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US Army Corps of Engineers

Toxic and Hazardous
Materials Agency

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Task Order 006 Environmental Investigation for Property Transfer

**Fort Holabird Crime
Records Center**

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ENVIRONMENTAL INVESTIGATION AND ALTERNATIVES ASSESSMENT

Contract No. DAAA15-90-D-0009

March 1992

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Prepared for:

U.S. ARMY TOXIC AND
HAZARDOUS MATERIALS AGENCY
Aberdeen Proving Ground (Edgewood Area)
Maryland 21010-5401

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FINAL

**TASK ORDER 006
ENVIRONMENTAL INVESTIGATION FOR PROPERTY TRANSFER**

**ENVIRONMENTAL INVESTIGATION
AND
ALTERNATIVES ASSESSMENT**

Fort Holabird Crime Records Center
Baltimore, Maryland

Contract No. DAAA15-90-D-0009

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EXECUTIVE SUMMARY

BACKGROUND AND OBJECTIVES

Roy F. Weston, Inc. (WESTON) was retained by the United States Army Toxic and Hazardous Materials Agency (USATHAMA) to conduct an Environmental Investigation/ Alternatives Assessment (EI/AA) for property transfer of the Fort Holabird Crime Records Center (CRC). The EI/AA was performed in accordance with a Work Plan prepared by WESTON.

The objectives of the EI/AA were to:

- Determine the nature, magnitude, and extent of any environmental contamination.
- Develop information to assess the health and environmental risks associated with closure and transfer of the property.
- Develop and evaluate remedial action alternatives to a level necessary to enable the Army to make a decision regarding preparation of the property for transfer.

The EI/AA was conducted in accordance with the National Contingency Plan (NCP) and the appropriate guidelines published in the U.S. Environmental Protection Agency's (EPA's) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, October 1988.

SITE DESCRIPTION

The CRC occupies a 7-acre site at Detroit and Oak Avenues within the city limits of Baltimore. The site consists of three buildings (Buildings 305, 306, and 307), a grassy strip that formerly was the site of two other buildings (Buildings 302 and 308), and a parking area (see Figure ES-1). Only Building 305 is currently used.

SITE HISTORY

Although Fort Holabird was established in 1917 on 96 acres, the installation had grown to 349 acres by the end of World War II. The land on which the CRC is located was acquired in 1941.

Between 1941 and the 1970s, the present CRC property was used by the Quartermaster Corps, the Signal Corps, and the Army Intelligence School. The CRC has operated in Building 305 since 1975.

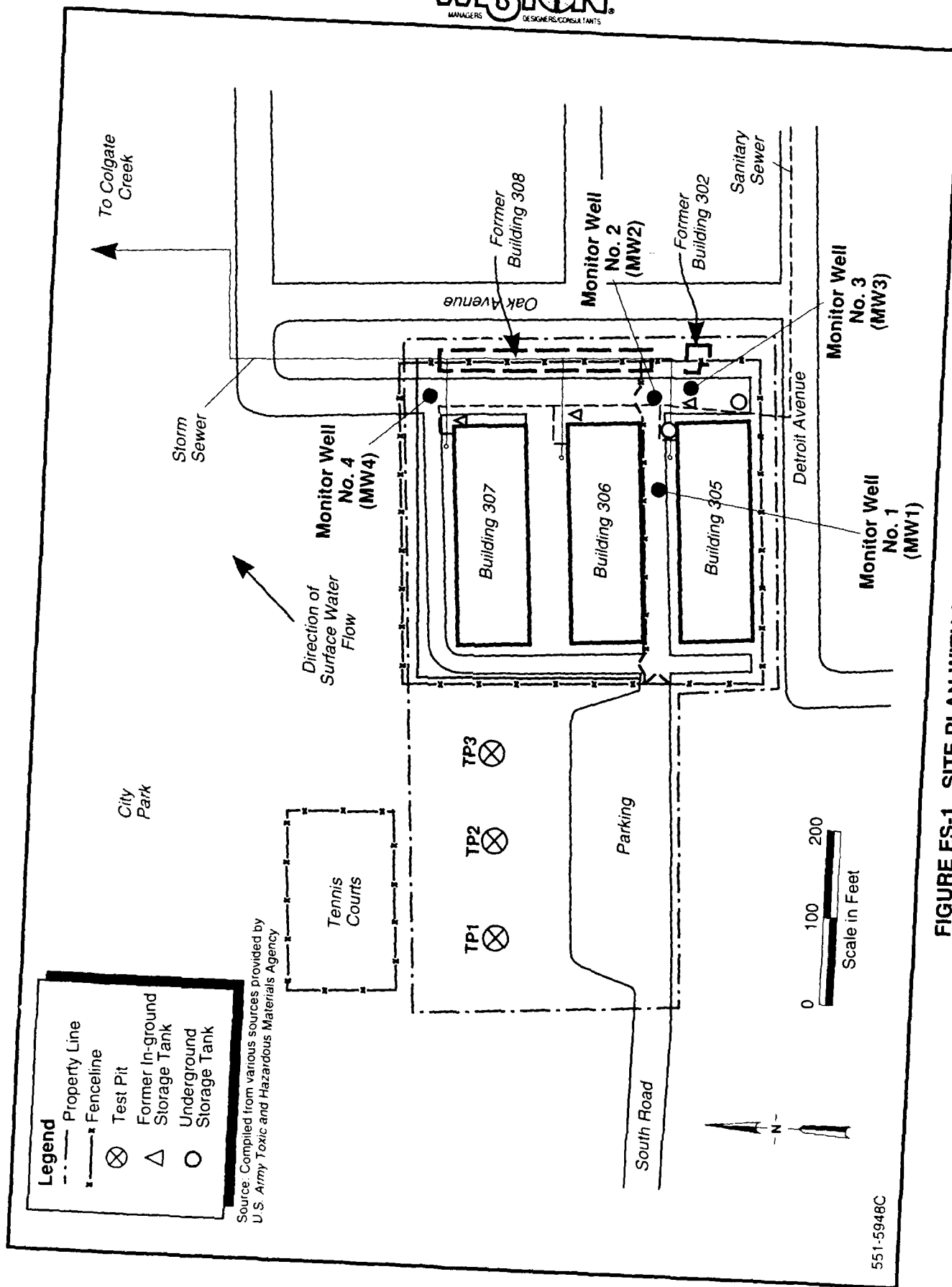


FIGURE ES-1 SITE PLAN WITH SAMPLING LOCATIONS

All three remaining buildings at the CRC are one-story, wooden frame structures that were built in 1942. Buildings 302 and 308 were reportedly demolished in the early 1970s, and the area where the buildings stood was leveled and planted with grass in 1984. Building 302 may have housed an incinerator used for burning paper.

PREVIOUS INVESTIGATIONS

Environmental Photographic Interpretation Center (EPIC) 1989 - In August 1989, EPIC issued their "Installation Assessment, Army Base Closure Program, Fort Holabird, Baltimore, Maryland, Interim Report." This report contained the results of their analysis of historical aerial photography of Fort Holabird. Although these results showed potential contamination of surface and groundwater from past activity, they did not specifically indicate any visible contamination in the CRC area.

Tank Removal Report, 1989 - Reports of the observations of the removal of three in-ground fuel oil storage tanks have been issued by an inspector from the State of Maryland, Department of the Environment. Evidence of leaking was reported in the tanks at Buildings 305 and 306. Three monitoring wells were installed in the vicinity of the Building 305 tank, and one monitoring well was installed near the Building 307 tank. Sampling conducted in 1990 revealed a total petroleum hydrocarbon concentration of 0.93 mg/L in monitoring well No. 3.

Enhanced Preliminary Assessment, 1990 - This report was prepared by WESTON to present findings and conclusions of environmental conditions at the Fort Holabird CRC and to provide recommendations for further action. No environmental sampling was performed as part of the assessment. The findings and recommendations were based on WESTON's experience with similar facilities and on current regulatory agency requirements.

Environmental Impact Statement (EIS), 1990 - The purpose of the EIS was to evaluate methods to implement the closing and excessing of the Fort Holabird CRC. The alternatives evaluated were: no action; residential reuse; and industrial reuse. Although no formal screening process was implemented, industrial reuse was determined to be the most likely alternative.

SITE CHARACTERIZATION ACTIVITIES

The site characterization activities performed in the field at the CRC as part of the EI were as follows:

Three existing monitoring wells were sampled on 23 April 1991. The wells (Nos. 2, 3, and 4) were in the vicinity of the former in-ground storage tanks near Buildings 305 and 307 (see Figure ES-1). A duplicate sample was taken from monitoring well No. 3. All groundwater samples were analyzed for the following parameters: Resource Conservation and Recovery Act (RCRA) metals, base neutral acid extractables (BNAs), volatile organic compounds (VOCs), and total petroleum hydrocarbons (TPH).

Three test pits were excavated in a grassy area adjacent to the parking lot (see Figure ES-1). The area contains a fill material of unknown origin. Each pit was excavated to a depth of between 48 and 54 inches. The presence of contamination was checked using the following methods: a reading above background on the HNu photoionization device; visible staining of soil; or artifacts in the soil. If contamination was observed by any of these methods, a soil sample was to be taken.

A 500-gallon diesel underground storage tank (UST) installed in 1985 was hydrostatic leak tested.

Asbestos surveying and sampling were performed to assess suspect asbestos-containing materials (ACM). A total of 21 samples was collected from suspect ACM in Buildings 305, 306, and 307. Polarized Light Microscopy (PLM) with dispersion staining was used to analyze the suspect materials collected in the buildings.

Radon sampling was conducted in Building 305 on the ground floor level. Radon levels were measured using 10 alpha-type radon detectors that were exposed for 90 days. In addition, there was a field blank, a duplicate, and a spike, for a total of 13 detectors.

SITE CHARACTERIZATION RESULTS

Analytical results of the groundwater samples are listed in Table ES-1. Silver was detected at low levels in the three samples from the three monitoring wells. Arsenic was detected in two samples from monitoring wells No. 3 and 4. Barium was detected in all four samples including the duplicate sample. Lead was detected at low levels in two samples from monitoring wells No. 2 and 3. Chromium was detected in only one sample (MW03D). BNAs and VOCs were detected in the samples from monitoring well No. 3, the same well where TPH had been detected earlier, although TPH were not detected in any of the samples during the current sampling. The likely source of the contamination is fuel oil that leaked from the in-ground storage tank formerly located adjacent to Building 305.

The three test pits (TP-1, TP-2, and TP-3) contained a sandy fill material under a layer of topsoil. No HNu readings above background were measured. No stains in the soil or artifacts were encountered during excavation. No soil samples were taken because there were no signs of contamination.

The 500-gallon tank at Building 305 passed the leak test and therefore is considered tight under State of Maryland regulations.

The analytical results for each asbestos sample are provided in Table ES-2. Of the 21 samples collected, 14 were found to contain greater than 1% asbestos and are therefore considered ACM. Two samples were found to contain 1% asbestos, and another two samples were found to contain less than 1% asbestos (three of these four samples are

Table ES-1

**Groundwater Investigation Results -
Compounds Detected Above Detection Limits
(all values in $\mu\text{g/L}$)**

Monitoring Well No. 3

Compound	Sample ID/Well No. MW03	MW03D
METALS		
Silver	0.8	ND
Arsenic	ND	3.7
Barium	54.0	98.0
Chromium	ND	15.1
Lead	ND	9.9
BNAs		
2-Methylnaphthalene	200.0	200.0
Dibenzofuran	5.2	6.9
Di-N-Butylphthalate	ND	1.3
Fluorene	7.2	10.0
Dimethylnaphthalene	200.0	400.0
Trimethylnaphthalene	NA	70.0
Methylnaphthalene	200.0	200.0
Naphthalene	231.0	198.0
N-Nitrosodiphenylamine	ND	3.5
VOCs		
1,2-Dimethylbenzene	10.0	9.0
Benzene	28.4	25.5
Chloroform	6.8	6.5
Ethylbenzene	17.6	16.5

Monitoring Wells Nos. 2 and 4

Compound	Sample ID/Well No. MW02	MW04
METALS		
Silver	0.4	0.9
Arsenic	ND	3.8
Lead	6.2	ND
Barium	52.0	18.2

ND = Not detected.

TABLE ES-2

ANALYTICAL RESULTS FOR ASBESTOS SAMPLES FROM BUILDINGS

LOCATION	QUAD(a)	LAB ID	MATERIAL TYPE	COLOR	FRIABILITY	ASBESTOS CONTENT (%) (b)				
						CH	AM	CR	OT	TL
BUILDING 305										
INSIDE-BREAK AREA	SE	FJ609	FLOOR TILE	TAN	NON-FRIABLE	5	ND	ND	ND	5
INSIDE-BATHROOM	NE	FJ610	FLOOR TILE	GREEN	NON-FRIABLE	5	ND	ND	ND	5
OUTSIDE-WEST SIDE	SW	FJ611	TAR PAPER	BLACK	FRIABLE	<1	ND	ND	ND	<1
OUTSIDE-WEST SIDE	NW	FJ612	TAR PAPER	BLACK	FRIABLE	<1	ND	ND	ND	<1
BUILDING 306										
INSIDE	W	FJ597	WALL BOARD	WHITE	NON-FRIABLE	ND	ND	ND	ND	ND
INSIDE	S	FJ598	FLOOR TILE	TAN	NON-FRIABLE	3	ND	ND	ND	3
INSIDE-BATHROOM	NE	FJ599	FLOOR TILE	GRAY	NON-FRIABLE	5	ND	ND	ND	5
INSIDE	NE	FJ600	TAR PAPER	BLACK	FRIABLE	ND	ND	ND	ND	ND
INSIDE-BOILER ROOM	NE	FJ602	PIPE INSULATION	WHITE	FRIABLE	5	25	ND	ND	30
INSIDE-BOILER ROOM	NE	FJ603	PIPE INSULATION	WHITE	FRIABLE	ND	1	ND	ND	1
INSIDE-BOILER ROOM	NE	FJ604	PIPE INSULATION	ORANGE	FRIABLE	43	ND	ND	ND	40
INSIDE-BOILER ROOM	NE	FJ605	PIPE INSULATION	GRAY	FRIABLE	40	ND	ND	ND	40
BUILDING 307										
INSIDE	S	FJ606	FLOOR TILE	GREEN	NON-FRIABLE	5	ND	ND	ND	5
OUTSIDE-EAST SIDE	SE	FJ607	TAR PAPER	BLACK	FRIABLE	1	ND	ND	ND	1
OUTSIDE-NORTH SIDE	NW	FJ608	TRANSITE PANEL	GRAY	NON-FRIABLE	40	ND	ND	ND	40
INSIDE-BOILER ROOM	NE	FJ613	BOILER INSULATION	WHITE	FRIABLE	20	ND	ND	ND	20
INSIDE-BOILER ROOM	NE	FJ614	BOILER INSULATION	WHITE	FRIABLE	25	ND	ND	ND	25
INSIDE-BOILER ROOM	NE	FJ615	PIPE INSULATION	WHITE	FRIABLE	1	30	ND	ND	31
INSIDE-BOILER ROOM	NE	FJ616	PIPE INSULATION	GRAY	FRIABLE	40	ND	ND	ND	40
INSIDE-BOILER ROOM	NE	FJ617	PIPE INSULATION	GRAY	FRIABLE	50	ND	ND	ND	50
INSIDE-BOILER ROOM	NE	FJ618	PIPE INSULATION	WHITE	NON-FRIABLE	ND	ND	ND	ND	ND

FOOTNOTES:

a - QUAD CODES (relative to building sampled)

N - NORTH
 S - SOUTH
 E - EAST
 W - WEST
 C - CENTER
 NE - NORTHEAST
 SE - SOUTHEAST
 NW - NORTHWEST
 SW - SOUTHWEST

b - ASBESTOS CONTENT (%)

CH - CHRYSOLITE
 AM - AMOSITE
 CR - CROCIDOLITE
 OT - OTHER
 TL - TOTAL
 ND - NONE DETECTED

tar paper samples). According to EPA's definition, the tar paper is considered non-ACM. However, WESTON recommends that additional samples of the tar paper should be collected, which is present in all three buildings, in order to confirm that it is actually non-ACM because the results are borderline. Of the 14 ACM samples, eight are friable materials and six are nonfriable materials. All of the friable ACM are associated with the boiler insulation and pipe insulation in Buildings 306 and 307. The radon investigation results indicated that the radon levels in Building 305 were very low (all detectors except the spike reported average radon concentrations of less than the detection limit of 0.3 pCi/L) and were well below the EPA's recommended level of 4 pCi/L.

RISK ASSESSMENT

A risk assessment was performed to assess potential human health risks associated with groundwater contamination at the CRC in the absence of any remedial action. Since arsenic concentrations that were detected in the site groundwater were typical of background levels for the groundwater in this area, arsenic was not included in the risk assessment. Human exposure to the contaminants at the CRC was evaluated under a future use scenario. Because the groundwater is currently unused, no current use scenario for the groundwater was evaluated. The future use scenario conservatively assumed the groundwater would be used as a potable water supply for an industrial facility, with exposure estimates based on a worker ingesting 1 liter and taking a shower each working day. The lifetime carcinogenic risk for a hypothetical future user of the groundwater was calculated to be 1E-05 (one-in-one-hundred-thousand). The majority of the risk (69%) is attributed to benzene.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

EPA policy, as reflected in the Superfund Amendments and Reauthorization Act of 1986 (SARA) and in the National Contingency Plan (NCP), provides that the development and evaluation of remedial actions under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, or Superfund) must include a comparison of alternative site responses to applicable or relevant and appropriate federal and state environmental and public health requirements. Although any remedial actions that may be conducted at the CRC will not be regulated under CERCLA, it will be used as a guideline.

ARARs for the CRC are divided into the following chemical-specific and action-specific requirements:

Chemical-Specific Requirements

- The Safe Drinking Water Act (SDWA) mandates EPA to establish regulations to protect human health from contaminants in drinking water. Maximum contaminant levels (MCLs) are enforceable standards that take into consideration human health effects, available treatment technologies,

and costs of treatment. Benzene detected in monitoring well No. 3 is the only contaminant in the groundwater detected above the MCLs. The drinking water standards may not apply to the groundwater at the CRC because it is not used, and brackishness caused by seawater infiltration may make future use impractical.

- Maryland water quality regulations resemble the national standards set forth by EPA under the SDWA and Clean Water Act (CWA).
- Contaminated groundwater caused by USTs is regulated under Maryland UST Regulations. The State of Maryland, Department of Environment has informed the Army that based on the results of groundwater sampling, no further action is required pertaining to the groundwater at Fort Holabird.

Action-Specific ARARs

- Asbestos remedial activities must comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations in the Clean Air Act (CAA).
- The CWA applies to point-source direct discharges into navigable waters and indirect discharges to Publicly Owned Treatment Works (POTWs). The CWA would only be applicable if a groundwater recovery system were installed.

DEVELOPMENT AND ANALYSIS OF ALTERNATIVES

Three alternatives were developed to address groundwater contamination at the CRC. These alternatives are:

- Alternative 1: No Action - No remedial actions are performed.
- Alternative 2: Additional Groundwater Monitoring - One or more additional wells would be installed for further investigation of the nature and extent of the groundwater contamination.
- Alternative 3: On-Site Groundwater Treatment - Air stripping technology would be used to remediate groundwater contamination.

Two alternatives were developed to address asbestos at the CRC. These alternatives are:

- Alternative 1: No Action - No remedial actions are performed.
- Alternative 2: Remedial Action-Abatement Options - ACM would either be encapsulated, enclosed, or removed and disposed of.

The developed alternatives were subjected to a detailed evaluation. The evaluation criteria included:

- Compliance with ARARs.
- Short-term effectiveness.
- Long-term effectiveness and permanence.
- Overall protection of human health and the environment.
- Reduction of toxicity, mobility, and volume of contaminants.
- Implementability.
- Cost.

A summary of the evaluation results for each alternative is presented in Table ES-3.

RECOMMENDATIONS

Due to the low risk nature of the groundwater contamination, the recommended groundwater alternative is Alternative 1: No Action.

The recommended asbestos alternative is Alternative 2: Asbestos Removal. Friable asbestos in Buildings 306 and 307 boiler rooms should be removed prior to the buildings' reuse, reoccupation, or demolition. The non-friable asbestos in Buildings 305, 306, and 307 should be removed prior to demolition, and records should be maintained at the facility to alert any maintenance personnel to the potential risks of disturbing the non-friable ACM.

Table ES-3
Summary of Evaluation of Alternatives

Evaluation Criteria	Groundwater			Asbestos	
	Alternative 1: No Action	Alternative 2: Additional Monitoring	Alternative 3: On-Site Treatment	Alternative 1: No Action	Alternative 2: Asbestos Abatement
Compliance with ARARs	Complies with ARARs if drinking water standards are not applied	Complies with ARARs if drinking water standards are not applied	Complies with drinking water standards	Does not comply with ARARs	Complies with ARARs
Short-term effectiveness	No additional impact	No additional impact	Slight risk due to release of contaminated air	No additional impact	Slight risk of asbestos emissions during removal
Long-term effectiveness	No additional impact	No additional impact	High degree of effectiveness and permanence	No additional impact	High degree of effectiveness and permanence
Overall protection of human health and the environment	Sufficiently protective of human health and the environment	Sufficiently protective of human health and the environment	Sufficiently protective of human health and the environment	Risks to on-site workers are not mitigated	Sufficiently protective of human health and the environment
Reduction of toxicity, mobility, and volume of contaminants	No active treatment of contaminants	No active treatment of contaminants	Effective reduction of toxicity, mobility, and volume of contaminants	No active treatment of asbestos	Effective reduction of toxicity, mobility, and volume of contaminants
Implementability	Readily implemented	Readily implemented	Readily implemented	Readily implemented	Readily implemented
Cost	No costs	Low costs	Moderate to high costs	No costs	Cannot be determined from available information



SECTION 1

INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

Roy F. Weston, Inc. (WESTON) was retained by the United States Army Toxic and Hazardous Materials Agency (USATHAMA) to conduct an Environmental Investigation/Alternatives Assessment (EI/AA) for property transfer of the Fort Holabird Crime Records Center (CRC). The EI/AA was performed in accordance with a Work Plan prepared by WESTON.

The objectives of the EI/AA were to:

- Determine the nature, magnitude, and extent of any environmental contamination.
- Develop information to assess the health and environmental risks associated with closure and transfer of the property.
- Develop and evaluate remedial action alternatives to a level necessary to enable the Army to make a decision regarding preparation of the property for transfer.

The EI/AA was conducted in accordance with the National Contingency Plan (NCP) and the appropriate guidelines published in the United States Environmental Protection Agency's (EPA's) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, October 1988. However, a formal remedial investigation/feasibility study (RI/FS) was not performed, since the CRC investigation was not conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, or Superfund) and because the CRC is not a National Priorities List (NPL) site. The advantage of conducting the EI/AA in accordance with the procedural intent of an RI/FS is that it facilitates regulatory review by following a consistent and established investigative approach.

Section 1 of this report presents a site description, site history, and summary of previous investigations. Section 2 summarizes the quality assurance (QA) and quality control (QC) program and the procedures used during the sampling. The site characterization activities performed in the field are described in Section 3 and the results are discussed in Section 4. A risk assessment for the site is included in Section 5. Applicable or relevant and appropriate requirements (ARARs) are identified in Section 6. Section 7 presents the development and analysis of remedial alternatives. Section 8 is a comparison of the remedial alternatives and recommendations. Section 9 lists pertinent references.

1.2 SITE DESCRIPTION

The CRC occupies a 7-acre site at Detroit and Oak Avenues, within the city limits of Baltimore, Maryland (Figure 1-1). The site consists of three buildings (Buildings 305, 306, and 307), a grassy strip that formerly was the site of two other buildings (Buildings 302 and 308), and a parking area (Figure 1-2). Only Building 305 is currently used.

1.2.1 DEMOGRAPHY AND LAND USE

Although there is a wide variety of occupations and industries in the city of Baltimore, the leading industries that line the city's harbor include primary metals, transportation equipment, food and related products, apparel and related products, and fabricated metal products.

The CRC property is zoned M-3, which is an industrial use category designated for manufacturing and related activities. East and southeast of Fort Holabird lie the residential communities of Dundalk and St. Helena. The Baltimore Parks and Recreation area, known as Project Open Space, is located north of the fort, and the Holabird Industrial Park is located west and southwest of the fort.

1.2.2 SURFACE WATER HYDROLOGY

The CRC is located on a peninsula between two inlets of the Chesapeake Bay, the Patapsco and Back Rivers. The land is gently rolling, and the elevation within 1 mile of the site varies from sea level to 60 ft. The nearby area is completely urbanized, and there are no significant stands of trees. The closest major surface water is the Patapsco River, which is heavily used by marine traffic and has a great deal of heavy industry located on its banks.

No standing surface waters are located within the CRC property boundaries. All surface water drains north-northeast of Colgate Creek, approximately 1,000 ft to the north, either by direct surface runoff or conveyance through storm sewers. According to CRC personnel, a localized minor drainage problem currently exists west of Buildings 305, 306, and 307 that involves some ponding of rainwater due to partial clogging of the storm pipe located adjacent to Building 307. Colgate Creek flows into the Patapsco River, which is an inlet of the Chesapeake Bay.

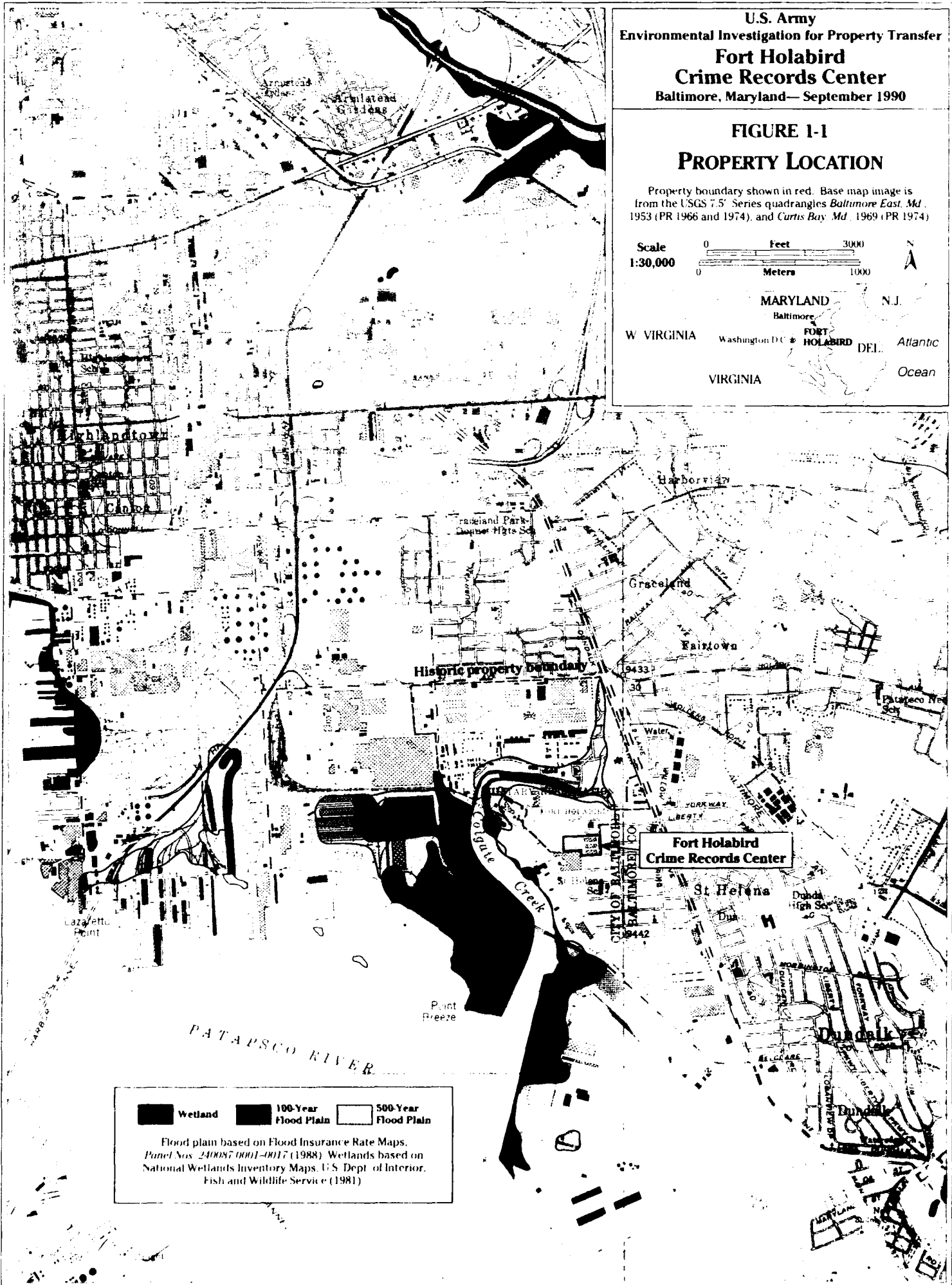
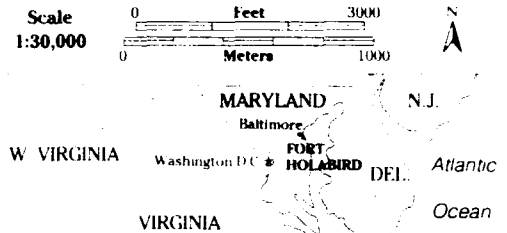
1.2.3 SOILS

The area of the CRC has been mapped by the United States Soil Conservation Service (USSCS) as a complex of the Beltsville soil series and urban soils. This designation indicates that the site's natural soil profiles have been disturbed by earth-moving activities, but that a certain percentage of the natural soil profile can be found, typically buried under fill material.

U.S. Army
Environmental Investigation for Property Transfer
Fort Holabird
Crime Records Center
Baltimore, Maryland—September 1990

FIGURE 1-1
PROPERTY LOCATION

Property boundary shown in red. Base map image is from the USGS 7.5' Series quadrangles *Baltimore East, Md.* 1953 (PR 1966 and 1974), and *Curtis Bay, Md.* 1969 (PR 1974)



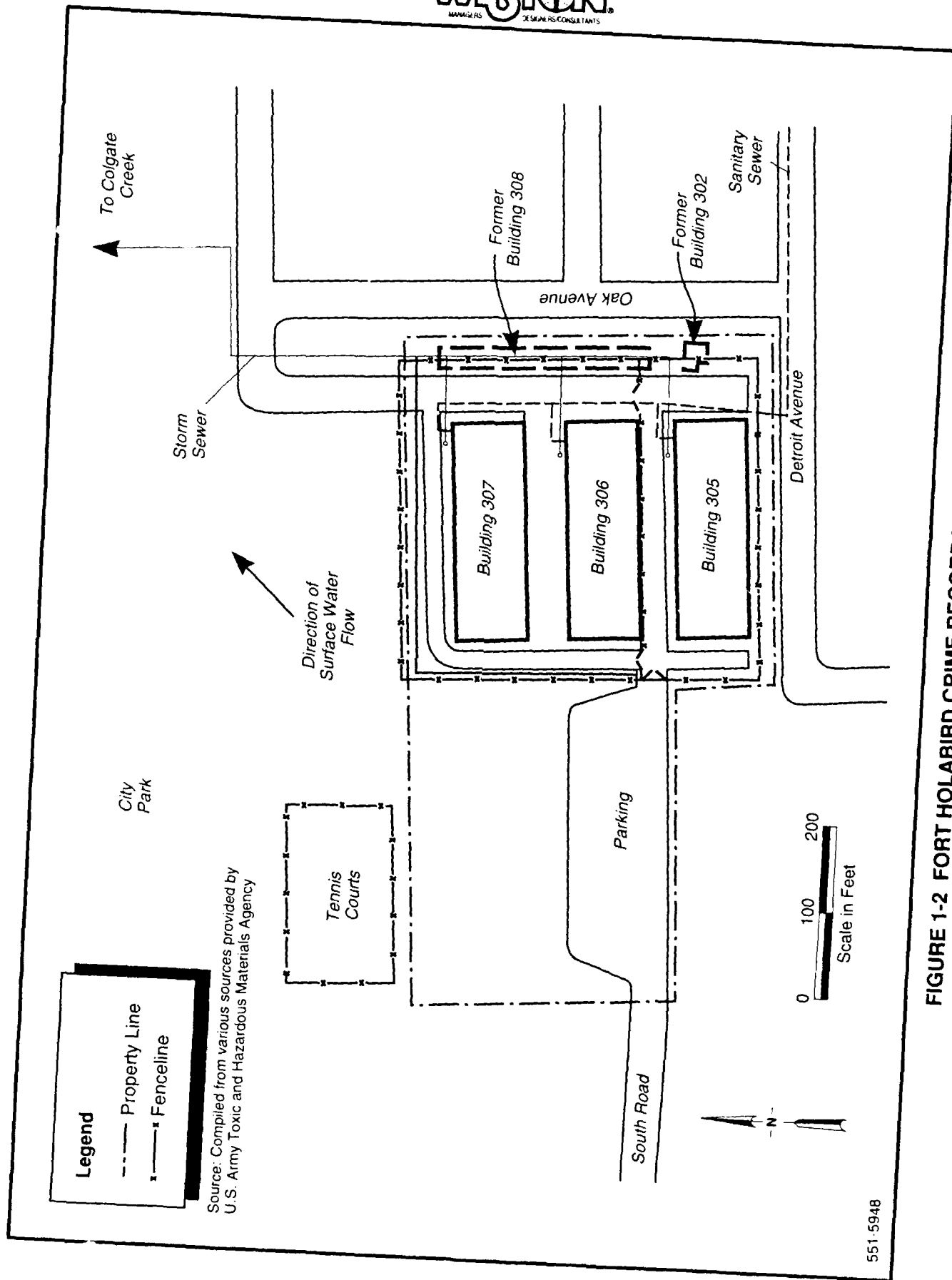


FIGURE 1-2 FORT HOLABIRD CRIME RECORDS CENTER SITE PLAN

The Beltsville soil has developed from stratified Coastal Plain sediments. In a typical natural profile, the Beltsville soil series is characterized by a restrictive zone in the soil profile occurring between 18 and 36 inches below ground surface. This restriction in the soil profile causes slow water movement through the upper portion of the soil, creating a shallow perched water table and the ponding of water during the wetter times of the year. The soil textures of the Beltsville soil profile range from a silt loam to a gravelly sandy loam.

1.2.4 GEOLOGY

The top geological strata in the area of the CRC property consist of an approximately 10-ft-thick layer of sediment. Below that is the Patapsco Formation, which is made up of sand and interbedded with layers of silty clay predominantly made up of quartz, illite, and kaolinite. The Patapsco Formation is approximately 60 ft thick in the CRC area. The next layer is the Arundel Formation, which is clay interbedded with lenses of sandy silt containing traces of lignitic material. The clay minerals are predominantly kaolinite and illite. This formation is approximately 130 ft thick. The next layer above bedrock is the Patuxent Formation, which is made up of sand and gravel and interbedded with lenses of silty clay with quartz as the predominant mineral. The bedrock consists of a complex assemblage of schist, gneiss, and gabbro.

1.2.5 HYDROGEOLOGY

The principal groundwater aquifers in the CRC area are the Patapsco and Patuxent Formations. The Patapsco Formation is capable of yielding large quantities of water; however, it is brackish in the CRC area because of encroachment by seawater and is not used as a water source. The Patuxent Formation is the most important water-bearing formation in the Baltimore area. It is capable of yielding large quantities of water, and in the CRC area, is not brackish. These aquifers are separated by the Arundel Clay Formation.

Monitoring wells that were installed indicate that the depth to groundwater is generally less than 10 ft. The low elevation (15 to 20 ft) and the proximity to the Patapsco River contribute to the high water table. The groundwater flow direction in the CRC area cannot be determined using the measured groundwater levels due to a very low groundwater gradient and the close spacing of the wells.

1.2.6 WATER SUPPLY

Although there are several wells in the area that use water from the Patuxent Formation for industrial purposes, groundwater in the city of Baltimore or in nearby suburbs is not used for drinking water. Municipal water is obtained from surface water north of the city.

1.3 SITE HISTORY

Fort Holabird was established in 1917 when 96 acres of land were allocated for a quartermaster mechanical repair unit. The installation grew to approximately 349 acres during World War II. The land on which the CRC is located was acquired in 1941.

After World War II, Fort Holabird was sold off piece by piece. The largest transaction occurred during the period of 1977 to 1979, when 223 acres was sold to the city of Baltimore to form the Holabird Industrial Park and a recreational park. The only original parts of Fort Holabird that still remain are two tracts of land, totaling 15 acres, that contain the CRC and the Defense Investigative Services (DIS).

Between 1941 and the 1970s, the buildings located on the present CRC property were used by the Quartermaster Corps, the Signal Corps, and the Army Intelligence School. The CRC has operated in Building 305 since 1975.

The three remaining buildings at the CRC (Buildings 305, 306, and 307) are one-story, wooden frame structures that were built in 1942. In the past, these buildings have been used as classrooms, warehouses, offices, and a bowling alley. Buildings 302 and 308 were demolished in the early 1970s, and the area where the buildings stood was leveled and planted with grass in 1984. Building 302 may have housed an incinerator used for burning paper.

Three 6,000-gallon in-ground storage tanks formerly located adjacent to each of the northeast corners of Buildings 305, 306, and 307, respectively, were removed and disposed of off-site in 1989. The removals are discussed in detail in Subsection 1.4.4 of this report.

A 4,000-gallon underground storage tank (UST) was installed in 1989 at the northeast corner of Building 305 to replace the removed in-ground tank. The tank stores No. 2 fuel oil that is used to fuel the boiler in the building. The construction of the tank is double-walled steel with cathodic protection, a resin/tar coating, and an outer wrapping. The annular space between the walls is monitored for leakage by a fluid detection system. Continuous automatic sensing equipment is used to detect liquid hydrocarbons and hydrocarbon vapors. No releases from the tank have been detected. Three monitoring wells were installed, one at the western end of the tank and two at the eastern end, to allow collection of groundwater samples.

A 500-gallon UST was installed sometime in 1985. The tank was provided to store diesel fuel for the Building 305 emergency electrical generator and had not been leak tested prior to the current field work.

1.4 PREVIOUS INVESTIGATIONS

1.4.1 ENVIRONMENTAL PHOTOGRAPHIC INTERPRETATION CENTER INSTALLATION ASSESSMENT

The Environmental Photographic Interpretation Center (EPIC), through an interagency agreement between EPA and USATHAMA, provided imagery analysis of Fort Holabird for USATHAMA's portion of the Army Base Closure Environmental Restoration Program. This analysis used archival black and white, color, and color infrared photographs acquired from the imagery libraries of the National Ocean Survey, U.S. Geological Survey, EPA, Agricultural Stabilization and Conservation Service, National Archives and Records Administration, and one private aerial survey company.

The objective of the imagery analysis was to obtain, analyze, and provide to USATHAMA aerial photographs taken between 1938 and 1985. The analysis concentrated upon those man-made features that may have caused some deleterious alteration of groundwater or surface water quality.

EPIC issued its "Installation Assessment, Army Base Closure Program, Fort Holabird, Baltimore, Maryland, Interim Report" in August 1989. This report contained the results of their analysis of historical aerial photography of Fort Holabird. These results showed potential contamination of surface water and groundwater from past activity based on 4 years of photography (1944, 1957, 1960, and 1985). However, the results did not specifically indicate any visible contamination in the CRC area. Potential sources of contamination from man-made features were identified in areas adjacent to the CRC and other areas of the historic Fort Holabird.

1.4.2 ENHANCED PRELIMINARY ASSESSMENT

An Enhanced Preliminary Assessment was prepared by WESTON at the request of USATHAMA. The purpose of this assessment was to present findings and conclusions concerning the environmental conditions at the Fort Holabird CRC and to provide recommendations for further action.

The Enhanced Preliminary Assessment was based primarily on the environmental conditions observed at the CRC property on 23 and 24 October 1989. Past site conditions and management practices were evaluated based on readily available records and the recollections of people interviewed.

No environmental sampling was performed as part of this earlier assessment. The findings and recommendations for further action were based on WESTON's experience with similar facilities and on current regulatory requirements. The findings are discussed in detail in "Task Order 2, Enhanced Preliminary Assessment, Fort Holabird Crime Records Center, Maryland."

1.4.3 ENVIRONMENTAL IMPACT STATEMENT

A draft Environmental Impact Statement (EIS) was prepared by the Army as part of closure under the Defense Authorization Amendments and Base Closure and Realignment Act of 1988. The purpose of the EIS was to evaluate alternative methods to implement the closing and excessing of Fort Holabird CRC. The alternatives that were evaluated in the EIS were:

- No Action.
- Residential Reuse.
- Industrial Reuse.

Although no formal screening process was implemented, industrial reuse was determined to be the most likely alternative. The EIS concluded that the effects of realignment and closure at the Fort Holabird CRC would have no impact on the environment surrounding the base.

1.4.4 TANK REMOVAL/MONITORING WELL INSTALLATION

Reports of the observations recorded during the removal of three in-ground storage tanks have been issued by an inspector from the State of Maryland, Department of the Environment (Hazardous and Solid Waste Management Administration).

These tanks, formerly located adjacent to each of the northeast corners of Buildings 305, 306, and 307, contained No. 2 fuel oil for use in boilers located in each building. Each tank had a capacity of 6,000 gallons and had single-walled steel construction. One-third of each tank was buried underground in a cement vault; the above-ground portion of each tank was contained by mortared brick sidewalls.

Because leaking was suspected from the tank in Building 305, all three tanks were removed and disposed of off-site in 1989. The excavation created by the removal of these tanks was backfilled with what appeared to be clean soil brought from off-site by the tank removal contractor. During the removal of the tank in Building 305, the state inspector noted an oil residue floating on top of the water in the cement vault where the tank was stored. A small perforation in the tank sidewall was discovered by the inspector. To determine if any free product had escaped through the storm drainage system to Colgate Creek, the inspector checked the inlet and outlet structures of the storm drainage system and Colgate Creek and found no visible evidence of oil contamination.

The inspector observed a slight petroleum sheen on standing water in the excavation pit of the tank at Building 306 and a visible perforation on the bottom of the tank.

An inspection of the tank at Building 307 revealed neither a similar sheen on the standing water in its excavation pit nor a visible perforation of the tank.

Three monitoring wells (Nos. 1 through 3) were installed near the former location of the Building 305 tank, and one monitoring well (No. 4) was installed near the Building 307 tank. All four wells were sampled for total recoverable petroleum hydrocarbons (TPH) in October 1990 by Environmental Technology, Inc. TPH were detected in monitoring well No. 3 at a concentration of 0.93 mg/L. TPH were not detected in the other wells.

1.4.5 ASBESTOS SURVEYS

An asbestos survey was conducted under a contract by the Fort Meade Facilities Engineering Department for Building 305. The survey indicated that the boiler insulation contained asbestos. The insulation has since been encapsulated by wrapping the pipes with a tape-like material.

In response to complaints from personnel working in the office area of the CRC, two asbestos surveys were conducted by the U.S. Army Medical Department at Fort Meade. The first survey was performed on 5 February 1987, when representative samples were taken from ceiling pipes and acoustic ceiling tiles. No asbestos-containing materials (ACM) were found on these pipes or on the surface area of acoustic ceiling tiles. The second survey was performed on 22 June 1988, when the air in the ventilation system of the CRC was sampled. No asbestos fibers were detected.

1.4.6 EI/AA WORK PLAN

A Work Plan for performing an environmental investigation to support a property transfer was prepared by WESTON in December 1990. The Work Plan included a technical plan, a sampling design plan, and a health and safety plan. The scope of the Work Plan included the following tasks:

- Drilling three shallow monitoring wells.
- Sampling groundwater from the three new wells and from three existing wells.
- Excavating three test pits in the fill area adjacent to the parking lot and sampling, if necessary.
- Leak testing the 500-gallon diesel UST.
- Sampling oil in an electrical transformer.
- Sampling Building 305 for radon.
- Sampling Buildings 305, 306, and 307 for asbestos.

USATHAMA revised the scope of work in a letter dated 5 March 1991 and during the project opening meeting conducted on 11 April 1991. The following changes were made to the tasks:

- The three new wells would not be installed. The existing wells were determined to be sufficient for a groundwater characterization.
- Three existing wells would be sampled as stated in the Work Plan. The wells sampled were changed by USATHAMA during the site visit from monitoring wells Nos. 1, 2, and 3 to monitoring wells Nos. 2, 3, and 4, because sampling of monitoring well No. 4, which is further removed from monitoring wells Nos. 2 and 3, provides groundwater data over a greater area of the site. In addition, monitoring well No. 4 is located near a former in-ground storage tank adjacent to Building 307.
- The electrical transformer would not be sampled, because it had been sampled previously. A copy of the analytical report is included in Appendix A.
- The locations of the existing wells would be surveyed. Map coordinates and elevations would be transferred to the Installation Restoration Data Management Information System (IRDMIS).



SECTION 2

SUMMARY OF QUALITY CONTROL (QC) PROGRAM AND FIELD PROCEDURES

2.1 QC PROGRAM

2.1.1 EQUIPMENT CALIBRATION

All instruments, including pH and conductivity meters and the HNu photoionization detector, were calibrated prior to use by field personnel. All calibrations performed were documented in a field logbook. A copy of the field logbook is provided in Appendix B.

2.1.2 DECONTAMINATION

All sampling equipment was decontaminated prior to use by WESTON laboratory personnel. Dedicated bailers were used for sampling individual wells. Submersible pumps were decontaminated when used between wells to prevent cross-contamination. Decontamination was accomplished using an Alconox wash and deionized water rinse approved by USATHAMA. Sample results of the deionized water are provided in Appendix C.

Sample containers were cleaned in accordance with EPA protocols by the container vendor. Detailed information concerning the sample containers is presented in the Fort Holabird CRC Supplemented Quality Control Plan prepared by WESTON.

2.1.3 SAMPLE PRESERVATION AND HANDLING

To prevent/retard the degradation of analytes in samples during transportation and storage, samples were preserved and stored as outlined in the USATHAMA January 1990 Quality Assurance Program.

2.1.4 SAMPLE IDENTIFICATION AND MANAGEMENT PROCEDURES

All samples collected at the CRC were identified and documented by procedures set forth in Subsection 6.1.1.2 of the USATHAMA January 1990 Quality Assurance Program. All samples were labeled at the time of collection. The label indicated sample location, date and time of sampling, sampler initials, preservative, and analyses to be run on the sample.

All samples taken were documented on a chain-of-custody form. Custody seals were used on sample containers to prevent unauthorized opening. Samples were transported to the WESTON laboratory by field personnel.

2.2 GROUNDWATER SAMPLING PROCEDURE

Groundwater sampling was performed in accordance with the procedure described in the EI/AA Work Plan prepared by WESTON.

A summary of the sampling procedure is as follows:

- Measure and record the depth from the top of the casing to the water level.
- Pump a quantity of water from the well equal to five times the volume of water in the well casing.
- If the well goes dry during pumping, allow the well to recover and empty again.
- Record temperature, pH, and specific conductivity measurements at the start, twice during, and at the conclusion of presampling purging.
- Obtain a sample using a dedicated bailer immediately after pumping.
- Triple-rinse the sample containers prior to filling.
- Decontaminate the pump prior to sampling the next well.

SECTION 3**SITE CHARACTERIZATION ACTIVITIES****3.1 GROUNDWATER INVESTIGATION****3.1.1 INVESTIGATION AREA DESCRIPTION**

Three existing monitoring wells (monitoring wells Nos. 2, 3, and 4) located in the vicinity of Buildings 305 and 307 (see Figure 3-1) were sampled as part of the EI. The wells had been installed in 1989 after two in-ground storage tanks were found to be leaking during removal. These removals were discussed in Subsection 1.4.4. The wells are also in the vicinity of former Building 302, which may have housed an incinerator.

3.1.2 INVESTIGATION PROGRAM

The monitoring wells were sampled on 23 April 1991 according to the procedures described in Subsection 2.2. Five volumes were pumped from monitoring wells Nos. 2 and 4 before sampling. Only 2.5 volumes were pumped from monitoring well No. 3 before sampling because the well went "dry" quickly and was slow to recover. An oil odor and oil sheen were observed in the sample taken from monitoring well No. 3. A duplicate sample was taken from monitoring well No. 3.

All groundwater samples were analyzed for the following parameters:

- RCRA metals.
- Base neutral acid extractables (BNAs).
- Volatile organic compounds (VOCs).
- Total petroleum hydrocarbons (TPH).

3.2 SOIL INVESTIGATION**3.2.1 INVESTIGATION AREA DESCRIPTION**

A soil investigation was conducted in a grassy area adjacent to the parking lot (see Figure 3-2). The area contains a fill material of unknown origin.

3.2.2 INVESTIGATION PROGRAM

Three test pits were excavated at evenly spaced intervals using a backhoe. Each pit was excavated to a depth of between 48 and 54 inches. The presence of contamination in the fill materials was checked by the following methods:

- A reading above background on the HNu photoionization device.

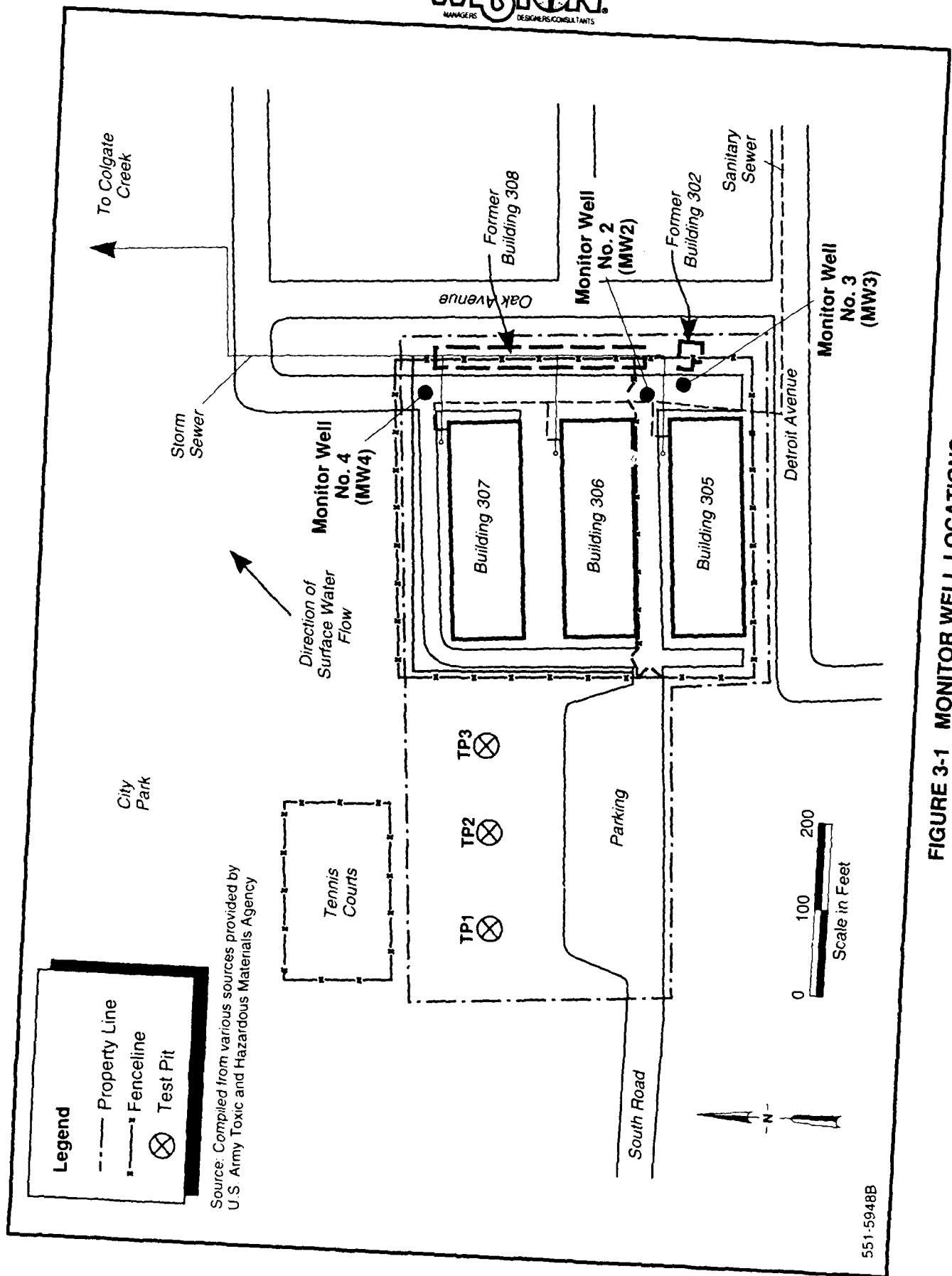


FIGURE 3-1 MONITOR WELL LOCATIONS

551-5948B

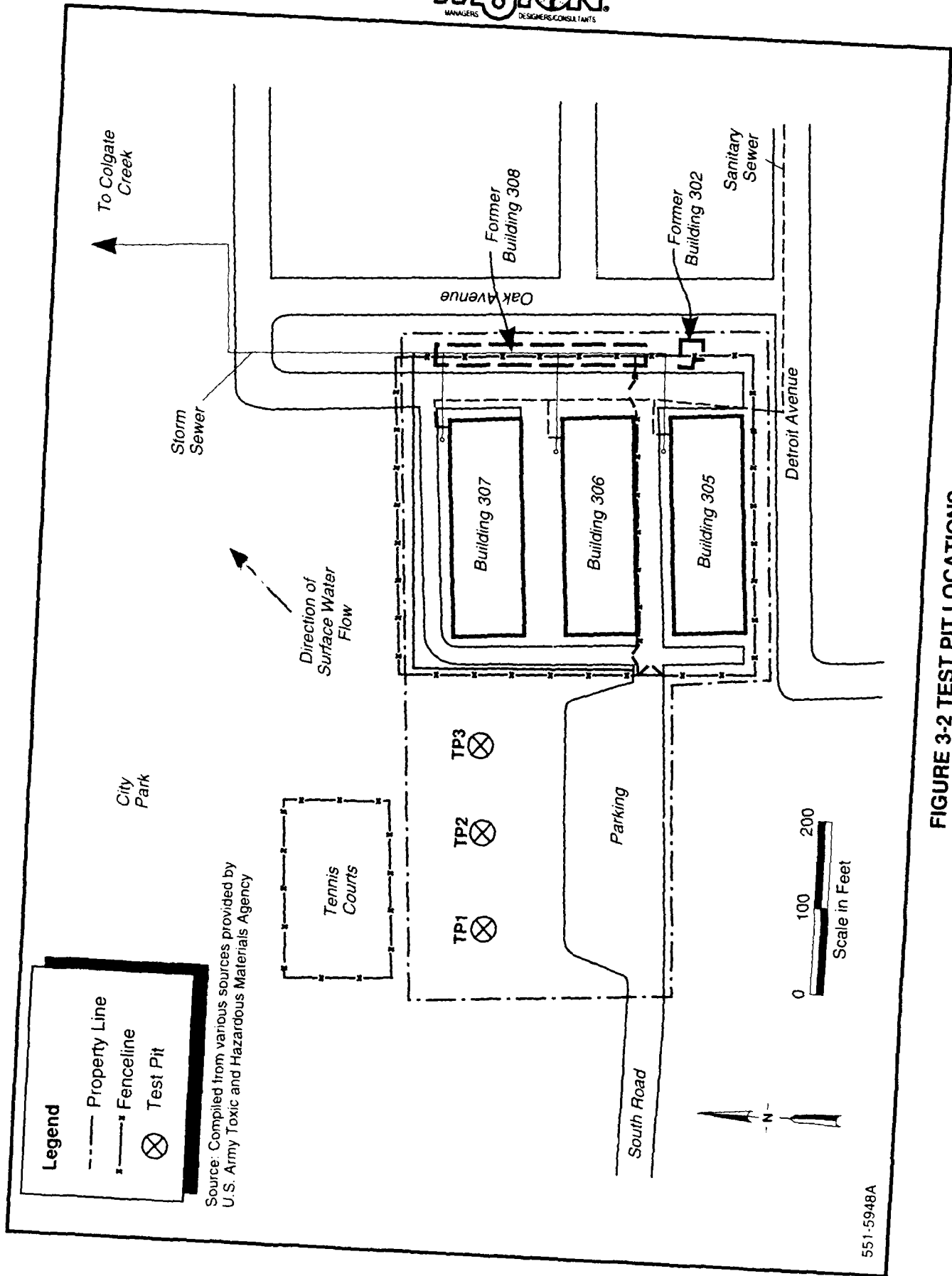


FIGURE 3-2 TEST PIT LOCATIONS

551-5948A

- Visible staining of soil.
- Artifacts indicating the possible presence of hazardous materials.

If contamination was observed by any of these methods, a soil sample was to be taken.

3.3 UNDERGROUND STORAGE TANK (UST) LEAK TESTING

3.3.1 STUDY AREA DESCRIPTION

A 500-gallon diesel underground fuel tank, which was installed in 1985 to service the electrical generator at Building 305, was leak tested as part of the current EI.

3.3.2 INVESTIGATION PROGRAM

The tank was hydrostatic leak tested on 23 April 1991 in accordance with the precision test requirements of Regulation .13L of the State of Maryland Oil Pollution and Tank Management Regulations. According to this regulation, storage systems with a total capacity of 550 gallons or less may be tested in accordance with Regulation .22, "Hydrostatic Test for Underground Tanks with a Total Capacity of 550 Gallons or Less."

3.4 ASBESTOS INVESTIGATION

3.4.1 STUDY AREA DESCRIPTION

Asbestos sampling was performed to assess suspect ACM in Buildings 305, 306, and 307.

3.4.2 INVESTIGATION PROGRAM

The asbestos survey work was conducted by EPA-accredited personnel who have been trained according to AR200-1 requirements for inspectors. Copies of their accreditation certificates are included in Appendix D.

A total of 21 samples were collected from suspect ACM in Buildings 305, 306, and 307. A summary of the samples taken is provided in Table 3-1. The following materials were sampled:

- Wall board in Building 306 (one sample).
- Floor tiles in Buildings 305, 306, and 307 (five samples).
- Tar paper in Buildings 305, 306, and 307 (four samples).
- Pipe insulation in Buildings 306 and 307 (eight samples).
- Transite panel in Building 307 (one sample).
- Boiler insulation in Building 307 (two samples).

Table 3-1

Asbestos Sample Locations

Location	QUAD ^a	Lab ID	Material Type
Building 305			
Inside - Break Area	SE	FJ609	Floor Tile
Inside - Bathroom	NE	FJ610	Floor Tile
Outside - West Side	SW	FJ611	Tar Paper
Outside - West Side	NW	FJ612	Tar Paper
Building 306			
Inside	W	FJ597	Wall Board
Inside	S	FJ598	Floor Tile
Inside - Bathroom	NE	FJ599	Floor Tile
Inside	NE	FJ600	Tar Paper
Inside - Boiler Room	NE	FJ602	Pipe Insulation
Inside - Boiler Room	NE	FJ603	Pipe Insulation
Inside - Boiler Room	NE	FJ604	Pipe Insulation
Inside - Boiler Room	NE	FJ605	Pipe Insulation
Building 307			
Inside	S	FJ606	Floor Tile
Outside - East Side	SE	FJ607	Tar Paper
Outside - North Side	NW	FJ608	Transite Panel
Inside - Boiler Room	NE	FJ613	Boiler Insulation
Inside - Boiler Room	NE	FJ614	Boiler Insulation
Inside - Boiler Room	NE	FJ615	Pipe Insulation
Inside - Boiler Room	NE	FJ616	Pipe Insulation
Inside - Boiler Room	NE	FJ617	Pipe Insulation
Inside - Boiler Room	NE	FJ618	Pipe Insulation

Footnotes:

^aQUAD Codes (relative to building sampled).

N - North	NE - Northeast
S - South	SE - Southeast
E - East	NW - Northwest
W - West	SW - Southwest
C - Center	

3.5 RADON INVESTIGATION

3.5.1 STUDY AREA DESCRIPTION

Radon sampling was conducted in Building 305 on the ground floor level.

3.5.2 INVESTIGATION PROGRAM

Radon levels were measured by placing 10 Terradex Radtrack R alpha track detectors in Building 305 for 90 days. These detectors were activated by opening the aluminum pouch and placing the detector on a wall or table. At the end of 90 days the detectors were sealed with gold foil, preventing further activation. The detectors were then shipped to Terradex for analysis. There were three additional detectors, one a field blank, one a spike, and one a duplicate. The purpose of the field blank was to identify background levels to which the detectors were exposed during handling and shipping. The field blank was set aside, without opening the aluminum-foil pouch, while the remainder of the detectors were in place at the radon sampling locations. When the actually placed detectors were collected for return shipment to Terradex, the aluminum-foil pouch on the field blank was opened and immediately closed with the adhesive gold seals, without actual placement. The spike was sent to an EPA radiation laboratory and exposed to a known radon level.

SECTION 4**SITE CHARACTERIZATION RESULTS****4.1 GROUNDWATER INVESTIGATION RESULTS****4.1.1 FIELD RESULTS****4.1.1.1 Groundwater Levels**

Groundwater levels were measured on 23 April 1991. These levels, measured from the top of casings, were subtracted from the top of casing elevations that were surveyed to a nearby benchmark. The resulting values are the groundwater elevations (see Table 4-1). The large difference in groundwater levels between MW04 and the other wells is believed to be a result of MW04 being poorly developed.

The direction of groundwater flow cannot be determined using the measured groundwater levels due to a very low groundwater gradient and the close spacing of the wells.

4.1.1.2 Field Measurements

The pH of the well water ranged from 4.1 to 5.8. The lowest pH (4.1) was detected in MW03. Groundwater temperatures ranged from 12 to 16°C. The specific conductance of the groundwater ranged from 170 to 300 micromhos. Groundwater field results are summarized in Table 4-2. These values are consistent with the groundwater characteristics generally found in the CRC area.

4.1.2 LABORATORY ANALYTICAL RESULTS

Analytical results of compounds detected at concentrations above detection limits in groundwater samples are listed in Table 4-3. A complete list of analyzed compounds and analytical results is provided in Appendix E.

4.1.2.1 TPH

TPH were not detected in any of the groundwater samples.

4.1.2.2 Soluble Metals

Five of the seven metals that were analyzed were detected at concentrations above the detection limits in at least one groundwater sample. Silver and barium were detected in groundwater samples from all monitoring wells (MW02, MW03, and MW04). Arsenic, lead, and chromium were each detected in at least one sample. Selenium and cadmium were not detected at concentrations above detection limits in any samples.

Table 4-1

Groundwater Elevations

Monitoring Well	Top of Casing ^a	Depth to Water ^b	Water Level Elevation ^a
MW02	28.41	5.11	23.30
MW03	28.87	5.41	23.46
MW04	27.05	16.40	10.65

^aFeet above mean sea level.

^bFeet below top of casing.

Table 4-2**Groundwater Field Measurements**

Sample Location	pH (Units)	Temperature (°C)	Specific Conductance (umho)
MW02	5.8	12	190
MW03	4.1	12.5	282
MW04	5.2	14	293

Note: Data are from the last recorded values during purging of the wells prior to sampling on 23 April 1991.

Table 4-3

**Groundwater Investigation Results -
Compounds Detected Above Detection Limits
(all values in $\mu\text{g/L}$)**

Monitoring Well No. 3

Compound	Sample ID/Well No. MW03	MW03D
METALS		
Silver	0.8	ND
Arsenic	ND	3.7
Barium	54.0	98.0
Chromium	ND	15.1
Lead	ND	9.9
BNAs		
2-Methylnaphthalene	200.0	200.0
Dibenzofuran	5.2	6.9
Di-N-Butylphthalate	ND	1.3
Fluorene	7.2	10.0
Dimethylnaphthalene	200.0	400.0
Trimethylnaphthalene	NA	70.0
Methylnaphthalene	200.0	200.0
Naphthalene	231.0	198.0
N-Nitrosodiphenylamine	ND	3.5
VOCs		
1,2-Dimethylbenzene	10.0	9.0
Benzene	28.4	25.5
Chloroform	6.8	6.5
Ethylbenzene	17.6	16.5

Monitoring Wells Nos. 2 and 4

Compound	Sample ID/Well No. MW02	MW04
METALS		
Silver	0.4	0.9
Arsenic	ND	3.8
Lead	6.2	ND
Barium	52.0	18.2

ND = Not detected.

4.1.2.3 BNAs

BNAs were detected in groundwater samples taken from monitoring well No. 3. No BNAs were detected at concentrations above detection limits in monitoring wells Nos. 2 or 4. Dibenzofuran, fluorene, 2-methylnaphthalene, dimethylnaphthalene, methylnaphthalene, and naphthalene were detected in both samples (MW03 and MW03D) taken from monitoring well No. 3. Di-N-butylphthalate, trimethylnaphthalene, and N-nitrosodiphenylamine were detected only in the duplicate sample (MW03D).

4.1.2.4 VOCs

VOCs were detected in groundwater samples taken from monitoring well No. 3. No VOCs were detected at concentrations above the detection limits in monitoring wells Nos. 2 or 4. 1,2-Dimethylbenzene, benzene, chloroform, and ethylbenzene were detected in both samples (MW03 and MW03D) taken from monitoring well No. 3.

4.1.3 CONCLUSIONS

Based on the results of the groundwater investigation, it can be concluded that the groundwater in the vicinity of monitoring well No. 3 is contaminated with BNAs and VOCs. The most likely source of the contamination is No. 2 fuel oil that leaked from the in-ground storage tank formerly located adjacent to Building 305. The extent and migration of the contamination cannot be determined because there are insufficient wells in the vicinity for this purpose. However, based on the lack of contamination in nearby monitoring wells Nos. 2 and 4, it is likely the contamination is localized to the groundwater in the area surrounding monitoring well No. 3. Since the most likely source of contamination has been removed, further contamination of the groundwater seems unlikely.

Based on the site inspection on 10 January 1992 by a representative of the Hazardous and Solid Waste Management Administration's Underground Storage Tank Division and on a review of the available analytical data on the subsurface condition of the soils and groundwater in the area of the removed underground storage tanks, the State of Maryland Department of the Environment concluded that the Fort Holabird Crime Records Center is in compliance with Maryland regulation 26.10.02-11. A copy of the Notice of Compliance letter from the head of the Enforcement Section of Maryland's Underground Storage Tank Program, dated 16 March 1992, is included in Appendix F.

4.2 SOIL INVESTIGATION RESULTS

4.2.1 FIELD RESULTS

The three test pits (TP-1, TP-2, and TP-3) contained a sandy fill material under a layer of topsoil. None of the HNu readings observed in the test pits or for the removed soils were above background. No stains in the soil or artifacts were encountered during the excavation.

Test pit logs are located in Appendix G.

4.2.2 LABORATORY ANALYTICAL RESULTS

No soil samples were taken from the test pits because there was no sign of contamination.

4.2.3 CONCLUSIONS

The fill material used in the grassy area adjacent to the parking lot showed no sign of contamination.

4.3 UST LEAK TESTING

4.3.1 FIELD RESULTS

The hydrostatic leak test was performed on 23 April 1991. According to State of Maryland regulations, a fluctuation of more than 4 inches in the liquid level in the test equipment sight tub during a 1-hour test period indicates that the tank system has failed the test. The level for the Building 305 tank only fluctuated 0.5 inches during the test period. A copy of the leak test results is provided in Appendix H.

4.3.2 CONCLUSIONS

The 500-gallon tank at Building 305 passed the leak test and therefore is considered tight under State of Maryland regulations. The results indicate that the tank has not contributed to any soil and groundwater contamination that may exist in the area.

4.4 ASBESTOS INVESTIGATION RESULTS

4.4.1 LABORATORY ANALYTICAL RESULTS

The asbestos investigation included 21 samples from three buildings. Detailed results of the investigation are provided in Table 4-4. A copy of the analytical results for the asbestos samples from the three buildings is included in Appendix I.

All three buildings contained ACM. The results of the asbestos survey are summarized for each material type as follows:

- Wall Board- One sample of wall board was collected from Building 306. The sample was found not to contain asbestos.
- Floor Tile- Five samples of floor tile were collected from the buildings. All samples were confirmed to be ACM.

TABLE 4-4

ANALYTICAL RESULTS FOR ASBESTOS SAMPLES FROM BUILDINGS

LOCATION	QUAD(a)	LAB ID	MATERIAL TYPE	COLOR	FRIABILITY	ASBESTOS CONTENT (%) (b)				
						CH	AM	CR	OT	TL
BUILDING 305										
INSIDE-BREAK AREA	SE	FJ609	FLOOR TILE	TAN	NON-FRIABLE	5	ND	ND	ND	5
INSIDE-BATHROOM	NE	FJ610	FLOOR TILE	GREEN	NON-FRIABLE	5	ND	ND	ND	5
OUTSIDE-WEST SIDE	SW	FJ611	TAR PAPER	BLACK	FRIABLE	<1	ND	ND	ND	<1
OUTSIDE-WEST SIDE	NW	FJ612	TAR PAPER	BLACK	FRIABLE	<1	ND	ND	ND	<1
BUILDING 306										
INSIDE	W	FJ597	WALL BOARD	WHITE	NON-FRIABLE	ND	ND	ND	ND	ND
INSIDE	S	FJ598	FLOOR TILE	TAN	NON-FRIABLE	3	ND	ND	ND	3
INSIDE-BATHROOM	NE	FJ599	FLOOR TILE	GRAY	NON-FRIABLE	5	ND	ND	ND	5
INSIDE	NE	FJ600	TAR PAPER	BLACK	FRIABLE	ND	ND	ND	ND	ND
INSIDE-BOILER ROOM	NE	FJ602	PIPE INSULATION	WHITE	FRIABLE	5	25	ND	ND	30
INSIDE-BOILER ROOM	NE	FJ603	PIPE INSULATION	WHITE	FRIABLE	ND	1	ND	ND	1
INSIDE-BOILER ROOM	NE	FJ604	PIPE INSULATION	ORANGE	FRIABLE	40	ND	ND	ND	40
INSIDE-BOILER ROOM	NE	FJ605	PIPE INSULATION	GRAY	FRIABLE	40	ND	ND	ND	40
BUILDING 307										
INSIDE	S	FJ606	FLOOR TILE	GREEN	NON-FRIABLE	5	ND	ND	ND	5
OUTSIDE-EAST SIDE	SE	FJ607	TAR PAPER	BLACK	FRIABLE	1	ND	ND	ND	1
OUTSIDE-NORTH SIDE	NW	FJ608	TRANSITE PANEL	GRAY	NON-FRIABLE	40	ND	ND	ND	40
INSIDE-BOILER ROOM	NE	FJ613	BOILER INSULATION	WHITE	FRIABLE	20	ND	ND	ND	20
INSIDE-BOILER ROOM	NE	FJ614	BOILER INSULATION	WHITE	FRIABLE	25	ND	ND	ND	25
INSIDE-BOILER ROOM	NE	FJ615	PIPE INSULATION	WHITE	FRIABLE	1	30	ND	ND	31
INSIDE-BOILER ROOM	NE	FJ616	PIPE INSULATION	GRAY	FRIABLE	40	ND	ND	ND	40
INSIDE-BOILER ROOM	NE	FJ617	PIPE INSULATION	GRAY	FRIABLE	50	ND	ND	ND	50
INSIDE-BOILER ROOM	NE	FJ618	PIPE INSULATION	WHITE	NON-FRIABLE	ND	ND	ND	ND	ND

FOOTNOTES:

a - QUAD CODES (relative to building sampled)

N - NORTH
 S - SOUTH
 E - EAST
 W - WEST
 C - CENTER
 NE - NORTHEAST
 SE - SOUTHEAST
 NW - NORTHWEST
 SW - SOUTHWEST

b - ASBESTOS CONTENT (%)

CH - CHRYSOLITE
 AM - AMOSITE
 CR - CROCIDOLITE
 OT - OTHER
 TL - TOTAL
 ND - NONE DETECTED

- Tar Paper- Four samples of tar paper were collected from the interior and exterior of the buildings. Two of the samples were found to contain less than 1% asbestos and one sample was found to contain 1% asbestos. The EPA definition of ACM is "any material that contains greater than 1% asbestos". In accordance with EPA's definition of ACM, the tar paper is considered non-ACM. However, WESTON recommends that additional samples of the tar paper should be collected in order to confirm its ACM status.
- Pipe Insulation- Eight samples of pipe insulation were collected from Buildings 306 and 307 boiler rooms. Six samples were confirmed to be ACM.
- Transite Panel- One sample of transite panel was collected from the exterior of Building 307. This sample was confirmed to be ACM.
- Boiler Insulation- Two samples of boiler insulation in Building 307 were collected. These samples were confirmed to be ACM.

Of the 21 samples collected, 18 were asbestos positive and 3 were asbestos negative.

4.4.2 CONCLUSIONS

Asbestos emissions are regulated under the National Emission Standard for Hazardous Air Pollutants (NESHAP). Under NESHAP, ACM are defined as a material that contains greater than 1% asbestos. Fourteen of the 21 samples analyzed contain asbestos greater than 1% and are therefore ACM. Of the 14 ACM, 8 are friable and 6 are nonfriable. Friability is based on whether dry material can be crumbled, pulverized, or reduced to powder by hand pressure. All of the friable ACM are associated with the insulation for the boilers and boiler piping located in Buildings 306 and 307 boiler rooms. Nonfriable ACM are in the form of floor tile and transite panel.

4.5 RADON INVESTIGATION RESULTS

4.5.1 LABORATORY ANALYTICAL RESULTS

Alpha-track radon detectors were placed at ten locations. In addition, there was a field blank, a duplicate, and a spike, for a total of 13 detectors. All of the detectors except for the spike reported average radon concentrations of less than the detection limit of 0.3 pCi/L. The result for the spike was 4.1 pCi/L, which agreed exactly with the known radon level to which the detector was exposed. A copy of the analytical results of the radon investigation in Building 305 is provided in Appendix J.

4.5.2 CONCLUSION

Based on the results of the radon investigation, it can be concluded that radon levels are very low in Building 305 and are well below the EPA's recommended level of 4 pCi/L.



SECTION 5

RISK ASSESSMENT

5.1 INTRODUCTION

This report represents a preliminary baseline assessment of the potential human health risks associated with groundwater contamination at the Fort Holabird CRC site in Baltimore, Maryland. The risk assessment evaluates the potential human health risks under the no action alternative, i.e., in the absence of any remedial (corrective) action. The no action alternative is evaluated in a baseline risk assessment because, according to the National Contingency Plan (NCP) (40 CFR 300, 1990), "The effectiveness of the institutional controls in controlling risk may appropriately be considered in evaluating the effectiveness of a particular remedial alternative, but not as part of the baseline risk assessment."

The technical direction for the performance of the risk assessment comes primarily from several EPA documents, including the Risk Assessment Guidance for Superfund--Human Health Evaluation Manual, Part 1 (EPA, 1989a); the Exposure Factors Handbook (EPA, 1989b); and the Superfund Exposure Assessment Manual (EPA, 1988a).

Included in this report is a preliminary asbestos exposure assessment conducted in Buildings 305, 306, and 307.

WESTON developed an Asbestos Priority Index System in conjunction with the TRADOC Asbestos Deficiency Abatement Project Program for use by U.S. Army facilities. The Asbestos Priority Index System was developed in order to prioritize additional assessment and abatement action, which may be required for facilities that contain hazardous and friable ACM.

The risk assessment includes several components:

- Site Characterization (Subsection 5.2).
- Contamination Characterization (Subsection 5.3).
- Exposure Assessment (Subsection 5.4).
- Toxicity Assessment (Subsection 5.5).
- Risk Characterization (Subsection 5.6).

Brief descriptions of the five major subsections of the baseline risk assessment follow. The relationship of the components of the human health risk assessment process is illustrated in Figure 5-1.

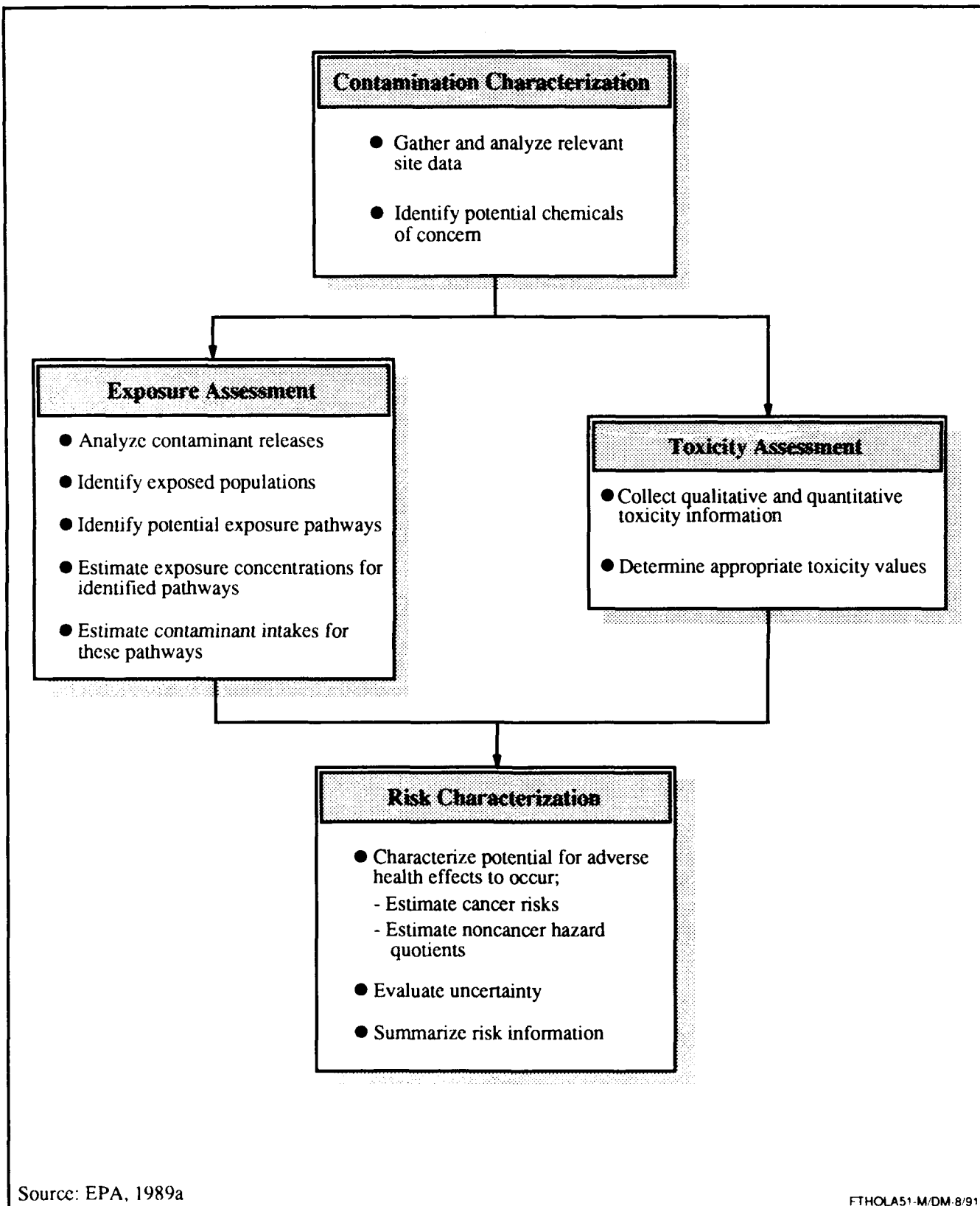


FIGURE 5-1 SCHEMATIC OF THE RISK ASSESSMENT PROCESS

Site Characterization (Subsection 5.2)

The purpose of the site characterization is to provide an overview of the site characteristics. This subsection provides the framework for establishing the background site description. It provides a general site description, including maps of the site, and a discussion of site history. In addition, the site characterization describes the physical characteristics of the site, including climate, geology, soils, groundwater hydrology, and the presence and location of area surface waters. This detailed description of the site provides the exposure setting and sets the scenarios of human exposure based on local land and water uses.

Contamination Characterization (Subsection 5.3)

The purpose of the contamination characterization is to describe the extent to which media at the CRC site are contaminated. The contamination characterization is composed of two principal technical elements: the evaluation of site data and the selection of site-related contaminants for which health risks are assessed.

Exposure Assessment (Subsection 5.4)

The objective of the exposure assessment is to estimate the chemical doses to potential human receptors. In this subsection, local land and water uses under both current and future use scenarios are characterized, and the pathways through which chemicals may migrate from the site are identified. Based on this information, potentially exposed populations and potential exposure routes are discussed, and exposure scenarios are developed. The models used to calculate chemical doses for all potential receptors through all potential exposure pathways and routes are presented, and the doses calculated using these models are summarized.

Toxicity Assessment (Subsection 5.5)

This subsection of the risk assessment evaluates the toxicity of each of the chemicals of concern. Applicable human toxicity values are identified for each chemical of concern for all relevant exposure routes. These include reference doses (RfDs) with which to evaluate potential noncarcinogenic health effects and cancer slope factors (CSFs) with which to evaluate carcinogenic potential. The primary sources of RfDs and CSFs were EPA's Integrated Risk Information System (IRIS), which represents EPA's most current database for toxicological information and the Health Effects Assessment Summary Tables (EPA, 1991a). If an EPA-derived toxicity value is not available for a chemical, an appropriate value is derived, when possible, from toxicity data or from a health-based standard.

Risk Characterization (Subsection 5.6)

In the risk characterization, the results of the exposure assessment and toxicity assessment are integrated to evaluate the potential carcinogenic and noncarcinogenic risks to humans. Based on the exposure doses calculated in the exposure assessment,

and the toxicity values identified in the toxicity assessment, potential risks are evaluated for each chemical through each exposure route and for all chemicals through all exposure routes combined.

5.2 SITE CHARACTERIZATION

A detailed physical description of the site, which includes the geology, soils, and land use, is provided in Subsection 1.2. The site history is described in Subsection 1.3. See Subsections 1.2 and 1.3 for the site description and history.

5.3 CONTAMINATION CHARACTERIZATION

The groundwater monitoring and soil sampling programs are described in Subsections 4.1 and 4.2. For the purpose of the risk assessment, the data were summarized using the arithmetic average when an analyte was detected in more than one well. In cases where an analyte was detected in only one well, that concentration was used to calculate the exposure dose (see Subsection 5.4) for that compound. The VOCs and BNAs were detected only in the sample from monitoring well No. 3, whereas inorganics (with the exception of chromium) were detected in more than one well. The detected concentrations for monitoring wells Nos. 2, 3, and 4 are presented in Table 4-3. The minimum, maximum, arithmetic average, and detection frequency are presented in Table 5-1. Note that duplicate samples were analyzed for MW03. In calculating the average exposure concentration, the average of the duplicates was used to represent the concentration of the contaminants detected in MW03. In addition, only concentrations reported above detection limits were used.

5.4 EXPOSURE ASSESSMENT

Exposure assessment is the estimation of the magnitude, frequency, and duration of exposure to human receptors. The exposure assessment uses the site description and contamination characterization discussed in previous subsections to identify potentially exposed human populations, define actual and potential exposure pathways, and calculate estimated daily intakes for the substances of potential concern. The results of the exposure analysis are integrated with toxicity data in the assessment of health risks in subsequent subsections.

5.4.1 ENVIRONMENTAL SETTING

As described in Subsection 1.2, the CRC is located within the city limits of Baltimore, Maryland, and consists of three buildings situated on 7 acres of land (see Figures 1-1 and 1-2). The site is zoned for industrial use and is surrounded by residential communities, a recreational area, and an industrial park. For a detailed description of the surface water hydrology, soils, and geology, see Subsection 1.2.

Table 5-1

Data Summary for Risk Assessment
($\mu\text{g/L}$)

	Minimum	Maximum	Arithmetic Average	Detection Frequency
COMPOUND				
METALS				
Arsenic	3.67	3.83	3.75	2/3
Barium	18.2	76.0	48.73	3/3
Chromium	15.1	15.1	15.1	1/3
Lead	6.2	9.91	8.06	2/3
Silver	0.4	0.93	0.70	3/3
ORGANICS*				
Benzene	26.95	26.95	26.95	1/3
Chloroform	6.69	6.69	6.69	1/3
Dibenzofuran	6.05	6.05	6.05	1/3
1,2-Dimethylbenzene	9.5	9.5	9.5	1/3
Dimethylnaphthalenes	300.0	300.0	300.0	1/3
Di-n-butylphthalate	1.3	1.3	1.3	1/3
Ethylbenzene	17.05	17.05	17.05	1/3
Fluorene	8.6	8.6	8.6	1/3
Methylnaphthalene	200.0	200.0	200.0	1/3
2-Methylnaphthalene	200.0	200.0	200.0	1/3
Naphthalene	214.5	214.5	214.5	1/3
N-Nitrosodiphenylamine	3.5	3.5	3.5	1/3
Trimethylnaphthalenes	70.0	70.0	70.0	1/3

*Organics were detected only in the sample from monitoring well No. 3.

5.4.1.1 Groundwater Uses

The hydrogeology and groundwater uses are described in Subsections 1.2.5 and 1.2.6, respectively. In Subsections 1.2.5 and 1.2.6, it is stated that the principal aquifers in the vicinity of the CRC are the Patapsco and Patuxent Formations. The Patapsco Formation was described as capable of yielding large quantities of water, but brackish and unusable as a water source. The Patuxent Formation was described as the most important water-bearing formation in the Baltimore area. Although there are several wells in the vicinity of the CRC that use water from the Patuxent Formation for industrial purposes, groundwater in the city of Baltimore and in the immediate vicinity is not used for drinking purposes. Municipal water is obtained from surface water sources north of the city.

5.4.2 SCREENING OF CONTAMINATED MEDIA

The concentrations of contaminants in affected media are screened to focus the risk assessment on the contaminants of greatest concern that are related to activities at the site. The concentrations of compounds detected in the site groundwater samples are presented in Table 5-1.

Conversations with the Chief, Hydrology Section, of the Maryland Geological Survey indicate that background levels of arsenic in the groundwater in the CRC area are about 1 $\mu\text{g/L}$ (Maryland Geological Survey, 1991). Arsenic levels detected in the site groundwater samples (less than 3.0 $\mu\text{g/L}$ in Wells No. 2 and 3, 3.6 $\mu\text{g/L}$ in a duplicate sample from Well No. 3, and 3.8 $\mu\text{g/L}$ in Well No. 4) are comparable to the reported background concentrations and are well below the MCL. Since arsenic concentrations are typical of background levels for the groundwater in this area, arsenic need not be included in the risk assessment. Background data were not available on the remaining inorganic substances. It is assumed that all organic substances are site-related. As a result, all organic substances and inorganics other than arsenic are evaluated in the risk assessment.

5.4.3 EXPOSURE SCENARIOS

5.4.3.1 Current Use Scenario

As stated in Subsection 5.4.1.1, there are no known current uses of groundwater at or in the vicinity of the CRC site because the source of municipal water is surface water located north of the city of Baltimore. As a result, no current use scenario will be evaluated.

5.4.3.2 Future Use Scenario

For the future use scenario, it is assumed that the CRC site will be developed for an industry that uses groundwater as a potable water supply and that a worker is exposed directly to contaminants through ingestion, inhalation, and dermal routes. Because of difficulties associated with estimating indirect exposure to industrial process water, only

direct exposure pathways are evaluated. Specifically, the pathways evaluated and found to result in acceptable risks were (1) ingestion of groundwater by industrial workers (a very unlikely but conservative assumption, since groundwater in this area of the city is not used for drinking purposes; (2) inhalation of organic vapors (simulated via shower inhalation exposure modeling); and (3) dermal contact/adsorption of organics (simulated via dermal shower exposure modeling).

5.4.3.3 Potential Exposure to Surface Water

Colgate Creek is located approximately 1,200 feet west of the CRC site and is the nearest perennial stream. Although the potential exists for exposure to the creek, the potential for exposure to site-related contamination is thought to be limited. Contamination at the CRC site resulted from a leak in an underground storage tank (UST). Remedial activities at the CRC site included removal of the leaking UST and contaminated soil that surrounded the tank. As a result, the primary and secondary contaminant release mechanisms have been removed, though substances detected in groundwater indicate that some material remains in place. The potential for contaminants to migrate off-site is thought to be limited because organic compounds have been detected in only one well and not in either of the surrounding wells. Because contamination appears to be limited to a small part of the site, off-site exposure to Colgate Creek is not evaluated.

5.4.4 EXPOSURE DOSE MODELS AND ASSUMPTIONS

5.4.4.1 Introduction

Doses for the hypothetical future worker are calculated based on two averaging times: the number of years of exposure (i.e., 25 years for a worker) and the number of years in an average lifetime (i.e., 70 years; EPA, 1991b). Doses averaged over the number of years of exposure are calculated for all contaminants. These doses will be used to evaluate the potential for noncarcinogenic health effects and will be referred to as exposure duration-averaged doses. Doses averaged over a 70-year lifetime will be calculated only for those substances that are classified as carcinogens. Thus, these average lifetime doses will be used to evaluate only carcinogenic risk and will be referred to as lifetime-averaged doses.

5.4.4.2 Drinking Water Ingestion

EPA (1991b) recommends a 2 L/day daily ingestion rate for adults. For workers, it is assumed that one-half of his/her daily water intake occurs at work. The exposure model and assumptions used to calculate drinking water exposure doses are presented in Table 5-2.

5.4.4.3 Inhalation While Showering

Inhalation while showering is evaluated only for volatile organic compounds. Risk from exposure to semivolatiles and inorganics is not evaluated because these substances will not volatilize from water. Inhalation while showering is evaluated following a procedure described by McKone and Knezovitch (1991) that suggests that inhalation

Table 5-2

Model for Calculating Doses Through Drinking Water Ingestion

$$\begin{array}{ccc} \text{Drinking Water Ingestion Dose} & = & \frac{\text{CW} \times \text{GIR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}} \\ (\text{mg/kg-day}) & & \end{array}$$

Where:

- CW = Chemical concentration in groundwater (mg/L).
 DWIR = Drinking water ingestion rate (L/day).
 EF = Exposure frequency (days/year).
 ED = Exposure duration (years).
 BW = Body weight (kg).
 AT = Averaging time (period over which exposure is averaged -- days).

Assumptions:

1. The chemical concentration in groundwater (CW) is presented in Table 5-1.
 2. The following drinking water ingestion rate (DWIR) was assumed:
 1 liter per day future worker (EPA,1991b)
 3. An exposure frequency (EF) of 250 days per year for the future worker (EPA, 1991b).
 4. An exposure duration (ED) of 25 years was assumed for the future worker (EPA, 1991b).
 5. A body weight (BW) of 70 kg was assumed for workers (EPA, 1991b).
 6. In calculating a daily intake with which to evaluate carcinogenic risk, an averaging time (AT) of 25,550 days was assumed. In calculating a daily intake with which to evaluate noncarcinogenic risk, an averaging time of 9,125 days was assumed for the future worker (EPA, 1989a).
-

exposures in showers could be equivalent to an ingestion rate of one to four liters. The paper describes a procedure to estimate the transfer efficiency of trichloroethene (61 percent) from shower water to room air. The trichloroethene transfer efficiency is used to evaluate the volatile organic compounds detected at the CRC site because no other transfer factors are available.

The exposure assumptions for the shower inhalation pathway are primarily obtained from McKone and Knezovitch (1991). The exposure algorithm and all assumptions are presented in Table 5-3.

5.4.4.4 Dermal Contact While Showering

Dermal exposure is expected to occur when organic substances in water are transmitted across the skin. The skin surface area of 18,150 cm² for the adult worker is based on total body surface area (EPA, 1989a). The exposure algorithm and assumptions used to evaluate dermal contact while showering are presented in Table 5-4. The permeability constants that are used to evaluate this pathway are estimated following a procedure described in Brown and Rossi (1989) that relies on the K_{ow} (octanol-water partition coefficient) of the compound to be evaluated. K_{ow} s were not available for all compounds. The permeability constant equation, K_{ow} s, and permeability constants for the compounds of interest are presented in Table 5-5.

The exposure duration- and lifetime-averaged doses for the ingestion, inhalation, and dermal exposure pathways are presented in Tables 5-6 and 5-7, respectively.

5.5 TOXICITY ASSESSMENT

5.5.1 INTRODUCTION

The purpose of the toxicity assessment is to characterize the toxicologic properties of the contaminants of concern, which involves the identification of toxicity values (i.e., reference doses and cancer slope factors). The toxicity values identified in this subsection are used in Subsection 5.6 to evaluate the potential health risks posed by the doses that were estimated in Subsection 5.4.4. When available, human health toxicity values that have been developed by EPA have been used for the risk assessment. When appropriate established values were not available, the toxicity values were derived from other existing toxicity values or data.

5.5.2 NONCARCINOGENIC RISK VERSUS CARCINOGENIC RISK-BASED TOXICITY VALUES

In evaluating potential health risks, both carcinogenic and noncarcinogenic health effects must be considered. Excessive exposure to all pollutants can potentially produce noncarcinogenic health effects, while the potential for carcinogenic effects is limited to

Table 5-3

Model for Calculating Doses Through Inhalation While Showering

$$\text{Shower Inhalation Dose (mg/kg-day)} = \frac{\text{CW} \times \text{PHI} \times \text{IR} \times \text{SD} \times \text{FR} \times \text{EF} \times \text{ED}}{\text{VR} \times \text{BW} \times \text{AT}}$$

Where:

- CW = Chemical concentration in groundwater (mg/L).
- PHI = Transfer efficiency (unitless).
- IR = Inhalation rate (m³/min).
- SD = Shower duration (min/day)
- FR = Water flow rate (L/min).
- EF = Exposure frequency (days/year).
- ED = Exposure duration (years).
- VR = Ventilation rate (m³/min).
- BW = Body weight (kg).
- AT = Average time (period over which exposure is averaged - days)

Assumptions:

1. The transfer efficiency from water to air is 61% (McKone and Knezovitch, 1991).
 2. The inhalation rate for an adult is 0.014 m³/min (McKone and Knezovitch, 1991).
 3. The shower duration is 10 min/day (McKone and Knezovitch, 1991).
 4. The water flow rate is 10 L/min (McKone and Knezovitch, 1991).
 5. The exposure frequency (EF) for the future worker is 250 days/year (EPA, 1991b).
 6. An exposure duration (ED) of 25 years was assumed for the future worker (EPA, 1991b).
 7. The ventilation rate is 0.5 m³/min (McKone and Knezovitch, 1991).
 8. A body weight (BW) of 70 kg was assumed for workers (EPA, 1991b).
 9. In calculating a daily intake with which to evaluate carcinogenic risk, an averaging time (AT) of 25,500 days was assumed. In calculating a daily intake with which to evaluate noncarcinogenic risk, an average time of 9,125 days was assumed for the future worker (EPA, 1989a).
-

Table 5-4

Model for Calculating Doses Through Dermal Contact While Showering

$$\text{Shower Dermal Dose (mg/kg-day)} = \frac{\text{CW} \times \text{SA} \times \text{PC} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}}$$

Where:

- CW = Chemical concentration in groundwater (mg/L).
- SA = Skin surface area available for contact (cm²).
- PC = Chemical-specific dermal permeability constant (cm/hr).
- ET = Exposure time (hours/day).
- EF = Exposure frequency (days/year).
- ED = Exposure duration (years).
- CF = Volumetric conversion factor for water (1 liter/1,000 cm³).
- BW = Body weight (kg).
- AT = Average time (period over which exposure is averaged - days)

Assumptions:

1. The skin surface area available for contact is 18,150 cm² for the worker (EPA, 1989a).
 2. The dermal permeability constant is chemical-specific and presented in Table 5-5.
 3. The exposure time is 0.167 hours/day (10 minutes) (McKone and Knezovitch, 1991).
 4. The exposure frequency (EF) for the future worker is 250 days/year (EPA, 1991b).
 5. An exposure duration (ED) of 25 years was assumed for the future worker (EPA, 1991b).
 6. A body weight of 70 kg was assumed for workers (EPA, 1991b).
 7. In calculating a daily intake with which to evaluate carcinogenic risk, an averaging time (AT) of 25,500 days was assumed. In calculating an intake with which to evaluate noncarcinogenic risk, an averaging time of 9,125 days was assumed for the future worker (EPA, 1989a).
-

Table 5-5

Calculation of Dermal Permeability Constants^a

Organics	Permeability Constants (cm/hr)	Reference
Benzene	2.6/E-02	EPA, 1987 ^b
Chloroform	1.95E-02	EPA, 1987 ^b
Dibenzofuran	NA ^c	---
1,2-Dimethylbenzenes	2.61E-02 ^d	---
Dimethylnaphthalenes	7.27E-02 ^e	---
Di-n-butylphthalate	9.89E-02	EPA, 1987 ^b
Ethylbenzene	6.80E-02	EPA, 1987 ^b
Fluorene	9.11E-02	EPA, 1987 ^b
Methylnaphthalene	7.27E-02 ^e	---
2-Methylnaphthalene	7.27E-02 ^e	---
Naphthalene	7.27E-02	EPA, 1987 ^b
N-nitroso-biphenylamine	6.50E-02	ATSDR, 1988
Trimethylnaphthalenes	7.27E-02 ^e	---

^aCalculated from Brown and Rossi (1989) using $PC = 0.1 \times (K_{ow}^{0.75} / (120 + K_{ow}^{0.75}))$

^bAverage of values listed in reference.

^cNo data are available for this or similar compounds.

^dNo data are available for this compound. K_{ow} for benzene is used.

^eNo data are available for this compound. K_{ow} for naphthalene is used.

Table 5-6

**Exposure Duration-Averaged Doses for Hypothetical Future Workers
(mg/kg-day)**

	Groundwater Ingestion	Shower Inhalation	Shower Dermal	Total
<u>Inorganics</u>				
Barium	4.77E-04	NA	NA	4.77E-04
Chromium	1.48E-04	NA	NA	1.48E-04
Lead	7.88E-05	NA	NA	7.88E-05
Silver	6.82E-06	NA	NA	6.82E-06
<u>Organics</u>				
Benzene	2.64E-04	4.50E-04	2.08E-05	7.35E-04
Chloroform	6.55E-05	1.12E-04	3.85E-06	1.81E-04
Dibenzofuran	5.92E-05	NA	NA	5.92E-05
1,2-Dimethylbenzene	9.30E-05	NA	7.34E-06	1.00E-04
Dimethylnaphthalenes	2.94E-03	NA	6.46E-04	3.58E-03
Di-n-butylphthalate	1.27E-05	NA	3.81E-06	1.65E-05
Ethylbenzene	1.67E-04	2.85E-04	3.43E-05	4.86E-04
Fluorene	8.41E-05	NA	2.32E-05	1.07E-04
Methylnaphthalene	1.96E-03	NA	4.30E-04	2.39E-03
2-Methylnaphthalene	1.96E-03	NA	4.30E-04	2.39E-03
Naphthalene	2.10E-03	NA	4.62E-04	2.56E-03
N-Nitrosodiphenylamine	3.42E-05	NA	6.73E-06	4.10E-05
Trimethylnaphthalenes	6.85E-04	NA	1.51E-04	8.36E-04

Table 5-7

**Lifetime-Averaged Doses for Hypothetical Future Workers
(mg/kg-day)**

	Groundwater Ingestion	Shower Inhalation	Shower Dermal	Total
<u>Organics</u>				
Barium	9.42E-05	1.61E-04	7.44E-06	2.62E-04
Chloroform	2.34E-05	3.99E-05	1.38E-06	6.47E-05
N-Nitrosodiphenylamine	1.22E-05	NA	2.40E-06	1.46E-05

substances with evidence of carcinogenicity. Therefore, it is necessary to identify and select noncarcinogenic toxicity values for each of the chemicals selected for evaluation and to identify and select carcinogenic toxicity values only for those chemicals that have evidence of carcinogenicity.

5.5.2.1 Noncarcinogenic Risk-Based Toxicity Values

The toxicity values used to evaluate the potential for noncarcinogenic health effects are generically referred to in this document as RfDs. The term RfD was developed by EPA to refer to a daily intake of a chemical to which an individual can be exposed without any expectation of noncarcinogenic adverse health effects occurring (e.g., organ damage, biochemical alterations, birth defects). The term is used in this assessment to apply to any established or derived toxicity value fitting this description. In general terms, the RfD is derived from a NOAEL (no-observed-adverse-effect level) or LOAEL (lowest-observed-adverse-effect level) by applying standard order-of-magnitude uncertainty factors and an additional modifying factor to account for professional assessment of scientific uncertainties in the available data (EPA, 1989a).

For noncarcinogenic health effects, it is assumed that a threshold dose exists below which there is no potential for toxicity. A NOAEL is that dose at which no toxic effects are observed in any of the test subjects. Figure 5-2 illustrates this threshold theory. A variety of regulatory agencies have used the threshold approach for noncarcinogenic substances in the development of health effects criteria, including worker-related threshold limit values (TLVs), air quality standards, Food and Drug Administration (FDA) food additive regulations, drinking water regulations, etc.

5.5.2.2 Carcinogenic Risk-Based Toxicity Values

The toxicity values that are used in the evaluation of carcinogenic risk in Subsection 5.6 are cancer slope factors that have been developed by EPA. It is assumed by EPA in developing cancer slope factors that the risk of cancer is linearly related to dose. This means that even if all of the cancer data obtained from laboratory animals or epidemiological studies are for relatively high doses, it is conservatively assumed that these high doses can be extrapolated linearly to extremely small doses, with some risk of cancer remaining. Figure 5-3 illustrates this approach. In effect, the nonthreshold theory assumes that even a small number of molecules (possibly even a single molecule) of a carcinogen may cause changes in a single cell that could result in the cell dividing in an uncontrolled manner and eventually cancer. The slope factors are usually derived by EPA by a linearized multistage model and usually reflect the upper-bound limit of the potency of the chemical. As a result, the calculated carcinogenic risk is likely to represent a plausible upper limit to the risk. The actual risk is unknown, but is likely to be lower than the predicted risk, and may be even as low as zero (EPA, 1986; 1989a).

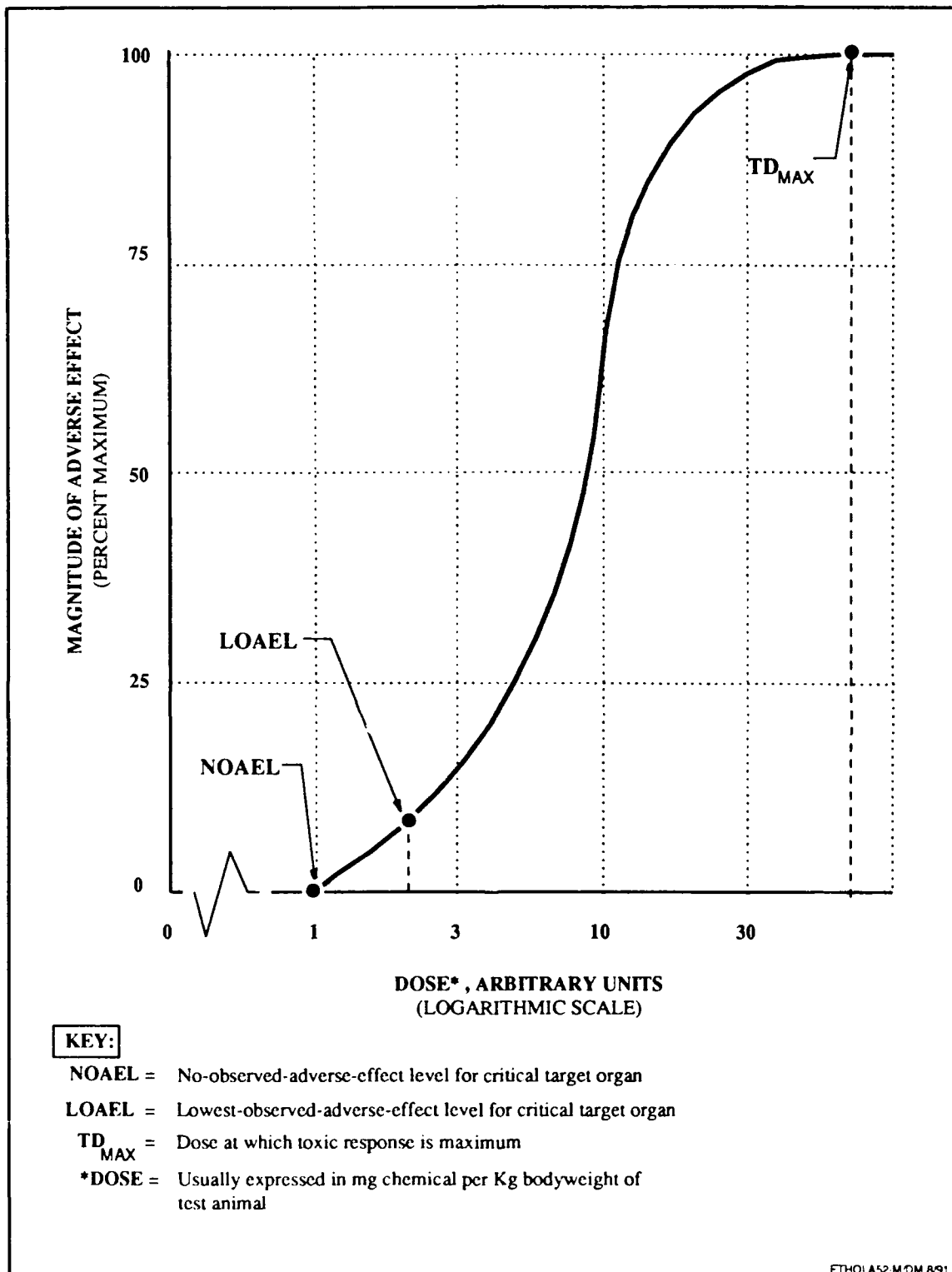


FIGURE 5-2 HYPOTHETICAL DOSE-RESPONSE CURVE FOR A "THRESHOLD" OR NONCARCINOGENIC CHEMICAL

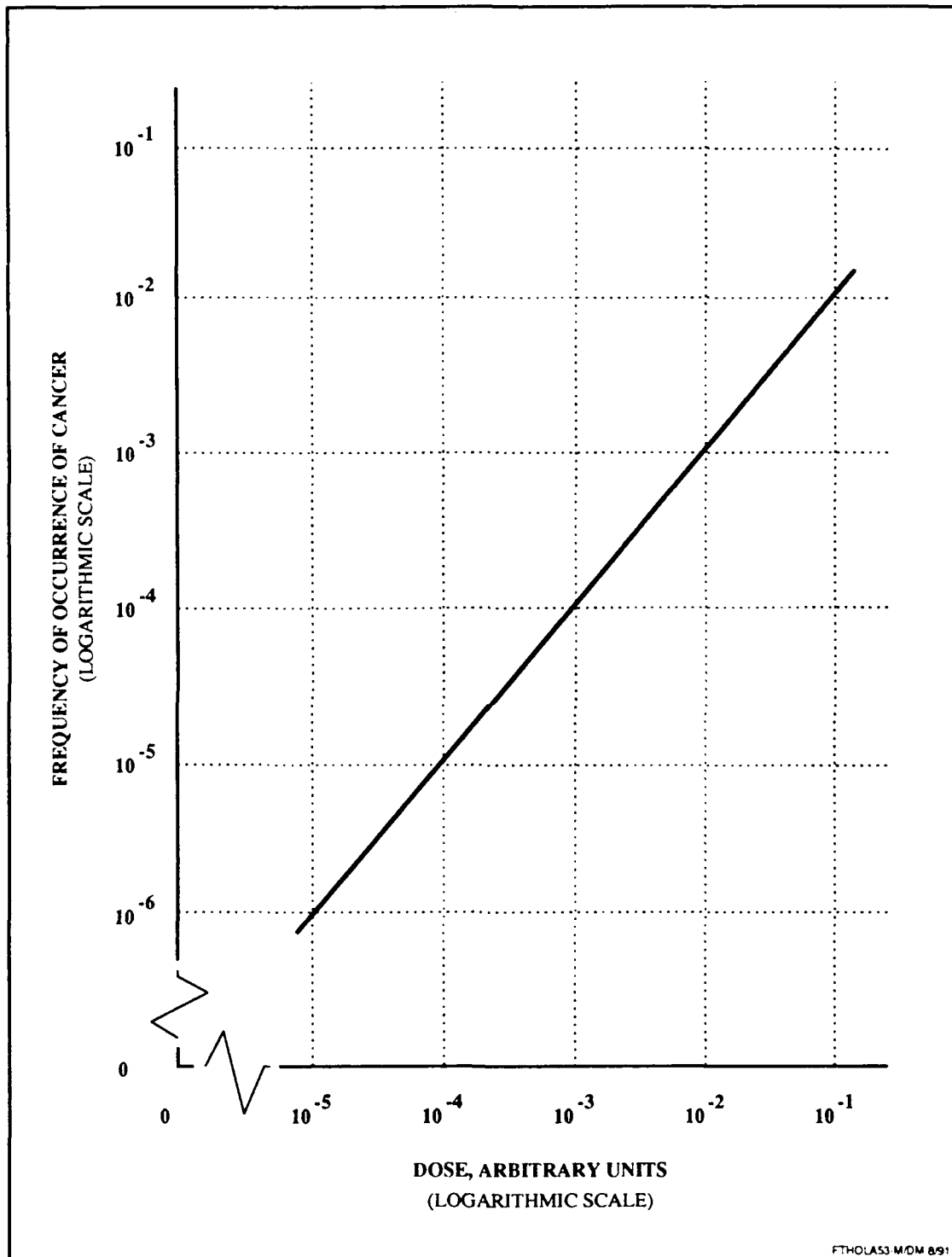


FIGURE 5-3 HYPOTHETICAL DOSE-RESPONSE CURVE FOR A "NO THRESHOLD" OR CARCINOGENIC CHEMICAL

There is some dispute as to whether the extrapolation from high to low doses is a realistic approach. It has been argued that at low doses cells may have the ability to detoxify carcinogens or repair the cellular damage that may indirectly result in cancer. Although it is important to recognize the limitations of using data from high dose studies, quantitative adjustments to published slope factors are not used in this analysis. It is important that this risk assessment use the same approach to calculating carcinogenic risk as other risk assessments so that the predicted risks can be compared.

5.5.3 CHRONIC RfDs FOR NONCARCINOGENIC EFFECTS

The toxicity of a substance depends, in part, on its route of entry into the body and on the length of exposure. Therefore, RfDs are classified according to both the route of administration (e.g., oral, inhalation, or dermal) and the duration of exposure (e.g., chronic or subchronic). Chronic RfDs are used in this risk assessment because long-term exposure to groundwater is the only duration of concern.

Oral Route

Chronic oral RfDs were listed in the Health Effects Assessment Summary Tables (HEAST) for eight of the detected compounds (EPA, 1991a). RfDs for the remaining compounds were derived following the procedures described below.

A chronic oral RfD for lead was calculated based on a proposed maximum contaminant level (MCL) of 5 $\mu\text{g/L}$. An MCL is an enforceable standard for public drinking water supplies. In 1985, EPA proposed a maximum contaminant level goal (MCLG) for lead of 20 $\mu\text{g/L}$. This was based on blood levels of 15 to 20 $\mu\text{g/L}$ in infants representing levels of concern, and was calculated assuming 100% exposure from drinking water. An MCLG is a nonenforceable health goal. Subsequently, EPA proposed an MCLG of zero and an MCL of 5 to 10 $\mu\text{g/L}$ (EPA, 1988b). The most conservative proposed MCL (i.e., 5 $\mu\text{g/L}$) was used to derive the oral RfD for lead. Assuming the consumption of 2 liters of water/day and a body weight of 70 kg (EPA, 1991b), a chronic oral RfD of $1.40\text{E-}04$ mg/kg-day was calculated for lead.

The chronic oral RfD for benzene was derived from a NOAEL of 1 mg/kg-day according to EPA guidelines (EPA, 1989a). The RfD for benzene was based on a 26-week study in rats in which leucopenia and erythrocytopenia were the toxic endpoints (Wolf et al., 1956). Applying uncertainty factors of 10 each for extrapolating from animals to humans, and for human variation, a chronic RfD of $1\text{E-}03$ was derived.

The chronic oral RfD for 1,2-dimethylbenzene was derived from the lowest reported lethal oral dose (LD_{50}) of 5,000 mg/kg based on exposure in rats (RTECS, 1991). The LD_{50} was divided by 100,000 according to an approach described by Layton et al., (1987) and resulted in an RfD of $5\text{E-}02$ mg/kg-day.

The RfD for naphthalene was used for dimethylnaphthalene, methylnaphthalene, 2-methylnaphthalene, and trimethylnaphthalene because RfDs were not available for substituted naphthalenes.

The RfD for n-nitrosodiphenylamine was derived from an LD₅₀ of 2,500 mg/kg, which is the oral dose that is lethal to 50% of the test animals. The LD₅₀ was divided by 100,000 as described above, and resulted in an RfD of 2.5E-02 mg/kg-day. Oral RfDs for noncarcinogenic health effects are listed in Table 5-8.

Inhalation Route

Noncarcinogenic health effects following inhalation exposure are evaluated only for volatile organic compounds because these are the only substances that are expected to volatilize from shower water. The inhalation RfD for ethylbenzene was converted to a chronic RfD by assuming a breathing rate of 20 m³/day and a body weight of 70 kg (EPA, 1991a).

The chronic inhalation RfDs for benzene and chloroform were derived from occupational exposure limits (OELs). It is recognized that there are several factors that limit the usefulness of OELs in the derivation of chronic inhalation RfDs. OELs are intended to protect healthy workers from adverse health effects when exposed to a chemical in the work place over a 40-hour work week. Inhalation RfDs are intended to protect the general population, including sensitive subpopulations, based on continuous exposure. Furthermore, OELs are derived by consensus rather than by a standardized procedure that incorporates standard uncertainty factors according to the nature of the toxicological database from which the RfD is derived. OELs may also be based on toxic endpoints other than chronic noncarcinogenic health effects.

In consideration of the limitations of the OELs, an equation was developed to derive chronic inhalation RfDs from OELs, incorporating uncertainty factors to account for potential continuity of exposure and variability in human sensitivity. The equation and assumptions that were used to calculate inhalation RfDs from OELs are presented in Table 5-9. The approach is consistent with EPA guidelines for deriving a chronic RfD from a NOAEL (EPA, 1989a). The equation calculates a daily dose to an exposed worker normalized over a 7-day exposure period (i.e., the NOAEL), and adjusts the dose by an uncertainty factor of 10 to take into account human variability and by a modifying factor of 10 to account for the possibility of continuous daily exposure over a lifetime. The chronic inhalation RfDs are presented in Table 5-10.

Dermal Route

No RfDs have been developed for the dermal route. As a result, dermal RfDs were derived for the chemicals of concern in accordance with EPA guidelines by multiplying the values used as the chronic oral RfDs by an appropriate gastrointestinal absorption factor (EPA, 1989a). Oral toxicity values for organic compounds are commonly based on data from oral studies in which the agent is administered in drinking water or by gavage. Absorption through these routes would be expected to be close to or at 100%. Assuming the possibility of less than total absorption, a gastrointestinal factor of 0.90

Table 5-8

**RfDs for Noncarcinogenic Effects
(mg/kg-day)**

	Chronic Oral RfD	Source or Basis
<u>Inorganics</u>		
Barium	5E-02	EPA, 1991a
Chromium	5E-03 ^a	EPA, 1991a
Lead	1.4E-04 ^b	---
Silver	3E-03	EPA, 1991a
<u>Organics</u>		
Benzene	1E-03 ^b	---
Chloroform	1E-02	EPA, 1991a
Dibenzofuran	NA	---
1,2-Dimethylbenzene	5E-02 ^b	---
Dimethylnaphthalenes	4E-03 ^c	EPA, 1991a
Di-n-butylphthalate	1E-01	EPA, 1991a
Ethylbenzene	1E-01	EPA, 1991a
Fluorene	4E-02	EPA, 1991a
Methylnaphthalene	4E-03 ^c	EPA, 1991a
2-Methylnaphthalene	4E-03 ^c	EPA, 1991a
Naphthalene	4E-03	EPA, 1991a
N-	2.5E-02 ^b	---
Nitrosodiphenylamine	4E-03 ^c	EPA, 1991a
Trimethylnaphthalenes		

^aRfD Cr (VI) is used because the value is more conservative than Cr (III).

^bDerived value (see Subsection 5.5.3).

^cValue for naphthalene is used because no RfD is available for specific compound.

Table 5-9

**Approach to Deriving a Chronic Inhalation Reference Dose (RfD)
from an Occupational Exposure Limit (OEL)**

Chronic inhalation RfD (mg/kg-day)	=	$\frac{\text{OEL (mg/m}^3\text{)} \times \text{Air breathed per work day (m}^3\text{/day)}}{\text{Body weight (kg)} \times \text{Uncertainty factor}}$	x	Work week adjustment factor
------------------------------------	---	--	---	-----------------------------

Where:

Chronic inhalation RfD = Chronic inhalation reference dose.

OEL = Occupational exposure limit.

Air breathed per work day = 10 m³. This value has been used by EPA when deriving an inhalation acceptable chronic intake (AIC) for the public from worker exposure levels (EPA, 1984).

Work week adjustment factor = 5 days/7 days. Because the OEL is based on a 5-day work week, an adjustment was made to average the dose over a 7-day week.

Body weight = 70 kg (weight of an average adult) (EPA, 1989a).

Uncertainty factor = 100. A factor of 100 is recommended by the U.S. EPA when deriving RfDs from human data to account for human variation (i.e., to protect sensitive members of the general population (e.g., children and the elderly) (EPA, 1989a). An additional modifying factor of 10 was included to take into account a continuous exposure for a resident (versus an intermittent exposure for a worker) and a lifetime exposure for a resident (versus a less than lifetime exposure for a worker). Uncertainty factors of 10 to 100 are commonly used by government agencies where deriving public health criteria from OELs (EPA, 1984; MDNR, 1989; PAMS, 1983).

Table 5-10

**RfDs for Noncarcinogenic Effects
(mg/kg-day)**

	Chronic Inhalation RfD	Source or Basis
<u>Inorganics</u>		
Barium	NA ^a	---
Chromium	NA	---
Lead	NA	---
Silver	NA	---
<u>Organics</u>		
Benzene	3E-02 ^b	ACGIH-TLV
Chloroform	5E-02 ^b	ACGIH-TLV
Dibenzofuran	NE ^c	---
1,2-Dimethylbenzene	NA	---
Dimethylnaphthalenes	NA	---
Di-n-butylphthalate	NA	---
Ethylbenzene	3E-01 ^d	EPA, 1991a
Fluorene	NA	---
Methylnaphthalene	NA	---
2-Methylnaphthalene	NA	---
Naphthalene	NA	---
N-Nitrosodiphenylamine	NA	---
Trimethylnaphthalenes	NA	---

^aExposure to this compound is not applicable through inhalation route.

^bDerived from occupational exposure limit (see Subsection 5.5.3).

^cHealth criterion is not available. Compound not evaluated.

^dDerived from inhalation reference concentration assuming an inhalation rate of 20 m³/day and a body weight of 70 kg.

ACGIH-TLV = American Conference of Governmental Industrial Hygienists -
Time-Weighted Average

was used for volatile compounds and 0.50 was used for semivolatile compounds. It should be noted that applying a gastrointestinal factor to an oral RfD results in a more conservative toxicity value. The chronic dermal RfDs for the contaminants of concern are presented in Table 5-11.

5.5.4 CANCER SLOPE FACTORS

All chemicals in this study that have evidence of carcinogenicity in animals and/or humans and are classified as carcinogens by EPA (Groups A, B, or C) and/or the International Agency for Research on Cancer (IARC) (Groups 1, 2A, or 2B) are considered in this evaluation to be carcinogens (CIS, 1988; EPA, 1989a). The carcinogenic chemicals addressed in this evaluation and their EPA and IARC carcinogenicity classifications are presented in Table 5-12. An explanation of the EPA and IARC carcinogenicity classification systems is presented in Table 5-13.

Like reference doses, slope factors are classified according to the route of administration. As previously noted, the carcinogenic potency of a chemical depends on its route of entry into the body. In some cases, a carcinogen may produce tumors only at or near a specific natural route of entry (e.g., nasal passages), and may not be carcinogenic through other exposure routes.

Oral Route

Oral slope factors in units of $(\text{mg/kg-day})^{-1}$ are available for all the carcinogens of potential concern by the oral route. The slope factors and their source are listed in Table 5-14.

Inhalation Route

Inhalation slope factors in units of $(\text{mg/kg-day})^{-1}$ are available for all the carcinogens of potential concern by the inhalation route. The slope factors and their source are listed in Table 5-15.

Dermal Route

Although few data are available concerning the carcinogenic activity of chemicals that are systemically absorbed through dermal exposure, it is assumed that all of the chemicals that are carcinogenic through the oral route are potentially carcinogenic through the dermal route. In the absence of dermal slope factors for the carcinogens, a dermal slope factor was derived from each chemical, in accordance with EPA guidance, by dividing its respective oral slope factor by an appropriate gastrointestinal absorption factor (EPA, 1989a). As a result, each dermal slope factor represents the potency of the absorbed dermal dose. This is consistent with the overall approach for

Table 5-11

**RfDs for Noncarcinogenic Effects^a
(mg/kg-day)**

	Chronic Dermal RfD
<u>Inorganic</u>	
Barium	NA ^b
Chromium	NA
Lead	NA
Silver	NA
<u>Organics</u>	
Benzene	9E-04
Chloroform	9E-03
Dibenzofuran	NE ^c
1,2-Dimethylbenzene	2.5E-02
Dimethylnaphthalenes	2E-03
Di-n-butylphthalate	5E-02
Ethylbenzene	9E-02
Fluorene	2E-02
Methylnaphthalene	2E-03
2-Methylnaphthalene	2E-03
Naphthalene	2E-03
N-Nitrosodiphenylamine	1.25E-02
Trimethylnaphthalenes	2E-03

^aDerived from oral RfD (see Subsection 5.5.3).

^bExposure to this compound is not applicable through dermal route.

^cHealth criterion is not available. Compound not evaluated.

Table 5-12

EPA and IARC Categorizations of the Carcinogenic Pollutants

Pollutant	EPA ^a Carcinogenicity Category	IARC ^b Carcinogenicity Category
Benzene	A	1
Chloroform	B2	2B
N-Nitrosodiphenylamine	B2	3

^aEPA, 1991b.

^bIARC, 1987.

Table 5-13
EPA and IARC Categorizations of Carcinogens
Based on Human and Animal Evidence

EPA Categorization of Carcinogens (EPA, 1986)					
Animal Evidence					
Human Evidence	Sufficient	Limited	Inadequate	No Data	No Evidence
Sufficient	A	A	A	A	A
Limited	B1	B1	B1	B1	B1
Inadequate	B2	C	D	D	D
No data	B2	C	D	D	E
No evidence	B2	C	D	D	E

Key:

- Group A - Human carcinogen (sufficient evidence from epidemiological studies).
- Group B1 - Probable human carcinogen (at least limited evidence of carcinogenicity to humans).
- Group B2 - Probable human carcinogen (a combination of sufficient evidence in animals and inadequate data in humans).
- Group C - Possible human carcinogen (limited evidence in animals in the absence of human data).
- Group D - Not classified (inadequate animal and human data).
- Group E - No evidence for carcinogenicity (no evidence for carcinogenicity in at least two adequate animal tests in different species, or in both epidemiological and animal studies).

Table 5-13
EPA and IARC Categorizations of Carcinogens
Based on Human and Animal Evidence
(continued)

IARC Categorization of Carcinogens (IARC, 1987)	
Group 1	- Human carcinogen (sufficient evidence of carcinogenicity in humans).
Group 2A	- Probable human carcinogen (limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals).
Group 2B	- Possible human carcinogen (limited evidence of carcinogenicity in humans and insufficient evidence of carcinogenicity in experimental animals; insufficient evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals; or insufficient evidence of carcinogenicity in humans and limited evidence of carcinogenicity in experimental animals, with supporting evidence from other relevant data).
Group 3	- Not classifiable (substances in this category do not fall into any other category).
Group 4	- Probably not carcinogenic to humans.

Table 5-14

**Cancer Slope Factors
(mg/kg-day⁻¹)**

	Oral Slope Factor	Source or Basis
Benzene	2.90E-02	EPA, 1991a
Chloroform	6.10E-03	EPA, 1991a
N-Nitrosodiphenylamine	4.90E-03	EPA, 1991a



Table 5-15

**Cancer Slope Factors
(mg/kg-day)⁻¹**

	Inhalation Slope Factor	Source or Basis
Benzene	2.9E-02	1991a
Chloroform	8.1E-02	1991a

calculating potential risk of dermal exposure, in which the chemical intakes through dermal contact are expressed as absorbed dermal doses. The absorption factors for volatiles and semivolatiles are 0.9 and 0.5, respectively. Dermal slope factors in units of $(\text{mg/kg-day})^{-1}$ are presented in Table 5-16 for the carcinogens of potential concern through the dermal route.

5.6 RISK CHARACTERIZATION

The objective of the risk characterization is to integrate the information developed in the exposure assessment (Subsection 5.4) and the toxicity assessment (Subsection 5.5) into an evaluation of the potential health risks associated with contaminants at the CRC site. This subsection presents an analysis of the nature and degree of health risks posed to the hypothetical future worker described in Subsection 5.4. Risk estimates are derived for the total contaminant contribution through the ingestion, inhalation, and dermal pathways.

Human health risks are discussed independently for potential carcinogenic and noncarcinogenic effects of pollutants because of the different toxicological endpoints, relevant exposure durations, and methods employed in characterizing risk. Excessive exposure to all pollutants can potentially produce noncarcinogenic health effects, while the potential for carcinogenic effects is limited to exposure to certain substances.

5.6.1 APPROACHES TO EVALUATING RISK

5.6.1.1 Noncarcinogenic Risk

Noncarcinogenic risks are evaluated by comparing predicted pollutant daily intakes to RfDs. This is accomplished by the calculation of hazard quotients and a hazard index. A hazard quotient for a particular contaminant is the ratio between the estimated daily intake through a given exposure route and the applicable RfD, as illustrated by the following equation:

$$\text{HQ} = \text{EDI/RfD}$$

Where:

- HQ = Hazard quotient.
- EDI = Estimated daily intake (mg/kg-day).
- RfD = Reference dose (mg/kg-day).

The hazard quotients are summed to determine the hazard index (i.e., all contaminants combined).

Table 5-16

Dermal Cancer Slope Factors*
(mg/kg-day)⁻¹

Organics	Dermal Slope Factor
Benzene	3.22E-02
Chloroform	6.78E-03
N-Nitrosodiphenylamine	9.80E-03

*Derived from oral cancer slope factor (see Subsection 5.5.4).

In the case of chronic RfDs, chronic hazard indices and a chronic hazard quotient are calculated by comparing the chronic daily intakes based on a yearly average dose to the chronic RfDs.

The methodology used to evaluate noncarcinogenic risk, unlike the methodology used in the evaluation of carcinogenic risk, is not a measure of and cannot be used to determine quantitative risk. The hazard quotient or hazard index is not a mathematical prediction of incidence of effects or severity of those effects (EPA, 1986). If a hazard quotient or hazard index exceeds "one" (>1), it simply indicates that there might be a potential for noncarcinogenic health effects occurring under the defined exposure conditions. Because RfDs incorporate a margin of uncertainty, if the criterion of one (1) is exceeded, it does not necessarily indicate that an adverse effect is likely. Conversely, however, a hazard quotient or index of less than or equal to one (≤ 1) indicates that it is unlikely for even sensitive populations to experience adverse noncarcinogenic health effects.

5.6.1.2 Carcinogenic Risk

Carcinogenic risks, which are expressed as a lifetime risk (i.e., the risk posed to an individual over a lifetime), are calculated for carcinogenic contaminants using the following equation:

$$\text{Cancer Risk} = \text{ADI} \times \text{CSF}$$

Where:

Cancer Risk	=	Lifetime carcinogenic risk (expressed as a probability).
ADI	=	Average daily intake (averaged over 70 years) (mg/kg-day).
CSF	=	Cancer slope factor (mg/kg-day) ⁻¹ .

The average daily intake (average over 70 years) represents a time-weighted average of the chronic estimated daily intakes for the worker.

5.6.2 SUMMARY OF RISK CALCULATIONS

5.6.2.1 Noncarcinogenic Risk

The hazard index (sum of hazard quotients for individual compounds) for chronic ingestion of groundwater is approximately 4. Though the hazard index exceeds 1, it does not necessarily imply that adverse noncarcinogenic health effects will be experienced by the hypothetical worker population. Safety factors are employed in the development of RfDs that would allow for some exposure in excess of the RfD. In addition, a value of 4 for a hazard index is not greatly different from 1. The hazard quotients and hazard index are provided in Table 5-17.

Table 5-17

Hazard Quotients and Hazard Index for Hypothetical Future Workers

	Groundwater Ingestion	Shower Inhalation	Shower Dermal	Total
<u>Inorganics</u>				
Barium	9.54E-03	NA	NA	9.54E-03
Chromium	2.95E-02	NA	NA	2.95E-02
Lead	5.63E-01	NA	NA	5.63E-01
Silver	2.27E-03	NA	NA	2.27E-03
<u>Organics</u>				
Benzene	2.64E-01	1.50E-02	2.31E-02	3.02E-01
Chloroform	6.55E-03	2.24E-03	4.28E-04	9.21E-03
Dibenzofuran	NA	NA	NA	NA
1,2-Dimethylbenzene	1.86E-03	NA	2.94E-04	2.15E-03
Dimethylnaphthalenes	7.34E-01	NA	3.23E-01	1.06E+00
Di-n-butylphthalate	1.27E-04	NA	7.61E-05	2.03E-04
Ethylbenzene	1.67E-03	9.50E-04	3.82E-04	3.00E-03
Fluorene	2.10E-03	NA	1.16E-03	3.26E-03
Methylnaphthalene	4.89E-01	NA	2.15E-01	7.04E-01
2-Methylnaphthalene	4.89E-01	NA	2.15E-01	7.04E-01
Naphthalene	5.25E-01	NA	2.31E-01	7.56E-01
N-Nitrosodiphenylamine	1.37E-03	NA	5.38E-04	1.91E-03
Trimethylnaphthalenes	1.71E-01	NA	7.53E-02	2.47E-01
Total	3.29E+00	1.82E-02	1.09E+00	4.39E+00

NA = Not applicable. Health criterion not available.

5.6.2.2 Carcinogenic Risk

The lifetime carcinogenic risk for the hypothetical future worker is $1\text{E-}05$ (one-in-one-hundred-thousand). The majority of the total risk (69%) is attributed to benzene. Approximately 30% of the total carcinogenic risk is attributed to chloroform exposure. The total carcinogenic risk and risk by compound are presented in Table 5-18.

Carcinogenic risk may be divided into ranges that represent different levels of concern to regulatory officials: the de minimis risk range, the risk range of regulatory concern, and the nonacceptable risk range. The de minimis risk range, a value that is equal to or less than $1\text{E-}06$ (one-in-one-million), represents a level that is considered so small that it is not of concern to regulatory officials. Depending on potential uses of the site, the risk range of concern is greater than $1\text{E-}06$ but less than $1\text{E-}04$ (40 CFR 300, 1990). Media concentrations that result in excess lifetime cancer risks that exceed $1\text{E-}04$ (one-in-ten-thousand) are generally viewed by regulators as requiring some cleanup effort.

Although the total risk for the CRC site ($1\text{E-}05$) exceeds the de minimis risk range ($1\text{E-}06$), it is one order of magnitude below the level generally recognized as requiring cleanup ($1\text{E-}04$).

5.7 EXPOSURE ASSESSMENT - ASBESTOS

Several subjective factors, such as condition of material, material friability, accessibility, etc., enter into algorithm formula calculations. Therefore, the Asbestos Priority Indices provide relative rather than absolute ratings of exposure and hazard potential. However, the Asbestos Priority Index System can be a useful tool in prioritizing areas and ranking facilities for further study and possible abatement actions if it is used as a qualitative exposure and hazard assessment guide. Exposure assessment requires the survey personnel to assign a quantity to seven factors:

- Material friability
- Occupant accessibility
- Material condition
- Material condition
- Level of activity
- Number of assigned occupants
- Average exposure hours
- Percent asbestos content

5.7.1 METHODOLOGY

Each area of suspect ACM within a facility is inventoried and a preliminary assessment of conditions is made using the Asbestos-Containing Material Evaluation and Priority Index Form. These forms, which were completed during the field survey of the Building 306 and 307 boiler rooms, are included in Appendix B.2. The field inventory data are combined with the analytical results to provide a Priority Index Number Ranking.

Table 5-18

Carcinogenic Risk for Hypothetical Future Worker

Organics	Groundwater Ingestion	Shower Inhalation	Shower Dermal	Total
Benzene	2.73E-06	4.66E-06	2.40E-08	7.64E-06
Chloroform	1.43E-07	3.23E-06	9.33E-09	3.39E-06
N-Nitrosodiphenylamine	5.99E-08	NA	2.36E-08	8.35E-8
Total	2.93E-06	7.90E-06	2.73E-07	1.11E-05

5.7.2 Priority Value Ranking

The TRADOC methodology utilizes a Priority Action Guide with three categories of recommended action. These categories are defined in Table 5-19.

Table 5-20 presents a prioritized listing, from highest priority ranking (priority index code "C", which correlates with a priority index number of 1,000 and greater), through median priority ranking (priority index code "B", which correlates with a priority index number of 100 or greater, but less than 1,000), to the lowest priority ranking (priority index code "A", which correlates with a priority index number of less than 100), of the friable materials surveyed in Buildings 305, 306, and 307.

Table 5-19

Property Action Guide*

<u>Priority Index Value</u>	<u>Priority Index Ranking</u>	<u>Recommended Action Categories</u>
Less Than 100	A	A long-term corrective measure can usually be deferred; however, the building should be surveyed each year for evidence of change in conditions (deterioration) or occupancy level. Interim control measures should be initiated as directed in an O&M Program.
100 but Less Than 1,000	B	Review management special considerations/ remarks, as necessary, to further analyze the situation for justified action; defer unless these considerations justify long-term control measures. Interim control measures should be initiated as directed in an O&M program.
1,000 and Greater	C	Army Asbestos Deficiency Abatement Project for long-term corrective measures should be initiated as recommended.

*From TRADOC Chapter 6.

NOTE:

The asbestos priority index value produced by this technique is designed for rating areas containing ACM in a relative fashion only and should not be interpreted beyond this purpose.

The asbestos priority index value indicates the relative potential for personnel exposure to airborne asbestos fibers.

Table 5-20

Exposure Assessments - Priority Order

USATHAMA

BUILDING NO.	SAMPLE NO.	AREA	MATERIAL TYPE	PRIOR. INDEX CODE	PRIORITY INDEX NUMBER	EXPOSURE FACTORS					AVG. EXP. HOURS	% ASB.
						1	2	3	4	5		
0306	FJ605	MECHANICAL ROOM	4-8" PIPE RUN	B	3.750E02	3	3	2	1	1	1.00	40
0307	FJ616	MECHANICAL ROOM	4-8" PIPE RUN	B	3.750E02	3	3	2	1	1	1.00	40
0307	FJ617	MECHANICAL ROOM	4-8" PIPE FITTING	B	3.750E02	3	3	2	1	1	1.00	50
0306	FJ602	MECHANICAL ROOM	4-8" PIPE RUN	B	1.325E02	3	3	2	1	1	1.00	30
0307	FJ613	MECHANICAL ROOM	BOILERS/TANKS	B	1.325E02	3	3	2	1	1	1.00	20
0307	FJ615	MECHANICAL ROOM	DEBRIS	B	1.325E02	3	3	2	1	1	1.00	31
0306	FJ603	MECHANICAL ROOM	4-8" PIPE FITTING	A	2.300E01	3	3	2	1	1	1.00	1

Priority Index Codes

- A [=] Long Term Corrective Measure
- B [=] Review Management Special Considerations/Remarks
- C [=] Army Asbestos Deficiency Abatement Project

Priority Index Numbers Are In Scientific Notation

Exposure Factors

- 1 [=] Material Friability
- 2 [=] Occupant Accessibility
- 3 [=] Material Condition
- 4 [=] Level Of Activity
- 5 [=] Number Of Assigned Occupants

SECTION 6

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

EPA policy, as reflected in SARA and in the NCP, provides that the development and evaluation of remedial actions under CERCLA must include evaluating alternative site responses in relation to applicable or relevant and appropriate federal and state environmental and public health requirements.

Although any remedial actions that may be conducted at the Fort Holabird CRC will not be regulated under CERCLA, it will be used as a guideline.

ARARs are defined as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.
- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site.

ARARs may be divided into the following categories:

- Chemical-specific requirement are health- or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants, or contaminants. These limits may take the form of cleanup levels or discharge levels.
- Location-specific requirements are restrictions on activities that are based on the characteristics of a site or its immediate environment. An example would be restrictions on wetlands development. The CRC is located in a developed urban area; therefore, location-specific ARARs are not addressed in this alternatives assessment.
- Action-specific requirements are controls or restrictions on particular types of activities in related areas such as hazardous waste management or wastewater treatment. An example would be RCRA incineration standards.

The chemical-specific and action-specific ARARs for the CRC are summarized in Table 6-1 and are described in more detail in Subsections 6.1 and 6.2.

6.1 CHEMICAL-SPECIFIC ARARs

Chemical-specific requirements set health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances, pollutants, or contaminants (52 CFR 32496). These requirements generally set protective cleanup levels for the chemicals of concern in the designated media or indicate a safe level of discharge that may be incorporated in a remedial activity.

6.1.1 SAFE DRINKING WATER ACT (SDWA)

The Safe Drinking Water Act (SDWA) mandates EPA to establish regulations to protect human health from contaminants in drinking water. EPA has promulgated primary and secondary drinking water regulations applicable to public water systems. National Primary Drinking Water Standards (NPDWS) are established in 40 CFR Part 141 and include MCLs. The MCLs are enforceable standards that take into consideration human health effects, available treatment technologies, and costs of treatment.

Table 6-2 lists the current SDWA MCLs for contaminants detected in the Fort Holabird groundwater samples. All groundwater samples taken contained concentrations of metals below the applicable MCL. Ethylbenzene was detected in both samples from monitoring well No. 3 at concentrations well below the MCL. No other compounds detected at concentrations above the detection limits had values above the existing MCLs, with the exception of benzene, which was detected in both samples (MW03 and MW03D) taken from monitoring well No 3 at concentrations above the MCL.

However, the SDWA MCLs do not currently apply to the groundwater at the CRC because groundwater in the City of Baltimore and in the immediate vicinity is not used for drinking purposes. The proximity of salt water in the Baltimore Harbor and excessive reliances on the Patapsco Formation (the upper surficial aquifer) in the early 1930 and 1940s resulted in salt water intrusion and degradation of the resource. Residences and industries in the Baltimore area now rely on municipal water that is obtained from surface water far north of the city.

6.1.2 MARYLAND WATER POLLUTION CONTROL REGULATIONS

Maryland water quality regulations resemble the national standards set forth by EPA under the SDWA and the CWA. Maryland has adopted the MCLs established under the SDWA.



Table 6-1

ARARs for the Fort Holabird CRC

Chemical-Specific

- Safe Drinking Water Act (SDWA)
- Maryland Water Pollution Control Regulations
- Maryland UST Regulations

Action-Specific

- Clean Water Act (CWA)
 - Clean Air Act (CAA)
-

Table 6-2

Pertinent SDWA Standards

Compound	MCL ($\mu\text{g/L}$)	Regulatory Status
METALS		
Arsenic	50	Final
Barium	1,000	Final
Chromium	50	Final
Lead	50	Final
Silver	50	Final
ORGANICS		
Benzene	5	Final
Ethylbenzene	700	Proposed

6.1.3 MARYLAND UST REGULATIONS

Under the Code of Maryland Regulations, Title 26, Subtitle 10, Chapter 2, the State of Maryland reserves the right to require a corrective action plan for contaminated soil and groundwater caused by USTs. The state considers the following factors in its approval of corrective action plans:

- The physical and chemical characteristics of the regulated substance, including its toxicity, persistence, and potential for migration.
- The hydrogeologic characteristics of the facility and the surrounding area.
- The proximity, quality, and current and future uses of nearby water and groundwater.
- The potential effects of residual contamination on nearby surface water and groundwater.
- An exposure assessment.

The State of Maryland, Department of Environment has informed the Army that based on the results of current and past groundwater samples from Fort Holabird, no further corrective action plans pertaining to the groundwater will be required.

6.1.4 EPA RADON GUIDELINES

The EPA has issued guidelines setting the maximum acceptable level of radon in air at 4 pCi/L. This level was determined to be achievable considering radon remediation technology currently available. If radon levels in an occupied area exceed 4 pCi/L, then the EPA recommends that steps be taken to reduce the radon concentrations to below 4 pCi/L. If the radon concentration is measured at less than 4 pCi/L, then remedial action to reduce the levels may not be effective and is not worth the expense.

6.2 ACTION-SPECIFIC ARARs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities that are selected to carry out an alternative. Since there are usually several alternative actions for any remedial site, various requirements may be applicable or relevant and appropriate. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved.

6.2.1 CLEAN AIR ACT (CAA)

Because asbestos was found in building and insulation materials on-site, remedial activities must be designed to comply with NESHAP regulations in the CAA. All



procedures for controlling asbestos emissions during removal and/or demolition (40 CFR 61.147) and during disposal must follow NESHAP's procedures.

Remedial technologies that could result in air emissions must be designed so that emissions meet federal or state air emission standards.

6.2.2 CLEAN WATER ACT (CWA)

The CWA applies to point-source direct discharges into navigable waters and indirect discharges to a Publicly Owned Treatment Works (POTW). In the case of indirect discharges to a POTW, the POTW sets forth pretreatment standards. The CWA would only be applicable to the Fort Holabird site if a groundwater recovery system was installed.

SECTION 7

DEVELOPMENT AND ANALYSIS OF ALTERNATIVES

7.1 INTRODUCTION

This section develops and analyzes remedial alternatives that address the groundwater contamination, including one "no action" alternative, and asbestos that exist at the Fort Holabird CRC. Three groundwater remedial alternatives were developed to provide an appropriate range of options and sufficient information for comparison among alternatives. Two alternatives, including one "no action" alternative, were developed to address asbestos abatement. The alternatives are presented in Subsections 7.3 through 7.5 and are evaluated using criteria described in Subsection 7.2.

The alternatives include:

- Groundwater
 - Alternative 1 - No Action.
 - Alternative 2 - Additional Groundwater Monitoring.
 - Alternative 3 - On-Site Groundwater Treatment.
- Asbestos
 - Alternative 1 - No Action.
 - Alternative 2 - Asbestos Abatement.

7.2 EVALUATION CRITERIA

The following criteria were evaluated for each of the developed alternatives and represent the basis for comparing alternatives:

- Compliance with ARARs.
- Short-term effectiveness.
- Long-term effectiveness and permanence.
- Overall protection of human health and the environment.
- Reduction of toxicity, mobility, and volume of contaminants.
- Implementability.
- Cost.

7.2.1 COMPLIANCE WITH ARARs

This criterion is used to determine how each alternative complies with applicable and relevant regulations (Section 6) and relative risks developed in Section 5. The chemical-, location-, and action-specific requirements are discussed along with any other appropriate criteria, advisories, and guidance as they apply to each alternative.

7.2.2 SHORT-TERM EFFECTIVENESS

This evaluation criterion involves consideration of the short-term effectiveness of the alternative during construction and implementation. The evaluation focuses on protection of the community and the on-site personnel during implementation of remedial measures and potential environmental impacts.

7.2.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

This evaluation criterion involves consideration of the long-term effectiveness and performance of the alternative once it has been implemented. The evaluation focuses on the presence of receptors, the magnitude of the remaining risk from untreated waste or treatment residues, and the adequacy and reliability of controls that are used to manage treatment residuals or untreated waste.

7.2.4 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

This evaluation criterion involves consideration of the overall protection of human health and the environment. The overall assessment of protection draws on the assessments conducted for other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

7.2.5 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME OF CONTAMINANTS

Consideration of this evaluation criterion is a result of recent statutory preference for selecting remedial actions that permanently and significantly reduce the toxicity, mobility, and volume of the contaminants and associated media.

The following factors are considered in this evaluation:

- The treatment process and materials.
- The amount of hazardous materials.
- The degree of reduction in toxicity, mobility, or volume.
- The degree of which treatment will be irreversible.
- The type and quantity of materials that remain after remediation.

7.2.6 IMPLEMENTABILITY

This criterion establishes the technical and administrative feasibility of implementing an alternative. Technical aspects evaluated for each alternative include: construction and operation activities; reliability of the technologies involved; ease of undertaking additional remedial action; and monitoring after completion of activities. Administrative concerns include establishing contact with appropriate agencies to implement remedial actions (e.g., obtaining permits for construction and operation of

a treatment unit). The availability of materials and equipment needed is another factor that must be considered when evaluating the implementability of an alternative.

7.2.7 COST

A remedial program must be implemented and operated in a cost-effective manner and must mitigate the environmental and human health concerns at the site. In considering the cost-effectiveness of the various alternatives, the following categories are evaluated:

- Capital Costs -- These costs include expenditures for equipment, labor, and materials necessary to install remedial actions. Indirect costs may be incurred for engineering, financial, or other services not directly involved with installation of remedial alternatives, but necessary for completion of this activity.
- Operating and Maintenance Costs -- These costs include post-construction expenditures incurred to ensure effective implementation of the alternative. Such costs may include, but are not limited to, operating labor, maintenance materials and labor, rental equipment, disposal of residues, and administrative, insurance, and licensing costs.

7.3 EVALUATION OF GROUNDWATER ALTERNATIVE 1: NO ACTION

7.3.1 DESCRIPTION

The no action alternative provides a basis for comparing existing site conditions with those resulting from implementation of the other proposed alternatives. Under the no action alternative, no additional measures would be used to remediate contamination at the site. Access to the site would be prohibited only by the existing site fence. Therefore, public access would be only passively restricted.

Implementing no remedial activities at the site allows the existing groundwater contamination to remain in place. Since the probable source of the contamination has already been removed, increases in the level of contamination at the site are unlikely. Although the potential for exposure to contaminants is not reduced, the risk created by the current level of contaminants is considered to be sufficiently low to make no action a viable alternative.

7.3.2 COMPLIANCE WITH ARARs

The no action alternative would comply with ARARs. Drinking water standards apply to groundwater that is or may be used as a drinking water source. Based on the fact that the groundwater is not currently used as a drinking water source and the fact that its brackish nature would preclude future use, drinking water standards do not apply to the site groundwater. Furthermore, the risk assessment (Section 5) indicates that there is acceptable risk involved with the contamination under any viable, complete pathway that may be encountered, as related to future industrial use. In addition, the

State of Maryland, Department of Environment has informed the Army that no further corrective action plans pertaining to the groundwater at Fort Holabird are required.

7.3.3 SHORT-TERM EFFECTIVENESS

Implementation of the "no action" alternative will cause no additional groundwater impact. The only impact is that which is already posed by the existing contamination.

7.3.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Implementation of this alternative will cause no additional environmental impact. Since the probable source of the groundwater contamination has been removed, increases in the level of contamination at the site are unlikely. In the long-term, biodegradation and/or natural attenuation will probably reduce the level of contamination even further.

7.3.5 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The risks to the community and site personnel are not mitigated in this alternative; however, due to the low risk nature of the contamination, the alternative is believed to be sufficiently protective of human health and the environment.

7.3.6 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME OF CONTAMINANTS

In this alternative, there is no active treatment process for the contamination. As a result, groundwater contaminants will be destroyed by only passive, natural processes.

7.3.7 IMPLEMENTABILITY

The no action alternative requires no implementation.

7.3.8 COST

There are no capital or operating and maintenance costs associated with the no action alternative.

7.4 EVALUATION OF GROUNDWATER ALTERNATIVE 2: ADDITIONAL GROUNDWATER MONITORING

7.4.1 DESCRIPTION

This alternative provides for further investigation of the nature and extent of the groundwater contamination. One or more additional wells would be installed in the area of monitoring well No. 3. Sampling of the new well(s) would be conducted as outlined in Subsection 2.2. The need for further monitoring or remedial actions would be based on the results of the groundwater sampling.

7.4.2 COMPLIANCE WITH ARARs

This alternative would comply with ARARs. Drinking water standards apply to groundwater that is or may in the future be used as a drinking water source. Based on the fact that the groundwater is not currently used and its brackish nature would probably preclude future use, drinking water standards do not apply to the site groundwater. The risk assessment (Section 5) indicates that there is acceptable risk involved with the contamination, even if the groundwater were to be used as a drinking water source for a future industrial work force.

7.4.3 SHORT-TERM EFFECTIVENESS

Implementation of this alternative will cause no additional environmental impact on the groundwater at the site.

7.4.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Implementation of this alternative will cause no additional environmental impact. The characterization of volume and extent provided by this alternative could provide a basis for a future remedial action with long-term effectiveness and permanence.

7.4.5 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The risks to the community and site personnel posed by groundwater contamination are not mitigated in this alternative. Due to the low risk nature of the contamination, the alternative is believed to be sufficiently protective of human health and the environment.

7.4.6 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME OF CONTAMINANTS

In this alternative, there is no active treatment process for the contamination. The characterization of volume and extent provided by this alternative could provide a basis for a future remedial action that would reduce the toxicity, mobility, and volume of the contaminants.

7.4.7 IMPLEMENTABILITY

This alternative can be readily implemented using existing well construction techniques.

7.4.8 COST

The cost to implement this alternative is dependent upon the number of additional wells to be installed. The cost is expected to be relatively low compared to implementation of a remediation program.

7.5 EVALUATION OF GROUNDWATER ALTERNATIVE 3: ON-SITE TREATMENT OF GROUNDWATER

7.5.1 DESCRIPTION

Air stripping is a technology used to remediate groundwater contaminated with organic compounds. Air stripping involves feeding the contaminated groundwater to the top of a packing media while stripping air from the atmosphere is fed to the bottom of the packing media. As air passes through the packing media and contacts the groundwater, it strips the contaminants from the aqueous phase. The treated groundwater can be discharged to the sanitary sewer or surface water. The contaminated air is vented to the atmosphere with or without air emissions control depending on the location and the amount of stripped contaminants.

7.5.2 COMPLIANCE WITH ARARs

Implementation of an air stripping treatment program would comply with ARARs. The concentration of contaminants in the groundwater could be reduced to levels below the applicable MCLs.

7.5.3 SHORT-TERM EFFECTIVENESS

The emission of contaminated air into the atmosphere during air stripper operation could pose a short-term risk to the surrounding community. Air emission controls would reduce or eliminate this risk.

7.5.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Implementation of the air stripping alternative will greatly reduce or eliminate the potential long-term risks associated with the groundwater contamination. Since the source of this contamination has been removed, this treatment will provide a permanent solution to the contamination. The time frame necessary to implement this remediation is unknown without further definition of subsurface conditions at the site.

7.5.5 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The risks to human health and the environment will be reduced or eliminated with the implementation of this alternative.

7.5.6 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME OF CONTAMINANTS

This alternative will reduce or eliminate the toxicity, mobility, and volume of the contaminants present in the groundwater.

7.5.7 IMPLEMENTABILITY

This alternative can be readily implemented using existing, widely available air stripping technology.

7.5.8 COST

The cost of implementing an air stripping alternative is dependent on the amount of groundwater that would be treated. Since the amount of groundwater that would require pumping is unknown, formulation of an accurate cost to implement this alternative is not feasible. In addition, requirements for air pollution control equipment could significantly impact the cost of this alternative.

7.6 EVALUATION OF ASBESTOS ALTERNATIVE 1: NO ACTION

7.6.1 DESCRIPTION

The no action alternative provides a basis for comparing existing site conditions with those resulting from implementation of the other proposed alternatives. Under the no action alternative, no additional measures will be used to remediate asbestos at the site. ACM would remain at the site in its present condition.

7.6.2 COMPLIANCE WITH ARARs

The no action alternative will not comply with ARARs. Under NESHAP, friable ACM must be removed from a building prior to demolition. Due to the state of disrepair of Buildings 306 and 307, demolition is seen as likely. At that time, removal of friable ACM located in Buildings 306 and 307 boiler rooms and removal of transite panels in Buildings 306 and 307 would be required.

7.6.3 SHORT-TERM EFFECTIVENESS

Implementation of this alternative will cause no additional environmental impact. The only impact is that which is already posed by the existing ACM.

7.6.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Implementation of this alternative will cause no additional environmental impact. Deterioration of ACM over time will likely increase the risks associated with personnel exposure and airborne emissions to the environment.

7.6.5 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The risks to the community and to site personnel are not mitigated in this alternative. Exposure to airborne asbestos emissions could result due to the present condition and further deterioration of ACM over time.

7.6.6 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME OF CONTAMINANTS

In this alternative, there is no asbestos remediation and therefore no reduction of toxicity, mobility, or volume of ACM on-site.

7.6.7 IMPLEMENTABILITY

The no action alternative requires no implementation.

7.6.8 COST

There are no capital or operating and maintenance costs associated with the no action alternative.

7.7 EVALUATION OF ASBESTOS ALTERNATIVE 2: REMEDIAL ACTION - ABATEMENT OPTIONS

7.7.1 DESCRIPTION

"Abatement" refers to any action that tends to reduce or diminish. In the area of remedial action for ACM, current state-of-the-art methods for the reduction of airborne asbestos fibers consist of the following three options:

- Encapsulation: Coating the exterior surface of ACM with a compound ("encapsulant") for the purpose of locking down any fibers that would otherwise become airborne.
- Enclosure: The construction of airtight barriers in order to isolate ACM from the rest of the building interior.
- Removal: The removal of ACM and replacement with non-asbestos materials. This is usually accomplished by isolating the entire removal area to perform "gross removal" or, for jobs of a small scale, isolation of the ACM in specially designed plastic bags for "glovebag removal".

Ultimately, removal is the only final solution for asbestos hazards because the ACM continue to remain in place under the options of encapsulation and enclosure.

7.7.2 COMPLIANCE WITH ARARs

Asbestos removal to disposal would be performed in compliance with the latest NESHAP asbestos regulations. Under NESHAP, friable ACM located in the boiler rooms in Buildings 306 and 307 and transite panels (also in Buildings 306 and 307) must be removed from the buildings prior to demolition.



The friable ACM in Buildings 306 and 307 boiler rooms should be removed prior to the buildings' reuse or reoccupation due to the ACM's extremely damaged condition, friability, and accessibility. Otherwise, the ACM should be removed prior to the buildings' demolition. This action is consistent with current Army guidance concerning ACM.

The non-friable ACM in Buildings 305, 306, and 307 should be identified on records maintained at the facility as a long-term corrective measure, which will alert any maintenance personnel to the potential risks of disturbing the non-friable ACM.

7.7.3 SHORT-TERM EFFECTIVENESS

Emission of ACM fibers into the atmosphere during asbestos removal could pose a risk to the surrounding community. Using the state-of-the-art asbestos removal procedure, which is in compliance with all the latest federal, state, and local asbestos regulations, would reduce or eliminate this risk.

7.7.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

This technology will, in the long term, eliminate the hazards of human exposure to ACM and eliminate emission of asbestos fibers to the environment.

7.7.5 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The risks to human health and the environment will be greatly reduced or eliminated with the implementation of this alternative.

7.7.6 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME OF CONTAMINANTS

Asbestos removal will eliminate the toxicity, mobility, and volume of asbestos that is present in the buildings.

7.7.7 IMPLEMENTABILITY

Asbestos abatement is a proven technology that can be readily implemented.

7.7.8 COST

The cost of asbestos abatement is highly dependent on the amount of ACM present, the abatement method selected, and the physical condition of the ACM. Since these factors were not included in the scope of this asbestos characterization, the cost of asbestos abatement cannot be accurately determined.



SECTION 8

EVALUATION OF ALTERNATIVES

8.1 COMPARISON OF ALTERNATIVES

In the following analysis, the groundwater alternatives are evaluated in relation to one another for each evaluation criteria. The purpose of this analysis is to identify the relative advantages and disadvantages of each alternative. These remedial alternatives are:

- Groundwater
 - Alternative 1: No Action.
 - Alternative 2: Additional Groundwater Monitoring.
 - Alternative 3: On-Site Treatment of Groundwater.
- Asbestos
 - Alternative 1: No Action.
 - Alternative 2: Remedial Action - Abatement Options.

8.1.1 COMPLIANCE WITH ARARs

Groundwater

Alternatives 1 and 2 would comply with ARARs since drinking water standards are not applicable to the site groundwater. Alternative 3 would comply with ARARs even if drinking water standards were applied. The risk assessment (Section 5) showed very little risk involved with the current groundwater contamination. The State of Maryland, Department of Environment has informed the Army that no corrective action plan is required pertaining to the groundwater at Fort Holabird.

Asbestos

Alternative 1 would not comply with ARARs since there is no treatment of exposed, friable ACM as required under NESHAP. Alternative 2 would comply with ARARs, provided abatement is performed according the NESHAP regulations.

8.1.2 SHORT-TERM EFFECTIVENESS

Groundwater

Alternatives 1 and 2 will cause no additional environmental impact. The emission of contaminated air to the atmosphere during air stripping operation is a short-term risk associated with Alternative 3.

Asbestos

Alternative 1 will cause no additional environmental impact. The possible emission of asbestos into the air during removal is a short-term risk associated with Alternative 2.

8.1.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Groundwater

Implementation of Alternatives 1 and 2 will cause no additional environmental impact. Alternative 3 will provide a high degree of long-term effectiveness and permanence.

Asbestos

Implementation of Alternative 1 will cause no additional environmental impact. Alternative 2 will provide a high degree of long-term effectiveness and permanence.

8.1.4 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Groundwater

Due to the low risk nature of the groundwater contamination, all three alternatives are believed to be sufficiently protective of human health and the environment.

Asbestos

The risks to site personnel and the community are not mitigated under Alternative 1. Alternative 2 greatly reduces the risk of airborne asbestos exposure of site personnel and airborne asbestos emissions to the environment.

8.1.5 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME OF CONTAMINANTS

Groundwater

In Alternatives 1 and 2 there is no active treatment process for the contamination. Alternative 3 provides for reduction of the toxicity, mobility, and volume of contaminants.

Asbestos

Alternative 1 provides no reduction of the toxicity, mobility, and volume of contaminants. The removal option of Alternative 2 will greatly reduce the toxicity, mobility, and volume of contaminants. The encapsulation and enclosure options of Alternative 2 will not reduce the toxicity or volume of the asbestos; however, the mobility will be controlled.

8.1.6 IMPLEMENTABILITY

Groundwater

All three alternatives can be readily implemented.

Asbestos

Both alternatives can be readily implemented.

8.1.7 COST

Groundwater

There are no costs associated with Alternative 1. Alternative 3 is expected to have relatively high cost and is dependent on the amount of groundwater to be treated. The cost of Alternative 2 is dependent on the number of wells installed and should be low relative to Alternative 3.

Asbestos

There are no costs associated with Alternative 1. The costs to implement Alternative 2 cannot be determined based on the information collected under the scope of this report.

8.2 RECOMMENDATION

8.2.1 GROUNDWATER

The recommended alternative is Alternative 1: No Action. This alternative was chosen for the following reasons:

- The groundwater in the vicinity of the CRC is not used. Future use of the Patapsco Formation is considered unlikely because other more reliable water sources are available (municipal water and the Patuxent Formation). Presumably, if the Patapsco Formation is pumped to any appreciable extent, the salt water plume will recontaminate the aquifer, rendering it unusable. For these reasons, future use and subsequent exposure to groundwater from the Patapsco Formation is considered unlikely.
- The risk assessment (Section 5) showed a maximum lifetime carcinogenic risk of 1E-05 for industrial exposure pathways, although this use is not expected. This is well below the level generally recognized as requiring cleanup.



- The source of the contamination has been removed making further contamination at the groundwater unlikely. Based on the lack of contamination in wells close to MW03, it is likely the contamination is localized to the area surrounding MW03.
- The State of Maryland, Department of the Environment has informed the Army that based on the sampling results, no further corrective action pertaining to the groundwater is required.

8.2.2 ASBESTOS

The recommended asbestos alternative is Alternative 2: Asbestos Removal. Friable asbestos in Buildings 306 and 307 boiler rooms should be removed prior to the buildings' reuse, reoccupation, or demolition. The non-friable asbestos in Buildings 305, 306, and 307 should be removed prior to demolition, and records should be maintained at the facility to alert any maintenance personnel to the potential risks of disturbing the non-friable ACM.



SECTION 9

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APPENDIX A

PCB ANALYTICAL RESULTS FOR ELECTRICAL TRANSFORMER RESULTS



MET ELECTRICAL TESTING COMPANY, INC.

REPORT

Attention: Preston O. Ferrell

ISSUED TO: Semco, Incorporated
Electrical & Mechanical Contractors
P.O. Box 132
Ellicott City, Maryland 21043

DATE OF REPORT: 5/18/90
REPORT NO: 28360Y

PROJECT: PCB Analysis
Bldg. 305
Fort Holobird, MD

DESCRIPTION:

Each sample of insulating fluid submitted for evaluation of contamination by Polychlorinated Biphenyls (PCBs) was tested using analytical procedures including a microprocessor based gas chromatograph. The values produced are in parts per million (ppm) and are computed by weight based upon the appropriate Aroclor or a peak by peak analysis as a reference.

A control number, the Analysis Number, has been arbitrarily assigned to each sample. This number is cross referenced for convenience and must be used if referring to the testing documentation.

CHEMICAL EVALUATION:

The results of the samples submitted for PCB contamination analysis are as follows:

<u>ANALYSIS #</u>	<u>SAMPLE #</u>	<u>DEVICE DESIGNATION</u>	<u>PCB IN PPM</u>
A45484			30

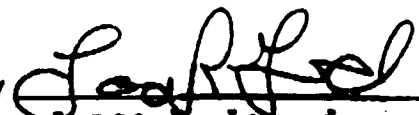
This report certifies that the above equipment has been tested in compliance with recognized standards or for safe use in a specified manner, or in accordance with Federal, State or Municipal regulations.

The report is accurate and true to the best of our knowledge

and belief. All equipment used in making physical determinations is accurate and bears recent and direct traceability to the NBS. The evaluations performed are in accordance with the laws for the practice of Professional Engineering.

MET ELECTRICAL TESTING COMPANY, INC.
916 West Potomaco Ave. • Baltimore, MD 21230
Phone (301) 354-2200



BY 
Lance R. Levand

APPENDIX B
FIELD LOGBOOK



APPENDIX B.1

FIELD LOGBOOK
(SOIL AND GROUNDWATER SURVEY)

8

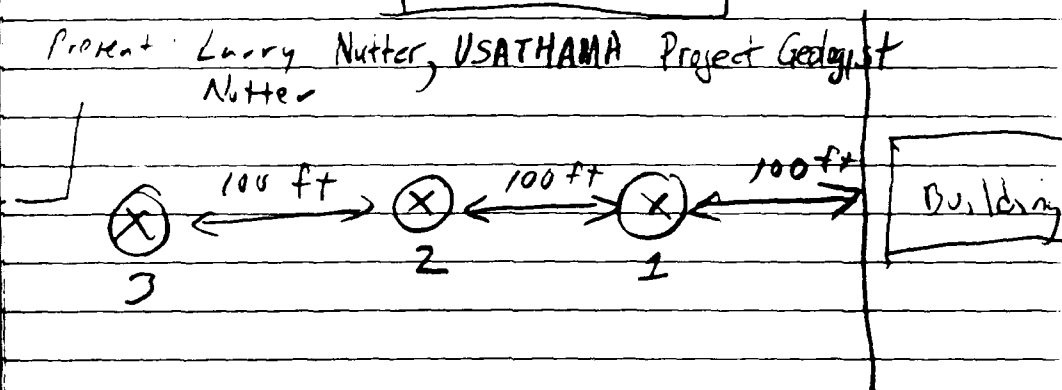
HNU calibrated - 0800

Background HNU - 04 readings

4/23/91 07:30 Arrived onsite. Began sign in

M Heaney Test pits - Ft Holabird
K McNeillSupervised by
K McNeill

Tennis court

Project Larry Nutter, USATHAMA Project Geologist
Nutter

Parking Lot

Test Pit 1

No HNU readings - above 6 ft, re

Descrip

top soil, some rocks - 16"

sandy clay, silt - 0" - 48"

No staining observed

Pit Depth - 48" 4' wide 8' long

No sample taken - no staining,
no odor, no readings

Pictures 11, 12, 13

Back-filled w/ removed soil

Test Pit 2

0-12" No HNU reading above bkgd

Description:

Top soil, some rocks

No staining, no odor

12'-54" No HNU reading above
bkgd

Description:

Sandy silt, No staining,
no odor

Pit dimensions

4 1/2' D x 4' W x 6' L

Pictures 14, 15, 16

No sample taken

Test pit 3

0-12" No HNU reading
above bkgd

Description:

Topsoil, some rocks

No staining, no odor

10

12" - 36" Dark brown sand

36" - 54" Light sand

No HNu readings, no
staining, no odor

Pit dimensions:
4 1/2' D x 6' L x 4' W

Pictures 17, 18, 19

No sample taken

4/23/91 M4 Weather: Sunny, 70°F, Moderate Wind, Fair Air Quality
 Groundwater 8:00 Hydrostatic test initiated by John Goodwin
 Sampling of ADA Environmental. Completed @ 10:30
 1½ test duration, ½" drop

8:45 Calibrated pH meter by M. Heaney

10 = 9.8

4 = 4

7 = 7

Well volume = 0.91 gal/ft

(includes stand pipe @ 30% voids)

	DTW	Water Column	Volume	Volume
4:00 Water Levels MW2	5.41	14.59	13.3	66.4
DTW (Top Inner Casing) MW3	5.11	14.89	13.5	67.5
Wells are 20' deep MW4	16.40	3.60	3.3	16.4

Gallons per foot = 0.91

Measuring from west side of casing

MW2 Purge

9.	DTW	Purge Vol	Net pH	Temp °C	conductivity µMHO
9:08	5.41	14 gal	14 4.1	12	257
9:31	11:27	7	21 -	12	261
12:30	10.70	8	29 3.9	16	300
13:55	11.44	6	35 4.1	12.5	282

Effective yield is 0.12 gpm

Purge volume is ~2.5 volumes (35 gal / 13.3)

Purge called complete by Larry Nutter of USA THAMA

MW3 Purge

10:04	10	10			
10:08	6	16	4.6	13	170
10:10	5	21	4.9	13	180
10:17	5	26			
10:25	1	27	4.1	12.5	200
11:30	8	35			
11:43	10	45	4.4	12	190
12:00	8	53			
12:15	6	59			
12:20	6	65	5.8	12	190
12:25	5	70			

12

4/23/74

11:00 Galileo Gutierrez and Al Harvey arrive at
for Asbestos Sampling

Observations: Bldg 306 floor tile
is mostly tar paper
Bldg 306 possibly
asbestos floor tile in
bathrooms in North wing
2 colors

Bldg 306 projection room
(^{floor} West corner upstairs)
is transite

Bldg 306 boiler exterior insulation
fiberglass. Interior insulation of
boiler is completely inaccessible

Bldg 306 appears to be tar paper under

Bldg 307 transite on northside & West
southside & eastside and meta on top

Bldg 307 Boiler Room exterior boiler
appears to be frame asbestos.

Interior boiler insulation is

Visible 3-4 feet inside door

but is inaccessible to sample

Bldg 307 floor tile throughout appears to be

transite

10:00-12:00 Mark Plank & Joshi (USATHAMA Project Officers) onsite
to observe purging of ANO2 & Tank Test.

17:00 Asbestos samples leave site to return to
Winged Laboratory in Bldg 305

Increased total sample quantity to 25 to 100 lbs.

4/23 M4

14:10

MW03

Sampled by M. Heaney M4

Vials triple rinsed. Used lab. cleaned 1 3/4" teflon barker.

2 40 ml VOA vials (added 1 drop HCl via pipette after filling)

1 950 ml BN

1 950 ml TPH

1 950 ml for metals filter

Samples are clear. No odor

14:45

~~15:00~~MW04 Purge Begun. Coffee & Cream ^{Heavy} Color

Purged 35 gal. in under 4 minutes

15:05

Purged 30 gal. in approx 3 minutes 20

DTW Purge Vol Net Vol. pH Temp °C Cond

14:45 16.16 35 35 5.6 15 286

15:05 16.55 30 65 5.2 14 293

15:06 17.51 (recovered to within 1 foot of orig. in less than 1 minute after pumping very dry)

Approx yield = 9 gpm

16:20

MW02

Sampled by M. Heaney M4

Same sequence as MW03

Slight oil sheen. Strong oil odor in sample bottle.

16:35

MW02D

Sampled by M. Heaney M4

Duplicate sample from MW02

Slight oil sheen. Strong oil odor

Turbidity masks some of oil sheen

16:50

MW04

Sampled by M. Heaney M4

Same sequence as MW03

Turbid appearance. Slight odor. ^{Rotten eggs} Maybe hydrogen

17:00

Left Decon area. Set up field

Filtration area in parking lot of Ft. Harner

17:30 ~~19:00~~

M4

Filtration of metals progressing slowly

Using hand pump vacuum. ~~working~~

14

4/23/21

Metals Filtration Procedure:

Apparatus: Nalgene disposable filterware
w/ .45 micron filter

Add 1 drop 10% HNO_3 to filter

Rinse with laboratory DI water

Filter till clogged

Clean filter with DI water

Add 1 drop 10% HNO_3 to filter

between samples

And 1 drop 10% HNO_3 to sample bottle

19:00 Filter performance begins to deteriorate
on MnO_2 . Other samples ~~clear~~ clear

19:15 Filtration complete

19:20 Trip Blanks observed by M Herney ml
& Logged as VOA Trip Blank

19:35 Left site.

10/21/21

4/24

10:30 1 Sample cooler w/ custody seals & chain of custody
delivered by John J. Ziemer
to WESTON Analytics, Lionville PA



APPENDIX B.2

FIELD LOGBOOK
(ASBESTOS SURVEY)

ASBESTOS SURVEY DATA

CLIENT: 1547 HALL A WESTON-ATC PROJECT NO. 22FI-11-
 LOCATION: PT. HARBOR, MD. BLDG NAME: _____ BLDG NO.: 305
 BLDG DESCRIPTION: _____ NO. FLOORS: 1 USING AGENCY: _____
 BLDG MANAGER: _____ TELEPHONE: _____ SYMBOL: _____
 TYPE OCCUPANCY: ADULTS (GOVT/PUBLIC) CHILDREN: (SCHOOL/INFANTS/TODDLERS)
 SURVEY TECHNICIANS: CSG/LL SURVEY DATE: 4/23/91

ITEM NO.	AREA	MATERIAL TYPE	QUANTITY	DIFFICULTY FACTORS				SAMPLE NO.	PHOTO NO.	E.A. FORM NO.	REMARKS	NOTES
				EA	MB	MH	CPX					
1.	BREAK ROOM	J	1730	10	10	10	10	R FJ609				91
2.	MALE BATHROOM ENTRY	J	1915	10	10	10	10	R FJ610				92
3.	CORRIDOR	J	214	10	10	10	10	R FJ611				93
4.	EXTERIOR SLIDING WALLS	M	1718	10	10	20	20	R FJ612				94
5.	EXTERIOR SLIDING WALLS	M	1001	10	10	20	20	R FJ613				
6.												
7.												
8.												
9.												
10.												
11.												
12.												
13.												
14.												
15.												
16.												
17.												
18.												
19.												
20.												
21.												

MATERIAL TYPES				DIFFICULTY FACTORS			
MATERIAL TYPE	QTY UNITS	MATERIAL TYPE	QTY UNITS	COMPONENT	CRITERIA	DIFFICULTY NUMBER	
A PIPE FITTINGS <4"	EA	L AIR HANDLING EQUIP.	MSF	ENTRY ACCESS (EA)	NO RESTRICTION.....	1.0	
B PIPE FITTINGS 4-8"	EA	N ACOUS. WALL TILE	MSF		DIFFICULT SETUP.....	1.5	
C PIPE FITTINGS 8-14"	EA	O CEILING BOARD	MSF	MATERIAL BARRIER (MB)	NO OBSTRUCTION.....	1.0	
D PIPE FITTINGS >14"	EA	P CEILING TILE	MSF		OBSTRUCTION.....	1.5	
E PIPE RUNS <4"	LF	Q DEBRIS	MSF	MAX. RAIL HEIGHT (MH)	0 TO 10 FT ABOVE GRADE.....	1.0	
F PIPE RUNS 4-8"	LF	R EXPANSION JOINTS	EA		>10 TO 20 FT ABOVE GRADE.....	1.5	
G PIPE RUNS 8-14"	LF	S EXTERIOR SIDING	MSF		>20 FT ABOVE GRADE.....	2.0	
H PIPE RUNS >14"	LF	T TRANS. CORR PANEL	VSF	COMPLEXITY (CPX)	EASY.....	1.0	
I SPRAY/THROW MATL	MSF	U TRANS. PANEL BCL	VSF		MEDIUM.....	2.0	
J FLOOR TILE	MSF				DIFFICULT.....	3.0	
K BOILERS/TANKS	MSF						
		M OTHER MATL (NOTES)					
		Z OTHER MATL (NOTES)					

ASBESTOS SURVEY DATA (CONTINUED)

NOTE NO.	NOTES/REMARKS/COMMENTS/DETAILS/OTHER MATERIALS, QUANTITY, ETC.
01	9"X9" TAN FL. TILE
02	9"X9" GREEN FL. TILE
03	BLACK TAR PAPER BET. ALUM. SIDING & ^{INNER} WOODEN SIDING THROUGH OUT. ~~TAR~~
04	REPLICATE SAMPLE OF BLACK TAR PAPER.
	NOTE:
	ACCORDING TO WORK PLAN (PER M. HEANEY):
	- (ONLY) 2 FLOOR TILE SAMPLES INSIDE (THE BLDG.)
	- (ONLY) 2 EXTERIOR SAMPLES OUTSIDE (TAR PAPER BET. ALUMINUM + WOODEN SIDINGS).
	- NO OTHER INSPECTION TO BE DONE.
	BEFORE ROOF + THE (INSIDE) AREA OF THE ROOF NOT TO BE INSPECTED.

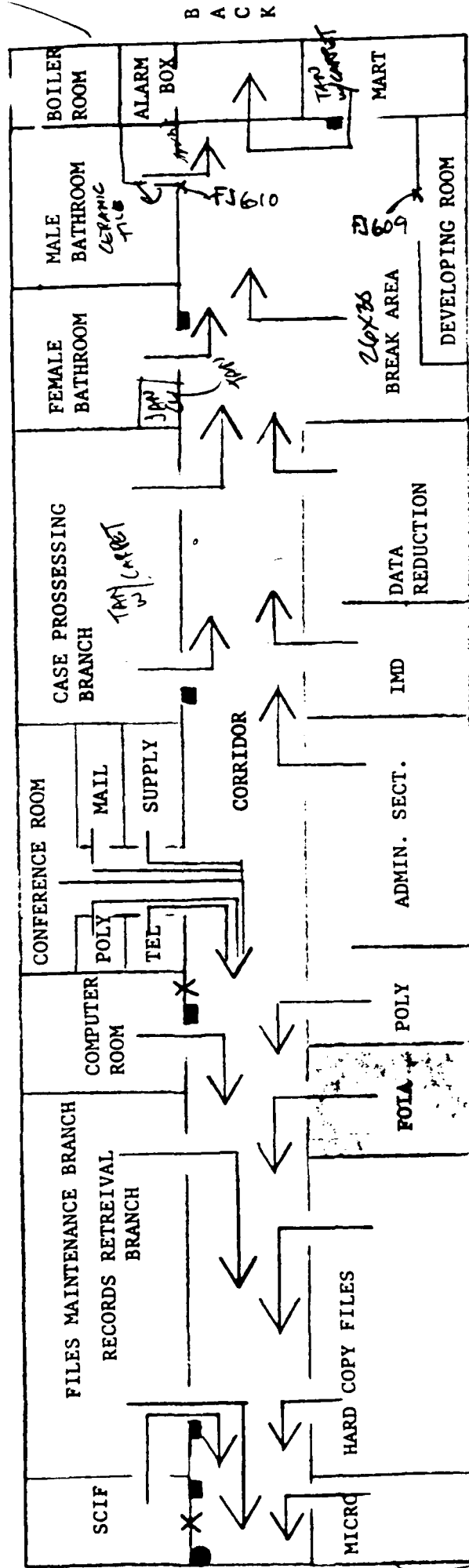
ADDITIONAL PIPE INFORMATION FOR DESIGN

NOTE NO.	_____	_____	_____	_____	_____	_____	_____
INSUL O.D., IN.	_____	_____	_____	_____	_____	_____	_____
INSUL THKNS, IN	_____	_____	_____	_____	_____	_____	_____
PIPE O.D., IN	_____	_____	_____	_____	_____	_____	_____
QUANTITY, LF	_____	_____	_____	_____	_____	_____	_____
NOTE NO.	_____	_____	_____	_____	_____	_____	_____
INSUL O.D., IN.	_____	_____	_____	_____	_____	_____	_____
INSUL THKNS, IN	_____	_____	_____	_____	_____	_____	_____
PIPE O.D., IN	_____	_____	_____	_____	_____	_____	_____
QUANTITY, LF	_____	_____	_____	_____	_____	_____	_____

Asbestos Sample Locations

for

Building 305



Asbestos Sample Locations

- Extinguisher Location
- Alarm Location
- Blocked Door

CLIENT/SUBJECT LISATHAMA

W.O. NO. 22 FI-11-06

TASK DESCRIPTION Bldg 305

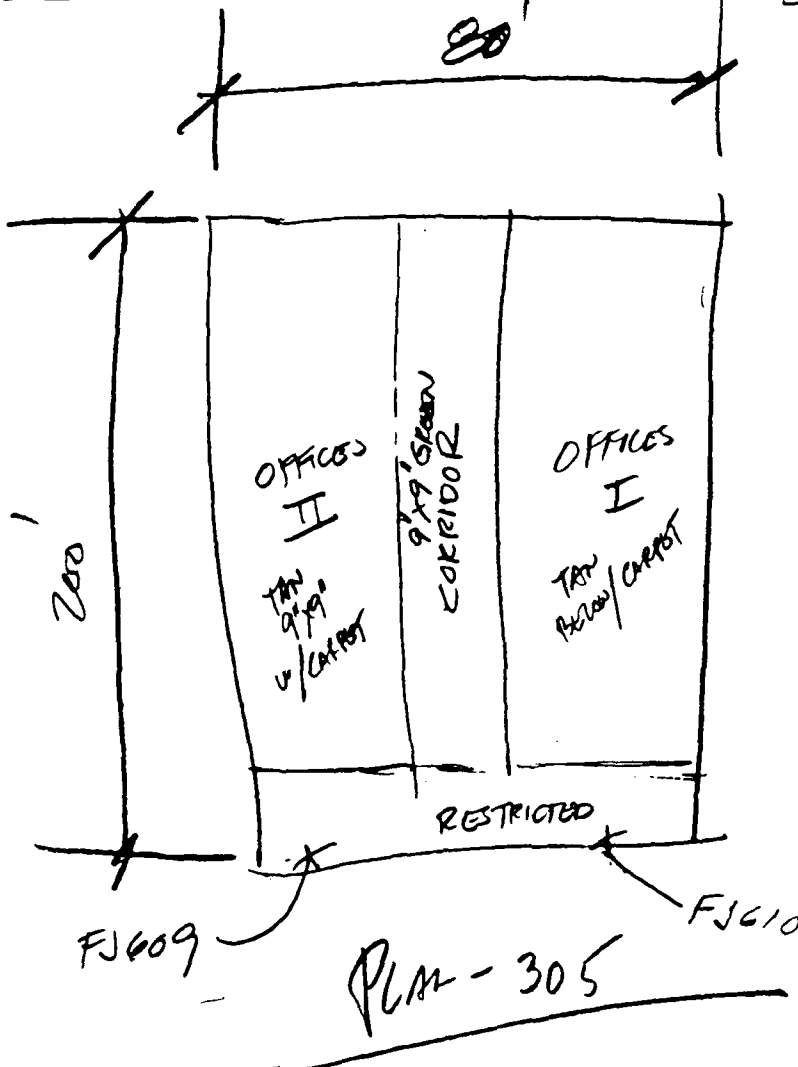
TASK NO. _____

PREPARED BY AH DEPT 1041 DATE 4-22-01

MATH CHECK BY _____ DEPT _____ DATE _____

METHOD REV. BY _____ DEPT _____ DATE _____

APPROVED BY	
DEPT _____	DATE _____



ASBESTOS SURVEY DATA

CLIENT: USATHAMA WESTON-ATC PROJECT NO. 2281-11-06
 LOCATION: FT. HOLABIRD, MD BLDG NAME: _____ BLDG NO.: 306
 BLDG DESCRIPTION: _____ NO. FLOORS: _____ USING AGENCY: _____
 BLDG MANAGER: _____ TELEPHONE: _____ SYMBOL: _____
 TYPE OCCUPANCY: ADULTS (GOVT/PUBLIC) CHILDREN: (SCHOOL/INFANTS/TODDLERS)
 SURVEY TECHNICIANS: GG/AH SURVEY DATE: 4/23/91

ITEM NO.	AREA	MATERIAL TYPE	QUANTITY	DIFFICULTY FACTORS				REM. METHOD	SAMPLE NO.	PHOTO NO.	E.A. FORM NO.	REMARKS	NOTES
				EA	MB	MB	CPX						
1.	GROUND FLOOR	M	17.9	10	10	10	10	R	FJ597	1597			01
2.	AREA II	J	450	10	10	10	10	R	FJ598	1598			02
3.	SECOND FLOOR	U	1625	10	10	10	10	R	FJ600	1991			03
4.	LATRINE	J	450	10	10	10	10	R	FJ599	1599			04
5.	AREA II	M	360	10	10	10	10	R	FJ600	1600			05
6.	GROUND FLOOR HALL	M	1190	10	10	10	10	R	FJ600				05
7.	AREA III	M	1110	10	10	10	10	R	FJ600				05
8.	EXTERIOR WALLS	M	17.8	10	10	20	20	R	FJ601				06
9.	MEDIA AREA	M	3.0	10	10	20	20	R	FJ597				06
10.		E	130	10	10	15	10	R	FJ602				07
11.		B	125	10	10	15	10	R	FJ603				08
12.		F	140	10	15	15	20	R	FJ604				09
13.		B	138	10	15	15	20	R	FJ603				10
14.		F	130	10	15	15	20	R	FJ605				11
15.		B	133	10	15	15	20	R	FJ603				12
16.		F	1004	10	10	10	10	R	FJ604				13
17.													
18.													
19.													
20.													
21.													

MATERIAL TYPES		QTY. UNITS		MATERIAL TYPES		QTY. UNITS		DIFFICULTY FACTORS		
A	PIPE FITTINGS <4"	EA		L	AIR HANDLING EQUIP.	MSF		COMPONENT	CRITERIA	DIFFICULTY NUMBER
B	PIPE FITTINGS 4-8"	EA		N	ACOUS. WALL TILE	MSF		ENTRY ACCESS (EA)	NO RESTRICTION.....	1.0
C	PIPE FITTINGS 8-14"	EA		O	CEILING BOARD	MSF			DIFFICULT SETUP.....	1.5
D	PIPE FITTINGS >14"	EA		P	CEILING TILE	MSF				
E	PIPE RUNS <4"	LF		Q	DEBRIS	MSF		MATERIAL BARRIER (MB)	NO OBSTRUCTION.....	1.0
F	PIPE RUNS 4-8"	LF		R	EXPANSION JOINTS	EA			OBSTRUCTION.....	1.5
G	PIPE RUNS 8-14"	LF		S	EXTERIOR SIDING	MSF				
H	PIPE RUNS >14"	LF		T	TRANS. CORR PANEL	MSF		MATERIAL HEIGHT (MH)	0 TO 10 FT ABOVE GRADE.....	1.0
I	SPRAY/THROWN MATL	MSF		U	TRANS. PANEL BD.	MSF			10 TO 20 FT ABOVE GRADE.....	1.5
J	FLOOR TILE	MSF							>20 FT ABOVE GRADE.....	2.0
K	OUTLETS/PLUGS	MSF						COMPLEXITY (CPX)	EASY.....	1.0
				M	OTHER MATL (NOTES)				MEDIUM.....	2.0
				Z	OTHER MATL (NOTES)				DIFFICULT.....	3.0

ASBESTOS SURVEY DATA (CONTINUED)

NOTE NO.	NOTES/REMARKS/COMMENTS/DETAILS/OTHER MATERIALS, QUANTITY, ETC.
01	WAUBOARD - DRYWALL GYPSUM TYPE FOUND THROUGHOUT THE GROUND FLR. AREA
02	TAN 9"X9" FL. TILE
03	GREY TRANS PANEL - WALLS + CEILING
04	GREY 9"X9" FL. TILE
05	BLK. TAR PAPER FLOORING
06	BLK. TAR PAPER EXT. SIDING (LOCATED BETWEEN ALUM. SIDING AND WOOD).
07	HEATING HOT WATER SYSTEM - INSULATION (MAG. ^{WHT})
08	" " - FITTING (MAG. ^{WHT} .)
09	PAINTED ORANGE, AIR CELL INSULATION
10	PAINTED ORANGE, FITTINGS REFERENCED - NO SAMPLE TAKEN (ASSUMED ASBESTOS)
11	PAINTED GREY, AIRCELL INSULATION
12	PAINTED GREY, FITTINGS ASSUMED ASBESTOS AND NOT SAMPLED - REFERENCED
13	AIRCELL INSULATION ON FLOOR
14	9"X9" BRO/GREEN FLOOR TILE.

ADDITIONAL PIPE INFORMATION FOR DESIGN

NOTE NO.	_____	_____	_____	_____	_____	_____	_____
INSUL O.D., IN.	_____	_____	_____	_____	_____	_____	_____
INSUL THKNS, IN	_____	_____	_____	_____	_____	_____	_____
PIPE O.D., IN	_____	_____	_____	_____	_____	_____	_____
QUANTITY, LF	_____	_____	_____	_____	_____	_____	_____

NOTE NO.	_____	_____	_____	_____	_____	_____	_____
INSUL O.D., IN.	_____	_____	_____	_____	_____	_____	_____
INSUL THKNS, IN	_____	_____	_____	_____	_____	_____	_____
PIPE O.D., IN	_____	_____	_____	_____	_____	_____	_____
QUANTITY, LF	_____	_____	_____	_____	_____	_____	_____

ASBESTOS-CONTAINING MATERIAL EVALUATION AND PRIORITY INDEX

CLIENT USATAMA PROJECT NO. 100-1-1
 FACILITY 1st HOLDING BUILDING 306
 AREA BOILER ROOM EVALUATOR GE/AF DATE 4-28-87
 OCCUPANCY 1 - EXCEPT FOR ANY 1 HOURS/WK
LOTTIE HENDERSON

1. Material Friability: High - 3; Medium - 2; Low - 1
2. Occupant Accessibility: High - 3; Medium - 2; Low - 1
3. Material Condition: Good - 1; Poor - 2
4. Level of Activity: High - 3; Medium - 2; Low - 1
5. Asbestos Fiber Content - 0: 1-9% - 1; 10-39% - 2; 40-100% - 3
6. Calculation

3
3
2
1
3

Probability Factor x Number of Occupants x Occupancy Duration + 40 Hrs Wk - Priority Index Number

	x	1	x	1	+		-	
--	---	---	---	---	---	--	---	--

7. Utility Maintenance Frequency UNKNOWN
8. Life Cycle Projection for Structure UNKNOWN
9. Renovation Schedule UNKNOWN
10. Public Utilization of Structure NONE
11. Other Unique Characteristics VAINT BUILDING
12. Remarks 100-1-1 LAMPED A 100-1-1 LAMP
POTENTIAL ASBESTOS EXPOSURE - ALL FIBERS
LOW TO THE FLOOR - 100-1-1

CLIENT/SUBJECT FT HOLABIRD (USATHAMA) W.O. NO. _____

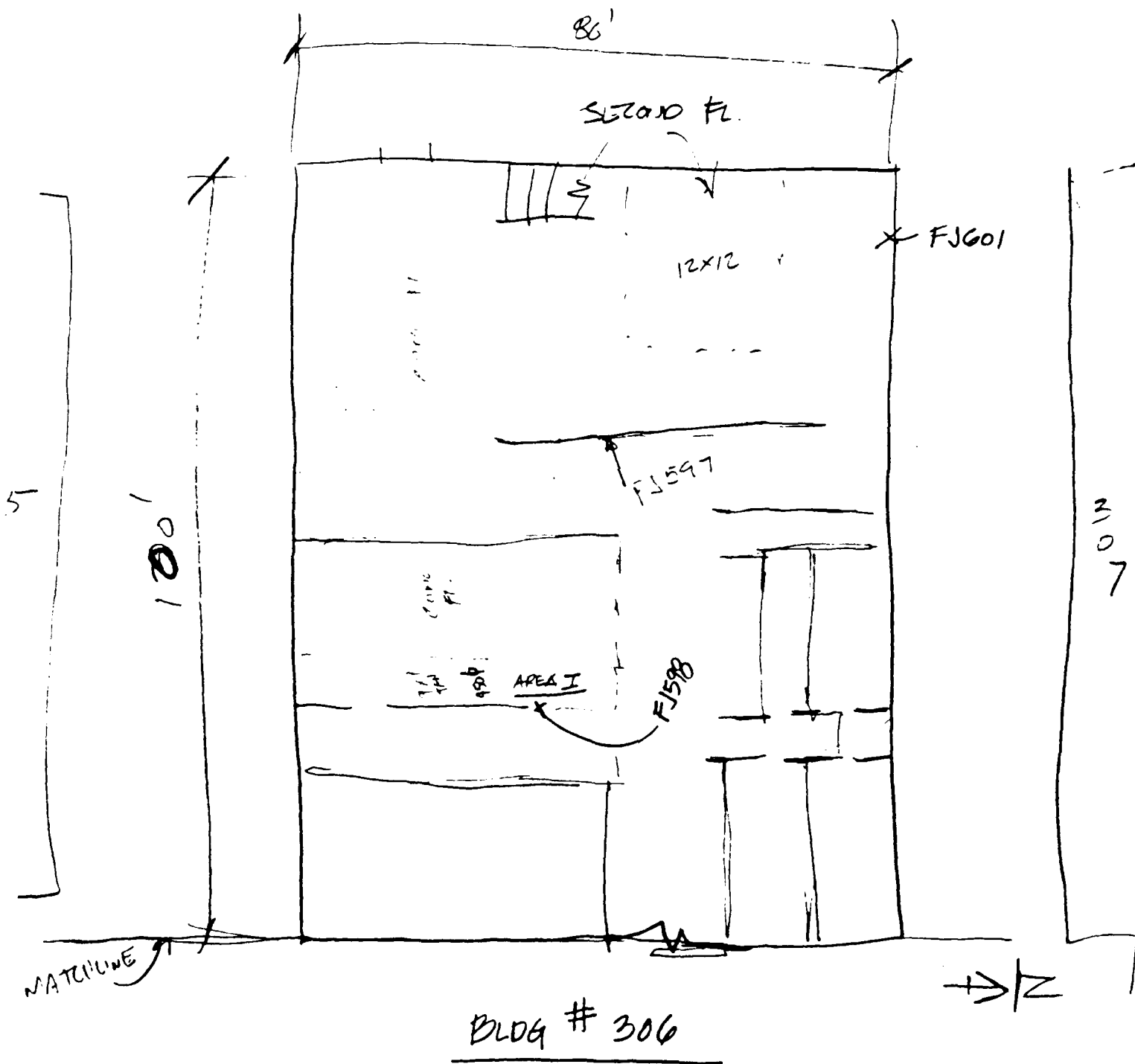
TASK DESCRIPTION (ASBESTOS INSPECTION) BLDG. 306 TASK NO. _____

PREPARED BY ABH DEPT PG41 DATE 4-23-91

MATH CHECK BY _____ DEPT _____ DATE _____

METHOD REV. BY _____ DEPT _____ DATE _____

APPROVED BY	
DEPT _____	DATE _____





SHEET 2 of 3

CLIENT/SUBJECT UAT HAMA (ET. HOLAMIA D)

W.O. NO. 2281-11-06

TASK DESCRIPTION BLDG. 306 (CONT.)

TASK NO. _____

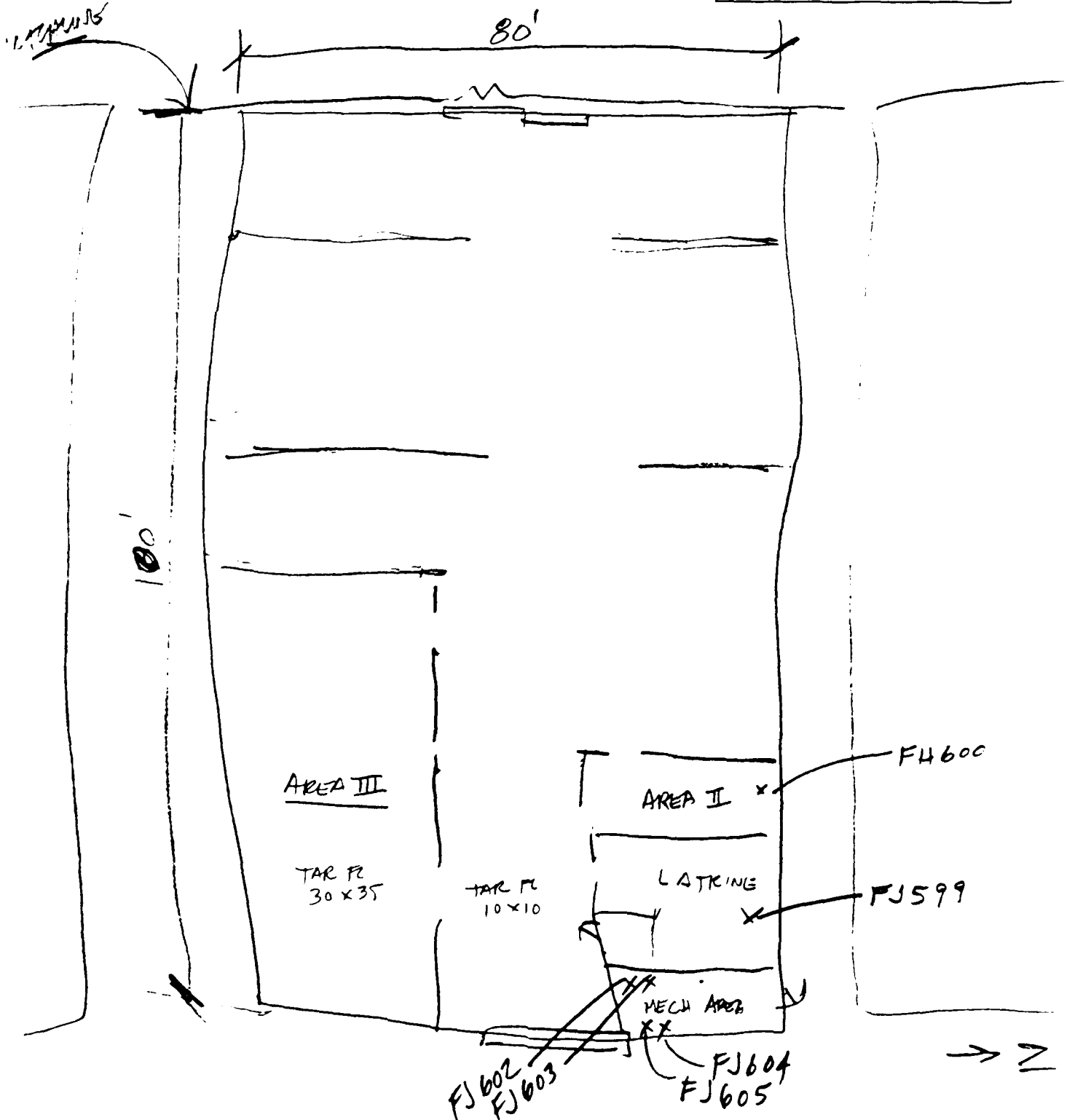
PREPARED BY AC/1 DEPT _____ DATE 4-23-91

APPROVED BY _____

MATH CHECK BY _____ DEPT _____ DATE _____

METHOD REV. BY _____ DEPT _____ DATE _____

DEPT _____ DATE _____



ASBESTOS SURVEY DATA

CLIENT: USATHAMA WESTON-ATC PROJECT NO. 224-11-00
 LOCATION: FT. HOLABIRD, MD. BLDG NAME: _____ BLDG NO.: 307
 BLDG DESCRIPTION: _____ NO. FLOORS: 1 USING AGENCY: _____
 BLDG MANAGER: _____ TELEPHONE: _____ SYMBOL: _____
 TYPE OCCUPANCY: ADULTS (GOVT/PUBLIC) CHILDREN: (SCHOOL/INFANTS/TODDLERS)
 SURVEY TECHNICIANS: GG/AT SURVEY DATE: 4/23/91

ITEM NO.	AREA	MATERIAL TYPE	QUANTITY	DIFFICULTY FACTORS				SAMPLE NO.	PHOTO NO.	E.A. FORM NO.	REMARKS	NOTES
				EA	MB	MH	CPX					
1.	GROUND FLOOR	M	3.5	10	15	10	20	R FJ600				0.5
2.	GROUND FLOOR/LATRINE	J	10.5	10	15	10	20	R FJ600				1.4
3.	GROUND FLOOR/LATRINE	M	5.6	10	10	10	10	R FJ597				0.1
4.	EXT. WALLS	M	14.0	10	10	20	20	R FH607				0.6
5.		M	7.0	10	10	20	20	R FH608				1.5
6.	MECH. ROOM	K	2.5	10	10	10	20	R FJ613				1.6
7.		K	10.0	10	10	10	10	R FJ614				1.7
8.		Q	4.0	10	10	10	10	R FJ615				1.8
9.		F	1.0	10	10	15	20	R FJ616				1.9
10.		B	1.0	10	10	15	20	R FJ617				1.9
11.	EXT. WALL, SOUTH EAST	E	1.8	10	10	10	10	R FJ604				2.0
12.	MECH. ROOM	M	2.5	10	10	15	10	R FJ618				0.1
13.												
14.												
15.												
16.												
17.												
18.												
19.												
20.												
21.												

MATERIAL TYPES		QTY UNITS		MATERIAL TYPES		QTY UNITS		DIFFICULTY FACTORS		
A	PIPE FITTINGS	<4"	EA	L	AIR HANDLING EQUIP.	MSF		COMPONENT	CRITERIA	DIFFICULTY NUMBER
B	PIPE FITTINGS	4-8"	EA	M	ACOUS. WALL TILE	MSF		ENTRY ACCESS (EA)	NO RESTRICTION.....	1.0
C	PIPE FITTINGS	8-14"	EA	O	CEILING BOARD	MSF			DIFFICULT SETUP.....	1.8
D	PIPE FITTINGS	>14"	EA	P	CEILING TILE	MSF				
E	PIPE RUNS	<4"	LF	Q	DEBRIS	MSF				
F	PIPE RUNS	4-8"	LF	R	EXPANSION JOINTS	EA		MATERIAL BARRIER (MB)	NO OBSTRUCTION.....	1.0
G	PIPE RUNS	8-14"	LF	S	EXTERIOR SIDING	MSF			OBSTRUCTION.....	1.8
H	PIPE RUNS	>14"	LF	T	TRANS. CORR PANEL	MSF				
I	S. RAY/TRANS. MATL	MSF		U	TRANS. PANEL RD.	MSF		MATERIAL HEIGHT (MH)	0 TO 10 FT ABOVE GRADE.....	1.0
J	FLOOR TILE	MSF							>10 TO 20 FT ABOVE GRADE....	1.8
K	BOILERS/TANKS	MSF							>20 FT ABOVE GRADE.....	2.0
				M	OTHER MATL (NOTES)			COMPLEXITY (CPX)	EASY.....	1.0
				Z	OTHER MATL (NOTES)				MEDIUM.....	2.0
									DIFFICULT.....	3.0

ASBESTOS SURVEY DATA (CONTINUED)

NOTE NO.	NOTES/REMARKS/COMMENTS/DETAILS/OTHER MATERIALS, QUANTITY, ETC.
15	GREY TRANS. BOND (EXT. SIDING)
16	BOILER INSUL. (EXTERIOR) SIDES & TOP, & BACK. ASSUMED INSIDE INS. AS SAME AS EXTERIOR.
17	REPLICATE OF BOILER INSUL.
18	DEBRIS THROUGHOUT MECH AREA. (MAG-TYPE INSUL.)
19	AIRCELL-TYPE INSUL. ON EXHAUST PIPES ON BOILERS ALL PIPES HAVE SAME TYPE INSUL. (BOTH ORANGE & GRAY PAINTED PIPES).
20	AIRCELL-TYPE INSUL. ON SOUTH EAST CORNER OF BLDG. 307 (EXT.) COVERED W/BLK. TAR PAPER.
*	NOTES ARE COMBINED WITH THOSE OF BLDG. 306

ADDITIONAL PIPE INFORMATION FOR DESIGN

NOTE NO.	_____	_____	_____	_____	_____	_____	_____
INSUL O.D., IN.	_____	_____	_____	_____	_____	_____	_____
INSUL THKNS, IN	_____	_____	_____	_____	_____	_____	_____
PIPE O.D., IN	_____	_____	_____	_____	_____	_____	_____
QUANTITY, LF	_____	_____	_____	_____	_____	_____	_____

NOTE NO.	_____	_____	_____	_____	_____	_____	_____
INSUL O.D., IN.	_____	_____	_____	_____	_____	_____	_____
INSUL THKNS, IN	_____	_____	_____	_____	_____	_____	_____
PIPE O.D., IN	_____	_____	_____	_____	_____	_____	_____
QUANTITY, LF	_____	_____	_____	_____	_____	_____	_____

ASBESTOS-CONTAINING MATERIAL EVALUATION AND PRIORITY INDEX

CLIENT CATHOLIC PROJECT NO. 25-1-11-01
 FACILITY IT HALLWAY, MD BUILDING 307
 ARPA 1-100 EVALUATOR 1-100 DATE 5-1-87
 OCCUPANCY NE-EXCEPT HOURS/WK 1
ANY TO THE 1-100

1. Material Friability: High - 3; Medium - 2; Low - 1
2. Occupant Accessibility: High - 3; Medium - 2; Low - 1
3. Material Condition: Good - 1; Poor - 2
4. Level of Activity: High - 3; Medium - 2; Low - 1
5. Asbestos Fiber Content - 0: 1-9% - 1; 10-39% - 2; 40-100% - 3

3
2
1
1
3

6. Calculation

Probability Factor x Number of Occupants x Occupancy Duration + $\frac{40 \text{ Hrs}}{\text{Wk}}$ = Priority Index Number

 x 1 x 1 + =

7. Utility Maintenance Frequency UNKNOWN

8. Life Cycle Projection for Structure UNKNOWN

9. Renovation Schedule UNKNOWN

10. Public Utilization of Structure 1-100

11. Other Unique Characteristics 1-100

12. Remarks EXTENSIVE DAMAGE TO WALLS

1-100
1-100
1-100

CLIENT/SUBJECT USXTHAMA (Ft. HOLABIRD)

W.O. NO. 2221-11-0

TASK DESCRIPTION BLDG. # 307

TASK NO. _____

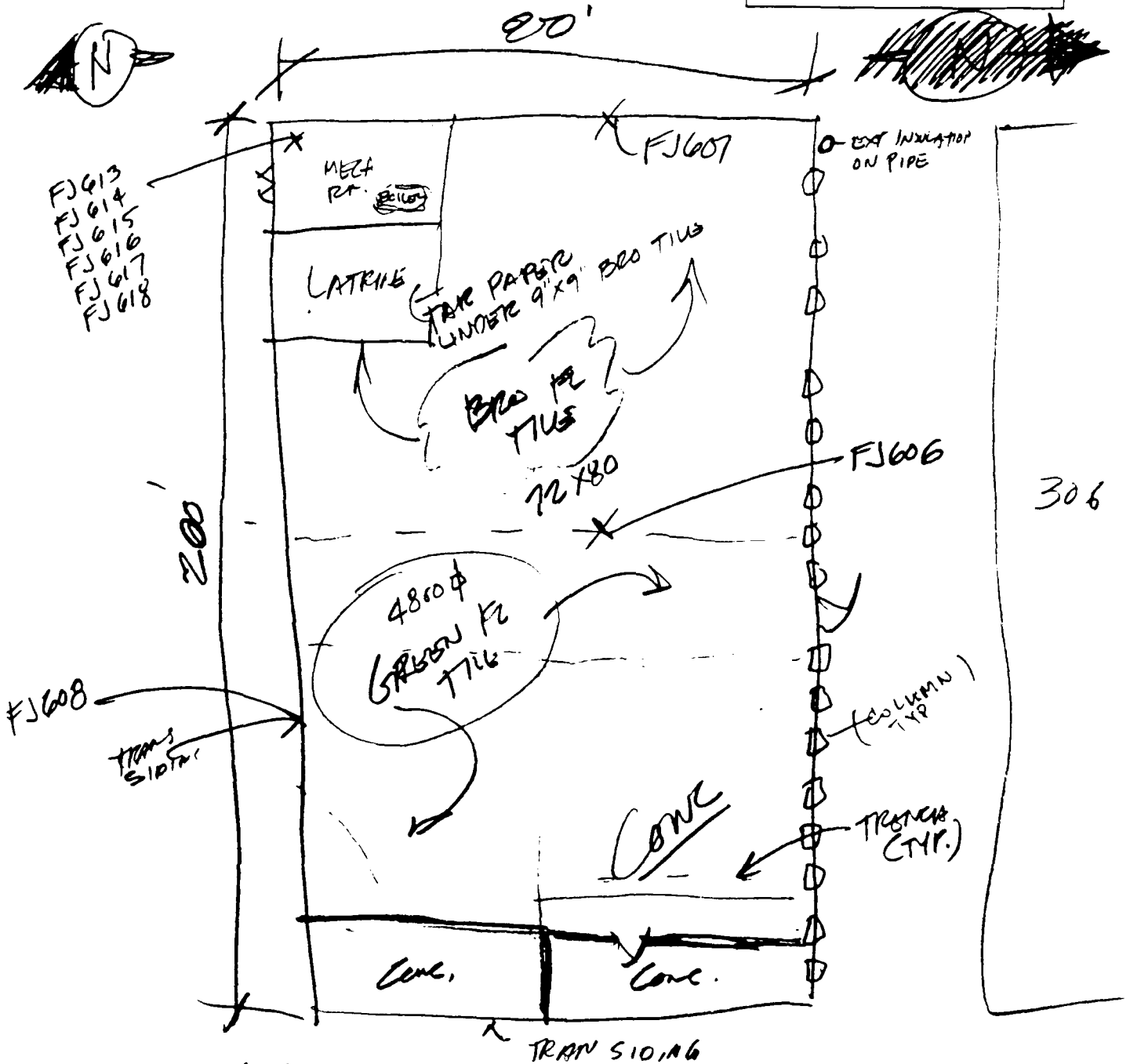
PREPARED BY A DEPT 41 DATE 4-30-

APPROVED BY

MATH CHECK BY _____ DEPT _____ DATE _____

METHOD REV. BY _____ DEPT _____ DATE _____

DEPT _____ DATE _____



* GENERAL NOTE

→ 4'x2' WHT CEILING PANELS THROUGHOUT (FIBERGLASS)

BLDG # 307

NOTE:

→ DOOR AREA HAS FIBERGLASS INSULATION



1635 Pumphrey Avenue
Auburn, AL 36830-4303
Phone: 205-826-6100

SOIL MATERIAL DATA

CLIENT USATHAMA

WESTON PROJECT NO. 2281-11-06-0021

FACILITY FT. HOLABIRD, MD

DATE 4-25-91

DESCRIPTION OF SAMPLES BULK SAMPLES

LAB DATA REVIEWED BY _____

RECEIVED FROM	RECEIVED BY	DATE	TIME	NO. SAMPLES
1. <u>G. Gutierrez</u>	_____	_____	_____	<u>22</u>
2. _____	_____	_____	_____	_____
3. _____	_____	_____	_____	_____

SAMPLE IDENTIFICATION	H.A. NO.	BUILDING IDENTIFICATION	COLOR	SYSTEM CODE	FR A	DESCRIPTION
✓ F.J. 5.9.7		3.0.6	WH	O.T.H.N		WALL BOARD
✓ F.J. 5.9.8		3.0.6	T.N	O.T.H.N		9x9 IN. FLOOR TL
✓ F.J. 5.9.9		3.0.6	GY	O.T.H.N		9x9 IN. FLOOR TL
✓ F.J. 6.0.0		3.0.6	B.K	O.T.H.F		TAR PAPER
✓ F.J. 6.0.1		3.0.6	B.K	O.T.H.F		TAR PAPER
✓ F.J. 6.0.2		3.0.6	WH	UNK F		4-8 IN. PIPE
✓ F.J. 6.0.3		3.0.6	WH	UNK F		4-8 IN. FITTING
✓ F.J. 6.0.4		3.0.6	DR	UNK F		4-8 IN. PIPE
✓ F.J. 6.0.5		3.0.6	GY	UNK F		4-8 IN. PIPE
✓ F.J. 6.0.6		3.0.7	GR	O.T.H.N		9x9 IN. FLOOR TL
✓ F.J. 6.0.7		3.0.7	B.K	O.T.H.F		TAR PAPER
✓ F.J. 6.0.8		3.0.7	GY	O.T.H.N		TRANSITE PANEL
✓ F.J. 6.0.9		3.0.5	T.N	O.T.H.N		9x9 IN. FLOOR TL
✓ F.J. 6.1.0		3.0.5	GR	O.T.H.N		9x9 IN. FLOOR TL
✓ F.J. 6.1.1		3.0.5	B.K	O.T.H.F		TAR PAPER
✓ F.J. 6.1.2		3.0.5	B.K	O.T.H.F		TAR PAPER
✓ F.J. 6.1.3		3.0.7	WH	O.T.H.F		BOILER INSUL
✓ F.J. 6.1.4		3.0.7	WH	O.T.H.F		BOILER INSUL

BULK MATERIAL DATA (CONTINUED)

SAMPLE IDENTIFICATION	H.A. NO.	BUILDING IDENTIFICATION	COLOR	SYSTEM CODE	FRIABLE	DESCRIPTION
FJ615		307	WH	OTH	F	PIPE DEBRIS
FJ616		307	GY	UNK	F	4-8 IN PIPE
FJ617		307	GY	UNK	F	4-8 IN FITTING
FJ618		307	WH	OTH	N	WALLBOARD

SYSTEM CODES

STE = STEAM
 HW = HEATING HOT WATER
 CHW = CHILLED WATER
 DOM = DOMESTIC WATER
 UNK = UNKNOWN
 OTH = OTHER

COLOR CODES

BK = BLACK
 WH = WHITE
 YL = YELLOW
 BL = BLUE
 GR = GREEN
 RD = RED
 GY = GRAY
 TN = TAN

TEST

F = FRIABLE
 N = NONFRIABLE



APPENDIX C

ANALYTICAL RESULTS FOR DECONTAMINATION WATER

Table C-1

Inorganics Data Summary for Decontamination Water

Sample	Site ID	Analyte	Results	Units	Reporting Limit
-001	A1-08	Silver, Total	10.0	u	μg/L 10.0
		Aluminum, Total	200	u	μg/L 200
		Arsenic, Total	10.0	u	μg/L 10.0
		Barium, Total	200	u	μg/L 200
		Beryllium, Total	5.0	u	μg/L 5.0
		Calcium, Total	5000	u	μg/L 5000
		Cadmium, Total	5.0	u	μg/L 5.0
		Cobalt, Total	50.0	u	μg/L 50.0
		Chromium, Total	10.0	u	μg/L 10.0
		Copper, Total	25.0	u	μg/L 25.0
		Cyanide, Total	10.0	u	μg/L 10.0
		Iron, Total	100	u	μg/L 100
		Mercury, Total	0.2	u	μg/L 0.20
		Potassium, Total	5000	u	μg/L 5000
		Magnesium, Total	5000	u	μg/L 5000
		Manganese	15.0	u	μg/L 15.0
		Sodium, Total	5000	u	μg/L 5000
		Nickel, Total	40.0	u	μg/L 40.0
		Lead, Total	3.0	u	μg/L 3.0
		Antimony, Total	60.0	u	μg/L 60.0
		Selenium, Total	5.0	u	μg/L 5.0
		Thallium, Total	10.0	u	μg/L 10.0
		Vanadium, Total	50.0	u	μg/L 50.0
		Zinc, Total	20.0	u	μg/L 20.0

APPENDIX D
INSPECTOR ACCREDITATION CERTIFICATES OF
ASBESTOS SURVEY PERSONNEL

This is to certify that

GALILEO GUTIERREZ

Has completed coursework that meets
all criteria required for the
EPA-Model Accreditation Annual Refresher Course

Inspecting Building For Asbestos-Containing Materials

J. Allet Munnie
Program Director

Michael C. Skobnicki
Exam Administrator

WESTON
1835 PUMPHREY AVE.
AUBURN, AL 36830-4303

036
Certificate Number

MARCH 1, 1990
Course Date

MARCH 1, 1991
Expiration Date

Number 4058

Expiration Dates:

EPA 11/10/90

Certificate of Training

ASBESTOS TRAINING ACADEMY, INC.

HEREBY CERTIFIES THAT

Alvin B. Harvey
SS# 199-62-3706

HAS SUCCESSFULLY COMPLETED A 24 HOUR COURSE ENTITLED

Asbestos Inspector Training Course
INCLUDING CLASSROOM LECTURES AND HANDS-ON INSTRUCTION

and has successfully passed the examination

CERTIFIED BY

United States Environmental Protection Agency

ON THIS 10th DAY OF November, 19 89

Gerald Schwartz
INSTRUCTOR

Gerald Schwartz

INSTRUCTOR

Ronald J. Rominski
DIRECTOR

Ronald J. Rominski

APPENDIX E
ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES



Fort Holabird Criminal Records Center

Groundwater Investigation Results

Sample Data: 23 April 1991

(All Values in µg/L)

Compound	Test Method	Certified Report Limit	Sample ID/Well Number			
			MW02 AA-88-0421	MW03 AA-88-0422	MW03D AA-88-0422	AW04 AA-88-0579
TOTAL PETROLEUM HYDROCARBONS (TPH)	00*	3,250	ND	ND	ND	ND
METALS						
Silver	SD24	3.2	0.4	0.8	ND	0.9
Arsenic	SD24	3.0	ND	ND	3.7	3.8
Lead	SD24	4.7	6.2	ND	9.9	ND
Selenium	SD24	4.1	ND	ND	ND	ND
Barium	SS16	1.53	52.0	54.0	98.0	18.2
Cadmium	SS16	2.6	ND	ND	ND	ND
Chromium	SS16	4.4	ND	ND	15.1	ND
BNAs**	**					
1,2,3-Trichlorobenzene		3.6	ND	ND	ND	ND
1,2,4-Trichlorobenzene		2.8	ND	ND	ND	ND
1,2-Dichlorobenzene		10	ND	ND	ND	ND
1,3-Dichlorobenzene		8.5	ND	ND	ND	ND
1,4-Dichlorobenzene		4.4	ND	ND	ND	ND
2,4,5-Trichlorophenol		50	ND	ND	ND	ND
2,4,6-Trichlorophenol		10	ND	ND	ND	ND
2,4-Dichlorophenol		10	ND	ND	ND	ND
2,4-Dimethylphenol		10	ND	ND	ND	ND
2,4-Dinitrophenol		50	ND	ND	ND	ND
2,4-Dinitrotoluene		5.5	ND	ND	ND	ND
2,6-Dinitrotoluene		6.6	ND	ND	ND	ND
2-Chlorophenol		10	ND	ND	ND	ND
2-Chloronaphthalene		9.6	ND	ND	ND	ND
2-Methylnaphthalene		10	ND	200.0	200.0	ND
2-Methylphenol		10	ND	ND	ND	ND
2-Nitroaniline		50	ND	ND	ND	ND
2-Nitrophenol		10	ND	ND	ND	ND
3,3-Dichlorobenzidine		6	ND	ND	ND	ND
3-Nitroaniline		50	ND	ND	ND	ND
4,6-Dinitro-2-Cresol		50	ND	ND	ND	ND
4-Bromophenylphenyl Ether		10	ND	ND	ND	ND
4-Chloroaniline		10	ND	ND	ND	ND
4-Chloro-3-Cresol		10	ND	ND	ND	ND
4-Chlorophenylphenyl Ether		10	ND	ND	ND	ND
4-Methylphenol		10	ND	ND	ND	ND
4-Nitroaniline		50	ND	ND	ND	ND
4-Nitrophenol		50	ND	ND	ND	ND
Alpha-Benzenehexachloride		6.8	ND	ND	ND	ND
Alpha-Chlordane		30	ND	ND	ND	ND
Alpha-Endosulfan		30	ND	ND	ND	ND
Aldrin		12	ND	ND	ND	ND
Acenaphthene		14	ND	ND	ND	ND
Acenaphthylene		19	ND	ND	ND	ND



For Polabird Criminal Records Center

Groundwater Investigation Results

Sample Data: 23 April 1991

(All Values in $\mu\text{g/L}$)

(continued)

Compound	Test Method	Certified Report Limit	Sample ID/Well Number			
			MW02 AA-88-0421	MW03 AA-88-0422	MW03D AA-88-0422	AW04 AA-88-0579
BNA (continued)**	**					
Anthracene		20	ND	ND	ND	ND
Bis(2-Chloroethoxy)Methane		10	ND	ND	ND	ND
Bis(2-Chloroisopropyl)Ether		10	ND	ND	ND	ND
Bis(2-Chloroethyl)Ether		8.1	ND	ND	ND	ND
Bis(2-Ethylhexyl)Phthalate		32	ND	ND	ND	ND
Benzo[a]anthracene		14	ND	ND	ND	ND
Benzo[a]pyrene		10	ND	ND	ND	ND
Benzo[b]fluoranthene		23	ND	ND	ND	ND
Beta-Benzenehexachloride		4.9	ND	ND	ND	ND
Butylbenzyl Phthalate		10	ND	ND	ND	ND
Beta-Endosulfan		6	ND	ND	ND	ND
Benzoic Acid		50	ND	ND	ND	ND
Benzo[g,h,i]perylene		7.1	ND	ND	ND	ND
Benzo[k]fluoranthene		21	ND	ND	ND	ND
Benzyl Alcohol		10	ND	ND	ND	ND
Chrysene		15	ND	ND	ND	ND
Hexachlorobenzene		8.3	ND	ND	ND	ND
Hexachlorocyclopentadiene		10	ND	ND	ND	ND
Hexachloroethane		5.1	ND	ND	ND	ND
Chlordane		30	ND	ND	ND	ND
P-Chlorophenylmethyl Sulfide		5.9	ND	ND	ND	ND
P-Chlorophenylmethyl Sulfoxide		6.8	ND	ND	ND	ND
P-Chlorophenylmethyl Sulfone		38	ND	ND	ND	ND
Dibenz[a,h]anthracene		7.5	ND	ND	ND	ND
Delta-Benzenehexachloride		6.4	ND	ND	ND	ND
Dibenzofuran		10	ND	5.2	6.9	ND
Diethyl Phthalate		10	ND	ND	ND	ND
Dithiane		7.7	ND	ND	ND	ND
Dieldrin		11	ND	ND	ND	ND
Dimethyl Phthalate		10	ND	ND	ND	ND
Di-N-Butyl Phthalate		10	ND	ND	1.3	ND
Di-N-Octyl Phthalate		15	ND	ND	ND	ND
Endrin		6.6	ND	ND	ND	ND
Endrin Ketone		6	ND	ND	ND	ND
Endosulfan Sulfate		6	ND	ND	ND	ND
Fluoranthene		20	ND	ND	ND	ND
Fluorene		10	ND	7.2	10.0	ND
Hexachlorobutadiene		18	ND	ND	ND	ND
Heptachlor		6.2	ND	ND	ND	ND
Heptachlor Epoxide		7.2	ND	ND	ND	ND
Indeno[1,2,3-C,D]pyrene		7.2	ND	ND	ND	ND
Isophorone		10	ND	ND	ND	ND
Lindane		5.8	ND	ND	ND	ND
Dimethylnaphthalene		10	NA	200.0	400.0	NA
Trimethylnaphthalene		10	NA	NA	NA	NA
Methylnaphthalene		10	ND	200.0	200.0	ND
Methoxychlor		30	ND	ND	ND	ND
Malathion		7.3	ND	ND	ND	ND
Naphthalene		17	ND	231.0	198.0	ND



Fort Holabird Criminal Records Center

Groundwater Investigation Results

Sample Data: 23 April 1991

(All Values in $\mu\text{g/L}$)

(continued)

Compound	Test Method	Certified Report Limit	Sample ID/Well Number			
			MW02 AA-88-0421	MW03 AA-88-0422	MW03D AA-88-0422	AW04 AA-88-0579
BNAs (continued)**	**					
Nitrobenzene		10	ND	ND	ND	ND
Nitrosodi-n-propylamine		4.5	ND	ND	ND	ND
N-Nitrosodiphenylamine		10	ND	ND	3.5	ND
1,4-Oxathiane		9.1	ND	ND	ND	ND
Pentachlorophenol		50	ND	ND	ND	ND
Phenanthrene		22	ND	ND	ND	ND
Phenol		10	ND	ND	ND	ND
2,2-Bis(P-Chlorophenyl)-1,1-Dichloroethane		9.7	ND	ND	ND	ND
2,2-Bis(P-Chlorophenyl)-1,1-Dichloroethene		9.3	ND	ND	ND	ND
2,2-Bis(P-Chlorophenyl)-1,1-Dichloroethene		7.3	ND	ND	ND	ND
2,2-Bis(P-Chlorophenyl)-1,1-Dichloroethene		4.7	ND	ND	ND	ND
2,2-Bis(P-Chlorophenyl)-1,1-Trichloroethane		17	ND	ND	ND	ND
Parathion						
Pyrene						
VOCs***	***					
1,1,1-Trichloroethane		4.1	ND	ND	ND	ND
1,1,2-Trichloroethane		17	ND	ND	ND	ND
1,1-Dichloroethylene		18	ND	ND	ND	ND
1,1-Dichloroethane		1.1	ND	ND	ND	ND
1,2-Dichloroethene		1.1	ND	ND	ND	ND
1,2-Dichlorobenzene		9.7	ND	ND	ND	ND
1,2-Dichloroethane		7.6	ND	ND	ND	ND
1,2-Dichloropropane		2.8	ND	ND	ND	ND
1,2-Dimethylbenzene		2	10.0	9.0	ND	ND
1,3-Dichlorobenzene		9.2	ND	ND	ND	ND
1,3-Dichloropropane		3.8	ND	ND	ND	ND
1,3-Dimethylbenzene		2.0	ND	ND	ND	ND
1,4-Dichlorobenzene		8.1	ND	ND	ND	ND
(2-Chloroethoxy)ethene		82	ND	ND	ND	ND
Acetone		10	ND	ND	ND	ND
Bromodichloromethane		7.9	ND	ND	ND	ND
Cis-1,3-Dichloropropylene		5	ND	ND	ND	ND
Vinyl Acetate		10	ND	ND	ND	ND
Chloroethene		2.9	ND	ND	ND	ND
Chloroethane		5	ND	ND	ND	ND
Benzene		2.4	28.4	25.5	ND	ND
Carbon Tetrachloride		5.6	ND	ND	ND	ND
Methylene Chloride		5.4	ND	ND	ND	ND
Bromomethane		10	ND	ND	ND	ND
Chloromethane		1.6	ND	ND	ND	ND
Bromoform		8.2	ND	ND	ND	ND
Chloroform		0.83	6.8	6.5	ND	ND



Fort Holabird Criminal Records Center

Groundwater Investigation Results

Sample Data: 23 April 1991

(All Values in $\mu\text{g/L}$)

(continued)

Compound	Test Method	Certified Report Limit	Sample ID/Well Number			
			MW02 AA-88-0421	MW03 AA-88-0422	MW03D AA-88-0422	AW04 AA-88-0579
VOCs(continued)***	***					
Chlorobenzene		1.4	ND	ND	ND	ND
Carbon Disulfide		5	ND	ND	ND	ND
Dibromochloromethane		6.5	ND	ND	ND	ND
Ethylbenzene		9.3	17.6	16.5	ND	ND
Toluene		8.7	ND	ND	ND	ND
Methylethyl Ketone		10	ND	ND	ND	ND
Methylisobutyl Ketone		10	ND	ND	ND	ND
Methyl-n-butyl Ketone		10	ND	ND	ND	ND
Styrene		5	ND	ND	ND	ND
Trans-1,3-Dichloropropene		5	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane		4.7	ND	ND	ND	ND
Tetrachloroethylene		2.7	ND	ND	ND	ND
Trichloroethylene		7	ND	ND	ND	ND

ND = NOT DETECTED

NA = NOT ANALYZED

D = DUPLICATE

* Total Petroleum Hydrocarbons (TPH) analysis does not require USATHAMA certification. The determination is reported as Method "00".

** BNAs in groundwater samples were analyzed using Method UM16.

*** Method UM17 was used for the analysis of VOCs in groundwater samples.



APPENDIX F

NOTICE OF COMPLIANCE FROM STATE OF MARYLAND DEPARTMENT OF THE ENVIRONMENT



STATE OF MARYLAND
DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway Baltimore, Maryland 21224
(301) 631-

William Donald Schaefer
Governor

Robert Perciasepe
Secretary

March 16, 1992

NOTICE OF COMPLIANCE

Mr. Andrew Maly
U.S. Army Toxic & Hazardous Materials Agency
ATTN: CETHA-BC-B
Aberdeen Proving Ground, Maryland 21010-5401

RE: Fort Holabird Crime Record Center
Building 305, 306 and 307
Baltimore, Maryland
Case #9-1310 BA

Dear Mr. Maly:

On January 10, 1992, a representative of the Hazardous and Solid Waste Management Administration's Underground Storage Tank Division made an inspection and reviewed the report submitted by Roy F. Weston, Inc. dated November 1991, on the above-referenced property.

Based on this inspection and information submitted, it has been determined that three (3) underground storage tanks have been removed and four (4) monitoring wells have been installed. The November 1991 report contains limited information which addresses the subsurface condition of the soils and groundwater in the area of the removed underground storage tanks. Based on the site inspection and sample analysis the Administration does not presently require any corrective action at this site. Thus, the above-referenced property is now in compliance with Maryland regulation 26.10.02-.11.

The Administration hereby closes its case in reference to this site. This notice should not be construed as a waiver of the Administration's right to take any other enforcement action it deems appropriate with respect to this site. If there are any questions concerning this matter, please telephone this office at (410) 631-3442.

Sincerely,

Herbert M. Meade
Head of Enforcement Section
Underground Storage Tank Program

HMM:dh

cc: Mr. Richard Collins
Mr. Bernard Bigham
Mr. Robert Bangert
Mr. Thomas Walter



APPENDIX G

TEST PIT LOGS

**TEST PIT LOG
FORT HOLABIRD
APRIL 1991**

**Test Pit No.: TP3
Log by: Kevin McNeill
Date Completed: 4/23/91**

**Subcontractor: Hardin-Huber
Operator: Brian Siwinski
Method: Backhoe**

Total Depth: 4 ft.

Samples taken: None

Test Pit I.D.	Depth Interval	HNu Readings	General Description
TP1	0 - 6"	Background	Dark brown topsoil, some rocks, moist
	6" - 4'	Background	Brown sandy clay, silt, moist

**TEST PIT LOG
FORT HOLABIRD
APRIL 1991**

**Test Pit No.: TP2
Log by: Kevin McNeill
Date Completed: 4/23/91**

**Subcontractor: Hardin-Huber
Operator: Brian Siwinski
Method: Backhoe**

Total Depth: 4.5 ft.

Samples taken: None

Test Pit I.D.	Depth Interval	HNu Readings	General Description
TP2	0 - 1'	Background	Dark brown topsoil, some rocks, moist
	1' - 4.5'	Background	Brown sandy silt, moist

**TEST PIT LOG
FORT HOLABIRD
APRIL 1991**

**Test Pit No.: TP1
Log by: Kevin McNeill
Date Completed: 4/23/91**

**Subcontractor: Hardin-Huber
Operator: Brian Siwinski
Method: Backhoe**

Total Depth: 4.5 ft.

Samples taken: None

Test Pit I.D.	Depth Interval	HNu Readings	General Description
TP3	0 - 1'	Background	Dark brown topsoil, some rocks, moist
	1' - 3'	Background	Dark brown sand, moist
	3' - 4.5'	Background	Light brown sand, moist

APPENDIX H
BUILDING 305 UST LEAK TEST RESULTS

(301) 578-0956

A & A Environmental Services
Division of
A & A Waste Oil Company, Inc.
3635 Woodland Avenue
Baltimore, Maryland 21215

HYDROSTATIC TEST

Weston Services Incorporated
Building 9 - 1 Weston Way
West Chester, Pennsylvania
ATTN: KEVIN McNEILL (G2S)

DATE: 23 May 1991Tank Size: 500 GALLONSProduct: #2 DIESEL FUELInches Start of Test: 63 INCHESInches After Test: 62.5 INCHESProduct Level +/- inches: -0.5Start Time: 08:36Finish Time: 10:06

REMARKS: Test was done at the Crime Records Center, Ft. Holibird,
Maryland. Had to disconnect suction & return lines and plug
off emergency generator.

TESTER: JOHN C. GOODWIN
CERT.#: MD 0058



APPENDIX I

ANALYTICAL RESULTS FOR ASBESTOS SAMPLES FROM BUILDINGS

POLARIZED LIGHT MICROSCOPY BULK SAMPLE ANALYSIS SUMMARY

Weston W.O. No. 2281-11-06-0021

Receipt Date 04/26/91 through 04/26/91

Print Date: 05/07/91

AO LAB ID NO.	CLIENT/CLIENT ID	BLOG	HA	MATERIAL TYPE	SYSTEM	LOCATION	SIZE	COLOR	FRIABILITY	RESULTS							LAYERS ANALYST
										CH	AM	CR	OT	TL			
FJ597	USATHAMA	306		WALL BOARD	--	--	--	WHITE	NON-FRIABLE	ND	ND	ND	ND	ND	Yes	06806	
FJ598	USATHAMA	306		FLOOR TILE	--	--	9X9"	TAN	NON-FRIABLE	3	ND	ND	ND	3	No	06806	
FJ599	USATHAMA	306		FLOOR TILE	--	--	9X9"	GRAY	NON-FRIABLE	5	ND	ND	ND	5	Yes	06806	
FJ600	USATHAMA	306		TAR PAPER	--	--	--	BLACK	FRIABLE	ND	ND	ND	ND	ND	No	06806	
FJ601	USATHAMA	306		TAR PAPER	--	--	--	BLACK	FRIABLE	empty vial					No		
FJ602	USATHAMA	306		PIPE	--	--	4-8"	WHITE	FRIABLE	5	25	ND	ND	30	No	06806	
FJ603	USATHAMA	306		PIPE FITTING INS	--	--	4-8"	WHITE	FRIABLE	ND	1	ND	ND	1	No	06806	
FJ604	USATHAMA	306		PIPE	--	--	4-8"	ORANGE	FRIABLE	40	ND	ND	ND	40	Yes	06806	
FJ605	USATHAMA	306		PIPE	--	--	4-8"	GRAY	FRIABLE	40	ND	ND	ND	40	No	06806	
FJ606	USATHAMA	307		FLOOR TILE	--	--	9X9"	GREEN	NON-FRIABLE	5	ND	ND	ND	5	Yes	06806	
FJ607	USATHAMA	307		TAR PAPER	--	--	--	BLACK	FRIABLE	1	ND	ND	ND	1	No	06806	
FJ608	USATHAMA	307		TRANSITE PANEL	--	--	--	GRAY	NON-FRIABLE	40	ND	ND	ND	40	No	06806	
FJ609	USATHAMA	305		FLOOR TILE	--	--	9X9"	TAN	NON-FRIABLE	5	ND	ND	ND	5	Yes	06806	
FJ610	USATHAMA	305		FLOOR TILE	--	--	9X9"	GREEN	NON-FRIABLE	5	ND	ND	ND	5	No	06806	
FJ611	USATHAMA	305		TAR PAPER	--	--	--	BLACK	FRIABLE	<1	ND	ND	ND	<1	No	06806	
FJ612	USATHAMA	305		TAR PAPER	--	--	--	BLACK	FRIABLE	<1	ND	ND	ND	<1	No	06806	
FJ613	USATHAMA	307		BOILER INSULATION	--	--	--	WHITE	FRIABLE	20	ND	ND	ND	20	No	06806	
FJ614	USATHAMA	307		BOILER INSULATION	--	--	--	WHITE	FRIABLE	25	ND	ND	ND	25	No	06806	
FJ615	USATHAMA	307		PIPE DEBRIS	--	--	--	WHITE	FRIABLE	1	30	ND	ND	31	No	06806	
FJ616	USATHAMA	307		PIPE	--	--	4-8"	GRAY	FRIABLE	40	ND	ND	ND	40	No	06806	
FJ617	USATHAMA	307		PIPE FITTING INS	--	--	4-8"	GRAY	FRIABLE	50	ND	ND	ND	50	No	06806	
FJ618	USATHAMA	307		PIPE FITTING INS	--	--	--	WHITE	NON-FRIABLE	ND	ND	ND	ND	ND	Yes	06806	

RESULTS LEGEND

CH - Chrysotile AM - Amosite CR - Crocidolite OT - Other TL - Total ND - None Detected

Upon issue, this report may be reproduced only in full. All analyses are performed in accordance with the methods set forth in U.S. EPA 600/M4-82-020, as amended. Weston's Optical Microscopy Laboratory is accredited by the National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program for asbestos fiber analysis (Laboratory Code 1254).



APPENDIX J

ANALYTICAL RESULTS OF RADON INVESTIGATION IN BUILDING 305

LANDAUER

CERTIFICATION OF TECHNICAL DATA CONFORMITY

The Contractor, Landauer, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. DACA 72-89-D-0002 is complete, accurate, and complies with all requirements of the contract.

September 23, 1991
Date

Cindy J. Ochampaugh
C. J. Ochampaugh, QC Supervisor

dc Mc for J F . or

U S ARMY TOXIC & HAZARDOUS
MATERIALS AGENCY
ATPA CETHA-BC-B (M PLANE)
BLDG 448C
ABERDEEN PROVING GROUND, MD 21010-5401

LANDAUER

Landauer, Inc. 2 Science Road Glenwood, Illinois 60425-1580
Telephone (708) 755-7000 Facsimile (708) 755-7016

0406503

Acct. No.

PROGRAM NAME 077162

Detector Number	Detector Type	Starting Date	Ending Date	Field Data / Comments	Exposure pCi/l days	Avg Radon Conc pCi/l
1785728	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785734	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785736	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785738	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785742	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785753	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785754	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785755	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785760	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785769	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785773	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	366.5	4.1
1785776	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3
1785777	DRNA	17-MAY-91	15-AUG-91	* - LESS THAN INDICATED VALUE	* 30.0	* 0.3

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Q.C. Release DLB	Process No. A12688	Report Date 13-SEP-91	Date Received 16-AUG-91
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