USATHAMA

U.S. Army Toxic and Hazardous Materials Agency

Remedial Action

DECISION DOCUMENT

February, 1988

Leaseback Area

Alabama Army Ammunition Plant

US ARMY
MATERIEL
COMMAND

DECISION MEMORANDUM
REMEDIAL ACTION

Site: Leaseback Area, Alabama Army Ammunition Plant (AAAP)
Talladega, Alabama.

Documents Reviewed:

- Evaluation of Decontamination Alternatives, GSA and Leaseback Areas, Alabama Army Ammunition Plant, Draft Report, Environmental Science and Engineering, Inc. (ESE), 1980.

- Final Report for the Alabama Army Ammunition Plant, Leaseback Area, Decontamination Operations Project, Rockwell International, Atomics International Division, Energy Systems Group, 1982.

- Identification of Decontamination Requirements for the GSA and Leaseback Areas at the AAAP, Draft Report. Environmental Science and Engineering, Inc.(ESE), 1980.

- Alabama Army Ammunition Plant, Feasibility Study, Draft Report, Environmental Science and Engineering, Inc. (ESE), 1986.

- Environmental Survey of Alabama Army Ammunition Plant, Environmental Science and Engineering, Inc. (ESE), 1981.

Description of Selected Remedy:

Prior to decontamination operations, 21,000 cubic feet of friable asbestos, 186 PCB contaminated electrical switches and 789 mercury containing instruments were removed and disposed of according to Federal and State of Alabama regulations. Decontamination operations involved destruction of

explosive residues, primarily nitrocellulose (NC) and 2,4 and 2,6 Dinitrotoluene (DNT), by burning the contaminated areas. Depending on the structure to be decontaminated, the residues were burned using hand-held flamer rigs, detonators or a mixture of dunnage, diesel and compressed air. An extensive sampling, analysis and data management program was implemented to allow certification of decontamination operations.

Declaration:

Consistent with the Army's intention to decontaminate the Leaseback Area for industrial use by Kimberly Clark, contracts for survey and decontamination operations were awarded to Environmental Science and Engineering and Rockwell International, respectively. The decontamination measures implemented by Rockwell provided permanent remediation of fire and explosion hazards due to explosives residues and asbestos inhalation hazards. The operations were consistent with applicable Federal, State and Local regulations.

Following certification of decontamination by USATHAMA and Rockwell, the Leaseback Area was released to Kimberly Clark.

CONCUR: _____ Date: 29 FEB 88

for STEPHEN L. ETZEL
Colonel, GS
Director
Plant Operations Directorate

APPROVED: _____ Date: 31 Mar 88

J HAROLD MASHBURN
Colonel, CM
Commanding
U.S. Army Toxic & Hazardous Materials Agency

SUMMARY OF REMEDIAL ACTION
LEASEBACK AREA
ALABAMA ARMY AMMUNITION PLANT (AAAP)

SITE LOCATION AND DESCRIPTION

The Alabama Army Ammunition Plant (AAAP) is located in Talladega County in northeastern Alabama, approximately 4 miles north of Childersburg and 40 miles southeast of Birmingham (Fig. 1). The plant was established in 1941 as the Alabama Ordnance Works on 13,233 acres of land located near the junction of the Talladega Creek and the Coosa River. The terrain is level to rolling and largely suited to pasture and timberland, with elevations ranging from 384 to 600 feet above Mean Sea level (MSL).

In 1977, a 1,354 acre parcel was sold to Kimberly Clark Corporation. Contained within this parcel were nitrocellulose and smokeless powder manufacturing areas. To allow the government to remove the equipment and decontaminate these manufacturing facilities for industrial use, a 272 acre area was leased back to the government until August 1983 (Rockwell, 1982). This area, on which this Decision Memorandum is based, is referred to as the Leaseback Area (Fig. 2). A detailed diagram of the Leaseback Area is shown in Figure 3. An aerial photograph of the area is shown in Figure 4.

Contaminated soil has been the primary source of surface and groundwater contamination. The groundwater resources below the AAAP consist of the dolomite aquifer of the Coosa Valley and a shallow, low yielding residual clay aquifer. The dolomite aquifer is the productive potable groundwater resource. The shallow aquifer is considerably less productive than its deeper counterpart. The groundwater flows in a west-northwesterly direction towards the Coosa River, and away from the 140 residences which lie within a mile or two of the AAAP and use groundwater sources for potable water.

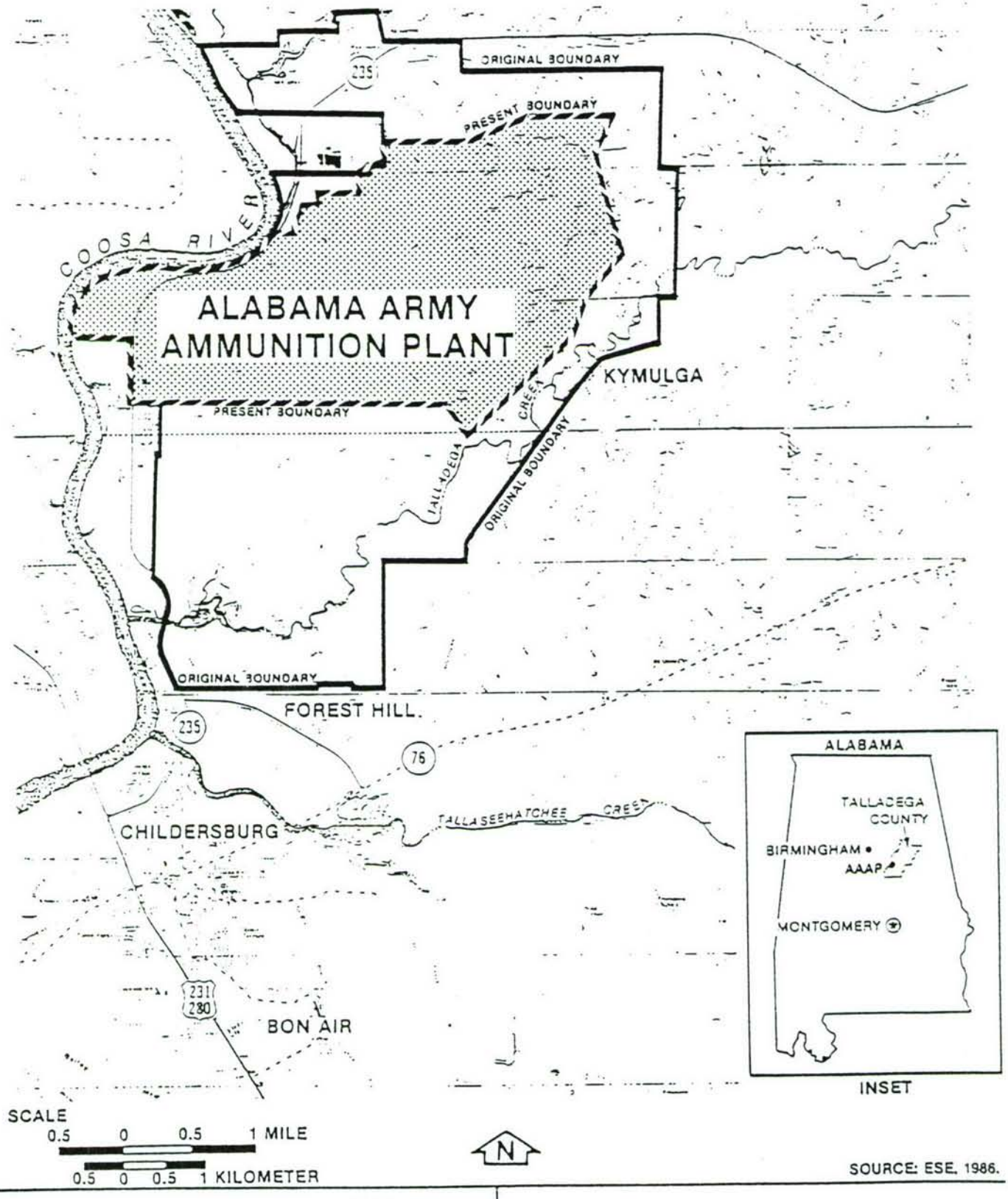


FIGURE 1. Location Map of the AAAP

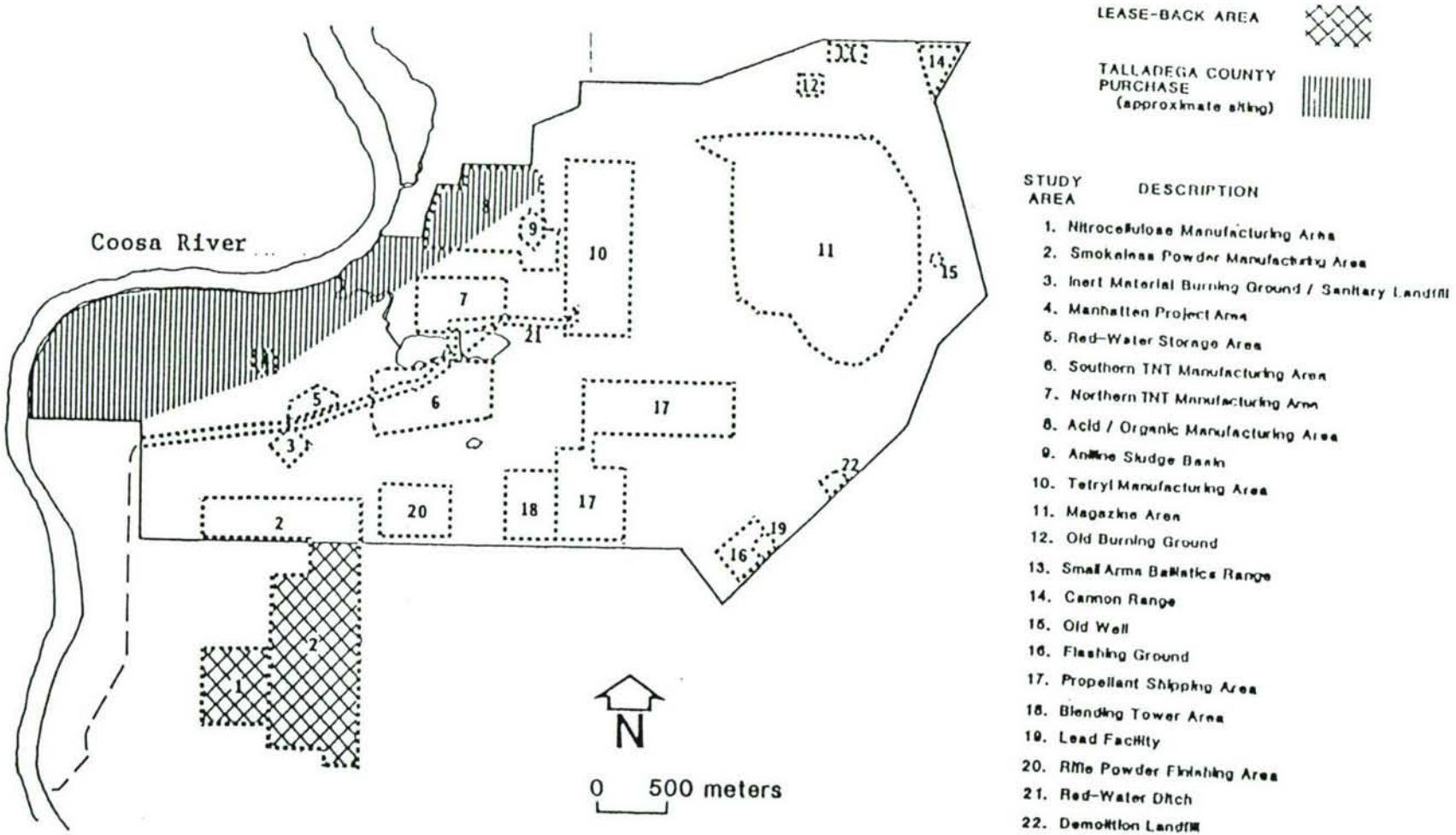
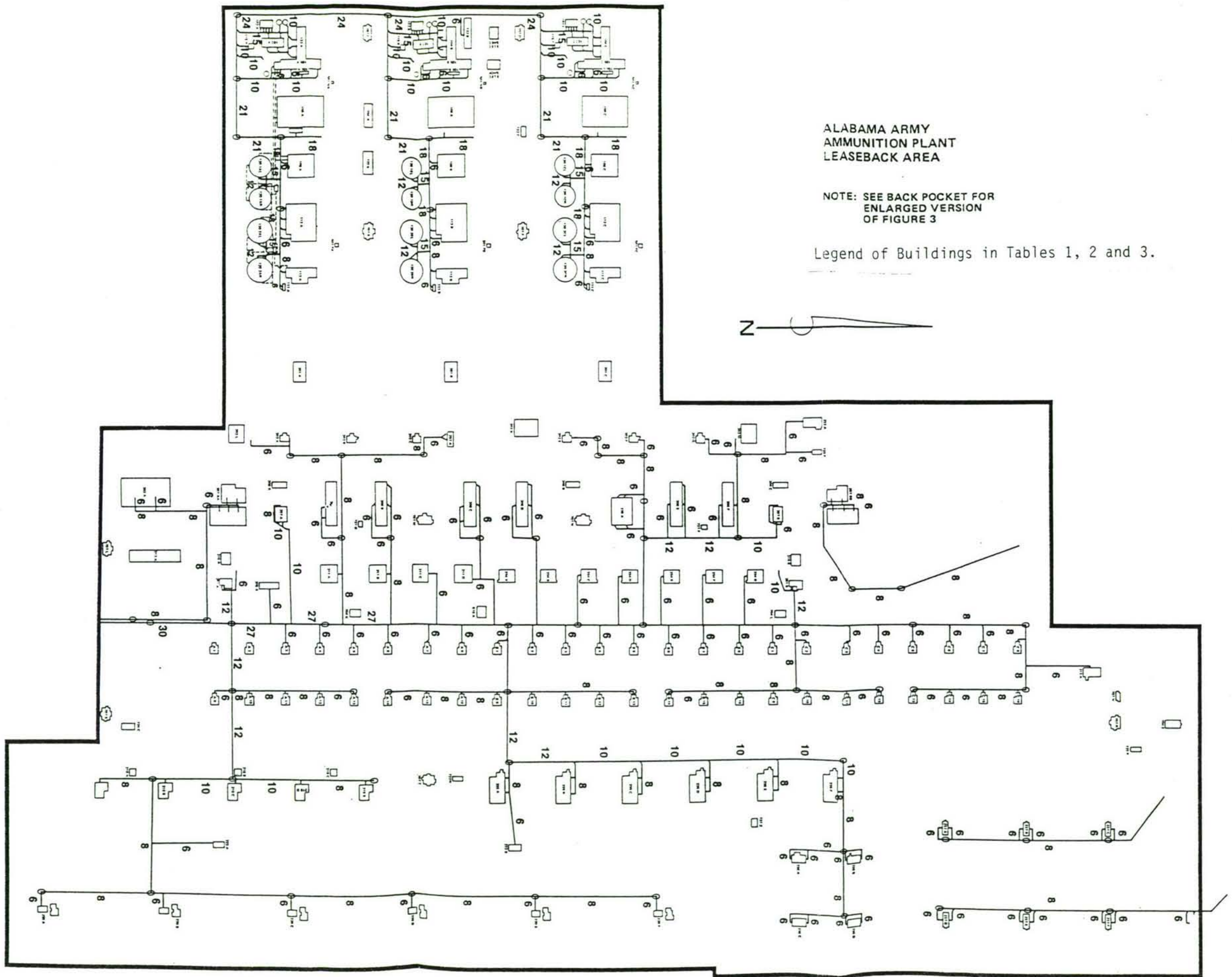


FIGURE 2. Location of Leaseback Area

SOURCE: Rockwell, 1982



ALABAMA ARMY
AMMUNITION PLANT
LEASEBACK AREA

NOTE: SEE BACK POCKET FOR
ENLARGED VERSION
OF FIGURE 3

Legend of Buildings in Tables 1, 2 and 3.

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Figure 3. AAAP Leaseback Area

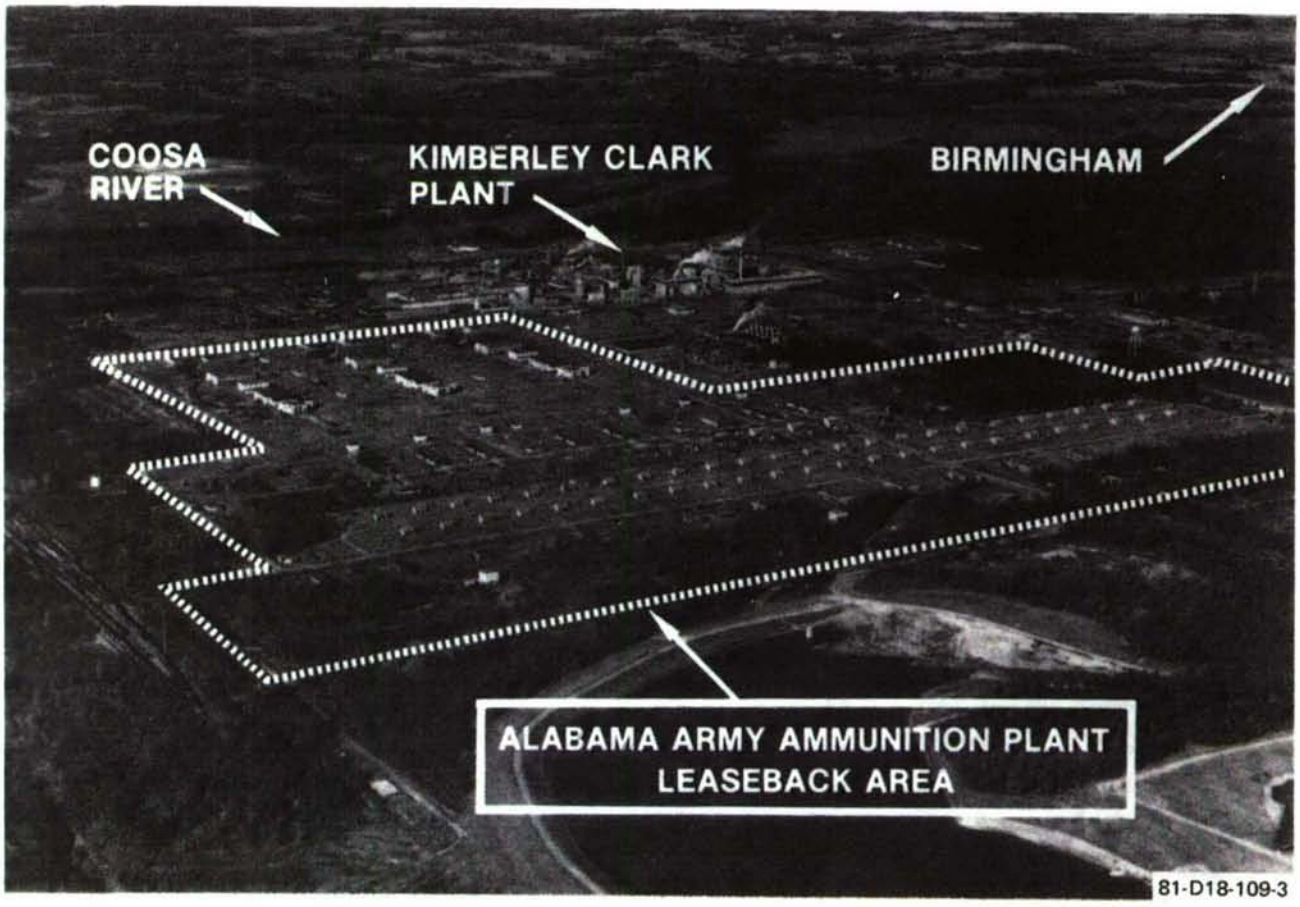

Figure 4. Aerial Photograph of Leaseback Area

SITE HISTORY

The AAAP was built in 1941 and operated during WWII as a government owned/contractor operated (GO/CO) facility by E.I. duPont de Nemours & Co., to produce nitrocellulose (NC), single-base smokeless powder, trinitrotoluene (TNT), dinitrotoluene (DNT) and trinitrophenyl-n-methylnitramine (tetryl). Activities at the AAAP included the manufacture of explosives, DNT, H_2SO_4, aniline, N.N dimethylaniline and diphenylamine. Spent acids were recycled. Other wastes resulting from these operations were disposed of at the AAAP. Operations were terminated and the plant reverted to standby status in August 1945. The prime contractor decontaminated machinery, equipment, buildings and ground areas, finishing in January 1946. The government released the constructing and operating contractor in a final settlement in September 1946.

During the period from April 1955 to October 1957, Associated Contractors and the Rust Engineering Company, under contract to the U.S. Army (Army), rehabilitated three nitrocellulose (NC) production lines, three TNT and one DNT line. Due to a depletion of funds, the rehabilitation stopped when approximately 75 percent complete. The plant was maintained in various stages of standby status until the early 1970's. In 1973, the Army declared the AAAP excess to its needs. In the same year, the General Services Administration (GSA) declined to accept 1,620 acres of the former manufacturing area because it could not be certified free of contaminants. In 1977, a 1,354 acre parcel was sold to Kimberly Clark, Inc. Contained within the parcel were the Nitrocellulose Manufacturing Area and Smokeless Powder Manufacturing Area (Study Areas 1 and 2, Fig. 2). To allow the government to remove equipment and decontaminate these facilities, an area comprising of 272 acres was leased back to the government until August, 1983. This parcel of property was the Leaseback Area considered in this document. Several other parcels of the original property have subsequently been sold.

CURRENT SITE STATUS

It was necessary that the Leaseback Area be decontaminated before being returned to Kimberly Clark for industrial use. Chemical contamination was found in several components in the Leaseback Area:

1. Soils,
2. Buildings,
3. Equipment in buildings, and
4. Industrial sewers and sumps.

Specific contaminants included:

1. Dinitrotoluene,
2. Nitrocellulose,
3. Smokeless powder grains and pellets, and
4. Asbestos (friable insulation and Transite).

Of these, the first three posed explosive hazards, while the fourth is known to pose a respiratory hazard.

The end land use for the Leaseback Area, as designated by Kimberly Clark, is industrial development. Because contaminants were not present above USATHAMA industrial land use threshold levels, general decontamination of Leaseback Area soils was not required. However, asbestos contamination in the immediate vicinity of structures in the Leaseback Area had to be removed. In addition, potentially hazardous explosives, contaminants in buildings, equipment, and industrial sewers had to be removed or destroyed, or the contaminated components isolated from human contact and the surrounding environment. Table 1 summarizes the Leaseback Area contamination which had to be dealt with prior to release. Table 2 lists the contaminants in the Industrial Sewers. Sumps in the Leaseback Area are listed in Tables 3 and 4. A survey of the contaminant levels in the Leaseback Area is presented in Table 5.

Table 1. Contamination Status of Buildings and Equipment in the Leaseback Area

Building Series Name and Number (Fig.3)	Contaminated Equipment (Number of Items)	Building Space and Equipment Surface Contaminants
Study Area 1 --Nitrocellulose Manufacturing Area		
105 A-C Nitrating Houses (3)	39	NC, Asbestos
106 A-C Spent Acid Filter House (3)	15	NC
108 A-C Boiling Tub House (3)	None	NC, Asbestos
109 A-C Pulping House (3)	17	NC, Asbestos
111 A and 111 C Slurry Tank House	None	NC, Asbestos
111 B Nitrocellulose Moisture	4	NC
112 A-C Poacher Tub House (3)	6	NC, Asbestos
113 A-C Blending Tub and Final Wringer House (3)	3	NC, Asbestos
120 A-C Savall Tanks (12) (4 tanks/line)	11	NC
122A and 122 B Wood Pulp Stone House	None	Asbestos
201 A-C Nitrocellulose Lag Storehouse	None	NC
202 A-G Dehydrating Press House (6)	13	NC

Table 1.(cont.)
Contamination Status of Buildings and Equipment in the Leaseback Area

Building Series Name and Number	Contaminated Equipment (Number of Items)	Building Space and Equipment Surface Contaminants
Study Area 2 --Smokeless Powder Manufacturing Area		
206 A-C Ether Mix House (3)	*	Asbestos
207 A, 207 B Ether Manufacturing and Alcohol Rectification House (2)	*	Asbestos
207AA, 207BB Ether-Alcohol Storage Tanks (2)	*	*
208 A-F Mix Houses (6)	72	NC, DNT, Asbestos
209 A Scrap Reworking House (1)	7	NC, DNT
211 A-D Horizontal Press House (4)	53	NC, DNT, Asbestos
211 AB and 211 CD Solvent Recovery Pump House (2)	*	NC, DNT
213 A Solvent Recovery Car Wash and Dry Houses (1)	7	NC,DNT, asbestos
214 A-1 to A-16, B-1 to B-16 C-1 to C-16, Solvent Recovery Houses (48)	183	NC, DNT
214 AA to AA4, BB 1 to BB 4 CC 1 to CC 4 (12)	*	*
216 A and 216 B (2)	*	*
217 A Knife Grinding and Die Shop (1)	None	Asbestos
218 A to C Unloading and Screen House (3)	22	NC, DNT

Table 1. (cont.)
Contamination Status of Buildings and Equipment in the Leaseback Area

Building Series Name and Number	Contaminated Equipment (Number of Items)	Building Space and Equipment Surface Contaminants
219 A to E Water Dry House, Cannon Powder (5)	6	NC, DNT
220 A to F Controlled Circulation Dryers (6)	14	NC, DNT, Asbestos
227 A, 227 C, 227 E Dry Ingredients Storehouses (3) (in Leaseback Area)	None	NC, DNT
233 A Screen Cleaning House (1)	13	NC, DNT, Asbestos
234 A to G Vertical Press House (7)	118	NC, DNT, Asbestos
234A, to GG Solvent Recovery Pump House Vertical Presses (4)	4	NC, DNT
235 A to F Rifle Powder Water Dry House (6)	38	NC, DNT, Asbestos
236 A to D Sweetie Barrel House (4)	4	NC, DNT, Asbestos
237 A to G Tray Dryer House (7)	25	NC, DNT
251 A to B Activated Carbon Solvent Recovery Building (2)	40	NC, DNT, Asbestos
257 A DNT Service House (1)	3	DNT, Asbestos

NC Nitrocellulose
DNT Dinitrotoluene
TNT Trinitrotoluene
* Not surveyed

Source: Environmental Science and Engineering, Inc., 1980.

Table 2. Contaminated Industrial Sewers in the Leaseback Area--Smokeless Powder Manufacturing Area (Study Area 2)

Sewer Line Identification	Contaminant(s)	Status
Series 237 Buildings (Tray Dryer Houses)	Powder grains, NC, DNT	Contaminated, explosive/ chemical hazard
Series 235 and 236 Buildings (Rifle Powder Water Dry Houses, Sweetie Barrel Houses)	Powder grains, NC, DNT	Contaminated, explosive/ chemical hazard
Series 220 Buildings (Controlled Circulation Dryer Houses)	Powder grains, NC, DNT	Contaminated, explosive/ chemical hazard
Series 202, 251, 211, 206, 207, 234, 208 Buildings (Mixing and Extrusion Facilities)	NC, DNT, powder pellets	Contaminated, explosive/ chemical hazard
Series 219 Buildings (Cannon Powder Water Dry Houses)	NC, DNT, powder pellets	Contaminated, explosive/ chemical hazard
Series 214 Buildings (Solvent Recovery Houses and Sewer Truck Line)	NC, DNT, powder pellets	Contaminated, explosive/ chemical hazard

Note: DNT = dinitrotoluene
NC = nitrocellulose

Source: Environmental Science and Engineering, Inc., 1980.

Table 3. Sumps in the Leaseback Area--Nitrocellulose Manufacturing Area (Study Area 1)

Building Number	Building Type	Number of Sumps
102-A	Tank Farm	0
102-B	Tank Farm	0
102-C	Tank Farm	0
104-A	Wood Pulp Dry House	0
104-B	Cotton Dry House	0
104-C	Cotton Dry House	0
105-A	Nitrating House	0
105-B	Nitrating House	0
105-C	Nitrating House	0
106-A	Spent Acid Filter House	0
106-B	Spent Acid Filter House	0
106-C	Spent Acid Filter House	0
108-A	Boiling Tub House	1
108-B	Boiling Tub House	1
108-C	Boiling Tub House	1
109-A	Pulping House	0
109-B	Pulping House	0
109-C	Pulping House	0
111-A	Slurry Tank House	0
111-B	Slurry Tank House	0
111-C	Slurry Tank House	0
112-A	Poacher Tub House	0
112-B	Poacher Tub House	0
112-C	Poacher Tub House	0
113-A	Blend/Final Wring House	0
113-B	Blend/Final Wring House	0
113-C	Blend/Final Wring House	0
120-A	Save-All Tank	4
120-B	Save-All Tank	4
120-C	Save-All Tank	4
122-B	Wood Pulp Dry House	0
TOTAL		15

Source: Environmental Science and Engineering, Inc., 1980.

Table 4. Sumps in the Leaseback Area--Smokeless Powder Manufacturing Area (Study Area 2)

Building Number	Building Type	Number of Sumps
201-A	Nitrocellulose Storage House	0
201-B	Nitrocellulose Storage House	0
201-C	Nitrocellulose Storage House	0
202-A	Dehydrating House	1
202-B	Dehydrating House	1
202-C	Dehydrating House	1
202-E	Dehydrating House	1
202-F	Dehydrating House	1
202-G	Dehydrating House	1
202-L	Dehydrating House	0
202-M	Dehydrating House	0
203-A	Ether/Alcohol Tanks	0
207-A	Ether/Alcohol House	4
207-B	Ether/Alcohol House	3
208-A	Mixer House	3
208-B	Mixer House	4
208-C	Mixer House	4
208-D	Mixer House	3
208-E	Mixer House	3
208-F	Mixer House	3
209-A	Scrap Rework House	1
211-A	Horizontal Press House	1
211-B	Horizontal Press House	1
211-C	Horizontal Press House	1
211-D	Horizontal Press House	1
211-AB	Solvent Recovery House	0
211-CD	Solvent Recovery House	0
213-A	Solvent Recovery Car Wash	1
214-A1 thru A16	Solvent Recovery House	16
214-B1 thru B16	Solvent Recovery House	16
214-C1 thru C16	Solvent Recovery House	16

Table 4. Sumps in the Leaseback Area--Smokeless Powder Manufacturing Area (Study Area 2) (Continued, Page 2 of 3)

Building Number	Building Type	Number of Sumps
217-A	Knife Grinding House	0
218-A	Screening House	1
218-B	Screening House	1
218-C	Screening House	1
219-A	Water Dry House	1
219-B	Water Dry House	1
219-C	Water Dry House	1
219-D	Water Dry House	1
219-E	Water Dry House	1
220-A	Controlled Circulation Dryer	1
220-B	Controlled Circulation Dryer	1
220-C	Controlled Circulation Dryer	1
220-D	Controlled Circulation Dryer	1
220-E	Controlled Circulation Dryer	1
220-F	Controlled Circulation Dryer	1
222-A	Transfer House	0
222-B	Transfer House	0
233-A	Screen Cleaning House	1
234-A	Vertical Press House	1
234-B	Vertical Press House	1
234-C	Vertical Press House	1
234-D	Vertical Press House	2
234-E	Vertical Press House	1
234-F	Vertical Press House	1
234-G	Vertical Press House	1
234-AB	Solvent Recovery House	0
234-CD	Solvent Recovery House	0
234-EF	Solvent Recovery House	0
234-GG	Solvent Recovery House	0
235-A	Rifle Powder Water Dry House	2
235-B	Rifle Powder Water Dry House	2
235-C	Rifle Powder Water Dry House	2
235-D	Rifle Powder Water Dry House	2
235-E	Rifle Powder Water Dry House	2
235-F	Rifle Powder Water Dry House	2

Table 4. Sumps in the Leaseback Area--Smokeless Powder Manufacturing Area (Study Area 2) (Continued, Page 3 of 3)

Building Number	Building Type	Number of Sumps
236-A	Sweetie Barrel House	3
236-B	Sweetie Barrel House	3
236-C	Sweetie Barrel House	3
236-D	Sweetie Barrel House	3
237-A	Tray Dry House	3
237-B	Tray Dry House	3
237-C	Tray Dry House	3
237-D	Tray Dry House	3
237-E	Tray Dry House	3
237-F	Tray Dry House	3
237-G	Tray Dry House	3
251-A	Activated Carbon House	2
251-B	Activated Carbon House	3
257-A	DNT Service House	2
TOTAL		162

Source: Environmental Science and Engineering, Inc., 1980.

Table 5. Alabama Army Ammunition Plant Soil Contaminants
(Leaseback Area)

Contaminant	Area	Observations
2,4 - DNT and 2,6 - DNT	2	Less than 112-1140 ppb
lead	1	Less than 10 - 3000 ppm
1,3,5 - Trinitrobenzene (TNB)	2	614 ppb

Source: Rockwell, 1982

The Environmental Science and Engineering Survey (1981) identified the presence of substantial amounts of friable asbestos in the Leaseback Area buildings. In the northeastern portion of the Leaseback Area, propellant grains were found at the outflow of the industrial sewer system serving the tray dry houses (the 237 series buildings). Contamination was also found throughout the industrial sewer system of the Leaseback Area.

ALTERNATIVES EVALUATION

The work in the Leaseback Area covered two elements of the Defense Environmental Restoration Program: Installation Restoration Program (IRP) and Building Demolition and Debris Removal (BD/DR). Though the two elements can be essentially independent, alternatives for implementation of cleanup under the IRP necessitated BD/DR. This had to be taken into consideration in evaluating the alternatives. For example, alternatives involving equipment salvage were considered for the Leaseback area. Another factor in the selection of the final alternative was the time constraint under which the Rockwell International Energy Systems Group (hereafter referred to as Rockwell), the contractor for the final cleanup, had to operate. The site had to be returned to Kimberly Clark by August 1983 and Rockwell had 15 months beginning September 1981 to decontaminate the Leaseback Area.

A Feasibility Study was conducted by Environmental Science and Engineering (ESE, 1980). Decontamination alternatives were grouped under the following heads:

ASBESTOS

There are four alternatives for disposition of friable asbestos and Transite in the Leaseback Area. One alternative includes flashing Transite to destroy explosives contamination. This one and two others also involve removal, packing in leakproof containers, and sanitary landfilling. A fourth alternative consists of patching or covering Transite walls with wallboard

and plaster to seal in asbestos. Evaluation of the decontamination alternatives for asbestos are summarized in Table 6.

The safety of decontamination workers is the most important consideration, both in flashing Transite and in handling friable asbestos. Technical feasibility, that is, the degree of decontamination or isolation of asbestos, is also of prime importance in all alternatives. Regulatory constraints in the form of asbestos processing/disposal regulations is another key factor.

EQUIPMENT

There are six alternatives for equipment disposition. They include options for destruction, landfill, salvage, and isolation/maintenance. Evaluations of the decontamination alternatives for equipment in the Leaseback Areas are summarized in Table 7.

The alternatives are split into two broad categories, those dealing with salvageable equipment and those dealing with nonsalvageable equipment.

Non-salvageable equipment can be decontaminated either with the building or separately. Equipment can be burned along with buildings scheduled for destructive flashing. However, non-salvageable equipment must be removed from buildings that are not scheduled for destructive decontamination.

Flashing of some equipment may require using a hand-held torch, which is hazardous to the workers involved. Dismantling and reselling equipment is time-consuming, and removal from AAAP property may not be completed within the schedule for release of the Leaseback Area.

Table 6. Evaluation Summary of Decontamination Alternatives for Asbestos in Buildings, Walls, Siding, and Pipe Insulation - Leaseback Area

Alternatives	Basis (Number of Units)	Net Cost (Thousands $)	Schedule
1A-Transite Contaminated with Explosives			
Non-Destructive Decontamination: Remove, Containerize, and Dispose	**	1,695	6 months.
IB-Non Contaminated Transite			
Remove, Containerize, and Dispose	**	1,596	6 months.
IC-Patch and Cover			
Without Torching	**	157	4 months.
With Torching	**	235	4 months
ID-Friable Asbestos			
Spray with Binder; Remove, Containerize, and Dispose	**	415	2 months

Net cost is 150 percent of raw costs to cover contingency fund, overhead, and profit.

**Assumptions

1. 60 buildings.
2. 900 m^2 Transite each.
3. 80 m^2 friable asbestos each.
4. Approximately 3 weeks per 3-man crew per building.

Source: Environmental Science and Engineering, Inc., 1980.

Table 7. Evaluation Summary of Decontamination Alternatives for Equipment Leaseback Area

Alternatives	Basis (Number of Units)	Net Cost (Thousands $)	Schedule
2A-Salvageable Equipment Non-Destructive Decontamination	**	249	
2B-Salvageable Scrap Destructive Decontamination	**	38.5	
2C-Salvageable Equipment Equipment Not Contaminated	NA	80.0	
2D-Non-Salvageable Equipment Decontaminate with Building, Removed Debris	NA	***	
2E-Non-Salvageable Equipment Decontaminate Separately, Remove and Burn	**	83.5	
2F-Non-Salvageable Equipment Equipment Not Contaminated	NA	80.0	

Net Cost is 150 percent of raw costs to cover contingency fund, overhead, and profit.

**Assumptions:

1. 200 pieces of salvageable equipment (contaminated) at an average cost of $500.00 per piece.
2. 200 pieces of salvageable equipment (non-contaminated).
3. 100 pieces of equipment salvageable as scrap (contaminated)
4. 217 pieces of non-salvageabele equipment; remove and burn.
5. 217 pieces of non-salvageable equipment; remove only.

No decontamination required, removal only.

***Included in cost of decontaminating building.

NA=Not applicable

Source: Environmental Science & Engineering, Inc. 1980.

BUILDINGS

Three alternatives are assessed for the decontamination of buildings in the Nitrocellulose Manufacturing Area (Study Area 1), Table 8, and Smokeless Powder Manufacturing Area (Study Area 2), Table 9.

Worker safety is the most important consideration in the two flashing alternatives. The technical feasibility of hand-held flashing and track-mounted flashing is questionable in many applications. Technical feasibility with respect to both the complete destruction of contaminants and damage to salvageable buildings is a problem in non-destructive techniques. Regulatory constraints and scheduling problems assume importance in landfilling hazardous wastes on site. Regulatory constraints are also a key factor in on-site sanitary landfill development. Although the permitting leadtime for a sanitary landfill is not nearly as great as for a hazardous waste site, on-site sanitary landfilling may not be feasible within Leaseback Area release deadlines.

INDUSTRIAL SEWERS AND SUMPS

Explosives-contaminated industrial sewers and sumps occur in the Smokeless Powder Manufacturing Area (Study Area 2) in the Leaseback Area. Six alternatives for decontamination of sewers and sumps are identified. The alternatives are flashing, flushing, plugging, excavating/flashing/refilling, excavating/hauling/landfilling, and mechanical cleaning. Closed-circuit television inspection is part of all alternatives. Evaluation of the decontamination alternatives for industrial sewers and sumps in the Leaseback Area are summarized in Table 10.

Because of the relative inaccessibility of the sewers, technical feasibility is a major consideration in all but the plugging alternative. Worker safety is also important because of the presence of relatively high concentrations of propellants in confined quarters. Television inspection is the first step in all cleanup operations. This method enables workers to

Table 8. Evaluation Summary of Decontamination Alternatives for Buildings Nitrocellulose Manufacturing Area (Study Area 1)

Alternatives	Basis (Number of Units)		Net Cost (Thousands $)	Schedule
3A-Destructive Flashing, Clean up Residues, Decontaminate Surrounding Land	**		80	9 months
3B-Destructive Flashing, Demolish, Remove Remaining Debris, Decontaminate Surrounding Land	**	Landfill		
		On-Site	354	1 month
		Off-Site	361	2 months
3C-Demolish, Remove Debris Decontaminate	**	Landfill		
		On-Site	176	2 months
		Off-Site	195	3 months

Net cost is 150 percent of raw costs to cover contingency fund, overhead, and profit.
**32 buildings; 14,864 m^2.

Source: Environmental Science and Engineering, Inc., 1980

Table 9. Evaluation Summary of Decontamination Alternatives for Buildings-Smokeless Powder Manufacturing Area (Study Area 2)

Alternatives		Basis (Number of Units)	Net Cost (Thousands $)	Schedule
4A				
Non-Destrucive Flashing		**	231	12 months
Clean Up Residue				
Decontaminate				
Surrounding Land				
4B				
Destructive Flashing,	Landfill	**		
Demolish, Remove	On-Site		998	2 months
Decontaminate	Off-Site		1,020	3 months
Surrounding Land				
4C				
Demolish, Remove Debris	Landfill	**		
Decontaminate	On-Site		502	4 months
Surrounding Land	Off-Site		554	5 months

Net cost is 150 percent of raw costs to cover contingency fund, overhead, and profit.
**91 buildings; 42,270 m^2.

Source: Environmental Science and Engineering, Inc. 1980.

Table 10. Evaluation Summary of Decontamination Alternatives for Industrial Sewers and Sumps - Smokeless Powder Manufacturing Area (Study Area 2)

Alternatives		Basis (Number of Units)	Net Cost (Thousands $)	Schedule
5A				
Flash:				
Charcoal		**	168	3 months
Solvent		**	152	3 months
5B				
Flush and Treat Flushing Water on Site		**	92.2	3 months
5C				
Plug with Concrete		**	59	3 months
5D				
Excavate Sewers; Flash with Charcoal, Refill with Soil and Debris		**	2,689	3 months
5E				
Excavate Sewers, Remove and Haul to Hazardous Waste Landfill	Landfill	**		
	On-Site		3,179	3 months
	Off-Site		10,312	3 months
5F				
Television Inspection and Mechanical Cleaning		**	296	3 months

Net cost is 150 percent of raw costs to cover contingency fund, overhead, and profit.
**56 manholes and 141 sumps.

Source: Environmental Science and Engineering, Inc., 1980

accurately assess the amount of visible contamination in sewers. Television inspection can contribute to overall safety by identifying gross contamination. Breaks in the sewer lines may be locatable by this method.

Flashing, flushing, and mechanical cleaning may be halted by the presence of large blockages in the sewer lines. Flushing can be complicated by breaks in the sewer line which may introduce flushing water and contaminants into the soil and increase the potential for groundwater contamination. Flushing water can be treated using a truck-mounted activated carbon system. Treated effluent can be land-sprayed on site. Used carbon can be removed by the contractor for regeneration or disposal. This cost is included in the overall treatment cost. Plugging may not prove an effective means of dealing with contamination if unknown amounts of smokeless powder pellets are allowed to remain in the sewers. However, plugging is the most easily implemented alternative.

Excavation of sewer lines for decontamination and/or landfilling is complicated by the presence of concrete on the sides and tops of the sewers. Several crews with extensive equipment support would be required to accomplish this task within the required time schedule.

SOIL

Soil contamination in the Leaseback Area is confined to the immediate vicinity of the existing buildings and process pipelines and consists of propellants and small amounts of friable asbestos insulation and Transite. All three soil decontamination alternatives are potentially applicable in this area. Because Leaseback Area buildings are essentially intact, contaminants are primarily contained within and have not been introduced into large areas of the soil. Evaluations of decontamination alternatives for soil in the Leaseback Area are summarized in Tables 11 and 12.

Worker safety and effectiveness of decontamination are the fundamental considerations of the flashing alternative. Decontamination effectiveness

Table 11. Evaluation Summary of Decontamination Alternatives for Soil - Nitrocellulose Manufacturing Area (Study Area 1)

Alternatives		Net Cost (Thousands $)	Schedule
6A Flash Soil in Situ, Revegetate		19.6	2 months
6B Strip Contaminated Soil, Haul and Landfill	Landfill	17.2	1 week
Backfill w/Clean Soil Revegetate	On-Site	127.0	2 weeks
6C Apply Impervious Cap	Asphalt	1.56	1 month
	Clay	1.3	1 month
	Concrete	7.96	1 month

Net cost is 150 percent of raw costs to cover contingency fund, overhead, and profit.

Source: Environmental Science and Engineering, Inc., 1980.

Table 12. Evaluation Summary of Decontamination Alternatives for Soil - Smokeless Powder Manufacturing Area (Study Area 2)

Alternatives		Net Cost (Thousands $)	Schedule
7A Flash Soil *in situ* Revegetate		55.7	6 months
7B Strip Contaminated Soil Haul and Landfill, Backfill with Clean Soil, Revegetate	Landfill On-Site Off-Site	 48.9 361.0	 3 weeks 6 weeks
7C Apply Impervious Cap	Asphalt: Clay: Contrete:	4.4 3.65 22.6	3 months 3 months 3 months
7D Remove Drums from Old Well	NA	NA	NA

Net cost is 150 percent of raw costs to cover contingency fund, overhead, and profit.

Source: Environmental Science and Engineering, Inc., 1980.

directly impacts the factors of environmental hazard, public health and safety, and the technical feasibility of the alternative.

Regulatory constraints and scheduling (development and permitting leadtime) are limiting factors in on-site hazardous waste landfilling. On-site hazardous waste landfill development cannot be accomplished within Leaseback Area deadlines. It may be marginally feasible to develop a sanitary landfill in the GSA or Industrial Areas within the leaseback Area timeframe. Energy consumption for hauling is a key factor in off-site hazardous waste landfilling. From a time viewpoint, off-site hauling is highly feasible. The integrity of isolation is importrant to the feasibility of capping. Allowing contamination to remain in place can also limit future land use. Capping is more applicable to small areas of greater contamination than to large areas.

An assessment of total costs for the decontamination operation is listed in Table 13. Because of the inter-dependency of alternatives between the different groups described above and the time constraint the set of minimum cost alternatives was not feasible.

Table 13. Summary of Total Costs for Leaseback Area Decontamination

Component	Minimum Alternative	Minimum (Net Cost)* (thousand $)	Maximum Alternative	Maximum (Net Cost)* (thousand $)
Equipment	IVA thru IVF	299	IVA thru IVF	299
Asbestos	VC, VD	572	VA, VD	2,074
Buildings	IIIA	310	IIIC	6,610
Soil	IC	5	IB	489
Industrial Sewers & Sumps	VIC	59		296
TOTAL		1,245		9,768

* Net cost is 150 percent of raw costs to cover contingency fund, overhead, and profit.

Source: Environmental Science and Engineering, Inc., 1980.

SELECTED REMEDY

ASBESTOS REMOVAL

Rockwell carried out an independent assessment of contamination around the Leaseback Area. Their survey illustrated in greater detail, the nature and extent of the contamination. Based on this data and those from earlier surveys, Rockwell excluded the remedial actions for different facets of the Leaseback Area. Because of the time constraint and the diverse nature of the contamination, some of the selected remedies were different from those evaluated as being the best by ESE (1980) from a cost point of view. The decontamination operations were subsequently approved by USATHAMA.

Before the decontamination operations could begin, it was necessary that all friable asbestos be removed from the buildings. Option 1D (Table 6) was the selected alternative. After being thoroughly wetted, the friable asbestos was placed in plastic bags marked with appropriate warning labels. The bags were tightly sealed and transported to a sealed asbestos repository located adjacent to the Leaseback Area (Fig. 5)

INTERMEDIATE RESPONSE ACTION

While preparing the buildings for decontamination, Rockwell found several oil insulated electrical switches that contained PCBs in excess of 50 ppm. (The levels of PCBs in the oil were of the order of 100 to 500 ppm). With one exception, these switches were all found in buildings in the nitrocellulose production area. In addition, hundreds of implements containing mercury, such as thermometers, mercury switches and instrumentation relays were found.

Proposals for removal were submitted by Rockwell to USATHAMA. Subsequent to USATHAMA's approval, the PCB and mercury contaminated implements were transported to Chemical Waste Management's waste disposal

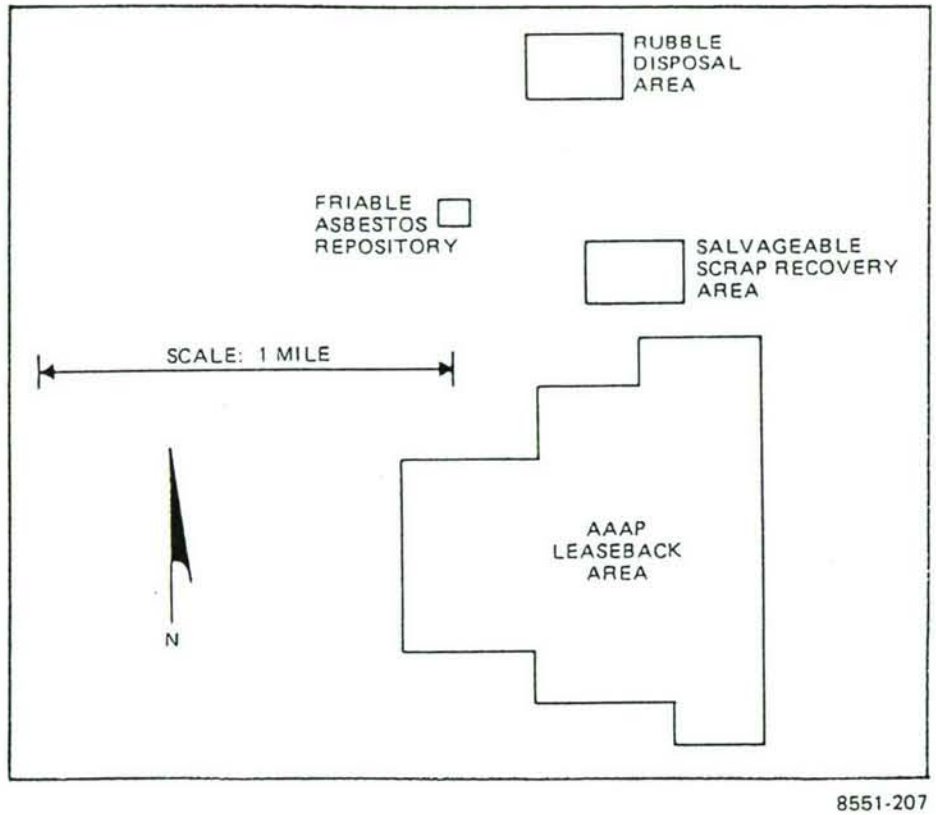

Figure 5. Location of Repository and Rubble Disposal Sites

facility at Emelle, Alabama (under EPA generator number ALD980604003). As of 1982, Chemical Waste Management landfill was one of only two licensed PCB disposal facilities in eastern U.S. All removal and disposal operations were conducted in accordance with applicable Federal and State of Alabama hazardous waste management regulations.

DECONTAMINATION OF BUILDINGS

Further survey and study by Rockwell indicated that burning was the most feasible alternative for decontaminating buildings after all friable asbestos, PCB and mercury contaminated components were removed. This allowed completion of decontamination operations at a moderate cost within a short time span. Preparations included loading straw and wood dunnage into the building and spraying the dunnage with diesel fuel. The mix was ignited using road flares or electrically fired igniters. Certipak data was collected to verify the decontamination.* (See below)

DECONTAMINATION OF SEWERS, FLOOR DRAINS, SUMPS AND BASEMENTS

Rockwell decided to excavate and decontaminate approximately 47,000 feet of the industrial sewer system. The decontamination was carried out using hand held flamer rigs. Decontaminated sewer sections were hauled to the rubble disposal site by the demolition contractor for final disposal (Fig. 5).

The floor drains were decontaminated by flashing explosives using explosive techniques which incinerated any residues in the drain to a non-reactive condition. The subsurface sumps, basements and tanks were decontaminated using compressed air and a mixture of wood and charcoal doused with diesel fuel. The dunnage was ignited with lighted road flares. The heat produced in the decontamination process was an effective decontaminant.

* A certipak is a temperature sensitive device whose changes in physical form indicate whether the temperature was high enough to achieve complete decontamination of explosive residues in buiding.

PROPELLANT GRAIN DECONTAMINATION

The propellant grain contamination in area 237 sewer outflow area was excavated and placed in nearby buildings before decontamination. The buildings were decontaminated by burning. This minimized expenses for this part of the decontamination operations.

DEMOLITION/SALVAGEABLE SCRAP REMOVAL

Data gathered by ESE (1980) and Rockwell (1982) indicated that 193 buildings in the Leaseback Area would have to be decontaminated. During this decontamination, 145 were demolished and their rubble hauled to a rubble disposal area located within AAAF just north of the Leaseback Area (Fig. 5).

Salvageable metal scrap like tanks, pumps, equipment, process lines and structural steel which were readily retrievable were hauled to a storage area just north of the Leaseback Area (Fig. 5). Two subcontractors were used for this work:

1) Wrecking Corporation of America, St., Louis Inc., Alexandria, Virginia, for excavating sewers.

2) Asphalt Products, Inc., Childersburg, Alabama, for rubble cleanup/-removal and salvageable scrap storage.

After completing demolition and salvageable scrap removal operations, the entire Leaseback Area was disked and inspected by Rockwell and USATHAMA representatives.

SCHEDULE

The schedule for the decontamination of the Leaseback Area is shown in Figure 6. The decontamination operations began with the removal of friable asbestos in mid-December 1981 and ended with the final decontamination burns at the end of July 1982. The demolition of decontaminated buildings and the disposal of rubble and scrap metal recovery was completed by September 1982.

PROJECT SCHEDULE

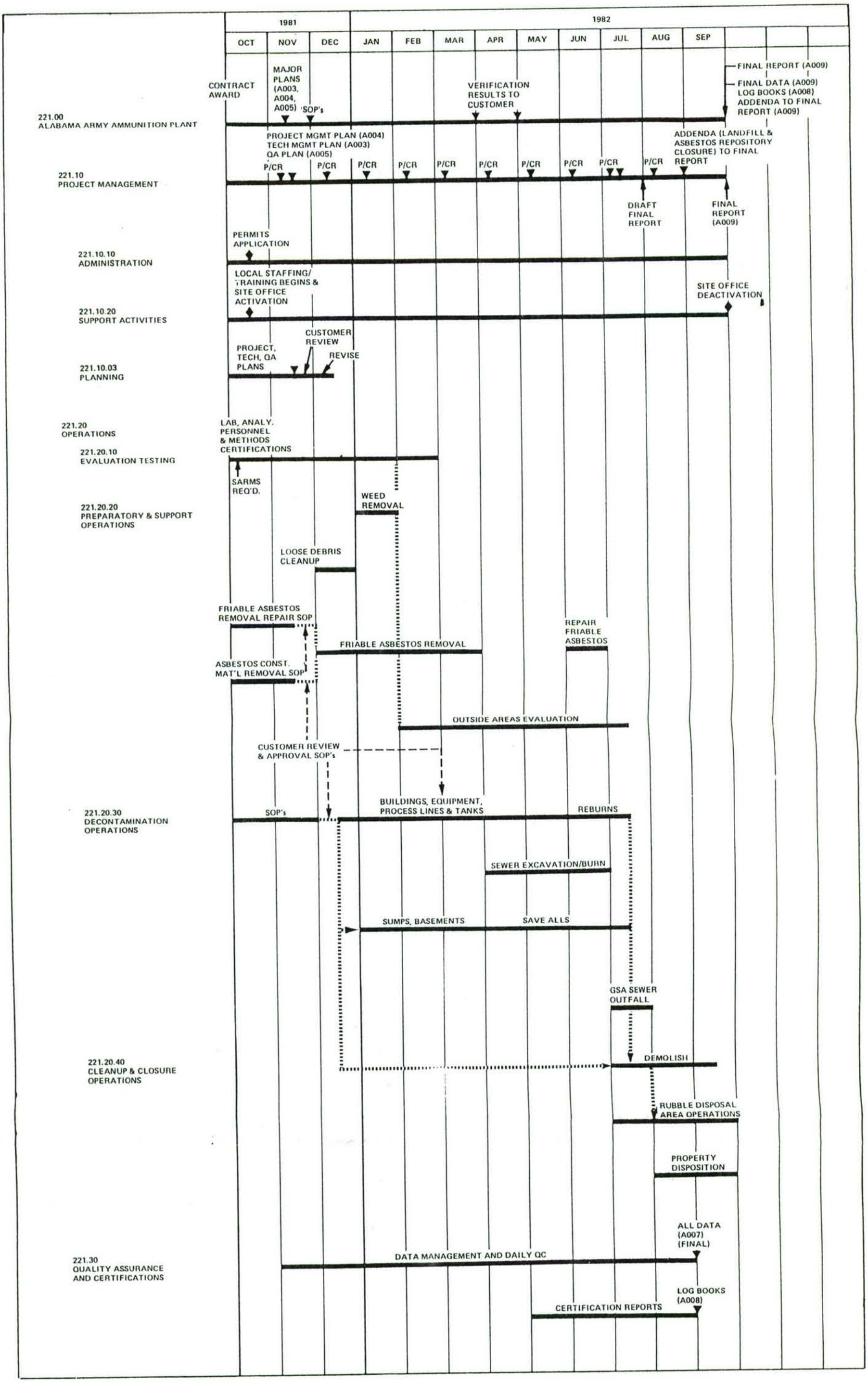

Figure 6 Project Schedule

REFERENCES

1. Environmental Science and Engineering, Inc. "Alabama Army Ammunition Plant Feasibility Study". Draft Report. ESE, (1986).

2. Environmental Science and Engineering, Inc. "Environmental Survey of Alabama Army Ammunition Plant". ESE, (1981).

3.. Environmental Science and Engineering, Inc. "Evaluation of Decontamination Alternatives, GSA and Leaseback Areas, Alabama Army Ammunition Plant." ESE, (1980).

4. Rockwell International Atomics International Division, Energy Systems Group. "Final Report for the Alabama Army Ammunition Plant, Leaseback Area, Decontamination Operations Project". (1982)

5. Rosenblatt, D.H., J.C. Dacoe and D.R. Cogley. An environmental fate model leading to preliminary pollutant limit values for human health effects. Technical report 8005, ADB0459917L. U.S. Army Medical BioEngineering Research and Development Laboratory, Fort Detrick, Frederick, MD. (1980).

6. U.S.A.T.H.A.M.A. Installation Restoration Program (30 June 1987).

7. U.S. Environmental Protection Agency (EPA). Office of Waste Programs Enforcement. "The Endanger Assessment Handbook." Washington, D.C. Prepared by PRC Engineering, Chicago, IL. (1985)

Figure 3