain-of-custody documentation is not routinely maintained. Samples for organic analyses, which are sent off-site to a commercial laboratory, are documented with that laboratory's chain-of-custody forms.

3. Water levels are not routinely measured prior to and after sampling. In addition, no written procedure or protocol is available.

4. Purging of wells is not based on volume and in some cases may be inadequate. While purging is not believed to be of critical importance for tritium analyses, it is necessary to adequately monitor aquifer conditions.

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5. Monitor well locations are not related to specific contaminant sources and may not provide adequate monitoring as a result. This issue is addressed in the discussions on sources and in Section 3.4.4.3 and Section 4.5.3.2.

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4.0 NON-MEDIA-SPECIFIC FINDINGS AND OBSERVATIONS

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, direct radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section because the areas addressed are not necessarily tied to one medium as was the case with the discussions in Section 3.0. The discussions include an environmental monitoring program section where appropriate and where information was available. The findings for hazardous, mixed, radioactive and solid waste management are summarized in a single Section (4.1.5). Section 4.5, Inactive Waste Sites and Releases, contains a special discussion of the plutonium contamination of the Miami-Erie Canal.

4.1 Waste Management

4.1.1 General Description of Pollution Sources/Control - Hazardous Waste

The Mound Plant generates approximately 20,000 gallons of hazardous waste per year. Most of this waste is generated in buildings 27, B, 28, E, and DS. Table 4.1-1 depicts the hazardous waste stream management information set forth in the most recent Mound Waste Management Site Plan (MRC, 1986f). The Mound hazardous waste streams are composed of organic solvents, excess paints and paint thinners, waste corrosive solutions, spent plating-bath solutions, photoprocessing wastes, explosive wastes, solvent-water wastes containing trace amounts of explosives and out-of-date laboratory chemicals. Mound also generates waste oils and toxic and polymeric wastes such as MOCA (4,4'-methylenebis (2-chloraniline)).

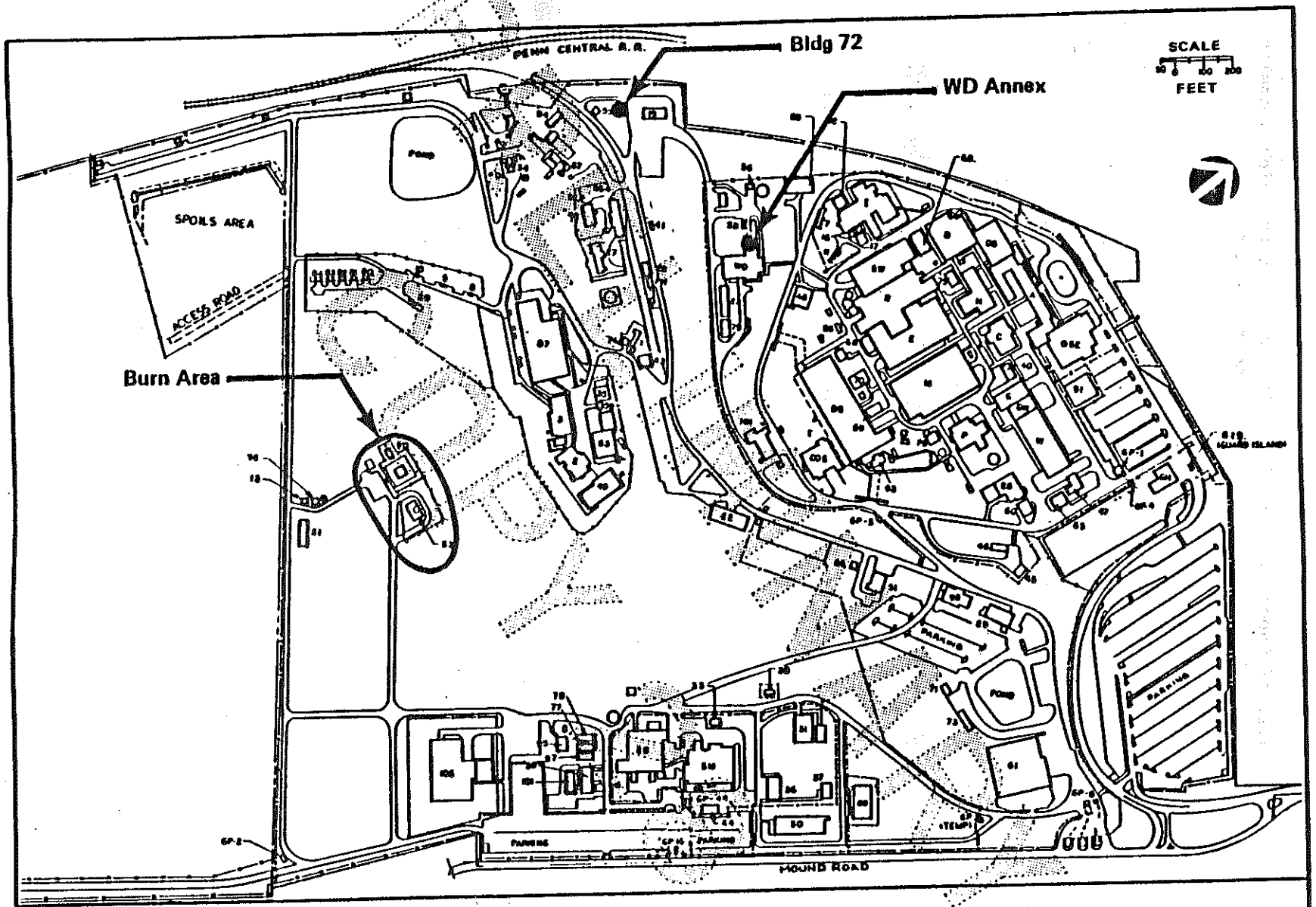
The Resource Conservation and Recovery Act (RCRA) Part A Permit notification for Mound identified one container storage facility (Building 72), a thermal treatment area (the burn area), and a glass melter (in the WD Annex) that handle explosive or hazardous waste (Figure 4.1-1). The thermal treatment area contains a rotary kiln, a retort, and a burning cage. The kiln and retort are used and will continue to be used as needed to dispose of explosives and waste

Table 4.1-1

MOUND'S ESTIMATED ANNUAL HAZARDOUS WASTE GENERATION

Waste Description	Process/Source	Annual Quantity
Organic solvents	Various cleaning operations, excluding those required for processing explosives	9,800 gal
Waste oils	Machining operations, hydraulic systems, pump oils, used motor oil	2,000 gal
Discarded excess paints and thinners	Paint shop, outdated paint, cleaning solutions from paint operations	300 gal
Waste corrosive solutions	Plating operations and other sources	800 gal
Spent plating-bath solutions	Plating shop	1,400 gal
EP toxic wastes Liquid (chromium, mercury, etc.)	Fluorescent bulbs, water treatment	2,700 gal
Polymeric wastes	Various processes	500 gal
Photoprocessing wastes	Various functional groups	1,200 gal
Explosive wastes consisting of mild detonating fuse (MDF), pyrotechnic materials, rejected components, operational wastes, and bulk high explosives/pyrotechnics	Production areas in 22 buildings throughout the facility	1,100 lb
Laboratory wastes	Lab R&D and analytical work	990 lb
Miscellaneous wastes (e.g., combustibles)	Miscellaneous lab operations	650 gal

Source: Mound Waste Management Site Plan, 1986 (MRC, 1986f)



Source: MRC Drawings, April 1985: Site Plan

Figure 4.1-1

Mound Hazardous Waste Management Sites Reported in RCRA Part A Permit

NOT FOR PUBLIC DISSEMINATION
May contain unclassified controlled nuclear information subject to Section 148 of the AEA, as amended (42 USC 2168). Approval by the Department of Energy prior to release is required.

NOT FOR PUBLIC DISSEMINATION
May contain unclassified controlled nuclear information subject to Section 148 of the AEA, as amended (42 USC 2168). Approval by the Department of Energy prior to release is required.

materials containing explosives. The burning cage has been used in the past, but according to the Part A Permit, there are no plans to continue to use it in the future. In November 1986, Mound prepared a RCRA Part B Permit application for the operation of the glass melter to dispose of hazardous waste.

The Mound Plant also maintains an unsheltered and unpermitted drum storage area in an open field east of the burn area. There are approximately 200 drums in this location. The drums have been stored in the field since Building 72 (the former waste storage location) was dismantled in late 1985 and moved to its new site. Half of the drums are marked as containing waste oil, and the remainder are identified as plating shop waste, solvent waste, explosive/solvent waste, herbicide, mixed lab chemicals, photographic waste, batteries, kitchen grease, and other assorted wastes. The soil at the south end of the drum area shows evidence that leakage has occurred where the waste oil drums are stored. There are dark stains on the ground throughout this area. During August 1986, Mound was actively sampling these containers to identify the contents of the drums.

The Mound Plant operates a hazardous waste solvent collection system. The collection system captures the great majority of hazardous wastes generated on-site. The waste is picked up at the point of generation by Mound Waste Management staff and consolidated into 55-gallon drums at the container storage facility (Building 72) prior to transport to an off-site disposal contractor. GSX Services Inc., a division of Chemical Waste Management, has been the disposal contractor for the last several years. GSX ships the waste to its accumulation point in Green Brier, Tennessee, and sends wastes to a number of Chemical Waste Management locations in the eastern United States for disposal. The weekly collection schedule is supervised by Mound Waste Management staff, who collect information pertaining to the quantity and type of waste when possible.

The Survey, during its review of the processes, buildings, and equipment, encountered additional potential sources of hazardous substance contamination. These include drum staging, contamination of waste oil with organic solvents, improper use of sink drains for disposal of wastes, hazardous waste contamination of trash, and hazardous waste contamination of sanitary sludge. Each of these potential sources is discussed below.

The Survey team found that waste oil drums were being contaminated with waste organic solvents. For example, Building M used freon and other organic solvents in degreasing and cleaning maintenance operations. While there are waste oil drums outside the building, there are no waste solvent containers. Maintenance shop personnel indicated that any waste solvents collected are put into the waste oil drum for disposal. This practice mixes a hazardous waste with a nonhazardous waste and makes the disposal of waste oils, which are not otherwise contaminated, more difficult and costly.

Small quantities of hazardous waste are entering the Mound sanitary sewer system and solid waste disposal system. The Survey team found evidence that laboratory and process chemicals, acids, and bases were routinely disposed of by being poured into the sink. The practice differed throughout the site. The practice at Building 28 is to neutralize and test any acid solutions with litmus paper prior to flushing to the drain. Acids, bases, and reagents in E Building are flushed to the drain with copious amounts of water. Some laboratories in R Building did not necessarily flush with water when disposing of acids. In addition, photoprocessing waste liquids, which may contain silver, a toxic heavy metal, were also handled differently throughout the site. Photoprocessing wastes are drummed at some locations and disposed of down the drain at other locations (e.g., Buildings 3 and 59).

The Mound sanitary wastewater treatment plant has a substantial capability for removing heavy metal ions by adsorption on inorganic suspended solids and biological floc, which are removed from the wastewater stream by sedimentation. The sediment forms the sludge of the sanitary treatment plant which is extracted from the plant and placed in drying beds. The dried sludge is packaged into plywood crates for shipment to the DOE's Nevada Test Site (NTS) as low-level radioactive waste. Mound shipped 4,573 cubic feet of this waste to NTS between October 1985 and July 1986. The sludge has the potential to contain heavy metal and radionuclide constituents.

The sludge was tested by the extraction procedure toxicity test once in early 1985 to determine if the waste was hazardous. The results of the test did not show the waste to be hazardous. However, the EP toxicity test will not detect the presence of hazardous organic solvent waste. Volatile organic solvents (e.g., short chain

alcohols, acetone, trichloroethylene and 1,1,1 trichloroethane) are discharged to the Mound sanitary sewer system, in addition to heavy metals. These substances are likely to be removed by evaporation or biodegradation without harm to the microorganisms of the sewage treatment plant, but they may be incorporated into the sludge. In addition, the broken and misaligned piping of the sanitary treatment system may release the solvent wastes to groundwater and subsurface soils before reaching the treatment plant.

Certain laboratory chemicals and materials that are out of date continue to be disposed of in the trash (i.e., nonhazardous, nonradioactive solid waste) despite efforts to segregate and properly dispose of such material. An epoxy curing agent is typically disposed of in Building 49 trash rather than being given to Waste Management.

Mound has disposed of hazardous waste in the on-site solid waste landfill in the past. In addition, hazardous solvents were burned in the landfill area at the southern portion of the site. It is estimated that 1,000 cubic feet of hazardous waste that had been disposed of in the old landfill was placed in the new clay-lined landfill (DOE, 1986b). The area is discussed in detail in Section 4.5.

4.1.2 General Description of Pollution Sources/Control - Mixed Waste

Liquid scintillation vials are the only mixed waste previously identified at the Mound Plant. Scintillation counting is used to monitor worker exposure to radiation in environmental monitoring and other analytical programs. Scintillation vials typically contain xylene (a listed hazardous waste) or other ignitable solvents in combination with alpha or beta-emitting radionuclides, typically plutonium-238, plutonium-239 or tritium. Mound segregates its scintillation vials into those with a radionuclide content of less than 50 μCi/liter and those greater than 50μCi/liter. The 50 μCi/l level is derived from the Nuclear Regulatory Commission regulation which permits the disposal of 5μCi/l per gram of tritium used for liquid scintillation counting without regard to its radioactivity (10CFR 20.396). Mound has disposed of beta-emitting scintillation vials below 50μCi/liter through the site hazardous waste contractor. No alpha radiation area scintillation vials are

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disposed of via the hazardous waste contractor unless they have no detectable alpha contamination. Beta-emitting scintillation vials containing greater than 50 μCi/l and alpha vials containing any radioactivity are being stored in Building 23 until such time as the NTS has obtained authorization to dispose of mixed waste.

The Cotter concentrate material stored in Building 21 has been subjected to EP toxicity testing and was found to contain toxic levels of selenium. This substance continues to be stored as a possible raw material for processing. The Cotter concentrate material was tested in 1986 by an outside laboratory under contract to Mound. The Cotter concentrate will have to be treated as a mixed waste if DOE declares the material a waste.

The EPA is currently studying a proposal to designate waste oil as a hazardous waste. Mound waste oil contaminated with alpha and/or beta-emitting radionuclides will be considered a mixed waste if the proposal becomes final. Waste oil drums contaminated with radiation are occasionally stored in Building 23. Alternatively, waste oil would be considered hazardous or mixed if it was contaminated with waste solvents containing radioactive material. Waste oil contaminated with radioactive waste is generated in SW Building.

Byproduct waste is discussed within the radioactive waste section.

4.1.3 General Description of Pollution Sources/Control - Radioactive Waste

The majority of total waste generated on-site is radioactive waste. Mound is now generating approximately 160,000 ft^3/yr of low level waste (LLW) and 10,000 ft^3 of transuranic (TRU) waste (MRC, 1986f). LLW is packaged and sent to the NTS. TRU waste is transported to a DOE facility in Idaho. No high-level waste is generated at Mound.

Radioactive wastes are generated on the Main Hill and SM/PP Hill areas. Buildings SW, R, T, SM, PP, WT, WD and the laundry are the major generators of such waste. SW Building generates and solidifies tritiated waters and oils. WD solidifies both alpha (i.e., plutonium-bearing) and beta (i.e., tritium-bearing) wastes. R Building generates radioactive wastes from D&D activities occurring in a section of the building. T Building generates radioactive wastes in various research and

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development projects conducted throughout the building. Radioactive wastes from SM and PP Buildings are primarily solid, alpha-contaminated D&D wastes that are placed in boxes and staged at Building 31 prior to shipment to NTS. Liquid alpha waste is transported from D&D operations on the SM/PP Hill to WD via tank truck. The WT Building was involved in the 1969 alpha waste line rupture incident and is undergoing D&D. The alpha wastes from the operation are boxed and staged near WT prior to shipment off-site. The WD Building has four influent tanks for the storage and treatment of alpha waste prior to precipitation in a large claro-flocculator and subsequent solidification. Beta waste contamination from an abandoned radioactive waste line also enters the four influent alpha waste tanks. Tritium-contaminated liquid waste is solidified in a separate operation at WD. Both alpha and beta solidified and packaged wastes are staged at Buildings 23 and 31 prior to shipment off-site to DOE disposal or storage locations. The cyclone incinerator and glass melter in the WD Annex have also been used to dispose of combustible low-level radioactive waste on a trial basis. The laundry sends contaminated alpha wastes from the cleaning of protective garments to WD via above-ground piping. Finally, as stated below, the sanitary wastewater treatment plant creates a sludge that is considered low-level radioactive waste.

Table 4.1-2 contains specific information related to the sources of radioactive waste discussed above as well as information regarding other radioactive waste treatment facilities (e.g., the drum compactors and the effluent removal system to remove airborne tritium from waste streams.) The Building 57 sludge is generated by the sanitary treatment plant described in Section 3.3.2. The sewer system connected to the treatment plant contains numerous breaks which result in the potential for hazardous materials to enter the system as discussed in Section 3.3.4.3.

DOE Albuquerque Operations Office has identified one byproduct waste at Mound to date: the sewage-disposal (SD) cemented sludge that was generated from the now inactive SD facility. The SD facility is being decommissioned and the waste material is being packaged for shipment to NTS.

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Table 4.1-2

MOUND'S RADIOACTIVE WASTE MANAGEMENT FACILITIES

Facility	Waste Managed	Facility Description
Waste Disposal Solidification (WD Bldg.)	Liquid alpha waste (Pu-238)	Equipment for coprecipitation/ flocculation of waste, solidification of sludge, and adsorption/filtration of supernatant.
Staging Area (Bldg. 23)	Tritiated waste; TRU waste; non-TRU alpha waste	One-story concrete block building, 14 ft high x 30 ft wide x 117 ft long, having a gross area of 3500 ft.^{2}
Compactor (WD)	Alpha waste	Hydraulic-ram compactor.
Staging Area (Bldg. 31)	Tritiated waste; TRU waste; non-TRU alpha waste	One-story sheet metal building, 12 ft high x 60 ft wide x 102 ft long, having a gross area of 6100 sq. ft.
Compactor (Bldg. 38)	Low specific activity (LSA) (alpha)	Hydraulic ram compactor.
Waste Solidification Facility (SW-149)	Tritiated waste	Tritiated liquid solidification and packaging for offsite shipment and burial.
Effluent Removal System (SW basement)	Tritiated waste	Air detritiation system removes tritium from process effluent streams before they are released to the atmosphere.
Cyclone Incinerator (WDA)	LSA (alpha, beta)	Developmental single-stage cyclonic combustion chamber, wet off-gas treatment system, and high-efficiency filter used for R&D activities, not for line-generated wastes.
Glass Melter (WDA)	(Alpha, beta, gamma)	Developmental refractory chamber containing molten glass over which waste is burned, wet off-gas treatment system, and high-efficiency filter used for R&D activities, not for line-generated wastes. (Mound is attempting to obtain permit for the unit to treat hazardous waste).
Compactor (R/SW)	LSA (beta)	Hydraulic ram compactor.
Equipment at Various Waste Generating Bldgs. (R, PP, WD, H, WTS)	Low-level alpha solid waste	Where practical, compactors are used to reduce waste volume in drums prior to shipment.
Bldg. 57 (Sewage Disposal Plant) Cemented Sludge	Low-level solid waste	Waste sludge is collected in chamber, removed, dried, packaged and sent to NTS

Source: Mound Waste Management Site Plan (MRC, 1986f)

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4.1.4 General Description of Pollution Sources/Control - Nonhazardous Waste

Mound generates 450 tons per year of garbage and trash and about 200 tons per year of noncontaminated wood and metal scrap (MRC, 1986f). The garbage and trash are disposed of at the nearby Pinnacle landfill by a private contractor. The wood and metal scrap is staged at Building 59 prior to sale to reclaimers. The Health Physics staff examines each scrap lot prior to sale. The trucks of the private trash hauler are scanned for radioactivity prior to leaving the site. On two occasions, the trucks have been found to emit sufficient radiation to trigger alarms. One incident involved radioactively contaminated medical waste brought on-site from another location, and the second involved a sealed source improperly disposed with the trash.

4.1.5 Findings and Observations

4.1.5.1 Category I

There were no waste management Category I findings.

4.1.5.2 Category II

1) Potential for Release of Hazardous Waste to Soils - The storage of hazardous waste and waste oil drums at the field east of the burn area has the potential for unmonitored releases of hazardous waste and radionuclides to the soil. The field containing the 193 waste drums is located on SM/PP Hill approximately 250 yards southeast of the burn area. The area measures approximately 50 by 100 feet. The drums at the southern end of the field, about 50 percent of the total drums, are all marked as containing waste oil. The drums at the northern end are marked as containing plating shop waste, solvent waste, explosive/solvent waste, batteries, kitchen grease, herbicides, photographic solution, epoxy preforms, laboratory chemicals, scintillation vials (<50 μCi/l) and other chemical wastes. Soil stains are visible at the southern end of the field. The drums have been in the field since October 1985, and there are no immediate plans to provide sufficient indoor capacity to accommodate all of them. The majority of the drums are on pallets but many are not.

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The soil in the field will be tested in the sampling and analysis phase of the Survey in order to determine if hazardous substances can be detected.

2) Unpermitted Hazardous Waste Storage Unit - The Mound Plant is operating a hazardous waste storage facility without interim status notification and without a permit. This is the same area discussed in detail in the previous finding. The State of Ohio has the authority to initiate enforcement actions at a facility which is storing hazardous waste at a unit that does not have interim status operating authority. Mound has not notified the State of the existence of this facility.

3) Potential for Release of Plutonium Wastewater - The unloading of liquid radioactive waste from tank trucks at the WD Building has the potential for a spill and uncontained release of alpha waste to the stormwater system. The tank truck normally carries 3,500 gallons of plutonium-contaminated water. The wastewater is a low level waste stream that contains an average alpha activity between 100-1000 disintegrations per minute per milliliter. The activity typically remains at the lower portion of this range. The area at which the liquid plutonium waste is off-loaded from the tank truck is cemented and sloped to a storm drain. The drain is normally open but can be closed with tools that lie beneath the storm drain grating. An operator would have to put his or her hand in the waste liquid to reach the tools needed to close the drain in the event of a large release. In addition, operators were uncertain if the drain was normally open or normally closed. The lack of curbing in the vicinity of the off-loading station to prevent waste liquid from reaching the storm drain results in the continuing potential for release of radioactive liquid wastewater.

4.1.5.3 Category III

1) Leak Detection System Operation - The leak detection system of WD influent alpha waste tanks C and D is configured in such a way that there is a potential for the release of liquid waste in the event of a leak. These tanks each have a capacity of 10,000 gallons. They contain primarily plutonium wastewater but also receive some tritium inflow from an abandoned radioactive waste line. The leak detection lines of the two tanks are small enough to be clogged by silt accumulation. A leak could go undetected if the line clogged. In addition, the leak detection lines for tanks C and D are manifolded such that there is a single outfall

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from the system. Any leakage from the outfall could be coming from tank C or D or both. The response to a leak could be hampered while the operator attempted to determine which tank had ruptured. One of the WD influent alpha waste tanks leak detection lines has a valve in it. A leak could go undetected if the valve were inadvertently closed. The WD personnel are aware of the problems with the leak detection system and regularly clear the lines of silt. Leak detection lines of tanks A and B have been replaced with large-diameter piping to avoid clogging. There are no current plans for similar replacement of C and D tank lines.

2) Leakage Within Building 23 - Radioactive waste drums at Building 23 and radioactive materials in drums at Building 21 are stored too close together to allow visual inspection of the drums in order to identify potential leakers. The Survey team encountered a leak of a tar-like substance among radioactive waste drums in Building 23. The substance covered the floor in an area of the building, but the drums were stacked too tightly to determine the location of the leaking drum. Building 23 has a sump to collect waste, but the spilled liquid material did not reach the sump. Waste drums stored directly on the floor of a building (such as those in Building 23) are not arranged so as to provide sufficient inspection space, and drums can come in contact with liquids on the floor. Drums that are in contact with liquids may result in accelerated deterioration and a higher potential for leakage. A number of drums in the densely packed section of Building 23 will be sampled in the sampling and analysis phase of the Survey to determine if potential leaks could involve hazardous substances or PCBs.

3) Temporary Waste Solvent Staging Areas - Waste solvents are stored in locations that could result in unmonitored releases to soils or the stormwater system. The Environmental Survey team noticed that a number of these waste storage locations had nearby storm drains or floor drains that could provide an avenue for liquid release in the event of a spill. For example, the waste solvent staging pad for Building 28 (one of the largest hazardous waste generators on-site) is near a large storm drain, and the B Building and the DS Building storage sheds have floor drains adjacent to the waste drums. None of these temporary storage facilities was equipped with curbing or barriers to contain the flow of spills. Sampling and analysis of the soil or sediment beneath drains will be undertaken to determine if there is physical evidence of waste material entering these pathways.

4) Wastewater Treatment Plant Sludge Sent to NTS May be a Hazardous Waste - The wastewater treatment plant sludge which is removed, deposited in drying beds, and packaged for shipment as low level waste to the Nevada Test Site may contain heavy metals (e.g., silver and cadmium) and organic solvents (e.g., acetone, methylene chloride) thus constituting a mixed waste. The Survey team found examples of laboratory sinks (other than those connected to radioactive waste or chemical waste storage systems) or drains in buildings M, R, 3, 49 and others that received small quantities of solvent, photographic solution (with silver), acid or bases that would enter the sanitary treatment plant. The sludge from the treatment plant is dried on drying beds adjacent to the treatment plant and packaged in boxes for shipment to NTS. The boxes and their contents are subjected to a radiological analysis but are not routinely sampled for the presence of hazardous constituents. The chemical constituents of the sludge can be expected to vary due to the changing nature of research and development (R&D) activities at Mound and the use of different solvents and chemicals on various R&D projects.

The NTS does not have approval to dispose of radioactive mixed waste and has requested that shipment of such waste to NTS end. Mound does not have a regular sewage treatment plant sludge testing program (although a one-time test was performed) that could identify whether the sludge may be a radioactive mixed waste. Survey-related sampling and analysis will be performed to add information pertaining to the constituents of the sewage treatment plant sludge which is being sent to NTS. The information is expected to help define the potential for such waste to be considered a radioactive mixed waste.

5) Potential for Hazardous Materials to Contaminate Burn Cubicle Ash - There is a potential for ash generated during the use of the burn cubicle (i.e., the facility at the burn area) to be contaminated with hazardous materials. If the ash is hazardous, it does not appear to be being handled in a manner consistent with proper hazardous waste management.

The burn cubicle contains one 55 gallon drum which has been fitted with an air blower device to provide excess combustion air to wastes which are combusted in the drum. The area immediately surrounding the drum is used to burn waste designated as HE-contaminated. The waste includes paper, plastic, cloth products

and other HE-contaminated trash. The material is generated in laboratories throughout the Mound Plant (e..g, Building DS), are brought to the burn area and stored until there is a sufficient quantity to initiate a burn. The material is potentially contaminated with quantities of HE such as PETN and HMX but also contains organic solvents. The organic solvents (such as acetone and freon) are contained on tissue paper used in laboratory operations to clean equipment, parts and components. The area around the 55 gallon drum contains a concrete floor approximately 12 feet by 12 feet with walls approximately 10 feet high. The area is covered by a chain link fence ceiling. HE-contaminated trash is placed on the concrete floor of the cubicle and fitted with a remote igniter to initiate combustion. The operator activates the igniter from outside the cubicle and monitors the burn. The cubicle can be used to burn up to 40 pounds of HE-contaminated trash per event. Typically, only 5-6 pounds of such waste is burned at one time. In addition, the cubicle has occasionally been used to flash various pieces of metal equipment to remove HE contamination prior to being considered for off-site salvage.

The ash that results from burning the trash is collected from the floor and placed in a 55 gallon drum located directly outside the cubicle. The ash may contain small amounts of organic solvent or metals which remain in the ash if there is incomplete combustion of the ash. The ash in the drum will be tested to determine if it contains a hazardous waste.

4.1.5.4 Category IV

1) Hazardous Waste Contamination of the General Trash - The Mound Waste Management hazardous waste collection system is well organized, but small quantities of waste material continue to contaminate separate waste streams. As discussed earlier, organic solvents contaminate some waste oil drums, and laboratory chemicals find their way into the general trash. It is difficult for any waste management operation to ensure complete segregation of different waste streams when large numbers of workers, buildings, processes, and laboratories are involved. Worker education and information campaigns can be an effective way to reacquaint workers with the proper procedures for waste disposal. Mound has conducted such campaigns in the past and should be aware of the need to do so again.

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2) Silver Recovery Unit Not Yet in Operation - A silver recovery system has been purchased but has been in storage for over a year. A portion of the waste in the exposed drum field and in Building 72 is silver-bearing photoprocessing waste. Therefore, the continued failure to use the silver recovery system has resulted in aggravating the problem of hazardous waste storage.

3) Increased Disposal Cost Due to Mixing of Waste Solvents - The practice of mixing waste solvents due to operation of chemical waste disposal sinks can result in an additional analysis cost, thus increasing the cost of hazardous waste disposal. Some of the process area laboratories have installed chemical sinks which drain to waste solvent drums in nearby solvent storage sheds. The equipment helps assure that waste solvents are properly disposed of, but it creates a problem due to the mixing of solvents in the waste drum. Solvent disposers require drum analysis or charging for drum analysis prior to disposal. Mound Waste Management is well aware of the problem and is considering the cost effectiveness of alternatives.

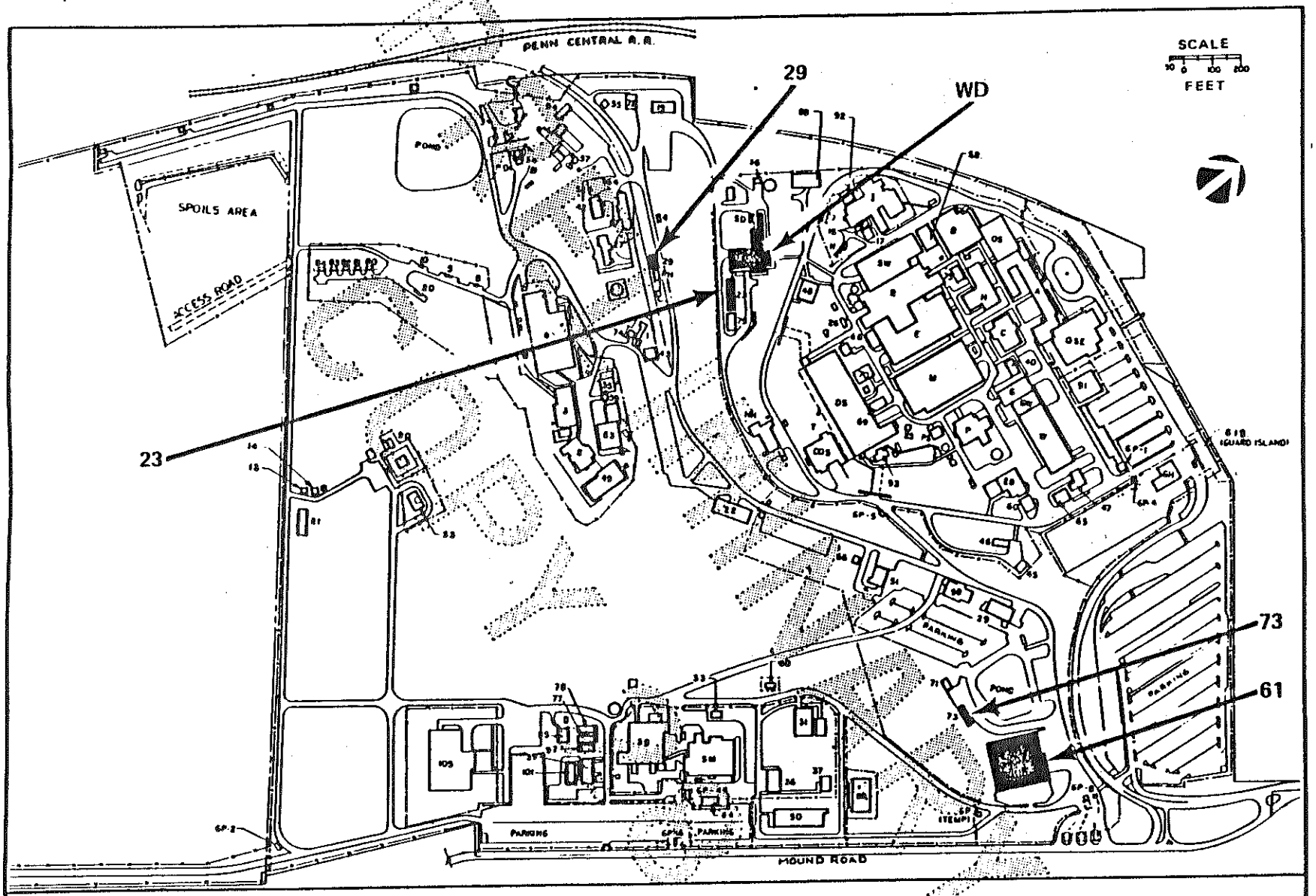
4.2 Toxic and Chemical Materials

4.2.1 General Description of Pollution Sources and Controls

Mound operations involving the use of toxic and chemical materials were reviewed to determine if any activity results in environmental problems. The Survey examined the use and storage of polychlorinated biphenyls (PCBs), pesticides, herbicides, asbestos, solvents, and fuel.

Eighteen PCB transformers are operational at this facility. All are mounted on concrete pads that are diked to contain spillage in the event of a leak. Access to these units is limited by use of locked cages for outdoor units and secure rooms for the indoor units. All units are labeled both on the unit and at the point of entry to its location. The units are inspected monthly.

Radioactive contaminated PCB fluids are stored in Building 23 (Figure 4.2-1) awaiting disposition. The material is stored in ten 30-gallon drums within 55-gallon drums and one 55-gallon drum in an 80-gallon drum. In addition, eighteen 55-gallon drums contain the rags, gloves, and materials that were used to decontaminate and



Source: MRC Drawing, April 1985: Site Plan

Major Mound Toxic and Chemical Materials Storage Locations

Figure 4.2-1

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decommission a PCB hydraulic press that has been replaced at the facility. Building 23 is a new storage building for housing wastes pending shipment to a disposal site.

Asbestos materials are used throughout the Mound site. Asbestos-containing building materials such as insulation and transite pipe are common. Procedures are in place to remove and dispose of these materials. A representative from the Industrial Hygiene section monitors all remodeling at the site to ensure that it complies with accepted work practices and to see that friable asbestos does not become airborne. Mound has maintained records of asbestos disposal since 1980.

Large quantities of bulk asbestos are stored in Warehouse Building 61 (Figure 4.2-1). The material is stored in heavy bags as received from the supplier. The stock is stored on shelves above the floor and covered with heavy plastic to prevent accidental contact and breakage of the bags. This material is processed in Building 29 (Figure 4.2-1), where it is used to formulate a plastic material for a final product manufactured at the facility. An air filtration system is in place to prevent asbestos emissions from the process operations.

There are drums stages outside many buildings that are deteriorating and in need of redrumming or safe storage. These may be "orphan" drums of raw material that have been misdirected. For example, a rusting drum of caustic is staged just north of the asphalt-lined pond in an area that can drain to the pond. Five deteriorating drums whose markings had become illegible were located in the open behind WD. Any leakage from these drums could enter the nearby storm drains. Similar drums were found at many of the buildings visited throughout the site. The condition of many of these drums represented a potential for unmonitored release to soils or stormwater.

Freon gas is used as a refrigerant and the solvent is used as a degreaser. These materials represent potential sources of chlorofluoroalkanes in the form of volatile gas releases. Compressed gas tanks are stored in Building 73 (Figure 4.2-1). No potential problems were evident with regard to the storage and use of these chemicals.

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Herbicides at Mound are handled by the Maintenance staff. Currently, the specific products used at the site include Roundup, Lasso, Trimec and Mine/D. No herbicides are used that require user registration. Staff members are trained and supervised in the proper use, preparation, and application of all chemicals used. Weather conditions and forecasts are considered when herbicide applications are scheduled. Records are maintained concerning the personnel assigned, the chemicals used, and the area treated.

No pesticides are applied by Mound personnel. Since 1980, the practice has been to contract the work to licensed operators. No record of pesticide or herbicide use before 1980 was available. Applications of pesticides are scheduled for Saturdays, when the number of people on-site is minimal.

A records review and physical inspection was conducted of all underground tanks containing hazardous substances or radionuclides. A listing of these tanks was forwarded by the site to the Ohio State Fire Marshal in May 1986 through the Dayton Area Office. This compilation was checked and then used by the Survey team as a listing for inspection purposes.

No tanks on-site were double-walled, nor were any cathodically protected. Several of the tanks were used for storage of various petroleum products including gasoline, diesel fuel, and aviation fuel. There are four No. 2 fuel oil tanks adjacent to the powerhouse, each of 25,000-gallon capacity. This fuel oil is only used 1 or 2 months per year when natural gas is in short supply. Monthly, the amount of fuel in these tanks is measured by stick, with an accuracy of perhaps 50 gallons. However, this method was not sufficient to detect a small chronic leak approximately 20 years ago; the leak was discovered when oil was found in a storm sewer next to the tank.

There are another five small diesel emergency generator day tanks varying in capacity between 825 gallons and 4,000 gallons. Although these tanks are measured monthly, the generators also are tested monthly to assure proper operation for varying periods of time. There is no way, therefore, to gauge the fuel consumption and no way to detect anything but a catastrophic leak.

In addition, there are three petroleum tanks adjacent to the garage building used for fueling vehicles. There is no leak protection on these tanks or any measurement system in place to detect losses. These tanks are to be abandoned when a new garage is built in the near future. Mound has a policy of excavating unused tanks and installing only double-walled tanks for new subsurface installations. In accordance with that policy, these tanks will likely be removed.

There is one tank behind Building 51 that was used to store waste solvents prior to their being burned in the Building 51 incinerator. The incinerator was used from 1968 to 1972. The remaining contents of the tank were never inventoried, and no records were kept as to the type of waste which passed through the tank.

The remainder of the tanks are either associated with the plant nonradioactive waste sewer system, and are actually holding or equalization tanks, or are a part of the radiological treatment system at SM/PP area and the WD Building. The tanks at SM/PP area are all unused and are either already excavated or scheduled for decontamination and decommissioning. The tanks in WD Building are addressed in Section 4.1.

4.2.2 Findings and Observations

4.2.2.1 Category I

There are no toxic and chemical materials findings in Category I.

4.2.2.2 Category II

Potential for Release of Hazardous Substances to Soil and Surface Water - The placement and condition of certain chemical drums outside production area buildings warrant immediate attention to ensure that these drums do not release their contents. The responsibility for checking such drums has been delegated to the maintenance people of the buildings involved. Mound waste management in the past has conducted campaigns to identify and collect such drums before they become a problem. Current surveillance procedures for such drums have not

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resulted in the removal of deteriorating drums with the potential to release their contents. Drums of caustic, waste solvent and other chemical substances were found in many locations throughout the plant site.

4.2.2.3 Category III

1) Potential for Release From Underground Storage Tank - A 5000 gallon underground storage tank which is believed to contain 800 gallons of aviation fuel has the potential to leak to adjacent stormwater courses. The tank is located immediately north of the overflow pond and southwest of Building 34. The tank was formerly used for flame-testing containers at the Building 34 area, but has not been used since 1978. The tank has a total capacity of 5000 gallons, is 16 years old, and is made of steel. It is unlined and has no cathodic or external protection. The tank has been included on the report of underground storage tanks to the State of Ohio.

The combination of tank age, material of construction, lack of protection, substance type, and location increases the potential for an environmentally damaging release.

2) Potential for Release of Waste Solvents from Underground Storage Tank - A 1,000 gallon underground storage tank may contain waste solvents and has the potential to be a source of subsurface soil or groundwater contamination. The tank is located behind Building 51 and was used from 1968 to 1972 to store waste solvents prior to their burning in the Building 51 incinerator. Use of the incinerator was discontinued in 1972, however, and the remaining contents of the tank were never inventoried. Also, no records were kept of what quantities or types of waste passed through this tank. The tank is currently locked and the key has been lost. The tank is 15 years old and constructed of steel. It is unlined and has no cathodic or external protection. The tank was included on a 1986 notification of underground tanks to Ohio officials. Mound personnel stated that the tank was to be removed in the near future. The age, material of construction, lack of protection and potential substance contained increases the potential for environmentally damaging release.

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The sampling and analysis phase of the Survey will sample the tank to determine what if any substance remains.

4.2.2.4 Category IV

1) Minor PCB Leaks - Three PCB transformers had minor "weeps" at the sample take-off valve. The weeps were all of an extremely low rate (i.e., approximately one drip every 2 hours) and were contained. There were no stains or other indications that any of these leaks had spilled to the surrounding area. Therefore, the Survey team has focused on the deficiency in documentation related to the leaks.

Two of the leaking units were 215 gallon transformers in T building. Both units had drip pans in place to collect small leaks or weeps from these units. The drip pans contained absorbent stained with the leaking PCB, but the absorbent material did not appear fully saturated. A third transformer with a leak was found in building P-1. A drip pan was placed under the unit after notification was given to the Electric Maintenance Group.

No daily inspections records for the leaks were maintained. Containment of a PCB leak with a drip pan is a temporary action to avoid PCB contamination. All leaks must be repaired and clean-ups must begin within 48 hours of the discovery of a PCB leak (40 CFR 761.30). Daily inspections are required to verify containment of such leaks and records of the inspections are to be maintained. There was no record of when the leaks started nor was there information pertaining to actions taken (besides pan placement) to repair the leaks. In addition, Mound operating policy requires that the industrial hygienist is to be notified in the event of a PCB leak, but the hygienist was unaware of the three leaks identified above.

2) Radioactively Contaminated PCB Fluid Storage - The radioactive PCB fluid stored in Building 29 has been held for more than a year without final disposition of the contaminated material. The material is radioactively contaminated and is being stored until a suitable DOE disposal option becomes available.

4.3 Direct Radiation

4.3.1 General Description of Pollution Sources/Control

Direct external radiation is defined as exposure to gamma photons, x-rays, and beta particles coming from radioactive material outside the body. This does not include radiation from ingested or inhaled radioactivity.

There are no sources of direct radiation exposure except for that which emanates from the contaminated soil. Figure 4.3-1 presents the results of an aerial survey in July 1976 showing the levels of direct radiation (EG&G, 1976). As can be seen in the figure, the higher level areas coincide with those identified in Section 3.2 as soil contaminated areas. The monitoring program for the contaminated soil is discussed in Section 3.2. Since there are no other sources of direct radiation, Mound has no additional direct radiation measurement as part of its environmental monitoring program.

4.3.2 Findings and Observations

4.3.2.1 Category I

There are no direct radiation Category I findings.

4.3.2.2 Category II

There are no direct radiation Category II findings.

4.3.2.3 Category III

There are no direct radiation Category III findings.

4.3.2.4 Category IV

There are no direct radiation Category IV findings.

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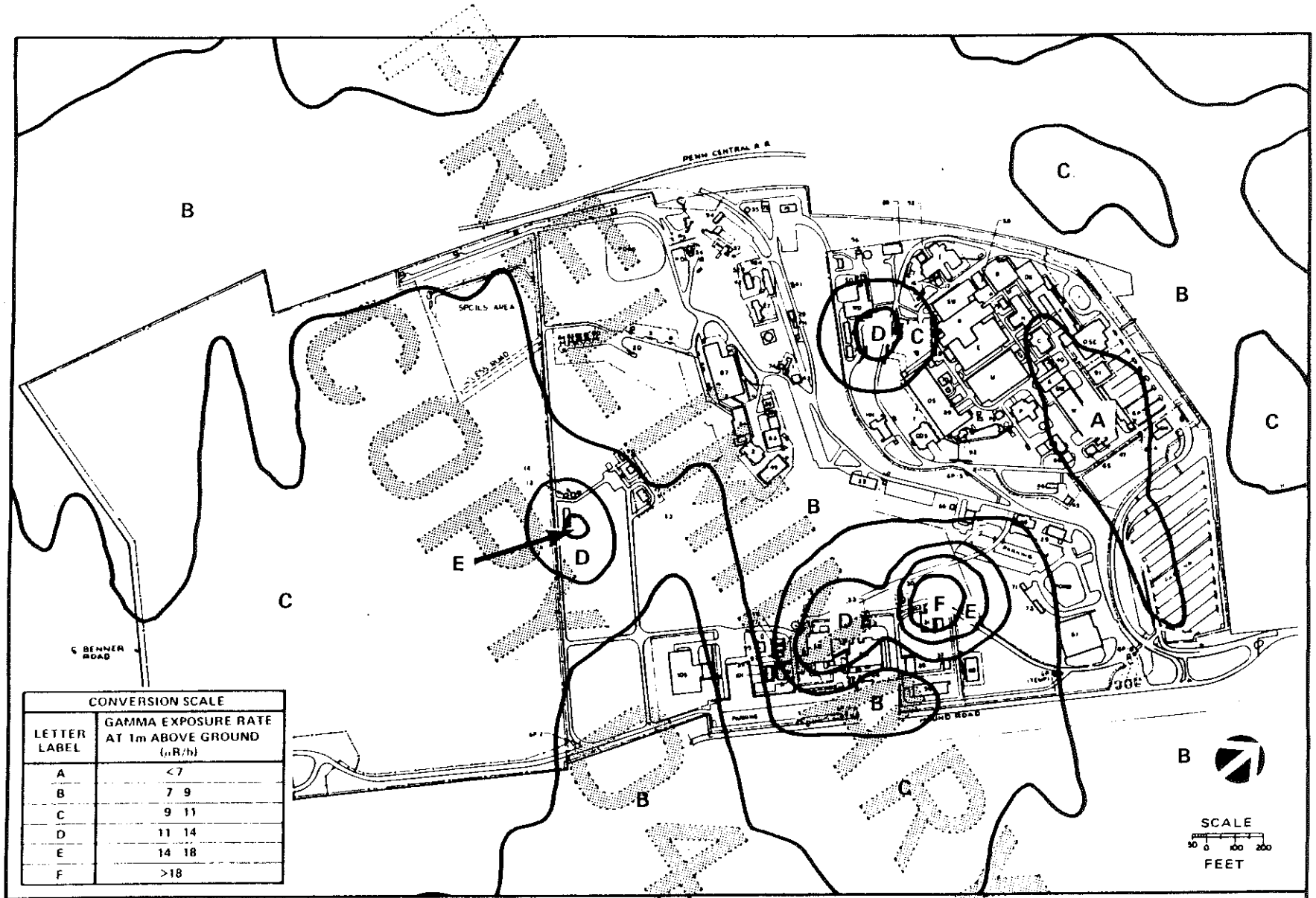

CONVERSION SCALE	
LETTER LABEL	GAMMA EXPOSURE RATE AT 1m ABOVE GROUND (μR/h)
A	<7
B	7 9
C	9 11
D	11 14
E	14 18
F	>18

Source: EG&G Graphic Overview System, 1976

Mound Direct Radiation Levels

Figure 4.3-1

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4.4 Quality Assurance

4.4.1 General Description of Data Handling Procedures

Two Mound laboratories reporting to the Environmental Manager are responsible for the environmental measurements of air, water, soil, and occasional biota samples for uranium, thorium, polonium, americium, curium, and tritium. Effluent monitoring data are provided by a second laboratory unit that analyzes basic inorganic chemical parameters such as flow, suspended solids, BOD, coliform, pH, oil and grease, COD, residual chlorine, dissolved solids, cyanide, and metal analyses. All organic analyses are contracted to an independent laboratory off-site (ETC Corp. in Edison, N.J.).

Quality assurance measures are coordinated through the Mound QC supervisor, who is independent of the laboratory operations. He coordinates laboratory participation in two performance sample programs. The first is a DOE program covering radiochemical measurements. This program, conducted by the DOE Environmental Measurement Laboratory (EML), distributes QA samples to participating laboratories twice a year. The second performance sample program involves Monsanto corporate operations. For the most part, this program covers NPDES sample analysis.

4.4.2 Findings and Observations

4.4.2.1 Category I

There are no quality assurance Category I findings.

4.4.2.2 Category II

There are no quality assurance Category II findings.

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4.4.2.3 Category III

1) Insufficient Laboratory QA Protocols - The Mound Plant is not following accepted quality assurance procedures. The reliability of each measurement is not fully documented on a routine basis, and there is a potential for major errors in environmental monitoring data.

The Environmental Survey team found no confirmed evidence of invalid data, but the protocols presently used for quality assurance are not sufficient to defend the validity of the data. Mound participates in both DOE and Monsanto quality assurance programs, but there is no consistent, day-to-day verification that the data are of acceptable quality. The sampling and analysis phase of the Survey will split samples with Mound at the NPDES monitoring points, and an independent analysis will be performed. The analytical data will be compared to gain information pertaining to the overall quality of Mound data.

Specific aspects of the finding are discussed below:

- Bacteriological procedures for the determination of fecal coliform were modified significantly from the referenced protocol. The procedure used at Mound determines total coliform by presumptive tests. The incubation medium differs from that specified by the approved method and the incubation temperature was 35°C, not 44.5°C. No confirmations are made. NPDES regulations are specific as to the method used for this determination.

- Performance samples received from EML and the Monsanto programs are distributed to the laboratories as received. The sample containers are easily distinguished from routine Mound environmental samples. This practice alerts the analyst that this is a performance check and obviates the purpose of the check.

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- Chain-of-custody is not complete. Sample personnel deliver environmental samples to the laboratory but no collector signature is recorded. This is a problem, because there is no documentation of sample handling and it would be difficult to substantiate sample routing.

- Internal standards are added to all radiochemical samples before analysis. Duplicate analyses are performed to document laboratory precision, but no spike of the isotope being determined is added to the sample to determine the percent of recovery of the isotope being analyzed. This spike is the measure of the accuracy in the analysis.

- Minimum acceptance criteria for the internal standard in radiochemical determinations are not specified in the analytical procedures. This results in the acceptance of low recovery rate data (below 20%) not normally allowable by QA procedures.

- Daily maintenance and calibration records of equipment, such as balances and thermometers, are not recorded in a permanent record book. Documentation of the performance of the equipment is necessary to substantiate the analytical data.

- Analytical protocols are not available to the analyst in the laboratory. A method manual was prepared, but it merely references the publication where the method can be found. It is important that the details of analytical procedures be readily available to the analyst to help ensure proper methodology.

- Specific sampling methods for each type of sample medium were not available to the sample collector. As discussed above, formal procedures should be available to help verify proper sample collection in the field.

- Quality assurance measurements of duplicates and spikes are not determined with each radiochemical and inorganic sample batch analyzed. Accepted quality assurance practice specifies that quality control measures of blank, duplicate, and spike be related to each result reported.

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As a minimum, these measures are run with every batch of ten samples or less. Mound is not analyzing these quality control measures this frequently.

4.4.2.4 Category IV

There are no quality assurance Category IV findings.

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4.5 Inactive Waste Sites and Releases

4.5.1 General Description of Pollution Sources/Control

The Mound Plant has been in operation since 1948. During that period it has been in continuous use performing a wide variety of research and development activities for weapons components involving chemical, and high explosive materials. In June 1986, the Albuquerque Operations Office issued the Phase I Report of the Comprehensive Environmental Assessment and Response Program, (CEARP) in compliance with DOE Order 5480.14. The results of the CEARP are discussed in the environmental monitoring portion of this report. Table 4.5-1 presents a comparison of the CEARP site designations with sites identified by the Survey team after an independent search and analysis of the Mound site.

This section of the report discusses only those areas on-site that have or may have areas contaminated with non-radiological constituents and all off-site chemical and radiological areas. On-site areas that have or may have radioactive contamination are discussed in Section 3.2 (Soil).

The Environmental Survey has identified 10 inactive waste sites or release locations (see Figure 4.5-1). These areas include one for which previous location information (DOE, 1986b) must be changed to define its location more accurately (site 5), and one new area located by the Environmental Survey team (site 4). Three of the sites have the potential for groundwater contamination, two have the potential for surface-water contamination, and one has the potential for contamination of both.

Site 1 - Former location of solid waste landfill; adjacent to the existing large retention pond in the southern portion of the facility. There is a potential for contamination of both surface and groundwater. This site was a solid waste landfill that operated from 1948 through the mid-1970s. In 1978, the majority of the buried waste materials were excavated and placed in an engineered landfill lined with 5 feet of clay on the bottom and 3 feet of clay on the top overlain with 2 to 5 feet of seeded topsoil. The capacity of this landfill was approximately 100,000 cubic yards. Also, in 1978 a stormwater retention pond was constructed on the northern portion of the landfill.

Table 4.5.1

DOE DESIGNATIONS OF INACTIVE WASTE SITES

DOE Designation	CEARP Designation
1	B
2(1)	I
3	J
4	None
5	C
6	None
7	None
8	A
9	F
10	H

Source: DOE, 1986b

(1) Site 2 contains two separate areas

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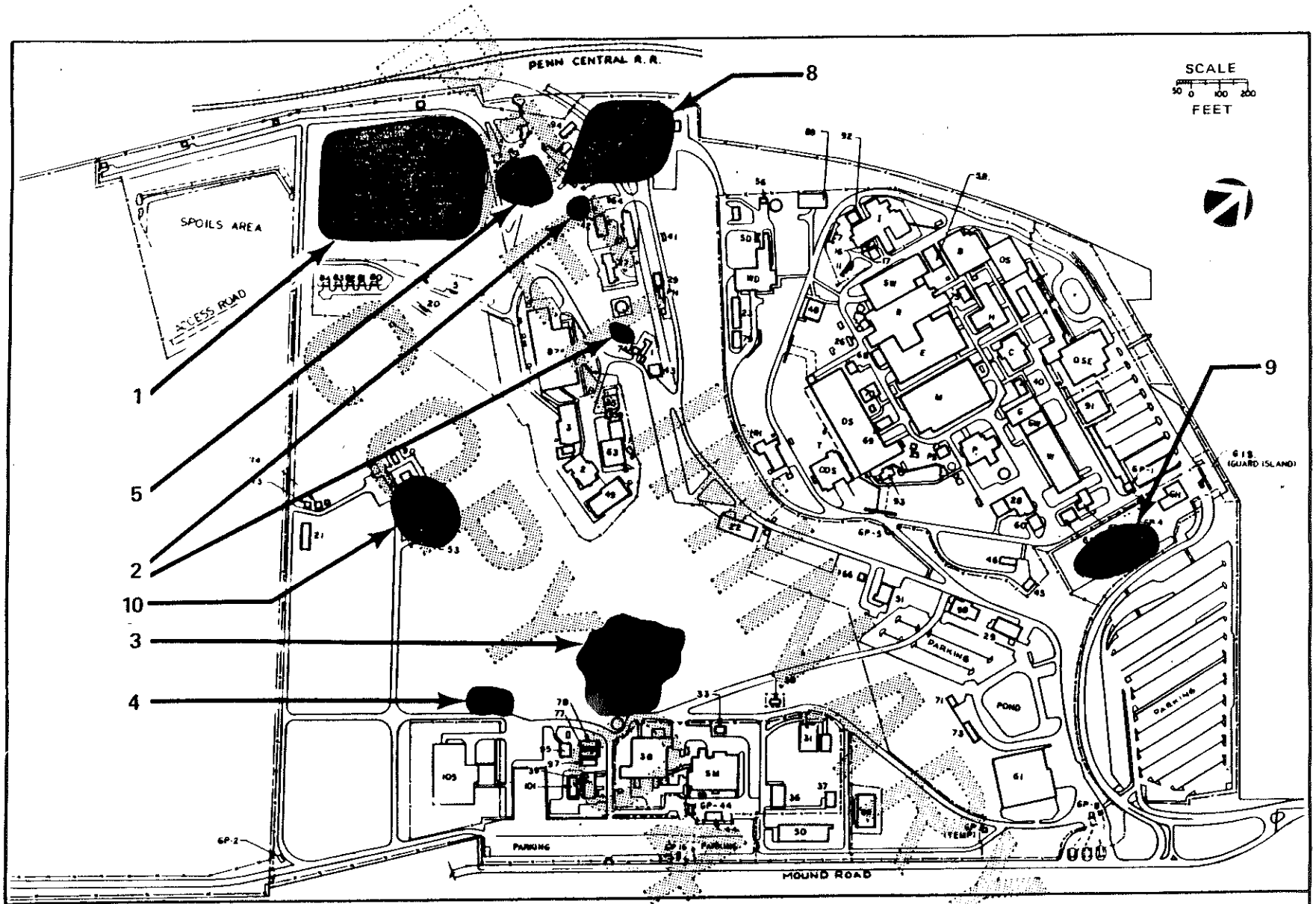

Source: MRC Drawing, April 1985: Site Plan

Figure 4.5-1

Location of Inactive Waste Sites and Releases on the Mound Plant

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The clay-lined landfill constructed in 1978 contained drains inside the landfill, all of them approximately 8 feet higher than the inside bottom of the landfill. These drains discharge into the overflow pond from a single pipe at average pond water level. The purpose of these drains was to drain the liquid out of the excavated wastes placed inside the clay liner. These wastes were completely saturated during the 1978 excavation and the drain pipes flowed leachate into the overflow pond for 6 months, according to construction personnel. The drains could not be placed lower in the fill, and they still drain by gravity into the pond.

Two areas of past disposal in the vicinity of the former solid waste landfill were not excavated and placed inside the clay liner. One of the two areas is outside the boundary of the 1978 landfill at its southwestern corner, immediately east of the roadway surrounding the landfill. This area contains approximately 14,000 cubic yards of wood and metal debris, including, according to interview records and employees' verbal statements, up to 5,000 crushed drums that formerly contained thorium wastes. The second area, which has a volume of approximately 16,000 cubic yards, contains unknown waste materials and is located beneath the current landfill.

Based on the compilation of verbal information, interviews, and report records reviewed by the Survey team, Site 1 received limited quantities of hazardous wastes from 1948 to 1978, probably solvent chemicals and miscellaneous nonradioactive solid or semisolid chemical wastes. Radioactive wastes are not believed to ever have been disposed of at this site.

<u>Site 2</u> - Solvent disposal leach beds, with a potential for groundwater contamination. This area actually consisted of two separate infiltration/evaporation basins which received liquid wastes from a high explosive process discharge. The two solvent leach beds are located directly behind Buildings 1 and 42. Solvents and high explosive wastewater would be discharged to the pits, where the liquid fraction of the waste would seep into the ground or evaporate. There were no outlets from these leach beds. Aerial photographs show that the leach bed behind Building 42 was consistently filled, whereas the bed behind Building 1 was consistently empty. A review of the records showed that the leach bed behind Building 42 had a much higher wastewater load. The area is directly adjacent to a major Mound drainage pathway.

Site 3 - Construction spoil site, with a potential for surface-water contamination. Site 3 consists of a very large landfilled area on the east side of the SM/PP Hill. There are no records of the type or origin of material (other than building debris) that was disposed of in this area. A visual examination of the area identified a dozen empty, partially crushed drums in the debris. The area is now covered by vegetation and is located near a small stream that drains the hillside.

Site 4 - Solvent storage area, with a potential for surface-water contamination. This is a new location that was unreported in previous documentation. It consists of an area of approximately 14,400 ft^2 where drums were staged.

The drum storage area was located by the search of old aerial photographs that was conducted as part of the Survey. These photos showed 100 to 500 drums located along the edges of this area. Additionally, a 1976 plan sheet for the new landfill/overflow pond construction showed this location and labeled it "waste spoils area."

A review of reports, records, and employee interview notes did not reveal any documentation other than the aerial photographs showing that this site was used for disposal of chemical or radiological wastes.

Site 5 - Stagnant area of water about 150 feet in diameter in which there is potential for contamination of groundwater. An unknown quantity of lithium carbonate and other organic solvents was dumped in an area of stagnant water. The actual area of disposal was under and around Building 34, not the area to the east of Building 34 that was reported in previous documentation. The quantity of material disposed of is not known.

Site 6 - The Survey team found that the dirt road immediately adjacent to the Miami-Erie Canal indicated the presence of radioactivity. The direct radiation readings approximately 3 feet above the road were from three to five times background readings. The Survey team was not able to determine the cause of the radioactive contamination. However, the road appeared to be partially constructed of an ash material which may be fly ash from a coal-fired boiler. Coal fly ash typically contains a radioactive component due to the natural radioactivity of the native coal. It is not uncommon to use fly ash as a part of the road bed material.

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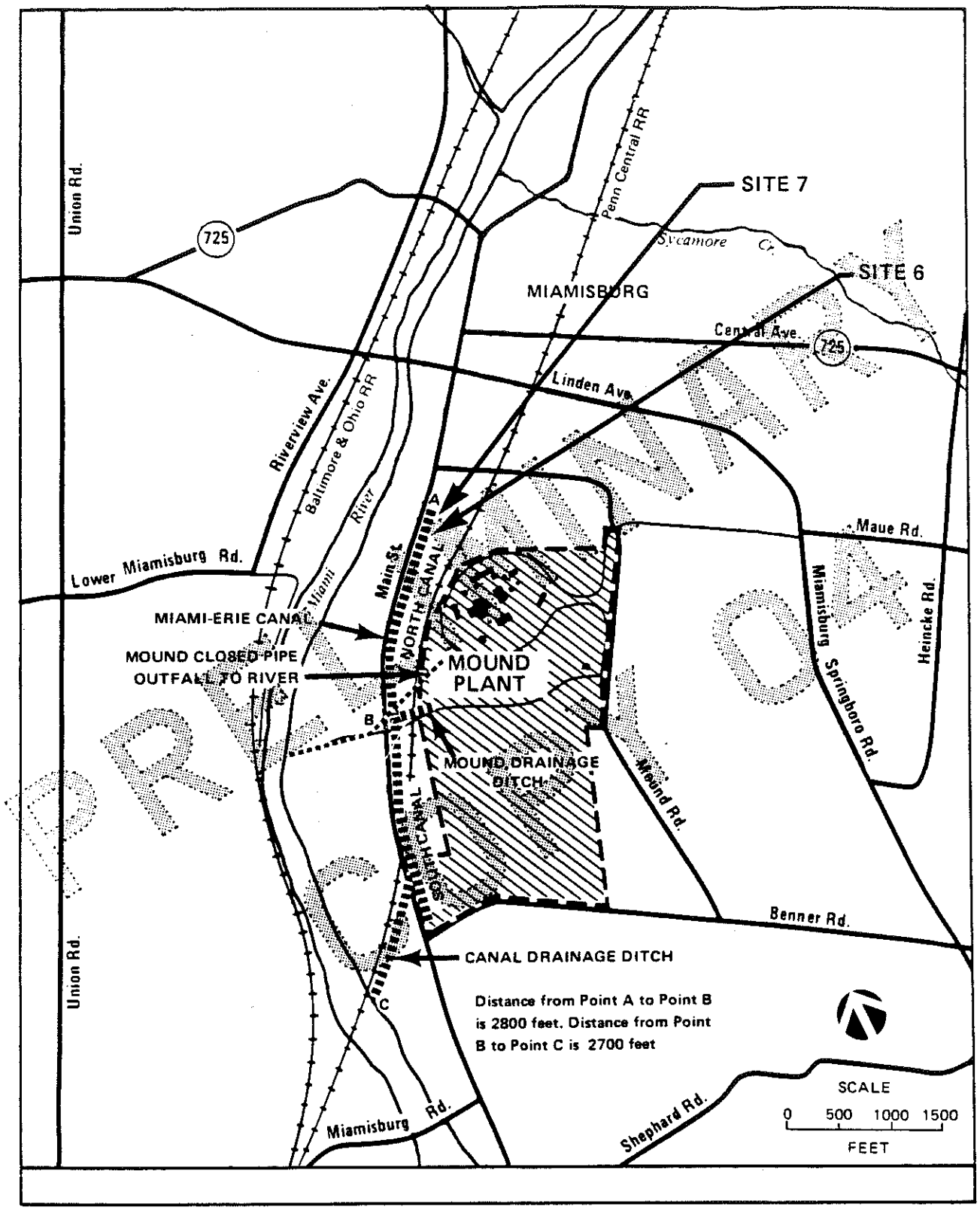
Site 7 - Off-site plutonium contamination of the Miami-Erie Canal. The site has a potential for groundwater contamination. In addition, the site was the focus of a Notice of Intent to initiate action filed under CERCLA by the State of Ohio. A special detailed discussion of the events preceding and following the 1969 plutonium waste pipeline rupture and the resulting contamination of the Miami-Erie Canal is presented below because this is the only off-site contaminated area.

In January 1969, an incident occurred which resulted in the release of plutonium from the Mound Plant. As a result of a waste pipeline rupture, plutonium-contaminated soils were washed by precipitation into the plant stormwater system and discharged through NPDES Outfall 5002. This contaminated soil eventually was transported into the North Canal and two small associated ponds, the South Canal, the canal-overflow creek, and ultimately the Great Miami River (see Figure 4.5-2).

The pipeline which ruptured was a buried waste pressure sewer that carried waste plutonium in acid solution from the Building 41 pump station in a northerly direction up the Main Hill to the WD Building for treatment. This liquid waste was generated in the SM/PP area and carried by gravity via two underground pipelines (2,650 feet each) to the Building 41 pump station. The gravity pipelines were buried from 6 to 23 feet below grade and crossed the storm drainage creek above ground in the vicinity of Building 22. The pipeline system was originally built in 1967 concurrently with the construction of the plutonium processing building (38). Processing operations began in 1968. The pipeline system was abandoned by 1976 "after several leaks developed in the underground lines and caused the surrounding soil to become contaminated; this contamination was subsequently released off-site via natural rain runoff" (MRC, 1978c). As of the date of the Environmental Survey in August 1986, the entire gravity pipeline had been decontaminated and decommissioned by excavation and removal. Similar D&D work is underway on Building 41 and the pressure waste pipeline to the WD Building, although excavation and removal are not yet complete. Since the abandonment of the pipeline, liquid waste from the SM/PP area has been sent to WD Building via tank trucks.



Miami-Erie Canal Location Map

Figure 4.5-2

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When the rupture occurred in January 1969 up the hill from Building 41, the leak was detected at the liquid waste receiving point in WD Building. The actual location of the failure was determined by released vapors resulting from chemical reaction between the highly acidic liquid and the calcareous soils. Immediately after this detection, however, mitigating actions were taken by site personnel, including excavation of soil containing approximately 185 curies of ^{238}Pu which was placed in metal drums, and repair of the pipeline. Approximately 2 days after the completion of excavation and pipeline repair, a 3-day period of heavy rainfall began before the site could be closed properly. This resulted in further erosion of the steep hillside. Although analyses of the aqueous runoff were performed for ^{238}Pu and found to be negative, the "bed-load" sediment was not present in the runoff samples taken. Site personnel now speculate that the plutonium migrated off-site because of the mechanism of bed-load sediment transport, wherein particles are scoured and eroded and are only in temporary suspension. After the 3-day rainfall and over the following 3 weeks, an additional 35 curies of ^{238}Pu in soil were removed from the hillside and placed in metal drums. In April 1969, the excavations were filled with uncontaminated soil.

Routine environmental sampling began in 1971. The results of this sampling indicated the presence of plutonium in the sediment of the canal. Core samples of sediment from the canal taken in January and February 1974 clearly indicated that the amount of plutonium in the canal was above the baseline levels expected. Mound reported these findings to ERDA and to local and State officials and concurrently commenced a very intensive study. This work (MRC, 1974) involved sampling as well as the analysis for ^{238}Pu of over 1,750 soil, sediment, biota, water, and air samples. The study was conducted by Monsanto personnel with the assistance and advice of an outside consultant review group. The purposes of the study were to fully investigate the extent of the contamination, the source of the plutonium, how it was transported and deposited in the waterways, and what potential hazards these deposits might present to the public at the time of the study and in the future. The study was completed in September 1974 and presented to the public at a press conference the next month. Also in September 1974, as a result of the findings of the study, an additional quantity of soil containing 35 curies of ^{238}Pu was removed from the WD hillside and boxed. The results of the study were formally submitted in September 1975 (MRC, 1975b).

The conclusions of the study are summarized below:

1. Extent of contamination - About 5.2 curies of ^{238}Pu are deposited in the waterways off the site. The contamination has been buried under up to 3 feet of sediment as a result of natural drainage in the vicinity.

2. Source of contamination and method of transport and deposition - An intensive investigation identified the cause of the ^{238}Pu contamination to be the rupture in January 1969 of the underground liquid waste pipeline and the subsequent rain erosion/migration of ^{238}Pu contaminated soil particles from the excavated pipeline area. The plutonium was described as strongly sorbed by the soil, where it was immobilized. The eroded soil, suspended in moving water, settled according to normal sedimentation processes in the waterways adjacent to Mound Plant.

3. Present and potential hazards to the public - The health and safety aspects of the ^{238}Pu sediment deposits were evaluated under the prevailing conditions and under credible worst-case future conditions. Overall, the ^{238}Pu deposits were evaluated and found to present no hazard to the public under the conditions that existed in the area at the time of the study. Also, on the basis of a detailed analysis of credible worst-case future conditions, the concentrations of plutonium in the sediment were not expected to present a hazard to the public in the future.

In January 1975, the manager of the Albuquerque Operations Office of ERDA appointed an ad hoc committee to evaluate the health and safety aspects of the off-site plutonium. This committee included representatives from the U.S. Environmental Protection Agency, U.S. Air Force, University of Cincinnati Medical School, Ohio State University Agronomy Department, New York University Medical Center and Battelle Pacific Northwest Laboratories. This committee published its findings in February 1976 (ERDA, 1976).

The findings of the report upheld the Mound Plant Study by stating that "the ^{238}Pu released to the environment during the 1969 process waste pipeline rupture is not, under present conditions, a health hazard to persons living in the vicinity of

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Mound Plant." They went on to caution: "However, the committee recognizes both that there are some deficiencies in the sampling data and that possible future physical modifications to the sites of plutonium deposition in the canal and pond areas would alter the amounts of plutonium available for contamination of the local human population." In the interest of avoiding future health risks, the committee made several recommendations, which are summarized below:

1. Increase the scope of the air sampling program, in particular extensive sampling in the vicinity of the pond and canal sediments to ensure that plutonium does not become airborne as a result of geologic, hydrologic, or meterologic forces or human intervention.

2. Improve on-site drainage, construct a large volume retention basin to help prevent the further off-site release of plutonium.

3. Install stream gauging and sediment sampling stations and perforated access tubes located on the WD hillside to monitor the translocation of plutonium.

4. Consider stabilization of the area of highest plutonium concentration in the North Canal, either by water or by other means.

5. Prepare autoradiograms of air samples collected in the area of the pond and canal to determine whether the airborne plutonium is in the form of plutonium particles or clay particles heavily contaminated with plutonium.

6. Give consideration to obtaining the information necessary to understand the dynamics of the adsorption of plutonium to clay and other surfaces in the soils and sediments for use in modeling the long-term behavior of plutonium in the environment of Mound Plant. This was recommended in order to properly address the question of long-term mobilization of plutonium released to the environment. The committee also concluded that off-site sampling results indicated that about 9 curies of plutonium were transported off-site as a result of the pipeline break, in comparison to the 5.2 curies of off-site deposition that was reported in the Mound Environmental Plutonium Study.

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Asbestos in CERCLA Sites - A review was conducted to determine the possibility that asbestos is buried in on-site locations where it currently is causing or has the potential to cause an environmental problem. The primary environmental concern for buried asbestos is wind-generated fugitive dust migration. Although asbestos fibers in drinking water pose a potential public health risk, there is no known hazard to flora or fauna from asbestos in surface waters.

The Survey team found adequate documentation as to disposal practices since 1980. However, no records were available prior to that date. None of the locations of solid waste disposal on-site was ever used specifically for asbestos disposal, nor was asbestos segregated from other construction debris and placed with any special procedures, according to the best available records and employee information.

The new construction spoils area had been open for approximately 2 years at the time of the Survey. When operations began, an attendant was stationed at the new construction spoils area to ensure that no material containing friable asbestos was disposed of. However, Site 3 had operated for approximately 30 years without controls to restrict the disposal of friable asbestos.

The following Mound waste sites or release locations were identified in previous documentation and reviewed by the Environmental Survey Team. The sites delineated below had a lower potential for migration of contamination because of either the small quantities disposed of, the presence of an impervious cover, or the likelihood that no contamination existed based on an independent review of the release scenario.

Site 8 - Construction spoil material from T Building. The site was used to receive soils excavated for the construction of T Building. However, it appears that the soil involved was uncontaminated.

Site 9 - Chromium plating bath disposal. Former employees stated in interviews that Area F received a one-time batch dumping of 110 gallons of chromium-containing wastes. This area could only be generally located and is now covered by the visitors' parking lot.

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Site 10 - Pyrotechnic wastes. This area consisted of land treatment/disposal of small quantities (less than 10 gallons per year) of wastewater-containing detergent, acetone, and other solvents with trace amounts of reacted pyrotechnic material. This took place in the vicinity of Building 90.

4.5.2 Environmental Monitoring Program

The Albuquerque Operations Office CEARP is a phased program to identify, assess, and correct existing or potential environmental problems. Phase 1 inventories areas of potential environmental concern through record reviews, literature searches, and employee interviews. The Phase 1 report for Mound was issued in June 1986. The Mound CEARP effort is continuing with a revisit evaluation of two of the ten areas under a supplemental Phase 1 investigation. These two areas are the lithium carbonate disposal area and the solvent disposal leach beds. This has been termed an "installation assessment." This field work is proposed by the draft outline for CEARP Phase 2 (DOE, 186c) to include supplemental field reconnaissance, with the possibility that these two sites may be designated for Phase 2 characterization. It is also proposed that WD Building will be reevaluated in the same fashion.

The new (1978) landfill area and the "characterization of tritium in water in the vicinity of Mound" have been recommended for extensive Phase 2 site characterization. This work in now in the planning stages.

One area, the plutonium in the Miami-Erie Canal, is scheduled to be evaluated under CEARP Phase 5, "Compliance and Verification." This will involve identifying and planning for any continuing monitoring requirements needed to demonstrate control of migration or adequately recognize future concerns.

As part of the site's overall environmental monitoring program, two ambient air sampling stations are located in the vicinity of the North Canal and pond. One station is in the Miamisburg City Park near the remaining pond of the two original ponds in the area. The second station is located atop the wellhouse for Miamisburg well No. 2. Continuous samples from both stations are composited and analyzed monthly for ^{238}Pu and $^{239, 240}Pu$.

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During calendar years 1974, 1975, and 1976, water and sediment samples were obtained and analyzed for plutonium from the North Canal, North Canal Pond, and South Canal. In 1977 and 1978, only the South Canal location was sampled and analyzed; since 1979, this station has also been eliminated.

A considerable monitoring program was conducted on air samples from the northerly pond area during the construction of the solar pond from May 1977 through October 1978 (MRC, 1979b). Other than the two continuous air sampling stations, however, no ongoing monitoring for plutonium is being conducted at present in the South Canal, the North Canal area, or the city of Miamisburg park solar pond and fishing pond.

4.5.3 Findings and Observations

4.5.3.1 Category I

There are no inactive waste sites and releases Category I findings.

4.5.3.2 Category II

There are no inactive waste site or releases in Category II findings.

4.5.3.3 Category III

1) Potential for Undetected Movement of Plutonium - The environmental monitoring program for the off-site plutonium contamination (Site 7) would not detect low probability releases.

Most Mound-specific and other scientific information indicates that plutonium adheres strongly to soil particles and therefore does not pose a threat to groundwater. However, some scientific literature from laboratory studies suggests that plutonium may become soluble and, therefore, mobile under certain complex conditions. Mound does not now sample media other than air in the vicinity of the canal for plutonium. The 1976 ad hoc committee report pertaining to the plutonium contamination of the canal included monitoring recommendations to

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detect the translocation of plutonium as well as studies regarding the adsorption of plutonium to clay. These recommendations are not presently being implemented. One of the concerns raised by the State of Ohio at a meeting with the Survey team was the potential for mobility of plutonium in the soils of the canal. The sampling and analysis phase of the Survey will emplace lysimeters in the North Canal approximately 15 feet below the surface to collect water in the unsaturated zone. The water will be tested for plutonium to determine if movement from the overlying sediments can be detected.

In addition, split-spoon samples of the soil column will be collected in 1-foot increments as the lysimeters are installed. The soil will be analyzed for plutonium to obtain a profile of plutonium contamination for comparison with profiles that were developed at nearly the same locations in the mid-1970s. The information derived from lysimeter installation and testing will expand the basis for understanding the site-specific potential for plutonium migration and for appropriate future monitoring actions.

2) Leachate Discharge From the New Landfill - The concentrated leachate in the lower 8 feet of the new landfill (Site 1) may discharge into the stormwater retention pond due to the design of the drain pipes inside the landfill and, therefore, potentially result in an uncontrolled discharge off-site. In addition, the concentrated leachate inside the landfill may eventually escape the bottom of the landfill.

The drain pipes inside the landfill (see Section 4.5.1), which were designed to drain the wastes after they were encased in clay, were installed approximately 8 feet above the clay bottom of the inside of the landfill. The wastes were wet when placed in the landfill. This elevation is believed to be as low as they could be placed and still drain by gravity into the overflow pond. It is assumed that the lower 8 feet of wastes are still saturated. Further, when the water level of the overflow pond rises about 1-2 feet over its normally maintained depth (which it frequently does after storms, since it is used as an equalization basin), the liquid from the pond is believed to be able to flow back into the landfill wastes. This creates a constantly saturated condition in the lower 8 feet of the wastes and a percolator type condition in the 8- to 10-foot layer. The trapped water in the lower 8 feet of the landfill may be quite concentrated in contaminants after

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leaching for 10 years. Eventually it may escape through the bottom of the landfill. The percolator condition remains a potential problem, whereas removal or permanent blockage of the drain pipes from inside the landfill would eliminate the problem. The existing condition has the potential to be constantly adding to the contamination of both the overflow pond sediment and the stormwater discharged through the overflow pond.

3) Potential Contamination From Solvent Leach Pit - Soils and groundwater in the vicinity of Building 42 may have been contaminated through the operation of a solvent leach bed (Site 2). The waste entering the leach pit contained approximately 80% water, 10% ethanol, and 10% acetone with trace amounts of high explosive. The wastewaters were discharged to a basin 25 feet square by 5 feet deep. No records of the quantity discharged were kept, but it is estimated that a few thousand gallons per year were disposed of in this manner. The discharges occurred for a period of 15 to 18 years and were halted in mid-1985.

A disposal pit of similar size was operated at Building 1. Similar waste material was disposed of, but the quantity was an order of magnitude less than that at the Building 27 pit. The Building 1 waste pit operated from the late 1960s until discharge was ended in 1985.

The solvent pit in the vicinity of Building 27 will be sampled to determine if solvent has contaminated the soils and groundwater beneath the site.

4) Potential Contamination From Construction Spoil Site - A historic construction spoil site (Site 3) may be a source of small quantities of radiological and chemical contamination of surface water. The area was formed by dumping loads of construction rubble over the east side of SM/PP Hill near the elevated water tank. The dumping occurred over a 30-year period. Approximately a dozen empty barrels are visible in the face of the debris. It is estimated that the area contains in excess of 100,000 cubic yards of material. The dumping of construction rubble in this area was stopped in the early 1980s. The available information did not identify the source of the debris. There was no information pertaining to controls which may have existed in the early years of dumping to prevent wastes other than construction rubble from being disposed of at this location. In addition, no records

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were available concerning asbestos disposal practices prior to 1980. It does not appear that asbestos was segregated from other construction debris. Therefore, it is possible that this area contains asbestos among the rubble.

The area will be sampled in the sampling and analysis phase of the Survey to determine if runoff from the area contains radioactive or chemical contaminants (including asbestos).

5) Potential Surface Contamination at an Old Solvent Storage Area - Waste solvents may have been released to the soil from drums stored at an old solvent-storage area in the southern portion of the site (Site 4). The area was located on the west side of the now existing road between SM/PP Hill and the Building 21 area, just before the road bends to the west when going south from SM/PP. The site appears on a number of old aerial photographs of Mound and shows between 100 and 500 drums located to the north of the old firing range. Construction plans dated 1976 from the landfill label the area as a waste spoil site. New construction in the vicinity has removed features previously visible from the aerial photographs, and a visual inspection of the site did not reveal any drums or debris. There are no records to indicate the length of time in which solvents were stored or staged in the area, but the site appears on aerial photographs over a period of several years. The site had an estimated areal extent of 80 by 180 feet.

The water and sediments in ponded water areas and in runoff areas in the vicinity will be sampled. The samples will be analyzed to determine if the area is contaminated with organic, heavy metal, or radionuclide contaminants that may have resulted from the old solvent-storage area.

6) Disposal of Organic Solvents to Soils - Organic solvents and lithium carbonate was disposed of in an area that is now partially covered by Building 34 (Site 5) and may pose a threat to groundwater. The waste was dumped into a pool of stagnant water approximately 150 feet in diameter. It is not known if the waste was radioactively contaminated or if the material was disposed of.

Groundwater in the vicinity of the organic solvent and lithium carbonate disposal area will be tested to determine if the radionuclide or chemical contamination has reached the aquifer.

7) Elevated Radiation Readings at Off-Site Dirt Road - Elevated beta/gamma radiation readings were detected by Survey personnel off-site on a dirt road east of the Miami - Erie Canal. A walk-over detected radiation readings of 10-12 counts per minute in an area where typical background is 3-4 counts per minute. The road is approximately 1/2 mile long and extends southward from the recreation parking lot. Activity readings were encountered along the entire span of road walked. The Survey team was not able to determine the cause of the radioactive contamination. The dirt road appeared to be partially constructed of an ash material which may be fly ash from a coal-fired boiler. Coal fly ash typically contains a radioactive component due to the natural radioactivity in the native coal. It is not an uncommon practice to use fly ash as a part of road bed material.

The sampling and analysis portion of the Survey will collect two surface soil samples in an attempt to determine the potential cause for elevated radionuclide readings.

4.5.3.4 Category IV

1) Potential for Breach in Landfill Cover - Approximately a dozen pine trees 3 feet high and perhaps 5 years old were growing on top of the landfill in the loam covering the clay seal. Since the roots of these trees would eventually grow through the clay cap and might cause it to leak, this presented a Category IV problem. This situation was immediately corrected by Monsanto personnel during the Survey by cutting these trees down.

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APPENDIX A
SURVEY PARTICIPANTS

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MOUND SURVEY PARTICIPANTS
AUGUST 18-29, 1986

DOE

Team Leader	R. Aiken
Assistant Team Leader	J. Boda
Operations Office Representative	R. Peterson

TECHNICAL SPECIALISTS

Waste Management/Contractor Coordinator	P. Alexandro, NUS
Surface Water	C. Winklehaus, ICF
Air	H. Firstenberg, NUS J. Glissmeyer, PNL
Radiation	W. Joyce, NUS
Inactive Waste Sites	K. Walter, NUS
Hydrogeology	W. Murray, NUS
Quality Assurance/TSCA	P. Byrne, NUS

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APPENDIX B

ENVIRONMENTAL SURVEY PLAN

MOUND PLANT

AUGUST 18-29, 1986

MIAMISBURG, OHIO

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1.0 INTRODUCTION

The Environmental Survey is a one time baseline inventory of existing environmental problems and environmental risks at DOE operating facilities. It will be conducted in accordance with the principles and procedures contained in the Draft DOE Environmental Manual distributed on May 16, 1986.

The Environmental Survey is an internal management tool to aid the Secretary in identifying current and potential environmental problems in all of DOE's facilities and in prioritizing these problems for appropriate corrective actions.

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2.0 SURVEY IMPLEMENTATION

The Environmental Survey will be managed by the Team Leader, Richard Aiken and the Assistant Team Leader, Joseph Boda. Ronald Peterson will serve as the Albuquerque Operations Office representative on the Environmental Survey team. Technical support will be provided by the following NUS Corporation personnel:

Peter Alexandro	NUS Coordinator/RCRA and Solid Waste
Patrick Byrne	QA/TSCA
Charles Winklehaus	Surface Water
William Joyce	Radiation
Hank Firstenberg	Air
John Glissmeyer	Air/Radiation
Kevin Walter	CERCLA
William Murray	Hydrogeology

2.1 Pre-Survey Activities

Members of the Survey team began reviewing Mound environmental documentation available at the DOE Office of Environmental Audit and Compliance in May, 1986. From that review, a memorandum dated June 4, 1986, was sent to the Albuquerque Operations Office requesting additional information. Messers Aiken, Boda, Alexandro, and Ballou (Argonne National Laboratory) conducted a pre-Survey site visit on July 1-3, 1986, to become familiar with the site, to identify any potential environmental problems, and to coordinate plans for the upcoming Survey with DOE/DAO and Monsanto personnel. During the pre-Survey visit, the team met with representatives of DOE/DAO and Monsanto and officials of the U.S. EPA and State regulatory agencies. In addition, the team toured the facility and gathered documents assembled by site personnel in response to the information request memorandum. The bulk of the information being supplied in response to the June 4 memorandum was assembled by the CEARP team in Los Alamos National Laboratory. Messers Aiken, Boda, Walter and Murray traveled to the Albuquerque Operations Office and Los Alamos National Laboratory on July 16-18, 1986, to review the data available at these offices on the Mound Plant. Additional

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information was requested from Monsanto at the time based upon the review of the data being sent by Los Alamos. The information from Los Alamos was received in Washington on July 18, 1986. This Survey plan is based upon the information received by the Survey team as of the end of July 1986.

2.2 On-Site Activities and Reports

The Environmental Survey will be conducted from August 18 through August 29, 1986. The Agenda for this Survey is shown on the attached table. Modifications to this agenda will be made during the conduct of the Survey. All modifications will be coordinated with the site officials designated as Survey contacts. The on-site activities of the Survey team will consist of interviews and consultations with, among others, environmental, safety, operations, waste management, purchasing, and warehousing personnel; a review of files and documents unavailable prior to the on-site portion of the Survey; and process-specific and area-specific tours of the facility.

A closeout briefing will be conducted on Friday, August 29, to describe observations and initial conclusions of the on-site activities. A Draft Report of the Survey will be prepared within 3 to 4 weeks of the conclusion of the Survey. Subsequently, an Interim Report will be prepared by the Survey team within 4 weeks of the completion of sample analyses. The Interim Report will have the data from the sample analyses incorporated into the report. The findings from each of the reports from all scheduled Surveys will be updated as appropriate and included in the Final Report to the Secretary, DOE, which is scheduled for completion in 1988.

2.3 Sampling and Analysis

Based upon the results of the on-site portion of the Survey, the Survey team will identify any sampling needs. Sampling and analysis for the Mound Survey will be conducted by a team from the Argonne National Laboratory. Mr. Donald McCown will be the Argonne sampling and analysis team leader. The Argonne sampling team will draft a Sampling Plan based upon the sampling needs identified by the Survey team.

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The Assistant Team Leader, Joseph Boda, will coordinate the review of this Sampling Plan with the Albuquerque Operations Office and EPA's Laboratory at Las Vegas which has quality assurance responsibility for the Survey's sampling and analysis efforts. The sampling will start on October 13. The sampling will take between 3-5 weeks to complete. Analysis of the samples will be conducted by Argonne following protocols provided in the Survey Manual, supplemented by the Mound Sampling Plan. Results of the sampling and analysis will be transmitted to the Survey Team Leader for incorporation into the Interim Report.

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3.0 AIR

3.1 Issue Identification

The air-related Survey activities will involve an assessment of the nonradioactive air emission sources in the facility, the administrative and add-on emission control technology applied to the sources, the in-stack continuous emission monitoring systems, and the ambient air monitoring systems. The emphasis of the Survey will be on operational and procedural practices associated with the emission sources and the emission control equipment, fugitive source of emission, both within and outside the process buildings, and mitigative procedures applied to fugitive emission sources.

The general approach to the Survey will include a review of existing air permits, pending applications, standard operating procedures, the inspection of processes and control equipment, and the compliance with DOE ALARA requirements for radionuclide emissions. The Survey will also review the air contaminants from the different processes in the facility, evaluate the existing controls applied to the air contaminant emissions, and assess the need for additional monitoring or emission controls to characterize or reduce the environmental consequences of the emissions.

The ambient air monitoring system, including the meteorological monitorng system and the air quality monitoring network, will be evaluated to assess if the existing monitoring program is adequate to characterize environmental impacts of the air emissions from the facility. The activities involved in this part of the Survey will include the inspection of the meteorological tower and ambient air quality samplers, a review of documentation applicable to the ambient air data acquisition, and an evaluation of the processing procedures used to assure the accuracy of the data. The primary emphasis will be on assessment of the use of these data to characterize the environmental impacts of plant operations and the defensibility of the reported data.

The lack of pre-Survey information available on air emissions from the Mound Plant has hampered the development of a detailed Survey plan in this area.

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Therefore, it will be desirable to arrange a briefing early in the Survey on the processes, the air emissions from the processes, and the controls and monitoring of emissions points (stacks and vents).

Areas of particular interest will include process emissions of the criteria pollutants (e.g., radioactive-bearing particulates, sulfur oxides, nitrogen oxides, hydrocarbons, carbon monoxide and lead) as well as regulated hazardous air pollutants (e.g., beryllium, asbestos, and mercury). The powerhouse, incinerators, and the asbestos-filled DAP molding compound process area will be areas of interest. In addition, the use of organic solvents, lubricants, and coolants will be assessed as a potential or actual source of emissions to determine if they are adequately characterized, monitored, and controlled. A focus of the organic emissions assessment will be directed at those substances considered to be hazardous or toxic air contaminants.

Fugitive emissions, both from processes and resuspension of contaminated soils, will be evaluated as a potential means of the airborne release of radionuclides and hazardous materials from the facility. Consideration will be given to historical and current operations to determine the potential for soils contamination and windborne releases.

3.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant:

- Air permits (Registrations, Installation, and Operation);
- Source and emissions inventories;
- Stack emission test data, emission calculations, etc.;
- Descriptive documentation on add-on emission controls;
- Standard operating procedures for process and control equipment;
- Correspondence between regulatory agencies relative to air issues;
- Reports on accidental releases of airborne substances;
- Ambient air monitorng program procedures relative to:
  - duty observer functions,
  - calibration procedures and records,

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- laboratory procedures and quality assurance,
- ambient air monitoring data, and
- application of ambient air monitoring data for impact assessments;

o Other records as determined on-site.

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4.0 RADIATION

4.1 Issue Identification

The radioactive Survey will involve an assessment of the facility-wide radioactive emissions, emissions control and monitoring, and the associated impact on the environment. The assessment will include discharges to the atmosphere, surface water, groundwater, soils and off-site disposal. The assessment will be conducted on a program-by-program basis including:

- Surveillance of weapon components contaminating radioactive materials;
- R&D of nuclear weapons components;
- Stable isotope;
- Safeguards of nuclear materials by use. of nuclear material measurements and control;
- Fabrication, radioactive module assembly, RTG assembly and testing;
- Recovery and purification of tritium;
- Procurement of ordnance materials for weapons;
- Research in separations technology.

The assessment will be based upon observations of programatic processes, operations, effluent control and monitoring equipment, and waste disposal along with discussions with operational and supervisory personnel. Operational reports, incidental reports, records and other data associated with continuous intermittent and any accidental releases will be reviewed. Also examined will be the radioactive dose assessment methodologies and biological pathway assessments. Of particular importance will be the potential of radioactive releases via unmonitored release pathways to the environment.

As assessment of the potential for health and environmental effects of the existing 19 areas of radioactive contamination identified in the Mound Site Development and Facility Utilization Master Plan wil be performed in addition to the Miami-Erie Canal, the tritium groundwater contamination, and the natural storm water

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runoff drainage ditch. The facility wide radiological Survey will be examined to identify additional contaminated areas and for validity of the analytical results.

The environmental monitorng program will be reviewed using both observation of monitoring stations, sample collection and analysis and review of prior annual reports and other DOE reporting requirements.

The radiological Survey will be coordinated with the air, water, solid waste, CERCLA and hydrogeology Surveys.

4.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant:

- Radionuclide environmental monitoring data (atmospheric, groundwater, surface water, soil, vegetation);
- Radionuclide effluent monitorng system design and monitoring data;
- Radiological accident reports and data;
- Laboratory procedures and analytical methods;
- Dose assessment methodologies;
- Plot plans with monitoring locations;
- Radiological food pathway assessment strategies;
- Other records as determined on-site.

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5.0 SURFACE WATER/DRINKING WATER

5.1 Surface Water/Drinking Water

5.1 Issue Identification

Because of the extensive history of the Mound Plant covering 40 years and the frequent expansions of the facilities on a compact site, the water and sewage systems have been severely taxed. The handling of some high and low level radioactive wastes in the sewage collections and treatment systems gives added importance to the integrity and efficient functioning of these systems. Recognizing this, a Survey of the sanitary and storm (including process) wastewater collection systems was conducted in 1983, including an internal inspection of many of the pipes with a closed-circuit TV camera. A program of repairs has been included in the FY 1988 budget request. This request also includes a proposal to remove certain non-contact cooling water flows from the storm water system and thereby improve the performance of the latter system and allow it to meet its NPDES requirements more consistently.

A review of the present condition of these wastewater collection and treatment systems will be made as part of this Survey. Mound process activities that generate wastewaters will be reviewed through a detailed process tour lasting several days. Discrete process liquid discharge points will be identified and evaluated to develop an inventory of wastewater sources. Liquid waste treatment, process, collection and handling equipment will be examined and records of operations will be reviewed. The objective of the review is to build a Survey information base for the identification of physical evidence of existing or potential environmental contamination.

The water and hazardous waste Surveys will be performed in unison for most buildings and activities due to a common need to review processes and waste discharge points. Buildings M, P, PS, W, G, GW, and 40 will be examined early the first week to view normal activities including maintenance activities generating process wastewaters and other liquid wastes such as hazardous degreasing solvent wastes in the garage. In addition, a record review session will be scheduled early in

the week to review drawings and materials pertaining to wastewater and stormwater treatment operation and maintenance. The record review will include viewing videotapes of the television Survey of the collection system. The first week will end with the completion of the detailed process tour of buildings in the northern portion of the Mound site. A major focus will be the examination of the effluent removal systems in the SW building.

The second week of the Survey will review wastewater-related activities in the plutonium processing areas and facilities in the southern portion of the site. Particular emphasis will be placed on the stormwater retention pond operation and new wastewater facilities and activities in the vicinity.

Extensive reviews will also be made of possible undetected sources of contaminants flowing to the storm and sanitary sewage systems. This will require review of most plant production schematic drawings, visits to the respective areas around production facilities and a thorough tour of plant buildings, yard areas, and grounds, particularly areas where the ground surface is or was known to be contaminated.

Other information sources and visitation points that will be examined are:

- NPDES permit requirements and treatment plant performance and/or effluent quality information; this will include observation of sample collection and analysis techniques used for the monitoring required by the NPDES permit;

- Residuals (sludge and sediment) disposal from the wastewater treatment plants, including the stormwater retention pond (both the technical and the administrative aspects);

- Spill protection provisions for fuels and hazardous materials storage units, including review of the SPCC Plan and of such physical controls as tank containment dikes and runon/runoff drainage control for potential contaminants;

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- Water quality information concerning raw and treated domestic and process waters, with particular attention to such parameters as tritium, trihalomethanes, coliforms, chlorine residuals, and asbestos fibers;

- Basic design parameter information such as storm runoff coefficients and tributary population to the sanitary wastewater treatment plant.

5.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant:

- Detailed drawings of the process, storm, and sanitary sewer systems and the domestic and process water systems both within buildings and in yard areas;

- Reports and films of the 1983 inspections of the plant sewer systems;

- Detailed drawings of the radioactive, storm, and sanitary wastewater treatment units;

- Detailed drawings of the domestic and process water supply treatment, storage, and distribution systems;

- Additional schematic diagrams and/or descriptions of all production processes;

- Spill Prevention, Control, and Countermeasure (SPCC) Plan on the site, covering all fuel and hazardous material storage units;

- Analytical data used for preparation of the NPDES monitoring reports;

- NPDES discharge monitoring reports and violation reduction studies;

- Records of drinking water quality both on and off-site;

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- Operators log books and reports for treatment plant operations;
- Sampling log books and laboratory tracking reports;
- Treatment plant and monitoring equipment maintenance records and/or logs;
- Progress reports and/or final reports for n-going R & D studies of wastewater control and treatment options;
- Internal memos and correspondence relating to surface water/drinking water problems;
- Applicable water quality standards for the Great Miami River;
- Other records as determined on-site.

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6.0 HAZARDOUS/RADIOACTIVE SOLID WASTES

6.1 Issue Identification

The procedure for solid/hazardous/radioactive waste Survey is to review known sources or activities and identify any additional sources or activities which have the potential to result in contamination of environmental media.

The waste portion of the Survey will concentrate on those facilities mentioned in Mound Part A RCRA notification. Specifically, the hazardous waste storage facility, the develomental cyclone incinerator, the glass melter, and the explosive waste treatment areas will be examined. In addition, the team will devote a significant portion of the time on-site to a detailed process-by-process investigation of hazardous or mixed waste generation, treatment, storage, and release points.

Hazardous wastes which have been identified in existing documentation (e.g., acetone, mercury compounds, spent plating solutions) will be tracked through the system and waste-related site activities and records reviewed to develop an inventory of Mound waste management practices.

The review of radioactive and non-hazardous solid waste will proceed similar to that for hazardous wastes. Known waste streams and activities such as the WD facility, tritium treatment processes, waste solidification processes for both alpha and beta wastes, waste compactors, waste incinerators, and waste certification processes will be the focus of the Survey. The detailed process tour described above will gather information on radioactive and non-hazardous solid wastes to delineate any previously unidentified sources of waste that have the potential to result in environmental contamination.

Discussions will be held with individuals knowledgeable of current and past waste management practices. This will be accomplished during the process tour, and in the process of reviewing facility records and documentation. The objective is to develop an understanding of past and existing waste management activities that may serve as the basis for problem identification by the Survey team.

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Existing documentation indicates fluctuations in tritium levels in groundwater. The review of solid/hazardous/radioactive waste will be coordinated with the CERCLA and hydrologic Surveys to identify any possible releases that may pose a threat to the environment.

6.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be reviewed at the Mound Plant:

- Waste analysis plans;
- Inspection documentation, (state and federal);
- Groundwater monitoring, sampling, and analytical documentation;
- Any release notification or occurrence documentation;
- Waste inventory documentation;
- Any enforcement action documentation;
- Groundwater monitoring system construction documentation;
- Internal facility inspection documentation;
- Additional RCRA manifests;
- Correspondence with regulatory agencies on solid waste;
- Records dealing with the reuse/recycling of wastes;
- Other records as determined on-site.

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7.0 HYDROGEOLOGY

7.1 Issue Identification

The preliminary review of the data available on the Mound Plant indicates that a large number of studies have been conducted to assess groundwater conditions. In addition, it is apparent that groundwater sampling is a regular part of the environmental monitoring conducted at the site. A substantial portion of these efforts have been directed towards known contamination resulting from historic releases of tritium and from the release of plutonium from a ruptured pipe in 1969.

This Survey effort will focus on a number of issues including evaluation of previous studies of known contamination problems, assessment of the adequacy of monitoring for both radiological and nonradiological contaminants, and a review of available information on the hydrogeology of the site and the surrounding area.

The tritium levels in the aquifer have been monitored since the mid-1970's and a remediation pumping program has been in operation since 1976. The objective of this remediation method is to reduce tritium levels in the aquifer to meet EPA standards. However, from the information received, it appears that pumping is continuing on an intermittent basis to maintain compliance. Therefore, this portion of the Survey will focus on determining if a continuing source of tritium exists. The hydrogeologic findings on this subject will be coordinated with those of the CERCLA, radiation, air, and surface water specialists to better understand this issue.

The plutonium release of 1969 has resulted in low levels of plutonium adsorbed on the sediments in the Miami-Erie Canal. Previous studies indicate that the plutonium is immobilized in the sediments and is not entering the groundwater. Given the continuing concern on this subject, the Survey will include inspections of the canal area and review of related studies with a view towards determining the potential for mobility. Other areas that will be reviewed during the Survey include the property to the south of the Mound Plant which was acquired in 1982 and the landfill area near the overflow pond. The information available to the Survey team prior to the on-site portion of the Survey did not provide sufficient information on

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the monitoring wells on the site in general. In addition, little analytical results were available to the Survey team from the monitoring program, particularly for nonradiological parameters.

In terms of the site hydrogeology, the Survey will focus on providing further definition in two areas. The first area is the extent and thickness of a confining clay layer in the Buried Valley Aquifer which divides the aquifer into two separate zones. This cannot be determined from data presently available to the Survey team. The second area is the potential for transport of contaminants with perched water traveling through the glacial till and limestone on the site.

7.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant:

- CEARP Phase II Generic and Installation Generic Work Plans;
- Weston Sampling Plan;
- Historic air photos (2 per year);
- Wells installation reports, boring logs;
- Maps of monitoring wells, domestic wells, etc. - material on loan to Weston;
- Well Sampling procedure, schedule;
- Monitoring parameters, data and results;
- Groundwater sampling QA/QC and lab procedures;
- Radiological Characterization Data;
- Other records as determined on-site.

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8.0 INACTIVE WASTE SITES/RELEASES (CERCLA)

8.1 Issue Identification

The objective of this portion of the Survey will be to identify and summarize environmental problems at or emanating from the Mound Plant which are caused by the following historical activities concerning hazardous wastes or mixed radioactive and hazardous wastes:

- o Past waste disposal areas on-site that have been identified;
- o Areas on-site where past undocumented disposal may have occurred;
- o Areas on-site where leaks, spills, or inadvertent disposal may have created ongoing sources of contamination or traceable plumes of surface or subsurface contamination. This will include a review of the status of underground tanks.

This effort will also include a review of existing documentation concerning several off-site areas that were used during the period of 1942 through 1948. Based on the review of data available to the team prior to the on-site portion of the Survey, it is apparent that a great deal is known and documented about buried hazardous and mixed waste. Areas identified as having received waste materials include lettered areas A through J, as enumerated in the Phase I report of The Comprehensive Environmental Assessment and Response Program (CEARP), and radiological areas 1 through 19, as listed in The Environmental Impact Statement and Waste Management Reports. Although all of these areas will be reviewed in the field and office, areas that will be the subject of the most detailed review include; Area B - overflow pond landfill, Area J - building demolition site, Area I (two locations) - high explosive & acetone disposal, and Area C - lithium carbonate disposal. The CERCLA portion of the Survey, since it relates to past handling, as well as disposal of hazardous and mixed chemicals/waste, will be highly coordinated with the RCRA, toxics, and radiological portions. To a lesser extent, the water portion of the Survey will be included in this coordination to check for storm and surface drainage or unknown/unpermited subsurface disposal of water that may form a

migration pathway for one of the sources of hazardous or mixed waste described above. Lastly, since subsurface water is the primary mode of migration for buried wastes, the CERCLA portion of the Survey will of course be coordinated with the groundwater portion.

8.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant (the publication numbers, where shown, are those that have been assigned by the Albuquerque operations/Los Alamos staff).

- #84-80 and #84-81, test borings and aerial Survey;
- Personnel interviews taken during the CEARP;
- Historic aerial photos of areas B, C, I and J;
- Site Survey draft report;
- #84-87 overflow pond/site landfill plans;
- #84-114, potential sources of groundwater contamination;
- #84-115, #84-119, #84,120, groundwater sampling well drawings;
- Phase II Work Plan - CEARP;
- Notifications and internal records of spills/releases;
- #84-123 site topography drawings;
- Records of facility expansion and building destruction;
- Technical manual MD-70180 waste disposal;
- Subsurface tank plans;
- Historical local files on waste handling/disposal;
- Other records as determined on-site.

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9.0 TOXIC SUBSTANCES AND QUALITY ASSURANCE

9.1 Issue Identification

The toxic Survey will include all raw materials and process-related chemicals used on the Mound site. Use, handling, and disposal of polychlorinated biphenyls (PCBs), asbestos, pesticides, and hazardous substances will be within the scope of this effort.

All toxic and hazardous substances purchased, used, or manufactured on the site will be evaluated. Tracking, control, and management of these substances will be reviewed. Records of usage will be evaluated to determine the potential for entering effluent streams.

The inventory of PCB and PCB contaminated electrical equipment in use at the facility will be reviewed for completeness. The condition of this equipment, its potential for leakage, and the quantity of contaminated fluids will be identified during inspection of building P. Obsolete or used PCB contaminated items in storage at facility 90 will be inspected for proper container/packaging, adequate storage protection requirements, and inventory controls. Disposal practices will be reviewed for current and past inventories to determine the method of disposal and location of disposal sites. Procedures for PCB analysis, removal, handling, and disposal will be reviewed. Inspection and reporting requirements for PCB transformers will be evaluated in an effort to focus the Survey teams attention as potential problem areas.

The use of asbestos at Mound as insulation or in processes will be reviewed to identify pathways of contamination. Also, asbestos removal and disposal practices will be evaluated, and disposal sites visited, to define potential areas of concern.

Pesticides usage on the site will be reviewed including application records, storage and disposal practices, and environmental monitoring to assess risk for environmental contamination.

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Other hazardous materials which are identified in 40 CFR 302 are used throughout the facility and include solvents used in the print shop, PS and maintenance shop, facility M. Also, asbestos filler which is regulated under TSCA in facility 29, and other regulated materials, will be evaluated for sources of potential releases to the environment.

The quality assurance Survey of the environmental program will be primarily an evaluation of the site sampling and analytical capabilities at Mound. The intent will be to verify and review the quality assurance procedures for obtaining process/effluent and environmental samples, performing the analytical work to identify the concentration of pollutants, and the handling and reporting of data. All aspects of the quality assurance program relating to environmental management of the Mound site will be reivewed, including operator training, equipment and instrument calibration/maintenance, precision and accuracy studies, blank, split, and spike sample analyses, sample handling and chain of custody procedures, data reduction and validation, data reporting and documentation, and calculation and logbook reviews.

The procedures for sampling and analysis will be monitored to ensure proper implementation and conformance to regulatory agency requirements. Quality assurance plans will be reviewed for the sampling and analytical activities, as well as any internal QA audits that have been completed.

The QA programs currently in force in the Mound Laboratories will be evluated. QA procedures imposed on any outside sampling or analytical laboratories will also be reviewed in this study effort.

9.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant.

- Toxic substances labeling and tracking system;
- Procedures for handling, control, and management of toxic substances;
- Inventory of toxic substances and purchasing records of chemical substances;

- PCB annual inventory documents (1978 to 1985);
- Inventory of current PCB-contaminated electrical equipment;
- Records of inspections of PCB transformers (1981 to present);
- Storage records of PCB items;
- Disposal records for PCB items;
- PCB handling, storage, and disposal procedures;
- Correspondence with fire department on PCB transformers;
- Locations of buildings containing asbestos, including usage;
- Asbestos disposal records, including method and location of disposal;
- Asbestos handling, removal, disposal procedures, and environmental monitoring;
- Records of asbestos use in process equipment and support facilities;
- Pesticide training, handling, storage, disposal records, and environmental monitoring;
- Standard operating procedures for pesticides;
- Analytical laboratory and environmental sampling quality assurance plans;
- QA audits of laboratory and sampling program;
- QA reports for the Mound laboratories;
- Laboratory and sampling procedures manuals;
- QA results for prepared and analytical samples;
- Operator training records (laboratory and sampling);
- Instrument maintenance and calibration records (laboratory and sampling);
- Laboratory and sampling calculations and workbooks;
- Precision and accuracy studies;
- Other records as determined on-site.

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10.0 SAMPLING AND ANALYSIS

10.1 Issue Identification

The four representatives of the Sampling and Analysis Team will be on site during the second week of the Survey to ensure that the sampling effort will fully achieve the desired objectives. The objectives of the visit are to obtain a familiarity with the site, identify the security implications associated with the sampling portion of the Survey, identify the health and safety concerns for the sampling team, and discuss logistical arrangements. At points, the sampling representative will be split into two teams: one to focus on the team management concerns and the other on health and safety issues.

10.2 Records Required

The Argonne personnel have no records review requirements.

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APPENDIX C
SITE-SPECIFIC SURVEY ACTIVITIES

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All on-site activities were conducted in accordance with the Survey Plan, modified as appropriate during the survey. The actual daily activities as conducted by the survey team are included herein.

In addition, the organizations that will be conducting the sampling and analysis of the Mound Plant are not the same as those identified in the Survey Plan. Planning is now underway with the Battelle Corporation to do the field sampling and with the Oak Ridge Gaseous Diffusion Laboratory (K-25) to perform the analyses.

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TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

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							SAMPLING & ANALYSIS	
AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	TEAM MGMT	HEALTH SAFETY
Monday - 8/18								
9:00 am	Introductions							
10:00 am	Mound Site History							
10:30 am	Security Briefing							
11:00 am	Health and Safety Briefing							
12:30 pm	Orientation Tour							
2:30 pm	Process Descriptions/Fit Tests							
Tuesday - 8/19								
am								
pm Air Emission Points Briefing/ Records Review	Rad Survey Data Review	Process & Equipment Evaluation of M,P,PS,W G,GW,40	Same as Water	Field Review of New Property w/MRC-Env Personnel	Field Review of New Property, w/MRC Env Personnel	Records Review, Purchasing E&H		
Wednesday - 8/20								
am	Process & Equipment Evaluation of WD	Same as Air	Process & Equipment Evaluation of PS,W,G,GW,4 0	Same as Water	Field Review of Canal & Park Areas	Same as GW	Evaluation of Equipment at A,B,E,DS M,P,T	

TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

	AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	SAMPLING & ANALYSIS: TEAM MGMT	SAMPLING & ANALYSIS: HEALTH SAFETY
pm	Process & Equipment Evaluation of SW, T, H, I, P	Same as Air	View Tapes of Collector System	Records Review (continued)	Field Review of On Site Potential Sources (continued)	Field Review of Rad Soil Survey Sites 1-19	Evaluation of Equipment at TF,5,29,38,50, Open Storage Areas		
Thursday - 8/21									
am	Process & Equipment Evaluation of M,PS Continued review of SW	Same as Air w/o PS	Process & Equipment Evaluation of B,28,PS	Same as Water	Observe Sampling and Well Measurement	Continue Field review of Rad Soil Survey Areas	Records Review		
pm	Process & Equipment Evaluation of 28, 60,51 hh,e,ds	Process & Equipment Evaluation of R,HH,68	Process & Equipment Evaluation of SW,R	Same as Water	Field Review of Water Supply Wells	Records Review	Evaluation of 29, Landfill areas		
Friday - 8/22									
am	Process & Equipment Evaluation HH, R,DS,I	Same as Air	Process & Equipment Evaluation of I, 48	Same as Water	Observe Lab Procedures	MRC Personnel Interviews	Revisits & Reviews 23,71,73		

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TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

	AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	SAMPLING & ANALYSIS TEAM MGMT	SAMPLING & ANALYSIS HEALTH SAFETY
pm	Meet with HVAC & Record Review	Same As Air	Process & Equipment Evaluation of WD,HH,23	Same as water.	Observe Lab Procedures (continued)	Field Review of Outside of Buildings (Main Hill)	Revisits & Reviews		
Monday - 8/25									
am	Process & Equiopment Evaluation of Plutonium Process Area	Same as air	Process & Equipment Evaluation of HH,57, Field Review of Ponds	Records Review	Records Review	Field & Documentation Review of Buried Tanks	Environmental Labs QA/Procedures		
pm	Process & Equipment Evaluation of Plutonium Process Area (continued)	Tritium discussion with Mound personnel	Same as Rad	Process & equipment Evaluation of 53,90,13,14, Records Review	Same as Rad	Same as Rad	Evaluation of Organic Analysis Procedures		

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TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

	AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	SAMPLING & ANALYSIS: TEAM MGMT	SAMPLING & ANALYSIS: HEALTH SAFETY
am	Process & Equipment Evaluation of 21, fire pit, lead meltor	Evaluation of 19 Soil Study Areas	Process & Equipment Evaluation of 49-87 Complex, 27	Same as Water	Record Review of Tritium Issue	Revisit w/Rad, Document, Review & Coordination	Purchasing Records & Lab QA	Introduction & Site Familiarizatio n w/o Ballou) Ballou-Accompany Survey Team	
pm	Process & Equipment Evaluation of 49-87 Complex	Field Review of Canal & Tritium Locations	Process & Equipment evaluation of P Parea	Same as water	Inspection of tanks in Bldg 34 area	Inspection of Tanks	Evaluation of Inorganic Analysis Procedures	Same as Rad	Health & Safety Personnel Meetings
Wednesday - 8/27									
am	Evaluation of Meteorological & Air Quality Stations, Observe Sampling Procedures	Revisits to WD,R,SW	Record Review	Solvent Pick-up run, 1	Revisits P, onsite areas	Follow-up buried tank A	Evaluation of Rad Analysis Procedures	Ballou/w Survey Team, S&A Team Leader-MRC Personnel Logistics	Same as Rad
pm	Observe sampling procedures, followup bldg. 29,51	Followup bldg. 51	Record Review	Followup, Bldg. 72,WD	Revisits	Notes, Review & Coordination	Record Review	With Asst. Team Leader-Sample Protocols	Health & Safety Personnel Meetings

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TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

	AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	SAMPLING & ANALYSIS: TEAM MGMT	SAMPLING & ANALYSIS: HEALTH SAFETY
Thursday - 8/28									
am	Process & Equipment Evaluation of G,GW,W	Record Review	Observe Sampling Data Review	Revisits WD & Waste Mgmt Personnel	Record Review	Record Review, Final Reinspection	Reviews and Rechecks with Waste Management Personnel	Revisits	Visit Sample Sites
pm	Review and Recheck	31,HH,23	Observe Sampling Procedures	Document Review & Revisits	Sampling Needs Development	Sampling Needs Development	Revisits	Attend Outbriefing Sites	Visit Sample
		Close Out Briefings with Team Leader and Assistant Team Leader							
Friday - 8/29									
am		Revisits and Rechecks							
pm		Outbriefing							

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APPENDIX D
MOUND FACILITY SOURCE EMISSION INVENTORY
VENTILATION HOODS

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Mound Plant Source Emission Inventory

Nomenclature List

ACET	Acetone
ACOH	Diacetone alcohol
ALC	Organic alcohols
ETOH	Ethyl Alcohol
MEOH	Methyl Alcohol
IPOH	Isopropyl Alcohol
1,1,1-TCE	1,1,1-Trichloroethane
TCE	Trichloroethylene
CCl_4	Carbon tetrachloride
CH_2Cl_2	Methylene chloride
CS_2	Carbon disulfide
DAP	Diallyl phthalate
H_2	Hydrogen gas
D_2	Deuterium (^2H) gas
T_2	Tritium (^3H) gas
HTO	Tritiated water
HF	Hydrofluoric acid
HCl	Hydrochloric acid
$HClO_4$	Perchloric acid
H_2SO_4	Sulfuric acid
HNO_3	Nitric acid
NaOH	Sodium hydroxide
NH_3	Ammonia
NH_4OH	Ammonium hydroxide
MEK	Methylethyl ketone

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
02-EF-01	02-104 -1	150	None	Explosive gases
03-EF-01	03-312 -1		None	ACET,ETOH
03-EF-02	03-316 -1		None	ACET,ETOH, Paint fumes,
03-EF-03	03-338 -1 03-338 -2 03-338 -3 03-338 -4	300	None	Explosive gases
03-EF-04	03-337 -1	520	None	Epoxy fumes
03-EF-05	03-328A-1	150	None	Explosive gases
26-EF-01	26-001 -1 26-001 -2 26-001 -3		None	Solder fumes,Oils, Metal vapors
27-EF-01	27-012 -1	650	None	ACET,ETOH,CH_2Cl_2, Toluene
28-EF-02	28-104A-1 28-104A-2 28-104A-3 28-105 -1	5,000	None	ACET,MEOH,IPOH, CH_2Cl_2,Bonding materials,Dust, Cutting oils
28-EF-06	28-005 -1	2,040	None	ACET,MEOH,IPOH CH_2Cl_2
28-EF-10	28-103 -3	1,000	None	ACET,MEOH,CH_2Cl_2
28-EF-11	28-103 -2	2,445	None	HCl,HF,H_2SO_4
28-EF-13	28-112 -2	1,250	None	HCl,HF,H_2SO_4

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
28-EF-18	28-108 -1 28-112 -1 28-112 -3	1,250	None	ACET,MEOH,ETOH,IPOH, CH_2Cl_2
28-EF-19	28-103 -1 28-108 -2	1,520	None	HCl,HF,H_2SO_4,ACET, IPOH
29-EF-03	29-005 -1 29-008 -1 29-008 -2 29-011 -1 29-013 -1 29-013 -2 29-013 -3 29-013 -4	18,890	HEPA Filter	ACET,Asbestos,DAP
29-DC-01	29-008 -3		Bag House	Asbestos,DAP
30-EF-01	30-001 -1		None	Metal vapors
36-EF-01	36-002 -1	350	None	ACET,ALC,Freon
36-EF-02	36-002 -2	825	None	MEOH
36-EF-03	36-003 -1	1,500	None	CH_2Cl_2
37-EF-01	37-004 -1 37-004 -2 37-004 -3 37-004 -4	3,500	Scrubber	Cyclohexane,HF,ACET, ALC,IPOH,CH_2Cl_2,H_2, Epoxy,Mineral oil,

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
SM/PP Stack	38-005A-1	32,000	Acid Scrubber + HEPA Filter	NaOH
	38-106 -1 38-111 -1 38-111 -2 38-113 -1 38-113 -2 38-113 -3 38-113 -4 38-113 -5		HEPA Filter	Radioactive vapors and particles, Acid fumes, ACET, IPOH
40-EF-02	40-005 -1	150	None	Developing fluids
40-EF-03	40-007 -1	390	None	Press cleaning fluids
42-EF-01	42-105 -1	340	None	ACET, ETOH, CH_2Cl_2
42-CHF-01	42-101A-1	4,500	None	MEOH, ETOH, CH_2Cl_2 Toluene, Chloro. Dimethyl., HYLSUL
42-CHF-02	42-108 -1	2,400	None	ACET, ETOH, CH_2Cl_2
42-CHF-03	42-109 -1	1,400	None	ACET, ETOH, CH_2Cl_2, Ether
43-EF-01	43-001 -1	600	None	Burnoff thermite materials
46-EF-05	46-001 -1 46-001 -2	130	None	Metal and Ceramic particles, HNO_3 and H_2SO_4 fumes

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
48-EF-03	48-205 -1	3,795	None	ACET,ALC, Ethyl Acetate
49-HF-01	49-107 -1	5,250	None	ACET,ALC,MEK, Solder fumes
	49-107 -2			
	49-107 -3			
	49-107 -4			
	49-107 -5			
	49-107 -6			
	49-107 -7			
49-HF-02	49-103 -1	3,600	None	ACET,MEK
49-HF-03	49-104 -1	1,850	None	ACET,ALC
49-HF-09	49-101 -1	1,035	None	ACET,ALC
	49-101 -2			
49-EF-01	49-124 -1	970	None	ACET,ALC
	49-124 -2			
	49-124 -6			
49-EF-02	49-124 -3	970	None	ACET,ALC, Solder fumes
	49-124 -4			
	49-124 -5			
49-EF-03	49-110 -3	1,350	None	ACET,ALC, Solder fumes
	49-110 -4			
	49-110 -5			
	49-110 -6			
49-EF-04	49-110 -1	970	None	ACET,ALC,1,1,1-TCE, Solder fumes
	49-110 -2			
51-EF-01	51-001 -1	700	None	ACET,IPA,MEOH
51-EF-02	51-001 -2	3,440	Spray Booth	Metal vapors

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
60-EF-01	60-001 -1 60-003 -1 60-106 -1 60-106 -2	4,050	None	ACET,ALC,CH_2Cl_2, Grinding oils
60-EF-02	60-101 -1	675	None	ACET,H_2SO_4
60-EF-03	60-101 -2	675	Scrubber	HF
63-EF-01	63-009 -1	2,000	None	Explosive powders
92-EF- A	92-001 -1 92-001 -2 92-001 -3	-	None	IPOH,Bonding materials,Solder fumes
A-EF-02	A-172 -1	-	None	ALC
-	B-105 -1	(Recirculated to room)		
-	B-105 -2	(Recirculated to room)		
-	B-105 -3	(Recirculated to room)		
-	B-105 -4	(Recirculated to room)		
B-EF-01	B-105B-1 B-105B-2 B-105B-3 B-112 -1 B-122 -1 B-122 -2 B-122 -3 B-126 -1 B-126 -2 B-126 -3 B-126 -4	4,810	None	ACET,ETOH,MEOH,IPOH, DAP,HNO_3,H_2SO_4, Freon,Solder fumes

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
B-EF-01	B-126 -5	4,810	None	ACET,ETOH,MEOH,IPOH, DAP,HNO_3,H_2SO_4, Freon,Solder fumes
	B-140 -1			
	B-140 -2			
	B-140 -3			
	B-140 -4			
	B-141 -1			
	B-141 -2			
	B-141 -3			
	B-141 -4			
	B-141 -5			
	B-141 -6			
B-EF-1A	B-153 -1	460	None	ACET,ETOH
B-EF-03	B-136 -1	3,280	None	ACET,IPOH,CH_2Cl_2, TCE,Toluene, 1,1,1-TCE,
B-EF- A	B-167 -1			
	B-167 -2			
	B-170 -1			
B-EF- B	B-165 -1	5,500	None	ACET,ETOH,IPOH, Bonding materials, Solder fumes
	B-165 -2			
	B-165 -3			
B-EF- C	B-164 -1	2,000	None	ACET,ETOH,IPOH, Toluene
	B-164 -2			
B-EF- D	B-154 -1	1,000	None	ETOH,Solvents
B-EF- E	B-157 -1	2,760	None	ACET,ETOH, Solder fumes
	B-157 -2			
	B-157 -3			
	B-157 -4			
DS-EF- 1	DS-125 -1	6,625	None	ACET,ETOH,CH_2Cl_2, 1,1,1-TCE,Freon, Bonding materials, Solder fumes
	DS-125 -2			
	DS-125B-1			
	DS-125B-2			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
DS-EF- 1	DS-125B-3 DS-125B-4 DS-125B-5 DS-127 -1 DS-127 -2 DS-127 -3 DS-127 -4	6,625	None	ACET,ETOH,CH_2Cl_2, 1,1,1-TCE,Freon, Bonding materials, Solder fumes
DS-EF- 3	DS-251 -1 DS-251 -2	745	None	ACET,IPOH, Freon,
DS-EF- 4	DS-245 -1	1,250	None	ACET,ALC,Xylene
DS-EF- 9	DS-214 -1 DS-217 -1 DS-222 -1 DS-222 -2 DS-223 -1	-	None	ACET,ALC, Bonding materials
DS-EF-13	DS-118 -1 DS-118 -2	1,700	None	ACET,ETOH,CH_2Cl_2, Bonding materials
DS-EF-19	DS-124 -1	1,525	None	ACET,ALC,HCl
DS-EF-25	DS-218C-1 DS-226 -1 DS-226 -2 DS-226 -3	5,280	None	ACET,ETOH,MEOH,IPOH, CS_2,Freon
DS-EF-26	DS-130 -1 DS-132 -1 DS-133 -1 DS-135 -1	3,030	None	ACET,ALC,Freon, Paint, Solder and Oil fumes
DS-EF-27	DS-131 -1	1,080	None	ACET,ALC,Toluene, 1,1,1-TCE,CCl_4
DS-S-PRV	DS-109B-1	530	None	ALC

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
E-EF- A	E-101 -1 E-101 -2	990	None	HF,ACOH,CCl_4
E-EF- B	E-103 -1	800	None	ACET,ETOH
E-EF- C	E-112 -1 E-112 -2	525	None	ACET,ETOH,MEOH,Ether CH_2Cl_2,HF,HCl
E-EF- D	E-113 -1 E-113 -2 E-113 -3 E-113 -4	2,280	None	ACET,ETOH,NaOH,HCl, HNO_3,H_2SO_4
E-EF- E	E-107 -1 E-107 -2	1,450	None	NH_3,HNO_3,H_2SO_4
Unknown	E-119 -1	-	-	ACET,IPOH,CH_2Cl_2
E-EF- F	E-120 -1 E-120 -2	1,205	None	ACET,ETOH,CH_2Cl_2
E-EF- G	E-123 -6	480	None	ETOH,IPOH, Bonding materials
E-EF- H	E-123 -1 E-123 -2 E-123 -5 E-123 -7 E-123 -8	2,630 (Out of Service)	None	ACET,ETOH,IPOH, Bonding material, Solder fumes,Epoxy
E-EF- I	E-130 -1 E-130 -2	1,500	None	ACET,ETOH,CH_2Cl_2
E-EF- J	E-123 -3 E-123 -4 E-123 -9	1,400	None	ETOH,Bonding materials,Solder fumes
E-EF- K	E-130 -3 E-130 -4	730	None	Solder fumes
E-EF- L	E-157 -2	600	None	MEOH,HCl,HNO_3, CH_2Cl_2, H_2SO_4

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
E-EF- M	E-157 -1	750	None	MEOH, HCl, HNO_3, CH_2Cl_2, H_2SO_4
E-EF- N	E-158 -1	2,800	None	ACET, ETOH, CH_2Cl_2
	E-158 -2			
	E-158 -3			
	E-158 -4			
	E-167 -1			
E-EF- O	E-174 -1	1,200	None	ACET, ETOH, HF, HNO_3, H_2SO_4, ACOH, Lactic acid, Glyerol
	E-174 -2			
E-EF- P	E-174 -3	750	None	$HClO_4$
E-EF- Q	E-176 -1	1,200	None	Metal particles
	E-176 -2			
E-EF- R	E-187 -1	600	None	Oil vapors
E-EF-1C	E-141 -1	16,000	None	HCl, HNO_3, H_2SO_4
	E-142 -1			
	E-142 -2			
	E-142 -3			
	E-143 -1			
	E-143 -2			
	E-144 -1			
	E-144 -2			
	E-150 -1			
	E-156 -1			
	E-156 -2			
H-EF-01	H-103 -1	7,700	None	ACET, ALC, CH_2Cl_2, Acetonitrile, Benzonitrile, HCl, HNO_3, H_2SO_4
	H-103 -3			
	H-104 -1			
	H-106 -1			
	H-106 -2			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
H-EF-02	H-103 -2	1,350	None	ACET,ALC, HCl,HNO_3,H_2SO_4
HH-EF-01	HH-008 -5	3,000	None	SO_2,He,N_2
HH-EF-02	HH-008 -4	2,345	None	ACET,CH_2BrCl,
	HH-011 -1			CH_2Cl_2,
	HH-122 -1			CS_2,H_2,SO_2,H_2SO_4
HH-EF-04	HH-024 -1	900	None	CS_2,CO,SO_2,NH_3,HCl, CH_4,H_2
HH-EF-05	HH-022 -1	615	None	ACET,IPOH,CO_2,H_2
HH-EF-07	HH-022 -2	2,890	None	CS_2,C_2H_5Cl,C_4H_7Cl,
	HH-022 -3			Hg vapors,H_2
	HH-023 -1	(Out of Service)		CS_2,NaOH,$NaHSO_3$
HH-EF-19	HH-008 -1	2,145	None	ACET,MEOH,CH_2Cl_2,
	HH-008 -2			CS_2,Toluene
	HH-008 -3			
HH-EF-20	HH-005 -1	1,600	None	CS_2
HH Stack	HH-018 -1	1,000	None	H_2,T_2
	HH-018 -2			
	HH-018 -3			
I-EF-02	I-053 -1	-	None	
I-EF-04	I-102B-1	630	None	Solder fumes
I-EF-06	I-002 -1	760	None	ACET,IPOH,CH_2Cl_2, Freon
I-EF-07	I-002 -2	1,710	None	ACET,IPOH,CH_2Cl_2,
	I-101 -1			Freon,Solder fumes
	I-101 -2			
I-EF-08	I-104 -1	3,000	None	ALC,Bonding materials

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
I-EF-09	I-002 -3	170	None	Solder fumes
	I-002 -4			
M-EF-01	M-007 -2	11,100	Bag House	Metal particles,
	M-007 -3			Plastic vapors,
	M-007 -4			Oil vapors
	M-007 -5			
	M-007 -6			
	M-007 -7			
	M-007 -8			
	M-007 -9			
	M-007 -10			
	M-007 -11			
	M-007 -12			
	M-007 -13			
	M-007 -14			
	M-007 -15			
	M-007 -16			
	M-007 -17			
	M-007 -18			
	M-007 -19			
	M-007 -20			
	M-007B-1			
M-DC-01	M-038A-1	820	Particle	Metal particles,
	M-038A-2		Filter	Plastic vapors,
	M-038A-3			Oil vapors
M-EF-02	M-003 -1	10,200	Bag house	Metal particles,
	M-003 -2			Plastic vapors,
	M-003 -3			Oil vapors
	M-003 -4			
	M-003 -5			
	M-028 -1			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
M-EF-02	M-028 -4	10,200	Bag house	Metal particles, Plastic vapors, Oil vapors
	M-028 -5			
	M-028 -6			
	M-028 -7			
	M-028 -8			
	M-028 -9			
	M-028 -10			
	M-028 -11			
	M-028 -12			
	M-103 -1			
	M-103 -2			
	M-103 -3			
	M-103 -4			
	M-103 -5			
	M-103 -6			
	M-103 -7			
	M-103 -8			
	M-103 -9			
	M-103 -10			
	M-103 -11			
M-EF-03	M-007A-1	1,250	None	ACET,ETOH,CH_2Cl_2
M-EF-04	M-007 -1	760	None	ACET,ETOH,CH_2Cl_2, 1,1,1-TCE
M-EF-05	M-007 -21	760	None	ACET,ETOH,CH_2Cl_2,
M-EF- A	M-108 -14	10,360	None	HCl,HNO_3,H_2SO_4,NaOH, Metal particles,Oil fumes,Plastic fumes
	M-108 -15			
	M-108 -16			
	M-108 -17			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
M-EF- A	M-108 -18	10,360	None	HCl, HNO_3, H_2SO_4, NaOH, Metal particles, Oil fumes, Plastic fumes
	M-108 -19			
	M-108 -20			
	M-108 -21			
	M-108 -27			
	M-108 -28			
	M-108 -29			
	M-108 -30			
	M-108 -31			
	M-108 -32			
	M-108 -33			
	M-108 -34			
	M-110 -1			
	M-110 -2			
	M-110 -3			
	M-110 -4			
M-EF- B	M-108 -1	1,740	None	ACET, Oil fumes
	M-108 -2			
	M-108 -3			
M-EF- C	M-108 -4	6,715	None	HCl, HNO_3, H_2SO_4, $CrO_4^{=}$ vapors, Metal particles
	M-108 -5			
	M-108 -6			
	M-108 -7			
	M-108 -8			
	M-108 -9			
	M-108 -10			
	M-108 -11			
	M-108 -12			
	M-108 -13			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
M-EF- D	M-108 -22	2,250	None	Cyanides,HCl, Metal particles
	M-108 -23			
	M-108 -24			
	M-108 -25			
	M-108 -26			
M-EF- E	M-225 -1	650	None	ALC,Paint fumes
M-EF- F	M-008 -1	1,000	None	Metal particles, Plastic particles, Plastic fumes,Oil vapors
	M-008 -2			
	M-008 -3			
	M-008 -4			
	M-008 -5			
	M-008 -6			
Unknown	M-008 -7	(Missing inventory)		Metal particles, Plastic vapors, Oil vapors
	M-008 -8	(Missing inventory)		
	M-008 -9	(Missing inventory)		
	M-019 -1	(Missing inventory)		
	M-019 -2	(Missing inventory)		
	M-019 -3	(Missing inventory)		
	M-019 -4	(Missing inventory)		
	M-019 -5	(Missing inventory)		
	M-019 -6	(Missing inventory)		
	M-019 -7	(Missing inventory)		
	M-019 -8	(Missing inventory)		
	M-019 -9	(Missing inventory)		
	M-019 -10	(Missing inventory)		
	M-019 -11	(Missing inventory)		
	M-019 -12	(Missing inventory)		
	M-019 -13	(Missing inventory)		
	M-019 -14	(Missing inventory)		
	M-019 -15	(Missing inventory)		
	M-019 -16	(Missing inventory)		

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
Unknown	M-019 -17	(Missing inventory)		Metal particles,
	M-020 -1	(Missing inventory)		Plastic vapors,
	M-028 -1	(Missing inventory)		Oil vapors
	M-028 -2	(Missing inventory)		
PS-EF- A	PS-001 -1	6,000	Spray booth	Paint,Toluene,Xylene
PS-EF- B	PS-002 -1	8,000	None	Toluene,Xylene
R-EF-02	R-162 -1	2,900	None	HCl,HF,HNO_3,H_2SO_4
	R-162 -2			
	R-162 -3			
	R-162 -4			
	R-162 -5			
RE-EF-01	R-021 -2	675	Particulate Filter	Radioactive and nonradioactive particulates
	R-021 -3			
	R-021 -4			
RE-EF-02	R-022 -1	2,300	None	Hg vapor,ACET, Xylene,Cutting oils
	R-022 -2			
	R-023 -1			
RE-EF-03	R-021 -1	6,300	Particulate Filter	Benzene,Chloroform, Dimethyl sulfoxide, Dimethly formamid, CH_2Cl_2, Hexane,H_2O_2,NH_3, HCl,HNO_3,H_2SO_4
	R-024 -1			
	R-025 -1			
	R-025 -2			
	R-025 -3			
	R-030 -1			
	R-033 -1			
RE-EF-05	R-169 -1	2,400	None	HCl,HNO_3,H_2SO_4
	R-169 -2			
	R-169B-1			
R-V-166	R-166 -3	1,600	Scrubber	HCl,HF,HNO_3,H_2SO_4
	R-166 -4			

PRELIMINARY COPY

Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
R-V-177	R-177 -1	765	None	HCl, HNO_3, H_2SO_4
HEFS Stack	R-106 -1	111,721	HEPA Filters	ACET, ETOH, IPOH, Ether, H_2, D_2, T_2, HTO, H_2SO_4
	R-106 -2			
	R-108 -1			
	R-108 -2			
	R-113 -1			
	R-114 -1			
	R-114 -2			
	R-116 -1			
	R-116 -2			
T-West	R-127 -1	41,440	Demsters, Prefilters HEPA Filters	ACET, MEOH, ETOH, IPOH, Toluene, Ether, HCl, HNO_3, H_2SO_4, H_2, D_2, T_2, HTO, Alpha radioactivity
	R-127 -2			
	R-127 -3			
	R-128 -1			
	R-128 -2			
	R-128 -3			
	R-128 -4			
	R-128 -5			
	R-128 -6			
	R-128 -7			
	R-128 -8			
	R-128 -9			
	R-128 -10			
	R-128 -11			
	R-134 -1			
	R-134 -2			
	R-140 -1			
	R-140 -2			
	R-159B-1			
	R-159B-2			
	R-164 -1			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
T-West	R-166 -1 R-166 -2 R-167 -1 R-167 -2 R-167 -3 R-167 -4 R-168 -1 R-168 -2 R-170 -1 R-170 -2 R-171 -1 R-172 -1 R-172 -2 R-179 -1 R-181 -1	41,440	Demsters, Prefilters HEPA Filters	ACET,MEOH,ETOH,IPOH, Toluene,Ether,HCl, HNO_3,H_2SO_4,H_2,D_2,T_2, HTO,Alpha radioactivity
1C-N Stack	SW-022 -1 SW-022 -2 SW-132 -1 SW-132 -2 SW-140 -1	18,241	HEPA Filters	ACET,MEOH,HNO_3, H_2SO_4,Alpha radioactivity
HEFS Stack	SW-002 -1 SW-002 -2 SW-008 -1 SW-008 -2 SW-008 -3 SW-008 -4 SW-009 -1 SW-009 -2 SW-013 -1 SW-013 -2 SW-013 -3	111,721	HEPA Filters	ACET,MEOH,ETOH,HCl, HNO_3,Cyanides, H_2,D_2,T_2,Oil fumes Alpha radioactivity, Metal particles

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
HEFS Stack	SW-013 -4	111,721	HEPA Filters	ACET,MEOH,ETOH,HCl,
	SW-013 -5			HNO_3,Cyanides,
	SW-013 -6			H_2,D_2,T_2,Oil fumes
	SW-013 -7			Alpha radioactivity,
	SW-013 -8			Metal particles
	SW-013 -9			
	SW-013 -10			
	SW-013 -11			
	SW-019 -1			
	SW-019 -2			
	SW-019 -3			
	SW-019 -4			
	SW-021 -1			
	SW-021 -2			
	SW-021 -3			
	SW-021 -4			
	SW-021 -5			
	SW-021 -6			
	SW-142 -1			
	SW-142 -2			
	SW-142 -3			
	SW-142 -4			
	SW-200 -1			
	SW-200 -2			
	SW-200 -3			
	SW-205 -1			
	SW-205 -2			
	SW-205 -3			
	SW-205 -4			
	SW-208 -1			
	SW-208 -2			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
NCDPF Stack	SW-125 -1	16,732	HEPA Filters	ACET,MEOH,H_2,D_2,T_2, Alpha radioactivity
	SW-150 -1			
	SW-150 -2			
	SW-150 -3			
	SW-150 -4			
	SW-150 -5			
	SW-238 -1			
	SW-238 -2			
	SW-240 -1			
	SW-240 -2			
T-E -03	T-307 -1	5,000	None	ACET,ETOH,TCE,H_2, T_2,HTO
	T-307 -2			
	T-307 -3			
	T-307 -4			
T-E -22	T-011 -1	32,000	HEPA Filter	ACET,ETOH,IPOH, CH_2Cl_2,H_2,T_2,HTO, Ethylene glycol
	T-011 -2			
	T-011 -3			
	T-015 -1			
	T-017 -1			
	T-037 -1			
	T-040 -1			
	T-048 -1			
	T-048 -2			
	T-050 -1			
	T-050 -2			
	T-058 -1			
	T-058 -2			
	T-058 -3			
	T-059 -1			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
T-E -31A	T-027 -1	5,000	None	ACET,ALC,TCE,Cl_2, NH_3,NH_4OH,T_2,Alpha radioactivity
	T-244 -1			
	T-246 -1			
	T-246 -2			
T-E -31B	T-061 -1	10,000	HEPA Filter	ACET,ALC,T_2,HTO
T-HE-12A	T-323 -1	900	None	ACET,ALC,Metal particles,Cutting oils
	T-323 -2			
T-HE-12B	T-315 -1	1,070	None	ALC,Acids
T-HE-23	T-214 -1	5,000	None	ACET,ALC,Hg vapors, Paint fumes
	T-214 -2			
	T-216 -1			
	T-218 -1			
	T-226 -1			
	T-227B-1			
	T-230 -1			
	T-248 -1			
	T-252 -1			
W-EF-01	W-125 -1	25,500	None	Weld and Solder fumes
	W-130 -1			
	W-130 -2			
	W-130 -3			
	W-130 -4			
	W-130 -5			
	W-130 -6			
	W-130 -7			
	W-130 -8			
	W-130 -9			
	W-130 -10			
	W-131 -1			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
W-EF-03	W-132 -2 W-132 -3	2,600	Particle Filter	Metal particles
W-EF- A	W-135 -5 W-135 -6	800	None	ACET,ETOH,CH_2Cl_2
W-EF- B	W-135 -1 W-135 -2 W-135 -3	2,000	None	ACET,ETOH,NH_3 Cleaning compounds,
W-EF- C	W-136 -1	800	None	Solvents,Acids
W-EF- D	W-132 -1	100	None	Metal particles
W-EF- E	W-117 -1	2,250	None	Unknown
WDALR Stack	WD-001B-1 WD-001B-2 WD-101 -1 WD-104 -1 WD-110 -1 WD-112 -1 WD-112 -2 WD-118B-1	17,784	HEPA Filters	ACET,Radioactive particles and vapor, HCl,HNO_3,H_2SO_4,ACOH

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Ref. 61

SRS/lm

Department of Energy
Albuquerque Operations
Dayton Area Office
P.O. BOX 66
Miamisburg, Ohio 45342

RECEIVED
NOV 2 1987
Environmental Protection Agency
SOUTHWEST DISTRICT

Mr. Scott Shane
Ohio Environmental Protection Agency
Southwest District Office
40 South Main Street
Dayton, Ohio 45402

Dear Scott:

Enclosed is a copy of the DOE/HQ's Environmental Survey for the Mound Facility. We discussed this program with you and Jack Van Kley during your visit of May 28, 1987. As previously described to you, this report is preliminary and will be modified based on additional information as well as the results of a five week sampling effort. At the conclusion of this sampling and analysis phase an "Interim Report" will be issued which will more closely define the areas that may need remedial action. As you can see from the report, there are comments incorporated into the report on the page facing the page the comments apply to. Since the report was preliminary these comments were an attempt to provide additional information and a more comprehensive perspective on the "findings" of the survey.

It is worth noting that the report concludes that there is generally good compliance with environmental statutes and there are "no environmental problems at the Mound Plant that represent an immediate threat to human life".

Also enclosed is a copy of the recent VOC data that you requested during your visit. This information is consistent with earlier data and does not indicate an immediate concern.

If there are any questions, please contact Richard Munson of my staff.

Very truly yours,

G. W. Johnson
Acting Area Manager

Enclosure: a/s

VOC MONITORING WELL DATA
MICROGRAMS/LITER

	CHLORO FORM	ETHYL BENZENE	TOLUENE	TRICHLORO ETHYLENE	1,2-DICHLORO ETHANE	METHYLENE CHLORIDE	TETRACHLORO ETHYLENE	TRANS-1,2 DICHLORO ETHYLENE	VINYL CHLORIDE
55-1									
12/86	6	131	ND	20	ND	28	B	88	45
63-1									
12/86	27	ND	ND	119	ND	4	32	52	ND
2/87	28	ND	ND	76	ND	ND	35	25	ND

ND = NOT DETECTED
B = BELOW METHOD DETECTION LIMIT

Ref. 81 (cont)

5.0 REFERENCES

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APPENDIX B
ENVIRONMENTAL SURVEY PLAN

MOUND PLANT

AUGUST 18-29, 1986

MIAMISBURG, OHIO

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1.0 INTRODUCTION

The Environmental Survey is a one time baseline inventory of existing environmental problems and environmental risks at DOE operating facilities. It will be conducted in accordance with the principles and procedures contained in the Draft DOE Environmental Manual distributed on May 16, 1986.

The Environmental Survey is an internal management tool to aid the Secretary in identifying current and potential environmental problems in all of DOE's facilities and in prioritizing these problems for appropriate corrective actions.

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2.0 SURVEY IMPLEMENTATION

The Environmental Survey will be managed by the Team Leader, Richard Aiken and the Assistant Team Leader, Joseph Boda. Ronald Peterson will serve as the Albuquerque Operations Office representative on the Environmental Survey team. Technical support will be provided by the following NUS Corporation personnel:

Peter Alexandro	NUS Coordinator/RCRA and Solid Waste
Patrick Byrne	QA/TSCA
Charles Winklehaus	Surface Water
William Joyce	Radiation
Hank Firstenberg	Air
John Glissmeyer	Air/Radiation
Kevin Walter	CERCLA
William Murray	Hydrogeology

2.1 Pre-Survey Activities

Members of the Survey team began reviewing Mound environmental documentation available at the DOE Office of Environmental Audit and Compliance in May, 1986. From that review, a memorandum dated June 4, 1986, was sent to the Albuquerque Operations Office requesting additional information. Messers Aiken, Boda, Alexandro, and Ballou (Argonne National Laboratory) conducted a pre-Survey site visit on July 1-3, 1986, to become familiar with the site, to identify any potential environmental problems, and to coordinate plans for the upcoming Survey with DOE/DAO and Monsanto personnel. During the pre-Survey visit, the team met with representatives of DOE/DAO and Monsanto and officials of the U.S. EPA and State regulatory agencies. In addition, the team toured the facility and gathered documents assembled by site personnel in response to the information request memorandum. The bulk of the information being supplied in response to the June 4 memorandum was assembled by the CEARP team in Los Alamos National Laboratory. Messers Aiken, Boda, Walter and Murray traveled to the Albuquerque Operations Office and Los Alamos National Laboratory on July 16-18, 1986, to review the data available at these offices on the Mound Plant. Additional

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information was requested from Monsanto at the time based upon the review of the data being sent by Los Alamos. The information from Los Alamos was received in Washington on July 18, 1986. This Survey plan is based upon the information received by the Survey team as of the end of July 1986.

2.2 On-Site Activities and Reports

The Environmental Survey will be conducted from August 18 through August 29, 1986. The Agenda for this Survey is shown on the attached table. Modifications to this agenda will be made during the conduct of the Survey. All modifications will be coordinated with the site officials designated as Survey contacts. The on-site activities of the Survey team will consist of interviews and consultations with, among others, environmental, safety, operations, waste management, purchasing, and warehousing personnel; a review of files and documents unavailable prior to the on-site portion of the Survey; and process-specific and area-specific tours of the facility.

A closeout briefing will be conducted on Friday, August 29, to describe observations and initial conclusions of the on-site activities. A Draft Report of the Survey will be prepared within 3 to 4 weeks of the conclusion of the Survey. Subsequently, an Interim Report will be prepared by the Survey team within 4 weeks of the completion of sample analyses. The Interim Report will have the data from the sample analyses incorporated into the report. The findings from each of the reports from all scheduled Surveys will be updated as appropriate and included in the Final Report to the Secretary, DOE, which is scheduled for completion in 1988.

2.3 Sampling and Analysis

Based upon the results of the on-site portion of the Survey, the Survey team will identify any sampling needs. Sampling and analysis for the Mound Survey will be conducted by a team from the Argonne National Laboratory. Mr. Donald McCown will be the Argonne sampling and analysis team leader. The Argonne sampling team will draft a Sampling Plan based upon the sampling needs identified by the Survey team.

The Assistant Team Leader, Joseph Boda, will coordinate the review of this Sampling Plan with the Albuquerque Operations Office and EPA's Laboratory at Las Vegas which has quality assurance responsibility for the Survey's sampling and analysis efforts. The sampling will start on October 13. The sampling will take between 3-5 weeks to complete. Analysis of the samples will be conducted by Argonne following protocols provided in the Survey Manual, supplemented by the Mound Sampling Plan. Results of the sampling and analysis will be transmitted to the Survey Team Leader for incorporation into the Interim Report.

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3.0 AIR

3.1 Issue Identification

The air-related Survey activities will involve an assessment of the nonradioactive air emission sources in the facility, the administrative and add-on emission control technology applied to the sources, the in-stack continuous emission monitoring systems, and the ambient air monitoring systems. The emphasis of the Survey will be on operational and procedural practices associated with the emission sources and the emission control equipment, fugitive source of emission, both within and outside the process buildings, and mitigative procedures applied to fugitive emission sources.

The general approach to the Survey will include a review of existing air permits, pending applications, standard operating procedures, the inspection of processes and control equipment, and the compliance with DOE ALARA requirements for radionuclide emissions. The Survey will also review the air contaminants from the different processes in the facility, evaluate the existing controls applied to the air contaminant emissions, and assess the need for additional monitoring or emission controls to characterize or reduce the environmental consequences of the emissions.

The ambient air monitoring system, including the meteorological monitorng system and the air quality monitoring network, will be evaluated to assess if the existing monitoring program is adequate to characterize environmental impacts of the air emissions from the facility. The activities involved in this part of the Survey will include the inspection of the meteorological tower and ambient air quality samplers, a review of documentation applicable to the ambient air data acquisition, and an evaluation of the processing procedures used to assure the accuracy of the data. The primary emphasis will be on assessment of the use of these data to characterize the environmental impacts of plant operations and the defensibility of the reported data.

The lack of pre-Survey information available on air emissions from the Mound Plant has hampered the development of a detailed Survey plan in this area.

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Therefore, it will be desirable to arrange a briefing early in the Survey on the processes, the air emissions from the processes, and the controls and monitoring of emissions points (stacks and vents).

Areas of particular interest will include process emissions of the criteria pollutants (e.g., radioactive-bearing particulates, sulfur oxides, nitrogen oxides, hydrocarbons, carbon monoxide and lead) as well as regulated hazardous air pollutants (e.g., beryllium, asbestos, and mercury). The powerhouse, incinerators, and the asbestos-filled DAP molding compound process area will be areas of interest. In addition, the use of organic solvents, lubricants, and coolants will be assessed as a potential or actual source of emissions to determine if they are adequately characterized, monitored, and controlled. A focus of the organic emissions assessment will be directed at those substances considered to be hazardous or toxic air contaminants.

Fugitive emissions, both from processes and resuspension of contaminated soils, will be evaluated as a potential means of the airborne release of radionuclides and hazardous materials from the facility. Consideration will be given to historical and current operations to determine the potential for soils contamination and windborne releases.

3.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant:

- Air permits (Registrations, Installation, and Operation);
- Source and emissions inventories;
- Stack emission test data, emission calculations, etc.;
- Descriptive documentation on add-on emission controls;
- Standard operating procedures for process and control equipment;
- Correspondence between regulatory agencies relative to air issues;
- Reports on accidental releases of airborne substances;
- Ambient air monitorng program procedures relative to:
  - duty observer functions,
  - calibration procedures and records,

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- laboratory procedures and quality assurance,
- ambient air monitoring data, and
- application of ambient air monitoring data for impact assessments;

o Other records as determined on-site.

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4.0 RADIATION

4.1 Issue Identification

The radioactive Survey will involve an assessment of the facility-wide radioactive emissions, emissions control and monitoring, and the associated impact on the environment. The assessment will include discharges to the atmosphere, surface water, groundwater, soils and off-site disposal. The assessment will be conducted on a program-by-program basis including:

- Surveillance of weapon components contaminating radioactive materials;
- R&D of nuclear weapons components;
- Stable isotope;
- Safeguards of nuclear materials by use of nuclear material measurements and control;
- Fabrication, radioactive module assembly, RTG assembly and testing;
- Recovery and purification of tritium;
- Procurement of ordnance materials for weapons;
- Research in separations technology.

The assessment will be based upon observations of programatic processes, operations, effluent control and monitoring equipment, and waste disposal along with discussions with operational and supervisory personnel. Operational reports, incidental reports, records and other data associated with continuous intermittent and any accidental releases will be reviewed. Also examined will be the radioactive dose assessment methodologies and biological pathway assessments. Of particular importance will be the potential of radioactive releases via unmonitored release pathways to the environment.

As assessment of the potential for health and environmental effects of the existing 19 areas of radioactive contamination identified in the Mound Site Development and Facility Utilization Master Plan wil be performed in addition to the Miami-Erie Canal, the tritium groundwater contamination, and the natural storm water

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runoff drainage ditch. The facility wide radiological Survey will be examined to identify additional contaminated areas and for validity of the analytical results.

The environmental monitorng program will be reviewed using both observation of monitoring stations, sample collection and analysis and review of prior annual reports and other DOE reporting requirements.

The radiological Survey will be coordinated with the air, water, solid waste, CERCLA and hydrogeology Surveys.

4.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant:

- Radionuclide environmental monitoring data (atmospheric, groundwater, surface water, soil, vegetation);
- Radionuclide effluent monitorng system design and monitoring data;
- Radiological accident reports and data;
- Laboratory procedures and analytical methods;
- Dose assessment methodologies;
- Plot plans with monitoring locations;
- Radiological food pathway assessment strategies;
- Other records as determined on-site.

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5.0 SURFACE WATER/DRINKING WATER

5.1 Surface Water/Drinking Water

5.1 Issue Identification

Because of the extensive history of the Mound Plant covering 40 years and the frequent expansions of the facilities on a compact site, the water and sewage systems have been severely taxed. The handling of some high and low level radioactive wastes in the sewage collections and treatment systems gives added importance to the integrity and efficient functioning of these systems. Recognizing this, a Survey of the sanitary and storm (including process) wastewater collection systems was conducted in 1983, including an internal inspection of many of the pipes with a closed-circuit TV camera. A program of repairs has been included in the FY 1988 budget request. This request also includes a proposal to remove certain non-contact cooling water flows from the storm water system and thereby improve the performance of the latter system and allow it to meet its NPDES requirements more consistently.

A review of the present condition of these wastewater collection and treatment systems will be made as part of this Survey. Mound process activities that generate wastewaters will be reviewed through a detailed process tour lasting several days. Discrete process liquid discharge points will be identified and evaluated to develop an inventory of wastewater sources. Liquid waste treatment, process, collection and handling equipment will be examined and records of operations will be reviewed. The objective of the review is to build a Survey information base for the identification of physical evidence of existing or potential environmental contamination.

The water and hazardous waste Surveys will be performed in unison for most buildings and activities due to a common need to review processes and waste discharge points. Buildings M, P, PS, W, G, GW, and 40 will be examined early the first week to view normal activities including maintenance activities generating process wastewaters and other liquid wastes such as hazardous degreasing solvent wastes in the garage. In addition, a record review session will be scheduled early in

the week to review drawings and materials pertaining to wastewater and stormwater treatment operation and maintenance. The record review will include viewing videotapes of the television Survey of the collection system. The first week will end with the completion of the detailed process tour of buildings in the northern portion of the Mound site. A major focus will be the examination of the effluent removal systems in the SW building.

The second week of the Survey will review wastewater-related activities in the plutonium processing areas and facilities in the southern portion of the site. Particular emphasis will be placed on the stormwater retention pond operation and new wastewater facilities and activities in the vicinity.

Extensive reviews will also be made of possible undetected sources of contaminants flowing to the storm and sanitary sewage systems. This will require review of most plant production schematic drawings, visits to the respective areas around production facilities and a thorough tour of plant buildings, yard areas, and grounds, particularly areas where the ground surface is or was known to be contaminated.

Other information sources and visitation points that will be examined are:

- NPDES permit requirements and treatment plant performance and/or effluent quality information; this will include observation of sample collection and analysis techniques used for the monitoring required by the NPDES permit;

- Residuals (sludge and sediment) disposal from the wastewater treatment plants, including the stormwater retention pond (both the technical and the administrative aspects);

- Spill protection provisions for fuels and hazardous materials storage units, including review of the SPCC Plan and of such physical controls as tank containment dikes and runon/runoff drainage control for potential contaminants;

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- Water quality information concerning raw and treated domestic and process waters, with particular attention to such parameters as tritium, trihalomethanes, coliforms, chlorine residuals, and asbestos fibers;

- Basic design parameter information such as storm runoff coefficients and tributary population to the sanitary wastewater treatment plant.

5.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant:

- Detailed drawings of the process, storm, and sanitary sewer systems and the domestic and process water systems both within buildings and in yard areas;

- Reports and films of the 1983 inspections of the plant sewer systems;

- Detailed drawings of the radioactive, storm, and sanitary wastewater treatment units;

- Detailed drawings of the domestic and process water supply treatment, storage, and distribution systems;

- Additional schematic diagrams and/or descriptions of all production processes;

- Spill Prevention, Control, and Countermeasure (SPCC) Plan on the site, covering all fuel and hazardous material storage units;

- Analytical data used for preparation of the NPDES monitoring reports;

- NPDES discharge monitoring reports and violation reduction studies;

- Records of drinking water quality both on and off-site;

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- Operators log books and reports for treatment plant operations;
- Sampling log books and laboratory tracking reports;
- Treatment plant and monitoring equipment maintenance records and/or logs;
- Progress reports and/or final reports for n-going R & D studies of wastewater control and treatment options;
- Internal memos and correspondence relating to surface water/drinking water problems;
- Applicable water quality standards for the Great Miami River;
- Other records as determined on-site.

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6.0 HAZARDOUS/RADIOACTIVE SOLID WASTES

6.1 Issue Identification

The procedure for solid/hazardous/radioactive waste Survey is to review known sources or activities and identify any additional sources or activities which have the potential to result in contamination of environmental media.

The waste portion of the Survey will concentrate on those facilities mentioned in Mound Part A RCRA notification. Specifically, the hazardous waste storage facility, the develomental cyclone incinerator, the glass melter, and the explosive waste treatment areas will be examined. In addition, the team will devote a significant portion of the time on-site to a detailed process-by-process investigation of hazardous or mixed waste generation, treatment, storage, and release points.

Hazardous wastes which have been identified in existing documentation (e.g., acetone, mercury compounds, spent plating solutions) will be tracked through the system and waste-related site activities and records reviewed to develop an inventory of Mound waste management practices.

The review of radioactive and non-hazardous solid waste will proceed similar to that for hazardous wastes. Known waste streams and activities such as the WD facility, tritium treatment processes, waste solidification processes for both alpha and beta wastes, waste compactors, waste incinerators, and waste certification processes will be the focus of the Survey. The detailed process tour described above will gather information on radioactive and non-hazardous solid wastes to delineate any previously unidentified sources of waste that have the potential to result in environmental contamination.

Discussions will be held with individuals knowledgeable of current and past waste management practices. This will be accomplished during the process tour, and in the process of reviewing facility records and documentation. The objective is to develop an understanding of past and existing waste management activities that may serve as the basis for problem identification by the Survey team.

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Existing documentation indicates fluctuations in tritium levels in groundwater. The review of solid/hazardous/radioactive waste will be coordinated with the CERCLA and hydrologic Surveys to identify any possible releases that may pose a threat to the environment.

6.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be reviewed at the Mound Plant:

- Waste analysis plans;
- Inspection documentation, (state and federal);
- Groundwater monitoring, sampling, and analytical documentation;
- Any release notification or occurrence documentation;
- Waste inventory documentation;
- Any enforcement action documentation;
- Groundwater monitoring system construction documentation;
- Internal facility inspection documentation;
- Additional RCRA manifests;
- Correspondence with regulatory agencies on solid waste;
- Records dealing with the reuse/recycling of wastes;
- Other records as determined on-site.

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7.0 HYDROGEOLOGY

7.1 Issue Identification

The preliminary review of the data available on the Mound Plant indicates that a large number of studies have been conducted to assess groundwater conditions. In addition, it is apparent that groundwater sampling is a regular part of the environmental monitoring conducted at the site. A substantial portion of these efforts have been directed towards known contamination resulting from historic releases of tritium and from the release of plutonium from a ruptured pipe in 1969.

This Survey effort will focus on a number of issues including evaluation of previous studies of known contamination problems, assessment of the adequacy of monitoring for both radiological and nonradiological contaminants, and a review of available information on the hydrogeology of the site and the surrounding area.

The tritium levels in the aquifer have been monitored since the mid-1970's and a remediation pumping program has been in operation since 1976. The objective of this remediation method is to reduce tritium levels in the aquifer to meet EPA standards. However, from the information received, it appears that pumping is continuing on an intermittent basis to maintain compliance. Therefore, this portion of the Survey will focus on determining if a continuing source of tritium exists. The hydrogeologic findings on this subject will be coordinated with those of the CERCLA, radiation, air, and surface water specialists to better understand this issue.

The plutonium release of 1969 has resulted in low levels of plutonium adsorbed on the sediments in the Miami-Erie Canal. Previous studies indicate that the plutonium is immobilized in the sediments and is not entering the groundwater. Given the continuing concern on this subject, the Survey will include inspections of the canal area and review of related studies with a view towards determining the potential for mobility. Other areas that will be reviewed during the Survey include the property to the south of the Mound Plant which was acquired in 1982 and the landfill area near the overflow pond. The information available to the Survey team prior to the on-site portion of the Survey did not provide sufficient information on

the monitoring wells on the site in general. In addition, little analytical results were available to the Survey team from the monitoring program, particularly for nonradiological parameters.

In terms of the site hydrogeology, the Survey will focus on providing further definition in two areas. The first area is the extent and thickness of a confining clay layer in the Buried Valley Aquifer which divides the aquifer into two separate zones. This cannot be determined from data presently available to the Survey team. The second area is the potential for transport of contaminants with perched water traveling through the glacial till and limestone on the site.

7.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant:

- CEARP Phase II Generic and Installation Generic Work Plans;
- Weston Sampling Plan;
- Historic air photos (2 per year);
- Wells installation reports, boring logs;
- Maps of monitoring wells, domestic wells, etc. - material on loan to Weston;
- Well Sampling procedure, schedule;
- Monitoring parameters, data and results;
- Groundwater sampling QA/QC and lab procedures;
- Radiological Characterization Data;
- Other records as determined on-site.

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8.0 INACTIVE WASTE SITES/RELEASES (CERCLA)

8.1 Issue Identification

The objective of this portion of the Survey will be to identify and summarize environmental problems at or emanating from the Mound Plant which are caused by the following historical activities concerning hazardous wastes or mixed radioactive and hazardous wastes:

- Past waste disposal areas on-site that have been identified;
- Areas on-site where past undocumented disposal may have occurred;
- Areas on-site where leaks, spills, or inadvertent disposal may have created ongoing sources of contamination or traceable plumes of surface or subsurface contamination. This will include a review of the status of underground tanks.

This effort will also include a review of existing documentation concerning several off-site areas that were used during the period of 1942 through 1948. Based on the review of data available to the team prior to the on-site portion of the Survey, it is apparent that a great deal is known and documented about buried hazardous and mixed waste. Areas identified as having received waste materials include lettered areas A through J, as enumerated in the Phase I report of The Comprehensive Environmental Assessment and Response Program (CEARP), and radiological areas 1 through 19, as listed in The Environmental Impact Statement and Waste Management Reports. Although all of these areas will be reviewed in the field and office, areas that will be the subject of the most detailed review include; Area B - overflow pond landfill, Area J - building demolition site, Area I (two locations) - high explosive & acetone disposal, and Area C - lithium carbonate disposal. The CERCLA portion of the Survey, since it relates to past handling, as well as disposal of hazardous and mixed chemicals/waste, will be highly coordinated with the RCRA, toxics, and radiological portions. To a lesser extent, the water portion of the Survey will be included in this coordination to check for storm and surface drainage or unknown/unpermited subsurface disposal of water that may form a

migration pathway for one of the sources of hazardous or mixed waste described above. Lastly, since subsurface water is the primary mode of migration for buried wastes, the CERCLA portion of the Survey will of course be coordinated with the groundwater portion.

8.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant (the publication numbers, where shown, are those that have been assigned by the Albuquerque operations/Los Alamos staff).

- #84-80 and #84-81, test borings and aerial Survey;
- Personnel interviews taken during the CEARP;
- Historic aerial photos of areas B, C, I and J;
- Site Survey draft report;
- #84-87 overflow pond/site landfill plans;
- #84-114, potential sources of groundwater contamination;
- #84-115, #84-119, #84,120, groundwater sampling well drawings;
- Phase II Work Plan - CEARP;
- Notifications and internal records of spills/releases;
- #84-123 site topography drawings;
- Records of facility expansion and building destruction;
- Technical manual MD-70180 waste disposal;
- Subsurface tank plans;
- Historical local files on waste handling/disposal;
- Other records as determined on-site.

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9.0 TOXIC SUBSTANCES AND QUALITY ASSURANCE

9.1 Issue Identification

The toxic Survey will include all raw materials and process-related chemicals used on the Mound site. Use, handling, and disposal of polychlorinated biphenyls (PCBs), asbestos, pesticides, and hazardous substances will be within the scope of this effort.

All toxic and hazardous substances purchased, used, or manufactured on the site will be evaluated. Tracking, control, and management of these substances will be reviewed. Records of usage will be evaluated to determine the potential for entering effluent streams.

The inventory of PCB and PCB contaminated electrical equipment in use at the facility will be reviewed for completeness. The condition of this equipment, its potential for leakage, and the quantity of contaminated fluids will be identified during inspection of building P. Obsolete or used PCB contaminated items in storage at facility 90 will be inspected for proper container/packaging, adequate storage protection requirements, and inventory controls. Disposal practices will be reviewed for current and past inventories to determine the method of disposal and location of disposal sites. Procedures for PCB analysis, removal, handling, and disposal will be reviewed. Inspection and reporting requirements for PCB transformers will be evaluated in an effort to focus the Survey teams attention as potential problem areas.

The use of asbestos at Mound as insulation or in processes will be reviewed to identify pathways of contamination. Also, asbestos removal and disposal practices will be evaluated, and disposal sites visited, to define potential areas of concern.

Pesticides usage on the site will be reviewed including application records, storage and disposal practices, and environmental monitoring to assess risk for environmental contamination.

Other hazardous materials which are identified in 40 CFR 302 are used throughout the facility and include solvents used in the print shop, PS and maintenance shop, facility M. Also, asbestos filler which is regulated under TSCA in facility 29, and other regulated materials, will be evaluated for sources of potential releases to the environment.

The quality assurance Survey of the environmental program will be primarily an evaluation of the site sampling and analytical capabilities at Mound. The intent will be to verify and review the quality assurance procedures for obtaining process/effluent and environmental samples, performing the analytical work to identify the concentration of pollutants, and the handling and reporting of data. All aspects of the quality assurance program relating to environmental management of the Mound site will be reivewed, including operator training, equipment and instrument calibration/maintenance, precision and accuracy studies, blank, split, and spike sample analyses, sample handling and chain of custody procedures, data reduction and validation, data reporting and documentation, and calculation and logbook reviews.

The procedures for sampling and analysis will be monitored to ensure proper implementation and conformance to regulatory agency requirements. Quality assurance plans will be reviewed for the sampling and analytical activities, as well as any internal QA audits that have been completed.

The QA programs currently in force in the Mound Laboratories will be evluated. QA procedures imposed on any outside sampling or analytical laboratories will also be reviewed in this study effort.

9.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the Mound Plant.

- Toxic substances labeling and tracking system;
- Procedures for handling, control, and management of toxic substances;
- Inventory of toxic substances and purchasing records of chemical substances;

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- PCB annual inventory documents (1978 to 1985);
- Inventory of current PCB-contaminated electrical equipment;
- Records of inspections of PCB transformers (1981 to present);
- Storage records of PCB items;
- Disposal records for PCB items;
- PCB handling, storage, and disposal procedures;
- Correspondence with fire department on PCB transformers;
- Locations of buildings containing asbestos, including usage;
- Asbestos disposal records, including method and location of disposal;
- Asbestos handling, removal, disposal procedures, and environmental monitoring;
- Records of asbestos use in process equipment and support facilities;
- Pesticide training, handling, storage, disposal records, and environmental monitoring;
- Standard operating procedures for pesticides;
- Analytical laboratory and environmental sampling quality assurance plans;
- QA audits of laboratory and sampling program;
- QA reports for the Mound laboratories;
- Laboratory and sampling procedures manuals;
- QA results for prepared and analytical samples;
- Operator training records (laboratory and sampling);
- Instrument maintenance and calibration records (laboratory and sampling);
- Laboratory and sampling calculations and workbooks;
- Precision and accuracy studies;
- Other records as determined on-site.

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10.0 SAMPLING AND ANALYSIS

10.1 Issue Identification

The four representatives of the Sampling and Analysis Team will be on site during the second week of the Survey to ensure that the sampling effort will fully achieve the desired objectives. The objectives of the visit are to obtain a familiarity with the site, identify the security implications associated with the sampling portion of the Survey, identify the health and safety concerns for the sampling team, and discuss logistical arrangements. At points, the sampling representative will be split into two teams: one to focus on the team management concerns and the other on health and safety issues.

10.2 Records Required

The Argonne personnel have no records review requirements.

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APPENDIX C
SITE-SPECIFIC SURVEY ACTIVITIES

PRELIMINARY COPY 28

All on-site activities were conducted in accordance with the Survey Plan, modified as appropriate during the survey. The actual daily activities as conducted by the survey team are included herein.

In addition, the organizations that will be conducting the sampling and analysis of the Mound Plant are not the same as those identified in the Survey Plan. Planning is now underway with the Battelle Corporation to do the field sampling and with the Oak Ridge Gaseous Diffusion Laboratory (K-25) to perform the analyses.

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TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

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							SAMPLING & ANALYSIS	
AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	TEAM MGMT	HEALTH SAFETY
Monday - 8/18								
9:00 am	Introductions							
10:00 am	Mound Site History							
10:30 am	Security Briefing							
11:00 am	Health and Safety Briefing							
12:30 pm	Orientation Tour							
2:30 pm	Process Descriptions/Fit Tests							
Tuesday - 8/19								
am								
pm Air Emission Points Briefing/ Records Review	Rad Survey Data Review	Process & Equipment Evaluation of M,P,PS,W G,GW,40	Same as Water	Field Review of New Property w/MRC-Env Personnel	Field Review of New Property, w/MRC Env. Personnel	Records Review, Purchasing E&H		
Wednesday - 8/20								
am	Process & Equipment Evaluation of WD	Same as Air	Process & Equipment Evaluation of PS,W,G,GW,4 0	Same as Water	Field Review of Canal & Park Areas	Same as GW	Evaluation of Equipment at A,B,E,DS M,P,T	

TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

	AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	SAMPLING & ANALYSIS TEAM MGMT	SAMPLING & ANALYSIS HEALTH SAFETY
pm	Process & Equipment Evaluation of SW, T, H, I, P	Same as Air	View Tapes of Collector System	Records Review (continued)	Field Review of On Site Potential Sources (continued)	Field Review of Rad Soil Survey Sites 1-19	Evaluation of Equipment at TF,5,29,38,50, Open Storage Areas		
Thursday - 8/21									
am	Process & Equipment Evaluation of M,PS Continued review of SW	Same as Air w/o PS	Process & Equipment Evaluation of B,28,PS	Same as Water	Observe Sampling and Well Measurement	Continue Field review of Rad Soil Survey Areas	Records Review		
pm	Process & Equipment Evaluation of 28, 60,51 hh,e,ds	Process & Equipment Evaluation of R,HH,68	Process & Equipment Evaluation of SW,R	Same as Water	Field Review of Water Supply Wells	Records Review	Evaluation of 29, Landfill areas		
Friday - 8/22									
am	Process & Equipment Evaluation HH, R,DS,I	Same as Air	Process & Equipment Evaluation of I, 48	Same as Water	Observe Lab Procedures	MRC Personnel Interviews	Revisits & Reviews 23,71,73		

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TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

	AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	SAMPLING & ANALYSIS: TEAM MGMT	SAMPLING & ANALYSIS: HEALTH SAFETY
pm	Meet with HVAC & Record Review	Same As Air	Process & Equipment Evaluation of WD,HH,23	Same as water	Observe Lab Procedures (continued)	Field Review of Outside of Buildings (Main Hill)	Revisits & Reviews		
Monday - 8/25									
am	Process & Equiopment Evaluation of Plutonium Process Area	Same as air	Process & Equipment Evaluation of HH,57, Field Review of Ponds	Records Review	Records Review	Field & Documentation Review of Buried Tanks	Environmental Labs QA/Procedures		
pm	Process & Equipment Evaluation of Plutonium Process Area (continued)	Tritium discussion with Mound personnel	Same as Rad	Process & equipment Evaluation of 53,90,13,14, Records Review	Same as Rad	Same as Rad	Evaluation of Organic Analysis Procedures		

PRELIMINARY DRAFT

TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

	AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	SAMPLING & ANALYSIS: TEAM MGMT	SAMPLING & ANALYSIS: HEALTH SAFETY
am	Process & Equipment Evaluation of 21, fire pit, lead meltor	Evaluation of 19 Soil Study Areas	Process & Equipment Evaluation of 49-87 Complex, 27	Same as Water	Record Review of Tritium Issue	Revisit w/Rad, Document, Review & Coordination	Purchasing Records & Lab QA	Introduction & Site Familiarizatio n w/o Ballou) Ballou-Accompany Survey Team	
pm	Process & Equipment Evaluation of 49-87 Complex	Field Review of Canal & Tritium Locations	Process & Equipment evaluation of P Parea	Same as water	Inspection of tanks in Bldg. 34 area	Inspection of Tanks	Evaluation of Inorganic Analysis Procedures	Same as Rad	Health & Safety Personnel Meetings
Wednesday - 8/27									
am	Evaluation of Meteorological & Air Quality Stations, Observe Sampling Procedures	Revisits to WD,R,SW	Record Review	Solvent Pick up run, 1	Revisits P, onsite areas	Follow-up buried tank A	Evaluation of Rad Analysis Procedures	Ballou/w Survey Team, S&A Team Leader-MRC Personnel Logistics	Same as Rad
pm	Observe sampling procedures, followup bldg. 29,51	Followup bldg. 51	Record Review	Followup Bldg. 72,WD	Revisits	Notes, Review & Coordination	Record Review	With Asst. Team Leader-Sample Protocols	Health & Safety Personnel Meetings

PRELIMINARY DRAFT

TABLE
Actual
Mound Survey Site Agenda
August 18-29, 1986

	AIR	RAD	WATER	RCRA	GW	CERCLA	TSCA/QA	SAMPLING & ANALYSIS: TEAM MGMT	SAMPLING & ANALYSIS: HEALTH SAFETY
Thursday - 8/28									
am	Process & Equipment Evaluation of G,GW,W	Record Review	Observe Sampling Data Review	Revisits W.D & Waste Mgmt Personnel	Record Review	Record Review, Final Reinspection	Reviews and Rechecks with Waste Management Personnel	Revisits	Visit Sample Sites
pm	Review and Recheck	31,HH,23	Observe Sampling Procedures	Document Review & Revisits	Sampling Needs Development	Sampling Needs Development	Revisits	Attend Outbriefing Sites	Visit Sample
		Close Out Briefings with Team Leader and Assistant Team Leader							
Friday - 8/29									
am		Revisits and Rechecks							
pm		Outbriefing							

PRELIMINARY

A

APPENDIX D
MOUND FACILITY SOURCE EMISSION INVENTORY
VENTILATION HOODS

PRELIMINARY
COPY 28

Mound Plant Source Emission Inventory

Nomenclature List

ACET	Acetone
ACOH	Diacetone alcohol
ALC	Organic alcohols
ETOH	Ethyl Alcohol
MEOH	Methyl Alcohol
IPOH	Isopropyl Alcohol
1,1,1-TCE	1,1,1-Trichloroethane
TCE	Trichloroethylene
CCl_4	Carbon tetrachloride
CH_2Cl_2	Methylene chloride
CS_2	Carbon disulfide
DAP	Diallyl phthalate
H_2	Hydrogen gas
D_2	Deuterium (^2H) gas
T_2	Tritium (^3H) gas
HTO	Tritiated water
HF	Hydrofluoric acid
HCl	Hydrochloric acid
$HClO_4$	Perchloric acid
H_2SO_4	Sulfuric acid
HNO_3	Nitric acid
NaOH	Sodium hydroxide
NH_3	Ammonia
NH_4OH	Ammonium hydroxide
MEK	Methylethyl ketone

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
02-EF-01	02-104 -1	150	None	Explosive gases
03-EF-01	03-312 -1		None	ACET,ETOH
03-EF-02	03-316 -1		None	ACET,ETOH, Paint fumes,
03-EF-03	03-338 -1 03-338 -2 03-338 -3 03-338 -4	300	None	Explosive gases
03-EF-04	03-337 -1	520	None	Epoxy fumes
03-EF-05	03-328A-1	150	None	Explosive gases
26-EF-01	26-001 -1 26-001 -2 26-001 -3		None	Solder fumes,Oils, Metal vapors
27-EF-01	27-012 -1	650	None	ACET,ETOH,CH_2Cl_2, Toluene
28-EF-02	28-104A-1 28-104A-2 28-104A-3 28-105 -1	5,000	None	ACET,MEOH,IPOH, CH_2Cl_2,Bonding materials,Dust, Cutting oils
28-EF-06	28-005 -1	2,040	None	ACET,MEOH,IPOH CH_2Cl_2
28-EF-10	28-103 -3	1,000	None	ACET,MEOH,CH_2Cl_2
28-EF-11	28-103 -2	2,445	None	HCl,HF,H_2SO_4
28-EF-13	28-112 -2	1,250	None	HCl,HF,H_2SO_4

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
28-EF-18	28-108 -1 28-112 -1 28-112 -3	1,250	None	ACET,MEOH,ETOH,IPOH, CH_2Cl_2
28-EF-19	28-103 -1 28-108 -2	1,520	None	HCl,HF,H_2SO_4,ACET, IPOH
29-EF-03	29-005 -1 29-008 -1 29-008 -2 29-011 -1 29-013 -1 29-013 -2 29-013 -3 29-013 -4	18,890	HEPA Filter	ACET,Asbestos,DAP
29-DC-01	29-008 -3		Bag House	Asbestos,DAP
30-EF-01	30-001 -1		None	Metal vapors
36-EF-01	36-002 -1	350	None	ACET,ALC,Freon
36-EF-02	36-002 -2	825	None	MEOH
36-EF-03	36-003 -1	1,500	None	CH_2Cl_2
37-EF-01	37-004 -1 37-004 -2 37-004 -3 37-004 -4	3,500	Scrubber	Cyclohexane,HF,ACET, ALC,IPOH,CH_2Cl_2,H_2, Epoxy,Mineral oil,

PRELIMINARY COPY

Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
SM/PP Stack	38-005A-1	32,000	Acid Scrubber + HEPA Filter	NaOH
	38-106 -1 38-111 -1 38-111 -2 38-113 -1 38-113 -2 38-113 -3 38-113 -4 38-113 -5		HEPA Filter	Radioactive vapors and particles, Acid fumes, ACET, IPOH
40-EF-02	40-005 -1	150	None	Developing fluids
40-EF-03	40-007 -1	390	None	Press cleaning fluids
42-EF-01	42-105 -1	340	None	ACET, ETOH, CH_2Cl_2
42-CHF-01	42-101A-1	4,500	None	MEOH, ETOH, CH_2Cl_2 Toluene, Chloro. Dimethyl., HYLSUL
42-CHF-02	42-108 -1	2,400	None	ACET, ETOH, CH_2Cl_2
42-CHF-03	42-109 -1	1,400	None	ACET, ETOH, CH_2Cl_2, Ether
43-EF-01	43-001 -1	600	None	Burnoff thermite materials
46-EF-05	46-001 -1 46-001 -2	130	None	Metal and Ceramic particles, HNO_3 and H_2SO_4 fumes

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
48-EF-03	48-205 -1	3,795	None	ACET,ALC, Ethyl Acetate
49-HF-01	49-107 -1	5,250	None	ACET,ALC,MEK, Solder fumes
	49-107 -2			
	49-107 -3			
	49-107 -4			
	49-107 -5			
	49-107 -6			
	49-107 -7			
49-HF-02	49-103 -1	3,600	None	ACET,MEK
49-HF-03	49-104 -1	1,850	None	ACET,ALC
49-HF-09	49-101 -1	1,035	None	ACET,ALC
	49-101 -2			
49-EF-01	49-124 -1	970	None	ACET,ALC
	49-124 -2			
	49-124 -6			
49-EF-02	49-124 -3	970	None	ACET,ALC, Solder fumes
	49-124 -4			
	49-124 -5			
49-EF-03	49-110 -3	1,350	None	ACET,ALC, Solder fumes
	49-110 -4			
	49-110 -5			
	49-110 -6			
49-EF-04	49-110 -1	970	None	ACET,ALC,1,1,1-TCE, Solder fumes
	49-110 -2			
51-EF-01	51-001 -1	700	None	ACET,IPA,MEOH
51-EF-02	51-001 -2	3,440	Spray Booth	Metal vapors

PRELIMINARY COPY

Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
60-EF-01	60-001 -1	4,050	None	ACET, ALC, CH_2Cl_2, Grinding oils
	60-003 -1			
	60-106 -1			
	60-106 -2			
60-EF-02	60-101 -1	675	None	ACET, H_2SO_4
60-EF-03	60-101 -2	675	Scrubber	HF
63-EF-01	63-009 -1	2,000	None	Explosive powders
92-EF- A	92-001 -1	-	None	IPOH, Bonding materials, Solder fumes
	92-001 -2			
	92-001 -3			
A-EF-02	A-172 -1	-	None	ALC
-	B-105 -1	(Recirculated to room)		
-	B-105 -2	(Recirculated to room)		
-	B-105 -3	(Recirculated to room)		
-	B-105 -4	(Recirculated to room)		
B-EF-01	B-105B-1	4,810	None	ACET, ETOH, MEOH, IPOH, DAP, HNO_3, H_2SO_4, Freon, Solder fumes
	B-105B-2			
	B-105B-3			
	B-112 -1			
	B-122 -1			
	B-122 -2			
	B-122 -3			
	B-126 -1			
	B-126 -2			
	B-126 -3			
	B-126 -4			

PRELIMINARY COPY

Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
B-EF-01	B-126 -5	4,810	None	ACET,ETOH,MEOH,IPOH, DAP,HNO_3,H_2SO_4, Freon,Solder fumes
	B-140 -1			
	B-140 -2			
	B-140 -3			
	B-140 -4			
	B-141 -1			
	B-141 -2			
	B-141 -3			
	B-141 -4			
	B-141 -5			
	B-141 -6			
B-EF-1A	B-153 -1	460	None	ACET,ETOH
B-EF-03	B-136 -1	3,280	None	ACET,IPOH,CH_2Cl_2, TCE,Toluene, 1,1,1-TCE,
B-EF- A	B-167 -1			
	B-167 -2			
	B-170 -1			
B-EF- B	B-165 -1	5,500	None	ACET,ETOH,IPOH, Bonding materials, Solder fumes
	B-165 -2			
	B-165 -3			
B-EF- C	B-164 -1	2,000	None	ACET,ETOH,IPOH, Toluene
	B-164 -2			
B-EF- D	B-154 -1	1,000	None	ETOH,Solvents
B-EF- E	B-157 -1	2,760	None	ACET,ETOH, Solder fumes
	B-157 -2			
	B-157 -3			
	B-157 -4			
DS-EF- 1	DS-125 -1	6,625	None	ACET,ETOH,CH_2Cl_2, 1,1,1-TCE,Freon, Bonding materials, Solder fumes
	DS-125 -2			
	DS-125B-1			
	DS-125B-2			

PRELIMINARY COPY

Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
DS-EF- 1	DS-125B-3	6,625	None	ACET,ETOH,CH_2Cl_2,
	DS-125B-4			1,1,1-TCE,Freon,
	DS-125B-5			Bonding materials,
	DS-127 -1			Solder fumes
	DS-127 -2			
	DS-127 -3			
	DS-127 -4			
DS-EF- 3	DS-251 -1	745	None	ACET,IPOH,
	DS-251 -2			Freon,
DS-EF- 4	DS-245 -1	1,250	None	ACET,ALC,Xylene
DS-EF- 9	DS-214 -1	-	None	ACET,ALC,
	DS-217 -1			Bonding materials
	DS-222 -1			
	DS-222 -2			
	DS-223 -1			
DS-EF-13	DS-118 -1	1,700	None	ACET,ETOH,CH_2Cl_2,
	DS-118 -2			Bonding materials
DS-EF-19	DS-124 -1	1,525	None	ACET,ALC,HCl
DS-EF-25	DS-218C-1	5,280	None	ACET,ETOH,MEOH,IPOH,
	DS-226 -1			CS_2,Freon
	DS-226 -2			
	DS-226 -3			
DS-EF-26	DS-130 -1	3,030	None	ACET,ALC,Freon,
	DS-132 -1			Paint, Solder and
	DS-133 -1			Oil fumes
	DS-135 -1			
DS-EF-27	DS-131 -1	1,080	None	ACET,ALC,Toluene,
				1,1,1-TCE,CCl_4
DS-S-PRV	DS-109B-1	530	None	ALC

PRELIMINARY COPY

Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
E-EF- A	E-101 -1 E-101 -2	990	None	HF, ACOH, CCl_4
E-EF- B	E-103 -1	800	None	ACET, ETOH
E-EF- C	E-112 -1 E-112 -2	525	None	ACET, ETOH, MEOH, Ether CH_2Cl_2, HF, HCl
E-EF- D	E-113 -1 E-113 -2 E-113 -3 E-113 -4	2,280	None	ACET, ETOH, NaOH, HCl, HNO_3, H_2SO_4
E-EF- E	E-107 -1 E-107 -2	1,450	None	NH_3, HNO_3, H_2SO_4
Unknown	E-119 -1	-	-	ACET, IPOH, CH_2Cl_2
E-EF- F	E-120 -1 E-120 -2	1,205	None	ACET, ETOH, CH_2Cl_2
E-EF- G	E-123 -6	480	None	ETOH, IPOH, Bonding materials
E-EF- H	E-123 -1 E-123 -2 E-123 -5 E-123 -7 E-123 -8	2,630 (Out of Service)	None	ACET, ETOH, IPOH, Bonding material, Solder fumes, Epoxy
E-EF- I	E-130 -1 E-130 -2	1,500	None	ACET, ETOH, CH_2Cl_2
E-EF- J	E-123 -3 E-123 -4 E-123 -9	1,400	None	ETOH, Bonding materials, Solder fumes
E-EF- K	E-130 -3 E-130 -4	730	None	Solder fumes
E-EF- L	E-157 -2	600	None	MEOH, HCl, HNO_3, CH_2Cl_2, H_2SO_4

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
E-EF- M	E-157 -1	750	None	MEOH, HCl, HNO_3, CH_2Cl_2, H_2SO_4
E-EF- N	E-158 -1	2,800	None	ACET, ETOH, CH_2Cl_2
	E-158 -2			
	E-158 -3			
	E-158 -4			
	E-167 -1			
E-EF- O	E-174 -1	1,200	None	ACET, ETOH, HF, HNO_3, H_2SO_4, ACOH, Lactic acid, Glyerol
	E-174 -2			
E-EF- P	E-174 -3	750	None	$HClO_4$
E-EF- Q	E-176 -1	1,200	None	Metal particles
	E-176 -2			
E-EF- R	E-187 -1	600	None	Oil vapors
E-EF-1C	E-141 -1	16,000	None	HCl, HNO_3, H_2SO_4
	E-142 -1			
	E-142 -2			
	E-142 -3			
	E-143 -1			
	E-143 -2			
	E-144 -1			
	E-144 -2			
	E-150 -1			
	E-156 -1			
	E-156 -2			
H-EF-01	H-103 -1	7,700	None	ACET, ALC, CH_2Cl_2, Acetonitrile, Benzo-nitrile, HCl, HNO_3, H_2SO_4
	H-103 -3			
	H-104 -1			
	H-106 -1			
	H-106 -2			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
H-EF-02	H-103 -2	1,350	None	ACET,ALC, HCl,HNO_3,H_2SO_4
HH-EF-01	HH-008 -5	3,000	None	SO_2,He,N_2
HH-EF-02	HH-008 -4	2,345	None	ACET,CH_2BrCl,
	HH-011 -1			CH_2Cl_2,
	HH-122 -1			CS_2,H_2,SO_2,H_2SO_4
HH-EF-04	HH-024 -1	900	None	CS_2,CO,SO_2,NH_3,HCl, CH_4,H_2
HH-EF-05	HH-022 -1	615	None	ACET,IPOH,CO_2,H_2
HH-EF-07	HH-022 -2	2,890	None	CS_2,C_2H_5Cl,C_4H_7Cl,
	HH-022 -3			Hg vapors,H_2
	HH-023 -1	(Out of Service)		CS_2,NaOH,$NaHSO_3$
HH-EF-19	HH-008 -1	2,145	None	ACET,MEOH,CH_2Cl_2,
	HH-008 -2			CS_2,Toluene
	HH-008 -3			
HH-EF-20	HH-005 -1	1,600	None	CS_2
HH Stack	HH-018 -1	1,000	None	H_2,T_2
	HH-018 -2			
	HH-018 -3			
I-EF-02	I-053 -1	-	None	
I-EF-04	I-102B-1	630	None	Solder fumes
I-EF-06	I-002 -1	760	None	ACET,IPOH,CH_2Cl_2, Freon
I-EF-07	I-002 -2	1,710	None	ACET,IPOH,CH_2Cl_2,
	I-101 -1			Freon,Solder fumes
	I-101 -2			
I-EF-08	I-104 -1	3,000	None	ALC,Bonding materials

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
I-EF-09	I-002 -3	170	None	Solder fumes
	I-002 -4			
M-EF-01	M-007 -2	11,100	Bag House	Metal particles,
	M-007 -3			Plastic vapors,
	M-007 -4			Oil vapors
	M-007 -5			
	M-007 -6			
	M-007 -7			
	M-007 -8			
	M-007 -9			
	M-007 -10			
	M-007 -11			
	M-007 -12			
	M-007 -13			
	M-007 -14			
	M-007 -15			
	M-007 -16			
	M-007 -17			
	M-007 -18			
	M-007 -19			
	M-007 -20			
	M-007B-1			
M-DC-01	M-038A-1	820	Particle	Metal particles,
	M-038A-2		Filter	Plastic vapors,
	M-038A-3			Oil vapors
M-EF-02	M-003 -1	10,200	Bag house	Metal particles,
	M-003 -2			Plastic vapors,
	M-003 -3			Oil vapors
	M-003 -4			
	M-003 -5			
	M-028 -3			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
M-EF-02	M-028 -4	10,200	Bag house	Metal particles, Plastic vapors, Oil vapors
	M-028 -5			
	M-028 -6			
	M-028 -7			
	M-028 -8			
	M-028 -9			
	M-028 -10			
	M-028 -11			
	M-028 -12			
	M-103 -1			
	M-103 -2			
	M-103 -3			
	M-103 -4			
	M-103 -5			
	M-103 -6			
	M-103 -7			
	M-103 -8			
	M-103 -9			
	M-103 -10			
	M-103 -11			
M-EF-03	M-007A-1	1,250	None	ACET, ETOH, CH_2Cl_2
M-EF-04	M-007 -1	760	None	ACET, ETOH, CH_2Cl_2, 1,1,1-TCE
M-EF-05	M-007 -21	760	None	ACET, ETOH, CH_2Cl_2,
M-EF-[illegible]A	M-108 -14	10,360	None	HCl, HNO_3, H_2SO_4, NaOH, Metal particles, Oil fumes, Plastic fumes
	M-108 -15			
	M-108 -16			
	M-108 -17			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
M-EF- A	M-108 -18	10,360	None	HCl, HNO_3, H_2SO_4, NaOH, Metal particles, Oil fumes, Plastic fumes
	M-108 -19			
	M-108 -20			
	M-108 -21			
	M-108 -27			
	M-108 -28			
	M-108 -29			
	M-108 -30			
	M-108 -31			
	M-108 -32			
	M-108 -33			
	M-108 -34			
	M-110 -1			
	M-110 -2			
	M-110 -3			
	M-110 -4			
M-EF- B	M-108 -1	1,740	None	ACET, Oil fumes
	M-108 -2			
	M-108 -3			
M-EF- C	M-108 -4	6,715	None	HCl, HNO_3, H_2SO_4, $CrO_4^{=}$ vapors, Metal particles
	M-108 -5			
	M-108 -6			
	M-108 -7			
	M-108 -8			
	M-108 -9			
	M-108 -10			
	M-108 -11			
	M-108 -12			
	M-108 -13			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
M-EF- D	M-108 -22	2,250	None	Cyanides,HCl, Metal particles
	M-108 -23			
	M-108 -24			
	M-108 -25			
	M-108 -26			
M-EF- E	M-225 -1	650	None	ALC,Paint fumes
M-EF- F	M-008 -1	1,000	None	Metal particles, Plastic particles, Plastic fumes,Oil vapors
	M-008 -2			
	M-008 -3			
	M-008 -4			
	M-008 -5			
	M-008 -6			
Unknown	M-008 -7	(Missing inventory)		Metal particles, Plastic vapors, Oil vapors
	M-008 -8	(Missing inventory)		
	M-008 -9	(Missing inventory)		
	M-019 -1	(Missing inventory)		
	M-019 -2	(Missing inventory)		
	M-019 -3	(Missing inventory)		
	M-019 -4	(Missing inventory)		
	M-019 -5	(Missing inventory)		
	M-019 -6	(Missing inventory)		
	M-019 -7	(Missing inventory)		
	M-019 -8	(Missing inventory)		
	M-019 -9	(Missing inventory)		
	M-019 -10	(Missing inventory)		
	M-019 -11	(Missing inventory)		
	M-019 -12	(Missing inventory)		
	M-019 -13	(Missing inventory)		
	M-019 -14	(Missing inventory)		
	M-019 -15	(Missing inventory)		
	M-019 -16	(Missing inventory)		

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
Unknown	M-019 -17	(Missing inventory)		Metal particles,
	M-020 -1	(Missing inventory)		Plastic vapors,
	M-028 -1	(Missing inventory)		Oil vapors
	M-028 -2	(Missing inventory)		
PS-EF- A	PS-001 -1	6,000	Spray booth	Paint,Toluene,Xylene
PS-EF- B	PS-002 -1	8,000	None	Toluene,Xylene
R-EF-02	R-162 -1	2,900	None	HCl,HF,HNO_3,H_2SO_4
	R-162 -2			
	R-162 -3			
	R-162 -4			
	R-162 -5			
RE-EF-01	R-021 -2	675	Particulate Filter	Radioactive and
	R-021 -3			nonradioactive
	R-021 -4			particulates
RE-EF-02	R-022 -1	2,300	None	Hg vapor,ACET,
	R-022 -2			Xylene,Cutting oils
	R-023 -1			
RE-EF-03	R-021 -1	6,300	Particulate Filter	Benzene,Chloroform,
	R-024 -1			Dimethyl sulfoxide,
	R-025 -1			Dimethly formamid,
	R-025 -2			CH_2Cl_2,
	R-025 -3			Hexane,H_2O_2,NH_3,
	R-030 -1			HCl,HNO_3,H_2SO_4
	R-033 -1			
RE-EF-05	R-169 -1	2,400	None	HCl,HNO_3,H_2SO_4
	R-169 -2			
	R-169B-1			
R-V-166	R-166 -3	1,600	Scrubber	HCl,HF,HNO_3,H_2SO_4
	R-166 -4			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
R-V-177 HEFS Stack	R-177 -1	765	None	HCl, HNO_3, H_2SO_4
	R-106 -1	111,721	HEPA Filters	ACET, ETOH, IPOH, Ether, H_2, D_2, T_2, HTO, H_2SO_4
	R-106 -2			
	R-108 -1			
	R-108 -2			
	R-113 -1			
	R-114 -1			
	R-114 -2			
	R-116 -1			
	R-116 -2			
T-West	R-127 -1	41,440	Demsters, Prefilters, HEPA Filters	ACET, MEOH, ETOH, IPOH, Toluene, Ether, HCl, HNO_3, H_2SO_4, H_2, D_2, T_2, HTO, Alpha radioactivity
	R-127 -2			
	R-127 -3			
	R-128 -1			
	R-128 -2			
	R-128 -3			
	R-128 -4			
	R-128 -5			
	R-128 -6			
	R-128 -7			
	R-128 -8			
	R-128 -9			
	R-128 -10			
	R-128 -11			
	R-134 -1			
	R-134 -2			
	R-140 -1			
	R-140 -2			
	R-159B-1			
	R-159B-2			
	R-164 -1			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
T-West	R-166 -1 R-166 -2 R-167 -1 R-167 -2 R-167 -3 R-167 -4 R-168 -1 R-168 -2 R-170 -1 R-170 -2 R-171 -1 R-172 -1 R-172 -2 R-179 -1 R-181 -1	41,440	Demsters, Prefilters HEPA Filters	ACET,MEOH,ETOH,IPOH, Toluene,Ether,HCl, HNO_3,H_2SO_4,H_2,D_2,T_2, HTO,Alpha radioactivity
1C-N Stack	SW-022 -1 SW-022 -2 SW-132 -1 SW-132 -2 SW-140 -1	18,241	HEPA Filters	ACET,MEOH,HNO_3, H_2SO_4,Alpha radioactivity
HEFS Stack	SW-002 -1 SW-002 -2 SW-008 -1 SW-008 -2 SW-008 -3 SW-008 -4 SW-009 -1 SW-009 -2 SW-013 -1 SW-013 -2 SW-013 -3	111,721	HEPA Filters	ACET,MEOH,ETOH,HCl, HNO_3,Cyanides, H_2,D_2,T_2,Oil fumes Alpha radioactivity, Metal particles

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
HEFS Stack	SW-013 -4	111,721	HEPA Filters	ACET,MEOH,ETOH,HCl, HNO_3,Cyanides, H_2,D_2,T_2,Oil fumes Alpha radioactivity, Metal particles
	SW-013 -5			
	SW-013 -6			
	SW-013 -7			
	SW-013 -8			
	SW-013 -9			
	SW-013 -10			
	SW-013 -11			
	SW-019 -1			
	SW-019 -2			
	SW-019 -3			
	SW-019 -4			
	SW-021 -1			
	SW-021 -2			
	SW-021 -3			
	SW-021 -4			
	SW-021 -5			
	SW-021 -6			
	SW-142 -1			
	SW-142 -2			
	SW-142 -3			
	SW-142 -4			
	SW-200 -1			
	SW-200 -2			
	SW-200 -3			
	SW-205 -1			
	SW-205 -2			
	SW-205 -3			
	SW-205 -4			
	SW-208 -1			
	SW-208 -2			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
NCDPF Stack	SW-125 -1	16,732	HEPA Filters	ACET,MEOH,H_2,D_2,T_2, Alpha radioactivity
	SW-150 -1			
	SW-150 -2			
	SW-150 -3			
	SW-150 -4			
	SW-150 -5			
	SW-238 -1			
	SW-238 -2			
	SW-240 -1			
	SW-240 -2			
T-E -03	T-307 -1	5,000	None	ACET,ETOH,TCE,H_2, T_2,HTO
	T-307 -2			
	T-307 -3			
	T-307 -4			
T-E -22	T-011 -1	32,000	HEPA Filter	ACET,ETOH,IPOH, CH_2Cl_2,H_2,T_2,HTO, Ethylene glycol
	T-011 -2			
	T-011 -3			
	T-015 -1			
	T-017 -1			
	T-037 -1			
	T-040 -1			
	T-048 -1			
	T-048 -2			
	T-050 -1			
	T-050 -2			
	T-058 -1			
	T-058 -2			
	T-058 -3			
	T-059 -1			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
T-E -31A	T-027 -1	5,000	None	ACET,ALC,TCE,Cl_2, NH_3,NH_4OH,T_2,Alpha radioactivity
	T-244 -1			
	T-246 -1			
	T-246 -2			
T-E -31B	T-061 -1	10,000	HEPA Filter	ACET,ALC,T_2,HTO
T-HE-12A	T-323 -1	900	None	ACET,ALC,Metal particles,Cutting oils
	T-323 -2			
T-HE-12B	T-315 -1	1,070	None	ALC,Acids
T-HE-23	T-214 -1	5,000	None	ACET,ALC,Hg vapors, Paint fumes
	T-214 -2			
	T-216 -1			
	T-218 -1			
	T-226 -1			
	T-227B-1			
	T-230 -1			
	T-248 -1			
	T-252 -1			
W-EF-01	W-125 -1	25,500	None	Weld and Solder fumes
	W-130 -1			
	W-130 -2			
	W-130 -3			
	W-130 -4			
	W-130 -5			
	W-130 -6			
	W-130 -7			
	W-130 -8			
	W-130 -9			
	W-130 -10			
	W-131 -1			

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Mound Plant Source Emission Inventory

Ventilation Hoods

Emission Point	Hood Number	Flow (cfm)	Control Equipment	Air Contaminant
W-EF-03	W-132 -2 W-132 -3	2,600	Particle Filter	Metal particles
W-EF- A	W-135 -5 W-135 -6	800	None	ACET,ETOH,CH_2Cl_2
W-EF- B	W-135 -1 W-135 -2 W-135 -3	2,000	None	ACET,ETOH,NH_3, Cleaning compounds,
W-EF- C	W-136 -1	800	None	Solvents,Acids
W-EF- D	W-132 -1	100	None	Metal particles
W-EF- E	W-117 -1	2,250	None	Unknown
WDALR Stack	WD-001B-1 WD-001B-2 WD-101 -1 WD-104 -1 WD-110 -1 WD-112 -1 WD-112 -2 WD-118B-1	17,784	HEPA Filters	ACET,Radioactive particles and vapor, HCl,HNO_3,H_2SO_4,ACOH

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Appendices

APPENDIX A
SURVEY PARTICIPANTS

PRELIMINARY COPY 28

MOUND SURVEY PARTICIPANTS
AUGUST 18-29, 1986

DOE

Team Leader	R. Aiken
Assistant Team Leader	J. Boda
Operations Office Representative	R. Peterson

TECHNICAL SPECIALISTS

Waste Management/Contractor Coordinator	P. Alexandro, NUS
Surface Water	C. Winklehaus, ICF
Air	H. Firstenberg, NUS J. Glissmeyer, PNL
Radiation	W. Joyce, NUS
Inactive Waste Sites	K. Walter, NUS
Hydrogeology	W. Murray, NUS
Quality Assurance/TSCA	P. Byrne, NUS

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Ref. 62

CONTACT REPORT

Mound
Richard Janowiecki - Mound
Donna Gorby-Lee - RAPCA

December 21, 1987

GDF Inspection

The purpose of this visit was to conduct a GDF inspection for a first issue PTO. There is an above-ground unleaded gas tank and a diesel fuel tank. A tanker truck was delivering gas--he was hooked up to the vapor balance system. Permit can be approved.

DG-L/klp
12/29/87

...ance Street
...ox 1405
...andria, Virginia 22313
836 6210

Management
Consultants

Ref. 83

No. 68-01-7038
Rec'd FEB 17 1987
By [illegible]
File 05-13-12

February 11, 1987

ATKEARNEY

Ms. Pat Vogtman
Regional Project Officer
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, IL 60604

Reference: EPA Contract No. 68-01-7038; Work Assignment No. R05-13-12; Completeness/Technical Review of Part B Application United States Department of Energy - Mound, Miamisburg, Ohio; OH6890008984; Final Deliverable

Dear Ms. Vogtman:

We have completed our review of the above-referenced application. Attached please find the completeness/technical checklist, technical exhibits, and associated deficiency comments.

The Part B Application addressed the following RCRA-regulated units:

- Containerized hazardous waste storage unit (Building 72)
- Containerized mixed radioactive waste storage unit (Building 23)
- Containerized explosive waste storage unit (Magazine 53)
- Containerized pyrotechnic material storage unit (pyro shed)
- Glass melter incinerator
- Retort
- Thermal treatment unit "incinerator"
- Pyrotechnic waste conversion unit (biodegradation)
- Open burn area

Review of the application revealed that the majority of the applicable regulations were minimally addressed. The application also refers to several potentially RCRA-regulated units (see General Comments). The Part A application does not correlate with the Part B application in terms of waste constituents, quantities, and units. The applicant has been requested to address these issues accordingly.

MIXED RADIOACTIVE WASTES

The issue of jurisdiction over mixed radioactive waste was raised during the review. Based on a conversation with Jim Michaels of the EPA-HQ, and the July 3, 1986 Federal Register entitled "Part VI, Environmental Protection Agency, Hazardous Waste: State Authorization to regulate Hazardous Components of Radioactive Mixed Waste; Notice", it was verified that both the EPA and the Nuclear Regulatory Commission (NRC) have jurisdiction over mixed radioactive wastes. The EPA regulates the hazardous aspects of the wastes with RCRA while the NRC regulates the radioactive aspects. To address these situations, EPA coordinates the permitting of these facilities with the NRC in an effort to properly and completely regulate all appropriate units. Mr. Michaels also stated that when Ohio receives state authorization, the authorization will not include regulation of mixed radioactive wastes. Consequently, the permitting of this facility will remain a federal or state/federal responsibility until the state obtains authorization for the radioactive mixed waste component.

OPEN BURNING/OPEN DETONATION OF EXPLOSIVE WASTES

Section 4.3.1 (Open Burning) of the Part B Application states that "Open burning of explosive-contaminated waste is conducted on an as needed basis...." Based on the November 7, 1986, Federal Register entitled "Part VIII, Environmental Protection Agency; 40 CFR Parts 260, 264, and 270; Hazardous Waste Management System; of Miscellaneous Units; Proposed Rulemaking" (Subpart X), open burning of explosive hazardous waste is not currently regulated as a permittable unit under RCRA.

Open burning/open detonation of explosive wastes are covered under and should be permitted under the proposed Subpart X. Consequently, once the subpart is adopted, the burn areas will qualify for permitting. It should also be understood that when Ohio receives state authorization, the authorization probably will not include Subpart X. Consequently, the permitting of the burn areas will remain a federal or state/federal responsibility until the state obtains authorization for Subpart X.

OVERVIEW OF THE INCINERATORS

The Incinerator portion of the Mound Facility consists of (1) a glass melter furnace system, (2) a rotary kiln retort, (3) a batch drum "incinerator", and (4) a cyclone incinerator. The application focuses on the glass melter unit and provides only brief summaries of the retort, the batch "incinerator", and the cyclone incinerator.

The glass melter system consists of an electrically heated glass melter connected to a wet off-gas scrub system. The melter is an elongated chamber, heated by six electrodes and containing a pool of molten glass on the chamber floor. The glass acts as a heat sink which tends to maintain a uniform temperature within the chamber. Wastes and combustion gas pass through the chamber to a primary and secondary wet scrubber (spray chamber and venturi scrubber) followed by a high efficiency filter. In theory, a certain percentage of the ash contained in the waste feed material is entrained in the molten glass; the glass can be drained in either a continuous or batch mode.

The DOE has used the glass furnace (and its ash entrainment capabilities) for incinerating low-level radioactive wastes. In this permit application, DOE is proposing to incinerate hazardous wastes (including wastes contaminated with heavy metals) in the glass furnace. The results of an experimental burn are presented in the application.

The retort, as described briefly in the application, is a propane-fired rotary kiln that is used to incinerate explosive wastes. The batch "incinerator" incinerates explosive wastes in a 55 gallon drum placed in a 10-foot cubicle with steel-plate walls and an expanded metal screen roof. Neither of these combustion devices is equipped with pollution control devices. The cyclone incinerator includes a single-stage cyclonic combustion chamber, a wet off-gas treatment system, and a high-efficiency filter. It is a developmental unit which is available for hazardous waste treatment.

Based on discussions with control agency staff in Ohio, the DOE has operated the glass melter furnace as an experimental facility with very limited operation. The operation of the other thermal units is more uncertain.

INCINERATOR POLICY ISSUES

The following issues which relate to EPA policy were noted during the review of the Mound application:

Glass Melter Furnace

1. Full documentation of the test burn (i.e., original data sheets, QA/QC data, etc.) was not included in the application. Therefore, only a cursory review of methods and results could be completed. DOE must submit a detailed test report to allow a thorough audit of the test results.

2. The particulate testing involved single point sampling with a Method 5 train. Although the requirements for Method 5 sampling in a small duct (e.g., less than 7 in. at Mound) are vague, single point sampling is of questionable value. A more representative sample can be collected by using a number of sampling points (at least four points).

   The highest particulate emission rate may occur at a different location than the center point (which was sampled at Mound). Therefore, the particulate emission rate from the glass melter may have been biased.

3. The summary data for organic destruction (page 4-48) indicate good performance on organics. However, the statement on page 4-58 that the furnace has a uniform chamber temperature should be proved for normal operating rates. A potential problem is that the flue gas flow rate will get high enough that the heat transfer from the glass and the chamber walls will be inadequate to heat the combustion products to the required temperature. The off-gas temperatures in Table 4-21 seem to show that the gas exits at a temperature below that of the furnace. The location of the off-gas is not given with enough accuracy to help explain the difference.

4. Due to the unique features of the glass furnace, the RCRA requirements for automatic waste feed cutoff are not necessarily appropriate controls for this unit. EPA and DOE should discuss appropriate parameters to consider for automatic waste cutoff.

5. Although not a current part of the RCRA incineration regulations, the emission of significant amounts of toxic metals (or radioactive material) from an incinerator can have potential environmental and health impacts.

Retort Furnace

Based on the limited information provided in the permit application (pages 4-64 through 4-66), the retort appears to meet the definition of a RCRA incinerator. DOE-Mound must provide complete information in the permit application to obtain either a permit or an exemption (if applicable). The retort appears to be similar to the units installed at various military facilities (the military units typically are permitted as RCRA incinerators). Environmental concerns include uncontrolled emissions and the management of residual ash (unexploded waste, etc.).

Batch Drum "Incinerator"

The information provided for the batch unit in the permit application (page 4-66) is very incomplete. DOE-Mound must provide further information to obtain either a permit or an exemption (if applicable).

Cyclone Incinerator

The information provided for the cyclone incinerator in the permit application (page 3 of Appendix D) is also very incomplete. DOE-Mound must provide further information to obtain either a permit or an exemption (if available).

Should you have any questions, please contact me or Dennis Judd the Work Assignment Manager, who can be reached at 415/382-7844.

Sincerely,

Amy E. Schaffer for

Monica B. Roll
Technical Director

Enclosure

cc: K. Chiu, EPA Region V
D. Beasley
[redacted]
J. Gers
D. Judd, HLAN
B. Boomer, MRI

GENERAL COMMENTS
U. S. DEPARTMENT OF ENERGY: MOUND
MIAMISBURG, OHIO
OH6890008984

The Part B application makes reference to a number of units, listed below, which could potentially qualify as RCRA regulated units. Amend Part A application to include any of these units which are RCRA regulated. In addition, amend the Part B application to fully address all regulations applicable to these units.

The Contingency Plan (Figure 2, Appendix D) lists the following potential hazardous waste management units.

- Radioactive Waste Disposal (WD)
- Burn Area Firing Shed (13)
- Thorium Sludge Storage (21)
- Waste Materials Staging Center (23)
- Contaminated Materials Storage (31)
- Incinerator (51)
- Effluent Water Continuous Monitoring System (55)
- Chemical Waste (72)
- Sanitary Disposal (SD)
- Chemical Storage/Handling - WD Building, Dock WD-3

Section 6.2 (Site Activities) of the Contingency Plan also describes:

- Bunker 53 for storage of solid hazardous explosive waste

- A cyclone incinerator that includes a single-stage cyclonic conduction chamber, a wet off-gas treatment system, and a high frequency filter.

The open burning/open detonation of explosive wastes is not currently regulated as a permitable unit under RCRA. The November 7, 1986, Federal Register entitled, "Part VIII, Environmental Protection Agency; 40 CFR Parts 260, 264, and 270; Hazardous Waste Management System; Standards for Owners and Operators of Miscellaneous Units; Proposed Rulemaking," addresses open burning of explosive wastes under proposed Sub-part X. Consequently, the

open burning area could not be reviewed as a regulated unit for the purpose of being included in the RCRA permit based on existing regulations. USDOE Mound is advised, however, to incorporate a complete section on the burn area within the Part B Application. This will be beneficial in the event the proposed regulations are adopted prior to the RCRA permit for USDOE Mound being issued.

COMPLETENESS AND TECHNICAL REVIEW
U. S. DEPARTMENT OF ENERGY: MOUND
MIAMISBURG, OHIO
OH6890008984

A. PART A APPLICATION: 270.13

Provide a clear copy of Figures 3 and 4 of the Part A Application.

The Part A Application states that there is a process design capacity for container storage of 19,250 gallons. The Contingency Plan (Appendix D) states that Building 72 is "capable of holding 360 55-gallon drums single stacked or 720 drums if double stacked," for a maximum storage capacity of 39,600 gallons (720 x 55). Section 4.1.1 of the Part B Application states that this building "is capable of holding 350 55-gallon drums." In Appendix E, the maximum waste inventory provided in the Closure Cost Estimates for the four closure plans indicate different storage capacities than either of these figures. Resolve these discrepancies and revise the Part A Application, Section 4.1.1 of the Part B Application, the Contingency Plan, and the Closure Plan accordingly. Clarify if the additional container storage capacities of Building 23, Magazine 53, and the pyrotechnic waste shed, as stated in the Contingency Plan and the Closure Plan, are included in the container storage process design capacity as provided in the Part A Application.

Revise the Part A Application to include all RCRA-regulated units (see page 1, General Comments).

B. FACILITY DESCRIPTION

B-2 Topographic Map:

B-2a General Requirements: 270.14(b)(19)

Provide the map scale on Topographic Maps A-2 and A-3. The term "graphic" that was provided in the scale section does not clearly indicate the map scale. The figures (maps) must be at a scale of 1 inch equal to not more than 200 feet.

Revise Figure 1-6, "Surface Water and Land Uses Around the Site," so that it clearly shows the surrounding land uses up to a distance of 1000 feet from the site boundaries. The copy

provided was illegible and at a scale of 1 inch equals 2000 feet. The figure (map) must be at a scale of 1 inch equal to not more than 200 feet.

Revise Table 1-1 and Topographic Map A-4 to include the locations of the pyro shed and the pyrotechnic waste conversion unit, as described in Section III C of the Part A Application. In addition, provide the location(s) of fire control facilities other than the fire station (i.e., fire hydrants). Revise Topographic Map A-4 to include the location of the sewer lines for the facility.

Revise Fig. 1-14 to clearly show the pick-up locations and travel routes. The copy provided was illegible. The figure (map) must be at a scale of 1 inch equal to not more than 200 feet.

B-4 Traffic Information: 270.14(b)(10)

Section 1.13.2 of the Part B Application states that construction traffic has badly deteriorated some roads at the Mound Site. Supply documentation from the Bowser-Morner Testing Laboratories, Inc. Report or other information from Shaw, Weiss and De Naples Consulting Engineers, (as referenced in Section 1.13.2 of the Part B Application), which shows the adequacy of access roadway surfaces and load-bearing capacity for the onsite traffic. This information should also address the deteriorated roads mentioned above.

C. WASTE CHARACTERISTICS

C-1 Chemical and Physical Analyses: 264.13(a), 270.14(b)(2)

Provide information on hazardous characteristics and the basis for hazard designations of wastes as provided in Appendix C, C-1 Waste Analysis Data. It is difficult to correlate the waste analysis data provided in Appendix C, and C-1, to the Description of Hazardous Wastes provided in Section IV of the Part A Application. For example, the Part A Application lists seven D002 waste streams and the Waste Analysis Plan lists 23 D002 waste streams. Provide a clear correlation between all of the wastes listed in the Part A Application and those listed in Appendix C. Both documents must address all hazardous wastes managed at the Mound facility. Provide the source of information (i.e., laboratory report) which contains the chemical and physical analyses presented in Appendix C, Section C-1, and correlate the analyses with the appropriate

waste streams. The applicant may wish to refer to the EPA guidance manual entitled, Waste Analysis Plans - A Guidance Manual, EPA # 1 530-SW-84-012, Oct. 1984.

In the attached Closure Plans (Appendix E), it is stated that "The composition of virtually all hazardous waste generated at the site is known from process conditions; hence hazardous waste characterization is accomplished by declaration instead of chemical analysis." Then in the same paragraph it is also stated "However, chemical analyses will be conducted to identify unknown wastes." Clarify this situation. Note that a waste description, along with a laboratory report is necessary for each hazardous waste stored, treated, or disposed of at the facility.

C-1a Containerized Waste: 270.15(b)(1)

The applicant states in Section 3.2.7, page 3-4, that EPA Method 9095 will be used as needed. However, owners and/or operators that store containers of wastes in areas without a secondary containment system must provide the test procedures and results, or other documentation or information which show that the wastes do not contain free liquids. Provide the test results, or other documentation or information which show that (the containerized) wastes do not contain free liquids. Section 3.2.7 of the Part B Application states that the Paint Filter Liquids Test, Method 9095 in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods," EPA Publications No. SW-846, will be used; however, the waste analysis plan does not address this. Revise the waste analysis plan to incorporate the use of the Paint Filter Liquids Test

C-1e Waste Incinerated: 270.62(b)(2)(i)

Provide specific criteria for the selection of wastes to be incinerated on-site. Provide a list of minimum and maximum values for the selection criteria (including maximum allowable hazardous constituent concentrations) due to potential routine variations, in the waste composition. The applicant may wish to refer to Guidance Manual for Hazardous Waste Incineration Permits, SW-966, U.S. EPA, 1983 for assistance.

C-2a Parameters amd Rationale: 264.13 (b)(1)

List the "major components" that will be analyzed in Table 3-1. If, for example, cyanide processes are used in plating

operations, the plating wastes should be analyzed for the presence of cyanide.

D. PROCESS INFORMATION

D-1 Containers

D-1a Containers with Free Liquids

Clarify if containers of wastes in Building 72, 23, and Magazine 53 and the pyrotechnic waste shed will or will not contain free-standing liquids. From the information submitted in the Part B Application, it appears probable that containers of waste stored in Buildings 72 and 23 may contain free liquids, and that containers of waste stored in Magazine 53 and the pyrotechnic waste shed may not contain free liquids. Consequently, comments D-1a(1) through D-1a(3)(e) pertain to Building 72 and 23, and Comments D-1a(1) through D-1b(4) pertain to Magazine 53 and the pyrotechnic waste shed. However, comments D-1a(1) through D-1a(3)(e) must be addressed for any of these units which will store containers with free-standing liquids. Similarly, Comments D-1b(1) through D-1b(4) must be addressed for any of the above units which will not store containers with free-standing liquids.

D-1a(1) Description of Containers: 264.171, 264.172

Provide the following information about the containers used to store hazardous waste: approximate number of each type of container if more than one type is used; construction materials; dimensions and useable volumes; Department of Transportation (DOT) specifications or other manufacturer specifications; specifications for any liners used; container condition (new, used, reconditioned), and markings and labels.

D-1a(2) Container Management Practices: 264.173

Indicate the aisle space maintained between rows of containers and provide the maximum number, volume, and stacking height of containers stored in each diked bay of Building 72, and the radioactive mixed waste storage portion of Building 23.

D-1a(3) Secondary Containment System Design and Operation: 270.15(a)(1) 264.175(a), 264.175(d)

Provide design and profile drawings of Building 72 that show the secondary containment system. Include the dimensions of

the dikes and the sloped floors. The drawings must include details of the drain and 55-gallon stainless steel drum at the center of the base of each bay. Indicate on the drawings the areas in which incompatible wastes will be stored.

Provide design and profile drawings of Building 23. The design and profile drawings must show the secondary containment system if containers with free-standing liquids are stored. The drawings must also include details of the floor drains and the "manually-controlled" concrete collection sump in Building 23.

D-1a(3)(a) <u>Requirement for the Base Liner to Contain the Liquids</u>: 264.175(b)(1)

Demonstrate the capability of the base of each bay in Building 72 and Building 23 to contain liquids, including:

- Statement that base is free of cracks or gaps.
- Demonstration of imperviousness of base to waste and precipitation
- Engineering evaluation of structural integrity of base
- Discussion of compatibility of base with liner.

D-1a(3)(b) <u>Containment System Drainage</u>: 270.15(a)(2), 264.175(b)(2)

Demonstrate for Building 23 that the base is sloped or that the containment system is designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation, unless the containers are elevated or are otherwise protected from contact with accumulated liquids.

D-1a(3)(c) <u>Containment System Capacity</u>: 270.15(a)(3), 264.715(b)(3)

For Building 72, provide the calculations which demonstrate that the 650-gallon containment capacity per bay is sufficient to contain 10% of the total volume of the containers or the volume of the largest container, whichever is greater.

For Building 23, provide calculations that demonstrate that the containment system has sufficient capacity to contain 10 percent of the total volume of the containers or the volume of the largest container, whichever is greater.

These demonstrations must discuss the volume of the largest container, total volume of containers, containment structure capacity, and volume displaced by containers and other structures in the containment system.

Clarify what is meant by "plywood is located between levels of stacked drums." Clarify if the plywood is used in lieu of pallets and how many levels of stacked drums there are.

D-1a(3)(d) Control of Run-on: 270.15(a)(4), 264.175(b)(4)

Run-on into the containment system must be prevented unless the collection system has sufficient capacity in excess of that required in paragraph D-1a(3)(c) above to contain any run-on that may enter the system. Describe the dikes, berms, drainage system or other facilities, used to prevent run-on, or provide calculations demonstrating that the containment system has sufficient excess capacity to contain run-on. A 24-hour, 25-year storm event may be used as the basis for the calculations.

D-1a(3)(e) Removal of Liquids from Containment System: 264.175(b)(5) and 270.15(a)(5)

Spilled or leaked waste and accumulated precipitation must be removed from the sump or collection area in a timely manner to prevent overflow of the containment system. Describe the procedures and equipment used during removal of liquids. Provide sump pump and piping drawings for Buildings 72 and 23; specify the methods used to determine if the material removed is a hazardous waste and for handling it as such.

D-1b Containers Without Free Liquids

From the information submitted in the Part B Application, it appears probable that containers of waste stored in Magazine 53 and the pyrotechnic waste shed may not contain free liquids. If this is the case, address comments D-1b(1) through D-1b(4) below. If free liquids are stored in Magazine 53 and the pyrotechnic waste shed, address all of the comments in Section D-1a.

D-1b(1) Test for Free Liquids: 270.15(b)(1)

Submit test procedures and results or other documentation or information to show that the wastes to be stored in the container storage area do not contain free liquids.

D-1b(2) Description of Containers: 264.171 and 264.172

Provide the following information about the containers used to treat/store hazardous waste: approximate number of each type

of container; construction materials; dimensions and useable volumes; DOT specifications or other manufacturer specifications; liner specifications (if applicable); container condition (new, used, reconditioned); and markings and labels.

D-1b(3) Container Management Practices: 264.173

Describe the container management practices used to ensure that hazardous waste containers are always kept closed during storage, except when adding or removing waste, and are not opened, handled, or stored in a manner that may cause them to rupture or leak. Include a discussion of procedures for transporting containers across the facility. Indicate the aisle space maintained between rows of containers and provide the maximum potential number, volume, and stacking height of containers for each area in which containers are stored.

D-1b(4) Container Storage Area Drainage: 270.15(b)(2) and 264.175(c)

Describe how the storage area is designed or operated to drain and remove liquids and/or describe how containers are otherwise kept from contact with standing liquids.

D-5 Incinerators

General: Provide complete information in the permit application to obtain either a permit or an exemption (if applicable) for the retort furnace (described on page 4-64) the batch "incinerator" (described on page 4-66) and the cyclone incinerator (described in Section 6.2 of the Contingency Plan).

***** NOTE: Comments D-5c(1) through D-5c(4)(a) apply to the Glass Melter Furnace:

D-5c(1) Engineering Description of Incinerator: 270.19(c)(2)

Waste Feed System: Describe the waste feed system used for liquid wastes and provide a more detailed description of the solid waste feed system.

Automatic Waste Feed Cutoff System: Describe the proposed system including parameters and set points, the actions mechanism, and calibration/testing. [Note: The request for a 5,000 ppm CO alarm point is far beyond the range that has been shown to produce acceptable results. Also, a maximum flue gas flow rate should be specified in the permit conditions in addition to the parameters given in Table 4-24.]

Process Monitoring:

1. Describe how the parameters on page 4-21 recorded.

2. Provide the ranges of the monitoring instruments.

3. Provide a more detailed description of the position of the sensors (the P&I diagram in Figure 4-5 is inadequate in detail).

Air Pollution Control Equipment:

1. Provide information on the interaction of the "cyclone incinerator" shown in Figure 4-4 with the glass melting furnace. If both units are in use, provide either a discussion of the effect of that unit or a description of the method to prevent air in leakage from the unit.

2. State in the application if the HEPA filters will be used when the furnace is burning hazardous wastes.

Stack Gas Monitoring: Provide a more detailed description of the CO and O_2 monitors and their sampling system including a sketch of the sample extraction and preparation system. Include the ranges of the instruments.

D-5c(4) Results of Previous Trial Burns: 270.19(c)(5)

Provide in the permit application a detailed report of the test burns including raw data, calculations, all sampling and analytical methods, and QA/QC results.

D-5c(4)(a) Sampling and Analysis Techniques: 270.19(c)(5)(i)

1. Provide further discussion on the validity of single point particulate sampling with a Method 5 train. Such a sample does not appear to be representative.

2. Figure 4-8 should indicate the distances to the velocity measuring points following the bend in the duct. Details of the traverse points used for the P-type pitot tube measurements and detailed comparisons of the pitot tube results with the Annubar results should be given.

3. The modification to the standard VOST sampling system should be justified. In particular, the efficiency of the modified train for the more volatile POHCs should be established.

4. The "Duncan Drill Brush" procedure used to recover the probe rinse should be described and justified.

5. The pressure drop across the Venturi during the test should be provided.

F. PROCEDURES TO PREVENT HAZARDS

F-1a(2)(a) Barrier: 264.14(b)(2)(i)

The site plan (Figure 1-8) referenced in the Securities Procedures and Equipment section (p. 5-1) of the application does not show the entry points, guard posts, and guard islands. Provide a site plan in which the entry points, guard posts, and guard islands are clearly indicated.

F-1a(3) Warning Signs: 264.14(c)

Additional signs must be posted, in sufficient numbers, to be seen from any approach to the active portion of the various units in addition to the signs posted at the various entrances.

F-2a General Inspection Requirements: 270.14(b)(5), 264.15(a), 264.15(b), and 264.33

The checklists, as provided in Figures 5-1 and 5-2, do not address inspection of all of the health and safety and spill control equipment discussed in the contingency plan. Revise the checklists to include all of the equipment listed in the contingency plan. An example of additional equipment in the contingency plan which was not included in the checklists is "protective clothing and equipment including face shields, gloves, aprons, etc." In addition, revise the checklist to incorporate the inspection of security devices.

F-2a(1) Types of Problems: 264.15(b)(3)

The checklists must identify the types of problems to look for during the inspection of the health and safety equipment, spill control equipment, and safety devices.

F-2a(2) Frequency of Inspection: 264.15(b)(4)

Describe the frequency of inspection for the items listed in Comment F-2a(1). The frequency of inspection should be based on the rate of possible deterioration and malfunction of the equipment.

In addition to the weekly inspection of Building 72, the Frequency of Inspection Provision must also state that areas subject to spills, such as loading and unloading areas, be inspected daily when in use. Revise Section 5.2.1 to include the above stipulation.

F-2b(1) Container Inspection: 264.174

Demonstrate that the container storage areas are also inspected weekly for deterioration caused by corrosion and other factors. In addition, include inspection of the container containment systems where applicable.

F-2b(5)(a) Inspection of Incinerator and Associated Equipment: 264.347(b)

Describe the procedures for daily visual inspection of the incinerators and their associated equipment for leaks, spills, fugitive emissions, and signs of tampering. Provide an inspection form (the forms provided on pages 5-5 and 5-6 appear to be process log sheets).

F-3a(1) Internal Communication: 264.32(a)

Describe the internal communication or alarm system used to provide immediate emergency instruction (voice or signal) to facility personnel.

F-3a(2) External Communications: 264.32(b)

Specify where telephones are located in relation to hazardous waste units. Describe which waste management and emergency personnel are issued and rely upon hand-held radios. Indicate which communication equipment is also to be used for summoning emergency assistance from local police departments, fire departments, or state or local emergency response teams.

F-3a(4) Water for Fire Control: 264.32(d)

Demonstrate that the facility has water at adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers, or water spray systems.

F-3b Aisle Space Requirement: 264.35

Demonstrate that the facility maintains sufficient aisle space to allow unobstructed movement of personnel, fire protection equipment, or spill control equipment to any area of the facility in an emergency as stated in Section 5.3.3 on page 5-10 of the Part B Application

F-4b Run-off: 270.14(b)(8)(ii)

Describe the procedures, structures, or equipment used to prevent run-off from each hazardous waste handling area to other areas of the facility or the environment.

F-4c Water Supplies: 270.14(b)(8)(iii)

Being able to dike a street-level storm sewer in the vicinity of the storage area with spill control pillows and absorbents (page 5-11) does not adequately describe the procedures, structures, or equipment used to prevent contamination of water supplies. Describe how contamination of water supplies is prevented at each hazardous waste management unit, as well as for the entire facility.

F-5a Precautions to Prevent Ignition or Reaction of Ignitable or Reactive Wastes: 270.14(b)(9) and 264.17(a)

Describe the precautions taken to prevent ignition when ignitable or reactive wastes are handled. Precautions should include separation of these wastes from sources of ignition such as open flames, smoking, cutting and welding operations, hot surfaces, frictional heat, sparks (static, electrical, or mechanical), or radiant heat, and prevention of spontaneous ignition (e.g., heat-producing chemical reactions). Demonstrate that when ignitable or reactive waste is being handled, smoking and open flames are confined to specifically designated locations. "No Smoking" signs must be conspicuously placed wherever a potential hazard exists from ignitable or reactive wastes.

F-5b General Precautions for Handling Ignitable or Reactive Waste and Mixing of Incompatible Wastes: 270.14(b)(9) and 264.17(b)

Describe the precautions taken by a facility that treats, stores, or disposes of ignitable or reactive waste, or accidentally mixes incompatible waste or incompatible wastes and other materials, to prevent reactions that: (1) generate extreme heat or pressure, fire, explosions, or violent reactions; (2) produce uncontrolled flammable fumes, dusts, or gases in sufficient quantities to threaten human health or the environment; (3) produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosions; (4) damage the structural integrity of the device or the facility; or (5) by similar means threaten human health or the environment.

F-5d Management of Incompatible Wastes in Containers: 270.15(d), 264.177

Describe the procedure used by "Waste Management" (page 4-4) to approve wastes that can be stored in new drums, reconditioned drums, or re-used drums. Provide the procedures used to guarantee that incompatible wastes are never placed in the same container and/or in incompatible containers.

G. CONTINGENCY PLAN

General Comment. When providing the additional information requested in Section G, it must be understood that the contingency plan should be prepared as a stand-alone document. This is essential because the contingency plan is distributed to local fire departments, police departments, and hospitals. Consequently, the contingency plan should contain all required information within its text and should not refer the reader to other portions of the Part B Application.

G-2 Emergency Coordinators: 264.52(d), 264.55

Provide a statement of authorization for the coordinator to commit the necessary resources to carry out the plan.

G-3 Implementation: 264.52(a), 264.56(d)

Describe how the plan will be implemented.

G-4b Identification of Hazardous Materials: 264.56(b)

Describe procedures to identify what hazardous materials may be involved in an emergency situation.

G-4c Assessment: 264.56(c), 264.56(d)

Describe the criteria used to assess possible hazards to human health and the environment resulting from a fire, release, or explosion, and the need for evacuation and notification of authorities. Demonstrate the type and level of interaction between the Emergency Response Coordinator (ERC) and the DOE-DAO Manager during an emergency.

G-4d Control Procedures: 264.52(a)

Specify control procedures to be taken in the event of a fire, explosion, or release.

G-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases: 264.56(e)

Describe the steps necessary to ensure that fires, explosions, or releases do not occur, reoccur, or spread to other hazardous waste at the facility.

G-4f Storage and Treatment of Released Material: 264.56(g)

Describe procedures for treatment, storage, or disposal of any material that results from a release, fire, or explosion at the facility.

G-4g Incompatible Wastes: 264.56(h)(1)

Describe provisions to prevent incompatible wastes from being treated, stored, or located in an affected area until clean-up procedures are completed.

G-4h Post-emergency Equipment Maintenance: 264.56(h)(2)

Describe the procedures that are used to ensure that all emergency equipment listed in the contingency plan and used in an emergency incident is cleaned and fit for its intended use before operations are resumed. Clarify when and which decontamination processes are used, and how the determination is made that equipment is fit for reuse.

G-4i Container Spills and Leakage: 264.52, 264.171

Specify procedures to be used when responding to container spills or leakage, including procedures and scheduling for expeditious removal of spilled waste and repair or replacement of the container(s).

G-6 Coordination Agreements: 264.52(c) and 264.37

Coordination agreements for emergency support must be made with local police and fire departments, hospitals, contractors, and state and local emergency response teams, or their refusal to enter into a coordination agreement must be documented. Although the Mound facility maintains its own fire, security, and medical departments and the Miamisburg Fire Department has participated in practice drills with the Mound Fire Department, these agreements and the concomitant familiarity with the facility of the outside agencies are necessary in the event that a major fire or emergency occurs that is beyond the capacity of Mound personnel to control.

G-7 Evacuation Plan: 264.52(f)

Revise the evacuation sections of the contingency plan (Appendix D) to show primary and alternative evacuation routes.

G-8 Required Reports: 264.56(j)

Describe the provisions for submission of reports of emergency incidents within 15 days of occurrence, and maintenance of records identifying the time, date, and details of an emergency.

H. PERSONNEL TRAINING

H-1a Job Title/Job Description: 264.16(d)(1), 264.16(d)(2)

Provide the job title and description for each employee whose position at the facility is related to hazardous waste management.

H-1b Training Content, Fregency, and Techniques: 264.16(c) and 264.16(d)(3)

Revise the training program section to address the content, frequency, and techniques used in both introductory and continuing training courses (including an annual review of initial training) for each employee.

H-1c Training Director: 264.16(a)(2)

Demonstrate that the Waste Management Supervisor, who conducts all training sessions, is trained in hazardous waste management. In addition, demonstrate that all personnel serving as trainers, such as Monsanto Company or U.S. Doe employees or consultants for the hazardous waste training program are trained in hazardous waste management.

H-1d Relevance of Training to Job Position: 164.16(a)(2)

Demonstrate and clarify how the various topics used in the introductory and continuing training program are relevant to the appropriate facility personnel and their positions.

I. CLOSURE AND POST-CLOSURE REQUIREMENTS

General Comment

The following RCRA-regulated units are described in the Part A Application but were not addressed in the closure plans. Prepare Closure Plans for the following units:

- Magazine 53
- "Incinerator" (Thermal Treatment Unit)
- Retort
- Pyrotechnic Waste Conversion Unit

I-1a Closure Performance Standard: 264.111

The performance standards given for E-1 and E-2 (none were provided for E-3 and E-4) state that, after closure, the need for further maintenance is minimized; however, there is no discussion on how the need is minimized. Describe how closure minimizes the need for post-closure maintenance of wastes.

I-1b Partial Closure Activities: 264.112(a)(1)

The plans submitted in Appendix E of the Part B Permit Application and the statement on page 8-1 indicate partial closures will occur at the facility. Provide in each plan in Appendix E the identification of the maximum extent of operation at the facility after each partial closure.

I-1c Maximum Waste Inventory: 264.112(a)(2)

Building 72

The maximum potential waste inventory for the Building 72 Container Storage Facility as stated in Closure Plan E-1 is 320,000 pounds. The closure cost estimate states 25 drums. The Part A Application lists the capacity of the Container Storage Facility at 19,250 gallons which equates to 350 drums single stacked, and page 3 of the Contingency Plan states that 720 drums can be double stacked in the Container Storage Area. Resolve these discrepancies and use the maximum possible number of drums that can be stored in this unit when preparing the Closure Plan and when addressing the costs for final disposal of waste.

Building 23

The maximum waste inventory for the waste storage area in Building 23, as stated in Closure Plan E-2, is 200 drums, while the Closure Cost Estimate states 250 drums. Resolve this discrepancy using the maximum number of drums that can be stored in this unit.

Glass Melter Furnace

The maximum waste inventory for the glass melter furnace, as stated in Closure Plan E-3, is 100 drums, while the Closure Cost Estimate states 20 drums. Resolve this discrepancy and use the maximum number of drums that can be stored in this unit.

I-1d Inventory Removal, Disposal, or Decontamination of Equipment: 264.112(a)(3) and 264.114

All four closure plans state that the nature and extent of contamination and the evidence of residual hazardous waste after decontamination procedures will be determined by visual observation. That, "if necessary, samples of contaminating waste will be taken and analyzed..." Justify how visual observation alone can determine the extent and nature of contamination. Describe the parameters to be used to determine when samples will be taken and what they will be analyzed for.

I-1d(1) Closure of Containers: 264.178

Show that at closure all hazardous waste and hazardous waste residue will be removed from the containment system and how remaining containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous residues will be decontaminated or removed. Describe the sampling/testing procedures or other means to be used to ensure that no contamination remains on, in, or around the storage area and containment system.

The plans for Buildings 23 and 72 states "the composition of virtually all hazardous waste generated at the site is known from process conditions; hence, hazardous waste characterization is accomplished by declaration instead of chemical analysis." The same paragraph also states, "However, chemical analyses will be conducted to identify unknown wastes." Clarify this situation.

The certification of closure for the container storage areas must be signed by the owner or operator and by an independent registered professional engineer. Adjust the closure costs to reflect this change, if necessary.

I-1d(5) Closure of Incinerators: 264.351

Provide additional discussion of the methods used to "check for contamination" in auxiliary equipment and ducts.

The certification of closure must be signed by the owner or operator and by an independent registered professional engineer. Adjust the closure costs to reflect this change, if necessary.

I-1f Schedule for Closure: 264.112(a)(4)

Closure Plan E-1 states that Building 72 is planned to be closed during the year 2011. The plan further states that all closure activities will be completed within six months after approval of the Closure Plan. Resolve this discrepancy to account for the probability of this RCRA permit being issued before the year 2011. The 6-month (180-day) time period should be used for prior notification to the EPA Regional Administrator that closure activities will begin.

Resolve similar discrepancies in Closure Plan E-2, which indicates planned closure by 1990 and also states closure activities will be completed within six months of approval of the Closure Plan.

Resolve similar discrepancies in Closure Plan E-4, which indicates planned closure by 1999 and also states that the "Closure Schedule will be initiated" upon receipt of approval of the plan.

The schedule for closure for buildings 72 and 23 states that USDOE Mound will "temporarily relocate any remaining hazardous wastes that require analysis or cannot be shipped off site immediately to a limited access area until arrangements have been made for off site transport and disposal of the wastes." Indicate the length of time the wastes will be "temporarily relocated," and describe the limited access area.

I-4 Closure Cost Estimate: 270.14(b)(15), 264.142 and 264.197(c)(3)

Closure Plan E-1 (Building 72)

Clarify and address the following:

- Indicate if the wastes and the 2-foot by 4-foot by 7-foot steel boxes are disposed together or if the boxes are reused. If the boxes are reused, describe the decontamination procedures and associated costs.

- Clarify what is meant by the term "EPA-approved" in reference to the steel boxes.

- The Closure Cost Estimate addresses 78 boxes; however, it does not address the box being used for removal of electrical services. Revise the closure cost estimate to include the box being used for the removal of electrical services.

- The Closure Cost Estimate addresses 25 drums. (see comment under I-1c). The cost estimate must be based upon the maximum (worst-case) inventory.

- The Closure Cost Estimate stipulates $200 for transportation and disposal of each drum and $500 for disposal of each box. Justify that these figures address the transportation costs associated with the distance to the final disposal facility. Also confirm that the final disposal facility will be EPA-approved for the disposal of hazardous wastes.

- Provide costs associated with personal protective equipment which will be used during closure as described on pages 3 through 5 of the Closure Plan.

- Provide a cost breakdown for the analytical support figure provided. The breakdown should address the number and type of samples and analysis which will be conducted.

- Adjust closure costs to reflect certification of closure being performed by an independent registered professional engineer.

- Update the closure costs using an inflation factor.

Closure Plan E-2 (Mixed Waste Storage Area in Building 23)

Clarify and address the following:

- The Closure Cost Estimate stipulates $200 for disposal of each drum. Justify that these figures address the transportation costs associated with the distance to the final disposal facility.

- Confirm that the final disposal facility is approved to accept mixed radioactive wastes.

- Address the costs of transporting the wastes off-site. Clarify if the costs are included in the $200 fee for disposal of each drum.

- Provide a cost breakdown for identification and analysis of unknown wastes.

- Provide costs associated with personal protective equipment which will be used during closure as described on pages 3 through 5 of the Closure Plan.

- Clarify what "complete remaining activities" means in Section "G" of the cost estimate for closure.

- Adjust closure costs to reflect certification of closure being performed by an independent registered professional engineer.

- Update the closure costs using an inflation factor.

<u>Closure Plan E-3 (Glass Melter/Pyro Converter)</u>

Clarify and Address the following:

- The Closure Cost Estimate addresses "20 drums at $50" (see comment under I-1c). The cost estimate must be based upon the maximum (worst-case) inventory.

- Justify how the $50 figure given for containers allows for the cost of the drum and ITS transportation and final disposal. Also confirm that the final disposal facility will be EPA-approved.

- Clarify what is meant by the term "materials" in the Closure Cost Estimate and present a cost breakdown.

- Describe the types of equipment that will be rented and a cost breakdown associated with the types of equipment.

- Indicate where the main furnace will be shipped to for disposal. Describe how $1000 cost as indicated in the estimate pays for transportation and/or disposal.

- Describe what is meant by "complete any remaining activities" in the Closure Cost Estimate.

- Describe how the main furnace will be packaged for disposal.

- Estimate analytical costs associated with closure of this unit.

- Estimate costs for personal protective equipment.

- Adjust closure costs to reflect certification of closure being performed by an independent registered professional engineer.

- Update the closure costs using an inflation factor.

K. OTHER FEDERAL LAWS: 270.14(b)(20) and 270.3

Demonstrate compliance with the requirements of other applicable federal laws, such as the Fire and Wildlife Coordination Act or the National Historical Preservation Act of 1966.

L. PART B CERTIFICATION: 270.11

Applications must be accompanied by a certification letter as specified in 270.11(d). The required signatures for a municipal, state, federal, or other public agency are either a principal executive officer or ranking elected official.

Facility Name USDOE Mound
ID No. OH6890008984
Date Part B Received 12/15/86
Date Completeness Review Due 2/13/87

COMPLETENESS/TECHNICAL EVALUATION CHECKLIST

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
A. PART A APPLICATION		Y	N	A		App. B
B. FACILITY DESCRIPTION						
B-1	General description	Y	Y			P. 1-1
B-2	Topographic map					
B-2a	General requirements	Y	N	B-2a		Pp. 1-7 to 1-14, Figs A-1 to A-11
B-2b	Additional requirements for land disposal facilities					Not Applicable
B-3a	Seismic standard	Y	Y			P. 1-14
B-3b	Floodplain standard	Y	Y		B-3b	P. 1-14, Fig A-12
B-3b(1)	Demonstration of compliance	Y	Y			P. 1-14
B-3b(1)(a)	Flood proofing and flood protection measures					Not Applicable
B-3b(1)(b)	Flood plan					Not Applicable
B-3b(2)	Waiver					Not Applicable
B-3b(3)	Plan for future compliance with floodplain standard					Not Applicable
B-4	Traffic information	Y	N	B-4		Pp. 1-22 to 1-25, Fig 1-14
C. WASTE CHARACTERISTICS						
C-1	Chemical and physical analyses, including sampling/analysis methods	Y	N	C-1	C-1	Pp. 3-1 and 3-2; App. C, C-1
C-1a	Containerized wastes	Y	N	C-1a	C-1a-d,f	App. C ; P. 3-4

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
C-1b	Waste in tank systems					Not Applicable
C-1c	Waste in piles					Not Applicable
C-1d	Landfilled wastes					Not Applicable
C-1e	Wastes incinerated and wastes used in performance tests	Y	N	C-1e	C-1e	Pp. 3-1 to 3-5; 4-2 to 4-4; 4-15to 4-18
C-1f	Wastes to be land treated					Not Applicable
C-2	Waste analysis plan					
C-2a	Parameters and rationale	Y	N	C-2a	C-2a	P. 3-3
C-2b	Test methods	Y	Y		C-2b	App. C
C-2c	Sampling methods	Y	Y		C-2c	App. C, Pp. A-1 to A-6
C-2d	Frequency of analyses	Y	Y			P. 3-4
C-2e	Additional requirements for wastes generated off-site					Not Applicable
C-2f	Additional requirements for ignitable, reactive or incompatible wastes	Y	Y			P. 3-4; App. C, C-2

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
D. PROCESS INFORMATION						
D-1	Containers					
D-1a	Containers with free liquids					See comment D-1a
D-1a(1)	Description of containers	Y	N	D-1a(1)	D-1a(1)/(2)	Pp. 4-1 to 4-4
D-1a(2)	Container management practices	Y	N	D-1a(2)	D-1a(1)/(2)	Pp. 4-2 to 4-8; 5-10 and 5-11
D-1a(3)	Secondary containment system design and operation	Y	N	D-1a(3)	D-1a(3)(a) thru (d)	Pp. 4-4 to 4-8
D-1a(3)(a)	Requirement for the base or liner to contain liquids	Y	N	D-1a(3)(a)	"	Pp. 4-4 to 4-8
D-1a(3)(b)	Containment system drainage	Y	N	D-1a(3)(b)	"	Pp. 4-4 and 4-7
D-1a(3)(c)	Containment system capacity	Y	N	D-1a(3)(c)	"	Pp. 4-4 and 4-7
D-1a(3)(d)	Control of run-on	Y	N	D-1a(3)(d)	"	Pp. 4-4 to 4-8
D-1a(3)(e)	Removal of liquids from containment systems	Y	N	D-1a(3)(e)	D-1a(3) D-1(3)(e)	Pp. 4-4 to 4-8
D-1b	Containers without free liquid					
D-1b(1)	Test for free liquids	N	N	D-1b(1)		Not Addressed
D-1b(2)	Description of containers	N	N	D-1b(2)		Not Addressed
D-1b(3)	Container management practices	N	N	D-1b(3)		Not Addressed
D-1b(4)	Container storage area drainage	N	N	D-1b(4)		Not Addressed

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
D-2	Tank systems					Not Applicable
D-2a	Existing tank systems	___	___	___	___	___
D-2a(1)	Assessment of existing tank system integrity	___	___	___	___	___
D-2a(2)	External corrosion practices	___	___	___	___	___
D-2b	New tank systems	___	___	___	___	___
D-2b(1)	Assessment of new tank system integrity	___	___	___	___	___
D-2b(2)	External corrosion protection	___	___	___	___	___
D-2b(3)	Description of tank system installation and testing plans and procedures	___	___	___	___	___
D-2c	Dimensions and capacity of each tank	___	___	___	___	___
D-2d	Description of feed systems, safety cutoff, bypass systems, and pressure control	___	___	___	___	___
D-2e	Diagram of piping, instrumentation, and process flow for each tank system	___	___	___	___	___
D-2f	Containment and detection of releases	___	___	___	___	___

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
D-3	Waste piles					Not Applicable
D-3a	List of wastes	___	___	___	___	
D-3b	Liner exemption					
D-3b(1)	Enclosed dry piles					
D-3b(1)(a)	Protection from precipitation	___	___	___	___	
D-3b(1)(b)	Free liquids	___	___	___	___	
D-3b(1)(c)	Run-on protection	___	___	___	___	
D-3b(1)(d)	Wind dispersal control	___	___	___	___	
D-3b(1)(e)	Leachate generation	___	___	___	___	
D-3b(2)	Alternate Design/No Migration	___	___	___	___	
D-3c	Liner engineering report					
D-3c(1)	Liner description	___	___	___	___	
D-3c(2)	Liner location relative to high water table	___	___	___	___	
D-3c(3)	Calculation of necessary soil liner thickness	___	___	___	___	
D-3c(4)	Liner strength requirements	___	___	___	___	
D-3c(5)	Liner strength demonstration	___	___	___	___	
D-3c(6)	Liner/waste compatibility testing results	___	___	___	___	
D-3c(7)	Liner installation					
D-3c(7)(a)	Synthetic liner seaming	___	___	___	___	
D-3c(7)(b)	Soil liner compaction	___	___	___	___	

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
D-4	Surface impoundments					Not Applicable
D-4a	List of wastes	___	___	___	___	
D-4b	Liner system exemption requests					
D-4b(1)	Exemption based on existing portion	___	___	___	___	
D-4b(2)	Exemption based on alternative design and location	___	___	___	___	
D-4c	Liner system, general items					
D-4c(1)	Liner system description	___	___	___	___	
D-4c(2)	Liner system location relative to high water table	___	___	___	___	
D-4c(3)	Loads on liner system	___	___	___	___	
D-4c(4)	Liner system coverage	___	___	___	___	
D-4c(5)	Liner system exposure prevention	___	___	___	___	
D-4d	Liner system foundation					
D-4d(1)	Foundation description	___	___	___	___	
D-4d(2)	Subsurface exploration data	___	___	___	___	
D-4d(3)	Laboratory testing data	___	___	___	___	
D-4d(4)	Engineering analyses					
D-4d(4)(a)	Settlement potential	___	___	___	___	
D-4d(4)(b)	Bearing capacity	___	___	___	___	
D-4d(4)(c)	Potential for excess hydrostatic or gas pressure	___	___	___	___	

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
D-5	Incinerators	N	N	X		P. 4-64 and P. 4-66
D-5a	Justification for exemption					Not applicable
D-5b	Trial burn					
D-5b(1)	New incinerator start-up/ shakedown conditions (reserved)					Not applicable
D-5b(2)	Trial burn plan					
D-5b(2)(a)	Engineering description of incinerator					Not applicable
D-5b(2)(b)	Sampling, analysis and monitoring procedures including QA/QC plan					Not applicable
D-5b(2)(c)	Trial burn schedule					Not applicable
D-5b(2)(d)	Test protocols					Not applicable
D-5b(2)(e)	Pollution control equipment operation					Not applicable
D-5b(2)(f)	Shutdown procedures					Not applicable
D-5b(2)(g)	New incinerator post-trial burn operation (reserved)					Not applicable
D-5c	Data in lieu of trial burn					
D-5c(1)	Engineering description of incinerator	N	N	D-5c(1)		P. 4-9 to 4-15; P. 4-18 to 4-23
D-5c(2)	Expected incinerator operation	N		C-1e		P. 4-23; P. 4-59, P. 4-62 to 4-63
D-5c(3)	Design and operating condition comparisons					Not applicable
D-5c(4)	Results of previous trial burns	N	N	D-5c(4)		P. 4-23 through 4-61

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
D-5c(4)(a)	Sampling and analysis techniques	N	N	D-5c(4)(a)		P. 4-23 to P. 4-44
D-5c(4)(b)	Methods and results	N	N	D-5c(4)		P. 4-44 to P. 4-62
D-5d	Determinations	N	N	D-5c(4)		P. 4-44 to 4-62

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
D-6	Landfills					Not Applicable
D-6a	List of wastes	____	____	____	____	____
D-6b	Liner system exemption requests					____
D-6b(1)	Exemption based on existing portion	____	____	____	____	____
D-6b(2)	Exemption based on alternative design and location	____	____	____	____	____
D-6b(3)	Exemption for monofills	____	____	____	____	____
D-6b(4)	Groundwater monitoring exemption					____
D-6b(4)(a)	Engineered structure	____	____	____	____	____
D-6b(4)(b)	No liquid waste	____	____	____	____	____
D-6b(4)(c)	Exclusion of liquids	____	____	____	____	____
D-6b(4)(d)	Containment system	____	____	____	____	____
D-6b(4)(e)	Leak detection system	____	____	____	____	____
D-6b(4)(f)	Operation of leak detection system	____	____	____	____	____
D-6b(4)(g)	No migration	____	____	____	____	____
D-6c	Liner system, general items					____
D-6c(1)	Liner system description	____	____	____	____	____
D-6c(2)	Liner system location relative to high water table	____	____	____	____	____
D-6c(3)	Loads on liner system	____	____	____	____	____
D-6c(4)	Liner system coverage	____	____	____	____	____

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
D-7	Land treatment					Not Applicable
D-7a	Treatment demonstration					
D-7a(1)	Demonstration wastes					
D-7a(2)	Demonstration data sources					
D-7a(2)(a)	Existing literature					
D-7a(2)(b)	Operating data					
D-7a(3)	Laboratory/field testing programs					
D-7a(3)(a)	Toxicity testing					
D-7a(3)(b)	Field plot testing					
D-7a(3)(c)	Laboratory testing					
D-7b	Land treatment program					
D-7b(1)	List of wastes					
D-7b(2)	Operating procedures					
D-7b(2)(a)	Waste application rates					
D-7b(2)(b)	Waste application Methods					
D-7b(2)(c)	Control of soil pH					
D-7b(2)(d)	Enhancement of microbial or chemical reactions					
D-7b(2)(e)	Control of soil moisture					
D-7c	Unsaturated zone monitoring plan					
D-7c(1)	Soil-pore liquid monitoring					
D-7d(1)(a)	Sampling location					

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
E. GROUNDWATER MONITORING						
E-1	Exemption from groundwater protection requirements					Not Applicable
E-1a	Waste piles					
E-1b	Landfill					
E-1c	No migration					
E-2	Interim status period groundwater monitoring data					
E-3	Aquifer identification					
E-4	Contaminant plume description					
E-5	Detection monitoring program					
E-5a	Indicator parameters, waste constituents, reaction products to be monitored					
E-5a(1)	Hazardous waste characterization					
E-5a(2)	Behavior of constituents					
E-5a(3)	Detectability					
E-5b	Groundwater monitoring program					
E-5b(1)	Description of wells					
E-5b(2)	Representative samples					
E-5b(3)	Locations of background groundwater monitoring wells that are not upgradient					
E-5c	Background values					

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
E-7g	Sampling, analysis and statistical procedures					
E-7g(1)	Sample collection					
E-7g(2)	Sample preservation and shipment					
E-7g(3)	Analytical procedure					
E-7g(4)	Chain of custody					
E-7g(5)	Additional requirements for compliance point monitoring					
E-7g(5)(a)	Sampling frequency					
E-7g(5)(b)	Testing for Appendix VIII hazardous constituents					
E-7g(5)(c)	Compliance point groundwater quality values					
E-7g(6)	Annual determination					
E-7g(7)	Statistical determination					
E-7g(7)(a)	Statistical procedure					
E-7g(7)(b)	Results					
F. PROCEDURES TO PREVENT HAZARDS						
F-1	Security					
F-1a	Security procedures and equipment					
F-1a(1)	24-hour surveillance system	Y	Y			P. 5-1
F-1a(2)	Barrier and means to control entry					
F-1a(2)(a)	Barrier	Y	N	F-1a(2)(a)		P. 5-1; Fig. 1-8

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
F-1a(2)(b)	Means to control entry	Y	Y			P. 5-1
F-1a(3)	Warning signs	Y	N	F-1a(3)		P. 5-1
F-1b	Waiver					Not Applicable
F-1b(1)	Injury to intruder					
F-1b(2)	Violation caused by intruder					
F-2	Inspection schedule					
F-2a	General inspection requirements	Y	N	F-2a		Pp. 5-2 to 5-9
F-2a(1)	Types of problems	Y	N	F-2a(1)		Pp. 5-2 to 5-9
F-2a(2)	Frequency of inspections	Y	N	F-2a(2)		Pp. 5-2 to 5-9; App. D, Pp. 14-16
F-2b	Specific process inspection requirements					
F-2b(1)	Container inspection	Y	N	F-2b(1)		Pp. 5-2 to 5-9
F-2b(2)	Tank inspection					Not Applicable
F-2b(2)(a)	Tank construction materials					
F-2b(2)(b)	Tank surrounding area					
F-2b(2)(c)	Tank overfilling control equipment					
F-2b(2)(d)	Tank monitoring data					
F-2b(2)(e)	Tank level of waste					
F-2b(2)(f)	Tank condition assessment					
F-2b(3)	Waste pile inspection					Not Applicable
F-2b(3)(a)	Run-on and run-off control system					

	Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
F-2b(3)(b) Wind dispersal system					
F-2b(3)(c) Leachate collection and removal system					
F-2b(4) Surface impoundment inspection					Not Applicable
F-2b(4)(a) Condition assessment					
F-2b(4)(a)(1) Overtopping control system					
F-2b(4)(a)(2) Impoundment contents					
F-2b(4)(a)(3) Deterioration					
F-2b(4)(b) Structural integrity					
F-2b(5) Incinerator inspection					
F-2b(5)(a) Incinerator and associated equipment	N	N	F-2b(5)(c)		Pp. 5-2 and 5-5 to 5-7
F-2b(5)(b) Incinerator waste feed cut-off system and associated alarms	N	N	D-5c(1)		Pp. 4-19; 5-7
F-2b(6) Landfill inspection					Not Applicable
F-2b(6)(a) Run-on and run-off control system					
F-2b(6)(b) Wind dispersal control system					
F-2b(6)(c) Leachate collection and removal system					
F-2b(7) Land treatment facility inspection					Not Applicable
F-2b(7)(a) Run-on and run-off control system					

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
F-2b(7)(b)	Wind dispersal control system					
F-3	Waiver or documentation of preparedness and prevention requirements					
F-3a	Equipment requirements					
F-3a(1)	Internal communications	Y	N	F-3a(1)		P.5-10
F-3a(2)	External communications	Y	N	F-3a(2)		P. 5-10
F-3a(3)	Emergency equipment	Y	Y			P. 5-10; App. D,P. 15
F-3a(4)	Water for fire control	Y	N	F-3a(4)	F-3a(4)	P. 5-10; App. D
F-3b	Aisle space requirement	Y	N	F-3b		P. 5-10
F-4	Preventive procedures, structures, and equipment					
F-4a	Unloading operations	Y	Y			Pp. 5-10 to 5-11
F-4b	Run-off	Y	N	F-4b	F-4b	Pp. 5-10 to 5-11
F-4c	Water supplies	Y	N	F-4c		P . 5-11
F-4d	Equipment and power failure	Y	Y			P. 5-11
F-4e	Personnel protection equipment	Y	Y			P. 5-12
F-5	Prevention of reaction of ignitable, reactive, and incompatible wastes					
F-5a	Precautions to prevent ignition or reaction of ignitable or reactive wastes	N	N	F-5a	F-5a/b	Not Addressed

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
F-5b	General precautions for handling ignitable or reactive waste and mixing of incompatible waste	N	N	F5b	F-5a/b	Not Addressed
F-5c	Management of ignitable or reactive wastes in containers	Y	Y		F-5c/d	P. 4-4; App. D, P. 5
F-5d	Management of incompatible wastes in containers	Y	N	F-5d	F-5c/d	P. 4-4
F-5e	Management of ignitable or reactive wastes in tanks					Not Applicable
F-5f	Management of incompatible wastes in tanks					Not Applicable
F-5g	Management of ignitable or reactive wastes placed in waste piles					Not Applicable
F-5h	Management of incompatible wastes placed in waste piles					Not Applicable
F-5i	Management of ignitable or reactive wastes placed in surface impoundments					Not Applicable
F-5j	Management of incompatible wastes placed in surface impoundments					Not Applicable
F-5k	Management of ignitable or reactive wastes placed in landfills					Not Applicable
F-5l	Management of incompatible wastes placed in landfills					Not Applicable
F-5m	Management of ignitable or reactive wastes placed in land treatment units					Not Applicable

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
F-5n	Management of incompatible wastes placed in land treatment units					Not Applicable See General Comment G.
G. CONTINGENCY PLAN						
G-1	General information	Y	Y			App. D, P. 2
G-2	Emergency coordinators	Y	N	G-2		App. D, Pp. 1, A-1,A-2
G-3	Implementation	Y	N	G-3		App. D, P. 1
G-4	Emergency response procedures					
G-4a	Notification	Y	Y			App. D, Pp. 10 to 18
G-4b	Identification of hazardous materials	Y	N	G-4b		App. D, Pp. 10-18
G-4c	Assessment	Y	N	G-4c		App. D, Pp. 10-18
G-4d	Control procedures	Y	N	G-4d	G-4d	App.D, Pp. 10-18
G-4e	Prevention of recurrence or spread of fires, explosions, or releases	Y	N	G-4e		App. D,Pp. 10-18
G-4f	Storage and treatment of released material	Y	N	G-4f		App. D, P. 11
G-4g	Incompatible waste	Y	N	G-4g		App. D, P. 11
G-4h	Post-emergency equipment maintenance	Y	N	G-4h		App. D, P. 16
G-4i	Container spills and leakage	Y	N	G-4i	G-4i	App. D, P. 10 to 18
G-4j	Tank spills and leakage					Not Applicable
G-4j(1)	Tank spills and leakage					

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
G-4j(2)	Spills and leaks from tanks containing wastes F020, F021, F022, F023, F026, and F027					
G-4k	Surface impoundments spills and leakage					Not Applicable
G-4k(1)	Emergency repairs					
G-4k(1)(a)	Stopping waste addition					
G-4k(1)(b)	Containing leaks					
G-4k(1)(c)	Stopping leaks					
G-4k(1)(d)	Preventing catastrophic failure					
G-4k(1)(e)	Emptying the impoundment					
G-4k(2)	Certification					
G-4k(3)	Repairs as a result of sudden drop					
G-4k(3)(a)	Existing portions of surface impoundment					
G-4k(3)(b)	Other portions of surface impoundment					
G-5	Emergency equipment	Y	Y			App. D, Pp. 14to 16
G-6	Coordination agreements	Y	N	G-6		P. 6-1; App. D, Pp. 16 to 17
G-7	Evacuation plan	Y	N	G-7		App. D, Pp. 17, C-1 to C-13
G-8	Required reports	Y	N	G-8		App. D, Pp. 10 to 13

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
H. PERSONNEL TRAINING						
H-1	Outline of the training program					
H-1a	Job title/job description	Y	N	H-1a		Pp. 7-1 to 7-12
H-1b	Training content, frequency, and techniques	Y	N	H-1b		Pp. 7-1 to 7-12
H-1c	Training director	Y	N	H-1c		Pp. 7-1 to 7-12
H-1d	Relevance of training to job position	Y	N	H-1d		Pp. 7-1 to 7-12
H-1e	Training for emergency response	Y	Y			Pp. 7-1 to 7-12
H-2	Implementation of training program	Y	Y			P. 7-10
I. CLOSURE AND POST-CLOSURE REQUIREMENTS						
I-1	Closure plans					See General Comment
I-1a	Closure performance standard	Y	N	I-1a		App. E
I-1b	Partial and final closure activities	Y	N	I-1b		P. 8-1
I-1c	Maximum waste inventory	Y	N	I-1c		App. E
I-1d	Inventory removal, disposal or decontamination of equipment	Y	N	I-1d		App. E
I-1d(1)	Closure of containers	Y	N	I-1d(1)		App. E
I-1d(2)	Closure of tanks					Not Applicable
I-1d(3)	Closure of waste piles					Not Applicable
I-1d(4)	Closure of surface impoundments					Not Applicable

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
I-1d(5)	Closure of incinerators	Y	N	I-1d(5)		Appendix E
I-1d(6)	Closure of land treatment facilities					Not Applicable
I-1d(6)(a)	Continuance of treatment					
I-1d(6)(b)	Vegetative cover					
I-1e	Closure of disposal units					Not Applicable
I-1e(1)	Disposal impoundments					
I-1e(1)(a)	Elimination of liquids					
I-1e(1)(b)	Waste stabilization					
I-1e(2)	Cover design					
I-1e(3)	Minimization of liquid migration					
I-1e(4)	Maintenance needs					
I-1e(5)	Drainage and erosion					
I-1e(6)	Settlement and subsidence					
I-1e(7)	Cover permeability					
I-1e(8)	Freeze/thaw effects					
I-1f	Schedule for closure	Y	N	I-1f		App. E
I-1g	Extensions for closure time					Not Applicable
I-2	Post-closure plan					Not Applicable
I-2a	Inspection plan					
I-2b	Monitoring plan					
I-2c	Maintenance plan					

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
I-2d	Land treatment					
I-3	Notice in deed					Not Applicable
I-4	Closure cost estimate	Y	N	I-4	I-4	App. E; P. 8-1
I-5	Financial assurance mechanism for closure					Not Applicable-Federal Facility; P. 8-1
I-5a	Closure trust fund					
I-5b	Surety bond					
I-5b(1)	Surety bond guaranteeing payment into a closure fund					
I-5b(2)	Surety bond guaranteeing performance of closure					
I-5c	Closure letter of credit					
I-5d	Closure insurance					
I-5e	Financial test and corporate guarantee for closure					
I-5f	Use of multiple financial mechanisms					
I-5g	Use of financial mechanism for multiple facilities					
I-6	Post-closure cost estimate					Not Applicable
I-7	Financial assurance mechanism for post-closure care					Not Applicable
I-7a	Post-closure trust fund					
I-7b	Surety bond					
I-7b(1)	Surety bond guaranteeing payment into a post-closure trust fund					

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
I-7b(2)	Surety bond guaranteeing performance of post-closure care	____	____	____	____	____
I-7c	Post-closure letter of credit	____	____	____	____	____
I-7d	Post-closure insurance	____	____	____	____	____
I-7e	Financial test and corporate guarantee for post-closure care	____	____	____	____	____
I-7f	Use of multiple financial mechanisms	____	____	____	____	____
I-7g	Use of a financial mechanism for multiple facilities	____	____	____	____	____
I-8	Liability requirements					Not Applicable
I-8a	Coverage for sudden accidental occurrences					____
I-8a(1)	Endorsement or certification	____	____	____	____	____
I-8a(2)	Financial test for liability coverage	____	____	____	____	____
I-8a(3)	Use of multiple insurance mechanisms	____	____	____	____	____
I-8b	Coverage for nonsudden accidental occurrences					____
I-8b(1)	Endorsement or certification	____	____	____	____	____
I-8b(2)	Financial test for liability coverage	____	____	____	____	____
I-8b(3)	Use of multiple insurance mechanisms	____	____	____	____	____
I-8c	Request for variance	____	____	____	____	____

		Complete (Y/N)	Technically Adequate (Y/N)	See Attached Comment	See Attached Exhibit	Location of Information
I-9	State mechanisms					
I-9a	Use of state-required mechanism					
I-9b	State assumption of responsibility					
J. CORRECTIVE ACTION FOR SOLID WASTE MANAGEMENT UNITS						Not Applicable
J-1	Solid waste management units					
J-1a	Characterize the solid waste management unit					
J-1b	No solid waste management units					
J-2	Releases					
J-2a	Characterize releases					
J-2b	No releases					
K. OTHER FEDERAL LAWS		Y	N	K		Not Addressed
L. PART B CERTIFICATION		N	N	L		Not Addressed

_ Hydraulic computer model used to establish 100-year frequency flood elevation profile

_ Appropriateness of hydraulic method and computer model

_ Identification of 100-year floodplain and flood elevation

_ Identification of facility in relation to 100-year floodplain and flood elevation

_ Appropriateness of identification procedure

_ _____

_ _____

III. BASIS OF TECHNICAL DECISION

_ Calculations performed by reviewer (attach all calculations).

_ Verification of applicant's calculations.

o location in application _____

_____

X Published literature or other materials (cite below or attach a listing).

Appendix A-12 flood insurance rate map
(Technically adequate)

Reviewer: DLJ Date: 1/21/87

Exhibit C-1

C-1: PHYSICAL AND CHEMICAL DESCRIPTION OF WASTES

I. FACTORS CONSIDERED

X Wastes to be handled, RCRA number and basis for hazard designation

X Hazardous constituents listed in Appendix VII to 40 CFR Part 261

X Treatment, storage and disposal units (or processes) to be permitted, as well as specific process requirements and tolerance limits

X Physical descriptions of wastes

X Chemical descriptions of wastes

X Sources of wastes (i.e., how generated)

X Physical state of wastes

X Ignitability, reactivity and/or incompatibility

_ Source of data (e.g., lab reports, documented data from a similar process)

_ Appendix VIII constituents, where applicable

_ _____

_ _____

II. BASIS OF TECHNICAL DECISION

_ Data provided by applicant (e.g., laboratory analytical results, material safety data sheets).

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1/21/87

C-1a-d, f: WASTE CHARACTERIZATION INFORMATION FOR SPECIFIC PROCESSES

I. FACTORS CONSIDERED

Containerized Wastes

X Free liquids content of wastes stored in areas without secondary containment

X Acceptability of test method for determining free liquids

- Other documentation of free liquids content

- _____

Wastes in Tank Systems

N/A - Hazardous characteristics of wastes to be stored or treated in tank systems

Wastes in Piles (when waiver is requested under 264.250(c)(1))

N/A

- Free liquids content of wastes

- Acceptability of test method for determining free liquids

- Other documentation of free liquids content

Landfilled Wastes (where a liner and leachate collection system are not employed)

N/A

- Free liquids content of wastes

- Acceptability of test method for determining free liquids

- Other documentation of free liquids content

_____

Wastes to be Land Treated

N/A - Cadmium content of wastes

- pH of waste

II. BASIS OF TECHNICAL DECISION

X Verification of applicant supplied data.

o location in application Appendix C

Pp. 3-1 and 3-2

- Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1-21/87

Exhibit C-1e

C-1e: WASTE TO BE INCINERATED OR USED IN PERFORMANCE TESTS

I. FACTORS CONSIDERED

X Wastes or waste mixtures to be burned

X Physical state of wastes

X Viscosity of liquids

_ Appendix VIII constituents levels in wastes

_ Appendix VIII constituents excluded from analysis and rationale for exclusion

- _ analytical methods used
- _ heat value (BTU content) of wastes
- _ chlorine content of wastes
- _ ash content of wastes

X Data submitted in lieu of trial burn

- _ quantification of principal organic hazardous constituents
- _ similarity of wastes used in performance tests to those to be incinerated
- _ source of data

II. BASIS OF TECHNICAL DECISION

_ Evaluation of data provided by applicant.

o location in application _____

_____

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: B. Boomer Date: 1/21/87

Exhibit C-2a

C-2a: WASTE ANALYSIS PLAN - PARAMETERS AND RATIONALE

I. FACTORS CONSIDERED

X Parameters to be analyzed for

X Wastes to be managed and their hazard characteristics

X Hazardous waste TSD processes and appropriateness of parameters to be analyzed for to those processes

X Process tolerance limits

X Waste characterization data provided in Part B application

X Reactive or ignitable wastes

X Potential waste incompatibilities

X Physical states of wastes

X Rationale for parameters selected

X Sources of wastes and variability of waste composition

_ _____

_ _____

II. BASIS OF TECHNICAL DECISION

X Verification of applicant supplied data.

o location in application: P. 3-3

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1/21/87

Exhibit C-2b

C-2b: WASTE ANALYSIS PLAN - TEST METHODS

I. FACTORS CONSIDERED

X Test parameters

X Physical state of samples

X Wastes and their constituents

X Possible interferences

X Acceptability of test methods

X Accuracy and limits of detection

X QA/QC program

_ _____

_ _____

II. BASIS OF TECHNICAL DECISION

_ Verification of applicant supplied data.

o location in application App. C

_ Published literature or other materials (cite below or attach a listing).

U. S. EPA; SW-846 1982; Test methods for evaluating solid waste.

(Technically adequate)

Reviewer: DLL Date: 1/21/87

Exhibit C-2c

C-2c: WASTE ANALYSIS PLAN - SAMPLING METHODS

I. FACTORS CONSIDERED

X Physical state (i.e., solid, liquid, gas) of wastes

X Potential for layered wastes

X Sampling devices and procedures

X Locations of sampling

X Randomness or representativeness of samples

X Composite vs. grab samples

X Sample containers

X Method of identifying samples

X Chain of custody procedures

X Preservation of samples

X QA/QC program

_ _____

_ _____

II. BASIS OF TECHNICAL DECISION

X Verification of applicant supplied data.

- o location in application: App. C
  Pp. A-1 to A-6

_ Published literature or other materials (cite below or attach a listing).

Waste analysis plans a guidance manual; September 1984; Research Triangle Institute.
(Technically adequate)

Reviewer: DLJ Date: 1/21/87

Exhibit D-1a(1)/(2)

D-1a(1)/(2): DESCRIPTION OF CONTAINERS AND CONTAINER MANAGEMENT PRACTICES

I. UNIT(S): Containers in building 72, 23, Pyro Shed, Magazine 51

II. FACTORS CONSIDERED

X Types and dimensions of containers

X Materials of construction

X Liners or coatings

X Waste-container compatibility

X Container handling equipment and methods

X Free liquids in containers

X Procedures for adding and removing wastes from containers

_ _____

_ _____

III. BASIS OF TECHNICAL DECISION

X Verification of applicant supplied data.

o location in application: Pp. 4-4 to 4-7

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: Laura E. Rogers Date: 1/11/87

D-1a(3)(a) thru (d): CONTAINER STORAGE - SECONDARY CONTAINMENT SYSTEM DESIGN AND OPERATION

I. UNIT(S): Builings 72,23

II. FACTORS CONSIDERED

Containment system base or liner

X Material of construction

X Cracks, gaps, construction joints or other paths of liquid migration through base

_ _____

_ _____

Containment system drainage

X Slope of base

X Collection sumps

X Elevation of containers on pallets or other devices

_ _____

_ _____

Containment system capacity

X Maximum number and volume of containers in storage

X Containment area shape and dimensions

X Secondary containment capacity (including collection sumps)

X Any take-out volumes, such as stairways, etc.

_ _____

_ _____

Control of run-on

X Physical devices to prevent run-on (e.g., walls, dikes, berms)

X Elevation of container storage area above grade

_ Design storm and calculated run-on volume

X Containment system capacity (including collection sumps)

_ _____

_ _____

III. BASIS OF TECHNICAL DECISION

X Calculations performed by reviewer (attach all calculations).

X Verification of applicant supplied data.

- o location in application: Pp. 4-4-4-7

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: Laura E. Rogers Date: 1/11/87

D-1a(3)(e): REMOVAL OF LIQUIDS FROM CONTAINMENT SYSTEM

I. UNIT(S): Building 72,23

II. FACTORS CONSIDERED

X Inspection schedule

X Physical method of liquids removal

X Criteria that trigger removal

X Presence or absence of a roof over containment area

X Plan for testing liquids accumulating in containment system

X Method of disposal of accumulated liquids

_ _____

_ _____

III. BASIS OF TECHNICAL DECISION

_ Calculations performed by reviewer (attach all calculations).

X Verification of applicant supplied data.

o location in application Pp. 4-4 to 4-7

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: Laura E. Rogers Date: 1/11/87

F-3a(4): WATER FOR FIRE CONTROL

I. UNIT(S): All

II. FACTORS CONSIDERED

X Adequacy and volume of water

X Adequacy and pressure of water

Types of equipment

- X fire hoses
- X foam producing equipment
- X automatic sprinklers
- X water spray systems
- X pumps
- _ water tanks
- _ holding ponds

X Location of equipment

X Potential for fire

X Availability of off-site equipment

_ _____

_ _____

III. BASIS OF TECHNICAL DECISION

X Verification of applicant supplied data.

- o location in application P. 5-10; Appendix D

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1/21/87

Exhibit F-4b

F-4b: RUNOFF FROM HAZARDOUS WASTE HANDLING AREAS

I. UNIT(S): All

II. FACTORS CONSIDERED

X Runoff onto other parts of facility

X Runoff off-site

X Erosion control measures

X Capacity of runoff control system, considering:

- layout of system
- shape and slope of ditches
- capacity of ditches
- capacity of sumps, detention basins, etc.

Flow from

X precipitation

X spills

X run-on

- _____
- _____

III. BASIS OF TECHNICAL DECISION

- Calculations performed by reviewer (attach all calculations).
- Verification of applicant's calculations.
  - o location in application: Pp. 5-11,1-12 to 1-14
- Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1/21/87

F-5a/b: HANDLING OF IGNITABLE, REACTIVE AND COMPATIBLE WASTES

I. FACTORS CONSIDERED

Ignitable Wastes

X Ignitable wastes to be handled

X Conditions that will cause ignition

X Sources of ignition (e.g., flames, radiant heat sources) in the vicinity of ignitable wastes

X Precautions to prevent ignition

X Potential for spontaneous ignition

X Designated areas for smoking and open flames

X Locations of "No Smoking" signs

_____

_____

Reactive Wastes

X Reactive wastes to be handled

X Types of reactions and possible reaction products

X Conditions that will trigger reaction

X Materials near wastes that will cause reaction

X Potential for structural damage resulting from reaction

X Designated areas for smoking and open flames

X Locations of "No Smoking" signs

_____

_____

Incompatible Wastes to be Mixed

X Wastes to be mixed and their characteristics

X Methods of mixing

X Types of reactions that could occur

X Reaction products

X Methods used to evaluate potential consequences

X Precautions taken to control reactions

II. BASIS OF TECHNICAL DECISION

_ Verification of information provided by applicant.

o location in application Not Addressed

_ Published literature or other materials (cite below or attach a listing)

(Technically inadequate)

Reviewer: DLT Date: 1/21/87

F-5c/d: IGNITABLE, REACTIVE AND INCOMPATIBLE WASTES IN CONTAINERS

I. FACTORS CONSIDERED

X Distance of ignitable or reactive wastes from the facility's property line

_ Washing of containers between uses

X Reuse of containers

X Separation of incompatible wastes by dike, berm, wall or other device

_ _____

_ _____

II. BASIS OF TECHNICAL DECISION

_ Verification of applicant-supplied information.

o location in application: ~~P. 4-4; App. D, P. 5~~

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1/21/87

G-4d: EMERGENCY RESPONSE PROCEDURES - CONTROL OF FIRE, EXPLOSION OR OTHER RELEASE

I. UNIT(S): All

II. FACTORS CONSIDERED

X Nature of emergency (fire, explosion, etc.)

X Waste materials involved and their characteristics

X Character and extent of released materials

X Response procedures to control or contain release

X Health and safety precautions taken during control or containment operations

_ _____

_ _____

III. BASIS OF TECHNICAL DECISION

X Evaluation of applicant's contingency plan.

o location in application Appendix D

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1/21/87

G-4i: CONTAINER SPILLS AND LEAKAGE

I. UNIT(S): Building 72 and 23, Magazine 51, Pyro Shed

II. FACTORS CONSIDERED

Procedures for:

X locating leaking container

X repair or replacement of leaking container

X overpack of leaking container

X container/waste compatibility for new container or overpack

X timing of cleanup effort

X method of cleanup

X treatment or disposal of spilled or leaked material

X treatment or disposal of contaminated material

X inspection of other containers in contact with leaked material for possible incompatibility

X health problems and safety procedures used during cleanup

_ _____

_ _____

III. BASIS OF TECHNICAL DECISION

X Verification of applicant supplied data.

o location in application App. D, Pp. 10 to 18

_ Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1/21/87

I-4: CLOSURE COST ESTIMATE

I. UNIT(S): All Units

II. FACTORS CONSIDERED

X Major cost items; general

- X on-site treatment and/or disposal of remaining waste
- X off-site treatment and/or disposal of remaining waste
- X transportation of remaining wastes
- X testing for contaminated soil
- X removal, transportation, and disposal of contaminated soil
- - removal, transportation, and disposal or treatment of contaminated wastewaters
- X removal, transportation, and disposal or treatment of residues generated during decontamination
- X testing for contaminated equipment
- X equipment decontamination
- X disposal of contaminated equipment
- X certification by professional engineer
- - decontamination or disposal of tank systems
- - contingent cost estimates for closure and post-closure care for tank systems without secondary containment (or a variance)

Major cost items; impoundments

N/A - dewatering or solidification of liquids

- - solidification or stabilization of sludges

- Major cost items; landfills
  - final grading for cover
  - gas vents
  - clay cover
  - synthetic cover
  - drainage layer
  - vegetation layer (soil)
  - establishment of vegetation
- Date cost estimate prepared November 7, 1986

X Inflation factors used to update costs

X Maximum quantity and types of waste

X Appropriateness of unit costs used

X Appropriateness of labor and materials quantities

- _____
- _____

III. BASIS OF TECHNICAL DECISION

- Calculations performed by reviewer (attach all calculations).

X Verification of applicant's calculations.

  - o location in application Appendix E, P 8-1

- Published literature or other materials (cite below or attach a listing).

(Technically inadequate)

Reviewer: DLJ Date: 1/21/87

B-3b: 100-YEAR FLOODPLAIN STANDARD

I. UNIT(S): All Units

II. FACTORS CONSIDERED

Federal Emergency Management Agency Federal Insurance Administration (FIA) Map provided

X Location of facility in relation to 100-year floodplain and flood elevation

X Appropriateness of location procedure

_ FIA MAP PROVIDED

_ _____

FIA Map not provided

_ 100-year rainfall

_ Size and shape of contributing drainage basin

_ Land use or development of drainage basin

_ Vegetation cover of drainage basin

_ Drainage basin slope

_ Drainage basin soils

_ Karst topography of drainage basin

_ Hydrologic method used to establish 100-year frequency flood flow

_ Hydrologic computer model used to establish 100-year frequency flood flow

_ Appropriateness of hydrologic method and computer model

_ Roughness coefficients (Manning's "n" values) for floodplain

_ Geometry of bridges, culverts, stream channels, etc.

_ Hydraulic method used to establish 100-year frequency flood elevation profile

NUS CORPORATION

Laboratory Services Division
5350 Campbells Run Road
Pittsburgh, PA 15205

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

Ref. B5

LAB ANALYSIS REPORT

CLIENT NAME: MONSANTO RESEARCH CORPORATION
ADDRESS: P.O. BOX 32
MIAMISBURG, OH 45342

REPORT DATE: 09/27/85

ATTENTION: ~~MR. WM. R. DEAL~~

NUS CLIENT NO: 899301
VENDOR NO: 05606500
WORK ORDER NO: 55830
DATE RECEIVED: 08/29/85

WD SLUDGE ANALYSIS

SAMPLE IDENTIFICATION			NUS SAMPLE NO	RESULTS	UNITS
WD SLUDGE 63.12 GRAMS		06/11	15081908L		
M275	EP TOXICITY PACKAGE				
M038	Arsenic, leachable (As)			0.001	mg/l
M048	Barium, leachable (Ba)			< 0.1	mg/l
M098	Cadmium, leachable (Cd)			0.012	mg/l
M148	Chromium, leachable (Cr)			0.13	mg/l
M208	Lead, leachable (Pb)			0.07	mg/l
M258	Mercury, leachable (Hg)			< 0.0002	mg/l
M298	Selenium, leachable (Se)			< 0.004	mg/l
M308	Silver, leachable (Ag)			0.03	mg/l
S907	Initial pH of leachate			9.8	
S908	Final pH of leachate			6.2	
S909	Acid Required/100 gm			400	ml
S910	EP Toxicity Extraction				
WD SLUDGE 60.94 GRAMS		06/11	15081909L		
M275	EP TOXICITY PACKAGE				
M038	Arsenic, leachable (As)			0.001	mg/l

A Halliburton Company

CLIENT ORIGINAL

NUS CORPORATION

Laboratory Services Division
5350 Campbells Run Road
Pittsburgh, PA 15205

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

LAB ANALYSIS REPORT

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ADDRESS: P.O. BOX 32
MIAMISBURG, OH 45342

ATTENTION: MR. WM. R. DEAL

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NUS CLIENT NO: 899301
VENDOR NO: 05606500
WORK ORDER NO: 55830
DATE RECEIVED: 08/29/85

SAMPLE IDENTIFICATION		NUS SAMPLE NO	RESULTS	UNITS
M048	Barium, leachable (Ba)		< 0.1	mg/l
M098	Cadmium, leachable (Cd)		0.012	mg/l
M148	Chromium, leachable (Cr)		0.15	mg/l
M208	Lead, leachable (Pb)		0.05	mg/l
M258	Mercury, leachable (Hg)		< 0.0002	mg/l
M298	Selenium, leachable (Se)		< 0.004	mg/l
M308	Silver, leachable (Ag)		0.03	mg/l
S907	Initial pH of leachate		9.9	
S908	Final pH of leachate		6.9	
S909	Acid Required/100 gm		400	ml
S910	EP Toxicity Extraction			
WD SLUDGE BATCH #191		03/18	15081910L	
M275	EP TOXICITY PACKAGE			
M038	Arsenic, leachable (As)		0.002	mg/l
M048	Barium, leachable (Ba)		< 0.1	mg/l
M098	Cadmium, leachable (Cd)		0.007	mg/l
M148	Chromium, leachable (Cr)		0.24	mg/l
M208	Lead, leachable (Pb)		0.08	mg/l
M258	Mercury, leachable (Hg)		< 0.0002	mg/l
M298	Selenium, leachable (Se)		< 0.004	mg/l
M308	Silver, leachable (Ag)		0.03	mg/l
S907	Initial pH of leachate		9.9	
S908	Final pH of leachate		7.1	
S909	Acid Required/100 gm		400	ml
S910	EP Toxicity Extraction			

COMMENTS:

Reviewed and Approved by: JMC

A Halliburton Company

CLIENT ORIGINAL

In Bldg 51

Ref. 86

EXIST. MH

EXIST. 8" VCP

EXIST. 48" CMP STORM

RUN OFF

DROP EXIST. STORM M.H.

REINF. PVMT.

RELOCATE & LOWER EXIST. 48" CMP

C.B.

GRADE

42" MIN.

#1 CU GROUND

4-4" Ø CONDUIT

CONCRETE ENCASED ELECTRICAL DUCT

RELOCATED O.H. 12,000 V., ADT, & TELE., THIS CONTRACT

NEW 1,000 GAL. U.G. WASTE OIL TANK

SCRUBBER

STACK

DOCK

OFFICE

INCINERATOR

SS. C.B.

TIPPING FLOOR

NEW ELEC. M.H.

REST RM.

RISER

TO BLDG. 29 ELEC. SUB. STA.

TO STORM CATCH BASIN

TO BLDG. 29

NEW 12 FT. BLACKTOP DRIVE

EXIST. GAS, STEAM, & COND., ON STANCHIONS

NEW LINE & P.I.V.

NEW BLACKTOP APRON

SALT STORAGE

EXIST. POLE ADD GUARDS

EXIST. POLE

EXIST. F.H. - ADD GUARDS

EXIST. 8" AC

EXISTING 20 FT. BLACKTOP ROAD

MOVE EXIST. O.H. 12,000 V. ADT & TELE. ADD TWO NEW POLES, GUYS, + WIRE

MRC JOB 7309

LEGEND-

S	SANITARY SEWER
FW	FIRE PROTECTION WATER
DW	DOMESTIC WATER
WW	WASTE WATER (STORM WATER FOR REUSE)
SS	STORM SEWER
FH	FIRE HYDRANT
PIV	POST INDICATOR VALVE
MH	MAN HOLE
AC	ASBESTOS CEMENT PIPE
CB	CATCH BASIN
CMP	CORRUGATED METAL PIPE

SCALE: 1" = 30'

MONSANTO RESEARCH CORPORATION
MOUND LABORATORY
MIAMISBURG, OHIO

SITE PLAN-
INCINERATOR FACILITY

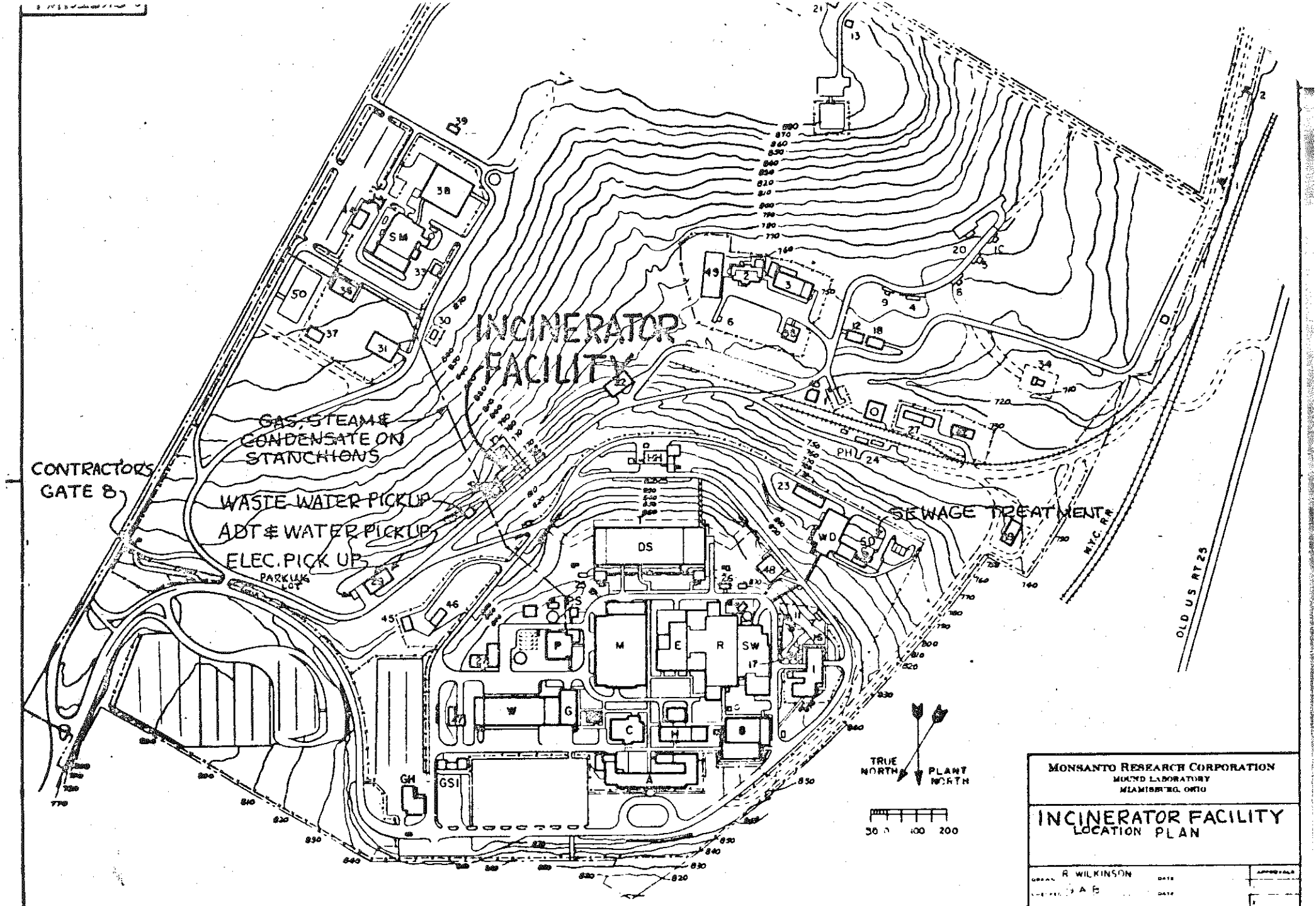
ENG. W. RUSSELL | DATE 6-30-70

APP. | APP.

APP. | APP.

SKETCH No 2

CLASSIFICATION
LEVEL UNCL.
DATE 6-30-70 INIT. WR



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Ref. 87

MRC-MOUND

Operated for the United States
Department of Energy

May 10, 1988

Mr. Bill Rohrer
Pope-Reid Associates
245 East Sixth Street
Suite 813
St. Paul, MN 55101

Dear Mr. Rohrer:

During your Visual Site Inspection of Mound last week, you requested the following additional technical information:

- WD Pipeline - The waste transfer system was built in 1967 and used starting in 1968. Usage of one pipe, which carried non-recoverable process distillate, was discontinued in 1974; usage of a second pipe, which carried wastewater from showers, drains, etc., was discontinued in 1976. Both pipes were removed in 1986; soil is still being removed.

- WD Sludge - Analytical data for three cemented WD sludge samples are enclosed. All of the parameters measured were below the corresponding RCRA values for the EP toxicity characteristic.

- SD Plant - The old sanitary waste disposal plant was operated from 1948 to the 1970s. Drawing No. 351700-02001, showing dimensions and basic features of the old facility, is enclosed.

- "Refuse Piles" - Figure 10-1 of our Part B permit application shows three areas designated "refuse piles." Two of the areas, located below Magazine 53, are orphan soil consisting of soil and rock which were shown to you during your visit. The third area, located across the road, consists of sand and gravel and is used by Mound for onsite repair work.

MONSANTO RESEARCH CORPORATION P.O. BOX 32 Miamisburg, Ohio 45342 (513) 865-4020

a subsidiary of Monsanto Company

- Environmental Monitoring Reports - Copies of Environmental Monitoring Reports for the past five years, 1982-1986, are enclosed.

You also requested clarification of statements in your Reference No. 50, which seemed to indicate that an old incinerator, which had been located in Building 51 and operated for only a short time some years ago, was listed on our Part A permit application. Please send us a copy of the referenced Mary Walker letter so that we can resolve this question.

If you require additional information, please contact me.

Sincerely,

Richard J. Janowiecki

Richard J. Janowiecki
Engineering Specialist

RJJ:km
Enclosure

cc: A. D. Bickerton, DOE/DAO
R. A. Neff
C. S. Friedman
R. K. Blauvelt

Ref. 88

MLM-3055

Environmental Monitoring at Mound: 1982 Report

Daniel G. Carfagno and Billy M. Farmer

April 25, 1983

Monsanto

MOUND
Miamisburg, Ohio 45342

operated by
MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company

for the
U. S. DEPARTMENT OF ENERGY
Contract No. DE-AC04-76-DP00053

Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed Copy: A04
Microfiche copy: A01

MLM-3055
UC-41

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Foreword

This report was prepared by the Environmental Section of the Administrative Services Department at Monsanto Research Corporation - Mound. Sample analyses and data reduction were performed by the Environmental Laboratory Group. Particulate samples offsite were collected by the Air Pollution Control Section of the Montgomery County Combined General Health District, which acts as the Regional Air Pollution Control Agency in this area for the Ohio Environmental Protection Agency. All other sampling was performed by personnel in the Environmental Section.

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Introduction

Monsanto Research Corporation - Mound occupies 306 acres of land in Miamisburg, Ohio. This location is approximately 16 km (10 mi) southwest of Dayton, Ohio. The predominant geographical feature in the five-county region surrounding Mound is the Great Miami River, which flows from northeast to southwest through Miamisburg. The river valley is highly industrialized. The remainder of the region is predominantly farmland, dotted with light industry and small communities. The locations and populations of these communities are shown in Figure 1. The population distribution surrounding Mound is shown in Figure 2. Drinking water for the area is obtained from a buried valley aquifer that generally follows the Great Miami River. The primary agricultural activity in the area

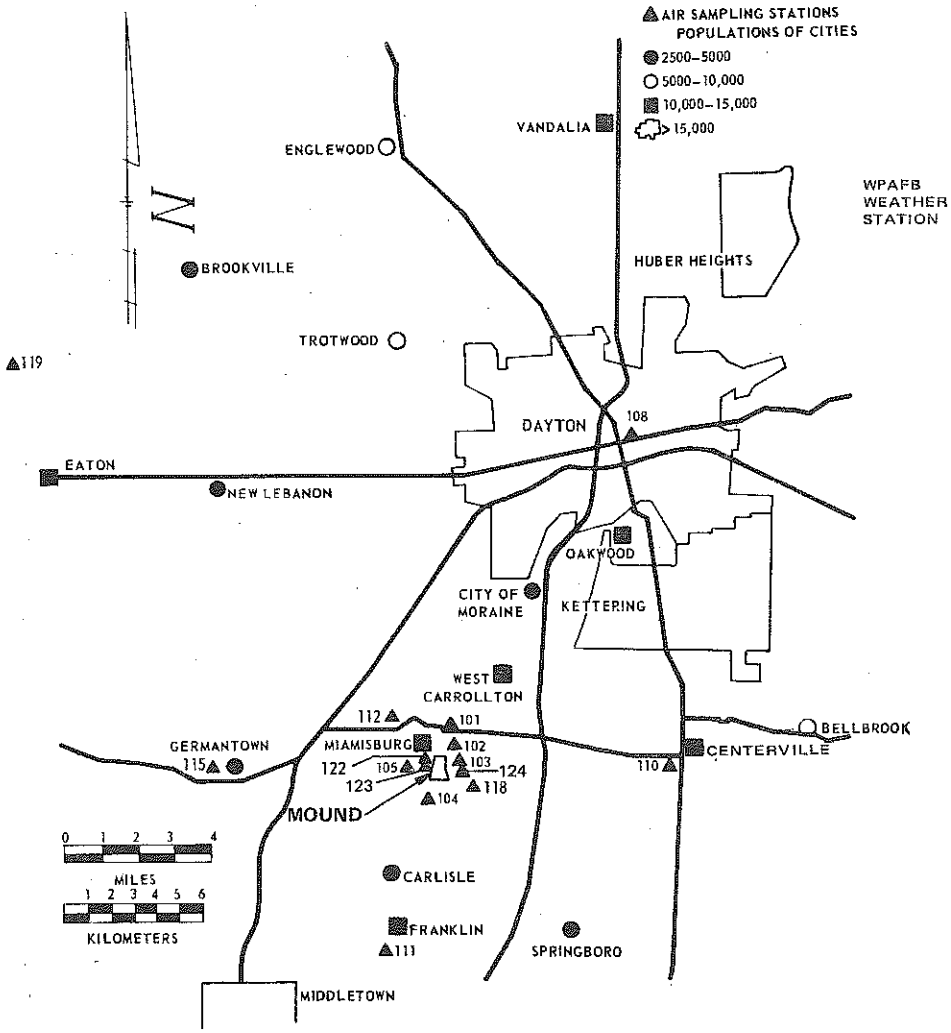
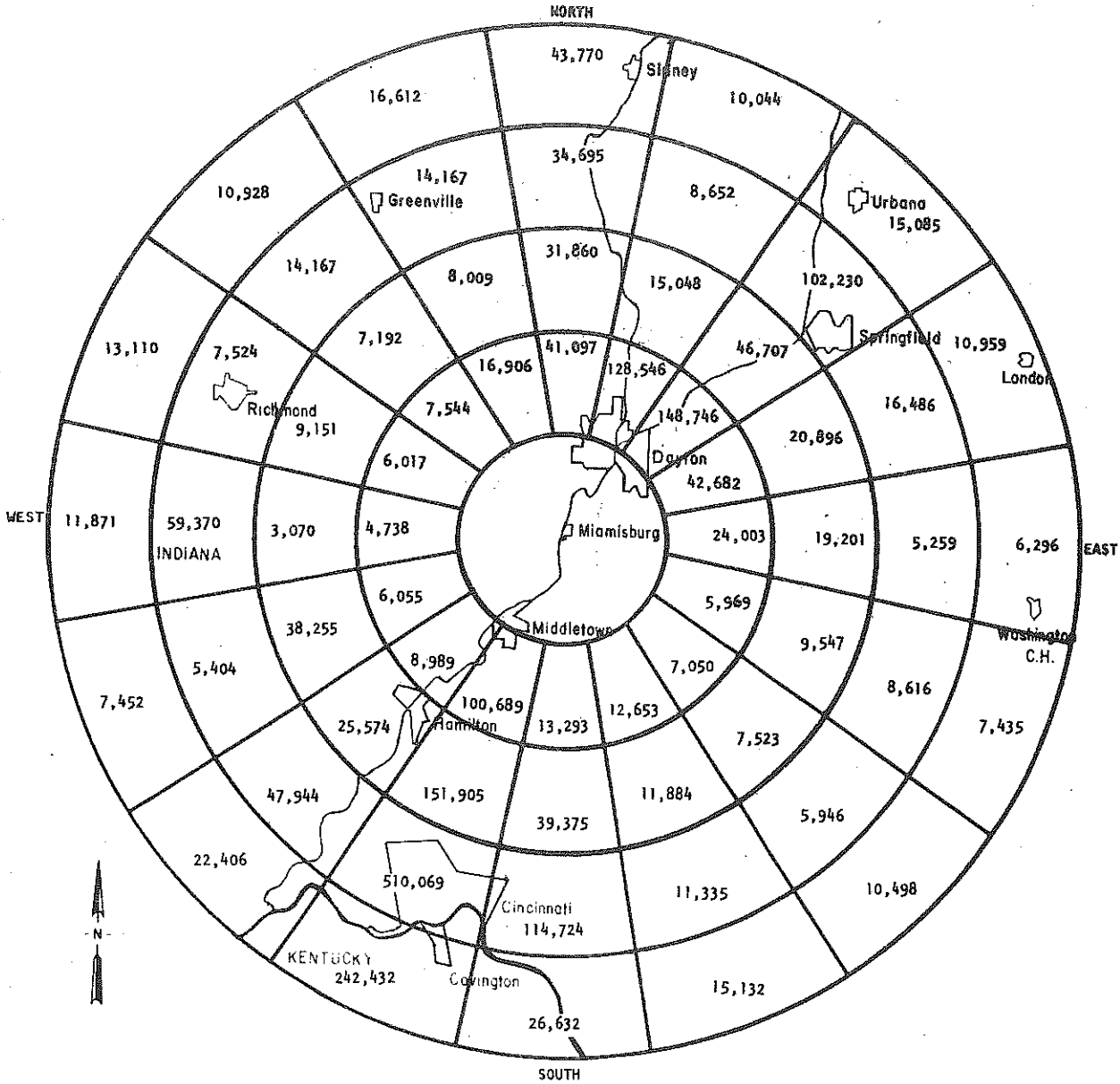


FIGURE 1 - Offsite air sampling locations.



Cumulative Population Totals
Present Population 0 - 50 Miles

0-10	320,964
0-20	895,941
0-30	1,341,138
0-40	2,307,726
0-50	2,778,388

FIGURE 2 - 1970 population within 50 miles of Mound.

is raising field crops such as corn and soybeans. Approximately 10% of the land in agricultural use is devoted to pasturing livestock [1].

The climate in the area is considered moderate. Average annual precipitation is 91 cm (36 in.) and is evenly distributed throughout the year. Winds are predominantly from the south or west, except during the summer, when they are recorded more frequently from out of the southwest [2]. The annual average wind speed measured at Mound was 4.2 m/s (10.3 mi/hr) for 1982. Figure 3 shows the wind rose compiled at Mound, and Table 1 shows average wind speed and percent frequency for each of 16 wind directions.

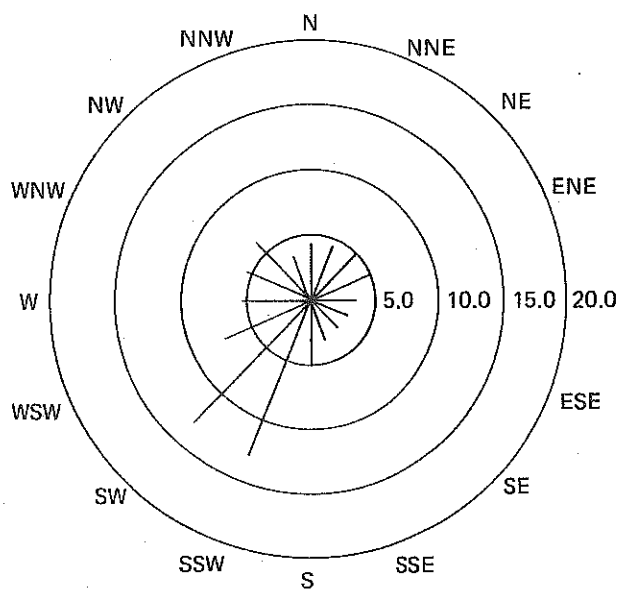


FIGURE 3 - The relative frequency of winds from different directions for Mound.

Mound began operations in 1949. Its mission currently includes 1) research, development, engineering, production, and surveillance of components for the Department of Energy (DOE) weapons programs; 2) separation, purification, and sale of stable isotopes; and 3) DOE programs in solar energy, fossil fuels, nuclear safeguards and waste management, heat source testing, and fusion fuel systems. The radionuclides of primary concern that result from Mound's current or past operations are plutonium-238 and tritium.

Radionuclides in particulate form are removed from process air effluents by high efficiency particulate air (HEPA) filters. Air effluents are filtered first at their points of origin (i.e., gloveboxes) and then just before reaching the release point (i.e., the stack). The filtering system at the stack consists of two banks of HEPA filters in series, each bank having a collection efficiency of 99.95%. Radionuclides are removed from liquid effluents, such as process wastes, by chemical processing. Solid radioactive wastes are packaged and shipped offsite for burial at approved burial sites. Wastes generated in the processing of explosive materials are collected and disposed of according to the Defense Armament and Research Command (DARCOM) Regulation 385-100 and DOE/EV/06194-1.

An onsite, sanitary waste treatment plant provides secondary treatment, in accordance with U.S. Environmental Protection Agency (EPA) requirements [3],

Table 1 - AVERAGE ANNUAL PERCENT FREQUENCY OF WIND DIRECTION AND AVERAGE WIND SPEED (M/S) FOR 1982

Direction	Percent	Average Speed (m/s)
N	3.9	4.1
NNE	4.4	4.0
NE	4.8	4.1
ENE	5.1	4.1
E	3.4	3.7
ESE	3.1	3.4
SE	2.8	3.5
SSE	3.1	3.5
S	5.1	4.0
SSW	12.5	5.4
SW	12.9	5.7
WSW	7.3	5.0
W	5.4	5.5
WNW	5.6	5.4
NW	6.2	4.9
NNW	3.6	4.3
CALM	11.0	-
Total	100	4.2

using an activated sludge process operating in the extended aeration mode. All domestic sewage generated onsite is treated in this facility. The influent and effluent at the sewage treatment plant are also monitored for radioactivity to ensure no undetected release can occur to the environment via the sanitary sewage plant. Digested sludge from the sewage plant is shipped offsite for burial at an approved burial site. All wastewater is discharged from the site to the Great Miami River. Nonradioactive 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 was transported during 1982 to a sanitary landfill site approved by both the state and county. Waste solvents and chemicals are moved offsite by a commercial-industrial waste disposal firm.

Mound's compliance with regulations prescribed by DOE for the safety of its employees and the public has been demonstrated throughout the history of the facility. The fundamental objective of the Mound Environmental Control

Program, an ongoing program since Mound began operations, is the containment of radioactive effluents to levels well within the existing standards. As part of this program, effluents are monitored and controlled at each operating step, resulting in no more than low-level releases of airborne or liquid wastes to the environment. With early detection, control techniques can be implemented, thus ensuring that concentrations are well within existing standards and meet the DOE guideline "as-low-as-reasonably-achievable" (ALARA).

As part of the Mound Environmental Program monitoring functions, air, water, vegetation, foodstuff, and sediment samples are collected from the environment at distances up to 48 km (30 mi) from Mound's boundaries. These samples are then analyzed for the specific radionuclides handled at Mound. A summary of the monitoring program is shown in Table 2.

The results of the environmental analyses for 1982 are provided in this report. The primary purpose of the report is to detail what impact, if any, Mound's operations have had on the adjacent environment in 1982. To serve this purpose, several calculational techniques used throughout this report should be described. The concentrations of various radionuclides reported here that result from Mound's operations are termed "incremental." The term incremental denotes a concentration value that exceeds normal environmental levels of the same radionuclide. The "environmental level" is that level found in the environment where Mound would have no impact. Environmental levels of radionuclides in various mediums are shown in Table 3.

To determine concentrations of radionuclides found in the environment, the instrument background and reagent blanks were subtracted from the sample count. This value was then used in averages, as opposed to using the lower detection limit (LDL), which had been the practice in years past.

For comparative purposes and for single sample evaluation, however, the lower detection limit is shown for each set of data in this report. The LDL is the estimated standard deviation of the blanks at the 95% confidence level.

The error estimates shown with each set of data are estimates of the standard error of the estimated mean at the 95% confidence level. These values include all sources of variability including sampling, analyses, counting statistics, and the propagated error involved when substracting the environmental levels from the actual data.

Summary

The environment locally surrounding Mound was monitored primarily for tritium and plutonium-238. The results are reported for 1982. Environmental mediums analyzed included air, water, vegetation, foodstuffs, and sediment.

Table 2 - MONITORING PROGRAM

	Sampling Frequency	Parameter Measured
Air Surveillance		
Offsite		
15 locations	Weekly	HTO, Pu, particulate
Onsite		
5 locations	Weekly	HTO, Pu, particulate
Stack Emission		
15 locations	Daily	HT, HTO, Pu, U
Water Surveillance - Offsite		
River		
5 locations	Daily	HTO, Pu, U
Pond		
8 locations	Monthly	HTO, Pu, U
Municipal Drinking Water		
12 locations	Quarterly	HTO, Pu
Well Water		
6 locations	Monthly	HTO, Pu
Water Surveillance - Onsite		
Effluent Water		
3 locations	Daily	Flow, suspended solids, BOD_5, fecal coliform, pH, oil and grease, COD, residual chlorine, dissolved solids, cyanide, chromium, cadmium, nickel, copper, HTO, Pu, U
Silt Surveillance - Offsite		
River		
5 locations	Quarterly	Pu
Pond		
8 locations	Quarterly	Pu
Vegetation and Foodstuff Surveillance		
Vegetation		
3 locations	Biannually	HTO, Pu
Foodstuffs		
3 locations	Annually	HTO, Pu
Environmental Level Surveillance		
Four Mediums		
6 locations	Quarterly	HTO, Pu

Table 3 - ENVIRONMENTAL CONCENTRATIONS OF RADIONUCLIDES IN VARIOUS MEDIUMS

Plutonium-238 in air[a]	=	0.03	± 0.03	x 10^{-17}	µCi/ml
Tritium oxide in air[a]	=	0.73	± 0.29	x 10^{-11}	µCi/ml
Plutonium-238 in river water[b]	=	0.7	± 1.8	x 10^{-12}	µCi/ml
Tritium in river water[b]	=	0.48	± 0.19	x 10^{-6}	µCi/ml
Plutonium-238 in surface water[c]	=	0.1	± 0.6	x 10^{-12}	µCi/ml
Tritium in surface water[c]	=	0.57	± 0.15	x 10^{-6}	µCi/ml
Plutonium-238 in well water[d]	=	0.8	± 1	x 10^{-12}	µCi/ml
Tritium in well water[c]	=	0.64	± 0.15	x 10^{-6}	µCi/ml
Uranium-233, 234 in river water[b]	=	7.2	± 2.5	x 10^{-10}	µCi/ml
Uranium-238 in river water[b]	=	7.0	± 2.2	x 10^{-10}	µCi/ml
Plutonium-238 in river silt[b]	=	N.D.[e]			
Plutonium-238 in surface water silt[c]	=	0.0008	± 0.004	x 10^{-6}	µCi/g
Tritium in grass[d]	=	0.63	± 0.14	x 10^{-6}	µCi/g
Tritium in tomatoes[d]	=	0.55	± 0.35	x 10^{-6}	µCi/g
Plutonium in grass[d]	=	0.00036	± 0.00038	x 10^{-6}	µCi/g
Plutonium in potatoes[d]	=	0.00015	± 0.00051	x 10^{-6}	µCi/g
Plutonium in fish[d]	=	0.00013	± 0.00021	x 10^{-6}	µCi/g

[a]Measured at offsite sampler 119.

[b]Measured 20 mi upstream on Great Miami River.

[c]Measured 28 mi northwest of Mound.

[d]Measured 30 mi west of Mound.

[e]Not detectable. (Environmental level cannot be detected above reagent blanks.)

The average concentrations of plutonium-238 and tritium were within the applicable standards (adopted by the U.S. DOE) for radioactive species.

Mound initiated its Potable Water Standards Project in 1975 to bring the local aquifer into compliance with a new EPA standard for tritium in community drinking water. The EPA regulations, which became effective on June 24, 1977, lowered the existing DOE standard by a factor of 50. Mound's three wells and eight offsite wells were out of compliance with the 20 nCi/L standard. Following an extensive study of the aquifer, a decision was made to attempt to bring the aquifer into compliance through high-volume pumping of water with replacement by induced infiltration of water from the Great Miami River. By 1981, all wells had been

brought into compliance, and in 1982 the wells were kept in compliance with occasional high-volume pumping.

Data concerning the emission of non-radioactive species into the atmosphere are also presented. All emissions were 7% or less of the applicable emissions standard.

The average incremental concentrations of plutonium-238 and tritium oxide in air measured at all offsite locations during 1982 were 0.26×10^{-17} µCi/ml and 1.7×10^{-11} µCi/ml, respectively. These correspond to 0.01% and 0.02% of their respective Radioactivity Concentration Guides (RCG). Details of the applicable standards are given in the Appendix.

The average incremental concentration of plutonium-238 measured at all locations in the Great Miami River during 1982 was 1.82×10^{-12} µCi/ml which is 0.00009% of the RCG. The average concentration of tritium measured at all locations in the Great Miami River during 1982 was 0.12×10^{-6} µCi/ml which is 0.01% of the RCG.

Radionuclide effluent data for 1982 are summarized in Table 4.

The average incremental concentrations of plutonium-238 found during 1982 in surface and area drinking water were also a fraction of the DOE RCG. In addition, the average incremental concentration of tritium in surface water and the average concentration in area and municipal drinking water were a fraction of each respective DOE RCG and EPA standard.

Although there are no specific standards (RCG) for plutonium-238 and tritium in foodstuffs, the concentrations found, if compared to the water standard, are also a small fraction of the RCG. Sediment was sampled at several offsite water sampling locations. No adverse impact to the environment could be determined from the radionuclide levels found in these sediments.

The dose commitment estimates indicate that, in all cases, the levels are at or within 1% of the DOE standard. The person-rem calculated to 80 km for the

Table 4 - EFFLUENT DATA FOR 1982

Radionuclide	Medium	Quantity	
Tritium	air	4283	Ci
Tritium	water	13.7	Ci
Plutonium-238	air	0.021	mCi
Plutonium-238	water	1.21	mCi
Uranium-233, 234	water	0.56	mCi

total population as a result of Mound operations during 1982 was 14 person-rem. Natural radiation would result in approximately 390,000 person-rem for the area.

A National Pollutant Discharge Elimination System (NPDES) permit regulates nonradioactive pollutants in Mound's effluent water. The NPDES permit requires this effluent to be characterized by analyzing samples collected at four onsite locations. Approximately 3% of the 1358 NPDES measurements exceeded maximum permit limitations. None of these exceptions, however, had an adverse impact on the Great Miami River or caused the river to exceed Ohio Stream Standards.

The data contained in this summary demonstrate the status of compliance with various current regulatory agency standards and demonstrate Mound's emphasis on the as-low-as-reasonably-achievable (ALARA) concept.

Environmental surveillance

Quality Assurance

The Mound Environmental Section quality control program is documented in a quality control manual published in 1981 [4]. Because the analytical results of many samples approach the lower detection limit, an essential part of the quality control program for environmental monitoring is the determination of "blank values." A "blank value" is determined by carrying out the chemical analysis without a sample, but rather using deionized water, or an unused filter paper, or only the reagents used in the analysis. Analyzing blanks is essential to verify the absence of laboratory contamination. Data on the variation of the "blank values" are used to calculate lower detection limits, which are given with each set of data.

An essential part of Mound's quality control program is the analysis of reference samples from a reliable outside laboratory. Over the past several years Mound has participated in the DOE Quality Assessment Program. This program is conducted by the Department of Energy's Environmental Measurements Laboratory (EML) which prepares "reference" samples for analysis by DOE laboratories throughout the country. During 1982, however, samples were not provided by EML. Consequently, Mound obtained outside reference samples from other sources.

Water samples containing tritium, plutonium, and uranium were obtained from the Environmental Protection Agency (EPA) through their "Environmental Radioactivity Laboratory Intercomparison Studies Program." Air filter and soil samples containing plutonium or uranium were not available through this program. Results from the EPA program of significance to the environmental program at Mound are summarized in Table 5. Comparing the ratio of the Mound value to the EPA value in the last column, shows that the values agree with each other to within the two sigma errors of each concentration.

Table 5 - MOUND'S RESULTS ON SAMPLES FROM THE U.S. EPA ENVIRONMENTAL RADIOACTIVITY LABORATORY INTERCOMPARISON STUDIES PROGRAM - 1982

Sample Type (Date)	Isotope	Mound Value ± 1 σ Error (pCi/L)	EPA Value ± 1 σ Error (pCi/L)	Ratio Mound to EPA Value
Water (6/82)	^{3}H	1770 ± 60	1830 ± 340	0.97
Water (8/82)	^{3}H	2920 ± 20	2890 ± 360	1.01
Water (7/82)	^{239}Pu	6.0 ± 0.1	6.9 ± 0.7	0.87
Water (8/22)	^{238}U, ^{234}U	28.1 ± 0.4	30 ± 6	0.94

For reference samples in the area of nonradioactive pollutants, Mound depended upon samples supplied by a Monsanto Company program. In 1982, Monsanto's Environmental Analytical Science Center (EASC) in Dayton, Ohio began a NPDES Water/Wastewater Standards program. The purpose of this program was to provide standard reference samples for Monsanto environmental laboratories that are carrying out analytical measurements as required by the National Pollutant Discharge Elimination System (NPDES). Results from this Monsanto program that were of significance to the environmental program at Mound are summarized in Table 6. As with the determination of the radionuclide concentrations, the data here indicate agreement between the Mound measured concentration and the theoretical value within experimental errors.

In summary, the agreement between Mound measured concentrations and reference values of an EPA or Monsanto quality control laboratory indicate good reliability of the data generated in the routine environmental monitoring program at Mound.

Air - Radioactive

In 1982, the offsite air-sampling network consisted of 15 continuously operating air-sampling stations used for sampling both tritium oxide and plutonium. Ten sampling stations are located within a 1.6 km (1 mi) radius of Mound, and four samplers are located in or near population centers. The remaining sampler (#119) is approximately 44.8 km (28 mi) from Mound in the least prevailing wind direction. This sampler receives no measurable contribution from Mound operations and serves as a baseline sample for computing environmental levels.

Table 6 - MOUND'S RESULTS ON MONSANTO-EASC-NPDES WATER/WASTEWATER STANDARDS - 1982

Sample ID	Parameter Measured	Average Mound Value (mg/L)	EASC Value (mg/L)	Theoretical Value (mg/L)	Ratio-Mound to Theoretical Value
82-1-D-1[a]	COD[d]	55 ± 4	48.4	50	1.10
82-1-D-2	COD	101 ± 3	97.6	100	1.01
82-1-D-3	COD	257 ± 19	254.1	250	1.03
82-1-Z-1[b]	Zn	4.43 ± 0.03	4.46	4.33	1.02
82-2-TM-1[b]	Zn	0.025 ± 0.01	0.026	0.025	1.0
82-2-TM-2	Zn	0.63 ± 0.01	0.648	0.625	1.0
82-2-TM-3	Zn	1.66 ± 0.23	1.895	1.875	0.89
82-2-TM-1[b]	Cu	0.05[e] ± 0.053	0.053	0.050	1.00
82-2-TM-2	Cu	1.25 ± 0.01	1.262	1.250	1.00
82-2-TM-3	Cu	2.32 ± 0.35	2.485	2.500	0.93
82-2-TM-1[b]	Cd	0.02[f]	0.026	0.025	0.8
82-2-TM-2	Cd	0.045 ± 0.007	0.048	0.050	0.9
82-2-TM-3	Cd	0.22 ± 0.05	0.026	0.250	0.9
82-2-TM-1[b]	Cr	0.075 ± 0.007	0.074	0.075	1.0
82-2-TM-2	Cr	0.50 ± 0.01	0.463	0.500	1.0
82-2-TM-3	Cr	1.13 ± 0.19	1.237	1.250	0.90
82-3-SS-1[c]	SS[e]	48	55.9	56	0.86
82-3-SS-2[c]	SS[e]	450	499.3	502	0.90
82-3-SS-3[c]	SS[e]	1370	1293.3	1302	1.05

[a]Average value given is for this sample number and two other identical samples.

[b]For these metals the average value given is for this sample number and one other identical sample.

[c]The value for suspended solids is not an average, but is the value for the given sample number only.

[d]Chemical oxygen demand.

[e]Suspended solids.

[f]Based on two measurements, but no estimate of error is given.

The levels from sampler #119 are subtracted from levels detected at other locations. The samplers currently in operation are located at critical distances and directions, based on a diffusion model developed for Mound. The locations of the sampling stations are shown in Figure 1.

Two types of samples are collected at each sampling station. One is a particulate air sample for plutonium-238 analysis, and the other, from a bubbler-type sampler, is for tritium oxide analysis. The particulate sample is collected on a 200-mm diameter Microsorban disk by a continuously operating (24 hr/day, 7 days/week) high-volume air sampler. The air is sampled at an average rate of 1.3×10^6 cm^3/min ($\sim$45 ft^3/min). The Microsorban disk is changed weekly, and represents a sample of approximately 13,000 m^3 of air. Plutonium-238 analyses were performed on a monthly composite for three sampling locations, #122, #123, and #124, and on quarterly composites for the other offsite locations.

The analytical scheme for plutonium-238 incorporates the following basic steps: addition of a known amount of plutonium-242 tracer, ignition to 600°C, leaching with nitric acid, separation of plutonium with anion exchange resin, electrodeposition of plutonium, and, finally, alpha spectrometry.

The average incremental offsite plutonium-238 air concentration for all locations was 0.26×10^{-17} µCi/ml which is 0.01% of the DOE RCG. The RCG used for comparison is the guide for the soluble form of the isotope and for the general population. This is the most restrictive RCG for plutonium-238 and is applied since the solubility of the measured particles in the human body is unknown. The analytical results are summarized in Table 7.

Table 8 shows concentrations of plutonium-239, 240, and plutonium-238, including environmental levels, so that a ratio comparison between these radionuclides can be made. This ratio is a sensitive, qualitative indicator of variations in environmental observations. Ratios greater than that observed at location #119 ($\sim$0.1) results from a concentration of plutonium-238 in excess of that from atmospheric fallout and are indicative of the influences of Mound operations. Quantitative comparisons are best made with the DOE standard; i.e., percent of standard as shown in Table 7.

Figure 4 shows the concentration of plutonium-239 for the past eleven years. The pronounced peaks show the increase which is observed during the spring season each year. The magnitude of the springtime peaks had been decreasing during 1979 and 1980, but a significant increase was observed in 1981, most likely as result of atmospheric weapons testing by the People's Republic of China in October, 1980. Results for 1982 show a decrease from 1981.

Table 7 - INCREMENTAL CONCENTRATIONS OF PLUTONIUM-238 IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1982

Location	Number of Samples	Range[d] (10^{-17} µCi/ml)	Average[a,c,d,e] (10^{-17} µCi/ml)	Percent of RCG[b]
101	4	0.05 - 0.41	0.18 ± 0.25	0.009
102	4	0.21 - 0.63	0.42 ± 0.29	0.02
103	4	0.1 - 0.68	0.37 ± 0.38	0.02
104	4	0.09 - 0.23	0.14 ± 0.10	0.007
105	4	0.01 - 0.12	0.06 ± 0.07	0.003
108	4	E.L. - 0.03	E.L.	-
110	4	E.L. - 0.04	E.L.	-
111	4	E.L. - 0.08	0.03 ± 0.10	0.002
112	4	E.L. - 0.05	0.01 ± 0.04	0.0005
115	4	E.L. - 0.03	0.01 ± 0.07	0.0005
118	4	E.L. - 0.14	0.08 ± 0.10	0.004
122	12	0.02 - 0.50	0.25 ± 0.11	0.01
123	12	0.43 - 6.51	1.71 ± 1.14	0.09
124	12	0.15 - 1.09	0.43 ± 0.18	0.02

[a]Lower Detection Limit (LDL) for ^{238}Pu in air for quarterly samples is 0.03 x 10^{-17} µCi/ml. This is 0.0015% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 2000 x 10^{-17} µCi/ml for the soluble form of ^{238}Pu for the general population.

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

[d]Average environmental level (E.L.) subtracted from data.

[e]Lower Detection Limit (LDL) for ^{238}Pu in air for monthly samples is 0.1 x 10^{-17} µCi/ml. This is 0.005% of the RCG.

Table 8 - CONCENTRATIONS OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1982

Location	Number of Samples	$^{239,240}Pu$ Range (10^{-17} µCi/ml)	$^{239,240}Pu$ Average[a,b] (10^{-17} µCi/ml)	^{238}Pu Average[a,b] (10^{-17} µCi/ml)	Ratio $^{238}Pu/^{239,240}Pu$
101	4	0.003 - 0.62	0.26 ± 0.41	0.21 ± 0.25	0.81
102	4	0.03 - 0.53	0.26 ± 0.32	0.45 ± 0.29	1.73
103	4	0.02 - 0.47	0.23 ± 0.32	0.4 ± 0.38	1.74
104	4	0.04 - 0.44	0.22 ± 0.29	0.17 ± 0.10	0.77
105	4	0.02 - 0.45	0.21 ± 0.32	0.09 ± 0.06	0.43
108	4	0.05 - 0.63	0.27 ± 0.41	0.03 ± 0.03	0.11
110	4	0.03 - 0.43	0.20 ± 0.29	0.03 ± 0.06	0.15
111	4	0.04 - 0.54	0.26 ± 0.32	0.06 ± 0.10	0.23
112	4	0.04 - 0.56	0.25 ± 0.35	0.04 ± 0.03	0.16
115	4	0.05 - 0.41	0.20 ± 0.25	0.04 ± 0.06	0.20
118	4	0.04 - 0.54	0.27 ± 0.38	0.11 ± 0.10	0.41
119	4	0.04 - 0.51	0.26 ± 0.35	0.03 ± 0.03	0.12
122	12	N.D.[c] - 0.53	0.23 ± 0.11	0.28 ± 0.11	1.22
123	12	0.04 - 0.63	0.26 ± 0.11	1.74 ± 1.14	6.69
124	12	0.04 - 0.59	0.25 ± 0.11	0.46 ± 0.18	1.84

[a]Lower Detection Limit (LDL) for $^{239,240}Pu$ in air for samplers 101 through 119 is 0.01 x 10^{-17} µCi/ml, and the LDL for samplers 122 through 124 is 0.2 x 10^{-17} µCi/ml. The LDL for ^{238}Pu is 0.03 x 10^{-17} µCi/ml for samplers 101 through 119 and 0.1 x 10^{-17} µCi/ml for samplers 122 through 124.

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

[c]Not detectable. (Values cannot be detected above reagent blanks.)

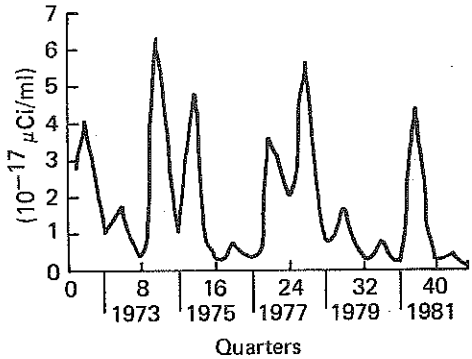


FIGURE 4 - Concentration of plutonium-239 (from weapons testing fallout) in air since 1972.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm^3/min through 200 ml of ethylene glycol. Ethylene glycol is used because this material eliminates evaporation and freezing problems associated with sample collection [5]. Tritium (oxide) in the air is collected in the solution. Tritium oxide rather than elemental tritium is sampled and analyzed because the RCG for the oxide is 200 times more restrictive than it is for elemental tritium [6]. A sample representing $\sim$30 m^3 of air is collected, and an aliquot representing 1.5 m^3 is counted in a liquid scintillation spectrometer. The average incremental concentration of tritium oxide measured during 1982 for all offsite locations, not including the environmental level found at sampler #119, was 1.7×10^{-11} μCi/ml. This concentration is 0.02% of the RCG. The RCG used for comparison is the most restrictive RCG for tritium for the general population. The results are summarized in Table 9. Environmental levels for plutonium-238 and tritium in air as measured at sampler #119 are shown in Table 3.

An onsite perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of stack emission control systems. The onsite sampling locations are shown in Figure 5. Particulate samples and tritium samples are collected by the onsite samplers at approximately the same flow rate as the offsite samplers and are analyzed in the same manner.

The average incremental plutonium-238 concentration measured for all locations onsite is 3.3×10^{-17} μCi/ml, which is 0.05% of the RCG. The results are summarized in Table 10. Table 11 presents onsite concentrations of plutonium-239, plutonium-240, and plutonium-238, including environmental levels, so that a ratio comparison between these radionuclides can be made.

The average incremental onsite tritium oxide concentration for all locations was 4.0×10^{-11} μCi/ml, which is 0.02% of the RCG. The results are summarized in Table 12.

The RCGs used for onsite comparison are those applicable for exposed individuals in the population. The total amounts of plutonium-238 and tritium discharged to the atmosphere during 1982 were 0.021 mCi and 4283 Ci, respectively.

Table 9 - INCREMENTAL CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1982

Location	Number of Samples	Tritium Oxide Range[d] (10^{-11} µCi/ml)	Tritium Oxide Average[a,c,d] (10^{-11} µCi/ml)	Percent of RCG[b]
101	32	E.L. - 17.5	4.7 ± 1.5	0.07
102	52	E.L. - 18.8	3.57 ± 1.05	0.05
103	50	E.L. - 10.2	3.13 ± 0.86	0.04
104	51	E.L. - 6.38	1.09 ± 0.55	0.02
105	50	E.L. - 4.27	0.81 ± 0.48	0.01
108	46	E.L. - 4.77	0.73 ± 0.52	0.01
110	51	E.L. - 4.75	0.63 ± 0.49	0.009
111	49	E.L. - 4.04	0.57 ± 0.49	0.008
112	51	E.L. - 4.12	0.81 ± 0.48	0.01
115	51	E.L. - 3.67	0.11 ± 0.41	0.002
118	37	E.L. - 5.14	0.66 ± 0.57	0.009
122	51	E.L. - 9.01	1.7 ± 0.69	0.02
123	52	E.L. - 27.8	2.8 ± 1.3	0.04
124	43	E.L. - 7.07	2.0 ± 0.68	0.03

[a]Lower Detection Limit (LDL) for tritium oxide in air is 0.5×10^{-11} µCi/ml which is 0.007% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 7000×10^{-11} µCi/ml for the general population and for soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

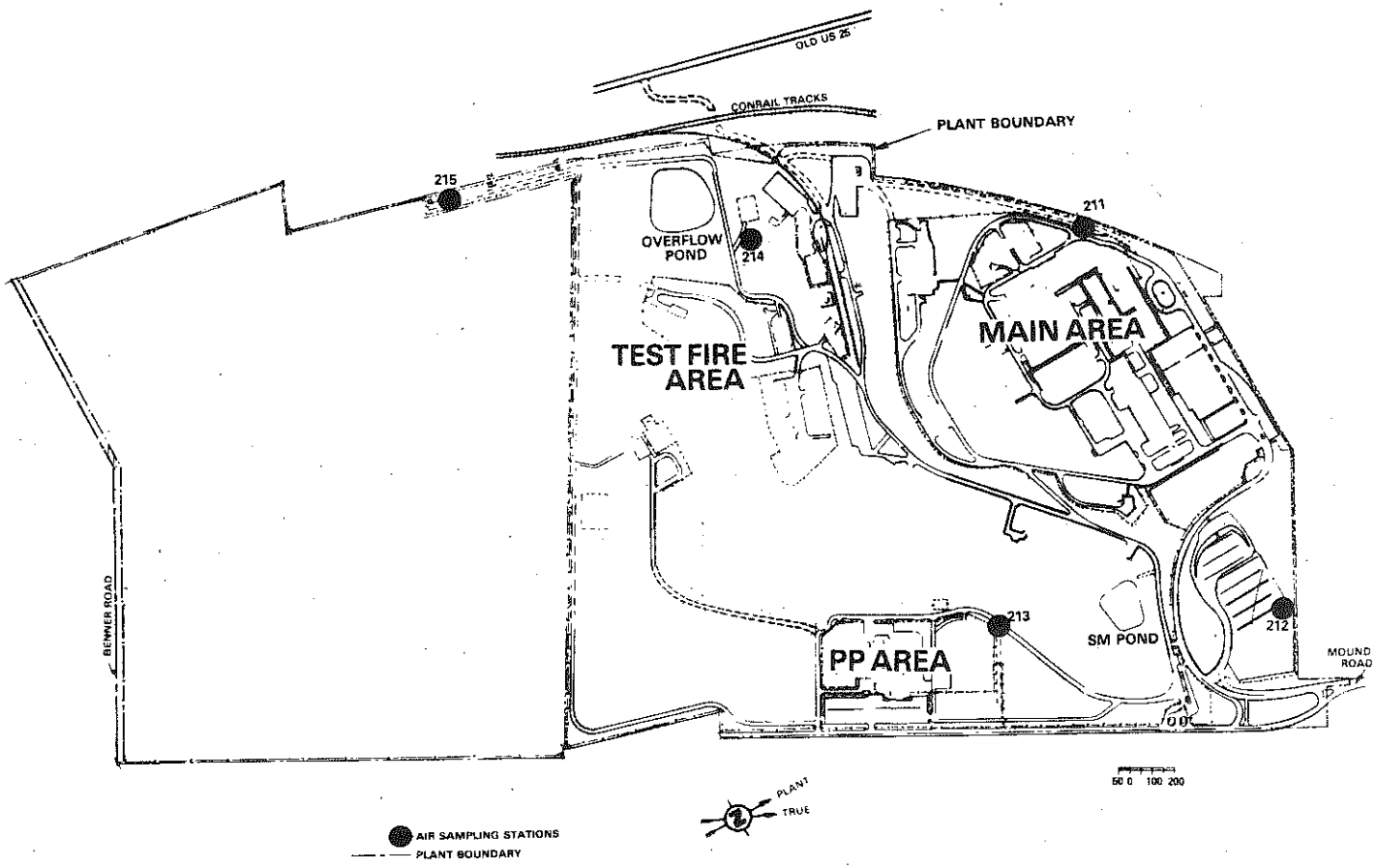


FIGURE 5 - Onsite air sampling locations.

Table 10 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN AIR AT ONSITE SAMPLING LOCATIONS IN 1982

Location	Number of Samples	Range[d] (10^{-17} µCi/ml)	Average[a,c,d] (10^{-17} µCi/ml)	Percent of RCG[b]
211	12	1.66 - 63	8.8 ± 10.9	0.13
212	12	0.25 - 3.46	0.85 ± 0.57	0.01
213	12	1.72 - 12.5	3.83 ± 1.87	0.05
214	12	0.73 - 5.02	2.39 ± 0.92	0.03
215	12	0.16 - 1.51	0.52 ± 0.31	0.007

[a]Lower Detection Limit (LDL) for ^{238}Pu in air is 0.1×10^{-17} µCi/ml which is 0.001% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 7000×10^{-17} µCi/ml for the soluble form of plutonium-238 for individuals in the population.

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

[d]Average environmental level (E.L.) subtracted from data.

Table 11 - CONCENTRATION OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT ONSITE SAMPLING LOCATIONS IN 1982

		$^{239,240}Pu$		^{238}Pu	
Location	Number of Samples	Range (10^{-17} µCi/ml)	Average[a,b] (10^{-17} µCi/ml)	Average[a,b] (10^{-17} µCi/ml)	Ratio $^{238}Pu/^{239,240}Pu$
211	12	0.1 - 0.58	0.29 ± 0.13	8.83 ± 10.9	30.4
212	12	0.03 - 0.52	0.25 ± 0.11	0.88 ± 0.57	3.52
213	12	0.01 - 0.55	0.24 ± 0.11	3.86 ± 1.87	16.1
214	12	0.04 - 0.57	0.28 ± 0.11	2.42 ± 0.92	8.64
215	12	0.002 - 0.48	0.24 ± 0.11	0.55 ± 0.31	2.29

[a]Lower Detection Limit (LDL) for $^{239,240}Pu$ in air is 0.02×10^{-17} µCi/ml. The LDL for ^{238}Pu is 0.1×10^{-17} µCi/ml.

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

Table 12 - INCREMENTAL CONCENTRATION OF TRITIUM OXIDE IN AIR AT ONSITE SAMPLING LOCATIONS IN 1982

Location	Number of Samples	Tritium Oxide Range[d] (10^{-11} µCi/ml)	Tritium Oxide Average[a,c,d] (10^{-11} µCi/ml)	Percent of RCG[b]
211	52	E.L. - 15.8	5.26 ± 1.25	0.03
212	50	E.L. - 10.7	3.93 ± 0.96	0.02
213	48	E.L. - 61	5.65 ± 2.66	0.03
214	41	E.L. - 9.0	3.02 ± 0.84	0.02
215	46	E.L. - 6.48	2.07 ± 0.66	0.01

[a]Lower Detection Limit (LDL) for tritium oxide in air is 0.5×10^{-11} µCi/ml which is 0.003% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = $20,000 \times 10^{-11}$ µCi/ml for individuals in the population and soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

Air- Nonradioactive

The primary source of nonradioactive airborne emissions is the Mound steam power plant. This plant is normally fueled with natural gas, but has the capability to burn fuel oil. During unusually cold weather, if the natural gas supply to Mound is interrupted, fuel oil with <1% sulfur content is burned. Approximately 62,000 gal of fuel oil was burned during 1982.

Additional sources of airborne emissions are as follows. A waterwash, paint spray booth is operated intermittently in the Mound paint shop. Wastes from operations involving explosives are disposed of by open burning under a permit issued by the Regional Air Pollution Control Agency (RAPCA). A maintenance grinding operation and a carpenter shop are operated on an intermittent basis. Fire-fighter training exercises are held at an open outdoor facility under a burning permit issued by RAPCA.

Emissions from sources registered with the Regional Air Pollution Control Agency (RAPCA) and the Ohio EPA for which applicable emission standards exist are summarized in Table 13. The emissions were estimated from emission factors established by the U.S. EPA or from material balances [7]. The particulates from the grinding and carpenter shop operations are captured by cyclone air cleaners rated at 95% efficiency.

Table 13 - NONRADIOACTIVE AIRBORNE EMISSIONS 1982

Emission Source	Pollutant	Emission	Emission Standard[a]	% of Standard
Power House	Particulates	0.013 lb/10^6 Btu Input	0.2 lb/10^6 Btu	6.5
Power House	Sulfur Oxides	0.018 lb/10^6 Btu Input	1.6 lb/10^6 Btu	1.1
Paint Shop	Organics	0.32 lb/day	40 lb/day	0.8
Explosives Burning	Particulates	7 lb	NA	NA
Fire Fighter Training	Particulates	18 lb	NA	NA

[a]Ohio EPA Air Pollution Regulations 3745-17-01 through 3745-17-13 and 3745-21-01 through 3745-21-08.

NA - not applicable.

Nonradioactive airborne emissions at Mound were all within applicable standards and had minimal impact on ambient air quality. This is further demonstrated by the particulate concentration data summarized in Tables 14 and 15.

The data presented are weekly particulate concentrations measured at Mound's offsite and onsite air-sampling sites. The particulate concentration at onsite locations is somewhat lower than at offsite locations. The particulate concentration also appears to be independent of distance from Mound. This would suggest no influence from Mound operations. For comparison purposes, the State of Ohio - Ambient Quality Standard for airborne particulates is also given in Table 14.

Water - Radioactive

Water sampling locations along the banks of the Great Miami River were selected according to guidelines recommended by the U.S. EPA [8]. The locations, shown in Figure 6, provide samples that are representative of river water after considerable mixing of the effluent from Mound has occurred. Water samples are normally collected and filtered in the field at these locations five days per week, and are subjected to specific analyses for plutonium-238 and tritium.

Large-volume water samples are analyzed by compositing daily samples for a quarterly analysis. The average incremental concentration of plutonium-238 measured for all locations in the Great Miami River was 1.82×10^{-12} μCi/ml which is 0.00009% of the RCG for the

Table 14 - 1982 WEEKLY PARTICULATE CONCENTRATION DATA OFFSITE[a]

Location	Number of Samples	Range ($\mu g/m^3$)	Average ($\mu g/m^3$)[b]
101	41	42 - 202	97 ± 14
102	49	7 - 234	76 ± 11
103	52	27 - 161	67 ± 8
104	51	35 - 212	91 ± 11
105	50	22 - 153	66 ± 8
108	52	47 - 239	109 ± 12
110	52	24 - 170	63 ± 8
111	52	28 - 476	103 ± 19
112	52	34 - 212	73 ± 9
115	47	18 - 152	65 ± 7
118	50	26 - 203	80 ± 11
119	48	19 - 209	64 ± 10
122	51	21 - 183	60 ± 9
123	52	28 - 185	76 ± 9
124	52	29 - 228	78 ± 10

[a]Ohio Ambient Air Quality Standard = 60 $\mu g/m^3$.

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

These data are obtained by the Mound air monitoring program and are indicative only of the particulate air loading of the Dayton metropolitan area. Mound particulate discharges presented in Table 13 make a negligible contribution to the surrounding area. In addition, Table 15 presents onsite particulate data.

general population, the most restrictive standard for plutonium-238. These results are summarized in Table 16.

Weekly samples are analyzed for tritium. The average incremental concentration of tritium measured at all locations in the Great Miami River was 0.12×10^{-6} $\mu Ci/ml$ which is 0.01% of the RCG for the general population. These results are summarized in Table 17.

The total amounts of plutonium-238, tritium, and uranium-233, 234 discharged to the Great Miami River during 1982 were 1.21 mCi, 13.7 Ci, and 0.56 mCi, respectively. These concentrations were 0.02%, 0.43% and 0.002% of the most restrictive RCG for individuals in the population. It should be noted that a drainage control system consisting of retention basins and an overflow pond was placed in operation in 1979 to

Table 15 - 1982 WEEKLY PARTICULATE CONCENTRATION DATA ONSITE

Location	Number of Samples	Range ($\mu g/m^3$)	Average ($\mu g/m^3$)[a]
211	51	25 - 169	73 ± 8
212	51	30 - 168	72 ± 8
213	51	27 - 346	86 ± 13
214	49	15 - 204	60 ± 9
215	52	26 - 231	70 ± 9

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

reduce plutonium levels in plant effluents. The system reduced the quantity of plutonium-238 discharged in 1982 by approximately 75% as compared to 1978.

Uranium-233, 234, and 238 were also monitored at the river water sampling locations during 1982. The average incremental concentrations of uranium-233, 234, were 0.08×10^{-10} µCi/ml which is 0.00008% of the RCG. Uranium-238 was at the environmental level shown in Table 3. In addition, as shown in Table 18, the ratio of uranium-233, 234 to uranium-238 is slightly greater than unity, which is in range of background ratios reported [9]. This is expected as a result of secular equilibrium.

Seven additional surface water locations, such as ponds, in all quadrants surrounding Mound as shown in Figure 6 are sampled quarterly for plutonium and tritium analyses. The samples used for plutonium-238 determination are also large volume water samples. The large volume of sample increases the sensitivity of the analysis for plutonium. A smaller aliquot (10 ml) is taken which is adequate for the tritium analysis. The average concentrations of plutonium-238 and tritium for all locations were 1.5×10^{-12} µCi/ml and 0.1×10^{-6} µCi/ml, respectively, which are 0.00008% and 0.01% of the respective RCG for the general population. The results of the surface water samples are summarized in Tables 19 and 20. Environmental levels (Table 3) have been subtracted from the concentration of plutonium and tritium in water.

During 1982, Mound continued to monitor the results of a previously reported program for reducing the concentration of tritium in a nearby aquifer. The Potable Water Standards Project was initiated in 1975 to bring the local aquifer into compliance with a new EPA standard for tritium in community drinking water. The standard, 20 nCi/L, was 50 times lower than previously existing

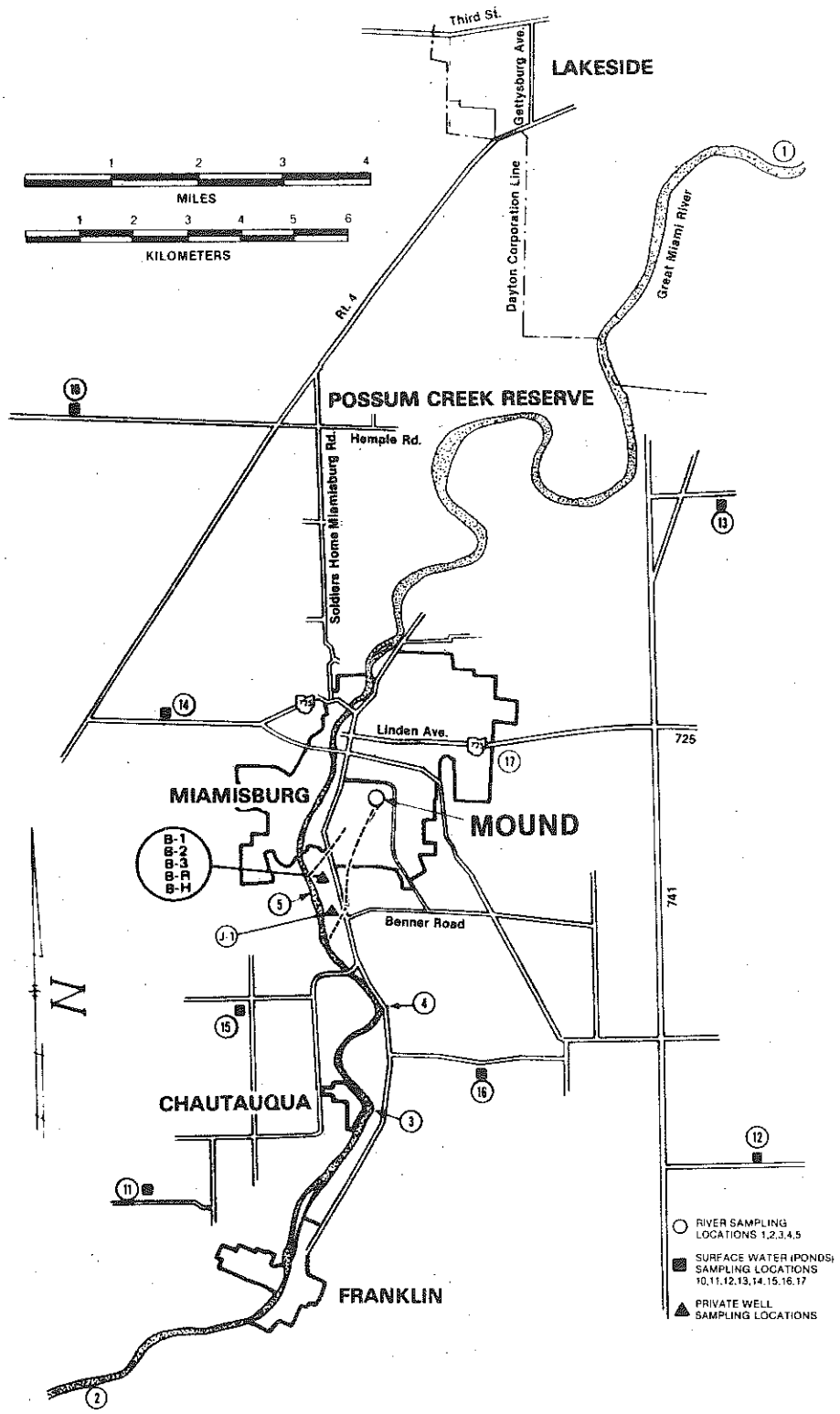


FIGURE 6 - Offsite water sampling locations.

Table 16 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN THE GREAT MIAMI RIVER IN 1982

Location	Number of Samples[a]	Plutonium-238 Range[d] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,e] (10^{-12} µCi/ml)	Percent of RCG[c]
1	4	E.L. - 0.7	0.2 ± 1.8	0.00001
2	4	E.L. - 2.3	0.7 ± 1.9	0.00004
3	3	0.2 - 13	4.5 ± 18	0.0002
4	4	1.9 - 4.7	2.7 ± 2.3	0.0001
5	4	0.2 - 2.1	1.0 ± 1.5	0.00005

[a]Composite large volume water samples for each location from water collected during 1982.

[b]Lower Detection Limit (LDL) for ^{238}Pu in water is 0.4×10^{-12} µCi/ml which is 0.00002% of the RCG.

[c]Radioactivity Concentration Guide (RCG) = $2{,}000{,}000 \times 10^{-12}$ µCi/ml for the general population and the soluble form of plutonium-238.

[d]Average environmental level (E.L.) subtracted from data.

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

DOE standards, leaving Mound's three wells and eight offsite private wells out of compliance. The background level of tritium in the aquifer had been increased by past tritium operations at Mound, but the concentrations of tritium were well within the DOE standard. Release of tritium process liquid effluents to the environment had been discontinued in 1970. The project involved an extensive study of the aquifer, and a decision was made to attempt to bring the aquifer into compliance with the EPA standard through high-volume pumping of water from the aquifer with replacement by induced infiltration of water from the Great Miami River. By 1981, all wells were in compliance, the final report was issued, and the project was transferred to the routine environmental monitoring program. During 1982, the wells were kept in compliance, and an attempt was made to reduce the amount of high-volume pumping. Mound Well #1 was not pumped at all for this program, and Miamisburg Well #2 was used less than half of the year. The average concentration of tritium in all affected offsite wells during 1982 was 9×10^{-6} µCi/ml, or 55% below the EPA standard. Occasional pumping of the aquifer will continue in 1983 to ensure that wells remain in compliance. This project will continue on a routine basis until data

Table 17 - INCREMENTAL CONCENTRATION OF TRITIUM IN THE GREAT MIAMI RIVER IN 1982

Location	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,c,d] (10^{-6} µCi/ml)	Percent of RCG[b]
1	30	E.L. - 0.6	0.06 ± 0.21	0.006
2	30	E.L. - 0.6	0.11 ± 0.21	0.011
3	30	E.L. - 0.5	0.13 ± 0.21	0.013
4	30	E.L. - 0.6	0.17 ± 0.21	0.017
5	29	E.L. - 0.7	0.13 ± 0.22	0.013

[a]Lower Detection Limit (LDL) for tritium in water is 0.2×10^{-6} µCi/ml which is 0.04% of the RCG.

[b]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000×10^{-6} µCi/ml for the general population and the soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

indicate that pumping can be terminated. Additional details concerning this project have been reported by Styron and Meyer [10]. Analytical results from the private wells are summarized in Table 21.

Drinking water from communities in the surrounding area is sampled and analyzed quarterly for tritium. These communities and their relative locations are shown in Figure 1. The average concentration of tritium for all locations was 0.8×10^{-6} µCi/ml which is 4% of the standard adopted by the U.S. EPA in 1977 for community drinking water systems.

Data from the analyses of community drinking water samples are summarized in Table 22. The environmental level in Table 3 for tritium in water is not subtracted from these data.

Four private wells and Miamisburg city water were sampled and analyzed quarterly for plutonium-238. These samples were also large-volume water samples. The average incremental plutonium-238 concentration for these locations was 0.7×10^{-12} µCi/ml which is 0.00003% of the applicable DOE RCG for the general population. These results are shown in Table 23.

Table 18 - INCREMENTAL CONCENTRATION OF $^{233,234}U$ AND ^{238}U IN THE GREAT MIAMI RIVER IN 1982

Location	Number of Samples[a]	$^{233,234}U$ Range[d] (10^{-10} µCi/ml)	$^{233,234}U$ Average[a,b,c,e] (10^{-10} µCi/ml)	$^{233,234}U$ Percent of RCG[f,g]	^{238}U Range[e] (10^{-10} µCi/ml)	^{238}U Average[a,b,c,e] (10^{-10} µCi/ml)	^{238}U Percent of RCG[f,g]	Ratio[d] $^{233,234}U/^{238}U$
1	4	E.L. - 1.7	0.2 ± 3.3	0.0002	E.L. - 0.3	E.L.	-	1.1
2	4	E.L. - 0.9	E.L.	-	E.L. - 0.4	E.L.	-	1.1
3	4	E.L. - 0.5	E.L.	-	E.L. - 1.4	E.L.	-	0.9
4	4	E.L. - 0.7	0.2 ± 2.7	0.0002	E.L. - 0.09	E.L.	-	1.1
5	4	E.L. - 0.5	E.L.	-	E.L.	E.L.	-	1.1

[a]Composite large volume water samples for each location.

[b]Lower Detection Limit (LDL) for $^{233,234}U$ and ^{238}U in water is 0.02×10^{-10} µCi/ml and 0.06×10^{-10} µCi/ml, respectively.

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

[d]A ratio slightly greater than unity indicates naturally occurring uranium [11]. Does not have environmental levels subtracted.

[e]Average environmental level (E.L.) subtracted from data.

[f]DOE Concentration Guide (RCG) for $^{233,234}U = 100,000 \times 10^{-10}$ µCi/ml for the general population.

[g]DOE Concentration Guide (RCG) for $^{238}U = 400,000 \times 10^{-10}$ µCi/ml for the general population.

Table 19 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SURFACE WATER IN 1982

Location	Number of Samples[a]	Plutonium-238 Range[d,e] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,c,e] (10^{-12} µCi/ml)	Percent of RCG[c]
10	3	0.8 - 6.6	2.9 ± 7.2	0.0001
11	4	0.3 - 4.8	2.7 ± 3.4	0.0001
12	4	E.L. - 3.0	1.0 ± 2.3	0.00005
13	4	E.L. - 4.0	1.5 ± 3.0	0.00008
14	4	E.L. - 3.0	0.8 ± 2.6	0.00004
15	4	E.L. - 1.0	0.4 ± 1.3	0.00002
16	4	E.L. - 3.7	1.0 ± 3.0	0.00005
17	4	1.0 - 2.6	1.7 ± 1.3	0.00009

[a]Composite large volume water samples were used for each location.

[b]Lower Detection Limit (LDL) for ^{238}Pu in water is 0.4×10^{-12} µCi/ml which is 0.00002% of the RCG.

[c]Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = 2,000,000 $\times 10^{-12}$ µCi/ml for the general population and soluble form of plutonium-238.

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

[e]Average environmental level (E.L.) subtracted from data.

Water - Nonradioactive

Mound discharges an average of 0.82 million gallons of water per day to the Great Miami River. Nonradioactive pollutants in this effluent water are regulated by an NPDES (National Pollutant Discharge Elimination System) permit issued by Region V of the U.S. EPA. This permit requires Mound to characterize its effluent water by analyzing samples collected at four onsite locations.

A 24-hr composite, flow proportional sample, and grab sample are collected from discharges 001-A, 001-B, and 002. Discharge 001-A contains the effluent from the sanitary sewage treatment plant. Discharge 001-B includes storm water runoff, single-pass cooling water, zeolite softener backwash, boiler-plant blowdown, and discharge from the radioactive waste disposal facility. Discharge 002 consists of single-pass cooling water, cooling tower blowdown,

Table 20 - INCREMENTAL CONCENTRATION OF TRITIUM IN SURFACE WATER IN 1982

Location	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,b,d] (10^{-6} µCi/ml)	Percent of RCG[c]
10	18	E.L. - 0.4	E.L.	-
11	18	E.L. - 0.5	0.02 ± 0.23	0.002
12	17	E.L. - 1.8	0.18 ± 0.39	0.018
13	19	E.L. - 0.4	E.L.	-
14	19	E.L. - 1.2	0.22 ± 0.26	0.022
15	18	E.L. - 0.8	0.10 ± 0.24	0.010
16	19	E.L. - 1.4	0.09 ± 0.31	0.009
17	18	E.L. - 0.7	0.20 ± 0.23	0.020

[a]Lower Detection Limit (LDL) for tritium in water is 0.1×10^{-6} µCi/ml which is 0.01% of the RCG.

[b]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000×10^{-6} µCi/ml for the general population and soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

zeolite softener backwash, and most of the storm water runoff. An 8-hr composite, time proportional sample is collected from discharge 001-C, the effluent from the electroplating facility which subsequently flows to the sanitary sewage treatment plant. The water samples are analyzed for water quality parameters according to standard methods [11]. The results of effluent analyses for 1982 are summarized in Table 24.

The EPA additionally requires Mound to monitor the flow from two wells which are periodically pumped as a part of the Potable Water Standards Project. One hundred and thirty million gallons were discharged from one of these wells, discharge 003, in 1982. No water was discharged from the other well, discharge 004.

Table 21 - TRITIUM IN PRIVATE WELLS IN 1982

Location	Number of Samples	Tritium Range[e] (10^{-6} µCi/ml)	Tritium Average[a,b,d,e] (10^{-6} µCi/ml)	Percent Standard[c]
B-1	44	4.9 - 14	8.1 ± 0.6	41
B-3	12	6.1 - 7.8	7.0 ± 0.4	35
J-1	12	4.3 - 9.3	6.6 ± 0.9	33
B-R	39	9.2 - 14	12 ± 0.4	60
B-H	44	4.8 - 13	11 ± 0.8	55

[a]All wells are now in compliance with the new EPA Standard of 20 x 10^{-6} µCi/ml.

[b]Lower Detection Limit (LDL) for tritium in water is 0.3 x 10^{-6} µCi/ml which is 2% of the EPA Standard.

[c]EPA Standard for tritium in community drinking water systems = 20 x 10^{-6} µCi/ml. Mound is using the EPA Standard as a guide for the private water supplies.

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

[e]Environmental level is included in these data for comparison to the EPA Standard.

A total of 1358 NPDES analyses were performed in 1982. From these measurements, an effluent parameter exceeded its maximum discharge limit 47 times. In addition, Mound effluents exceeded monthly average limits 20 times in 1982. High suspended solids resulting from storm runoff were responsible for 29 of the 35 exceptions caused by weather conditions. Cold temperatures stressing the sewage treatment plant and deicing of snow covered roads were the cause of the other weather-related exceptions: suspended solids and dissolved solids, respectively. A total of 21 exceptions, pH and suspended solids, were related to boiler blowdown from the powerhouse. Most of these exceptions were caused by the replacement of the hydrogen zeolite unit with a reverse osmosis unit designed to improve the quality of boiler feedwater. During the installation of the reverse osmosis unit the boilers were fed with tap water. This necessitated more frequent and higher volume boiler blowdowns to prevent the buildup of solids in the boiler. The electroplating operations were responsible for seven exceptions. Two of these exceptions resulted from cleaning and

Table 22 - SUMMARY OF TRITIUM LEVELS IN COMMUNITY DRINKING WATER IN 1982

Locations	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,c,d] (10^{-6} µCi/ml)	Percent Standard[b]
Bellbrook	4	0.4 - 1.1	0.7 ± 0.5	3.5
Centerville	4	0.2 - 1.0	0.6 ± 0.5	3.0
Dayton	4	0.4 - 0.8	0.6 ± 0.3	3.0
Franklin	3	0.4 - 0.9	0.7 ± 0.7	3.5
Germantown	4	0.2 - 0.9	0.6 ± 0.6	3.0
Kettering	4	0.5 - 1.5	0.9 ± 0.8	4.5
Miamisburg	4	0.8 - 2.9	1.7 ± 1.5	8.5
Middletown	4	0.3 - 1.0	0.6 ± 0.6	3.0
Moraine	4	0.5 - 1.1	0.8 ± 0.5	4.0
Springboro	4	0.6 - 1.3	0.9 ± 0.4	4.5
Waynesville	4	0.5 - 1.0	0.7 ± 0.4	3.5
West Carrollton	4	0.6 - 1.1	0.9 ± 0.4	4.5

[a]Lower Detection Limit (LDL) for tritium oxide is 0.2×10^{-6} µCi/ml which is 1% of the EPA Standard for community drinking water.

[b]EPA Drinking Water Standard for tritium = 20×10^{-6} µCi/ml for community drinking water systems.

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

[d]Environmental level is included in these data for comparison to the EPA Standard.

dismantling equipment prior to the startup of the new electroplating facility. The last electroplating exception of 1982 occurred during startup of the new facility.

In summary, the number of exceptions has approximately doubled since last year, 1981. Increased rainfall and subsequent storm runoff accounts for half of the 1982 exceptions. Upgrading facilities and installing new facilities for the powerhouse and electroplating were major causes of exceptions in 1982; however, these modifications will result in better operation and will decrease the frequency of future exceptions.

According to data obtained from the U.S. Geological Survey, the flow rate of the Great Miami River in 1982 averaged 2000 million gallons per day (MGD) with a minimum and maximum of 290 MGD and 16,700 MGD, respectively. The magnitude

Table 23 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN PRIVATE WELLS AND MIAMISBURG MUNICIPAL DRINKING WATER IN 1982

Location	Number of Samples[a]	Plutonium-238 Range[e] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,e] (10^{-12} µCi/ml)	Percent of RCG[c]
Miamisburg	4	E.L.	E.L.	-
B-1	4	E.L. - 6.1	1.9 ± 4.6	0.0001
B-3	4	E.L. - 1.9	0.8 ± 1.7	0.00004
J-1	4	E.L.	E.L.	-

[a]Composite large volume water samples were analyzed from each location from water collected during 1982.

[b]Lower Detection Limit (LDL) for ^{238}Pu is 0.4×10^{-12} µCi/ml which is 0.00002% of the RCG.

[c]Applicable DOE Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = $2{,}000{,}000 \times 10^{-12}$ µCi/ml for the general population and soluble form of plutonium-238.

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

[e]Average environmental level (E.L.) subtracted from data.

of this river flow is significantly greater than Mound effluents and, in all cases, the above exceptions had no adverse impact on the Great Miami River. In addition, a review of the data in Table 24 indicates that Mound effluents did not cause the Great Miami River to exceed Ohio Stream Standards.

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is any significant uptake and concentration of radionuclides by plant or animal life. Samples were collected in Miamisburg, Centerville, and Bellbrook. Centerville and Bellbrook are in the prevailing wind direction from Mound at a distance of 8 km (5 mi) and 16 km (10 mi), respectively. Both communities are shown in Figure 1. Fish were collected in the Great Miami River. Mound's outfalls are shown as dotted lines in Figure 6. The plutonium-238 content of the foodstuff and vegetation samples is determined by ashing the samples, then proceeding with the same techniques used

Table 24 - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM DATA FOR 1982

Parameter	Units	Number of Samples	Minimum		Maximum		Average		NPDES Permit Limits Maximum[b]		NPDES Permit Limits Monthly Average	
Discharge 001-A												
Flow Rate[a]	MGD	Cont.	0.05		0.32		0.10		-[c]		-[c]	
pH	pH units	243	7.3		8.2		-		9.0		-[c]	
Biochem. O_2 Demand	mg/l (kg/day)	94	1.1	(0.3)	9.5	(3.8)	3.8	(1.4)	15	(14.2)	10.0	(4.9)
Suspended Solids	mg/l (kg/day)	98	3.6	(1.0)	39.0	(15.3)	10.5	(4.2)	30	(28.4)	15	(7.4)
Fecal Coliform	MPN/100 ml	98	< 5		24,000		169		2000		1000	
Discharge 001-B												
Flow Rate	MGD	Cont.	0.1		0.26		0.07		-[c]		-[c]	
pH	pH units	100	7.3		9.6		-		9.0		-[c]	
Susp. Solids (Oct-Mar)	mg/l (kg/day)	42	1.3	(0.1)	125	(16.6)	20.9	(4.8)	30	(11.4)	20	(7.6)
Susp. Solids (Apr-Sept)	mg/l (kg/day)	52	2.3	(0.3)	126	(47.9)	22.8	(6.4)	50	(19.0)	20	(7.6)
Dissolved Solids	mg/l	15	625		20,000		6020		-[c]		-[c]	
Grease and Oil	mg/l	13	< 0.5		4.0		1.7		10		-[c]	
Residual Chlorine	mg/l	96	< 0.02		< 0.02		0.16		0.02		-[c]	
Chemical O_2 Demand	mg/l	12	< 4.0		150		58.9		-[c]		-[c]	
Discharge 001-C												
Cyanide	mg/l	46	< 0.04		0.20		< 0.04		1.0		-[c]	
Chromium	mg/l	46	< 0.01		0.37		0.06		0.5		-[c]	
Cadmium	mg/l	46	< 0.01		0.21		0.03		0.1		-[c]	
Nickel	mg/l	46	0.04		15.2		0.57		0.5		-[c]	
Copper	mg/l	46	0.03		0.68		0.15		0.5		-[c]	
Discharge 002												
Flow Rate	MGD	Cont.	0.16		1.80		0.65		-[c]		-[c]	
pH	pH units	31	7.9		8.5		-		9.0		-[c]	
Suspended Solids	mg/l (kg/day)	102	2.8	(3.6)	556	(2120)	28.9	(96.0)	30	(91)	15	(34)
Dissolved Solids	mg/l (kg/day)	24	488	(797)	1680	(5710)	986	(2460)	2000	(6065)	1500	(3412)
Grease and Oil	mg/l	12	< 0.5		3.6		1.0		10		-[c]	
Residual Chlorine	mg/l	96	< 0.02		< 0.02		< 0.02		0.02		-[c]	

[a] Includes flow from Discharge 001-C. The maximum flow from 001-C is approximately 2000 gal/day.

[b] pH has a minimum limit of 6.5 and a maximum limit of 9.0.

[c] No limit applicable.

for plutonium-238 analyses of air samples (see section on Air - Radioactive). The tritium content of the foodstuff and vegetation samples is determined by distilling the water from the sample, then analyzing the distillate for tritium. The results of the foodstuff, vegetation, and fish analyses are summarized in Tables 25 and 26. The concentration is given in terms of the sample weight (wet weight) before ashing or distilling. The samples of aquatic life analyzed included only the edible, fleshy portions of fish. These analyses indicate no evidence of any significant uptake or concentration by plant or animal life of the radionuclides handled at Mound. Environmental levels for foodstuffs and vegetation have been subtracted from the data (Table 3).

Silt - Radioactive

Silt samples were collected from the river and surface water sample locations shown in Figure 6.

The results of the silt sample analyses are found in Table 27 and 28.

Table 25 - INCREMENTAL PLUTONIUM-238 IN FOODSTUFFS AND VEGETATION IN 1982

Location	Type of Sample	Number of Samples	Plutonium-238 Range[a] (10^{-6} µCi/g)	Plutonium-238 Average[a,b,c] (10^{-6} µCi/g)
Miamisburg	Grass	8	E.L. - 0.012	0.0015 ± 0.0034
	Potatoes	4	E.L. - 0.00004	E.L.
Centerville	Grass	8	E.L. - 0.0001	E.L.
	Potatoes	4	E.L. - 0.0003	E.L.
Bellbrook	Grass	8	E.L. - 0.0014	0.0001 ± 0.0006
	Potatoes	4	E.L.	E.L.
Mound (outfall to river)	Fish	8	E.L. - 0.0004	E.L.

[a]Average environmental level (E.L.) subtracted from data.

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

[c]Lower Detection Limit (LDL) for plutonium-238 in grass samples is 0.0004×10^{-6} µCi/g. LDL for plutonium-238 in potato samples is 0.0004×10^{-6} µCi/g. LDL for plutonium-238 in fish samples is 0.0002×10^{-6} µCi/g.

Table 26 - INCREMENTAL CONCENTRATION OF TRITIUM IN VEGETATION IN 1982

Location	Type of Sample	Number of Samples	Tritium Range[c] (10^{-6} µCi/g)	Tritium Average[a,b,c,d] (10^{-6} µCi/g)
Miamisburg	Grass	8	0.20 - 0.84	0.49 ± 0.22
	Tomatoes	4	0.34 - 0.58	0.48 ± 0.38
Centerville	Grass	8	E.L. - 0.97	0.24 ± 0.36
	Tomatoes	4	E.L.	E.L.
Bellbrook	Grass	8	E.L. - 0.11	0.01 ± 0.15
	Tomatoes	4	E.L. - 0.07	E.L.

[a]LDL for tritium in grass is 0.04 x 10^{-6} µCi/g.

[b]LDL for tritium in tomatoes is 0.09 x 10^{-6} µCi/g.

[c]Average environmental level (E.L.) subtracted from data.

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

Table 27 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM RIVER MONITORING LOCATIONS IN 1982

Location	Number of Samples	^{238}Pu Range (10^{-6} µCi/g)	^{238}Pu Average[a,b,c] (10^{-6} µCi/g)
1	4	N.D.[c] - 0.003	0.0006 ± 0.004
2	4	0.01 - 0.09	0.03 ± 0.06
3	4	0.04 - 0.07	0.05 ± 0.03
4	4	0.01 - 0.29	0.10 ± 0.22
5	4	0.008 - 0.22	0.06 ± 0.16

[a]Lower Detection Limit (LDL) for ^{238}Pu in silt is 0.001 x 10^{-6} µCi/g.

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

[c]Not detectable. (Environmental level and sample values cannot be detected above reagent blanks, therefore includes environmental level.)

Table 28 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM SURFACE WATER MONITORING LOCATIONS IN 1982

Location	Number of Samples	^{238}Pu Range[c] (10^{-6} µCi/g)	^{238}Pu Average[a,b,c] (10^{-6} µCi/g)
10	4	E.L. - 0.001	E.L.
11	4	E.L.	E.L.
12	4	E.L.	E.L.
13	4	E.L.	E.L.
14	4	E.L. - 0.004	0.0003 ± 0.006
15	4	E.L. - 0.065	0.016 ± 0.054
16	4	E.L. - 0.005	0.0008 ± 0.006

[a]Lower Detection Limit (LDL) for ^{238}Pu is 0.001 x 10^{-6} µCi/g.

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

[c]Average environmental level (E.L.) subtracted from data.

Evaluation of dose commitment to the public

A dose assessment was performed for radionuclides in the environment from Mound operations. These radionuclides are plutonium-238 and tritium. Tritium (oxide) is the only radionuclide at Mound for which the critical organ is the whole body. The critical organs for plutonium-238 are assumed to be the lung for insoluble material and the bone for soluble material. The solubility of plutonium-238 in the receptor is unknown at Mound; however, it is highly probable that most of the plutonium-238 is in the oxide form, which is very insoluble. In order to provide a realistic but conservative dose commitment estimate, it is assumed that 50% of the plutonium-238 is insoluble and 50% is soluble. This technique remains conservative, since it is expected that most of the plutonium-238 is insoluble.

The factor used for the lung dose calculations has also been changed to provide a more realistic dose assessment. In past years, maximum pulmonary deposition was used as the basis for lung dose estimates. This may be overly conservative. It is recommended by the ICRP Task Group on Lung Dynamics that an Activity Median Aerodynamic Diameter (AMAD) of 1.0 µm be used as a standard aerosol when particle size determination cannot be made [12]. This implies a

more probable particle size for inhaled particles.

The term "dose commitment," as used in this report, is that cumulative dose for a period of 50 yr from 1 yr of exposure to a given radionuclide.

Plutonium-238 Assumptions and Methodology

The dose commitment estimates for plutonium-238 were based on environmental monitoring data for 1982. The estimates for maximum dose commitment to the lung at the site boundary and maximum dose commitment to the lung in individuals were based on the maximum onsite incremental average concentration of plutonium-238 in air from onsite samplers (sampler 211, Table 10), since the samplers are in close proximity to the site boundary. The maximum dose commitment to the lung in population group(s) was based on the maximum offsite average incremental concentration of plutonium-238 in air (sampler 123, Table 7).

The estimates for maximum dose commitment to the bone at the site boundary and in individuals were also based on the maximum onsite average incremental concentration of plutonium-238 in air and the maximum offsite average concentration of plutonium-238 in drinking water (average of B-1 and B-3, Table 23). The maximum dose commitment to the bone for individuals in population group(s) was calculated using airborne concentrations of plutonium-238 only, since the concentration of plutonium-238 in Miamisburg drinking water was at the environmental level.

The terms "maximum dose commitment at the site boundary" and "maximum dose commitment to individuals" refer to the maximum dose commitment possible for individuals to receive, assuming they remain at the site boundary 24 hr/day and 365 days/yr. The term "maximum dose commitment for individuals in population group(s)" refers to those individuals who reside in an area adjacent to Mound and who receive the maximum dose commitment values found in the offsite environment.

The calculational methods can be found in the Appendix. The results of the dose commitment estimate calculations are shown in Table 29.

The data indicate that in all cases of dose commitment comparisons, the dose commitments are well within 1% of the DOE standard. In addition, to provide a relative comparison of these dose commitment values, the maximum dose to the lung of an individual around Mound is 0.12 mrem/50 yr. This would be equivalent to the additional dose to an individual smoking 0.2 cigarettes/yr [13] or visiting a friend who lives in a brick house (as compared to a wooden house) for 3 hours [14].

Tritium (oxide) Assumptions and Methodology

The dose commitment estimates for tritium (oxide) were also based on environmental monitoring data for 1982. The

Table 29 - DOSE COMMITMENT ESTIMATES

	Plutonium-238 (mrem/50 yr)				Tritium Oxide (mrem/50 yr)	
	Lung	% of Applicable DOE Standard	Bone	% of Applicable DOE Standard	Whole Body	% of Applicable DOE Standard
Maximum dose equivalent at the site boundary	0.12	-	1.85	-	1.2	-
Maximum dose equivalent to an individual	0.12	0.008	1.85	0.12	1.2	0.2
Maximum dose equivalent to an individual in the population group(s)	0.02	0.004	0.36	0.07	0.18	0.1

concentrations used for dose commitment estimates for tritium (oxide) were arrived at by the same method as that used for plutonium. The maximum average onsite air incremental concentration was measured at sampler 213 (Table 12), and the maximum drinking water incremental concentration was the average measured at location B-R (Table 21). The maximum average offsite air incremental concentration was measured at sampler 101 (Table 9), and the maximum incremental concentration in drinking water for individuals in a population group was that measured in the Miamisburg drinking water. The total dose commitment for the whole body was obtained by adding the dose commitment of tritium (oxide) in air and the dose commitment of tritium (oxide) in water. The calculational methods can be found in the Appendix. The results of the dose commitment estimate calculations are shown in Table 29.

The tritium data indicate dose commitment levels well within 1% of the DOE standards. For example, the maximum whole body dose commitment to an individual around Mound from tritium is 1.2 mrem. This value is equivalent to the additional dose to an individual from Ohio taking a 4-day vacation in Colorado [15].

Environmental data indicate that Mound's influence does not reach 32 km (20 mi); however, 32 km will be the assumed limit for Mound's impact.

The person-rem dose commitment estimate calculation were based on tritium (oxide) data from environmental air sampling stations in two ranges: 0-8 km (0-5 mi) and 8-21 km (5-20 mi). The 0-8 km range includes 10 samplers within 1.6 km (1 mi) of Mound.

Dose Commitment

The average concentration of tritium (oxide) in air was obtained by averaging ten offsite tritium air samplers less the concentration found at sampler #119. From this average concentration, a dose commitment was determined and multiplied by the number of people from 0 to 8 km.

The average tritium (oxide) concentration from the four other offsite samplers (less the concentration at sampler 119) was used to obtain the person-rem from 8 to 32 km. Eight area segments from 8 to 32 km were obtained by letting each sampler represent one segment concentration and the average of two adjacent samplers would represent another segment. These segment concentrations were then multiplied by their respective population. By using the four samplers and this averaging technique, a more realistic person-rem value could be obtained.

The person-rem from tritium (oxide) in community water was based on average concentrations of tritium (oxide) in various community water supplies, less appropriate environmental levels, and weighing these concentrations with respective populations.

The calculations for the air and water dose commitment estimates are shown in the Appendix.

It is estimated that the total population from 0 to 32 km is receiving 14 person-rem from Mound's emissions. The remaining population from 32 km to 80 km (20 to 50 mi) is not receiving any dose commitment from tritium (oxide) emissions. Thus, the dose commitment from Mound's emission is 14 person-rem for the 0-80 km range.

For comparison, the person-rem values from natural radiation, including cosmic rays, terrestrial, and internal radiation would be approximately 390,000 person-rem for the 0 to 80 km (50 mi) range [16]. The dose commitment from natural background tritium alone is 80 person-rem for the 0 to 80 km range [16].

Acknowledgement

The authors gratefully acknowledge, C. T. Bishop, W. D. Gloekler, and C. E. Styron for their contributions to this report; K. D. DeVilbiss, W. D. Gloekler, B. J. Hollon, L. C. Hopkins, V. C. Lacy, L. L. Roush, F. K. Tomlinson, E. E. Wallace and P. A. Watkins, for their work in sample collection and analyses; and K. N. McLennan for typing the report.

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Appendix

Applicable Standards

RADIOACTIVE STANDARDS

In conformance with DOE Order 5480.1, Chapter XI, "Requirements for Radiation Protection," offsite sample results are compared with RCG's established for the general population. These RCG's are derived by dividing the RCG's for an uncontrolled area by three.

Onsite sample results are compared with the uncontrolled area RCG's which are applicable for individuals in the population.

The RCG values (in microcuries per milliliter - μCi/ml) used for comparison purposes for the various types of samples in this report are listed below. In all cases, these are the most restrictive RCG's.

Plutonium-238 (Soluble Form)

Air

General Population	2×10^{-14} μCi/ml
Uncontrolled Area (Individuals in the Population)	7×10^{-14} μCi/ml

Water

General Population	2×10^{-6} μCi/ml
Uncontrolled Area (Individuals in the Population)	5×10^{-6} μCi/ml

Tritium (Soluble Form)

Air

General Population	7×10^{-8} μCi/ml
Uncontrolled Area (Individuals in the Population)	2×10^{-7} μCi/ml

Water (DOE RCG is compared to water not used for drinking purposes)

General Population	1×10^{-3} μCi/ml
Uncontrolled Area (Individuals in the Population)	3×10^{-3} μCi/ml

As of June 24, 1977, community drinking water quality is regulated by the EPA National Interim Primary Drinking Water Regulations for Radionuclides. The new standard = 20×10^{-6} μCi/ml (20,000 pCi/l).

Foodstuffs There are no RCG values specified for foodstuffs. However, to give some perspective, the foodstuff values can be compared to the RCG values for plutonium and tritium in water.

Soil There are no guidelines established for radioactive species in soil. (The U.S. EPA has guidelines under consideration.)

NONRADIOACTIVE STANDARDS

Water Region V of the U.S. EPA has issued a discharge permit under NPDES regulations covering Mound liquid effluent streams. The discharge limitations for each effluent stream are as follows:

Discharge 001-A	7-day Average	30-day Average
BOD_5 mg/l (kg/day)	15 (14.2)	10 (4.9)
Suspended Solids mg/l (kg/day)	30 (28.4)	15 (7.4)
Fecal Coliform N/100 ml	2000	1000
pH	6.5 - 9.0	-

Discharge 001-B	Daily Maximum	Daily Average
Suspended Solids mg/l (kg/day)		
(Oct-Mar)	30 (11.4)	20 (7.6)
(Apr-Sept)	50 (19)	20 (7.6)
Oil and Grease mg/l	10	-
COD	Monitor Only	
Dissolved Solids	Monitor Only	
Residual Chlorine mg/l	0.02	
pH	6.5 - 9	

Discharge 001-C	Daily Maximum
Cyanide mg/l	1.0
Chromium - Total mg/l	0.5
Cadmium mg/l	0.1
Nickel mg/l	0.5
Copper mg/l	0.5

Discharge 002	Daily Maximum	Daily Average
Suspended Solids mg/l (kg/day)	30 (91)	15 (34)
Dissolved Solids mg/l (kg/day)	2000 (6065)	1500 (3412)
Oil and Grease mg/l	10	-
Residual Chlorine	0.02	-
pH	6.5 - 9	

The Ohio EPA has established Water Quality Standards (3745-1-01-3745-1-09). The standards listed below are excerpted from these regulations. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/liter)
Dissolved Oxygen	5.0
pH (pH units)	6-9
Fecal Coliform (N/100 ml)	200 per 100 ml
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250
Chromium (hexavalent)	0.05
Cyanide (free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil and Grease	5
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075*
Zinc	0.075 - 0.5*

*Dependent on $CaCO_3$ hardness.

Dose Commitment Calculations

PLUTONIUM-238 CALCULATIONAL METHODS

These dose commitment to the lung resulting from inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1CI_a t_1 f_a f_r \ \Sigma EF(RBE)\eta}{\lambda m}(1-e^{-\lambda t_2})$$

Appendix

where

$D(t)$ = 50-yr dose commitment delivered to the lung in 365 days of continuous exposure to plutonium-238 in air, rem/50 yr

C = average airborne concentration, μCi/ml

I_a = average air intake = 2×10^7 ml/day [1]

t_1 = time exposed, 365 days

t_2 = duration of dose, 50 yr

f_a = fraction of inhaled material reaching organ of interest = 0.3 for the pulmonary region [2]

f_r = fraction of pulmonary deposition undergoing long-term retention = 0.6 for actinide (class Y) [2]

$\Sigma EF(RBE)\eta$ = effective energy deposition per disintegration = 57 [1]

λ = effective decay rate, 0.0014 day^{-1} for actinides (class Y) from the pulmonary region [3]

m = lung mass, 1000 g [1]

The dose commitment to bone resulting from inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1CI_a f_a t_1 \Sigma EF(RBE)\eta}{\lambda m} (1-e^{-\lambda t_2})$$

where

f_a = 0.2 [1]

$EF(RBE)$ = 280 [1]

$m = 7 \times 10^3$ g [1]

$= 3 \times 10^{-5} day^{-1}$ [1]

The dose commitment to bone resulting from ingestion of plutonium-238 in water was calculated by:

$$D(t) = \frac{51.1CI_w f_a t_1 \Sigma EF(RBE)}{\lambda m} (1-e^{-\lambda t_2})$$

where

I_w = average quantity of water intake, 2200 cm^3 [1]

$f_a = 2.4 \times 10^{-5}$ [1]

TRITIUM OXIDE CALCULATIONAL METHODS

The dose commitment to the whole body resulting from exposures to tritium (oxide) in air was calculated by:

$$D(t)a = \frac{\overline{C}a}{Ra} \times S$$

where

$D(t)a$ = dose commitment, mrem/50 yr

$\overline{C}a$ = average concentration of tritium (oxide) in air

Ra = RCG for tritium (oxide) in air [4]

S = Radiation protection standard in mrem/50 yr [4]

The dose commitment to the whole body resulting from uptake of tritium (oxide) in water was calculated by:

$$D(t)w = \frac{\overline{C}w}{Rw} \times S$$

where

$D(t)w$ = dose equivalent in mrem/50 yr

$\overline{C}w$ = average concentration

Rw = RCG for tritium (oxide) in water [4]

S = radiation protection standard in mrem/50 yr [4]

These dose commitment values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection [5] and the National Council on Radiation Protection Measurements [6].

PERSON-REM CALCULATIONS

The equations used for this calculation were:

$$\overline{D}(t)a = \frac{\overline{C}a}{Ra} \times S$$

where

$\overline{D}(t)a$ = dose commitment from tritium (oxide) in air

$\overline{C}a$ = average tritium (oxide) concentration in air

Ra = RCG for tritium (oxide) in air [4]

S = radiation protection standard for tritium (oxide) in air in mrem/50 yr [4]

$$\overline{D}(t)w = \frac{\overline{C}w}{Rw} \times S$$

where

$\overline{D}(t)w$ = dose commitment from tritium (oxide) in water

$\overline{C}w$ = average tritium (oxide) concentration in water

Rw = RCG for tritium (oxide) in water [4]

S = radiation protection standard for tritium (oxide) in water, mrem/50 yr [4]

These dose commitment values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection [5] and the National Council on Radiation Protection and Measurements [6].

The total person-rem from 0 to 32 km is obtained by:

$$\sum_{0}^{32} R = \left(D(t)a\sum_{0}^{8} P\right) + \sum_{0}^{8} \overline{D}(t)a\sum_{8}^{32} P + \sum_{0}^{32}\left(\overline{D}(t)wP\right)$$

where

$\sum_{0}^{32} R$ = person-rem within 32 km

$\overline{D}(t)a\sum_{0}^{8} P$ = average dose commitment x population from 0-8 km

$\sum_{0}^{8} \overline{D}(t)a\sum_{8}^{32} P$ = summation of dose commitments x the respective populations within eight direction segments from Mound from 8-32 km

$\sum_{0}^{32}\left(\overline{D}(t)wP\right)$ = summation of dose commitments x respective population from 0-32 km

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Donald A. McKown
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Monte Sula
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Battelle, Pacific Northwest Lab

J. P. Corley, Technical Leader
Occupational and Environmental Safety Department
Battelle, Pacific Northwest Lab

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Mason and Hanger - Silas Mason Co., Inc.

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Savannah River Plant

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National Lead of Ohio

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MLM-3143

Environmental Monitoring at Mound: 1983 Report

Daniel G. Carfagno and Billy M. Farmer

April 25, 1984

MOUND
Miamisburg, Ohio 45342

operated by
MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company

for the
U. S. DEPARTMENT OF ENERGY
Contract No. DE-AC04-76-DP00053

Monsanto

Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed Copy: A03
Microfiche copy: A01

MLM-3143
UC-41

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Foreword

This report was prepared by the Environmental Section of the Administrative Services Department at Monsanto Research Corporation - Mound. Sample analyses and data reduction were performed by the Environmental Laboratory Group. Particulate samples offsite were collected by the Air Pollution Control Section of the Montgomery County Combined General Health District, which acts as the Regional Air Pollution Control Agency in this area for the Ohio Environmental Protection Agency. All other sampling was performed by personnel in the Environmental Section.

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Introduction

Monsanto Research Corporation - Mound occupies 306 acres of land in Miamisburg, Ohio. This location is approximately 16 km (10 mi) southwest of Dayton, Ohio. The predominant geographical feature in the five-county region surrounding Mound is the Great Miami River, which flows from northeast to southwest through Miamisburg. The river valley is highly industrialized.

The remainder of the region is predominantly farmland, dotted with light industry and small communities. The locations and populations of these communities are shown in Figure 1. The population distribution surrounding Mound is shown in Figure 2. Drinking water for the area is obtained from a buried valley aquifer that generally follows the Great Miami River. The primary agricultural activity in the area

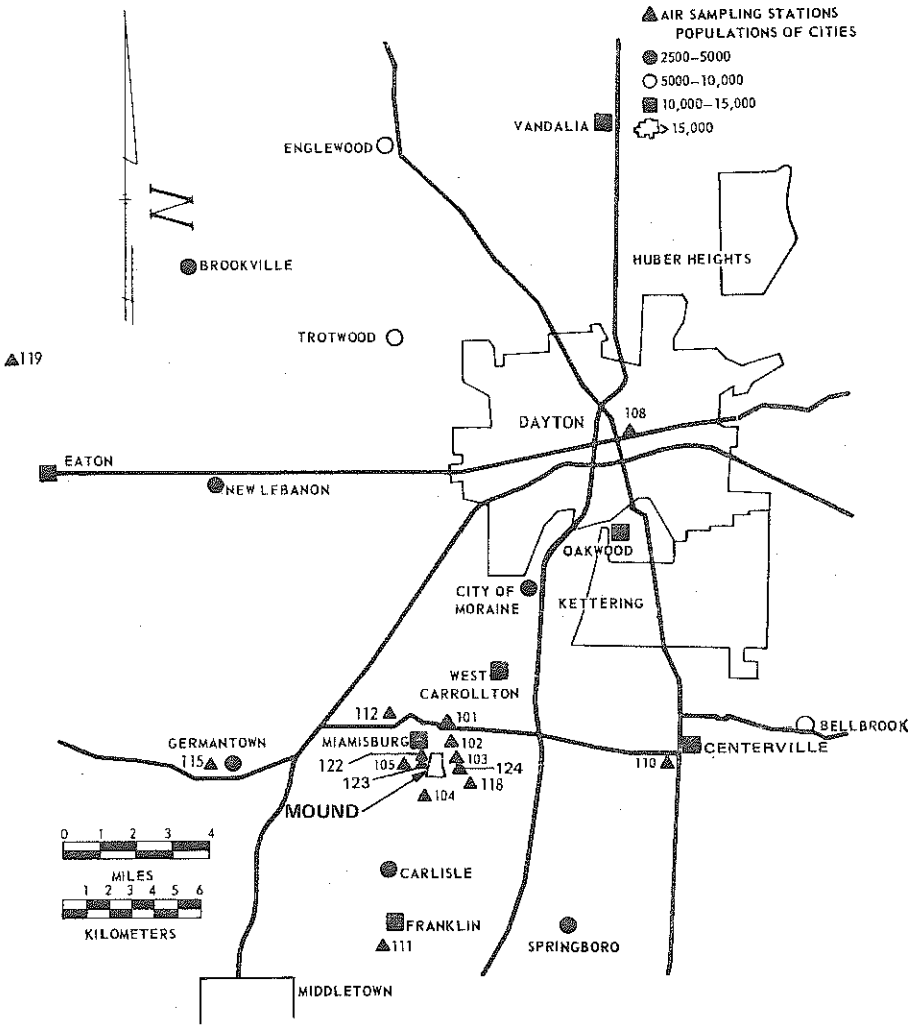
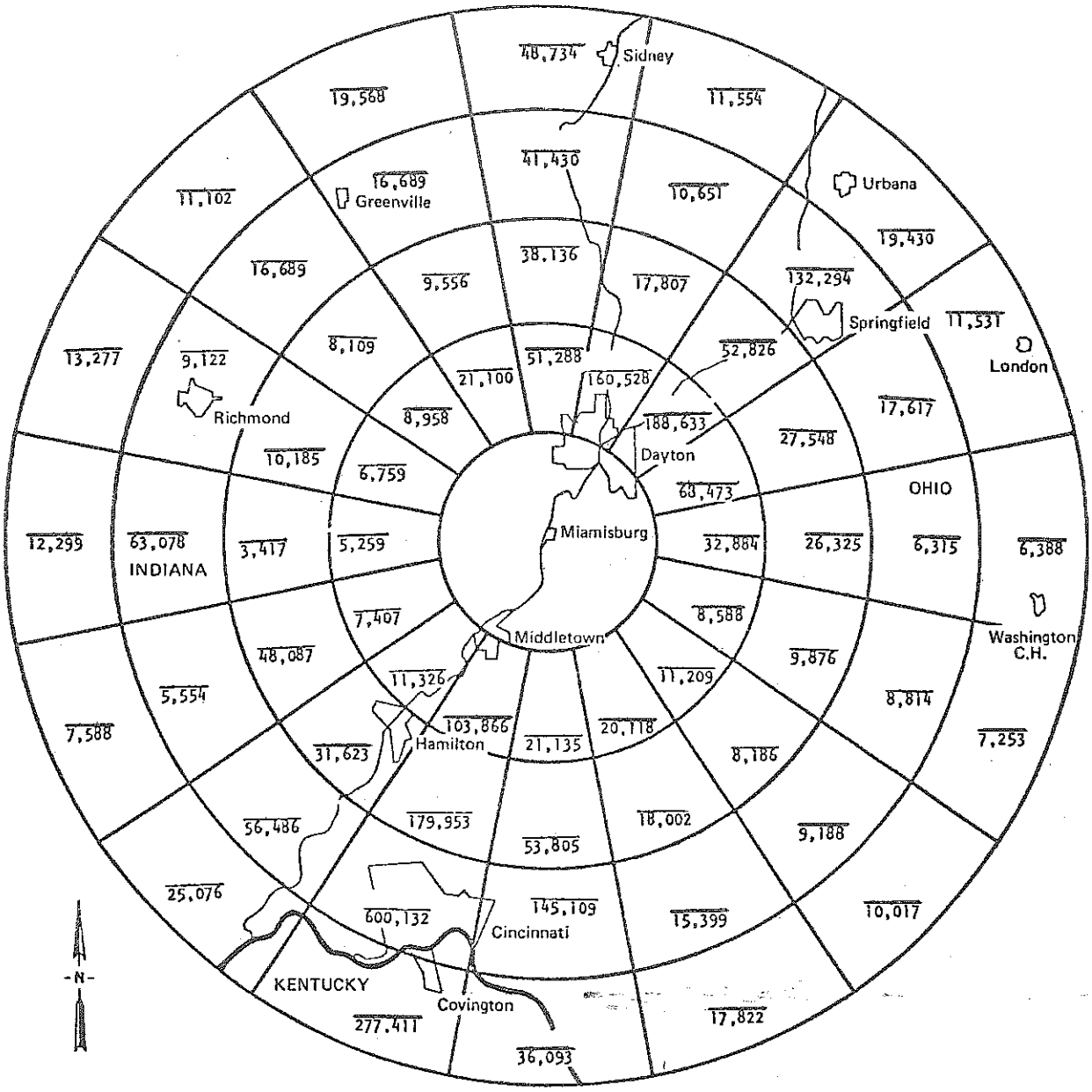


FIGURE 1 - Offsite air sampling locations.



Cumulative Population Totals
1980 Population 0 - 50 Miles

0-10	398,259
0-20	1,125,790
0-30	1,669,231
0-40	2,823,798
0-50	3,358,941

FIGURE 2 - Projected 1980 population within 50 miles of Mound.

is raising field crops such as corn and soybeans. Approximately 10% of the land in agricultural use is devoted to pasturing livestock [1].

The climate in the area is considered moderate. Average annual precipitation is 91 cm (36 in.) and is evenly distributed throughout the year. Winds are predominantly from the south or west, except during the summer, when they are recorded more frequently from out of the southwest [2]. The annual average wind speed measured at Mound was 4.1 m/s (9.2 mi/hr) for 1983. Figure 3 shows the wind rose compiled at Mound, and Table 1 shows average wind speed and percent frequency for each of 16 wind directions.

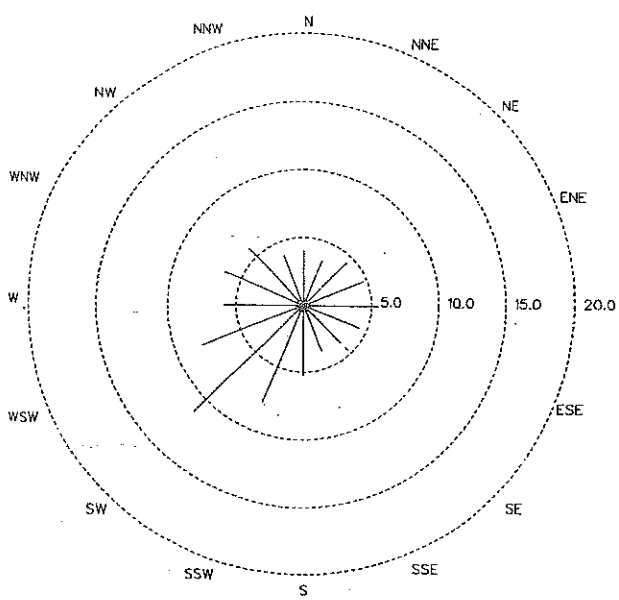


FIGURE 3 - The relative frequency of winds from different directions for Mound.

Mound began operations in 1949. Its mission currently includes 1) research, development, engineering, production, and surveillance of components for the Department of Energy (DOE) weapons programs; 2) separation, purification, and sale of stable isotopes; and 3) DOE programs in solar energy, fossil fuels, nuclear safeguards and waste management, heat source testing, and fusion fuel systems. The radionuclides of primary concern that result from Mound's current or past operations are plutonium-238 and tritium.

Radionuclides in particulate form are removed from process air effluents by high efficiency particulate air (HEPA) filters. Air effluents are filtered first at their points of origin (i.e., gloveboxes) and then just before reaching the release point (i.e., the stack). The filtering system at the stack consists of two banks of HEPA filters in series, each bank having a collection efficiency of 99.95%. Radionuclides are removed from liquid effluents, such as process wastes, by chemical processing. Solid radioactive wastes are packaged and shipped offsite for burial at approved burial sites. Wastes generated in the processing of explosive materials are collected and disposed of according to the Defense Armament and Research Command (DARCOM) Regulation 385-100 and DOE/EV/06194-1.

An onsite, sanitary waste treatment plant provides secondary treatment, in accordance with U.S. Environmental Protection Agency (EPA) requirements [3], using an activated sludge process operating in the

Table 1 - AVERAGE ANNUAL PERCENT FREQUENCY OF WIND DIRECTION AND AVERAGE WIND SPEED (M/S) FOR 1983

Direction	Percent	Average Speed (m/s)
N	4.0	4.6
NNE	3.6	4.1
NE	4.4	4.1
ENE	4.7	4.1
E	5.5	4.3
ESE	4.4	3.7
SE	4.7	4.2
SSE	3.8	3.9
S	5.2	4.3
SSW	7.8	4.9
SW	11.2	5.3
WSW	8.0	5.2
W	5.8	5.0
WNW	6.2	4.8
NW	5.8	4.6
NNW	3.9	4.1
CALM	11.0	-
Total	100.0	4.1

extended aeration mode. All domestic sewage generated onsite is treated in this facility. The influent and effluent at the sewage treatment plant are also monitored for radioactivity to ensure no undetected release can occur to the environment via the sanitary sewage plant. Digested sludge from the sewage plant is shipped offsite for burial at an approved burial site. All wastewater is discharged from the site to the Great Miami River. Nonradioactive 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 was transported during 1983 to a sanitary landfill site approved by both the state and county. Waste solvents and chemicals are moved offsite by a commercial-industrial waste disposal firm.

Mound's compliance with regulations prescribed by DOE for the safety of its employees and the public has been demonstrated throughout the history of the facility. The fundamental objective of the Mound Environmental Control Program, an ongoing program since Mound began

operations, is the containment of radioactive effluents to levels well within the existing standards. As part of this program, effluents are monitored and controlled at each operating step, resulting in no more than low-level releases of airborne or liquid wastes to the environment. With early detection, control techniques can be implemented, thus ensuring that concentrations are well within existing standards and meet the DOE guideline "as-low-as-reasonably-achievable" (ALARA).

As part of the Mound Environmental Program monitoring functions, air, water, vegetation, foodstuff, and sediment samples are collected from the environment at distances up to 48 km (30 mi) from Mound's boundaries. These samples are then analyzed for the specific radionuclides handled at Mound. A summary of the monitoring program is shown in Table 2.

The results of the environmental analyses for 1983 are provided in this report. The primary purpose of the report is to detail what impact, if any, Mound's operations have had on the adjacent environment in 1983. To serve this purpose, several calculational techniques used throughout this report should be described. The concentrations of various radionuclides reported here that result from Mound's operations are termed "incremental." The term incremental denotes a concentration value that exceeds normal environmental levels of the same radionuclide. The "environmental level" is that level found in the environment where Mound would have no impact. Environmental levels of radionuclides in various mediums are shown in Table 3.

To determine concentrations of radionuclides found in the environment, the instrument background and reagent blanks were subtracted from the sample count. This value was then used in averages, as opposed to using the lower detection limit (LDL), which had been the practice in years past.

For comparative purposes and for single sample evaluation, however, the lower detection limit is shown for each set of data in this report. The LDL is the estimated standard deviation of the blanks at the 95% confidence level.

The error estimates shown with each set of data are estimates of the standard error of the estimated mean at the 95% confidence level. These values include all sources of variability including sampling, analyses, counting statistics, and the propagated error involved when subtracting the environmental levels from the actual data.

Summary

The environment locally surrounding Mound was monitored primarily for tritium and plutonium-238. The results are reported for 1983. Environmental mediums analyzed included air, water, vegetation, foodstuffs, and sediment.

The average concentrations of plutonium-238 and tritium were within the applicable standards (adopted by the U.S. DOE) for radioactive species.

Table 2 - MONITORING PROGRAM

	Sampling Frequency	Parameter Measured
Air Surveillance		
Offsite		
15 locations	Weekly	HTO, Pu, particulate
Onsite		
5 locations	Weekly	HTO, Pu, particulate
Stack Emission		
15 locations	Daily	HT, HTO, Pu, U
Water Surveillance - Offsite		
River		
5 locations	Daily	HTO, Pu, U
Pond		
7 locations	Monthly	HTO, Pu, U
Municipal Drinking Water		
12 locations	Quarterly	HTO, Pu
Well Water		
5 locations	Monthly	HTO, Pu
Water Surveillance - Onsite		
Effluent Water		
3 locations	Daily	Flow, suspended solids, BOD_5, fecal coliform, pH, oil and grease, COD, residual chlorine, dissolved solids, cyanide, chromium, cadmium, nickel, copper, HTO, Pu, U
Silt Surveillance - Offsite		
River		
5 locations	Quarterly	Pu
Pond		
7 locations	Quarterly	Pu
Vegetation and Foodstuff Surveillance		
Vegetation		
3 locations	Semiannually	HTO, Pu
Foodstuffs		
3 locations	Annually	HTO, Pu
Environmental Level Surveillance		
Four Mediums		
6 locations	Quarterly	HTO, Pu

Table 3 - ENVIRONMENTAL CONCENTRATIONS OF RADIONUCLIDES IN VARIOUS MEDIUMS

Plutonium-238 in air[a]	=	0.02	± 0.09	x 10^{-17}	µCi/ml
Tritium oxide in air[a]	=	0.14	± 0.26	x 10^{-11}	µCi/ml
Plutonium-238 in river water[b]	=	1.6	± 0.2	x 10^{-12}	µCi/ml
Tritium in river water[b]	=	0.15	± 0.09	x 10^{-6}	µCi/ml
Plutonium-238 in surface water[c]	=	0.6	± 0.6	x 10^{-12}	µCi/ml
Tritium in surface water[c]	=	0.11	± 0.05	x 10^{-6}	µCi/ml
Plutonium-238 in well water[d]	=	2.5	± 3.2	x 10^{-12}	µCi/ml
Tritium in well water[c]	=	0.12	± 0.06	x 10^{-6}	µCi/ml
Uranium-233, 234 in river water[b]	=	7.24	± 1.75	x 10^{-10}	µCi/ml
Uranium-238 in river water[b]	=	7.21	± 2.83	x 10^{-10}	µCi/ml
Plutonium-238 in river silt[b]	=	0.0018	± 0.0045	x 10^{-6}	µCi/g
Plutonium-238 in surface water silt[c]	=	0.0009	± 0.0017	x 10^{-6}	µCi/g
Tritium in grass[d]	=	0.69	± 0.08	x 10^{-6}	µCi/g
Tritium in tomatoes[d]	=	0.57	± 0.08	x 10^{-6}	µCi/g
Plutonium in grass[d]	=	0.00032	± 0.00019	x 10^{-6}	µCi/g
Plutonium in potatoes[d]	=	0.00044	± 0.00137	x 10^{-6}	µCi/g
Plutonium in fish[d]	=	0.00052	± 0.00038	x 10^{-6}	µCi/g

[a]Measured at offsite sampler 119.

[b]Measured 20 mi upstream on Great Miami River.

[c]Measured 28 mi northwest of Mound.

[d]Measured 30 mi west of Mound.

Data concerning the emission of nonradioactive species into the atmosphere are also presented. All emissions were 9% or less of the applicable emissions standard.

The average incremental concentrations of plutonium-238 and tritium oxide in air measured at all offsite locations during 1983 were 0.26 x 10^{-17} µCi/ml and 1.4 x 10^{-11} µCi/ml, respectively. These correspond to 0.01% and 0.02% of their respective Radioactivity Concentration Guides (RCG). Details of the applicable standards are given in the Appendix.

The average incremental concentration of plutonium-238 measured at all locations in the Great Miami River during 1983 was 0.16 x 10^{-12} µCi/ml which is 0.00008% of the RCG. The average incremental concentration of tritium measured at all locations in the Great Miami River during 1983 was 0.01 x 10^{-6} µCi/ml which is 0.001% of the RCG.

Radionuclide effluent data for 1983 are summarized in Table 4.

Table 4 - EFFLUENT DATA FOR 1983

Radionuclide	Medium	Quantity	
Tritium	air	4293	Ci
Tritium	water	7.94	Ci
Plutonium-238	air	0.004	mCi
Plutonium-238	water	1.0	mCi
Uranium-233,234	water	0.5	mCi

The average incremental concentrations of plutonium-238 found during 1983 in surface and area drinking water were also a fraction of the DOE RCG (less than 0.00006%). In addition, the average incremental concentration of tritium in surface water and the average concentration in area and municipal drinking water were a fraction of each respective DOE RCG (less than 0.02%) and EPA standard (less than 32% and less than 2%, respectively).

Although there are no specific standards (RCG) for plutonium-238 and tritium in foodstuffs, the concentrations found, if compared to the water standard, are also a small fraction of the RCG. Sediment was sampled at several offsite water sampling locations. No adverse impact to the environment could be determined from the radionuclide levels found in these sediments.

The dose commitment estimates indicate that, in all cases, the levels are at or within 1% of the DOE standard. The person-rem calculated to 80 km for the total population as a result of Mound operations during 1983 was 13 person-rem. Natural radiation would result in approximately 470,000 person-rem for the area.

A National Pollutant Discharge Elimination System (NPDES) permit regulates nonradioactive pollutants in Mound's effluent water. The NPDES permit requires this effluent to be characterized by analyzing samples collected at four onsite locations. Out of 1402 NPDES measurements taken in 1983, fewer than 3% exceeded maximum permit limitations.

None of these exceptions, however, had an adverse impact on the Great Miami River or caused the river to exceed Ohio Stream Standards.

The data contained in this summary demonstrate the status of compliance with various current regulatory agency standards and demonstrate Mound's emphasis on the as-low-as-reasonably-achievable (ALARA) concept.

Environmental surveillance

Quality Assurance

Mound's Environmental Section quality control program has been documented in a quality control manual [4]. Because many of the samples analyzed contain contaminant concentrations at or below the lower detection limit of the analytical method being used, an essential part of the quality control program for environmental monitoring is the determination of "blank values." A "blank value" is a

measured amount of contaminant determined by carrying out the chemical analysis without a sample, but rather using deionized water, a clean filter paper, or only the reagents used in the analysis. Analyzing blanks is essential in verifying the absence of excessive laboratory contamination or detector background. Also, the standard deviations of the "blank values" are used to calculate lower detection limits, which are given with each set of environmental data.

An essential part of Mound's quality control program is the analysis of reference samples from a reliable outside laboratory. During 1983, Mound analyzed samples from DOE's Environmental Measurements Laboratory (EML) from the U. S. Environmental Protection Agency (EPA) and from Monsanto's Environmental Science Center (ESC). The EML samples contained trace radionuclides; the EPA and ESC samples contained nonradioactive contaminants.

The EML reference samples consisted of air filters, water, soil, tissue, and vegetation. The concentrations obtained for tritium, plutonium, and uranium in these samples are given in Table 5. These samples were prepared in November of 1982 (8211) and May of 1983 (8305). Errors are given for the Mound values, the EML values, and the concentration ratios. In general the Mound and EML values agree with each other within experimental error. In all cases where the Mound and EML values did not agree within experimental error, the ratio of the Mound concentration to the mean concentration of all of the laboratories participating in the program gave ratios closer to unity. Overall, results from this comparison indicate good agreement between Mound's data and EML's reference values.

In regard to the measurement of nonradioactive contaminants, Mound participated in the 1983 EPA Quality Assurance Program for Water Analysis, and in Monsanto Company's NPDES Water/Wastewater Standards program for 1983. Results are summarized in Tables 6 and 7.

In regard to the EPA program, Mound's measured concentrations fell within the "EPA Acceptance Limits" except for chromium. The chromium concentration was about 3% below the lower acceptance limit given by the EPA. It is believed that the low-measured concentration of chromium was caused by an atomic absorption matrix effect. Deviations observed in the measurement of chromium in Monsanto's program are less than 10% (Table 7). Other data in Table 7 indicate good agreement between Mound's measured concentrations and Monsanto's reference values.

In summary, the agreement between Mound measured concentrations and reference values of EML, the EPA, or Monsanto indicate good reliability of the data generated in the routine environmental monitoring program at Mound.

Air - Radioactive

In 1983, the offsite air-sampling network consisted of 15 continuously operating air-sampling stations used for sampling

Table 5 - MOUND'S DOE QUALITY ASSESSMENT PROGRAM RESULTS FOR 1983

Sample Type	Sample No.	Isotope Determined	Concentration, pCi/(g or ml)[a] Mound	EML[b]	Concentration Ratio Mound to EML	
Air	8211	Pu-238	1.78 ± 0.16[c]	1.99 ± 0.16[d]	0.89 ± 0.12[e]	
		Pu-239	1.48 ± 0.14	1.50 ± 0.14	0.99 ± 0.13	
Air	8305	Pu-239	2.82 ± 0.20	2.99 ± 0.03	0.94 ± 0.08	
Water	8211	H-3	12.5 ± 0.3	12.9 ± 0.5	0.97 ± 0.05	
		Pu-238	0.0035 ± 0.0001	0.0027 ± 0.0001	1.30 ± 0.05	(1.21)[f]
		Pu-239	0.0042 ± 0.0001	0.0032 ± 0.0001	1.31 ± 0.04	(1.22)
		U-234	0.0064 ± 0.0001	0.0064 ± 0.0004	1.00 ± 0.06	
		U-238	0.0064 ± 0.0001	0.0064 ± 0.0004	1.00 ± 0.06	
Water	8305	H-3	11.8 ± 0.2	10.8 ± 0.2	1.09 ± 0.04	
		Pu-239	0.0063 ± 0.0001	0.0087 ± 0.0003	0.72 ± 0.04	(0.92)
		U-234	0.0112 ± 0.0002	0.0116 ± 0.0039	0.97 ± 0.33	
		U-238	0.0111 ± 0.0002	0.0116 ± 0.0050	0.96 ± 0.41	
Soil	8211	Pu-238	0.0050 ± 0.0007	0.0040 ± 0.0004	1.25 ± 0.17	(1.06)
		Pu-239	0.100 ± 0.012	0.110 ± 0.003	0.91 ± 0.12	
		U-234	0.56 ± 0.03	0.54 ± 0.03	1.04 ± 0.08	
		U-238	0.58 ± 0.07	0.66 ± 0.02	0.88 ± 0.12	
Soil	8305	Pu-238	0.025 ± 0.008	0.027 ± 0.004	0.93 ± 0.32	
		Pu-239	1.40 ± 0.07	1.56 ± 0.14	0.89 ± 0.10	
		U-234	0.93 ± 0.04	0.96 ± 0.05	0.97 ± 0.07	
		U-238	0.88 ± 0.03	0.97 ± 0.05	0.91 ± 0.06	
Tissue	8305	Pu-238	0.011 ± 0.003	0.013 ± 0.001	0.85 ± 0.24	
		Pu-239	0.14 ± 0.01	0.15 ± 0.01	0.94 ± 0.10	
Vegetation	8211	Pu-239	0.084 ± 0.016	0.108 ± 0.010	0.78 ± 0.29	
	8305	Pu-238	0.12 ± 0.02	0.081 ± 0.005	1.43 ± 0.24	(1.32)
		Pu-239	0.035 ± 0.010	0.020 ± 0.001	1.75 ± 0.51	(1.51)
		U-234	0.0060 ± 0.0017	0.0100 ± 0.0010	0.60 ± 0.19	(0.85)
		U-238	0.0066 ± 0.0020	0.0090 ± 0.0010	0.73 ± 0.24	(0.85)

[a]Units are pCi/filter for air samples, pCi/ml for water and pCi/g for soil, tissue and vegetation samples.

[b]Environmental Measurements Laboratory.

[c]These are two sigma errors based on counting statistics or replicate analyses.

[d]EML's errors are "standard errors of the mean."

[e]The error in the ratio is calculated as $(S_M^2 + S_E^2)^{\frac{1}{2}}$ where S_M and S_E are Mound's and EML's relative errors.

[f]Where a number in parentheses is given, this is the ratio of the Mound concentration to the mean concentration of all of the laboratories participating in the program.

Table 6 - MOUND'S 1983 EPA QUALITY ASSURANCE PROGRAM RESULTS FOR WATER ANALYSIS

Parameter Measured	Mound Value[a]	True Value	EPA Acceptance Limits[b]
Cadmium	69 ± 3 µg/l	75.1 µg/l	58.0 - 85.6 µg/l
Chromium	58 ± 13 µg/l	81.6 µg/l	59.5 - 102 µg/l
Copper	740 ± 15 µg/l	718 µg/l	619 - 800 µg/l
Nickel	140 ± 13 µg/l	149 µg/l	118 - 178 µg/l
pH	7.16 ± 0.10	7.10	6.95 - 7.26
Total Suspended Solids	21.5 ± 1.0 mg/l	21.0 mg/l	17.3 - 24.6 mg/l
Oil and Grease	13.2 ± 1.0 mg/l	13.0 mg/l	8.40 - 16.8 mg/l
Chemical Oxygen Demand	117 ± 9 mg/l	117 mg/l	92.7 - 131 mg/l
5-Day Biological Oxygen Demand	66.2 ± 6.0 mg/l	77.3 mg/l	48.5 - 104 mg/l

[a]Errors given here are based on instrument response or replicate measurements.

[b]The range considered acceptable by the EPA. (The calculations used to establish this range were not given by the EPA.)

Table 7 - SUMMARY OF MOUND'S PERFORMANCE IN THE MONSANTO NPDES WATER/WASTEWATER STANDARDS ROUND ROBIN FOR 1983

Parameter Measured	No. of Quarters Participating	Range of Concentrations Measured (mg/l)	Average Deviation[a] Low Level	Intermediate Level	High Level
Chemical Oxygen Demand	2	25 - 250	6%	4%	6%
Total Organic Carbon	1	20 - 100	<1%	8%	4%
Cadmium	3	0.025 - 0.50	8%	4%	3%
Chromium	3	0.075 - 2.5	4%	9%	2%
Copper	3	0.050 - 5.0	13%	3%	5%
Zinc	3	0.025 - 3.75	10%	3%	2%
Total Suspended Solids	2	56 - 1302	8%	<1%	<1%

[a]Deviation from Monsanto's reference concentration expressed as a percent.

both tritium oxide and plutonium. Ten sampling stations are located within a 1.6 km (1 mi) radius of Mound, and four samplers are located in or near population centers. The remaining sampler (#119) is approximately 44.8 km (28 mi) from Mound in the least prevailing wind direction. This sampler receives no measurable contribution from Mound operations and serves as a baseline sample for computing environmental levels.

The levels from sampler #119 are subtracted from levels detected at other locations. The samplers currently in operation are located at critical distances and directions, based on a diffusion model developed for Mound. The locations of the sampling stations are shown in Figure 1.

Two types of samples are collected at each sampling station. One is a particulate air sample for plutonium-238 analysis, and the other, from a bubbler-type sampler, is for tritium oxide analysis. The particulate sample is collected on a 200-mm diameter Microsorban disk by a continuously operating (24 hr/day, 7 days/week) high-volume air sampler. The air is sampled at an average rate of 1.3×10^6 cm^3/min (~45 ft^3/min. The Microsorban disk is changed weekly and represents a sample of approximately 13,000 m^3 of air. Plutonium-238 analyses were performed on a monthly composite for three sampling locations, #122, #123, and #124, and on quarterly composites for the other offsite locations.

The analytical scheme for plutonium-238 incorporates the following basic steps: use of an internal tracer, chemical treatment, separation of plutonium with anion exchange resin, and alpha spectrometry.

The average incremental offsite plutonium-238 air concentration for all locations was 0.26×10^{-17} μCi/ml which is 0.01% of the DOE RCG. The RCG used for comparison is the guide for the soluble form of the isotope and for the general population. This is the most restrictive RCG for plutonium-238 and is applied since the solubility of the measured particles in the human body is unknown. The analytical results are summarized in Table 8.

Table 9 shows concentrations of plutonium-239, 240, and plutonium-238, including environmental levels, so that a ratio comparison between these radionuclides can be made. The ratio is a sensitive, qualitative indicator of variations in environmental observations. Ratios significantly greater than that observed at location #119 (~0.2) result from a concentration of plutonium-238 in excess of that from atmospheric fallout and are indicative of the influences of Mound operations. Quantitative comparisons are best made with the DOE standard; i.e., percent of standard as shown in Table 8.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm^3/min through

Table 8 - INCREMENTAL CONCENTRATIONS OF PLUTONIUM-238 IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1983

Location	Number of Samples	Range[d] (10^{-17} µCi/ml)	Average[a,c,d,e] (10^{-17} µCi/ml)	Percent of RCG[b]
101	4	0.03 - 0.13	0.08 ± 0.11	0.004
102	4	0.07 - 0.71	0.26 ± 0.5	0.01
103	4	0.15 - 1.26	0.63 ± 0.76	0.03
104	4	0.03 - 1.36	0.41 ± 1.0	0.02
105	4	0.02 - 0.1	0.05 ± 0.1	0.003
108	4	E.L. - 0.02	E.L.	-
110	4	E.L. - 0.1	0.04 ± 0.12	0.002
111	4	E.L. - 0.12	0.05 ± 0.14	0.003
112	4	E.L. - 0.06	0.02 ± 0.1	0.001
115	4	E.L. - 0.18	0.05 ± 0.17	0.003
118	4	E.L. - 0.07	0.04 ± 0.1	0.002
122	12	E.L. - 0.94	0.18 ± 0.2	0.009
123	12	0.23 - 3.31	1.22 ± 0.63	0.06
124	12	0.14 - 1.27	0.58 ± 0.22	0.03

[a]Lower Detection Limit (LDL) for ^{238}Pu in air for quarterly samples is 0.03 x 10^{-17} µCi/ml. This is 0.0015% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 2000 x 10^{-17} µCi/ml for the soluble form of ^{238}Pu for the general population.

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

[d]Average environmental level (E.L.) subtracted from data.

[e]Lower Detection Limit (LDL) for ^{238}Pu in air for monthly samples is 0.1 x 10^{-17} µCi/ml. This is 0.005% of the RCG.

200 ml of ethylene glycol. Ethylene glycol is used because this material eliminates evaporation and freezing problems associated with sample collection [5]. Tritium (oxide) in the air is collected in the solution. Tritium oxide rather than elemental tritium is sampled and analyzed because 60 to 70% of the tritium emission is in the oxide form, and the RCG for the oxide is 200 times more restrictive than it is for elemental tritium [6]. A sample representing ∿30 m³ of air is collected, and an aliquot representing 0.15 m³ is counted in a liquid scintillation spectrometer. The average incremental concentration of tritium oxide measured during 1983 for all offsite locations, not including the environmental level found at sampler #119, was 1.4 x 10^{-11} µCi/ml. This concentration is 0.02% of the RCG. The RCG used for comparison is

Table 9 - CONCENTRATIONS OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1983

Location	Number of Samples	$^{239,240}Pu$ Range (10^{-17} µCi/ml)	$^{239,240}Pu$ Average[a,b] (10^{-17} µCi/ml)	^{238}Pu Average[a,b] (10^{-17} µCi/ml)	Ratio $^{238}Pu/^{239,240}Pu$
101	4	0.06 - 0.91	0.29 ± 0.65	0.1 ± 0.06	0.34
102	4	0.06 - 0.71	0.24 ± 0.49	0.28 ± 0.49	1.17
103	4	0.07 - 0.76	0.25 ± 0.54	0.65 ± 0.75	2.6
104	4	0.06 - 0.69	0.23 ± 0.49	0.43 ± 1.0	1.87
105	4	0.05 - 0.76	0.25 ± 0.54	0.07 ± 0.05	0.28
108	4	0.06 - 0.52	0.19 ± 0.35	0.02 ± 0.03	0.11
110	4	0.02 - 0.63	0.21 ± 0.45	0.06 ± 0.08	0.29
111	4	0.07 - 0.48	0.19 ± 0.32	0.07 ± 0.11	0.37
112	4	0.03 - 0.8	0.25 ± 0.59	0.04 ± 0.05	0.16
115	4	0.03 - 0.66	0.22 ± 0.46	0.07 ± 0.14	0.32
118	4	0.06 - 0.96	0.31 ± 0.68	0.06 ± 0.05	0.19
119	4	0.03 - 0.2	0.1 ± 0.13	0.02 ± 0.09	0.2
122	12	0.002 - 0.89	0.15 ± 0.4	0.2 ± 0.18	1.33
123	12	N.D.[c] - 2.05	0.27 ± 0.91	1.24 ± 0.62	4.59
124	12	0.03 - 2.21	0.28 ± 0.97	0.6 ± 0.2	2.14

[a]Lower Detection Limit (LDL) for $^{239,240}Pu$ in air for samplers 101 through 119 is 0.02 x 10^{-17} µCi/ml, and the LDL for samplers 122 through 124 is 0.3 x 10^{-17} µCi/ml. The LDL for ^{238}Pu is 0.03 x 10^{-17} µCi/ml for samplers 101 through 119 and 0.1 x 10^{-17} µCi/ml for samplers 122 through 124.

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

[c]Not detectable. (Values cannot be detected above reagent blanks.)

the most restrictive RCG for tritium for the general population. The results are summarized in Table 10. Environmental levels for plutonium-238 and tritium in air as measured at sampler #119 are shown in Table 3.

An onsite perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of stack emission control systems. The onsite sampling locations are shown in Figure 4. Particulate samples and tritium samples are collected by the onsite samplers at approximately the same flow rate as the offsite samplers and are analyzed in the same manner.

Table 10 - INCREMENTAL CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1983

Location	Number of Samples	Tritium Oxide Range[d] (10^{-11} µCi/ml)	Tritium Oxide Average[a,c,d] (10^{-11} µCi/ml)	Percent of RCG[b]
101	51	E.L. - 6.82	2.53 ± 0.61	0.04
102	51	E.L. - 9.73	2.6 ± 0.63	0.04
103	48	E.L. - 10.2	1.97 ± 0.67	0.03
104	49	E.L. - 4.56	0.78 ± 0.42	0.01
105	49	E.L. - 3.95	0.77 ± 0.43	0.01
108	51	E.L. - 2.88	0.45 ± 0.38	0.006
110	50	E.L. - 4.5	0.24 ± 0.62	0.003
111	51	E.L. - 3.54	0.46 ± 0.39	0.007
112	52	E.L. - 2.9	0.73 ± 0.39	0.01
115	51	E.L. - 1.52	0.02 ± 0.34	0.0003
118	50	E.L. - 5.35	0.75 ± 0.43	0.01
122	50	E.L. - 17.2	2.15 ± 0.8	0.03
123	52	E.L. - 19.7	3.07 ± 1.06	0.04
124	51	E.L. - 26.6	3.26 ± 1.23	0.05

[a]Lower Detection Limit (LDL) for tritium oxide in air is 0.4×10^{-11} µCi/ml which is 0.003% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 7000×10^{-11} µCi/ml for the general population and for soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

The average incremental plutonium-238 concentration measured for all locations onsite is 2.5×10^{-17} µCi/ml, which is 0.04% of the RCG. The results are summarized in Table 11. Table 12 presents onsite concentrations of plutonium-239, 240, and plutonium-238, including environmental levels, so that a ratio comparison between these radionuclides can be made. The quantity of plutonium-238 discharged to the atmosphere during 1983 was 0.004 mCi.

The average incremental onsite tritium oxide concentration for all locations was 3.3×10^{-11} µCi/ml, which is 0.02% of the RCG. The results are summarized in Table 13. The quantity of tritium discharged to the atmosphere during 1983 was 4293 Ci. The RCGs used for onsite

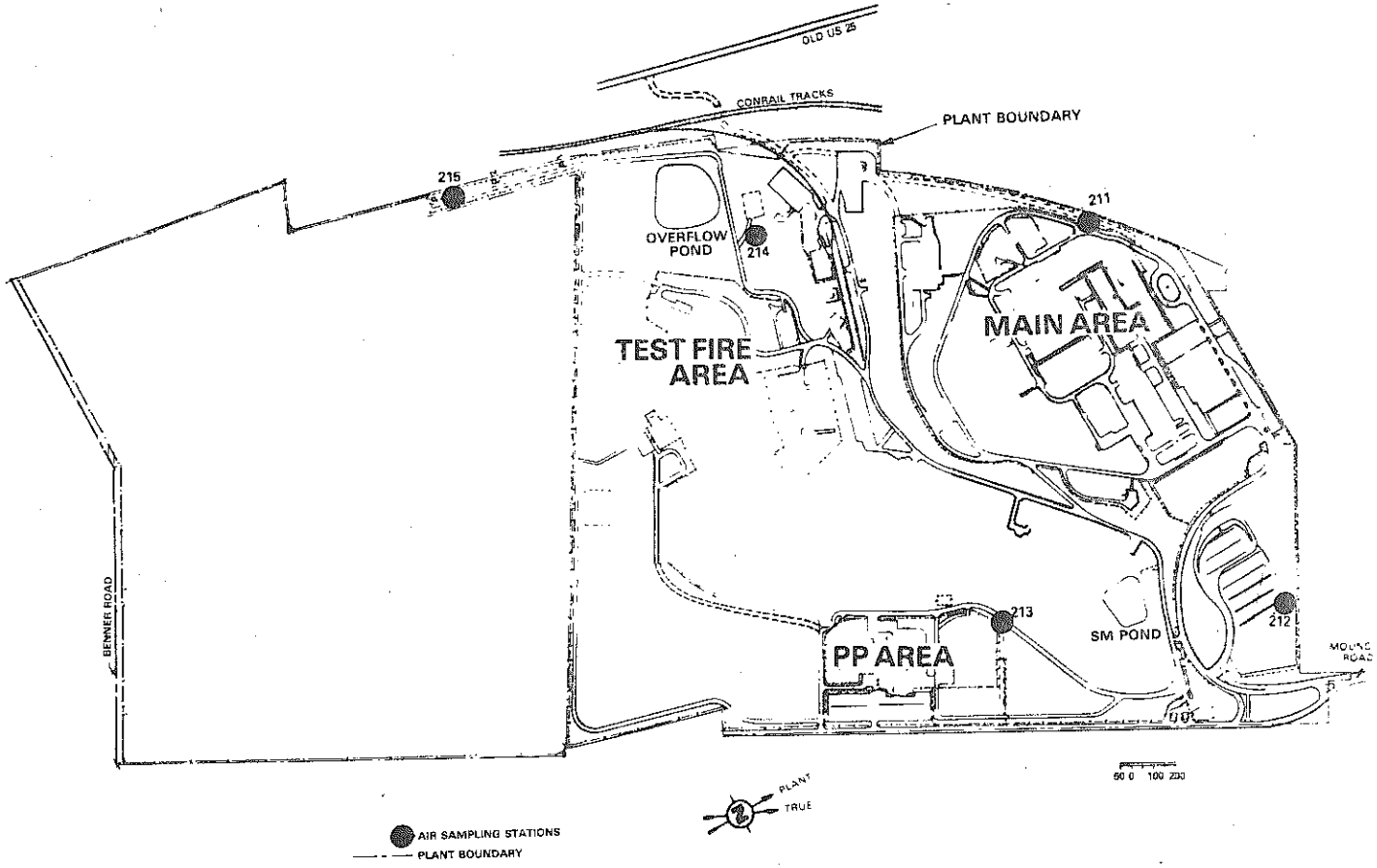


FIGURE 4 - Onsite air sampling locations.

Table 11 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN AIR AT ONSITE SAMPLING LOCATIONS IN 1983

Location	Number of Samples	Range[d] (10^{-17} µCi/ml)	Average[a,c,d] (10^{-17} µCi/ml)	Percent of RCG[b]
211	12	0.76 - 11.4	2.94 ± 1.89	0.04
212	12	0.25 - 1.07	0.6 ± 0.24	0.009
213	12	3.84 - 15.1	7.42 ± 1.74	0.11
214	12	0.33 - 2.93	1.32 ± 0.54	0.02
215	12	0.13 - 0.6	0.27 ± 0.13	0.004

[a]Lower Detection Limit (LDL) for ^{238}Pu in air is 0.1×10^{-17} µCi/ml which is 0.001% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 7000×10^{-17} µCi/ml for the soluble form of plutonium-238 for individuals in the population.

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

[d]Average environmental level (E.L.) subtracted from data.

Table 12 - CONCENTRATION OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT ONSITE SAMPLING LOCATIONS IN 1983

		$^{239,240}Pu$		^{238}Pu	
Location	Number of Samples	Range (10^{-17} µCi/ml)	Average[a,b] (10^{-17} µCi/ml)	Average[a,b] (10^{-17} µCi/ml)	Ratio $^{238}Pu/^{239,240}Pu$
211	12	0.03 - 1.35	0.23 ± 0.23	2.96 ± 1.89	12.9
212	12	0.04 - 1.55	0.23 ± 0.27	0.62 ± 0.22	2.7
213	12	0.03 - 1.78	0.3 ± 0.3	7.44 ± 1.74	24.8
214	12	0.02 - 1.51	0.22 ± 0.27	1.34 ± 0.53	6.09
215	12	0.01 - 1.41	0.19 ± 0.25	0.29 ± 0.09	1.53

[a]Lower Detection Limit (LDL) for $^{239,240}Pu$ in air is 0.03×10^{-17} µCi/ml. The LDL for ^{238}Pu is 0.1×10^{-17} µCi/ml.

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

Table 13 - INCREMENTAL CONCENTRATION OF TRITIUM OXIDE IN AIR AT ONSITE SAMPLING LOCATIONS IN 1983

Location	Number of Samples	Tritium Oxide Range[d] (10^{-11} µCi/ml)	Tritium Oxide Average[a,c,d] (10^{-11} µCi/ml)	Percent of RCG[b]
211	49	E.L. - 12.0	3.53 ± 0.88	0.02
212	49	E.L. - 15.8	3.21 ± 0.81	0.02
213	46	E.L. - 22.5	4.25 ± 1.21	0.02
214	52	E.L. - 44.5	3.43 ± 1.84	0.02
215	51	E.L. - 17.3	2.12 ± 0.86	0.01

[a]Lower Detection Limit (LDL) for tritium oxide in air is 0.4×10^{-11} µCi/ml which is 0.003% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = $20,000 \times 10^{-11}$ µCi/ml for individuals in the population and soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

comparison are those applicable for exposed individuals in the population.

Air- Nonradioactive

The primary source of nonradioactive airborne emissions is the Mound steam power plant. This plant is normally fueled with natural gas, but has the capability to burn fuel oil. During unusually cold weather, if the natural gas supply to Mound is interrupted, fuel oil with <1% sulfur content is burned. Approximately 138,000 gal of fuel oil was burned during 1983.

Additional sources of airborne emissions are as follows. A waterwash, paint spray booth is operated intermittently in the Mound paint shop. Wastes from operations involving explosives are disposed of by open burning under a permit issued by the Regional Air Pollution Control Agency (RAPCA). Fire-fighter training exercises are held at an open outdoor facility under a burning permit issued by RAPCA.

Emissions from sources and the applicable emission standards are summarized in Table 14. The emissions were estimated from emission factors established by the U.S. EPA [7]. Nonradioactive airborne emissions at Mound were all within applicable standards and had minimal impact on ambient air quality. This is further demonstrated by the particulate concentration data summarized in Tables 15 and 16.

Table 14 - NONRADIOACTIVE AIRBORNE EMISSIONS 1983

Emission Source	Pollutant	Emission	Emission Standard[a]	% of Standard
Powerhouse	Particulates	0.017 lb/10^6 Btu Input	0.2 lb/10^6 Btu	8.5
Powerhouse	Sulfur Oxides	0.012 lb/10^6 Btu Input	1.6 lb/10^6 Btu	0.75
Paint Shop	Organics	0.40 lb/day	40 lb/day	1
Explosives Burning	Particulates	12 lb	NA	NA
Fire Fighter Training	Particulates	110 lb	NA	NA

[a]Ohio EPA Air Pollution Regulations 3745-17-01 through 3745-17-13 and 3745-21-01 through 3745-21-08.

NA - not applicable.

The data presented are weekly particulate concentrations measured at Mound's offsite and onsite air-sampling sites. The particulate concentration at onsite locations is somewhat lower than at offsite locations. The particulate concentration also appears to be independent of distance from Mound. This would suggest no influence from Mound operations. For comparison purposes, the State of Ohio - Ambient Quality Standard for airborne particulates is also given in Table 15.

Water - Radioactive

Water sampling locations along the banks of the Great Miami River were selected according to guidelines recommended by the U. S. EPA [8]. The locations, shown in Figure 5, provide samples that are representative of river water after considerable mixing of the effluent from Mound has occurred. Water samples are normally collected and filtered in the field at these locations five days per week, and are subjected to specific analyses for plutonium-238 and tritium.

Large-volume water samples are analyzed by compositing daily samples for a quarterly analysis. The average incremental concentration of plutonium-238 measured for all locations in the Great Miami River was 0.16 x 10^{-12} µCi/ml which is 0.000008% of the RCG for the general population, the most restrictive standard for plutonium-238. These results are summarized in Table 17.

Weekly samples are analyzed for tritium. The average incremental concentration of tritium measured at all locations in the Great Miami River was 0.01 x 10^{-6} µCi/ml which is 0.001% of the RCG for the general population. These results are summarized in Table 18.

Air-Nonradioactive

Table 15 - 1983 WEEKLY PARTICULATE CONCENTRATION DATA OFFSITE[a]

Location	Number of Samples	Range ($\mu g/m^3$)	Average ($\mu g/m^3$)[b]
101	52	31 - 216	105 ± 12
102	52	11 - 165	78 ± 9
103	52	8 - 115	63 ± 6
104	50	29 - 174	86 ± 9
105	52	22 - 116	62 ± 6
108	52	47 - 154	98 ± 8
110	52	27 - 234	74 ± 10
111	50	26 - 394	104 ± 20
112	52	37 - 180	73 ± 7
115	51	28 - 229	80 ± 13
118	52	37 - 145	84 ± 8
119	52	17 - 202	57 ± 8
122	52	18 - 93	51 ± 5
123	52	34 - 296	81 ± 11
124	52	31 - 139	75 ± 8

[a]Ohio Ambient Air Quality Standard = 60 $\mu g/m^3$.

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

These data are obtained by the Mound air monitoring program and are indicative only of the particulate air loading of the Dayton metropolitan area. Mound particulate discharges presented in Table 14 make a negligible contribution to the surrounding area. In addition, Table 16 presents onsite particulate data.

Table 16 - 1983 WEEKLY PARTICULATE CONCENTRATION DATA ONSITE

Location	Number of Samples	Range ($\mu g/m^3$)	Average ($\mu g/m^3$)[a]
211	50	12 - 339	73 ± 13
212	52	4 - 305	67 ± 12
213	51	21 - 265	117 ± 14
214	52	4 - 136	57 ± 7
215	52	7 - 95	53 ± 6

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

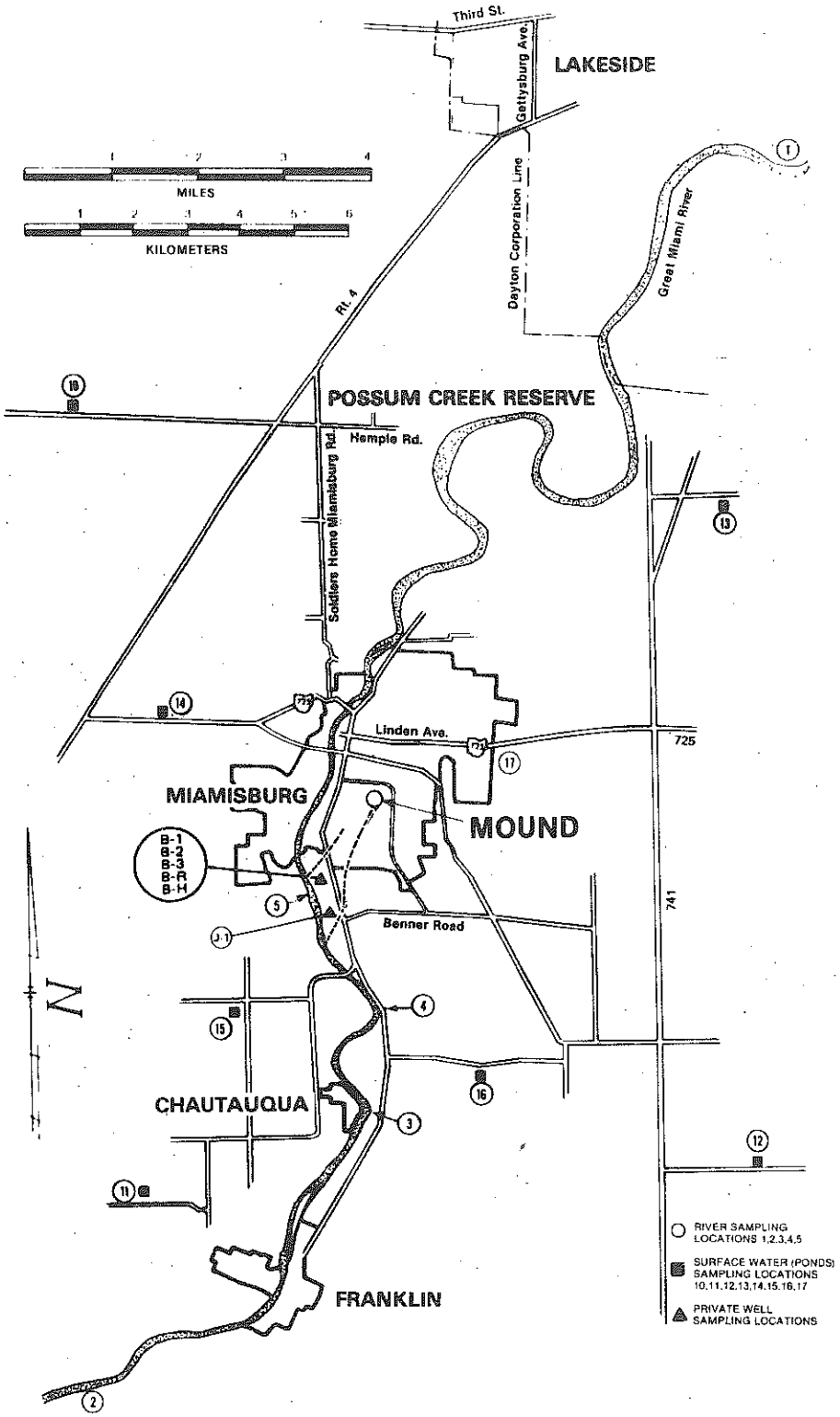


FIGURE 5 - Offsite water sampling locations.

Table 17 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN THE GREAT MIAMI RIVER IN 1983

Location	Number of Samples[a]	Plutonium-238 Range[d] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,e] (10^{-12} µCi/ml)	Percent of RCG[c]
1	4	E.L. - 0.4	E.L.	-
2	4	E.L. - 0.9	0.1 ± 1.3	0.000005
3	4	E.L. - 1.4	0.6 ± 1.1	0.00003
4	4	E.L. - 0.4	0.1 ± 0.5	0.000005
5	4	E.L. - 0.7	E.L.	-

[a]Composite large volume water samples for each location from water collected during 1983.

[b]Lower Detection Limit (LDL) for ^{238}Pu in water is 0.2×10^{-12} µCi/ml which is 0.00001% of the RCG.

[c]Radioactivity Concentration Guide (RCG) = $2{,}000{,}000 \times 10^{-12}$ µCi/ml for the general population and the soluble form of plutonium-238.

[d]Average environmental level (E.L.) subtracted from data.

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

Table 18 - INCREMENTAL CONCENTRATION OF TRITIUM IN THE GREAT MIAMI RIVER IN 1983

Location	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,c,d] (10^{-6} µCi/ml)	Percent of RCG[b]
1	11	E.L. - 0.14	E.L.	-
2	11	E.L. - 0.48	0.01 ± 0.15	0.001
3	11	E.L. - 0.21	E.L.	-
4	11	E.L. - 0.2	0.03 ± 0.13	0.003
5	11	E.L. - 0.26	0.01 ± 0.11	0.001

[a]Lower Detection Limit (LDL) for tritium in water is 0.2×10^{-6} µCi/ml which is 0.04% of the RCG.

[b]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000×10^{-6} µCi/ml for the general population and the soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

Uranium-233, 234, and 238 were also monitored at the river water sampling locations during 1983. The average incremental concentrations of uranium-233, 234, were 0.08 x 10^{-10} µCi/ml which is 0.0008% of the RCG. Uranium-238 was at the environmental level shown in Table 3. In addition, as shown in Table 19, the ratio of uranium-233, 234 to uranium-238 is slightly greater than unity, which is in range of background ratios reported [9]. This is expected as a result of secular equilibrium.

The total amounts of plutonium-238, tritium, and uranium-233, 234 discharged to the Great Miami River during 1983 were 1.0 mCi, 7.94 Ci, and 0.5 mCi, respectively. These concentrations were 0.02%, 0.24% and 0.002% of the most restrictive RCG for individuals in the population.

Seven additional surface water locations, such as ponds, in all quadrants surrounding Mound as shown in Figure 5 are sampled quarterly for plutonium and tritium analyses. The samples used for plutonium-238 determinations are also large volume water samples. The large volume of sample increases the sensitivity of the analysis for plutonium. A smaller aliquot (10 ml) is taken which is adequate for the tritium analysis. The average concentrations of plutonium-238 and tritium for all locations were 0.9 x 10^{-12} µCi/ml and 0.2 x 10^{-6} µCi/ml, respectively, which are 0.00005% and 0.02% of the respective RCG for the general population. The results of the surface water samples are summarized in Tables 20 and 21. Environmental levels (Table 3) have been subtracted from the concentration of plutonium and tritium in water.

Drinking water from communities in the surrounding area is sampled and analyzed quarterly for tritium. These communities and their relative locations are shown in Figure 1. The average concentration of tritium for all locations was 0.3 x 10^{-6} µCi/ml which is 2% of the standard adopted by the U. S. EPA in 1977 for community drinking water systems. Data from the analyses of community drinking water samples are summarized in Table 22. The environmental level in Table 3 for tritium in water is not subtracted from these data.

Drinking water from private wells are also analyzed for tritium. The average concentration of tritium for all private well locations was 6.3 x 10^{-6} µCi/ml which is 32% of the U. S. EPA Standard. These data are shown in Table 23.

Three private wells and Miamisburg city water were sampled and analyzed quarterly for plutonium-238. These samples were also large-volume water samples. The average incremental plutonium-238 concentration for these locations was at the environmental level and represents 0.0001% of the RCG. These results are shown in Table 24.

Water - Nonradioactive

Mound discharges an average of 0.83 million gallons of water per day to the Great Miami River. Nonradioactive pollutants in this effluent water are regulated by a National Pollutant Discharge Elimination System (NPDES) permit. This

Table 19 - INCREMENTAL CONCENTRATION OF $^{233,234}U$ AND ^{238}U IN THE GREAT MIAMI RIVER IN 1983

Location	Number of Samples[a]	$^{233,234}U$ Range[d] (10^{-10} µCi/ml)	$^{233,234}U$ Average[a,b,c,e] (10^{-10} µCi/ml)	$^{233,234}U$ Percent of RCG[f]	^{238}U Range[e] (10^{-10} µCi/ml)	^{238}U Average[a,b,c,e] (10^{-10} µCi/ml)	^{238}U Percent of RCG[g]	Ratio[d] $^{233,234}U/^{238}U$
1	4	E.L. - 2.6	0.4 ± 2.9	0.004	E.L. - 1.4	E.L.	-	1.1
2	4	E.L. - 0.3	E.L.	-	E.L.	E.L.	-	1.1
3	4	E.L. - 0.3	E.L.	-	E.L.	E.L.	-	1.2
4	4	E.L. - 0.1	E.L.	-	E.L.	E.L.	-	1.1
5	4	E.L. - 0.8	E.L.	-	E.L. - 0.2	E.L.	-	1.1

[a]Composite large volume water samples for each location.

[b]Lower Detection Limit (LDL) for $^{233,234}U$ and ^{238}U in water is 0.08×10^{-10} µCi/ml and 0.06×10^{-10} µCi/ml, respectively.

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

[d]A ratio slightly greater than unity indicates naturally occurring uranium [11]. Does not have environmental levels subtracted.

[e]Average environmental level (E.L.) subtracted from data.

[f]DOE Concentration Guide (RCG) for $^{233,234}U$ = $10,000 \times 10^{-10}$ µCi/ml for the general population.

[g]DOE Concentration Guide (RCG) for ^{238}U = $2,000 \times 10^{-10}$ µCi/ml for the general population.

Table 20 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SURFACE WATER IN 1983

Location	Number of Samples[a]	Plutonium-238 Range[d,e] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,c,e] (10^{-12} µCi/ml)	Percent of RCG[c]
11	4	E.L. - 16.2	4.4 ± 12.4	0.0002
12	4	E.L. - 0.6	E.L.	-
13	4	E.L. - 3.2	0.8 ± 2.6	0.00004
14	4	0.2 - 1.8	0.7 ± 1.3	0.00004
15	4	E.L. - 1.1	0.5 ± 1.2	0.00003
16	4	E.L. - 0.3	E.L.	-
17	4	E.L. - 1.1	0.1 ± 1.4	0.000005

[a]Composite large volume water samples were used for each location.

[b]Lower Detection Limit (LDL) for ^{238}Pu in water is 0.2×10^{-12} µCi/ml which is 0.00001% of the RCG.

[c]Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = 2,000,000 $\times 10^{-12}$ µCi/ml for the general population and soluble form of plutonium-238.

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

[e]Average environmental level (E.L.) subtracted from data.

permit, issued by Region V of the U. S. EPA, requires Mound to characterize their effluent water by analyzing samples collected at four onsite locations.

A 24-hr composite, flow proportional sample, and grab sample are collected from discharges 001-A, 001-B, and 002. Discharge 001-A contains the effluent from the sanitary sewage treatment plant. Discharge 001-B includes storm water runoff, single-pass cooling water, zeolite softener backwash, boiler-plant blowdown, and discharge from the radioactive waste disposal facility. Discharge 002 consists of single-pass cooling water, cooling tower blowdown, zeolite softener backwash, and most of the storm water runoff. An 8-hr composite, time proportional sample is collected from discharge 001-C, the effluent from the electroplating facility. The water samples are analyzed for water quality parameters according to standard methods [11]. The results of effluent analyses for 1983 are summarized in Table 25.

Table 21 - INCREMENTAL CONCENTRATION OF TRITIUM IN SURFACE WATER IN 1983

Location	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,b,d] (10^{-6} µCi/ml)	Percent of RCG[c]
10	14	E.L. - 0.33	0.07 ± 0.09	0.007
11	21	E.L. - 0.25	0.03 ± 0.07	0.003
12	22	E.L. - 0.22	0.03 ± 0.06	0.003
13	23	E.L. - 0.29	0.11 ± 0.07	0.01
14	21	E.L. - 0.58	0.28 ± 0.08	0.03
15	20	E.L. - 0.49	0.23 ± 0.09	0.02
16	23	E.L. - 0.24	0.03 ± 0.09	0.003
17	23	0.13 - 0.73	0.4 ± 0.09	0.04

[a]Lower Detection Limit (LDL) for tritium in water is 0.2×10^{-6} µCi/ml which is 0.01% of the RCG.

[b]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000×10^{-6} µCi/ml for the general population and soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

The EPA additionally requires Mound to monitor the flow from two wells which are periodically pumped as a part of the Potable Water Standards Project. Approximately 24 million gallons were discharged from one of these wells, discharge 003, in 1983. No water was discharged from the other well, discharge 004.

A total of 1402 NPDES analyses were performed in 1983. From these measurements, an effluent parameter exceeded its maximum discharge limit 32 times. Mound effluents additionally exceeded monthly average limits 13 times in 1983. The increased solids content in Mound's effluents from storm runoff after rain and snow precipitation was responsible for 31 suspended solids exceptions.

Maintenance operations were responsible for seven of the exceptions: blowdown from a chilled water loop and a boiler caused two suspended solids exceptions and two pH exceptions, respectively. Cleaning electroplating equipment caused two copper exceptions. A residual chlorine exception occurred from backflushing a water softening system. The resin

Table 22 - SUMMARY OF TRITIUM LEVELS IN COMMUNITY DRINKING WATER IN 1983

Locations	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,c,d] (10^{-6} µCi/ml)	Percent Standard[b]
Bellbrook	3	0.15 - 0.23	0.2 ± 0.1	1.0
Centerville	4	0.007 - 0.28	0.1 ± 0.2	0.5
Dayton	4	0.09 - 0.28	0.2 ± 0.2	1.0
Franklin	4	0.26 - 0.42	0.3 ± 0.1	1.5
Germantown	4	0.12 - 0.3	0.2 ± 0.1	1.0
Kettering	4	0.2 - 0.49	0.3 ± 0.2	1.5
Miamisburg	3	0.66 - 1.7	1.1 ± 1.4	5.5
Middletown	3	0.11 - 0.35	0.2 ± 0.3	1.0
Moraine	4	0.24 - 0.41	0.3 ± 0.1	1.5
Springboro	4	0.15 - 0.63	0.3 ± 0.3	1.5
Waynesville	4	0.13 - 0.34	0.2 ± 0.1	1.0
West Carrollton	4	0.26 - 0.46	0.4 ± 0.1	2.0

[a]Lower Detection Limit (LDL) for tritium oxide is 0.1 x 10^{-6} µCi/ml which is 0.5% of the EPA Standard for community drinking water.

[b]EPA Drinking Water Standard for tritium = 20 x 10^{-6} µCi/ml for community drinking water systems.

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

[d]Environmental level is included in these data for comparison to the EPA Standard.

in the softeners are rinsed with tap water containing a trace of chlorine to assure bacterial disinfection of the resin.

Two exceptions resulted after equipment malfunctions: a check valve stuck open during the filling of a water tower. The spilled water washed mud into effluent 002 which caused a suspended solids exception. A fecal coliform exception occurred at the sewage treatment plant, effluent 001A, when the chlorine feeder malfunctioned. A ten-gallon spill of #2 fuel oil into a storm sewer caused an oil and grease exception. The primary causes of four exceptions, three suspended solids and one residual chlorine, are unknown.

In summary, the number of maximum exceptions represents 2% of the NPDES measurements in 1983. Over half of these maximum exceptions and all of the average

Table 23 - TRITIUM IN PRIVATE WELLS IN 1983

Location	Number of Samples	Tritium Range[e] (10^{-6} µCi/ml)	Tritium Average[a,b,d,e] (10^{-6} µCi/ml)	Percent Standard[c]
B-1	47	3.9 - 7.5	5.6 ± 0.2	28
B-3	12	5.8 - 9.1	7.4 ± 0.7	37
J-1	13	3.1 - 4.4	3.7 ± 0.2	19
B-R	43	5.0 - 13	8.0 ± 0.5	40
B-H	46	5.2 - 9.5	6.9 ± 0.3	35

[a]All wells are now in compliance with the new EPA Standard of 20 x 10^{-6} µCi/ml.

[b]Lower Detection Limit (LDL) for tritium in water is 0.2 x 10^{-6} µCi/ml which is 1% of the EPA Standard.

[c]EPA Standard for tritium in community drinking water systems = 20 x 10^{-6} µCi/ml. Mound is using the EPA Standard as a guide for the private water supplies.

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

[e]Environmental level is included in these data for comparison to the EPA Standard.

exceptions were caused by runoff from rain and snow. The combined discharge from all of Mound's effluents containing storm runoff averaged 81 kg per day of suspended solids during 1983. This represents a solids erosion equivalent to about one pound per acre per day.

According to data obtained from the U. S. Geological Survey, the flow rate of the Great Miami River in 1983 averaged 1320 million gallons per day (MGD) with a minimum and maximum of 223 MGD and 14,730 MGD, respectively. The above exceptions had no adverse impact on the Great Miami River. In addition, a review of the data in Table 25 shows that Mound effluents did not cause the Great Miami River to exceed Ohio Stream Standards.

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is any significant uptake and concentration of radionuclides by plant or animal life. Samples were collected in Miamisburg, Centerville, and Bellbrook. Centerville and Bellbrook are in the prevailing wind direction from Mound at a distance of 8 km (5 mi) and 16 km (10 mi), respectively. Both communities are

Table 24 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN PRIVATE WELLS AND MIAMISBURG MUNICIPAL DRINKING WATER IN 1983

Location	Number of Samples[a]	Plutonium-238 Range[e] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,e] (10^{-12} µCi/ml)	Percent of RCG[c]
Miamisburg	4	E.L.	E.L.	-
B-1	4	E.L. - 0.2	E.L.	-
B-3	4	E.L.	E.L.	-
J-1	4	E.L.	E.L.	-

[a]Composite large volume water samples were analyzed from each location from water collected during 1983.

[b]Lower Detection Limit (LDL) for ^{238}Pu is 0.2×10^{-12} µCi/ml which is 0.00001% of the RCG.

[c]Applicable DOE Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = $2{,}000{,}000 \times 10^{-12}$ µCi/ml for the general population and soluble form of plutonium-238.

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

[e]Average environmental level (E.L.) subtracted from data and is 0.0001% of the RCG.

shown in Figure 1. Fish were collected in the Great Miami River. Mound's outfalls are shown as dotted lines in Figure 5. The plutonium-238 content of the foodstuff and vegetation samples is determined by ashing the samples, then proceeding with the same techniques used for plutonium-238 analyses of air samples (see section on Air - Radioactive). The tritium content of the foodstuff and vegetation samples is determined by distilling the water from the sample, then analyzing the distillate for tritium. The results of the foodstuff, vegetation, and fish analyses are summarized in Tables 26 and 27. The concentration is given in terms of the sample weight (wet weight) before ashing or distilling. The samples of aquatic life analyzed included only the edible, fleshy portions of fish. These analyses indicate no evidence of any significant uptake or concentration by plant or animal life of the radionuclides handled at Mound. Environmental levels for foodstuffs and vegetation have been subtracted from the data (Table 3).

Silt - Radioactive

Silt samples were collected from the river and surface water sample locations shown in Figure 5.

Foodstuffs and Vegetation

Table 25 - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM DATA FOR 1983

Parameter	Units	Number of Samples	Minimum	Maximum	Annual Average	NPDES Permit Limits Maximum[b]	NPDES Permit Limits Monthly Average
Discharge 001-A							
Flow Rate[a]	MGD	Cont.	0.04	0.16	0.09	-[c]	-[c]
pH	pH units	247	7.1	8.4	-	9.0	-[c]
Biochem. O_2 Demand	mg/l (kg/day)	94	1.0 (0.3)	7.9 (2.4)	3.4 (1.2)	15 (14.2)	10.0 (4.9)
Suspended Solids	mg/l (kg/day)	100	2.6 (0.9)	17.6 (7.3)	9.0 (3.4)	30 (28.4)	15 (7.4)
Fecal Coliform	MPN/100 ml	96	23	16,000	172	2000	1000
Discharge 001-B							
Flow Rate	MGD	Cont.	0.02	0.39	0.08	-[c]	-[c]
pH	pH units	101	7.2	9.4	-	9.0	-[c]
Susp. Solids (Oct-Mar)	mg/l (kg/day)	48	1.3 (0.2)	26.3 (6.5)	11.6 (3.2)	30 (11.4)	20 (7.6)
Susp. Solids (Apr-Sept)	mg/l (kg/day)	50	1.7 (0.4)	40.7 (23.5)	12.5 (5.3)	50 (19.0)	20 (7.6)
Dissolved Solids	mg/l	19	715	18,600	7200	-[c]	-[c]
Grease and Oil	mg/l	12	0.2	64.0	3.7	10	-[c]
Residual Chlorine	mg/l	99	< 0.02	0.20	< 0.02	0.02	-[c]
Chemical O_2 Demand	mg/l	12	< 4.0	120	29.0	-[c]	-[c]
Discharge 001-C							
Cyanide	mg/l	50	< 0.04	0.36	< 0.04	1.0	-[c]
Chromium	mg/l	50	< 0.01	0.20	0.04	0.5	-[c]
Cadmium	mg/l	50	< 0.01	0.08	0.02	0.1	-[c]
Nickel	mg/l	50	0.01	0.50	0.12	0.5	-[c]
Copper	mg/l	50	0.05	0.62	0.17	0.5	-[c]
Discharge 002							
Flow Rate	MGD	Cont.	0.19	1.55	0.66	-[c]	-[c]
pH	pH units	38	7.8	8.5	-	9.0	-[c]
Suspended Solids	mg/l (kg/day)	102	4.7 (7.6)	184 (1080)	26.6 (78.2)	30 (91)	15 (34)
Dissolved Solids	mg/l (kg/day)	24	442 (1250)	1465 (4720)	901 (2560)	2000 (6065)	1500 (3412)
Grease and Oil	mg/l	12	0.1	0.9	0.4	10	-[c]
Residual Chlorine	mg/l	98	< 0.02	< 0.02	< 0.02	0.02	-[c]

[a]Includes flow from Discharge 001-C. The maximum flow from 001-C is approximately 2000 gal/day.

[b]pH has a minimum limit of 6.5 and a maximum limit of 9.0.

[c]No limit applicable.

Table 26 - INCREMENTAL PLUTONIUM-238 IN FOODSTUFFS AND VEGETATION IN 1983

Location	Type of Sample	Number of Samples	Plutonium-238 Range[a] (10^{-6} µCi/g)	Plutonium-238 Average[a,b,c] (10^{-6} µCi/g)
Miamisburg	Grass	8	0.0002 - 0.051	0.019 ± 0.017
	Potatoes	4	E.L.	E.L.
Centerville	Grass	8	E.L. - 0.002	0.0002 ± 0.0007
	Potatoes	4	E.L. - 0.0008	E.L.
Bellbrook	Grass	8	E.L. - 0.0004	0.0001 ± 0.0003
	Potatoes	4	E.L. - 0.0003	E.L.
Mound (outfall to river)	Fish	8	E.L. - 0.002	0.0004 ± 0.001

[a]Average environmental level (E.L.) subtracted from data.

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

[c]Lower Detection Limit (LDL) for plutonium-238 in grass samples is 0.0001×10^{-6} µCi/g. LDL for plutonium-238 in potato samples is 0.0002×10^{-6} µCi/g. LDL for plutonium-238 in fish samples is 0.0003×10^{-6} µCi/g.

The results of the silt sample analyses are found in Tables 28 and 29.

Evaluation of dose commitment to the public

A dose assessment was performed for radionuclides in the environment from Mound operations. These radionuclides are plutonium-238 and tritium. Tritium (oxide) is the only radionuclide at Mound for which the critical organ is the whole body. The critical organs for plutonium-238 are assumed to be the lung for insoluble material and the bone for soluble material. The solubility of plutonium-238 in the receptor is unknown at Mound; however, it is highly probable that most of the plutonium-238 is in the oxide form, which is very insoluble. In order to provide a realistic but conservative dose commitment estimate, it is assumed that 50% of the plutonium-238 is insoluble and 50% is soluble. The model used for soluble plutonium results in a higher dose estimate than that for the insoluble material. This technique remains conservative, since it is expected that most of the plutonium-238 is insoluble.

Table - 27 - INCREMENTAL CONCENTRATION OF TRITIUM IN VEGETATION IN 1983

Location	Type of Sample	Number of Samples	Tritium Range[c] (10^{-6} µCi/g)	Tritium Average[a,b,c,d] (10^{-6} µCi/g)
Miamisburg	Grass	8	6.4 - 12.0	9.2 ± 2.2
	Tomatoes	4	0.4 - 0.6	0.5 ± 0.18
Centerville	Grass	8	E.L. - 0.4	0.13 ± 0.15
	Tomatoes	4	E.L. - 0.15	0.07 ± 0.2
Bellbrook	Grass	8	0.01 - 0.19	0.1 ± 0.1
	Tomatoes	4	E.L. - 0.05	E.L.

[a]LDL for tritium in grass is 0.09 x 10^{-6} µCi/g.

[b]LDL for tritium in tomatoes is 0.07 x 10^{-6} µCi/g.

[c]Average environmental level (E.L.) subtracted from data.

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

Table 28 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM RIVER MONITORING LOCATIONS IN 1983

Location	Number of Samples	^{238}Pu Range[c] (10^{-6} µCi/g)	^{238}Pu Average[a,b,c] (10^{-6} µCi/g)
1	2	E.L.	E.L.
2	2	0.009 - 0.014	0.01 ± 0.03
3	2	0.03 - 0.45	0.24 ± 2.71
4	2	0.05 - 0.06	0.05 ± 0.05
5	2	0.007 - 0.008	0.007 ± 0.007

[a]Lower Detection Limit (LDL) for ^{238}Pu in silt is 0.0005 x 10^{-6} µCi/g.

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

[c]Average environmental level (E.L.) subtracted from data.

Table 29 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM SURFACE WATER MONITORING LOCATIONS IN 1983

Location	Number of Samples	^{238}Pu Range[c] (10^{-6} μCi/g)	^{238}Pu Average[a,b,c] (10^{-6} μCi/g)
11	4	E.L. - 0.0003	0.0001 ± 0.0017
12	4	E.L. - 0.0003	0.0001 ± 0.0018
13	4	E.L. - 0.0019	0.0001 ± 0.0027
14	4	E.L. - 0.0007	0.0004 ± 0.0018
15	4	0.0008 - 0.0039	0.0015 ± 0.003
16	4	E.L. - 0.0016	0.0009 ± 0.0021

[a]Lower Detection Limit (LDL) for ^{238}Pu is 0.0005×10^{-6} μCi/g.

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

[c]Average environmental level (E.L.) subtracted from data.

The factor used for the lung dose calculations has also been changed to provide a more realistic dose assessment. In past years, maximum pulmonary deposition was used as the basis for lung dose estimates. This may be overly conservative. It is recommended by the ICRP Task Group on Lung Dynamics that an Activity Median Aerodynamic Diameter (AMAD) of 1.0 μm be used as a standard aerosol when particle size determination cannot be made [12]. This implies a more probable particle size for inhaled particles.

The term "dose commitment," as used in this report, is that cumulative dose for a period of 50 yr from 1 yr of exposure to a given radionuclide.

Plutonium-238 Assumptions and Methodology

The dose commitment estimates for plutonium-238 were based on environmental monitoring data for 1983. The estimates for maximum dose commitment to the lung at the site boundary and maximum dose commitment to the lung in individuals were based on the maximum onsite incremental average concentration of plutonium-238 in air from onsite samplers (sampler 213, Table 11), because the samplers are in close proximity to the site boundary. The maximum dose commitment to the lung in population group(s) was based on the maximum offsite average incremental concentration of plutonium-238 in air (sampler 123, Table 8).

The estimates for maximum dose commitment to the bone at the site boundary and in individuals were based only on the maximum onsite average incremental concentration of plutonium-238 in air. The maximum offsite average concentration of plutonium-238 in drinking water was at environmental levels (Table 24). The maximum dose commitment to the bone for individuals in population group(s) was calculated using airborne concentrations of plutonium-238 only, because the concentration of plutonium-238 in Miamisburg drinking water was at the environmental level also.

The terms "maximum dose commitment at the site boundary" and "maximum dose commitment to individuals" refer to the maximum dose commitment possible for individuals to receive, assuming they remain at the site boundary 24 hr/day and 365 days/yr. The term "maximum dose commitment for individuals in population group(s)" refers to those individuals who reside in an area adjacent to Mound and who receive the maximum dose commitment values found in the offsite environment.

The calculational methods can be found in the Appendix. The results of the dose commitment estimate calculations are shown in Table 30.

The data indicate that in all cases of dose commitment comparisons, the dose commitments are well within 1% of the DOE standard. In addition, to provide a relative comparison of these dose commitment values, the maximum dose to the lung of an individual around Mound is 0.1 mrem/50 yr. This would be equivalent to the additional dose to an individual smoking

Table 30 - DOSE COMMITMENT ESTIMATES

	Plutonium-238 (mrem/50 yr)				Tritium Oxide (mrem/50 yr)	
	Lung	% of Applicable DOE Standard	Bone	% of Applicable DOE Standard	Whole Body	% of Applicable DOE Standard
Maximum dose equivalent at the site boundary	0.1	-	1.56	-	0.83	-
Maximum dose equivalent to an individual	0.1	0.007	1.56	0.1	0.83	0.17
Maximum dose equivalent to an individual in the population group(s)	0.02	0.004	0.26	0.05	0.15	0.09

0.2 cigarettes/yr [13] or visiting a friend who lives in a brick house (as compared to a wooden house) for 3 hours [14].

Tritium (oxide) Assumptions and Methodology

The dose commitment estimates for tritium (oxide) were also based on environmental monitoring data for 1983. The concentrations used for dose commitment estimates for tritium (oxide) were arrived at by the same method as that used for plutonium. The maximum average onsite air incremental concentration was measured at sampler 213 (Table 13), and the maximum drinking water incremental concentration was the average measured at location B-R (Table 23). The maximum average offsite air incremental concentration was measured at sampler 124 (Table 10), and the maximum incremental concentration in drinking water for individuals in a population group was that measured in the Miamisburg drinking water. The total dose commitment for the whole body was obtained by adding the dose commitment of tritium (oxide) in air and the dose commitment of tritium (oxide) in water.

The calculational methods can be found in the Appendix. The results of the dose commitment estimate calculations are shown in Table 30.

The tritium data indicate dose commitment levels well within 1% of the DOE standards. For example, the maximum whole body dose commitment to an individual around Mound from tritium is 0.83 mrem. This value is equivalent to the additional dose to an individual from Ohio taking a 3-day vacation in Colorado [15].

The person-rem dose commitment estimate calculation was based on tritium (oxide) data from environmental air sampling stations in two ranges: 0.8 km (0-5 mi) and 8-21 km (5-20 mi). The 0-8 km range includes 10 samplers within 1.6 km (1 mi) of Mound.

The average concentration of tritium (oxide) in air was obtained by averaging ten offsite tritium air samplers less the concentration found at sampler #119. From this average concentration, a dose commitment was determined and multiplied by the number of people from 0 to 8 km.

The average tritium (oxide) concentration from the four other offsite samplers (less the concentration at sampler 119) was used to obtain the person-rem from 8 to 32 km. Eight area segments from 8 to 32 km were obtained by letting each sampler represent one segment concentration and the average of two adjacent samplers would represent another segment. These segment concentrations were then multiplied by their respective population. By using the four samplers and this averaging technique, a more realistic person-rem value could be obtained.

The person-rem from tritium (oxide) in community drinking water was based on average concentrations of tritium (oxide) in various community water supplies, less appropriate environmental levels, and weighing these concentrations with respective populations.

The calculations for the air and water dose commitment estimates are shown in the Appendix.

It is estimated that the total population from 0 to 32 km is receiving 13 person-rem from Mound's emissions. The remaining population from 32 km to 80 km (20 to 50 mi) is not receiving any dose commitment from tritium (oxide) emissions. Thus, the dose commitment from Mound's emission is 13 person-rem for the 0-80 km range.

For comparison, the person-rem values from natural radiation, including cosmic rays, terrestial, and internal radiation, would be approximately 470,000 person-rem for the 0 to 80 km (50 mi) range [16]. The dose commitment from natural background tritium alone is 100 person-rem for the 0 to 80 km range [16].

Acknowledgement

The authors gratefully acknowledge C. T. Bishop, W. D. Gloekler, and C. E. Styron for their contributions to this report; K. D. DeVilbiss, W. D. Gloekler, B. J. Hollon, L. C. Hopkins, V. C. Lacy, L. L. Roush, F. K. Tomlinson, E. E. Wallace and P. D. Watkins for their work in sample collection and analyses; and K. N. McLennan for typing the report.

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Appendix

Applicable Standards

RADIOACTIVE STANDARDS

In conformance with DOE Order 5480.1, Chapter XI, "Requirements for Radiation Protection," offsite sample results are compared with RCG's established for the general population. These RCG's are derived by dividing the RCG's for an uncontrolled area by three.

Onsite sample results are compared with the uncontrolled area RCG's which are applicable for individuals in the population.

The RCG values (in microcuries per milliliter - μCi/ml) used for comparison purposes for the various types of samples in this report are listed below. In all cases, these are the most restrictive RCG's.

Plutonium-238 (Soluble Form)

Air

General Population	2×10^{-14} μCi/ml
Uncontrolled Area (Individuals in the Population)	7×10^{-14} μCi/ml

Water

General Population	2×10^{-6} μCi/ml
Uncontrolled Area (Individuals in the Population)	5×10^{-6} μCi/ml

Tritium (Soluble Form)

Air

General Population	7×10^{-8} μCi/ml
Uncontrolled Area (Individuals in the Population)	2×10^{-7} μCi/ml

Water (DOE RCG is compared to water not used for drinking purposes)

General Population	1×10^{-3} μCi/ml
Uncontrolled Area (Individuals in the Population)	3×10^{-3} μCi/ml

As of June 24, 1977, community drinking water quality is regulated by the EPA National Interim Primary Drinking Water Regulations for Radionuclides. The new standard = 20×10^{-6} μCi/ml (20,000 pCi/l).

Foodstuffs There are no RCG values specified for foodstuffs. However, to give some perspective, the foodstuff values can be compared to the RCG values for plutonium and tritium in water.

Soil There are no guidelines established for radioactive species in soil. (The U.S. EPA has guidelines under consideration.)

NONRADIOACTIVE STANDARDS

Water Region V of the U.S. EPA has issued a discharge permit under NPDES regulations covering Mound liquid effluent streams. The discharge limitations for each effluent stream are as follows:

Discharge 001-A	7-day Average	30-day Average
BOD_5 mg/l (kg/day)	15 (14.2)	10 (4.9)
Suspended Solids mg/l (kg/day)	30 (28.4)	15 (7.4)
Fecal Coliform N/100 ml	2000	1000
pH	6.5 - 9.0	-

Discharge 001-B	Daily Maximum	30-Day Average
Suspended Solids mg/l (kg/day)		
(Oct-Mar)	30 (11.4)	20 (7.6)
(Apr-Sept)	50 (19)	20 (7.6)
Oil and Grease mg/l	10	-
COD	Monitor Only	
Dissolved Solids	Monitor Only	
Residual Chlorine mg/l	0.02	
pH	6.5 - 9	

Discharge 001-C	Daily Maximum
Cyanide mg/l	1.0
Chromium - Total mg/l	0.5
Cadmium mg/l	0.1
Nickel mg/l	0.5
Copper mg/l	0.5

Discharge 002	Daily Maximum	Daily Average
Suspended Solids mg/l (kg/day)	30 (91)	15 (34)
Dissolved Solids mg/l (kg/day)	2000 (6065)	1500 (3412)
Oil and Grease mg/l	10	-
Residual Chlorine	0.02	-
pH	6.5 - 9	

The Ohio EPA has established Water Quality Standards (3745-1-01-3745-1-09). The standards listed below are excerpted from these regulations. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/liter)
Dissolved Oxygen	5.0
pH (pH units)	6-9
Fecal Coliform (N/100 ml)	200 per 100 ml
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250
Chromium (hexavalent)	0.05
Cyanide (free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil and Grease	5
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075*
Zinc	0.075 - 0.5*

*Dependent on $CaCO_3$ hardness.

Dose Commitment Calculations

PLUTONIUM-238 CALCULATIONAL METHODS

These dose commitment to the lung resulting from inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1CI_a t_1 f_a f_r \ \Sigma EF(RBE)\eta}{\lambda m}(1-e^{-\lambda t_2})$$

where

$D(t)$ = 50-yr dose commitment delivered to the lung in 365 days of continuous exposure to plutonium-238 in air, rem/50 yr

C = average airborne concentration, μCi/ml

I_a = average air intake = 2×10^7 ml/day [1]

t_1 = time exposed, 365 days

t_2 = duration of dose, 50 yr

f_a = fraction of inhaled material reaching organ of interest = 0.3 for the pulmonary region [2]

f_r = fraction of pulmonary deposition undergoing long-term retention = 0.6 for actinide (class Y) [2]

$\Sigma EF(RBE)\eta$ = effective energy deposition per disintegration = 57 [1]

λ = effective decay rate, 0.0014 day^{-1} for actinides (class Y) from the pulmonary region [3]

m = lung mass, 1000 g [1]

The dose commitment to bone resulting from inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1CI_a f_a t_1 \Sigma EF(RBE)\eta}{\lambda m}(1-e^{-\lambda t_2})$$

where

f_a = 0.2 [1]

$EF(RBE)$ = 280 [1]

$m = 7 \times 10^3$ g [1]
$= 3 \times 10^{-5} day^{-1}$ [1]

The dose commitment to bone resulting from ingestion of plutonium-238 in water was calculated by:

$$D(t) = \frac{51.1CI_w f_a t_1 \Sigma EF(RBE)}{\lambda m}(1-e^{-\lambda t_2})$$

where

I_w = average quantity of water intake, 2200 cm^3 [1]

$f_a = 2.4 \times 10^{-5}$ [1]

TRITIUM OXIDE CALCULATIONAL METHODS

The dose commitment to the whole body resulting from exposures to tritium (oxide) in air was calculated by:

$$D(t)a = \frac{\overline{C}a}{Ra} \times S$$

where

$D(t)a$ = dose commitment, mrem/50 yr

$\overline{C}a$ = average concentration of tritium (oxide) in air

Ra = RCG for tritium (oxide) in air [4]

S = Radiation protection standard in mrem/50 yr [4]

The dose commitment to the whole body resulting from uptake of tritium (oxide) in water was calculated by:

$$D(t)w = \frac{\overline{C}w}{Rw} \times S$$

where

$D(t)w$ = dose equivalent in mrem/50 yr

$\overline{C}w$ = average concentration

Rw = RCG for tritium (oxide) in water [4]

S = radiation protection standard in mrem/50 yr [4]

These dose commitment values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection [5] and the National Council on Radiation Protection Measurements [6].

PERSON-REM CALCULATIONS

The equations used for this calculation were:

$$\overline{D}(t)a = \frac{\overline{C}a}{Ra} \times S$$

where

$\overline{D}(t)a$ = dose commitment from tritium (oxide) in air

$\overline{C}a$ = average tritium (oxide) concentration in air

Ra = RCG for tritium (oxide) in air [4]

S = radiation protection standard for tritium (oxide) in air in mrem/50 yr [4]

$$\overline{D}(t)w = \frac{\overline{C}w}{Rw} \times S$$

where

$\overline{D}(t)w$ = dose commitment from tritium (oxide) in water

$\overline{C}w$ = average tritium (oxide) concentration in water

Rw = RCG for tritium (oxide) in water [4]

S = radiation protection standard for tritium (oxide) in water, mrem/50 yr [4]

These dose commitment values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection [5] and the National Council on Radiation Protection and Measurements [6].

The total person-rem from 0 to 32 km is obtained by:

$$\sum_{0}^{32} R = \left(D(t)a\sum_{0}^{8} P\right) + \sum_{0}^{8}\overline{D}(t)a\sum_{8}^{32} P + \sum_{0}^{32}\left(\overline{D}(t)wP\right)$$

where

$\sum_{0}^{32} R$ = person-rem within 32 km

$\overline{D}(t)a\sum_{0}^{8} P$ = average dose commitment x population from 0-8 km

$\sum_{0}^{8}\overline{D}(t)a\sum_{8}^{32} P$ = summation of dose commitments x the respective populations within eight direction segments from Mound from 8-32 km

$\sum_{0}^{32}\left(\overline{D}(t)wP\right)$ = summation of dose commitments x respective population from 0-32 km

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MLM-3246

Environmental Monitoring at Mound: 1984 Report

Daniel G. Carfagno and Billy M. Farmer

April 25, 1985

MOUND
Miamisburg, Ohio 45342

operated by
MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company

for the
U. S. DEPARTMENT OF ENERGY
Contract No. DE-AC04-76-DP00053

Monsanto

Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed Copy: A03
Microfiche copy: A01

MLM-3246
UC-41

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Foreword

This report was prepared by the Environmental Section of the Administrative Services Department at Monsanto Research Corporation - Mound. Sample analyses and data reduction were performed by the Environmental Laboratory Group. Particulate samples offsite were collected by the Air Pollution Control Section of the Montgomery County Combined General Health District, which acts as the Regional Air Pollution Control Agency in this area for the Ohio Environmental Protection Agency. All other sampling was performed by personnel in the Environmental Section.

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Introduction

Monsanto Research Corporation - Mound occupies 306 acres of land in Miamisburg, Ohio. This location is approximately 16 km (10 mi) southwest of Dayton, Ohio. The predominant geographical feature in the five-county region surrounding Mound is the Great Miami River, which flows from northeast to southwest through Miamisburg. The river valley is highly industrialized.

The remainder of the region is predominantly farmland, dotted with light industry and small communities. The locations and populations of these communities are shown in Figure 1. The population distribution surrounding Mound is shown in Figure 2. Drinking water for the area is obtained from a buried valley aquifer that generally follows the Great Miami River. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land in agricultural use is devoted to pasturing livestock [1].

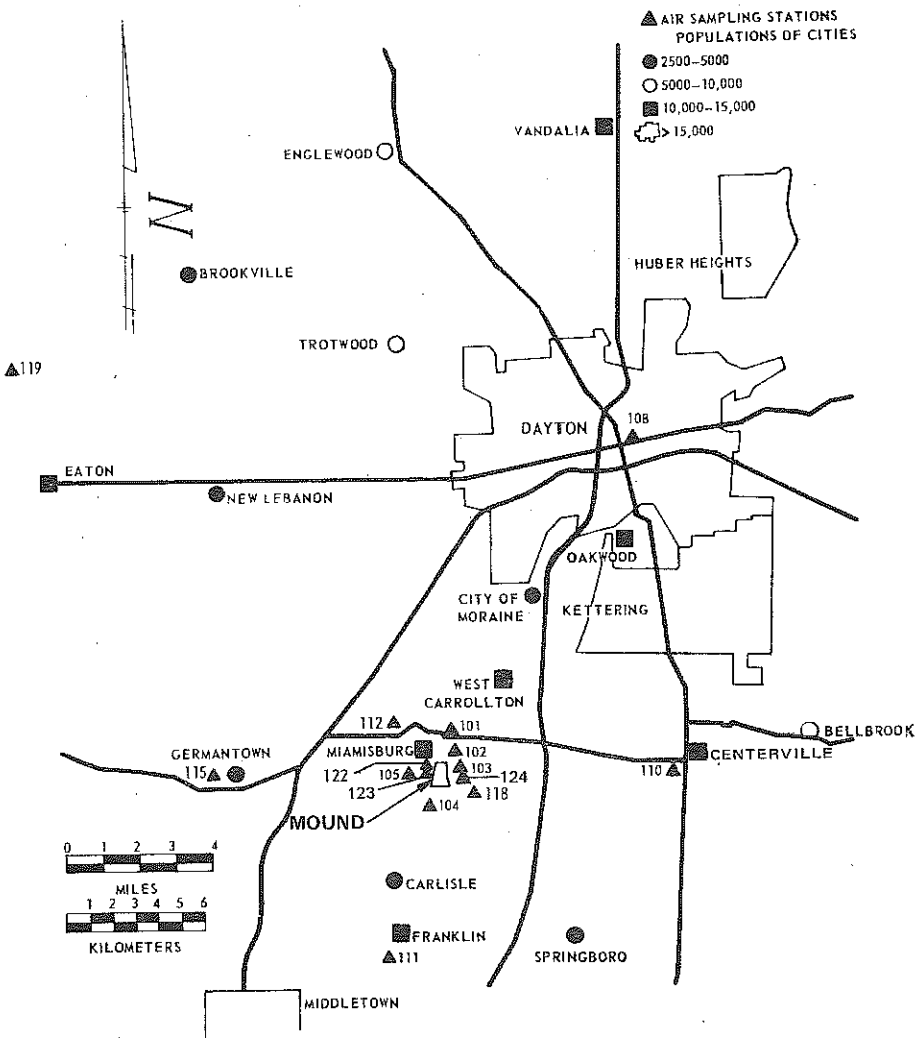
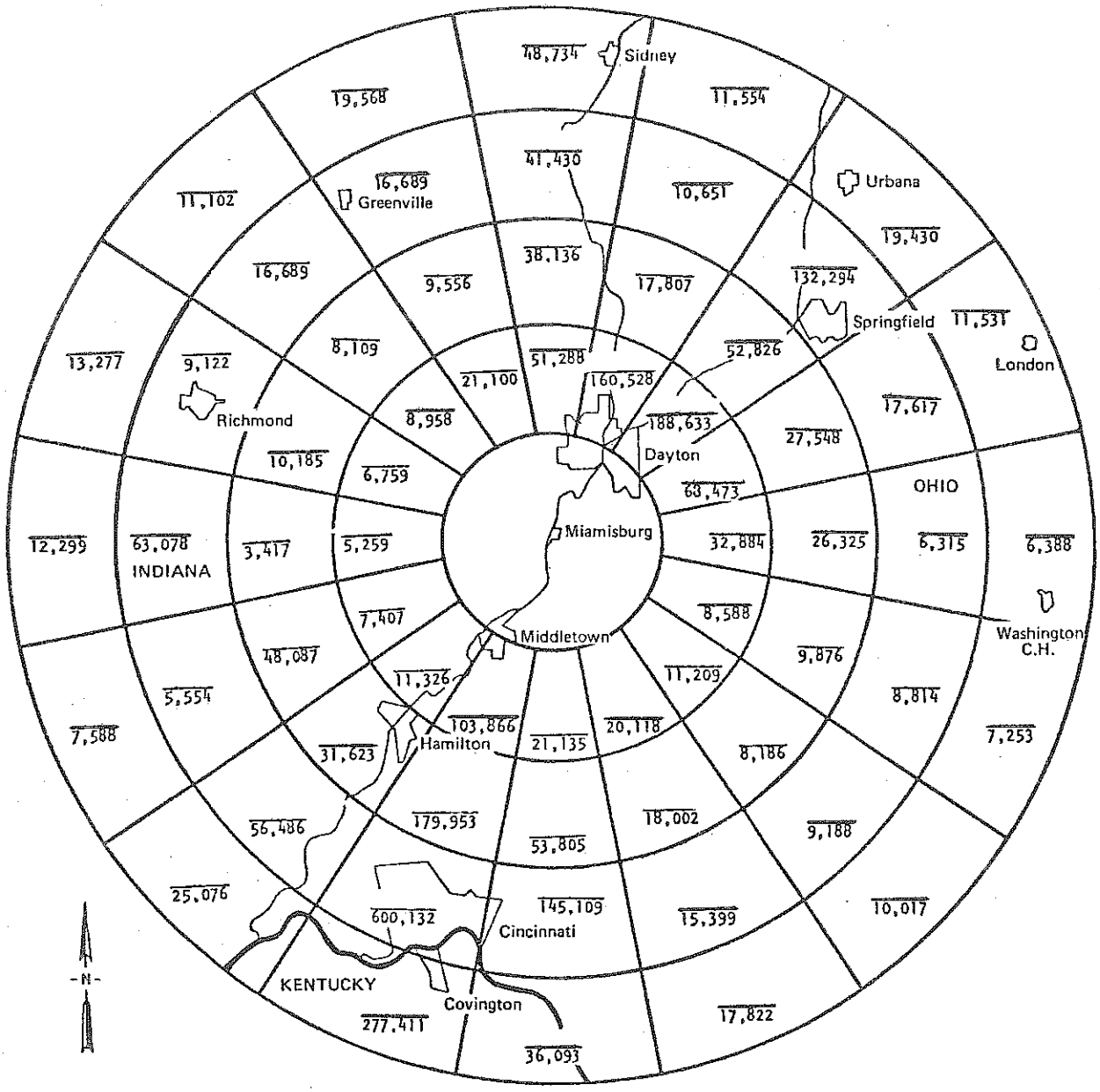


FIGURE 1 - Offsite air sampling locations.



Cumulative Population Totals
1980 Population 0 - 50 Miles

0-10	398,259
0-20	1,125,790
0-30	1,669,231
0-40	2,823,798
0-50	3,358,941

FIGURE 2 - Projected 1980 population within 50 miles of Mound.

The climate in the area is considered moderate. Average annual precipitation is 91 cm (36 in.) and is evenly distributed throughout the year. Winds are predominantly from the south or west, except during the summer, when they are recorded more frequently from out of the southwest [2]. The annual average wind speed measured at Mound was 4.6 m/s (10.3 mi/hr) for 1984. Figure 3 shows the wind rose compiled at Mound, and Table 1 shows average wind speed and percent frequency for each of 16 wind directions.

Mound began operations in 1949. Its mission currently includes (1) research, development, engineering, production, and surveillance of components for the Department of Energy (DOE) weapons programs; (2) separation, purification, and sale of stable isotopes; and (3) DOE programs in nuclear safeguards and waste management, heat source testing, and fusion fuel systems. The radionuclides of primary concern that result from Mound's current or past operations are plutonium-238 and tritium.

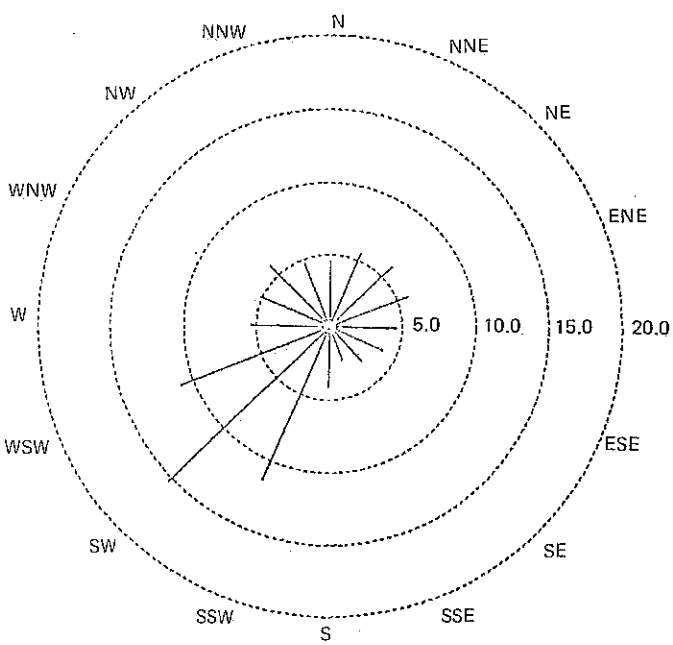


FIGURE 3 - The relative frequency of winds from different directions for Mound.

Radionuclides in particulate form are removed from process air effluents by high efficiency particulate air (HEPA) filters. Air effluents are filtered first at their points of origin (i.e., gloveboxes) and then just before reaching the release point (i.e., the stack). The filtering system at the stack consists of two banks of HEPA filters in series, each bank having a collection efficiency of 99.95%. Radionuclides are removed from liquid effluents, such as process wastes, by chemical processing. Solid radioactive wastes are packaged and shipped offsite for burial at approved burial sites. Wastes generated in the processing of explosive materials are collected and disposed of according to the Defense Armament and Research Command (DARCOM) Regulation 385-100 and DOE/EV/06194-1.

An onsite, sanitary waste treatment plant provides secondary treatment, in accordance with U.S. Environmental Protection Agency (EPA) requirements [3], using an activated sludge process operating in the extended aeration mode. All domestic sewage generated onsite is treated in this facility. The influent and effluent at the sewage treatment plant are also monitored for radioactivity to ensure no undetected release can occur to the environment via the sanitary sewage plant. Digested sludge from the sewage plant is shipped offsite for burial at an approved burial site. All wastewater is discharged from the site to the Great

Table 1 - AVERAGE ANNUAL PERCENT FREQUENCY OF WIND DIRECTION AND AVERAGE WIND SPEED (m/s) FOR 1984

Direction	Percent	Average Speed (m/s)
N	4.5	4.2
NNE	5.3	4.1
NE	6.0	4.0
ENE	5.7	4.2
E	4.5	4.4
ESE	4.1	4.5
SE	3.3	4.2
SSE	2.5	4.1
S	4.1	4.1
SSW	11.5	4.8
SW	15.3	5.1
WSW	11.0	5.3
W	5.4	4.7
WNW	5.2	5.1
NW	5.9	4.6
NNW	4.7	4.4
CALM	0.7	-
Total	100.0	4.6

Miami River. Nonradioactive 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 was transported during 1984 to a sanitary landfill site approved by both the state and county. Waste solvents and chemicals are moved offsite by a commercial-industrial waste disposal firm.

Mound's compliance with regulations prescribed by DOE for the safety of its employees and the public has been demonstrated throughout the history of the facility. The fundamental objective of the Mound Environmental Control Program, an ongoing program since Mound began operations, is the containment of radioactive discharges to levels well within the existing standards. As part of this program, waste streams are monitored and controlled at each operating step, resulting in no more than low-level releases of airborne or liquid wastes to the environment. With early detection,

control techniques can be implemented, thus ensuring that concentrations are well within existing standards and meet the DOE guideline "as-low-as-reasonably-achievable" (ALARA).

The same objective applies to nonradioactive discharges, control to levels well within applicable standards. This is achieved primarily by directing waste streams to the appropriate waste treatment system; e.g., sewage treatment plant, solvent collection system, or filtration. The guideline here also is ALARA.

As part of the Mound Environmental Program monitoring functions, air, water, vegetation, foodstuffs, and sediment samples are collected from the environment at distances up to 48 km (30 mi) from Mound's boundaries. These samples are then analyzed for the specific radionuclides handled at Mound. A summary of the monitoring program is shown in Table 2.

The results of the environmental analyses for 1984 are provided in this report. The primary purpose of the report is to detail what impact, if any, Mound's operations have had on the adjacent environment in 1984. To serve this purpose, several calculational techniques that are used throughout this report are described. The concentrations of various radionuclides reported here that result from Mound's operations are termed "incremental." The term incremental denotes a concentration value that exceeds normal environmental levels of the same radionuclide. The "environmental level" is that level found in the environment where Mound operations would have no impact. Environmental levels of radionuclides in various media as measured by Mound are shown in Table 3.

To determine concentrations of radionuclides found in the environment, the instrument background and reagent blanks were subtracted from the sample count. This value was then used in averages.

For comparative purposes and for single sample evaluation, the lower detection limit (LDL) is shown for each set of data in this report. The LDL is the estimated standard deviation of the blanks at the 95% confidence level.

The error estimates shown with each set of data are estimates of the standard error of the estimated mean at the 95% confidence level. These values include all sources of variability including sampling, analyses, counting statistics, and the propagated error involved when the environmental levels are subtracted from the actual data.

Table 2 - MONITORING PROGRAM

	Sampling Frequency	Parameter Measured
Air Surveillance		
Offsite		
15 locations	Weekly	HTO, Pu, particulate
Onsite		
5 locations	Weekly	HTO, Pu, particulate
Stack Emission		
15 locations	Daily	HT, HTO, Pu, U
Water Surveillance - Offsite		
River		
5 locations	Daily	HTO, Pu, U
Pond		
7 locations	Monthly	HTO, Pu, U
Municipal Drinking Water		
12 locations	Quarterly	HTO, Pu
Well Water		
5 locations	Monthly	HTO, Pu
Water Surveillance - Onsite		
Effluent Water		
3 locations	Daily	Flow, suspended solids, BOD_5, fecal coliform, pH, oil and grease, COD, residual chlorine, dissolved solids, cyanide, chromium, cadmium, nickel, copper, HTO, Pu, U
Silt Surveillance - Offsite		
River		
5 locations	Quarterly	Pu
Pond		
7 locations	Quarterly	Pu
Vegetation and Foodstuff Surveillance		
Vegetation		
3 locations	Semiannually	HTO, Pu
Foodstuffs		
3 locations	Annually	HTO, Pu
Environmental Level Surveillance		
Four Mediums		
6 locations	Quarterly	HTO, Pu

Table 3 - ENVIRONMENTAL CONCENTRATIONS OF RADIONUCLIDES IN VARIOUS MEDIUMS

Plutonium-238 in air[a]	=	0.0002	±	0.05	x 10^{-17}	μCi/ml
Tritium oxide in air[a]	=	0.41	±	0.25	x 10^{-11}	μCi/ml
Plutonium-238 in river water[b]	=	0.4	±	4.5	x 10^{-12}	μCi/ml
Tritium in river water[b]	=	0.23	±	0.09	x 10^{-6}	μCi/ml
Plutonium-238 in surface water[c]	=	1.4	±	1.8	x 10^{-12}	μCi/ml
Tritium in surface water[c]	=	0.21	±	0.07	x 10^{-6}	μCi/ml
Plutonium-238 in well water[d]	=	0.6	±	1.4	x 10^{-12}	μCi/ml
Tritium in well water[c]	=	0.14	±	0.06	x 10^{-6}	μCi/ml
Uranium-233, 234 in river water[b]	=	6.21	±	4.35	x 10^{-10}	μCi/ml
Uranium-238 in river water[b]	=	5.97	±	3.15	x 10^{-10}	μCi/ml
Plutonium-238 in river silt[b]	=	0.0001	±	0.0009	x 10^{-6}	μCi/g
Plutonium-238 in surface water silt[c,e]	=	N.D.				
Tritium in grass[d]	=	0.2	±	0.1	x 10^{-6}	μCi/g
Tritium in tomatoes[d]	=	0.28	±	0.18	x 10^{-6}	μCi/g
Plutonium in grass[d]	=	0.0003	±	0.0003	x 10^{-6}	μCi/g
Plutonium in potatoes[d]	=	0.0003	±	0.0005	x 10^{-6}	μCi/g
Plutonium in fish[d,e]	=	N.D.				

[a]Measured at offsite sampler 119.
[b]Measured 20 mi upstream on Great Miami River.
[c]Measured 28 mi northwest of Mound.
[d]Measured 30 mi west of Mound.
[e](N.D.) environmental level cannot be detected above reagent blanks.

Summary

The environment locally surrounding Mound was monitored primarily for tritium and plutonium-238. The results are reported for 1984. Environmental media analyzed included air, water, vegetation, foodstuffs, and sediment.

The average concentrations of plutonium-238 and tritium were within the applicable standards (adopted by the U.S. DOE) for radioactive species.

Data concerning the emission of nonradioactive species into the atmosphere are also presented. All of these emissions were 7% or less of the applicable emissions standard.

The average incremental concentrations of plutonium-238 and tritium oxide in air measured at all offsite locations during 1984 were 0.48×10^{-17} µCi/ml and 0.81×10^{-11} µCi/ml, respectively. These correspond to 0.02% and 0.01% of their respective Radioactivity Concentration Guides (RCG) [6]. Details of the applicable standards are given in the Appendix.

The average incremental concentration of plutonium-238 measured at all locations in the Great Miami River during 1984 was 1.1×10^{-12} µCi/ml which is 0.00006% of the RCG. The average incremental concentration of tritium measured at all locations in the Great Miami River during 1984 was 0.04×10^{-6} µCi/ml which is 0.004% of the RCG.

Radionuclide effluent data for 1984 are summarized in Table 4.

The average incremental concentrations of plutonium-238 found during 1984 in surface and area drinking water were also a fraction of the DOE RCG (less than 0.00002%). In addition, the average incremental concentration of tritium in surface water was a fraction of the DOE RCG (less than 0.02%). The average concentrations in area and municipal drinking water were also a fraction of the EPA standard (less than 31% and less than 2%, respectively).

Although there are no specific standards (RCG) for plutonium-238 and tritium in foodstuffs, the concentrations found, if judged by the water standard, are also a small fraction of the RCG. Sediment was sampled at several offsite water sampling locations. No adverse impact to the environment could be determined from the radionuclide levels found in these sediments.

The dose commitment estimates indicate that, in all cases, the levels are at or within 0.2% of the DOE standard. The person-rem calculated to 80 km for the total population as a result of Mound operations during 1984 was 8 person-rem. Natural radiation would result in approximately 470,000 person-rem for the area.

A National Pollutant Discharge Elimination System (NPDES) permit regulates

Table 4 - EFFLUENT DATA FOR 1984

Radionuclide	Medium	Quantity	
Tritium	air	3430	Ci
Tritium	water	8.47	Ci
Plutonium-238	air	0.0065	mCi
Plutonium-238	water	1.34	mCi
Uranium-233,234	water	0.47	mCi

nonradioactive pollutants in Mound's effluent water. The NPDES permit requires this effluent to be characterized by analyzing samples collected at four onsite locations. Less than 4% of the 1468 NPDES measurements exceeded maximum permit limitations.

None of these exceptions, however, had an adverse impact on the Great Miami River or caused the river to exceed Ohio Stream Standards.

The data contained in this summary demonstrate the status of compliance with various current regulatory agency standards and demonstrate Mound's emphasis on the as-low-as-reasonably-achievable (ALARA) concept.

Environmental Surveillance

Quality Assurance

A very essential part of Mound's Quality Assurance Program is the analysis of reference samples from reliable outside laboratories. During 1984, Mound analyzed reference samples from DOE's Environmental Measurements Laboratory (EML); from the U. S. Environmental Protection Agency (EPA); and from a private laboratory, Analytical Products Group, Inc. (APG). The EML samples contained trace radionuclides in air filter, water, soil, tissue, and vegetation samples. The EPA and APG samples contained nonradioactive contaminants in water.

Concentrations of plutonium, uranium, and tritium in two sets of EML samples analyzed in 1984 are given in Table 5. Agreement between the Mound values and the EML reference values is better than 20% in all but one measured parameter, plutonium-239 in water, sample No. 8311. For this water sample, the ratio of the Mound plutonium-239 concentration value to the mean of values from all the laboratories participating in the program was 0.84, which is in the acceptable range.

In Table 6 the Mound results in the 1984 EPA Quality Assurance Program for the determination of nonradioactive parameters in water are compared to the EPA "true values." All nine of the measured parameters were within the acceptance limits established by the EPA. A second part of Mound's Quality Assurance Program involved the analysis of reference samples prepared by APG. Analysis of these samples is part of a Monsanto Company quality control program. Mound analyzed two sets of APG samples in 1984, and these results are summarized in Table 7. In the APG reports, the difference between the Mound value and the reference value is expressed in the number of standard deviations of the Mound value from the mean value. When this number of standard deviations from the mean exceeds two, this generally indicates a problem in the measurement. Of the 10 parameters measured in the APG samples, Mound's results varied from 0.1 to 1.9 standard deviations from the mean of all the participating laboratories; no values exceeded two standard deviations from the mean.

Another essential part of Mound's Quality Assurance Program is the determination of "blank value." A "blank value" is a measurement for a contaminant determined by following through the chemical analysis procedure without a true sample, but rather using deionized water, a clean filter paper, or only the reagents used in the analysis. Analysis of blanks is essential because many of the samples analyzed contain contaminant concentration at or below the lower detection limit of the analytical method being used. Analyzing blanks is essential in verifying the absence of excessive laboratory contamination or detector background. Also, the standard deviation of the blank values is used to calculate lower detection limits, which are given with each set of environmental data.

Other aspects of Mound's Environmental Section quality control program have been documented in a quality control manual [4].

In summary, the agreement between Mound measured concentrations and reference values of EML, the EPA, or APG, along with a formal quality control program, indicates good reliability of the data generated in the routine environmental monitoring program.

Table 5 - MOUND'S DOE QUALITY ASSESSMENT PROGRAM RESULTS FOR 1984

Sample Type	Sample No.	Isotope Determined	Concentration, pCi/(g or ml)[a] Mound	EML[b]	Concentration Ratio Mound to EML
Air Filter	8311	Pu-239	1.69 ± 0.05[c]	2.12 ± 0.15[d]	0.80 ± 0.07[e]
Water	8311	H-3	67.1 ± 0.7	69.4 ± 6.2	0.97 ± 0.09
		Pu-239	0.0102 ± 0.0001	0.0150 ± 0.0020	0.68 ± 0.009[f]
		U-234	0.0064 ± 0.0001	0.0061 ± 0.0002	1.04 ± 0.04
		U-238	0.0065 ± 0.0002	0.0060 ± 0.0002	1.08 ± 0.04
Water	8405	Pu-239	0.0247 ± 0.0006	0.030 ± 0.002	0.82 ± 0.06
		U-234	0.0210 ± 0.0004	0.022 ± 0.001	0.95 ± 0.05
		U-238	0.0211 ± 0.0004	0.023 ± 0.001	0.92 ± 0.04
Soil[g]	8311	Pu-238	0.038 ± 0.007	0.040 ± 0.006	0.95 ± 0.24
		Pu-239	0.012 ± 0.004	0.011 ± 0.002	1.10 ± 0.50
		U-234	0.66 ± 0.04	0.74 ± 0.12	0.89 ± 0.16
		U-238	0.65 ± 0.03	0.81 ± 0.18	0.80 ± 0.19
Soil[g]	8405	Pu-238	0.053 ± 0.010	0.054 ± 0.001	0.98 ± 0.18
		Pu-239	3.03 ± 0.08	3.13 ± 0.13	0.97 ± 0.05
		U-234	0.98 ± 0.08	0.83 ± 0.05	1.18 ± 0.14
		U-238	0.97 ± 0.06	0.83 ± 0.05	1.17 ± 0.10
Tissue	8311	Pu-238	0.071 ± 0.011	0.074 ± 0.007	0.96 ± 0.19
		Pu-239	0.017 ± 0.002	0.019 ± 0.004	0.89 ± 0.22
Vegetation	8311	Pu-238	0.064 ± 0.013	0.065 ± 0.006	0.98 ± 0.23
		Pu-239	0.015 ± 0.002	0.016 ± 0.002	0.94 ± 0.17
Vegetation	8405	Pu-239	0.059 ± 0.06	0.068 ± 0.05	0.87 ± 0.11

[a]Units are pCi/filter for air samples, pCi/ml for water, and pCi/g for soil, tissue and vegetation samples.

[b]Environmental Measurements Laboratory.

[c]Mound's errors are two sigma errors based on counting statistics or replicate analyses.

[d]EML's errors are "standard errors of the mean."

[e]The error in the ratio is calculated as $(S_M^2 + S_E^2)^{1/2}$ where S_M and S_E are the Mound and EML relative errors.

[f]The ratio of Mound's Pu-239 concentration in water to the mean of all the laboratories participating in the program was 0.84.

[g]Soil concentrations given for Mound are the average of two values determined independently.

Table 6 - MOUND'S 1984 EPA QUALITY ASSURANCE PROGRAM RESULTS FOR THE DETERMINATION OF NON-RADIOACTIVE PARAMETERS IN WATER

Parameter Measured	Mound Value[a]	True Value	EPA Acceptance Limits[b]
Cadmium	450 µg/l	474 µg/l	361-541 µg/l
Chromium	133 µg/l	124 µg/l	87-156 µg/l
Copper	260 µg/l	260 µg/l	222-296 µg/l
Nickel	354 µg/l	372 µg/l	306-434 µg/l
pH	7.67	7.70	7.51-7.87
Total Suspended Solids	38.5 mg/l	39.9 mg/l	32.2 -42.5 mg/l
Oil and Grease	15.6 mg/l	15.0 mg/l	3.69-33.5 mg/l
Chemical Oxygen Demand	43 mg/l	47 mg/l	31.0 -59.0 mg/l
5-Day Biochemical Oxygen Demand	35.3 mg/l	31.1 mg/l	18.3 -42.9 mg/l

[a]Errors in Mound's values are 10% or less.

[b]Any measured concentration falling in this range is considered acceptable by the EPA.

Table 7 - SUMMARY OF MOUND'S PERFORMANCE IN THE ANALYTICAL PRODUCTS GROUP PROFICIENCY TESTING PROGRAM FOR 1984

Parameter Measured in Water	Parameter Range Measured	Range of Observed Number of Standard Deviations from the Mean
Biochemical Oxygen Demand	17-266 mg/l	0.6 - 1.5
Chemical Oxygen Demand	28-429 mg/l	0.3 - 0.7
Oil and Grease	16- 25 mg/l	0.1 - 0.2
pH	4.10-9.72	0.1 - 0.7
Cyanide	3 mg/l	1.4
Residual Chlorine	0.33-2.95 mg/l	0.3 - 0.4
Cadmium	20-230 µg/l	0.2 - 1.9
Chromium	30-260 µg/l	0.4 - 1.7
Copper	50-196 µg/l	0.1 - 0.6
Nickel	35-230 µg/l	0.2 - 1.2

Air - Radioactive

In 1984, the offsite air-sampling network consisted of 15 continuously operating air-sampling stations used for sampling both tritium oxide and plutonium. Ten sampling stations are located within a 1.6 km (1 mi) radius of Mound, and four samplers are located in or near population centers. The remaining sampler (#119) is approximately 44.8 km (28 mi) from Mound in the least prevailing wind direction. This sampler receives no measurable contribution from Mound operations and serves as a baseline sample for computing environmental levels.

The levels from sampler #119 are subtracted from levels detected at other locations. The samplers currently in operation are located at critical distances and directions, based on a diffusion model developed for Mound [17]. The locations of the sampling stations are shown in Figure 1.

Two types of samples are collected at each sampling station. One is a particulate air sample for plutonium-238 analysis, and the other, from a bubbler-type sampler, is for tritium oxide analysis. The particulate sample is collected on a 200-mm diameter Microsorban disk by a continuously operating (24 hr/day, 7 days/week) high-volume air sampler. The air is sampled at an average rate of 1.3×10^6 cm^3/min (~45 ft^3/min). The Microsorban disk is changed weekly and represents a sample of approximately 13,000 m^3 of air. Plutonium-238 analyses were performed on a monthly composite for three sampling locations, #122, #123, and #124, and on quarterly composites for the other offsite locations.

The analytical scheme for plutonium-238 incorporates the following basic steps: use of an internal tracer, chemical treatment, separation of plutonium with anion exchange resin, and alpha spectrometry.

The average incremental offsite plutonium-238 air concentration for all locations was 0.48×10^{-17} µCi/ml which is 0.02% of the DOE RCG. The RCG used for comparison is the guide for the soluble form of the isotope and for the general population. This is the most restrictive RCG for plutonium-238 and is applied since the solubility of the measured particles in the human body is unknown. The analytical results are summarized in Table 8.

Table 9 shows concentrations of plutonium-239, 240, and plutonium-238, including environmental levels. The ratio of plutonium-238 to plutonium-239 had been used in the past as a qualitative indicator of variations in environmental observations. The concentrations of both plutonium-238 and 239 from atmospheric fallout have been decreasing over the years. In fact, the concentration of plutonium-238 from fallout is below the detection limit of the analyses and at this point the ratio becomes meaningless. The data in Table 9 are provided for the sake of completeness. Quantitative comparisons are best made with the DOE standard; i.e., percent of standard as shown in Table 8.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm^3/min through 200 ml of ethylene glycol. Ethylene glycol is used because this material

Table 8 - INCREMENTAL CONCENTRATIONS OF PLUTONIUM-238 IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1984

Location	Number of Samples	Range[d] (10^{-17} µCi/ml)	Average[a,c,d,e] (10^{-17} µCi/ml)	Percent of RCG[b]
101	4	0.12 - 0.5	0.29 ± 0.27	0.01
102	4	0.12 - 3.61	1.12 ± 2.66	0.06
103	3	0.27 - 0.62	0.46 ± 0.45	0.02
104	4	0.07 - 0.44	0.23 ± 0.25	0.01
105	4	0.008 - 0.15	0.08 ± 0.11	0.004
108	4	0.01 - 0.22	0.07 ± 0.17	0.004
110	3	E.L. - 0.07	0.02 ± 0.11	0.001
111	4	0.001 - 0.04	0.02 ± 0.06	0.001
112	4	E.L. - 0.05	0.02 ± 0.06	0.001
115	4	E.L. - 0.07	0.03 ± 0.08	0.002
118	4	0.11 - 1.37	0.5 ± 0.95	0.03
122	12	E.L. - 0.69	0.21 ± 0.12	0.01
123	12	0.15 - 4.9	1.5 ± 0.86	0.08
124	12	0.17 - 12.69	2.2 ± 2.2	0.11

[a] Lower Detection Limit (LDL) for ^{238}Pu in air for quarterly samples is 0.03 x 10^{-17} µCi/ml. This is 0.0015% of the RCG.

[b] Radioactivity Concentration Guide (RCG) = 2000 x 10^{-17} µCi/ml for the soluble form of ^{238}Pu for the general population.

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

[d] Average environmental level (E.L.) subtracted from data.

[e] Lower Detection Limit (LDL) for ^{238}Pu in air for monthly samples is 0.1 x 10^{-17} µCi/ml. This is 0.005% of the RCG.

eliminates evaporation and freezing problems associated with sample collection [5]. Tritium (oxide) in the air is collected in the solution. Tritium oxide rather than elemental tritium is sampled and analyzed because 60 to 70% of the tritium emission is in the oxide form, and the RCG for the oxide is 200 times more restrictive than it is for elemental tritium [6]. A sample representing ∿30 m³ of air is collected, and an aliquot representing 0.15 m³ is counted in a liquid scintillation spectrometer. The average incremental concentration of tritium oxide measured during 1984 for all offsite locations, not including the environmental level found at sampler #119, was 0.81 x 10^{-11} µCi/ml. This concentration is 0.01% of the RCG. The RCG used for comparison is the most restrictive RCG for tritium for the general population. The results are summarized in Table 10. Environmental levels for plutonium-238 and tritium in air as

Table 9 - CONCENTRATIONS OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1984

Location	Number of Samples	$^{239,240}Pu$ Range (10^{-17} µCi/ml)	$^{239,240}Pu$ Average[a,b] (10^{-17} µCi/ml)	^{238}Pu Average[a,b] (10^{-17} µCi/ml)
101	4	0.03 - 0.1	0.06 ± 0.05	0.29 ± 0.27
102	4	0.04 - 0.07	0.06 ± 0.02	1.12 ± 2.66
103	3	0.04 - 0.07	0.05 ± 0.04	0.46 ± 0.45
104	4	0.01 - 0.09	0.04 ± 0.06	0.23 ± 0.25
105	4	0.02 - 0.05	0.03 ± 0.02	0.08 ± 0.1
108	4	0.02 - 0.07	0.05 ± 0.04	0.07 ± 0.16
110	3	0.01 - 0.05	0.03 ± 0.05	0.02 ± 0.1
111	4	0.02 - 0.09	0.05 ± 0.05	0.02 ± 0.03
112	4	0.02 - 0.07	0.04 ± 0.04	0.02 ± 0.03
115	4	0.02 - 0.07	0.04 ± 0.03	0.03 ± 0.06
118	4	0.02 - 0.08	0.05 ± 0.04	0.5 ± 0.95
119	4	0.01 - 0.06	0.04 ± 0.03	0.0002 ± 0.05
122	12	0.02 - 0.08	0.05 ± 0.01	0.21 ± 0.11
123	12	0.03 - 0.13	0.07 ± 0.02	1.5 ± 0.86
124	12	0.02 - 0.21	0.06 ± 0.03	2.2 ± 2.2

[a]Lower Detection Limit (LDL) for $^{239,240}Pu$ in air for samplers 101 through 119 is 0.02 x 10^{-17} µCi/ml, and the LDL for samplers 122 through 124 is 0.02 x 10^{-17} µCi/ml. The LDL for ^{238}Pu is 0.03 x 10^{-17} µCi/ml for samplers 101 through 119 and 0.1 x 10^{-17} µCi/ml for samplers 122 through 124

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

measured at sampler #119 are shown in Table 3.

An onsite perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of stack emission control systems. The onsite sampling locations are shown in Figure 4. Particulate samples and tritium samples are collected by the onsite samplers at approximately the same flow rate as the offsite samplers and are analyzed in the same manner.

The average incremental plutonium-238 concentration measured for all locations onsite is 4.26 x 10^{-17} µCi/ml, which is 0.06% of the RCG. The results are summarized in Table 11. Table 12 presents onsite concentrations of plutonium-239, 240, and plutonium-238, including environmental levels, for the sake of completeness. The quantity of plutonium-238 discharged to the atmosphere during 1984 was 0.0065 mCi.

Table 10 - INCREMENTAL CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1984

Location	Number of Samples	Tritium Oxide Range[d] (10^{-11} µCi/ml)	Tritium Oxide Average[a,c,d] (10^{-11} µCi/ml)	Percent of RCG[b]
101	53	E.L. - 11.7	1.88 ± 0.66	0.03
102	51	E.L. - 6.99	1.72 ± 0.53	0.02
103	53	E.L. - 3.96	1.15 ± 0.55	0.02
104	52	E.L. - 8.43	0.87 ± 0.55	0.01
105	53	E.L. - 3.84	0.5 ± 0.39	0.007
108	50	E.L. - 3.18	0.26 ± 0.38	0.004
110	34	E.L. - 2.88	0.09 ± 0.34	0.001
111	48	E.L. - 1.89	E.L.	-
112	51	E.L. - 4.45	0.11 ± 0.4	0.002
115	53	E.L. - 2.12	E.L.	-
118	52	E.L. - 3.68	0.19 ± 0.37	0.003
122	51	E.L. - 5.81	1.44 ± 0.54	0.02
123	51	E.L. - 9.2	1.58 ± 0.65	0.02
124	52	E.L. - 13.7	1.61 ± 0.67	0.02

[a]Lower Detection Limit (LDL) for tritium oxide in air is 0.7×10^{-11} µCi/ml which is 0.01% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 7000×10^{-11} µCi/ml for the general population and for soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

The average incremental onsite tritium oxide concentration for all locations was 2.39×10^{-11} µCi/ml, which is 0.01% of the RCG. The results are summarized in Table 13. The quantity of tritium discharged to the atmosphere during 1984 was 3430 Ci. The RCGs used for onsite comparison are those applicable for exposed individuals in the population.

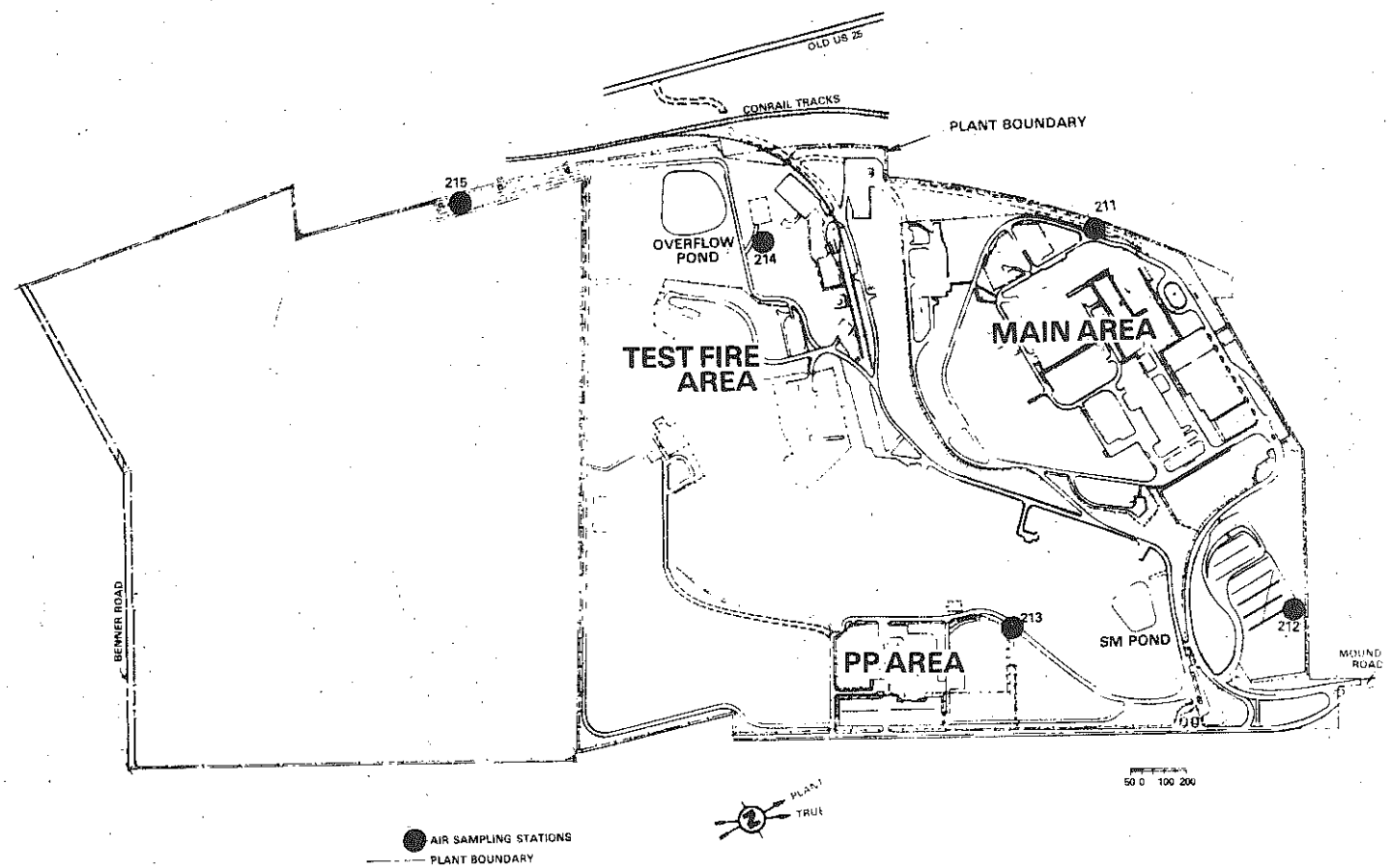


FIGURE 4 - Onsite air sampling locations.

Table 11 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN AIR AT ONSITE SAMPLING LOCATIONS IN 1984

Location	Number of Samples	Range[d] (10^{-17} µCi/ml)	Average[a,c,d] (10^{-17} µCi/ml)	Percent of RCG[b]
211	12	0.92 - 9.97	4.19 ± 1.74	0.06
212	12	0.18 - 7.48	1.71 ± 1.41	0.02
213	12	1.83 - 27.0	12.6 ± 5.39	0.18
214	12	0.05 - 6.38	2.32 ± 1.36	0.03
215	12	E.L. - 1.4	0.5 ± 0.29	0.007

[a]Lower Detection Limit (LDL) for ^{238}Pu in air is 0.1×10^{-17} µCi/ml which is 0.001% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = 7000×10^{-17} µCi/ml for the soluble form of plutonium-238 for individuals in the population.

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

[d]Average environmental level (E.L.) subtracted from data.

Table 12 - CONCENTRATION OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT ONSITE SAMPLING LOCATIONS IN 1984

		$^{239,240}Pu$		^{238}Pu
Location	Number of Samples	Range (10^{-17} µCi/ml)	Average[a,b] (10^{-17} µCi/ml)	Average[a,b] (10^{-17} µCi/ml)
211	12	N.D.[c] - 0.21	0.1 ± 0.03	4.19 ± 1.74
212	12	0.01 - 0.19	0.06 ± 0.03	1.71 ± 1.41
213	12	0.03 - 0.21	0.11 ± 0.04	12.6 ± 5.39
214	12	0.02 - 0.21	0.07 ± 0.04	2.32 ± 1.36
215	12	0.01 - 0.16	0.06 ± 0.03	0.5 ± 0.29

[a]Lower Detection Limit (LDL) for $^{239,240}Pu$ in air is 0.02×10^{-17} µCi/ml. The LDL for ^{238}Pu is 0.1×10^{-17} µCi/ml.

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

[c]Not detectable. (Values cannot be detected above reagent blanks.)

Table 13 - INCREMENTAL CONCENTRATION OF TRITIUM OXIDE IN AIR AT ONSITE SAMPLING LOCATIONS IN 1984

Location	Number of Samples	Tritium Oxide Range[d] (10^{-11} µCi/ml)	Tritium Oxide Average[a,c,d] (10^{-11} µCi/ml)	Percent of RCG[b]
211	49	E.L. - 16.0	2.21 ± 0.81	0.01
212	50	E.L. - 6.79	2.11 ± 0.53	0.01
213	49	E.L. - 14.2	2.83 ± 0.72	0.01
214	53	E.L. - 17.3	2.67 ± 1.0	0.01
215	51	E.L. - 18.3	2.15 ± 0.97	0.01

[a]Lower Detection Limit (LDL) for tritium oxide in air is 0.7×10^{-11} µCi/ml which is 0.003% of the RCG.

[b]Radioactivity Concentration Guide (RCG) = $20,000 \times 10^{-11}$ µCi/ml for individuals in the population and soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

Air - Nonradioactive

The primary source of nonradioactive airborne emissions is the Mound steam power plant. This plant is normally fueled with natural gas, but can burn fuel oil. During unusually cold weather, if the natural gas supply to Mound is interrupted, fuel oil with <1% sulfur content is burned. Approximately 53,000 gal of fuel oil was burned during 1984.

Additional sources of airborne emissions are as follows. A waterwash, paint spray booth is operated intermittently in the Mound paint shop. Wastes from operations involving explosives are disposed of by open burning under a permit issued by the Regional Air Pollution Control Agency (RAPCA). Fire-fighter training exercises are held at an open outdoor facility under a burning permit issued by RAPCA.

Emissions from sources and the applicable emission standards are summarized in Table 14. The emissions were estimated from emission factors established by the U.S. EPA [7]. Nonradioactive airborne emissions at Mound were all within applicable standards and had minimal impact on ambient air quality. This is further demonstrated by the particulate concentration data summarized in Tables 15 and 16.

The data presented are weekly particulate concentrations measured at Mound's offsite and onsite air-sampling sites (Figures 1 and 4). The particulate concentration at onsite locations is generally within the range of the offsite locations. The particulate concentration also appears to be independent of distance from Mound. This would suggest no influence from Mound operations. For comparison, the State of Ohio - Ambient Quality Standard for airborne particulates is also given in Table 15.

Table 14 - NONRADIOACTIVE AIRBORNE EMISSIONS 1984

Emission Source	Pollutant	Emission	Emission Standard[a]	% of Standard
Powerhouse	Particulates	0.013 lb/10^6 Btu Input	0.2 lb/10^6 Btu	6.5
Powerhouse	Sulfur Oxides	0.005 lb/10^6 Btu Input	1.6 lb/10^6 Btu	0.3
Paint Shop	Organics	0.5 lb/day	40 lb/day	1.3
Explosives Burning	Particulates	8.2 lb	NA	NA
Fire Fighter Training	Particulates	35 lb	NA	NA

[a]Ohio EPA Air Pollution Regulations 3745-17-01 through 3745-17-13 and 3745-21-0 through 3745-21-08.

NA - not applicable.

Table 15 - 1984 WEEKLY PARTICULATE CONCENTRATION DATA OFFSITE[a]

Location	Number of Samples	Range ($\mu g/m^3$)	Annual Arithmetic Average ($\mu g/m^3$)[b]
101	51	30 - 142	54 ± 6
102	53	9 - 64	38 ± 3
103	52	15 - 95	34 ± 4
104	51	12 - 105	40 ± 4
105	53	17 - 65	33 ± 3
108	53	30 - 95	53 ± 4
110	38	15 - 62	34 ± 3
111	47	5 - 88	43 ± 4
112	51	1 - 63	38 ± 4
115	53	3 - 82	38 ± 4
118	52	18 - 82	40 ± 3
119	52	15 - 64	30 ± 3
122	52	13 - 66	28 ± 3
123	52	1 - 77	39 ± 4
124	52	0.4 - 74	38 ± 4

[a]Ohio Ambient Air Quality Standard = 60 $\mu g/m^3$ (annual geometric mean).

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

These data are obtained by the Mound air monitoring program and are indicative only of the particulate air loading of the Dayton metropolitan area. Mound particulate discharges presented in Table 14 make a negligible contribution to the surrounding area. In addition, Table 16 presents onsite particulate data.

Table 16 - 1984 WEEKLY PARTICULATE CONCENTRATION DATA ONSITE

Location	Number of Samples	Range ($\mu g/m^3$)	Annual Arithmetic Average ($\mu g/m^3$)[a]
211	53	18 - 163	54 ± 8
212	50	13 - 74	39 ± 4
213	53	22 - 295	84 ± 14
214	53	11 - 129	36 ± 5
215	53	14 - 52	32 ± 2

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

Water - Radioactive

Water sampling locations along the banks of the Great Miami River were selected according to guidelines recommended by the U. S. EPA [8]. The locations, shown in Figure 5, provide samples that are representative of river water after considerable mixing of the effluent from Mound has occurred. Water samples are normally collected and filtered in the field at these locations five days per week, and are subjected to specific analyses for plutonium-238 and tritium.

Large-volume water samples are analyzed by compositing daily samples for a quarterly analysis. The average incremental concentration of plutonium-238 measured for all locations in the Great Miami River was 1.1×10^{-12} µCi/ml which is 0.00006% of the RCG for the general population, the most restrictive standard for plutonium-238. These results are summarized in Table 17.

Weekly samples are analyzed for tritium. The average incremental concentration of tritium measured at all locations in the Great Miami River was 0.04×10^{-6} µCi/ml which is 0.004% of the RCG for the general population. These results are summarized in Table 18.

Uranium-233, 234, and 238 were also monitored at the river water sampling locations during 1984. The average incremental concentrations of uranium-233, -234 were 0.72×10^{-10} µCi/ml which is 0.0007% of the RCG. The average incremental concentration for uranium-238 was 0.22×10^{-10} µCi/ml, which is 0.01% of the RCG. In addition, as shown in Table 19, the ratio of uranium-233, -234 to uranium-238 is slightly greater than unity, which is in range of background ratios reported [9]. This is expected as a result of secular equilibrium.

The total amounts of plutonium-238, tritium, and uranium-233, -234 discharged to the Great Miami River during 1984 were 1.34 mCi, 8.47 Ci, and 0.47 mCi, respectively. The average concentrations of these materials in the discharge system were 1.17×10^{-9} µCi/ml, 7.38×10^{-6} µCi/ml, and 4.11×10^{-10} µCi/ml, respectively. These concentrations were 0.02%, 0.25%, and 0.01% of the most restrictive RCG for individuals in the population.

Seven additional surface water locations, such as ponds, in all quadrants surrounding Mound as shown in Figure 6 are sampled quarterly for plutonium and tritium analyses. The samples used for plutonium-238 determinations are also large volume water samples. The large volume of sample increases the sensitivity of the analysis for plutonium. A smaller aliquot (10 ml) is taken which is adequate for the tritium analysis. The average concentrations of plutonium-238 and tritium for all locations were 0.33×10^{-12} µCi/ml and 0.11×10^{-6} µCi/ml, respectively, which are 0.00002% and 0.01% of the respective RCG for the general population. The results of the surface water samples are summarized in Tables 20 and 21. Environmental levels (Table 3) have been subtracted from the concentration of plutonium and tritium in water.

Drinking water from communities in the surrounding area is sampled and analyzed quarterly for tritium. These communities and their relative locations are shown in Figure 1. The average concentration of tritium for all locations was 0.3×10^{-6} µCi/ml which is 2% of the standard

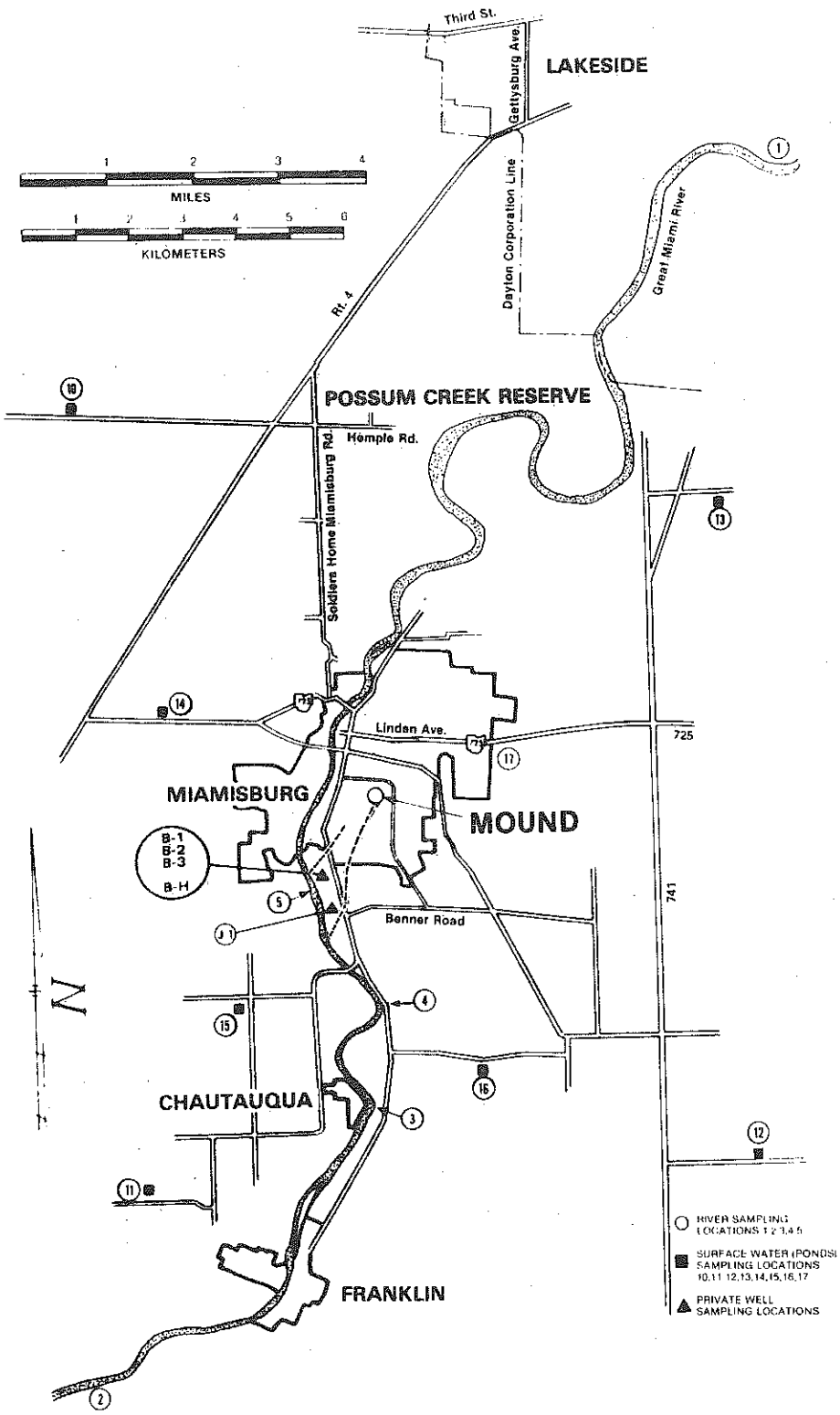


FIGURE 5 - Offsite water sampling locations.

Table 17 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN THE GREAT MIAMI RIVER IN 1984

Location	Number of Samples[a]	Plutonium-238 Range[d] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,e] (10^{-12} µCi/ml)	Percent of RCG[c]
1	4	E.L. - 5.5	1.6 ± 6.1	0.00008
2	4	E.L. - 2.7	1.1 ± 4.9	0.00006
3	4	E.L. - 1.7	0.7 ± 4.7	0.00004
4	4	E.L. - 3.5	1.2 ± 5.1	0.00006
5	4	E.L. - 1.7	0.7 ± 4.8	0.00004

[a]Composite large volume water samples for each location from water collected during 1984.

[b]Lower Detection Limit (LDL) for ^{238}Pu in water is 0.2×10^{-12} µCi/ml which is 0.00001% of the RCG.

[c]Radioactivity Concentration Guide (RCG) = $2{,}000{,}000 \times 10^{-12}$ µCi/ml for the general population and the soluble form of plutonium-238.

[d]Average environmental level (E.L.) subtracted from data.

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

Table 18 - INCREMENTAL CONCENTRATION OF TRITIUM IN THE GREAT MIAMI RIVER IN 1984

Location	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,c,d] (10^{-6} µCi/ml)	Percent of RCG[b]
1	33	E.L. - 0.65	E.L.	-
2	35	E.L. - 0.25	0.01 ± 0.11	0.001
3	34	E.L. - 0.69	0.05 ± 0.12	0.005
4	35	E.L. - 0.79	0.08 ± 0.11	0.008
5	34	E.L. - 1.84	0.07 ± 0.16	0.007

[a]Lower Detection Limit (LDL) for tritium in water is 0.2×10^{-6} µCi/ml which is 0.04% of the RCG.

[b]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000×10^{-6} µCi/ml for the general population and the soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

Table 19 - INCREMENTAL CONCENTRATION OF $^{233,234}U$ AND ^{238}U IN THE GREAT MIAMI RIVER IN 1984

Location	Number of Samples[a]	$^{233,234}U$ Range[d] (10^{-10} µCi/ml)	$^{233,234}U$ Average[a,b,c,e] (10^{-10} µCi/ml)	$^{233,234}U$ Percent of RCG[f]	^{238}U Range[e] (10^{-10} µCi/ml)	^{238}U Average[a,b,c,e] (10^{-10} µCi/ml)	^{238}U Percent of RCG[g]	Ratio[d] $^{233,234}U/^{238}U$
1	4	1.2 - 2.6	1.7 ± 4.5	0.02	0.2 - 1.1	0.6 ± 3.2	0.03	1.2
2	4	E.L. - 1.0	0.1 ± 4.6	0.001	E.L.	E.L.	-	1.2
3	3	E.L. - 1.2	E.L.	-	E.L. - 0.9	E.L.	-	1.1
4	4	E.L. - 1.1	0.7 ± 4.4	0.007	E.L. - 0.7	0.3 ± 3.2	0.02	1.1
5	4	E.L. - 2.0	1.1 ± 4.5	0.01	E.L. - 0.7	0.2 ± 3.3	0.01	1.2

[a]Composite large volume water samples for each location.

[b]Lower Detection Limit (LDL) for $^{233,234}U$ and ^{238}U in water is 0.1×10^{-10} µCi/ml and 0.09×10^{-10} µCi/ml.

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

[d]A ratio slightly greater than unity indicates naturally occurring uranium [11]. Does not have environmental levels subtracted.

[e]Average environmental level (E.L.) subtracted from data.

[f]DOE Concentration Guide (RCG) for $^{233,234}U = 10,000 \times 10^{-10}$ µCi/ml for the general population.

[g]DOE Concentration Guide (RCG) for $^{238}U = 2,000 \times 10^{-10}$ µCi/ml for the general population.

Table 20 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SURFACE WATER IN 1984

Location	Number of Samples[a]	Plutonium-238 Range[d,e] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,c,e] (10^{-12} µCi/ml)	Percent of RCG[c]
11	4	E.L. - 6.5	0.8 ± 6.3	0.00004
12	4	E.L.	E.L.	-
13	4	E.L. - 1.7	E.L.	-
14	4	E.L.	E.L.	-
15	4	E.L. - 8.1	1.5 ± 7.2	0.00008
16	4	E.L.	E.L.	-
17	4	E.L. - 1.7	E.L.	-

[a]Composite large volume water samples were used for each location.

[b]Lower Detection Limit (LDL) for ^{238}Pu in water is 0.2 x 10^{-12} µCi/ml which is 0.00001% of the RCG.

[c]Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = 2,000,000 x 10^{-12} µCi/ml for the general population and soluble form of plutonium-238.

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

[e]Average environmental level (E.L.) subtracted from data.

Table 21 - INCREMENTAL CONCENTRATION OF TRITIUM IN SURFACE WATER IN 1984

Location	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,c,d] (10^{-6} µCi/ml)	Percent of RCG[b]
10	4	0.01 - 0.05	0.02 ± 0.08	0.002
11	19	E.L. - 0.33	E.L.	-
12	20	E.L. - 0.3	E.L.	-
13	20	E.L. - 0.22	E.L.	-
14	19	0.03 - 0.77	0.43 ± 0.15	0.04
15	19	E.L. - 1.54	0.21 ± 0.19	0.02
16	14	E.L. - 0.07	E.L.	-
17	19	0.05 - 0.51	0.23 ± 0.11	0.02

[a]Lower Detection Limit (LDL) for tritium in water is 0.1 x 10^{-6} µCi/ml which is 0.01% of the RCG.

[b]DOE Radioactivity Concentration Guide (RCG) which is compared to tritium concentration in water not used for drinking purposes = 1000 x 10^{-6} µCi/ml for the general population and soluble form of tritium.

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

[d]Average environmental level (E.L.) subtracted from data.

adopted by the U. S. EPA in 1977 for community drinking water systems. Data from the analyses of community drinking water samples are summarized in Table 22. The environmental level in Table 3 for tritium in water is not subtracted from these data because the EPA standard assesses total concentration including background.

Drinking water from private wells are also analyzed for tritium. The average concentration of tritium for all private well locations was 6.02 x 10^{-6} µCi/ml which is 30% of the U. S. EPA Standard. These data are shown in Table 23.

Three private wells and Miamisburg city water were sampled and analyzed quarterly for plutonium-238. These samples were also large-volume water samples. The average incremental plutonium-238 concentration for these locations was 0.02 x 10^{-12} µCi/ml, which is 0.0001% of the RCG. These results are shown in Table 24.

Table 22 - SUMMARY OF TRITIUM LEVELS IN COMMUNITY DRINKING WATER IN 1984

Locations	Number of Samples	Tritium Range[d] (10^{-6} µCi/ml)	Tritium Average[a,c,d] (10^{-6} µCi/ml)	Percent Standard[b]
Bellbrook	7	0.16 - 0.33	0.3 ± 0.06	1.5
Centerville	7	0.28 - 0.41	0.3 ± 0.04	1.5
Dayton	7	0.04 - 0.36	0.2 ± 0.1	1.0
Franklin	7	0.27 - 0.51	0.3 ± 0.07	1.5
Germantown	7	0.06 - 0.31	0.1 ± 0.08	0.5
Kettering	7	0.11 - 0.5	0.2 ± 0.1	1.0
Miamisburg	7	0.97 - 1.3	1.1 ± 0.1	5.5
Middletown	7	0.07 - 0.34	0.2 ± 0.09	1.0
Moraine	7	0.17 - 0.33	0.2 ± 0.05	1.0
Springboro	7	0.16 - 0.45	0.3 ± 0.08	1.5
Waynesville	7	0.05 - 0.28	0.1 ± 0.07	0.5
West Carrollton	7	0.11 - 0.59	0.3 ± 0.2	1.5

[a]Lower Detection Limit (LDL) for tritium oxide is 0.2 x 10^{-6} µCi/ml which is 1.0% of the EPA Standard for community drinking water.

[b]EPA Drinking Water Standard for tritium = 20 x 10^{-6} µCi/ml for community drinking water systems.

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

[d]Environmental level is included in these data for comparison to the EPA Standard.

Table 23 - TRITIUM IN PRIVATE WELLS IN 1984

Location	Number of Samples	Tritium Range[e] (10^{-6} µCi/ml)	Tritium Average[a,b,d,e] (10^{-6} µCi/ml)	Percent Standard[c]
B-1	44	1.7 - 7.0	4.7 ± 0.4	24
B-2	7	7.8 - 9.3	8.4 ± 0.5	42
B-3	7	5.9 - 9.3	7.5 ± 1.1	38
J-1	7	2.3 - 4.8	3.5 ± 1.0	18
B-H	44	3.7 - 8.4	6.0 ± 0.4	30

[a]All wells are now in compliance with the new EPA Standard of 20 x 10^{-6} µCi/ml.

[b]Lower Detection Limit (LDL) for tritium in water is 0.2 x 10^{-6} µCi/ml which is 1% of the EPA Standard.

[c]EPA Standard for tritium in community drinking water systems = 20 x 10^{-6} µCi/ml. Mound is using the EPA Standard as a guide for the private water supplies.

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

[e]Environmental level is included in these data for comparison to the EPA Standard.

Table 24 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN PRIVATE WELLS AND MIAMISBURG MUNICIPAL DRINKING WATER IN 1984

Location	Number of Samples[a]	Plutonium-238 Range[e] (10^{-12} µCi/ml)	Plutonium-238 Average[b,d,e] (10^{-12} µCi/ml)	Percent of RCG[c]
Miamisburg	4	E.L.	E.L.	-
B-1	4	E.L. - 0.2	E.L.	-
B-2	3	E.L. - 0.2	0.1 ± 1.5	0.000005
B-3	4	E.L. - 0.5	E.L.	-
J-1	4	E.L. - 0.2	E.L.	-

[a]Composite large volume water samples were analyzed from each location from water collected during 1984.

[b]Lower Detection Limit (LDL) for ^{238}Pu is 0.2×10^{-12} µCi/ml which is 0.00001% of the RCG.

[c]Applicable DOE Radioactivity Concentration Guide (RCG) for ^{238}Pu in water = $2{,}000{,}000 \times 10^{-12}$ µCi/ml for the general population and soluble form of plutonium-238.

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

[e]Average environmental level (E.L.) subtracted from data.

Water - Nonradioactive

Mound discharged an average of 0.82 million gallons of water per day in 1984 to the Great Miami River. Nonradioactive pollutants in this effluent water are regulated by a National Pollutant Discharge Elimination System (NPDES) permit. This permit, issued by Region V of the U. S. EPA, requires Mound to characterize its effluent water by analyzing samples collected at four onsite locations.

A 24-hr composite, flow proportional sample and a grab sample are collected from discharges 001-A, 001-B, and 002. Discharge 001-A contains the effluent from the sanitary sewage treatment plant. Discharge 001-B includes storm water runoff, single-pass cooling water, zeolite softener backwash, boiler-plant blowdown, and discharge from the radioactive waste disposal facility. Discharge 002 consists of single-pass cooling water, cooling tower blowdown, zeolite softener backwash, and most of the storm water runoff. A time proportional sample (8-hr composite) is collected from the effluent from the electroplating facility (discharge 001-C). The water samples are analyzed for water quality parameters according to standard methods [11]. The results of effluent analyses for 1984 are summarized in Table 25.

The EPA additionally requires Mound to monitor the flow from two wells which are periodically pumped as a part of the Potable Water Standards Project. Approximately 90 million gallons were discharged from one of these wells, discharge 003, in 1984. No water was discharged from the other well, discharge 004.

In all, 1468 NPDES analyses were performed in 1984. From these measurements, an effluent parameter exceeded its maximum discharge limit 58 times. Mound effluents additionally exceeded monthly average limits 23 times in 1984.

Sixty-two of the above exceptions were for suspended solids in effluents 001B and 002. Soil erosion from storm runoff and construction was responsible for these exceptions.

Cold weather caused an additional 12 NPDES exceptions: salting of roads for snow and ice removal resulted in three dissolved solids exceptions. Nine exceptions affecting suspended solids, biochemical oxygen demand, and fecal coliform occurred at the sewage treatment plant after temperatures dropped into the subzeros. The extreme cold stressed the bacteria in the activated sludge which reduced the plant's treatment efficiency.

Plant operations were responsible for the remaining seven exceptions: backflushing of water softeners caused two residual chlorine exceptions. The resin in these softeners is rinsed with water containing a trace of chlorine to ensure bacterial disinfection of drinking water supplies. Three exceptions, one copper and two nickel, occurred at the electroplating lab. The total mass of nickel and cadmium discharged from the three exceptions was less than 150 g. Boiler blowdown caused one pH exception. One fecal coliform exception resulted when the chlorination system injected an insufficient amount of chlorine into the sanitary treatment plant effluent.

Table 25 - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM DATA FOR 1984

Parameter	Units	Number of Samples	Minimum	Maximum	Annual Average	NPDES Permit Limits Maximum[b]	NPDES Permit Limits Monthly Average
Discharge 001-A							
Flow Rate[a]	MGD	Cont.	0.02	0.14	0.09	-[c]	-[c]
pH	pH units	249	7.3	8.3	7.6	9.0	-[c]
Biochem. O_2 Demand	mg/l (kg/day)	110	1.8 (0.7)	61 (21.7)	6.2 (2.4)	15 (14.2)	10 (4.9)
Suspended Solids	mg/l (kg/day)	106	4.5 (1.6)	83.8 (26.7)	12.5 (4.7)	30 (28.4)	15 (7.4)
Fecal Coliform	MPN/100 ml	101	9	24000	159	2000	1000
Discharge 001-B							
Flow Rate	MGD	Cont.	0.02	0.25	0.08	-[c]	-[c]
pH	pH units	102	7.6	9.4	8.4	9.0	-[c]
Susp. Solids (Oct-Mar)	mg/l (kg/day)	50	1.3 (0.2)	177 (57)	17.8 (5.5)	30 (11.4)	20 (7.6)
Susp. Solids (Apr-Sept)	mg/l (kg/day)	53	2.3 (0.4)	667 (142)	69.5 (20.4)	50 (19)	20 (7.6)
Dissolved Solids	mg/l	25	638	15800	7700	-[c]	-[c]
Grease and Oil	mg/l	13	0.2	2.1	1.0	10	-[c]
Residual Chlorine	mg/l	102	<0.02	0.5	<0.02	0.02	-[c]
Chemical O_2 Demand	mg/l	12	14	140	32	-[c]	-[c]
Discharge 001-C							
Cyanide	mg/l	50	<0.04	0.07	<0.04	1	-[c]
Chromium	mg/l	50	<0.05	0.35	<0.05	0.5	-[c]
Cadmium	mg/l	50	<0.01	0.08	0.01	0.1	-[c]
Nickel	mg/l	50	<0.05	9.80	0.31	0.5	-[c]
Copper	mg/l	50	<0.05	2.20	0.14	0.5	-[c]
Discharge 002							
Flow Rate	MGD	Cont.	-	1.48	0.65	-[c]	-[c]
pH	pH units	49	7.9	8.6	8.2	9.0	-[c]
Suspended Solids	mg/l (kg/day)	107	5.0 (7.2)	144 (363)	25.7 (67.3)	30 (91)	15 (34)
Dissolved Solids	mg/l (kg/day)	25	510 (1400)	1890 (4010)	980 (2800)	2000 (6065)	1500 (3412)
Grease and Oil	mg/l	13	0.3	1.0	0.7	10	-[c]
Residual Chlorine	mg/l	101	<0.02	0.15	<0.02	0.02	-[c]

[a] Includes flow from 001-C. The maximum flow from 001-C is approximately 2000 gal/day.
[b] pH has a minimum limit of 6.5 and a maximum limit of 9.0.
[c] No limit applicable.

In summary, the number of maximum exceptions represents <4% of the NPDES measurements in 1984. Soil erosion from storm runoff and construction caused 76% of the exceptions, maximum and average. The combined discharge from all of Mound's effluents containing storm runoff averaged 80 kg per day of suspended solids during 1984. This represents a solids erosion equivalent to about one pound per acre per day.

According to data obtained from the U. S. Geological Survey, the flow rate of the Great Miami River in 1984 averaged 1680 million gallons per day (MGD) with a minimum and maximum of 267 MGD and 11,400 MGD, respectively. The magnitude of this river flow is significantly greater than Mound effluents. In addition, a review of the data in Table 25 shows that Mound effluents did not cause the Great Miami River to exceed Ohio Stream Standards, and these exceptions had no adverse impact on the Great Miami River.

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is any significant uptake and concentration of radionuclides by plant or animal life. Samples were collected in Miamisburg, Centerville, and Bellbrook. Centerville and Bellbrook are in the prevailing wind direction from Mound at a distance of 8 km (5 mi) and 16 km (10 mi), respectively. Both communities are shown in Figure 1. Fish were collected in the Great Miami River. Mound's outfalls are shown as dotted lines in Figure 5. The plutonium-238 content of the foodstuff and vegetation samples is determined by ashing the samples, then proceeding with the same techniques used for plutonium-238 analyses of air samples (see section on Air - Radioactive). The tritium content of the foodstuff and vegetation samples is determined by distilling the water from the sample, then analyzing the distillate for tritium. The results of the foodstuff, vegetation, and fish analyses are summarized in Tables 26 and 27. The concentration is given in terms of the sample weight (wet weight) before ashing or distilling. The samples of aquatic life analyzed included only the edible, fleshy portions of fish. These analyses indicate no evidence of any significant uptake or concentration by plant or animal life of the radionuclides handled at Mound. Environmental levels for foodstuffs and vegetation have been subtracted from the data (Table 3).

Table 26 - INCREMENTAL PLUTONIUM-238 IN FOODSTUFFS AND VEGETATION IN 1984

Location	Type of Sample	Number of Samples	Plutonium-238 Range[a] (10^{-6} µCi/g)	Plutonium-238 Average[a,b,c] (10^{-6} µCi/g)
Miamisburg	Grass	8	E.L. - 0.0008	0.00006 ± 0.0005
	Potatoes	4	E.L.	E.L.
Centerville	Grass	8	E.L. - 0.0004	0.00006 ± 0.0003
	Potatoes	4	E.L.	E.L.
Bellbrook	Grass	8	E.L. - 0.00004	E.L.
	Potatoes	4	E.L.	E.L.
Mound (outfall to river)	Fish	8	E.L. - 0.0004	0.00003 ± 0.0002

[a]Average environmental level (E.L.) subtracted from data.

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

[c]Lower Detection Limit (LDL) for plutonium-238 in grass samples is 0.0002×10^{-6} µCi/g. LDL for plutonium-238 in potato samples is 0.00008×10^{-6} µCi/g. LDL for plutonium-238 in fish samples is 0.0002×10^{-6} µCi/g.

Table 27 - INCREMENTAL CONCENTRATION OF TRITIUM IN VEGETATION IN 1984

Location	Type of Sample	Number of Samples	Tritium Range[c] (10^{-6} µCi/g)	Tritium Average[a,b,c,d] (10^{-6} µCi/g)
Miamisburg	Grass	8	0.03 - 0.45	0.23 ± 0.16
	Tomatoes	4	0.08 - 0.27	0.15 ± 0.23
Centerville	Grass	8	0.01 - 0.32	0.16 ± 0.12
	Tomatoes	4	E.L. - 0.17	0.02 ± 0.24
Bellbrook	Grass	8	E.L. - 0.12	E.L.
	Tomatoes	4	E.L.	E.L.

[a]LDL for tritium in grass is 0.06 x 10^{-6} µCi/g.

[b]LDL for tritium in tomatoes is 0.09 x 10^{-6} µCi/g.

[c]Average environmental level (E.L.) subtracted from data.

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

Silt - Radioactive

Silt samples were collected from the river and surface water sample locations shown in Figure 5.

The results of the silt sample analyses are found in Tables 28 and 29. No adverse impact to the environment could be determined from the radionuclide levels found in these sediments.

Table 28 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM RIVER MONITORING LOCATIONS IN 1984

Location	Number of Samples	^{238}Pu Range[c] (10^{-6} µCi/g)	^{238}Pu Average[a,b,c] (10^{-6} µCi/g)
1	3	0.0002 - 0.0027	0.001 ± 0.003
2	3	0.02 - 0.05	0.03 ± 0.03
3	3	0.0002 - 0.04	0.02 ± 0.05
4	3	0.33 - 2.14	0.94 ± 2.58
5	3	0.02 - 0.06	0.04 ± 0.06

[a]Lower Detection Limit (LDL) for ^{238}Pu in silt is 0.0005×10^{-6} µCi/g.

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

[c]Average environmental level (E.L.) subtracted from data.

Table 29 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM SURFACE WATER MONITORING LOCATIONS IN 1984

Location	Number of Samples	^{238}Pu Range[c] (10^{-6} µCi/g)	^{238}Pu Average[a,b,c] (10^{-6} µCi/g)
11	3	0.0001 - 0.0008	0.0004 ± 0.001
12	3	0.0002 - 0.0018	0.003 ± 0.009
13	3	N.D. - 0.0003	0.00003 ± 0.0007
14	3	0.0003 - 0.0015	0.0007 ± 0.002
15	3	0.0007 - 0.0021	0.001 ± 0.002
16	3	0.0001 - 0.0025	0.001 ± 0.003

[a]Lower Detection Limit (LDL) for ^{238}Pu is 0.0005×10^{-6} µCi/g.

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

[c](N.D.) - Environmental Level and sample values cannot be detected above reagent blanks, therefore includes environmental level.

Evaluation of Dose Commitment to the Public

A dose assessment was performed for radionuclides in the environment from Mound operations. These radionuclides are plutonium-238 and tritium. Tritium (oxide) is the only radionuclide at Mound for which the critical organ is the whole body. The critical organs for plutonium-238 are assumed to be the lung for insoluble material and the bone for soluble material. The solubility of plutonium-238 in the receptor is unknown at Mound; however, it is highly probable that most of the plutonium-238 is in the oxide form, which is very insoluble. In order to provide a realistic but conservative dose commitment estimate, it is assumed that 50% of the plutonium-238 is insoluble and 50% is soluble. The model used for soluble plutonium results in a higher dose estimate than that for the insoluble material. This technique remains conservative, since it is expected that most of the plutonium-238 is insoluble.

The term "dose commitment," as used in this report, is that cumulative dose for a period of 50 yr from 1 yr of exposure to a given radionuclide.

Plutonium-238 Assumptions and Methodology

The dose commitment estimates for plutonium-238 were based on environmental monitoring data for 1984. The estimates for maximum dose commitment to the lung at the site boundary and maximum dose commitment to the lung in individuals were based on the maximum onsite incremental average concentration of plutonium-238 in air from onsite samplers (sampler 213, Table 11), because the samplers are in proximity to the site boundary. The maximum dose commitment to the lung in population group(s) was based on the maximum offsite average incremental concentration of plutonium-238 in air (sampler 124, Table 8).

The estimates for maximum dose commitment to the bone at the site boundary and in individuals were based on the maximum onsite average incremental concentration of plutonium-238 in air and the maximum offsite average concentration of plutonium-238 in drinking water (average of B-2, B-2 and B-3 is 0.03×10^{-12} µCi/ml) (Table 24). The maximum dose commitment to the bone for individuals in population group(s) was calculated using airborne concentrations of plutonium-238 only, because the concentration of plutonium-238 in Miamisburg drinking water was at the environmental level.

The terms "maximum dose commitment at the site boundary" and "maximum dose commitment to individuals" refer to the maximum dose commitment possible for individuals to receive, assuming they remain at the site boundary 24 hr/day and 365 days/yr. The term "maximum dose commitment for individuals in population group(s)" refers to those individuals who reside in an area adjacent to Mound and who receive the maximum dose commitment values calculated in the offsite environment.

The calculational methods can be found in the Appendix. The results of the dose commitment estimate calculations are shown in Table 30.

The data indicate that in all cases of dose commitment comparisons, the dose commitments are within 0.2% of the DOE standard. In addition, to provide a relative comparison of these dose commitment values, the maximum dose to the lung of an individual around Mound is 0.2 mrem/50 yr. This would be equivalent to the additional dose to an individual smoking 0.3 cigarettes/yr [13] or visiting a friend who lives in a brick house (as compared to a wooden house) for 6 hours [14].

Table 30 - DOSE COMMITMENT ESTIMATES

	Plutonium-238 (mrem/50 yr)				Tritium Oxide (mrem/50 yr)	
	Lung	% of Applicable DOE Standard	Bone	% of Applicable DOE Standard	Whole Body	% of Applicable DOE Standard
Maximum dose equivalent at the site boundary	0.17	-	2.65	-	0.7	-
Maximum dose equivalent to an individual	0.17	0.01	2.65	0.18	0.7	0.14
Maximum dose equivalent to an individual in the population group(s)	0.03	0.006	0.46	0.09	0.13	0.08

Tritium (Oxide) Assumptions and Methodology

The dose commitment estimates for tritium (oxide) were also based on environmental monitoring data for 1984. The concentrations used for dose commitment estimates for tritium (oxide) were calculated using the same method as that used for plutonium. The maximum average onsite air incremental concentration was measured at sampler 213 (Table 13), and the maximum drinking water incremental concentration was the average measured at location B (average of B-1, B-2, and B-3 is 6.7 x 10^{-6} μCi/ml) (Table 23). The maximum average offsite air incremental concentration was measured at sampler 101 (Table 10), and the maximum incremental concentration in drinking water for individuals in a population group was that measured in the Miamisburg drinking water. The total dose commitment for the whole body was obtained by adding the dose commitment of tritium (oxide) in air and the dose commitment of tritium (oxide) in water.

The calculational methods can be found in the Appendix. The results of the dose commitment estimate calculations are shown in Table 30.

The tritium data indicate dose commitment levels within 0.2% of the DOE standards. For example, the maximum whole body dose commitment to an individual around Mound from tritium is 0.7 mrem. This value is equivalent to the additional dose to an individual from Ohio taking a 3-day vacation in Colorado [15].

The person-rem dose commitment estimate calculation was based on tritium (oxide) data from environmental air sampling stations in two ranges: 0.8 km (0-5 mi) and 8-21 km (5-20 mi). The 0-8 km range includes 10 samplers within 1.6 km (1 mi) of Mound.

The average concentration of tritium (oxide) in air was obtained by averaging concentrations found at 10 offsite tritium air samplers and then subtracting the concentration found at sampler #119. From this average concentration, a dose commitment was determined and multiplied by the number of people from 0 to 8 km.

The average tritium (oxide) concentration from the four other offsite samplers (less the concentration at sampler 119) was used to obtain the person-rem from 8 to 32 km. Eight area segments from 8 to 32 km were obtained by letting each sampler represent one segment concentration and the average of two adjacent samplers represent another segment. These segment concentrations were then multiplied by their respective population. Using the concentrations from the four samplers and this averaging technique gives a more realistic population dose value.

The person-rem from tritium (oxide) in community drinking water was based on average concentrations of tritium (oxide) in various community water supplies, less appropriate environmental levels, and weighting these concentrations with respective populations.

The calculations for the air and water dose commitment estimates are shown in the Appendix.

It is estimated that the total population from 0 to 32 km is receiving 8 person-rem from Mound's emissions. The remaining population from 32 km to 80 km (20 to 50 mi) is expected to receive negligible dose commitment from tritium (oxide) emissions. Thus, the dose commitment from Mound's emission is estimated to be 8 person-rem for the 0-80 km range.

For comparison, the population dose values from natural radiation, including cosmic rays, terrestial, and internal radiation, would be approximately 470,000 person-rem for the 0 to 80 km (50 mi) range [16]. The dose commitment from background tritium alone is 0.03 mrem and results in a population dose of 100 person-rem for the 0 to 80 km range [16].

Acknowledgements

The authors gratefully acknowledge C. T. Bishop and W. D. Gloekler for their contributions to this report; K. D. DeVilbiss, C. D. Dunn, W. D. Gloekler, B. J. Hollon, L. C. Hopkins, V. C. Lacy, L. L. Roush, F. K. Tomlinson, E. E. Wallace, and P. A. Watkins for their work in sample collection and analyses; and K. N. McLennan for typing the report.

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Appendix

Applicable Standards

RADIOACTIVE STANDARDS

In conformance with DOE Order 5480.1, Chapter XI, "Requirements for Radiation Protection," offsite sample results are compared with RCG's established for the general population. These RCG's are derived by dividing the RCG's for an uncontrolled area by three.

Onsite sample results are compared with the uncontrolled area RCG's which are applicable for individuals in the population.

The RCG values (in microcuries per milliliter - μCi/ml) used for comparison purposes for the various types of samples in this report are listed below. In all cases, these are the most restrictive RCG's.

Plutonium-238 (Soluble Form)

Air

General Population	2×10^{-14} μCi/ml
Uncontrolled Area (Individuals in the Population)	7×10^{-14} μCi/ml

Water

General Population	2×10^{-6} μCi/ml
Uncontrolled Area (Individuals in the Population)	5×10^{-6} μCi/ml

Tritium (Soluble Form)

Air

General Population	7×10^{-8} μCi/ml
Uncontrolled Area (Individuals in the Population)	2×10^{-7} μCi/ml

Water (DOE RCG is compared to water not used for drinking purposes)

General Population	1×10^{-3} μCi/ml
Uncontrolled Area (Individuals in the Population)	3×10^{-3} μCi/ml

As of June 24, 1977, community drinking water quality is regulated by the EPA National Interim Primary Drinking Water Regulations for Radionuclides. The new standard = 20×10^{-6} μCi/ml (20,000 pCi/l).

Foodstuffs There are no RCG values specified for foodstuffs. However, to give some perspective, the foodstuff values can be compared to the RCG values for plutonium and tritium in water.

Soil There are no guidelines established for radioactive species in soil. (The U.S. EPA has guidelines under consideration.)

NONRADIOACTIVE STANDARDS

Water Region V of the U.S. EPA has issued a discharge permit under NPDES regulations covering Mound liquid effluent streams. The discharge limitations for each effluent stream are as follows:

Discharge 001-A	7-day Average	30-day Average
BOD_5 mg/l (kg/day)	15 (14.2)	10 (4.9)
Suspended Solids mg/l (kg/day)	30 (28.4)	15 (7.4)
Fecal Coliform N/100 ml	2000	1000
pH	6.5 - 9.0	-

Discharge 001-B	Daily Maximum	30-Day Average
Suspended Solids mg/l (kg/day)		
(Oct-Mar)	30 (11.4)	20 (7.6)
(Apr-Sept)	50 (19)	20 (7.6)
Oil and Grease mg/l	10	-
COD	Monitor Only	
Dissolved Solids	Monitor Only	
Residual Chlorine mg/l	0.02	
pH	6.5 - 9	

Discharge 001-C	Daily Maximum
Cyanide mg/l	1.0
Chromium - Total mg/l	0.5
Cadmium mg/l	0.1
Nickel mg/l	0.5
Copper mg/l	0.5

Discharge 002	Daily Maximum	Daily Average
Suspended Solids mg/l (kg/day)	30 (91)	15 (34)
Dissolved Solids mg/l (kg/day)	2000 (6065)	1500 (3412)
Oil and Grease mg/l	10	-
Residual Chlorine	0.02	-
pH	6.5 - 9	

The Ohio EPA has established Water Quality Standards (3745-1-01-3745-1-09). The standards listed below are excerpted from these regulations. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/liter)
Dissolved Oxygen	5.0
pH (pH units)	6-9
Fecal Coliform (N/100 ml)	200 per 100 ml
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250
Chromium (hexavalent)	0.05
Cyanide (free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil and Grease	5
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075*
Zinc	0.075 - 0.5*

*Dependent on $CaCO_3$ hardness.

Dose Commitment Calculations

PLUTONIUM-238 CALCULATIONAL METHODS

These dose commitment to the lung resulting from inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1CI_a t_1 f_a f_r \ \Sigma EF(RBE)\eta}{\lambda m}(1-e^{-\lambda t_2})$$

where

$D(t)$ = 50-yr dose commitment delivered to the lung in 365 days of continuous exposure to plutonium-238 in air, rem/50 yr

C = average airborne concentration, μCi/ml

I_a = average air intake = 2×10^7 ml/day [1]

t_1 = time exposed, 365 days

t_2 = duration of dose, 50 yr

f_a = fraction of inhaled material reaching organ of interest = 0.3 for the pulmonary region [2]

f_r = fraction of pulmonary deposition undergoing long-term retention = 0.6 for actinide (class Y) [2]

$\Sigma EF(RBE)\eta$ = effective energy deposition per disintegration = 57 [1]

λ = effective decay rate, 0.0014 day^{-1} for actinides (class Y) from the pulmonary region [3]

m = lung mass, 1000 g [1]

The dose commitment to bone resulting from inhalation of airborne plutonium-238 was calculated by:

$$D(t) = \frac{51.1CI_a f_a t_1 \Sigma EF(RBE)\eta}{\lambda m}(1-e^{-\lambda t_2})$$

where

f_a = 0.2 [1]

$EF(RBE)$ = 280 [1]

$m = 7 \times 10^3$ g [1]

$= 3 \times 10^{-5} day^{-1}$ [1]

The dose commitment to bone resulting from ingestion of plutonium-238 in water was calculated by:

$$D(t) = \frac{51.1CI_w f_w t_1 \Sigma EF(RBE)}{\lambda m}(1-e^{-\lambda t_2})$$

where

I_w = average quantity of water intake, 2200 cm^3 [1]

f_w = fraction of ingested material reaching organ of interest, 2.4×10^{-5} [1]

TRITIUM OXIDE CALCULATIONAL METHODS

The dose commitment to the whole body resulting from exposures to tritium (oxide) in air was calculated by:

$$D(t)a = \frac{\overline{C}a}{Ra} \times S$$

where

$D(t)a$ = dose commitment, mrem/50 yr

$\overline{C}a$ = average concentration of tritium (oxide) in air

Ra = RCG for tritium (oxide) in air [4]

S = Radiation protection standard in mrem/50 yr [4]

The dose commitment to the whole body resulting from uptake of tritium (oxide) in water was calculated by:

$$D(t)w = \frac{\overline{C}w}{Rw} \times S$$

where

$D(t)w$ = dose equivalent in mrem/50 yr

$\overline{C}w$ = average concentration

Rw = RCG for tritium (oxide) in water [4]

S = radiation protection standard in mrem/50 yr [4]

These dose commitment values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection [5] and the National Council on Radiation Protection Measurements [6].

PERSON-REM CALCULATIONS

The equations used for this calculation were:

$$\overline{D}(t)a = \frac{\overline{C}a}{Ra} \times S$$

where

$\overline{D}(t)a$ = dose commitment from tritium (oxide) in air

$\overline{C}a$ = average tritium (oxide) concentration in air

Ra = RCG for tritium (oxide) in air [4]

S = radiation protection standard for tritium (oxide) in air in mrem/50 yr [4]

$$\overline{D}(t)w = \frac{\overline{C}w}{Rw} \times S$$

where

$\overline{D}(t)w$ = dose commitment from tritium (oxide) in water

$\overline{C}w$ = average tritium (oxide) concentration in water

Rw = RCG for tritium (oxide) in water [4]

S = radiation protection standard for tritium (oxide) in water, mrem/50 yr [4]

These dose commitment values were divided by 1.7 in order to reflect the quality factor of one as recommended by the International Commission on Radiological Protection [5] and the National Council on Radiation Protection and Measurements [6].

The total person-rem from 0 to 32 km is obtained by:

$$\sum_{0}^{32} R = \left(D(t)a\sum_{0}^{8} P\right) + \sum_{0}^{8}\overline{D}(t)a\sum_{8}^{32} P + \sum_{0}^{32}\left(\overline{D}(t)wP\right)$$

where

$\sum_{0}^{32} R$ = person-rem within 32 km

$\overline{D}(t)a\sum_{0}^{8} P$ = average dose commitment x population from 0-8 km

$\sum_{0}^{8}\overline{D}(t)a\sum_{8}^{32} P$ = summation of dose commitments x the respective populations within eight direction segments from Mound from 8-32 km

$\sum_{0}^{32}\left(\overline{D}(t)wP\right)$ = summation of dose commitments x respective population from 0-32 km

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MLM-3349

Environmental Monitoring at Mound: 1985 Report

Daniel G. Carfagno and Billy M. Farmer

May 5, 1986

MOUND
Miamisburg, Ohio 45342

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U. S. DEPARTMENT OF ENERGY
Contract No. DE-AC04-76-DP00053

Monsanto

Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed Copy: A03
Microfiche copy: A01

MLM-3349
UC-41

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Foreword

This report was prepared by the Environmental Section of the Administration Department at Monsanto Research Corporation - Mound pursuant to DOE Order 5484.1 for the calendar year 1985. Sample analyses and data reduction were performed by the Environmental Laboratory Group. Particulate samples offsite were collected by the Air Pollution Control Section of the Montgomery County Combined General Health District, which acts as the Regional Air Pollution Control Agency in this area for the Ohio Environmental Protection Agency. All other sampling was performed by personnel in the Environmental Section.

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Introduction

Mound is a government-owned facility operated by Monsanto Research Corporation for the U. S. Department of Energy (DOE). Occupying 306 acres of land in Miamisburg, Ohio, the Mound facility is approximately 16 km (10 mi) southwest of Dayton, Ohio. The predominant geographical feature in the five-county region surrounding Mound is the Great Miami River, which flows from northeast to southwest through the city of Miamisburg. The river valley is highly industrialized.

The remainder of the region is predominantly farmland, dotted with light industry and small communities. The locations and populations of these communities are shown in Figure 1. The population distribution surrounding Mound is shown in Figure 2. Drinking water for the area is obtained from a buried valley aquifer that generally follows the Great Miami River. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land in

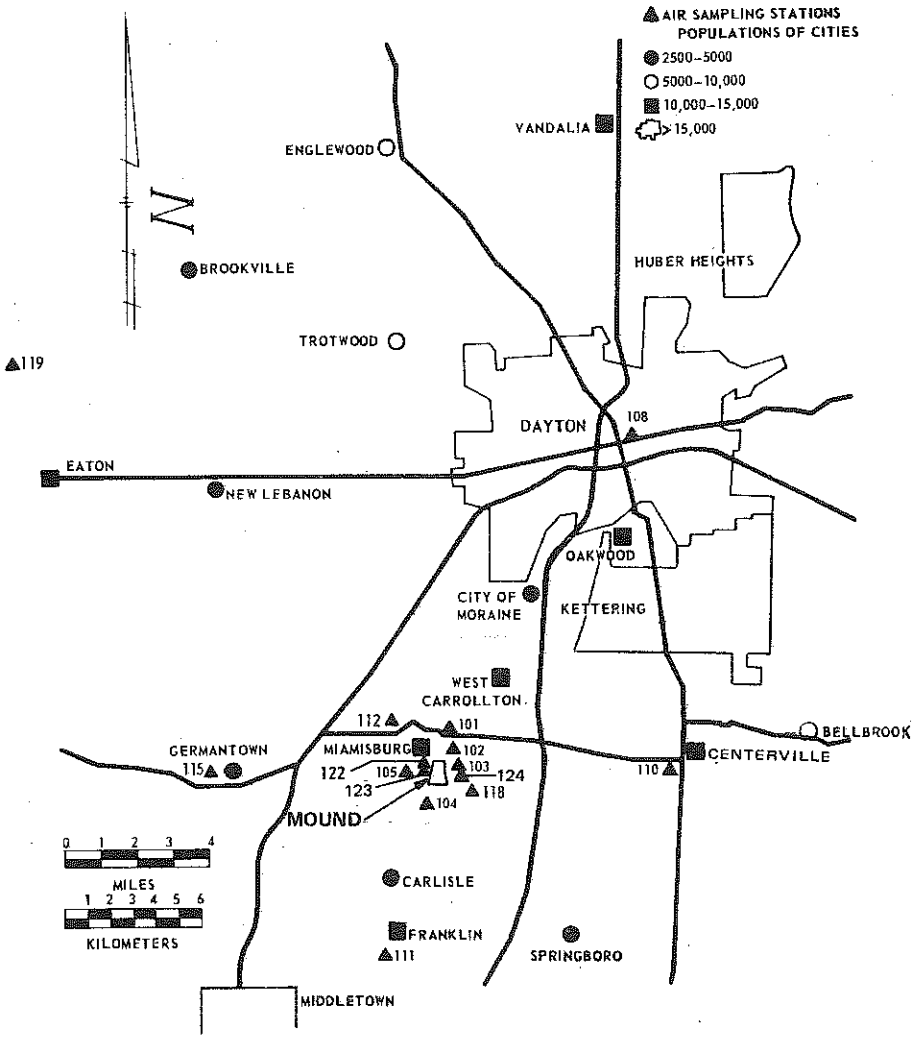
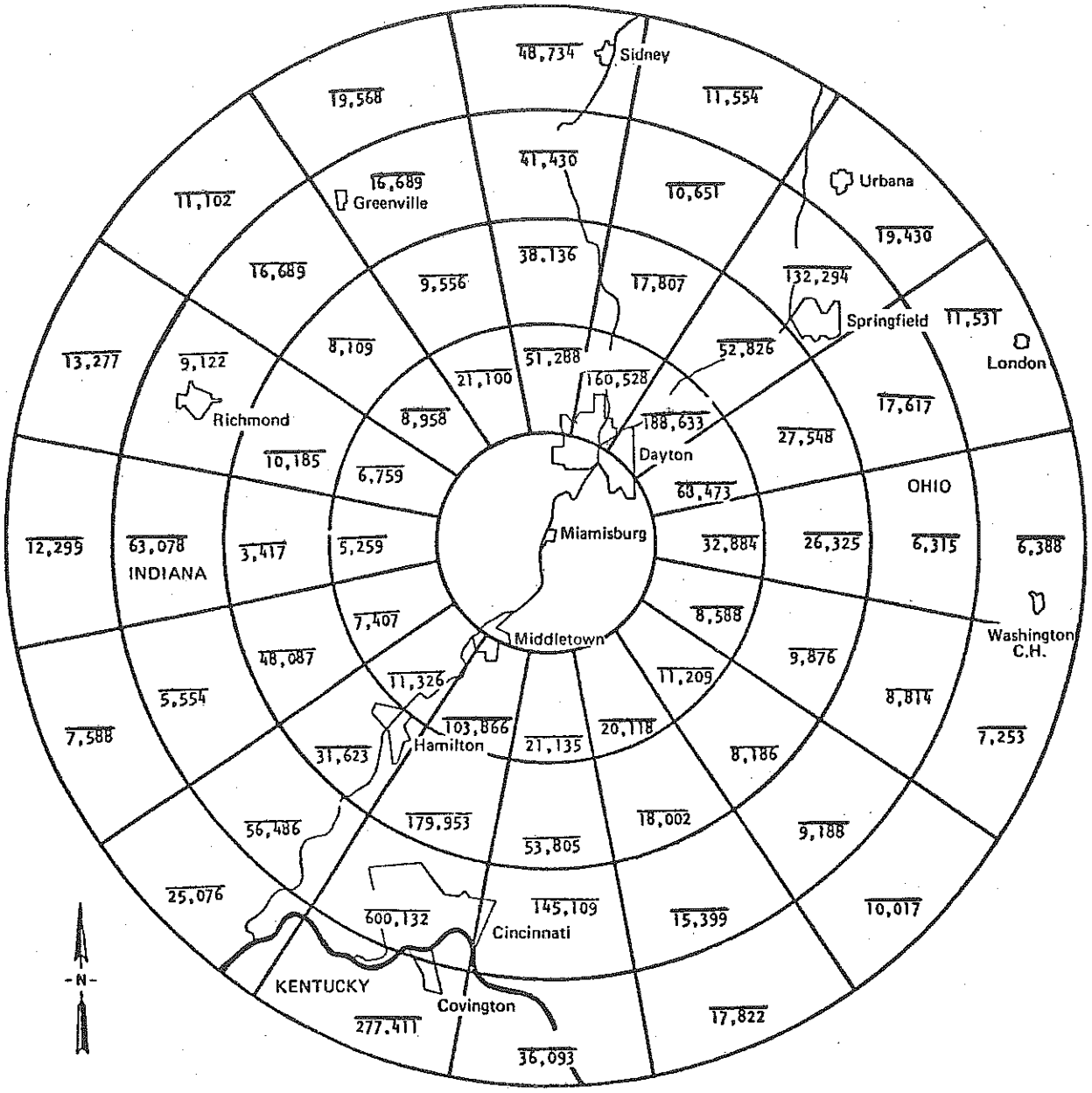


FIGURE 1 - Offsite air sampling locations.



Cumulative Population Totals
1980 Population 0 - 50 Miles

0-10	398,259
0-20	1,125,790
0-30	1,669,231
0-40	2,823,798
0-50	3,358,941

FIGURE 2 - Projected 1980 population within 50 miles of Mound.

agricultural use is devoted to pasturing livestock [1].

The climate in the area is considered moderate. Average annual precipitation is 91 cm (36 in.) and is evenly distributed throughout the year. Winds are predominantly from the south or west, except during the summer, when they are recorded more frequently from out of the southwest [2]. The annual average wind speed measured at Mound over a 4-yr period was 4.4 m/s (10.1 mi/hr). Figure 3 shows the wind rose for the same period compiled at Mound, and Table 1 shows average wind speed and percent frequency for each of 16 wind directions.

In 1949, Mound began operations for the production of nuclear weapon components. Currently, its mission includes (1) research, development, engineering, production, and surveillance of components for DOE weapons programs; (2) separation, purification, and sale of stable isotopes; and (3) DOE programs in nuclear safeguards and waste management, heat source testing, and fusion fuel systems. The radionuclides of primary concern that result from Mound's current or past operations are plutonium-238 and tritium.

Radionuclides in particulate form are removed from process air effluents by high efficiency particulate air (HEPA)

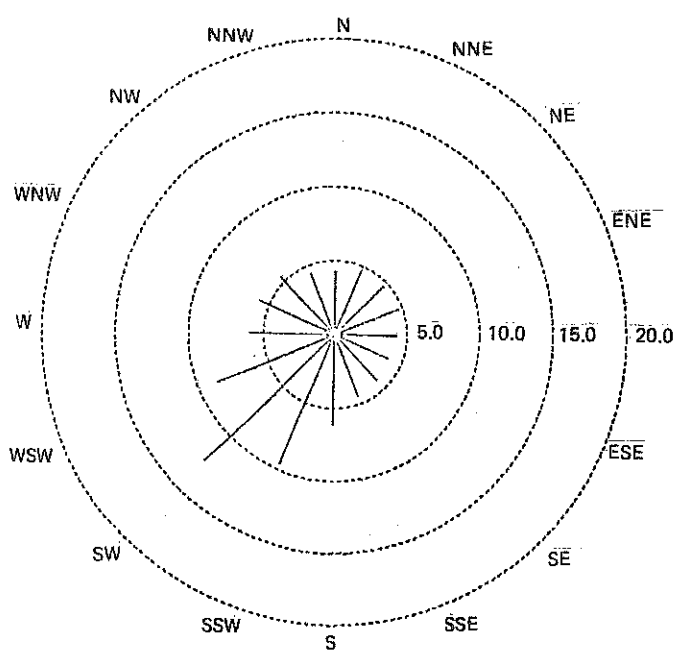


FIGURE 3 - The relative frequency of winds from different directions for Mound, averaged from 1981 through 1984.

Table 1 - FOUR-YEAR (1981-1984) AVERAGE PERCENT FREQUENCY OF WIND DIRECTION AND WIND SPEED

Direction	Percent	Average Speed (m/s)
N	4.2	4.3
NNE	4.5	4.1
NE	4.9	4.0
ENE	4.9	4.0
E	4.5	4.1
ESE	4.1	3.9
SE	4.4	4.1
SSE	4.7	4.2
S	6.0	4.4
SSW	9.7	5.0
SW	12.4	5.6
WSW	8.7	5.2
W	5.4	5.0
WNW	5.3	5.1
NW	6.0	4.7
NNW	4.4	4.4
Calm	6.1	-
TOTAL	100.0	4.4

filters. Air effluents are filtered first at their points of origin (i.e., gloveboxes) and then just before reaching the release point (i.e., the stack). The filtering system at the stack comprises two banks of HEPA filters in series, each bank having a collection efficiency of 99.95%. Radionuclides are removed from liquid effluents, such as process wastes, by chemical processing. Solid radioactive wastes are packaged and shipped offsite for burial at approved burial sites. Wastes generated in the processing of explosive materials are collected and disposed of according to the Defense Armament and Research Command (DARCOM) Regulation 385-100 and DOE/EV/06194-1.

An onsite, sanitary waste treatment plant provides secondary treatment, in accordance with U.S. Environmental Protection Agency (EPA) requirements [3], using an activated sludge process operating in the extended aeration mode. All domestic sewage generated onsite is treated in this facility. The influent and effluent at the sewage treatment plant are monitored for radioactivity to ensure no undetected release can occur to the environment via the sanitary sewage plant. Digested sludge from the sewage plant is shipped offsite as low specific activity (LSA) radioactive waste for burial at an approved burial site. All wastewater is discharged from the site to the Great Miami River. Nonradioactive solid wastes are disposed of according to a recycling and reclamation program whenever possible. White paper, scrap metal, and wood are sold for reclamation. During 1985, general refuse was transported to a sanitary landfill site approved by both the state and county. Waste solvents and chemicals are moved offsite by a commercial-industrial waste disposal firm.

Mound's compliance with regulations prescribed by DOE for the safety of its employees and the public has been demonstrated throughout the history of the facility. The fundamental objective of the Mound Environmental Control Program, an ongoing program since Mound began operations, is the containment of radioactive discharges to levels well within the existing standards. As part of this program, waste streams are monitored and controlled at each operating step, resulting in no more than low-level releases of airborne or liquid wastes to the environment. With early detection, control techniques can be implemented, thus ensuring that concentrations are well within existing standards and meet the DOE guideline "as-low-as-reasonably-achievable" (ALARA).

The same objective -- control to levels well within applicable standards -- applies to nonradioactive discharges. This is achieved primarily by directing waste streams to the appropriate waste treatment system; e.g., sewage treatment plant, solvent collection system, or filtration. The guideline here also is ALARA.

As part of the Mound Environmental Program monitoring functions, air, water, vegetation, foodstuffs, and sediment samples are collected from the environment at distances up to 48 km (30 mi) from Mound's boundaries. These samples are then analyzed for the specific radionuclides handled at Mound. A summary of the monitoring program is shown in Table 2.

The results of the environmental analyses for 1985 are provided in this report. The primary purpose of the report is to detail what impact, if any, Mound's

Table 2 - MONITORING PROGRAM

	Sampling Frequency	Parameter Measured
Air Surveillance		
Offsite		
15 locations	Weekly	HTO, Pu, particulate
Onsite		
5 locations	Weekly	HTO, Pu, particulate
Stack Emission		
15 locations	Daily	HT, HTO, Pu, U
Water Surveillance - Offsite		
River		
5 locations	Daily	HTO, Pu, U
Pond		
7 locations	Monthly	HTO, Pu, U
Municipal Drinking Water		
12 locations	Quarterly	HTO, Pu
Well Water		
5 locations	Monthly	HTO, Pu
Water Surveillance - Onsite		
Effluent Water		
3 locations	Daily	Flow, suspended solids, BOD_5, fecal coliform, pH, oil and grease, COD, residual chlorine, dissolved solids, cyanide, chromium, cadmium, nickel, copper, HTO, Pu, U
Silt Surveillance - Offsite		
River		
5 locations	Quarterly	Pu
Pond		
7 locations	Quarterly	Pu
Vegetation and Foodstuff Surveillance		
Vegetation		
3 locations	Semiannually	HTO, Pu
Foodstuffs		
3 locations	Annually	HTO, Pu
Environmental Level Surveillance		
Four Mediums		
6 locations	Quarterly	HTO, Pu

operations have had on the environment in 1985. To serve this purpose, several calculational techniques that are used throughout this report are described. The concentrations of various radionuclides reported here that result from Mound's operations are termed "incremental." The term "incremental" denotes a concentration value that exceeds normal environmental levels of the same radionuclide. The "environmental level" is that level found in the environment where Mound operations would have no impact. These environmental levels are subtracted from all onsite and offsite data except where noted. Some values may be negative which are included in averages. These values, if negative, are reported as the environmental level (e.l.). Environmental levels of radionuclides in various media as measured during 1985 by Mound are shown in Table 3.

To determine concentrations of radionuclides found in the environment, the instrument background and reagent blanks were subtracted from the sample count. This value was then used in averages.

For comparative purposes and for single sample evaluation, the lower detection limit (LDL) is shown for each set of data in this report. The LDL is the estimated standard deviation of the blanks at the 95% confidence level.

The error estimates shown with each set of data are estimates of the standard error of the estimated mean at the 95% confidence level. These values include all sources of variability including sampling, analyses, counting statistics, and the propagated error involved when the environmental levels are subtracted from the actual data.

Table 3 - ENVIRONMENTAL CONCENTRATIONS OF RADIONUCLIDES IN VARIOUS MEDIUMS IN 1985

Plutonium-238 in air[a]	$= 0.15 \pm 0.13 \times 10^{-18}$	µCi/mL
Tritium oxide in air[b]	$= 2.54 \pm 1.99 \times 10^{-12}$	µCi/mL
Plutonium-238 in river water[b]	$= 0.25 \pm 1.03 \times 10^{-12}$	µCi/mL
Tritium in river water[b]	$= 0.13 \pm 0.04 \times 10^{-6}$	µCi/mL
Plutonium-238 in surface water[c]	$= 6.23 \pm 16.6 \times 10^{-12}$	µCi/mL
Tritium in surface water[c]	$= 0.1 \pm 0.06 \times 10^{-6}$	µCi/mL
Plutonium-238 in well water[d]	$= 1.1 \pm 1.92 \times 10^{-12}$	µCi/mL
Tritium in well water[c]	$= 0.1 \pm 0.05 \times 10^{-6}$	µCi/mL
Uranium-233,234 in river water[b]	$= 0.71 \pm 0.44 \times 10^{-9}$	µCi/mL
Uranium-238 in river water[b]	$= 0.76 \pm 0.06 \times 10^{-9}$	µCi/mL
Plutonium-238 in river silt[b]	$= 0.65 \pm 1.2 \times 10^{-9}$	µCi/g
Plutonium-238 in surface water silt[c]	$= 0.33 \pm 0.61 \times 10^{-9}$	µCi/g
Tritium in grass[d]	$= 0.53 \pm 0.07 \times 10^{-6}$	µCi/g
Tritium in tomatoes[d]	$= 0.66 \pm 0.1 \times 10^{-6}$	µCi/g
Plutonium-238 in grass[d]	$= 0.23 \pm 0.18 \times 10^{-9}$	µCi/g
Plutonium-238 in potatoes[d,e]	= n.d.	
Plutonium-238 in fish[d]	$= 0.04 \pm 0.23 \times 10^{-9}$	µCi/g

[a]Measured at offsite sampler 119.

[b]Measured 20 mi upstream on Great Miami River.

[c]Measured 28 mi northwest of Mound.

[d]Measured 30 mi west of Mound.

[e](n.d.) environmental level cannot be detected above reagent blanks.

Summary

The environment locally surrounding Mound was monitored primarily for tritium and plutonium-238. The results are reported for 1985. Environmental media analyzed included air, water, vegetation, foodstuffs, and sediment.

The average concentrations of plutonium-238 and tritium were within the DOE interim Derived Concentration Guides (DCG) for radioactive species [4,5].

Data concerning the emission of nonradioactive species into the atmosphere are also presented. All of these emissions were less than 3% of the applicable emissions standard.

The average incremental concentrations of plutonium-238 and tritium oxide in air measured at all offsite locations during 1985 were 6.8 x 10^{-18} µCi/mL and 9.6 x 10^{-12} µCi/mL, respectively. These correspond to 0.02% and 0.007%, respectively, of the DOE DCGs [5]. Details of the applicable standards are given in the Appendix.

The average incremental concentration of plutonium-238 measured at all locations in the Great Miami River during 1985 was 2 x 10^{-12} µCi/mL which is estimated to be 0.0005% of the DOE DCG. The average incremental concentration of tritium measured at all locations in the Great Miami River during 1985 was 0.02 x 10^{-6} µCi/mL which is estimated to be 0.001% of the DOE DCG.

Radionuclide effluent data for 1985 are summarized in Table 4.

The average incremental concentrations of plutonium-238 found during 1985 in surface and area drinking water were also estimated to be a fraction of the DOE DCG (less than 0.0006%). In addition, the average incremental concentration of tritium in surface water was estimated to be a fraction of the DOE DCG (less than 0.006%).

All tritium in drinking water data is compared to the U. S. EPA Drinking Water Standard. When these comparisons are made, no environmental level is subtracted from the data. The average concentrations in area and municipal drinking water were also a fraction of the U. S. EPA standard (less than 25% and less than 1.5%, respectively).

The concentrations found in foodstuffs were extremely low. Although no DOE DCG is available for foodstuffs, the average concentrations are a small fraction of the water DCG (0.02%). Sediment samples were obtained at several offsite water sampling locations. The concentrations of these samples were extremely low and therefore represent no adverse impact to the environment.

The dose equivalent estimates indicate that the levels are within 1% of the DOE standard [4]. The person-rem calculated to 80 km for the total population as a result of Mound operations during 1985 was 6.7 person-rem. Natural radiation would result in approximately 670,000 person-rem for the area.

Table 4 - EFFLUENT DATA FOR 1985

Radionuclide	Medium	Quantity
Tritium	air	4795 Ci
Tritium	water	5.82 Ci
Plutonium-238	air	5.1 x 10^{-6} Ci
Plutonium-238	water	9.9 x 10^{-4} Ci
Uranium-233,234	water	4.0 x 10^{-4} Ci

A National Pollutant Discharge Elimination System (NPDES) permit regulates nonradioactive pollutants in Mound's effluent water. The NPDES permit requires this effluent to be characterized by analyzing samples collected at four onsite locations. Less than 0.2% (or three) of the 1227 NPDES measurements exceeded maximum permit limitations. All exceptions occurred at the sanitary wastewater treatment plant; biochemical oxygen demand and fecal coliform were the parameters involved.

None of these exceptions, however, had an adverse impact on the Great Miami River or caused the river to exceed Ohio Stream Standards which are found in the Appendix.

The data contained in this summary demonstrate the status of compliance with various current regulatory agency standards and demonstrate Mound's emphasis on the as-low-as-reasonably-achievable (ALARA) concept.

Environmental Surveillance

Quality Assurance

A very essential part of Mound's Quality Assurance Program is the analysis of reference samples from reliable outside laboratories. During 1985, Mound analyzed reference samples from DOE's Environmental Measurements Laboratory (EML); from the U. S. Environmental Protection Agency (EPA); and from a private laboratory, Analytical Products Group, Inc. (APG). The EML samples contained trace radionuclides in air filter, water, soil, tissue, and vegetation samples. The EPA and APG samples contained nonradioactive contaminants in water.

Concentrations of plutonium, uranium, and tritium in the two sets of EML samples analyzed in 1985 are given in Table 5. Agreement between the Mound values and the EML reference values is better than 30% in all but two samples. Also, agreement between the Mound values and the EML reference values is better than 15% for 75% of all the EML reference samples measured. Of the two samples that showed a deviation of more than 30%, one was a measurement of Pu-238 in soil (sample 8505), where the reference concentration was approaching Mound's lower detection limit. The EML reference value for this sample was 0.0040 pCi/g with a reported error of 50%. Mound's measured value of 0.0019 pCi/g, although low, is not unreasonable considering the error limits on both the Mound and the EML concentrations. The other measurement that varied from the EML value by more than 30% was the Pu-239 in soil measurement of sample no. 8511. Although the Mound value was high in one of the measurements of Pu-239 in this soil, the error in the measurement was 18%. Another measurement of that sample gave a Pu-239 concentration within 13% of the reference value of 0.24 pCi/g.

In Table 6 the Mound results in the 1985 EPA Quality Assurance Program for the determination of nonradioactive parameters in water are compared to the EPA "true values." All nine of the measured parameters were within the acceptance limits established by the EPA. A second part of Mound's Quality Assurance Program involved the analysis of reference samples prepared by APG. Analysis of these samples is part of a Monsanto Company quality control program. Mound analyzed three sets of APG samples in 1985, and these results are summarized in Table 7. In the APG reports, the difference between the Mound value and the APG reference value is expressed as the number of standard deviations of the Mound value from the average determined for all participating laboratories. When this number of standard deviations from this average exceeds two standard deviations, this generally indicates a problem in the measurement. Of the 11 parameters measured in the APG samples, Mound's results varied from 0.1 to 1.3 standard deviations from the average values of all the participating laboratories; no values exceeded two standard deviations.

Another essential part of Mound's Quality Assurance Program is the determination of "blank values." A "blank value" is a measurement result for a contaminant determined by following through the chemical analysis procedure without a true sample, but rather using deionized water, a clean filter paper, or only the reagents used in the analysis. Analysis of "blanks" is essential because many of the samples analyzed show contaminant

Table 5 - MOUND'S DOE QUALITY ASSESSMENT PROGRAM RESULTS FOR 1985

Sample Type	Sample No.	Isotope	Concentration[a] (pCi/(g/ or mL) Mound	EML[b]	Concentration Ratio Mound to EML
Air Filter	8511	Plutonium-239	5.02 ± 0.2[c]	4.91 ± 0.2[d]	1.02 ± 0.06[e]
Water	8505	H-3	20.3 ± 0.8	18.5 ± 0.4	1.1 ± 0.04
		Plutonium-239	0.037 ± 0.004	0.0428 ± 0.0001	0.86 ± 0.09
		Uranium-234	0.027 ± 0.002	0.022 ± 0.001	1.23 ± 0.1
		Uranium-238	0.027 ± 0.003	0.022 ± 0.002	1.23 ± 0.17
Water	8511	H-3	21.4 ± 0.2	19.5 ± 1.2	1.1 ± 0.07
			21.0 ± 0.4	19.5 ± 1.2	1.08 ± 0.07
		Plutonium-239	0.05 ± 0.002	0.04 ± 0.008	1.25 ± 0.06
			0.051 ± 0.005	0.04 ± 0.008	1.28 ± 0.12
		Uranium-234	0.022 ± 0.004	0.023 ± 0.003	0.96 ± 0.21
		Uranium-234[f]	0.022 ± 0.001	0.023 ± 0.003	0.96 ± 0.13
		Uranium-238	0.022 ± 0.004	0.022 ± 0.001	1.00 ± 0.18
		Uranium-238	0.022 ± 0.001	0.022 ± 0.001	1.00 ± 0.06
Soil	8505	Plutonium-238	0.0019 ± 0.0007	0.004 ± 0.002	0.48 ± 0.3
		Plutonium-239	0.036 ± 0.001	0.035 ± 0.003	1.03 ± 0.08
		Plutonium-239	0.035 ± 0.003	0.035 ± 0.003	1.0 ± 0.11
		Uranium-234	0.89 ± 0.09	0.91 ± 0.03	0.98 ± 0.1
		Uranium-234	0.89 ± 0.07	0.91 ± 0.03	0.98 ± 0.09
		Uranium-238	0.88 ± 0.09	0.98 ± 0.05	0.9 ± 0.1
		Uranium-238	0.83 ± 0.07	0.98 ± 0.05	0.85 ± 0.09
Soil	8511	Plutonium-239	0.33 ± 0.06	0.24 ± 0.01	1.38 ± 0.25
		Plutonium-239	0.27 ± 0.01	0.24 ± 0.01	1.13 ± 0.06
		Uranium-234	0.65 ± 0.13	0.63 ± 0.02	1.03 ± 0.21
		Uranium-234	0.63 ± 0.02	0.63 ± 0.02	1.0 ± 0.04
		Uranium-238	0.67 ± 0.13	0.63 ± 0.02	1.08 ± 0.21
		Uranium-238	0.65 ± 0.03	0.62 ± 0.02	1.05 ± 0.06
Vegetation	8505	Plutonium-239	0.045 ± 0.003	0.044 ± 0.004	1.02 ± 0.11
	8511	Plutonium-239	0.48 ± 0.01	0.37 ± 0.03	1.3 ± 0.11
	8511	Uranium-234	0.15 ± 0.06	0.135 ± 0.003	1.11 ± 0.43
		Uranium-238	0.16 ± 0.06	0.135 ± 0.003	1.19 ± 0.44
Tissue	8505	Plutonium-239	0.007 ± 0.002	0.0081 ± 0.0005	0.86 ± 0.25
	8511	Plutonium-239	0.41 ± 0.02	0.41 ± 0.02	1.0 ± 0.06

[a] Units are pCi/filter for air samples, pCi/mL for water, and pCi/g for soil, tissue, and vegetation samples.

[b] Environmental Measurements Laboratory.

[c] Mound's errors are two sigma errors based on counting statistics or replicate analysis.

[d] EML's errors are "standard errors of the mean."

[e] The error in the ratio is calculated as $(SM^2 + SE^2)^{1/2}$, where SM and SE are the Mound and EML relative errors.

[f] When two values are given for one isotope in the same sample, measurements were made by two different analysts.

Table 6 - MOUND'S 1985 EPA QUALITY ASSURANCE PROGRAM RESULTS FOR THE DETERMINATION OF NONRADIOACTIVE PARAMETERS IN WATER

Parameter Measured	True Value	Mound[a] Value	EPA[b] Acceptable Limits
Cadmium	391 μg/L	400 μg/L	345-441 μg/L
Chromium	66.2 μg/L	50 μg/L	48.9-83.5 μg/L
Copper	694 μg/L	670 μg/L	606-764 μg/L
Nickel	288 μg/L	300 μg/L	244-330 μg/L
pH	6.0	6.01	5.85-6.13
Total Suspended Solids	95.3 mg/L	98.1 mg/L	77.4-106 mg/L
Oil and Grease	19 mg/L	20 mg/L	9.6-25.6 mg/L
Chemical Oxygen Demand	128 mg/L	104 mg/L	99.9-145 mg/L
5-Day Biochemical Oxygen Demand	83.5 mg/L	75 mg/L	52.0-104 mg/L

[a]Errors in Mound's values are 10% or less.

[b]Any measured concentrations falling in this range are considered acceptable by the EPA.

Table 7 - SUMMARY OF MOUND'S PERFORMANCE IN THE ANALYTICAL PRODUCTS GROUP PROFICIENCY TESTING PROGRAM FOR 1985

Parameter Measured in Water	Parameter Range Measured	Range of Observed Number of Standard Deviations from the Average
Biochemical Oxygen Demand	10-276 mg/L	0.1-1.2
Chemical Oxygen Demand	20-418 mg/L	0.1-1.3
Total Suspended Solids	32-300 mg/L	0.4-1.3
Oil and Grease	10-40 mg/L	0.2-0.8
pH	5.01-8.89	0.1-0.8
Cyanide	0.16-2.8 mg/L	0.1-0.9
Residual Chlorine	0.56-1.2 mg/L	0.1-0.6
Cadmium	30-177 μg/L	0.2-0.6
Chromium	128-240 μg/L	0.2-0.3
Copper	65-247 μg/L	0.1-0.8
Nickel	64-265 μg/L	0.1-0.4

concentrations at or below the lower detection limit of the analytical method being used. Analyzing "blanks" is essential in verifying the absence of excessive laboratory contamination or detector background. Also, the standard deviation of the "blank values" is used to calculate lower detection limits, which are given with each set of environmental data in this report.

Other aspects of Mound's Environmental Section quality control program have been documented in a quality control manual [6].

In summary, the agreement between Mound measured concentrations and reference values of EML, the EPA, or APG, along with a formal quality control program, indicates good reliability of the data generated in the routine environmental monitoring program.

Air - Radioactive

In 1985, the offsite air-sampling network consisted of 15 continuously operating air-sampling stations used for sampling both tritium oxide and plutonium. Ten sampling stations are located within a 1.6 km (1 mi) radius of Mound, and four samplers are located in or near population centers. The remaining sampler (#119) is approximately 44.8 km (28 mi) from Mound in the least prevailing wind direction. This sampler receives no measurable contribution from Mound operations and serves as a baseline sample for computing environmental levels.

The levels from sampler #119 are subtracted from levels detected at other locations. The samplers currently in operation are located at critical distances and directions, based on a diffusion model developed for Mound [7]. The locations of the sampling stations are shown in Figure 1.

Two types of samples are collected at each sampling station. One is a particulate air sample for plutonium-238 analysis, and the other, from a bubbler-type sampler, is for tritium oxide analysis. The particulate sample is collected on a 200-mm diameter Microsorban or fiberglass disk by a continuously operating (24 hr/day, 7 days/week) high-volume air sampler. The air is sampled at an average rate of 1.3×10^6 cm³/min (∿45 ft³/min). The Microsorban disk is changed weekly and represents a sample of approximately 13,000 m³ of air. Individual sample flow rates are used to calculate concentrations at each location. Plutonium-238 analyses were performed on a monthly composite for three sampling locations, #122, #123, and #124, and on quarterly composites for the other offsite locations.

The analytical scheme for plutonium-238 incorporates the following basic steps: use of an internal tracer, chemical treatment, separation of plutonium with anion exchange resin, and alpha spectrometry.

The average incremental offsite plutonium-238 air concentration for all locations was 6.8×10^{-18} µCi/mL, which is estimated to be 0.02% of the DOE DCG. The analytical results are summarized in Table 8.

Table 9 shows concentrations of plutonium-239, -240, and plutonium-238, including environmental levels for the sake of completeness.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm³/min through 200 mL of ethylene glycol. Ethylene glycol is used because this material eliminates evaporation and freezing problems associated with sample collection [8]. Tritium (oxide) in the air is collected in the solution. Tritium oxide rather than elemental tritium is sampled and analyzed because 60 to 70% of the tritium emission is in the oxide form, and the Derived Air Concentration is much more restrictive (>10,000 times) than it is for elemental tritium [9]. A sample representing ∿30 m³ of air is collected, and an aliquot representing 0.15 m³ is counted in a liquid scintillation spectrometer. The average incremental concentration of tritium oxide measured during 1985 for all offsite locations, not including the environmental level

Table 8 - INCREMENTAL CONCENTRATIONS OF PLUTONIUM-238 IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1985

Location	Number of Samples	Plutonium-238 (10^{-18} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
101	3	1.13	4.95	2.46 ± 5.36	0.008
102	4	3.1	14.7	8.05 ± 9.14	0.027
103	4	2.2	10.8	6.35 ± 5.88	0.021
104	4	1.04	2.89	1.73 ± 1.31	0.006
105	4	0.46	6.03	2.47 ± 4.2	0.008
108	4	e.l.	0.19	0.05 ± 0.28	0.0002
110	4	e.l.	0.15	0.04 ± 0.22	0.0001
111	4	0.08	0.32	0.21 ± 0.21	0.0007
112	4	0.005	2.61	0.85 ± 1.89	0.003
115	4	e.l.	0.005	e.l.	-
118	4	1.06	17.4	10.8 ± 11	0.036
122	12	0.66	37.4	8.43 ± 6.64	0.028
123	12	1.06	352	40.2 ± 62.7	0.134
124	12	2.16	56.8	13.7 ± 9.43	0.046

[a]Lower detection limit (LDL) for monthly values of plutonium-238 in air is 0.69 x 10^{-18} µCi/mL; for quarterly values, 0.14 x 10^{-18} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

[d]DOE DCG for plutonium-238 in air is 30,000 x 10^{-18} µCi/mL.

found at sampler #119, was 9.6 x 10^{-12} µCi/mL. This concentration is estimated to be 0.007% of the DOE DCG. The results are summarized in Table 10. Environmental levels for plutonium-238 and tritium in air as measured at sampler #119 are shown in Table 3. These environmental levels of plutonium-238 and tritium in air are subtracted after the averaging procedures are completed.

An onsite perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of stack emission control systems. The onsite sampling locations are shown in Figure 4. Particulate samples and tritium samples are collected by the onsite samplers at approximately the same flow rate as the offsite samplers and are analyzed in the same manner.

The average incremental plutonium-238 concentration measured for all locations onsite is 99 x 10^{-18} µCi/mL, which is estimated to be 0.3% of the DOE DCG. The results are summarized in Table 11. Table 12 presents onsite concentrations of plutonium-239, 240, and plutonium-238, including environmental levels, for the sake of completeness. The quantity of plutonium-238 discharged to the atmosphere during 1985 was 5.1 x 10^{-6} Ci.

Table 9 - CONCENTRATIONS OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1985

Location	Number of Samples	Plutonium-239,240 (10^{-18} µCi/mL) Minimum[c]	Maximum	Average[a,b]	Plutonium-238 (10^{-18} µCi/mL) Average[a,b]
101	3	0.07	0.42	0.25 ± 0.43	2.6 ± 5.36
102	4	0.15	0.38	0.27 ± 0.16	8.19 ± 9.14
103	4	0.24	0.55	0.39 ± 0.21	6.5 ± 5.88
104	4	0.12	0.26	0.17 ± 0.11	1.88 ± 1.3
105	4	0.09	0.25	0.17 ± 0.1	2.62 ± 4.19
108	4	0.22	0.42	0.33 ± 0.13	0.2 ± 0.25
110	4	0.01	0.33	0.16 ± 0.21	0.18 ± 0.17
111	4	0.09	0.44	0.21 ± 0.25	0.35 ± 0.16
112	4	0.08	0.38	0.22 ± 0.2	0.99 ± 1.89
115	4	0.1	0.39	0.23 ± 0.2	0.08 ± 0.17
118	4	0.16	0.41	0.29 ± 0.2	11 ± 11
119	4	0.04	0.31	0.13 ± 0.2	0.15 ± 0.13
122	12	n.d.	0.87	0.33 ± 0.17	8.58 ± 6.64
123	12	0.08	3.72	0.84 ± 0.63	40.3 ± 62.7
124	12	n.d.	0.7	0.2 ± 0.24	13.8 ± 9.43

[a]Lower detection limit (LDL) for monthly values of plutonium-238 in air is 0.69×10^{-18} µCi/mL; for quarterly values, 0.14×10^{-18} µCi/mL. Lower detection limit (LDL) for monthly values of plutonium-239,240 in air is 0.38×10^{-18} µCi/mL; for quarterly values, 0.08×10^{-18} µCi/mL.

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

[c]The (n.d.) indicates that the values cannot be detected above the reagent blanks.

Table 10 - INCREMENTAL CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1985

Location	Number of Samples	Tritium Oxide (10^{-12} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
101	42	e.l.	40.4	17.4 ± 3.98	0.017
102	51	3.94	70.9	29.2 ± 5.03	0.029
103	52	e.l.	43.6	10.9 ± 3.57	0.011
104	52	e.l.	52.3	9.39 ± 4.08	0.009
105	49	e.l.	26.6	4.89 ± 3.09	0.005
108	50	e.l.	21.2	2.3 ± 2.91	0.002
110	49	e.l.	26.2	0.99 ± 2.72	0.001
111	51	e.l.	20.8	e.l.	-
112	52	e.l.	19.5	2.45 ± 2.81	0.002
115	45	e.l.	11.6	e.l.	-
118	50	e.l.	31.7	6.49 ± 3.1	0.006
122	51	e.l.	68.3	11.7 ± 4.79	0.012
123	52	e.l.	116	20.2 ± 6.62	0.020
124	50	e.l.	55.5	18.2 ± 4.04	0.018

[a]Lower detection limit (LDL) for tritium oxide in air is 14×10^{-12} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

[d]DOE DCG for tritium oxide in air is $100,000 \times 10^{-12}$ µCi/mL. This value has been adjusted to include the fraction of tritium oxide which is absorbed through the skin as part of the inhalation pathway.

Table 11 - INCREMENTAL CONCENTRATIONS OF PLUTONIUM-238 IN AIR AT ONSITE SAMPLING LOCATIONS IN 1985

Location	Number of Samples	Plutonium-238 (10^{-18} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
211	12	17.2	1269	182 ± 223	0.61
212	12	2.26	42.8	16.8 ± 8.08	0.06
213	12	35	369	153 ± 61.8	0.51
214	12	12.1	772	126 ± 136	0.42
215	12	0.96	137	16.5 ± 24.3	0.06

[a]Lower detection limit (LDL) plutonium-238 in air is 0.69 x 10^{-18} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

[d]DOE DCG for plutonium-238 in air is 30,000 x 10^{-18} µCi/mL.

Table 12 - CONCENTRATIONS OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT ONSITE SAMPLING LOCATIONS IN 1985

Location	Number of Samples	Plutonium-239,240 (10^{-18} µCi/mL) Minimum[c]	Maximum	Average[a,b]	Plutonium-238 (10^{-18} µCi/mL) Average[a,b]
211	12	n.d.	7.97	1.21 ± 1.39	182 ± 223
212	12	n.d.	0.93	0.31 ± 0.28	16.9 ± 8.07
213	12	0.1	3.03	0.99 ± 0.54	153 ± 61.8
214	12	n.d.	2.29	0.76 ± 0.44	126 ± 136
215	12	n.d.	1.59	0.37 ± 0.29	16.6 ± 24.3

[a]Lower detection limit (LDL) for monthly values of plutonium-238 in air is 0.69 x 10^{-18} µCi/mL. Lower detection limit (LDL) for monthly values of plutonium-239,240 in air is 0.38 x 10^{-18} µCi/mL.

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

[c]The (n.d.) indicates that the values cannot be detected above the reagent blanks.

The average incremental onsite tritium oxide concentration for all locations was 27 x 10^{-12} µCi/mL, which is estimated to be 0.02% of the DOE DCG. The results are summarized in Table 13. The quantity of tritium discharged to the atmosphere during 1985 was 4795 Ci.

Table 13 - INCREMENTAL CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT ONSITE SAMPLING LOCATIONS IN 1985

Location	Number of Samples	Tritium Oxide (10^{-12} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
211	52	e.l.	167	32.7 ± 13.3	0.033
212	50	1.54	115	29.7 ± 6.84	0.030
213	49	e.l.	104	27.3 ± 6.84	0.027
214	52	e.l.	189	24.8 ± 9.19	0.025
215	52	e.l.	134	19.8 ± 7.28	0.020

[a]Lower detection limit (LDL) for tritium oxide in air is 14 x 10^{-12} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

[d]DOE DCG for tritium oxide in air is 100,000 x 10^{-12} µCi/mL. This value has been adjusted to include the fraction of tritium oxide which is absorbed through the skin as part of the inhalation pathway.

Air - Nonradioactive

The primary source of nonradioactive airborne emissions is the Mound steam power plant. This plant is normally fueled with natural gas, but can burn fuel oil. During unusually cold weather, if the natural gas supply to Mound is interrupted, fuel oil with <1% sulfur content is burned. Approximately 43,000 gal of fuel oil was burned during 1985.

Additional sources of airborne emissions are as follows. A waterwash, paint spray booth is operated intermittently in the Mound paint shop. Wastes from operations involving explosives are disposed of by open burning under a permit issued by the Regional Air Pollution Control Agency (RAPCA). Fire-fighter training exercises are held at an open outdoor facility under a burning permit issued by RAPCA.

Emissions from sources and the applicable emission standards are summarized in Table 14. The emissions were estimated from emission factors established by the U.S. EPA [10]. Emission factors allow calculation of emissions based on quantity of material used or consumed. Nonradioactive airborne emissions at Mound were all within applicable standards and had minimal impact on ambient air quality. This is further demonstrated by the particulate concentration data summarized in Tables 15 and 16.

The data presented are weekly particulate concentrations measured at Mound's offsite and onsite air-sampling sites (Figures 1 and 4). The particulate concentration at onsite locations is generally within the range of the offsite locations. The particulate concentration also appears to be independent of distance from Mound. This would suggest no influence from Mound operations. For comparison, the State of Ohio - Ambient Quality Standard for airborne particulates is also given in Table 15.

Table 14 - NONRADIOACTIVE AIRBORNE EMISSIONS 1985

Emission Source	Pollutant	Emission	Emission Standard[a]	% of Standard
Powerhouse	Particulates	0.005 lb/10^6 Btu Input	0.2 lb/10^6 Btu	2.6
Powerhouse	Sulfur Oxides	0.004 lb/10^6 Btu Input	1.6 lb/10^6 Btu	0.3
Paint Shop	Organics	0.6 lb/day	40 lb/day	1.5
Explosives Burning	Particulates	9.4 lb	NA	NA
Fire Fighter Training	Particulates	71 lb	NA	NA

[a]Ohio EPA Air Pollution Regulations 3745-17-01 through 3745-17-13 and 3745-21-0 through 3745-21-08.

NA - not applicable.

Table 15 - 1985 PARTICULATE CONCENTRATIONS OFFSITE

Location	Number of Samples	Particulates[a,b] (μg/m³) Minimum	Maximum	Annual Arithmetic Average (μg/m³)
101	41	28	98	50 ± 4
102	52	7	133	40 ± 6
103	52	3	61	32 ± 3
104	47	15	286	42 ± 11
105	52	13	47	31 ± 2
108	52	18	86	50 ± 4
110	52	10	51	31 ± 3
111	52	14	72	39 ± 3
112	47	13	49	31 ± 2
115	45	15	106	36 ± 4
118	51	14	96	39 ± 4
119	51	12	56	26 ± 3
122	52	11	69	32 ± 4
123	52	7	65	36 ± 3
124	52	13	58	34 ± 3

[a]Ohio Ambient Air Quality Standard = 60 μg/m³ (annual geometric mean).

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

These data are obtained by the Mound air monitoring program and are indicative only of the particulate air loading of the Dayton metropolitan area. Mound particulate discharges presented in Table 14 make a negligible contribution to the surrounding area. Table 16 presents onsite particulate data.

Table 16 - 1985 PARTICULATE CONCENTRATIONS ONSITE

Location	Number of Samples	Particulates (μg/m³) Minimum	Maximum	Annual[a] Arithmetic Average (μg/m³)
211	51	18	127	50 ± 7
212	48	4	57	29 ± 3
213	52	28	108	62 ± 5
214	52	5	122	45 ± 6
215	52	4	63	30 ± 3

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

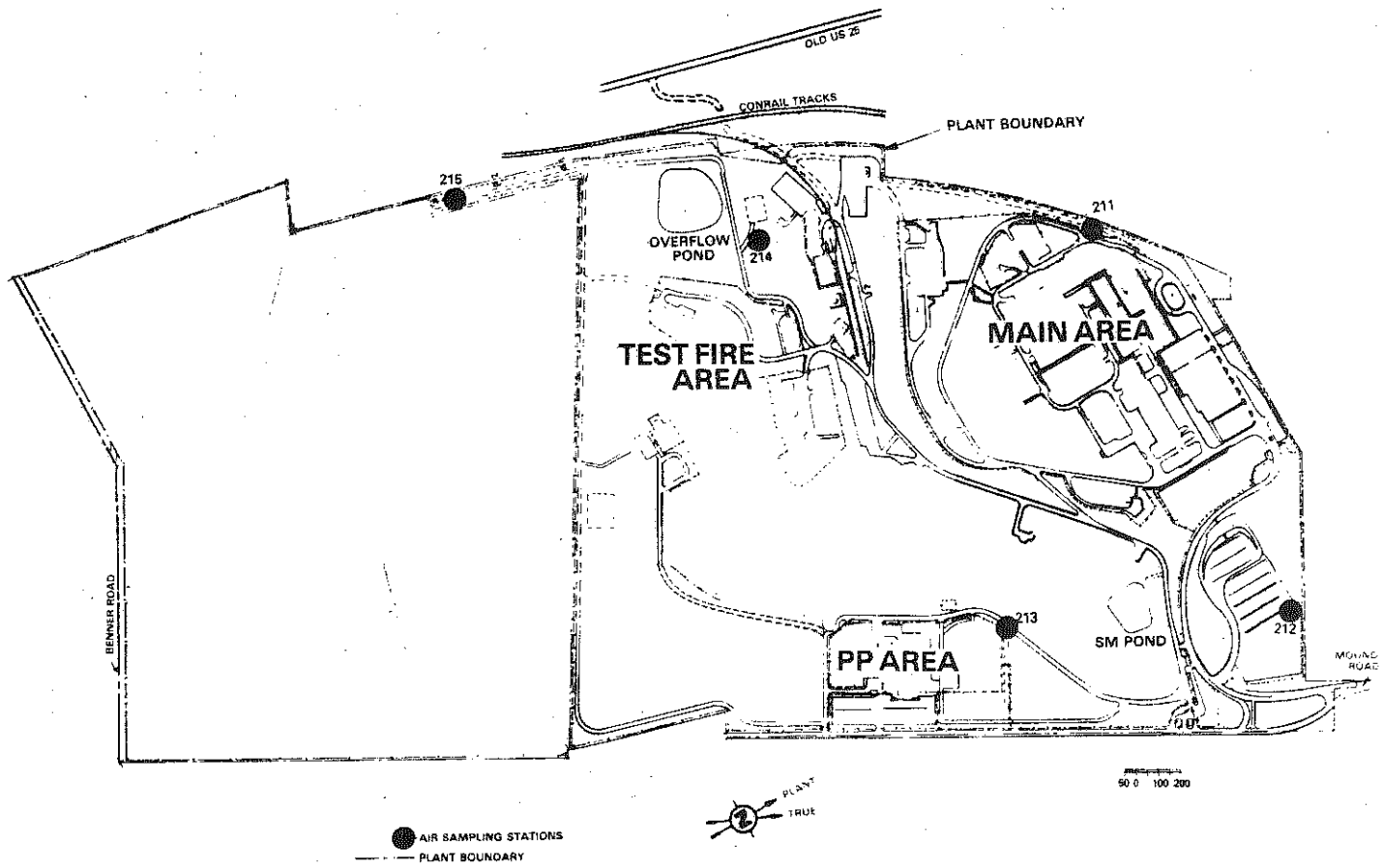


FIGURE 4 - Onsite air sampling locations.

Water - Radioactive

Water sampling locations along the banks of the Great Miami River were selected according to guidelines recommended by the U. S. EPA [11]. The locations, shown in Figure 5, provide samples that are representative of river water after considerable mixing of the effluent from Mound has occurred. Water samples are normally collected and filtered in the field at these locations five days per week, and are subjected to specific analyses for plutonium-238 and tritium.

Large-volume water samples are analyzed by compositing daily samples for a quarterly analysis. The average incremental concentration of plutonium-238 measured for all locations in the Great Miami River was 2×10^{-12} µCi/mL, which is 0.0005% of the DOE DCG. These results are summarized in Table 17.

Weekly samples are analyzed for tritium. The average incremental concentration of tritium measured at all locations in the Great Miami River was 0.02×10^{-6} µCi/mL, which is estimated to be 0.001% of the DOE DCG. These results are summarized in Table 18.

Uranium-233, 234, and 238 were also monitored at the river water sampling locations during 1985. The average incremental concentrations of uranium-233, -234 were 0.03×10^{-9} µCi/mL, which is estimated to be 0.006% of the DOE DCG. The average incremental concentration for uranium-238 was at the environmental level. In addition, as shown in Table 19, the ratio of uranium-233, -234 to uranium-238 is slightly greater than unity, which is in range of background ratios reported [12]. This is expected as a result of secular equilibrium.

The total amounts of plutonium-238, tritium, and uranium-233, -234 discharged to the Great Miami River during 1985 were 9.9×10^{-4} Ci, 5.82 Ci, and 4.0×10^{-4} Ci, respectively. The average concentrations of these materials in the discharge system were 0.75×10^{-9} µCi/mL, 9.5×10^{-6} µCi/mL, and 0.48×10^{-9} µCi/mL, respectively. These concentrations were estimated to be 0.19%, 0.48%, and 0.1%, respectively, of the DOE DCG.

Seven additional surface water locations, such as ponds, in all quadrants surrounding Mound as shown in Figure 5 are sampled monthly for plutonium and tritium analyses. The samples used for plutonium-238 determinations are also large volume water samples. The large volume of sample increases the sensitivity of the analysis for plutonium. A smaller aliquot (10 mL) is taken which is adequate for the tritium analysis. The average concentrations of plutonium-238 and tritium for all locations were 3.3×10^{-12} µCi/mL and 0.11×10^{-6} µCi/mL, respectively, which are 0.0008% and 0.006%, respectively, of the DOE DCG. The results of the surface water samples are summarized in Tables 20 and 21. Environmental levels (Table 3) have been subtracted from the concentration of plutonium and tritium in water.

Drinking water from communities in the surrounding area is sampled and analyzed quarterly for tritium. These communities and their relative locations are shown in Figure 1. The average concentration of tritium for all locations was 0.24 nCi/L which is 1.2% of the standard adopted by the U. S. EPA in 1977 for community drinking water systems. Data from the analyses of community drinking water samples are summarized in Table 22. The

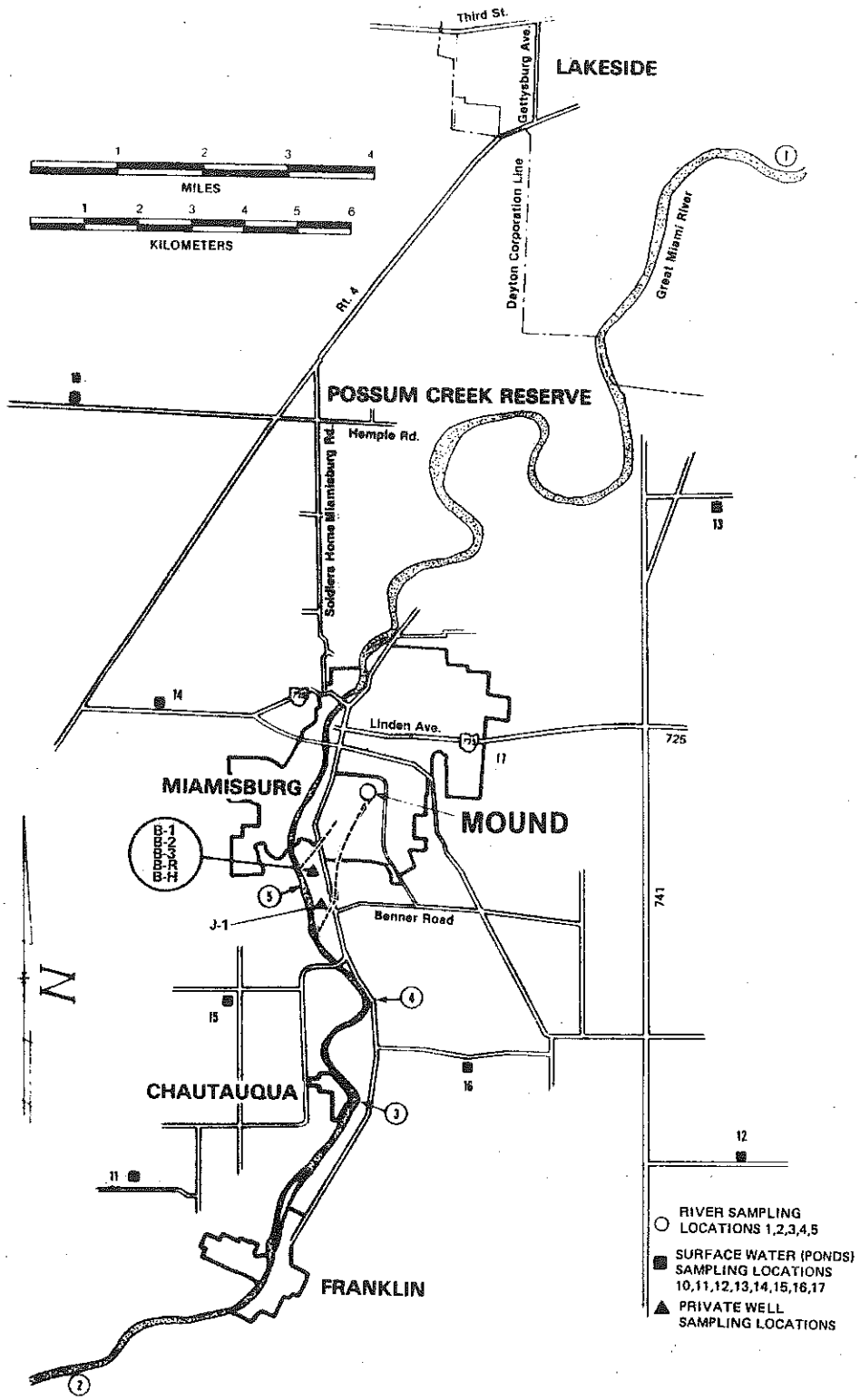


FIGURE 5 - Offsite water sampling locations.

Table 17 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN THE GREAT MIAMI RIVER IN 1985

Location	Number of Samples	Plutonium-238 (10^{-12} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
1	4	0.25	8.25	2.68 ± 6.11	0.0007
2	4	e.l.	2.15	0.5 ± 2.94	0.0001
3	4	0.15	8.65	3.18 ± 6.44	0.0008
4	4	0.45	2.95	1.78 ± 2.19	0.0004
5	4	0.15	3.95	1.85 ± 2.7	0.0005

[a]Lower detection limit (LDL) plutonium-238 in river water is 0.56 x 10^{-12} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

[d]DOE DCG for plutonium-238 in river water is 400,000 x 10^{-12} µCi/mL.

Table 18 - INCREMENTAL CONCENTRATIONS OF TRITIUM IN THE GREAT MIAMI RIVER IN 1985

Location	Number of Samples	Tritium (10^{-6} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
1	29	e.l.	0.17	0.004 ± 0.05	0.0002
2	29	e.l.	0.12	0.011 ± 0.047	0.0006
3	29	e.l.	0.27	0.017 ± 0.055	0.0009
4	29	e.l.	0.22	0.025 ± 0.049	0.0013
5	29	e.l.	0.25	0.039 ± 0.058	0.0020

[a]Lower detection limit (LDL) for tritium in river water is 0.04 x 10^{-6} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

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

environmental level in Table 3 for tritium in water is not subtracted from these data because the EPA standard assesses total concentration including background.

Drinking water from private wells is also analyzed for tritium. The average concentration of tritium for all private well locations was 4.85 nCi/L, which is 24% of the U. S. EPA Standard. These data are shown in Table 23.

Three private wells and Miamisburg city water were sampled and analyzed quarterly for plutonium-238. These samples were also large-volume water samples. The average incremental plutonium-238 concentration for these locations was 0.4 x 10^{-12} µCi/mL, which is 0.0001% of the DOE DCG. These results are shown in Table 24.

Table 19 - INCREMENTAL CONCENTRATION OF URANIUM-233,234 AND URANIUM-238 IN THE GREAT MIAMI RIVER IN 1985

Location	Number of Samples	Uranium-233,234 (10^{-9} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG	Uranium-238 (10^{-9} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Ratio[e] Uranium-233,234/ Uranium-238
1	4	e.l.	0.26	0.07 ± 0.71	0.014	e.l.	0.21	e.l.	1.1
2	4	e.l.	0.13	e.l.	-	e.l.	e.l.	e.l.	1.1
3	4	e.l.	0.13	0.004 ± 0.73	0.001	e.l.	e.l.	e.l.	1.2
4	4	e.l.	0.22	0.03 ± 0.74	0.006	e.l.	0.02	e.l.	1.2
5	3	0.04	0.14	0.07 ± 0.68	0.014	e.l.	e.l.	e.l.	1.1

[a]Lower detection limit (LDL) for uranium-233,234 is 0.04 x 10^{-9} µCi/mL. The LDL for Uranium-238 is 0.005 x 10^{-9} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from data.

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

[e]Environmental level not subtracted from these data.

Table 20 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SURFACE WATER IN 1985

Location	Number of Samples	Plutonium-238 (10^{-12} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
10	3	e.l.	e.l.	e.l.	-
11	4	e.l.	e.l.	e.l.	-
12	4	e.l.	e.l.	e.l.	-
13	4	e.l.	e.l.	e.l.	-
14	4	e.l.	e.l.	e.l.	-
15	4	e.l.	e.l.	e.l.	-
16	4	e.l.	e.l.	e.l.	-
17	4	e.l.	122	26.7 ± 103	0.0067

[a]Lower detection limit (LDL) plutonium-238 in surface water is 0.6 x 10^{-12} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

[d]DOE DCG for plutonium-238 in water is 400,000 x 10^{-12} µCi/mL.

Table 21 - INCREMENTAL CONCENTRATION OF TRITIUM IN SURFACE WATER IN 1985

Location	Number of Samples	Tritium (10^{-6} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
10	8	e.l.	0.29	0.09 ± 0.13	0.005
11	10	e.l.	0.2	0.07 ± 0.08	0.004
12	10	e.l.	0.29	0.05 ± 0.12	0.003
13	10	e.l.	0.2	0.06 ± 0.09	0.003
14	10	0.09	0.41	0.23 ± 0.10	0.012
15	10	e.l.	0.33	0.14 ± 0.11	0.007
16	10	e.l.	0.15	e.l.	-
17	10	0.04	0.4	0.21 ± 0.09	0.011

[a]Lower detection limit (LDL) for tritium in surface water is 0.03 x 10^{-6} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

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

Table 22 - TRITIUM LEVELS IN COMMUNITY DRINKING WATER IN 1985

Location	Number of Samples	Tritium (nCi/L) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of EPA Standard
Bellbrook	16	0.02	0.22	0.1 ± 0.03	0.50
Centerville	16	0.07	0.18	0.12 ± 0.02	0.60
Dayton	16	0.005	0.21	0.1 ± 0.03	0.50
Franklin	16	0.1	0.66	0.31 ± 0.07	1.55
Germantown	16	0	0.26	0.13 ± 0.04	0.65
Kettering	16	0.13	0.42	0.28 ± 0.04	1.40
Miamisburg	15	0.58	1.2	0.8 ± 0.1	4.00
Middletown	16	0	0.39	0.19 ± 0.06	0.95
Moraine	16	0.1	0.38	0.22 ± 0.04	1.10
Springboro	16	0.13	0.42	0.29 ± 0.05	1.45
Waynesville	16	0	0.21	0.07 ± 0.04	0.35
West Carrollton	16	0.12	0.43	0.25 ± 0.06	1.25

[a]Lower detection limit (LDL) for tritium in community drinking water is 0.04 nCi/L.

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

[c]Average environmental level (e.l.) not subtracted from the data to compare to the EPA standard of 20 nCi/L.

Table 23 - TRITIUM IN PRIVATE WELLS IN 1985

Location	Number of Samples	Tritium (nCi/L) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of EPA Standard
B-1	31	2	9	4.1 ± 0.5	20.5
B-2	2	6	6	6 ± 0	30.0
B-3	8	5	7	5.6 ± 0.6	28.0
J-1	8	2	4	2.3 ± 0.6	11.5
B-H	36	3	8	5.6 ± 0.3	28.0
B-R	2	5	6	5.5 ± 6.4	27.5

[a]Lower detection limit (LDL) for tritium in well water is 0.04 nCi/L.

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

[c]Average environmental level (e.l.) not subtracted from the data to compare to the EPA standard of 20 nCi/L.

Table 24 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN PRIVATE WELLS AND MIAMISBURG MUNICIPAL DRINKING WATER IN 1985

Location	Number of Samples	Plutonium-238 (10^{-12} µCi/mL) Minimum[c]	Maximum[c]	Average[a,b,c]	Percent of[d] DOE DCG
Miamisburg	4	e.l.	e.l.	e.l.	-
B-1	4	e.l.	0.1	e.l.	-
B-2	1	1.8	1.8	1.8	0.0005
B-3	4	e.l.	0.1	e.l.	-
J-1	4	e.l.	0.5	e.l.	-

[a]Lower detection limit (LDL) plutonium-238 in surface water is 0.6 x 10^{-12} µCi/mL.

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

[c]Average environmental level (e.l.) subtracted from the data.

[d]DOE DCG for plutonium-238 in water is 400,000 x 10^{-12} µCi/mL.

Water - Nonradioactive

Mound discharged an average of 0.64 million gallons of water per day in 1985 to the Great Miami River. Nonradioactive pollutants in this effluent water are regulated by a National Pollutant Discharge Elimination System (NPDES) permit. This permit, issued by the Ohio EPA, requires Mound to characterize its effluent water by analyzing samples collected at four onsite locations.

A 24-hr composite, flow proportional sample and a grab sample are collected from discharges 001-A, 001-B, and 002. Discharge 001-A contains the effluent from the sanitary sewage treatment plant. Discharge 001-B includes storm water runoff, single-pass cooling water, zeolite softener backwash, boiler-plant blowdown, and discharge from the radioactive waste disposal facility. Discharge 002 consists of single-pass cooling water, cooling tower blowdown, zeolite softener backwash, and most of the plant storm water runoff. A time proportional sample (8-hr composite) and a grab sample are collected from the electroplating facility (discharge 001-C).

The Ohio EPA modified the terms of the NPDES permit twice during 1985. The Ohio EPA ordered Mound in February 1985 to take certain corrective actions to allow better control of suspended solids discharges at effluents 001B and 002 by August 1985. Mound successfully implemented these actions and was in compliance with suspended solids limits by June 20, 1985. Mound's NPDES permit was subsequently renewed effective October 1985 for a five-year period. The permit limits are found in Table 25 and the Appendix. The changes in the renewed permit include: fecal coliform and residual chlorine are to be monitored in effluent 001-A during the summer months only; the dissolved solids and residual chlorine monitoring requirements were deleted for effluent 001-B; the measurement of pH and total toxic organics (TTO) was added to effluent 001-C; dissolved solids, grease and oil, and residual chlorine were deleted as monitoring requirements for effluent 002. The results of effluent analyses for 1985 are summarized in Table 25. These water samples were analyzed for water quality parameters according to standard methods [13].

The EPA additionally requires Mound to monitor the flow and pH from a well which is periodically pumped as a part of the Potable Water Standards Project. Approximately 30 million gallons were pumped from this well, discharge 003, in 1985.

In all, 1227 NPDES analyses were performed in 1985. From these measurements, an effluent parameter exceeded its maximum discharge limit 3 times. Mound also exceeded monthly average limits 4 times in 1985. These exceptions all occurred in the effluent from the sewage treatment plant. Suspended solids, biochemical oxygen demand, and fecal coliform were the parameters that exceeded permit limits. Varying influent loadings occasionally make it difficult to operate the plant within all NPDES limits. Process controls for the treatment plant can be set more precisely when the influent loading is consistent on a daily basis. The influent loading at Mound can vary up to 300% from one day to the next. This requires choosing process control parameters which are a compromise between

Table 25 - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM DATA FOR 1985

Parameter	Units	No. of Samples	Minimum	Maximum	Annual Average	NPDES Permit Limits Maximum[b]	NPDES Permit Limits Monthly Average
Discharge 001-A							
FLow Rate[a]	MGD	Cont.	0.04	0.22	0.09	c	c
pH	s.u.	213	6.8	8.3	7.5	9.0	c
Biochemical Oxygen Demand	mg/L	97	1.2	18	7.7	15	10
Suspended Solids	mg/L	94	5.8	24	14	30	15
Fecal Coliform	MPN/100 mL	89	3	4700	120	2000	1000
Residual Chlorine	mg/L	22	0.03	0.48	0.26	0.5	c
Discharge 001-B							
Flow Rate	MGD	Cont.	0.02	0.20	0.09	c	c
pH	s.u.	89	7.9	9.1	8.5	9.5	c
Suspended Solids (Jan-Feb)	mg/L	17	2.3	22.2	10.3	30	20
Suspended Solids (Mar-Dec)	mg/L	44	2.3	30	9.8	45	30
Dissolved Solids	mg/L	15	700	17700	6700	c	c
Grease and Oil	mg/L	12	0.8	5.4	2.5	10	c
Residual Chlorine	mg/L	76	<0.02	<0.02	<0.02	<0.02	c
Chemical Oxygen Demand	mg/L	19	4	53	21	c	c
Discharge 001-C							
Cyanide	mg/L	45	<0.04	<0.04	<0.04	1.0	0.65
Chromium	mg/L	45	<0.05	0.10	<0.05	0.5	c
Cadmium	mg/L	45	<0.01	0.06	<0.02	0.1	c
Nickel	mg/L	45	<0.05	0.36	<0.08	0.5	c
Copper	mg/L	45	<0.05	0.48	<0.13	0.5	c
pH (Oct 1 - Dec 31)	s.u.	3	7.9	8.4	8.2	9.0	c
Total Toxic Organics	mg/L	1	<1.11	<1.11	<1.11		2.13[c]
Discharge 002							
Flow Rate	MGD	Cont.	0.0	1.9	0.46	c	c
pH	s.u.	48	7.8	8.5	8.1	9.0	c
Suspended Solids (Jan - Feb)	mg/L	17	3.7	27.3	12.8	30	15
Suspended Solids (Mar - Dec)	mg/L	44	5.0	42	19.5	45	30
Dissolved Solids	mg/L	18	690	1500	1025	2000	1500
Grease and Oil	mg/L	9	<0.02	2.8	1.3	10	c
Residual Chlorine	mg/L	76	<0.02	<0.02	<0.02	0.02	c

[a]Includes flow from 001-C. The maximum flow from 001-C is approximately 2000 gal/day.

[b]pH also has a minimum limit of 6.5.

[c]No limit applicable.

treating the high demand influent and the low demand influent.

In summary, the number of maximum exceptions represents 0.2% of the NPDES measurements. The exceptions were all minor perturbations of short duration and did not adversely impact the water quality of the Great Miami River. Data from the U. S. Geological Survey show that flow in the Great Miami River at Miamisburg in 1985 averaged 1660 million gallons per day (MGD) with a minimum and maximum of 270 MGD and 16,000 MGD, respectively. The magnitude of this river flow is significantly greater than Mound effluents such that the above exceptions would have no measurable impact on the Great Miami River. In addition, a review of the data in Table 25 shows that Mound effluents did not cause the Great Miami River to exceed Ohio Stream Standards which are shown in the Appendix.

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is any significant uptake and concentration of radionuclides by plant or animal life. Samples were collected in Miamisburg, Centerville, and Bellbrook. Centerville and Bellbrook are in the prevailing wind direction from Mound at a distance of 8 km (5 mi) and 16 km (10 mi), respectively. Both communities are shown in Figure 1. Fish were collected in the Great Miami River. Mound's outfalls are shown as dotted lines in Figure 5. The plutonium-238 content of the foodstuff and vegetation samples is determined by ashing the samples, then proceeding with the same techniques used for plutonium-238 analyses of air samples (see section on Air - Radioactive). The tritium content of the foodstuff and vegetation samples is determined by distilling the water from the sample, then analyzing the distillate for tritium. The results of the foodstuff, vegetation, and fish analyses are summarized in Tables 26 and 27. The concentration is given in terms of the sample weight (wet weight) before ashing or distilling. The samples of aquatic life analyzed included only the edible, fleshy portions of fish. These analyses indicate no evidence of any significant uptake or concentration by plant or animal life of the radionuclides handled at Mound. Environmental levels for foodstuffs and vegetation have been subtracted from the data (Table 3).

Table 26 - INCREMENTAL PLUTONIUM-238 IN FOODSTUFFS AND VEGETATION IN 1985

Location	Type of Sample	Number of Samples	Plutonium-238 (10^{-9} µCi/g) Minimum[a]	Maximum[a]	Average[a,b,c]
Miamisburg	Grass	8	e.l.	0.2	e.l.
	Potatoes	4	e.l.	0.87	0.25 ± 1.3
Centerville	Grass	8	e.l.	0.12	e.l.
	Potatoes	4	e.l.	0.65	0.21 ± 1.1
Bellbrook	Grass	8	e.l.	0.09	e.l.
	Potatoes	4	e.l.	0.48	e.l.
Mound (outfall to river)	Fish	8	e.l.	0.54	0.1 ± 0.32

[a]Average environmental level (e.l.) subtracted from data.

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

[c]Lower detection limit (LDL) for plutonium-238 in grass is 0.31×10^{-9} µCi/g. For plutonium-238 in potatoes, the LDL is 0.65×10^{-9} µCi/g. For plutonium-238 in fish, the LDL is 0.26×10^{-9} µCi/g.

Table 27 - INCREMENTAL CONCENTRATION OF TRITIUM IN VEGETATION IN 1985

Location	Type of Sample	Number of Samples	Tritium (10^{-6} μCi/g) Minimum[a]	Maximum[a]	Average[a,b,c]
Miamisburg	Grass	8	0.27	0.58	0.44 ± 0.11
	Tomatoes	4	1.2	1.4	1.3 ± 0.16
Centerville	Grass	8	e.l.	0.12	e.l.
	Tomatoes	4	e.l.	0.05	0.03 ± 0.1
Bellbrook	Grass	8	e.l.	0.16	0.06 ± 0.09
	Tomatoes	4	e.l.	0.11	0.04 ± 0.15

[a]Average environmental level (e.l.) subtracted from data.

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

[c]Lower detection limit (LDL) for tritium in grass is 0.02 x 10^{-6} μCi/g. For tritium in tomatoes, the LDL is 0.03 x 10^{-6} μCi/g.

Silt - Radioactive

Silt samples were collected from the river and surface water sample locations shown in Figure 5.

The results of the silt sample analyses are found in Tables 28 and 29. No adverse impact to the environment could be determined from the radionuclide levels found in these sediments.

Table 28 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM RIVER SAMPLING LOCATIONS IN 1985

Location	Number of Samples	Plutonium-238 (10^{-9} µCi/g) Minimum[c]	Maximum[c]	Average[a,b,c]
1	4	e.l.	3.7	0.9 ± 3.3
2	4	6.2	17	13 ± 7.7
3	4	29	43	36 ± 11
4	4	34	173	123 ± 98
5	4	4.4	21	11 ± 13

[a]Lower detection limit (LDL) for plutonium-238 in silt is 0.4×10^{-9} µCi/g.

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

[c]Average environmental level (e.l.) subtracted from data.

Table 29 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM SURFACE WATER LOCATIONS IN 1985

Location	Number of Samples	Plutonium-238 (10^{-9} µCi/g) Minimum[c]	Maximum[c]	Average[a,b,c]
10	3	0.6	0.8	0.7 ± 0.7
11	4	0.8	41	11 ± 32
12	4	0.08	2.3	1.4 ± 0.6
13	4	0.4	11	3.4 ± 8.5
14	4	0.7	10	3.3 ± 10
15	4	e.l.	1.9	1.1 ± 2.2
16	4	0.08	0.6	0.4 ± 0.7

[a]Lower detection limit (LDL) for plutonium-238 in surface water silt is 0.4×10^{-9} µCi/g.

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

[c]Average environmental level (e.l.) subtracted from data.

Evaluation of Effective Dose Equivalent to the Public

The dose assessment techniques have been revised according to the Department of Energy guidelines. The "effective dose equivalent" is used in the dose assessment evaluation in this report [4].

The effective dose equivalent values for the plutonium-238 and tritium exposures from the air, water, and vegetation pathways are calculated and summed to estimate the maximum dose at the site boundary and to the individual. The general assumptions used in these determinations follow.

The solubility of ingested or inhaled plutonium-238 in the receptor is unknown. However, it is highly probable that most of the plutonium-238 is in the oxide form, which is very insoluble. In order to provide a realistic but conservative effective dose equivalent estimate, it is assumed that 50% of the plutonium-238 is inhalation class W, 50% is inhalation class Y for air, and an f1 value of 10^{-4} for water and vegetation.

The term "effective dose equivalent," as used in this report, is that cumulative effective dose equivalent for a period of 50 yr from 1 yr of exposure to a given radionuclide. This effective dose equivalent is composed of the sum of the effective dose equivalents from the air, water, and foodstuffs pathways.

Dose Assessment Assumptions and Methodology

The effective dose equivalent estimates for plutonium-238 and tritium were based on environmental monitoring data for 1985. The estimates for maximum effective dose equivalent in air at the site boundary and maximum effective dose equivalent to individuals were based on the maximum onsite incremental average concentration of plutonium-238 and tritium (oxide) in air from onsite samplers (sampler 211, Table 11, and sampler 211, Table 13, respectively). These samplers are in proximity to the site boundary.

The estimates for water for maximum effective dose equivalent at the site boundary and in individuals were based on the maximum average incremental concentration of plutonium-238 and tritium in wells. The maximum offsite average concentration of plutonium-238 and tritium in drinking water was the average of B-1, B-2 and B-3.

The terms "maximum effective dose equivalent at the site boundary" and "maximum effective dose equivalent to individuals" refer to the maximum dose equivalent for individuals to receive, assuming they remain at the site boundary 24 hr/day, 365 days/yr. During this continuous occupancy, it is assumed that the individual continually breathes air with maximum concentrations of radionuclides found at our onsite samplers. It is also assumed that the same individual consumes all his drinking water at the maximum radionuclide concentrations found in offsite wells. In addition, the same individual is assumed to consume a portion of foodstuffs with the maximum radionuclide concentrations found offsite. All of these contributions, air, water, and foodstuffs, are added to obtain an estimate of the total maximum effective dose equivalent. The estimated contributions from each pathway and the estimated total maximum effective dose equivalent are shown in Table 30.

The data indicate that, in all cases of effective dose equivalent comparisons, the dose equivalents are less than 1% of the DOE standard. In addition, to put 0.88 mrem into perspective, the mean annual whole body dose equivalent difference from living in Ohio as opposed to living in Colorado for 1 year due to natural radiation is about 75 mrem [14,15]. One jet flight over the Atlantic would expose an individual to 2.6 mrem [16].

Table 30 - EFFECTIVE DOSE ESTIMATES

MAXIMUM EFFECTIVE DOSE EQUIVALENT AT THE SITE BOUNDARY AND TO INDIVIDUALS IN THE POPULATION

Pathway	Plutonium (mrem)	Tritium (mrem)	Total (mrem)	Total (mSv)	Percent of DOE Standard
Air	0.58	0.026	0.61	(0.0061)	0.61
Water	0.00017	0.235	0.24	(0.0024)	0.24
Foodstuffs	0.0165	0.016	0.03	(0.0003)	0.03
TOTAL	0.6	0.28	0.88		0.88

The person-rem dose equivalent estimate calculation was based on tritium (oxide) and plutonium-238 data from environmental air sampling stations in two ranges: 0-8 km (0-5 mi) and 8-21 km (5-20 mi). The 0-8 km range includes 10 samplers within 1.6 km (1 mi) of Mound.

The average concentration of tritium (oxide) and plutonium in air was obtained by averaging concentrations found at 10 offsite tritium air samplers and then subtracting the concentration found at sampler #119. From this average concentration, a dose equivalent was determined and multiplied by the number of people from 0 to 8 km.

The average tritium (oxide) concentration from the four other offsite samplers (less the concentration at sampler 119) was used to obtain the person-rem from 8 to 32 km. Eight area segments from 8 to 32 km were obtained by letting each sampler represent one segment concentration and the average of two adjacent samplers represent another segment. These segment concentrations were then multiplied by their respective population. Using the concentrations from the four samplers and this averaging technique gives a more realistic population dose value.

The person-rem from tritium (oxide) and plutonium-238 in community drinking water was based on average concentrations of tritium (oxide) and plutonium-238 in various community water supplies, less appropriate environmental levels, and weighting these concentrations with respective populations.

The person-rem from foodstuffs was based on average incremental concentrations of tritium (oxide) and plutonium-238 found in foodstuffs weighted with assumed consumption quantities and population. The total person-rem was obtained by adding the effect from the air, water, and foodstuffs pathways.

It is estimated that the total population from 0 to 32 km is receiving 6.7 person-rem from Mound's emissions. The remaining population from 32 km to 80 km (20 to 50 mi) is expected to receive negligible dose commitment from tritium (oxide) and plutonium-238 emissions. Thus, the effective dose equivalent from Mound's emission is estimated to be 6.7 person-rem for the 0-80 km range.

For comparison, the population effective dose values from natural radiation, including cosmic rays, terrestrial, and internal radiation, would be approximately 670,000 person-rem for the 0 to 80 km (50 mi) range [17]. The dose equivalent from background tritium alone is 0.004 mrem and results in a population whole body dose of 13 person-rem for the 0 to 80 km range [17].

Acknowledgements

The authors gratefully acknowledge C. T. Bishop and W. D. Gloekler for their contributions to this report; K. D. DeVilbiss, G. D. Dunn, W. D. Gloekler, V. S. Johnson, B. J. Hollon, L. C. Hopkins, V. C. Lacy, L. L. Roush, F. K. Tomlinson, and P. A. Watkins for their work in sample collection and analyses.

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Appendix

Applicable Standards

RADIOACTIVE STANDARDS

In conformance with the U. S. Department of Energy memoranda "Radiation Standard for Protection of the Public in the Vicinity of DOE Facilities" (8/5/85) and "Preparation of Annual Site Environmental Reports for Calendar Year 1985" (2/28/86), environmental sample results were used to estimate doses to compare with the DOE and EPA standards listed below.

RADIATION STANDARDS FOR PROTECTION OF THE PUBLIC IN THE VICINITY OF DOE FACILITIES

Dose Limits

1. ALL PATHWAYS

The effective dose equivalent for any member of the public from all routine DOE operations[1] (natural background and medical exposures excluded) shall not exceed the values given below:

	Effective Dose Equivalent[2]	
	mrem/yr	(mSv/yr)
Occasional annual exposures[3]	500	(5)
Prolonged period of exposure[3]	100	(1)

No individual organ shall receive a committed effective dose equivalent of 5 rem/yr (50 mSv/yr) or greater.

[1] Routine DOE operations means normal planned operations and does not include actual or potential, accidental or unplanned releases.

[2] Effective dose equivalent will be expressed in rem (or millirem) with the corresponding value in Sievert (or milliSievert) in parenthesis.

[3] For the purposes of these standards, a prolonged exposure will be one that lasts, or is predicted to last, longer than 5 years.

2. AIR PATHWAY ONLY

(Limits of 40 CFR 61, Subpart H)

	Dose Equivalent	
	mrem/yr	(mSv/yr)
Whole body dose	25	(0.25)
Any organ	75	(0.75)

Drinking Water

As of June 24, 1977, community drinking water quality is regulated by the EPA National Interim Primary Drinking Water Regulations for Radionuclides. The new standard = 20 x 10^{-6} µCi/mL (20,000 pCi/L).

Soil

There are no guidelines established for radioactive species in soil. (The U.S. EPA has guidelines under consideration.)

NONRADIOACTIVE STANDARDS

Water

The Ohio EPA has issued a discharge permit under NPDES regulations governing Mound's liquid effluent streams. This permit is for the period from October 1, 1985, to September 27, 1990. The discharge limitations for each effluent stream are as follows:

Discharge 001-A EPA #601	7-day Average	Monthly Average
Residual Chlorine* (mg/L)	0.5	--
BOD_5 (mg/L)	15.	10.
Suspended Solids (mg/L)	30.	15.
Fecal Coliform* (n/100 mL)	2000.	1000.
pH (s.u.)	6.5 - 9.0 (daily limit)	

*May 1 through October 31

Discharge 001-B EPA #602	Daily Limit	Monthly Limit
COD (mg/L)	(Monitor only)	
Suspended Solids (mg/L)	45.	30.
Oil/Grease (mg/L)	10.	--
pH (S.U.)	6.5-9.5	--

Discharge 001-C EPA #603	Daily Limit	Monthly Limit
Cyanide (mg/L)	1.0	0.65
Chromium (μg/L)	500.	--
Cadmium (μg/L)	100.	--
Nickel (μg/L)	500.	--
Copper (μg/L)	500.	--
Total Toxic Organics (1/quarter) (μg/L)	2130.	--

Discharge 002 EPA #002	Daily Limit	Monthly Limit
Suspended Solids	45.	30.
pH (S.U.)	6.5-9.0	--

The Ohio EPA has established Water Quality Standards (3745-1-01-3745-1-09). The standards listed below are excerpted from these regulations. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/L)
Dissolved Oxygen	5.0
pH (pH units)	6-9
Fecal Coliform (N/100 mL)	200 per 100 mL
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250
Chromium (hexavalent)	0.05
Cyanide (free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil and Grease	5
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075*
Zinc	0.075 - 0.5*

*Dependent on $CaCO_3$ hardness.

Effective Dose Equivalent Calculations

The effective doses from both plutonium-238 and tritium oxide are calculated in a similar manner then summed for the significant pathways. The result is one value which represents a weighted result which is compared to the DOE standard shown above.

The technique in detail involves determining the concentration of the radionuclide through environmental monitoring then calculating the total effective dose equivalent by:

$$DE = \sum_{1}^{N} R \sum_{1}^{P} C_R I_a D_F C_F$$

where

DE = total Effective Dose Equivalent (Dose integrated through 50 years from 1 year of exposure) (mrem/50 year).

$\sum_{1}^{N} R$ = Sum of the different radionuclides

$\sum_{1}^{P}$ = Sum of the different pathways - air, water, and foodstuff

C_R = Average concentration of the radionuclide

I_a = Annual intake of the environmental media [1,2]

D_F = Dose factors for the particular radionuclide and type of intake [3]

C_F = Conversion factor to convert various units into units which can be used with DOE effective dose conversion factors

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Savannah River Plant

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MLM-3427

Environmental Monitoring at Mound: 1986 Report

Daniel G. Carfagno and Billy M. Farmer

May 11, 1987

MOUND
Miamisburg, Ohio 45342

operated by
MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company

for the
U. S. DEPARTMENT OF ENERGY
Contract No. DE-AC04-76-DP00053

Monsanto

Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed Copy: A03
Microfiche copy: A01

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Foreword

This report was prepared by the Environmental Section of the Administration Department at Monsanto Research Corporation - Mound pursuant to DOE Order 5484.1 for the calendar year 1986. Sample analyses and data reduction were performed by the Environmental Laboratory Group. Particulate samples offsite were collected by the Air Pollution Control Section of the Montgomery County Combined General Health District, which acts as the Regional Air Pollution Control Agency in this area for the Ohio Environmental Protection Agency. All other sampling was performed by personnel in the Environmental Section.

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Introduction

Mound is a government-owned facility operated by Monsanto Research Corporation for the U. S. Department of Energy (DOE). Occupying 1.24 km² (306 acres) of land in Miamisburg, Ohio, the Mound facility is approximately 16 km (10 mi) southwest of Dayton, Ohio. The predominant geographical feature in the five-county region surrounding Mound is the Great Miami River, which flows from northeast to southwest through the city of Miamisburg. The river valley is highly industrialized. The remainder of the region is predominantly farmland, dotted with light industry and small communities. The locations and populations of these communities are shown in Figure 1. The population distribution surrounding Mound is shown in Figure 2. Drinking water for the area is obtained from a buried valley aquifer that generally follows the Great Miami River. The primary agricultural activity in the area is raising field crops such as corn and soybeans. Approximately 10% of the land in

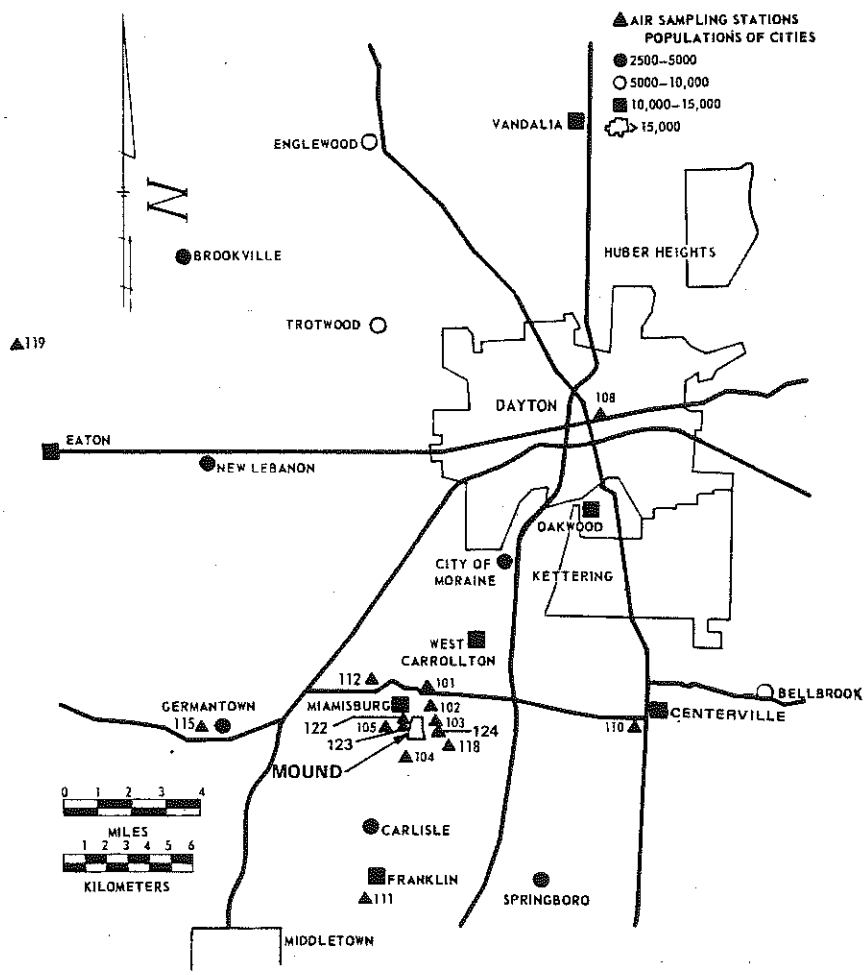
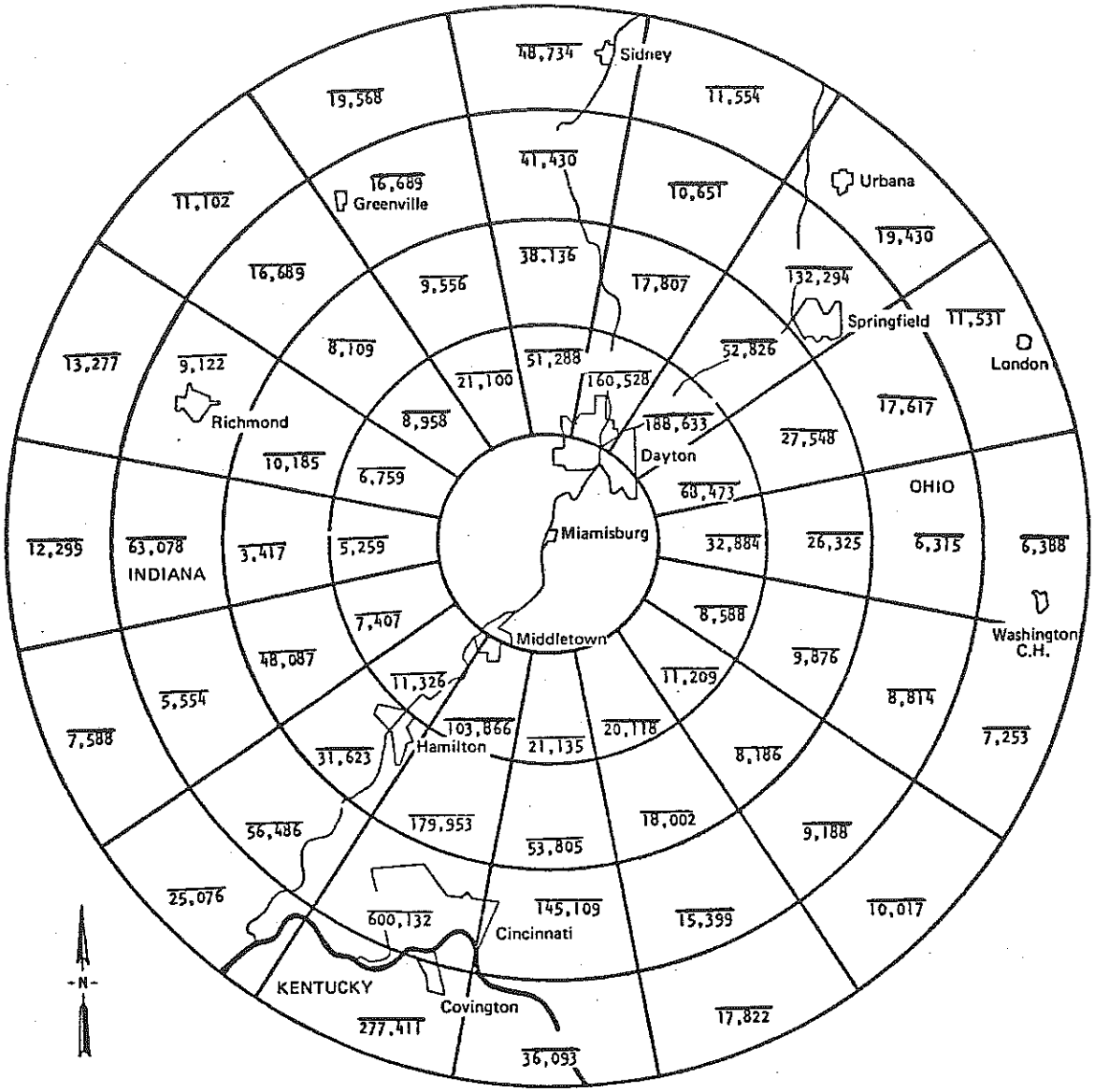


FIGURE 1 - Offsite air sampling locations.



Cumulative Population Totals
1980 Population 0 - 50 Miles

0-10	398,259
0-20	1,125,790
0-30	1,669,231
0-40	2,823,798
0-50	3,358,941

FIGURE 2 - Projected 1980 population within 50 miles of Mound.

agricultural use is devoted to pasturing livestock [1].

The climate in the area is considered moderate. Average annual precipitation is 91 cm (36 in.) and is evenly distributed throughout the year. Precipitation measured at Mound in 1986 was 94 cm (37 in.). Winds are predominantly from the south or west, except during the summer, when they are recorded more frequently from out of the southwest [2]. The annual average wind speed measured by the National Weather Service at Dayton, Ohio, for 1986 was 3.9 m/s (8.7 mi/hr). Figure 3 shows the wind rose for 1986 compiled by the National Weather Service at Dayton, and Table 1 shows average wind speed and percent frequency for each of 16 wind directions.

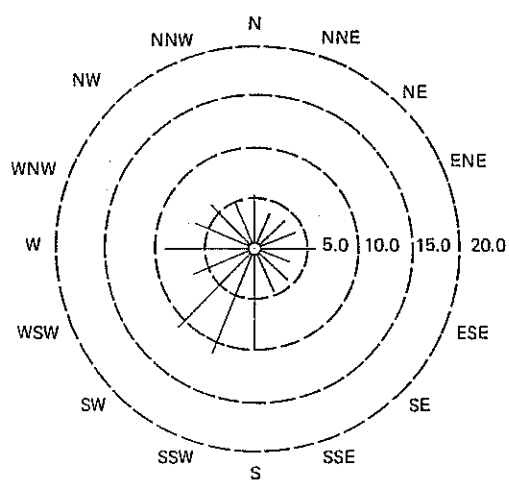


FIGURE 3 - The relative frequency of winds from different directions from the National Weather Service, Dayton, Ohio, for 1986.

In 1949, Mound began operations for the production of nuclear weapon components. Currently, its mission includes (1) research, development, engineering, production, and surveillance of components for DOE weapons programs; (2) separation, purification, and sale of stable isotopes; and (3) DOE programs in nuclear safeguards and waste management, heat source testing, and fusion fuel systems. The radionuclides of primary concern that result from Mound's current or past operations are plutonium-238 (Pu-238) and tritium (HT, HTO).

Radionuclides in particulate form are removed from process air effluents by high efficiency particulate air (HEPA) filters. Air effluents are filtered first at their points of origin (i.e., gloveboxes) and then just before reaching

Table 1 - PERCENT FREQUENCY OF WIND DIRECTION AND WIND SPEED FROM THE NATIONAL WEATHER SERVICE, DAYTON, OHIO, FOR 1986

Direction	Percent Frequency	Average Speed (m/s)
N	5.1	4.0
NNE	3.2	3.9
NE	3.5	3.7
ENE	4.2	3.2
E	5.7	3.6
ESE	2.9	3.8
SE	4.4	3.4
SSE	4.6	3.4
S	10.0	4.0
SSW	11.6	4.7
SW	11.4	4.6
WSW	6.9	4.3
W	9.3	4.6
WNW	6.3	4.5
NW	5.9	4.5
NNW	5.0	4.3
	Average	3.9

Total relative frequency of calms distributed above is 5.6%

the release point (i.e., the stack). The filtering system at the stack comprises two banks of HEPA filters in series, each bank having a collection efficiency of 99.95%. Radionuclides are removed from liquid effluents, such as process wastes, by chemical processing. Solid radioactive wastes are packaged and shipped offsite for burial at approved burial sites. Wastes generated in the processing of explosive materials are collected and disposed of according to the Defense Armament and Research Command (DARCOM) Regulation 385-100 and DOE/EV/06194-1.

An onsite, sanitary waste treatment plant provides secondary treatment, in accordance with U.S. Environmental Protection Agency (EPA) requirements [3], using an activated sludge process operating in the extended aeration mode. The waste treatment plant was upgraded in 1986 by the installation of a continuous backwash sand filter. All domestic sewage generated onsite is treated in this facility. The influent and effluent at the sewage treatment plant are monitored for radioactivity to ensure no undetected release can occur to the environment via the sanitary sewage plant. All wastewater, after appropriate treatment, is discharged from the site to the Great Miami River. Digested sludge from the sewage plant is shipped offsite as low specific activity (LSA) radioactive waste for burial at an approved burial site. Nonradioactive solid wastes are disposed of according to a recycling and reclamation program whenever possible. White paper, scrap metal, and wood are sold for reclamation. During 1986, general refuse was transported to a sanitary landfill site approved by both the state and county. Hazardous wastes are containerized, manifested, and moved offsite by a commercial-industrial waste disposal firm for treatment or disposal using EPA-approved procedures.

Mound's compliance with regulations prescribed by DOE for the safety of its employees and the public has been demonstrated throughout the history of the facility. The fundamental objective of the Mound Environmental Control Program, an ongoing program since Mound began operations, is the containment of radioactive discharges to levels well within the existing standards. As part of this program, waste streams are monitored and controlled at each operating step, resulting in no more than low-level releases of airborne or liquid wastes to the environment. With early detection, control techniques can be implemented, thus ensuring that concentrations are well within existing standards and follow the "as-low-as-reasonably-achievable" (ALARA) DOE guideline.

The same objective -- control to levels well within applicable standards -- applies to nonradioactive discharges. This is achieved primarily by directing waste streams to the appropriate waste treatment system; e.g., sewage treatment plant, solvent collection system, or filtration. ALARA guidelines are also maintained for nonradioactive discharges.

As part of the Mound Environmental Program monitoring functions, air, water, vegetation, foodstuffs, and sediment samples are collected from the environment at distances up to 64 km (40 mi) from Mound's boundaries. These samples are then analyzed for the specific radionuclides handled at Mound. A summary of the monitoring program is shown in Table 2.

Table 2 - MONITORING PROGRAM

Air Surveillance	Sampling Frequency	Parameter Measured[a]
Offsite: 14 locations	Weekly	HTO, Pu, particulate
Onsite: 5 locations	Weekly	HTO, Pu, particulate
Stack Emission: 15 locations	Daily	HT, HTO, Pu, U
Water Surveillance - Offsite		
River: 5 locations	Daily	HTO, Pu, U
Pond: 8 locations	Quarterly	HTO, Pu, U
Municipal Drinking Water: 12 locations	Quarterly	HTO, Pu
Well Water: 6 locations	Monthly	HTO, Pu
Water Surveillance - Onsite		
Effluent Water:		
3 locations	Daily	Flow, suspended solids, BOD_5, fecal coliform, pH, oil and grease, COD, residual chlorine, dissolved solids, HTO, Pu, U
1 location	Semimonthly	Cyanide, chromium, cadmium, nickel, copper
	Quarterly	Total toxic organics
Silt Surveillance - Offsite		
River: 5 locations	Quarterly	Pu
Pond: 7 locations	Quarterly	Pu
Vegetation and Foodstuff Surveillance		
Vegetation: 6 locations	Semiannually	HTO, Pu
Foodstuffs: 6 locations	Annually	HTO, Pu
Environmental Level Surveillance		
Five Mediums		
6 locations	Quarterly	HTO, Pu

[a]HTO,HT - Tritium
Pu - Plutonium
U - Uranium
BOD_5 - Five-day biochemical oxygen demand
COD - Chemical oxygen demand

The results of the environmental analyses for 1986 are provided in this report. The primary purpose of the report is to detail what impact, if any, Mound's operations have had on the environment in 1986. Several terms that are used throughout this report are described below. The concentrations of various radionuclides reported here that result from Mound's operations are termed "incremental." The term "incremental" denotes a concentration value that exceeds normal environmental levels of the same radionuclide. The "environmental level" is the background concentration found in the environment at a distance from the plant where Mound operations would have no impact. These environmental levels are subtracted from all onsite and offsite data except where noted. Some individual values may be negative and are included as such in averages. These values, if negative, are reported as the average environmental level (e.l.). Environmental levels of radionuclides in various media as measured during 1986 by Mound are shown in Table 3.

To determine concentrations of radionuclides found in the environment, the instrument background and reagent blanks were subtracted from the sample count. This value was then used in averages. The incremental concentration was obtained by subtracting the environmental level (background concentration) from the concentration measured in the various environmental media.

For comparative purposes and for single sample evaluation, the lower detection limit (LDL) is shown for each set of data in this report. The LDL is the estimated standard deviation of the blanks at the 95% confidence level.

The error estimates shown with each set of data are estimates of the standard error of the estimated mean at the 95% confidence level. These values include all sources of variability including sampling, analyses, counting statistics, and the propagated error involved when the environmental levels are subtracted from the actual data.

Table 3 - ENVIRONMENTAL CONCENTRATIONS OF RADIONUCLIDES IN VARIOUS MEDIUMS IN 1986

Plutonium-238 in air[a]	$= 0.16 \pm 0.35 \times 10^{-18}$	µCi/mL
Tritium oxide in air[b]	$= 0.91 \pm 2.41 \times 10^{-12}$	µCi/mL
Plutonium-238 in river water[b]	$= 0.9 \pm 8.4 \times 10^{-12}$	µCi/mL
Tritium in river water[b]	$= 0.05 \pm 0.04 \times 10^{-6}$	µCi/mL
Plutonium-238 in surface water[c]	$= 3.4 \pm 1.6 \times 10^{-12}$	µCi/mL
Tritium in surface water[c]	$= 0.06 \pm 0.05 \times 10^{-6}$	µCi/mL
Plutonium-238 in well water[d]	$= 3.1 \pm 3.9 \times 10^{-12}$	µCi/mL
Tritium in well water[d]	$= 0.05 \pm 0.04 \times 10^{-6}$	µCi/mL
Uranium-233,234 in river water[b]	$= 0.75 \pm 0.13 \times 10^{-9}$	µCi/mL
Uranium-238 in river water[b]	$= 0.7 \pm 0.02 \times 10^{-9}$	µCi/mL
Plutonium-238 in river silt[b]	$= 0.55 \pm 1.4 \times 10^{-9}$	µCi/g
Plutonium-238 in surface water silt[c]	$= 0.02 \pm 1.6 \times 10^{-9}$	µCi/g
Tritium in grass[c]	$= 0.29 \pm 0.06 \times 10^{-6}$	µCi/g
Tritium in tomatoes[e]	$= 0.96 \pm 0.12 \times 10^{-6}$	µCi/g
Plutonium-238 in grass[c,f]	= n.d.	
Plutonium-238 in potatoes[e]	$= 0.02 \pm 0.15 \times 10^{-9}$	µCi/g
Plutonium-238 in fish[e]	$= 0.09 \pm 0.13 \times 10^{-9}$	µCi/g

[a]Measured at offsite sampler 119.

[b]Measured 32 km (20 mi) upstream on Great Miami River.

[c]Measured 61 km (38 mi) southeast of Mound.

[d]Measured 58 km (36 mi) southeast of Mound.

[e]Measured 64 km (40 mi) west of Mound.

[f](n.d.) environmental level cannot be detected above reagent blanks.

Summary

The local environment around Mound was monitored primarily for tritium and plutonium-238. The results are reported for 1986. Environmental media analyzed included air, water, vegetation, foodstuffs, and sediment.

The average concentrations of plutonium-238 and tritium were within the DOE interim air and water Derived Concentration Guides (DCG) for these radionuclides [4,5].

The average incremental concentrations of plutonium-238 and tritium oxide in air measured at all offsite locations during 1986 were 7.5×10^{-18} µCi/mL and 10.4×10^{-12} µCi/mL, respectively. These correspond to 0.03% and 0.01%, respectively, of the DOE DCGs for uncontrolled areas [5]. Details of the applicable standards are given in the Appendix.

The average incremental concentration of plutonium-238 measured at all locations in the Great Miami River during 1986 was 2.1×10^{-12} µCi/mL which is 0.0005% of the DOE DCG. The average incremental concentration of tritium measured at all locations in the Great Miami River during 1986 was 0.09×10^{-6} µCi/mL which is 0.005% of the DOE DCG.

Radionuclide effluent data for 1986 are summarized in Table 4.

The average incremental concentrations of plutonium-238 found during 1986 in surface and area drinking water were less than 0.00006% of the DOE DCG. In addition, the average incremental concentration of tritium in surface water was less than 0.005% of the DOE DCG.

Table 4 - EFFLUENT DATA FOR 1986

Radionuclide	Medium	Quantity
Tritium	air	3555 Ci
Tritium	water	6.47 Ci
Plutonium-238	air	5.8×10^{-6} Ci
Plutonium-238	water	6.9×10^{-4} Ci
Plutonium-239	air	1.3×10^{-7} Ci
Plutonium-239	water	5.3×10^{-6} Ci
Uranium-233,234	air	7.5×10^{-8} Ci
Uranium-233,234	water	4.1×10^{-4} Ci
Uranium-238	air	8.4×10^{-8} Ci

All tritium in drinking water data is compared to the U. S. EPA Drinking Water Standard. When these comparisons are made, no environmental level is subtracted from the data. The average concentrations in local private and municipal drinking water systems were less than 25% and 1.5%, respectively, of the U. S. EPA standard.

The concentrations found in foodstuffs were extremely low. Although no DOE DCG is available for foodstuffs, the average concentrations are a small fraction of the water DCG (0.04%). Sediment samples were obtained at offsite surface water sampling locations. The concentrations of these samples were extremely low and therefore represent no adverse impact to the environment.

The dose equivalent estimates for the average air, water, and foodstuff concentrations indicate that the levels are within 1% of the DOE standard of 100 mrem [4]. The air emission dose as calculated with the EPA AIRDOS model is 1% of the EPA air emission standard of 25 mrem. The person-rem calculated to 80 km for the total population as a

result of Mound operations during 1986 was 16 person-rem. Background radiation would result in approximately 670,000 person-rem for the area.

Data for the emission of nonradioactive species into the atmosphere are also presented. All of these emissions were 25% or less of the applicable air emissions standard.

A National Pollutant Discharge Elimination System (NPDES) permit regulates nonradioactive pollutants in Mound's effluent water. The NPDES permit requires this effluent to be characterized by analyzing samples collected at four onsite locations. Less than 0.5% of the 820 NPDES measurements exceeded maximum permit limitations. Parameters involved were biochemical oxygen demand, fecal coliform, suspended solids, and copper.

None of these exceptions, however, had an adverse impact on the water quality of the Great Miami River or caused the river to exceed Ohio Stream Standards which are found in the Appendix.

Environmental Surveillance

Quality Assurance

An essential part of Mound's Quality Assurance Program is the analysis of reference samples from reliable outside laboratories. During 1986, Mound analyzed reference samples from DOE's Environmental Measurements Laboratory (EML); from the U. S. Environmental Protection Agency (EPA); and from a private laboratory, Analytical Products Group, Inc. (APG). The EML samples contained trace radionuclides in air filters, water, soil, and vegetation. The EPA and APG samples contained nonradioactive contaminants in water.

Concentrations of plutonium, uranium, and tritium in the EML samples analyzed in 1986 are given in Table 5. Agreement between the Mound values and the EML reference values is better than 20% in all but two measurements. Two of the results, plutonium-238 and plutonium-239 in vegetation were higher than the EML values by a factor of about two. When these results were obtained from EML, two additional vegetation samples were analyzed for plutonium. The results of these two samples essentially agreed with the earlier measurements. The average of all four Mound measurements for Pu-238 was 0.146 pCi/g ± 12%, and for Pu-239 it was 0.0362 pCi/g ± 16%. The ratios of the average of the Mound measurements to the EML reference values are 2.17 for Pu-238 and 2.13 for Pu-239, essentially the same as given in Table 5.

It was postulated that there could possibly be an error in the value of the tracer that was used in this analysis. However, since the same tracer was used in the determination of plutonium in the

Table 5 - MOUND'S DOE QUALITY ASSESSMENT PROGRAM RESULTS FOR 1986

Sample Type	Sample No.	Isotope	Concentration[a] Mound	Concentration[a] EML[b]	Concentration Ratio Mound to EML
Air Filter	8606	Plutonium-239	2.33 ± 6%[c]	2.39 ± 2%[d]	0.97 ± 0.06[e]
Water	8606	H-3	20.7 ± 1%	21.8 ± 1%	0.95 ± 0.01
		Plutonium-239	0.061 ± 1%	0.056 ± 3%	1.09 ± 0.003
		Uranium-234	0.035 ± 1%	0.032 ± 12%	1.08 ± 0.13
		Uranium-238	0.034 ± 1%	0.033 ± 6%	1.04 ± 0.06
Soil	8606	Uranium-234	0.46 ± 2%	0.56 ± 2%	0.82 ± 0.02
		Uranium-238	0.050 ± 2%	0.053 ± 6%	0.95 ± 0.02
Vegetation	8606	Plutonium-238	0.132 ± 6%	0.067 ± 13%	1.97 ± 0.28
	8606	Plutonium-239	0.033 ± 12%	0.017 ± 11%	1.94 ± 0.32

[a]Units are pCi/filter for air samples, pCi/mL for water, and pCi/g for soil and vegetation samples.

[b]Environmental Measurements Laboratory.

[c]Mound's errors are two sigma errors based on counting statistics or replicate analysis.

[d]EML's errors are "standard errors of the mean."

[e]The error in the ratio is calculated as $(SM^2 + SE^2)^{1/2}$, where SM and SE are the Mound and EML relative errors.

air filter sample and this measurement showed excellent agreement with the reference value (see Table 5), the tracer concentration was not believed to be in error. It was observed that four other laboratories also had unusually high results for the measurement of plutonium in the vegetation samples from EML.

In Table 6 the Mound results in the 1986 EPA Quality Assurance Program for the determination of nonradioactive parameters in water are compared to the EPA "true values." All eleven of the measured parameters were within the acceptance limits established by the EPA.

A second part of Mound's Quality Assurance Program in the measurement of nonradioactive parameters in water involved the analysis of reference samples prepared by Analytical Products Group, Inc. (APG). Analysis of these APG samples is part of a Monsanto Company quality control program. Mound analyzed four sets of APG samples in 1986, and these results are summarized in Table 7. In the APG reports, the difference between the Mound value and the APG reference value is expressed as the number of standard deviations of the Mound value from the average determined for all participating laboratories. When this number of standard deviations from this average exceeds two standard deviations, this generally indicates a problem in the measurement. The range of the observed number of standard deviations

Table 6 - MOUND'S 1986 EPA QUALITY ASSURANCE PROGRAM RESULTS FOR THE DETERMINATION OF NONRADIOACTIVE PARAMETERS IN WATER

Parameter Measured	True Value	Mound[a] Value	EPA[b] Acceptable Limits
Cadmium	307 µg/L	310 µg/L	269-348 µg/L
Chromium	274 µg/L	270 µg/L	213-331 µg/L
Copper	380 µg/L	360 µg/L	332-422 µg/L
Nickel	532 µg/L	540 µg/L	460-605 µg/L
pH	6.70	6.65	6.54-6.83
Total Suspended Solids	35.6 mg/L	35 mg/L	26.6-37.5 mg/L
Oil and Grease	16 mg/L	15.9 mg/L	7.4-22.1 mg/L
Total Cyanide	1.05 mg/L	1.13 mg/L	0.609-1.36 mg/L
Total Residual Chlorine	1.14 mg/L	1 mg/L	0.721-1.49 mg/L
Chemical Oxygen Demand	97.9 mg/L	87 mg/L	70.8-115 mg/L
5-Day Biochemical Oxygen Demand (BOD)	63.8 mg/L	62 mg/L	40.4-87.3 mg/L

[a]Standard deviations (precision) in Mound's values are generally ±10% or less; for BOD standard deviation is closer to ±30%.

[b]Any measured concentrations falling in this range are considered acceptable by the EPA.

Table 7 - SUMMARY OF MOUND'S PERFORMANCE IN THE ANALYTICAL PRODUCTS GROUP PROFICIENCY TESTING PROGRAM FOR 1986

Parameter Measured in Water	Parameter Range Measured	Range of Observed Number of Standard Deviations from the Average
Biochemical Oxygen Demand	13.4-275 mg/L	0.1-1.3
Chemical Oxygen Demand	21.6-42 mg/L	0.1-1.2
Total Suspended Solids	36.4-429 mg/L	0.5-1.7
Oil and Grease	4.1-43.4 mg/L	0.1-0.8
pH	5.00-9.21	0.1-0.6
Cyanide	0.18-2.55 mg/L	0.1-2.2
Residual Chlorine	0.27-5.07 mg/L	0.1-0.6
Cadmium	29-238 μg/L	0.1-0.7
Chromium	74-235 μg/L	0.1-0.4
Copper	46-163 μg/L	0.1-2.3
Nickel	63-173 μg/L	0.1-0.6

from the average for each parameter measured is given in Table 7. For the 81 measurements made on the standard APG samples, there were only two measurements where the Mound value varied from the average value by more than two standard deviations.

One copper measurement was 2.3 standard deviations from the mean; the copper concentration measured, 46.3 μg/L, is near Mound's lower detection limit for the measurement of copper. One cyanide measurement differed from the average by 2.2 standard deviations. This measurement was for a rather low reference sample value of 0.18 mg/L, where Mound's measurement was 0.23 mg/L. Five other cyanide measurements differed from the average by less than one standard deviation.

Another essential part of Mound's Quality Assurance Program is the determination of "blank values." A "blank value" is a measurement result for a contaminant determined by carrying out the chemical analysis procedure without a true sample, but rather using deionized water, a clean filter paper, or only the reagents used in the analysis. Analysis of "blanks" is essential because many of the samples analyzed show contaminant concentrations at or below the lower detection limit of the analytical method being used. Analyzing "blanks" is essential in verifying the absence of excessive laboratory contamination or detector background. Also, the standard deviation of the "blank values" is used to calculate lower detection limits, which are given with each set of environmental data in this report.

Other aspects of Mound's Environmental Section quality control program have been documented in a quality control manual [6].

In summary, along with a formal quality control program, the agreement between Mound measured concentrations and reference values of EML, the EPA, or APG, indicates good reliability of the data generated in the routine environmental monitoring program.

Air - Radioactive

In 1986, the offsite air-sampling network consisted of 15 continuously operating air-sampling stations used for sampling both tritium oxide and plutonium. Ten sampling stations are located within a 1.6 km (1 mi) radius of Mound, and four samplers are located in or near population centers. The remaining sampler (#119) is approximately 44.8 km (28 mi) from Mound in the least prevailing wind direction. This sampler receives no measurable contribution from Mound operations and serves as a baseline sample for computing background environmental levels.

The radionuclide concentrations from sampler #119 are subtracted from concentrations detected at other locations. The samplers currently in operation are located at critical distances and directions, based on a diffusion model developed for Mound [7]. The locations of the sampling stations are shown in Figure 1.

Two types of samples are collected at each sampling station. One is a particulate air sample for plutonium-238 analysis, and the other, from a bubbler-type sampler, is for tritium oxide analysis. The particulate sample is collected on a 200-mm diameter Microsorban or fiberglass disk by a continuously operating (24 hr/day, 7 days/week) high-volume air sampler. The air is sampled at an average rate of 1.3×10^6 cm³/min (∿45 ft³/min). The Microsorban disk is changed weekly and represents a sample of approximately 13,000 m³ of air. Individual sample flow rates are used to calculate concentrations at each location. Plutonium-238 analyses were performed on a monthly composite for three sampling locations, #122, #123, and #124, and on quarterly composites for the other offsite locations.

The analytical scheme for plutonium-238 incorporates the following basic steps: use of an internal tracer, chemical treatment, separation of plutonium with anion exchange resin, and alpha spectrometry.

The average incremental offsite plutonium-238 air concentration for all locations was 7.5×10^{-18} µCi/mL, which is 0.03% of the DOE DCG. The analytical results are summarized in Table 8.

Table 9 shows concentrations of plutonium-239,240 and plutonium-238, including environmental levels for the sake of completeness.

The gas bubbler sample is also collected on a continuous basis by bubbling air at approximately 3×10^3 cm³/min through 200 mL of ethylene glycol. Ethylene glycol is used because this material eliminates evaporation and freezing problems associated with sample collection [8]. Tritium (oxide) in the air is collected in the solution. Tritium oxide rather than elemental tritium is sampled and analyzed because about half of the tritium emission is in the oxide form, and the Derived Air Concentration is much more restrictive (25,000 times) than it is for elemental tritium [9]. A sample representing ∿30 m³ of air is collected, and an aliquot representing 0.15 m³ is counted in a liquid scintillation spectrometer. The average incremental concentration of tritium oxide measured during 1986 for all offsite locations, not including the environmental level found at sampler #119, was 10.4×10^{-12} µCi/mL. This concentration is

Table 8 - INCREMENTAL CONCENTRATIONS OF PLUTONIUM-238 IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1986

Location	Number of Samples	Plutonium-238 (10^{-18} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG
101	4	0.49	10.2	3.5 ± 7.24	0.012
102	4	3.41	38.3	14.3 ± 26.2	0.048
103	4	3.08	23.8	10.5 ± 14.6	0.035
104	4	0.41	19.8	5.91 ± 14.8	0.02
105	4	0.27	26.4	7.06 ± 20.5	0.024
108	4	e.l.	0.26	e.l.	-
110	4	e.l.	0.33	0.05 ± 0.48	0.0002
111	4	e.l.	0.56	0.3 ± 0.56	0.001
112	4	0.18	13.3	3.52 ± 10.3	0.012
115	3	e.l.	0.81	0.27 ± 1.21	0.001
118	4	0.58	3.96	1.94 ± 2.4	0.007
122	12	0.93	77.3	9.9 ± 13.6	0.033
123	10	1.49	66.5	26.7 ± 17.8	0.089
124	12	1.14	82.3	20.7 ± 16.4	0.069

[a]Average environmental level (e.l.) found in Table 3 is subtracted from the data.

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

[c]Lower detection limit (LDL) for monthly values of plutonium-238 in air is 0.23 x 10^{-18} µCi/mL; for quarterly values, 0.08 x 10^{-18} µCi/mL.

[d]DOE DCG for plutonium-238 in air is 30,000 x 10^{-18} µCi/mL.

Table 9 - CONCENTRATIONS OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1986

Location	Number of Samples	Plutonium-239,240 (10^{-18} µCi/mL) Minimum[a]	Maximum	Average[b,c]	Plutonium-238 (10^{-18} µCi/mL) Average[b,c]
101	4	0.07	0.41	0.25 ± 0.24	3.66 ± 7.23
102	4	0.05	0.37	0.28 ± 0.25	14.5 ± 26.2
103	4	0.03	0.39	0.24 ± 0.25	10.6 ± 14.6
104	4	0.01	0.62	0.27 ± 0.41	6.07 ± 14.8
105	4	0.08	0.41	0.27 ± 0.24	7.22 ± 20.5
108	4	0.15	0.41	0.22 ± 0.23	0.13 ± 0.32
110	4	0.25	0.58	0.29 ± 0.4	0.21 ± 0.33
111	4	0.09	0.23	0.15 ± 0.15	0.46 ± 0.43
112	4	0.08	0.21	0.13 ± 0.12	3.68 ± 10.3
115	3	0.11	0.28	0.15 ± 0.28	0.43 ± 1.15
118	4	0.07	0.38	0.2 ± 0.22	2.1 ± 2.37
119	4	0.05	0.28	0.18 ± 0.18	0.16 ± 0.35
122	12	n.d.	1.01	0.26 ± 0.19	10.1 ± 13.6
123	10	n.d.	0.99	0.36 ± 0.24	26.8 ± 17.8
124	12	n.d.	1.43	0.37 ± 0.28	20.8 ± 16.4

[a]The (n.d.) indicates that the values cannot be detected above the reagent blanks.

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

[c]Lower detection limit (LDL) for monthly values of plutonium-238 in air is 0.23 x 10^{-18} µCi/mL; for quarterly values, 0.08 x 10^{-18} µCi/mL. Lower detection limit (LDL) for monthly values of plutonium-239,240 in air is 0.15 x 10^{-18} µCi/mL; for quarterly values, 0.04 x 10^{-18} µCi/mL.

0.01% of the DOE DCG. The results are summarized in Table 10. Environmental levels for plutonium-238 and tritium in air as measured at sampler #119 are shown in Table 3. These environmental levels of plutonium-238 and tritium in air are subtracted from the sample data.

An onsite perimeter network consisting of five continuous, high-volume air samplers is used to further assess the effectiveness of stack emission control systems. The onsite sampling locations are shown in Figure 4. Particulate samples and tritium samples are collected by the onsite samplers at approximately the same flow rate as the offsite samplers and are analyzed in the same manner.

The average incremental plutonium-238 concentration measured for all locations onsite is 94×10^{-18} µCi/mL, which is 0.3% of the DOE DCG. The results are summarized in Table 11. Table 12 presents onsite concentrations of plutonium-239,240, and plutonium-238, including environmental levels, for the sake of completeness. The quantity of plutonium-238 discharged to the atmosphere during 1986 was 5.8×10^{-6} Ci.

The average incremental onsite tritium oxide concentration for all locations was 25×10^{-12} µCi/mL, which is 0.03% of the DOE DCG. The results are summarized in Table 13. The quantity of tritium discharged to the atmosphere during 1986 was 3555 Ci.

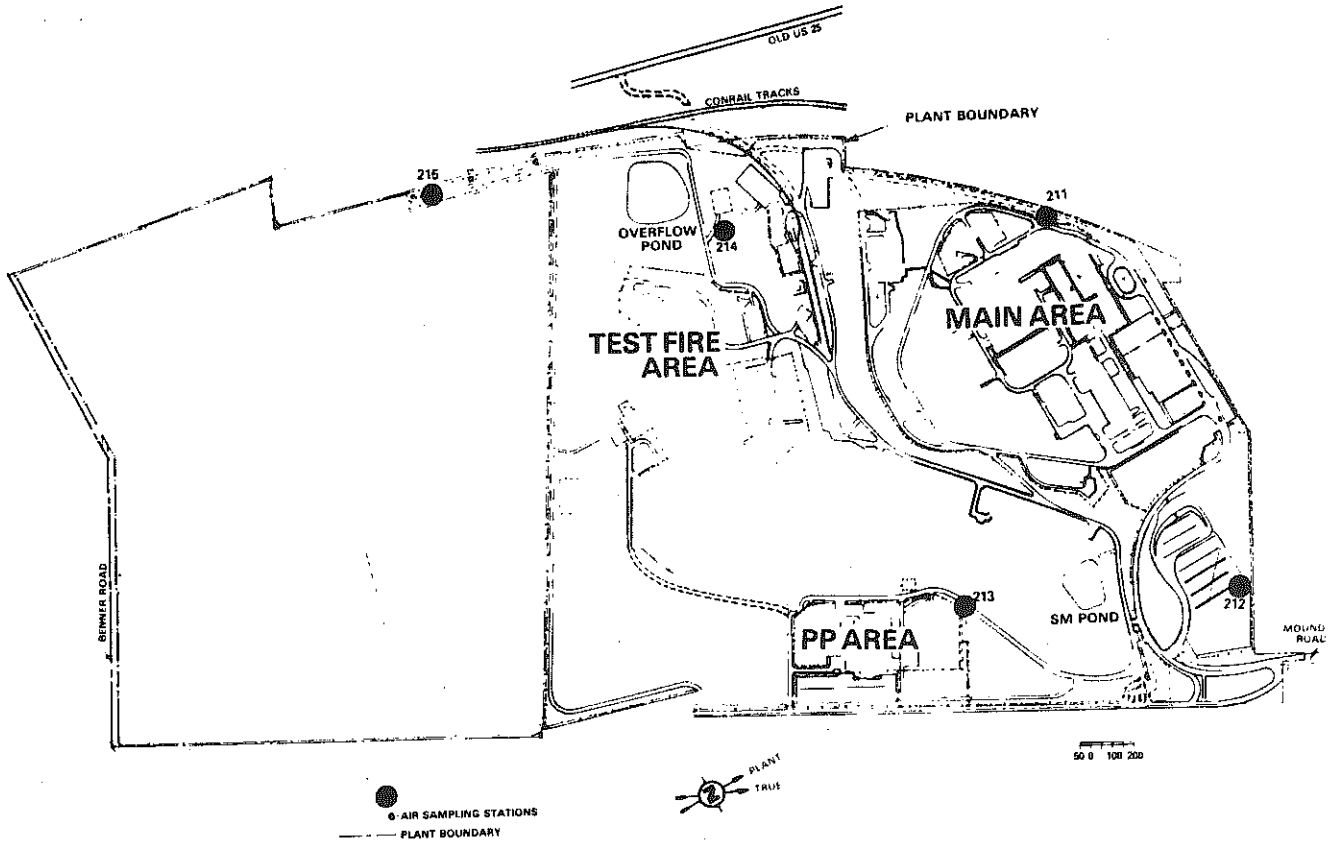


FIGURE 4 - Onsite air sampling locations.

Table 10 - INCREMENTAL CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT OFFSITE SAMPLING LOCATIONS IN 1986

Location	Number of Samples	Tritium Oxide (10^{-12} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG
101	48	e.l.	85.8	24.5 ± 7.07	0.025
102	50	e.l.	120	23.2 ± 7.37	0.023
103	49	e.l.	31.9	8.57 ± 4.36	0.009
104	50	e.l.	60.5	11 ± 4.87	0.011
105	50	e.l.	35.3	3.96 ± 4.03	0.004
108	51	e.l.	37.2	5.61 ± 3.44	0.006
110	49	e.l.	32.9	3.68 ± 3.69	0.004
111	52	e.l.	59	3.63 ± 4.08	0.004
112	47	e.l.	38.9	4.02 ± 3.89	0.004
115	50	e.l.	188	6.73 ± 8.36	0.007
118	48	e.l.	32	4.5 ± 4	0.005
122	52	e.l.	93.6	13.7 ± 5.72	0.014
123	43	e.l.	53.5	12 ± 5.64	0.012
124	48	e.l.	89.6	21.2 ± 5.75	0.021

[a]Average environmental level (e.l.) found in Table 3 subtracted from the data.

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

[c]Lower detection limit (LDL) for tritium oxide in air is 17 x 10^{-12} µCi/mL.

[d]DOE DCG for tritium oxide in air is 100,000 x 10^{-12} µCi/mL. This value has been adjusted to include the fraction of tritium oxide which is absorbed through the skin as part of the inhalation pathway.

Table 11 - INCREMENTAL CONCENTRATIONS OF PLUTONIUM-238 IN AIR AT ONSITE SAMPLING LOCATIONS IN 1986

Location	Number of Samples	Plutonium-238 (10^{-18} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG
211	11	8.29	388	125 ± 91	0.42
212	12	4.19	194	53.4 ± 39.1	0.18
213	12	53	447	178 ± 79.3	0.59
214	12	7.35	372	93.4 ± 67.5	0.31
215	12	1.55	127	22.4 ± 22	0.08

[a]Average environmental level (e.l.) found in Table 3 subtracted from the data.

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

[c]Lower detection limit (LDL) plutonium-238 in air is 0.23 x 10^{-18} µCi/mL.

[d]DOE DCG for plutonium-238 in air is 30,000 x 10^{-18} µCi/mL.

Table 12 - CONCENTRATIONS OF PLUTONIUM INCLUDING ENVIRONMENTAL LEVELS IN AIR AT ONSITE SAMPLING LOCATIONS IN 1986

Location	Number of Samples	Plutonium-239,240 (10^{-18} µCi/mL) Minimum [a]	Maximum	Average[b,c]	Plutonium-238 (10^{-18} µCi/mL) Average[b,c]
211	11	n.d.	3.76	0.92 ± 0.73	125 ± 91
212	12	n.d.	0.82	0.31 ± 0.2	53.5 ± 39.1
213	12	0.53	5.53	1.47 ± 0.98	178 ± 79.3
214	12	n.d.	1.55	0.63 ± 0.36	93.6 ± 67.5
215	12	n.d.	1.14	0.31 ± 0.21	22.5 ± 22

[a]The (n.d.) indicates that the values cannot be detected above the reagent blanks.

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

[c]Lower detection limit (LDL) for monthly values of plutonium-238 in air is 0.23 x 10^{-18} µCi/mL. Lower detection limit (LDL) for monthly values of plutonium-239,240 in air is 0.15 x 10^{-18} µCi/mL.

Table 13 - INCREMENTAL CONCENTRATIONS OF TRITIUM OXIDE IN AIR AT ONSITE SAMPLING LOCATIONS IN 1986

Location	Number of Samples	Tritium Oxide (10^{-12} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG
211	50	e.l.	94	23.8 ± 6.42	0.024
212	51	e.l.	75.3	21.1 ± 5.78	0.021
213	50	2.19	123	40.9 ± 8.74	0.041
214	50	e.l.	100	21.3 ± 6.67	0.021
215	51	e.l.	64.4	15.5 ± 5.45	0.016

[a]Average environmental level (e.l.) found in Table 3 subtracted from the data.

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

[c]Lower detection limit (LDL) for tritium oxide in air is 17 x 10^{-12} µCi/mL.

[d]DOE DCG for tritium oxide in air is 100,000 x 10^{-12} µCi/mL. This value has been adjusted to include the fraction of tritium oxide which is absorbed through the skin as part of the inhalation pathway.

Air - Nonradioactive

The primary source of nonradioactive airborne emissions is the Mound steam power plant. This plant is normally fueled with natural gas, but can burn fuel oil. During unusually cold weather, if the natural gas supply to Mound is interrupted, fuel oil with <1% sulfur content is burned. Approximately 87,000 liters (23,000 gal) of fuel oil were burned during 1986.

Additional sources of airborne emissions are as follows. A waterwash, paint spray booth is operated intermittently in the Mound paint shop. Wastes from operations involving explosives are disposed of by open burning under a permit issued by the Regional Air Pollution Control Agency (RAPCA). Fire-fighter training exercises are held at an open outdoor facility under a burning permit issued by RAPCA.

Emissions from sources and the applicable emission standards are summarized in Table 14. The emissions were estimated from emission factors established by the U.S. EPA [10]. Emission factors allow calculation of emissions based on quantity of material used or consumed. Nonradioactive airborne emissions at Mound were all within applicable standards and had minimal impact on ambient air quality. This is further demonstrated by the particulate concentration data summarized in Tables 15 and 16.

The data presented are weekly particulate concentrations measured at Mound's offsite and onsite air-sampling sites (Figures 1 and 4). The particulate concentration at onsite locations is generally within the range of the offsite locations. The particulate concentration also appears to be independent of distance from Mound. This would suggest no influence from Mound operations. For comparison, the State of Ohio - Ambient Quality Standard for airborne particulates is also given in Table 15.

Table 14 - NONRADIOACTIVE AIRBORNE EMISSIONS - 1986

Emission Source	Pollutant	Emission	Emission Standard[a]	% of Standard
Powerhouse	Particulates	0.005 lb/10^6 Btu Input	0.02 lb/10^6 Btu	25
Powerhouse	Sulfur Oxides	0.002 lb/10^6 Btu Input	1.6 lb/10^6 Btu	0.1
Paint Shop	Organics	0.7 lb/day	40 lb/day	1.7
Explosives Burning	Particulates	23 lb	NA	NA
Fire Fighter Training	Particulates	19 lb	NA	NA

[a]Ohio EPA Air Pollution Regulations 3745-17-10, 3745-18-06, and 3745-21-07.

NA - Not applicable.

Table 15 - 1986 PARTICULATE CONCENTRATIONS OFFSITE

Location	Number of Samples	Particulates[a] (μg/m³) Minimum	Maximum	Annual[a,b] Arithmetic Average (μg/m³)
101	49	20	85	47 ± 4
102	51	12	86	37 ± 4
103	52	9	47	31 ± 2
104	52	5	244	68 ± 13
105	52	13	57	34 ± 3
108	45	7	60	41 ± 3
110	42	16	54	33 ± 3
111	52	16	102	41 ± 4
112	50	5	48	29 ± 2
115	41	11	276	45 ± 13
118	50	0.2	68	36 ± 4
119	48	4	62	26 ± 3
122	52	9	46	28 ± 2
123	38	16	50	34 ± 3
124	52	2	54	31 ± 3

[a]Ohio Ambient Air Quality Standard = 60 μg/m³ (annual geometric mean).

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

These data are obtained by the Mound air monitoring program and are indicative only of the particulate air loading of the Dayton metropolitan area. Mound particulate discharges presented in Table 14 make a negligible contribution to the surrounding area. Table 16 presents onsite particulate data.

Table 16 - 1986 PARTICULATE CONCENTRATIONS ONSITE

Location	Number of Samples	Particulates (μg/m³) Minimum	Maximum	Annual[a] Arithmetic Average (μg/m³)
211	51	7	123	52 ± 8
212	52	1	91	31 ± 3
213	50	2	116	64 ± 6
214	52	16	149	46 ± 6
215	52	4	62	32 ± 3

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

Water - Radioactive

Water sampling locations along the banks of the Great Miami River were selected according to guidelines recommended by the U. S. EPA [11]. The locations, shown in Figure 5, provide samples that are representative of river water after considerable mixing of the effluent from Mound has occurred. Water samples are normally collected and filtered in the field at these locations five days per week and are subjected to specific analyses for plutonium-238 and tritium.

Water samples are analyzed by compositing daily samples for a quarterly analysis. The average incremental concentration of plutonium-238 measured for all locations in the Great Miami River was 2.1 x 10^{-12} µCi/mL, which is 0.0005% of the DOE DCG. These results are summarized in Table 17.

Weekly samples are analyzed for tritium. The average incremental concentration of tritium measured at all locations in the Great Miami River was 0.09 x 10^{-6} µCi/mL, which is 0.005% of the DOE DCG. These results are summarized in Table 18.

Uranium-233, 234, and 238 were also monitored at the river water sampling locations during 1986. The average incremental concentration of uranium-233,234 was at the environmental level. The average incremental concentration for uranium-238 was also at the environmental level. In addition, as shown in Table 19, the ratio of uranium-233,234 to uranium-238 is slightly greater than unity, which is in range of background ratios reported [12]. This is expected as a result of secular equilibrium.

The total discharges to the Great Miami River during 1986 consisted of 6.9 x 10^{-4} Ci of plutonium-238, 6.47 Ci of tritium, 4.1 x 10^{-4} Ci of uranium-233,234, and 5.3 x 10^{-6} Ci of plutonium-239. The average concentrations of these materials in the discharge system were: plutonium-238, 0.35 x 10^{-9} µCi/mL; tritium, 10.4 x 10^{-6} µCi/mL; uranium-233,234, 0.45 x 10^{-9} µCi/mL; and plutonium-239, 0.006 x 10^{-9} µCi/mL. The percentages of DOE DCG for these concentrations were: plutonium-238, 0.09%; tritium, 0.5%; uranium-233, 234, 0.09%; and plutonium-239, 0.002%.

Seven additional surface water locations, such as ponds, in all quadrants surrounding Mound as shown in Figure 5 are sampled quarterly for plutonium and tritium analyses. The average concentrations of plutonium-238 and tritium for all locations were 0.2 x 10^{-12} µCi/mL and 0.09 x 10^{-6} µCi/mL, respectively, which are 0.00005% and 0.005%, respectively, of the DOE DCG. The results of the surface water samples are summarized in Tables 20 and 21. Environmental levels (Table 3) have been subtracted from the concentration of plutonium and tritium in water.

Drinking water from communities in the surrounding area is sampled and analyzed quarterly for tritium. These communities and their relative locations are shown in Figure 5. The average concentration of tritium for all locations was 0.28 nCi/L which is 1.4% of the standard adopted by the U. S. EPA in 1977 for community drinking water systems. Data from the analyses of community drinking water samples are summarized in Table 22. The environmental level in Table 3 for tritium in water is not subtracted from these

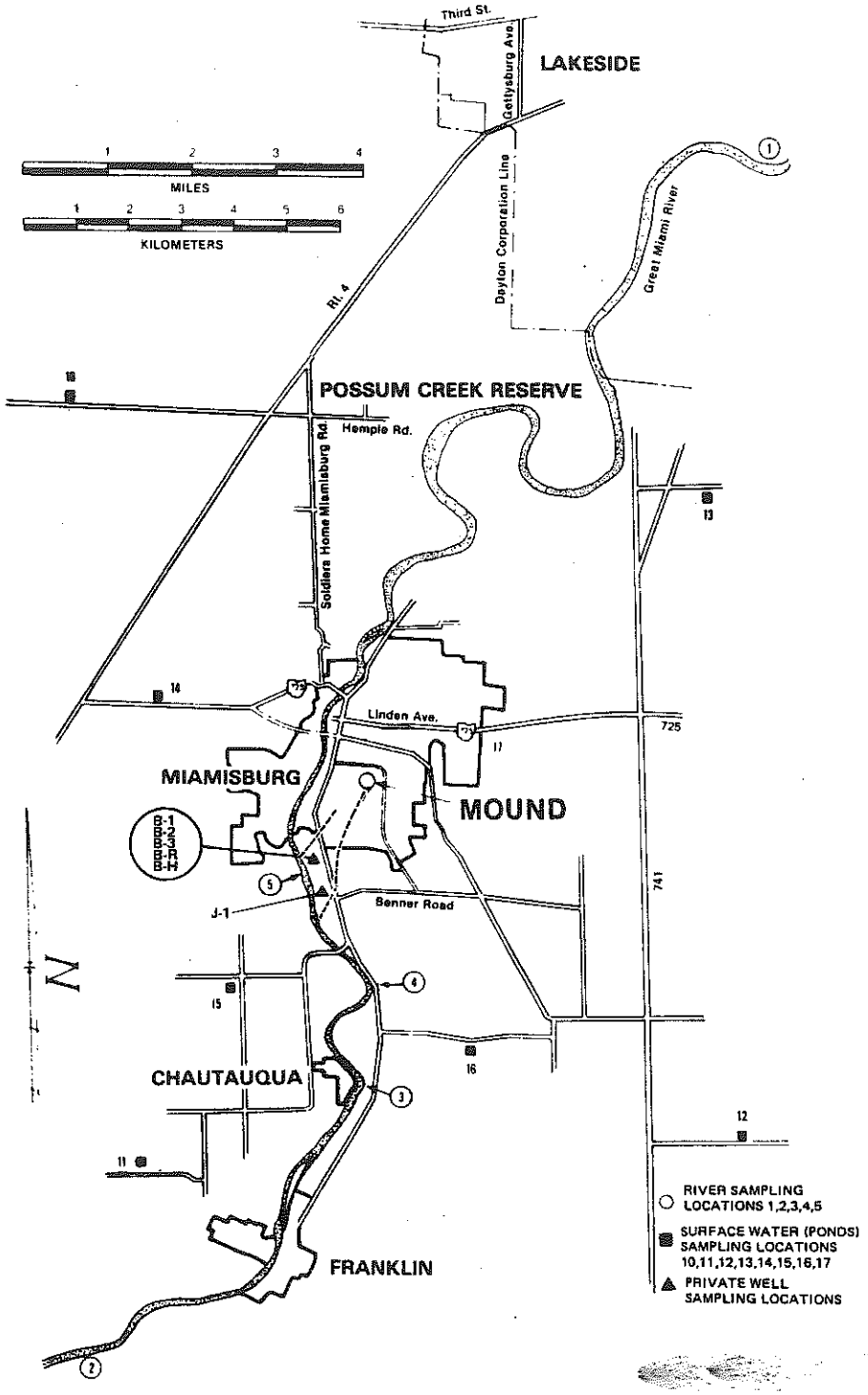


FIGURE 5 - Offsite water sampling locations.

Table 17 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN THE GREAT MIAMI RIVER IN 1986

Location	Number of Samples	Plutonium-238 (10^{-12} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG
1	3	1.08	4.65	2.41 ± 9.65	0.0006
2	3	e.l.	3.33	1.17 ± 10.4	0.0003
3	3	0.9	3.48	2.21 ± 8.94	0.0006
4	3	e.l.	2.78	1.3 ± 9.29	0.0003
5	3	1.2	7.68	3.56 ± 12.2	0.0009

[a]Average environmental level (e.l.) found in Table 3 subtracted from the data.

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

[c]Lower detection limit (LDL) plutonium-238 in water is 1.7×10^{-12} µCi/mL.

[d]DOE DCG for plutonium-238 in water is $400,000 \times 10^{-12}$ µCi/mL.

Table 18 - INCREMENTAL CONCENTRATIONS OF TRITIUM IN THE GREAT MIAMI RIVER IN 1986

Location	Number of Samples	Tritium (10^{-6} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG
1	36	e.l.	0.61	0.06 ± 0.06	0.003
2	37	e.l.	0.71	0.1 ± 0.07	0.005
3	37	e.l.	0.65	0.08 ± 0.06	0.004
4	36	e.l.	0.75	0.1 ± 0.07	0.005
5	36	e.l.	0.83	0.11 ± 0.07	0.006

[a]Average environmental level (e.l.) found in Table 3 subtracted from the data.

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

[c]Lower detection limit (LDL) for tritium in water is 0.05×10^{-6} µCi/mL.

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

Table 19 - INCREMENTAL CONCENTRATION OF URANIUM-233,234 AND URANIUM-238 IN THE GREAT MIAMI RIVER IN 1986

Location	Number of Samples	Uranium-233,234 (10^{-9} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG	Uranium-238 (10^{-9} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Ratio[e] Uranium-233,234 / Uranium-238
1	3	e.l.	0.04	e.l.	-	e.l.	e.l.	e.l.	1.1
2	3	e.l.	0.08	e.l.	-	e.l.	0.1	e.l.	1.1
3	3	e.l.	0.09	e.l.	-	e.l.	0.1	e.l.	1.1
4	3	e.l.	e.l.	e.l.	-	e.l.	e.l.	e.l.	1.1
5	3	e.l.	e.l.	e.l.	-	e.l.	e.l.	e.l.	1.2

[a]Average environmental level (e.l.) found in Table 3 subtracted from data.

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

[c]Lower detection limit (LDL) for uranium-233,234 is 0.01 x 10^{-9} µCi/mL. The LDL for Uranium-238 is 0.005 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 is 600 x 10^{-9} µCi/mL.

[e]Environmental level not subtracted from these data.

Table 20 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SURFACE WATER IN 1986

Location	Number of Samples	Plutonium-238 (10^{-12} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG
10	1			e.l.	-
11	3	e.l.	e.l.	e.l.	-
12	3	e.l.	e.l.	e.l.	-
13	3	e.l.	9.22	1.67 ± 16.6	0.0004
14	3	e.l.	e.l.	e.l.	-
15	3	e.l.	e.l.	e.l.	-
16	3	e.l.	e.l.	e.l.	-
17	3	e.l.	e.l.	e.l.	-

[a]Average environmental level (e.l.) found in Table 3 subtracted from the data.

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

[c]Lower detection limit (LDL) plutonium-238 in surface water is 1.7 x 10^{-12} µCi/mL.

[d]DOE DCG for plutonium-238 in water is 400,000 x 10^{-12} µCi/mL.

Table 21 - INCREMENTAL CONCENTRATION OF TRITIUM IN SURFACE WATER IN 1986

Location	Number of Samples	Tritium (10^{-6} µCi/mL) Minimum[a]	Maximum	Average[a,b,c]	Percent of[d] DOE DCG
10	8	0.04	0.21	0.1 ± 0.07	0.005
11	15	e.l.	0.13	e.l.	-
12	16	e.l.	0.07	e.l.	-
13	16	0.02	0.23	0.11 ± 0.06	0.006
14	12	e.l.	0.39	0.18 ± 0.12	0.009
15	16	e.l.	0.27	0.08 ± 0.08	0.004
16	16	e.l.	0.16	0.02 ± 0.07	0.001
17	16	0.16	0.37	0.28 ± 0.06	0.014

[a]Average environmental level (e.l.) found in Table 3 subtracted from the data.

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

[c]Lower detection limit (LDL) for tritium in surface water is 0.05 x 10^{-6} µCi/mL.

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

Table 22 - TRITIUM LEVELS IN COMMUNITY DRINKING WATER IN 1986

Location	Number of Samples	Tritium (nCi/L) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of EPA Standard
Bellbrook	16	0	0.42	0.21 ± 0.06	1.05
Centerville	16	0.03	0.51	0.2 ± 0.07	1
Dayton	16	0.06	0.57	0.23 ± 0.08	1.15
Franklin	16	0.15	0.44	0.28 ± 0.05	1.4
Germantown	16	0.07	0.34	0.19 ± 0.05	0.95
Kettering	16	0.02	0.41	0.2 ± 0.06	1
Miamisburg	20	0.44	1.06	0.83 ± 0.07	4.15
Middletown	16	0.06	0.36	0.19 ± 0.04	0.95
Moraine	16	0.04	0.36	0.16 ± 0.05	0.8
Springboro	16	0.23	0.45	0.37 ± 0.03	1.85
Waynesville	16	0.1	0.29	0.19 ± 0.03	0.95
West Carrollton	12	0.18	0.37	0.28 ± 0.04	1.4

[a]Average environmental level (e.l.) not subtracted from the data. The EPA standard of 20 nCi/L assesses total concentration including background.

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

[c]Lower detection limit (LDL) for tritium in community drinking water is 0.05 nCi/L..

data because the EPA standard assesses total concentration including background.

Drinking water from private wells is also analyzed for tritium. The average concentration of tritium for all private well locations was 4.4 nCi/L, which is 22% of the U. S. EPA Standard. These data are shown in Table 23.

Four private wells and Miamisburg city water were sampled and analyzed quarterly for plutonium-238. The average incremental plutonium-238 concentration for these locations was 0.05 x 10^{-12} µCi/mL, which is 0.00001% of the DOE DCG. These results are shown in Table 24.

Table 23 - TRITIUM IN PRIVATE WELLS IN 1986

Location	Number of Samples	Tritium (nCi/L) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of EPA Standard
B-1	17	3	4	3.6 ± 0.2	18
B-2	4	4	5.4	4.9 ± 1	24.5
B-3	7	4	5.2	4.8 ± 0.4	24
J-1	6	2	3.1	2.3 ± 0.4	11.5
B-H	34	4.1	6.8	5.1 ± 0.2	25.5
B-R	13	3.9	6.9	5.6 ± 0.5	28

[a]Average environmental level (e.l.) not subtracted from the data. The EPA standard of 20 nCi/L assesses total concentration including background.

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

[c]Lower detection limit (LDL) for tritium in well water is 0.05 nCi/L.

Table 24 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN PRIVATE WELLS AND MIAMISBURG MUNICIPAL DRINKING WATER IN 1986

Location	Number of Samples	Plutonium-238 (10^{-12} µCi/mL) Minimum[a]	Maximum[a]	Average[a,b,c]	Percent of[d] DOE DCG
Miamisburg	3	e.l.	1.7	0.23 ± 5	0.00006
B-1	3	e.l.	e.l.	e.l.	-
B-2	3	e.l.	0.81	e.l.	-
B-3	3	e.l.	e.l.	e.l.	-
J-1	2	e.l.	e.l.	e.l.	-

[a]Average environmental level (e.l.) found in Table 3 subtracted from the data.

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

[c]Lower detection limit (LDL) plutonium-238 in surface water is 1.7×10^{-12} µCi/mL.

[d]DOE DCG for plutonium-238 in water is $400,000 \times 10^{-12}$ µCi/mL.

Water - Nonradioactive

Mound discharged an average of 2.8 million liters (0.74 million gallons) of water per day in 1986 to the Great Miami River. Nonradioactive pollutants in this effluent water are regulated by a National Pollutant Discharge Elimination System (NPDES) permit. This permit, issued by the Ohio EPA, requires Mound to characterize its effluent water by analyzing samples collected at four onsite locations.

A 24-hr composite, flow proportional sample and a grab sample are collected from discharges 001-A, 001-B, and 002. Discharge 001-A contains the effluent from the sanitary sewage treatment plant. Discharge 001-B includes storm water runoff, single-pass cooling water, cooling tower blowdown, zeolite softener backwash, boiler plant blowdown, and discharge from the radioactive waste disposal facility. Discharge 002 consists of single-pass cooling water, cooling tower blowdown, zeolite softener backwash, and most of the plant storm water runoff. A time proportional sample (8-hr composite) and a grab sample are collected from the electroplating facility at discharge 001-C.

Mound's NPDES permit was renewed in October 1985 for a five-year period. The permit limits are found in Table 25 and in the Appendix. Results of effluent analyses for 1986 are summarized in Table 25. These water samples were analyzed for water quality parameters according to methods found in Standard Methods Edition 16 [13].

The EPA also requires Mound to monitor the flow and pH from a well which is periodically pumped as a part of the Potable Water Standards Project. Approximately 57 million liters (15 million gallons) were pumped from this well, discharge 003, in 1986. The pH was 7.6.

There were 820 samples analyzed for NPDES parameters during 1986. Effluent parameters exceeded maximum limits four times. These exceptions were reported to the Ohio EPA immediately. Monthly average limits were exceeded three times. These were reported to the Ohio EPA in the regular monthly reports. Parameters exceeded were biochemical oxygen demand (BOD), fecal coliform, copper, and suspended solids.

The BOD maximum exception was a result of a hydraulic surge in the aeration tanks caused from using an intermittent mode to control dissolved oxygen. This condition also contributed to the monthly average exception. Fecal coliform was above normal due to insufficient chlorination of the effluent, affecting both the maximum and monthly average limits. The copper exception was attributed to a small leak in a floor drain trap in the surface finishing laboratory. The suspended solids exception at effluent discharge 001B was caused by soil erosion which resulted from repair work on the storm drain system. Above normal rainfall of 5 in. in June was a contributing factor to the monthly average suspended solids exception at discharge 002.

In summary, the number of maximum exceptions represents 0.5% of the total NPDES measurements. All exceptions were of no consequence and short duration.

There was no adverse impact on the water quality of the Great Miami River. Data from the U. S. Geological Survey show that flow in the Great Miami River at Miamisburg in 1986 averaged 2100 million

Table 25 - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM DATA FOR 1986

Parameter	Units	No. of Samples	Minimum	Maximum	Annual Average	NPDES Permit Limits Maximum	NPDES Permit Limits Monthly Average
Discharge 001-A							
Flow Rate[a]	MGD	Cont.	0.05	0.17	0.10	c	c
pH	s.u.	56	7.2	8.5	8.3	9[b]	c
Biochemical Oxygen Demand	mg/L	80	0	19	4.8	15	10
Suspended Solids	mg/L	58	0.3	21	6.8	30	15
Fecal Coliform	MPN/100 mL	30	2	7050	325	2000	1000
Residual Chlorine	mg/L	129	0.15	0.43	0.33	0.5	c
Discharge 001-B							
Flow Rate	MGD	Cont.	0.02	0.22	0.08	c	c
Chemical Oxygen Demand	mg/L	78	4	150	30	c	c
Suspended Solids	mg/L	59	1.7	53	16.5	45	30
Grease and Oil	mg/L	23	0.4	3.5	1.4	10	c
pH	s.u.	54	7.7	9.3	8.5	9.5[b]	c
Discharge 001-C							
Cyanide	mg/L	24	<0.04	<0.04	<0.04	1	0.65
Chromium	µg/L	24	<50	<50	<50	500	c
Cadmium	µg/L	24	<10	22	<12	100	c
Nickel	µg/L	24	<50	180	<59	500	c
Copper	µg/L	24	60	809	160	500	c
pH	s.u.	28	7.5	8	7.7	9[b]	c
Total Toxic Organics	mg/L	4	<1.1	<1.1	<1.1	2.13	c
Discharge 002							
Flow Rate	MGD	Cont.	0	2.5	0.56	c	c
Suspended Solids	mg/L	54	4.3	54[d]	17.8	45	30
pH	s.u.	51	7.9	8.9	8.4	9[b]	c

[a]Includes flow from 001-C. The maximum flow from 001-C is approximately 2000 gal/day.

[b]pH also has a minimum limit of 6.5.

[c]No limit applicable.

[d]Rain exclusion - 2.48 in. over 3 days.

gallons per day (MGD), with a minimum and maximum of 272 MGD and 13,900 MGD, respectively. The magnitude of this river flow is significantly greater than Mound effluents, such that the above exceptions would have no measurable effect on the Great Miami River. In addition, a review of the data in Table 25 shows that Mound effluents did not cause the Great Miami River to exceed Ohio Stream Standards as shown in the Appendix.

Foodstuffs and Vegetation - Radioactive

Various locally grown foodstuffs and vegetation samples are collected from the surrounding area. The intent of this portion of the Environmental Monitoring Program is to determine whether there is uptake and concentration of radionuclides by plant or animal life. Samples were collected in Miamisburg, Centerville, Bellbrook, Trotwood, Franklin, and Germantown. Centerville and Bellbrook are in the prevailing wind direction from Mound at a distance of 8 km (5 mi) and 16 km (10 mi), respectively. Both communities are shown in Figure 1. Fish were collected in the Great Miami River. Mound's outfalls are shown as dotted lines in Figure 5. The plutonium-238 content of the foodstuff and vegetation samples is determined by ashing the samples, then proceeding with the same techniques used for plutonium-238 analyses of air samples (see section on Air - Radioactive). The tritium content of the foodstuff and vegetation samples is determined by distilling the water from the sample, then analyzing the distillate for tritium. The results of the foodstuff, vegetation, and fish analyses are summarized in Tables 26 and 27. The concentration is given in terms of the sample weight (wet weight) before ashing or distilling. The samples of aquatic life analyzed included only the edible, fleshy portions of fish. These analyses indicate no evidence of any significant uptake or concentration by plant or animal life of the radionuclides handled at Mound, and they are consistent with data obtained in previous years (1980-1985). Environmental levels for foodstuffs and vegetation have been subtracted from the data (Table 3).

Table 26 - INCREMENTAL PLUTONIUM-238 IN FOODSTUFFS AND VEGETATION IN 1986

Location	Type of Sample	Number of Samples	Plutonium-238 (10^{-9} µCi/g) Minimum	Maximum	Average[a,b]
Miamisburg	Grass[c,d]	4	n.d.	2.2	0.78 ± 1.6
	Potatoes[e]	4	e.l.	0.11	e.l.
Centerville	Grass	4	n.d.	0.47	n.d.
	Potatoes	4	e.l.	0.18	e.l.
Bellbrook	Grass	4	n.d.	0.38	0.1 ± 0.55
	Potatoes	4	e.l.	0.16	e.l.
Trotwood	Grass	4	n.d.	n.d.	n.d.
	Potatoes	4	e.l.	0.26	0.04 ± 0.3
Franklin	Grass	4	n.d.	0.49	0.09 ± 0.54
	Potatoes	4	e.l.	0.2	0.02 ± 0.3
Germantown	Grass	4	n.d.	0.3	0.11 ± 0.27
	Potatoes	4	e.l.	0.11	0.01 ± 0.22
Mound (outfall to river)	Fish	8	e.l.	0.33	0.03 ± 0.21

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

[b]Lower detection limit (LDL) for plutonium-238 in grass is 0.29×10^{-9} µCi/g. For plutonium-238 in potatoes, the LDL is 0.14×10^{-9} µCi/g. For plutonium-238 in fish, the LDL is 0.14×10^{-9} µCi/g.

[c]Average environmental level (e.l.) not subtracted from data. The environmental level was not detectable.

[d]n.d. - not detectable above blank levels.

[e]Average environmental level (e.l.) found in Table 3 subtracted from data.

Table 27 - INCREMENTAL CONCENTRATION OF TRITIUM IN VEGETATION IN 1986

Location	Type of Sample	Number of Samples	Tritium (10^{-6} µCi/g) Minimum[a]	Maximum[a]	Average[a,b,c]
Miamisburg	Grass	8	0.41	1.4	0.95 ± 0.37
	Tomatoes	4	0.09	0.27	0.18 ± 0.17
Centerville	Grass	8	0.64	1.06	0.84 ± 0.15
	Tomatoes	4	0.06	0.1	0.08 ± 0.12
Bellbrook	Grass	8	0.34	0.76	0.53 ± 0.15
	Tomatoes	4	e.l.	0.1	0.04 ± 0.17
Trotwood	Grass	8	0.74	1.13	0.94 ± 0.15
	Tomatoes	4	0.17	0.25	0.2 ± 0.13
Franklin	Grass	8	0.37	0.69	0.53 ± 0.1
	Tomatoes	4	e.l.	0.1	e.l.
Germantown	Grass	8	0.33	0.7	0.49 ± 0.15
	Tomatoes	4	e.l.	0.15	0.02 ± 0.23

[a]Average environmental level (e.l.) found in Table 3 subtracted from data.

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

[c]Lower detection limit (LDL) for tritium in grass is 0.1 x 10^{-6} µCi/g. For tritium in tomatoes, the LDL is 0.08 x 10^{-6} µCi/g.

Silt - Radioactive

Silt samples were collected from the river and surface water sample locations shown in Figure 5.

The results of the silt sample analyses are found in Tables 28 and 29. No adverse impact to the environment could be determined from the radionuclide levels found in these sediments.

Table 28 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM RIVER SAMPLING LOCATIONS IN 1986

Location	Number of Samples	Plutonium-238 (10^{-9} µCi/g) Minimum[a]	Maximum[a]	Average[a,b,c]
1	3	e.l.	4.6	1.4 ± 7.1
2	3	11	28	22 ± 23
3	2	24	61	43 ± 235
4	3	92	535	302 ± 552
5	3	8.7	17	13 ± 11

[a]Average environmental level (e.l.) found in Table 3 subtracted from data.

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

[c]Lower detection limit (LDL) for plutonium-238 in silt is 0.4×10^{-9} µCi/g.

Table 29 - INCREMENTAL CONCENTRATION OF PLUTONIUM-238 IN SILT FROM SURFACE WATER LOCATIONS IN 1986

Location	Number of Samples	Plutonium-238 (10^{-9} µCi/g) Minimum[a]	Maximum[a]	Average[a,b,c]
10	1			0.86
11	3	e.l.	0.5	0.2 ± 1.8
12	3	e.l.	2	0.9 ± 3.1
13	3	0.2	1.6	1.0 ± 2.4
14	3	0.05	5.1	2.0 ± 6.9
15	3	0.2	2.8	1.5 ± 3.6
16	3	e.l.	2.1	1.0 ± 3.2

[a]Average environmental level (e.l.) found in Table 3 subtracted from data.

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

[c]Lower detection limit (LDL) for plutonium-238 in surface water silt is 0.5×10^{-9} µCi/g.

Evaluation of Effective Dose Equivalent to the Public

The dose assessment techniques have been revised according to the Department of Energy guidelines. The "effective dose equivalent" is used in the dose assessment evaluation in this report [4].

The effective dose equivalent values for the plutonium-238 and tritium exposures from the air, water, and vegetation pathways are calculated and summed to estimate the maximum dose at the site boundary and to the individual. The general assumptions used in these determinations follow.

The solubility of ingested or inhaled plutonium-238 in the receptor is unknown. However, it is highly probable that most of the plutonium-238 is in the oxide form, which is very insoluble. In order to provide a realistic but conservative effective dose equivalent estimate, it is assumed that 50% of the plutonium-238 which is inhaled is soluble (class W) and 50% is insoluble (class Y). It is also assumed that the plutonium-238 that is ingested is soluble ($f1 = 10^{-4}$).

The term "effective dose equivalent," as used in this report, is that cumulative effective dose equivalent for a period of 50 yr from 1 yr of exposure to a given radionuclide. This effective dose equivalent is composed of the sum of the effective dose equivalents from the air, water, and foodstuffs pathways.

Dose Assessment Assumptions and Methodology

The effective dose equivalent estimates for plutonium-238 and tritium were based on environmental monitoring data for 1986. The estimates for maximum effective dose equivalent in air at the site boundary and maximum effective dose equivalent to individuals were based on the maximum onsite incremental average concentration of plutonium-238 and tritium (oxide) in air from onsite samplers (sampler 213, Table 11, and sampler 213, Table 13, respectively). These samplers are in proximity to the site boundary.

The estimates for water for maximum effective dose equivalent at the site boundary and in individuals were based on the maximum average incremental concentration of plutonium-238 and tritium in wells. The maximum offsite average concentration of plutonium-238 was the Miamisburg community water location and for tritium it was the average at location BR.

The terms "maximum effective dose equivalent at the site boundary" and "maximum effective dose equivalent to individuals" refer to the maximum dose equivalent for individuals to receive, assuming they remain at the site boundary 24 hr/day, 365 days/yr. During this continuous occupancy, it is assumed that the individual continually breathes air with maximum concentrations of radionuclides found at the onsite samplers. It is also assumed that the same individual consumes all his drinking water at the maximum radionuclide concentrations found in offsite wells. In addition, the same individual is assumed to consume a portion of foodstuffs with the maximum radionuclide concentrations found offsite. All of these contributions, air, water, and foodstuffs, are added to obtain an estimate of the total maximum effective dose equivalent. The estimated contributions from each pathway and the estimated total maximum effective dose equivalent are shown in Table 30.

The maximum dose to an individual from Mound's operations is an estimated 0.92 mrem which is less than 1% of the DOE standard of 100 mrem. To put this 0.92 mrem into perspective, one jet flight over the Atlantic would expose an

Table 30 - EFFECTIVE DOSE ESTIMATES

MAXIMUM EFFECTIVE DOSE COMMITMENT AT THE SITE BOUNDARY AND TO INDIVIDUALS IN THE POPULATION

Pathway	Plutonium (mrem)	Tritium (mrem)	Total (mrem)	Total (mSv)	Percent of DOE Standard
Air	0.57	0.03	0.6	(0.006)	0.6
Water	0.00006	0.26	0.26	(0.0026)	0.26
Foodstuffs	0.04	0.02	0.06	(0.0006)	0.06
TOTAL	0.61	0.31	0.92	(0.0092)	0.92

individual to 2.6 mrem (14). In addition, if an individual from Ohio would move to Colorado for one year, he would receive an additional 75 mrem as compared to living in Ohio for that one year (15,16).

The person-rem dose equivalent estimate calculation was based on tritium (oxide) and plutonium-238 data from environmental air sampling stations in two ranges: 0-8 km (0-5 mi) and 8-21 km (5-20 mi). The 0-8 km range includes 10 samplers within 1.6 km (1 mi) of Mound.

The average concentration of tritium (oxide) and plutonium in air was obtained by averaging concentrations found at 10 offsite tritium air samplers and then subtracting the concentration found at sampler #119. From this average concentration, a dose equivalent was determined and multiplied by the number of people from 0 to 8 km.

The average tritium (oxide) concentration from the four other offsite samplers (less the concentration at sampler 119) was used to obtain the person-rem from 8 to 32 km. Eight area segments from 8 to 32 km were obtained by letting each sampler represent one segment concentration and the average of two adjacent samplers represent another segment. These segment concentrations were then multiplied by their respective population. Using the concentrations from the four samplers and this averaging technique gives a more realistic population dose value.

The person-rem from tritium (oxide) and plutonium-238 in community drinking water was based on average concentrations of tritium (oxide) and plutonium-238 in various community water supplies, less appropriate environmental levels, and weighting these concentrations with respective populations.

The person-rem from foodstuffs was based on average incremental concentrations of tritium (oxide) and plutonium-238 found in foodstuffs weighted with assumed consumption quantities and population. The total person-rem was obtained by adding the effect from the air, water, and foodstuffs pathways.

It is estimated that the total population from 0 to 32 km is receiving 16 person-rem from Mound's emissions. The remaining population from 32 km to 80 km (20 to 50 mi) is expected to receive negligible dose commitment from tritium (oxide) and plutonium-238 emissions. Thus, the effective dose equivalent from Mound's emission is estimated to be 16 person-rem for the 0-80 km range.

For comparison, the population effective dose values from natural radiation, including cosmic rays, terrestrial, and internal radiation, would be approximately 670,000 person-rem for the 0 to 80 km (50 mi) range [17].

AIRDOS Calculations

A copy of the EPA AIRDOS computer code was obtained from Oak Ridge National Laboratory (ORNL). Appropriate meteorological data for 1986 from the National Weather Service facility at Dayton were used. The computer code was executed for compliance with 40 CFR 61. These data are reported to the U. S. EPA.

Acknowledgements

The authors gratefully acknowledge C. T. Bishop, W. D. Gloekler, and L. L. Roush for their contributions to this report; K. D. DeVilbiss, W. D. Gloekler, V. S. Johnson, L. C. Hopkins, V. C. Lacy, L. L. Roush, F. K. Tomlinson, P. A. Watkins, and P. A. Rutland for their work in sample collection and analyses.

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Appendix

Applicable Standards

RADIOACTIVE STANDARDS

In conformance with the U. S. Department of Energy memoranda "Radiation Standard for Protection of the Public in the Vicinity of DOE Facilities" (8/5/85) and "Preparation of Annual Site Environmental Reports for Calendar Year 1985" (2/28/86), environmental sample results were used to estimate doses to compare with the DOE and EPA standards listed below.

RADIATION STANDARDS FOR PROTECTION OF THE PUBLIC IN THE VICINITY OF DOE FACILITIES

Dose Limits

1. ALL PATHWAYS

The effective dose equivalent for any member of the public from all routine DOE operations[1] (natural background and medical exposures excluded) shall not exceed the values given below:

	Effective Dose Equivalent[2]	
	mrem/yr	(mSv/yr)
Occasional annual exposures[3]	500	(5)
Prolonged period of exposure[3]	100	(1)

No individual organ shall receive a committed effective dose equivalent of 5 rem/yr (50 mSv/yr) or greater.

[1]Routine DOE operations means normal planned operations and does not include actual or potential, accidental or unplanned releases.

[2]Effective dose equivalent will be expressed in rem (or millirem) with the corresponding value in Sievert (or milliSievert) in parenthesis.

[3]For the purposes of these standards, a prolonged exposure will be one that lasts, or is predicted to last, longer than 5 years.

2. AIR PATHWAY ONLY

(Limits of 40 CFR 61, Subpart H)

	Dose Equivalent	
	mrem/yr	(mSv/yr)
Whole body dose	25	(0.25)
Any organ	75	(0.75)

Drinking Water

As of June 24, 1977, community drinking water quality is regulated by the EPA National Interim Primary Drinking Water Regulations for Radionuclides. The new standard = 20 x 10^{-6} μCi/mL (20,000 pCi/L).

Soil

There are no guidelines established for radioactive species in soil. (The U.S. EPA has guidelines under consideration.)

NONRADIOACTIVE STANDARDS

Water

The Ohio EPA has issued a discharge permit under NPDES regulations governing Mound's liquid effluent streams. This permit is for the period from October 1, 1985, to September 27, 1990. The discharge limitations for each effluent stream are as follows:

Discharge 001-A EPA #601	7-day Average	Monthly Average
Residual Chlorine* (mg/L)	0.5	--
BOD_5 (mg/L)	15.	10.
Suspended Solids (mg/L)	30.	15.
Fecal Coliform* (n/100 mL)	2000.	1000.
pH (s.u.)	6.5 - 9.0 (daily limit)	

*May 1 through October 31

Discharge 001-B EPA #602	Daily Limit	Monthly Limit
COD (mg/L)	(Monitor only)	
Suspended Solids (mg/L)	45.	30.
Oil/Grease (mg/L)	10.	--
pH (S.U.)	6.5-9.5	--

Discharge 001-C EPA #603	Daily Limit	Monthly Limit
Cyanide (mg/L)	1.0	0.65
Chromium (μg/L)	500.	--
Cadmium (μg/L)	100.	--
Nickel (μg/L)	500.	--
Copper (μg/L)	500.	--
Total Toxic Organics (1/quarter) (μg/L)	2130.	--

Discharge 002 EPA #002	Daily Limit	Monthly Limit
Suspended Solids	45.	30.
pH (S.U.)	6.5-9.0	--

The Ohio EPA has established Water Quality Standards (3745-1-01-3745-1-09). The standards listed below are excerpted from these regulations. These standards are stream standards and apply to a stream beyond a suitable mixing zone permitted for discharges. They should not be compared with effluent concentrations.

Constituent	Average Concentration (mg/L)
Dissolved Oxygen	5.0
pH (pH units)	6-9
Fecal Coliform (N/100 mL)	200 per 100 mL
Dissolved Solids	1500
Ammonia	1.5
Arsenic	0.05
Barium	0.8
Cadmium	0.005
Chloride	250

Constituent	Average Concentration (mg/L)
Chromium (hexavalent)	0.05
Cyanide (free)	0.005
Fluoride	1.3
Foaming Agents (MBAS)	0.5
Iron	1
Lead	0.04
Manganese	1
Mercury	0.0005
Oil and Grease	5
Phenols	0.01
Selenium	0.005
Silver	0.001
Copper	0.005 - 0.075*
Zinc	0.075 - 0.5*

*Dependent on $CaCO_3$ hardness.

Effective Dose Equivalent Calculations

The effective doses from both plutonium-238 and tritium oxide are calculated in a similar manner then summed for the significant pathways. The result is one value which represents a weighted result which is compared to the DOE standard shown above.

The technique in detail involves determining the concentration of the radionuclide through environmental monitoring then calculating the total effective dose equivalent by:

$$DE = \sum_{1}^{N} R \sum_{1}^{P} C_R I_a D_F C_F$$

where

DE = total Effective Dose Equivalent (Dose integrated through 50 years from 1 year of exposure) (mrem/50 year).

$\sum_{1}^{N} R$ = Sum of the different radionuclides

$\sum_{1}^{P}$ = Sum of the different pathways - air, water, and foodstuff

C_R = Average concentration of the radionuclide

I_a = Annual intake of the environmental media [1,2]

D_F = Dose factors for the particular radionuclide and type of intake [3]

C_F = Conversion factor to convert various units into units which can be used with DOE effective dose conversion factors

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