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NOVEMBER 22, 1989

FINAL
REMEDIAL INVESTIGATION REPORT
(VOLUME IA OF V)

WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

EPA WORK ASSIGNMENT NUMBER 200-3LC9
UNDER
CONTRACT NUMBER 68-01-7250

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PITTSBURGH, PENNSYLVANIA

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November 22, 1989
RM/III/89-1125
No Response Required

Mr. Jeffrey Pike
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Region III
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Philadelphia, PA 19107

Subject: REM III PROGRAM - EPA CONTRACT NO. 68-01-7250
WHITMOYER LABORATORIES SITE,
LEBANON COUNTY, PENNSYLVANIA
FINAL REMEDIAL INVESTIGATION REPORT

Dear Mr. Pike:

Please find enclosed 13 copies (12 bound and 1 unbound) of the Final Remedial Investigation (RI) Report for the Whitmoyer Laboratories Site. The RI report has been revised, based on EPA and PADER written comments and subsequent discussions. At your request, we have also forwarded two copies to the Pennsylvania Department of Environmental Resources.

If you have any questions or comments regarding this report, please feel free to contact me, or our Site Manager, Mr. John Trepanowski, at (215) 971-0900.

Very truly yours,

John F Gorgol
Regional Manager, Region III

JFG/JJT/ddh

cc: J McKenzie - EPA
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File: W.A. No. 200-3LC9 (1S17/563)
Daily

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EXECUTIVE SUMMARY

SITE BACKGROUND

The Whitmoyer Laboratories Site occupies approximately 22 acres in Jackson Township, Lebanon County, Pennsylvania. An animal pharmaceutical production facility operated at the site until 1987, when the facility was abandoned. (One building at the facility is currently used as a food storage warehouse.) Principal products of the facility included organic arsenicals, cresylic acid-based products, piperazine-based products, ethylenediamine dihydroiodide, and chlorhexidine gluconate. Wastes from production of these compounds remained on site when the facility was abandoned.

Widespread environmental contamination at the site was first identified in 1964. A private-party remediation effort involving placement of highly contaminated wastes into a concrete vault and removal and treatment of contaminated groundwater was initiated at this time. The groundwater pump-and-treat program continued until 1971, when it was terminated. Arsenic-bearing treatment sludges were collected in two banks of lagoons. The sludge was consolidated into one bank of lagoons ("consolidated lagoons") in late 1976 and 1977.

In 1984, the United States Environmental Protection Agency (EPA) Technical Assistance Team sampled surface water, sediment, and groundwater at the site. The sampling results triggered the need to list the site on the National Priorities (Superfund) List.

In 1987, Ebasco Services Inc. ("Ebasco") received a Work Assignment from the EPA under the REM III contract to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the site. An RI/FS Work Plan (Ebasco, 1988a) was approved by the EPA in June 1988, and the field investigation began shortly thereafter.

In an effort to expedite the remediation of concentrated liquids abandoned at the site, EPA decided to also have REM III prepare an assessment document for these liquids immediately after RI/FS data were received. The Final Concentrated Liquids Assessment (Ebasco, 1989) was prepared in March 1989. EPA signed a Record of Decision (EPA, 1989a) addressing these liquids in June 1989. The concentrated liquids are addressed primarily in the Concentrated Liquids Assessment and not by this report. Additional potential operable units will be addressed in the Whitmoyer Laboratories Feasibility Study.

OBJECTIVES

The primary goal of the RI was to determine whether the site presents current or future human health or environmental risks, and to collect the data necessary to evaluate appropriate

remedial actions to mitigate any identified risks. The following specific objectives were developed to meet those goals:

- Characterize the waste materials found on site to determine whether they are potential sources of environmental contamination, as well as assess their particular material-handling and waste-processing parameters.

- Package and characterize abandoned laboratory wastes to stabilize their storage and to develop disposal options.

- Characterize the onsite buildings to determine whether they present a threat to human health and the environment.

- Determine the nature and extent of contamination in onsite and offsite surface and subsurface soil, groundwater, surface water, and sediments.

- Characterize the hydrogeologic regime at the site and evaluate contaminant migration routes that may transport contaminants from the source areas.

- Identify current and/or potential receptors of environmental contamination and evaluate the risks associated with these exposures.

FIELD INVESTIGATION

Various field sampling and other data collection activities were conducted to meet the objectives of the RI. The field investigation activities included the following:

- Topographic mapping; surveying all sample locations, staff gauges, and monitoring well locations; and surveying property boundaries.

- Sampling of onsite waste materials as follows:

  - Vault wastes (September 1988)
  - Consolidated and excavated lagoon wastes (September 1988)
  - Buried drum wastes (September 1988)
  - Tank and vessel wastes (August and November 1988)
  - Laboratory wastes (May 1989)

- Inventorying laboratory wastes, characterizing unknown wastes, consolidating compatible wastes into appropriate containers, and analyzing one prominent waste for RCRA hazardous waste characteristics (March, April, and May 1989).

- Inventorying miscellaneous wastes abandoned on site (October 1988).

- Sampling of building materials and equipment, building air, building surface accumulations, and roof runoff (August, November, and December, 1988).

- Sampling of onsite and offsite surface and subsurface soils (August, September, October, and November 1988).

- Conducting two rounds of surface-water sampling from Tulpehocken Creek (July and October 1988), one round of surface-water sampling from nearby ponds and quarries (October 1988), and one round of sediment sampling from these water bodies (October 1988).

- Sampling of fish and benthic macroinvertebrates from potentially affected surface waters (October 1988).

- Identifying potentially affected wetlands in the site vicinity (October 1988).

- Performing two rounds of monitoring well sampling; and one round of municipal supply well, industrial water supply well, and residential well sampling (November and December 1988, and January 1989).

- Conducting three rounds of water-level measurements (November 1988, and January and April 1989).

- Aquifer testing (January 1989).

Most samples were analyzed for the Target Compound List organics and the Target Analyte List Metals, or selected compounds from these lists. Many samples were analyzed for additional chemical and/or physical parameters. The analytical data base used in this report was developed from validated RI analytical results.

GEOLOGY/HYDROLOGY

Depths to bedrock at the site range from 0 feet at outcrop locations to 19 feet. Overlying the limestone bedrock are predominantly natural silts and clays, with deposits of alluvium present along the floodplain of Tulpehocken Creek. Fill material (miscellaneous soil, debris, and waste material) was encountered extensively within the site boundaries. Depth to groundwater in the onsite monitoring wells was found to range from 1 to 28 feet below ground surface. Because the summer of 1988 was exceptionally dry, normal water levels may be higher.

Groundwater flows principally across the site to the north and east. There is a local groundwater flow component to the southeast along the southern site boundary. Groundwater flow has a significant downward vertical gradient over most of the site. Based on recorded water-level measurements, aquifer testing data, and groundwater chemical data, the groundwater beneath the site consists of a one-aquifer system. Significant

groundwater contamination was detected in the deepest onsite well, which monitors a fracture zone 375 feet deep. Average linear horizontal velocities in the shallow, medium-depth, and deep monitoring wells are estimated at approximately 1,200, 100, and 26 feet/year, respectively.

Fractures in the bedrock generally decrease with depth. Most of the single-family residence potable water wells obtain groundwater from relatively shallow depths.

Tulpehocken Creek/Union Canal flows along the northern site boundary. Flow by the site is controlled to a large degree by the ongoing dewatering of a limestone quarry west of the site and subsequent discharge to the creek. The creek is also receiving groundwater discharge along certain reaches.

There are several nearby ponds and quarries. These water bodies also receive groundwater discharge.

INVESTIGATION RESULTS

Sampling and analysis of wastes, buildings, soil, surface water, and sediment show that the site is contaminated with arsenic, other toxic metals, volatile organics, aniline compounds, phthalate acid esters, polynuclear aromatic hydrocarbons (PAHs), phenolic compounds, n-nitrosodiphenylamine, and dibenzofuran. The RI results are summarized below.

- The major site contaminants are arsenic, volatile organics (primarily tetrachloroethene, trichloroethene, 1,2-dichloroethene, 1,1-dichloroethene, and benzene), aniline, 4-chloroaniline, PAHs (including benzo(a)pyrene), and bis(2-ethylhexyl)phthalate.

- The vault wastes contained high concentrations of arsenic (>12%) and aniline (>12% in still bottoms). The consolidated and excavated lagoon materials contain elevated arsenic levels. Remnants of iron-arsenic sludge were found in the excavated lagoon fill. Both the vault and lagoon wastes are considered to be significant sources of contamination in soil and groundwater. One hundred ninety drums containing laboratory wastes were securely packaged. Arsenic and PAHs were found in the buried drum wastes; their total waste quantity is small in comparison with the other wastes, however.

- Building material and equipment contain elevated metal levels. Toxicity Characteristic Leachate Procedure (TCLP) extracts often contain arsenic concentrations in excess of the Resource Conservation and Recovery Act (RCRA) hazardous waste characteristic level of 5 mg/L. Significant levels of arsenic were detected in surface buildups and the ambient air within the production buildings.

- Onsite surface soils were generally contaminated (primarily with arsenic), with the exception of parts of the southwest corner of the site. Major contaminants detected include arsenic, PAHs, aniline, and n-nitrosodiphenylamine.

- With the exception of portions of the southwest corner of the site, onsite subsurface soils were also generally contaminated (primarily with arsenic). Major contaminants detected include arsenic, PAHs, aniline, volatile organics, and n-nitrosodiphenylamine. Potentially-heavily-contaminated soils beneath tanks were not sampled during the RI.

- Significant concentrations of arsenic were detected in some offsite surface and subsurface soils, principally to the north and east of the site. This arsenic may act as a source for future groundwater contamination. Inhalation/ingestion of contaminated offsite surface soils is a significant exposure pathway. In some areas (especially for offsite soils), contaminated soils were only observed in the bottom of the soil borings/test pits. In these cases, the presence of contaminants in the soils is thought to be a result of sorption of contaminants from contaminated groundwater, rather than the result of waste deposition on the ground surface.

- Onsite groundwater downgradient of the vault and lagoon areas are contaminated primarily with arsenic. Onsite groundwater downgradient of other source areas are contaminated with arsenic, aniline, volatile organics, and 4-chloroaniline. Significant contamination was detected in groundwater samples from shallow, medium-depth, and deep monitoring wells.

- Once in the groundwater, contaminants are generally moving both downward through the overburden and fractured bedrock and laterally with the groundwater flow. During the RI, groundwater arsenic concentrations in excess of the Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL) were observed in residential wells located 1200 feet southeast and 4000 feet east of the site. Arsenic contamination was also detected in the Lakeside Quarry and Wenger Quarries 1 and 2 surface-water bodies. These quarries, which are located approximately 8000 feet (1.6 miles) east of the site, and 1800 feet northeast of the site, respectively, are believed to have been contaminated by the discharge of site-contaminated groundwater.

- In addition to the contamination detected in nearby ponds and quarries, groundwater discharge is apparently contaminating Tulpehocken Creek waters downstream of the site. No significant surface-water contamination was detected in surface-water samples in Tulpehocken

Creek/Union Canal adjacent to the site. It was determined that groundwater discharge was not occurring along this stretch of the creek during the RI field sampling activities. It is possible that this lack of discharge can be attributed to the exceptionally dry summer of 1988, which may have caused the groundwater table to be unusually low.

- Elevated levels of arsenic were detected in Tulpehocken Creek/Union Canal sediment samples collected adjacent to, and downstream of, the site. The most contaminated sediments were found adjacent to the site, indicating that surface runoff has transported these materials from the site. The sediment sample from Charming Forge Lake also contained elevated levels of arsenic, indicating that this lake is acting as a sediment trap for Tulpehocken Creek.

- Only minor pockets of wetlands (less than 0.1 acre total) were identified adjacent to the site. Floodplain forest wetlands were identified along Tulpehocken Creek, beginning approximately 3.5 miles downstream of the site.

- Whole body and fish tissue samples from Tulpehocken Creek/Union Canal and nearby ponds and quarries contained undetectable levels of arsenic (detection limit = 2 mg/kg). These results indicate that potentially affected fish are not bioaccumulating significant levels of arsenic.

- A benthic macroinvertebrate survey was conducted downstream of the site; no effects on the benthic population that could be attributed to site-related contamination were noted. Sensitive benthic species, e.g., mayflies and caddis flies, were identified, indicating the Tulpehocken Creek water quality was not having a deleterious effect on the benthos.

HUMAN HEALTH AND ENVIRONMENTAL CONCERNS

A risk assessment was performed to evaluate the current or potential human health and environmental impacts associated with site-related contamination. Contaminants of concern were selected based on their toxicity as well as their occurrence and distribution in the environmental media at the Whitmoyer Laboratories Site. Although arsenic is the principal contaminant of concern, several volatile and base neutral/acid extractable compounds (including n-nitrosodiphenyl-amine and PAHs) were also detected in one or more environmental media. Human and environmental receptors potentially exposed to the contaminants are as follows:

- People who at some time <u>in the future</u> may reside on the site property. It is assumed that these residents would utilize the groundwater underlying the site as a domestic water supply source. In reality, residential use of the

site is a possible but unlikely scenario given the past use of the site as a manufacturing complex. Additionally, the use of the groundwater underlying the site as a domestic water supply source is unlikely due to the availability of a public water supply at the site.

- Individuals residing in the vicinity of the site (i.e., within the influence of the groundwater contamination plume resultant from past manufacturing and disposal activities at the site) and relying upon a private groundwater supply well as their domestic water supply source. Historical information and the RI results indicate that several private water supplies in the vicinity of the Whitmoyer Laboratories Site contain arsenic levels exceeding 50 µg/L, the current Federal SDWA MCL. Although municipal water lines have been extended to serve impacted residences north of the site, several residences south and east of the site and one residence west of the site still receive bottled water as a drinking water supply source, because of the elevated arsenic levels in their private groundwater supplies.

- Workers who, at some time in the future, perform work tasks within buildings or work out-of-doors at the site. It is assumed that the groundwater aquifer underlying the site is used as a water supply source for drinking and showering. Additionally, it is assumed that the buildings are reoccupied in their present conditions, i.e., the buildings have not been cleaned or renovated in any manner.

- Individuals using the area adjoining the site for recreational purposes. Current recreational uses of the adjoining area would include swimming or fishing in the lakes and quarries in the vicinity of the site and wading and fishing along Tulpehocken Creek. Public beaches did not exist along any of the surface water bodies sampled during the RI. However, exposure could occur as a result of the opportunistic use of the lakes and quarries for swimming. Additionally, Tulpehocken Creek is used extensively for fishing. The creek and some of the lakes and quarries in the vicinity of the site are periodically stocked with fish. Myerstown Pond is the site of a small community park.

- Farm workers cultivating agricultural fields adjoining the site. Arsenic levels detected in soil samples collected from some of the fields adjoining the site exceed background soil levels of arsenic.

- Farm families or other residents whose diet includes homegrown vegetables/beef grown on/pastured on fields adjoining the site. Agricultural fields adjoining the site are used for pasture and cropland.

- Terrestrial and aquatic flora and fauna inhabiting the site or utilizing habitats along the Tulpehocken Creek, the Union Canal, the lakes/quarries in the vicinity of the site, and any wetlands downstream of the site.

The following items summarize the results of the public and environmental risk assessment performed for the Whitmoyer Laboratories Site:

- Contaminant levels in the groundwater underlying the site exceed available Federal SDWA MCLs. The average concentration of arsenic exceeds the current MCL by approximately a factor of 1,000. Such standards exceedances indicate a potential for adverse health effects associated with exposures to the groundwater as a water supply source.

  Exposures to the onsite groundwater under two future land use scenarios were evaluated (commercial and residential). Under the conditions specified in the risk assessment, the Dose/RfD ratio calculated for arsenic alone is greater than 1,000 (average contaminant levels-ingestion route of exposure) when the residential land use scenario is evaluated and is only minimally reduced under the commercial land use scenario. The Dose/RfD[1] ratio for several other indicator contaminants (antimony, 1,2-dichloroethene, tetrachloroethene, and 4-chloroaniline) also exceeds unity; the summed Hazard Index (HI) for all indicator compounds is well over 1,000. Adverse noncarcinogenic health are anticipated when the Dose/RfD ratio for individual compounds or the summed Hazard Index exceeds unity. Cancer risk levels estimated for the onsite groundwater approach unity due to the high levels of arsenic detected. Additionally, cancer risk levels estimated for tetrachloroethene, trichloroethene, 1,2-dichloroethene, and aniline exceed 1×10^{-3} (residential use scenario).

- Contaminant levels detected in offsite monitoring wells and residential wells are considerably reduced from levels detected in the onsite monitoring wells. Although low-level organic contamination is noted in the offsite groundwater wells, arsenic is still the predominant contaminant of concern. The Dose/RfD ratio calculated for arsenic in offsite and residential monitoring wells ranges from 0.5 to 1.87 when average contaminant levels are evaluated under the residential use scenario. Adverse health effects are possible when the ratio exceeds 1.

[1] The Dose/RfD ratio (hazard quotient) is the ratio between an exposure dose estimated for an exposure scenario and the reference dose for a contaminant of concern. Adverse noncarcinogenic health effects are not anticipated if the ratio is less than 1.

No other indicator chemical detected in the offsite/residential wells produces a Dose/RfD ratio exceeding 1. The excess lifetime cancer risk estimated using average arsenic concentrations detected in the offsite/residential wells range from 9.05×10^{-4} to 2.99×10^{-2}, which is considerably reduced from the cancer risk levels calculated for contaminant concentrations in the onsite wells.

- The risk analysis evaluation of <u>onsite surface soil exposures (accidental ingestion, inhalation, and dermal contact) under the residential land use scenario</u> predicted adverse noncarcinogenic risk for receptors of concern. The Dose/RfD ratio for arsenic (assuming that a small child is the receptor of concern) ranged from 1.7 (the Southwest area-average contaminant levels) to 470 (Drum Burial Area 2 - maximum contaminant levels), indicating that adverse noncarcinogenic health effects would be anticipated under the conditions established by the exposure model. Cancer risk levels estimated for arsenic range from approximately 3.9×10^{-4} to 1.44×10^{-2} across the five areas of the site evaluated (risk levels for average contaminant levels).

- <u>Direct contact with or inadvertent ingestion of contaminated onsite surface soils under the commercial land use scenario</u> are exposures of concern. As expected, the carcinogenic and noncarcinogenic risks predicted by the risk assessment under this scenario are reduced from those predicted under the residential land use scenario. The accidental route of exposure produces a Dose/RfD ratio for arsenic that exceeds unity for three of five areas of the site evaluated; adverse noncarcinogenic effects are possible under the conditions established for the exposure scenario. No other compound or combination of compounds produces a Dose/RfD ratio (or HI for the summed values) exceeding unity for the accidental ingestion or dermal contact exposure scenarios. Cancer risk levels estimated for arsenic (accidental ingestion route of exposure) range from 1×10^{-2} to 5×10^{-5} across the five areas of the site and do not exceed 1×10^{-6} when the dermal route of exposure is evaluated. Based on these results, the risk analysis predicts possible adverse noncarcinogenic and carcinogenic health effects for potential receptors working outdoors at the site.

- <u>Accidental ingestion of contaminated dusts</u> coating physical surfaces within facility buildings is an exposure of concern under the commercial land use scenario. Given the conditions established by the risk assessment methodology, the Dose/RfD ratio calculated for arsenic

exceeds unity for contaminant levels detected within several buildings. Excess lifetime cancer risks above 1×10^{-2} are predicted by the risk analysis. These results indicate that the dusts coating the physical surfaces of buildings may present potential noncarcinogenic and carcinogenic risk to workers stationed within the buildings. Due to uncertainty in the risk assessment methodology, these results must be viewed more qualitatively than quantitatively.

- Air monitoring conducted within building facilities at the Whitmoyer Laboratories Site indicates that arsenic levels do not exceed available health-based standards and criteria. The levels detected are not above the Occupational Safety and Health Administration arsenic standard developed for the protection of healthy adult workers. It should be noted, however, that under the conditions of the risk assessment, the risk analysis results predict estimated lifetime cancer risks in excess of 1×10^{-4} for a worker exposed to measured arsenic levels within some of the onsite buildings.

- Accidental ingestion of waste materials by a receptor trespassing across the site is an exposure scenario of concern. Noncarcinogenic health effects are anticipated. The summed Hazard Index for all contaminants of concern exceeds unity. Excess lifetime cancer risks exceed 1 x 10-3 under the conditions established for the risk assessment.

- The consumption of crops grown on contaminated agricultural fields adjoining the site is an exposure scenario of potential concern; the consumption of animal products pastured on the fields is not. Noncarcinogenic health effects are possible for the former scenario (i.e. the Dose/RfD ratio calculated for arsenic levels in the surface soils exceeds unity) under the conditions established by the risk assessment methodology. However, the assessment methodology used to evaluate the consumption of homegrown vegetables grown on contaminated soils assumed that all of the total arsenic present in the soils was available to plants and that the plant survives to produce a reasonable crop. Both assumptions are highly conservative. Consequently, the risk analysis results indicate a potential health risk. A more detailed investigation involving the determination of available arsenic in soils and crop analyses would be necessary to further define the health risk posed by this exposure scenario.

- Inhalation of contaminated soil particulates made airborne by the plowing of agricultural fields adjoining the site is an exposure of concern. The excess lifetime cancer risk estimated for a farm worker exposed for a 40-year

working lifetime exceeds 1×10^{-2} when average arsenic levels in the adjoining agricultural fields are evaluated.

- Fugitive dust emissions and potential adverse health effects associated with inhalation of contaminated particulates from the site were estimated using the Cowherd model and conservative estimates of potential exposures. The estimated lifetime cancer risk associated with the average or maximum arsenic level detected in the two site areas of concern did not exceed 1×10^{-4}.

- Risks from direct contact and inadvertent ingestion of surface water and sediments from Tulpehocken Creek and ponds/quarries in the vicinity of the site were estimated to be two to three orders of magnitude lower than risks associated with onsite surface soil exposures. Contaminant levels do not produce Hazard Indices exceeding unity or excess lifetime cancer risks exceeding 1×10^{-5}.

- Based on the aquatic life survey and sampling conducted during the RI, no evidence of impacts on the ecosystem from the site was observed. Fish tissue concentrations were below 2 mg/kg, the method detection limit. Sensitive benthic species, e.g., stoneflies and mayflies, were found in downstream waters of Tulpehocken Creek.

Table ES-1 summarizes the major results of the risk analysis.

TABLE ES-1

RISK ANALYSIS SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Medium/Scenario	Average Case Scenario		Reasonable Worst Case Scenario	
	Dose/RfD Ratio	Excess Lifetime Cancer Risk	Dose/RfD Ratio	Excess Lifetime Cancer Risk
GROUNDWATER[1] Residential Use Scenario				
Onsite groundwater	1,440	Approaches unity	6,310	Approaches unity
Offsite groundwater	1.17	2.1×10^{-3}	8.46	1.52×10^{-2}
Residential Wells	1.87	3.37×10^{-3}	16.6	2.99×10^{-2}
SURFACE SOILS Onsite-Residential[2] Use Scenario				
Lagoon Area	16	3.7×10^{-3}	56	1.3×10^{-2}
Southwest Area	1.7	3.9×10^{-4}	4.7	1.1×10^{-3}
Drum Burial Area	61	1.44×10^{-2}	470	1.1×10^{-1}
Production Area	8.8	2.09×10^{-3}	16.7	4×10^{-3}
Union Canal Area	17	4.1×10^{-3}	110	2.5×10^{-2}
Onsite-Commercial[3] Use Scenario				
Lagoon Area	0.6	6.15×10^{-4}	2.15	2.21×10^{-3}
Southwest Area	6.39×10^{-2}	6.57×10^{-5}	0.182	1.87×10^{-4}
Drum Burial Area	2.35	2.42×10^{-3}	18.2	1.87×10^{-2}
Production Area	0.341	3.51×10^{-4}	0.645	6.63×10^{-4}
Union Canal Area	0.7	6.91×10^{-4}	4.70	4.19×10^{-3}

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TABLE ES-1
RISK ANALYSIS SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

SURFACE SOILS (Continued)	
Offsite - Commercial[4] Use Scenario	• Excess lifetime cancer risk estimated for a receptor working downwind of site as a result of exposure to airborne migration of soil contaminant does not exceed 1×10^{-4}. • Excess lifetime cancer risk estimated for a receptor (farm worker) working adjoining fields is in excess of 1×10^{-2} when average soil contaminant levels are evaluated.
Offsite - Agricultural[5] Use Scenario	• Dose/RfD ratio estimated for consumption of crops raised on contaminated fields range from 4.1 to 24.6 when average contaminant levels are evaluated. Excess lifetime cancer risk range from 6.3×10^{-3} to 3.8×10^{-2}.
AIR/DUSTS Facility Buildings[6]	• Dose/RfD ratio calculated for worker exposure (incidental ingestion of contaminated dusts) to contaminated dusts in facility buildings ranged as high as 361. Excess lifetime cancer risks were in excess of 1×10^{-2}. • Air monitoring of facility buildings indicated that arsenic levels in the air within the buildings did not exceed current health-based standards. However, quantitative risk analysis results predict excess lifetime cancer risk in excess of 1×10^{-4}.

1 Risk analysis results for residential use scenario: ingestion exposure.
2 Risk analysis results for residential use scenario: ingestion, inhalation-dermal contact exposure.
3 Risk analysis results for commercial use scenario: incidental ingestion of soils via workers performing tasks out of doors.
4 Risk analysis results for commercial use scenario: inhalation of contaminated soil particulates migrating from the site.
5 Risk analysis results for agricultural use scenario: consumption of farm products grown on contaminated fields.
6 Risk analysis for inhalation/incidental ingestion exposures to contaminated dust.

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

NUS Corporation (NUS), under contract to Ebasco Services Incorporated (Ebasco), prepared this Remedial Investigation (RI) Report for the U.S. Environmental Protection Agency (EPA), under Work Assignment Number 200-3LC9, REM III Contract Number 68-01-7250. This report presents the results of the RI conducted for the Whitmoyer Laboratories Site in Lebanon County, Pennsylvania.

1.2 SCOPE AND OBJECTIVES

The RI was conducted according to the Work Plan submitted to and approved by EPA in June 1988. The primary goals of this investigation are to determine whether the Whitmoyer Laboratories Site presents any current or future human health or environmental risk, and to collect the data necessary to evaluate appropriate remedial actions that are consistent with the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the latest EPA guidance. Specific objectives were developed to meet these goals. The RI objectives, which were provided in the Final Remedial Investigation/Feasibility Study (RI/FS) Work Plan (hereafter, "RI/FS Work Plan") (Ebasco, 1988a), are summarized as follows:

- Characterize the consolidated and excavated lagoon contents and vault wastes as potential sources of onsite and offsite contamination.
- Characterize other wastes on site, such as those found in vessels, tanks, and drum burial areas, to determine whether they are potential sources of environmental contamination.
- Characterize other potential "hot spots" (e.g., the waste pit areas) on site to determine whether they are potential sources of environmental contamination.
- Package and characterize abandoned laboratory wastes to stabilize their storage and to develop disposal options.
- Estimate the quantity of wastes on site as well as assess particular material-handling and waste-processing parameters (in support of a forthcoming FS).
- Characterize the onsite buildings to determine whether they present a threat to human health and the environment.
- Evaluate, in all environmental media (as well as the waste samples), the extent of contamination that has resulted from business activity and/or waste disposal activities.

- Characterize the hydrogeologic regime at the site through the installation, sampling, and hydrogeologic testing of monitoring wells.

- Evaluate contaminant migration routes that are acting at the site to transport contaminants off site, as well as characterize the extent of offsite impacts of contamination.

- Identify current and/or potential receptors of environmental contamination and evaluate the risks associated with these exposures.

- Employ quality-controlled and quality-assured field and laboratory procedures in every task of the investigation.

Various sample collection activities were conducted from July 1988 until May 1989 to meet these objectives. This RI Report presents the findings and conclusions of these activities, with the following exceptions. EPA has expedited the evaluation and remediation of concentrated liquids which were abandoned at the site in tanks, process vessels, and other containers. Sampling and analysis of the liquids are described in the Whitmoyer Laboratories Concentrated Liquids Assessment (Ebasco, 1989). A Record of Decision addressing the concentrated liquids was signed by EPA (1989a) on June 30, 1989. The RI/FS Work Plan (Ebasco, 1988a) proposed sampling and analysis for approximately 800 drums that had been abandoned at the site. After existing information on the drum contents was compiled, the EPA in October 1988 elected to sample, stabilize, and remove the drums for offsite treatment/disposal utilizing emergency response authorities.

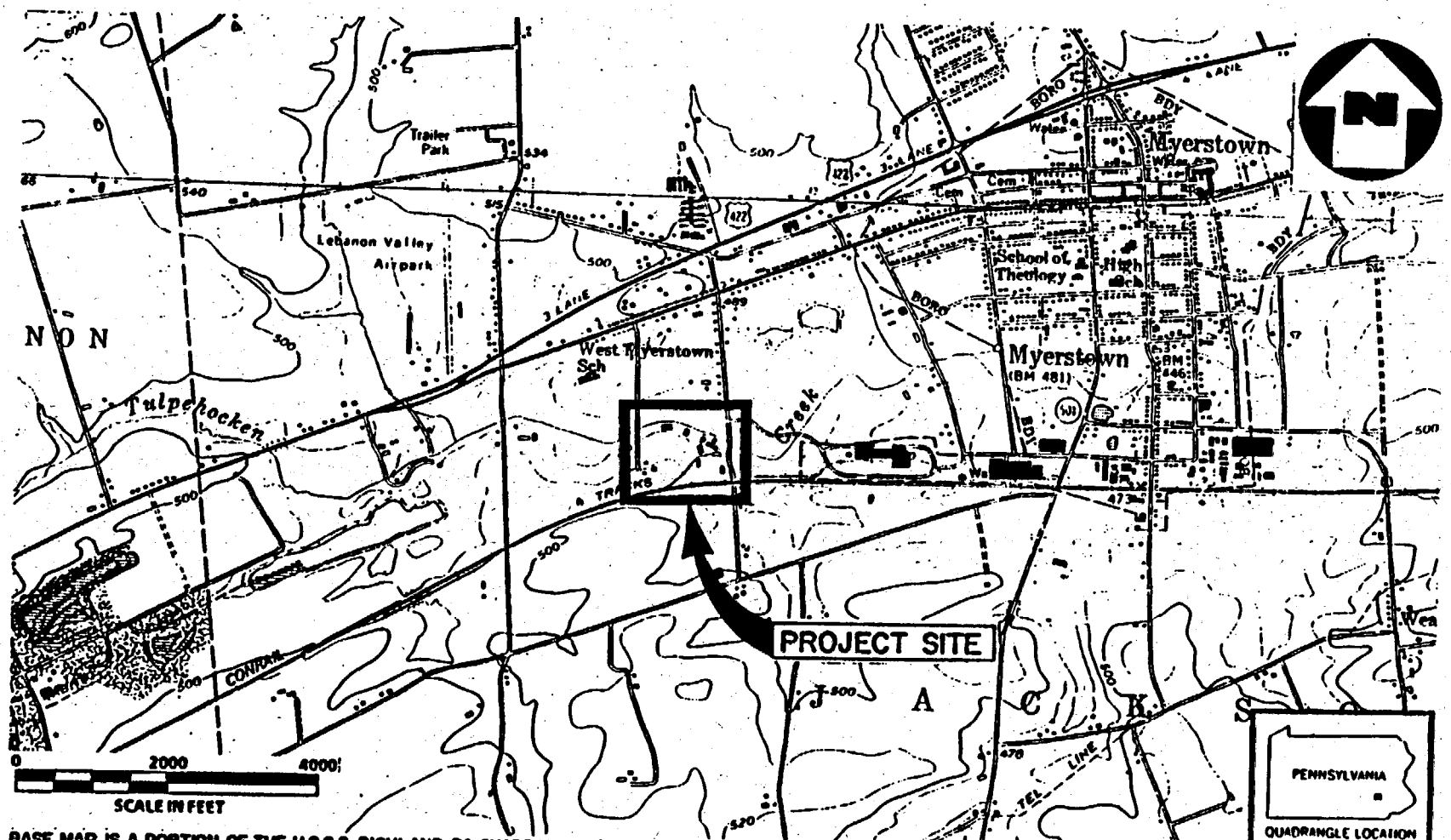
A Feasibility Study Report addressing all of the wastes and environmental media at the site except the concentrated liquids, the approximately 800 drums, and soils, is scheduled to be published in January 1990. A Feasibility Study Report addressing onsite and offsite soils is scheduled for publication in July 1990.

1.3 SITE BACKGROUND INFORMATION

This section provides a site description and a brief site history of the Whitmoyer Laboratories Site. For a more detailed site background, the reader is referred to the RI/FS Work Plan (Ebasco, 1988a).

1.3.1 Site Location and Description

The Whitmoyer Laboratories Site is located on approximately 22 acres in Jackson Township, Lebanon County, Pennsylvania, about 1 mile southwest of the borough of Myerstown (see Figure 1-1). The site lies between the Union Canal of Tulpehocken Creek and the Conrail (Reading) Railroad. Fairlane Avenue forms the site's eastern boundary, while Creamery Street



BASE MAP IS A PORTION OF THE U.S.G.S. RICHLAND, PA QUADRANGLE (7.5 MINUTE SERIES, 1955, PHOTOREVISED 1969). CONTOUR INTERVAL 20'.

FIGURE 1-1

LOCATION MAP

WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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adjoins the site to the west (see Figure 1-2). Coordinates for the site are latitude 40°21'57" and longitude 76°19'34". The site is located on the Richland, Pennsylvania, 7.5 minute series quadrangle.

Land surrounding the site is predominantly farmland, with scattered farmhouses. A Sterling Drug factory is located 2,000 feet east of the site, while P J Valves, a manufacturing plant, is located about 1,500 feet to the south. The West Myerstown Elementary School lies approximately one-third of a mile northwest of the site. A large active limestone quarry, locally referred to as the Calcite Quarry, is located approximately 1.5 miles west of the site.

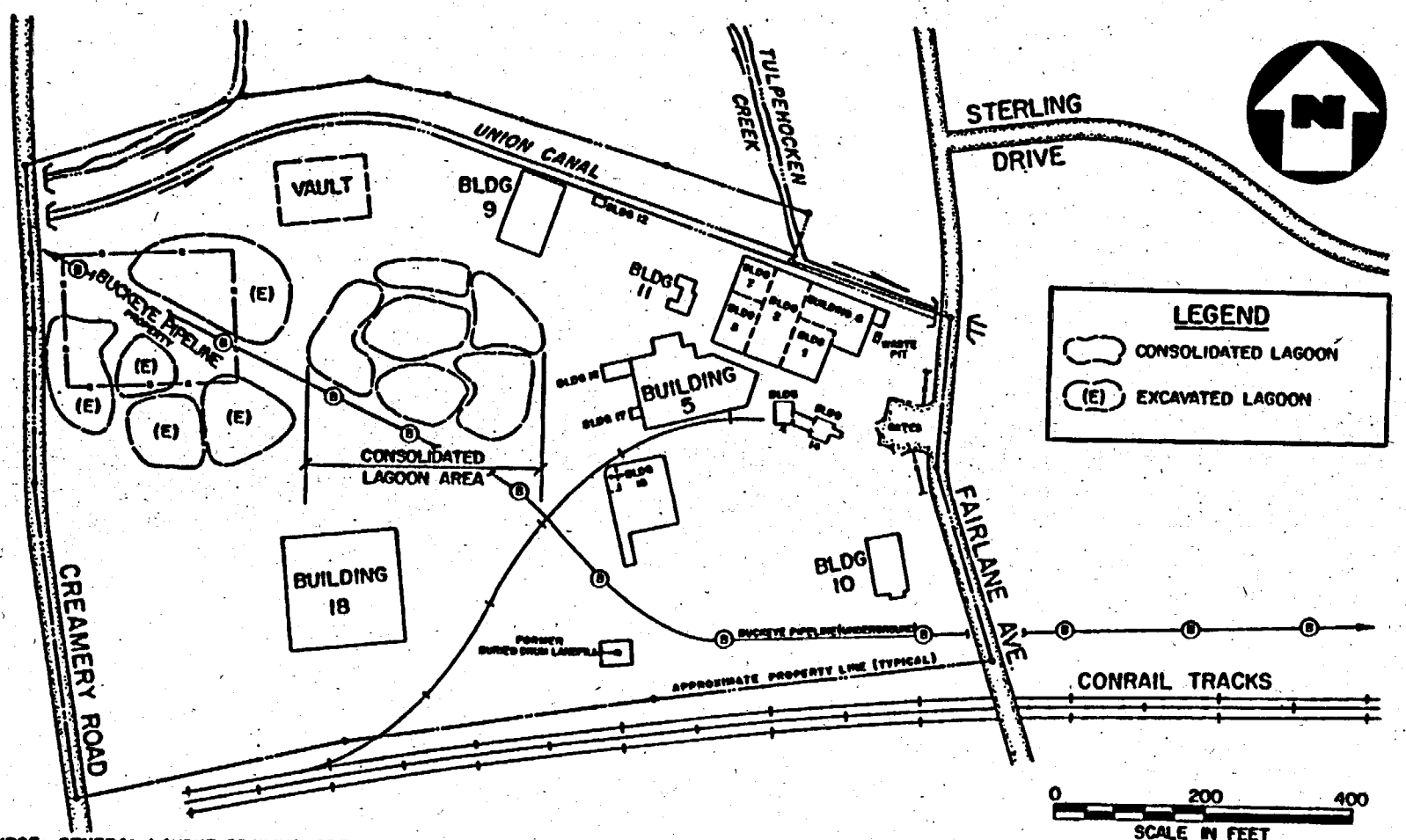
The Union Canal branches from Tulpehocken Creek just west of the site, and rejoins the creek near the site's eastern boundary. Tulpehocken Creek joins the Schuylkill River near Reading, Pennsylvania. The Schuylkill River flows into the Delaware River, which eventually empties into the Atlantic Ocean. Tulpehocken Creek and the Schuylkill River serve as drinking water supplies and irrigation sources downstream of the site.

The site itself is presented in greater detail in Figure 1-2. Major site features, which are described later in this report, include 17 buildings, 23 storage tanks, a concrete waste storage vault, two sets of lagoons, a waste pit, a petroleum products pipeline and pump station, and a railroad spur. All of these features have been abandoned, except Building 18, which is operated by Major Foods as a food warehouse, and the pipeline and pump station, which is owned and operated by Buckeye Pipe Line Company.

1.3.2 Site History

The earliest activity at the site occurred in the early 1900s, when an oil pipeline was constructed across the site. This activity probably was performed by Tuscarora Oil Company or a predecessor.

In September 1934, C W Whitmoyer formed Whitmoyer Laboratories, Incorporated (WLI), by merging his operations with another animal pharmaceutical company. There is little documentation of WLI operations prior to 1957. Reportedly, only nonhazardous, vitamin-based and fish-oil-based products were manufactured. In 1957 the production of organic arsenicals reportedly commenced at the site. The primary organic chemical used was aniline. Coal tar dip, piperazine, sulfa products, biodin, and ethylenediamine dihydroiodide (EDDI) were also produced in 1964. Wastewater from all of these processes was routed to an unlined lagoon.



SOURCE: GENERAL LAYOUT DRAWING, PREPAREDNESS, PREVENTION & CONTINGENCY PLAN, DEC. 22, 1982.

FIGURE 1-2

GENERAL ARRANGEMENT
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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Lime was added to the process wastewater to precipitate arsenic. The arsenic precipitate consisted of sodium-arsenic compounds, calcium-arsenic compounds, and possibly organically-bound arsenic. Estimates of the quantity of arsenic placed in the unlined lagoon range as high as 4,000,000 pounds or more, with the most likely figure being 1.5 million pounds. The lagoon occupied the same area as the consolidated lagoons shown on Figure 1-2.

In 1964 WLI was bought by, and became a wholly owned subsidiary of, Rohm & Haas (R&H). In late 1964 arsenic pollution in soils, groundwater, and surface water caused by wastewater disposal in the unlined lagoon was first noted. Once this contamination was identified, a three-phased remediation effort was initiated by R&H. This effort consisted of

- Termination of process wastewater disposal in the lagoon and excavation of lagoon sludges and other hot spots.
- Groundwater pumping and treatment.
- Supply of bottled water to nearby residents with contaminated wells.

A concrete vault measuring 123 feet long by 83 feet wide and 12 feet deep was constructed in late 1964 and early 1965 to accept the lagoon sludges and other contaminated material. An estimated 750,000 pounds of arsenic were reportedly placed in the vault.

The extraction and treatment of contaminated groundwater was initiated concurrently with the excavation project (i.e., in December 1964). The cumulative amount of arsenic extracted from the groundwater by the end of pumping (March 1971) reportedly was 450,000 pounds. No comparable analyses for aniline or other contaminants were performed, as these were not contaminants of concern at that time and were not measured.

The extracted water was treated with ferric sulfate to precipitate iron-arsenic compounds (possibly ferric arsenate). The iron-arsenic compound(s) were allowed to precipitate in the existing lagoons, which had been refurbished. Additional lagoons were also constructed to the west of the original lagoon(s) to provide added settling and storage capacity (see Figure 1-2).

In late 1976 and 1977, R&H consolidated the lagoon sludges. Sludge reportedly containing 200,000 pounds of arsenic was excavated from the westernmost lagoons and placed in the easternmost lagoons (see Figure 1-2). The consolidation reportedly raised the height of the material in the receiving lagoons an additional 5 to 8 feet, on the average. No records were identified revealing the nature of the cover material used for the consolidated lagoons. This area is well vegetated (EPA, 1981).

In 1978 Beecham Laboratories of Clifton, New Jersey, purchased WLI from R&H. The plant managerial staff remained essentially intact.

In 1979 Buckeye Oil Company repaired a section of pipeline running through the site. In the course of these repairs, underground excavation uncovered a burial ground containing old rusted metal and deteriorated fiber drums that contained arsenical waste products. It was reported that this area was used as a small dumping ground. It was covered in approximately 1958 or 1959. The burial area, which was approximately 30 feet by 40 feet and about 7 feet deep, was excavated and disposed of off site.

On May 14, 1982, Beecham sold WLI to Stafford Laboratories, Inc., of Phoenix, Arizona. Again the plant managerial staff remained essentially intact. Stafford Laboratories, WLI's parent corporation, filed for bankruptcy in the summer of 1984.

In February, 1984, EPA's Technical Assistance Team (TAT) conducted an assessment of the Whitmoyer Laboratories Site. Elevated levels of arsenic were detected in the downgradient surface water and sediment and the onsite monitoring well samples. Elevated organics were also detected in the onsite monitoring well samples.

Based on analytical results from the samples collected by EPA TAT, the Whitmoyer Laboratories Site was proposed for the National Priorities List (NPL) in October 1984. The site was finalized on this list in June 1986.

On May 17, 1985, WLI submitted a revised RCRA (Resource Conservation and Recovery Act) Hazardous Waste Treatment and Storage Closure Plan to the Pennsylvania Department of Environmental Resources (PADER). This closure plan only related to the then-current hazardous waste activities. The closure plan called for all containerized waste to be shipped off site to a permitted treatment, storage, and disposal (TSD) facility within 90 days of plan implementation. Additionally, all liquid wastes stored in tanks, sludge remaining in the bottoms of tanks, waste generated during closure of the WLI plant, and contaminated soil identified during closure were to be transported off site to a TSD facility.

The WLI plant reportedly last operated in January of 1987. These operations were reportedly on a limited scale. The site was essentially abandoned; very little of the closure plan was implemented.

In November 1987, the EPA instructed its REM III contractor to perform a Remedial Investigation/Feasibility Study (RI/FS) on the Whitmoyer Laboratories Site. RI fieldwork commenced on site in July 1988, and was completed in May 1989.

In October 1988, the EPA began an emergency response to dispose of abandoned drums at an offsite facility. This response is currently ongoing.

On June 30, 1989, the EPA signed a Record of Decision calling for the removal of concentrated liquids abandoned at the site, followed by offsite treatment/disposal. The Remedial Design for this activity is currently underway.

EPA has also proposed an emergency response to connect residences with contaminated residential wells to the Myerstown municipal water supply. This water line is currently in the design phase. In the meantime, the EPA is supplying the targeted residences with bottled water.

1.4 REPORT ORGANIZATION

The organization and content of this report (Volume I) are described below. Appendices are provided in Volumes II through V.

Section 1.0 - Introduction

This section summarizes the scope and objectives of the RI. Included are descriptions of the site and relevant background information.

Section 2.0 - Field Investigation Activities

This section describes the various tasks of the field investigation activities, including the hydrogeologic investigation and media sampling activities.

Section 3.0 - Physical Characteristics of the Study Area

This section describes the site features, demography and land use, climate, soils, geology, hydrogeology, and surface-water hydrology.

Section 4.0 - Nature and Extent of Contamination

This section presents the results of the sampling and analysis program at the site. Included are data on the nature and extent of contamination observed in groundwater, soil, surface water, and sediments, as well as in the waste materials found on site.

Section 5.0 - Contaminant Fate and Transport

Potential contaminant migration routes, the physical and chemical properties of the contaminants as they relate to environmental fate and transport, and contaminant persistence are discussed in this section.

Section 6.0 - Human Health and Environmental Concerns

This section presents an assessment of the human health and environmental risks associated with chemical contamination currently found at the site. Applicable or relevant and appropriate regulations (ARARs) are identified for the site contaminants, actual and potential carcinogenic and noncarcinogenic risks are estimated, and an assessment of environmental hazards is presented.

Section 7.0 - Summary and Conclusions

This section summarizes the findings of the RI and sets the stage for the forthcoming Feasibility Study (FS) Report for the site.

2.0 FIELD INVESTIGATION ACTIVITIES

A number of field investigation activities were performed to address the RI objectives presented in Section 1.2 of this report. The field investigation activities, as developed in the Work Plan (Ebasco, 1988a) and the Field Operations Plan (FOP), (Ebasco, 1988b), are briefly summarized in the following section. Deviations from these documents are noted. Table 2-1 summarizes all field activities that were conducted from July 1988 until May 1989.

2.1 SURFACE FEATURES/TOPOGRAPHIC MAPPING

Topographic surveying and mapping of the Whitmoyer Laboratories Site and the surrounding area were performed by a professional land surveyor registered in the Commonwealth of Pennsylvania. The survey work included an aerial photographic survey with accompanying vertical and horizontal ground control. As a result of this work, a topographic map encompassing the area within a 2-mile by 2-mile square, with the site in the square's center, a contour interval of 10 feet, and a scale of 1 inch = 400 feet, was prepared. A second topographic map encompassing the area within a 2,000-foot by 3,200-foot rectangle, with the northeast corner of the site in the rectangle's center, a contour interval of 2 feet, and a scale of 1 inch = 100 feet, was also prepared. Two permanent survey monuments were installed on site.

The surveying subcontractor also prepared a property location map delineating the Whitmoyer Laboratories, Inc. property boundary. This boundary was based on a compilation of property maps from the appropriate local town office and/or tax assessor's maps. The property location map contains the name and addresses of each property owner and has a scale of 1 inch = 50 feet.

Upon completion of the field activities, a professional land surveyor registered in the Commonwealth of Pennsylvania surveyed the locations of surface water/sediment samples in the site vicinity; waste samples; surface soil samples; soil borings; test pits; new monitoring wells installed during the RI, as well as existing wells; and staff gauges. Pertinent survey data for these locations are presented later in this report. The locations have been accurately plotted on appropriate sample location maps.

2.2 CONTAMINANT SOURCE INVESTIGATIONS

During the course of the RI, a number of areas were identified as potential contaminant sources. These sources include the vault; consolidated and excavated lagoons; tanks and vessels; drum burial areas; laboratory wastes; miscellaneous wastes, including outdated products, paint, and used oil; and approximately 800 drums.

TABLE 2-1

FIELD INVESTIGATION SUMMARY
WHITMOYER LABORATORIES SITE,
LEBANON COUNTY, PENNSYLVANIA

Activity	Purpose	Description
Surveying	Develop horizontal and vertical ground control for site; locate well and staff gauge elevations for groundwater flow characterization; locate sampling sites; establish property boundaries.	Established surface topography; surveyed all sample locations, staff gauges, and monitoring well locations; surveyed property boundaries; developed site base maps.
Waste Sampling	Characterize wastes to allow subsequent identification and screening of remediation options.	Individual samples collected and submitted for chemical and physical analyses. Includes vault drummed material and calcium-arsenic sludge; lagoon iron-arsenic sludge and sludge/soil mixture; buried drum, tank, and vessel (piping) sampling.
Laboratory Waste Sampling and Packaging	Consolidate waste into compatible groups and characterize consolidated wastes to identify remediation options.	Laboratory waste segregated into compatible groups and consolidated into appropriate containers for transport and treatment/disposal. Selected samples collected and analyzed for chemical and physical analyses.
Drummed Waste Characterization	Characterize wastes to allow subsequent identification and screening of remediation options.	Initial drum characterization identified imminent threats posed by drummed wastes. Emergency response activities for drum removal were initiated.
Miscellaneous Wastes	Characterize wastes to allow subsequent identification and screening of remediation options.	Miscellaneous wastes, including outdated products, abandoned paint, used oil, etc., were inventoried. Since there was existing information on these wastes, no samples were collected.
Buildings	Characterize buildings to allow subsequent identification and screening of remediation options.	Individual samples of building material and equipment collected and submitted for chemical analyses, including asbestos. Wipe samples collected from building surfaces and submitted for chemical analysis. Chemical and physical analyses performed on building air. Water samples collected from roof drains and chemically analyzed.
Surface Soil Sampling	Characterize surface soils to allow for subsequent identification of remediation options.	Samples collected from onsite and offsite surface soils and submitted for chemical and physical analyses.

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TABLE 2-1
FIELD INVESTIGATION SUMMARY
WHITMOYER LABORATORIES SITE,
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Activity	Purpose	Description
Soil Borings and Test Pit Excavations	Characterize subsurface soils to allow subsequent identification and screening of soils remediation options; establish depth to bedrock throughout site.	Soil borings and test pits were excavated on site and off site. Selected soil samples submitted for chemical and physical analyses.
Monitoring Well Placement	Establish bedrock geology and hydrology, and allow for groundwater sampling.	Drilling, installation, and development of shallow, medium-depth, and deep monitoring wells.
Ecological Sampling	Identify potentially affected wetlands and characterize fish and benthic macroinvertebrate populations.	Assessed downstream locations for wetlands. Collected fish from Tulpehocken Creek and local quarries and submitted selected samples for chemical analysis. Collected benthic macroinvertebrate samples for population and diversity analyses.
Groundwater Sampling	Characterize groundwater to allow subsequent identification and screening of remediation options, using newly installed and existing monitoring wells and residential, industrial, and public supply wells located in the site vicinity.	Two separate rounds of groundwater samples collected from monitoring wells; one round of samples collected from residential, industrial, and public supply wells. Samples submitted for chemical and physical analyses.
Aquifer Testing	Characterize site hydrogeology.	Pump tests and rising head/falling head (slug) tests performed on REM III-installed, onsite monitoring wells.
Surface-Water/ Sediment Sampling	Characterize surface water and sediment to allow subsequent identification and screening of remediation options.	Two rounds of surface-water samples and one round of sediment samples collected from Tulpehocken Creek/Union Canal. One round of surface-water and sediment samples collected from nearby ponds and quarries. Samples submitted for chemical and physical analyses.

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When existing information on the 800 drums being stored at the Whitmoyer Laboratories Site was compiled, the presence of corrosive, flammable, and potentially explosive compounds was identified. Additionally, it was noted that many of the drums were badly deteriorated. At EPA's request, REM III personnel wrote a memorandum describing existing information on the drum contents and the threats they posed. Based on this information, EPA Region III initiated an emergency response action to sample, stabilize, and remove the drums for offsite treatment/disposal. This action was initiated in October 1988 and is currently ongoing. REM III personnel continued to provide technical support during the response action.

Except for the drums, each contaminant source was sampled (where appropriate) to determine whether they presented risks to human health and/or the environment. The tanks and vessels were sampled during the weeks of August 15 and November 28, 1988. Sampling and analysis of the contents of the tanks and vessels are described in the Whitmoyer Laboratories Concentrated Liquids Assessment (Ebasco, 1989). Sampling of the remaining source areas is discussed in further detail in this section.

The analytical results from the contaminant source investigations are discussed in Section 4.1. Contaminant fate and transport are discussed in Section 5.0.

2.2.1 Vault Investigation

The vault investigation objectives were to obtain a sample of the calcium-arsenic sludge for treatability testing; confirm historical reports of the presence of aniline still bottom drums, charcoal (spent carbon) drums, and calcium-arsenic sludge in the vault; visually confirm waste volume estimates; confirm reported chemical concentrations for the still bottom and sludge wastes (the two predominant wastes present in the vault); and determine the leachability of the still bottom and sludge wastes (as measured by the RCRA Toxicity Characteristic Leaching Procedure [TCLP]).

The Whitmoyer FOP (Ebasco, 1988b) proposed collecting waste samples using two borings drilled into the waste. After discussions with the drilling subcontractor, EPA's Technical Assistance Team (who previously had sampled the vault contents), and REM III personnel, EPA decided to modify the vault sample acquisition program by collecting samples with a backhoe rather than a drill. Because of the backhoe's ability to collect bulk samples and the inherent risk in sampling the vault's concentrated waste, the sampling program was modified to reduce the number of excavations from two to one.

The vault excavation was advanced on September 14 and 15, 1988, to a depth of 8.5 feet. Soil and drums apparently containing aniline still bottom tars, arsenical carbon waste, and small bottles of laboratory waste were encountered to a depth of 8.5 feet, at which point a gray sludge-like material (thought to

be the original calcium-arsenic wastewater treatment sludge) was encountered. The majority of the upper 8.5 feet of waste appeared to be the aniline still bottom tars. One grab sample each of the still bottoms and calcium-arsenic sludge were collected on September 15, 1988. A duplicate of the sludge sample was also collected. Samples were collected in accordance with the procedures specified in Section 4.1.2.2 of the Whitmoyer FOP (Ebasco, 1988b). Each sample was packaged, shipped, and analyzed under high-concentration protocols.

The three vault waste samples (including the duplicate) were analyzed for the full set of Target Compound List/Target Analyte List (TCL/TAL) parameters, plus aniline. Since the wastes were considered high-concentration, no blanks accompanied the samples.

The two vault waste samples (excluding the duplicate) were extracted using the TCLP, with the extract being analyzed for TAL metals.

In the RI/FS Work Plan, installation of well points and injection of a tracer inside the vault were proposed. Because of the low groundwater table encountered during the field activities, effective tracer testing would necessarily have involved injection of large quantities of tracer fluids into the vault. Since the arsenic in the calcium-arsenic sludge is relatively soluble and the vault walls are cracked and may allow fluid transmission through these cracks, injection of large quantities of fluids could have caused a substantial contaminant release. Therefore, EPA decided to omit the well point installation and tracer testing from the vault investigation.

Soil borings and monitoring wells drilled adjacent to the vault were also sampled as part of the RI. Sampling of these excavations is discussed in Sections 2.4 and 2.5, respectively.

2.2.2 Lagoons Investigation

A set of eight lagoons ("consolidated lagoons"), which were used first for treating process wastewater and later for settling out iron-arsenic sludge from a groundwater pump and treat program, are located in the central part of the Whitmoyer Laboratories property (see Figure 1-2). These lagoons still contain iron-arsenic sludge. Reportedly, the lagoon sludge is underlain by a thin soil or clay liner. A separate set of seven lagoons ("excavated lagoons") west of the consolidated lagoons reportedly had their contents excavated in 1976-1977; the excavated lagoons' sludge was dug out, mixed with soil (including dike material) to form a sludge/soil mixture, and placed atop the consolidated lagoons sludge. The sludge/soil mixture was reportedly capped with an unknown capping material. Reportedly, the excavated lagoons were filled with clean fill material.

2.2.2.1 Consolidated Lagoon Investigation

Objectives of the consolidated lagoon investigation include confirming historical reports of capping, sludge/soil mixture, sludge, and liner material in the lagoons; establishing chemical concentrations for these materials; determining the leachability of these materials; developing volume estimates for these materials; determining whether the capping and liner material are restricting pore water flow (due to impermeability); determining whether the lagoon material is capable of supporting increased loads, which could occur during remediation; and collecting treatability study samples of the iron-arsenic sludge and sludge/soil mixture. To collect soil samples for chemical analysis, eight soil borings (one per lagoon) were advanced in the lagoons to bedrock. These soil borings are numbered SB-47, SB-48, and SB-50 through SB-55. The borings' locations are shown on Figure 2-1. A breakdown of chemical sampling and analysis of the consolidated lagoons follows:

Analyte	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Total
Arsenic and Iron	16	1	1		18
TCL Base/Neutral/Acid Extractables (BNA) plus Aniline	24	2	2		28
TCL Volatile Organics (VOA)	8	1	1	2	12
TAL Metals	8	1	1		10
TCL Pesticide/PCBs	6	1	1		8
Cyanide	6		1		7
pH and Eh	6	1			7
TCLP Metals	8				8

These samples were collected between September 2, 1988, and September 7, 1988. Each sample was packaged, shipped, and analyzed under medium-concentration protocols.

Table 2-2 summarizes each boring, including boring depth, depth intervals sampled, sample category (cap, sludge/soil mixture, sludge, and liner), and the analysis(es) performed on each sample.

Five additional soil borings (SB-49 and SB-76 through SB-79) were advanced into the consolidated lagoons material to collect Shelby tube samples. Four tube samples each of the capping material and liner were taken, whereas two tube samples each of the sludge/soil mixture and the sludge were collected. Shelby tube samples were collected on September 2, 1988, and October 19 and 20, 1988.

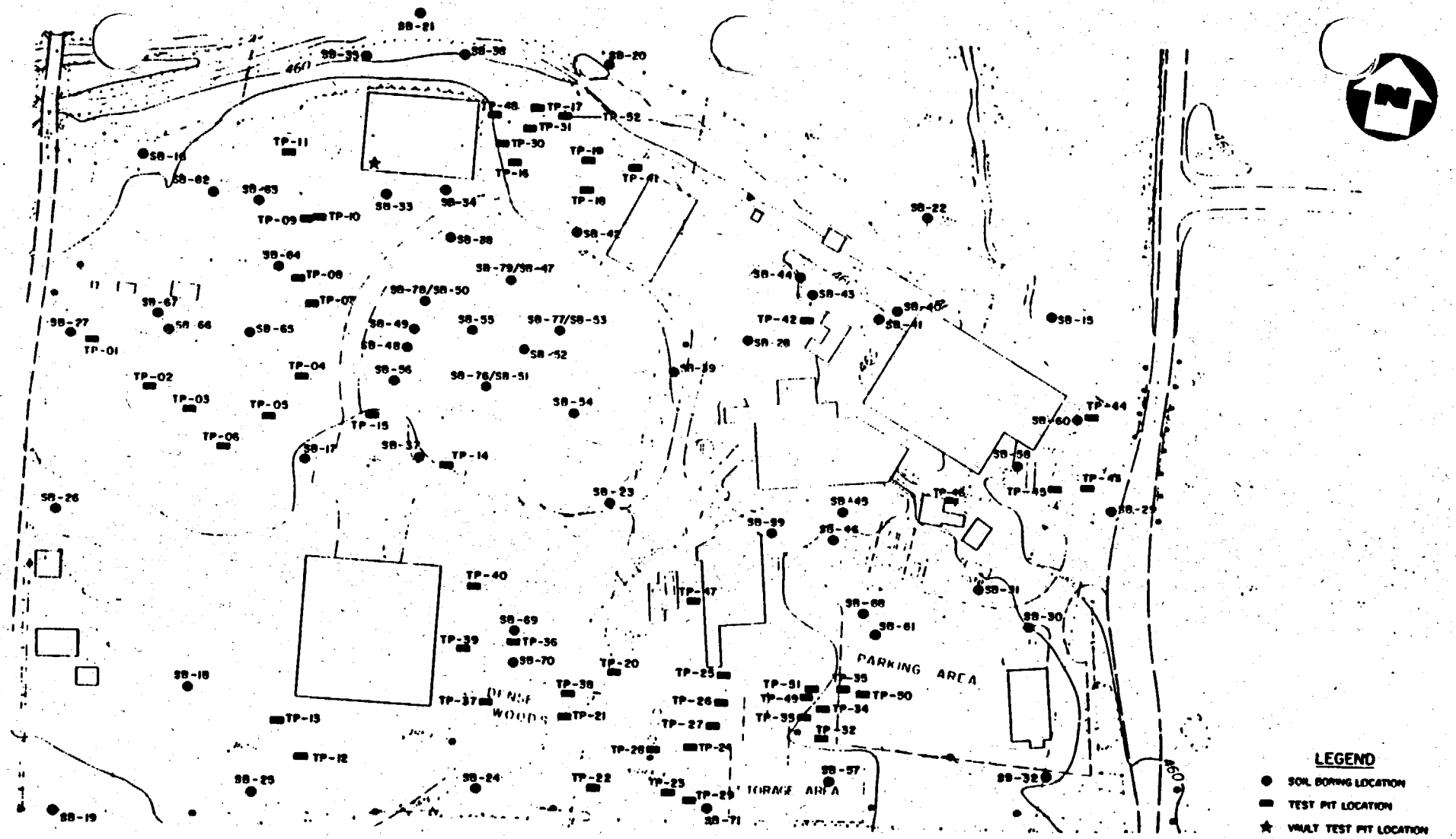

FIGURE 2-1

ONSITE SOIL BORING & TEST PIT LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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TABLE 2-2

SAMPLING SUMMARY OF CONSOLIDATED LAGOON BORINGS
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Boring No.	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-47	8.0	0.0 to 0.3 (C)		X	X		
		1.0 to 4.0 (SS)	X	X		X	X
		7.5 to 8.0 (L)		X	X		
SB-48(1)	10.0	0.0 to 0.3 (C)		X	X		
		2.0 to 4.0 (SS)		X	X		
		8.0 to 9.0 (S)	X	X		X	X
SB-49(2)	7.5	0.8 to 2.5					
		6.0 to 7.5					
SB-50(1)	6.0	0.0 to 0.3 (C)		X	X		
		2.0 to 4.0 (SS)	X	X		X	X
		5.0 to 6.0 (S)		X	X		
SB-51	12.0	0.0 to 0.3 (C)		X	X		
		2.0 to 4.0 (SS)		X	X		
		8.0 to 10.0 (S)	X	X		X	X
SB-52	9.5	0.0 to 0.3 (C)		X	X		
		6.0 to 8.0 (S)	X	X		X	X
		8.0 to 9.3 (S)		X	X		
SB-53	13.0	0.0 to 0.3 (C)		X	X		
		5.0 to 8.0 (SS)	X	X		X	X
		10.0 to 11.5 (S)		X	X		
SB-54	11.5	0.0 to 0.3 (C)		X	X		
		8.0 to 9.5 (S)		X	X		
		10.0 to 10.5 (L)	X	X		X	X

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TABLE 2-2
SAMPLING SUMMARY OF CONSOLIDATED LAGOON BORINGS
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
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Boring No.	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-55	7.5	0.0 to 0.3 (C) 2.0 to 4.0 (SS) 4.0 to 6.0 (SS)	X	X X X	X X	X	X
SB-76(2)	10.5	0.0 to 1.0 8.0 to 10.0 10.0 to 10.5					
SB-77(2)	10.0	0.0 to 1.6 4.0 to 4.8					
SB-78(2)	5.5	0.0 to 2.0 3.0 to 5.0 5.0 to 5.5					
SB-79(2)	7.0	4.0 to 6.0 6.0 to 6.7					

- Indicates no sample obtained for analysis from specific interval.
X Indicates sample obtained from specific interval for analysis.
C Indicates sample is from capping material.
SS Indicates sample is from sludge/soil material.
S Indicates sample is from sludge material.
L Indicates sample is from liner material.

(1) Additional samples obtained from each sample interval for pesticide/PCB, Eh, pH, and cyanide analysis.
(2) Samples obtained from each sample interval for geotechnical analyses.

The Work Plan called for analysis of the four capping samples for unit weight/water content, grain size distribution, specific gravity, Atterberg limits, and triaxial permeability. All four samples of the capping material were analyzed for unit weight/water content, and triaxial permeability. However, because of an insufficient amount of sample, only two samples were analyzed for grain size distribution, whereas no analyses of specific gravity and Atterberg limits were completed.

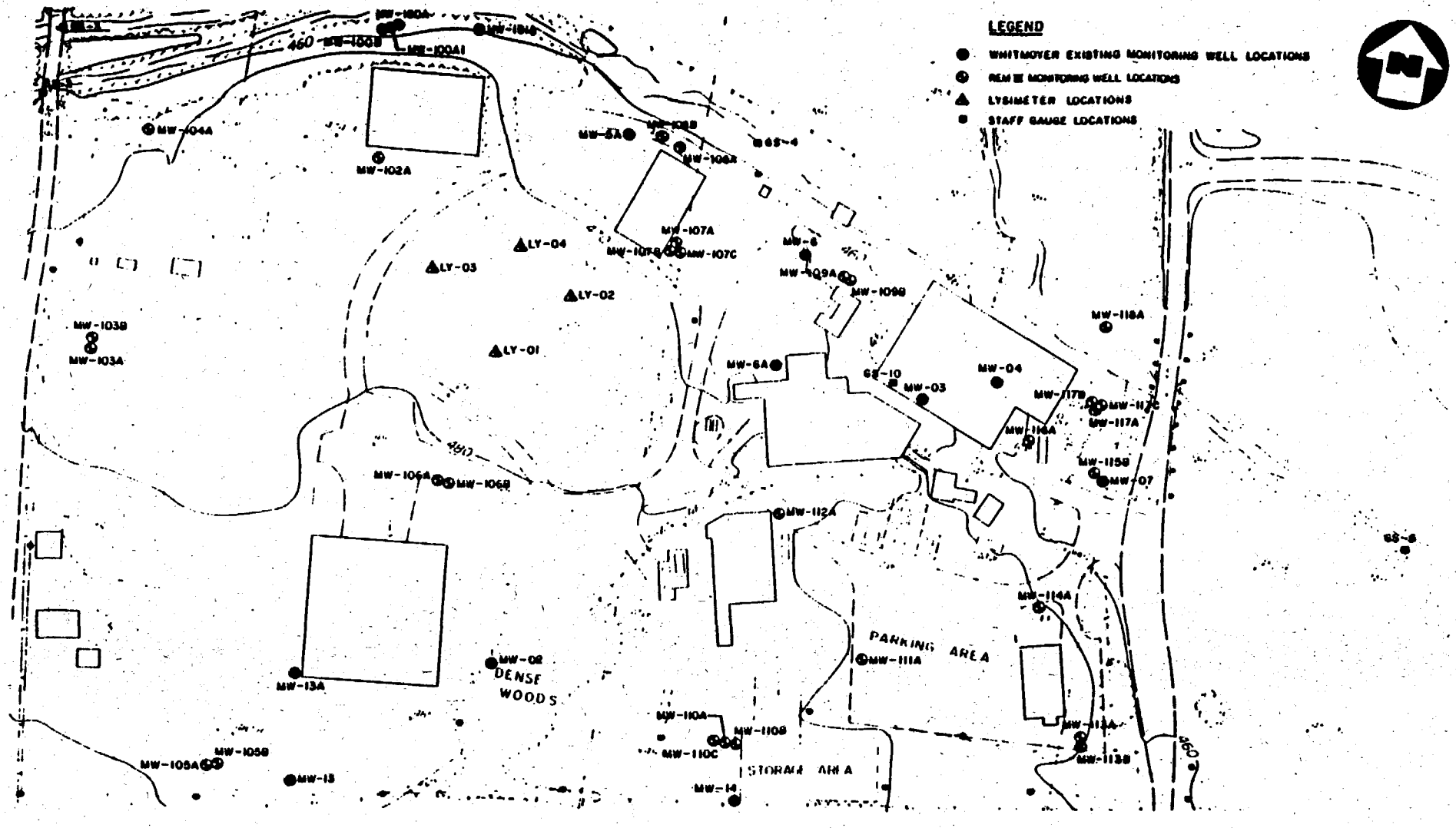
All of the sludge/soil mixture and sludge samples were analyzed for unit weight/water content, one-dimensional consolidation, grain-size distribution, and specific gravity. Each of the two sludge samples and one of the two sludge/soil mixtures were tested for unconfined compressive strength. There was insufficient sample recovery in the other sludge/soil mixture Shelby tube to perform this test.

Of the four attempted liner samples, only two Shelby tubes (from SB-76 and SB-79) contained liner material. In the other tubes, no liner was present between the sludge and underlying bedrock. The liner samples were analyzed for unit weight/water content and triaxial permeability. There was insufficient sample to perform the planned grain-size distribution and specific gravity analyses.

Four vacuum pressure lysimeters were installed within the consolidated lagoon wastes (two each in the sludge and sludge/soil mixture) to sample pore water concentrations. Each lysimeter was installed in conjunction with the collection of the thin-walled tube samples (Shelby tubes). When drilling activities commenced, a team geologist carefully recorded lithology changes and other pertinent data of the test boring. Once the sludge/soil and sludge materials were encountered, lysimeter installation depths were selected.

Each lysimeter boring was backfilled to the desired depth with a silica flour slurry. Once the silica flour backfill was in place, the lysimeter was placed into the boring. (Prior to installation, each lysimeter was decontaminated and tested to ensure it was in working condition.) The silica flour slurry was then placed around the lysimeter to a depth of approximately 5 inches above the lysimeter intake. At this point, a 1-foot bentonite seal was placed on top of the silica flour slurry. The remainder of the boring was backfilled with a cement/bentonite grout. To complete lysimeter installation, a protective steel casing with a locking cap was placed around the lysimeter stick-up. Figure 2-2 illustrates the locations of the four vacuum lysimeters.

The four vacuum lysimeters were scheduled for sampling during each round of groundwater sampling. However, for unknown reasons, all four lysimeters produced insufficient quantities of water for sampling, and no samples were collected. (Iron from the iron-arsenic sludge material may have clogged the lysimeter



ONSITE MONITORING WELL LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

FIGURE 2-2

0 100 200
SCALE IN FEET

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openings.) In April 1989, REM III personnel tried once again to sample the lysimeters, but were unsuccessful.

Soil borings/test pits and monitoring wells excavated adjacent to the consolidated lagoons are discussed in Sections 2.4 and 2.5.

2.2.2.2 Excavated Lagoon Investigation

The objectives of the excavated lagoon investigation include verifying the removal of the iron-arsenic sludge from the lagoons and establishing contaminant concentrations for the material used to fill the lagoons. To meet these objectives, eight test pits and five soil borings were advanced at the former lagoon locations to bedrock. The test pits are numbered TP-1 through TP-5, and TP-8 through TP-10, whereas the soil borings are numbered SB-62 through SB-64, SB-66, and SB-67. SB-65 is the site of a surface soil sample in the lagoon area. The excavation locations are shown on Figure 2-1. Table 2-3 is a summary of samples collected.

Excavated lagoon samples collected for chemical analysis include the following:

Analyte	Arsenic/ Iron	TCL VOA	TCL BNA plus Aniline	TAL Metals	TCLP Metals
Number of Samples(1)	20(2)	3	3	3	3

(1) Blanks collected with these samples are discussed in the soils investigation section (Section 2.4).
(2) Includes one duplicate.

All samples were packaged, shipped, and analyzed under low-concentration protocols.

Soil borings, test pits, and monitoring wells excavated adjacent to the former locations of the excavated lagoons are discussed in Sections 2.4 and 2.5, respectively. The analytical results from the excavated lagoons investigation are discussed in Section 4.1.2.

2.2.3 Buried Drum Investigation

At the time RI fieldwork began, site records indicated that buried drums might be present at the Whitmoyer Site. One of the objectives of the test pitting program developed for the RI was to determine whether buried drums were present. If buried drums were uncovered, investigation objectives included determining the drum burial extent, ascertaining whether these drums had leaked, and collecting samples of any concentrated wastes remaining.

The excavations uncovered two drum burial areas, one 100 feet east of the vault (Burial Area 1) and one adjacent to the buried

TABLE 2-3

EXCAVATED LAGOONS SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Excavation No.	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-62	3.0	0.0 to 0.3 2.0 to 3.0			X X		
SB-63	3.5	1.5 to 2.5	X	X		X	X
SB-64	3.5	2.0 to 2.5			X		
SB-65*	0.0	0.0 to 0.3			X		
SB-66	6.0	2.0 to 4.0			X		
SB-67	5.0	0.0 to 0.3 3.0 to 4.5	X	X	X	X	X
TP-01	3.0	3.0			X		
TP-02	3.1	0.0 to 0.3 3.0			X X		
TP-03	3.0	2.0 3.0	X	X	X	X	X
TP-04	8.7	0.0 to 0.5 3.0 to 3.4 8.0 to 9.0			X X X		
TP-05	7.0	6.0 to 7.0			X		
TP-08	4.0	0.0 to 0.5 3.5 to 4.0			X X(1)		
TP-09	7.0	3.7 to 3.9			X		
TP-10	5.0	0.0 to 0.5 3.4 to 3.6			X X		

* Surface sample only.
X Indicates sample obtained from specific interval for analysis.
(1) Indicates duplicate sample collected.

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drum landfill reportedly cleaned up by Whitmoyer Laboratories, Inc. in 1979 (Burial Area 2--see Figure 1-2). Five test pits (TP-17, TP-30, TP-31, TP-48, and TP-52) were excavated at Burial Area 1 (BA-1) to determine the buried drum extent. Two of the five test pits (TP-17 and TP-31) encountered buried metal drums. The full extent of the buried drums at BA-1 could not be determined, since the burial area extended beneath a 5,000-gallon tanker truck full of concentrated liquids. Based on visual observation, approximately 20 drums appear to be buried at BA-1. Since the investigators were unable to excavate near or under the tank truck, this figure is only a rough estimate. All of the drums appeared to contain a black oozing tar with a creosote-like odor.

Three samples were collected from BA-1, one of the black tarry material and two from fill material above the buried drums. The samples were collected on September 21, 1988 (from TP-17). The tar sample was submitted as a duplicate and analyzed for TCL VOAs, TCL BNA plus aniline, TAL metals, and TCLP metals (no duplicate). The fill samples were analyzed for arsenic, iron, and BNA plus aniline. Each sample was packaged, shipped, and analyzed under low-concentration protocols.

The remaining test pits served as observation trenches. No samples were collected from these excavations.

Buried metal drums were first uncovered at BA-2 by REM III personnel on September 15, 1988, while excavating a sump for collecting drilling water generated from monitoring wells MW-110A, MW-110B, and MW-110C. Ten test pits (TP-20 through TP-29) were completed to delineate the extent of Burial Area 2.

Buried metal drums were uncovered only in TP-24 (which was located adjacent to the drilling sump). Unlike the buried drums uncovered in 1979, which reportedly contained arsenical waste products, the drums uncovered by the REM III Project Team appeared to be empty. The burial area appeared to be a small landfill of crushed, discarded drums. A fish oil odor was noted while digging TP-24. It is possible that some of the discarded drums once contained sludge from fish oil tanks.

Black staining was noted on the limestone bedrock at the base of TP-24 (3.3 feet deep). The stained material was sampled for arsenic, iron, and BNA plus aniline.

A second sample from TP-24 was collected from a 3-inch black layer of fill material located near the ground surface. This material appears unrelated to the drums. This sample was also analyzed for arsenic, iron, and TCL BNA plus aniline. Each sample was packaged, shipped, and analyzed under low-concentration protocols.

Samples were also collected from most of the other test pits in the buried drum vicinity. These samples are discussed in Section 2.4.

2.2.4 Laboratory Waste Investigation

At the time the RI/FS Work Plan was prepared, the presence of laboratory wastes and product batch samples (hereafter "laboratory wastes") on the first floors of Buildings 2 and 8 was known. During the course of the buildings investigation, additional laboratory wastes were identified in Buildings 4, 5, and 10 and on the second floor of Building 8. Most of the laboratory waste containers were clearly labeled, although the contents of some containers could not be ascertained.

A laboratory waste packaging subcontractor was procured by REM III to package these wastes for ultimate disposal. Subcontractor duties included performing field tests on unknown wastes, segregating wastes into compatible groups, consolidating compatible wastes into appropriate containers, and labeling the containers in accordance with U.S. Department of Transportation (DOT) regulations for offsite shipment. Packaging activities commenced on March 29, 1989, and were completed on May 26, 1989.

No containers of unknown (unlabeled) solids were encountered. One prominent solid waste, labeled feed grain, was chemically analyzed in a REM III laboratory using the RCRA Extraction Procedure (EP) Toxicity testing procedure to determine whether it was a RCRA characteristic hazardous waste.

Thirty-five unlabeled containers with liquids were field-analyzed to determine their waste classification. Once the unknown liquids were classified (as, for example, a nonaqueous flammable liquid or an aqueous acid), the liquids were consolidated with other compatible liquids.

Concentrated hazardous wastes (e.g., RCRA listed wastes) were generally laboratory-packed in fiber drums. Fiber drums were used, since incineration is a likely remediation alternative. The remaining wastes were packaged in DOT Specification 17-H drums. Drums containing potentially corrosive wastes were also lined with a polyethylene liner.

Some waste oxidizers needed to be laboratory-packed. The remaining waste oxidizers (e.g., nitrates and nitrites) were added to 55-gallon drums nearly full with water to stabilize them. The oxidizer-water mixture was sealed in the drums to await ultimate disposal.

Following completion of the consolidation activities, the containers (drums) were staged in Building 5 (outside of the Tulpehocken Creek flood plain).

One hundred ninety (190) laboratory waste containers, including 26 labpacks, were filled during the packaging effort. Container contents are discussed in Section 4.1.4.

2.2.5 Miscellaneous Waste Activities

When the REM III Project Team entered the buildings as part of the field investigation, a large quantity of miscellaneous wastes, including unsold outdated products, old paint, used oil, corn meal (which was used to clean out piping), and unused product feedstocks that had been abandoned by Whitmoyer Laboratories, Inc., was discovered. To develop disposal options for these wastes, a miscellaneous waste inventory was taken during the period of October 11-13, 1988. Since nearly all of the miscellaneous wastes were clearly labeled, no samples were collected.

Miscellaneous liquid wastes are included as part of the Whitmoyer Laboratories Site's concentrated liquids operable unit. The inventory and classification of these liquids are discussed in the Concentrated Liquids Assessment (Ebasco, 1989). The inventory of miscellaneous solid wastes is presented in Section 4.1.5.

2.3 BUILDING INVESTIGATIONS

During the time the RI/FS Work Plan was prepared, conditions within the 17 buildings were not well known. With the then-current data base, a building sampling program was developed in which 158 wipe samples, 10 asbestos samples, 12 air samples, and 7 samples of roof runoff [exclusive of quality assurance/quality control (QA/QC) samples] were to be collected. Once the buildings were entered, however, the deteriorated building conditions dictated the need to modify the building sampling program. Based upon visual observations and the need to evaluate building material and equipment remediation options, the building sampling program was modified. Such modifications included reducing the number of wipe sample stations from 156 to 63 and adding 52 building material (and equipment) samples, 36 additional air samples, and 18 additional asbestos samples (exclusive of QA/QC samples).

The revised sampling program is discussed below. Soil borings/test pits and monitoring wells located adjacent to the buildings are discussed in Sections 2.4 and 2.5, respectively. The analytical results from the building investigations are discussed in Section 4.2.

2.3.1 Air Sampling

In the RI/FS Work Plan, the proposed air sampling program consisted of sampling the production buildings for aniline, and sampling Building 5 for methyl bromide, which was used as a fumigant there. These samples were proposed primarily for personnel health and safety objectives; Level C organic vapor cartridges are not approved by the National Institute for Occupational Safety and Health (NIOSH) for filtering aniline or methyl bromide.

When the buildings were entered, positive HNU (up to 50 ppm) and Organic Vapor Analyzer (OVA) readings (greater than 10 ppm) were detected. The buildings' dust and grime buildup and abandoned chemicals appeared to present inhalation health risks, if no action were taken. To quantify these risks and establish baseline air concentrations, a second phase of air sampling was added to the field investigation program. Air samples using high-volume (Hi-Vol) air samplers were collected and analyzed for arsenic, TCL BNA plus aniline, TCL pesticide/PCBs, and TAL metals.

2.3.1.1 Aniline and Methyl Bromide Sampling

Air samples for aniline and methyl bromide analyses were collected during the week of August 15, 1988. Thirteen air samples, including one duplicate, one matrix spike sample, and one field blank, were submitted for aniline analysis. All but two of the aniline samples were collected with SKC Model 222-4, low-flow, personal air sampling pumps. These pumps were equipped with manifolds to facilitate duplicate sample collection. The sampling pump flow rate varied between 60 and 76 cubic centimeters per minute (cc/min). Sampling time averaged 400 minutes. The other two aniline samples (Stations 6 and 7) were collected with Gillian pumps. Each pump's flow rate varied between 70 and 75 cc/min. Sampling duration was 400 minutes. Samples were collected in 75/150 mg silica gel tubes. The aniline samples (along with 18 clean silica gel tubes for laboratory spiking) were packaged, shipped, and analyzed using low-concentration protocols. Aniline sampling stations were as follows (see Figure 1-2 for building locations):

Station Number	Station
1	Second floor doorway between Buildings 2 and 3
2	Building 2, First floor
3	Building 1, First floor
4	Building 6, First floor
5	Building 8, First floor
6	Building 3, First floor
7	Building 7, First floor
8	Building 1, Second floor
9 (1)	Building 2, First floor
12	Building 5, Third floor

(1) Duplicate and matrix spike samples also collected here.
Note: There are no Stations 10 and 11.

Six air samples, including one duplicate, one matrix spike, and two field blanks, were submitted for methyl bromide analysis. The methyl bromide samples were collected with SKC Model 222-4, low-flow, personal air sampling pumps with manifolds. Sampling flow rate averaged 50 cc/min. Sampling duration was 220 minutes. Each sample was collected in a 400 mg petroleum-based charcoal tube and a 200 mg petroleum-based charcoal tube arranged in series. Thus, one sample consisted of one of each type of tube. The methyl bromide samples (along with 18 each 200 mg and 400 mg clean tubes for laboratory spiking) were packaged, shipped, and analyzed using low-concentration protocols.

Methyl bromide sampling stations were as follows:

Station Number	Station
13 (1)	Building 5, Third floor
16	Building 8, First floor

(1) Duplicate and matrix spike samples also collected here.
Note: There are no Stations 14 and 15.

All sampling pumps were calibrated prior to each use. Aniline and methyl bromide air sampling results are presented in Section 4.2.

2.3.1.2 Hi-Vol Sampling

Sampling using high-volume (Hi-Vol) filter/polyurethane foam (PUF) plug samplers was performed as part of the air monitoring program to measure ambient arsenic, other TAL metal, BNA extractable plus aniline, and pesticide/PCB concentrations in building air. Forty-four samples, including four duplicates (collocated samples) and four field blanks (samples which were placed in the Hi-Vol sampler for extended periods of time without the Hi-Vol sampler operating), were collected from 18 air sampling stations. Table 2-4 summarizes air samples collected during the RI program. Analytical and sample weighing results are presented in Section 4.2.

"Micro-quartz" Hi-Vol filters, which were used to collect TAL metal and arsenic samples, were preconditioned using procedures outlined in Appendix B of 40 CFR Part 50.11. Preconditioning was performed in a temperature- and humidity-controlled environmental chamber. Each filter was weighed on a calibrated balance. Standard weight, tare weight, zero and calibration checks were done routinely. Preparation of PUF cartridges, which were used for BNA extractable plus aniline and pesticide/PCB samples, was in accordance with steps outlined in Method TO-4 (EPA, 1984a). Extraction with acetone and placement in a water-aspirated vacuum oven for drying came first. Next, each plug was tightly sealed in a container, labeled, and shipped to the site.

TABLE 2-4

HI-VOL SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Sample Number	Sample Station (Building/ Floor)	Analyte(s)
AS0017-1	8/1	Arsenic, TCL BNA plus aniline
AS0018-1	5/3	Arsenic, TCL Pesticides/PCBs
AS0019-1D(1)	5/1	Arsenic, TCL BNA plus aniline
AS0020-1	1/1	Arsenic, TCL BNA plus aniline
AS0017-2	8/1	Arsenic
AS0022-1	1/2	Arsenic
AS0019-1	5/1	Arsenic
AS0021-1D	6/1	Arsenic, TCL BNA plus aniline, TCL Pesticides/PCBs
AS0018-2	5/3	Arsenic
AS0021-1	6/1	Arsenic, TCL BNA plus aniline, TCL Pesticides/PCBs
AS0005-1F(2)	6/1	Arsenic
AS0023-1	8/1	Arsenic
AS0024-1	5/2	Arsenic
AS0025-1	3/1	Arsenic
AS0022-2	1/2	Arsenic
AS0021-1	6/1	TAL metals
AS0021-1D	6/1	TAL metals
AS0023-2	8/1	Arsenic
AS0024-2	5/2	Arsenic
AS0025-2	3/1	Arsenic
AS0020-2	1/1	Arsenic
AS0021-2	6/1	Arsenic
AS0026-1	6/2	Arsenic

TABLE 2-4
HI-VOL SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Sample Number	Sample Station (Building/ Floor)	Analyte(s)
AS0027-1	9/1	Arsenic
AS0028-1	11/1	Arsenic
AS0029-1	3/2	Arsenic
AS0030-1	2/1	Arsenic
AS0030-1D	2/1	Arsenic
AS0026-2	6/2	Arsenic
AS0027-2	9/1	Arsenic
AS0028-2	11/2	Arsenic
AS0029-2	3/2	Arsenic
AS0032-1	7/1	Arsenic
AS0030-1	2/1	TAL metals
AS0031-1	2/2	Arsenic
AS0006-1F	2/1	TAL metals
AS0007-1F	2/2	Arsenic
AS0034-1	10/2	Arsenic
AS0033-1	10/1	Arsenic
AS0031-2	2/2	Arsenic
AS0032-2	7/1	Arsenic
AS0033-1	10/1	TAL metals
AS0034-2	10/2	Arsenic
AS0004-1F	6/1	TCL Pesticides/PCBs, TCL BNA plus aniline

(1) D = Duplicate (collocated) sample
(2) F = Field Blank

The air monitoring program utilized six Hi-Vol/PUF samplers. The Hi-Vol/PUF samplers were calibrated prior to and at the completion of the sampling program, in accordance with procedures outlined in Method TO-4 (EPA, 1984a). Using a five-point calibration procedure, the pressure drops across the calibration orifice were recorded and converted into flow rates from an accompanying calibration curve. A graph of flow rate versus magnehelic gauge reading (pressure drop) was drawn for later volume calculations. Each sampler's timer and motor clock were also checked using a stop watch. Pre-sample, one-point calibrations included referencing flow rates from the initial five-point calibration curve and comparing with the flow rate obtained using a dummy head. In addition, a visual inspection of the sampling equipment was done before and after each sampling period.

The Hi-Vol "Micro-quartz" filters and PUF cartridges were handled using procedures outlined in Method TO-4 (EPA, 1984a). This included use of polyester gloves, forceps, and properly sealed containers.

After proper installation of filters and plug cartridges by previously referenced methods, the samplers were run in accordance with General Metal Works, Model PS-1, Hi-Vol Sampler Operating Instructions. The sampler was usually placed in the center of a room. During sampling the exhaust hose was extended through a window to prevent air recycling. Sampling periods were typically eight hours long and were scheduled at various times of day.

All calibration, filter weighing, and sampling events were recorded in log books and on record forms.

2.3.2 Wipe Sampling

Wipe sampling was performed as part of the process building investigation to determine whether surface buildup due to manufacturing is a threat to human health and whether there is a need for building surface decontamination. Originally, wipe sampling at 156 points was proposed; because of visual observations made during building entry, it was determined that fewer samples would be required for investigation. Sixty-three wipe sample stations were sampled. Samples were obtained from ceilings, floors, and walls of selected areas. Table 2-5 provides a summary of wipe samples collected. Wipe samples were collected on November 10 and 11, 1988.

Wipe sampling was performed in accordance with approved EPA methods (EPA, 1987) and Section 4.2.4 of the FOP (Ebasco, 1988b). Unbiased grab samples were collected by rubbing the surface of moistened filter paper over a circumscribed area of 100 cm^2. Various types of filter paper and moistening solutions were used, based upon analytical parameters. For collecting metal samples, Whatman 541 filter paper moistened with deionized water was used. For collection of organic samples, a glass

TABLE 2-5

WIPE SAMPLE SUMMARY(1)
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Building Number	Floor(s) Sampled	Area(s) Sampled(2)	Analysis
1	1st, 2nd	W, C, F	Arsenic, BNA/Aniline
2	1st, 2nd	W, C, F	Arsenic, BNA/Aniline
3	1st, 2nd	W, C, F	Arsenic, BNA/Aniline
4	1st	W, F	Arsenic, BNA/Aniline
5	1st, 2nd 3rd 3rd	W, C, F W, C* F	Arsenic, BNA/Aniline Arsenic, BNA/Aniline Arsenic, BNA/Aniline Pesticides/PCBs
6	1st 1st 2nd 3rd	W, C F W, C, F W	TAL Metals, BNA/Aniline TAL Metals, BNA/Aniline Pesticides/PCBs Arsenic, BNA/Aniline Arsenic, BNA/Aniline
7	1st	W, C, F	Arsenic, BNA/Aniline
8	1st 2nd	W, F W, C, F	TAL Metals, BNA/Aniline Arsenic, BNA/Aniline
9	1st	W**, C, F**	Arsenic, BNA/Aniline
10	1st 2nd 2nd	W, C, F F C, W	Arsenic, BNA/Aniline TAL Metals, BNA/Aniline Arsenic, BNA/Aniline
11	1st	W, C, F	Arsenic, BNA/Aniline
18	1st	W**, C, F**	Arsenic, BNA/Aniline

* Third-floor ceiling sample was obtained from the grain chute.
** Two different samples obtained.
(1) Exclusive of QA/QC samples.
(2) W = Wall
C = Ceiling
F = Floor

fiber filter moistened with a 1:4 acetone/hexane mixture was used. After each sample was obtained, the paper was placed into a clean bottle and sent to the laboratory for analysis. A wipe sampling program summary follows:

Analyte	Samples	Duplicates	Dip Blanks	Total
Arsenic	57	3	3	63
TAL Metals	6	1	1	8
TCL BNA plus aniline	63	3	3	69
TCL Pesticide/PCBs	2	1	1	4

Dip blanks were collected by moistening clean sheets of the appropriate filter paper with the corresponding wetting solution (e.g., TAL metals and arsenic dip blanks were collected by moistening Whatman 541 filter paper sheets with deionized water) and placing the wetted paper directly in a clean sample bottle. The wipe samples were packaged, shipped, and analyzed under low-concentration protocols.

2.3.3 Building-Material Sampling

Building-material (and equipment) sampling was not part of the field investigation program presented in the RI/FS Work Plan. Based on the need to better define proper remediation options for these materials, a building-material and equipment sampling program was developed and added to the field investigation. This program was designed to establish leachable concentrations of arsenic, other TAL metals, BNA plus aniline, and pesticides/PCBs for building materials (e.g., wood, brick, and concrete block) and equipment at the site. The TCLP was used to estimate the leachate generation potential for these materials. TAL metal concentrations were also measured for selected samples to determine the amount of metals present in the materials and to allow comparisons between the total and leachable metal concentrations.

Fifty-two (52) grab building materials and equipment samples were collected from 11 buildings between November 7 and 10, 1988. Sample locations are presented in Table 2-6. Samples were collected from walls, ceilings, floors, and equipment, using appropriate decontaminated equipment (e.g., wood chisels, jackhammers, and drills). Only material fragments less than 1.5 inches in diameter were submitted for laboratory analysis. This practice was instituted at the request of the EPA Contract Laboratory Program (CLP) laboratories performing analyses on the material. Once collected, samples were placed into clean jars and sent to the laboratory for analysis.

TABLE 2-6

BUILDING MATERIAL SAMPLE SUMMARY(1)
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Bldg. Number	Floor(s) Sampled	Area(s) Sampled(2)	Analysis
1	1st 2nd	W, C*, F W	TCLP Arsenic, BNA and Aniline TCLP Arsenic
2	1st 2nd	W, C*, F W, F	TCLP Arsenic TCLP Arsenic
3	1st 2nd	W, C*, F W	TCLP Arsenic TCLP Arsenic
4	1st	W, F	TCLP Arsenic
5	1st, 2nd 3rd 3rd 4th (grain tower)	W, C, F W F F	TCLP Arsenic TCLP Arsenic TCLP Arsenic, Pesticides/PCBs TCLP Arsenic
6	1st 1st 1st 2nd, 3rd	F PV W, C* W	TCLP Metals, TAL Metals, TCLP BNA and Aniline, TCLP Pesticides/PCBs TCLP metals and TAL Metals TCLP Metals, TAL Metals, TCLP BNA and Aniline TCLP Arsenic
7	1st	W, C, F	TCLP Arsenic
8	1st 2nd	W, F W, C, F	TCLP Metals, TAL Metals TCLP Arsenic
9	1st	W**, C, F**	TCLP Arsenic
10	1st, 2nd	W, C, F	TCLP Arsenic
11	1st	W, C, F	TCLP Arsenic

* Sample represents ceiling of the first level and floor of second level
** Two different areas sampled
(1) QA/QC samples are not indicated
(2) W = Wall
C = Ceiling
F = Floor
PV = Process vat

Building material and equipment samples were analyzed as follows:

Analyte	Samples	Duplicates	Rinsate Blanks	Total
TCLP Arsenic	46	3		49
TCLP Metals	6	1		7
TCLP BNA plus Aniline	6	1		7
TCLP Pesticides/PCBs	2	1		3
TAL Metals	5	1	1	7

The building material (and equipment) samples were packaged, shipped, and analyzed under low-concentration protocols.

2.3.4 Asbestos Sampling

An asbestos survey was conducted to identify the locations of asbestos-containing materials (ACM) and to determine their extent and condition. Asbestos sampling was performed on December 1, 1988, and December 19, 1988. During these dates, bulk samples were collected to verify asbestos content of material suspected of containing asbestos. The condition and extent of the suspect materials were visually verified and estimated.

The actual technique used to collect the samples was as follows:

- The area where the sample was taken was moistened with water to reduce fiber release.
- The sample was extracted using a clean knife. All layers of the material were included in the sample. Approximately 1 square inch (surface area) of material was collected for each sample.
- The sample was then placed in the container and again sprayed with water. The container was then sealed air tight.
- The sampling tools were then decontaminated using a water spray and then wiped off with a cloth.
- The hole where the sample was extracted was sprayed with adhesive to reduce fiber release and then sealed with duct tape.
- For easy identification, the sample number was then spray painted on the location where the sample was taken.

Pertinent information, including sample number, probable type of ACM (e.g., transite), sample location, condition of probable ACM, and amount of suspected ACM, was recorded in the field logbook.

Twenty-eight bulk asbestos sampling stations were sampled during the survey. Sampling locations are shown on Table 2-7. Bulk samples were analyzed by the current EPA polarized light microscopy protocol (EPA, 1982a). All samples were packaged, shipped, and analyzed using low concentration protocols.

2.3.5 Roof-Drain Sampling

Documents in the site files indicate that high arsenic concentrations were present in roof runoff (WLI, 1975; WLI, 1976a). To determine whether present-day rain runoff from the roof of the Building 1-7 complex contains elevated levels of arsenic and BNA organics plus aniline, a roof-drain sampling program was developed. To meet this objective, the RI/FS Work Plan required sampling rain spouts during a rain event, if possible. However, during the course of the field investigation, it did not rain sufficiently to cause significant roof runoff. As a result, an artificial rain event was created by hosing down the roof with potable water from the Myerstown Municipal Water Authority. As the roof of the process building complex was hosed down, team members collected water from each roof drain sampling point (Figure 2-3). The roof area of each sample was hosed down for a minimum of five minutes prior to collecting each sample to avoid sampling initial "shock levels" with higher levels of suspended solids. To ensure homogeneous samples, roof runoff was first collected in a large clean bottle, then transferred to the appropriate sample bottles. Samples were not field filtered.

Sampling teams collected six roof drain samples (exclusive of QA/QC samples), on November 16, 1988. All six samples were analyzed for arsenic. Two of the six samples were also analyzed for BNA plus aniline. Sample stations and analyses performed were as follows:

Process Building Complex	
Sample Location	Analysis
1	Total Arsenic
2	Total Arsenic
3 (1)	Total Arsenic, BNA/Aniline
4	Total Arsenic
5	Total Arsenic, BNA/Aniline
6	Total Arsenic

(1) Duplicate samples for arsenic and BNA/aniline were also collected at this station.

Note: A potable water blank was also analyzed for total arsenic and BNA plus aniline.

TABLE 2-7

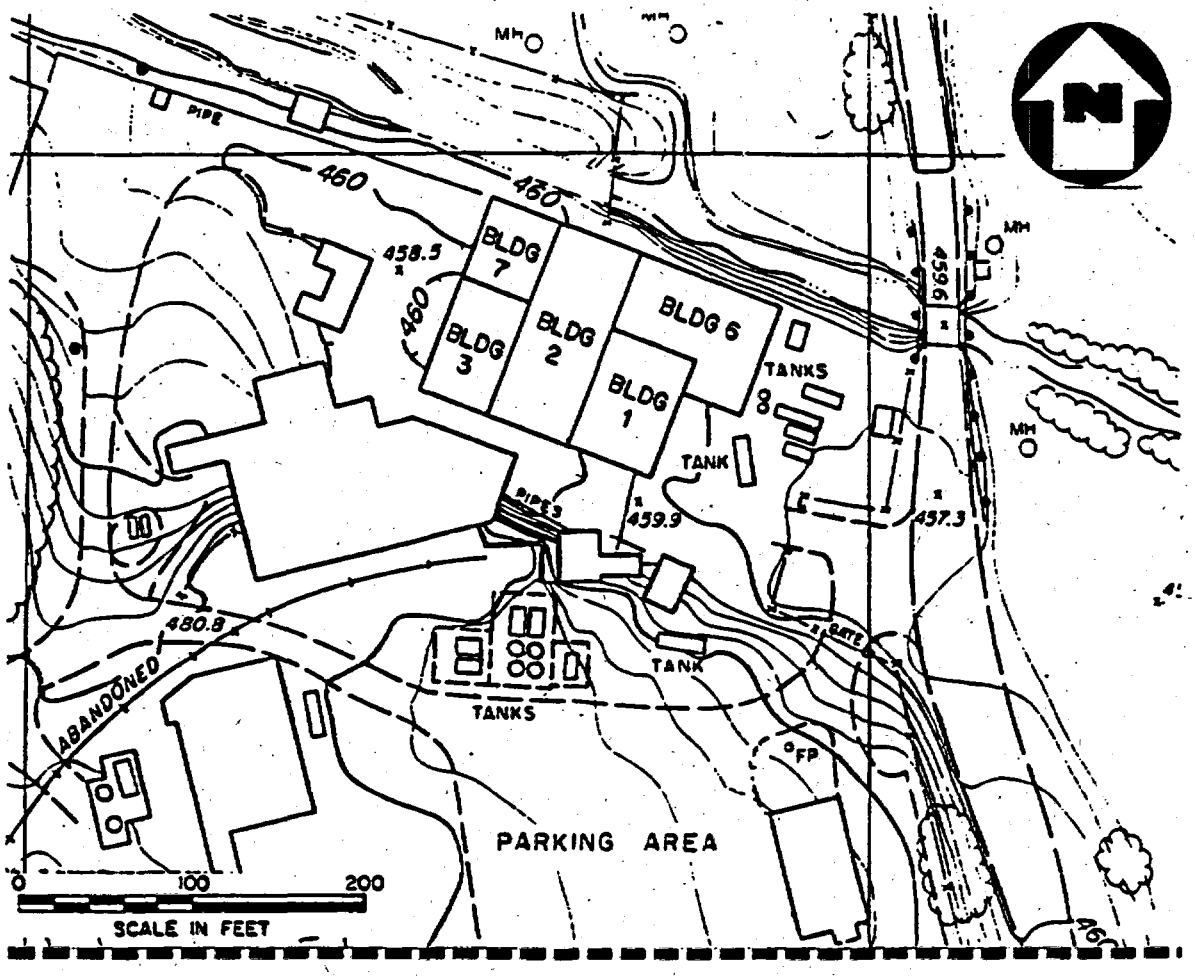
ASBESTOS BULK SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Building Number	Sample Location and Description
10	Ceiling tile above stairwell, east side, first floor
10	Second floor laboratory, floor tile
10	Second floor laboratory, transite oven lining
10	Second floor laboratory, ceiling tile
10	First floor, pipe elbows in men's locker room (above ceiling)
6	First floor, southeast corner next to stairwell, 2-inch pipe that runs along south wall
6	First floor pipe south side near Tanks 62 and 60 (white wrap insulation)
6	First floor pipe south side near Tanks 62 and 60 (brown wrap insulation)
1	Two-inch pipe on the second floor(1)
2	Second floor, 3-inch pipe running along south wall (air cell)
2	Ten-foot section of air cell above entrance between Buildings 1 and 2
2	Fourteen-foot section of pipe running east and west from heating unit
2	Piping from boiler No. 3 - north end of building
7	Storage tank on west side of building (north tank)
7	Storage tank on west side of building (south tank)
5	Four-inch riser along south wall on third floor
11	Floor tile in building
9	Northeast office - 2 risers attached to heater (metal jacket)(1)
9	Two-inch riser on second floor against north wall
8	Tar-papered line that runs between Buildings 5 and 8, contains 2 lines (brown line)
8	Tar-papered line that runs between Buildings 5 and 8, contains 2 lines (white line)

TABLE 2-7
ASBESTOS BULK SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Building Number	Sample Location and Description
4	Twelve-inch-diameter pipe around boiler with metal jacket(1)
4	Insulation on boiler
14	Insulation on large tank
14	Three-inch steam line along east wall
14	Six-inch steam condensate line outside northeast corner
14	Four-foot x two-foot tank insulation outside northeast corner
1	Four-inch pipe outside (east of) Building 1 next to aniline/PCE tank

(1) Duplicate sample collected here



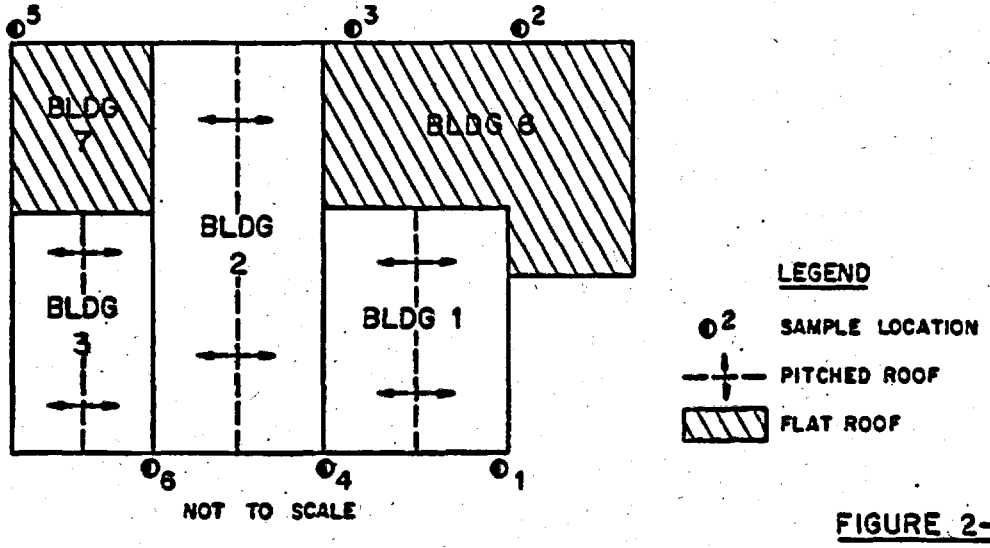


FIGURE 2-3

ROOF DRAINAGE SAMPLE LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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The roof drain samples were packaged, shipped, and analyzed under low-concentration protocols.

To determine contaminant contribution, if any, to the roof drain samples from the potable water supply and/or the water transmission system (the hose, etc.), field blanks were prepared by directing the potable water directly into clean sample containers.

2.4 SOIL INVESTIGATIONS

The soils investigation was performed to obtain surface and subsurface soil samples for physical and chemical analysis to achieve the following objectives:

- Determine the extent of onsite and offsite surface soil contamination.
- Determine the extent of onsite and offsite subsurface soil contamination.
- Determine whether previously unknown concentrated wastes were buried on site.
- Define contamination "hot spots."
- Determine background levels of contamination, especially for inorganics.

To achieve these objectives, a total of 83 soil borings (including the 13 consolidated lagoon and 6 excavated lagoon borings described in Section 2.2.2) and 52 test pits (including the 15 test pits associated with the drum burial areas--as described in Section 2.2.3; and 8 excavated lagoon test pits--as described in Section 2.2.2) were excavated and 108 surface soil samples were collected.

Known or suspected source areas investigated by the soils program include the waste pits (Buildings 6, 9, and 11), 1951 waste pit, photographic anomalies, diamino diphenyl arsonic acid (DDAA) storage areas, and drum storage areas. These areas are described in the RI/FS Work Plan. Additionally, soils adjacent to the vault, consolidated and excavated lagoons, and process buildings were investigated to provide data to determine the extent of contamination associated with these items. Test pits were excavated at areas of known or suspected source contamination.

Areas believed to be free of source contamination (non-source areas) were also sampled. These locations are situated both on site and off site. The non-source areas were primarily sampled using soil boring techniques. Table 2-8 provides the rationale for each soil boring and test pit.

TABLE 2-8

SOIL BORING/TEST PIT SAMPLING RATIONALE
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Sample Locations	Rationale
SB-01, SB-02, SB-03, SB-04, SB-05, SB-06, SB-07, SB-08, SB-09, SB-10, SB-11, SB-12, SB-13, SB-14, SB-15, SB-72, SB-73, SB-74, SB-75, SB-80, SB-81, SB-82, SB-83	Provide data regarding the extent of contamination in offsite soils in the site vicinity.
SB-16, SB-17, SB-18, SB-19, SB-20, SB-21, SB-22, SB-24, SB-25, SB-26, SB-27, SB-28, SB-29, SB-30, SB-31, SB-32	Evaluate onsite soil conditions in areas not adjacent to identified or suspected source areas.
SB-33, SB-34, SB-35, SB-36	Determine soil contaminant concentrations around perimeter of the vault.
SB-23, SB-37, SB-38, SB-39, SB-42, SB-56, TP-06, TP-07, TP-11	Confirm extent of the lagoons and determine soil contaminant concentrations.
SB-40, SB-41, SB-43, SB-44, SB-45, SB-46, SB-61, SB-68, SB-69, SB-70, SB-71	Determine whether buried drums or waste exists and contaminant concentrations of soils in known or suspected past drum storage areas.
SB-47, SB-48, SB-49, SB-50, SB-51, SB-52, SB-53, SB-54, SB-55, SB-76, SB-77, SB-78, SB-79	Determine thicknesses and chemical and physical properties of consolidated lagoon sludges and sludge/soil mixtures.
SB-57	Determine whether residual soil contamination is present underneath the present drum storage area (south of Building 8).
SB-58, SB-59, SB-60	Evaluate soil contaminant concentrations around process buildings.
SB-62, SB-63, SB-64, SB-65, SB-66, SB-67, TP-01, TP-02, TP-03, TP-04, TP-05, TP-08, TP-09, TP-10	Determine soil contaminant concentrations and whether sludge still remains within the excavated lagoon area after the lagoons consolidation.
TP-12, TP-13, TP-14, TP-15, TP-16, TP-18, TP-19, TP-36, TP-37, TP-38, TP-49, TP-50, TP-51	Determine whether buried waste exists and soil contaminant concentrations.

TABLE 2-8
SOIL BORING/TEST PIT SAMPLING RATIONALE
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Sample Locations	Rationale
TP-17, TP-20, TP-21, TP-22, TP-23, TP-24, TP-25, TP-26, TP-27, TP-28, TP-29, TP-30, TP-31, TP-48, TP-52	Determine vertical/horizontal extent of buried waste discovered during test pit excavation activities.
TP-39, TP-40	Determine whether residual soil contamination exists at the former DDAA storage area.
TP-32, TP-33, TP-34, TP-35	Determine soil contaminant concentrations within the 1951 waste pit area.
TP-41, TP-42, TP-43, TP-44, TP-45	Determine whether residual soil contamination is present at Buildings 6, 9, and 11 waste pits.
TP-46, TP-47	Determine whether contaminated soil exists in areas where piperazine was used (Buildings 4 and 8).

2.4.1 Surface Soil Activities

Both onsite and offsite source area and non-source area surface soils were sampled during the field investigations. Most surface soil samples were collected at subsurface soil sampling locations (i.e., soil boring and test pit locations).

Six additional surface soil samples unrelated to soil borings and test pits were collected off site (Figure 2-4), to determine the extent of surface soil contamination due to airborne releases from past operations. Potential fallout from the waste evaporation stack was modeled, and a sampling grid was constructed based on the model (Ebasco, 1988a). The additional surface samples were collected at grid points where surface samples related to soil borings and test pit locations were not being collected.

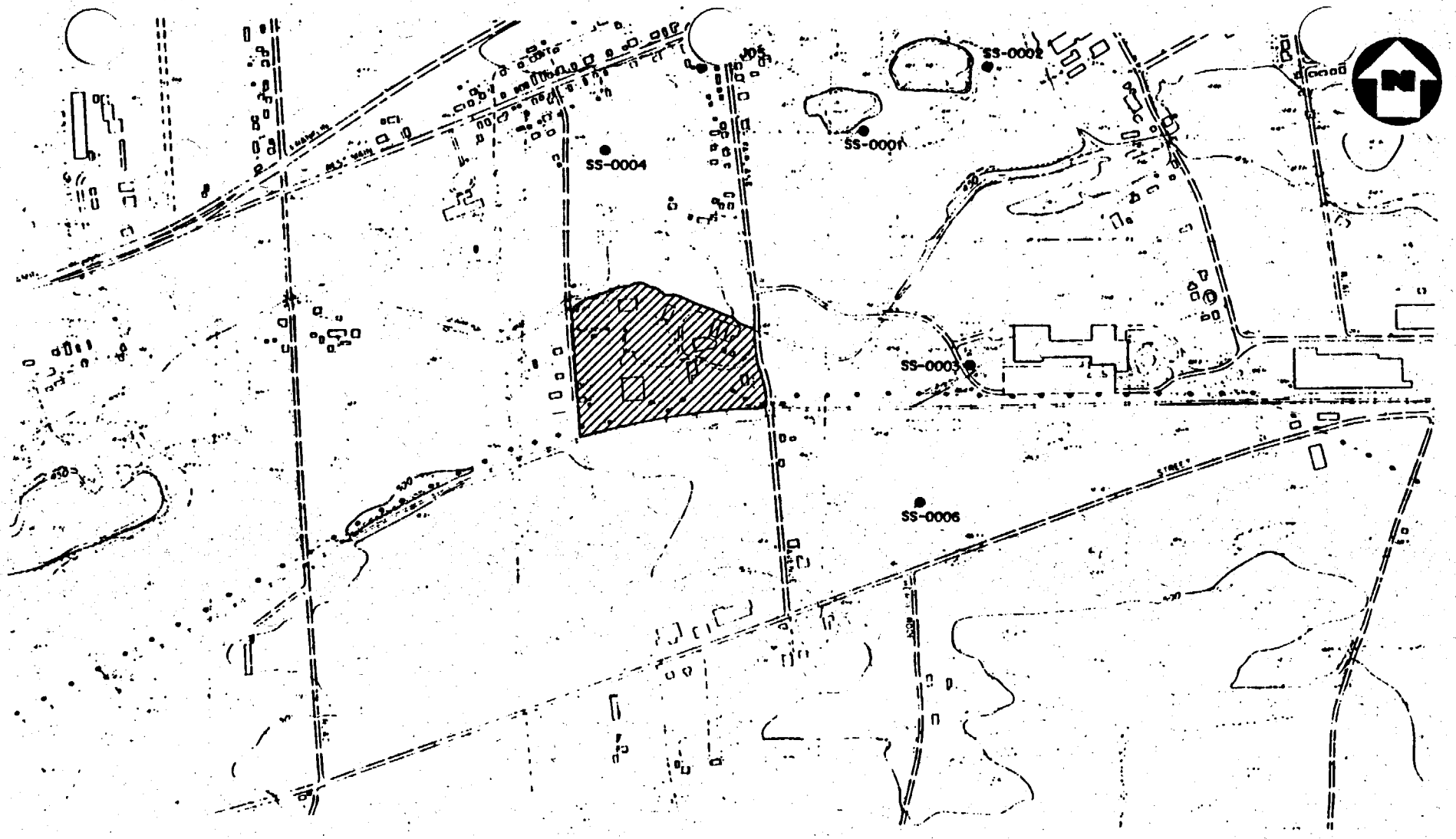
Surface soil samples were not collected when the ground surface consisted of asphalt, gravel or concrete. Where surface soil samples could be obtained, plant material (when present) was removed and surface samples collected from the top 6 inches of soil. During sampling, a geologist classified the soil according to the Unified Soil Classification System (USCS), which is based on grain size, color, percent moisture, density or consistency of soil, and other relevant field observations. After soil classification, the surface soil samples were collected using a decontaminated stainless-steel trowel. Each sample was placed directly into a clean glass jar and prepared for laboratory shipment. All surface samples were analyzed for arsenic and iron. Additional analyses, including TCL BNA plus aniline, TCL pesticides/PCBs, cyanide, pH, Eh, and cation exchange capacity (CEC), were performed on selected samples.

The six surface soil samples unrelated to soil borings or test pits were analyzed for arsenic and iron only. Chemical analysis of the surface soil samples collected at soil boring and test pit locations is described in Sections 2.4.2 and 2.4.3, respectively.

2.4.2 Soil Boring Activities

Eighty-three soil borings (including the lagoon borings) were drilled and sampled. The majority of the borings were placed at the approximate locations presented in the RI/FS Work Plan. Two boring locations (SB-21 and SB-22) had to be moved to minimize crop damage in a neighboring farmer's fields. Five test borings were added to the program for the installation of lysimeters and collection of thin-walled tube samples (SB-49, SB-76, SB-77, SB-78, and SB-79). Two soil borings (SB-40 and SB-41) were repeated, since unavoidable shipping delays caused holding times to be exceeded for the the original soil boring BNA/aniline samples.

Table 2-8 summarizes the rationale behind placement of each soil boring. Forty-three of these borings were associated with



SURFACE SOIL SAMPLE LOCATIONS
UNRELATED TO TEST BORINGS & TEST PITS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

FIGURE 2-4

0 600 1200
SCALE IN FEET

NUS CORPORATION

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source areas (areas of known or suspected contamination), whereas 40 were associated with non-source areas (areas not associated with known or suspected contamination). Soil boring locations are depicted in Figure 2-1 (on site) and Figure 2-5 (off site).

Soil borings were completed between August 17 and September 13, on October 19 and 20, and on November 15 and 16, 1988, by a REM III subcontractor. A drilling rig equipped with 8-inch outside diameter (OD) [5-5/8 inch inside diameter (ID)] hollow-stem augers was used for drilling and sampling. Subsurface soil samples were obtained using 3-1/2 inch OD (3-inch ID) split-barrel samplers. The split-barrel sampler was driven up to 24-inches by dropping a 340-pound hammer through a 18-inch freefall. Soil samples were obtained continuously throughout the total boring depth until refusal or bedrock was encountered. One test boring (SB-40) (located next to three underground fuel tanks) was terminated prior to refusal, for safety reasons, after organic vapors were detected by the HNU and wisps of smoke were noticed emitting from the boring. A complete log of each test boring was maintained; this log includes information pertaining to soil description and sample acquisition, as well as any other pertinent observations that were made. Soil-boring logs are contained in Appendix A.

One or two subsurface soil samples were collected from each test boring. Sample interval selection was based upon HNU readings, visual observations, and total depth of borings. Once a sample interval was selected, field crew members mixed the soil from that interval in a decontaminated stainless-steel bowl to ensure that homogeneous samples were sent to the laboratory(ies) for analysis. In the case of samples to be analyzed for TCL volatile organics, homogenization was not performed, but aliquots from different depths in the sample interval were composited. Table 2-9 is a compilation of intervals sampled for all borings, except for those in the lagoon areas. (Tables 2-2 and 2-3 provide this information.)

Table 3-5 of the RI/FS Work Plan provided a proposed number of samples that would be obtained from each source area. However, fewer samples were collected in some cases, due to shallower-than-expected depths to bedrock. The reduced number of samples, however, was sufficient to meet the RI/FS objectives, including risk assessment and remedial alternative evaluation.

Subsurface soil samples were analyzed for selected parameters, including TCL volatiles, TAL metals, TCL BNA plus aniline, TCL pesticides/PCBs, TCLP metals, cation exchange capacity, arsenic, and iron. Table 2-9 is a summary of the soil samples collected during the soil boring program and the analyses performed on each sample.

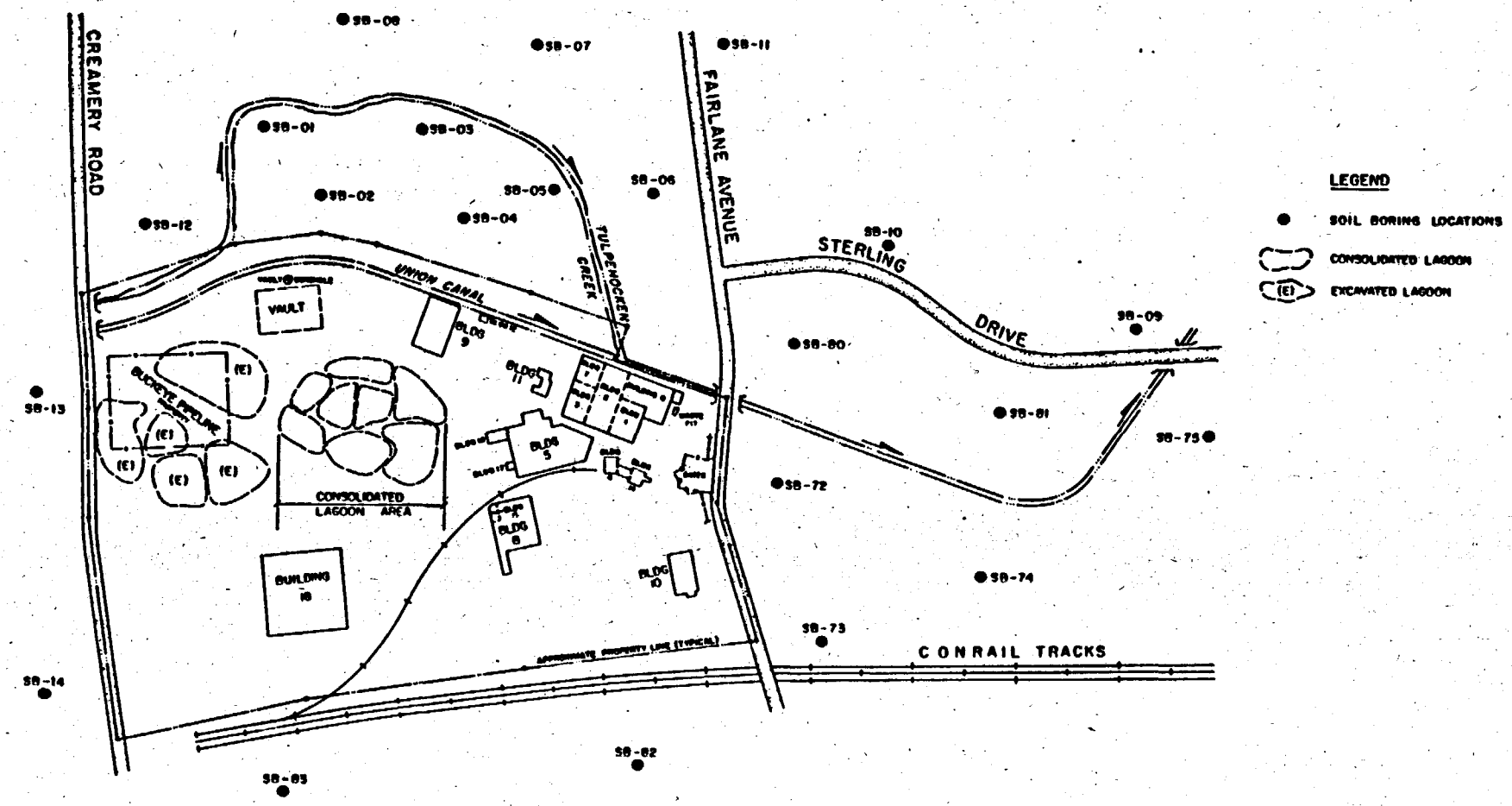

FIGURE 2-5

OFFSITE SOIL BORING LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

2-36

AR300088

TABLE 2-9

SOIL BORING SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Excavation Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-01	9.0	0.0 to 0.3			X		
		8.0 to 9.0			X		
SB-02	7.0	0.0 to 0.3			X		
		6.0 to 7.0			X		
SB-03	9.5	0.0 to 0.3			X		
		4.0 to 6.0			X		
		8.0 to 9.5	X	X	X	X	
SB-04	6.9	0.0 to 0.3			X		
		2.0 to 4.0			X		X
		6.0 to 6.5	X	X	X	X	
SB-05	12.0	0.0 to 0.3			X		
		4.0 to 6.0			X		X
		10.0 to 12.0	X	X	X	X	
SB-06	5.0	0.0 to 0.3			X		
		4.0 to 5.0	X	X	X	X	
SB-07	3.0	0.0 to 0.3			X		
		1.0 to 2.0	X	X	X	X	
SB-08	12.5	0.0 to 0.3			X		
		4.0 to 6.0			X		
		11.0 to 12.0	X	X	X	X	
SB-09	4.5	0.0 to 0.3			X		
		1.0 to 2.0			X		
SB-10	4.5	0.0 to 0.3			X		
		2.0 to 4.0	X	X	X	X	

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TABLE 2-9
SOIL BORING SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Excavation Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-11	8.9	0.0 to 0.3 2.0 to 4.0 6.0 to 8.0			X X X		
SB-12	8.0	0.0 to 0.3 4.0 to 6.0 6.0 to 8.0			X X X		
SB-13	9.9	0.0 to 0.3 6.0 to 8.0 8.0 to 9.9	 X	 X	X X X	 X	
SB-14	5.5	0.0 to 0.3 2.0 to 3.5			X X		
SB-15	11.5	0.0 to 0.3 4.0 to 6.0 10.0 to 11.5			X X X		
SB-16	7.0	0.0 to 0.3 4.0 to 6.0	 X	 X	X 	 X	
SB-17	8.8	0.0 to 0.3 2.0 to 4.0 6.0 to 8.0	 X	 X	X X 	 X	
SB-18	3.0	0.0 to 0.3 1.0 to 2.0			X X		 X
SB-19	2.0	0.0 to 0.3			X		
SB-20	9.5	0.0 to 0.3 4.0 to 6.0 8.0 to 9.5			X X X		

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TABLE 2-9
SOIL BORING SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE THREE

Excavation Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-21	14.5	0.0 to 0.3 4.0 to 6.0 10.0 to 12.0			X X		X
SB-22	8.0	0.0 to 0.3 2.0 to 4.0 6.0 to 8.0			X X X		
SB-23	8.5	0.0 to 0.3 2.0 to 4.0 4.0 to 6.0			X X		X
SB-24	5.0	0.0 to 0.3 4.0 to 5.0	X	X	X	X	
SB-25	5.0	0.0 to 0.3 2.0 to 3.0			X X		
SB-26	6.5	0.0 to 0.3 2.0 to 3.0	X	X	X	X	X
SB-27	3.0	0.0 to 0.3 2.0 to 3.0			X X		
SB-28	3.0	0.0 to 0.3 2.0 to 3.0			X(1) X		
SB-29	12.5	0.0 to 0.3 2.0 to 4.0 12.0 to 12.5			X X X		
SB-30	1.0	0.0 to 0.3			X		

TABLE 2-9
SOIL BORING SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE FOUR

Excavation Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-31	4.0	0.0 to 0.3			X		
SB-32	7.5	0.0 to 0.3 2.0 to 4.0	X(1)	X(1)	X	X(1)	X
SB-33	3.8	0.0 to 0.3 2.0 to 3.0			X X		
SB-34	6.0	0.0 to 0.3 2.0 to 4.0	X	X	X	X	X
SB-35	8.5	0.0 to 0.3 4.0 to 6.0 6.0 to 8.0	X(1)	X(1)	X X(1)	X(1)	X
SB-36	9.0	0.0 to 0.3 2.0 to 4.0			X X		
SB-37	8.0	0.0 to 0.3 1.0 to 2.0 7.0 to 8.0			X X X		
SB-38	3.5	0.0 to 0.3 2.0 to 3.0			X X		
SB-39	4.6	3.0 to 4.0			X		
SB-40	11.0	0.2 to 2.0 4.0 to 6.0 8.0 to 11.0			X X X		
SB-40R	11.0	1.0 to 3.0 3.0 to 5.0 8.0 to 9.0		X X X			

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TABLE 2-9
SOIL BORING SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE FIVE

Excavation Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-41	11.8	0.2 to 2.0			X		
		4.0 to 6.0			X		
		8.0 to 10.0	X	X		X	X
SB-41R	8.5	0.5 to 2.5		X			
		6.5 to 8.5		X			
SB-42	0.3	0.0 to 0.3			X		
SB-43	10.0	0.5 to 2.0		X	X		
		4.0 to 6.0		X	X		
		6.0 to 8.0	X	X		X	X
SB-44	8.8	0.0 to 0.3		X	X		
		4.0 to 6.0		X	X		
		6.0 to 8.0		X	X		
SB-45	10.0	0.4 to 2.0		X	X		
		4.0 to 6.0		X	X		
		8.0 to 10.0		X	X		
SB-46	10.0	3.0 to 5.0		X	X		
		9.0 to 10.0		X	X		
SB-56(2)	7.0	0.0 to 0.3			X		
		1.5 to 4.0	X	X		X	X
SB-57	8.0	0.2 to 2.0		X	X		
		4.0 to 6.0		X	X		
		6.0 to 8.0	X	X		X	X
SB-58(2)(3)	11.5	0.2 to 2.0			X		
		7.5 to 9.5	X	X		X	X

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TABLE 2-9
SOIL BORING SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE SIX

Excavation Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-59(3)	7.0	5.0 to 6.0			X		
SB-60(2)(3)	19.0	0.3 to 2.0 2.0 to 4.0 11.0 to 13.0	 X	 X	X X 	 X	 X
SB-61	4.0	2.0 to 4.0		X	X		
SB-68	1.3	No samples obtained					
SB-69	8.0	0.0 to 0.3 3.0 to 4.5		X X(1)	X X(1)		
SB-70	3.5	0.0 to 0.3 2.0 to 3.0	 X	X X	X 	 X	 X
SB-71	6.5	0.0 to 0.3 2.0 to 3.0 4.0 to 6.0	 X	X X X	X X 	 X	 X
SB-72	9.5	0.0 to 0.3 4.0 to 6.0 7.0 to 9.5	 X	 X	X X 	 X	 X
SB-73	9.0	0.0 to 0.3 4.0 to 6.0 6.0 to 8.0			X X X		
SB-74	12.0	0.0 to 0.3 4.0 to 6.0 10.0 to 12.0			X X X		

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TABLE 2-9
SOIL BORING SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE SEVEN

Excavation Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
SB-75	14.5	0.0 to 0.3 4.0 to 6.0 12.0 to 14.0			X X X		
SB-80	7.3	0.0 to 0.3 6.0 to 7.3			X(1) X		
SB-81	8.2	0.0 to 0.3 2.0 to 4.0 6.0 to 8.0			X X X		
SB-82	4.0	0.0 to 0.3 2.0 to 4.0			X X		
SB-83	3.3	0.0 to 0.3 2.0 to 3.3			X X		

\- Indicates no sample obtained for analysis from specific interval.
X Indicates sample obtained from specific interval for analysis.

(1) Duplicate sample collected.
(2) Additional sample obtained from last interval for pesticide/PCB analysis.
(3) Additional sample obtained from each sample interval for CEC analysis.

Note: Lagoon borings are not included in this table.

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Analyte	Surface Soil Samples	Subsurface Soil Samples	Duplicates	Trip Blanks	Rinsate Blanks	Total
TCL VOA		24	2	9	4	39
TAL Metals		24	2		4	30
TCL BNA plus Aniline	4	43	3		4	54
Arsenic and Iron	52	81	4		4	141
TCLP Metals		19				19
Cation Exchange Capacity	2	4				6

Note: These figures do not include the lagoon borings.

The soil boring samples were packaged, shipped, and analyzed under low-concentration protocols.

During the soil boring program, REM III personnel with a photoionization detector (HNU) continually monitored the breathing zone, the top of the hollow-stem augers, and the subsurface soils as they were exposed upon opening of the split-barrel sampler. HNU readings ranging from 0 to 200 parts per million (ppm) were observed when the subsurface soil samples were exposed, and readings up to 3 ppm (SB-58) were sometimes observed in the breathing zone. When elevated HNU readings in the breathing zone were measured, the drillers and the REM III personnel upgraded their level of personal protective equipment from Level "D" to Level "B." However, most of the soil borings were completed in Level "D" protection.

To prevent cross contamination, all downhole drilling equipment, including the test-boring rig, was decontaminated prior to the beginning of each test boring. Split-barrel samplers, thin-walled tube samplers (Shelby tubes), and additional sampling equipment were also decontaminated prior to use. Decontamination followed the procedures described in Section 3.7 of the FOP (Ebasco, 1988b). The test boring rig was steam-cleaned prior to each boring.

Decontamination of all sampling equipment and the test-boring rig was performed at the equipment decontamination area. This area was located on the western side of Building 8. A temporary pad, adequate to contain liquids generated during decontamination of drilling and sampling equipment, was constructed. The sloped pad was lined with plastic and had a collection sump at one end. When the collection sump was full, fluids were pumped temporarily into an existing concrete tank dike. Decontamination fluids (and water generated during

monitoring well installation and development) were transported, treated, and disposed by a separate subcontractor.

2.4.3 Test-Pit Activities

Fifty-two test pits, including those advanced at the drum burial and excavated lagoon locations, were excavated during the RI field investigation. Each test pit was excavated in known or suspected waste disposal areas, to provide visual evidence of waste disposal activities and to obtain soil/waste samples for chemical analysis. Of the 52 test pits, 40 were sampled for chemical analysis. The remaining 12 test pits (TP-27 through TP-31, TP-36, TP-37, and TP-48 through TP-52) served as observation trenches to determine the extent of buried wastes and debris found during sampling activities; no samples were collected from these pits. Table 2-8 presents the rationale for each test pit. Test pit locations are portrayed on Figure 2-1. Test pits were excavated between September 15 and September 29, 1988.

Test pit excavation was performed by the same subcontractor responsible for test borings. A backhoe was used for test pit excavation at the selected locations. Each test pit was extended vertically to bedrock. Generally, one or two subsurface soil samples were obtained from each test pit sampled, depending upon excavation depth, photoionization detector (HNU) readings, visual observations, and/or evidence of buried waste. Test pit documentation and logging was performed by the field geologist to ensure that accurate descriptions of the soil, sample intervals, and other pertinent information were recorded. Test pit logs are provided in Appendix B. Table 2-10 presents the intervals of sample acquisition.

Samples from the selected depths were collected directly from the center of the backhoe bucket. Each sample, with the exception of those analyzed for TCL volatile organics (VOAs), was homogenized using decontaminated stainless-steel mixing bowls and spoons prior to the placement in the appropriate sample containers.

After excavation, sampling, and logging activities were completed, each test pit was backfilled, using the remaining excavated soil. The backhoe was then driven to the decontamination pad, where the backhoe bucket was steam-cleaned to the satisfaction of the REM III field geologist. Sampling equipment was also decontaminated, using the procedures described in Section 3.7 of the FOP (Ebasco, 1988b). Decontamination activities were performed prior to excavation of each test pit.

TABLE 2-10

SOIL TEST PIT SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Test Pit Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
TP-06	7.5	0.0 to 0.5 6.5-7.5			X X		
TP-07	5.0	4.0-5.0			X		
TP-11	10.0	8.5-9.0	X	X		X	X
TP-12	4.6	0.0 to 0.6 4.0-4.5		X X	X X		
TP-13	3.6	0.0 to 0.5 2.0-3.0	X	X X	X	X	X
TP-14	8.6	0.0 to 0.5 3.0-4.0 8.0-8.5		X X X	X X X		
TP-15	6.5	0.0 to 0.5 3.0-3.5 5.0-6.5	X	X X X	X X	X	X
TP-16	1.4	0.0 to 0.5		X	X		
TP-17	8.6	0.0 to 0.5 2.0-3.0 7.0-8.0	X(1)	X X X(1)	X X	X(1)	X
TP-18	1.0	0.0 to 0.5		X	X		
TP-19	4.1	0.0 to 0.5 3.0-4.0	X	X X	X	X	X

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TABLE 2-10
SOIL TEST PIT SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Test Pit Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
TP-20	3.2	0.0 to 0.5 2.5-3.0		X X	X X		
TP-21	2.0	0.0 to 0.5 1.8-2.0	X	X X	X	X	X
TP-22	6.4	0.0 to 0.5 3.0-4.0 6.0-6.4		X X X	X X X		
TP-23	5.6	0.0 to 0.5 5.0-5.5	X	X X	X	X	X
TP-24	3.3	0.25 to 0.5 2.8-3.3		X X	X X		
TP-25	3.5	0.0 to 0.5		X	X		
TP-26	0.8	0.0 to 0.5		X	X		
TP-27	6.8	No samples taken					
TP-28	3.5	No samples taken					
TP-29	6.5	No samples taken					

TABLE 2-10
SOIL TEST PIT SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE THREE

Test Pit Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
TP-30	2.0	No samples taken					
TP-31	5.5	No samples taken					
TP-32	2.8	1.0		X	X		
TP-33	2.3	1.0		X	X		
TP-34	3.1	0.6 2.0-2.5	X	X X	X	X	X
TP-35	3.3	3.0-3.3	X	X		X	X
TP-36	3.5	No samples taken					
TP-37	3.8	No samples taken					
TP-38	2.5	0.0 to 0.6 2.0-2.5		X X	X X		
TP-39	1.6	0.0 to 0.5		X	X		
TP-40	1.7	0.0 to 0.5		X	X		
TP-41	8.5	0.0 to 0.5 2.8-4.0 8.0-8.5	X(1)	X X(1) X(1)	X X(1)	X(1)	X

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TABLE 2-10
SOIL TEST PIT SAMPLING SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE FOUR

Test Pit Number	Total Depth (Feet)	Intervals Sampled (Feet)	TCL Volatiles	BNA/Aniline	Arsenic/ Iron	TAL Metals	TCLP Metals
TP-42	3.9	0.0 to 0.5 3.0-3.9	 X	X X	X 	 X	 X
TP-43	3.1	0.0 to 0.5 3.0-3.1		X X	X X		
TP-44	4.7	0.0 to 0.5 4.0-4.7	 X	X X	X 	 X	 X
TP-45	1.5	0.5-1.0		X	X		
TP-46	2.1	0.3 to 0.5		X	X		
TP-47	2.4	0.3 to 0.5		X	X		
TP-48	8.5	No samples taken					
TP-49	1.6	No samples taken					
TP-50	1.8	No samples taken					
TP-51	2.1	No samples taken					
TP-52	6.0	No samples taken					

- Indicates no sample obtained for analysis from specific interval.
X Indicates sample obtained from specific interval for analysis.
(1) Indicates duplicate sample also obtained from specific interval for analysis.

Note: Lagoon test pits are not included in this table.

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Table 2-10 is a summary of the samples collected and the analyses performed on each sample. Samples of buried wastes are included in Table 2-10, whereas samples from the excavated lagoons are not. The test pit samples were analyzed as follows:

Analyte	Surface Soil Samples	Subsurface Soil Samples	Duplicates	Trip Blanks	Rinsate Blanks	Total
TCL VOA		12	2	2	5	21
TAL Metals		12	2	2		16
TCL BNA plus Aniline	22	30	3	2		57
Arsenic and Iron	23	20	1	2		46
TCLP Metals		12				12

All samples were packaged, shipped, and analyzed using low-concentration protocols.

Because of the possibility of encountering highly toxic buried wastes during test pitting activities, all subcontractor and field personnel activities were conducted in Level "B" personal protection.

During the test pit program, an HNU was used by field personnel to continually monitor the breathing zone, the top of the excavation, and the subsurface soils as they were exposed in the backhoe bucket. HNU readings ranging from 0 to 10 ppm were observed when the subsurface soil samples were exposed, and readings up to 1 ppm were sometimes observed in the breathing zone.

2.5 HYDROGEOLOGIC INVESTIGATION

The hydrogeologic investigation was designed to define the geologic/hydrogeologic setting in the site vicinity. Field activities implemented for the hydrogeologic investigation include evaluating existing wells, analyzing fracture-traces, borehole drilling and logging, installing monitoring wells, groundwater sampling, aquifer testing, installing staff gauges, and measuring water levels.

2.5.1 Existing-Well Evaluation

The existing-well evaluation was carried out to determine characteristics of the wells installed during previous site studies (and the groundwater pump-and-treat program) and to determine their usability during the RI for sampling, water-level measurements, and aquifer testing.

The well evaluation consisted of an assessment by the field geologists of the physical conditions of each well. Observations made include

- Confirmation of existing-well number.
- Well security (locked/unlocked).
- Casing condition.
- Casing size.
- Total depth. Comparison of total depth with depth shown in drilling log (indication of caving).
- Depth to groundwater.
- Presence and condition of pumps (if present).

The existing well evaluation was completed during the weeks of July 23, September 9, and September 16, 1988. Table 2-11 contains results of the existing well evaluation. Many of the previously installed wells (5, 8, 8A, 8B, 9, 9A, 10, 10A, 10B, 11, 11A, 12A, 15, 17 and 17B) were not found and had apparently been plowed over by a neighboring farmer. Based on this evaluation and the overall groundwater monitoring strategy, two existing wells (15A and 15B) were rehabilitated for use as monitoring wells, three other existing wells (3, 7, and 16) were sampled as is, and the remainder of the existing wells were used as water-level measurement points.

2.5.2 Fracture Trace Analysis

A fracture trace analysis of the site vicinity was conducted by the EPA Environmental Photographic Interpretation Center (EPIC), with the assistance of a REM III field team geologist, on July 28 and 29, 1988. The objective of the fracture trace analysis was to identify bedrock fracture zones that could serve as groundwater conduits (and appropriate monitoring well sites).

Existing aerial photographs of the site vicinity were obtained and stereoscopically analyzed in pairs, using a mirror stereoscope. Surface features that indicated underlying fracture zones were identified and field-verified. The observed fracture traces were plotted on a site vicinity map (see Figure 2-6) and compared with monitoring well locations proposed in the RI/FS Work Plan. Based on the results of the analysis (Table 2-12), four well clusters (MW-201, MW-202, MW-203, and MW-204) were relocated.

2.5.3 Monitoring Well Drilling and Installation Activities

Fifty monitoring wells, including two rehabilitated wells, were completed as part of the RI. These wells were installed to provide the data necessary to establish groundwater flow patterns, the vertical and lateral extent of significant groundwater contamination, and surface-water/groundwater interactions. The onsite and offsite monitoring well locations are shown on Figures 2-2 and 2-7, respectively. The wells were

TABLE 2-11

EXISTING WELL EVALUATION
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Well Number	Condition of Well Casing	Well Casing Material	Casing Size (Inches)	Original(1) Total Depth (Feet below ground)	Total Depth 1988 (Feet below ground)	Depth to Bedrock (Feet below ground)	Monitored Interval (Feet below ground)	Ground Elevation (Feet-msl)	Does Well Contain Pump?	Comments
Kohl	Rusty/Solid	Steel	8	14.35	12.69	ND	ND - 14.35	472.56	No	
1	Rusty/Solid	Steel	ND	350	ND	ND	ND	ND	Yes	Well inaccessible due to pump; pump is not working.
2	Rusty/Solid	Steel	8	400.0	76.0	7.0	22.0 - 323.75	485.60	Yes	Possible obstruction at 76 feet or cave-in; pump is not working.
3	Rusty/Solid	Steel	6	29.3	30.0	ND	ND - 29.3	458.94	Yes	Well appears to serve as a catch basin in Building No. 2; pump removed by NUS for sampling purposes.
4	Rusty/Solid	Steel	6	335+	ND	ND	ND - 335+	458.52	Yes	Well inaccessible due to pump; pump is not working.
5	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
5A	Rusty/Solid	Steel	6	158	158	2.0	13.5 - 158.0	462.80	Yes	Pump is not working.
6	Rusty/Solid	Steel	6	30	28.4	4.0	14.0 - 30.0	459.38	Yes	Pump is operable.
6A	Rusty/Solid	Steel	6	80	78.0	ND	18.0 - 80.0	467.39	No	Possible cave-in to 78.0 feet.
7	Rusty/Solid	Steel	6	52	48.0	4.0	17.0 - 52.0	457.60	Yes	Pump removed by REM III for sampling purposes.
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
8A	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
8B	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
9A	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.

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TABLE 2-11
EXISTING WELL EVALUATION
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Well Number	Condition of Well Casing	Well Casing Material	Casing Size (Inches)	Original(1) Total Depth (Feet below ground)	Total Depth 1988 (Feet below ground)	Depth to Bedrock (Feet below ground)	Monitored Interval (Feet below ground)	Ground Elevation (Feet msl)	Does Well Contain Pump?	Comments
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
10A	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
10B	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
11	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
11A	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
12A	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
13	Rusty/Solid	Steel	6	139	140	4.3	4.9 - 140.0	486.82	No	Possible error in original depth measurement.
13A	Rusty/Solid	Steel	6	190	185.5	3.5	3.8 - 190.0	485.32	No	Possible cave-in to 185.5 feet.
14	Rusty/Solid	Steel	6	132	25.0	10.0	12.5 - 132.0	481.24	No	Well caved-in to 25.0 feet.
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
15A*	Rusty/Solid	Steel	6	60	30.9	8.5	13.0 - 60	453.04	No	Cave-in to 30.9 feet.
15B*	Rusty/Solid	Steel	6	99.3	99.6	8.0	16.0 - 99.3	453.40	Yes	Pump removed by REM III for sampling purposes.
16	Rusty/Solid	Steel	6	118	118	6.0	9.0 - 118.0	453.31	No	
16A	Rusty/Solid	Steel	6	77	71	7.0	10.5 - 77.0	453.69	No	Possible cave-in to 71.0 feet.
16B	Rusty/Solid	Steel	6	ND	120	10.0	42.0 - 120.0	454.04	Yes	Pump removed by REM III for sampling purposes.
17	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.
17B	NA	NA	NA	NA	NA	NA	NA	NA	NA	Well not found.

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TABLE 2-11
EXISTING WELL EVALUATION
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE THREE

Well Number	Condition of Well Casing	Well Casing Material	Casing Size (Inches)	Original(1) Total Depth (Feet below ground)	Total Depth 1988 (Feet below ground)	Depth to Bedrock (Feet below ground)	Monitored Interval (Feet below ground)	Ground Elevation (Feet-msl)	Does Well Contain Pump?	Comments
VSP-1	Solid	Steel	0.25	8.69	7.97	NA	NA	472.01	NA	VSP designed for water withdrawal from vault interior.
VSP-2	Solid	Steel	0.25	9.21	8.27	NA	NA	472.00	NA	VSP designed for water withdrawal from vault interior.
VSP-3	Solid	Steel	0.25	9.25	8.78	NA	NA	472.34	NA	VSP designed for water withdrawal from vault interior.
VSP-4	Solid	Steel	0.25	ND	8.69	NA	NA	472.68	NA	VSP designed for water withdrawal from vault interior.

VSP Indicates vault stand pipe.
ND No data available.
NA Not applicable.
(1) Data based on files of Whitmoyer Laboratories, Inc.
* Wells 15A and 15B were rehabilitated as monitoring wells during the RI.

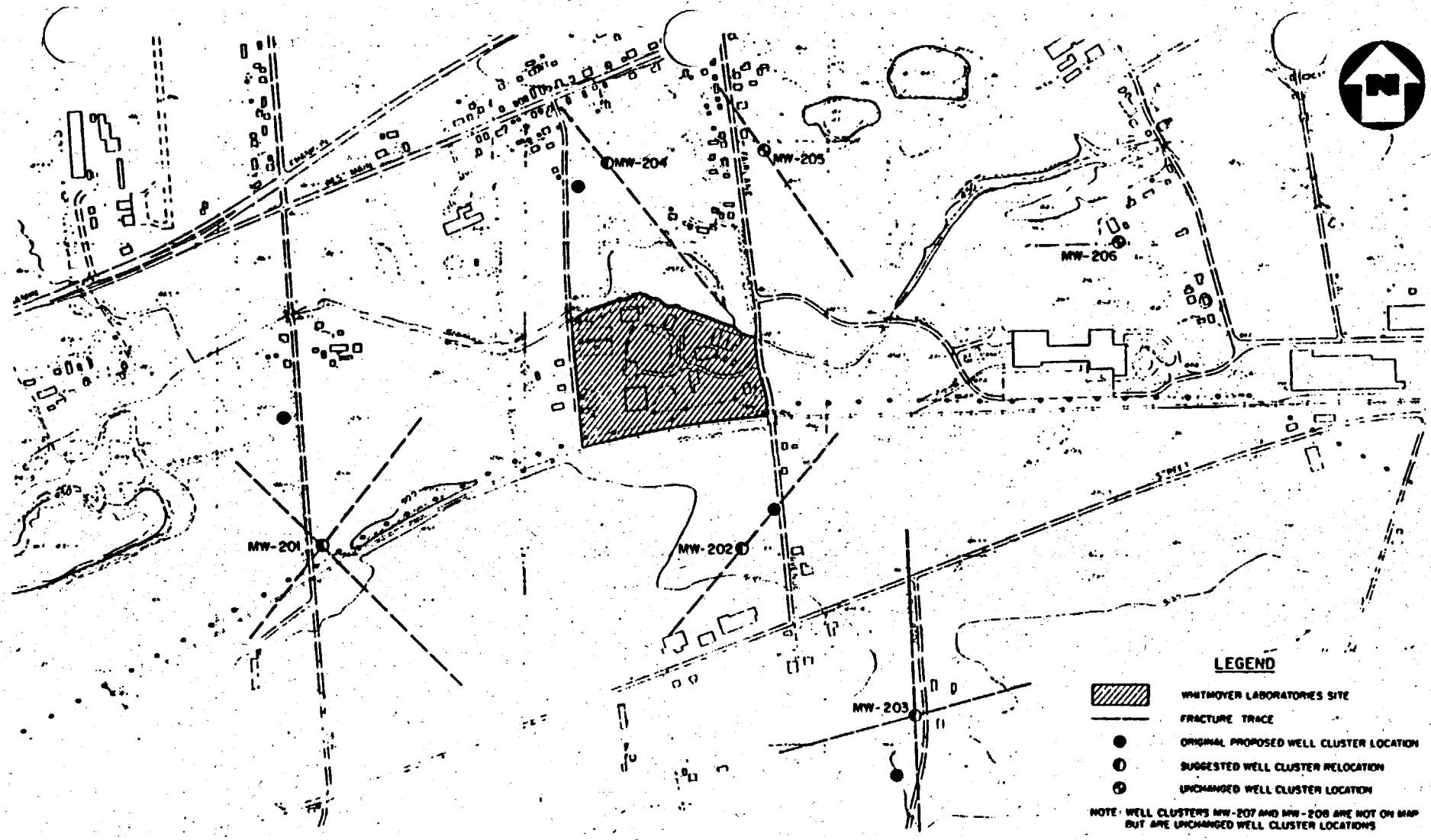

FIGURE 2-6

EPA / EPIC SUGGESTED REVISION OF PROPOSED OFFSITE MONITORING WELL LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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AR300107

TABLE 2-12

FRACTURE TRACE ANALYSIS/WELL LOCATION SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Monitoring Well Numbers	Suggested Location	Fracture Trace Signature	Rationale for Suggested Well Location	Rock Unit**
MW-201*	Northeast corner of the Ramona Road and Conrail railroad tracks.	Intersection of a weak NE/SW topographic/soil tonal trace and a strong NW/SE tonal trace.	Well located at this trace intersection should monitor groundwater flow between the site and quarry, as well as monitor potential secondary contamination from a nearby drum handler.	Ontelaunee Formation: Medium- to dark-gray, thick-bedded crystalline dolomite. Generally highly permeable aquifer. Median specific capacity of wells (for 1 hour) is 44 gpm per foot of drawdown.
MW-202*	Approximately 500 feet west of Fairlane Road.	Along a weak topographic trace.	Well located in area where surface expression of trace is greatest.	Epler Formation: Medium-light-gray, thick-bedded limestone and dolomite; cherty, partly fossiliferous; numerous beds of calcite. Typically poorly permeable aquifer but more permeable near contact with the Stonehenge Formation : Median specific capacity (except where adjacent to the Stonehenge Formation) of wells pumped for 1 hour is 0.3 gpm per foot of drawdown.
MW-203*	Placed approximately 26 feet west of Mergelrode Drive.	Intersection of a strong E/W topographic trace and a weak N/S topographic/soil tonal trace.	A well located at this intersection should have a high yield.	Near bedrock contact between the following: Epler Formation: Medium-light-gray, thick-bedded limestone and dolomite; cherty, partly fossiliferous; numerous beds of calcite. Typically poorly permeable aquifer but more permeable near contact with the Stonehenge Formation. Median specific capacity (except where adjacent to the Stonehenge Formation) of wells pumped for 1 hour is 0.3 gpm per foot of drawdown. Rickenbach Formation: Gray, finely crystalline, cherty, dolomite. Permeability unknown.

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TABLE 2-12
FRACTURE TRACE ANALYSIS/WELL LOCATION SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Monitoring Well Numbers	Suggested Location	Fracture Trace Signature	Rationale for Suggested Well Location	Rock Unit**
MW-204*	Between a corn field and the right field fence of a Midget League ball field.	At the intersection end of a weak NW/SE soil tonal trace and a bedrock contact.	A well located along this intersection should have a high yield.	Bedrock contact between the following: Ontelaunee Formation: Medium- to dark-gray, thick-bedded crystalline dolomite. Generally highly permeable aquifer. Median specific capacity of wells (for 1 hour) is 44 gpm per foot of drawdown. Annville Formation: Light-gray, finely crystalline, thick-bedded, high-calcium limestone. Permeability unknown. Not an important aquifer because of small areal extent and thinness.
MW-205	East of Fairlane Road along the boundary between a residence and a corn field.	At the intersection of the end of a strong NW/SE soil tonal trace and a bedrock contact.	A well located along this intersection should have a high yield.	Bedrock contact between the following: Ontelaunee Formation: Medium- to dark-gray, thick-bedded crystalline dolomite. Generally highly permeable aquifer. Median specific capacity of wells (for 1 hour) is 44 gpm per foot of drawdown. Annville Formation: Light-gray, finely crystalline, thick-bedded, high-calcium limestone. Permeability unknown. Not an important aquifer because of small areal extent and thinness.
MW-206	South side of Tulpehocken Creek	Surface manifestation of mapped inferred fault difficult to identify. Feature may be quite wide in this area.	Well placed on east side of inferred fault as accurately as possible.	Ontelaunee Formation: Medium- to dark-gray, thick-bedded crystalline dolomite. Generally highly permeable aquifer. Median specific capacity of wells (for 1 hour) is 44 gpm per foot of drawdown.

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TABLE 2-12
FRACTURE TRACE ANALYSIS/WELL LOCATION SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE THREE

Monitoring Well Numbers	Suggested Location	Fracture Trace Signature	Rationale for Suggested Well Location	Rock Units**
MW-207	East side of quarry.	Not on available maps.	Well located to monitor downgradient groundwater.	Annville Formation: Light-gray, finely crystalline, thick-bedded, high-calcium limestone. Permeability unknown. Not an important aquifer because of small areal extent and thinness.
MW-208	Southeast side of quarry.	Not on available maps.	Well located to monitor downgradient groundwater.	Annville Formation: Light-gray, finely crystalline, thick-bedded, high-calcium limestone. Permeability unknown. Not an important aquifer because of small areal extent and thinness.

* Indicates a revision of proposed offsite monitoring well location.
** Information taken from Pennsylvania Water Report W18 (Royer, 1983).

Considerations:

1. As depicted on Pennsylvania Water Report W18, the Whitmoyer Laboratories Site is situated on or close to a subsurface basin divide. Because this is a karst area, the location of this divide can change, depending on groundwater levels. It is recommended that data from the offsite wells be used to better define the subsurface drainage divide.
2. A drum handler is located close to MW-201. This may be a secondary contamination source that could affect data from MW-201.

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AR300110

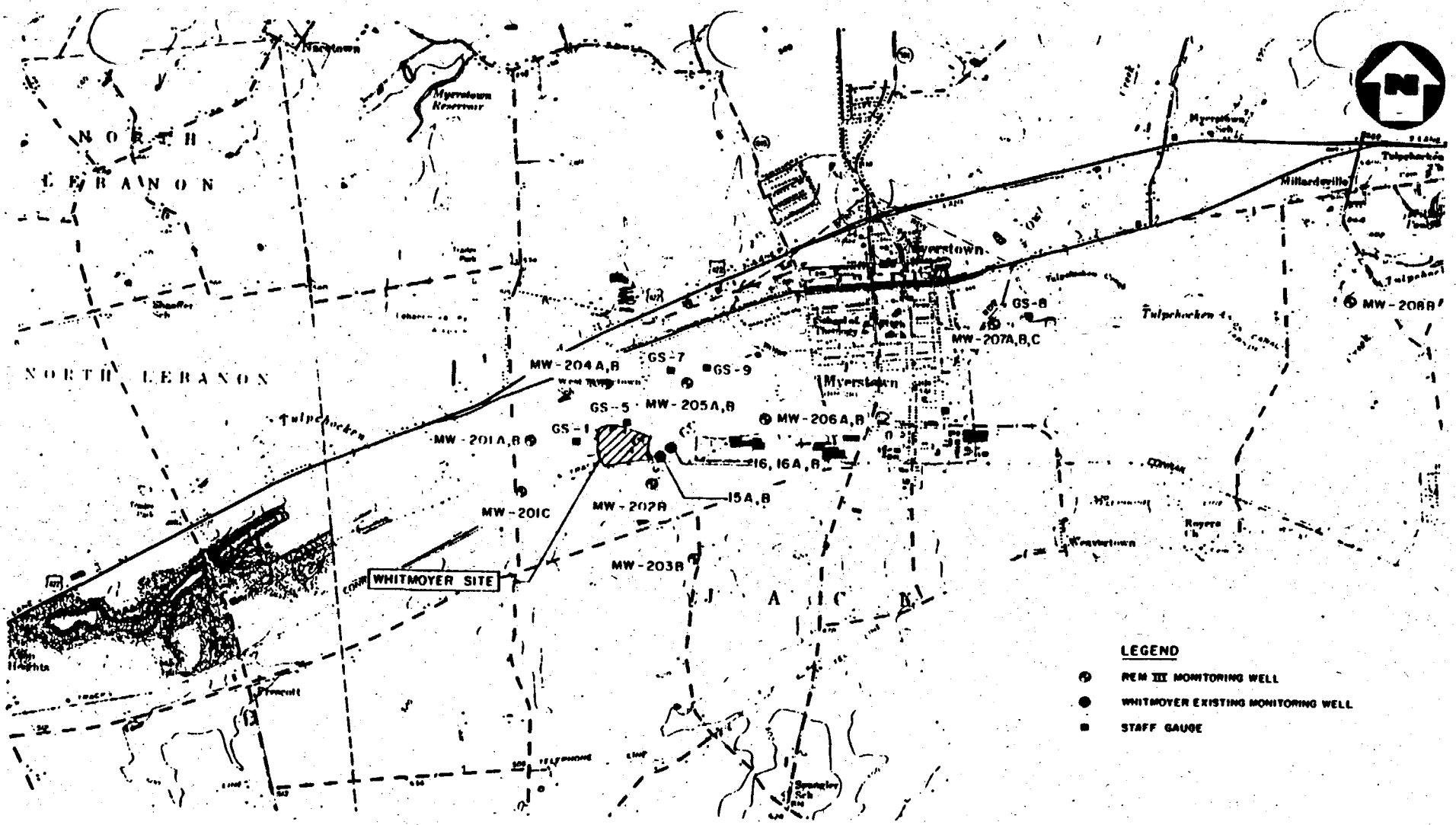

FIGURE 2-7

OFFSITE MONITORING WELL LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

AR300111

drilled and installed between September 8 and November 18, 1988. Tables 2-13 and 2-14, respectively, describe the rationale behind each onsite and offsite well installed.

In the RI/FS Work Plan, 30 onsite monitoring wells and 22 offsite monitoring wells, including 5 rehabilitated wells, were proposed for installation during the field investigation. However, because of hydrogeologic conditions encountered (see below), 33 onsite monitoring wells and 17 offsite monitoring wells, including the 2 rehabilitated wells, were installed.

Monitoring wells were assigned three depth designations: shallow (less than 60 feet deep), medium (60 to 150 feet deep), and deep (greater than 150 feet deep). Existing wells, e.g., 15B, were assigned the same number as Whitmoyer Laboratories, Inc. used in referring to these wells. New onsite wells were assigned numbers beginning with 100, while new offsite wells were assigned numbers beginning with 200. Shallow, medium, and deep monitoring wells are indicated by the letter following the well number; "A" indicates a shallow well, "B" indicates a medium-depth well, and "C" indicates a deep well.

Drilling was performed using air rotary drilling methods. Cuttings from offsite drillings were containerized, returned to the site, and stockpiled in a central collection area. Cuttings from onsite drillings were mounded near the drilling locations. All cuttings remained on site at the completion of field activities.

Table 2-15 is a summary of the monitoring wells installed. Approximately one-half (13 of 25 shallow wells) of the shallow monitoring well borings were drilled through the overburden approximately 5 feet into competent bedrock, using an 8-inch OD air hammer. At this point, 6-inch ID low-carbon steel casing was set and grouted into place, using a cement/bentonite grout mix placed by pressure grouting (packer method). After allowing the grout to set up overnight, the boring was continued into bedrock using a 5-7/8-inch OD air hammer, until a significant water-bearing fracture or set of fractures was encountered. To conclude drilling, the boring was advanced approximately 10 additional feet past the fracture to ensure penetration into the fracture zone and to create a sump for fracture-filling materials that could enter the borehole. The casing was equipped with a locking steel lid to prevent unauthorized access to the well. A cement apron was placed around the casing to prevent tampering and standing water infiltration.

Exceptions to this shallow well construction method were implemented when the water table existed above the bedrock or the water table was present in highly fractured bedrock (12 of 25 shallow wells). In this case, a 2- or 4-inch diameter PVC well with Schedule 40 casing and 0.020-inch slotted screen (20 slot size) was installed in the well boring. The annular space around the well screen was backfilled with a silica sand

TABLE 2-13

RATIONALE FOR ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Well No.	Depth	Const. Type	Investigation Area				Purpose						Location/Rationale
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-100A	S	PVC	X				X	X	X	X			Along north wall of vault, near standpipe with maximum water-level fluctuations. Determine leakage from vault in NW vault corner.
MW-100A1	S	PVC	X				X	X	X	X			Along north wall of vault, adjacent to MW-100A. Determine if void area within bedrock at 37 feet is pathway for contamination from lagoons and/or vault.
MW-100B	M	OB	X				X		X	X			Adjacent to MW-100A. Determine deeper water quality and vertical flow gradient near vault and canal.
MW-101A	S	PVC	X				X	X		X			Along north wall of vault, east of MW-100A and MW-100B. Determine water quality downgradient of vault, local flow directions, and leakage from vault in NE corner.
MW-102A	S	OB	X				X	X					Along south wall of vault. Determine water quality upgradient of vault, local flow directions, and contaminant contribution from lagoons to groundwater flowing under the vault.
MW-103A	S	PVC		X			X	X	X				West of western lagoon area. Determine water quality along west edge of site and the influence of quarry pumping.
MW-103B	M	OB		X			X		X				Adjacent to MW-103A. Determine water quality and influence of quarry pumping deeper in aquifer.

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TABLE 2-13
RATIONALE FOR ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Well No.	Depth	Const. Type	Investigation Area				Purpose						Location/Rationale
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-104A	S	PVC		X			X	X		X			Downgradient of excavated lagoon area. Determine contribution to groundwater from excavated lagoon fill.
MW-105A	S	OB				X	X	X	X				In southwest corner of property, near area of standing liquid in 1969 photograph. Determine groundwater quality in southwestern corner of site.
MW-105B	M	OB				X	X		X				Adjacent to MW-105A. Determine vertical gradients and deeper groundwater quality.
MW-106A	S	OB		X			X	X	X				Determine shallow groundwater quality upgradient of consolidated lagoon area.
MW-106B	M	OB		X			X		X				Adjacent to MW-106A. Determine vertical distribution of contamination and vertical flow gradients.
MW-107A	S	PVC		X			X	X	X				Downgradient of consolidated lagoons area. Determine shallow groundwater contamination.
MW-107B	M	OB		X			X		X				Adjacent to MW-107A. Determine vertical distribution of contamination and vertical flow gradients.
MW-107C	D	OB		X			X		X		X		Adjacent to MW-107A and MW-107B. Determine vertical distribution of contaminants, vertical flow gradients, and deep groundwater flow direction.

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TABLE 2-13
RATIONALE FOR ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE THREE

Well No.	Depth	Const. Type	Investigation Area				Purpose						location/Rationale
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-108A	S	PVC			X		X	X	X	X			Downgradient of Building 9 (maintenance garage) and related cesspool. Check for building-related groundwater contamination.
MW-108B	M	OB			X		X		X	X			Adjacent to MW-108A; check for deeper water quality in area of cesspool, and vertical gradients.
MW-109A	S	PVC			X		X	X	X	X			Downgradient of Building 11 and laboratory cesspool. Primary focus on releases from laboratory cesspool.
MW-109B	M	OB			X		X		X	X			Adjacent to MW-109A. Check for deeper water quality in potential former localized recharge area (cesspool) and vertical gradients.
MW-110A	S	OB				X	X	X	X				Along south edge of site. Measure water quality. Check for contaminant migration to south.
MW-110B	M	OB				X	X		X				Adjacent to MW-110A. Determine vertical gradients in southern area of site. Check for flow to south.
MW-110C	D	OB				X	X		X		X		Adjacent to MW-110A and MW-110B. Measure deep groundwater quality. Used with MW-107C and MW-117C to determine deep groundwater flow direction.

TABLE 2-13
RATIONALE FOR ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE FOUR

Well No.	Depth	Const. Type	Investigation Area				Purpose						Location/Rationale
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-111A	S	OB				X	X	X					Downgradient of drum storage area and potential waste dumping/burial area (1951 pit), two significant potential sources of contamination.
MW-112A	S	OB			X	X	X	X					South of Building 5 and potential waste disposal/burial area. Adjacent to Buildings 5 and 8 tanks.
MW-113A	S	OB				X	X	X	X				South of Building 10. Located between process buildings area and residential wells south of site containing high levels of contaminants.
MW-113B	M	OB			X	X	X		X				Adjacent to MW-113A. Check for potential for deeper contaminants to migrate south to residential wells.
MW-114A	S	OB			X		X	X					Downgradient of Building 10, upgradient of existing well No. 7 (highly contaminated).
MW-115A	M	OB				X	X		X				Adjacent to existing well No. 7. Determine deeper groundwater quality and vertical gradient.
MW-116A	S	PVC				X	X	X	X				Adjacent to Building 6 (arsenical production area). Determine shallow groundwater quality.

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TABLE 2-13
RATIONALE FOR ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE FIVE

Well No.	Depth	Const. Type	Investigation Area				Purpose						Location/Rationale
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions		
MW-117A	S	PVC			X	X	X	X	X	X			Downgradient of waste pit located adjacent to Building 6 (major potential source area for arsenic and organics).
MW-117B	M	OB			X	X	X		X	X			Adjacent to MW-117A. Check for vertical migration of contaminants. (Waste pit may have been a local groundwater recharge area during past operations.)
MW-117C	D	OB			X	X	X		X	X	X		Adjacent to MW-117A and MW-117B. Measure deep groundwater quality downgradient of waste pit and deep injection well (well No. 4). With MW-109C and MW-110C, determine deep groundwater flow direction.
MW-118A	S	PVC			X		X	X		X			Downgradient of Buildings 1, 2, and 6 (major chemical processing buildings); placed across canal from buildings because of access restrictions.

S Shallow
M Medium
D Deep

SW Surface Water
GW Groundwater

OB Open Borehole Monitoring Well
PVC PVC Monitoring Well

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TABLE 2-14

RATIONALE FOR OFFSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Well No.	Depth	Const. Type	Direction From Site	Purpose					Notes
				Water Quality	Shallow GW Flow Directions	Vertical Gradients	Secondary Source Area I.D.	SW/GW Inter-actions	
MW-201A	S	OB	W	X	X	X			Between site and active limestone quarry to the west. Provide data regarding influence of quarry pumping on groundwater flow directions and contaminant migration from site.
MW-201B	M	OB	W	X		X			Between site and active limestone quarry to the west. Provide data regarding influence of quarry pumping on medium-depth groundwater flow directions and contaminant migration from site.
MW-201C	D	OB	W	X		X			Between site and active limestone quarry to the west. Provide data regarding influence of quarry pumping on groundwater flow directions and contaminant migration from site. Check to see whether quarry is deep groundwater discharge point.
MW-202B	M	OB	S	X			X		Between site and contaminated wells to the south. Determine whether plant south of site may be potential secondary contaminant source area.
MW-203B	M	OB	S	X			X		Determine water quality south of the plant/contaminated residential well area.
MW-204A	S	OB	N	X	X	X			Determine shallow water quality between site and residential area to the north.
MW-204B	M	PVC	N	X		X			Adjacent to MW-204A. Determine medium-depth water quality between site and residential area to the north.
MW-205A	S	OB	N	X	X	X		X	Near Wenger Quarries northeast of site. Determine whether site groundwater is migrating to and discharging to ponds.
MW-205B	M	PVC	N	X		X		X	Adjacent to MW-205A. Determine whether site groundwater is migrating to and discharging to ponds.

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TABLE 2-14
RATIONALE FOR OFFSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Well No.	Depth	Const. Type	Direction From Site	Purpose					Notes
				Water Quality	Shallow GW Flow Directions	Vertical Gradients	Secondary Source Area I.D.	SW/GW Inter-actions	
MW-206A	S	OB	E	X	X	X		X	Located in area where inferred fault crosses Tulpehocken Creek. Check for shallow groundwater contaminant concentrations in fault zone.
MW-206B	M	OB	E	X		X		X	Adjacent to MW-206A. Check for deeper groundwater contaminant concentrations in fault zone.
MW-207A	S	OB	E	X	X	X		X	Adjacent to Lakeside Quarry east of Myerstown. Determine water quality and groundwater/surface water interactions in the pond vicinity.
MW-207B	M	OB	E	X		X		X	Adjacent to MW-207A. Determine medium-depth water quality and groundwater/surface water interactions in the pond vicinity.
MW-207C	D	OB	E	X		X		X	Adjacent to MW-207A and MW-207B. Determine deep water quality and groundwater/surface water interactions in the pond vicinity. Check to see if pond is deep groundwater discharge point.
MW-208B	M	PVC	E	X		X		X	Adjacent to large pond near Millardsville. Determine whether contaminant plume has reached Millardsville area.
15A*	S	PVC	SE	X	X	X			Determine shallow groundwater quality southeast of the site.
15B*	M	PVC	SE	X		X			Adjacent to 15A. Determine medium-depth water quality southeast of the site.

S - Shallow
M - M.
D - Deep

OB - Open Borehole Monitoring Well
PVC - PVC Monitoring Well

* Rehabilitated well

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TABLE 2-15

MONITORING WELL CONSTRUCTION DETAILS
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Well Number	Type	Depth to Bedrock (Feet)	Total Depth of Well (Feet)	Monitored Interval (Feet below ground)	Well Diameter (Inches)	Well Construction Type	Ground Elevation (Feet msl)
MW-100A	Bedrock	9.0	23.0	9.5 - 23.0	4.0	PVC	459.41
MW-100A1	Bedrock	9.0	44.0	27.0 - 44.0	2.0	PVC	459.54
MW-100B	Bedrock	9.5	128.0	60.0 - 128.0	6.0	Steel/Open	459.50
MW-101A	Overburden/ Bedrock	9.0	20.0	10.0 - 20.0(1)	4.0	PVC	458.33
MW-102A	Bedrock	4.0	52.0	10.0 - 52.0	6.0	Steel/Open	473.49
MW-103A	Bedrock	2.5	29.0	15.5 - 29.0	4.0	PVC	474.41
MW-103B	Bedrock	2.5	152.0	60.0 - 152.0	6.0	Steel/Open	474.14
MW-104A	Bedrock	7.0	30.5	17.5 - 30.5	4.0	PVC	467.33
MW-105A	Bedrock	1.0	46.0	26.0 - 46.0	6.0	Steel/Open	487.51
MW-105B	Bedrock	1.0	155.0	61.0 - 155.0	6.0	Steel/Open	487.37
MW-106A	Bedrock	7.0	44.0	21.0 - 44.0	6.0	Steel/Open	480.50
MW-106B	Bedrock(2)	7.0	74.0	60.0 - 74.0	6.0	Steel/Open	480.44
MW-107A	Bedrock	7.0	48.5	36.0 - 48.5	4.0	PVC	464.66
MW-107B	Bedrock	5.0	148.0	60.0 - 148.0	6.0	Steel/Open	464.71
MW-107C	Bedrock	7.0	385.0	150.0 - 385.0	6.0	Steel/Open	464.15
MW-108A	Overburden/ Bedrock	11.5	24.5	10.7 - 20.7(1)	2.0	PVC	462.08
MW-108B	Bedrock	11.5	129.0	60.0 - 129.0	6.0	Steel/Open	462.27
MW-109A	Overburden/ Bedrock	7.0	19.7	8.0 - 18.0(1)	4.0	PVC	459.06
MW-109B	Bedrock	7.0	194.0	59.5 - 194.0	6.0	Steel/Open	459.04

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TABLE 2-15
MONITORING WELL CONSTRUCTION DETAILS
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Well Number	Type	Depth to Bedrock (Feet)	Total Depth of Well (Feet)	Monitored Interval (Feet below ground)	Well Diameter (Inches)	Well Construction Type	Ground Elevation (Feet msl)
MW-110A	Bedrock	5.0	45.0	25.5 - 45.0	6.0	Steel/Open	482.34
MW-110B	Bedrock	5.5	195.0	60.0 - 195.0	6.0	Steel/Open	482.04
MW-110C	Bedrock	5.0	258.0	150.0 - 258.0	6.0	Steel/Open	482.25
MW-111A	Bedrock	5.0	80.0	14.0 - 80.0	6.0	Steel/Open	479.30
MW-112A	Bedrock	5.0	52.0	20.0 - 52.0	6.0	Steel/Open	480.23
MW-113A	Bedrock	5.0	52.5	14.0 - 52.5	6.0	Steel/Open	469.72
MW-113B	Bedrock(3)	5.0	252.0	89.5 - 252.0	6.0	Steel/Open	469.67
MW-114A	Bedrock	1.3	38.0	15.5 - 38.0	6.0	Steel/Open	469.98
MW-115B	Bedrock	12.0	126.0	60.0 - 126.0	6.0	Steel/Open	457.79
MW-116A	Overburden/ Bedrock	11.0	17.0	6.5 - 16.5(1)	2.0	PVC	458.75
MW-117A	Overburden/ Bedrock	16.0	27.5	16.0 - 26.0(1)	2.0	PVC	458.24
MW-117B	Bedrock	16.0	114.0	60.0 - 114.0	6.0	Steel/Open	458.45
MW-117C	Bedrock	16.0	301.0	154.0 - 301.0	6.0	Steel/Open	458.21
MW-118A	Overburden/ Bedrock	12.0	20.0	9.5 - 19.5(1)	4.0	PVC	454.22
MW-201A	Bedrock	7.0	39.0	19.0 - 39.0	6.0	Steel/Open	475.53
MW-201B	Bedrock	7.0	88.0	59.0 - 88.0	6.0	Steel/Open	475.38
MW-201C	Bedrock	4.5	250.0	148.0 - 250.0	6.0	Steel/Open	487.64
MW-202B	Bedrock	10.5	127.0	70.0 - 127.0	6.0	Steel/Open	473.50

TABLE 2-15
MONITORING WELL CONSTRUCTION DETAILS
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
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Well Number	Type	Depth to Bedrock (Feet)	Total Depth of Well (Feet)	Monitored Interval (Feet below ground)	Well Diameter (Inches)	Well Construction Type	Ground Elevation (Feet msl)
MW-203B	Bedrock	14.0	140.0	18.0 - 140.0	6.0	Steel/Open	477.72
MW-204A	Bedrock	14.5	55.0	19.0 - 55.0	6.0	Steel/Open	486.48
MW-204B	Bedrock	15.0	102.0	77.4 - 102.0	2.0	PVC	486.60
MW-205A	Bedrock	13.0	40.0	17.0 - 40.0	6.0	Steel/Open	468.83
MW-205B	Bedrock	15.0	64.0	52.1 - 64.0	4.0	PVC	468.40
MW-206A	Bedrock	1.0	90.0	35.0 - 90.0	6.0	Steel/Open	477.55
MW-206B	Bedrock	1.0	270.0	94.0 - 270.0	6.0	Steel/Open	477.94
MW-207A	Bedrock	5.0	55.0	10.0 - 55.0	6.0	Steel/Open	432.01
MW-207B	Bedrock	5.5	145.0	60.0 - 145.0	6.0	Steel/Open	432.29
MW-207C	Bedrock	6.0	182.0	150.0 - 182.0	6.0	Steel/Open	432.65
MW-208B	Bedrock	13.0	78.5	54.75 - 78.5	2.0	PVC	423.94
[15A]	Bedrock	8.5	(60.0) 30.9*	14.8 - 27.5	2.0	PVC	453.04
[15B]	Bedrock	8.0	(99.3) 96.9	59.5 - 99.3	2.0	PVC	453.40

* Bentonite seal placed from 27.5 to 30.9 feet below ground surface prior to well installation.
(1) Interval represents actual screened interval only. Monitored interval varies in overburden/bedrock wells due to rise and fall of static water level.
(2) Considered shallow bedrock well due to total depth and static water level.
(3) Considered deep bedrock well due to total depth and static water level.

[ ] Existing well rehabilitated by REM III using PVC riser/screen installation.
( ) Original depth of well.
PVC Indicates polyvinyl chloride riser/screen.
Steel/Open Indicates well constructed with a steel casing through the overburden and partial bedrock, with the borehole remaining open to specific depths in bedrock.

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(No. 20-30 U.S. sieve size) to a point approximately 2 feet above the top of the screened interval. A minimum 2-foot thick layer of bentonite pellets was then placed above the sand pack. When the bentonite pellets were fully hydrated (2 hours), a mixture of cement, bentonite powder, and water was pumped in the annular space above the bentonite seal using a tremie pipe until the level reached the ground surface.

Placement of a section of 5-inch-diameter steel pipe into the grout created a protective outer (surface) casing for the PVC pipe. This protective casing was equipped with a locking lid to prevent unauthorized access to the PVC well. Finally, an approximately 4-foot by 4-foot square, 3-inch thick, concrete pad was constructed around the well. Drilling and well construction logs for the shallow, medium, and deep wells are provided in Appendices C and D, respectively.

Existing well 15A was originally completed as a 60-foot-deep, open borehole. During the existing well evaluation, a total well depth of 30.9 feet was measured. This well apparently caved to this level. Well 15A was rehabilitated into a 2-inch-diameter, 20 slot PVC well monitoring the interval between 14.8 and 27.5 feet deep. To monitor this interval, a bentonite seal was placed on top of the caved material and the well was completed using the PVC well completion technique described above.

Overall, 25 shallow monitoring wells (including 2 at location MW-100 and rehabilitated well 15A) were installed. Twelve of the 25 wells were installed as PVC wells. Well depths ranged from 17 to 80 feet (see Table 2-15).

Medium-depth wells were drilled using air rotary methods similar to those used for the shallow wells completed in competent bedrock. These wells were drilled through overburden into bedrock to a depth of 60 to 90 feet, depending on shallow water-bearing zones and/or competent bedrock. At this point, a 6-inch-diameter steel casing was set in the 8-inch-diameter hole and grouted into place. After allowing the grout to set up overnight, the boring was continued until a water-bearing fracture was encountered. The boring was advanced 10 additional feet past the fracture and the hole terminated.

During the drilling of MW-204B, the field team anticipated installing a medium-depth, open borehole well. After installation of 60 feet of casing, the boring was continued downward in search of a medium-depth water zone. An 11-foot void cavity was encountered from 89 to 100 feet. This void cavity contained a mixture of sand and silt that upon drilling rose up the borehole into the casing due to the hydrostatic pressure. To monitor the void area, a 2-inch-diameter PVC well was constructed in the boring, using a well screen length of 15 feet and an 8-slot-size screen. The annular space around the well screen was filled with natural sand and limestone gravel to a point approximately 9.6 feet above the screen. A bentonite

pellet seal was then placed on top of the sand pack, and the remainder of the annulus was backfilled using a cement/bentonite grout mix.

For medium-depth well MW-208B, it was anticipated that a permanent steel casing would be installed to depths of 60 feet to seal off shallow groundwater fractures. However, during drilling activities, a large water-bearing fracture zone was encountered at the depth of 58 feet. A 2-inch-diameter Schedule 40 PVC well, instead of an open borehole well, was installed to a depth of 78.5 feet, using a well screen length of 20 feet (20 slot size). PVC well completion techniques described above were used for this well.

Well 15B was originally completed as a 99.3-foot-deep open borehole. This well was converted to a 2-inch-diameter, 20-slot PVC well monitoring the depth interval between 65 and 99.3 feet, so that water quality data from this intermediate depth could be collected. The standard PVC well completion technique described above was used.

All three PVC wells were completed with protective casing and a locking lid. Similarly, locking lids were placed on the casings of the medium-depth boreholes, and cement aprons were placed around the casing.

Overall, 19 medium-depth monitoring wells, including the 3 PVC wells, were installed. Well depths ranged from 64 to 252 feet.

The five deep monitoring wells were completed at depths ranging from 182.0 to 385.0 feet, using techniques similar to those described for the medium-depth open borehole wells, except that 6-inch permanent steel casing was set and grouted at depths of approximately 150 feet. The borings were then continued until a water-bearing fracture was encountered.

Two proposed offsite shallow wells (MW-202A and MW-208A) were deleted from the monitoring well program because of subsurface conditions encountered during drilling. In the area of the proposed MW-202 cluster, the first water-bearing zone was encountered at 112 feet. MW-202B was installed to monitor this groundwater zone, and MW-202A was deleted because of nonexistent shallow groundwater. In the case of MW-208A, pieces of foundry casts and additional miscellaneous debris were present in the drill cuttings of the boring. Apparently, the well location area was once a dumping ground for a local foundry. Since there was concern over possible extraneous contamination from the dump, the well was abandoned and the boring backfilled with a cement/bentonite grout to the surface.

The foundry casts and additional miscellaneous debris found at the MW-208 location are located approximately 3 miles downgradient from the site. Potential contamination from these materials should not have any relationship to the contamination found at the Whitmoyer Laboratories Site and vicinity.

Based on the results of the fracture-trace analysis, the location of the MW-201 cluster was moved to an area which appeared to have a strong fracture-trace signal. When MW-201C was drilled first, no evidence of shallow or medium-depth water-bearing fractures were encountered. Therefore, the shallow- and medium-depth monitoring wells (MW-201A and MW-201B, respectively) were relocated to an area approximately 375 yards north of the location of MW-201C (see Figure 2-7).

Three monitoring wells (MW-100A1, MW-106B, and MW-108B) not proposed in the RI/FS Work Plan were installed. Originally, it was anticipated that MW-1 and MW-5A would be sampled to determine medium-depth groundwater quality at their respective locations; however, the existing well evaluation found that MW-1 and MW-5A were inaccessible. Therefore, wells MW-106B and MW-108B were installed. Well MW-100A1 was added to monitor a 2-foot solution cavity (void) encountered in the area of the vault.

During the drilling of monitoring-well borings, the rig geologist logged the boring through inspection of rock cuttings and observations of drilling conditions. Each boring log contained the following information:

- Soil color
- Rock hardness
- Lithologic descriptions
- Depths of fractures/voids
- Estimated water yields
- Drilling methods
- HNU readings
- Any other pertinent observations

The drilling and installation of the monitoring wells closely followed the site FOP (Ebasco, 1988b) and Health and Safety Plan. The majority of the drilling was completed in Levels "D" personal protection, but some drilling was conducted in upgraded (Level "C" and "B") personal protection. Information detailing when upgraded protection was used and other remarks concerning monitoring well drilling and installation are recorded on the drilling logs (Appendix C).

All monitoring wells were developed after installation to remove sediments, drill cuttings, and residual drilling fluids from areas around the monitored interval of the boring. Wells were developed by air-lift methods. In some cases, certain wells did not produce sufficient water to properly develop. Potable water was injected into these wells before air-lift methods were initiated. All water injected into these wells was removed prior to completion of well development.

2.5.4 Groundwater Sampling

Groundwater sampling was performed to determine the nature and extent of the site-associated contamination in groundwater and to assess the risks to nearby populations through actual or potential groundwater exposure. During the RI, two rounds of groundwater samples were collected from all newly installed, rehabilitated, and selected existing monitoring wells. Additional groundwater samples were collected from selected residential wells.

2.5.4.1 Monitoring Well Sampling

Fifty-three monitoring wells (48 new, 2 rehabilitated, and 3 existing), were sampled during the field investigation. Figures 2-2 and 2-7 illustrate the locations of monitoring wells. The first sampling round occurred between November 28 and December 15, 1988; while the second round took place between December 19, 1988, and January 12, 1989. Table 2-16 summarizes the analyses performed on each groundwater sample.

Prior to obtaining groundwater samples, wells were purged of three to five volumes of water (or purged dry) to ensure that all stagnant water was removed. Purging was accomplished using stainless-steel bailers, suction pumps, and submersible pumps. Temperature, conductivity, Eh, pH, and dissolved oxygen were monitored during purging operations. Upon completion of purging, water samples were obtained using stainless-steel bailers. In the case of wells purged dry, sampling was not conducted until a minimum of 70 percent recovery of total well volume had taken place. Each sample was placed into the appropriate container(s) and preserved according to Section 2.0 of the FOP (Ebasco, 1988b). To prevent cross contamination, all nondedicated groundwater sampling equipment was decontaminated before each use, in accordance with Section 3.7 of the FOP (Ebasco, 1988b).

A summary of the first round monitoring well samples follows:

Analyte	Ground-water Samples	Duplicates	Bottle Blanks	Rinsate Blanks	Trip Blanks	Total
TCL VOA	53	3	3	3	11	73
TCL BNA plus Aniline	53	3	3	3		62
TCL Pesticide/PCBs	4	1	1	1		7
TAL Metals (filtered)	53	3	3	3		62
Arsenic SM 303E.5.d	4	1	1	1		7
Arsenic (Unfiltered)	53	3	3	3		62

TABLE 2-16

GROUNDWATER ANALYTICAL SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Groundwater Sample Station	VOAs		BNAs/ Aniline		Total Metals		Dissolved Metals		Arsenic/ Filtered		Arsenic/ Unfiltered		COD/TOC		Common Anions		Alkalinity		BOD		PCBs/ Pesticides		Cyanide	
	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2
RM0000	X		X		X								X		X		X		X					
RM0002	X	X	X	X	X							X	X	X	X		X		X	X				
RM0006	X		X		X								X		X		X		X					
RM0012	X		X		X								X		X		X		X					
RM0001	X		X		X								X		X		X		X					
RM0003*	X		X		X								X		X		X		X					
RM0004	X	X	X	X	X							X	X	X	X		X		X	X				
RM0005**	X	X	X	X	X							X	X	X	X		X		X	X				
MW-201A	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-108A	X	X	X	X			X		X***	X	X	X	X	X	X		X		X	X	X		X	
MW-201B	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-108A1	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-108B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-101A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-102A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-15A	X	X	X	X			X			X	X	X	X		X		X		X	X				
MW-15B**	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-103A**	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-201C	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-205A	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-107A	X	X	X	X			X		X***	X	X	X	X	X	X		X		X	X	X		X	
MW-205B	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-116A	X	X	X	X			X		X***	X	X	X	X	X	X		X		X	X	X		X	
MW-117B	X	X	X	X			X		X***	X	X	X	X	X	X		X		X	X	X		X	
MW-207A	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-207B	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-207C	X	X	X	X			X			X	X		X	X	X		X		X	X				

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TABLE 2-16
GROUNDWATER ANALYTICAL SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Groundwater Sample Station	VOAs		BNAs/ Aniline		Total Metals		Dissolved Metals		Arsenic/ Filtered		Arsenic/ Unfiltered		COD/TOC		Common Anions		Alkalinity		BOD		PCBs/ Pesticides		Cyanide	
	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2
MW-117C	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-117A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-204A	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-115B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-204B	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-7	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-208B	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-114A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-109A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-118A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-108A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-104A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-202B	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-168*	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-107C	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-206A	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-203B	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-106B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-106A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-107B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-206B	X	X	X	X			X			X	X		X	X	X		X		X	X				
MW-105B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-111A**	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-105A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-112A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				

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TABLE 2-16
GROUNDWATER ANALYTICAL SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE THREE

Groundwater Sample Station	VOAs		BNAs/ Aniline		Total Metals		Dissolved Metals		Arsenic/ Filtered		Arsenic/ Unfiltered		COD/TOC		Common Anions		Alkalinity		BOD		PCBs/ Pesticides		Cyanide	
	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2
MW-110A*	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-111A	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-108B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-110B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-110C	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-3	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-111B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-109B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
MW-103B	X	X	X	X			X			X	X	X	X	X	X		X		X	X				
RMW07A		X		X								X		X						X				
RMW07B		X		X								X		X						X				
RMW05		X		X								X		X						X				
RMW010		X		X								X		X						X				
RMW013		X		X								X		X						X				
RMW011		X		X								X		X						X				

* Duplicate collected in Round 1. **Duplicate collected in Round 2. ***Special digestion.

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Analyte	Ground-water Samples	Duplicates	Bottle Blanks	Rinsate Blanks	Trip Blanks	Total
Cyanide	4	1	1	1		7
Alkalinity	53	3				56
Total Organic Carbon (TOC)	53	3				56
Common Anions	53	3				56
Chemical Oxygen Demand (COD)	53	3				56
5-Day Biological Oxygen Demand (BOD_5)	53	3				56

Notes: Common anions include chloride, fluoride, nitrate, nitrite, orthophosphate, and sulfates.

Wells MW-100A, MW-107A, MW-116A, and MW-117B were analyzed for total arsenic (Standard Method 303E.5.d), cyanide, and TCL pesticide/PCBs.

A 0.45-micron nitrocellulose filter was used to filter metals samples. All samples were packed, shipped, and analyzed using low-concentration protocols.

Second round monitoring wells were analyzed as follows:

Analyte	Number of Samples	Duplicates	Bottle Blanks	Rinsate Blanks	Trip Blanks	Total
TCL VOA	53	3	3	3	12	74
TCL BNA plus Aniline	53	3	3	3		62
Filtered Arsenic	53	3	3	3		62
Unfiltered Arsenic	30	2	3	3		38
TOC	53	3				56
COD	53	3				56
BOD_5	53	3				56

All samples were packaged, shipped, and analyzed using low-concentration protocols.

Most groundwater samples were collected in Level "D" personal protection. Elevated HNU readings necessitated sampling some wells in Level "B" personal protection.

Groundwater sampling and analysis results are provided in Section 4.4.

2.5.4.2 Residential Wells

Groundwater samples were also collected from single family dwelling wells, Sterling Drug Company and P J Valves, Inc., water supply wells, and Myerstown Borough Well No. 8. Hereafter all of these wells will be referred to as "residential wells". These wells were sampled to assist in defining the nature and extent of contamination in groundwater and to support the human health risk assessment. Residential well sample locations were selected based on historical data from previous sampling, the availability of well logs, and depth/location of wells within the site vicinity.

Residential wells were sampled using procedures similar to those of the onsite/offsite monitoring wells. However, complete information concerning well characteristics (e.g., well depth, casing size) were typically not available to calculate well volumes; therefore, purging was performed by opening a tap situated upstream of any water treatment apparatus or holding tank, where available. Once the tap was opened, the system was purged for 15 minutes to ensure that a representative sample would be acquired. After sufficient purging, samples were collected directly from the tap using the appropriate sample containers. Where no taps upstream of water treatment systems or holding tanks existed, this situation was noted in the sample logs.

First-round residential well samples were analyzed as shown on Table 2-16. All samples were packaged, shipped, and analyzed using low-concentration protocols.

First-round residential well locations sampled include the following:

RW0001	John Zimmerman	50 South Ramona Road
RW0002	Dean Wagner	170 South Fairlane Avenue
RW0004	Ivan Weiler	351 Mill Avenue
RW0003	Stella Kreider	94 Creamery Road
RW0006	Carl Lutz	330 King Street
RW0008	Sterling Drug Company	1 Sterling Drive
RW0009	Fredrick Shaak	451 South Race Street
RW0012	H E Messerschmidt	60 Hergelrode Drive

First-round samples were collected between November 28 and 30, 1988.

Six additional residential wells were sampled during the second round of sampling. Three residential wells sampled during the first round (RW-02, RW-04, and RW-09) were also sampled during the second well sampling round. The second round samples were collected on December 19 and 20, 1988.

Second-round residential well sampling locations are as follows:

- RW0002 Ivan Weiler 351 Mill Avenue
- RW0004 Stella Kreider 94 Creamery Road
- RW0005 Timothy Gockley 328 King Street
- RW0007 P J Valves Company (east and west wells) 341 King Street
- RW0009 Frederick Shaak 451 Race Street
- RW0010 Richard Eiceman 600 South Locust Street
- RW0011 Myerstown Borough (Well Number 8)
- RW0013 Harold Swanger 431 South Race Street

Second-round samples (including one duplicate) were analyzed as shown on Table 2-16. The results of the groundwater sampling and analysis are provided in Section 4.4.

2.5.5 Aquifer-Testing Activities

Aquifer testing, including both slug tests and short-term pumping tests, was conducted to estimate the hydraulic characteristics of the groundwater flow system underlying the site. The aquifer tests were conducted during the week of January 16, 1989.

Slug tests were performed by inserting a slug of known volume into the well to be tested (falling-head test). As the slug was placed into the well below the static water level, a displacement of an equivalent volume of water took place, raising the water level in the well. The rate of recovery (time

until the static water level is regained) was measured and recorded through use of pressure transducers and level heads. After the falling-head test was completed, a second test was conducted (rising-head test). This test was performed by quickly removing the slug and measuring the rate of recovery back to the static water conditions. In most cases, recovery rates were extremely slow, and only one slug test per well (falling-head test) was conducted.

For most initial slug tests, data conforming to slug-testing protocols, i.e., usable data, were obtained. In a few instances, data obtained did not conform to the requirements of slug-testing protocols. In these cases, the data were discarded, and the slug test was repeated. All data generated were evaluated based on the hydrogeologic conditions encountered. Slug tests performed on slowly recharging wells were interpreted using methods developed by H S Cooper, J D Bredehoeft, and I S Papadopulos (Fetter, 1980). Fast recharging wells were interpreted using the Hvorslev method (Freeze and Cherry, 1979). Slug-test results are discussed in Section 3.3, and slug-testing data are presented in Appendix E.

In addition to the slug tests, three short-term pumping tests were performed using onsite monitoring wells. The selected wells (MW-106B, MW-110C, and MW-115B) were pumped at various rates and times, using a submersible pump. Observation wells were selected based on an estimated cone of depression that would radiate from the pumping well. The drawdown rates were constantly measured in the pumping well and observation wells. At the conclusion of the pumping operations, recovery rates were also measured. Test data were analyzed using curve matching techniques of Boulton and Streltsova-Adams (1977). The test analyses and results are discussed in Section 3.3, and pumping-test data are presented in Appendix F.

2.5.6 Staff-Gauge Installation

Ten staff gauges were installed during the field investigation to determine the hydrogeologic relationship between groundwater and surface water in the site vicinity. Originally, a total of eight staff gauges were proposed in the RI/FS Work Plan; however, two additional staff gauges were installed to aid in determining the relationship. Figures 2-2 and 2-7 show staff gauge locations.

2.5.7 Water-Level Measurements

Three comprehensive rounds of water-level measurements were obtained from all newly installed and existing monitoring wells, staff gauges, and vault standpipes. These pipes (draw tubes) monitor the materials immediately above the base of the vault, and were once used to dewater these materials. The three rounds were conducted on November 28, 1988 (just prior to the first round of groundwater sampling), January 16, 1989 (immediately following completion of the second round of groundwater

sampling), and April 5, 1989. Additionally, water-level measurements were obtained from the usable existing monitoring wells located during the existing well evaluation (September 14 and October 10, 1988). Water-level readings were obtained in accordance with the FOP (Ebasco, 1988b), using calibrated electric water-level indicators; measurements were recorded to the nearest 0.01 foot. To minimize atmospheric/precipitation effects on groundwater conditions, water-level measurements were obtained within a 24-hour period of consistent weather. Water-level measurement results are discussed in Section 3.3.

2.6 SURFACE-WATER AND SEDIMENT INVESTIGATION

The surface-water and sediment investigation was conducted to meet three main objectives: (1) to determine the contaminant levels in surface water and sediment as the Tulpehocken Creek enters and leaves the site; (2) to determine the extent of the downstream contamination, if any; and (3) to determine contaminant levels in ponds and quarries near the site.

2.6.1 Surface-Water Investigation

Two rounds of surface-water sampling were collected during the field investigation. Samples were collected from various points along Tulpehocken Creek/Union Canal and from nearby lakes and quarries (second round only). The rationale behind each surface-water sample location is presented in Table 2-17. Figure 2-8 depicts regional locations of surface-water sampling points and Figure 2-9 shows local surface water sampling points.

The first round of surface-water sampling took place during the week of July 19, 1988. Only samples from Tulpehocken Creek and Union Canal sample stations were collected. All samples were collected from downstream to upstream, to avoid biased results due to sediment disturbance. Prior to sampling, stream flow, water temperature, Eh, pH, dissolved oxygen, and specific conductivity levels were recorded. In general, samples were collected by immersing the appropriate sample container into the water; however, to avoid disturbing the sediment in areas of shallow water, the sampling team used a stainless-steel ladle to collect and transfer samples into proper containers. Once the containers were full, the samples were preserved, in accordance with Section 2.0 of the FOP (Ebasco, 1988b), and sent to the laboratory for analysis. Table 2-18 summarizes surface-water sampling.

Fourteen samples (exclusive of QA/QC samples) were taken during the first round. The surface-water samples obtained during the first round were analyzed for aniline, total arsenic and iron, dissolved (filtered) arsenic and iron, hardness, nitrite/nitrate, alkalinity, and suspended solids. Filtering was performed by passing the unpreserved sample through a 10 micron glass microfiber pre-filter. After passing through the pre-filter, the sample was then passed through a 0.45 micron

TABLE 2-17

SURFACE WATER/SEDIMENT LOCATIONS AND RATIONALE
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Station(1) Number	Description	Rationale
1 (2)	Tulpehocken Creek at T-489 Bridge - Upstream	Determine background surface water/sediment quality
2 (2,3)	Tulpehocken Creek at Ramona Road Bridge	Determine surface water/sediment quality as stream enters site
3	Union Canal upstream of vault	Assess impact from site on reach from Station 2 to Station 3
4 (3)	Union Canal at fish pond	Assess impact from site on reach from Station 3 to Station 4
5	Union Canal prior to confluence with Tulpehocken Creek	Assess impact from site on reach from Station 4 to Station 5
6	Tulpehocken Creek north of vault	Assess impact from site on reach from Station 2 to Station 6
7	Tulpehocken Creek north of stack	Assess impact from site on reach from Station 6 to Station 7
8 (2)	Tulpehocken Creek at Fairlane Avenue Bridge	Assess impact from site on reach from Stations 5 and 7 to 8
9	Tulpehocken Creek at Race Street	Assess impact from site on reach from Station 8 to Station 9
10 (2)	Tulpehocken Creek at College Street Bridge	Assess impact from site on reach from Station 9 to Station 10
11	Tulpehocken Creek above Sewage Treatment Plant (STP)	Assess impact from site on reach from Station 10 to Station 11
12	Tulpehocken Creek below STP	Assess impact of site (and STP) from Station 11 to Station 12
13 (2)	Tulpehocken Creek Womelsdorf Bridge	Assess impact of site on reach from Station 12 to Station 13
14	Tulpehocken Creek above Charming Forge Lake	Assess impact of site on reach from Station 13 to Station 14
15 (2,3)	Charming Forge Lake	Assess impact of site on Charming Forge Lake

TABLE 2-17
SURFACE WATER/SEDIMENT LOCATIONS AND RATIONALE
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Station(1) Number	Description	Rationale
16 (3)	Myerstown Pond	Assess impact from site
17 (3)	Lakeside quarry	Assess impact from contaminated groundwater
18	Wenger Quarry No. 1 (West)	Assess impact from contaminated groundwater
19	Wenger Quarry No. 2 (East)	Assess impact from contaminated groundwater
20	Abandoned quarry west of site	Assess impact from contaminated groundwater

(1) Station numbers can be cross-referenced with Figures 2-8 and 2-9.
(2) Benthic macroinvertebrate samples were collected at these sites.
(3) Fish samples were collected at these sites.

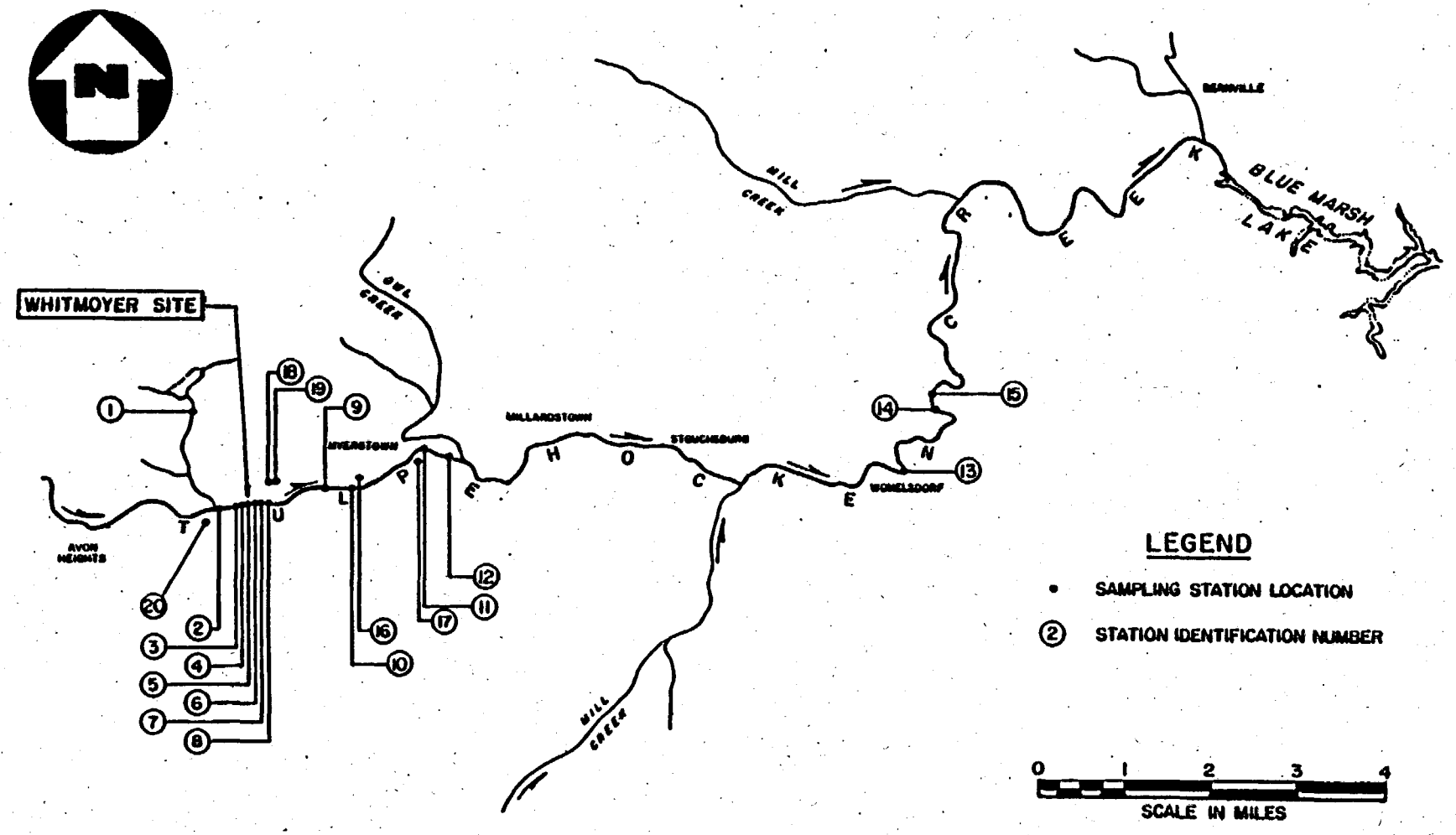

FIGURE 2-8

REGIONAL SURFACE WATER/SEDIMENT SAMPLING STATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

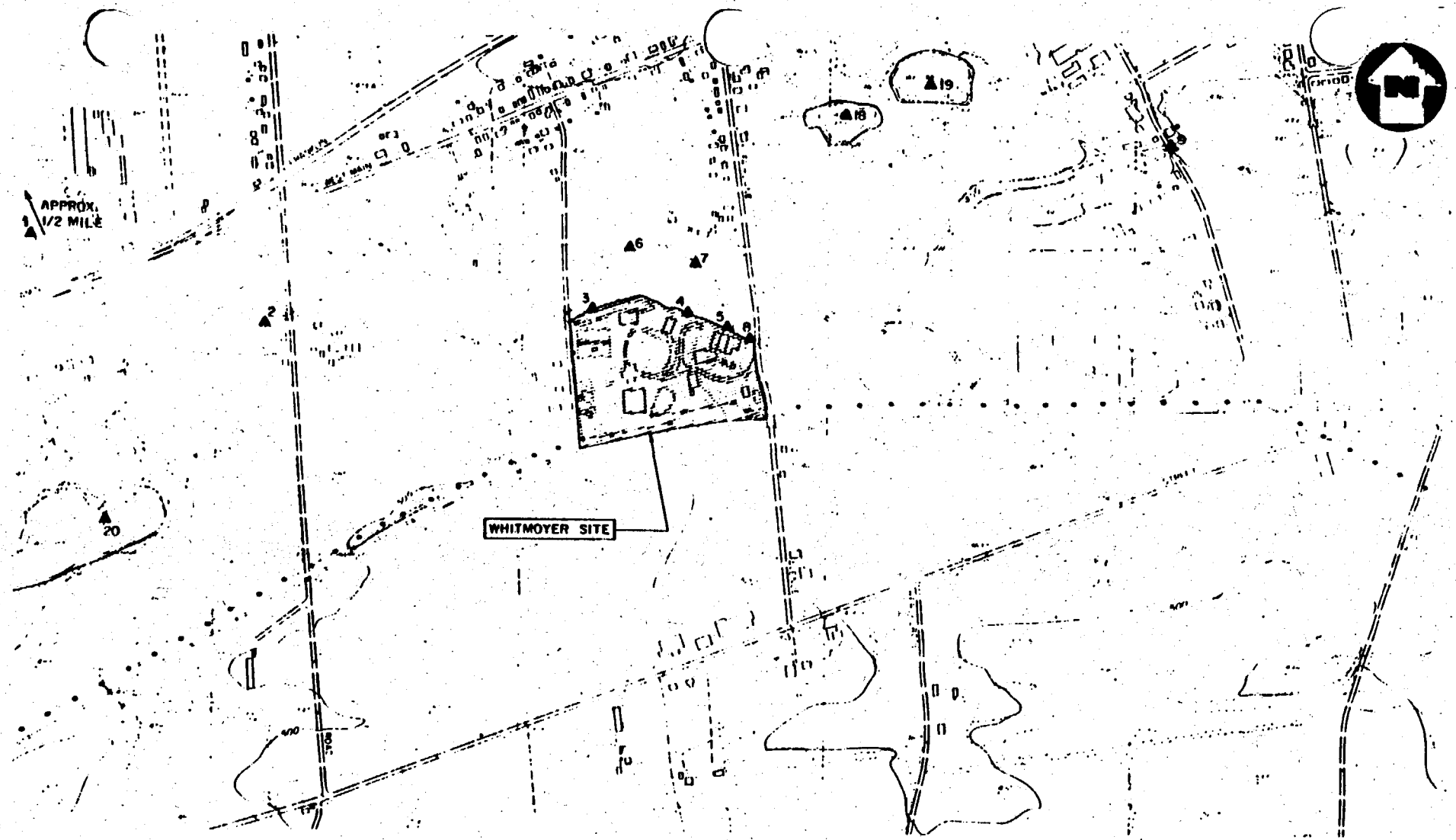

FIGURE 2-9

LOCAL SURFACE WATER/SEDIMENT SAMPLING LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

0 600 1200
SCALE IN FEET

NUS CORPORATION

2-06

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TABLE 2-18

SURFACE WATER ANALYTICAL SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Surface Water Station	Aniline		Total Arsenic and Iron		Dissolved Arsenic and Iron		Hardness		Nitrate/ Nitrite		Alkalinity		Total Suspended Solids		TCL VOAs		Total Metals		BNAs/ Aniline	
	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2	Rnd 1	Rnd 2
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
2	X		X		X	X	X	X	X	X	X	X	X	X		X		X		X
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
4**	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
5	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
6	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
7	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
8*	X		X		X	X	X	X	X	X	X	X	X	X		X		X		X
9	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
10	X		X		X	X	X	X	X	X	X	X	X	X		X		X		X
11	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
12	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
13	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
14	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
15		X		X				X				X		X						
16		X		X				X				X		X						
17		X		X				X				X		X						
18		X		X				X				X		X						
19		X		X				X				X		X						
20		X		X				X				X		X						

* Duplicate collected in Round 1.
** Duplicate collected in Round 2.

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nitrocellulose filter into the appropriate container and preserved.

One duplicate was submitted with the first-round samples; this duplicate was analyzed for all of the first-round analytes. A rinsate blank for the filtered arsenic and iron analysis and a bottle blank for unfiltered arsenic and iron, aniline, and nitrate/nitrite analyses also accompanied the first-round samples. All samples were packaged, shipped, and analyzed under low-concentration protocols.

Second-round sampling was performed between October 4 and 7, 1988, one week prior to benthic organism sampling (Section 2.7.2). Twenty surface-water stations were sampled, including the 14 locations sampled during the first round. The additional surface-water samples were collected from local lakes and quarries (see Figures 2-8 and 2-9). Prior to obtaining a surface-water sample, the water temperature, Eh, pH, dissolved oxygen, and specific conductivity were recorded. In addition, stream flow rates were measured at sample locations along the Tulpehocken Creek and dissolved oxygen profiles were measured at each lake and quarry.

Samples from Tulpehocken Creek were collected using the same techniques applied for first-round sampling. For the lakes and quarries, once the dissolved oxygen (D.O.) profiles for the bodies were completed, the sample team leader selected the sample depth, and the sample was collected in a Kemmerer sampler. Total depths, sample depths, and D.O. measurements for the lakes and quarries were as follows:

Station	Total Depth (Feet)	Sample Depth (Feet)	Dissolved Oxygen Level (mg/l)
16 - Myerstown Pond	5	3	13.3
17 - Lakeside Quarry	25	23	8.2
18 - Westernmost quarry on Wenger property	26	23	0.3
19 - Easternmost quarry on Wenger Property	36	33	0.2
20 - Quarry south of Tulpehocken Manor	70	65	0.3

Surface-water samples collected during the second round were analyzed for the same parameters as for the first round. At three of the sample locations (Station 2--Ramona Road; Station 8--Fairlane Avenue Bridge; and Station 10--College Street Bridge) the analytical suite was expanded. Samples from these stations were analyzed for TCL VOAs, TCL BNA plus aniline, TAL metals (unfiltered), arsenic and iron (filtered), total suspended solids (TSS), total alkalinity, nitrate/nitrite, and hardness.

During the second round of surface water sampling, five samples including one duplicate and one trip blank, were analyzed for TCL VOAs. Five samples, including one duplicate and one bottle blank, were analyzed for TCL BNA plus aniline and TAL metals. Twenty-one samples, including one duplicate, were analyzed for filtered (dissolved) arsenic and iron, TSS, total alkalinity, nitrate/nitrite, and hardness. Twenty samples, including one duplicate, one bottle blank, and one rinsate blank, were analyzed for unfiltered (total) arsenic and iron. Nineteen samples, including one duplicate and one rinsate blank, were analyzed for aniline. Stream flow measurements and D.O. profiles for lakes and quarries are discussed in Section 3.4. Sample results are presented in Section 4.5.

In the RI/FS Work Plan, surface-water sampling during a rain-event was proposed. This program was designed to provide data for an overland transport model. It was necessary that the rain-event sampling take place during a single, isolated rainfall of greater than 1 inch, and not be preceded or succeeded by another rain event within 24 hours. However, during the course of the field investigation, a rain event under the prescribed conditions did not occur. Therefore, this portion of the surface-water sampling program was omitted from the surface-water program.

2.6.2 Sediment Investigation

Sediment samples were collected concurrent with the second round surface-water samples, from the same sample locations. Twenty sediment locations were sampled, including 14 creek locations and 6 lake/quarry locations. Figures 2-8 and 2-9 illustrate surface-water/sediment sampling locations.

Each sediment sample from Tulpehocken Creek was collected using decontaminated stainless-steel trowels and mixing bowls. Decontaminated petite ponar dredges and boats were used to collect lake/quarry sediment samples. Sediment samples were homogenized in a stainless-steel mixing bowl. After the sample was homogenized, aliquots were placed into the appropriate sample containers for analysis. To prevent volatile loss, samples analyzed for volatile organics were not homogenized.

All Tulpehocken Creek/Union Canal sediment samples were submitted for arsenic, iron, aniline, tetrachloroethene (PCE), Eh, pH, TOC, and grain size distribution analysis. At three of the sample locations (Station 2--Ramona Road; Station 8--Fairlane Avenue Bridge; and Station 10--College Street Bridge) the analytical suite was expanded to include the remaining TCL VOA and TAL metal compounds, as well as the TCL BNA compounds (see Table 2-19). The six lake quarry samples were analyzed for arsenic, iron, Eh, pH, TOC, and grian size distribution.

Six sediment samples, including one duplicate, one trip blank, and one rinsate blank, were submitted for TCL VOA analysis.

TABLE 2-19

SAMPLING AND ANALYTICAL PROGRAM
SEDIMENTS
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Station Number	Total Arsenic and Iron	TOC	pH, Eh, and Grain Size	Aniline	PCE	Total VOAs	BNAs/ Aniline	TAL Metals
1	X	X	X	X	X			
2		X	X			X	X	X
3	X	X	X	X	X			
4**	X	X	X	X	X			
5	X	X	X	X	X			
6	X	X	X	X	X			
7	X	X	X	X	X			
8*		X	X			X	X	X
9	X	X	X	X	X			
10		X	X			X	X	X
11	X	X	X	X	X			
12	X	X	X	X	X			
13	X	X	X	X	X			
14	X	X	X	X	X			
15	X	X	X					
16	X	X	X					
17	X	X	X					
18	X	X	X					
19	X	X	X					
20	X	X	X					

* Duplicate sample collected for all analytes but pH, Eh, and grain size.

** Duplicate sample collected for all analytes but pH, Eh, TOC, and grain size.

Five samples, including one duplicate and one rinsate blank, were submitted for TAL metals and TCL BNA plus aniline. Twenty-one samples, including one duplicate, were analyzed for TOC. Twenty samples were submitted for Eh, pH, and grain size distribution analysis. Nineteen samples, including one duplicate and one rinsate blank, were submitted for arsenic and iron analysis. Fourteen samples, including one duplicate, one trip blank, and one rinsate blank, were analyzed for PCE. Thirteen samples, including one duplicate and one rinsate blank, were analyzed for aniline.

2.7 ECOLOGICAL INVESTIGATIONS

An ecological assessment was conducted at the Whitmoyer Laboratories Site to determine baseline ecological conditions, whether releases from the site are affecting downstream ecological receptors, and whether there are potentially affected wetlands along Tulpehocken Creek downstream of the site. To meet these objectives, aquatic biota and wetlands surveys were conducted. Field activities are discussed below. Survey results are presented in Section 3.7.

2.7.1 Wetlands Delineation

A jurisdictional wetlands survey along Tulpehocken Creek downstream from the site to Charming Forge Lake was conducted by REM III personnel on October 12 and 13, 1988. The species composition of the principal riparian plant communities, general soil and hydrological factors, and other pertinent information were qualitatively determined. Vegetative nomenclature followed U.S. Department of the Army (1987) protocols. Soil type classifications by the U.S. Department of Agriculture (1967, 1975, 1977, 1981, 1985) were adopted.

Wetlands were delineated in accordance with EPA jurisdictional wetland determination methodology, as presented in "Wetland Identification and Delineation Manual" (EPA, 1988a). Appendix G, the Wetlands Delineation Study Report, contains a more detailed description of the delineation activities. Wetlands survey results are discussed in Section 3.7.

2.7.2 Benthos Survey

Benthic samples were collected by REM III personnel from surface-water stations 1, 2, 8, 10, 13, and 15 (see Table 2-17) on Tulpehocken Creek on October 11 and 12, 1988. Samples were collected using D-frame kicknets. Each sample was processed in the field and then transferred into 1-liter sample bottles, fixed with 70 percent ethanol, and properly labeled. The samples were transferred to a REM III laboratory under chain-of-custody.

In the laboratory, the majority of the samples (all except Station 1) were subdivided prior to sorting. Once subdivided, the samples were examined under a low magnification (6X)

microscope, identified, and counted. Appendix H, the Aquatic Biological Survey Report, contains a detailed description of the sampling activities. Section 3.7 summarizes the benthos survey results.

2.7.3 Fish Sampling

Fishery surveys of Tulpehocken Creek (surface-water stations 2, 4, 10, and 15), Myerstown Pond (Station 16), and Lakeside Quarry (Station 17) were conducted by REM III personnel between October 11 and 14, 1988. Fish were collected using six-panel experimental gill nets, minnow traps, and electrofishing equipment.

Station 2 (Ramona Road) was sampled using electrofishing equipment and a block seine. Stations 4 and 10 (Union Canal and Tulpehocken Creek at the College Avenue Bridge) were sampled using a gill net and electrofishing equipment. Station 16 (Myerstown Pond) was sampled using gill nets, minnow traps, and boat-mounted electrofishing equipment. Three gill nets and minnow traps were used to sample Station 17 (Lakeside Quarry).

Fish sampling was attempted at Station 15 (Charming Forge Lake) using gill nets, minnow traps, and electrofishing equipment. These efforts proved unsuccessful. Therefore, electrofishing was used at the first pool downstream from Charming Forge Dam to collect fish samples.

Fish collected in the field were taken to the site trailer, where they were sorted by species and measured. A field fish log identifying each specimen collected and its length was maintained. The fish were wrapped in aluminum foil, stored in coolers containing dry ice, and transferred to a REM III laboratory under chain-of-custody for processing.

Prior to sample preparation, fishes were weighed in the laboratory. Composite fish samples were prepared in accordance with the FOP (Section 4.2.13). A 1-HP, stainless-steel, commercial grade food grinder was used for preparation of whole body fish samples. Fish tissue samples were prepared with a filleting knife. All processing equipment and work surfaces were decontaminated prior to preparation of each sample. Additional information on fish sampling activities is contained in Appendix H, the Aquatic Biological Surveys Report.

Fifteen fish tissue samples (including one duplicate) and nineteen whole body samples (including one duplicate) were submitted for arsenic analysis. The samples were packaged, shipped, and analyzed using low-concentration protocols. Table 2-20 is a summary of the fish submitted for chemical analysis. Analytical results are discussed in Section 4.6.

TABLE 2-20

FISH SAMPLE SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA

Sample Number	Station Number	Fish Species	Number of Fish Used in Sample	Analysis
FW0100	2	White Sucker	5	Whole Body
FT0100	2	White Sucker	5	Fish Tissue
FW0200	10	White Sucker	5	Whole Body
FT0200	10	White Sucker	5	Fish Tissue
FT0300	4	White Sucker	5	Fish Tissue
FW0300	4	White Sucker	5	Whole Body
FW0400	15	White Sucker	5	Whole Body
FT0400	15	White Sucker	5	Fish Tissue
FW0500	16	White Sucker	3	Whole Body
FT0500	16	White Sucker	3	Fish Tissue
FW0600	17	White Sucker	3	Whole Body
FT0600	17	White Sucker	3	Fish Tissue
FW0700	17	Carp	1	Whole Body
FT0700	17	Carp	1	Fish Tissue
FW0800	16	Carp	5	Whole Body
FT0800	16	Carp	5	Fish Tissue
FW0900	15	Carp	5	Whole Body
FT0900	15	Carp	5	Fish Tissue
FW1000	4	Carp	4	Whole Body
FT1000	4	Carp	5	Fish Tissue
FW1100	17	Yellow Perch	4	Whole Body
FT1100	17	Yellow Perch	5	Fish Tissue
FT1200	16	Channel Catfish	1	Fish Tissue
FW1300	2	Brown Trout	2	Whole Body

TABLE 2-20
FISH SAMPLE SUMMARY
WHITMOYER LABORATORIES SITE
LEBANON COUNTY, PENNSYLVANIA
PAGE TWO

Sample Number	Station Number	Fish Species	Number of Fish Used in Sample	Analysis
FW1400	15	Smallmouth Bass	1	Whole Body
FT1500	16	Largemouth Bass	5	Fish Tissue
FW1600	17	Brown Trout	1	Whole Body
FW1700	17	Largemouth Bass	3	Whole Body
FT1800	17	Largemouth Bass	1	Fish Tissue
FW1900	17	Bluegill	2	Whole Body
FW2000	2	Pumpkinseed	10	Whole Body
FW2100	16	Bluegill	4	Whole Body

3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

3.1 SURFACE FEATURES

The Whitmoyer Laboratories Site is located within the Lebanon Valley in southeastern Pennsylvania. The site and surrounding area are part of the broad, gently rolling valley. Site elevations range from approximately 450 feet above mean sea level (MSL) in the northeast corner of the property to 495 feet above MSL at the property's southwestern corner.

The Whitmoyer Laboratories Site, which has a total area of 22 acres, is bordered by Fairlane Avenue (east), Creamery Road (west), the Conrail (Reading) Railroad tracks (south), and Tulpehocken Creek/Union Canal (north) (see Figure 1-2). The property is situated on a bedrock ridge and flood plain. Buildings 1 through 7, 9, and 12 are situated in the 100-year flood plain, based on Federal Emergency Management Agency (FEMA, 1981) and U.S. Geological Survey (USGS, 1973) maps. The bedrock ridge lies about 10 to 20 feet higher in elevation than the flood plain area, with a relatively sharp drop separating the two units. This drop runs west from the main gate across to the southeast corner of Building 5, continuing west along the northern edge of the consolidated lagoons, the north side of the vault, and the north side of the excavated lagoons.

In addition to the buildings and tanks, prominent surface features on site include a railroad spur leading from the Conrail tracks to the area south of Building 5, and a Buckeye Pipe Line Company pumping station located over part of the excavated lagoons. Both the Whitmoyer property and the Buckeye Pipe Line pump station are surrounded by 4- to 6-foot-high chain-link fence.

The pump station services an underground petroleum products (gasoline, No. 2 fuel oil, diesel fuel, and kerosene) pipeline, which crosses the site (see Figure 1-2). In addition to the pipeline, a variety of underground utilities, including an 8-inch water distribution line for firefighting (using Union Canal water and a pump in Building 12), a process wastewater line leading to the Department 8101 pit, an underground line running from the Building 9 truck apron to an oil separation basin outside this building, sanitary sewer lines, potable water drains, and storm water drains (including roof drainage lines), are present in the subsurface.

3.2 GEOLOGY AND SOILS

The geologic conditions presented in this section are based on the findings of the RI as well as on previous site investigations and published local and regional data.

3.2.1 Regional Geology

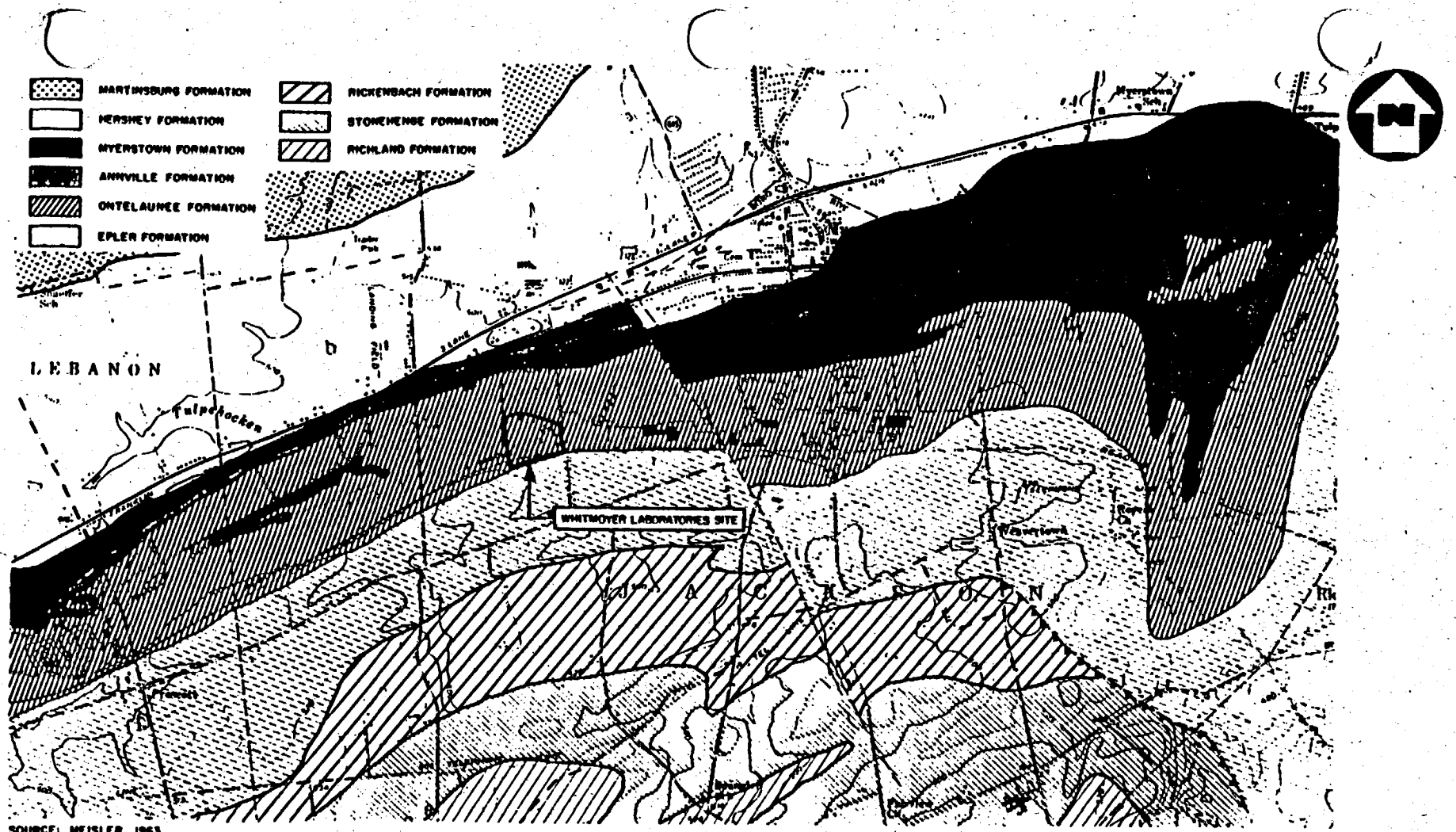
The Whitmoyer Laboratories Site is located within the Lebanon Valley section of the Great Valley and Ridge Physiographic Province. The general topography of the area is characterized by a broad, gently rolling valley developed by stream sculpture, with some sinkholes existing along the Tulpehocken Creek (Meisler, 1963). The Myerstown area (in which the site is located) is underlain by Ordovician Age limestones and dolomites, including those of the Beekmantown Group. Figure 3-1 identifies the regional bedrock geology. Soils overlying the area are primarily fine-grained residual soils derived from weathering of the bedrock surface. Near Tulpehocken Creek, adjacent to the site, coarser-grained alluvial deposits are present. A thin veneer of organic-rich topsoil overlies the residual soils throughout much of the area.

The Ontelaunee Formation, which underlies the site and adjacent areas, is described as a light- to dark-gray dolomite, which weathers to a dark grayish brown (Meisler, 1963). Regular parallel banding is characteristic of this formation, as is the presence of stylolites. The Ontelaunee Formation strikes N 60° E to N 80° E predominantly, with an overall dip to the southeast of approximately 30°. In the Myerstown area, this formation is approximately 500 feet thick.

The Annville and Myerstown Formation outcrop along a narrow east-northeast trending band approximately 1,000 and 1,300 feet north of the site area, respectively (see Figure 3-1). These units, which underlie much of the town of Myerstown, physically underlie the Ontelaunee Formation but are stratigraphically younger. The reversed position of these beds with respect to the Ontelaunee Formation (older beds overlie younger beds) is an indication that the bedrock units in the site area represent the overturned south limb of a recumbent fold (Meisler, 1963). The Annville Limestone is described as a thick-bedded, light blue to pink-gray, crystalline, high-calcium limestone, with gray mottling and banding at the base. The unit weathers to white in outcrops. In the Myerstown area, the Annville Limestone is about 250 feet thick and is extensively quarried. The Myerstown Limestone stratigraphically overlies and physically underlies the Annville Limestone (the bedding is overturned). Regional literature describes the Myerstown Limestone as a dark-gray, crystalline limestone, which becomes shaley near the base of the unit. The Myerstown Formation is approximately 250 feet thick and is separated from the Annville Formation by a 2- to 6-inch-thick seam of iron-stained clay.

Farther north, the Hershey Formation outcrops. This unit is described as a dark-gray, argillaceous limestone approximately 450 feet thick. The Borough of Myerstown primarily obtains its municipal groundwater supplies from this formation.

Immediately south of the Whitmoyer Laboratories Site, the Epler Formation outcrops. This unit, part of the Beekmantown Group



SOURCE: MEISLER, 1963.

FIGURE 3-1

BEDROCK GEOLOGY
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

0 2000 4000
SCALE IN FEET

NUS CORPORATION

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