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**Environment, Safety and Health
Office of Environmental Audit**

**Environmental Survey
Preliminary Report**

**Morgantown Energy Technology Center
Morgantown, West Virginia**

June 1988

MASTER

PREFACE
TO
THE DEPARTMENT OF ENERGY
ENVIRONMENTAL SURVEY PRELIMINARY REPORT
FOR THE MORGANTOWN ENERGY TECHNOLOGY CENTER

This report contains the preliminary findings based on the first phase of an Environmental Survey at the Department of Energy (DOE) Morgantown Energy Technology Center (METC) located at Morgantown, West Virginia, and the DOE Laramie Project Office (LPO), which is located in Laramie, Wyoming, and reports to METC. The Survey is being conducted by DOE Office of Environment, Safety and Health.

The METC 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 1989.

The findings in this report are subject to modification based on the results from the Sampling and Analysis (S&A) phase of the Survey. The findings are also subject to modification based on comments from METC 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.

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EXECUTIVE SUMMARY

Introduction

This report presents the preliminary findings from the first phase of the Environmental Survey of the U.S. Department of Energy (DOE) Morgantown Energy Technology Center (METC) conducted November 30 through December 4, 1987. In addition, the preliminary findings of the Laramie Project Office (LPO) Survey, which was conducted as part of the METC Survey on January 25 through 29, 1988, are presented in Appendices E and F.

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 METC. 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 METC, and interviews with site personnel.

The Survey team developed a Sampling and Analysis Plan to assist in further assessing certain environmental problems identified during its on-site activities at METC. The Sampling and Analysis Plan will be executed by the Oak Ridge National Laboratory (ORNL). When completed, the results will be incorporated into the METC Environmental Survey Interim Report. The Interim Report will reflect the final determinations of the Survey for METC.

Site Description

METC is located in and adjacent to the City of Morgantown and entirely in Monongalia County in northern West Virginia, approximately 190 miles northeast of Charleston, West Virginia, 155 miles west-northwest of Washington, D.C., and 55 miles south of Pittsburgh, Pennsylvania. The site consists of 132 acres of restricted-access, federally-owned land. It is bordered on the north by the Baltimore and Ohio

Railroad and the Monongahela River. West Run, Burroughs Run, undeveloped areas, rural farmland, and medium-density residential areas are adjacent to METC's eastern property line. Residential areas (predominantly light density with some medium density) are located adjacent to the southern and western property lines.

METC's on-site research and development role is focused on advanced high-risk, high-payoff technologies that private industry is reluctant to develop on its own. METC is the lead center for the following 14 fossil energy programs: coal gasification, fluidized-bed combustion, gas stream cleanup, fuel cells, heat engines, instrumentation and control, low-rank coal, components, oil shales, unconventional gas recovery, underground coal gasification, tar sands, Arctic and offshore research, and waste management. METC is currently a part of DOE's Office of Fossil Energy, and is a Government-owned and Government-operated facility.

State and Federal officials were unable to accept an invitation to meet with representatives of the Survey team on October 29-30, 1987, during the pre-Survey site visit to METC. Historical concerns of the West Virginia Department of Natural Resources (DNR) were determined, however, through correspondence provided by METC in response to the Survey team's original request for information. These concerns included the disposition of the industrial wastewater pond and determination of possible groundwater contamination in that vicinity and the proper disposal and closure of the frac-water pond and associated liquid resulting from the drilling of the gas well. In addition, treatment and disposal of wastewaters from METC has been of interest to the DNR.

The Wyoming Department of Environmental Quality (DEQ) expressed several concerns relative to field operations by the DOE's LPO. In a meeting held on January 25, 1988, in Cheyenne, Wyoming, concerns were raised by Wyoming over the validity and reliability of past and ongoing field sampling, a lack of a defensible quality assurance and quality control (QA/QC) sampling program, and DOE's commitment to fulfill previously agreed upon planning and implementation efforts for groundwater restoration and surface restoration at the LPO's Hoe Creek and Hanna sites.

Summary of Findings

Generally, the METC Survey findings reflect conditions that the management staffs at METC and the LPO are aware of and in many instances have taken, or are planning to take action to mitigate.

Most of the findings of the METC Survey are primarily administrative, technical, or procedural in nature. These findings are indirectly related to environmental risk and are amenable to quick resolution. However, major concerns exist regarding potential contamination in the METC wastewater system and an off-site stream. Most of the findings of the LPO portion of the METC Survey focus on groundwater restoration.

The major preliminary findings of the Environmental Survey for METC are:

- Potential for mercury, polynuclear aromatics, and heavy metals contamination in the on-site storm sewer drainage system, and possibly off-site contamination of surface water and sediment in Burroughs Run, a tributary of the Monongahela River;
- Potential for toxic contaminants to be present in the sludge of an on-site sedimentation pond;
- Potential contamination of surface water and sediment due to process wastewater pipeline cross-connections into the sanitary sewer system; and
- Evidence of groundwater contamination at the Laramie Project Office's Hoe Creek and Hanna underground coal gasification experimental sites, and a lack of a defensible quality assurance and quality control sampling and analysis program at both sites.

Overall Conclusions

The Survey found no environmental problems at either METC or LPO that represent an immediate threat to human life. The environmental problems identified at

METC by the Survey team 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 magnitude and risk, as described in this report. Although the sampling and analysis performed by the METC Survey in Morgantown 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 will contribute toward meeting this requirement.

No sampling and analysis has been directed by the Survey to be carried out at the LPO Hanna and Hoe Creek sites. Both of these sites have active ongoing sampling programs which make additional sampling and analysis unnecessary.

Transmittal and Follow-Up of Findings

The preliminary findings of the Environmental Survey for METC were shared with the DOE Office of Fossil Energy, the DOE Office of Environmental Guidance and Compliance (OEG), and with METC personnel at the Survey closeout briefing held December 4, 1987, and with LPO personnel at the Survey closeout briefing held January 29, 1988. METC staff discussed the preliminary environmental findings of the Survey and potential response actions to these environmental problems with the U.S. Environmental Protection Agency (EPA) Region III and the West Virginia DNR at meetings on December 16, 1987, and January 12, 1988, respectively. By January 29, 1988, METC had developed a draft action plan to address the Survey preliminary findings for the Morgantown facility. By May 4, 1988, METC had developed a draft action plan to address the Survey's preliminary findings for LPO sites at Hanna and Hoe Creek. A final action plan addressing all the Survey findings cited herein will be prepared by METC within 45 days after receiving this Preliminary Report. Those problems that involve extended studies and multiyear budget commitments will be the subject of the Environmental Survey Summary Report and the DOE-wide prioritization.

Within the Office of the Assistant Secretary for Environment, Safety and Health, the OEG has immediate responsibility for monitoring environmental compliance and

the status of the METC Survey findings. The Office of Environmental Audit will continue to assess the environmental problems through a program of systematic environmental audits that will be initiated toward the conclusion of the DOE Environmental Survey in 1989.

PRELIMINARY

1.0 INTRODUCTION

The purpose of this report is to present the preliminary findings made during the Environmental Survey, conducted November 30 through December 4, 1987, at the United States Department of Energy (DOE) Morgantown Energy Technology Center (METC), West Virginia, and the preliminary findings made during January 25 through January 29, 1988, from the DOE Laramie Project Office (LPO) in Laramie, Wyoming, which reports to METC. As a Preliminary Report, the contents are subject to revisions, which will be made in a forthcoming Interim Report, based on METC review and comments on technical accuracy, the results of the Sampling and Analysis (S&A) program, and other information that may come to the Survey team's attention prior to issuance of the Interim Report. METC is currently operated by DOE with support services provided by EG&G Washington Analytical Services Center, Inc. (EG&G).

The METC Survey is part of the larger DOE-wide Environmental Survey effort announced by Secretary John S. Herrington on September 18, 1985. The purpose of this 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 METC Environmental Survey was conducted by an interdisciplinary team of technical specialists headed and managed by a Team Leader and Assistant Team Leader from the DOE Office of Environmental Audit. A complete list of Survey participants and their affiliations is included in Appendix A.

The Survey team focused on all environmental media, using 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 DOE Environmental Survey Manual (DOE, 1987). Substantial use of existing information and of 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 B, and the Survey Plan is presented in Appendix C.

The preliminary Survey findings, in the form of existing and potential environmental problems, are presented in Sections 3.0 and 4.0. Section 3.0 includes those findings that pertain to a specific environmental medium (e.g., air or soil, surface water and groundwater), whereas Section 4.0 includes those that are non-media-specific (e.g., waste management, radiation, and quality assurance). Because the findings are highly varied in terms of magnitude, risk, and characterization, and consequently require different levels of management attention and response, they are further subdivided into four categories within Sections 3.0 and 4.0.

The criteria for placing a finding into one 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 preceding situation, within the timeframe 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.
- 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 timeframes for response, are the greatest. Environmental problems included within this category 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.

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 human 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 categories are arranged in order of relative significance. Comparing the relative significance of one finding to another between media categories is not appropriate or valid. The categorization and listing of findings in order of significance within each media category in this report is only the first step in a multistep iterative process to prioritize DOE problems.

The next portion of the METC Survey is the S&A phase. Oak Ridge National Laboratory (ORNL), the S&A team for METC, will begin taking samples in the summer of 1988. Prior to sampling, an S&A Plan will be prepared by DOE and ORNL in accordance with the protocols in the DOE Environmental Survey Manual. 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, and to fill existing data gaps or weaknesses.

An Interim Report will be prepared 6 to 8 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 as the site-specific source 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 are highly varied 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 action. The information in this Preliminary Report will assist METC in the planning of these near-term responses.

METC submitted a draft action plan dated January 29, 1988, in response to the preliminary findings presented at the conclusion of the on-site Survey activities at the Morgantown facility and summarized in the METC Survey Status Report dated December 30, 1987. METC submitted a draft action plan dated May 4, 1988, in response to the preliminary findings presented at the conclusion of the on-site Survey at the LPO Hanna and Hoe Creek sites and summarized in the METC Survey Status Report Supplement dated March 17, 1988. The draft action plan for the METC Survey has been reviewed by the Office of Environmental Guidance and Compliance (OEG), which has immediate responsibility for monitoring the status and overseeing the adequacy of corrective actions taken by the Operations Office in response to the Survey findings.

As required in the December 2, 1987, memorandum from the Assistant Secretary for Environment, Safety and Health to the Operations Office Managers entitled, Follow-up of Environmental Survey Findings, METC will prepare and submit a final action plan to the Deputy Assistant Secretary (DAS) for Environment within 45 days after receiving this Preliminary Report. The final action plan for the METC Survey will address all of the preliminary findings cited herein and incorporate OEG's comments on the draft action plan.

2.0 GENERAL SITE INFORMATION

In 1946, the U.S. Department of the Interior's Bureau of Mines established a coal research laboratory on the campus of West Virginia University. In 1954, the laboratory moved to the current site of the Morgantown Energy Technology Center (METC). Originally the site was known as the Appalachian Experiment Station. The name has been changed to the Morgantown Research Center, the Morgantown Energy Research Center, and its current name METC.

METC was transferred to the U.S. Energy Research and Development Administration (ERDA) in 1975. Subsequently in 1977 ERDA became part of the U.S. Department of Energy (DOE) and the Morgantown Energy Research Center was renamed the Morgantown Energy Technology Center.

2.1 Site Setting

Location

METC is located in northern West Virginia, approximately 190 miles northeast of Charleston, West Virginia, 155 miles west-northwest of Washington, D.C., and 55 miles south of Pittsburgh, Pennsylvania (see Figures 2-1 and 2-2). The site consists of 132 acres of restricted-access, federally-owned land, which ranges from 2,200 to 900 feet in width (east-west) and from 4,200 to 900 feet in length (north-south).

METC is bordered on the north by the Baltimore and Ohio Railroad and the Monongahela River (see Figure 2-3). West Run, Burroughs Run, undeveloped areas, rural farmland, and medium-density residential areas are adjacent to METC's eastern property line. Residential areas (predominantly light density with some medium density) are located adjacent to the southern and western property lines.

Population Distribution

The METC site is located in and adjacent to the City of Morgantown and entirely in Monongalia County. The populations of Morgantown and Monongalia County are 31,000 and 69,000, respectively (METC, 1978).

REGIONAL MAP

FIGURE 2-1

FIGURE 2-2

VICINITY MAP

Source: METC, 1987a

METC SITE

FIGURE 2-3

Currently there are approximately 675 full- and part-time employees at METC. Approximately 270 people are DOE employees and 260 people are EG&G (site services contractor) employees. Additional support contractors, university personnel involved in the Oak Ridge Associated Universities (ORAU) Program, and part-time Government employees comprise the remainder of the workforce.

Land Uses

Although METC encompasses a total area of 132 acres, approximately 45 acres of the site have been developed to date. The remaining site area contains approximately 60 acres that are either readily developable or have the potential to be developed, 16 acres that are nondevelopable, and 11 acres that are set aside for non-METC functions. The nondevelopable area consists of land that has been set aside for environmental reserves, is susceptible to flooding, or is steeply sloped.

As indicated in Figure 2-3, the southern portion of the METC site has been developed. Development consists of buildings, trailers, research facilities, utilities, roadways, and parking lots. Figure 2-4 indicates the buildings within the developed area. Table 2-1 summarizes the use assigned to each building. Except for an access road, a primary transformer station, and perimeter fence, the northern portion of the site is largely undeveloped woodland.

The U.S. Navy occupies the areas set aside for non-DOE functions. A 10-acre area, leased by the U.S. Navy from DOE, contains a radio tower with a guy wire system and antenna ground plane system.

A 1-acre area contains a radioactive field calibration unit. This area is reported by METC to have been constructed and operated by the DOE-Idaho Operations Office; however, no written documentation of this was made available to the Survey.

Figure 2-5 indicates land use for areas adjacent to the METC site. Low-density single-family dwellings, an apartment complex, and a mobile home park are located south and west of the developed portion of the site. The northern portion of the site is primarily bordered by rural farmland and the Monongahela River. The eastern portion of the site is bordered by undeveloped, rural farmland.

FIGURE 2-4

FACILITIES LAYOUT
MORGANTOWN ENERGY TECHNOLOGY CENTER

Source: METC, 1987a

LEGEND:

B-1 Administrative Offices
 B-2 General Purpose
 B-3 General Purpose
 B-4 Pilot Plant
 B-5 Boiler Plant
 B-6 Coal Preparation
 B-7 Facility Services & Security
 B-8 Pump House
 B-9 Gas Meter House
 B-10 Storage & Garage
 B-11 Storage
 B-12 Gasification Research
 B-13 Metrology Research
 B-14 Coal Drying
 B-15 Valve Test Control
 B-16 Chemical & Gas Storage
 B-17 Wastewater Treatment
 B-19 Warehouse & Receiving
 B-22 MQT Solids Test Unit
 B-22a Storage
 B-23 Storage
 B-24 Storage
 B-25 Research Lab
 B-27 Dynamic Test Unit
 B-27a Valve Test Control Room
 B-28 Gasifier Control Room
 B-29 Facility Maintenance Storage
 B-30 Data & Sampling Acquisition

T-1
 T-2
 T-3
 T-4
 T-5
 T-6
 T-8 Storage
 T-9
 T-10
 T-11
 T-12
 T-13
 T-14
 T-15
 T-20
 T-21
 T-22
 T-23
 T-24
 T-25
 T-26
 T-27
 T-28
 T-29
 T-30
 T-31
 T-32
 T-33
 T-34 Medical Unit
 T-35
 T-36
 T-40
 T-41
 T-42
 T-43
 T-44
 T-45
 T-46

Offices

Offices

Offices

TABLE 2-1
LIST OF METC BUILDINGS

Building Number	Use(s)
B-1	Administration Offices, Cafeteria, Reception Area
B-2	Library, Main Computer Center, Laboratories, Offices
B-3	Research, Fabrication Shop, Photo Lab, Shower Room, Offices
B-4	Research, Offices
B-5	Boiler and Compressor Plant
B-6	Coal Preparation
B-7	Offices, Security Headquarters
B-8	Pumphouse
B-9	Gas Meter House
B-10	Storage, Laboratory, Garage
B-11	Storage
B-12	Research
B-13	Research
B-14	Coal Preparation
B-15	Data Collection, Control
B-16	Chemical Storage
B-17	Wastewater Treatment
B-19	Warehouse
B-22	Research
B-22A	Research
B-23	Storage
B-24	Storage
B-25	Laboratory
B-27	Research
B-28	Research -- Gasifier Control Room
B-29	Storage -- Maintenance
Trailers T-1 thru T-36	Offices
Modular Offices T-40 thru T-46	Offices

Source: METC, 1987a

FIGURE 2-5

SURROUNDING LAND USES

Topography

With the exception of steeply sloped areas adjacent to the Monongahela River and Burroughs Run, the topography of the METC site consists of gently to moderately sloping terrain. Within the center of the site is a low-lying crescent-shaped area (approximately 10 acres) that is swampy most of the year. Site elevations vary from 800 feet at the confluence of West Run and the Monongahela River to 1,000 feet near the hill that has a Navy radio tower.

Major Water Bodies

The major water body in the vicinity of METC is the Monongahela River. The river provides a major water transportation system consisting of locks and dams for barge traffic. The Monongahela joins the Allegheny River at Pittsburgh to form the Ohio River.

Two other streams are located near METC. Burroughs Run is located near the southern boundary of the site and is a tributary of West Run. West Run is located adjacent to the eastern boundary of the site and is a tributary of the Monongahela River.

Hydrology

Most of Monongalia County is underlain by rocks of low permeability. Consequently well yield rates are generally low. The Conemaugh series and Pottsville series are the principal aquifers in the area. The two aquifers are separated by several hundred feet of impermeable material. Most domestic water supplies in the area are provided by the Conemaugh aquifer, an unconfined aquifer. The Pottsville aquifer is a deep aquifer regarded as the most important aquifer in the county. In areas under artesian pressure, yields average 45 gallons per minute (gpm) but may provide up to 250 gpm (METC, 1986c).

Climate

The climate of the METC area is temperate. For Morgantown, West Virginia, the annual mean temperature is 52.4 degrees Fahrenheit (°F). Average annual precipitation is 41.03 inches. Temperature extremes range from a low of -10°F to nearly 100°F. Precipitation is well-distributed throughout the year. February is considered the driest month while August is the wettest. Average annual snowfall for the Morgantown area is approximately 40 inches. Table 2-2 summarizes typical monthly temperatures and precipitation data for the Morgantown area.

The wind direction is predominantly south-southwest. Although wind speeds occasionally exceed 50 miles per hour (mph) during severe thunderstorms, destructive winds are not a serious problem. Tornadoes have been reported in the Morgantown area but are considered rare. In the deep valleys of the region, wind speeds are reduced and temperature inversions are frequent. Stagnation conditions for periods of 4 or more days occur one or two times a year. A 7-day stagnation period occurs, on average, once in 6 years (METC, 1978).

2.2 Overview of Major Site Operations

METC was originally established by the Federal Government to carry out research activities involving a coal research unit, a petroleum and natural gas unit, and a Federal mine inspection group. Since its inception, METC's functions have expanded from in-house research and development to project management, technological and administrative support, program development, technology data base development, and technical interchange with industry and academic institutions. METC is currently part of DOE's Office of Fossil Energy.

METC's research and development role is focused on advanced high-risk, high-payoff technologies that private industry is reluctant to develop on its own. METC managers are responsible for projects conducted by DOE national laboratories, academic institutions, and projects contracted with the private sector. METC is the lead center for the following 14 fossil energy programs: coal gasification, fluidized-bed combustion, gas stream cleanup, fuel cells, heat engines, instrumentation and

TABLE 2-2
MONTHLY CLIMATIC SUMMARY FOR MORGANTOWN,
WEST VIRGINIA

	Temperature (°F)			Precipitation (inches)
	Maximum	Minimum	Mean	
January	38.9	21.0	30.0	3.06
February	41.8	22.5	32.2	2.56
March	52.1	30.7	41.4	3.63
April	64.3	40.1	52.2	3.62
May	73.9	49.1	61.5	3.74
June	81.1	57.3	69.2	3.91
July	84.1	61.6	72.9	4.13
August	82.8	60.6	71.7	4.57
September	77.2	54.3	65.7	3.32
October	65.8	42.6	54.2	2.66
November	53.3	33.8	43.5	2.71
December	43.1	25.6	34.3	3.12
Average 52.4			Total	41.03

Source: METC, 1987a

control, low-rank coal, components, oil shales, unconventional gas recovery, Underground Coal Gasification (UCG), tar sands, Arctic and offshore research, and waste management.

The thrust of METC's current activities revolves around the development of a scientific and engineering knowledge base that will allow industry to develop and commercialize new technologies. Concepts that significantly improve environmental performance, energy efficiency, and cost effectiveness of fossil fuels are emphasized. METC's lead mission research and development programs are described below.

Coal Gasification

Coal gasification is a process by which methane and other combustible gases are produced from coal. This is accomplished by altering the chemical structure of the coal and subsequently increasing the hydrogen to carbon ratio of the material.

Gasification is achieved by the following generalized process. Crushed and dried coal is fed to the top of the gasification reactor while air and superheated steam are introduced through the bottom. The air and steam move up through the descending coal, combusting and gasifying the coal. Gasification reactors operate at high temperatures (800°C and up) and low pressures (ambient to 1,000 pounds per square inch [psi]) in order to make a methane-rich process gas. This process gas exits through the top of the gasifier. Ash and unreacted coal pass out the bottom of the gasifier via an ash hopper.

The process gas is sent to a series of condensers to separate liquids, such as water and light tars, from the gas. These liquids are either recycled to the process, as are the light tars and oils, or are containerized and handled as hazardous waste, as is the condensed process water. The process gas is then flared. A detailed description of the gasification reactors and combustion units of METC is included in Section 3.1.

METC's coal gasification research has been ongoing for over 30 years. Areas that have been investigated include advanced gasification; novel gasification and gas stream cleanup concepts; new process chemistries; process modeling; analytical and process control instrumentation; and design, construction, startup, and operation

of both pilot and commercial plants. Current research includes process and equipment development, process control and integration, proof-of-concept demonstration, and technology data base development.

Fluidized-Bed Combustion

METC's fluidized-bed combustion program focuses on advanced fluid-bed combustion design concepts, in-bed erosion, materials testing for in-bed components, and coal-water slurry combustion. Research activities cover process fundamentals to process development-scale plants. Recent research involves testing combustors using all types of coal, coal/water mixtures, and unconventional fuels such as wastes and shales.

Gas Stream Cleanup

DOE's gas stream cleanup program is led by METC. The program addresses the control of potentially harmful substances, pollutants, and process contaminants in coal conversion and utilization product gas streams. Program goals are to develop economically acceptable technologies to control pollutants and to lessen the effect of coal contaminants on downstream equipment.

Fuel Cells

DOE's fuel cells program is managed and implemented through METC. Program goals are to develop electrochemical energy conversion devices that continuously transform chemical energy from a fuel to electrical energy (i.e., fuel cells). The technology is to become economically competitive with existing power-generation systems. Research has focused on modular commercial applications with high efficiency, reasonable life, and minimal environmental impact.

Heat Engines

The heat engines program involves the use of coal or coal-derived fuel gas to power heat engines, primarily gas turbines and diesel engines. Research addresses coal-specific contaminant problems, such as ash deposits, component erosion by abrasive particles, alkali corrosion, and unacceptable nitrogen oxide (NO_x) emissions. Major

projects involve data gathering for coal/water mixtures, water-cooled components testing, low nitrogen oxide combustors, and heat engine systems. METC is conducting bench-scale and laboratory-scale combustion projects to observe the combustion of coal particles and coal/water mixture droplets.

Instrumentation and Control

The instrumentation and control program involves the development of measurement techniques used in process control. The techniques are important for improving process efficiency and plant availability. Research is conducted on electronic and optically based techniques that are adapted to high-temperature, high-pressure erosion, and corrosive environments.

Low-Rank Coal

Research activities have focused on fundamental aspects of the low-rank coal resource and to resolve environmental issues associated with its use. Recent research has been directed toward preparation techniques to reduce the sulfur content of these coals and reduction of sulfur dioxide emissions by direct injection of pressure-hydrated lime into a boiler.

Components

The components program is focused on means of improving the operating range and reliability of components that contain, alter, and control coal conversion processes. The program includes state-of-the-art valve testing and development, electroslag casting development, coal feeder development, ceramic corrosion/erosion testing of turbine materials, and research to identify suitable refractory materials for slagging gasifiers.

Oil Shales

METC's oil shale program addresses the means of converting oil shale to useful, clean energy forms. The program involves research in recovery kinetics and processing, novel recovery and utilization techniques, and environmental effects. Applications for low-grade (eastern) oil shales are also under study.

Unconventional Gas Recovery

The unconventional gas recovery program is geared toward methods of locating and recovering natural gas from abundant but difficult to recover unconventional sources. Eastern gas shales, western gas sands, and coalbed methane have been areas in which recent advances have been made.

Underground Coal Gasification

Research efforts of METC's UCG program focus on the production of clean fuels from coal deposits that are unsuitable for commercial exploitation using conventional mining techniques.

Tar Sands

METC's tar sands program is designed to eliminate uncertainties in the technology for extracting and processing tar sands (i.e., rocks that contain highly viscous bitumen "oil"). Laboratory experimentation, modeling, and field testing have been conducted. In-situ extraction and mining combined with a surface plant for extraction are two general methods of extracting oil from tar sands.

Arctic and Offshore Research

The Arctic and offshore research program is directed toward expanding knowledge of the Arctic sea ice and seafloor properties so that oil and gas resources in these harsh environments may be developed.

Clean Coal Technology Program

METC is responsible for managing a significant portion of the DOE's clean coal technology program. The program is a joint venture between Government and private industry with the purpose of demonstrating new coal usage technologies that are both economical and environmentally acceptable.

No state or Federal officials accepted an invitation to meet with representatives of the Survey team on October 30, 1987, during the pre-Survey site visit to METC. Historical concerns of the West Virginia Department of Natural Resources (DNR) were determined, however, through correspondence provided by METC in response to the Survey team's original request for information. These concerns included the disposition of the industrial wastewater pond and determination of possible groundwater contamination in that vicinity and the proper disposal and closure of the frac-water pond and associated liquid resulting from the drilling of the gas well. In addition, treatment and disposal of wastewaters from METC has been of interest to the DNR.

The Wyoming Department of Environmental Quality (DEQ) expressed several concerns relative to field operations by the DOE's Laramie Project Office (LPO). In a meeting held on January 25, 1988, in Cheyenne, Wyoming, concerns were raised by Wyoming over the validity and reliability of past and ongoing field sampling, a lack of a defensible quality assurance and quality control (QA/QC) sampling program, and DOE's commitment to fulfill previously agreed upon planning and implementation efforts for groundwater restoration and surface restoration at the LPO's Hoe Creek and Hanna sites.

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 as they relate to each medium.

3.1 Air

3.1.1 Background Environmental Information

3.1.1.1 Regulatory Requirements

METC is located in Monongalia County, which is part of the North Central West Virginia Intrastate Air Quality Control Region (AQCR) 235. This region is administered by U.S. Environmental Protection Agency (EPA) Region III and the West Virginia Air Pollution Control Commission for compliance with National Ambient Air Quality Standards (NAAQS) and West Virginia Air Quality Standards. Table 3-1 lists the NAAQS and the West Virginia standards for the regulated pollutants. The Federal standards establish limits for the protection of public health (Primary Standards) and welfare (Secondary Standards); West Virginia has adopted the Federal Standards and has no additional standards. The air quality in AQCR 235 has been designated by EPA as either being better than the national standards or not classified for each of the criteria pollutants (EPA, 1983).

Additional Federal and West Virginia regulations covering the emissions of radioactive and other toxic compounds include the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (Title 40 CFR Part 61) and West Virginia Air Pollution Control Regulation XV. West Virginia also regulates emissions of particulates (Regulation II) and sulfur dioxide (Regulation X) from fuel burning facilities.

TABLE 3-1

NATIONAL AND WEST VIRGINIA STATE AMBIENT AIR QUALITY STANDARDS

Pollutant	Type of Standard ^a	Averaging Time	Frequency Parameter	Concentration	
				ug/m ³	ppm
Carbon monoxide	Primary and secondary	1 hr 8 hr	Annual maximum ^b	40,000 10,000	35 9
Lead	Primary and secondary	Calendar quarter	Arithmetic mean	1.5	--
Nitrogen dioxide	Primary and secondary	1 yr	Arithmetic mean	100	0.05
Ozone	Primary and secondary	1 hr	Annual maximum ^c	235	0.12
Total suspended particulate matter	Primary ^d	24 hr	Annual maximum ^b	260	--
		1 yr	Annual geometric mean	75	--
	Secondary	24 hr	Annual maximum ^b	150	--
		1 yr	Annual geometric mean	60	--
PM ₁₀	Primary and secondary	24 hr	Annual maximum	150	--
		1 yr	Arithmetic mean	50	--
Sulfur dioxide	Primary	24 hr	Annual maximum ^b	365	0.14
		1 yr	Arithmetic mean	80	0.03
	Secondary	3 hr	Annual maximum ^b	1,300	0.5

Source: EPA, 1987 and West Virginia Air Pollution Control Commission, 1980

- Primary standards are for protection of health; secondary standards are for protection of welfare.
- Not to be exceeded more than once per year.
- Expected exceedance to be equal to or less than one day per year.
- Particulate NAAQS revised July 31, 1987 to PM₁₀ standard. West Virginia has until May 1988 to revise standards.

On July 1, 1987, EPA promulgated a new NAAQS for particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (designated PM₁₀). The PM₁₀ standards (listed in Table 3-1) will replace the total suspended particulate standards as the states revise their air quality implementation plans. EPA has established three categories of geographical areas based on their probability of exceeding the PM₁₀ standards. The majority of West Virginia counties, including those in AQCR 235, are in Group III, which are those areas that have a probability of less than 20 percent for exceeding the PM₁₀ standards. Group III areas need only submit plan revisions for their new source preconstruction review program and monitoring networks by May 1988. Monongalia County and the rest of AQCR 235 are presumed to be in compliance with the PM₁₀ standard until future monitoring data indicate exceedances.

The Clean Air Act Amendments of 1977 include requirements on the Prevention of Significant Deterioration (PSD) of air quality conditions in designated PSD areas. The areas designated as Class I Areas have the most stringent requirements on the allowable impact from major new sources. These requirements include preconstruction review, best available control technology for emissions, permissible increments in pollutants, visibility protection, and air quality monitoring. The Dolly Sods Wilderness Area is a Class I Area, located within the Monongahela National Forest, approximately 55 miles southeast of METC. Construction of any significant sources of air pollutants at METC may require extensive regulatory review under the PSD requirements. Significant sources are defined in 40 CFR 52.21(b)(23). At the time of the Survey, no new sources were planned at METC that would qualify as significant sources.

3.1.1.2 Air Quality

Total suspended particulates and sulfur dioxide concentrations are measured at three stations in Morgantown by the West Virginia Air Pollution Control Commission. The station at University High School on North Price Street samples only for total suspended particulates. The stations at Morgantown High School on Wilson Avenue and at the Morgantown Airport sample for total suspended particulates and sulfur dioxide. The sulfur dioxide is collected infrequently in sample collectors at the Morgantown High School location, but the airport location makes hourly determinations with an automated analyzer. Figure 3-1 shows the

AMBIENT AIR MONITORING SYSTEMS
MORGANTOWN, WEST VIRGINIA

FIGURE 3-1

locations of the monitoring stations and the METC property. Table 3-2 presents a summary of the 1986 data relative to the NAAQS averaging times for the two pollutants. The data show no exceedances of either the primary or secondary NAAQS for particulates or sulfur dioxide.

3.1.1.3 Meteorology

The climate of Morgantown is a continental mountainous-type characterized by mild summers and cold winters. The average annual temperature ranges from 45°F at higher elevations to 55°F at lower elevations. The average maximum temperatures range from 80° to 88°F in July. The average minimum temperatures range from 20°F to 26°F in January (NOAA, 1975).

Annual precipitation ranges from 40 to 54 inches, with approximately 3 inches of rain each month (NOAA, 1975). The balance of precipitation comes from frequent winter snow showers.

The prevailing winds are light and generally from the southwest or west, with some channeling of the flow through the Monongahela River valley. Stronger winds occur in the winter months from the northwest. Figure 3-2 presents a 5-year wind rose for Morgantown airport, which is 3.5 miles from METC. In general, the winds are less than 4 mph 24 percent of the time (NOAA, 1968).

3.1.2 **General Description of Pollution Sources and Controls**

The research programs at METC focus on minimizing pollutants from combustion of coal by improved burning conditions and application of advanced pollution controls. There are several research facilities within METC that emit regulated effluents to the atmosphere, and most of these emit more than one type of pollutant. At the time of the Survey, there were eight projects, or test facilities, two coal preparation areas, and a central heating plant that emitted air pollutants when operational. Table 3-3 lists the emission sources at METC and any available estimates of their worst-case hourly emission rates. Due to the research nature of the programs at METC, several of the facilities operate infrequently. Additionally, each test cycle may alter operating conditions, unit operations, and raw materials. Consequently, estimates of annual emissions would be highly variable.

TABLE 3-2

1986 AMBIENT AIR QUALITY DATA FOR MORGANTOWN, WEST VIRGINIA

Location	Total Suspended Particulates, $\mu\text{g}/\text{m}^3$		Sulfur Dioxide, $\mu\text{g}/\text{m}^3$					
	Highest 24-Hour Values ^a		Geometric Mean	Highest 24-Hour Values		Highest 3-Hour Values		Annual Arithmetic Mean
	1st	2nd		1st	2nd	1st	2nd	
Morgantown High School	92	83	38	79	71	NA ^b	NA	21
University High School	82	76	35	NA	NA	NA	NA	NA
Morgantown Airport	126	110	48	178	141	558	479	34

Source: West Virginia Air Pollution Control Commission, 1987

a. 1st = highest value; 2nd = second highest value.

b. NA = not applicable

MORGANTOWN WINDROSE
FIVE YEAR AVERAGE
1950 - 1954

FIGURE 3-2

TABLE 3-3
POTENTIAL ATMOSPHERIC EMISSIONS AT METC

Source	Bldg.	Worst-Case Rates (lb/hr) ^a			
		Part	SO ₂	H ₂ S	NO _x
Coal Gasification Pilot Plant	NA	6.5	151	0.81	21.7
18-Inch Fluidized Bed Combustor	B-4	0.98 ^b	2 ^b	NI	3 ^b
Pressurized Combustor	B-4	NI	0.8	<0.01	2.1
Fluidized Bed Combustor-Cold Model	B-4	NI	NA	NA	NA
Fluidized Bed Gasifier	B-12	0.03	3.8	0.22	3.1
Advanced Gas Entrained Reactor	B-12	Negligible	Negligible	Negligible	Negligible
Fluidized Bed Development Unit	B-27	NI	NI	NI	NI
Coal-Fired Diesel	B-13	Negligible	Negligible	Negligible	Negligible
Coal Preparation	B-6, B-14	NI	NA	NA	NA
Boiler Plant	B-5	0.024 ^b	0.025 ^b	Negligible	NI

Source: a) Schlesinger, 1986; b) Scardino and Soni, 1978

NI = No information

NA = Not applicable

The largest source of emissions, and the largest test facility, at METC is the coal gasification pilot plant, or gasifier. All the other emission sources combined would not emit as much as the gasifier does during a normal year of testing. Both the gasifier and the heating plant are registered with the West Virginia Air Pollution Control Commission, but none of the sources at METC are required to have a permit or to do emissions testing.

3.1.2.1 Forty-Two-Inch-Diameter Coal Gasification Pilot Plant

The stirred, fixed-bed gasifier at METC has been in intermittent operation since 1968. Normally, each test period is for a continuous 2-week run with two to four tests planned for each year. Table 3-4 presents the operational periods for the gasifier since September 1980. The Survey team air specialists made a separate trip to METC to observe the operation of the gasification plant on December 9, 1986.

The reactor chamber has an inside diameter of 42 inches and a bed depth of 7 feet (Scardino and Soni, 1978). Coal is fed into the top of the gasifier from two alternating feed hoppers. As the coal progresses downward through the gasifier, the coal is dried and then devolatilized. After devolatilization, the coal is predominantly char (or carbon plus ash). For gasification to occur, air and superheated steam are introduced through the bottom of the gasifier. They move up through the descending coal, combusting and gasifying the coal. Capacity is about 24 tons/day of coal, which produces approximately 2 million standard cubic feet per day (SCFD) of low-Btu gas that is mainly nitrogen, hydrogen, carbon monoxide, carbon dioxide, water, and methane (Cassidy, 1986).

As the coal is heated in the gasifier, the tars and liquids created in the devolatilization zone are swept out of the gasifier with the fuel gas stream. The fuel gas contains potentially toxic substances, including phenols, ammonia, and sulfur gases (hydrogen sulfide, carbonyl sulfide, and carbon disulfide) (Cassidy, 1986). The cleanup system on the METC gasifier is unique because it features sequential removal of particulates, tars, and oils. Figure 3-3 shows the major components of the gasifier and the cleanup system. The raw gas from the gasifier enters a low-velocity cyclone where 85 to 90 percent of the entrained particulates, primarily char, are separated from the gas. The dust is recovered through a

TABLE 3-4

METC GASIFIER OPERATION DATES

1980	September 3 to October 3 November 11 to November 22
1981	May 27 to June 16 July 16 to August 19
1982	March 15 to March 31 June 14 to June 18
1983	June 22 to July 1 September 19 to October 5 November 7 to November 19 December 5 to December 16
1984	Gasifier Not Operated
1985	Gasifier Not Operated
1986	September 30 to October 4 December 6 to December 19
1987	May 25 to June 4 October 13 to October 23 December 6 to December 11

Source: METC Environmental Management Personnel, 1987d

Source: Cassidy, 1986

FIXED-BED GASIFIER AND FULL FLOW CLEANUP SYSTEM
FLOW DIAGRAM

FIGURE 3-3

lockhopper and is recycled to the gasifier. The gas passes into the humidifier where water is sprayed into the gas, thereby reducing its temperature from 1,200°F to approximately 400°F (Cassidy, 1986). Cooling of the gas results in the condensation of high-molecular-weight tars that exit the system through a lockhopper. However, simple gravity separation does not fully separate all the tar droplets from the gas, and a second cyclone is used to remove the larger droplets. The gas then flows to a venturi scrubber where the very fine tar mist, which is not removed by the humidifier or tar trap cyclone, is separated from the gas stream. A venturi scrubber injects recycled water into the gas stream, and the captured oils are removed in a pressurized decanter vessel. The oily liquid is handled as a hazardous waste (see Section 4.1).

The sulfur-bearing compounds in the fuel gas are quite malodorous and must be destroyed before being emitted. After the venturi scrubber, the gas stream flows through a condensate pot and to the flare where it is combusted in a natural-gas flame. In the past, the gas stream was burned in an incinerator, which is still available and operational, but the flare is less susceptible to being extinguished during upset conditions. Should the flare be extinguished during operation, the smell of hydrogen sulfide and other malodorous gases will be detectable downwind of the gasifier. An upset incident occurred on June 9, 1987, that extinguished the flare and allowed raw fuel gas to be emitted for 2 hours. Several complaints were registered by nearby residents, and the incident was reported in the local newspaper and on local radio stations (Romano, 1987b). Since then, the flare has been modified for improved reliability by increasing the gas flow rate and by installation of remote-controlled pilot lights.

Associated with the gasifier are two gas cleanup test facilities, the hot gas desulfurization unit and the hot gas particulate cleanup unit, both in Building B-4. The desulfurization unit absorbs hydrogen sulfide from a sidestream of the gasifier fuel gas onto packed columns of zinc ferrite. After passing through the zinc ferrite, the fuel gas is returned to the gasifier for combustion in the flare. During the regeneration cycle, sulfur dioxide is emitted to the atmosphere at a rate of approximately 0.40 pound per hour (lb/hr) (Schlesinger, 1986), but the desulfurization unit does not operate each time the gasifier operates. Integration of a full-flow zinc ferrite system to the gasifier was being planned, but it has been put on permanent standby (Ayers, 1988). The particulate cleanup unit also

withdraws a small sidestream from the gasifier and is used for developing advanced particulate removal devices such as ceramic filters or electrostatic precipitators before being routed back to the gasifier. Thus, there are no additional emissions from the tests conducted on the hot gas particulate cleanup unit.

3.1.2.2 Eighteen-Inch Fluidized Bed Combustion Unit

The 18-inch fluidized bed combustor is located in Building B-4. Although built in 1978, the unit has never operated, and at the time of the Survey, no tests were planned for 1988 (Ayers, 1988). In the past, an older unit of similar design tested a wide variety of low-Btu coals, peats, oil shales, and coal refuse to investigate emissions and combustion efficiency. This unit was scrapped in the fall of 1987 (Ayers, 1988). To start the combustor, a bed of limestone is preheated with natural gas to a temperature of 1,200°F before the coal is injected into the bed. Once a combustion temperature of 1,450 to 1,700°F is achieved, the coal is fed into the combustor via a screw feeder and pneumatic injection system at a maximum rate of 100 lb/hr (Scardino and Soni, 1978). As combustion takes place, ash and spent limestone are removed from the bottom of the combustor by a lockhopper. Flue gas exits the top of the combustor to two cyclones in series, then to two bag filters in parallel before exiting to the atmosphere. During testing, the flue gas will be monitored for carbon dioxide, carbon monoxide, oxygen, sulfur dioxide, nitrogen oxides, and hydrocarbons.

3.1.2.3 Pressurized Combustor

The pressurized combustor in Building B-4 tests conventional coal/water mixtures and novel fuels to evaluate the combustion and emission characteristics of fuels. The most recent research objective has been to determine the behavior of alkali compounds in the fuel on advanced turbine designs. Maximum firing rate is 750,000 British thermal units per hour (Btu/hr), with an estimated 500 hours of operation in 1988 (Ayers, 1988). Estimated emission rates are less than 0.01 lb/hr for hydrogen sulfide and ammonia, 0.8 lb/hr for sulfur dioxide, and 2.1 lb/hr for nitrogen oxides. The only emission controls currently available are fuel specifications and combustion air control; future controls may include the use of a gas sorbent for sulfur removal (Schlesinger, 1986).

3.1.2.4 Fluidized Bed Combustor - Cold Model

The cold-model fluidized bed in Building B-4 does not burn any fuel. Only high-velocity air flow is used to support mixtures of coal and limestone or pellets of nylon, alumina, or ceramics for studies of the mechanics and aerodynamics of fluidization. A total of 42,000 cubic feet per minute (cfm) of air can be blown through the bed by two air compressors (Scardino and Soni, 1978). The air passes out the top of the fluid bed, through two cyclones, and through a series of four baghouses for particulate removal prior to being exhausted to the atmosphere. At the time of the Survey, there were no calculations of potential emissions from the cold-model fluidized bed.

3.1.2.5 Fluidized Bed Gasifier

The fluidized bed gasifier in Building B-12 provides fuel gas from coal for studies on the cleaning of pollutants from the gas stream, and for possible fluidization and gasification studies. Coal, air, and superheated steam are inputs to the gasifier. The coal feed rate is approximately 75 lb/hr. For a typical run, the gasifier supplies about 5,000 standard cubic-foot-per-hour (SCFH) gas output that passes through two cyclones to remove larger particles. The gas can then be used in cleanup studies on desulfurization and particulate removal (Scardino and Soni, 1978). Any portion of the generated fuel gas not used in the cleanup studies would pass through two porous metal filters to remove any remaining particulates, then to a gas-fired incinerator for combustion. Table 3-3 presents the emissions for the worst-case condition where all the fuel gas is incinerated. Ventilation air for Building B-12 is exhausted through a large filter house west of the building to capture any fugitive particulate emissions.

3.1.2.6 Advanced Gasification Entrained Reactor

The other piece of test equipment in Building B-12 is the advanced gasification entrained reactor. The reactor produces a very small gas stream for chemical kinetic studies. The coal feed rate is approximately 1 lb/hr entrained in a gas mixture of argon and either carbon dioxide, nitrogen, or steam (Schlesinger, 1986). The gas stream passes through filters and a condenser to remove particles and heavy liquids before passing through a cold trap (-40°F) to remove lighter oils. Samples are then

withdrawn for gas chromatograph/mass spectrometer analyses, and the remaining gas goes to the incinerator. Tests usually take from 10 to 12 hours with approximately 50 tests per year (Strickland, 1987). Due to the small coal feed rate and the fuel gas controls, emissions from the reactor are considered negligible (Schlesinger, 1986).

3.1.2.7 Fluidized Bed Development Unit

The fluidized bed development unit in Building B-27 was formerly called the vortexing fluidized bed combustor. The unit, or combustor, tests gasifier components and determines their effect on the fuel gas. As with the other METC test facilities, the project is constantly changing equipment and/or fuel types. Typical runs are for 4 hours and consume coal and limestone in a 2 to 1 ratio at a rate of approximately 60 lb/hr. Potential emissions include sulfur dioxide, nitrogen oxides, and particulates. At the time of the Survey, the emission controls consisted of two water-cooled condensers, a cyclone, a bag filter, and a Zurn-type scrubber. The scrubber forces the exhaust gas under and into 1 inch of water where particulates and water-soluble gases are removed (Harrington, 1987). No data had been compiled on the emissions at the time of the Survey. However, 90 percent in-bed sulfur capture by calcination and more than 99 percent particulate capture are expected by METC (Schlesinger, 1986).

3.1.2.8 Coal-Fired Diesel

A one-cylinder diesel engine in Building B-13 tests advanced fuels made from fossil fuels such as mild gasification liquids, shale oils, and liquefaction products. The engine operates for approximately 400 hours/year in 8-hour runs (Ayers, 1987), but most of the runs have been on diesel fuel to establish an operating baseline. Fuel consumption is approximately 30 lb/hr, and the exhaust includes sulfur dioxide at 200 parts per million (ppm), nitrogen oxides at less than 1,000 ppm, hydrocarbons at less than 400 ppm, carbon monoxide between 1 and 2 percent, and 20 percent carbon dioxide (Schlesinger, 1986). The only pollution control at the time of the Survey was the specification limits on the fuel. Future controls include a turbocharger to reduce nitrogen oxide emissions. An opacity meter measures the density of the exhaust as it exits the exhaust pipe outside the building.

3.1.2.9 Coal Preparation Facilities

Coal and other minerals (oil shale, sand, limestone) are dried, crushed, and classified, or screened, in Buildings B-6 and B-14. The equipment in Building B-6 was designed to provide large quantities of feedstock coal to the gasifier and the fluidized bed combustor at the rate of approximately 5 tons/hour (Ayers, 1988). However, most recent testing has required a much smaller volume of coal, and the equipment in B-6 operates infrequently. The equipment consists of a hammer mill to reduce the coal in size, four storage silos, a roller mill for further size reduction, and a vibrating screen. There are cyclones on the crushers and screen to collect and recycle the larger particles. The ventilation air for the entire building is exhausted through a large baghouse on the east side of the building.

Most coal preparation is presently conducted in Building B-14. However, Building B-14 operation has been at very low levels during the past few years as some coal is brought in crushed to specification (Harper, 1988). A rotary dryer outside the building can dry coal at a rate of 500 to 1,000 lb/hr and feed it to a hammer mill inside the building. Fines from the dryer are collected in a small cyclone and a bag filter. After the coal has been crushed inside the building, it is screened and stored in drums. Inside Building B-14 there is also a small crusher and screen system for handling wet coal. There are no controls on the dust generated inside the building. The baghouse that was planned for the building in 1978 (Scardino and Soni, 1978) has not been installed. Dust from operations is exhausted by a large ventilation fan in the east wall. The maximum expected processing rate is 400 tons/year, but there are no estimates of emissions since Building B-14 has never been monitored (Schlesinger, 1986).

3.1.2.10 Heating/Process Water Plant

The central heating and process hot water facilities are located in Building B-5. The boilers are fired with natural gas and produce steam sufficient to meet all of METC's heating requirements, as well as satisfy process steam needs for experiments. Additionally, natural gas is used to operate the compressors that furnish compressed air and inert gas to the site.

There are two boilers in Building B-5, each with a rated capacity of 15,000 lb/hr of steam at a pressure of 125 pound per square inch gauge (psig). Only one boiler is fired at a time, at a maximum of 11,000 lb/hr or about 73 percent of rated capacity. The other boiler is for standby purposes. This steam production rate of 11,000 lb/hr occurs for approximately 150 hours/year (Scardino and Soni, 1978). At other times, the production rate is much less. Process steam for the 42-inch gasifier is supplied by a third natural-gas-fired 7,500-lb/hr steam boiler, which is usually operated at 450 psig.

The heating plant is the only facility at METC for which there is an applicable West Virginia emission limit as determined by Regulation II and Regulation X for particulates and sulfur dioxide, respectively. Calculated maximum emission rates by METC for each of the two heating boilers is 0.024 lb/hr of particulates and 0.025 lb/hr of sulfur dioxide, while the West Virginia regulations would allow 1.35 lb/hr of particulates and 48 lb/hr of sulfur dioxide (Scardino and Soni, 1978). Similarly, the process boiler's emission rates are 0.026 lb/hr for both particulates and sulfur dioxide, while the emission limits are 1.44 lb/hr and 52 lb/hr for particulates and sulfur dioxide, respectively (Scardino and Soni, 1978). Emission rates are significantly less than the permitted rates because the boilers are fired on gas.

3.1.3 Environmental Monitoring Program

Currently, there is no program at METC for monitoring either stack emissions or ambient concentrations. Although the 42-inch gasifier at METC is capable of producing large amounts of air pollutants, these potential pollutants are controlled by burning in a natural gas flare (see source description in Section 3.1.2.1). The open-air arrangement of the flare prevents the collection of any reliable emissions samples from the flare.

Ambient air concentrations of pollutants have been measured by METC in two programs in the past. During 1980, two on-site air monitoring stations were installed at METC. One station was in the north, or downwind, quadrant from the 42-inch gasifier, and the other was in the south, or upwind quadrant. These stations had the capacity to measure ozone, nitrogen oxides, sulfur dioxide, total suspended particulates, and respirable particulates. Also, the stations were equipped with meteorological sensors for measuring wind speed and direction, temperature,

pressure, and relative humidity (Synder, 1984). Total suspended particulate and respirable particulate samples were collected immediately before, during, and after each run of the gasifier to assess background levels of particulates during gasifier inactivity and levels of particulates during gasifier operations. No data or data summaries for this program are available for review. The only result of the monitoring program is a statement in the 1981 Environment, Safety and Health Annual Report that the limited particulate data show concentrations well below standards (Pearson, 1982).

In 1982, the two air monitoring stations, named EPA-1 and EPA-2, were moved off-site. EPA-1 was located 2.5 miles northeast of METC, and EPA-2 was located 2.5 miles southwest of METC. Figure 3-4 shows the locations of the two stations relative to METC and Morgantown. Data were collected and analyzed from April 1982 to March 1984. Analysis of the data for the period showed that there were no significant changes in the monitored parameters during periods of gasifier operation (Synder, 1984). Table 3-5 presents the average values for the gaseous pollutants during periods of gasifier operation and for the remainder of the monitoring program. All arithmetic average concentrations of pollutants during gasifier operation fell within 1 standard deviation of the overall mean concentrations for the monitoring periods. Average concentrations of nitrogen dioxide and sulfur dioxide were below the NAAQS of 0.05 ppm and 0.03 ppm, respectively. Short-term (3- and 24-hour concentrations) were not analyzed, but a review of the data listing by the Survey found no daily values greater than the 24-hour NAAQS for sulfur dioxide of 0.14 ppm. The ozone standard of 0.12 ppm for 1 hour was exceeded on 62 days in 1982 and 36 days in 1983 at EPA-1. However, at EPA-2 the ozone concentrations exceeded the standard on only 5 days in 1982 with no exceedances during 1983 (Synder, 1984). The high ozone concentrations followed the typical seasonal pattern of being high in spring and summer, and low during fall and winter. The high ozone levels are not attributable to the operation of the gasifier or any other source at METC since there are no significant sources of the ozone precursors, nitrogen oxides, or volatile organics at METC.

Only 18 TSP samples and 15 respirable particulate samples were collected during 1983. The average value for the respirable particulate samples was 23 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) at both stations. All total suspended particulate samples collected at both stations were less than the 24-hour secondary standard (150

LOCATIONS OF AIR MONTORING STATIONS
RELATIVE TO METC

FIGURE 3-4

TABLE 3-5

**AVERAGE LEVELS OF POLLUTANTS DURING GASIFIER OPERATION
COMPARED TO OVERALL AVERAGE LEVELS BETWEEN 1982 AND 1984**

Station EPA-1

	NO	NO ₂	SO ₂	O ₃
Average Concentration (ppm) During Gasifier Operation	0.0038	0.0046	0.0098	0.0544
Average Concentration (ppm) 4/82 to 3/84	0.0028	0.0072	0.0073	0.0400
Standard Deviation	± 0.0017	± 0.0039	± 0.0036	± 0.0375

Station EPA-2

	NO	NO ₂	SO ₂	O ₃
Average Concentration (ppm) During Gasifier Operation	0.0019	0.0027	0.0095	0.0307
Average Concentration (ppm) 4/82 to 3/84	0.0020	0.0076	0.0091	0.0257
Standard Deviation	± 0.0016	± 0.0052	± 0.0053	± 0.0148

Source: Synder, 1984

$\mu\text{g}/\text{m}^3$). There were two collocated total suspended particulate samplers at EPA-2 that operated concurrently. The geometric means of these two samplers ($34.5 \mu\text{g}/\text{m}^3$ and $41.6 \mu\text{g}/\text{m}^3$) and of the sampler at EPA-1 ($29.6 \mu\text{g}/\text{m}^3$) were well below the secondary NAAQS of $60 \mu\text{g}/\text{m}^3$.

During the 2-year monitoring program, there was no quality assurance program to evaluate the accuracy and precision of the data (Synder, 1984). The summary data confirm that the accuracy of the data is suspect. The large variation between the two stations on the number of days on which the ozone standard was exceeded, and the differences between the collocated total suspended particulate samplers at EPA-2 are indications of poor accuracy. However, even though the accuracy of the data is suspect, the degree of any inaccuracies is not considered large enough to change the basic conclusion that operations of the gasifier and the other test facilities have an insignificant effect on the air quality at Morgantown. The small size of most sources and their infrequent operation preclude significant impact on local air quality conditions.

3.1.4 Findings and Observations

3.1.4.1 Category I

None

3.1.4.2 Category II

None

3.1.4.3 Category III

None

3.1.4.4 Category IV

None

3.2 Soil

3.2.1 Background Environmental Information

3.2.1.1 Surface Soils

The METC site is drained by the Monongahela River, West Run (a tributary of the Monongahela River), and Burroughs Run (a tributary of West Run). These water bodies receive runoff from small drainageways within the METC site. With the exception of steeply sloped areas adjacent to the Monongahela River and Burroughs Run, the topography of the METC site consists of gently to moderately sloping terrain. Within the center of the site is a low-lying crescent-shaped area (approximately 10 acres) that is swampy most of the year. Site elevations vary from 800 feet at the confluence of West Run and the Monongahela River to 1,000 feet at the hill that has a Navy radio tower.

METC soils are primarily comprised of two complexes. The Culleoka-Westmoreland silt loam is located primarily along the creek and river banks within the site. Monongahela silt loam is located throughout the remainder of the site. Both soil series were deposited by glacial Lake Monongahela and typically consist of varying proportions of silt loam, clays, and sands. Bedrock underlying the sediments is composed of interbedded shale, siltstone, sandstone, and limestone (METC, 1978).

Based on soil surveys conducted by the U.S. Department of Agriculture Soil Conservation Service in Monongalia County, these soils exhibit moderate available water capacity, low to moderate permeability, and rapid runoff characteristics. These soils are strongly acidic unless limed. Erosion can be severe in unprotected areas (METC, 1978).

3.2.1.2 Adjacent Land Uses

METC is bordered on the north by the Baltimore and Ohio Railroad and the Monongahela River (see Figure 2-3). West Run, Burroughs Run, undeveloped areas, rural farmland, and medium-density residential areas are adjacent to METC's eastern property line. Residential areas (predominantly light density with some medium density) are located adjacent to the southern and western property lines.

3.2.1.3 Wildlife and Vegetation

The Morgantown area is typical of an area covered with an Eastern deciduous forest. Although most of the area has been developed, patches of broad-leaved deciduous trees consisting of oak, beech, maple, and ash are common. Wildlife populations are moderate to abundant.

Vegetation at METC and the adjacent residential areas includes domestic trees and shrubs, such as red maples, arborvitae, and azaleas. The undeveloped northern portion of the site was used for small-scale vegetable farming approximately 30 years ago. Vegetation in the partially cleared tracts of this northern area consists of perennial grasses and sedges interspersed with clumps of staghorn sumac, locust, and young oaks. Wooded areas are dominated by medium to large broad-leaved deciduous trees including locust, tulip poplar, sycamore, beech, and a variety of oaks. Shrub and herb layers contain chokeberry, mulberry, and sumac. Bird and mammal populations in wooded areas of the METC site include raccoons, opossums, shrews, deer, and mice (METC, 1978).

3.2.2 **General Description of Pollution Sources and Controls**

3.2.2.1 Historic Site Operations

METC was originally established by the Federal Government in 1954 to conduct fossil fuel research activities. Facilities included a coal research unit and a petroleum and natural gas unit. A Federal mine inspection group was also located on the site. Since 1954, METC's goals and research activities have expanded. METC's current mission is to conduct research and development activities on advanced high-risk, high-payoff technologies that significantly improve the environmental performance, energy efficiency, and cost effectiveness of fossil fuels.

Since the METC facilities were constructed, the site landscape has changed significantly. Site grading has changed as a result of construction of several buildings. A pilot-scale coal gasification unit was constructed. Industrial wastewater treatment ponds used to treat wastewaters from the coal gasification unit have been constructed and have since been deactivated. A sedimentation

pond used to manage frac-water from gas well drilling has also been constructed and deactivated. Waste materials such as coal ash, tars, and metal scrap have been stored at several locations on the METC site.

Potential sources of soil pollution resulting from past practices include chemical leaks and spills; contaminants in waste storage/accumulation areas; closure of frac-water sedimentation ponds; and closure of an industrial wastewater pond. The currently existing sedimentation pond described in Section 3.3.3.1 is constructed over a clay-covered rock ledge at the southwest corner of the site adjacent to Burroughs Run. Past leaks from this pond were described by site personnel as being caused by muskrat holes and by partial resultant slumping of the earth berms which form the containment. Soil erosion and potentially overflow of contaminated sediment into Burroughs Run have resulted. Analyses of sludge from this pond are contained in Sections 4.5 and 3.3.

Three other ponds for various types of wastewater formerly existed on-site but are now removed. These are the industrial wastewater pond north of Building T-42, the Slurry Pond (002), and the frac-water pond. A complete description of these ponds is contained in Section 4.5.1.2. All three of the ponds contained sediments with contamination from METC processes. The majority of contaminated sediment and soil from the industrial wastewater pond was removed for proper disposal when the pond was remediated; however, some soil contamination remains and is now covered by a parking lot. The frac-water pond used for containment of gas well drilling fluids was believed to have been dredged and the sludge taken to the Marion County Landfill; however, when the liquid contents of the pond were drained to Burroughs Run, considerable carryover of sediment potentially resulted. The Slurry Pond (002) was formerly operated in series with the current sedimentation pond to settle out fine particulates prior to discharge of wastewater to Burroughs Run. Sludge from the cleaning and removal of this pond was reported to have been removed to the Marion County Landfill (see Section 4.5.1.2). Since the pond was in existence for over 15 years, the strong potential exists that sediment carryover to Burroughs Run due to upsets and breaches of the berms occurred as in the current sedimentation pond.

A detailed discussion of soil contamination resulting from waste storage/accumulation practices as well as chemical spills and leaks is presented in

Section 4.5. Frac-water ponds, structural fill materials, and closure of the industrial wastewater pond are also discussed in that section.

3.2.3 Environmental Monitoring Programs

METC does not conduct a regular soil monitoring program.

3.2.4 Findings and Observations

3.2.4.1 Category I

None

3.2.4.2 Category II

None

3.2.4.3 Category III

None

3.2.4.4 Category IV

None

3.3 Surface Water

3.3.1 **Background Environmental Information**

3.3.1.1 Regional Setting

The major surface-water bodies of interest include Burroughs Run, West Run, and the Monongahela River. Burroughs Run, a tributary of West Run, is located near the southern boundary of the METC site. As indicated in Figure 3-5, West Run is located adjacent to the eastern boundary of the METC site and is a tributary of the Monongahela River.

The Monongahela River joins the Allegheny River at Pittsburgh to form the Ohio River as indicated in Figure 3-6. The Monongahela River Basin includes a portion of the Appalachian Plateaus and the Allegheny Mountains. Although runoff from the METC site discharges into either Burroughs Run, West Run, or the Monongahela River, most surface-water runoff from the developed portion of the METC site discharges into Burroughs Run. Surface-water runoff from the remainder of the developed portion of the METC site discharges into unnamed tributaries of West Run.

3.3.1.2 Burroughs Run

Burroughs Run, with an average flow of approximately 2 cubic feet per second (cfs) (METC, 1978), has a 10-year, 7-day low flow of zero (HNTB, 1983a). The stream flows into and out of Suncrest Lake, which is located approximately 0.2 mile upstream of the METC site.

Water quality data for Burroughs Run are presented in Tables 3-6 and 3-7. The data indicate that dissolved oxygen concentrations do not meet the State Water Quality Criteria for the Monongahela River and its tributaries. The Burroughs Run watershed is heavily impacted by urban development. It is suspected that extensive commercial, industrial, and residential development along Chestnut Ridge Road has led to the deterioration of the Burroughs Run water quality. Relatively high levels of nitrogen and phosphorus in Burroughs Run are likely due to exfiltration from

LOCAL SURFACE-WATER BODIES

FIGURE 3-5

REGIONAL SURFACE-WATER MAP

FIGURE 3-6

TABLE 3-6

WATER QUALITY DATA FOR BURROUGHS RUN
NOVEMBER 2, 1977

Parameter	Data for Sampling Stations ^a			
	1	2	3	4
Depth (feet)	0.33	0.2	0.17	0.33
Width (feet)	1.0	3.0	3.0	2.0
Flow (cfs)	0.6	<0.1	0.4	0.6
Temperature (°C)	12.0	7.0	10.8	14.0
pH (Units)	6.9	6.7	6.7	7.2
Dissolved Oxygen	2.4	1.8	2.2	1.7
Biological Oxygen Demand	9.8	10.5	32.0	>41.0
Turbidity (JTU)	3.5	4.2	22.0	18.0
Color (CPU)	30.0	15.0	30.0	40.0
Suspended Solids	8.0	<5.0	50.0	13.0
Total Dissolved Solids	302.0	600.0	380.0	296.0
Total Alkalinity	117.0	226.0	164.0	202.0
Sulfates	67.6	73.0	119.0	106.0
Nitrite plus Nitrate	0.031	0.017	0.062	<0.004
Nitrogen: Total	11.03	9.42	18.06	53.0
Total Kjeldahl	11.0	9.20	18.0	53.0
Ammonia	7.6	7.4	18.0	29.0
Phosphate: Total	3.0	36.0	2.6	6.0
Ortho	2.37	0.71	1.69	4.62
Total Organic Carbon	15.1	13.9	22.8	57.1
Copper (µg/L)	3.76	<1.0	14.2	38.8
Chromium (µg/L): Total	3.61	6.22	20.60	8.18
Hexavalent	6.20	8.52	7.36	6.20
Iron (µg/L)	813.0	1340.0	1460.0	813.0
Lead (µg/L)	<0.8	<0.8	<0.8	<0.8
Nickel (µg/L)	4.22	19.20	12.90	9.04
Zinc (µg/L)	16.1	<15.0	40.2	60.3

Sources: METC, 1978

^a Data are in mg/L unless otherwise indicated.

TABLE 3-7

SURFACE-WATER QUALITY DATA FOR BURROUGHS RUN AND WEST RUN

Constituent	Burroughs Run (ppm)	West Run (ppm)
pH	7.71	7.71
Alkalinity (CaCO ₃)	868.0	NA
Acidity (CaCO ₃)	400.0*	3,190.0
Conductivity (mmhos)	534.0	1,311.0
Total Iron	0.83	31.0
Ferric Iron	0.63	28.4
Ferrous Iron	0.17	2.3
Sulfate	98.0	360.0
Chloride	94.1	11.4
Nitrates	3.30	0.86
Magnesium	10.6	22.8
Calcium	65.0	138.0
Potassium	8.0	6.2
Sodium	39.5	25.2
Lead	11.5	6.56

Source: METC, 1978

* Only one recorded reading for the period.

septic tanks, effluents from wastewater sewers, and runoff from paved areas upstream of the METC site (METC, 1978).

3.3.1.3 West Run

West Run is a moderate-sized creek with an average flow of about 15 cfs (DOE, 1978). The stream discharges into the Monongahela River about 0.38 mile below the confluence of Burroughs Run and West Run.

Water quality data for West Run are presented in Table 3-7. Relatively significant concentrations of acidity, total iron, and sulfate have been observed (METC, 1978). These may be indicative of acid mine drainage entering the stream upstream of the METC site.

3.3.1.4 Monongahela River

All surface-water drainage in Monongalia County eventually flows into the Monongahela River, the largest body of water in Morgantown. As indicated in Figure 3-7, the river is formed by the confluence of the Tygart and West Fork Rivers at Fairmont, West Virginia (approximately 32 miles upstream of the METC site). The Monongahela flows northwesterly for 128.7 miles into Pennsylvania. At Point Marion, Pennsylvania, it is joined by the Cheat River. The average flow of the Monongahela River, past Point Marion, is about 7,500 cfs (METC, 1978).

The total Monongahela River drainage area is 7,340 square miles, of which 57 percent or 4,150 square miles is in West Virginia and the remainder is in Pennsylvania and Maryland. The average river gradient is approximately 2.5 feet/mile from Fairmont to the Morgantown Locks and Dam. Downstream from the locks and dam, the average gradient decreases to 0.6 foot/mile. The river valley is relatively narrow throughout Monongalia County, with an average width of 500 to 1,000 feet. Most of the watershed consists of forested hills and narrow bottomland (METC, 1978). Within the METC site, 100-year floodplains encompass only steeply sloped land that is not developed. Consequently flooding is not considered a threat to existing METC facilities (METC, 1987a).

MORGANTOWN ENERGY TECHNOLOGY CENTER
SCHEMATIC OF WATER FLOW

FIGURE 3-7

3.3.1.5 Utilities

Since the METC site was originally developed, stormwater and wastewater collection systems have been significantly modified. Initially, sanitary sewage was collected and treated at a sewage treatment plant (STP) located on-site. Any other wastewater and stormwater runoff was collected by a storm sewer system that discharged into Burroughs Run and other tributaries of West Run.

Eventually, four wastewater collection systems were developed: industrial wastewater, contaminated wastewater, sanitary wastewater, and stormwater. In addition, wastewater treatment systems were developed for processing industrial and contaminated wastewaters. However, the integrity of each collection system was not maintained, due to the uncoordinated site development that had occurred between the 1950s and 1980s. Consequently, improper cross-connections between wastewater sources and collection systems were installed. Within the last 7 years, METC attempted to identify cross-connections and segregate wastewaters to prevent surface-water discharges of untreated or inadequately treated wastewater.

In 1983, a wastewater management plan (Sanders & Thomas, 1986) was developed for collecting and treating all METC wastewaters. The plan consisted of the four activities listed below.

1. Closure of the existing industrial waste pond. The pond was used as part of the industrial wastewater treatment system. It was the source of an odor problem and was identified as a potential source for groundwater contamination.
2. Modification of the wastewater collection systems. Sources of contaminated and sanitary wastewater would be redirected from the storm sewer system to the appropriate systems. Noncontact cooling water and noncontaminated stormwater would be redirected from the contaminated sewer system to the storm sewer system.
3. Construction of a new force main. The new force main would transport contaminated wastewater, sanitary sewage, and pretreated industrial wastewater to the City of Morgantown sewer system.

4. Construction of a new wastewater pretreatment facility. The facility would collect, equalize, and pretreat industrial wastewater; collect and equalize the contaminated and sanitary wastewater; and pump the wastewater to the municipal sewer system via the new force main.

To date, METC has closed the industrial waste pond; modified some of the wastewater collection systems; and constructed a new wastewater pretreatment facility. The proposal for construction of a new force main was changed. Instead METC has proposed the construction of a new gravity sewer to transport contaminated wastewater, sanitary sewage, and pretreated industrial wastewater to the City of Morgantown sewer system. Construction of the sewer has been scheduled for the fall of 1988 with completion in the spring of 1989 (Spengler, 1988).

METC obtains potable water from the City of Morgantown. Morgantown draws its water supply from the Monongahela River and Coburn Creek. Approximately 93,000 gpd are consumed by the METC facility (METC, 1986a).

3.3.2 General Description of Pollution Sources and Controls

Of the 93,000 gallons per day (gpd) of potable water consumed at METC, most leaves METC as sanitary wastewater, contaminated wastewater, and noncontact cooling water. The remainder is lost by evaporation during cooling. A schematic of water flow is given in Figure 3-7. Additional potable water is consumed intermittently when coal gasification and other synfuel experiments are conducted.

Stormwater runoff and underground drainage are also collected and discharged to Burroughs Run or tributaries of West Run. All surface-water discharges from the METC facility are summarized in Table 3-8. Outfall locations are indicated on Figure 3-8.

METC has no written Spill Prevention, Control, and Countermeasures (SPCC) plan to address potential spills of petroleum or toxic substances which may enter storm sewers or other discharges to surface waters.

TABLE 3-8

SUMMARY OF SURFACE-WATER DISCHARGES^a

Wastewater Category	Source	Average Flow (gpd)	Treatment	Outfall
Contaminated Wastewater	Noncontact cooling water	40,000	Sedimentation Pond	001
	Compressor condensate	100	Sedimentation Pond	001
	Laboratory wastewater (sink drains)	5,400	Sedimentation Pond	001
	Boiler blowdown	500	Sedimentation Pond	001
	Stormwater runoff (industrial areas)	34,000	Sedimentation Pond	001
Sanitary Wastewater	Sanitary wastewater	10,000	STP Filtration Chlorination Sedimentation Pond	001
Stormwater	Stormwater runoff (non-industrial areas)	55,500	None	003 thru 008
Underground Drainage	Underground drainage	Unknown	None	009

Source: Modified from METC, 1986a

- ^a A combination of wastewaters is discharged from Outfall 001 (see Section 3.3.2). Outfall 002 is no longer active. The outfall discharged contaminated wastewater from a sedimentation pond that has been removed.

Source: Modified from METC, 1986a

METC SURFACE-WATER OUTFALL LOCATIONS

FIGURE 3-8

The METC facility potentially discharges contaminants to surface waters from five categories of wastewater. Collection and treatment systems for each category are described in the following subsections. The five categories are defined as follows:

Industrial Wastewater - wastewater generated by the gasification unit and other synfuel processes.

Contaminated Wastewater - wastewater which is a mixture of laboratory wastewater, building washdown water, coal pile runoff, process cooling water overflow, and miscellaneous wastes discharged to floor drains.

Sanitary Wastewater - wastewater from restrooms, water fountains, cafeterias, etc. throughout the facility.

Stormwater - stormwater runoff.

Underground Drainage - groundwater drainage collected by perforated pipes, tile underdrains, and French drains.

3.3.2.1 Industrial Wastewater

The pretreatment plant was designed in 1984 to treat industrial wastes that were generated by the coal gasification unit and synfuel processes in general. Pretreatment plant effluent was to be discharged into the Morgantown sewer system. A primary design consideration was to provide a treatment system with adequate flexibility so that operations and process configurations could accommodate a wide range of wastewater flows and pollutant concentrations. Flexibility was necessary due to the diversity of wastewater types that may be generated by future research projects.

Gasifier wastewater included recirculation decanter condensate, ash quench water, process upset wastes (wastes that might originate from the Stretford unit (see Section 4.1), and contaminated stormwater runoff from the area surrounding the gasification unit. Most of the wastewater was produced by the gas cleanup systems that remove contaminants from raw gas. Raw product gas produced by the coal gasification processes contained gaseous, liquid, and solid contaminants. The

contaminants included particulates -- ash and unburned coal; condensable tars and oils; ammonia; phenol; and sulfur gases. Other industrial wastewaters considered during pretreatment plant design included fracturing fluid from gas recovery research and oil shale wastewater from off-site projects. Annual wastewater volume and composition ranges used as a basis for pretreatment plant design are summarized in Table 3-9.

Plant design was completed in 1984, while plant construction was completed in 1986. The plant process train consists of the following units (METC, 1986c):

- oil separators
- equalization/holding tanks
- dual media filters
- biological oxidation (activated sludge)
- ammonia stripping
- granular activated carbon (GAC)
- coagulation
- sedimentation
- sludge dewatering (filter press)

Although the pretreatment plant is available, to date it has not been operated to treat industrial wastewater due to the nature of recent research projects and the wastewaters that have been generated. Since 1986, METC has experimented with new gas cleanup processes. These processes significantly reduce the volume of wastewater produced, compared to the gas cleanup systems used in previous experiments. Consequently, all wastewater produced by the gasifier is collected in drums and shipped off-site for disposal.

3.3.2.2 Contaminated Wastewater

Contaminated wastewater is collected by the contaminated wastewater sewer system (CWSS) and discharged to the 001 Sedimentation Pond (formerly the 001 Slurry Pond). The 225,000-gallon earthen sedimentation pond has baffles to enhance sedimentation and oil booms to remove floating oil. There is no record of any impermeable liner being installed. Pond effluent is discharged into Burroughs Run via Outfall 001.

TABLE 3-9

**SUMMARY OF ANNUAL RECIRCULATION DECANter WASTEWATER VOLUME AND
COMPOSITION RANGE ^{a,b}**

Parameter	Low Btu at 500 hr/yr ^c (Air Blown)	Medium Btu at 1,500 hr/yr ^d (Oxygen Blown)
Flow, gallons/yr	22,500	288,000 (Lig.) to 720,000 (Bit.)
BOD ₅ , mg/L	12,000	7,000 to 20,600
TOC, mg/L	7,800	2,100 to 10,400
COD, mg/L	21,000	10,500 to 31,200
Phenols, mg/L	5,200	1,800 to 8,100
Oil and Grease, mg/L	2,200	125 to 9,400
Thiocyanate, mg/L as SCN	400	15 to 520
Total Cyanide, mg/L as CN	200	25 to 310
H ₂ S, mg/L as S	1,400	50 to 620
NH ₄ -N (Total), mg/L	10,000	2,200 to 16,900
NH ₃ -N (Free), mg/L	6,600	1,500 to 11,100
Alkalinity, mg/L as CaCO ₃	23,600	5,400 to 39,600

Source: HNTB, 1983

- ^a Indicated flows do not include an estimated 2 gpm for ash quench wastewater.
- ^b Assumed coal feed rates: 0.75 ton/hr for low-Btu operation; 1.0 ton/hr for medium-Btu operation.
- ^c Flow rate based on 0.75 gpm; concentrations based on METC data.
- ^d Flow rates based on 3.2 to 8.0 gpm range. The indicated range of concentrations represent the extreme condition using the unit mass emission rates. The minimum concentration is based on the maximum flow (8.0 gpm) and minimum unit mass emission rate; and the maximum concentration is based on the minimum flow (3.2 gpm) and the maximum mass emission rate.
- ^e Estimated as 3.57 times the free NH₃-N concentration.

The hydraulic retention time is approximately 2.5 days based on an average flow of 90,000 gpd. Pond effluent is discharged through an effluent weir where it is monitored using a flow meter. The contaminated wastewater flow typically ranges between 70,000 and 100,000 gpd. Occasionally the flow will exceed the capacity of the flow-recording device; however, it has been estimated that the maximum flow rate experienced at the pond is approximately 150,000 gpd (Site Management Support, 1987). High flows have been attributed to stormwater inflow that likely originates from cross-connections such as the connection of roof leaders to the CWSS at Building B-6.

The Sedimentation Pond sludge was sampled on January 21, 1988, and the analyses are summarized in Table 3-10. The wastewater sources that discharge into the CWSS are listed in Table 3-11. A summary of maximum contaminant concentrations for contaminated wastewater is given in Table 3-12.

3.3.2.3 Sanitary Wastewater

The METC facility has had a sanitary wastewater collection and treatment system in operation since 1954. The STP is an extended aeration activated sludge system with a design capacity of 15,000 gpd and a design population of 500 persons (Romano, 1988). The plant consists of a comminutor/bar screen, an aeration chamber (19,800 gallons), and a clarifier (10,000 gallons). Waste activated sludge is aerobically digested and hauled off-site for disposal by contract. The sludge is hauled off-site for disposal approximately four times a year and is analyzed prior to disposal.

The STP was upgraded in 1982. The upgrade brought the plant up to current design standards and included new air diffusers, new air compressor, overhaul of the gas chlorinator, new comminutor, and conversion of the sludge digester to an aerobic system (METC, 1983). The plant upgrade was designed to provide secondary treatment, with effluent being discharged into Burroughs Run via the stormwater sewer (Outfall 003).

To comply with current tertiary discharge limitations, METC has diverted the STP effluent to the industrial wastewater pretreatment plant (B-17) for additional treatment via dual-media filtration. The filter is a pressurized unit with a surface

TABLE 3-10
SEDIMENTATION POND SLUDGE ANALYSIS

Contaminant	Concentration		
	Sample #1	Sample #2	Sample #3
pH (standard units)	7.47	7.45	7.05
Phenolics (ppm)	<0.08	<0.08	<0.08
Cadmium (ppm)	1.22	2.0	1.7
Chromium VI (ppm)	<0.08	<0.08	<0.08
Iron (ppm)	6,700	11,800	8,800
Lead (ppm)	14	23	22
Mercury (ppm)	6.7	11.0	9.1
Nickel (ppm)	6.0	10	9.7
Silver (ppm)	1.0	1.2	1.2
Vanadium (ppm)	9.2	7.4	8.4
Total Chromium (ppm)	6.5	9.7	9.0
Naphthalene (µg/g)	<5	<5	<5
Xylene (µg/g)	0.65	0.15	0.29
Toluene (µg/g)	0.09	0.07	0.06

Source: METC, 1988 sampling data

TABLE 3-11

CONTAMINATED WASTEWATER SEWER SYSTEM DISCHARGE SOURCES

Source	Building	Type of Discharge
Floor/sink drains	B-2	Lab wastewater
Floor/sink drains	B-3	Machine shop wastewater
Floor drains	B-4	Contaminated stormwater runoff
Drain	B-6	Air filter discharge
Floor drain	B-6	Coal dust washdown ^a
Roof leaders	B-6	Stormwater
Drains	B-8	Storage well water
Floor drain	B-10	Garage washdown
Trench drains	B-10	Coal pile runoff
Trench drains	B-12	Contaminated stormwater runoff
Floor drains	B-12	Contaminated washdown
Floor drains	B-13	Contaminated washdown
Roof leaders	B-14	Stormwater
Trench drains	B-14	Contaminated stormwater runoff
Floor drains	B-14	Contaminated washdown
Floor drains	B-16	Contaminated washdown ^b
Floor/sink drains	B-25	Lab wastewater

Source: Misenhimer, 1988

^a Normally dry sweep building.

^b Connection to the CWSS was not confirmed on construction drawings.

TABLE 3-12

SUMMARY OF SANITARY AND CONTAMINATED WASTEWATER COMPOSITION

Parameter	Municipal Sewer Use Ordinance Limit	Raw Sanitary Wastewater Maximum	Contaminated Wastewater Maximum
BOD ₅ , mg/L	200	300	50 ^a
TSS, mg/L	300	300	50 ^b
Oil and Grease, mg/L	25	25	3.5 ^b
NH ₃ -N, mg/L	--	25	N/A ^c
CN (Total), mg/L	--	N/A ^c	N/A ^c
Phenols, mg/L	--	0.005 ^d	< .02 ^b
Cu, mg/L	--	N/A ^c	N/A ^c
Zn, mg/L	--	N/A ^c	N/A ^c
Cr, mg/L	--	< 0.01 ^d	< .01 ^b
Pb, mg/L	--	< 0.05 ^d	< .03 ^b
Hg, mg/L	--	< 0.0005 ^d	< .0005 ^b
Cd, mg/L	--	< 0.01 ^d	< .01 ^b
pH	> 6.5	6.5 to 9.0	7.2 to 10.6 ^b

Source: HNTB, 1983

a Based on a maximum observed Pond No. 1 monthly average COD of 85 mg/L and an assumed BOD₅ to COD ratio of 0.6.

b Based on Pond No. 2 monitoring data.

c Data not available but should be consistent with concentrations in potable water.

d Based on December 3, 1981, sanitary treatment plant influent data.

area of 1.77 square feet. The filter media are anthracite coal and garnet and the flow rate is 10 gallons per minute (gpm). Filter effluent is subsequently chlorinated in B-17, then pumped to the sedimentation pond. The chlorinator is a tablet type. Effluent is combined with contaminated wastewater in the sedimentation pond (see Section 3.3.2.2) and discharged into Burroughs Run via Outfall 001. A schematic drawing of the STP is given in Figure 3-9. Wastewater Influent may also be diverted to the holding tanks (capacity 350,000 gallons) located in the pretreatment plant.

Average daily and maximum wet weather flows have been approximately 12,000 gpd and 24,000 gpd, respectively (Spengler, 1986). The National Pollutant Discharge Elimination System (NPDES) permit application listed average daily flow as 10,000 gpd. The treatment plant has been upset once as a result of receiving a high-strength degreasing agent used to unclog a sewer pipe. The plant does not have any alarms to alert operators of any operating problems at the STP. Potential sources of stormwater and contaminated wastewater cross-connections to the sanitary sewer system are listed in Table 3-13.

3.3.2.4 Stormwater

The stormwater collection system consists of underground pipes, yard drains, catch basins, culverts, unlined ditches, and natural streambeds. Runoff from potentially contaminated areas is collected by the CWSS, while runoff from the remainder of the site drains into the stormwater collection system and natural drainageways. In addition, there are areas where underground drainage pipes discharge into storm sewers, streams, and drainageways. The stormwater and underground drainage outfalls (003 through 008 and 009, respectively) are indicated in Figure 3-8 and listed in Table 3-8.

Prior to 1983, wastewater from the analytical laboratories, photographic laboratories, garage, enhanced oil recovery laboratories, coal processing laboratories, and coal bin drainage discharged directly into the stormwater sewer system. The stormwater sewer system discharged into Burroughs Run.

Mercury contamination of the stormwater sewer system was reported in 1981 (Sanders & Thomas, 1981b). A study was conducted to determine the source and extent of mercury contamination. Sampling locations and results are given in Figure

Source: Modified from METC, 1987b

METC SANITARY WASTEWATER TREATMENT SYSTEM

FIGURE 3-9

TABLE 3-13

**POTENTIAL SOURCES OF STORMWATER AND CONTAMINATED
WASTEWATER DISCHARGED TO THE SANITARY SEWER SYSTEM**

Source	Building	Type of Discharge
Floor drains	B-4-C	Process wastewater
Floor drains	B-4-D	Process wastewater
Floor drains	B-15	Contaminated water

Source: Misenhimer, 1988

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3-10 and Table 3-14, respectively. It was concluded that mercury contamination originated from the analytical laboratories located in Buildings B-1, B-2, and B-3. As a result of the study, the following recommendations were presented (Sanders & Thomas, 1981b):

- Mercury should not be used at METC except when alternative chemicals are unsuitable for research purposes.
- The laboratory areas of Buildings B-1, 2, and 3 must be disconnected from the storm drainage system and connected instead to the industrial waste system.
- Five months of cleansing from rains may eliminate contamination. If no contamination is found, an annual monitoring program should be enacted to ensure continued compliance. If analysis shows a continuous reduction in contamination, an additional cleansing period may be allowed. If analysis shows no reduction in contamination, all contaminated storm drain lines will have to be replaced and removed to an approved disposal site.

To date mercury utilization has been minimized. In 1983, laboratory sink and floor drains were redirected to the CWSS. As described in Section 3.3.2.2, the CWSS discharges to the stabilization pond. However, no program was enacted to monitor mercury discharges from the stormwater sewers nor from stabilization pond effluent. Recent (January 1, 1988) analyses of an abandoned portion of the stormwater sewer system indicated mercury concentrations of 75 parts per million (ppm) in an unused limestone pit that formerly served Building B-1.

Since 1983, wastewater from the analytical laboratories, photographic laboratories, garage, enhanced oil recovery laboratories, coal processing laboratories, and coal bin drainage has been redirected to the CWSS. Current potential sources of contaminated water that discharge to the stormwater sewers are listed in Table 3-15. Although plans had been prepared for disconnecting several building drains from the stormwater sewer system, these projects have not been constructed to date (Site Management Support, 1987).

Source: Sanders & Thomas, 1981b

STORM DRAINAGE SYSTEM – MERCURY SAMPLING POINTS FIGURE 3-10

TABLE 3-14
MERCURY SAMPLING AND ANALYSIS

Sample No.	Location	Date	Hg (mg/L)	Date	Remarks
1	Neut. Tank	6/4/80	0.1	6/4/80	
2	Manhole	6/4/80	0.09	6/4/80	
3	Manhole	6/4/80	0.07	6/4/80	
Dist. H ₂ O		6/4/80	0.005	6/4/80	
4	Manhole	6/4/80	0.069	6/4/80	
5	Manhole	6/4/80		6/4/80	Manhole Covered
6	Manhole	6/4/80	0.07	6/4/80	
7	B-1 Rm 307	6/23/80	0.45	6/24/80	
Dist. H ₂ O		6/23/80	0.005	6/24/80	
8	B-1 Rm 339	6/23/80	0.06	6/24/80	
9	B-1 Rm 219	6/23/80	0.06	6/24/80	
10	B-1 Rm 203	6/23/80	0.195	6/24/80	
Dist. H ₂ O		6/23/80	0.005	6/24/80	
11	B-1 Rm 15	6/23/80	0.11	6/24/80	
12	B-3 Photo	6/23/80	0.085	6/24/80	Filtered Sample
13	B-3 Instr.	6/23/80	1.61	6/24/80	Filtered Sample
14	B-3 Lab	6/23/80	0.125	6/24/80	
15	B-2 Lab	6/23/80	0.36	6/24/80	
16	B-2 Lab	6/23/80	0.175	6/24/80	
17	B-2 FD	6/23/80	0.02	6/24/80	Filtered Sample
Dist. H ₂ O		6/23/80	0.09	6/24/80	
Dist. H ₂ O		6/23/80	0.05	6/24/80	
Dist. H ₂ O		6/23/80	0.03	6/24/80	
18	B-2 CB	6/23/80	0.025	6/24/80	Filtered Sample
19	B-5 Trench	6/24/80	0.12	6/25/80	
20	B-5 Shop	6/24/80	0.08	6/25/80	

TABLE 3-14
MERCURY SAMPLING AND ANALYSIS (Continued)

Sample No.	Location	Date	Hg (mg/L)	Date	Remarks
21	B-5 FD	6/24/80		6/25/80	High Oil & Grease - Not Tested
22	B-5 FD	6/24/80	0.025	6/25/80	Filtered Sample
Dist. H ₂ O		6/24/80	0.03	6/25/80	
23	B-4B FD	6/24/80	0.04	6/25/80	
24	B-4 Trench	6/24/80	0.025	6/25/80	
25	B-6 AD	6/24/80	0.02	6/25/80	
Dist. H ₂ O		6/24/80	0.01	6/25/80	
26	B-10 Trench	6/24/80	0.02	6/25/80	
27	Headwall	6/24/80	0.015	6/25/80	
28	B-10 Lab	6/24/80	0.015	6/25/80	
Dist. H ₂ O		6/24/80	0.005	6/25/80	
29	Headwall	6/24/80	0.01	6/25/80	
30	Headwall	6/24/80	0.05	6/25/80	
31	Manhole	6/24/80	0.03	6/25/80	
Dist. H ₂ O			0.005	6/25/80	
32	Manhole	6/24/80	0.008	6/25/80	
33	B-15 CB	6/24/80	0.023	6/25/80	
34	Neut Tank	6/24/80	---	---	High Oil & Grease - Not Tested

Source: Sanders & Thomas, 1981b

Parameters:

1. Maximum allowable mercury level 0.05 mg/L.
2. Perform analysis within 24 hours of sampling.
3. Perform analysis with distilled water as required to validate testing equipment purge and operation.
4. Grab samples shall be taken without the use of reagents.
5. Reference from which this table was taken did not differentiate between the dates (i.e., which was sampling and which was analytical).

TABLE 3-15

**SOURCES OF POTENTIALLY CONTAMINATED WATER DISCHARGED INTO THE
STORMWATER SEWER SYSTEM**

Source	Building	Type of Discharge	Outfall
Floor drains	B-5	Boiler blowdown ^a	003
Floor drains	B-5	Compressor oil spill	003
Floor drain	B-6	Coal dust washdown ^b	003
Lavatory drain	B-7	Contaminated water ^a	003
Trench drains ^c	B-10	Oil & grease	004
Floor drain	B-16	Contaminated washdown	003
Floor drains	B-16	Chemical spills ^d	003
Yard drains	Fuel pumps	Fuel spills	003

Source: Misenhimer, 1988

- a Plans to disconnect drains from stormwater sewer have not been implemented
- b Drain is normally closed, normally dry sweep area
- c Collect runoff from garage
- d Connection to stormwater sewer was not confirmed on construction drawings

3.3.2.5 Underground Drainage

Groundwater drainage systems have been installed at several locations throughout the METC site. These systems consist of 4-inch perforated polyvinyl chloride (PVC) pipes, 6-inch tile underdrain pipes, and a French drain. The underdrains discharge into storm sewers and Burroughs Run.

Outfall 009 is an underdrain outfall (see Figure 3-8) that discharges groundwater into Burroughs Run. The underdrain is located in an area near Building B-19 where power plant bottom ash was used as structural fill material. A reddish discoloration of the surface rock material is evident as a result of effluent discharged from the underdrain outfall.

In the area between Buildings B-16 and B-19, 6-inch tile underdrain pipes collect groundwater. In the vicinity of Building B-2, trailer T-40, and trailer T-41, 4-inch perforated PVC pipes collect groundwater. Drainage from these pipes flows into the stormwater sewer system and eventually discharges into Burroughs Run via Outfall 003.

A French drain, located between Buildings B-5 and B-6, discharges into the stormwater sewer system. The stormwater sewer discharges into a drainageway via Outfall 005.

Outfall 007 is a stormwater system outfall that receives underdrainage from a 4-inch perforated PVC pipe located underneath a parking lot. The parking lot is located north of Building B-7.

3.3.3 **Environmental Monitoring Program**

The METC Environmental Monitoring Program is composed of four elements to achieve regulatory and process control objectives. The four elements are:

- Sedimentation Pond - sampling influent and effluent flow bimonthly as required by the NPDES permit.

- Sewage Treatment Plant - sampling at major points of the STP system for process control; sampling influent and effluent discharges bimonthly as required by the NPDES permit.
- Potable Water Supply System - sampling at several locations throughout the facility annually.
- Burroughs Run - sampling upstream of Outfall 001 and downstream of Outfall 002 bimonthly as required by the NPDES permit.

In addition, stormwater and underdrain outfalls have been sampled as a result of Survey activities.

3.3.3.1 Sedimentation Pond

METC's sedimentation pond effluent discharge is regulated by the State of West Virginia NPDES Water Pollution Control Permit No. IW-6139-80. Effluent discharge limitations are summarized in Table 3-16. The existing permit officially expired on August 6, 1985, and was granted an extension until February 6, 1987.

A new NPDES permit application (No. WV0026211) was submitted by METC to the state on December 12, 1986. The new application combines existing WV/NPDES permits for the STP (No. WV0083259) and the stabilization pond (No. IW-6139-80) into one permit. To date the state has not acted upon the application. METC has been informed by the state that METC has done all that was required to file for a new permit, but the state has been unable to review the application due to manpower problems. It is expected that a new permit will be issued sometime in 1988. The state advised METC to continue to meet the existing permit requirements until a new permit is issued (Angoli, 1987a).

Table 3-17 summarizes the sampling strategy for the CWSS. As indicated in Table 3-17, no routine sludge sampling program exists. Average monthly analyses of sedimentation pond effluent discharge for the calendar year 1986, summarized in Table 3-18, indicate total suspended solids (TSS), total residual chlorine (TRC), and pH levels were exceeded occasionally. These exceedances were attributed to the following:

TABLE 3-16
EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS
FOR THE SEDIMENTATION POND

Effluent Characteristics ^a	Discharge Limitations					Monitoring Requirements	
	lb/day		Other Units (Specify)			Measurement Frequency	Sample Type
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Daily Max.		
Flow	N/A	N/A	N/A	N/A	0.15 mgd	1/month	Measured
Total Suspended Solids	N/A	N/A	N/A	N/A	60 mg/L	1/month	24 hr Composite
Total Dissolved Solids	N/A	N/A	N/A	N/A	Monitor	1/month	24 hr Composite
Total Cadmium	N/A	N/A	N/A	N/A	0.01 mg/L	1/month	24 hr Composite
Hexavalent Chromium	N/A	N/A	N/A	N/A	0.05 mg/L	1/month	24 hr Composite
Total Residual Chlorine	N/A	N/A	N/A	N/A	0.5 mg/L	1/month	Grab
Phenolics	N/A	N/A	N/A	N/A	0.005 mg/L	1/month	24 hr Composite

Source: Modified from WV/NPDES Permit IW-6139-80

^a The pH shall not be less than 6.0 standard units and not greater than 8.5 standard units and shall be monitored 1/month by way of a grab sample.

TABLE 3-17
SAMPLING STRATEGY FOR THE CONTAMINATED WASTEWATER TREATMENT SYSTEMS

Location of Sample Source	Sample Source	Sample Frequency	Parameters	Rationale for Sampling
1	001 Outfall	Bimonthly	pH, Total Phenolics, Total Residual Chlorine, Total Dissolved Solids, Total Suspended Solids, Total Cadmium, Hexavalent Chromium, Biochemical Oxygen Demand	Compliance, Determine Effectiveness of Pond Treatment
2	Slurry Pond Influent	Bimonthly	Biochemical Oxygen Demand	Determine Effectiveness of Pond Treatment

Source: METC, 1987b

TABLE 3-18
1986 MONTHLY 001 EFFLUENTS

	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Total Cadmium (mg/L)	Hexavalent Chromium (mg/L)	Total Residual Chlorine (mg/L)	Phenolics (mg/L)	pH (s.u.)
Permit Limitation	60	--	0.01	0.05	0.5	0.005	6.0-8.5
January	5	210	< 0.005	< 0.01	< 0.1	< 0.002	7.3
February	22	160	< 0.005	< 0.01	*	< 0.002	7.1
March	9	185	< 0.005	< 0.01	< 0.1	< 0.002	6.9
April	5	160	< 0.005	< 0.01	< 0.1	< 0.002	7.1
May	24	220	< 0.005	< 0.01	< 0.1	< 0.002	7.4
June	80	370	< 0.005	< 0.01	0.1	0.005	7.8
July	< 5	190	< 0.005	< 0.01	< 0.1	< 0.002	7.8
August	< 5	210	< 0.005	< 0.01	< 0.1	< 0.002	9.0
September	< 5	155	< 0.005	< 0.01	< 0.1	< 0.002	8.0
October	10	160	< 0.005	< 0.01	< 0.1	< 0.002	7.1
November	6	160	< 0.005	< 0.01	1.2	< 0.002	7.2
December	8	190	< 0.005	< 0.01	< 0.1	< 0.002	7.8
Average	15	198	< 0.005	< 0.01	0.1	< 0.002	7.5

Source: METC, 1987b

All monthly values are averages

* Sample contaminated

TSS concentrations exceeded the permit limitation in June of 1986. This was attributed to the development of a large algal bloom on the surface of the 001 stabilization pond. TRC concentrations exceeded the permit limitation in November of 1986 as a result of testing of the dual-media filter as a tertiary treatment unit for METC's sanitary wastewater. The tertiary effluent was chlorinated following filtration and the chlorinated effluent was discharged to the 001 stabilization pond. The controlled release of an aqueous solution of sodium hydroxide from the steam plant caused pH levels to slightly exceed the permit limitation in August of 1986. The solution was used to clean and condition the No. 3 boiler prior to operation following repair and retubing of the unit. The spent solution was then slowly discharged to the 001 stabilization pond. (METC, 1987b)

During the 1983-1985 period, permit limitations for phenolics and cadmium were exceeded occasionally. Phenolics concentrations ranged from 0.001 to 0.36 milligram per liter (mg/L). Cadmium concentrations ranged from <0.01 to 0.02 mg/L.

3.3.3.2 Sewage Treatment Plant

METC's sanitary effluent discharge is regulated by the State of West Virginia NPDES Water Pollution Control Permit No. WV0083259. As of March 1987, sanitary effluent discharge limitations were modified from secondary to more stringent tertiary limitations. These tertiary limitations are summarized in Table 3-19 and are in effect through March 11, 1990. In response to the more stringent tertiary limitations, effluent from the STP has been diverted to the industrial wastewater pretreatment plant (B-17) for additional treatment via dual-media filtration. Filter effluent is subsequently chlorinated in B-17, then pumped to the sedimentation pond.

Table 3-20 summarizes the sampling strategy for the sanitary wastewater treatment system. Figure 3-11 indicates the sample locations listed in Table 3-20.

TABLE 3-19

DISCHARGE LIMITATIONS AND MONITORING REQUIREMENTS FOR THE SEWAGE TREATMENT PLANT FACILITIES

Effluent Characteristics	Discharge Limitations				Monitoring Requirements	
	(Quantity) lb/day		Other Units (Specify)		Measurement Frequency	Sample Type
	Avg. Monthly	Max. Daily	Avg. Monthly	Max. Daily		
Flow				.015 mgd	1/Quarter	Measured
Biochemical Oxygen Demand (5-Day)	0.63	1.26	5 mg/L	10 mg/L	1/Quarter	8 hr. composite
Total Suspended Solids	3.78	7.56	30 mg/L	60 mg/L	1/Quarter	8 hr. composite
Total Kjeldahl Nitrogen (TKN)	2.25	4.5	18 mg/L	36 mg/L	1/Quarter	8 hr. composite
Fecal Coliform			counts 200 100 mL	counts 400 100 mL	1/Quarter	Grab
Dissolved Oxygen	Not less than 6.0 mg/L at any given time				1/Quarter	Grab

Source: Modified from WV/NPDES Permit No. WV00083259

The pH shall not be less than 6.0 standard units and not greater than 9.0 standard units and shall be monitored 1/quarter by grab sampling.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Effluent BOD₅ samples shall be collected at a location immediately preceding disinfection. Other effluent samples shall be collected at or as near as possible to the point of discharge.

TABLE 3-20

SAMPLING STRATEGY FOR SANITARY WASTEWATER TREATMENT SYSTEM

Location of Sample Source	Sample Source	Sample Frequency	Parameters	Rationale for Sampling
1	Influent to Activated Sludge Plant	Bimonthly	Biochemical Oxygen Demand, Total Suspended Solids, pH, Total Kjeldahl Nitrogen	Determine Loading and Effectiveness of Sanitary Wastewater Treatment System
2	Effluent from filters (prior to chlorination)	Bimonthly	Biochemical Oxygen Demand, Total Suspended Solids, pH, Fecal Coliform, Residual Cl, Total Kjeldahl Nitrogen	Determine Effectiveness of Sanitary Wastewater Treatment System; Compliance with state Regulations
3	Return Activated Sludge from Settling Chamber to Aerator	2-3 Per Week	Total Suspended Solids	Operational Control
4	Aeration Chamber	2-3 Per Week	Total Suspended Solids	Operational Control
5	Digester	Quarterly	Organics and Heavy Metals	Characterization Prior to Sludge Disposal
6	001 Outfall to Burroughs Run	Bimonthly	Biochemical Oxygen Demand, Total Suspended Solids, pH, Fecal Coliform, Residual Cl, Total Kjeldahl Nitrogen, Dissolved Oxygen	Compliance with state Regulation
7	Influent to dual-media filters			Operational Control
8	Effluent from chlorinator (prior to discharge into stabilization pond)		Residual Cl	Operational Control

Source: Misenhimer, 1988

SANITARY WASTEWATER TREATMENT SYSTEM
SAMPLING LOCATIONS

FIGURE 3-11

No 1987 sanitary wastewater treatment plant sampling data have been made available for review. Consequently the performance of the current treatment scheme cannot be presented. However, past sampling data do indicate that high-strength wastewater is entering the sanitary wastewater system.

Typical concentrations of biochemical oxygen demand, total suspended solids, and total Kjeldahl nitrogen for untreated domestic wastewater are listed in Table 3-21. Medium-strength domestic wastewater would be expected at a facility similar to METC. However, extremely high influent biochemical oxygen demand, total suspended solids, and total Kjeldahl nitrogen values have been recorded for the STP. These influent data, listed in Table 3-22, indicate high-strength process wastewaters are potentially entering the sanitary sewers through cross-connections and/or spills.

A new NPDES permit application (No. WV0026211) has been submitted by METC to the state and would combine existing WV/NPDES permits for the STP (No. WV0083259) and the Sedimentation Pond (No. WV-6139-80) into one permit. To date the state has not acted upon the application (see Section 3.3.3.1).

3.3.3.3 Potable Water Supply

To ensure that the drinking water supply at METC meets standards acceptable by the West Virginia State Board of Health, a regular sampling and analysis program was developed. The objectives of the program are twofold: to affirm the absence of bacterial growth and to provide assurance that the water supply remains uncontaminated by various process streams.

3.3.3.4 Burroughs Run

The program involves taking samples from several potable water sources throughout the METC site. The samples are analyzed for the contaminants listed in Table 3-23.

There is a program for routine sampling of Burroughs Run for BOD only. Samples are taken upstream of Outfall 001 and downstream of Outfall 003. Data from the sampling effort have not been reported in the environmental monitoring reports.

TABLE 3-21

TYPICAL COMPOSITION OF UNTREATED DOMESTIC WASTEWATER

Constituent	Concentration		
	Strong	Medium	Weak
Total suspended solids	350	220	100
Biochemical oxygen demand	400	220	110
Total nitrogen (as N)	85	40	20

Source: Metcalf & Eddy, Inc., 1979

TABLE 3-22

HIGH-STRENGTH SANITARY WASTEWATER INFLUENT DATA

Date	BOD (mg/L)	TSS (mg/L)	TKN (mg/L)
2/84	295	2,400	---
3/84	930	3,700	---
6/84	550	370	---
9/84	350	510	---
10/84	1,200	250	---
12/84	240	660	---
2/85	160	190	134
4/85	115	925	66
8/85	74	712	83
10/85	267	518	24
2/86	668	197	639
4/86	95	103	97
5/86	115	158	86
8/86	57	58	303

Source: Sanders & Thomas, 1986.

TABLE 3-23
POTABLE WATER ANALYSES AT METC

Contaminant	Contaminant
Phenolics	chlorine
color	cadmium
chemical oxygen demand	chromium
TSS	lead
biochemical oxygen demand	silver
chloride	iron
turbidity	magnesium
fluoride	mercury
nitrate	selenium
sulfide	sodium
sulfate	potassium
total organic carbon	arsenic
total coliform bacteria	zinc
pH	br monochloromethane
barium	d chloromethane
fecal coliform bacteria	dibromochloromethane

Source: Misenhimer, 1988

To date no problems have been documented.

3.3.3.5 Stormwater/Underdrain Outfalls

At the time of the Survey there was no program for routine sampling of stormwater and underdrain outfalls. Although samples were taken from some outfalls during the Survey team's site visit, these outfalls have not been sampled for several years. Data from METC's recent sampling effort are summarized in Table 3-24.

3.3.4 Findings and Observations

3.3.4.1 Category I

None

3.3.4.2 Category II

1. Potential surface-water and sediment contamination of West Run and Burroughs Run. Potential surface-water and sediment contamination of West Run and Burroughs Run may have resulted from past and possibly present on-site stormwater discharges containing polynuclear aromatics (PNAs), mercury, and other heavy metals.

Prior to 1983, wastewater from the analytical laboratories, photographic laboratories, garage, enhanced oil recovery laboratories, coal processing laboratories, and coal bin drainage discharged directly into the stormwater sewer system. The stormwater sewer system discharged into Burroughs Run, a tributary of West Run.

Mercury contamination of the stormwater sewer system was reported in 1981 (Sanders & Thomas, 1981b). Based on the results of stormwater sampling and analysis conducted to determine the source and extent of mercury contamination, it was concluded that mercury contamination originated from the analytical laboratories located in Buildings B-1, B-2, and B-3.

TABLE 3-24
STORMWATER AND UNDERGROUND DRAINAGE
OUTFALL SAMPLING ANALYSES

Parameter	Surface Water Outfall Location ⁽¹⁾							
	003(2)	003(3)	004(2)	004(3)	005(2)	005(3)	006(3)	009(3)
BOD ₅	<1	20	<1	45	<1	4	20	10
COD	12	31	15	73	12	100	26	41
TOC	5	9	3	6	2	4	4	5
pH (standard units)	8.78	8.55	7.10	8.48	7.06	8.60	7.94	7.96
total phenolics	0.008	0.012	0.017	<0.002	<0.002	<0.002	<0.002	<0.002
total solids	520	420	440	1340	330	540	290	330
total dissolved solids	520	250	440	140	330	120	250	240
total suspended solids	6	170	<5	1200	<5	420	44	90
total cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
chromium VI	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
lead	<0.01	0.007	<0.01	0.007	0.03	0.007	0.002	0.006
mercury	<0.002	<0.002	<0.002	<0.002	NA	<0.002	<0.002	<0.002
selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005
copper	NA	<0.1	NA	<0.1	NA	<0.1	NA	<0.1
iron	NA	3.7	NA	12	NA	5.4	NA	9.4
manganese	NA	0.16	NA	0.34	NA	0.21	NA	0.26
nickel	NA	<0.1	NA	<0.1	NA	<0.1	NA	<0.1
silver	NA	<0.05	NA	<0.05	NA	<0.05	NA	<0.05
vanadium	NA	<2	NA	<2	NA	<2	NA	<2
oil & grease	NA	10	NA	5	NA	5	<2	5

Source: METC, 1987c

- (1) All results expressed in mg/L unless otherwise designated
 (2) Sample taken on 12-3-1987
 (3) Sample taken on 12-17-1987

Since 1983, wastewater from the analytical laboratories, photographic laboratories, garage, enhanced oil recovery laboratories, coal processing laboratories, and coal bin drainage has been redirected to the contaminated wastewater sewer system (CWSS). The CWSS discharges to the sedimentation pond.

It is suspected that PNAs and heavy metals were deposited in the sediments of the storm sewers and Burroughs Run as a result of discharges prior to 1983. Consequently these sediments are a potential ongoing source of surface-water contamination.

It is suspected that contaminants may enter the storm sewer system via sources listed in Table 3-15 and unknown connections to the system. These unknown connections reflect the haphazard site development that has occurred since 1955. Consequently there are potentially additional sources of contamination entering the storm sewer system resulting in ongoing surface-water contamination.

3.3.4.3 Category III

1. Potential contamination of surface water and sediment in Burroughs Run.
Potential contamination of surface water and sediment in Burroughs Run may be occurring due to process wastewater cross-connections into the sanitary sewer system. These process wastewater contaminants may disrupt the biological treatment system for sanitary wastewater, or pass through it untreated and be discharged to the stabilization pond and Burroughs Run.

Medium-strength domestic wastewater would be expected at a facility similar to METC. However, extremely high influent biochemical oxygen demand, total suspended solids, and total Kjeldahl nitrogen values have been recorded for the sewage treatment plant (STP). These influent data indicate high-strength process wastewaters are potentially entering the sanitary sewers through cross-connections and/or spills. If process wastewaters are entering the sanitary sewer system, contaminants such as PNAs and heavy metals may also be present but are not detected because no analyses for these contaminants are required.

It is suspected that contaminants may enter the sanitary sewer system via sources listed in Table 3-13 and unknown connections to the system. These unknown connections reflect the extensive site development that has occurred since 1955. Consequently there are potentially additional sources of contamination entering the sanitary sewer system.

2. Potential contamination of surface water and sediments in Burroughs Run. Contamination of surface water and sediments in Burroughs Run may be occurring due to discharges of heavy metals from the outfall of the Building 19 underdrain. This potential contamination may be caused by power plant bottom ash backfill under the building.

Coal ash was used as structural fill material near Building B-19. The fill area has an underdrain system that discharges to Burroughs Run. A reddish discoloration of the surface rock material is evident as a result of effluent discharged from the underdrain outfall.

3. Potential presence of PNAs and other semi-volatile organics, mercury, and other heavy metals in sedimentation pond sludge. Potential presence of organics, mercury, and other heavy metals in sedimentation pond sludge may be acting as an ongoing source of contamination to Burroughs Run.

Since 1983, wastewater from the analytical laboratories, photographic laboratories, garage, enhanced oil recovery laboratories, coal processing laboratories, and coal bin drainage has been redirected from the storm sewer system to the CWSS. Although most laboratory waste chemicals are collected in separate containers and shipped off-site for disposal, some chemical wastes are discharged into sinks or may be spilled and enter floor drains. These wastewaters potentially consist of volatile organic solvents, PNAs, other semi-volatile organics, acids, bases, and heavy metals. These contaminants have been discharged into the stabilization pond and have likely settled out in the sludge. When relatively clean wastewaters pass through the stabilization pond, these contaminants may potentially leach out of the sludge. The pond effluent is discharged into Burroughs Run. Therefore, the sludge is potentially acting as an ongoing source of contamination to Burroughs Run.

3.3.4.4 Category IV

1. Potential contamination of the on-site potable water system. Potential contamination of the on-site potable water system may be occurring due to the lack of an inspection and maintenance program for backflow prevention devices for process connections to the potable water system.

Backflow preventers are installed as needed for experiments. However, there are no records of where backflow preventers are located and no maintenance/inspection program exists.

2. Lack of a Spill Prevention, Control, and Countermeasures (SPCC) program. There is currently no written SPCC plan at METC.

Potential sources of spills that could enter the stormwater sewer system include:

- Within the boiler plant (Building B-5), compressor oil is stored near a floor drain. If an oil spill enters the floor drain, it would pass through the stormwater sewer system and discharge into Burroughs Run via Outfall 003.
- Fuel pumps are located near yard drains. A fuel oil spill could enter the stormwater sewer system via the yard drains and discharge into Burroughs Run via Outfall 003.
- Within Building B-16, chemicals are stored near a floor drain. If a chemical spill enters the floor drain, it would pass through the stormwater sewer system and discharge into Burroughs Run via Outfall 003.

3.4 Hydrogeology

3.4.1 Background Environmental Information

METC is located in the Appalachian Plateau Physiographic Province along the flank of the Monongahela River Valley. The local area is characterized by steep terrain with knobby hills and is deeply dissected by weathering and erosion. Surficial deposits in the area are generally thin and consist of glacial lake sediments. In the Monongahela River Valley near Morgantown are deposits of silt and silty clay, apparently deposited in a lacustrine or slack-water environment caused by glacial obstruction of the north-flowing Monongahela River.

The underlying bedrock consists of consolidated sedimentary rocks of Mississippian, Pennsylvanian, and Permian ages. The Permian Dunkard Series has been eroded from the METC site but occurs in outcrops to the west. Beneath the Dunkard, the Monongahela Formation consists of interbedded sandstone, calcareous shale, fresh-water limestone, and coal beds. This formation has also been eroded from the METC site but occurs to the east and west.

The uppermost formation occurring beneath METC is the Conemaugh of Pennsylvanian age. This formation consists of interbedded sandstones, shales, siltstone, limestone, and coal beds. The Conemaugh varies from 550 to 600 feet in thickness and outcrops at the surface on the METC site.

Underlying the Conemaugh is the Allegheny Formation, also of Pennsylvanian age. As with the Conemaugh and the Monongahela Formations, the Allegheny consists of interbedded cyclic sandstones, siltstone, shale, marine limestone, and coal beds. This formation ranges from 225 to 300 feet in thickness.

The lowermost Pennsylvanian age rocks in the area are of the Pottsville Formation. The Pottsville is a massive sandstone with discontinuous shale interbeds. This formation is generally greater than 200 feet in thickness. The Pottsville is underlain by the Mississippian Mauch Chunk Formation, which is a relatively impermeable shale. Older rocks are of little interest from the perspective of groundwater supplies or contaminant migration. Deeper horizons have had considerable

importance as sources of oil and gas and historically productive wells exist along the river valley and on the METC site.

A general cross-section across Monongalia County from east to west is shown in Figure 3-12. As is apparent from the figure, METC lies on the east flank of the Indiana Anticline.

The principal aquifers in the Morgantown area are the Conemaugh Formation and the Pottsville Formation. The Conemaugh provides small domestic water supplies in the local area although the well yield is generally low. The Pottsville Formation is the most important aquifer in the region and is capable of sustaining yields in excess of 100 gallons per minute (gpm) in the Morgantown area. To the west of the Monongahela River, the Pottsville contains saline water. In general, shallow groundwater flow at the METC site is dominated by recharge in the upland areas and discharge to streams in the lowlands.

3.4.2 General Description of Pollution Sources and Controls

The most significant potential source of groundwater contamination at METC was the industrial wastewater pond which was constructed in 1975 to contain wastewater from the 42-inch gasifier and its associated gas cleaning equipment. The pond, with a capacity of about 1,000,000 gallons, was constructed by excavation and diking and was lined with a 3-mil Hypalon membrane. The characteristics of the wastewater discharged to this pond are discussed in detail in Section 4.5.

Additional potential sources of groundwater contamination include leakage from other ponds (including the Sedimentation Pond 001, former Slurry Pond 002, and the temporary settling pond, called the frac-water pond, that was used during drilling of the MERC-1 gas well) and surface spills in the process areas.

Although it is likely that these unlined ponds leaked some of their contents to the subsurface, it is unlikely that this represents a significant threat to groundwater for two reasons. First, the pond contents were generally dilute and did not include high concentrations of toxic constituents. Second, the ponds were located on top of the hillside near Burroughs Run. With an elevation difference of approximately 30 feet

Source: Carlston, 1958

EAST-WEST CROSS-SECTION
THROUGH COOPERS ROCK AND MORGANTOWN

FIGURE 3-12

between the ponds and Burroughs Run, any water released from the ponds would migrate rapidly to the surface water.

3.4.3 Environmental Monitoring Program and Data

The only groundwater monitoring conducted at the METC site is associated with the closure of the industrial wastewater pond. Although the pond was not classified as a Resource Conservation and Recovery Act (RCRA) storage facility, METC decided in 1983 to develop a program to evaluate groundwater contamination around the pond that followed the guidelines of 40 CFR Part 265, Subpart F "Groundwater Monitoring".

In the summer of 1983, 13 monitoring wells were installed at locations shown in Figure 3-13. Well placement was designed to provide information on all sides of the pond. Water level data from these wells indicated that the groundwater flowed toward the north. Based on RCRA regulations, wells were initially sampled for primary drinking water standard parameters, water quality parameters, and contaminant indicator parameters. Based on well yields and location, five wells were selected for regular sampling. These include 6D, 8D, 10D, 11B (shallow), and 12D. In addition, only five parameters were chosen for study. These include pH, total organic carbon (TOC), total phenolics, specific conductance, and chloride. Following closure of the pond in 1985 (described in detail in Section 4.5 of this report), well 1A was installed in the center of the old pond and was added to the sampling program. Unfortunately, well 1A is usually dry and no samples are obtained. At a later date, well 13C was added to the sampling program as a possible replacement for well 12D. A pipeline break in the plant area was thought to have adversely affected the water quality at well 12D so a second upgradient location was needed.

At the present time, wells 6D, 8D, 10D, 11B, 12D, and 13C are sampled on a quarterly basis and the samples are analyzed for the following parameters:

- COD (chemical oxygen demand)
- chloride
- TOC
- TDS (total dissolved solids)
- specific conductance
- naphthalene

Source: Modified from METC. 1985a

MONITORING WELL LOCATIONS,
INDUSTRIAL WASTEWATER POND

FIGURE 3-13

- pH
- phenolics
- xylene
- TOH

The results of laboratory analyses indicate that some variation over time occurs in the parameters that are monitored but no temporal trend is apparent. These results are depicted graphically in Figures 3-14 and 3-15. These charts show average concentrations for downgradient wells for various constituents. These average concentrations are compared to a baseline (indicated by a horizontal dashed line in the figures) which was established by repeated sampling at the beginning of the monitoring program. These baseline values are not intended to represent background values but provide a reference level for observing temporal trends during monitoring. For example, in Figure 3-15, the values prior to October 1986 appear to represent a trend of increasing specific conductivity values. Data collected since October 1986 show that the values have declined back to baseline levels. It is apparent from review of all these figures that over the long term the data consistently show that the industrial waste pond had little or no impact on groundwater quality.

3.4.4 Findings and Observations

3.4.4.1 Category I

None

3.4.4.2 Category II

None

3.4.4.3 Category III

None

Source: Romano, 1987c

TRENDS IN CHLORIDE, pH, TDS AND COD CONCENTRATION
FOR INDUSTRIAL WASTEWATER POND WELLS

FIGURE 3-14

Source: Romano, 1987c

TRENDS IN SPECIFIC CONDUCTANCE, TOH, AND TOC
FOR INDUSTRIAL WASTEWATER POND WELLS

FIGURE 3-15

3.4.4.4 Category IV

1. Unsecured monitoring wells. Monitoring wells that are not secured with locking covers provide an opportunity for inadvertent or accidental contamination or for intentional tampering.
2. Inadequacies in sampling procedures. The reliability of data from METC's groundwater monitoring program is reduced by inadequacies in sampling procedures. These inadequacies include lack of proper decontamination of the pumping equipment during purging and well purging too far in advance of sampling.

During the Survey at METC, field sampling procedures were observed and several inadequacies were noted. All wells were purged of three well casing volumes or until dry to remove stagnant water. This procedure was performed on the day preceding sampling, rather than immediately prior to sampling. This may allow some volatiles to escape detection. The reason given was that well recoveries were slow and insufficient sample would be obtained if the wells were purged on the same day as sampling.

Decontamination procedures for sampling equipment consisted of rinsing with distilled water. Some equipment was placed on the ground following decontamination; the submersible pump had no internal flushing; and samplers did not use rubber gloves when handling sampling equipment.

4.0 NON-MEDIA-SPECIFIC FINDINGS AND OBSERVATIONS

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, 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.

4.1 Waste Management

4.1.1 General Description of Pollution Sources and Controls - Hazardous Waste

Waste management activities at METC include the generation, handling, temporary storage, and transportation (by contractor) of accumulated hazardous waste. These wastes include all those currently regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA) and the West Virginia Hazardous Waste Management Act. A hazardous waste is any waste that exhibits hazardous characteristics as defined in 40 CFR 261, is listed as a hazardous waste by the U.S. Environmental Protection Agency (EPA), or the State of West Virginia, and is not excluded from regulation by special exemption. METC is a small-quantity generator of hazardous waste. It generates less than 1,000 kilograms of hazardous waste, less than 1 kilogram of acutely hazardous waste, and less than 100 kilograms of residues from the cleanup of a spill of acutely hazardous waste in any single month. METC is not a conditionally-exempt small-quantity generator because it occasionally generates more than 100 kilograms of hazardous waste in a month. In 1986, METC shipped 457 individual waste items from the site to Erieway, Incorporated of Bedford, Ohio, the hazardous waste disposal contractor. However, the majority of the items were not hazardous waste. Only 149 of these items were designated as hazardous wastes. Table 4-1 lists the chemical names of waste designated as hazardous that were shipped from METC in 1986. METC ships wastes which are not currently officially designated as hazardous to the hazardous waste contractor because many of the wastes have organic components which may be designated as hazardous wastes in the future. The contractor has the capability to solidify, treat,

TABLE 4-1

HAZARDOUS CHEMICAL WASTE SHIPPED FROM METC IN 1986

Nitrobenzene	Methanol
Silver Chromate	Calcium Carbide
Lead Chromate	Lead Carbonate
Calcium Hydride	Mercuric Sulfate
Acetic Anhydride	Mercury Oxide
Vanadium	Potassium Hydroxide
Hydrazine Sulfate	Lead Chloride
Mercury & Mercury Waste	Mercuric Nitrate
Waste HCL & HF	Ammonium Vanadate
Waste Solvent	Chromium Chloride
Acid Waste	Chromic Sulfate
Styrene	Cadmium Carbonate
Acetaldehyde NH ₃	Gasoline-Contaminated Soil
Morpholine	Trichloroethylene
Chloroform	Benzene
Lead Acetate	VD Pentoxide HCl
Osmium Tetroxide	N-Octanol
Trichloroethane	Degreaser Oil
Ammonium Hydroxide	Lab Pack 1
Ethylene Dichloride	Ethyl Ether
Acetone	COD Ampules
Turpentine	Sebacoyl Chloride
2-Propanol	Sulfuric Trioxide
Pentane	Acid/Metal Waste

Source: METC, 1986b

or recycle these wastes. Table 4-2 presents the quantity of hazardous waste generated per month in 1986. METC generated more than 100 kilograms of hazardous waste in March, May, July, and November 1986. July and November 1986 were the months with the highest generation rates. This was due to gasifier runs in May and October 1986.

The majority of METC waste that is sent to the hazardous waste disposal contractor is generated in three activity areas; pilot plant operations, site maintenance activities, and analytical laboratory operations. In addition, other activities such as the photographic laboratory and laser operations generate small quantities of hazardous waste.

The largest source of hazardous waste at METC is the analytical laboratory operation. In particular, the laboratories in Building B-25 generate the most hazardous waste at METC. Building B-25 was constructed in 1980 and contains approximately 15 laboratories. The Building B-25 laboratories perform physical and chemical analyses on coal and coal gasification process samples. Individual laboratories in Building B-25 collect waste solvents in either 5-gallon safety cans or used reagent bottles located in individual laboratories. For example, laboratory rooms 205 and 206 generate approximately 10 to 15 gallons of waste organic solvent per year. Toluene and xylene are the high-quantity solvents. Waste solvent bottles were marked "waste toluene," "waste pentane," and "waste methylene chloride" for waste segregation purposes.

Typical analytical laboratory hazardous waste consists of spent solvents, inorganic solids, waste acids and bases, waste gasifier samples, contaminated glassware, and a wide variety of out-of-date chemicals from laboratory shelves.

Site maintenance operations also generate waste shipped to the hazardous waste contractor from METC. The shops in Building B-3, the motor pool at Building B-10, and the photographic shop at Building B-3 generate small quantities of waste material. For example, the motor pool generates approximately two 55-gallon drums of waste oil and six lead acid batteries per year (neither of these are considered hazardous waste by regulation). The metal shop generates only about 15 gallons of waste solvent, 5 gallons of waste cutting oil, and six 55-gallon drums of nonhazardous waste metal turnings per year. Other site maintenance activities

TABLE 4-2

METC'S MONTHLY HAZARDOUS WASTE GENERATION RATES FOR 1986¹

Month	Approximate Quantity		
	Gallons	Pounds	Kilograms
January	3	31	14
February	11	95	43
March	41	339	154
April	1	11	5
May	56	469	213
June	2	20	9
July	120	1,000	454
August	10	86	39
September	19	161	73
October	0.05	0.4	0.2
November	102	854	388
December	0.00	0	0
Total	365	3,066	1,392

Source: METC, 1985b

- 1 All data are equivalent quantities expressed in different units.

generate rust inhibitors, antifreeze, compressor oil, waste kerosene, and spent degreasers and cleaners.

Pilot plant operations generate the majority of METC solid waste but less hazardous waste than analytical laboratory operations. The major source of the solid waste is the coal gasifier located at a large outdoor complex adjacent to Building B-4. The gasifier structure contains five large pieces of equipment: the producer, the cyclone, the humidifier, the tar trap, and the venturi scrubber. Figure 3-3 depicts each piece of equipment and its relative position in the process flow stream.

The gasifier produces a solid waste which METC analyzes on a batch basis to determine if it is a hazardous waste. The waste consists of coal ash, limestone, and sulfur, which is removed from the bottom of the producer and placed in 55-gallon drums. Approximately 100 to 200 pounds of producer waste is generated per hour of gasifier operation. In addition, 6 to 8 drums of liquid waste are generated by the gasifier vent at the waste packaging area over a typical 2-week gasifier run.

The cyclone removes dust from the producer off-gas stream. The cyclone generates approximately eight to ten 55-gallon drums of cyclone dust for every 2 weeks the gasifier is operated. METC analyzes the cyclone dust to determine if it is a hazardous waste. The analyses have never shown that the waste is hazardous.

The humidifier is located after the cyclone in the process flow. Its function is to spray water into the gas stream. A waste tar is condensed which is removed from the bottom of the unit and packaged in 55-gallon drums. The waste is considered a hazardous waste by METC.

The tar trap receives process gas treated in the humidifier. The tar trap produces a light liquid during gasifier operations. Approximately 60 drums of waste are produced from both the humidifier and the tar trap during a typical 2-week gasifier run. The waste is handled and treated as a hazardous waste. It is not considered to be a hazardous waste as defined by RCRA.

The venturi scrubber is the last piece of gas-handling equipment on the gasifier. The venturi produces a light oil-like waste. Approximately 30 drums of the waste are produced in a 2-week gasifier test. The waste is considered hazardous by METC.

The muffler located just below the gasifier flare acts as an expansion chamber, producing a condensate waste during gasifier operation. Approximately 12 to 15 drums of the waste are produced in a 2-week gasifier run.

In addition to the wastes discussed above, the cleanup of the gasifier after a test run typically generates one to three 55-gallon drums of contaminated solids and gasifier-derived trash.

Prior to 1984, the gasifier was operated in conjunction with a Stretford desulfurization unit, which removed sulfur from the gas stream. The Stretford unit was equipped with direct and indirect cooling water columns to reduce the temperature of the off-gas stream. The cooled gas was then routed to an electrostatic precipitator, which removed particulates. Gases passed through a proprietary Stretford solution and water scrubber columns which transferred the sulfur to a wastewater solution. As was discussed in Section 3.3, a wastewater treatment facility at Building B-17 was built to treat this wastewater, but it was never used. METC discontinued the use of the Stretford unit because of operational problems. METC now mixes limestone with the coal introduced to the gasifier for control of sulfur. The limestone absorbs sulfur from the coal. The limestone and sulfur are removed from the gasifier as a solid waste during each run. METC plans to dismantle the Stretford equipment to provide additional space in a crowded portion of the site.

The Stretford equipment contained approximately 30,000 gallons of Stretford solution in an aboveground tank. The solution was analyzed and was found to be hazardous for cadmium. At the time of the Survey, METC had arranged for the disposal of the Stretford solution by Erieway in March 1988.

The gasifier is operated on an infrequent basis. In recent years, it has been operated two or three times per year for approximately 2 weeks per run. For example, in 1987 the gasifier was operated May 25 to June 4, October 13 to October 23, and December 6 to December 11. Table 3-4 presents the dates the gasifier has been operated since its initial run in September 1980.

Other activities at METC generate hazardous waste. For example, lasers are used for certain physiochemical tests performed on coal. The lasers produce a waste dye that

is considered a hazardous waste. Approximately 1 gallon of the waste is generated per month. The METC photographic shop discharged waste photographic and printed circuit board waste solutions to the drain in the past, but now collects and recycles spent silver from the developing process.

4.1.1.1 Hazardous Waste Collection

The generator of waste is responsible for collection at the point of generation, labeling, temporary in-lab storage, and notification of Environmental personnel that waste is available for pickup. Prior to pickup by Environmental personnel, a numbered hazardous materials identification tag is completed by the generator. The type of waste and waste volume are described by the generator.

Hazardous waste collection is the responsibility of the Environmental Engineer. The Environmental Engineer dispatches a technician to collect hazardous waste upon notification from the generator that waste is available for pickup. The hazardous waste is transported to the temporary hazardous waste storage Building B-16 to await off-site shipment.

4.1.1.2 Hazardous Waste Storage

Building B-16 is the 270-day temporary hazardous waste storage facility for METC. The hazardous waste generated at METC is shipped over 200 miles for disposal and therefore it is acceptable to temporarily store hazardous waste up to 270 days (40 CFR 262.33). Located in the southern portion of the site, it is a 60-foot by 30-foot building with six separate storage areas. A 20-foot by 8-foot room in Building B-16 is devoted to flammable material storage, and a room of similar dimensions contains miscellaneous hazardous materials. Smaller rooms are devoted to caustic, acid, paint, and radioactive material storage. A large bulk storage area in the southern end of the building is used to store 55-gallon drums of hazardous waste. Shelves in this area of the building hold herbicides, pesticides, and other chemicals. Figure 4-1 depicts the configuration of Building B-16 and the associated outdoor drum storage pad. (See Section 4.2.1.4 for additional information.)

The Building B-16 storage pad is used to accumulate and temporarily store 55-gallon drums of waste destined for off-site disposal. The pad is covered, and is sloped to

Source: METC Environmental Management Personnel, 1987a

FLOOR PLAN OF METC, BUILDING B-6

FIGURE 4-1

retain spills on the pad. The pad measures 45 by 36 feet and is located adjacent to Building B-16. At the time of the Survey (November 30 to December 4, 1987), the pad contained 23 drums of nonhazardous waste, mostly waste oils, 2 drums of sulfur cake, and 6 drums of hazardous waste (i.e., waste photographic solutions, solvents, caustics, and heavy metals). In addition to the waste located at the Building B-16 pad, a drum labeled "contaminated liquid waste" was stored near Trailer 29. The drum is rusted and has no accumulation start date on the label to indicate duration of storage.

4.1.1.3 Hazardous Waste Disposal

All hazardous waste currently generated at METC is disposed of off-site by the hazardous waste contractor. The current primary hazardous waste contractor is Erieway Incorporated of Bedford, Ohio. Erieway offers solvent recovery, waste oil recovery, hazardous waste disposal, and hazardous waste solidification services. Erieway reclaims used oil and pumps off incinerable waste fractions for resale as a fuel. In addition, Erieway solidifies hazardous waste for land disposal by licensed landfills. Erieway has Ohio authorization to operate hazardous waste treatment and storage operations. Erieway uses Wayne Disposal, Incorporated, of Dearborn, Michigan, and Envirosafe Services, Inc., of Toledo, Ohio, as the disposal contractors for METC waste that is disposed of by landfill. Erieway uses Wayne primarily for the disposal of METC asbestos wastes. Wayne operates under authorization of the State of Michigan. Gasifier ash is subject to RCRA analysis. If the ash is hazardous, it is sent to Erieway for disposal. Erieway uses the Envirosafe landfill as its primary site for hazardous waste disposal. Envirosafe is licensed by Ohio to operate a hazardous waste landfill. Almost all gasifier ash in the past was nonhazardous.

Prior to 1984, METC used other hazardous waste contractors for hazardous waste disposal. The primary contractor was Triangle Resources Industries of Laurel, Maryland, but Chem-MET Services of Wyandotte, Michigan; Erieway; and Alburn Incorporated of Chicago, Illinois, were also used. A number of drums of liquid waste with METC markings were found at a property in Chicago formerly controlled by Alburn Incorporated in 1983 after the company went out of business. METC had received certificates from Alburn stating that all waste had been incinerated. After the notification, METC entered into negotiations to resolve the problem. A full discussion of circumstances related to the issue is contained in Section 4.5.1.1.

4.1.2 General Description of Pollution Sources and Controls - Mixed Waste

METC generates no mixed waste (i.e., waste that is both hazardous and radioactive).

4.1.3 General Description of Pollution Sources and Controls - Radioactive Waste

METC generates no radioactive waste. See Section 4.3 for a discussion of the use of sealed radiation sources at METC.

4.1.4 General Description of Pollution Sources and Controls - Solid Waste

METC generates two classes of solid waste, coal-derived solid waste and office/cafeteria trash. The coal-derived solid waste is composed of coal fines, fly ash, waste coal, lime ash, powdered rock dust, and gasifier ash and dust, which are analyzed and shown to be nonhazardous. These solid wastes are disposed of in the Marion County, West Virginia, landfill. METC transports the waste to the landfill in its trucks. Approximately 5 to 10 tons of solid waste per month are disposed of in this manner. This waste had been disposed of at the Morgantown City landfill; however, this has been prohibited. The operators of the landfill claimed that a truckload of smoldering gasifier ash from METC had been disposed of and was a potential fire hazard.

Office and cafeteria trash is collected in dumpsters and picked up by the City of Morgantown Sanitation Department for disposal at the city landfill. City sanitation trucks remove trash from METC 5 days/week.

4.1.5 Findings and Observations

4.1.5.1 Category I

None

4.1.5.2 Category II

None

4.1.5.3 Category III

None

4.1.5.4 Category IV

1. Improper storage of waste drum. There is one 55-gallon drum labeled "contaminated liquid waste" stored near Trailer 29. The drum is three-quarters filled with a liquid material. The drum is rusted and is within 15 feet of a storm drain. There is no indication of the length of time the drum has been stored at this location or the precise composition of the waste material. There is the potential for the drum to contain a hazardous waste. No accumulation start date is listed on the drum label as is required by Resource Conservation and Recovery Act (RCRA) regulations.

4.2 Toxic and Chemical Materials

4.2.1 General Description of Pollution Sources and Controls

4.2.1.1 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are present in regulated concentrations at METC in the dielectric fluid of three transformer units. These transformer units have PCB concentrations of more than 50 parts per million (ppm) and less than 500 ppm and are classified as PCB-contaminated. A listing of the PCB-contaminated transformer units presently at METC is included in Table 4-3.

The three PCB-contaminated transformer units are located at substation No. 3. This substation is south of Building B-5 and approximately in the center of the facility. The substation consists of nine transformer units on a concrete pad surrounded by an 8-foot chain link fence. There was no evidence of previous dielectric fluid releases such as stains on the pad or on the gravel surrounding the pad.

The PCB-contaminated units are properly labeled and the labels are visible from outside the fence. These transformers are inspected once a year by engineers from the Facilities Maintenance Group (Fizer, 1987).

The fluids in all the transformers and oil switches at METC were sampled and analyzed for PCB content in April 1985 (Envirometrics, 1985). At that time, two transformer units had PCB concentrations of over 500 ppm and were classified as PCB transformers, while seven other units were classified as PCB-contaminated (Shellito, 1985). All the oil switches were classified as non-PCB. Also in 1985, METC received seven transformer units from the DOE Homer City, Pennsylvania, facility, two of which contained PCBs at concentrations greater than 500 ppm and were classified as PCB transformers. Four transformer units were classified as PCB-contaminated transformers. Table 4-4 presents a listing of the transformer units received from Homer City that contained regulated concentrations of PCBs.

Disposal activities were conducted in November 1985 when nine transformer units were removed from METC. Included in this removal were the six units from Homer

TABLE 4-3

PCB-CONTAMINATED TRANSFORMERS AT METC

Identification Number	Location	PCBs (mg/L)	Labeled	Active or Inactive	Last Testing Date
8688325	TS-3	311	Yes	Active	4/85
B340886	TS-3	273	Yes	Active	4/85
8688318	TS-3	204	Yes	Active	4/85

Source: Envirometrics, 1985

PRELIMINARY

TABLE 4-4

PCB TRANSFORMERS AND
PCB-CONTAMINATED TRANSFORMERS RECEIVED FROM HOMER CITY SITE

Identification Number	PCBs (mg/L)	Oil Volume (gallons)	PCB (kg)
PAV 7072-01	580	150	0.33
PAV 7072-02	554	158	0.33
PAV 7073-03	496	170	0.32
PAV 7073-01	119	170	0.08
PAB 7075-01	123	170	0.08
PAV 7074-01	50	157	0.03

Source: Notich, 1987

City and three units (ID#s B703430, B459528, B703435) from METC (Rizzo, 1985). Additional disposal activities occurred in May 1987, when three transformer units (ID#s B795974, B793308, B709204) were removed from METC (Angoli, 1987b). Removal consists of physically removing the entire unit, carcass and dielectric fluid, from the site (Fizer, 1987). The dielectric fluid is drained from the carcass and incinerated (Rizzo, 1987). The carcass is landfilled (Struve, 1987). Table 4-5 contains additional information for the transformer units removed from METC since 1985.

Immediately prior to removal off-site, transformer units are disconnected and stored on the hazardous waste storage pad at Building B-16. The location of the hazardous waste storage pad is shown in Figure 4-2. Engineers from the Facility Maintenance Group (FMG) are responsible for disconnecting the units and transporting them to the storage pad. Environmental personnel accompany the engineers in the event that a unit is leaking or is damaged during transport.

In the event of a PCB release, Environmental personnel are trained in PCB spill control and remediation. EG&G, the prime site contractor, is responsible for instructing personnel in spill response and remediation (Romano, 1987a). There have not been any incidents of unit leakage or damage during disconnection and storage (Romano, 1987a).

There is a lack of documentation for PCB-related activities at METC prior to 1985. Information searches conducted during the Survey revealed several historic photographs depicting the flushing of a transformer carcass into a drum labeled with a yellow PCB label on or about June 1979. A search of the hazardous waste manifests currently on file at METC did not reveal any information concerning this disposal.

4.2.1.2 Asbestos

Asbestos-related activities at METC include removal, storage, and off-site disposal of asbestos insulation, asbestos-containing construction materials, and asbestos-coated equipment. EG&G, the prime site contractor, is responsible for overseeing asbestos-related activities at METC.

TABLE 4-5

TRANSFORMER UNITS REMOVED FROM METC SINCE 1985

Identification Number	Location	PCB (mg/L)	Oil Volume (gallons)	PCB (kg)	Date Removed From METC
B709204	TS-2	323	50	0.06	5/87
B795974	TS-2	642	50	0.12	5/87
B793308	TS-2	614	50	0.12	5/87
B703430	TS-3	75	50	0.01	11/85
B459528	TS-3	205	50	0.04	11/85
B703435	TS-3	69	50	0.01	11/85

Source: Shellito, 1985a

LOCATION OF HAZARDOUS WASTE STORAGE PAD
AT METC

FIGURE 4-2

The primary source of asbestos at METC is piping insulation (Hall, 1987). Asbestos inspections are conducted by EG&G approximately every 2 years to determine the status of asbestos materials on-site. Whenever asbestos is found exposed or damaged beyond repair, the material is removed, prepared for shipment, and ultimately disposed of in a secure landfill in Wayne, Michigan, approved to receive asbestos. Other potential sources of asbestos include construction materials such as cementos, which is a mixture of cement and asbestos, and asbestos-covered equipment such as ovens or process machinery.

The handling of asbestos is covered by METC Safety and Health Procedure No. E2-Control of Asbestos Exposures. This procedure details the administrative and engineering controls required during asbestos-handling projects (METC, 1986c). These projects are performed by either trained personnel from the FMG or by a bonded, licensed contractor (Hall, 1987). FMG personnel are trained by the site Industrial Hygienist in proper removal and bagging techniques (Hall, 1987).

Removed asbestos is double-bagged in "Asbestos" labeled plastic bags. The bags are placed in labeled 55-gallon drums and transported to the hazardous waste storage pad at Building B-16 to await disposal. The drums may stay at the storage pad for several months prior to being shipped off-site. During this storage period, the drums are inspected by the site Environmental Engineer at least once a week (Romano, 1987a).

Hazardous waste manifests for asbestos shipments off-site have been maintained since 1981. A listing of the annual asbestos shipment total including location and method of disposal is included in Table 4-6. The site Environmental Engineer inspects the Wayne, Michigan, secure landfill every quarter to ensure that METC-generated asbestos is being handled in accordance with regulations (Romano, 1987a).

4.2.1.3 Herbicides/Pesticides

The use of herbicides and pesticides at METC is currently limited to nonrestricted materials. The only herbicide being applied by on-site personnel is Cleen-Up for weed control in gravel areas. Documentation of application dates and amounts of

TABLE 4-6
ASBESTOS SHIPMENTS FROM METC

Date	Contractor	Quantity	Disposal Site	Disposal Method
11/81	TRI	1 x 4 #	Livingstone, La.	Secure landfill
1/82	TRI	1 x 2 #	Livingstone, La.	Secure landfill
12/84	Erieway	8 drums (380 lb)	Wayne, Mich.	Secure landfill
11/85	Erieway	3 drums (80 lb)	Wayne, Mich.	Secure landfill
7/86	Erieway	6 drums (475 lb)	Wayne, Mich.	Secure landfill
8/87	Erieway	4 drums (310 lb)	Wayne, Mich.	Secure landfill
8/87	Erieway	1 oven (1400 lb)	Wayne, Mich.	Secure landfill

Source: Notich, 1987

PRELIMINARY

Cleen-Up is not maintained. Pace, Inc., the janitorial contractor, is currently responsible for herbicide applications.

Pesticide usage at METC is documented from December 1981 to the present (Frye, 1987). A state-licensed local exterminator is selected each year and applications are made on a monthly basis. The areas that have been treated monthly since December 1981 are shown in Table 4-7 (Frye, 1987). Pesticides applied at METC since December 1981 are shown in Table 4-8 (Frye, 1987).

Pesticide applications were made during regular working hours until March 1984. At that time, complaints concerning odors were received by the Industrial Hygiene Department and applications were suspended (Anderson, 1987a). Applications were resumed in May 1984 after close of business on Fridays.

The exterminators are required to bring the pesticides on-site already prepared and ready for application. Equipment rinsates are to be applied to the infestation areas and not disposed of elsewhere on-site (Frye, 1987). Any excess pesticides are required to be taken off-site and the exterminators are required to document the quantity and strength of the pesticide used (Frye, 1987).

An inspection of Building B-16, Chemical and Gas Storage, during the Survey revealed two 5-gallon containers and a partially filled 30-gallon drum of Vegetation Control. The containers were labeled "Stored in 1982." Vegetation Control consists of 2, 4-D, Bromacil, and pentachlorophenol. Documentation concerning the use of this material could not be located.

A review by the Survey of the hazardous waste manifests generated by METC revealed that 261 pounds of Microcide Q herbicide was taken off-site in December 1984. Documentation concerning the use of this material could not be located.

4.2.1.4 Toxic and Process Chemicals

Toxic and process chemicals are stored in several locations at METC. Bulk items, such as cases of organic solvents, are kept in Building B-16. Gas cylinders containing sulfur dioxide and other toxic materials are stored in the Gas Cylinder Storage area between Buildings B-16 and B-24. Smaller amounts of organic and inorganic

TABLE 4-7

METC PEST CONTROL MONTHLY SERVICE AREAS

Building #	Application Area	Dec 1981- Nov 1982	Dec 1982- Nov 1983	Dec 1983- Nov 1984	Dec 1984- Nov 1985	Dec 1985- Nov 1986	Dec 1986- Nov 1987
B-1	Cafeteria 8 Restrooms 5 Janitor Closets Equipment Rm. Mechanical Rm.	X X X	X X X	X X X X	X X X X	X X X X X	X X X X X
B-2	2 Restrooms 1 Janitor Closet Lunchroom			X	X	X X	X X
B-3	Storeroom Shop Lunch Rm. 2 Restrooms Shower Room	X X	X X X	X X	X X X X	X X X X	X X X X
B-4	1 Restroom 1 Janitor Closet Lunchroom			X	X	X X	X X
B-5	2 Offices 1 Restroom				X	X X	X X
B-7	Security Office 2 Restrooms 1 Janitor Closet					X X X	X X X
B-15	2 Restrooms					X	X
B-19	All Spaces	X	X	X	X	X	X
B-25	2 Restrooms 1 Janitor Closet	X X	X X	X X	X X	X X	X X
T-40	2 Restrooms 1 Janitor Closet						X X
T-41	2 Restrooms 1 Janitor Closet						X X
T-42	2 Restrooms 1 Janitor Closet					X X	X X
T-44	2 Restrooms 1 Janitor Closet						X X
T-45	2 Restrooms 1 Janitor Closet						X X
T-46	2 Restrooms 1 Janitor Closet						X X

Source: Frye, 1987

TABLE 4-8
ANNUAL PESTICIDE USAGE AT METC

1982		1983		1984		1985		1986		1987	
Compound	Quantity (fl. oz.)	Compound	Quantity (fl. oz.)	Compound	Quantity (fl. oz.)	Compound	Quantity (fl. oz.)	Compound	Quantity (fl. oz.)	Compound	Quantity (fl. oz.)
Diazinon	NA	Diatox ¹	13.05	Diazinon	NA	Dursban	5.93	Dursban	5.16	Dursban	9.50
Baygon	NA	Dursban	5.33	Ficam W	0.40			Ficam W	1.70	Ficam W	0.35
Malathion	NA	Baygon	NA	Malathion	NA					Pyrethrum	1.50
Orthene	NA			Diatox ¹	1.33						
Diatox ¹	1.33										

Source: Frye, 1987

NA - Not Available

1 - Diatox is a mixture of 12 percent Dursban and 12 percent Vapona in water or diesel oil

chemicals are stored in the numerous laboratories around METC. Figure 4-3 shows the locations of the various chemical storage locations.

Building B-16, Chemical and Gas Storage, is a one-story, cinder block structure east of Building B-19. It is divided into six areas, with each area having a separate ventilation system. The main storage area is for bulk quantities of chemicals. The materials are stored on wooden shelves and pallets. Five smaller individual rooms are set up for flammable paint storage, acid storage, radioactive material storage, inorganic storage, and flammable solvent storage. Materials stored in the individual rooms are placed on shelves off the floor. There are three entrances to Building B-16, two standard metal doors and an overhead door. At the time of the Survey, dikes were not present at any of the doors (refer to Figure 4-1 for layout of Building B-16). METC staff reported that actions were initiated in order to rectify the lack of containment in Building B-16 after the completion of the on-site phase of the Survey.

The acquisition of toxic and process materials is initiated with the preparation of a purchase request. The purchase requests are reviewed by the Purchasing Department to determine if a Material Safety Data Sheet (MSDS) is presently on file for the material requested (METC, 1987b). In the event that an MSDS is not on file, a request for one is typed on the purchase request. Upon delivery of the material to Building B-19, Warehouse and Receiving, the purchase order is reviewed to determine if an MSDS was requested. If an MSDS was requested but not included in the shipment, the material is held at Building B-19 until an MSDS is obtained.

The MSDS master file at METC is updated every 2 weeks by the Industrial Hygiene Department and copies of the file are readily available to employees during each work shift (METC, 1987b).

Materials are distributed to the requestors by one of three methods. A small quantity of material will be taken by the requestor and returned to his or her workplace. Larger quantities are delivered to the requestor by PACE, the site janitorial contractor. PACE personnel have received chemical-handling training from the Industrial Hygiene Department (Hall, 1987). Large quantities of materials that can only be transported by forklift are delivered to the requestor by EG&G personnel. EG&G personnel have also received hazard communication training.

Source: METC, 1986b

CHEMICAL STORAGE LOCATIONS AT METC

FIGURE 4-3

This training includes 1-1/2 hours of general chemical-handling training, 1 hour on flammables, 1 hour on toxic chemicals, 1 hour on unstable and reactive chemicals, 1 hour on irritants, corrosives, and sensitizers, and 1 hour on carcinogens (Hall, 1987).

In the event of a spill or release of toxic chemicals at Building 16 or 19, Environmental personnel would be responsible for containment and remediation. There have never been any spills or releases of toxic materials at Building 19. A few beads of elemental mercury were discovered on the floor in the inorganic storeroom in Building 16 in October 1987 and were cleaned up (Hall, 1987). The elemental mercury was discovered during one of the site inspections conducted by EG&G. There are two walk-throughs and one formal inspection of Building 16 conducted annually. Personnel from the Environmental and Industrial Hygiene Departments perform these reviews. In addition, the site Industrial Hygienist tours Building 16 approximately once a month (Hall, 1987).

4.2.1.5 Storage Tanks

Aboveground Storage Tanks

There is one aboveground storage tank (AST) located at METC. The tank contains diesel fuel for the emergency generator for the U.S. Navy's facilities located in the northeast sector of METC. Figure 4-4 shows the location of the aboveground diesel fuel tank at METC.

The tank is constructed of steel and has a capacity of approximately 3,000 gallons. It is situated within a concrete secondary containment structure of adequate capacity. The tank was installed in 1964 and is 23 years old. Fuel is added to the tank about every 18 months and the fuel level is maintained at approximately 750 gallons (Bildstein, 1987).

Underground Storage Tanks

There are five underground storage tanks (USTs) at METC and two locations where underground tanks have been removed or abandoned in place. The use and history of each of these tanks will be discussed in the following paragraphs, along with a description of the system used to measure the tank contents. All of the existing

Source: Peebles, 1987

LOCATION OF ABOVEGROUND STORAGE TANK
METC

FIGURE 4-4

USTs, with the exception of the 500-gallon diesel fuel tank adjacent to Building B-12, were reported to the West Virginia Department of Natural Resources in a submission dated December 5, 1985.

There was a 500-gallon diesel fuel tank located west of Building B-1 that was installed in 1975 for the purpose of fueling an emergency diesel generator in Building B-1. When the generator was removed during the renovation of Building B-1 in 1982, the tank was no longer needed so its contents were pumped out and the tank filled with sand. During the lifetime of this tank, there was no system of inventory of tank contents. The generator was reported by site personnel to have been tested quarterly or yearly and the tank was filled once every few tests.

Prior to their current location adjacent to Building B-10, the underground gasoline tanks were located at the north side of Building B-2. This was the original location of the site garage and fueling station when the site was acquired in 1955. Originally there is believed to have been one tank, reportedly of steel construction and 500-gallon capacity at the Building B-2 location. This tank developed a leak in the late 1970s that was detected by the measurement system which is still in use today and is described below. When the tank was excavated and replaced it was determined by visual examination that it had been leaking from a bung hole in the top of the tank. A small amount of contaminated soil was reported by site personnel to have been removed when the tank was replaced with another steel tank of equal size. Later, in approximately 1981, the replacement tank was cut above the fuel level by a backhoe that was excavating a utility trench nearby. No fuel was spilled. Another steel replacement tank was installed at that time but was removed when in 1985 the garage and fueling station was moved to Building B-10.

At Building B-10, two underground fiberglass gasoline tanks, each of 500-gallon capacity, were installed in 1985. One of these tanks has a 1,000-gallon capacity and is used for storage of leaded fuel, and the other has a 2,000-gallon capacity and is used for unleaded fuel. The inventory measurement system currently in use is felt to be accurate enough to detect any leakage from either tank. To preclude unauthorized use, one operator records all gas pumped from the tanks. This information is tallied monthly and compared to gas shipments. It is believed that this system for gasoline has been in use since the startup of METC.

An 11,000-gallon diesel fuel UST was installed in approximately 1978 at the northwest corner of Building B-5. The tank is of bituminous coated steel with cathodic protection on the piping. The fuel was to have been used for dual fuel burners at the gas-fired boiler house. However, these dual fuel burners were never installed. The fuel is now used for diesel-powered METC vehicles. The contents of the tank are indicated by a gauge inside Building B-5 and are read by an operator periodically. No records of use are kept, however, and the accuracy of the mercury level gauge is believed to be approximately 5 percent of the tank volume. Therefore it would be difficult or impossible to determine if the tank was leaking using this inventory system.

A diesel fuel UST of unknown construction and size is located west of Building B-12. The diesel generator is located in a small unnumbered building next to the tank. In this building there is an electronic level gauge that reads to 2 percent increments. It is not known by site personnel if the generator is periodically tested or if any records of running time and tank inventory are kept. None could be located.

The only UST used for waste materials at METC is a 500-gallon stainless steel tank at the southeast corner of Building B-5. This tank was constructed in approximately 1985 to receive oily condensate water from the compressors located in Building B-5. This wastewater formerly was discharged continuously to the METC storm sewer system.

4.2.2 Findings and Observations

4.2.2.1 Category I

None

4.2.2.2 Category II

1. Potential for unconfined toxic chemical releases from Building B-16. Due to the design of Building B-16 and the current storage practices, spilled or unconfined toxic chemicals or wastes could be released into the environment. There is an open area drain in the main storage area directly adjacent to stockpiled chemicals. The area drain flows to the Sedimentation Pond, which

in turn flows to Burroughs Run. A release of materials into the drain has the potential to contaminate Burroughs Run.

One of the materials stored within 5 feet of the area drain is Vegetation Control, a herbicide which contains 2,4-D, Bromacil, and pentachlorophenol. The 2,4-D and pentachlorophenol are toxic to fish and wildlife.

There is no secondary containment for Building B-16. There are three entrances to the building and none have containment structures such as door dikes. A leak or spill would not be contained in the building and would be released to the environment.

There is a hole in the north exterior wall of Building B-16 at floor level. A spill or release of materials from the individual storage areas adjacent to the hole could exit the building and be released to the environment.

After completion of the on-site phase of the METC Environmental Survey, METC staff reported that actions were initiated by METC in order to rectify the lack of containment in Building B-16. A dike was placed around the area drain in late December 1987, temporary door dikes were installed in early January 1988, and the hole in the north wall was also repaired in early January 1988.

4.2.2.3 Category III

1. Past polychlorinated biphenyls (PCB) handling practices. There is a potential for PCBs to have been released to the environment through the mishandling of electrical equipment prior to the inventory in 1985. A lack of documentation prior to this inventory could imply a lack of analysis of dielectric fluids and therefore the potential for unreported PCB releases.

The only documentation located by the Survey of PCB activities at METC prior to the 1985 inventory was photographs of a transformer being drained and flushed. The transformer had a yellow PCB label attached. Subsequent photos showed pallets stained with oil. Documentation concerning this activity or the disposition of the stained pallet was not located.

2. Potential contamination of soil and groundwater from leaking underground storage tanks (USTs). There is a potential for soil and groundwater contamination from possible leaks of underground petroleum storage tanks. These tanks have not been leak-tested and there is no program to regularly measure and compare tank inventory to usage. The tanks are: 11,000-gallon diesel fuel tank at Building B-5; 500-gallon oily waste tank at Building B-5; and 500-gallon diesel fuel tank at Building B-12 generator.

4.2.2.4 Category IV

1. Lack of PCB annual report. METC does not prepare an annual PCB report as required in the Toxic Substances Control Act (TSCA).

There were two operational PCB transformers at METC until May 1987. 40 CFR 761.180 states that a facility using one or more PCB transformers shall develop and maintain records on the disposition of PCBs and PCB items. The records and documentation shall be maintained for at least 5 years after the facility ceases using or storing PCBs and PCB items.

2. Open secondary containment valve. The secondary containment drain valve for the diesel fuel tank located on the property assigned to the U.S. Navy was observed to be open.

The U.S. Navy's representative on-site at METC was informed of the valve's condition and the valve was closed.

4.3 Radiation

4.3.1 General Description of Pollution Sources and Controls

METC uses sealed radiation sources for measurement system purposes. In addition, two on-site X-ray units use sealed radiation sources. METC maintained 18 on-site sources in December 1987. The highest activity sources are three cobalt-60 sources located on the "producer," a portion of the gasifier. These sources are used to measure the level of the coal bed in various areas of the "producer."

Seven of the 18 METC sources are krypton-85 sources in the millicurie activity range. The krypton sources are all stored in the radiation storage vault of the B-16 storage building. Three radium-226 sources are located at the north and south coal hoppers and at the ash hopper near the gasifier. The sources are used to measure the amount of material in the hoppers. Three cobalt sources are located on the "producer" and are used to gauge the level of solid material in the reaction area. Three sources are sealed in equipment used for analytical purposes in B-25. The remaining two sources are in the custody of the METC radiation safety officer. The sources are stored in the B-17 Environment, Safety, and Health area. These are check sources used to calibrate radiation meters. Table 4-9 lists the METC radiation source inventory as of December 1987 including isotope, activity, and location.

Radiation has been used for other METC programs in the past. In particular, radiation was used in a program for which coal was irradiated to determine sulfur content. Two locations were used in conjunction with this activity, a well storage location in B-1 and an area known as the Sulfur Pit. These activities and locations are discussed in Section 4.5.

Bendix Field Engineering Corporation, in conjunction with the DOE-Idaho Operations Office (DOE-ID), constructed a field calibration facility in 1980 north of Building B-14. This facility provides calibration checks for radiometric well logging equipment. Radioactive sources of known strength are installed in four shallow wells and five surface canisters. In each case, the source material is fully containerized with no liquids or loose particles included. The facility has been used only a few times since it was built.

TABLE 4-9

LISTING OF RADIATION SOURCES AT METC - DECEMBER 1987

Item	Isotope	Quantity*	Location
1	Kr-85	15 mCi	B-16
2	Kr-85	15 mCi	B-16
3	Kr-85	2 mCi	B-16
4	Kr-85	2 mCi	B-16
5	Kr-85	10 mCi	B-16
6	Kr-85	2 mCi	B-16
7	Kr-85	2 mCi	B-16
8	Ra-226	0.75 mg	South Coal Hopper
9	Ra-226	1.00 mg	North Coal Hopper
10	Ra-226	1.50 mCi	Ash Hopper
11	Ni-63	15 mCi	B-25, Rm 115
12	Ni-63	15 mCi	B-25, Rm 115
13	H-3	200 mCi	B-25, Rm 108
14	Co-60	5 Ci	Producer
15	Co-60	4 Ci	Producer
16	Co-60	4 Ci	Producer
17	Cs-137	8 μ Ci	B-17, ES&H Area
18	Co-60	4.40 nCi	B-17, ES&H Area

* The identified quantity is that indicated in the record without accounting for decay. Specific activity dates vary widely.

METC has greatly reduced the number of radiation sources it uses. This reflects a conscious effort to change emphasis from extensive to minor use of radiation sources in measurement systems (METC, 1985b). In 1980, METC had an inventory of 64 radiation sources on-site. This was reduced to 21 sources by 1984 and 18 in 1987. The sources were transferred to other DOE installations that needed them. However, two sources could not be accounted for during the on-site portion of the Survey. Subsequent follow-up by METC could not locate the two sources. The sources may have been used in the operations at the "sulfur pit" as described in Section 4.5. Section 4.5.2.3 contains a finding related to potential soil contamination by radioactive materials in the vicinity of the Sulfur Pit.

4.3.2 Findings and Observations

4.3.2.1 Category I

None

4.3.2.2 Category II

None

4.3.2.3 Category III

None

4.3.2.4 Category IV

None

4.4 Quality Assurance

4.4.1 General Description of Data Handling Procedures

The environmental monitoring program at METC consists of the sampling and analysis of the National Pollutant Discharge Elimination System (NPDES) outfall, various process effluents, groundwater wells, and wastes for hazard characterization. The prime site contractor, EG&G Washington Analytical Services Center, Inc. (EG&G), administers the monitoring program and is responsible for selecting an analytical laboratory to perform the sampling and analyses.

The sampling and analysis schedule for METC's sanitary wastewater treatment effluent and NPDES discharge point is presented in Table 4-10. The Technical Program Manager (TPM) for EG&G occasionally adds or deletes sampling points from this schedule according to current requirements (Romano, 1987a). The sampling and analysis schedule for the groundwater wells at METC is presented in Table 4-11. Waste samples are analyzed according to the extraction procedure toxicity testing protocols required by the Resource Conservation and Recovery Act (RCRA). The sampling of all the environmental monitoring points is currently performed by the analytical support contractor, Technical Testing Laboratories, Inc. (TTL), and is discussed in detail in Section 9.4.

The analytical support contractor is required to comply with the quality assurance/quality control (QA/QC) requirements that are included in its contract with METC. These requirements include the following:

- Performing the required sampling, sample preservation, and storage activities according to U.S. Environmental Protection Agency (EPA) protocols
- Performing the required analyses according to EPA protocols
- Submitting a quarterly QA report including precision and accuracy data
- Maintaining instrument detection limits to below permitted effluent limits

TABLE 4-10
SAMPLING AND ANALYSIS SCHEDULE FOR METC SANITARY WASTEWATER TREATMENT AND DISCHARGE POINTS

[illegible]

(Units are mg/L except where noted)

AN - As Necessary

8 - Biweekly

Semiannually

Q - Quarterly

TABLE 4-11
SAMPLING AND ANALYSIS SCHEDULE FOR GROUNDWATER WELLS AT 005 INDUSTRIAL WASTEWATER POND AT METC

WELL #	Sampling Frequency	Chloride	Total Phenolics	Total Organic Carbon	Total Organic Halides	Chemical Oxygen Demand	Total Dissolved Solids (TDS)	Naphthalene (µg/L)	Xylene (µg/L)	pH (Units at 20°C)	Specific Conductance (µmhos/cm²)	Water Depth (ft)
6D	Q	•	•	•	•	•	•	•	•	•	•	•
8D	Q	•	•	•	•	•	•	•	•	•	•	•
10D	Q	•	•	•	•	•	•	•	•	•	•	•
11B Short	Q	•	•	•	•	•	•	•	•	•	•	•
12D	Q	•	•	•	•	•	•	•	•	•	•	•
13C	Q	•	•	•	•	•	•	•	•	•	•	•

(Units are mg/L except where noted)

Q - Quarterly

- Performing sufficient analytical duplicates and spikes in order to establish a measure of precision and accuracy
- Reviewing data prior to reporting to EG&G and repeating those analyses which are obviously out of character
- Analyzing NPDES check samples.

In addition to these QA measures, the EG&G TPM often sends duplicate samples to another analytical laboratory for verification of results (Romano, 1987a). The TPM is anticipating submitting blind check samples to the support contractor in order to document the laboratory's ability (Romano, 1987a). Occasionally, the TPM will identify an out-of-character result and will request that the point be resampled. This occurred in the fourth quarter of 1987 for phenols (Romano, 1987a). The first sample set showed phenols concentration to be above the Method Detection Limit (MDL). The resampled set showed the phenols concentration to be below the MDL and corresponding to previous data for that sample point.

METC has had an environmental monitoring program for at least 5 years (Romano, 1987a). A review of data by the Survey could not determine an exact date. The current support contractor, TTL, has been under contract since December 1985. TTL is accepted by the State of West Virginia for performing water and waste analysis (Romano, 1987a).

4.4.2 Findings and Observations

4.4.2.1 Category I

None

4.4.2.2 Category II

None

4.4.2.3 Category III

None

4.4.2.4 Category IV

1. Lack of accuracy data. Technical Testing Laboratories, Inc. (TTL), the current analytical support contractor for METC's environmental monitoring program, does not report accuracy data in the quarterly quality assurance (QA) report as required by contract.

Accuracy for a given parameter is determined by the percent recovery for a spike of that analyte in the sample. Spike recoveries of approximately 100 percent indicate that there are no interfering chemical species and that good laboratory practice was followed. Low recoveries (<80 percent) or high recoveries (>120 percent) indicate potential interferences or other contamination.

PRELIMINARY

4.5 Inactive Waste Sites and Releases

4.5.1 General Description of Pollution Sources and Controls

This section presents a description of potential and actual sources of environmental pollution that result from inactive waste disposal sites, and historic spills and releases of hazardous materials at METC. Included in this review of possible sources of pollution is the undeveloped 87-acre property north of the original 45-acre property. The following historic activities were investigated concerning hazardous wastes and toxic substances or mixed radioactive and hazardous wastes:

- Past release areas on-site that have been identified;
- Areas on-site where past undocumented disposal may have occurred; and
- Areas on-site where leaks, spills, or inadvertent disposal may have created ongoing sources of contamination or traceable plumes of surface or subsurface contamination.

Basic information about the disposition of hazardous wastes shipped off-site in the past is included. The review reported in this section, however, did not include the environmental fate of materials shipped off-site for disposal.

4.5.1.1 Historic Solid Waste Disposal

METC has existed as an entity since 1946, when it was created as an outgrowth of the Morgantown gas experiment started in 1942 at the University of West Virginia in Morgantown. The present original 45-acre property fronting on Collins Ferry Road was acquired in 1954 when the U.S. Bureau of Mines Appalachian Experimentation Station was formed as a consolidation of the following three units of the Bureau of Mines:

- Morgantown gas experiment

- Petroleum and Natural Gas Branch started in Franklin, Pennsylvania, in 1942
- Coal Mine Inspection Branch started in Fairmont, West Virginia, in 1944.

Originally, 10 buildings were built in 1955 on the property, which had been used as a borrow pit for surficial sand and gravel and deeper clay. Those original structures, Buildings B-1 through B-10, are all currently in use. Although the site had never had any use other than as a borrow pit and contained no structures, considerable regrading of the site was performed prior to building construction. Overburden materials were cut from the western edge of the site along Collins Ferry Road and filled into small valleys to the east and southeast corners of the site where the natural grade dropped off to Burroughs Run.

Building B-11 was constructed on the site in the mid-1960s and, in the period between 1975 and the present, Buildings B-12 through B-25 and Buildings B-27 through B-30 were constructed and a number of temporary trailer buildings were placed, all on the original 45-acre property.

In 1981, an undeveloped parcel of approximately 87 acres north of the original site was acquired by METC. This property, acquired for potential future growth of METC facilities, was formerly privately owned farmland. When acquired, the land had not been developed. It contained one abandoned, partially demolished single-story dwelling and a capped gas well, which had not been in operation for an unknown number of years. A single-track Baltimore and Ohio (B&O) Railroad coal-carrying freight line runs adjacent to the land along the Monongahela River. Collins Ferry Road, constructed a century ago as access to the river, is a dedicated roadway across the land although it is no longer in use. It is a dirt road cut for the most part along a steep side hill down to the B&O Railroad track. It was barricaded and posted several years ago by the local highway department (Sanders & Thomas, 1977). The upper or central area of the 87-acre newly acquired property is rolling terrain and is partially cleared. The areas adjacent to West Run Creek and the B&O Railroad are rugged, forested, and steep in many places. With the exception of the construction of a two-lane asphalt roadway around the property and some regrading, no construction has occurred at the property since its purchase in 1981. Figure 4-5

Source: METC, 1987a

METC SITE PLAN

FIGURE 4-5

shows the outline of the original 45-acre and 87-newly acquired acre properties and the layout of the main buildings and trailers currently on-site.

Since startup of operations at the current site in 1955, METC has conducted research and development to expand and commercialize the technology base for coal energy production, conversion, and utilization. Activities at METC include operation of research pilot-plant-scale equipment for coal gasification and coal combustion, gas stream cleanup, and fuel cells and heat engines. As is described in greater detail in Section 3.1, the most significant facilities include a 42-inch-diameter pressurized fixed-bed gasifier, an entrained coal devolatilization reactor, a fluidized-bed gasifier, and several fluidized-bed combustion reactors in a range of sizes. A thorough discussion of current solid waste generation is contained in Section 4.1 and of wastewater generation in Section 3.3. Historically, the types of solid waste generated by METC have not changed, although the quantities have varied depending on the length of time and numbers of runs that the gasifier is operated (see Section 3.1). Prior to the startup of the current gasifier in 1966-1967, similar solid wastes were generated but in lesser quantities. Most notably, wastewater generation greatly increased when hot gas desulfurization was instituted with the startup of the gasifier (see Section 3.3).

In 1985, the volume equivalent of 6,860 gallons of solid and hazardous waste was shipped by METC for off-site disposal (and an additional 680 cubic yards of soil and sludge and 8,300 gallons of spent activated carbon from the closure of the industrial wastewater pond--see Section 4.5.1.2). The wastes shipped off-site in 1985 included approximately 350 gallons, or 7 drums, of RCRA hazardous wastes. The remainder of the wastes was not known to be hazardous but potentially may have been so; therefore it was disposed of as such by licensed off-site contractors. The types of known hazardous waste generated in 1985 included contaminated solvents, mixed inorganic chemicals, and chemical-contaminated trash, all mostly from on-site laboratories. The other potentially hazardous wastes included emulsified coal oil, coal tar and water mixtures, sulfur cake, oil- and tar- contaminated trash from process areas, Stretford desulfurization liquor, miscellaneous waste industrial oils (including compressor oils), and waste automotive oil and antifreeze (METC, 1986c). Similar wastes have been generated since the construction of the facility in 1955. Since the promulgation of regulations under the Resource Conservation and Recovery Act (RCRA), in the period of 1980-1981, all potentially hazardous wastes

have been shipped to off-site disposal companies (see Section 4.1). Gasifier bottom ash, cyclone dust, waste coal fines, and miscellaneous nonhazardous scrap have all been trucked to the Marion County Landfill or the Morgantown City Landfill since startup of the site. Prior to the installation of the wet scrubber on the gasifier in about 1980, very few tars and coal oils were collected. Operators reported verbally during the Survey that most of these materials were flared. Tars and oils generated prior to about 1980 were likely disposed of, along with other solid wastes, in the county or city landfill. In the late 1970s, prior to the promulgation of regulations under RCRA in 1980, most chemical wastes were most likely dumped into METC's sewer systems (see Section 3.3). Since the construction of the site, there has been no reported burial or other disposal of solid or liquid wastes on-site, nor could the Survey find evidence of any disposal.

In 1982, approximately 272 drums containing over 14,000 gallons of METC-generated wastes, including contaminated Stretford slurry solution, were shipped to an off-site disposal firm named Alburn, Inc., of Chicago, Illinois. Although METC was provided with documentation of the proper incineration of these wastes, the firm subsequently went bankrupt and its site was declared a Federal Superfund site. Approximately 15 undisposed drums of sulfur cake were found at the Alburn site and attributed to METC. After negotiations, METC entered into a multiple responsible party remedial settlement to the U.S. Environmental Protection Agency (EPA) for cleanup of the site, based on its share of the total waste materials at the site. Since this settlement, METC has instituted a system of on-site inspection, as well as paperwork verification, of off-site waste disposal contractors under contract to the site (see Section 4.1).

Table 4-12 presents some of the previously discussed milestone dates of construction and operation, which may mark changes in historical solid waste generation.

4.5.1.2 Historic Industrial Wastewater Sludge Disposal

During the history of METC, four wastewater ponds have been used for holding wastewater prior to treatment or discharge, and for final sedimentation prior to disposal. Three of these ponds are no longer in existence; however, the Sedimentation Pond (001) is in current use for final sedimentation of several METC

TABLE 4-12
SOLID WASTE GENERATION CHRONOLOGY*

Date	Milestone
1955	Original 45-acre site acquired and Buildings B-1 through B-10 constructed.
March 1964	Leased 3.5 acres to U.S. Navy at northeast corner of original property for construction of an antenna and communication support building. (In approximately 1986 this lease was expanded to 10 acres.)
1967	Gasifier operation started.
1967/1968	Sulfur pit constructed.
1968	Sedimentation pond (001) and Slurry pond (002) constructed.
1969	Scrapyard behind Building B-11 started.
1975	Industrial wastewater pond constructed.
1977	Temporary settling pond (frac-water pond) constructed.
1980	Gasifier wet scrubber installed.
1981	Undeveloped 87-acre property purchased north of original 45-acre site.
1980/1981	Sulfur pit bulldozed over concurrent with removal of slurry pond 002.
1985	Industrial wastewater pond removed and backfilled.

Source: METC, 1987f

*Note: All dates are approximate.

wastewater streams including treated domestic wastewater (see Section 3.3.2). A second sedimentation pond formerly existed, called the Slurry Pond (002), which was operated in series with the existing Sedimentation Pond (001). In the same vicinity, a temporary settling pond was constructed to contain wastewaters from the drilling of an on-site gas well. This pond is also referred to as the Frac-Water Pond. A complete description of all of these ponds is provided in the following section.

Industrial Wastewater Pond

In 1975, an uncovered holding pond approximately 150 feet by 150 feet by 7 feet deep with a nominal capacity of 1 million gallons was constructed in an open field north of Building T-42 (see Figure 4-6 for location). The pond was built to contain wastewater generated by the operation of the 42-inch gasifier and associated gas cleanup apparatus. These wastewaters were collected in a sump under the gasifier and pumped to the holding pond. The discharge into this pond was referred to by the site as discharge #005. There the wastewater was treated by mechanical aeration and allowed to settle for up to several months (West Virginia University, 1983). Intermittently, wastewater from the pond was filtered through granular activated carbon (GAC) columns located at the pond edge and the filtered water discharged to the slurry ponds and ultimately Burroughs Run (see Section 3.3). Due to the operation of the gasifier for only a few days per year, this treatment process was operated as a batch system. The GAC filters were originally supplied by Calgon Corporation in a mobile trailer. Calgon is reported to have removed the GAC and regenerated it off-site. After approximately two gasifier runs (assumed to be 2 years), the Calgon trailer was replaced with a single GAC column permanently installed at the pond site. This system was replaced with a four-column system in the late 1970s. In both these permanent systems, although they were not supplied by Calgon, GAC was removed for off-site regeneration or disposal by the manufacturer, according to verbal information from current employees.

The pond itself was constructed on a hillside by excavation and diking. It was lined with a 3-mil Hypalon plastic membrane. Because of concerns that the liner may have been leaking, the pond was closed and removed in 1985. As a part of the closure plan study, groundwater monitoring wells were installed and the area

Source: METC, 1987a

INDUSTRIAL WASTEWATER POND

FIGURE 4-6

hydrology evaluated. This evaluation (DOE, 1983) resulted in the following conclusions:

- The highest observed groundwater level is significantly higher than the existing pond liquid level due to a point source discharging near the southeast corner of the pond.
- It appears that groundwater is entering the pond rather than being contaminated by percolation of pond contents into the groundwater table. This partially accounts for the dilution observed in the pond contents' characteristics when compared to raw gasifier wastes.
- The upper water table slopes away from the pond bottom so that direct contact only exists between a part of the pond liner (on the south side) and the water table.
- On the basis of the elevated groundwater table observed and its sloping away from the pond bottom, extensive contamination of groundwater is not expected.
- Analysis of specific conductance groundwater data indicates an area immediately below the pond which has most likely become contaminated as a result of the pond. This area will be analyzed in more detail during pond closure operations.

A thorough discussion of the impact of the site on area groundwater is contained in Section 3.4.

After study of several alternatives, a closure plan was approved by the State of West Virginia Department of Natural Resources (DNR) in May 1985. The plan provided that after the emptying of the remaining wastewater, the liner, sludge above the liner, and visibly contaminated soil under the liner be removed and disposed of at an off-site landfill as RCRA hazardous waste, even though analyses of the sludge and liquid showed neither to be hazardous wastes (see Table 4-13). A contract for removing the waste, and backfilling and construction of a parking lot over the area was awarded in July 1985. In the fall of 1985, the remediation was completed,

TABLE 4-13

**INDUSTRIAL WASTEWATER POND
RCRA HAZARDOUS WASTE CHARACTERISTIC TESTS**

Constituent	Pond Liquid Contents			Pond Sludge		RCRA Limit
	4/22/81**	6/11/81**	3/2/82**	3/22/82**	9/16/83***	
EP Toxicity Tests						
Arsenic, mg/L	0.014	0.057	0.019	<0.02	—	5.0
Barium, mg/L	0.07	0.1	0.27	<5.0	—	100.0
Cadmium, mg/L	<0.005	<0.005	<0.01	<0.10	—	1.0
Chromium, mg/L	<0.05	<0.05	<0.05	<0.50	—	5.0
Lead, mg/L	<0.05	<0.1	<0.05	<0.50	—	5.0
Mercury, mg/L	0.002	<0.0002	0.0007	<0.005	—	0.2
Selenium, mg/L	<0.002	0.100	0.057	<0.020	—	1.0
Silver, mg/L	<0.05	<0.01	<0.01	<0.50	—	5.0
Characteristic Tests						
Reactivity	—	*	*	*	—	—
Corrosivity, pH	6.8	7.9	7.6	8.4	6.5	2 ≤ pH ≤ 12.5
Corrosivity, mmpy	4.7	3.76	0.04	0.52	—	6.35
Flash Point, °C	56	>100	>100	>95	>80	60

Source: DOE, 1983

*No visible signs of decomposition, degradation, ignition, or explosion occurred up to 125°C.

**Date sampled; analyses by Kemron, Marietta, Ohio.

***Date sampled; analyses by EMS Labs, Indianapolis, Indiana

involving the removal of approximately 680 cubic yards of waste sludge, pond liner, and contaminated soil. Following the removal of approximately 560 cubic yards of sludge, liner, and visibly contaminated soil, soil samples were taken from the bottom of the excavated area to determine if any contaminated soil remained. During this sampling and analysis, 20 soil samples each were obtained on a grid pattern from depths 0-3 inches, 3-6 inches, and 12-15 inches for a total of 60 samples. These samples were analyzed for pH, total phenolics, and naphthalene.

The results showed phenolics of 50-100 mg/kg and naphthalene up to 100 milligrams per kilogram (mg/kg) at depths of approximately 21 inches below the pond liner. As a result, an additional 120 cubic yards of the most heavily contaminated soil were removed. Following this additional removal, 4 soil cores to a depth of 60 inches below the pond liner were obtained and analyzed for the same parameters. One of these cores in the north-central portion of the pond showed 590 mg/kg phenolics and up to 3,590 mg/kg naphthalene. A complete listing of the results from these four cores is shown in Table 4-14. Based on these results, although it was concluded that additional contaminated soil was present, it was concluded that further excavation was not warranted because "... excessive amounts of contaminated material needed to be removed to obtain levels close to background" (Shellito, 1985c). The site was then backfilled and the remediation completed without further excavation.

Slurry Ponds and Frac-Water Pond

The wastewater treatment system at METC involved final discharge of treated sanitary wastewater, treated industrial pond wastewater, cooling water, and contaminated stormwater (see Section 3.3) to two ponds in series for final sedimentation of coal fines and small particulates. These ponds, presumed to have been built in the late 1960s, were located at the southeast corner of the site. They were called the Slurry Pond (002) and the Sedimentation Pond (001). Figure 4-7 shows the location of these ponds. Both of the ponds are believed to be unlined but built in an area of natural clay. An additional "temporary settling pond" is also shown on this figure. This pond, also called the Frac-Water Pond, was constructed in approximately 1977-1978 to contain and settle formation water from the drilling of an on-site gas well.

TABLE 4-14

**INDUSTRIAL WASTEWATER POND
POST REMOVAL SOIL CORE ANALYSES**

Site	Depth* (inches)	pH	Phenol (ppm)	Naphthalene (ppm)
9	36-42	4.24	8	< 1
9	42-48	4.32	6	< 1
9	48-54	4.44	21	< 1
9	54-57	4.52	38.8	< 1
9	57-60	4.38	27	< 1
13	36-42	4.47	32	3.1
13	42-48	4.57	22	< 1
13	48-54	4.59	34	< 1
13	54-57	4.81	7.8	< 1
13	57-60	4.63	2.5	< 1
14	36-42	4.92	376	2,410
14	42-48	5.17	590	3,590
14	48-54	4.49	156	190
14	54-57	4.80	112	270
14	57-60	4.87	480	1,120
19	36-42	4.45	18	< 1
19	42-48	4.36	7	< 1
19	48-54	4.62	0.7	< 1
19	54-57	4.51	10	< 1
19	57-60	4.45	1.8	< 1

Source: Shellito, 1985c

*Depth is depth from original liner level.

Source: Sanders & Thomas, 1978

SLURRY PONDS, FRAC WATER POND,
BUILDING 5 COOLING WATER BASIN AND SULFUR PIT

FIGURE 4-7

In 1980, preliminary plans were made to construct a warehouse and receiving building (Building B-19) on top of the location of Slurry Pond (002) and the temporary settling pond. In January 1980, the gas well formation was fractured and 70,000 gallons of frac-water were removed from the well; 50,000 gallons of this waste were stored in tanks at the well site and 20,000 gallons in the temporary settling pond. In order to dispose of this frac-water, neutralization was accomplished with caustic, and the 20,000 gallons in the pond were sent to the Consolidation Gas lightburn station for disposal. The pond, however, filled up again with surface runoff and subsequently, all the remaining frac-water and runoff was discharged through the Sedimentation Pond (001) to Burroughs Run. Analyses of the frac-water are shown in Table 4-15.

Aerial photographs examined during the Survey show that, in August 1980, prior to the preparation of foundations for Building B-19, coal fines and sludge from the Slurry Pond (002) were drag-lined out onto the ground northeast of the pond to dry. METC staff who operated heavy equipment during this removal reported to the Survey that this sludge was then removed to the Marion County Landfill. Possibly, any remaining sludge from the temporary settling pond (Frac-Water Pond) was also disposed of in this manner. Analyses of the sludge from the temporary settling pond (Frac-water Pond) and Slurry Pond (002), based on 1980 data, are shown in Table 4-16. These sludges do not contain any significant amounts of toxics or heavy metals as shown by these analyses. However, 1988 analyses of the sludge from the Sedimentation Pond (001) show high levels of mercury, total chromium, and cadmium (see Table 3-10). Following the sludge removal from Slurry Pond (002), the area was prepared for the foundations and slab of Building 19 by filling with power plant bottom ash. The entire area of this fill is drained via underdrains to Burroughs Run, producing a source of potential contaminated wastewater (see Section 3.3). The source of the bottom ash used was Fort Martin Station of Morgantown, West Virginia. This ash was analyzed by the Extraction Procedure (EP) Toxicity Test (Sanders & Thomas, 1980) and found not to be RCRA hazardous waste.

Building B-5 Cooling Water Settling Basin

An open concrete basin was built during the initial site building construction in 1955, adjacent to Building B-8, to serve as a water reservoir for the Building B-5 cooling towers. The cooling towers were abandoned after a few years, since they

TABLE 4-15

**LABORATORY ANALYSIS OF CONTENTS OF MERC-1
TEMPORARY SETTLING POND (FRAC FLUID)**

Constituents (ppm)	1/22/80	3/25/80
Total solids	4109	7403
Suspended solids	454	61
Total volatile solids	2114	5006
pH	4.35	7.8
TOC	1060	742
Chlorides	525	----
Sulfates	41	----
Nitrates	3	----
Arsenic	0.057	0.026
Cadmium	0.021	----
Copper	0.038	0.018
Chromium	0.396	0.073
Lead	0.602	0.540
Mercury	0.558	0.281
Molybdenum	0.544	----
Silver	0.068	----
Phosphorus	0.464	----
Specific conductance	4000	----
COD	3631	3177
Acidity	740 ppm free, 802 total	----

Source: DOE, 1980a

TABLE 4-16
ANALYSIS OF SLUDGE FROM PONDS

Analysis ⁺	Temporary Settling Pond (ppm)	Coal Slurry Pond *** 001 (ppm)	Coal Slurry Pond *** 003 (ppm)
Zn	1.29	0.06	2.74
Fe	6.38*	0.13	0.10
Pb	<0.1	<0.1	<0.1
Mn	7.3	2.6	1.7
Ag	<0.01	<0.01	<0.01
Cd	<0.005	<0.005	<0.005
Cr (total)	<0.01	<0.01	0.01
Ba	1.13	<0.07	<0.07
As	0.06	0.68**	0.06
Se	<0.01	<0.01	<0.01
Hg	0.0003	0.0002	0.0002
Phenols	0.02	0.007	0.005
Cn	0.041	0.04	<0.04

Source: DOE, 1980b

⁺Four quarts of sludge was collected from 4 areas in the pond. Samples were then mixed to form a common sample. Two specimens were taken from the common sample for laboratory analysis. The average value is reported above (following ASTM method for acetic acid digestion, Federal Register, December 18, 1978).

*Values 2.85, 9.9

**Values 0.02, 1.35

***Note that sampling point 003 is assumed to be what was later called Slurry Pond (002), and sampling point 001 is assumed to be what is now called the Sedimentation Pond (001).

NOTE: See Table 3-10 for a 1988 analysis of Sedimentation Pond (001) sludge.

were presumed no longer needed due to changes in the research conducted in Building B-5. When the gasifier first started operations in the late 1960s, wastewater from the first two runs (presumed to be once per year) was discharged into the settling basin and allowed to settle. Current employees reported that Calgon Corporation was hired to treat the wastewater by GAC filtration. It is not known if any sludge was left or if that too was removed by Calgon. The basin is empty today and unused. Presumably, the previously mentioned industrial wastewater pond constructed in 1975 replaced this basin.

4.5.1.3 Sulfur Pit

In approximately 1968, a one-story cinderblock building was constructed at the eastern edge of the property under the current location of Building B-17. The building was set into a hillside and was surrounded on three sides by earth to within a few feet of the roof. The location of this building, which was called the "Sulfur Pit" can be seen on Figure 4-7 in Section 4.5.1.2. An aboveground support trailer was located next to the building and an incinerator was situated next to it. The use of the incinerator building could not be determined from records or employee interviews. The use of the sulfur pit was gathered during the Survey from interviews of current employees who had worked in the building.

During the period between 1968 and approximately 1977, experiments were conducted in this building with the objective of developing a method for rapid determination of the sulfur content of coal by detection of induced radiation. Neutron radiation sources were placed inside barrels of coal and the secondary induced gamma radiation from the coal was measured after various periods of time. The neutron sources used included mixed sources of beryllium with plutonium-238 or polonium-210, and pure sources of californium-252. These sources produced low-energy neutrons which caused the generation of gamma radiation in exposed coal. All sources were doubly encapsulated and were used one at a time in the Sulfur Pit. When not in use, these sources were kept in a 40-foot-deep dry well in the basement of Building B-1. A former employee estimated that approximately 20 barrels of coal were tested in this way over the life of the Sulfur Pit. After experimentation, the coal was reported by this employee to have been disposed of by METC at the Morgantown City Landfill. The Sulfur Pit and incinerator were demolished in place and covered with earth during the construction of Building B-

19 in approximately 1981. The disposition of radiation sources in general is covered in Section 4.3; however, the specific sources that were used in the Sulfur Pit were not separately accounted for.

4.5.1.4 Waste Product Handling and Storage

In the past and the present, the two major areas of generation of potentially hazardous wastes are the laboratories and the gasifier/pilot plant area. Current storage and handling of drums of waste materials at the gasifier area follow the guidelines of RCRA (see Section 4.1). Past storage of large quantities of ash, coal tar and water mixtures, etc. raised the possibility that past sloppy handling could have resulted in contamination. Historical aerial photographs from 1978 show accumulations of up to 100 drums and of piles of wastes, all in the vicinity of the current location of Building B-23. Building B-23 was not constructed at this location until the mid-1980s. Those drummed wastes, since they are in the vicinity of the gasifier, are presumed to be largely coal or coal tar and water mixtures. There is the potential that drums of waste chemicals from the laboratories were stored in this area. However, there is no verbal or written evidence of lab waste storage in this area. Verbal reports obtained during the Survey from long-term employees did confirm that wastes were removed to the Marion County Landfill on a frequent basis. During previous runs, there was reported to often be a dump-truck parked continuously in the area. This truck was loaded with wastes as they were generated. These wastes were then transported each day to the Marion County Landfill. It was also consistently reported by all employees interviewed that there were no substantial leaks or spills of wastes in this area and that rapid disposal ensured that the area and surface soils did not become contaminated. There was, however, a relatively small spill of Stretford Liquor to the wastewater system and Burroughs Run (See Section 4.5.1.6).

4.5.1.5 Scrap Material Storage

Historically, two areas on site have been used for storage of scrap materials and equipment and may have been utilized for storage of drums and piles of wastes. These drummed wastes may have included waste coal tars, coal tar and water mixtures, laboratory chemical wastes or other types of waste. There are no written storage records. The only evidence of this storage is aerial photographs.

The first area used for scrap storage is the area directly east of Building B-11. Building B-11 was built in approximately 1969. The building was used by the petroleum section to store parts, materials and possibly boring-core samples which were retained from off-site experiments. The fenced-in area just east of Building B-11 was not constructed when the building was erected, but rather it was added in the early 1980s (aerial photos show it absent in 1978 and present in 1983). The area fenced, however, has been used since as early as 1978 (by aerial photograph) and possibly earlier to store piles of scrap metal materials, piles of coal or ash, and a few drums of materials (or possibly empty drums). Storage of similar materials is also shown in aerial photographs to have taken place as early as 1978 in the area in between the future location of Building B-19 and Building B-11 (see Figure 4-8). By the time the fenced-in area is visible in 1983 photographs, all storage is contained within the fenced area.

The area near the on-site gas well (see Section 4.5.1.2) was also used for limited storage of scrap and potentially waste materials. Specifically, the area around the gas well and east of Building B-24 is shown in a 1983 aerial photograph as being used for storage of piles of scrap materials and drums (up to 50 estimated from the photograph). It is not known if the drums are empty or full. In this photograph, the gas well drilling rig, fracturing fluid tanks (12 of them), and mud pond have all been removed. It appears as if the area just became a scrap collection point after the gas well drilling was completed. It is possible that drummed wastes from drilling activities, grease, and potentially solvent chemicals could have been temporarily abandoned in this area. Aerial photographs from 1980 during the drilling of the well, and from 1978 before drilling do not show waste or scrap storage in this area. Examination of this area during the Survey revealed several large scrap metal production vessels and pipes and two small piles, about 6 feet in diameter, of ashlike material. No drums or chemical-stained soils were visible either on the surface or on the side of the hill south of this area. Figure 4-8 shows these two disposal areas.

4.5.1.6 Spills and Leaks

Table 4-17 lists the few spills and leaks at METC for which there are written records or spill reports. None of the spills are judged to have resulted in ongoing sources of

Source: METC, 1987a

SCRAP MATERIAL STORAGE AREAS

FIGURE 4-8

TABLE 4-17

REPORTED SPILLS AND LEAKS

7/5/85	75 gallons of gasoline spilled at METC gas station (Building B-10) during tank testing (Parrish, 1985).
6/27/85	Purple color reported in Burroughs Run; source never determined (Shellito, 1985b).
12/82	400 gallons of dilute Holmes-Stretford Desulfurization process liquor leaked onto the ground from the desulfurization unit, causing Burroughs Run to be contaminated (METC, 1983).

Sources: Various as indicated above

soil contamination or continuing release since the spilled materials were released to wastewater systems or Burroughs Run (See Section 3.3). Based on a review of the records, the gasoline spill is judged not to have resulted in any significant quantity of unrecovered contaminated soil. It is reported that the majority of the gasoline from the spill was recovered as liquid before it seeped into the ground.

4.5.1.7 Identification and Initial Assessment of Inactive Waste Disposal Sites

DOE Order 5480.14 of 1985 requires that a Phase I Installation Assessment be performed by April 1986 "to evaluate site history and records, and to locate those inactive waste disposal sites that may pose a risk to health, safety, and the environment as a result of migration of hazardous substances." The Phase I assessment format is spelled out in detail and includes a physical inspection and rating of nonradioactive sites with either the Hazard Ranking System (HRS) used by the U.S. Environmental Protection Agency (EPA) to rank sites, or the DOE's modified hazard ranking system. Additionally, by March 1987, the DOE Order requires that a Phase II characterization report be prepared following a detailed field investigation involving sampling and analyses at any sites found in the Phase I Installation Assessment.

The site had not conducted either a Phase I or Phase II investigation at the time of the on-site Survey.

4.5.2 Findings and Observations

4.5.2.1 Category I

None

4.5.2.2 Category II

None

4.5.2.3 Category III

1. Potential spills at scrap and waste accumulation areas. Potential spills and leaks from scrap and waste materials may have occurred at two historic waste accumulation areas near Buildings B-11 and B-24. Thus, soil may be contaminated with polychlorinated biphenyls (PCBs), heavy metals, and tars containing polynuclear aromatic hydrocarbons (PNAs) and, if so, would present the potential for runoff to surface waters. Historical aerial photographs show that:

- The scrapyard east of Building B-11 and the area south and across the road from Building B-11 were used to stockpile/store waste materials between the mid-1960s and the present. Currently the scrap materials are confined to a fenced-in area designated for that purpose and no hazardous materials or wastes are known to be present. The soil inside the fenced area is oil-stained.
- The area to the southeast of Building B-24 was used between approximately 1980 and the present for similar waste and scrap storage. This area currently has only a few scrap metal production vessels in storage; however, on the surface of the ground, two 6-foot-diameter areas of ashlike residue were found.

2. Potential soil contamination by radiological materials. Potential soil contamination may have resulted from the use of gamma- and neutron-emitting radiological materials on-site at the "Sulfur Pit" and in Building B-1. The Survey team was unable to locate data concerning the final disposition of two sources and any data from swipe tests that may have been taken to identify and characterize leaks.

Sources used from 1969-1979 included a 20-curie cesium-137 source and smaller sources of beryllium mixed with plutonium-238 (a "few curies"), beryllium mixed with polonium-210, and californium-252. All sources were reported to be doubly metal encapsulated and never altered, and at the conclusion of the experiments they were "properly disposed of." No records exist, however, of disposal or of the twice-yearly wipe samples taken to ensure

that no contamination had been transmitted to the Sulfur Pit walls, floors, or equipment. If the sources ever leaked, contamination could have occurred which is now buried in the rubble of the "Sulfur Pit," which was demolished and covered in place in the early 1980s.

During the sampling and analysis phase of the Survey, the area in the vicinity of the "Sulfur Pit" will be sampled to detect the presence of radionuclide contaminants in the soil.

4.5.2.4 Category IV

1. No assessment or characterization of inactive waste disposal sites. METC has not conducted an initial assessment and secondary characterization (preliminary assessment and site investigation) on the potential presence of inactive waste disposal of hazardous substances on-site in accordance with DOE Order 5480.14 of 1985.

Although no on-site burial or disposal of hazardous substances was determined to have occurred by this Survey, three areas were identified which may have become contaminated by spills and leaks of hazardous substances stored or used at these locations in the past. These areas are as follows:

- The scrapyard east of Building B-11;
- The waste and scrap storage area southeast of Building B-24; and
- The area of the former "Sulfur Pit" adjacent to the eastern edge of Building B-17.

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APPENDIX A
SURVEY PARTICIPANTS

PRELIMINARY

MORGANTOWN ENERGY TECHNOLOGY CENTER
SURVEY PARTICIPANTS
NOVEMBER 30 - DECEMBER 4, 1987

DOE

Team Leader	Richard Aiken
Assistant Team Leader	George Detsis

CONTRACT PERSONNEL

Coordinator	Peter Alexandro (NUS Corporation)
Assistant Coordinator	Kevin Walter (NUS Corporation)
Air	Roger Andes (NUS Corporation)
QA/Toxics	Mark Notich (NUS Corporation)
Surface Water	David Misenhimer (NUS Corporation)
Waste Management	Peter Alexandro (NUS Corporation)
Inactive Waste Sites	Kevin Walter (NUS Corporation)
Hydrogeology	William Murray (NUS Corporation)

LARAMIE PROJECT OFFICE
SURVEY PARTICIPANTS
JANUARY 25 - JANUARY 29, 1988

DOE

Assistant Team Leader	George Detsis
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CONTRACT PERSONNEL

Inactive Waste Sites	Kevin Walter (NUS Corporation)
Hydrogeology	William Murray (NUS Corporation)

APPENDIX B

SITE-SPECIFIC SURVEY ACTIVITIES

PRELIMINARY

B.1 Pre-Survey Preparation

The DOE Office of Environmental Audit, Assistant Secretary for Environment, Safety and Health, selected a Survey team for the Morgantown Energy Technology Center (METC) in the fall of 1987. The site is operated by the DOE with support services provided by EG&G Washington Analytical Services Center, Inc. (EG&G). Mr. Richard Aiken was designated the DOE Team Leader, and Mr. George Detsis the Assistant Team Leader. The remainder of the team was composed of contractor specialists from the NUS Corporation.

The Survey team members began reviewing the METC general environmental documents and reports in November 1987. Messrs. Aiken, Detsis, Walter, and Alexandro conducted a pre-Survey site visit on October 29-30, 1987, to gain familiarity with key METC personnel and to tour the site. Keith Owenby of the Oak Ridge National Laboratory (ORNL), who will be field sampling team leader, was also in attendance. A cursory review of the data generated in response to an information request of early September 1987 was also conducted during the pre-Survey site visit. The request listed environmental information of interest to the Survey team for planning purposes. The Survey team intensively reviewed the information generated during the pre-Survey visit, and during the week of November 2, 1987, prepared a Survey Plan for METC. This plan discussed the specific approach to the Survey for each of the technical disciplines and included a proposed schedule of activities for on-site activities. The Survey Plan was transmitted to METC on November 9, 1987.

B.2 On-site Activities

The on-site portion of the Survey of the Morgantown facility was conducted during the period of November 30 - December 4, 1987. The opening meeting (held on November 30, 1987), at the site was attended by representatives from METC and the Survey team members. Discussions during this meeting centered on the purpose of the Survey, logistics at METC, and an introduction of the personnel involved.

The on-site Survey of the Laramie Project Office's Hoe Creek and Hanna sites in Wyoming was conducted from January 25 through 29, 1988, by Messrs. Detsis, Walter, and Murray.

During the Survey, team members reviewed file materials, permits and applications, background studies, engineering drawings, accident reports, and operating logbooks. The production process was thoroughly analyzed to identify existing and potential pollutants. Site operations and monitoring procedures were observed. Extensive interviews were conducted with plant personnel regarding environmental controls, operations, monitoring and analysis, past operations, regulatory permits, and waste management.

Daily meetings of the Survey team members were held to report observations and compare findings. A representative from the Site Management Division of METC met daily and often more frequently with the DOE Team Leader and Assistant Team Leader to arrange for specific site personnel and facilities to be available, as needed, on the following day. METC or EG&G personnel accompanied Survey team members on all field reconnaissances.

The Survey team members identified further Sampling and Analysis (S&A) requirements necessary to complete the Survey effort. The S&A requirements were discussed by the team on December 2, 1987, and the request package was presented to ORNL representatives on December 3, 1987. ORNL was designated by DOE to provide a sampling team for METC and to perform the laboratory analytical services.

A site closeout briefing was held on December 4, 1987, at METC where the DOE Team Leader and Assistant Team Leader presented the preliminary observations of the Survey team. These observations were classified as preliminary, because additional research and, in some cases, additional field sampling were required to positively confirm the observations.

A site closeout briefing was held on January 29, 1988, at LPO, where the DOE Assistant Team Leader presented the preliminary observations of the Survey team. These observations were classified as preliminary, as future information concerning LPO may be required to positively confirm them.

B.3 Sampling and Analysis

ORNL will perform the Sampling and Analysis portion of the Survey. ORNL evaluated the S&A requests made by the Survey team for METC in Morgantown, West Virginia and determined logistics, costs, and schedules. There were no S&A requests by the Survey team for the LPO Survey due to ongoing S&A activities planned by LPO for both the Hanna and Hoe Creek sites. The S&A Plan prepared by ORNL includes a quality assurance plan and a health and safety plan. The S&A Plan will be completed during spring of 1988 and the sampling team will begin work at the site during the summer of 1988.

B.4 Report Preparation

An Environmental Survey Preliminary Report for METC will be prepared to summarize the findings from the on-site Survey effort. This report will be provided to METC for review. The findings presented in the Preliminary Report are considered preliminary until comments are received and S&A results are available. At that time, the comments and S&A results will be evaluated and an Interim Report will be prepared.

APPENDIX C
SURVEY PLAN

PRELIMINARY

ENVIRONMENTAL SURVEY PLAN

MORGANTOWN ENERGY TECHNOLOGY CENTER

NOVEMBER 30 - DECEMBER 4, 1987

MORGANTOWN, WEST VIRGINIA

November 9, 1987

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 DOE Environmental Survey Manual of August 1987.

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.

PRELIMINARY

2.0 SURVEY IMPLEMENTATION

The Environmental Survey of the Morgantown Energy Technology Center (METC) will be managed by the Team Leader, Richard Aiken and the Assistant Team Leader, George Detsis. James Harper will serve as the METC site contact person. Technical support will be provided by the following NUS Corporation personnel:

Peter Alexandro	NUS Coordinator/RCRA and Solid Waste
Kevin Walter	NUS Assistant Coordinator/CERCLA
Mark Notich	QA/TSCA
David Misenhimer	Surface Water
Roger Andes	Air
William Murray	Hydrogeology

2.1 Pre-Survey Activities

Members of the Survey team began reviewing METC environmental documentation available at the DOE Office of Environmental Audit and Compliance in November 1987. Messrs. Aiken, Detsis, Alexandro, and Walter conducted a pre-Survey site visit on October 29-30, 1987 to become familiar with the site, to identify any potential environmental problems, and to coordinate plans for the upcoming Survey. In addition, Keith Owenby of the Oak Ridge National Laboratory (ORNL), who will be the field sampling team leader, was also in attendance. During the pre-Survey visit, the team met with representatives of DOE and EG&G (support services contractor). In addition, the team toured the facility and discussed documents assembled by site personnel in response to the information request memorandum (October 29, 1987) which were received in Washington on November 2, 1987. This Survey plan is based upon the information received by the Survey team as of November 6, 1987.

2.2 On-Site Activities and Reports

The Environmental Survey will be conducted from November 30 through December 4, 1987 for the Morgantown facility. From January 25-29, 1988, a portion of the team will visit the Laramie Project Office and the Hoe Creek and Hanna sites in Wyoming. The agenda for both on-site visits is shown on the attached tables. 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, December 4, 1987 to present initial environmental findings on the on-site activities. A Preliminary Report of the Survey will be issued in late spring, 1988. The Laramie Project Office sites will be included as an appendix to the METC Preliminary Report. Subsequently, an Interim Report will be prepared by the Survey team following the completion of the Sampling and Analysis Report. The Interim Report will have the data from the sample analyses incorporated into the report. The findings from each of the Interim Reports from all scheduled Surveys will be updated as appropriate and included in the Final Environmental Survey Report to the Secretary, DOE, which is scheduled for completion in 1989.

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 METC Survey will be conducted by a team from the Oak Ridge National Laboratory (ORNL) in early summer of 1988. Mr. Keith Owenby will be the ORNL field sampling team leader. The ORNL sampling team will draft a Sampling Plan based upon the sampling needs identified by the Survey team.

The Assistant Team Leader, George Detsis, will coordinate the review of this Sampling Plan with the EPA's Laboratory at Las Vegas which has quality assurance responsibility for the Survey's sampling and analysis efforts. Sampling at most facilities takes between 3-5 weeks to complete, depending on the complexity of the sampling needs of each facility. Analysis of the samples will be conducted by ORNL following protocols provided in the Survey Manual, supplemented by the ORNL Sampling Plan. Results of the sampling and analysis will be transmitted to the Survey Team Leader for incorporation into the Interim Report.

3.0 AIR

3.1 Issue Identification

The air-related Survey activities will involve an assessment of the air emission sources within the facility and of any administrative and technological emission controls applied to the sources. The emphasis of the Survey will be on operational and procedural practices associated with the emission, sources and any emission control equipment. Fugitive sources of emissions both within and outside the buildings, will be investigated also, as will any mitigative procedures to control fugitive emissions.

The general approach to the Survey will include a review of any existing air permits, pending applications, and standard operating procedures. Processes and control equipment will be investigated. The Survey will also review any emissions monitoring data for the different processes in the facility, evaluate any 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.

Areas of particular interest will include emissions of the criteria pollutants (i.e., particulates, sulfur oxides, nitrogen oxides, hydrocarbons, carbon monoxide and lead) from fuel burning facilities as well as regulated hazardous air pollutants (e.g., asbestos, hydrogen fluoride and mercury) and odors. In addition, the use of organic solvents will be assessed as a potential or actual source of emissions to determine if they are adequately characterized, monitored, and controlled.

The past inactive ambient air monitoring system will be evaluated to assess if the monitoring program was 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 former ambient air quality sampling shelters, a review of documentation applicable to the ambient air data acquisition, and an evaluation of the data processing procedures which were used. 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.

3.2 Records Required

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

- Air permits (Registrations, Installation, and Operation);
- Source and emissions inventories (including any stack and vent inventory);
- Emission test data, emission calculations, etc.;
- Descriptive documentation on emission controls;
- Standard operating procedures for process and control equipment;
- Correspondence between regulatory agencies and any citizen's complaints relative to air issues;
- Reports on accidental or unplanned releases of airborne substances;
- Former ambient air monitoring program procedures;
- Other records as determined on site.

4.0 SURFACE WATER/DRINKING WATER

4.1 Issue Identification

A review of the present condition of the wastewater collection and treatment systems will be made as part of this Survey. METC process activities that generate wastewaters will be reviewed through a detailed process tour. 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 review will be performed in unison for most buildings and activities due to a common need to review processes and waste discharge points. Buildings will be examined to view normal activities including maintenance activities generating process wastewaters and other liquid wastes. In addition, a record review session will be scheduled to review drawings and materials pertaining to wastewater and stormwater treatment operation and maintenance.

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:

- 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 permits;
- Residuals (sludge) disposal from the wastewater treatment plant (both the technical and the administrative aspects);

- Spill protection provisions for fuels and hazardous materials storage units, including review of the Spill Prevention, Control, and Counter-measures (SPCC) Plan and of such physical controls as tank containment dikes and runoff drainage control for potential contaminants;
- Water quality information concerning domestic and process waters, with particular attention to such parameters as solvents and other organic chemicals, coliforms, chlorine residuals, and asbestos fibers;
- Basic design parameter information such as storm runoff coefficients and tributary population to the sanitary wastewater treatment plant.

4.2 Records Required

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

- Detailed drawings of the process, storm, and sanitary sewer systems and the domestic and process water systems both within buildings and in yard areas;
- Detailed drawings of the stormwater, sanitary, industrial, and contaminated wastewater treatment units;
- Detailed drawings of the domestic and process water supply distribution systems;
- Additional schematic diagrams and/or descriptions of all production processes;
- SPCC Plan on the site, covering all fuel and hazardous material storage units;
- Procedures for collecting wastewater samples;

- Analytical data used for preparation of the NPDES monitoring reports;
- NPDES discharge monitoring reports and violation reduction studies;
- Reports on the potable water system;
- Records of drinking water quality both on and off-site;
- Operators logbooks and reports for treatment plant operations;
- Sampling logbooks and laboratory tracking reports;
- Operation and Maintenance manuals for the stabilization pond, sewage treatment plant, and industrial pretreatment plant;
- Treatment plant and monitoring equipment maintenance records and/or logs;
- Progress reports and/or final reports for previous or on-going waste characterization studies or evaluations of wastewater control and treatment options;
- Records of time periods that the coal gasification and desulfurization systems have been in operation;
- Internal memos and correspondence relating to surface water/drinking water problems;
- Applicable water quality standards for Burrough's Run, West Fork Run, and the Monongahela River;
- Complete sanitary and storm sewer layout plans;
- Reports on the 1987 wastewater upgrade project;
- Reports on design of the industrial wastewater pretreatment plant;

- Reports and drawings on the modification of the on-site sewer system;
- Reports on the tie-in to the municipal sewer system;
- Reports on closure of the industrial wastewater pond;
- Other records as determined on-site.

PRELIMINARY

5.0 HAZARDOUS SOLID WASTES

5.1 Issue Identification

The procedure for the hazardous solid waste investigation 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 investigation will concentrate on those facilities with the potential to generate hazardous waste. Specifically, the sources of waste streams such as laboratory chemical waste, recoverable waste mercury, emulsified oil and water mixtures, coal tar wastes, contaminated Stretford Slurry Solution waste, spent activated carbon, waste solvent, waste fixer and developer, waste hydrofluoric acid and gasifier waste 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 possible additional hazardous waste generation, treatment, storage and release points.

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.

The methods of generation, collection, storage, and disposal of solid wastes will be reviewed to determine if they result in environmental problems.

5.2 Records Required

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

- Waste analysis plans;
- Waste analysis results;
- Inspection documentation (state and Federal)
- Internal facility inspection documentation;
- Any release notification or occurrence documentation;

- Any enforcement action documentation;
- Any additional RCRA manifests;
- Correspondence with regulatory agencies on solid waste;
- Records dealing with the reuse/recycling of wastes;
- Other records as determined on-site.

PRELIMINARY

6.0 HYDROGEOLOGY

6.1 Issue Identification

The preliminary review of data indicates that few studies have been conducted to assess groundwater conditions. In addition, it is apparent that groundwater sampling has not been included in environmental monitoring efforts prior to April of 1985. Available data is derived from 6 groundwater monitoring wells installed in 1985 around the decommissioned industrial wastewater holding pond.

As a result of the limited information, the Survey will focus on identifying additional sources of information on such topics as basic hydrogeologic setting for the site and the surrounding area, aquifer properties, water table configuration, groundwater users in the vicinity, etc. In addition, potential sources of groundwater contamination at METC will be reviewed. These may include active and inactive ponds or impoundments, known spills or releases of hazardous substances, waste and product chemical storage areas, etc.

The portion of the Survey devoted to the Laramie Project Office will focus on a review of information on monitoring results, existing subsurface conditions, and the potential for migration of contaminants from the in-situ burn area. The site visits to Hanna and Hoe Creek will focus on a review of existing facilities and past releases. Information on monitoring well locations and construction will also be reviewed.

6.2 Records Required

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

- Historic aerial photos (2 per year), as available;
- Well installation reports and boring logs;
- Maps of monitoring wells, domestic wells, etc.;
- Well sampling procedure, schedule;
- Monitoring parameters, data and results;
- Groundwater sampling QA/QC; and
- Other records as determined on-site.

7.0 INACTIVE WASTE SITES/RELEASES (CERCLA)

7.1 Issue Identification

The objective of this portion of the Survey will be to identify and summarize environmental problems at or emanating from METC which are caused by the following historical activities concerning hazardous wastes and toxic substances 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 off-site areas that were used during the history of the facility. Based on the review of data available to the team prior to the on-site portion of the Survey, it is apparent that little is known and documented about buried hazardous and mixed waste and no locations of burial have previously been identified. Of concern, however, is the potential for continuing releases of pollutants from the "reclaimed" industrial wastewater holding pond north of Building T-42.

The CERCLA portion of the Survey, since it relates to past handling, as well as disposal of hazardous and mixed chemicals/waste, will be 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/unpermitted subsurface disposal of water that may form a migration pathway for any source of hazardous or mixed waste. Lastly, since subsurface water is the primary mode of migration for buried wastes, the CERCLA portion of the Survey will be coordinated with the groundwater portion.

7.2 Records Required

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

- Soil boring logs from the various buildings construction site;
- Construction records of the removal of sludge and soil from the industrial wastewater holding pond;
- Historic aerial photos;
- Notifications and internal records of spills/releases;
- Site topography drawings;
- Records of facility expansion and building destruction;
- Subsurface tank plans;
- Historical local files on waste handling/disposal;
- Other records as determined on-site.

8.0 TOXIC SUBSTANCES AND QUALITY ASSURANCE

8.1 Issue Identification

The toxic Survey will include all raw materials and process-related chemicals used on the METC 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 the Survey. Obsolete or used PCB contaminated items in storage 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 team's attention on potential problem areas.

The use of asbestos at METC 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.

Aboveground and underground storage tanks will be reviewed for physical appearance, capability with stored material, inspection or tightness records, inventory monitoring records and maintenance records.

The quality assurance Survey of the environmental program will be primarily an evaluation of the site sampling and analytical capabilities at METC. 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 METC site will be reviewed, 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 conducted by Technical Testing Laboratories for the METC facility 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 METC laboratories will be evaluated. QA procedures imposed on any outside sampling or analytical laboratories will also be reviewed in this study effort.

8.2 Records Required

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

- 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;
- Inventory of current PCB-contaminated electrical equipment;
- Records of inspections of PCB transformers;
- 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 Contractor 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;
- Analytical subcontractor QC procedures;
- Storage tank inventory records;
- Storage tank maintenance records.

9.0 RADIATION

9.1 Issue Identification

Normally, the radioactive Survey involves an assessment of the facility-wide radioactive emissions, emissions control and monitoring, and the associated impact on the environment. It includes discharges to the atmosphere, surface water, groundwater, soils, and off-site disposal.

METC does not now process, treat, or store, and has never in its history of operations processed, treated, or stored radiological materials (with the exception of small check sources). The radiation portion of the Survey will be a review of records to verify this information. This review will be performed by the RCRA and Solid Waste Specialist.

PRELIMINARY

10.0 SAMPLING AND ANALYSIS

10.1 Issue Identification

The representatives of the ORNL Sampling and Analysis Team will be on-site during the last two days of the Survey (December 3-4, 1987) to ensure that the sampling effort will fully achieve the desired objectives. The purpose of the visit is to obtain a familiarity with the site, identify the security implications associated with the sampling portion of the Survey, identify any health and safety concerns for the sampling team, and discuss logistical arrangements for the field sampling team.

In addition, the Toxic Substances and Quality Assurance specialist from the Environmental Survey team will serve as the sampling team liaison and will coordinate sampling requests with the DOE Assistant Team Leader.

10.2 Records Required

The ORNL personnel have no records review requirements.

TABLE 1
ENVIRONMENTAL SURVEY ON-SITE AGENDA
MORGANTOWN ENERGY TECHNOLOGY CENTER, NOVEMBER 30-DECEMBER 4, 1987

	AIR	SURFACE WATER/DRINKING WATER	HAZARDOUS SOLID WASTES	HYDROGEOLOGY	INACTIVE WASTE SITES/RELEASES	TOXIC SUBSTANCES AND QUALITY ASSURANCE
MONDAY 11/30						
AM	Orientation and Facility Tour	Orientation and Facility Tour	Orientation and Facility Tour	Orientation and Facility Tour	Orientation and Facility Tour	Orientation and Facility Tour
PM	Pilot Plant - Bldg. B4	Stabilization pond Industrial wastewater treatment plant	Pilot Plant Bldg. B4 discussions w/ waste mgmt. personnel	Review aerial photos & boring logs	Review aerial photos & boring logs Interview former asst. facility director re historical waste disposal	Above ground tanks - visual review, records review Naval Area
TUESDAY 12/1						
AM	Producer, coal preparation - Bldg. B6, coal drying - Bldg. B14	Producer, desulfurizer sanitary wastewater treatment plant	Process & equipment evaluation of producer, coal prep & assoe. processes	Field walk new property	Field walk new property	Herbicide/pesticide- storage/usage/past history, toxic chemicals review Bldg. B16, B19
PM	Boiler plant - Bldg. B5, General purpose-Bldgs. B2, B3	Sewers & points of generation in Labs, boiler plant-Bldg. B5, compressor	Process & equipment evaluation of shops, photo lab, and solid waste handling	Field review old property & site boundaries, check rad source area	Field review old property & site boundaries, underground tanks inspection	Toxic chemicals (cont'd) misc storage areas, asbestos handling & disposal procedures
WEDNESDAY 12/2						
AM	Gasification research-Bldg. B12, Hot solids- Bldg. B22 Lab - Bldg. B25	Chemical storage Bldg - Bldg. B16, pumphouse- Bldg. B8, Coal storage areas	Review waste management records, waste analyses, rad & chemical storage- Bldg. B16	Records/analytical data-review	Waste disposal/spill records review followup questions staff in Bldgs. B4, B8, B22, B25	PCBs Bldg. B7 visual & records review, waste storage and disposal, lab QA
PM	Develop and document sampling and analysis needs					

TABLE 1
ENVIRONMENTAL SURVEY ON-SITE AGENDA
MORGANTOWN ENERGY TECHNOLOGY CENTER, NOVEMBER 30-DECEMBER 4, 1987

	AIR	SURFACE WATER/DRINKING WATER	HAZARDOUS SOLID WASTES	HYDROGEOLOGY	INACTIVE WASTE SITES/RELEASES	TOXIC SUBSTANCES AND QUALITY ASSURANCE
THURSDAY 12/3 AM	Dynamic test unit-Bldg. B27, old air monitoring program- shelters, sites, data	Visit sampling locations with sampling team, debrief team leader	Process evaluation of site 'abs (i.e., waste generation)	Debrief team leader	Attend individual debriefings with team leader	Visit sampling locations with sampling team debrief team leader
PM	Debrief team leader, follow up building inspections	Records/drawings review	Debrief team leader; equipment evaluation of waste storage	Observe well sampling	Debrief team leader; attend individual debriefings with team leader	Records review
FRIDAY 12/4 AM	Revisits & records review	Revisits & records review	Revisits & records review	Revisits & records review	Revisits & records review	Revisits & records review
PM	Close-out briefing	Close-out briefing	Close-out briefing	Close-out briefing	Close-out briefing	Close-out briefing

TABLE 2

ENVIRONMENTAL SURVEY ON-SITE AGENDA
LARAMIE PROJECT OFFICE; HANNA & HOE CREEK, WYOMING
JANUARY 25-29, 1988*

Monday, 1/25 PM	Meet with State and Federal regulators at State Offices in Cheyenne
Tuesday, 1/26 All Day	Records review and project overview. Laramie Project Office
Wednesday, 1/27 All Day	Visit Hanna Site
Thursday, 1/28 All Day	Visit Hoe Creek Site
Friday, 1/29 AM	Follow up in field or at Laramie**

* The visit will be conducted by William Murray (hydrogeologist), Kevin Walter (Environmental Waste Specialist), and George Detsis (DOE Assistant Team Leader).

** The schedule for field visits to Hanna and Hoe Creek will be alternated to other days between Tuesday and Friday if weather conditions necessitate.

APPENDIX D
CHEMICAL SYMBOLS, ABBREVIATIONS, AND ACRONYMS

PRELIMINARY

LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

Ag	silver
AIHA	American Industrial Hygiene Association
Alox	aluminum oxide
AQCR	Air Quality Control Region
As	arsenic
AST	aboveground storage tank
Ba	barium
BOD	biochemical oxygen demand
Btu	British thermal units
°C	degrees Centigrade
Ca	calcium
CaCO ₃	calcium carbonate
CaCrO ₄	calcium chromate
cc	cubic centimeters
Cd	cadmium
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cf	cubic feet
CFC	chlorofluorocarbon
cfm	cubic foot per minute
CFR	Code of Federal Regulations
cfs	cubic foot per second
Ci	curie
Cl	chloride
CO	carbon monoxide
Co	cobalt
COD	chemical oxygen demand
COS	carbonyl sulfide
CN	cyanide
cpm	counts per minute

LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

CPU	Color Units
Cr	chromium
Cs	cesium
CTBN	trade name resin product
CWA	Clean Water Act
CWSS	contaminated wastewater sewer system
cy	cubic yards
DOE	U.S. Department of Energy
DOE-ID	DOE Idaho Operations Office
DNR	Department of Natural Resources
EP	extraction procedure
EPA	U.S. Environmental Protection Agency
ERDA	Energy Research and Development Administration
ES&H	Environment, Safety & Health
°F	degrees Fahrenheit
Fe	iron
FMG	Facility Maintenance Group
ft ²	square feet
ft ³ /yr	cubic feet per year
g	gram
GAC	granular activated carbon
gal	gallon
gpd	gallon per day
gph	gallon per hour
gpm	gallon per minute
H	hydrogen ion
ha	hectare
HCl	hydrochloric acid
HEPA	high-efficiency particulate air (filter)
HF	hydrofluoric acid
Hg	mercury

LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

HP	Health Physics
hp	horsepower
HRS	Hazard Ranking System
HW	hazardous waste
H ₂ S	hydrogen sulfide
IH	Industrial Hygiene
ILW	intermediate-level waste
K	kilo (1000)
Kg	kilogram
Km	kilometer
Kr	krypton
L	liter
lb	pound
lb/hr	pound per hour
LETC	Laramie Energy Technology Center
LPO	Laramie Project Office
m	milli (1/1000)
μCi	millicurie
μ	micro (10 ⁻⁶)
μg	micrograms (10 ⁻⁶ gram)
μg/m ³	microgram per cubic meter
MCL	maximum contaminant level
MDL	Method Detection Limit
MERC	Morgantown Energy Research Center
METC	Morgantown Energy Technology Center
Mn	manganese
mg	milligram (1/1000 gram)
mg/L	milligram(s) per liter
mgd	million gallons per day
mL	milliliter
m ³	cubic meter
mph	mile(s) per hour

LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

MSDS	Material Safety Data Sheet
MW	mixed waste
NAAQS	National Air Quality Standards
NBS	U.S. National Bureau of Standards
nCi	nanocurie
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NH ₃ -N	ammonia/nitrogen
Ni	nickel
NOAA	National Oceanic and Atmospheric Administration
NO _x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
OEG	Office of Environmental Guidance and Compliance (DOE)
O&G	oil and grease
ORAU	Oak Ridge Associated Universities
ORNL	Oak Ridge National Laboratory
OSHA	U.S. Occupational Safety and Health Administration
o ₃	ozone
Pb	Lead
PbO	lead oxide
PCB	polychlorinated biphenyl
PM ₁₀	particulate matter = 10 microns
PNA	polynuclear aromatics
Po	polonium
POTW	publicly owned treatment works
ppb	part per billion
ppm	part per million
PVC	polyvinyl chloride
PSD	Prevention of Significant Deterioration
psi	pound(s) per square inch
psig	pound(s) per square inch gauge
Pu	plutonium

LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

QA	quality assurance
QC	quality control
R&D	research and development
RCRA	Resource Conservation and Recovery Act of 1976
S	sulfur
S&A	Sampling and Analysis
SCFD	Standard Cubic Foot per Day
SCFH	Standard Cubic Foot per Hour
SCN	thiocyanate
SDWA	Safe Drinking Water Act
Se	selenium
SO ₂	sulfur dioxide
SPCC	Spill Prevention, Control, and Countermeasures Plan
STL	Simulation Technology Laboratory
STP	Sewage Treatment Plant
SU	standard unit
T	temperature
TCA	trichloroethane
TCE	trichloroethylene
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TOH	total organic halogens
TPM	Technical Program Manager
TRC	total residual chlorine
TRU	transuranic
TSCA	Toxic Substances Control Act
TSP	total suspended particulates
TSS	total suspended solids
TTL	Technical Testing Laboratory
TVSS	total volatile suspended solids
UCG	Underground Coal Gasification
USFS	United States Forest Service

LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

USGS	United States Geological Survey
UST	underground storage tank
VOC	volatile organic compound
WWTP	wastewater treatment plant
Zn	zinc

PRELIMINARY

APPENDIX E

HANNA UNDERGROUND COAL GASIFICATION SITE

PRELIMINARY

**APPENDIX E
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A. Site Setting

The Hanna Underground Coal Gasification (UCG) site is a rectangular property of approximately 150 acres located in open rangeland in southeastern-central Wyoming. The site is situated just south of State Route 30, and north of Interstate 80. The nearest residences to the site are located in the City of Hanna, approximately 2 miles north of the Site. Figures E-1 and E-2 show the location of the site in relation to the State of Wyoming and the City of Hanna.

Surface elevations of the Hanna UCG site average approximately 7,000 feet. The topography of the site is gently rolling with its highest point in the southwest corner gradually dropping about 100 feet to the northeast corner (Cook and Oliver, 1985).

The area is mildly dissected prairie with low vegetative cover consisting of sagebrush and buffalo grass. The area experiences frequent strong winds and has a cool, temperate, continental climate consisting of long cold winters and short warm summers. The average annual precipitation generally is between 10 and 15 inches (Barrash et al., 1988).

B. Regional Geology

The Hanna UCG site is located in the Hanna Basin in south-central Wyoming. The target unit of the UCG experiments was the Hanna No. 1 Coal, which is a stratigraphic unit of the Hanna Formation of Paleocene age. The Hanna No. 1 Coal seam ranges in thickness from 25 to 32 feet and is overlain by 200 to 500 feet of overburden. The overburden has been subdivided into four lithologic units as described by Barrash et al. (1988). These units include siltstones, shales, and sandstones. The relative position of the Hanna No. 1 Coal and the four overburden units, identified as Units A, B, C, and D, are shown in the cross-section in Figure E-3.

C. Underground Coal Gasification (UCG) Overview

The purpose of UCG is to convert coal seams, in place, to a combustible gas that can be cleaned, treated, and upgraded for a variety of end uses such as the production of chemicals, substitute natural gas, liquid fuels, and electric power. Coal resources

LOCATION MAP SHOWING THE HANNA BASIN

FIGURE E-1

LOCATION MAP OF HANNA SITE

FIGURE E-2

Source: Cooke and Oliver, 1985

GENERALIZED NORTHEAST-SOUTHWEST
STRUCTURAL CROSS-SECTION OF THE HANNA UCG AREA

FIGURE E-3

targeted for UCG processing are those coal seams that are unsuitable for recovery using current mining technology because of technical, environmental, health and safety, or economic factors.

Conceptually, UCG processing is relatively simple and straightforward. Wells are drilled from the surface to provide access to the target coal seam. One well is used for injection of an oxidant, such as air or a mixture of oxygen and steam, into the seam, while another well serves as a production well for the gasification process gases. These two wells are connected within the seam using one of several linking techniques to provide an open pathway for the flow of large quantities of gaseous products. The coal seam is ignited at the injection well; the subsequent combustion of the coal results in the formation of a cavity that grows in a tear-drop geometry until the coal around the injection well and between the production well is consumed. During this process, the solid carbonaceous material in the seam is converted to a combustible gas comprised primarily of hydrogen, carbon monoxide, and methane, along with diluent gases such as carbon dioxide and steam. If air is used as the oxidant, the product gas stream also contains nitrogen as a major component. Since most coal seams contain some sulfur, the product gas stream has a hydrogen sulfide component.

Surface treatment of the product gas stream is similar to that for surface gasification processes. Initially, the raw gas is cleaned of any particulates and the hydrogen sulfide is removed to protect downstream equipment and the environment.

D. Site Operational History

The Hanna site is located on land leased by DOE from the owner, Union Pacific Resources Company. The site is located in an unpopulated rangeland area approximately 2 miles south of the City of Hanna, including the southwest quarter of Section 29 and the eastern half of the southeast quarter of Section 30 in Township 22 North, Range 81 West, Carbon County.

Under the direction of the Laramie Energy Technology Center (LETC), seven UCG experiments were conducted at the site between 1973 and 1979. The individual experimental sites are referred to as Hanna I, Hanna II (Phases 1, 2, 3), Hanna III, and

Hanna IV (a, b). Table E-1 shows the dates and sizes of these UCG sites. None of the sites are believed to have incurred surface subsidence; however, during the physical inspection of the site by the Survey team, on January 28, 1988, the ground was covered by 2 feet of snow.

In 1977, after the earlier experiments demonstrated favorable process results, a groundwater monitoring program was accomplished by monitoring various well types including process wells after completion of gasification; burn cavity monitoring wells; and peripheral non-burn cavity wells.

Currently, on a property immediately southeast and adjacent to the Hanna site, an industry-driven research UCG test project is being conducted by an industrial consortium headed by the Gas Research Institute. The Project is called "Rocky Mountain I". Since this is outside the Hanna site area and is not being conducted by DOE, it was not included within the scope of the Survey.

E. State Government Concerns

A meeting was conducted on January 25, 1987 with representatives of the Wyoming Department of Environmental Quality (DEQ) including the Department Director. The concerns of the DEQ regarding the Hanna Site expressed at the meeting were summarized in a letter of February 17, 1988, from the DEQ Director to the Survey Assistant Team Leader. These specific concerns as stated in the letter are:

1. Levels of phenol and other organics in each of the burn cavities are high.
2. Are high phenol levels actually a result of residuals on the well casing as DOE indicates or are they in the groundwater system? This question has not been settled to our satisfaction.
3. Some years ago DOE was notified that monitoring data indicated to us that a contamination plume may extend out of the burn area to the northwest. The issues (does it exist and to what extent) have never been resolved.

TABLE E-1
SUMMARY OF THE HANNA UCG EXPERIMENTS*

Experiment	Date	Coal Gasified (tons)	Gas Quality (Btu/scf)	Dry Gas Product (10 ⁶ scf/day)
Hanna I	03/73-03/74	4,000	126	1.6
Hanna II, Phase 1	05/75-08/75	1,210	152	1.7
Hanna II, Phase 2	12/75-05/76	2,535		
			138-175	8.5-12
Hanna II, Phase 3	05/76-07/76	4,190		
Hanna III	06/77-08/77	2,870	130	10
Hanna IVa	12/77-06/78	1,325		
			133	8.3
Hanna IVb	04/79-07/79	1,325		

Source: Barrash et al., 1988

4. What methodology will be employed in the full scale groundwater cleanup? What will the timetable be for this cleanup program? DOE has indicated the cleanup is scheduled for this summer, but to date no specific proposals have been supplied to us.
5. Final surface reclamation plans have not been supplied. Of concern is cleanup and disposal of any contaminated soils, as well as final revegetation and stabilization of the surface.
6. Historically, there have been problems with the lack of acceptable quality assurance/quality control (QA/QC) procedures for the groundwater monitoring program. This has called into question much of the historic groundwater monitoring data. All future monitoring should have acceptable procedures in place.

F. Site Hydrogeology

Three aquifer units have been described for the site and include the Hanna No. 1 Coal, Unit A (Lower Overburden), and Unit C (Upper Overburden) (Youngberg and Santoro, 1981). Based on a series of slug tests and injection tests conducted by Youngberg and Santoro (1981), transmissivities were calculated for the three aquifer units as shown in Table E-2. Based on water surface elevation data collected in 1981, groundwater flow velocities and directions were obtained and are listed in Table E-3.

The baseline groundwater quality for the site does not meet state standards for either domestic or livestock use. There are no water supply wells in the immediate vicinity as a result. Wildlife and livestock may use seeps and springs in outcrop areas as an emergency water supply.

G. Surface and Subsurface Sources of Pollution and Controls

Surface sources of pollution at the Hanna site include residual wastes resulting from the drilling and installation of process and monitoring wells, the surface treatment of the product gas stream, and the storage of equipment and materials on the site during the UCG tests. All surface equipment and all structures except two have

TABLE E-2
AQUIFER TEST RESULTS, HANNA UCG SITE

Aquifer	Average Transmissivity (gpd/ft)	Minimum Transmissivity (gpd/ft)	Maximum Transmissivity (gpd/ft)
Hanna No. 1 Coal	7.44	.14	27.50
Unit A (Lower Overburden)	4.71	.49	11.99
Unit C (Upper Overburden)	32.04	18.34	57.02

Source: Youngberg and Santoro (1981)

PRELIMINARY

TABLE E-3
GROUNDWATER FLOW VELOCITIES, HANNA UCG SITE

Aquifer	Flow Rate (ft/yr)	Direction
Hanna No. 1 Coal	11.90 (average) 0.23 (low) 44.10 (high)	N 16.59° W
Unit A (Lower Overburden)	3.17 (average) 0.33 (low) 8.06 (high)	S 87.55° E
Unit C (Upper Overburden)	1.63 (average) 0.93 (low) 2.90 (high)	N 3.82° W

Source: Youngberg and Santoro, 1981

been removed from the site. To the east of the Hanna I test site (see Figure E-4 in Section H), two wood-frame single-story buildings remain. One was used formerly as a carpenters shop and has a gravel floor. The other, with a concrete floor, was used as a garage and compressor building. Both buildings are currently being used by the industrial consortium conducting the Rocky Mountain I test southeast of the site (see Section D). In the last few years, most wells not currently used for monitoring at the site were abandoned by filling with bentonite cement grout and cutting the well casing 5 feet below grade. Examination of records and photographs in the possession of the Wyoming DEQ revealed limited records of the site. It is known that substantial equipment was present during the conduct of the seven tests between 1973 and 1979. This equipment probably included drums of solvent chemicals and petroleum products for use in the gas separation equipment. In 1984, 100 drums of waste chemicals were disposed of from the "North Site" located at the University of Wyoming Research Corporation in Laramie, which is under contract to the Laramie Project Office (LPO) (EG&G, Inc., 1983). These drums included the types of waste shown in Table E-4. A portion of these wastes is believed to have come from the Hanna site. Although it is possible that some of these types of wastes were spilled or leaked onto the soil at the Hanna site, due to the lack of records on the review of site operations, conclusions cannot be drawn.

The subsurface sources of pollution at the Hanna site are the five underground cavities produced by the Hanna I, II, III, and IV sites. Figure E-4 in Section H shows the location of these cavities. The UGG process leads to product gases that are recovered by means of production wells for surface processing and eventual use as a combustible fuel. In addition to this product stream, however, there are other gasification reaction products which remain underground. This second group of products includes coal ash, char, tars, and some product gases that escape into the media surrounding the gasification zone. These residual reaction products represent a source of potential groundwater contamination, both within the burn cavity and in the permeable subsurface zones around the cavity where product gases reached.

When groundwater re-enters a gasified coal seam, the residual reaction products may undergo leaching, dissolution, and hydrodynamic transport. Dissolved contaminants begin to move through the gasified coal seam as a plume of contaminated groundwater. If extensive fracturing or roof collapse has occurred,

TABLE E-4

**GENERAL CHARACTERISTICS OF WASTES DISPOSED OF IN 1984
AFTER STORAGE AT "NORTH SITE" IN LARAMIE, WYOMING**

Category	Quantity of Barrels	Types and Characteristics
A	23	Mixed hydrocarbon solvents and oil from fractionation (examples of solvents -- benzene, pentane, acetone, cyclohexane).
B	3	Aqueous solvents and water from in situ testing and laboratory analyses.
C	6	Chlorinated solvents in soils from laboratory analyses.
D	3	Mixed chemicals in laboratory packs.
E	11	Oil shale retort waste pond liquid (dewatered) sludge.
E	14	Oil shale retort waste pond Hypalon liner and dry sludge.
F	27	Underground coal gasification coal tars and water.
G	4	Sludge and shale oil with packing from retort process. Packing is plastic bristles, similar in nature to a baby bottle brush.
G	6	Sludge and waste shale oil from retort process.
H	1	Unknown gelatinous soapy substance.
I	1	Lubricating oil.
J	1	Unknown oil.
K	1	Bead catalyst.
L	16	Asbestos

Source: EG&G, Inc., 1983

the reaction-product contaminants may also find their way into other aquifers that lie above the coal seam (Wang et al., 1981).

The two major processes through which a groundwater system may be contaminated by a UCG experiment are pyrolysis and leachate development. The addition of waters from a source other than area groundwater, for quenching or as a hydrogen source, may also contribute to groundwater contamination. Pyrolysis is the process of thermal decomposition of coal. During the UCG process, the in-situ ignition of coal with the addition of steam and either ambient air or oxygen produces many chemical changes in the burn cavity. The three major processes which occur during the gasification of coal are (1) combustion/pyrolysis, (2) pyrolysis/reduction, and (3) drying and distillation. The most commonly reported products of these events are carbon dioxide, carbon monoxide, hydrogen, water, and methane. Also recognized are changes in temperature, pH, and in the concentrations of ammonia, hydrogen sulfide, hydrogen cyanide, phenols, and aromatic hydrocarbons.

Most of these products are gaseous and are removed through the production well; however, a small amount (less than 10 percent) of these gaseous products is left behind in the burn cavity or escapes into the surrounding strata through fissures or other porous channels. Phenols and other organic constituents are also gaseous at pyrolysis temperature and would be expected to follow a similar pattern. These hot product gases further pyrolysis reactions throughout the coal fissures; thus, additional pyrolysis products may be produced away from the burn cavity (Wang, 1981). Residual heat in the burn cavity may also cause continued formation of pyrolysis products after active gasification is terminated (Cook et al., 1985).

Leachate can be defined as an aqueous front passing through a medium; soluble constituents are removed from the medium and incorporated into, and move with, the front. At the Hanna UCG site, the medium consists of coal ash residue and subsided rubble; the aqueous front is the groundwater flowing through the burn cavity and surrounding strata after UCG. Through leaching, many inorganic constituents are removed from the coal ash and rubble and are carried along with the reinvading groundwater. The leachate contains most of the major cations and anions, which are highly soluble. It often also contains some of the transition or heavy metals and some nonmetallic inorganic species, such as boron and silica.

The chemical composition of the coal ash is the controlling factor in predicting the character of the leachate. Analysis of the Hanna I coal seam suggests that the predominant mineral constituents are kaolinite, illite, quartz, and other materials. Further laboratory leachate studies of the coal ash sample indicate that calcium sulfate, magnesium sulfate, sodium sulfate, and potassium chloride were also prevalent. The dominant oxides in the ash of preburn and postburn coal are silica, aluminum, iron, and calcium. The mineralogy of the postburn rubble is dominated by aluminosilicate minerals and various quartz forms. Other factors controlling the rate and composition of leachate formation are temperature, pH, groundwater flow rate, and presence of O₂ and CO₂. The sorptive and ion exchange capabilities of the surrounding coal and overburden strata, plus the mineral and elemental composition of the subsided rubble in the cavity, may also affect leachate development.

H. Environmental Monitoring Program and Data

Monitoring of groundwater quality at the Hanna UCG Site began in the mid-1970s when the U.S. Geological Survey sampled wells at the site. Pre- and post-burn samples were collected by LETC in 1977 and 1978. Additional studies were conducted in the 1980s to further evaluate water quality conditions. At the present time, there are 31 wells in place at the Hanna site and their locations are shown in Figure E-4. While some of the wells were designed for groundwater quality monitoring, production and injection wells are also present.

The sampling program included 46 analytical parameters that are listed in Table 2 of Cooke and Oliver (1985). From this list, 12 parameters were selected for further review and analyses and are believed to provide indications of gross changes in groundwater quality. These parameters include:

- ammonia-nitrogen
- bicarbonate
- boron
- fluoride
- manganese
- phenols
- sodium
- sulfate
- sulfide
- total dissolved solids (TDS)
- total organic carbon (TOC)
- water temperature

Source: Barrash et al., 1988

WELLS AND CAVITIES AT THE HANNA UCG SITE

FIGURE E-4

In order to evaluate the impacts of the UCG experiments on the groundwater quality, pre-burn baseline values were established for the 12 parameters listed above. These baseline values are listed in Table E-5. The selected parameter can be considered as representing two separate processes that affect groundwater quality. Boron, sulfide, ammonia, phenols, and water temperature represent the release of pyrolysis products into the groundwater. Sulfate, bicarbonate, sodium, manganese, fluoride, TDS, and TOC characterize contamination resulting from leaching from the coal and overburden material that is disturbed by the UCG burns.

These baseline values form the basis for the required levels of groundwater restoration at the site. Under Wyoming regulations, restoration is intended to return the water quality to the same condition that existed prior to the permitted experiments. The state recognizes that full restoration is not always technically feasible, so the regulations allow less than full restoration if best available technology is applied and the water quality is restored at least to the level of the class of use (domestic or livestock) that existed prior to the experiment. Target restoration levels for various contaminants at the Hanna site were established by agreement between DOE and the Wyoming DEQ.

A review of the groundwater quality database indicated that, following the UCG burns, boron levels were elevated in all cavity wells. Maximum levels of boron were two orders of magnitude higher than the measured baseline values. Continued measurements indicate that boron levels have decreased with time; however, boron still exceeds the restoration target level (established by agreement between DOE and Wyoming DEQ) in the Hanna II cavity.

Sulfide levels also were elevated after the UCG burns, with levels exceeding 10 milligrams per liter (mg/L). The levels declined fairly rapidly to less than 0.1 mg/L. Baseline data for the Hanna IV site had sulfide levels of less than 0.04 mg/L. The target restoration level agreed to by Wyoming DEQ is 0.5 mg/L. Ammonia concentrations also followed this pattern, with elevated levels apparent after the experiments. Ammonia concentrations have since declined to levels only slightly higher than baseline and within the target level.

TABLE E-5
WATER QUALITY BASELINE VALUES, HANNA III

Parameter	Lower Overburden		Coal	
	Average Concentration ^(1,2)	Number of Samples	Average Concentration ^(1,2)	Number of Samples
pH (std. units)	8.08	12	8.63	30
Temperature (°C)	10	--	10	--
TDS	2561	12	1223	30
Sodium	1107	12	510	30
Bicarbonate	1679	12	1106	30
Sulfate	677	12	19	28
Sulfide	BDL	BDL	BDL	BDL
Ammonia-nitrogen	1.66	12	1.15	30
Boron	0.07	12	0.04	18
Fluoride	1.22	12	1.86	30
Manganese	0.27	12	0.08	30
Phenols	--	--	--	--
TOC	14	12	41	30

Source: Barrash et al. 1988

1 All values in mg/L, unless otherwise specified.

2 All averages based only on values reported above the detection limit.

Phenol concentrations in cavity wells reached levels exceeding 2,000 micrograms per liter ($\mu\text{g/L}$), while baseline, as inferred from sampling perimeter wells, was less than 10 $\mu\text{g/L}$. Some of the higher values are questionable since the samples were collected from process wells. These wells were used for production of gas during the experiments and these wells are probably contaminated with combustion products as a result. Samples from cavity wells not used for production during the experiments show low levels of phenols.

Water temperatures increased greatly within the burn cavities to about 60°C during the experiments. Water temperatures have declined somewhat but have remained elevated due to the high heat retention capacity of the rocks.

Constituents that are measured to represent leaching processes are generally naturally occurring elements that have been released and mobilized as a result of the UCG burns. As the gasification of the coal proceeded, the coal lost its structural integrity, increasing the surface area exposed to groundwater by opening fractures and rubblizing the overburden. The concentrations of leachate constituents such as TDS, sodium, and sulfate increased after the experimental burns but did not reach peak values until later than the pyrolysis products. The leachate contaminants have also dissipated with time but remain above target restoration levels in some locations.

I. Groundwater Restoration Activities

A groundwater restoration demonstration project was conducted at the Hanna site in 1987 to demonstrate to Wyoming DEQ that best practicable treatment has been applied and the groundwater returned to livestock use standards (Barrash et al., 1988). This project was conducted in two phases to address two specific contaminant problems. The first phase was designed to restore the water quality in the Hanna III cavity which had elevated levels of TDS and sulfate. This phase involved pumping 208,100 gallons of water from the Hanna III cavity to a lined evaporation pond which had been constructed at the site. When the liquids have evaporated, the remaining solids can be disposed of.

The second phase of the restoration project was designed to clean up the Hanna I cavity waters, which had apparent elevated levels of phenols. Due to casing

damage, a submersible pump would not fit in Well I-3 so a new well was drilled into the Hanna I cavity. Sampling of the new well indicated that no phenol problem existed. It was concluded that since Well I-3 was a process well, tars accumulated on the casing and leachates from the tars produced misleading results from sampling this well. In order to comply with permits, Hanna I water was treated by carbon absorption even though the levels of phenols were low. Rather than discharge the treated water to the surface, LPO environmental staff reported that DOE received permission from Wyoming DEQ to inject the treated Hanna I water into the Hanna III cavity. After pumping and treating 122,284 gallons of Hanna I water, DOE was notified by letter that Wyoming DEQ had reversed their position and injection was ceased.

At the present time, groundwater at the Hanna site exceeds target restoration levels for several parameters at selected locations. The Hanna I experiment, which was the smallest test at the Hanna site, has had no apparent long-term effects on water quality and no target levels are presently exceeded at the Hanna I. In the Hanna II cavity, exceedances are measured for TDS, calcium, magnesium, and sulfate. In the Hanna III cavity and in Wells CBO 153, and OVB 139, elevated levels of TDS, sodium, magnesium, calcium, and sulfate are present. Elevated levels of boron are detected in the Hanna IV cavity. In wells OVB 136 and OVB 137, elevated levels of calcium and magnesium are measured. Well CBO 145 has elevated levels of sodium.

J. Monitoring Quality Assurance and Control

Since the late 1970s when a groundwater monitoring program was begun at the Hanna site, a series of outside contractors have been utilized by LETC to conduct both sampling and analysis at the site, primarily of groundwater. Throughout all of these contracts including the present agreement with Western Research Institute of Laramie, Wyoming, a Quality Assurance/Quality Control (QA/QC) Plan, specific to the project, has never been prepared by any contractor nor was this required by the contracts implemented. Additionally, inspection of the sampling by LETC staff was performed on only a limited basis, generally once or twice per year although sampling was occurring quarterly. The files at the LPO contained very few contractor records on the actual sampling procedures utilized and in some cases no records could be found on the analytical procedures utilized. One laboratory,

Applied Hydrology, which was contracted in fiscal years 1985-86 and 1986-87 did submit quarterly data reports, along with their sampling and analytical procedures. Conversely the contract of another lab, Naughtman Analytical Laboratories, which was contracted from fiscal year 1983-84, was canceled after 3 quarters due to the obviously inconsistent and erroneous data provided (Sharum, 1984).

The chronology of outside laboratories utilized for sampling and analyses at Hanna is shown in Table E-6.

K. Findings and Observations

Category I

None

Category II

None

Category III (Hydrology)

1. Contamination of groundwater. Groundwater at the Hanna site is contaminated with elevated levels of total dissolved solids, boron, calcium, sodium, magnesium, and sulfate as a result of coal gasification experiments. The highest levels of contamination occur close to the burn cavities but available data indicate that contamination has migrated to other on-site areas. There is no indication, however, of any off-site migration at this time.
2. Inadequate characterization of groundwater. Groundwater conditions at the Hanna site are inadequately characterized from both a hydrologic and a chemical perspective, resulting in uncertainty in the direction and extent of the migration of contaminants. This conclusion is based on several factors which include:
 - Inadequate or inappropriate well locations - a lack of clear understanding of groundwater flow directions has resulted in placement

TABLE E-6

**CHRONOLOGY OF OUTSIDE LABORATORIES UTILIZED FOR SAMPLING AND
ANALYSES AT HANNA SITE**

Contractor Firm	Subcontractor	Period of Performance
1. Western Research Institute Laramie, Wyoming	None	FY 1987-88
2. Applied Hydrology Associates, Inc. Denver, Colorado	a) Bookcliffs Commercial Laboratories, Steamboat Springs, Colorado b) Acculabs, Denver, Colorado	FY 1986-1987 FY 1985-1986
3. Hodkins Westerner Schoerner Laboratories Omaha, Nebraska	a) Local Sampler James Elliot, Gillette, Wyoming	FY 1984-1985
4. Naughtman Analytical Laboratories Davis, California	None	FY 1983-1984

Source: Personal Communication, U. Sharum, 1987

of some wells in less than optimal locations. In addition, some wells used for monitoring water quality were originally installed for other purposes and thus are not located in appropriate locations.

- Improper well construction - the use of inappropriate materials such as black plastic tape to secure pump wires to the piping, and improper techniques such as a lack of decontamination of the iron pipe used for casing the wells has reduced the usefulness of some wells for monitoring water quality.
- Improper sampling and analysis procedures - analytical results and observations by DOE personnel indicate that in some instances proper sampling and analysis procedures were not followed in monitoring water quality.
- Lack of locking well covers - wells used in monitoring water quality do not have locking well covers. In many cases, the wells have no covers at all. This provides an opportunity for inadvertent, accidental, or intentional contamination of the wells and thus reduces the reliability of data collected from the wells.

Category IV (Quality Assurance/Quality Control)

1. Inadequate quality assurance and control. There is inadequate quality assurance and quality control of the past and present sampling and analysis program.
 - a) Past sampling and analysis work was performed by several contractors without a QA/QC program to ensure the quality of the data. As a result, some past data are of highly questionable validity; specifically, data provided by Naughtman Analytical Laboratories of Davis, California, from mid-1983 to mid-1984, and possibly other contractors.

The following deficiencies were noted:

- Lack of a site sampling plan including specific procedures and protocols for well sampling, field filtration, bottle labeling, sample tracking and chain of custody, preservation and shipment of samples, holding and turnaround time and, analytical methods.
 - Lack of a QA project plan following the 11-point EPA standard outline.
 - Failure to use Contract Laboratory Procedure (CLP) procedures for hazardous substance list (HSL) organics to verify the accuracy and applicability of HSL analyses done by less stringent methods.
 - Lack of affirmative minimum requirements for education and experience of field sampling personnel.
 - Failure to implement requirements for demonstration of laboratory quality such as satisfactory participation in the EPA CLP - proficiency sample program.
 - Lack of an analytical QA/QC verification either using CLP deliverable packages for CLP work or specified numbers of splits, spikes, lab duplicates; minimum recovery percentages; etc.
- b) Present and planned February 1988-February 1989 sampling and analysis to be done by Western Research Institute (WRI) is being planned with non-specific or undocumented QA/QC procedures. Although WRI has the ability to perform all of the elements of a proper QA/QC program, the requirement that WRI write a sampling plan, develop a site-specific QA project plan, etc., has not been included in the cooperative agreement between DOE and WRI or in the proposal of September 1987 submitted by WRI.
- 2) Past data are not classified as to quality - Past groundwater analytical data have not been reviewed and characterized by quality levels, resulting in uncertain conclusions.

Such a characterization would require a review by LPO and METC of all written field inspection notes, contracting records, and interviews with former Laramie Energy Technology Center employees who inspected or reviewed sampling and analysis contractors.

PRELIMINARY

REFERENCES

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APPENDIX F

HOE CREEK UNDERGROUND COAL

GASIFICATION SITE

PRELIMINARY

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A. Site Setting

The Hoe Creek Underground Coal Gasification (UCG) Site is located approximately 20 miles south-southwest of Gillette, Wyoming (Figure F-1). The site includes approximately 80 acres in a rectangular parcel. The regional topography is characterized by rolling hills, clinker-capped buttes, and flatlands. Surface elevations on the Hoe Creek site range from a high of 4,790 feet in the central part of the site to a low of 4,700 feet in the northwest and southeast corners. The Hoe Creek UCG site is located in the Southern Powder River Basin in which the Powder, the Little Powder, and Belle Fourche Rivers are the major surface drainages. Hoe Creek is an ephemeral stream located about 1/4 mile south of the site that drains to the Belle Fourche River.

The land use in the area of the Hoe Creek Site consists of grazing, farming, and open rangeland. Two small summer residences are located adjacent to the site, the first being a small one- or two-room farmhouse situated approximately 800 feet east of the site, and the second being a mobile home situated approximately 200 feet from the northwest corner of the site. Neither residence was believed to be occupied when the Survey Team visited the site on January 26, 1988; however, cattle were grazing on the property immediately east of the site. The closest permanent residence to the site is believed to be a farm located approximately 4-5 miles east of the site. The area is sparsely populated. The climate is semi-arid and the average precipitation is 13-14 inches per year (Barrash et al., 1988).

B. Regional Geology

The Powder River Basin includes several thousand feet of sediments that were deposited between Cambrian and Tertiary times. The underground coal gasification experiments took place in the Eocene Wasatch Formation, which extends from the surface to a depth of approximately 750 feet.

The Wasatch formation consists of sands, silts, clays, and coal seams including the test unit, the Felix 2 Coal. Six stratigraphic units are described at the Hoe Creek site. These include, in ascending order, Underburden, Felix 2 Coal, Interburden, Felix 1 Coal, Lower Overburden, and Overburden. A geologic cross-section of the site from

GEOGRAPHIC SETTING OF THE HOE CREEK UCG SITE

FIGURE F-1

the southwest corner to the northeast corner is shown in Figure F-2 and illustrates the relative position of the units within the Wasatch Formation.

The Underburden consists of a laminated claystone and is relatively impervious. The Felix 2 coal is a blocky, sub-bituminous coal that averages 25 feet in thickness at the Hoe Creek site. The Interburden grades from a basal claystone to a fine-grained sandstone and back to a claystone at the top of the unit. The Felix 1 Coal is also a sub-bituminous coal and averages 14 feet in thickness. The Lower Overburden, referred to in some reports as the Channel Sand, is a fine- to medium-grained, cross-bedded sandstone that averages 30 feet in thickness. The Overburden, consisting of interbedded claystone, siltstone, and sandstone, outcrops at the surface at the Hoe Creek site.

C. Underground Coal Gasification (UCG) Overview

The purpose of UCG is to convert coal seams, in place, to a combustible gas that can be cleaned, treated, and upgraded for a variety of end uses such as the production of chemicals, substitute natural gas, liquid fuels, and electric power. Coal resources targeted for UCG processing are those coal seams that are unsuitable for recovery using current mining technology because of technical, environmental, health and safety, or economic factors.

Conceptually, UCG processing is relatively simple and straightforward. Wells are drilled from the surface to provide access to the target coal seam. One well serves for injection of an oxidant, such as air or a mixture of oxygen and steam, into the seam, while another well serves as a production well for the gasification process gases. These two wells are connected within the seam using one of several linking techniques to provide an open pathway for the flow of large quantities of gaseous products. The coal seam is ignited at the injection well; the subsequent combustion of the coal results in the formation of a cavity that grows in a tear-drop geometry until the coal around the injection well and between the production well is consumed. During this process, the solid carbonaceous material in the seam is converted to a combustible gas comprised primarily of hydrogen, carbon monoxide, and methane, along with diluent gases such as carbon dioxide and steam. If air is used as the oxidant, the product gas stream also contains nitrogen as a major

Source: Modified From Barrash, et al, 1988

CROSS-SECTION FOR HOE CREEK SITE

FIGURE F-2

component. Since most coal seams contain some sulfur, the product gas stream has a hydrogen sulfide component.

Surface treatment of the product gas stream is similar to that for surface gasification processes. Initially, the raw gas is cleaned of any particulates and the hydrogen sulfide is removed to protect downstream equipment and the environment.

D. Site Operational History

The Hoe Creek Site is owned by the U.S. Department of the Interior Bureau of Land Management and was leased for cattle grazing prior to its use for UCG experiments. Special land use permit W-52889 was issued on October 24, 1975 to the U.S. Department of Energy, San Francisco Operations Office. This permit was subsequently extended several times and in June 1982 application was made by the U.S. Department of Energy to transfer the permit to the Laramie Energy Technology Center (LETC). When LETC was made a private research facility, Western Research Institute, responsibility for the Hoe Creek Site was transferred to the Morgantown Energy Technology Center - Laramie Project Office.

Between 1975 and 1979, three separate test burns were conducted at the Hoe Creek Site by the Lawrence Livermore National Laboratory (LLNL). The three burns were called Hoe Creek I, II, and III. Tables F-1 and F-2 provide information on the characteristic of the tests, the dates on which they were conducted and the amount of coal consumed. As can be seen from Table F-2, Hoe Creek III was the largest and the last of the three tests. Additionally, it resulted in surface subsidence.

E. State Government Concerns

A meeting was conducted on January 25, 1988 with representatives of the Wyoming Department of Environmental Quality (DEQ), including the Department Director. The concerns of the DEQ regarding the Hoe Creek Site expressed at the meeting were summarized in a letter of February 17, 1988 from the DEQ Director to the Survey Assistant Team Leader. These specific concerns as stated in the letter are:

TABLE F-1

PHYSICAL CHARACTERISTICS OF HOE CREEK TEST BURNS

	Hoe Creek I	Hoe Creek II	Hoe Creek III
Well Separation (Ft)	33	60	130
Linking Method	Explosive Fracturing	Reverse Combustion	Directional Drilling + Reverse Combustion
Coal Gasified (tons)	130	2300	4200
System Pressure (pSIA)*	30	47	43
Feed Gases	Air	Air	Oxygen/Steam
Gas Loss (%)	7	20	14
Forward Gasification (days)	11	48	54
Overlying Coal Gasified	No	Yes	Yes
Extensive Roof Collapse & Interconnection of Aquifers	No	Yes	Yes
Surface Subsidence	No	No	Yes

Source: Wang et al., 1981

* System pressure is the pressure maintained in the gasification cavity during operation.

TABLE F-2

TIME AND DURATION OF HOE CREEK TEST BURNS

Test	Year	Duration (days)	Coal Consumed (tons)	Gas Quality (Btu/scf)
I	1979	11	123	101
II (air)	1977	13	286	108
II (O ₂)	1977	2	47	263
II (air)	1977	43	1,155	104
III (air)	1979	7	256	113
III (O ₂)	1979	47	3,251	212

Source: METC, 1986

1. Groundwater monitoring in 1986 and 1987 indicates many areas with unacceptable high phenol contamination problems. This includes the Hoe Creek II area (where groundwater restoration work was performed in 1987), the Hoe Creek III area, areas along the west boundary of the R&D license area, and a well east of the license boundary (DOE 17). Several wells are also exhibiting ammonia contamination problems.
2. The contaminated Felix 1 and 2 coal aquifers and contaminated overburden channel sand aquifers generally flow to the south and southeast. These units appear to outcrop just to the south of the license area, in an area where there are several springs which contribute flow to Hoe Creek. Therefore, there is a potential surface water contamination problem in the area.
3. As was stated in an August 18, 1987 letter to Urban Sharum, DOE, DEQ will not consider the Hoe Creek Site to be successfully restored and stabilized unless contaminant levels are at or below previously agreed to target restoration values (TRVs). This will necessitate restoration activity in the Hoe Creek III area, as well as additional work in the Hoe Creek II area. So far we have received no restoration schedule commitments for further restoration work.
4. Final surface reclamation plans for the site remain to be completed. Although DOE has made provisions to backfill, topsoil and revegetate the Hoe Creek III subsidence hole, the Department still needs to commit to Survey the site for contaminated soils, and clean up and dispose of them if necessary. (August and September 1979 inspections by Land Quality Division observed process water and tars being discharged directly to the surface, either by design or accident. We are not sure where all the tar and wastewater generated during the experiments was disposed of.)
5. The Hoe Creek monitoring program has been carried out inconsistently, has lacked QA/QC procedures, and wells have been contaminated during sampling. Therefore, much of the monitoring data is suspect. In the future these deficiencies must be corrected. Additionally, there are currently problems with open, unprotected and unmarked monitor wells, which adds to the problems noted immediately above.

F. Site Hydrogeology

The rock units present in the shallow section at the Hoe Creek UCG site include three aquifers and two or three aquitards. The two coal seams, Felix 1 and Felix 2, are aquifers along with the sandy portion of the Lower Overburden. The Underburden and the Interburden are aquitards. The claystone at the base of the Lower Overburden also acts as an aquitard in some parts of the site. Measurements of decreasing head with depth indicate that the site is a recharge area for the shallow aquifers. However, a reversal of heads between the Interburden and the Felix 2 Coal would suggest that the Felix 2 Coal is isolated from the shallower aquifers and from surface infiltration.

The potentiometric surface in the Felix 2 Coal (Figure F-3) indicates groundwater flow generally toward the east. Groundwater flow in the Felix 1 Coal is more complex, as indicated by the potentiometric surface map in Figure F-4. Flow in the Felix 1 in the northeast portion of the site may be substantially influenced by the presence of the three burn cavities. As a result of collapse of the burn cavities, the Felix 1 and Felix 2 coals are interconnected, allowing the Felix 1 to drain into the Felix 2. It has been suggested (Stone et al., 1983) that the influence of the interconnection is localized and does not extend beyond approximately 300 feet from the cavities.

The hydraulic conductivity of the various units has been measured at several locations at the Hoe Creek site. In general, the results indicate that the Felix 1 and Felix 2 coals are fairly good aquifers with hydraulic conductivities in the range of 1×10^{-3} to 5×10^{-4} cm/sec. The Lower Overburden, or Channel Sand, also comprises a good aquifer with hydraulic conductivities in the range of 1×10^{-3} to 1×10^{-4} cm/sec. The Interburden, between the Felix 1 and the Felix 2 coals, has a lower hydraulic conductivity, in the range of 1×10^{-4} to 2.5×10^{-5} cm/sec.

Groundwater quality in the area generally meets the Wyoming DEQ criteria for livestock use but is below the domestic use quality limits. Two private wells are known to exist east of the site that could potentially be affected by any changes in groundwater quality at the Hoe Creek site. One of these wells is a windmill used primarily for stock watering. The second is a dug well that has gone dry. There is also a seasonal dwelling to the northwest of the Hoe Creek site that is believed to

POTENTIOMETRIC SURFACE MAP FOR THE FELIX 2 COAL, FIGURE F-3
JUNE 1986

POTENTIOMETRIC SURFACE MAP FOR THE FELIX 1 GOAL, FIGURE F-4
JUNE 1986

be served by a well. Although the groundwater quality does not meet state standards for human consumption, it may be used by some residents as indicated in the quoted State of Wyoming Site Inspection Report (Mooney, 1986) which is included in Section 6, beginning on Page F-14.

G. Surface and Subsurface Sources of Pollution and Controls

Surface sources of pollution at the Hoe Creek Site include residual wastes resulting from the drilling and installation of process and monitoring wells, the surface treatment of the product gas stream, and the storage of equipment and materials on the site during the UCG tests. All surface equipment and structures were removed from the site in 1980 with the exception of well casings, fences around subsidence areas, and well sampling equipment. Examination of records and photographs in the possession of the Wyoming Department of Environmental Quality (DEQ) revealed that the following equipment and structures were in place at the site during the UCG tests:

- Gas separation equipment including equipment for separation and for incineration of produced gas.
- Two equipment/personnel trailers
- A vehicle parking area
- A soil berm around the Hanna III Site leading to a runoff and spill collection pond on the west side of the burn area.

Although small spills of tar, and tar and water/steam mixtures on the ground and into the spill collection pond was reported by Wyoming DEQ inspectors, no record of a substantial spill, leak or burial of hazardous materials was found. The sedimentation pond and equipment area was bladed. This soil is not believed to have been removed from the site, but may be stockpiled in a pile of topsoil presently on-site immediately west of the Hoe Creek II area. Visual examination of the entire surface of the site during the Survey did not reveal any locations of significantly discolored or stained soil.

The current physical status of the site is that the entire site is fenced; however, in some areas the fence is knocked down and gates to the area are unsecured. Hoe Creek Sites II and III are fenced to protect animals and humans from possible injury from falling into the approximately 20-foot-square, 10-foot-deep subsidence crater at Site III or a possible crater at Site II. The fence around Hoe Creek III was in good condition; however, the gates were unsecured. The Hoe Creek II fence had areas of the fencing knocked down as well as open and unsecured gates. The entire Hoe Creek site had numerous uncovered wells, some as large as approximately 14 inches. There were multiple roads and truck paths throughout the property remaining and an above-grade telephone wire was strung across the site from northeast to southwest, evidently providing service to an adjacent property. Although all surface equipment was removed, bits of pipe and other scrap from monitoring well construction and sampling remain scattered around the site, especially the Site III area.

The subsurface sources of pollution at the Hoe Creek Site are the three underground cavities produced by the Hoe Creek I, II, and III tests (see Figure F-3). The UCG process leads to product gases that are recovered by means of production wells for surface processing and eventual use as a combustible fuel. In addition to this product stream, however, there are other gasification reaction products which remain underground. This second group of products includes coal ash, char, tars, and some product gases that escape into the media surrounding the gasification zone. These residual reaction products represent a source of potential groundwater contamination, both within the burn cavity and the permeable subsurface zones around the cavity where product gases reached.

When groundwater re-enters a gasified coal seam, the residual reaction products may undergo leaching, dissolution, and hydrodynamic transport. Dissolved contaminants begin to move through the gasified coal seam as a plume of contaminated groundwater. If extensive fracturing or roof collapse has occurred, the reaction-product contaminants may also find their way into other aquifers that lie above the coal seam (Wang et al., 1981)

Pyrolysis of coal produces hundreds of organic compounds. They are mainly phenolic compounds and aromatic hydrocarbons. It also produces ammonia, hydrogen sulfide, and hydrogen cyanide. Pyrolysis occurs within the walls of the

cavity as a result of cavity heat, but, in general, the products formed in this manner are expected to be forced back into the cavity by steam generation in the cavity wells. However, the hot product gases ($\sim 1,000^{\circ}\text{C}$) that escape into the coal must also produce pyrolysis reactions along the surfaces of the cracks through which they escape. The resulting volatile pyrolysis products will be swept further into the coal by the escaping gases. As gasification continues, and especially if some of the cracks in the coal are comparatively large (as some Hoe Creek evidence suggests), these pyrolysis products will be "distilled" farther out in the surrounding coal and deposited on the surface along the cracks. Furthermore, since the hydrostatic pressure is lower in the overlying Felix No. 1 Coal than in Felix No. 2, the product gas within the cavity, whose pressure had been used to restrict groundwater entry and was approximately uniform throughout the cavity, likely escaped preferentially into the upper coal seam. As a result of the difference in gas leakage rates, more volatile contaminants will be dispersed into or perhaps produced in the upper (Felix No. 1) coal. In fact, the Felix No. 1 Coal has been found to contain up to 50 times the phenol concentration found in the Felix No. 2 coal (Wang, F.T. et al., 1982).

A natural control of the movement of UCG pyrolysis products in groundwater is physical absorption and adsorption onto coal in the affected coal seam. Sorption on other non-coal porous subsurface media such as sand is also believed to occur to a lesser extent (Wang et al., 1981). The degree to which this sorption constitutes an effective control on movement of contaminated groundwater is still under study at Hoe Creek. A second control of the movement of UCG pyrolysis products in groundwater is the pumping and treating of burn cavity groundwater. This control is described in detail in the latter section of this appendix entitled "Groundwater Restoration Activities".

The following excerpt from an August 28 inspection report by Wyoming DEQ geologist Glenn Mooney describes alleged contamination of the well belonging to the summer residence farmhouse 800 feet east of the site:

"On June 24, 1986, Mr. and Robert Maystrick of Papillion, Nebraska filed a complaint with the Land Quality Division regarding the alleged contamination of a well on their land which lies to the east of the project site and for the drying up of another well also on their property in the same area. An attempt was made during this inspection to contact Mrs. Cathy Carter, lessee of the

lands to the east of the project site, regarding a complaint the Maystricks had filed with the Department regarding their wells. There was no one home that day at the Carter Ranch. In response to a citizen's complaint from Mr. and Mrs. Robert Maystrick, owners of the lands adjacent to the site on the east, another attempt was made to contact Mrs. Cathy Carter, the surface lessee, and obtain permission to inspect the wells alleged to be affected by the past gasification experiments.

Mrs. Carter said we were welcome to inspect the wells, but didn't believe there was anything wrong with the windmill well since she and her stock had drunk from it for years without ill effects.

The windmill well was located in the SE1/4SE1/4SW1/4 Section 17, T47N., R74W., next to a small cabin that appeared to be in good repair (Photos Nos. 5a, 9a). The windmill was not running at the time of the inspection, but apparently had been run not long before as there was a trace of water in the adjacent stock tank. Also, water had been recently used to water a number of young trees planted around the building.

An attempt to probe the well was unsuccessful as there was no room to get the sounding probe past the steel plate which supported the pump and pipe string on top of the steel casing (Photo No. 5a). To probe the well it would be necessary to lift the pump and pipe string a few inches to allow introduction of the probe. This procedure would have some risk of damaging the pump or pipe string so should not be taken without full concurrence of the owners.

Water samples could be taken by simply running the windmill, but this would allow introduction of contaminants from the pump itself. The tiny amount of phenols noted in a sample taken earlier by Western Research Institute (WRI) could have originated in phenolic seals and packing material used in the pump:

The Maystricks also alleged that the Hoe Creek experiments caused a shallow dug well nearby to go dry. They said the well, dating back to the 1930s, had always contained water until about 1980 when it had gone dry.

This well was located on the banks of a small drainage about 100 yards downhill to the west of the cabin and windmill. The well was a dug well lined with brick and capped with a concrete-covered brick curb, closed off with a light manhole cover (Photos No. 6a, 7a). Investigation found the well was about 16 feet deep and had only mud at the bottom.

No apparent cause could be seen for this well going dry. The well is apparently completed in the alluvium of the small drainage which does run southeastward from past the Hoe Creek project site.

Conceivably, rupture of the strata underlying the alluvium by the collapse of a burn cavity could cause water contained in a water table aquifer in the alluvium to drain off into deeper aquifers.

However, the burn sites all lie on a hillside or hilltop and do not appear to be in alluvium, much less close enough to be in the alluvium of the affected drainage. No other changes to the hydrologic regime of the drainage were noted that could have caused this well to go dry.

In their letter, the Maystricks had said that DOE representatives had discussed placing a monitor well near the cabin in order to determine the possible contaminant plume extending east from the project site.

No monitor well was found, but a post bearing a hand-lettered sign reading "Monitor Well" was found just outside the fence enclosing the cabin (Photo No. 8a). It is assumed that if and when a monitor well is drilled, it will be at this location.

The Maystrick's windmill well should be sampled for the usual groundwater parameters plus the full suite of organic compounds associated with in-situ coal gasification. If this sample is negative for gasification by-products, then it should be safe to conclude that the well has not, at least yet, been affected by the Hoe Creek experiments.

If the sample is positive, then further work is indicated. This would likely include obtaining the landowner's permission to remove the pump from the

well, probing it for depth and other construction information, and taking samples with a sampling pump unit.

The problem of the shallow well having gone dry could be addressed by both a geologic investigation to look for possible outside geologic causes and by a hydrologic study of the near-surface groundwater flows in the area."

At the time of the Survey, it is believed that the Sampling and Analysis work recommended by to the Wyoming DEQ inspection report above, has not been performed.

H. Environmental Monitoring Program and Data

Studies at several locations have indicated that a broad range of residual gasification products may be introduced into the groundwater as a result of UCG experiments. These residual products include coal ash, char, tars, and some product gases that escape into the media surrounding the gasification zone (Wang et al., 1981). Five major mechanisms for groundwater contamination were discussed by Wang et al. (1982) and were reiterated by Docktor and McTernon (1985). These include:

- Contamination caused by hot product gases that escape into the surrounding coal during gasification and pyrolyze the coal along natural fractures.
- Continued pyrolysis of coal around the cavity by residual heat from the gasification burn.
- Leaching of coal ash after the burn by returning groundwater.
- Leaching of overburden materials that collapse into the burn cavity.
- Dissolution of aquifer material by water which was acidified by carbon dioxide escaping the cavity during gasification.

The relative importance of these mechanisms is largely dependent on site-specific conditions. During gasification burns at Hoe Creek, operating pressures in the burn cavities exceeded the hydrostatic pressure in the overlying formations. As roof collapse occurred during the experimental burns, product gases escaped into the Felix 1 Coal. As these product gases cooled, they may have deposited tar-like materials on the faces of fractures. As water reentered the cavity, it drained through the Felix 1 into the Felix 2.

Monitoring of groundwater conditions at Hoe Creek has taken place in numerous wells installed at various times over the years as additional data needs were identified. At the present time, there are 122 wells at the site; they are shown in Figure F-5. In general, monitoring data have indicated elevated levels of phenols, sulfates, ammonia, and mercury. The highest levels of contaminants occur close to the burn cavities and the levels of contamination appear to have declined over time. Reduction in contaminant levels away from the cavities and over time is the result of dilution, adsorption of organic constituents on the coal, microbial degradation, and leaching of source material.

Groundwater monitoring data for Hoe Creek are currently compared to target restoration levels established by agreement between DOE and the Wyoming DEQ. Baseline water quality was not established prior to the initiation of UCG experiments at the site. As a result, baseline conditions have been estimated from sampling wells believed to be unaffected by the experiments. These include nine wells on the western boundary of the property in upgradient locations and wells within 5 miles of the site that were sampled by the U.S. Geological Survey (USGS). Using these background values for guidance, target levels for groundwater reclamation were established. The target levels are below the concentration limits for the Livestock Use Water Class as defined by the Wyoming DEQ. The target levels are generally higher than the baseline values to allow for variability in sampling and analysis. Further information on the establishment of target levels using background values is contained in Barrash, et al., 1988.

The most recent sample results (November 1987) indicate that a number of wells still exceed target levels for phenols, sulfate, ammonia, and mercury. The phenols remain the most significant contaminant in terms of extent and concentrations. The wells that exceeded the target level for phenols (20 ppb) in November 1987 are

MONITORING WELL NETWORK AT THE HOE CREEK SITE FIGURE F-5

listed in Table F-3. All wells with phenols concentrations greater than 100 ppb are completed in the Felix 1 Coal, indicating that contamination is greater in that formation than in the original experimental target formation, the Felix 2 Coal. This is apparently the result of product gas migration into the lower pressure Felix 1. Contamination in the Felix 1 Coal near the Hoe Creek II burn cavity has migrated to the east. Near the Hoe Creek III burn cavity, contamination in the Felix 1 Coal has migrated to the south. Based on available data, it is difficult to determine whether or not off-site contaminant migration has occurred. Measurements of phenols in WS-14, which is located on the eastern edge of the property, exceed the target levels. Measurements in DOE-17, which is located east of the site, have exceeded target levels in the past but are currently within target levels. The data from these two wells suggest that contaminants have migrated off-site to the east but at low levels.

I. Groundwater Restoration Activities

A groundwater treatment system to remove phenols at the Hoe Creek site by carbon adsorption was tested at pilot scale in 1986 and at demonstration scale in 1987. The pilot scale system used granular activated carbon adsorbers and operated for approximately 1 month. A total of approximately 130,000 gallons of groundwater from Wells WS-10 and WS-22 were treated. Phenols in the effluent ranged from 69 ppb to less than 20 ppb, corresponding to removals of 89 percent to greater than 97 percent, respectively.

The demonstration scale system was designed for a continuous flow of 25 gallons per minute (gpm) and included filter cartridges and granular activated carbon adsorbers. The system operated for about 2 months and treated approximately 2 million gallons of groundwater from Wells WS-10 and WS-22. The treated water was reinjected to the Hoe Creek II burn cavity through Well A. The treatment system removed phenols from the groundwater to below 20 ppb before reinjection. Phenol concentrations in the water pumped from WS-10 and WS-22 declined initially but appeared to stabilize at about 200 ppb for the duration of the demonstration.

TABLE F-3

CONCENTRATIONS OF PHENOLS ($\mu\text{g/L}$)
EXCEEDING TARGET LEVELS, NOVEMBER 1987

Well	Concentration
W-1a	180
W-14b	20
W-22a	560
WS-5	20
WS-6	40
WS-7	90
WS-9	20
WS-10	310
WS-14	30
WS-15	20
WS-16	30
WS-17	50
WS-22	210
WS-23	220
WS-24	30
DOE-26	50
DOE-27	200
DW-4	40
DW-5	30

Source: Barresh, et al, 1988

Plans for groundwater monitoring in 1988 include sampling 17 wells bimonthly from March 1988 to March 1989 to evaluate seasonal and long-term stability. Samples will be analyzed for phenols and ammonia.

J. Monitoring Quality Assurance and Control

Since June of 1982 when the LETC assumed responsibility for the Hoe Creek Site, a series of outside contractors have been utilized by DOE to conduct both sampling and analysis at the site, primarily of groundwater. Throughout all of these contracts including the present agreement with WRI of Laramie, Wyoming, a Quality Assurance/Quality Control (QA/QC) Plan, specific to the project, has never been prepared by any contractor nor was this required by the contracts implemented. Additionally, inspection of the sampling by LETC was performed on only a limited basis, generally once or twice per year although sampling was occurring quarterly. The files at the Laramie Project Office contained very few contractor records on the actual sampling procedures utilized and in some cases no records could be found on the analytical procedures utilized. One laboratory, Applied Hydrology, which was contracted in fiscal years 1985-86 and 1986-87 did submit quarterly data reports along with their sampling and analytical procedures. Conversely the contract of another lab, Naughtman Analytical Laboratories which was contracted from fiscal year 1983-84, was canceled after 3 quarters due to the obviously inconsistent and erroneous data provided (Sharum, 1984).

The chronology of outside laboratories utilized for sampling and analysis at the Hoe Creek is shown in Table F-4.

K. Findings and Observations

Category I

None

Category II

None

TABLE F-4

**CHRONOLOGY OF OUTSIDE LABORATORIES UTILIZED FOR SAMPLING AND
ANALYSIS AT HOE CREEK SITE**

Contractor Firm	Subcontractor	Period of Performance
1. Western Research Institute Laramie, Wyoming	None	FY 1987-88
2. Applied Hydrology Associates, Inc. Denver, Colorado	a. Bookcliffs, commercial laboratories, Steamboat Springs, Colorado b. AccuLabs, Denver, Colorado	FY 1986-87 & FY 1985-86
3. Hodkins Westerner Schoenner Laboratories Omaha, Nebraska	a. Local sampler James Elliot, Gillette, Wyoming	FY 1984-85
4. Naughtman Analytical Laboratories Davis, California	None	FY 1983-84

Source: Personal Communication, U. Sharum, 1987

Category III (Hydrogeology)

1. Contamination of groundwater. Groundwater at the Hoe Creek Underground Coal Gasification (UCG) site is contaminated with phenols, sulfate, ammonia, and mercury as a result of the UCG experiments. The highest levels of contamination occur close to the subsurface cavities, but available data indicate that contamination has migrated to other areas on-site and has potentially migrated off-site. Restoration tests at the site have indicated that granular activated carbon adsorption will effectively remove phenols from the groundwater but continued leaching is likely to occur as groundwater moves through the site.

Levels of phenols in well WS-14, which is located at the eastern edge of the site, have ranged as high as 110 ppb in the past and are currently above the target restoration value of 20 ppb. Well DOE-17, which is off-site to the east of the property boundary, has had phenol levels higher than the target restoration value although it is currently within that goal.

It is likely that contamination will continue to leach out of the area around the burn cavities as groundwater moves through the site.

2. Inadequate characterization of groundwater. Groundwater conditions at the Hoe Creek site are inadequately characterized from both a hydrogeologic and a chemical perspective. As a result, the present extent of contamination and the likely future movement of the contaminant plumes cannot be evaluated. This conclusion is based on several factors which include:

- Inadequate or inappropriate well locations - a lack of clear understanding of groundwater flow directions has resulted in placement of some wells in less than optimal locations. In addition, some wells used for monitoring were originally installed for other purposes and thus are not located in appropriate locations.
- Improper well construction - the use of inappropriate materials such as black plastic tape to secure pump wires to the piping, and improper techniques such as a lack of decontamination of the iron pipe used for

casing the wells has reduced the usefulness of some wells for monitoring water quality.

- Improper sampling and analysis procedures - analytical results and observations by DOE personnel indicate that in some instances proper sampling and analysis procedures were not followed in monitoring water quality.
- Lack of locking well covers - wells used in monitoring water quality do not have locking covers. In many cases, the wells have no covers at all. This provides the opportunity for inadvertent, accidental, or intentional contamination of the wells, and thus reduces the reliability of data collected from the wells.

3. Improper well abandonment. The potential exists for cross-contamination between aquifers as well as for infiltration of surface runoff water through old well bores. Of the approximately 120 wells at the site, current monitoring plans call for use of only 16 wells. The rest of the wells, including injection and production wells from the experiments, various monitoring wells, hydrologic test wells, etc., should be properly abandoned if they are not intended to be used for monitoring or restoration.

Category IV (Inactive Waste Disposal)

1. Inadequate site security. The Hoe Creek site is not properly secured and poses a safety hazard for the public and livestock. For example, there are 4 large-diameter (approximately 14 inches) well casings on-site; two of them are completely open; 2 are covered but unlocked.

Category IV (Quality Assurance/Quality Control)

1. Inadequate quality assurance and control. There is inadequate quality assurance and quality control of the past and present sampling and analysis program for the Hoe Creek site.

- a. Past sampling and analysis work at Hoe Creek has been performed by several contractors without a QA/QC program to ensure the quality of the data. As a result some past data is of highly questionable validity; specifically data provided by Nachtman Analytical Laboratories of Davis, California, from mid-1983 to mid-1984, and possibly other contractors.

The following deficiencies were noted:

- Lack of a site sampling plan including specific procedures and protocols for well sampling, field filtration, bottle labeling, sample tracking and chain of custody, preservation and shipment of samples, holding and turnaround time, and analytical methods.
 - Lack of a QA project plan following the 11-point EPA standard outline.
 - Failure to use Contract Laboratory Procedure (CLP) procedures for hazardous substance list (HSL) organics to verify the accuracy and applicability of HSL analyses done by less stringent methods.
 - Lack of affirmative minimum requirements for education and experience of field sampling personnel.
 - Failure to implement requirements for demonstration of laboratory quality such as satisfactory participation in the EPA CLP - proficiency sample program.
 - Lack of an analytical QA/QC verification either using CLP deliverable packages for CLP work or specified numbers of splits, spikes, lab duplicates; minimum recovery percentages, etc.
- b. Present and planned February 88 - February 89 sampling and analysis to be done by Western Research Institute (WRI) is being planned with non-specific, or undocumented QA/QC procedures. Although WRI has the ability to perform all the elements of a proper QA/QC program, the requirement that WRI write a sampling plan, develop a site-specific QA

project plan etc., has not been included in the cooperative agreement between DOE and WRI or in the proposal of September 1987 submitted by WRI.

2. Past data are not classified as to quality. Past groundwater analytical data have not been reviewed and characterized by quality levels, resulting in uncertain conclusions.

Such a characterization would require a review by Laramie Project Office (LPO) and Morgantown Energy Technology Center (METC) of all written field inspection notes, contracting records, and interviews with former Laramie Energy Technology Center (LETC) employees who inspected or reviewed sampling and analysis contractors.

PRELIMINARY

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