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FINAL EXPANDED SITE INSPECTION

STAUFFER CHEMICAL COMPANY
BENTONVILLE, VIRGINIA

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Prepared for:

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1.0 INTRODUCTION

PRC Environmental Management, Inc. (PRC) was assigned by the U.S. Environmental Protection Agency (EPA) to conduct an expanded site inspection (ESI) of the Stauffer Chemical site under Contract No. 68-S5-3002, Technical Directive Document (TDD) No. 03-97-01-110.

The primary objective of an ESI is to determine if a site has the potential to be placed on the National Priorities List (NPL). The NPL identifies sites at which releases or threatened releases of hazardous substances pose a risk to public health or the environment sufficiently serious to warrant further investigation and possible remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Information gathered during the ESI will be used to generate a preliminary score under the Hazard Ranking System (HRS). The HRS is the primary criterion EPA uses to determine whether a site should be placed on the NPL (Federal Register 1990). ESIs are usually conducted at sites at which additional environmental sampling or installation of monitoring wells is necessary to fulfill the documentation requirements of the HRS and to address issues not adequately resolved through previous investigations.

Specifically, the objectives of the ESI for the Stauffer Chemical site are:

- To investigate and document necessary hypotheses or assumptions not completely tested during previous investigations
- To collect samples to support attribution of hazardous substances to operations conducted at the site
- To collect samples to establish representative background levels
- To collect any other data required under the HRS that have not yet been gathered
- To document current conditions at the site
- To assess the need for emergency response actions

This report documents the results of an ESI conducted at the Stauffer Chemical site, located in Bentonville, Warren County, Virginia. PRC obtained and reviewed information from the Commonwealth of Virginia, State Water Control Board (SWCB), and CERCLA files maintained by EPA Region 3. PRC conducted a site reconnaissance of the Stauffer Chemical site on July 31, 1996 (PRC 1996a). This reconnaissance included a visual inspection of the site and a review of deed information at the county court house. On the basis of information obtained during the site reconnaissance, PRC prepared a sampling plan for the ESI (PRC 1996b) and submitted the plan to EPA for approval. After EPA approved the sampling plan, PRC returned to the site on September 10-11, 1996 and collected 15 surface-water samples, 8 sediment samples, 10 soil (waste) samples, and 11 home well samples (PRC 1996a). The data validation reports are included as Appendix A.

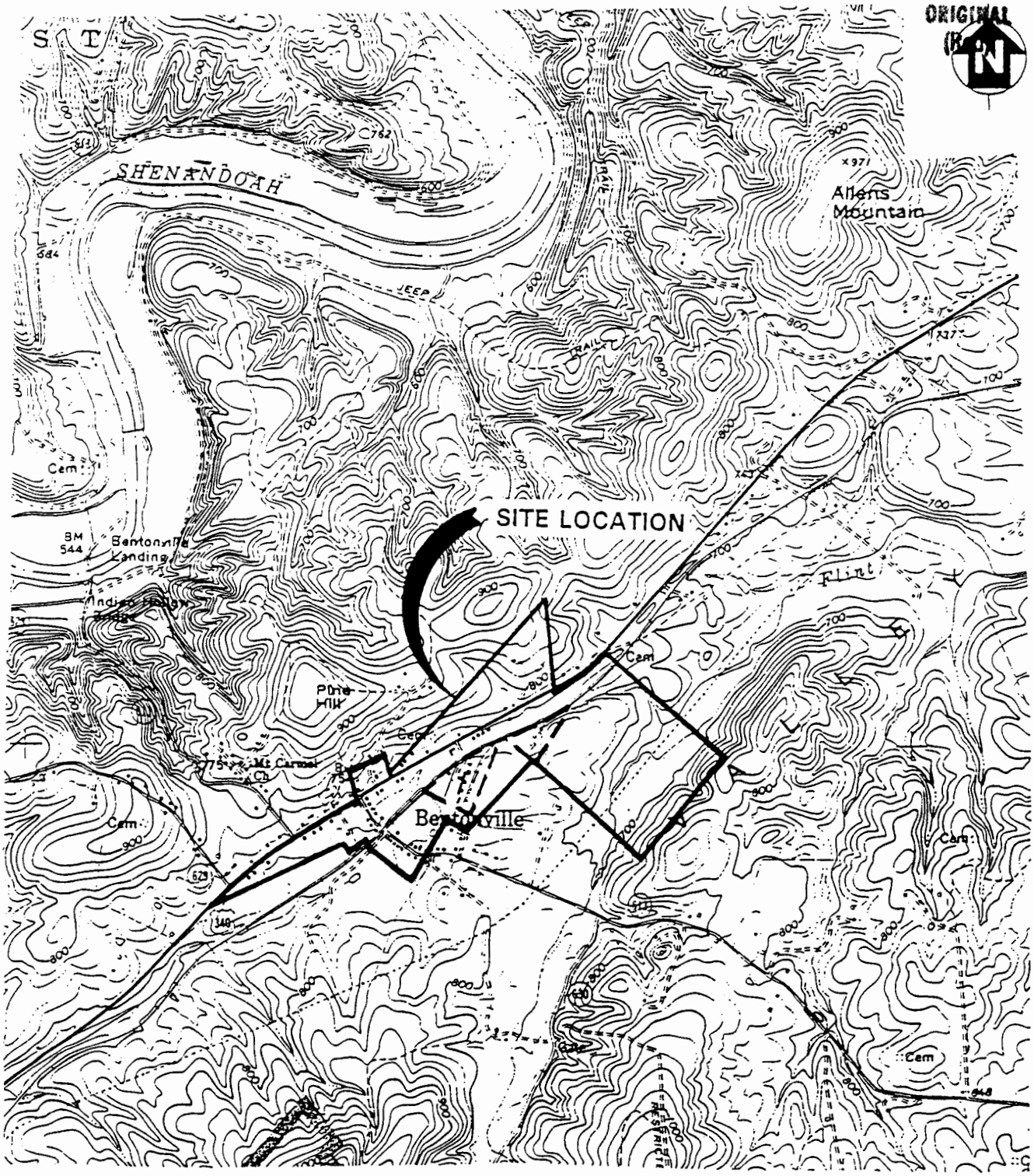
All field activities and quality assurance and quality control (QA/QC) procedures were conducted in accordance with the procedures set forth in the following documents: Guidance for Performing Site Inspections Under CERCLA, Interim Final, EPA, September 1992; A Compendium of Superfund Field Operations Methods, Office of Emergency and Remedial Response, EPA, December 1987; Quality Assurance/Quality Control Guidance for Removal Activities, EPA, April 1990; Data Quality Process for Superfund, Office of Emergency and Remedial Response, EPA, September 1993; and PRC's standard operating procedures (SOP).

2.0 SITE DESCRIPTION

This section describes the Stauffer Chemical site. It also discusses former operations and waste disposal practices, the site's regulatory history, and its current status.

2.1 SITE LOCATION

The Stauffer Chemical site is a former carbon disulfide manufacturing plant, approximately 26 acres in size, located in Bentonville, Warren County, Virginia (Figure 1). The site is located at the end of Bubb Lane, which is approximately 0.20 mile southeast of the intersection of U.S. Route 340 and State Route 613, off Route 613. The site location is shown on the United States Geological Survey (USGS) 7.5-minute series topographic map of Bentonville, Virginia, at coordinates north 38°49′58″ latitude and west 78°18′47″ longitude (USGS 1972; PRC 1996a).



SCALE 1:24000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

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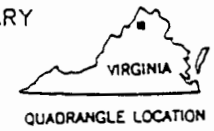
LEGEND

APPROXIMATE SITE BOUNDARY FROM 1945 TO 1957

AREA OF CONCERN



QUADRANGLE LOCATION

SOURCE: MODIFIED FROM USGS BENTONVILLE QUAD, 1972

STAUFFER CHEMICAL SITE
BENTONVILLE, VIRGINIA

FIGURE 1
SITE LOCATION

PRC ENVIRONMENTAL MANAGEMENT, INC.

2.2 SITE LAYOUT

The primary land use in the vicinity of the Stauffer Chemical site is residential. Adjacent to the site to the north are residences, a gas station/convenience store, and railroad tracks; to the east are Quail Hollow Estates (undeveloped except for one home), residences, and a farm; and to the south and west are residences (Figure 2). The gas station is the former office of the Stauffer Chemical facility (PRC 1996a).

Previous investigations indicated that the original size of the Stauffer Chemical site was 112 acres. A deed search revealed that the original size was actually 124 acres (Figure 1) (Application Title 1996). A review of aerial photographs for the Stauffer Chemical site revealed two areas of concern, one of approximately 13 acres that comprised the production and storage areas (production area) of the former Stauffer Chemical Company (Stauffer) carbon disulfide plant, and another of approximately 13-acres that includes a brick dump and an acid pond (acid pond area) (Figure 3). The photographs indicate that the acid pond was not constructed until after production at the site ceased and therefore, was not part of the carbon disulfide operation (EPA 1993). While the acid pond existed, it received surface-water runoff from the northeast section of the production area and the brick dump. The approximate two-acre brick dump was used as a disposal area for ash and sulfur wastes (NUS Corporation [NUS] 1985; Stauffer 1983a). The acid pond has been drained, leaving a drainage ditch that flows along the southeast side of the brick dump and to the northeast, along railroad tracks, to an off-site pond known as the northeast pond (Figure 3) (EPA 1993).

Currently, the 13-acre production area contains the structures formerly used in the manufacturing of carbon disulfide. The retort house, also referred to as the main building, the largest structure on site, exhibits major deterioration and damage. The retorts have been removed, and trees and shrubs are growing in their place. A large furnace remains in the north portion of the retort house. A smoke stack stands adjacent to the west side of the furnace room. Along the eastern wall of the retort house is a concrete sump. Adjacent to the north side of the concrete sumps are two concrete storage bins where sulfur, as evidenced by green staining, was unloaded from railroad cars and stored. Railroad tracks run adjacent to the east side of the concrete sump. Adjacent to the southwest wall of the concrete sump is an unroofed area with cinder block and brick walls approximately 25 feet high, that opens into the retort

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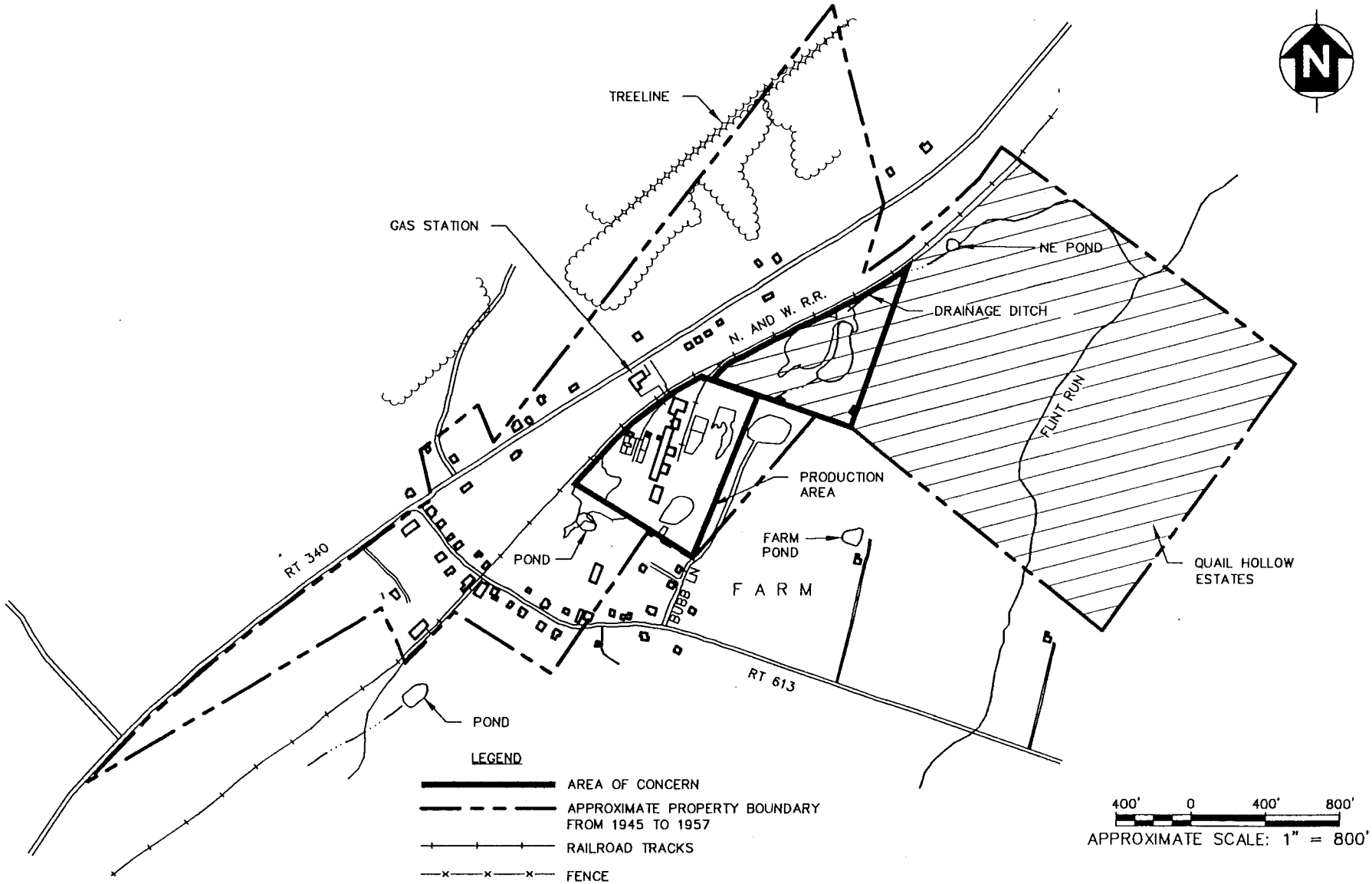

LEGEND

- AREA OF CONCERN
- APPROXIMATE PROPERTY BOUNDARY FROM 1945 TO 1957
- RAILROAD TRACKS
- FENCE
- PERENNIAL STREAM
- INTERMITTENT STREAM
- QUAIL HOLLOW ESTATES
- HOMES

400' 0 400' 800'

APPROXIMATE SCALE: 1" = 800'

SOURCE: MODIFIED FROM EPA VA-273, 1979
USGS BENTONVILLE QUAD, 1972
NUS, 1985

STAUFFER CHEMICAL SITE
BENTONVILLE, VIRGINIA

FIGURE 2
SURROUNDING LAND USE

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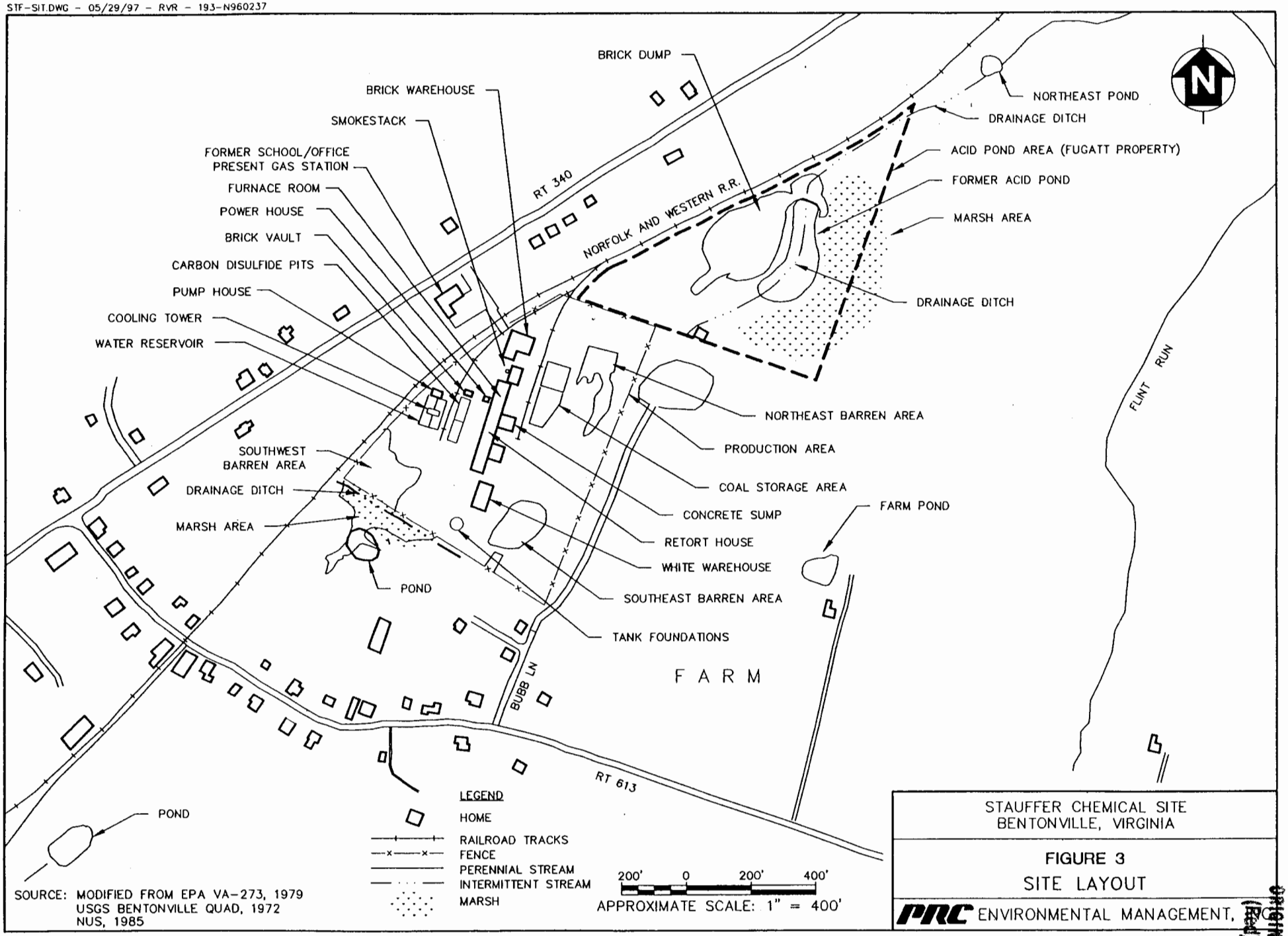

STAUFFER CHEMICAL SITE
BENTONVILLE, VIRGINIA

FIGURE 3

SITE LAYOUT

PRC ENVIRONMENTAL MANAGEMENT, INC.

ORIGINAL (Red)

house. Aerial photographs show this area to be filled with "dark-toned material," probably coal. Approximately 20 feet northeast of the concrete sump is a coal storage area approximately 200 feet by 50 feet in size. The coal storage area has an asphalt bottom and is surrounded by a three-foot-high wall of cinder blocks (Figure 3). Aerial photographs show large quantities of coal stored in that area during the period in which the plant was in operation (EPA 1993; NUS 1985; PRC 1996a).

North and south of the retort house are the brick warehouse and a second warehouse known as the white warehouse, respectively. Adjacent to the west wall of the retort house is a power house (Figure 3), and on the west side of the power house is a round in-ground steel structure approximately five feet in diameter and four feet deep. West of the steel structure is an in-ground brick vault that has two steel plate covers. The purpose of the round structure and the concrete vault has not been determined. Northwest of the brick vault are tank foundations (NUS 1985; PRC 1996b).

Two carbon disulfide pits, each approximately 5,000 square feet in size and 2 feet deep, are located west of the retort house adjacent to railroad spurs. A cooling tower, two water reservoirs, and a pump house are located west of the carbon disulfide pits (Figure 3) (EPA 1993; PRC 1996b).

Several fire hydrants, a gas well, and two railroad spurs are located in the production area. A barren area formerly used for the disposal of ash and sulfur wastes, approximately 0.5 acre in size, is located in the southwest corner of the production area. South of the barren area is a spring, a wetland, and a drainage ditch. The drainage ditch flows north toward the railroad tracks (Figure 3). Flow from the drainage ditch to the railroad tracks is impeded by a three-foot-high gravel and earth berm (PRC 1996b).

2.3 OWNERSHIP HISTORY

Stauffer Chemical Company owned and operated a carbon disulfide manufacturing plant at the site from 1945 until its closure in 1957 [Virginia Department of Environmental Quality (VADEQ) 1994]. The site of approximately 124 acres encompassed homes for workers, open land, and the production area (Figure 1). In 1958, Stauffer sold the site, dividing it into many parcels (EPA undated (a); VADEQ 1994). The majority of the site was sold for residential development (Figure 2). The former office building currently is a gas station/convenience store and at one time was used as a religious school. The 13-acre production area was sold to Everett Habron. Mr. Habron had the 13-acre parcel

placed into a spendthrift trust whose trustees were Max Eugene Van Horn and Marjorie Lee Van Horn. After Max Van Horn died in 1989, Marjorie Van Horn petitioned to be removed as a trustee; this request was granted in 1990. The court did not appoint another trustee at that time, but may have appointed Phyllis Habron, widow of Everett Habron, as the substitute trustee in about 1993. Although the court has ruled that the spendthrift trust was a fraudulent conveyance, the property is apparently still owned by the trust, subject to the judgement lien of the First Bank of Strasburg

The acid pond and brick dump were sold to B.K. Haynes Corporation, a development company, which established Quail Hollow Estates (Figure 2). Quail Hollow Estates consists of approximately 95 acres, divided into six parcels. Each of those parcels has been sold to private residents. One of the properties, owned by Raymond Fugatt, is a 6.678-acre parcel, encompassing the acid pond and brick dump. Mr. Fugatt owns the only home that has been constructed in Quail Hollow Estates. Homes have not been constructed on the other parcels (Appalachian Title 1996; EPA 1996; PRC 1996a).

2.4 OPERATIONAL HISTORY AND WASTE CHARACTERISTICS

According to representatives of Stauffer, the site operated from approximately 1945 to 1957 as a carbon disulfide manufacturing plant. Carbon disulfide is a volatile organic solvent used in the manufacture of rubber, synthetic fibers, and an insect fumigant. The plant also may have produced munitions during the 1940s (VADEQ 1994; SWCB 1983a). The plant closed when use of natural gas became the cheapest way to produce carbon disulfide. According to neighbors, the site operated from 1945 to 1963 (NUS 1986). Aerial photographs show raw materials on site until 1958 (EPA 1993).

Representatives of Stauffer indicated that, at a maximum capacity, the site produced approximately 40 tons per day of carbon disulfide and approximately 20 tons per day of sodium hydrosulfide, a by-product of tail gas recovery. Raw materials used included dry sulfur; hardwood charcoal or oil coke; sodium hydroxide; and coal for fuel, with fuel oil as a standby (Stauffer 1983a).

Carbon disulfide was produced in retorts, typically oval or cylindrical vessels approximately one meter in diameter by three meters high, and constructed of chrome alloy steel or cast iron. One retort produced approximately five tons of carbon disulfide per day; therefore, the Stauffer Chemical site may have employed eight retorts (Kirk-Othmer 1993; Stauffer 1983a). An interview with a former Stauffer employee indicated that there were 20 retorts on site (SWCB 1983a). The retorts were fired by

powdered coal. Dry sulfur was vaporized and superheated in a pipe-coil heat exchanger in the furnace and was fed to the retort. The vaporized sulfur reacted with carbon in the reactor section above each retort to form carbon disulfide and hydrogen sulfide. This gas stream passed through various separation and condensation stages to separate the two materials and trace sulfur. The carbon disulfide product was distilled and condensed to form a liquid (Stauffer 1983a). The liquid carbon disulfide was stored in two open carbon disulfide pits under water until it was shipped off site on railroad cars from a railroad spur adjacent to the carbon disulfide pits [EPA undated (b)]. It is not known whether the carbon disulfide was stored in tanks located under water in the carbon disulfide pits or whether the carbon disulfide was stored directly in the pits. Because carbon disulfide is heavier than water, it could have been stored directly in the pits; however, it is more likely that the liquid was stored in underwater tanks.

Specific information on the storage of carbon disulfide at the Stauffer site is not available. However, carbon disulfide usually is stored in inert-blanketed, closed tanks. Normally, carbon disulfide is transferred from vessels or tank cars through a downpipe by displacement with an inert material such as water or nitrogen. Direct pumping requires special equipment and is dangerous because of the volatile and explosive nature of carbon disulfide. Carbon disulfide is normally padded with water in storage tanks and bulk containers (Kirk-Othmer 1993).

The hydrogen sulfide gas fraction of the carbon disulfide manufacturing process, after being separated from the carbon disulfide, was passed through an oil absorption system for purification and separation of traces of carbon disulfide and was absorbed with 50 percent sodium hydroxide to produce sodium hydrosulfide. The residual tail gas was incinerated (Stauffer 1983a).

Raw products were totally reacted in the process, except for waste sulfur, residual ash from the reaction, filter sludges from sodium hydrosulfide, and other furnace debris. Those wastes were disposed of on the property in the barren areas (Stauffer 1983a). Depending on the quality of the raw materials, deposits on the inside walls of the retort may have been scraped off approximately once a month and retorts replaced every one to two years, due primarily to corrosion by sulfur vapor (Kirk-Othmer 1993). These wastes also may have been disposed of on the site.

Because the production process required large quantities of powdered coal, large piles of coal can be seen on aerial photographs throughout the production area. Because the process also consumed and

produced large quantities of water, two large water reservoirs were located on site. It is not known whether the reservoirs were used solely for water supplies or used for both water supplies and to contain cooling water discharged from the plant. A structure in the center of the reservoirs appears to be a cooling tower where wastewater from the plant was probably discharged, cooled, and then stored in the reservoir for reuse (EPA 1993; PRC 1996a).

Aerial photographs of the production area show extensive scarring of the ground. The earliest photograph, taken September 3, 1945, shows a newly constructed plant. No raw products are visible on site. Aerial photographs taken on October 21, 1950, however, show coal in the coal storage area and large ground scars in the southwest corner of the production area and brick dump. The acid pond had not been constructed; however, an intermittent stream emerges from the brick dump. Railroad cars can be seen on site, and the carbon disulfide pits are covered with a roof. An aboveground tank is located along the western fenceline, north of the water reservoirs (EPA 1993).

A photograph, taken on May 30, 1958, shows coal in the coal storage area and other areas on site, as well as ground scarring in the southwest, southeast, and northeast corners of the production area and in the brick dump. According to representatives of Stauffer, production at the site ceased in 1957, and the property was sold in 1958. However, that account seems unlikely because the May 30, 1958, aerial photograph shows large quantities of coal stored on site and railroad cars present (EPA 1993).

Aerial photographs taken on April 10, 1964 show the acid pond adjacent to a large scarred area (the brick dump). It is not known how the acid pond was constructed. The production area appears to have been abandoned; there are no coal piles on site, and no railroad cars are visible. The carbon disulfide pits are no longer covered by a roof, and dark material can be seen in the northern pit (EPA 1993).

An aerial photograph, taken on September 1, 1970 shows ground scars in the southwest, southeast, and northeast corners of the production area and in the brick dump. Those areas probably were used for disposal of wastes. No activity is apparent at the site. No significant changes are visible in aerial photographs taken on March 23, 1976 and October 21, 1979 (EPA 1993).

Review of the site operations and aerial photographs indicates that the major sources of potential contamination remaining on the site include the areas of scarred ground located in the southwest, southeast, and northeast corners of the production area (barren areas) and the brick dump. Those areas

EPA also continued to investigate the site. On February 22, 1984, EPA's contractor, NUS Corporation, inspected the site, collecting residential groundwater, sediment, and surface water samples. No background or waste samples were obtained. High levels of metals were detected in two springs that lie south of the retort house, in the acid pond, in discharge from the acid pond to a drainage ditch (intermittent tributary of Flint Run Creek), and in discharge from the northeast pond. The northeast pond receives drainage from the acid pond. Table 1 summarizes the specific contaminants detected and their concentrations. High concentrations of iron, at 203,200 milligrams per kilogram (mg/kg), and PCB (Aroclor 1260), at 220 micrograms per kilogram (μg/kg) were detected in a sediment sample obtained from the concrete sump. Numerous metals were detected in the aqueous samples (NUS 1985).

In May 1986, NUS conducted a second SI at the Stauffer Chemical site. The purpose of that SI was to collect additional samples for analysis for metals that were to be used in completing a toxicological report (NUS 1986a). Samples of residential well water, surface water, soil, and waste were collected. The samples, which revealed significant concentrations of metals in surface water and waste, are summarized in Table 2. The toxicological report indicated that concentrations of chromium, zinc, iron, aluminum, copper, and nickel in the surface water samples from the two ponds exceeded criteria protective of aquatic life and, in the case of chromium, perhaps were sufficiently high to be corrosive to the skin of sensitive persons. Drainage from the two ponds (acid pond and northeast pond) ultimately flows into Flint Run Creek. The presence of notable levels of chromium, aluminum, and zinc in the downstream creek sample indicated that a release of those metals had occurred from the site. It was recommended that a closure plan be developed and implemented at the site that included draining the two ponds and conducting groundwater and surface water monitoring at the site (NUS 1986b). The acid pond has been drained, however, the northeast pond has not (PRC 1996b). No groundwater or surface water monitoring is known to have occurred at the site.

In September 1996, PRC conducted an ESI at the site. Section 3.0 describes the field activities conducted at the site, including the number and location of samples collected and sample data summaries. No other investigations or actions are known to have been conducted at the site.

probably were used for disposal of waste ash and sulfur. The carbon disulfide pits also are a potential source of contamination because carbon disulfide may remain under water in the pits. Also, water in the reservoirs may contain contaminants released during the distillation, condensation, and cooling operations. The former acid pond, now a drainage ditch, and the storage areas for raw product, both sulfur and coal, also are potential sources of contamination.

2.5 PREVIOUS INVESTIGATIONS

The Stauffer Chemical site originally was investigated on September 14, 1982, when EPA and the Commonwealth of Virginia SWCB collected samples of soil, surface water, and groundwater from the site under a joint effort to investigate Superfund sites. The data revealed contamination of the well at the former Stauffer Chemical office, which was being used as a water supply by a school at the time of the investigation. The school moved to a location across the street in 1983, later closed, and is now the Bass residence. The original office/school building now houses a gas station. The contamination included volatile organic compounds (VOCs) that were later attributed to a nearby Gulf gasoline station. Samples from the brick dump and acid pond revealed high levels of metals, most notably total chromium (SWCB 1983b). Carbon disulfide was detected at concentrations ranging from 0.1 to 1 microgram per liter (μg/L) in two aqueous samples collected by EPA from the surface and bottom of what the report referred to as a "water-filled concrete sump located at the rear of the main building" (retort house) [EPA undated (a)]. After detecting the contamination, SWCB obtained an additional sample from a spring located in the southwest corner of the production area (the barren area). High levels of metals and total chromium also were detected in that sample. SWCB notified Stauffer of its findings and requested that Stauffer determine actions needed to eliminate the water quality problems (SWCB 1983b). After meeting with the SWCB, representatives of Stauffer determined that the data did not indicate the existence of any off-site groundwater or surface-water contamination, and that no further study or remediation was needed at the site (Stauffer 1983b).

The SWCB continued to investigate the site, conducting visits to the site and interviewing former employees of Stauffer. SWCB also conducted a survey of surface waters of the site in May 1983, concluding that the surface-water runoff from the site was impacting the diversity and density of a sensitive group of organisms, including fish species in Flint Run Creek. Surface water from the acid pond flows into Flint Run Creek (SWCB 1983c).

TABLE 1

ANALYTICAL DATA - NUS 1985 SI

STAUFFER CHEMICAL SITE, BENTONVILLE, VIRGINIA

Sample Location	Phase	Units	Compound Detected									
			Aroclor 1260 (μg/kg)	Aluminum	Chromium	Cobalt	Copper	Iron	Nickel	Manganese	Zinc	Boron
Sump Sediment	Solid	mg/kg	220	356	53.5	7.5	165	203,200	78.0	542	52.4	
Acid Pond	Aqueous	μg/L	ND	38,910	542	69	100 J	49,980	96	6,445	692	ND
Acid Pond Discharge	Aqueous	μg/L	ND	90,670	2,553	61	233	151,300	191	17,570	1,874	126
Lower (Northeast) Pond Discharge*	Aqueous	μg/L	ND	31,550	883	60	1,063	46,150	63	6,224	677	ND
Spring 1	Aqueous	μg/L	ND	121,000	118	104	441	23,350	182	13,530	492	ND
Spring 2	Aqueous	μg/L	ND	12,240	10	ND	ND	8,638	ND	1,024	78	ND

Notes:

* Receives drainage from the acid pond

J Estimated value questionable quantitative significance

ND Not detected

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TABLE 2

ANALYTICAL DATA - NUS 1986 SI

STAUFFER CHEMICAL SITE, BENTONVILLE, VIRGINIA

Sample Location	Phase	Units	Compound Detected										
			Aluminum	Arsenic	Barium	Chromium	Cobalt	Iron	Magnesium	Manganese	Nickel	Vanadium	Zinc
Background Aqueous	Aqueous	µg/L	323	ND	ND	ND	ND	789	5,670	42	ND	ND	13
Flint Run Creek	Aqueous	µg/L	4,260	ND	ND	50	ND	1,920	6,930	568	ND	ND	43
Acid Pond	Aqueous	µg/L	116,000	68	ND	2,310	400	257,000	50,400	15,300	310	345	1,800
Northeast Pond	Aqueous	µg/L	159,000	113	ND	3,230	107	488,000	55,800	18,900	375	503	2,270
Background Soil	Solid	mg/kg	7,560	2.8 F	97	13	17	13,400	382	93	ND	29	23
Waste - Barren Area	Solid	mg/kg	140	3.5 F	330	ND	ND	210	ND	8.9	ND	ND	11
Waste - Barren Area	Solid	mg/kg	1,930	3.4 F	413	10	ND	10,700	223	48	ND	15	17
Waste - West of Brick Dump	Solid	mg/kg	466	2.5 F	830	23	ND	2,580	ND	65	ND	ND	24
Waste - Brick Dump	Solid	mg/kg	17,400	13 F	155	172	ND	22,900	621	262	25	95	88

Notes:

ND Not detected

F Quantitative approximation based on quality assurance review

Shaded areas show concentrations that are three times background concentrations

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3.0 FIELD ACTIVITIES

Table 3 presents the sample number, medium, location, description, and results of analysis for all samples collected during the ESI. The following subsections describe waste and source sampling, the groundwater migration pathway, the surface-water migration pathway, and the soil exposure pathway and air migration pathway.

3.1 WASTE AND SOURCE SAMPLES

The subsections below present a discussion of waste and source sampling, the results of analysis of the samples, and conclusions that can be drawn from those results.

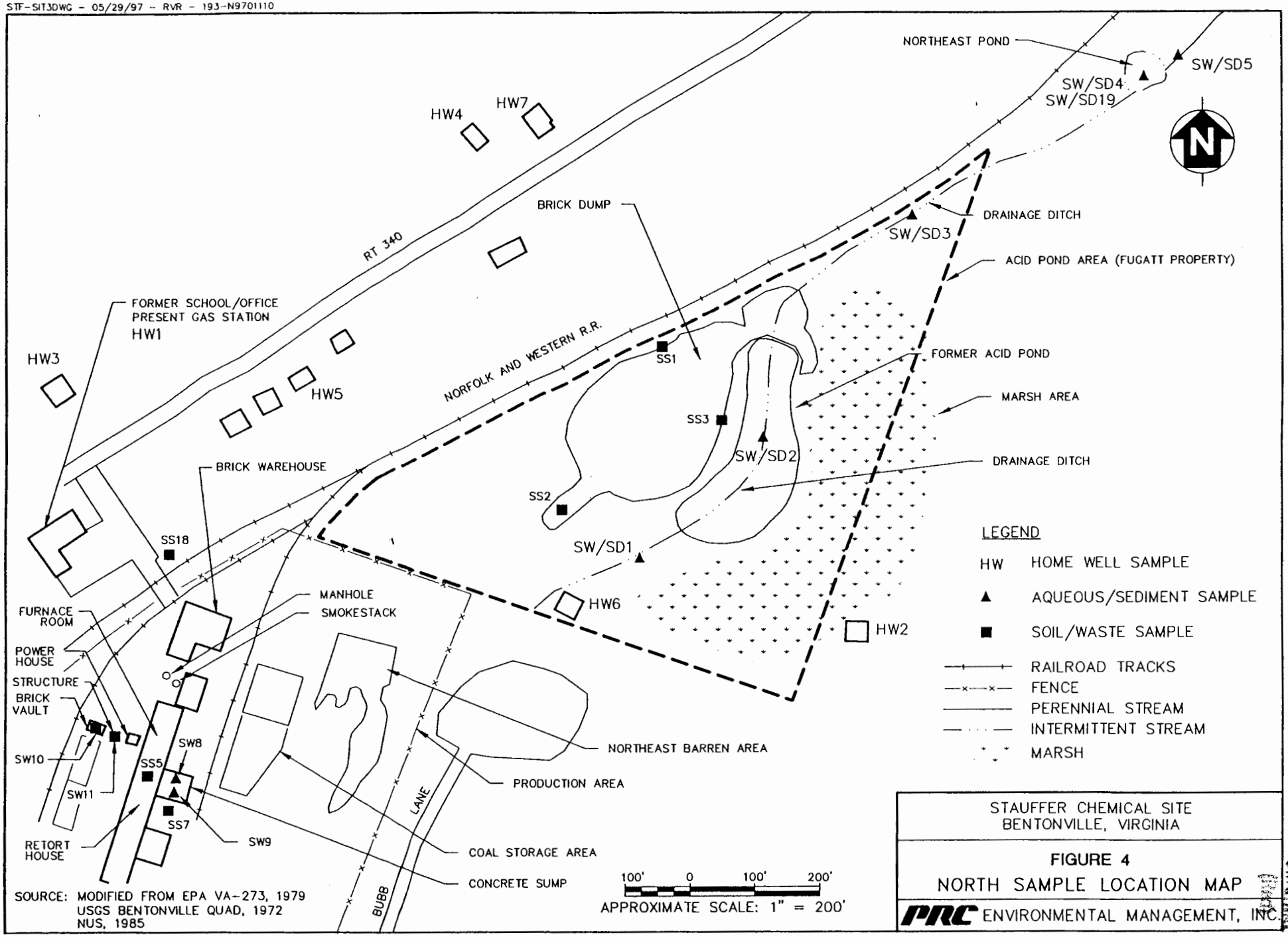
3.1.1 Sample Locations

The sampling locations for the ESI are shown on Figures 4 and 5 and described in Table 3. Soil samples (waste samples) were collected from areas where wastes had been stored or disposed. Sediment and surface-water samples were collected from a drainage ditch, formerly the acid pond, where wastes from the brick dump had been observed to migrate. Aqueous samples were collected from product storage areas and other storage areas currently filled with rainwater. Those areas include the concrete sump; brick vault; round steel structure; water reservoir; and two carbon disulfide pits. Because carbon disulfide is heavier than water, samples were collected with a sludge sampler from the bottom of the storage area.

The waste and source samples collected during the ESI were:

- Three soil samples (SS-1, SS-2, and SS-3) from the brick dump
- Three aqueous and sediment samples (SW-1/SD-1, SW-2/SD-2 and SW-3/SD-3) from the drainage ditch adjacent to the brick dump
- One soil sample (SS-5) from the retort house
- Two soil samples (SS-6 and SS-15) from the southwest barren area
- One soil sample (SS-7) from the contaminated soil area outside the retort house, south-west of the concrete sump, where wastes were visible
- One soil sample (SS-17) from the soil underlying tank foundations
- Two aqueous samples (SW-8 and SW-9), including a duplicate, from the concrete sump located along the east wall of the retort house
- One aqueous sample (SW-10) from the brick vault west of the power house
- One aqueous sample (SW-11) from the round steel structure located west of the power house
- One aqueous sample (SW-12) from the water reservoir located along the west boundary of the site

STF-SIT3DWG - 05/29/97 - RVR - 193-N9701110



STF-SIT2.DWG - 10/04/96 - RVR - 193-N960237

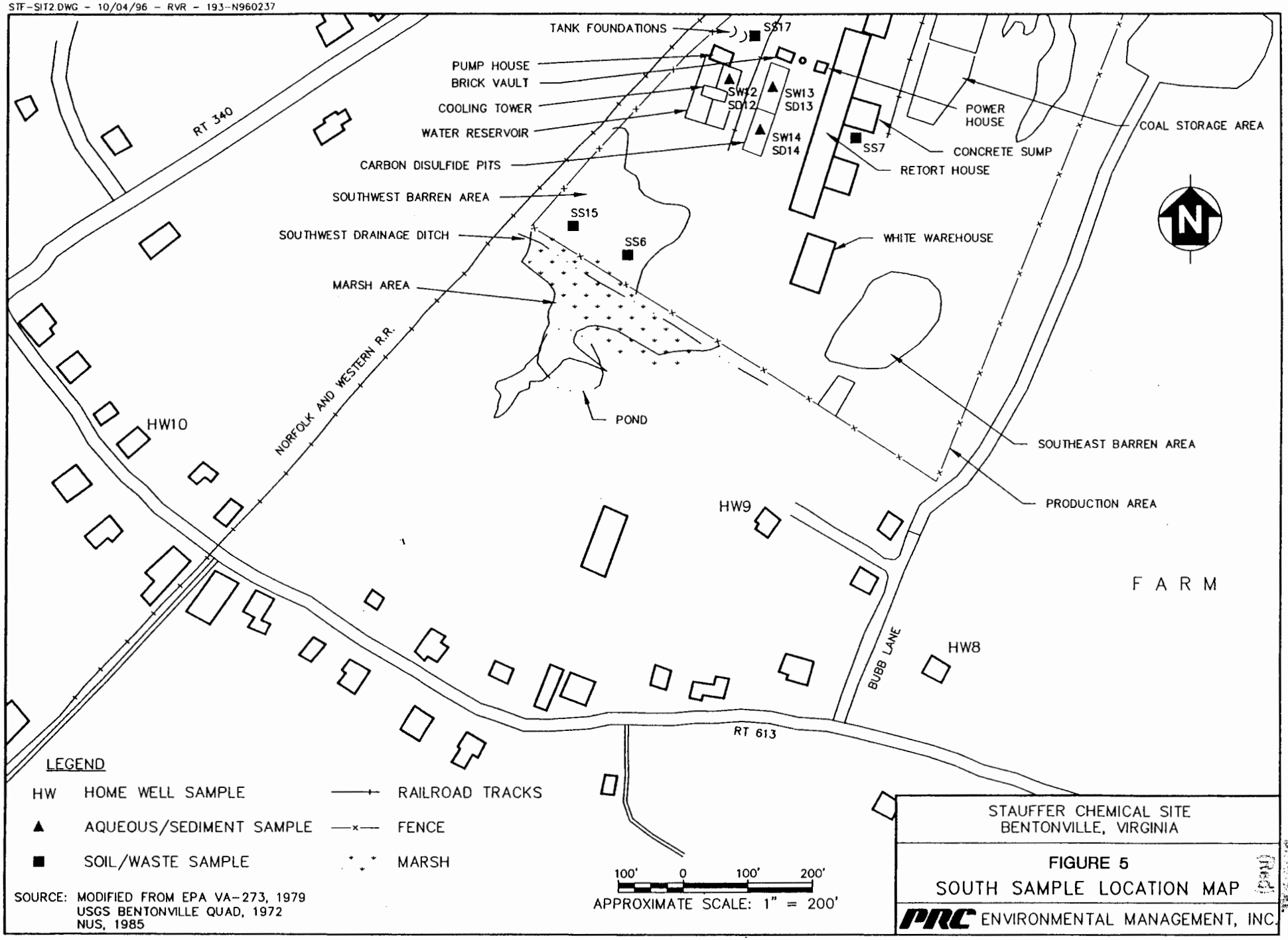


TABLE 3

SUMMARY OF SAMPLE LOCATIONS
(Page 1 of 4)

Sample Number	Date	Time	Location	Description
Source Sample Locations				
Soil Samples				
SS-1	9/11/96	1400	Northwest end of the brick dump.	Black coal ash with mixed yellow sulfur (moist).
SS-2	9/11/96	1405	Southwest end of the brick dump, approximately 150 feet from the Fugatt residence.	Black material with green sulfur and a brown substance.
SS-3	9/11/96	1415	Northeast corner of brick dump composite of different waste types: ash, sulfur, and stained soils.	Black, yellow, and white waste material.
SS-5	9/10/96	1500	Composite soil within the retort house.	Mixture of sand, silt, and clay and some ash wastes; clay orange in color.
SS-6	9/11/96	1750	Composite soil sample within the southwest barren area.	Gray, white, and black waste material and dense orange clay.
SS-7	9/11/96	1725	Soil sample southwest of the concrete sump.	Strong sulfur odor; soil consisting of green and white sulfur waste and black ash; sample both grainy and silty.
SS-15	9/11/96	1800	Southwest barren area. Composite waste sample.	Black coal, waste materials, and clay.
SS-17	9/11/96	1820	Tank foundations located along the northern boundary of the site.	Organic material, gray ash-like material and gravel.
SS-18	9/11/96	2000	West side of the railroad tracks, 200 feet west of the production area; background sample.	Brown silt loam with organic material.
Sediment				
SD-1	9/11/96	1545	Acid pond area drainage ditch.	Gray clay with small amounts of sand, no odor.
SD-2	9/11/96	1542	Acid pond area drainage ditch, north of SW-1, approximately 250 feet.	Grayish, black-brown silt and sand; sulfur odor.
SD-3	9/11/96	1615	Acid pond area, drainage ditch, north of SW-2, approximately 250 feet.	Silt, sand, and clay mixture, with a brown, black, and orange color.
Aqueous				
SW-1	9/11/96	1537	Acid pond area drainage ditch where the drainage ditch begins.	Clear water with suspended silt; location of the matrix spike/matrix spike duplicate (MS/MSD) sample for surface water.

ORIGINAL (Red)

Sample Number	Date	Time	Location	Description
SW-2	9/11/96	1531	Acid pond area, drainage ditch, north of SW-1, approximately 250 feet.	Clear water with suspended silt and green tint; sulfur odor.
SW-3	9/11/96	1610	Acid pond area, drainage ditch, north of SW-2, approximately 250 feet.	Clear water with suspended silt.
SW-8	9/10/96	1255	Concrete sump located along the east wall of the retort house; sample collected from the bottom of the sump with a sludge sampler.	Yellow and brown water.
SW-9	9/10/96	1315	Concrete sump located along the east wall of the retort house; sample collected from the bottom of the sump with a sludge sampler; duplicate of SW-8.	Yellow and brown water.
SW-10	9/10/96	1335	Brick vault located west of the power house.	Small sheen on the surface; black, clear water with some suspended particles.
SW-11	9/10/96	1053	Round steel structure located west of the power house; sample collected from the bottom of the structure with sludge sampler.	Clear water with some suspended black material.
SW-12	9/10/96	1255	Water reservoir located along the west boundary of the site; sample collected from the bottom of the structure with sludge sampler.	Clear water.
SW-13	9/10/96	1113	North carbon disulfide pit; sample collected from the bottom of the structure with sludge sampler.	Clear gray water.
SW-14	9/10/96	1155	South carbon disulfide pit; sample collected from the bottom of the structure with sludge sampler.	Clear water with brown suspended particles.
Groundwater				
HW-1	9/11/96	1420	Hand pump located at the gas station which was the former location of the Stauffer Chemical office.	Clear water; slight sulfur odors.
HW-14	9/11/96	1430	Hand pump located at the gas station which was the former location of the Stauffer Chemical office; duplicate sample of HW-1.	Clear water; slight sulfur odors.
HW-3	9/11/96	1215	Colleen Bass 2895 Stonewall Jackson Highway Bentonville, VA 22610 Sample collected from the hand pump.	Clear water.

ORIGINAL (Red)

Sample Number	Date	Time	Location	Description
HW-4	9/11/96	1645	Janet Monroe 3039 Stonewall Jackson Highway Bentonville, VA 22610 Sample collected from the hand pump.	Clear water.
HW-5	9/11/96	1630	Robert Ingels 2956 Stonewall Jackson Highway Bentonville, VA 22610	Clear water.
HW-6	9/11/96	1125	Raymond L. Fugatt Box 101 Bentonville, VA 22610	Clear water.
HW-7	9/11/96	1725	Rodger L. Presgraves 3055 Stonewall Jackson Highway Bentonville, VA 22610 Background sample location.	Clear water.
HW-8	9/11/96	1845	David Charlotte-Shoots 28 Bubb Lane Bentonville, VA 22610	Clear water.
HW-9	9/11/96	1845	Delmer Gradey 53 Bubb Lane Bentonville, VA 22610	Clear water.
HW-10	9/11/96	1815	Dellamay Manuel 53 Bentonville Road, Route 613 Bentonville, VA 22610	Clear water.
HW-11	9/11/96	1500	Earnest Rudacille 2777 Stonewall Jackson Highway Bentonville, VA 22610	Clear water.
SW-4	9/11/96	1245	Northeast pond, at convergence of the drainage ditch or intermittent tributary draining the brick dump.	Strong sulfur odor, suspended silt in water; impossible to collect sample without silt in the sample.
SD-4	9/11/96	1245	Northeast pond, at convergence of the drainage ditch or intermittent tributary draining the brick dump.	Silty sand (brown) mixed with gray and black sand and silt particles.

ORIGINAL (Red)

Sample Number	Date	Time	Location	Description
SW-19	9/11/96	1245	Northeast pond, at convergence of the drainage ditch or intermittent tributary draining the brick dump.	Strong sulfur odor, suspended silt in water; impossible to collect sample without silt in the samples; duplicate sample SW-4.
SD-19	9/11/96	1245	Northeast pond, at convergence of the drainage ditch or intermittent tributary draining the brick dump.	Silty sand (brown) mixed with gray and black sand and silt particles; duplicate sample SD-4.
SW-5	9/11/96	1200	Drainage ditch at the discharge point from the northeast pond.	Clear water with some suspended silt particles; sulfur odor in the air.
SD-5	9/11/96	1215	Drainage ditch at the discharge point from the northeast pond.	Orange-brown clay and sand mixture.
SD-6	9/11/96	1122	Flint Run Creek, downstream from the confluence of the perennial tributary draining the northeast pond and Flint Run Creek.	Clear water.
SD-6	9/11/96	1125	Flint Run Creek, downstream from the confluence of the perennial tributary draining the northeast pond and Flint Run Creek.	Mixture of orange-red clay, sand, and gray loam.
SW-7	9/11/96	1108	Flint Run Creek, upstream from the confluence of the perennial tributary draining the northeast pond and Flint Run Creek.	Clear water.
SD-7	9/11/96	1117	Flint Run Creek, upstream from the confluence of the perennial tributary draining the northeast pond and Flint Run Creek.	Mixture of roots, sand, and silt; brown to dark brown color.

- One aqueous sample (SW-13) from the north carbon disulfide pit
- One aqueous sample (SW-14) from the south carbon disulfide pit

The following subsection provides descriptions of the hazardous substances detected in the waste and source samples listed above.

3.1.2 Waste and Source Analytical Results

The following 10 source areas were identified at the Stauffer Chemical site:

- Brick dump and drainage ditch (contaminated soil)
- Retort house (contaminated soil)
- A barren area (contaminated soil) on the south west portion of the site
- Soil area outside the retort house (contaminated soil)
- Soil underlying tank foundations (contaminated soil)
- A concrete sump (impoundment) on the south east side of the retort house
- Brick vault (container)
- Round steel structure (container)
- Water reservoir (container)
- Two carbon disulfide pits (container)

The locations of the source areas and the samples are shown on Figures 4 and 5. Tables 4, 5, and 6 summarize the concentrations of contaminants detected in the soil (waste), sediment, and aqueous samples collected from the sources, respectively. Results of analysis of the background samples also are presented. The shaded areas in the tables indicate the concentrations of those contaminants that were detected in samples at concentrations three times or more above background levels.

Provided below are descriptions of sources and the analytical results from the samples collected from those sources.

Brick Dump and Drainage Ditch

The brick dump was used for disposal of waste ash and sulfur, as evidenced by the waste observed in the area. An acid pond was previously located adjacent to the east side of the brick dump. The pond has been drained. Currently, there is a drainage ditch at the location of the former acid pond. The acid pond received surface-water runoff from the northeast section of the production area and the brick

Table 4
Stauffer Chemical - Summary of Soil and Waste Sample Analysis

Sample Identification		SS-18	SS-1	SS-2	SS-3	SS-5	SS-6	SS-7	SS-15	SS-17	Risk-Based Concentration Soil Ingestion Residential[1]
Sample Location		background	brick dump	brick dump	brick dump	retort house	barren area	soil outside retort house	barren area	tank foundations	
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/10/96	9/10/96	9/10/96	
Time		2000	1400	1405	1415	1500	1750	1725	1800	1820	
Organic Traffic Report No.		CQC74	CQC66	CQC68	CQC72	CQC48	CQC59	CQC64	CQC61	CQC60	
Inorganic Traffic Report No.		MCMR90	MCMR80	MCMR82	MRMR85	MCMR67	MCMR31	MCMR79	MCMR52	MCMR32	
Sample Type		Background	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	
ORGANIC COMPOUNDS (ug/kg)											
VOLATILE ORGANIC COMPOUNDS	***CRQL***										
Methylene Chloride	10	24B	27B	19B	20B	14B	48B	27B	30B	20B	85000c
Acetone	10	7B	7B	8B	5B	5B	26B	8B	14B	15B	7800000
Carbon Disulfide	10	U	U	U	7J	U	U	U	U	U	7800000
1,1-Dichloroethene	10	U	U	U	U	U	5J	U	U	U	1100c
Chloroform	10	U	U	U	U	U	U	U	U	U	100000c
2-Butanone	10	U	U	U	U	U	U	U	12B	U	NA
Bromodichloromehane	10	U	U	4B	4B	U	U	U	U	U	10000
Toluene	10	U	2J	U	U	U	5J	U	U	U	16000000
											NA
SEMIVOLATILE ORGANIC COMPOUNDS	***CRQL***										NA
Naphthalene	330	U	99J	210J	470J	U	U	U	700J	U	3100000
2-Methylnaphthalene	330	U	U	130J	200J	U	U	U	120J	U	NA
Acenaphthalene	330	U	U	110J	U	U	U	U	U	U	NA
Dibenzofuran	330	U	U	100J	210J	U	U	U	310J	U	NA
Fluorene	330	U	U	75J	U	U	U	U	89J	U	NA
Phenanthrene	330	U	170J	1600	780	100J	U	970J	950J	130J	NA
Anthracene	330	U	U	220J	U	U	U	U	97J	U	23000000
Carbazole	330	U	U	94J	U	U	U	U	U	U	32000c
Di-n-butylphthalate	330	U	U	U	U	63J	U	U	U	U	NA
Fluoranthene	330	U	U	2400	310J	U	U	1400J	1000J	120J	3100000
Pyrene	330	U	U	2200	120J	U	U	U	1000J	79J	2300000
Butylbenzylphthalate	330	U	U	U	U	55J	U	U	U	U	NA
benzo(a)anthracene	330	U	U	1200	59J	U	U	U	560J	U	880c
Chrysene	330	U	U	1300	160J	U	U	1100J	800J	160J	88000c
bis(2-ethylhexyl)phthalate	330	51B	79B	220B	72B	330B	120B	U	U	370B	NA
Benzo(b)fluoranthene	330	U	U	1100	U	U	U	U	730J	140J	880c
Benzo(k)fluoranthene	330	U	U	290J	U	U	U	U	440J	65J	8800c
Benzo(a)pyrene	330	U	U	380J	U	U	U	U	280J	97J	88c
Indeno(1,2,3-cd)pyrene	330	U	U	150J	U	U	U	U	160J	U	880c
Dibenz(a,h)anthracene	330	U	U	U	U	U	U	U	60J	U	88c
Benzo(g,h,i)perylene	330	U	U	120J	U	U	U	U	150J	U	NA

Table 4
Stauffer Chemical - Summary of Soil and Waste Sample Analysis

Sample Identification		SS-18	SS-1	SS-2	SS-3	SS-5	SS-6	SS-7	SS-15	SS-17	Risk-Based
Sample Location		background	brick	brick	brick	retort	barren	soil outside	barren	tank	Concentration
			dump	dump	dump	house	area	retort house	area	foundations	Soil Ingestion
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/10/96	9/10/96	9/10/96	Residential[1]
Time		2000	1400	1405	1415	1500	1750	1725	1800	1820	
Organic Traffic Report No.		CQC74	CQC66	CQC68	CQC72	CQC48	CQC59	CQC64	CQC61	CQC60	
Inorganic Traffic Report No.		MCMR90	MCMR80	MCMR82	MRMR85	MCMR67	MCMR31	MCMR79	MCMR52	MCMR32	
Sample Type		Background	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	
PESTICIDES/PCB COMPOUNDS(ug/kg)	***CRQL***										
alpha-BHC	1.7	U	U	5.1	U	U	U	3.5J	U	U	NA
Aldrin	1.7	U	U	U	3.1J	U	U	6.5J	U	U	38c
Endosulfan sulfate	3.3	U	U	U	U	U	U	6.4J	U	U	470000
Endrin ketone	3.3	U	U	U	U	U	U	15J	U	U	NA
alpha Chlordane	1.7	U	U	U	U	U	U	U	U	9.3	490c
gamma Chlordane	1.7	U	U	U	U	U	U	4.1J	U	U	490c
Aroclor-1254	3.3	U	U	U	U	U	U	U	U	490	1600
Dieldrin										33	40c

Table 4
Stauffer Chemical - Summary of Soil and Waste Sample Analysis

Sample Identification		SS-18	SS-1	SS-2	SS-3	SS-5	SS-6	SS-7	SS-15	SS-17	Risk-Based Concentration Soil Ingestion Residential[1]
Sample Location		background	brick dump	brick dump	brick dump	retort house	barren area	soil outside retort house	barren area	tank foundations	
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/10/96	9/10/96	9/10/96	
Time		2000	1400	1405	1415	1500	1750	1725	1800	1820	
Organic Traffic Report No.		CQC74	CQC66	CQC68	CQC72	CQC48	CQC59	CQC64	CQC61	CQC60	
Inorganic Traffic Report No.		MCMR90	MCMR80	MCMR82	MRMR85	MCMR67	MCMR31	MCMR79	MCMR52	MCMR32	
Sample Type		Background	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	Surface soil and waste	
INORGANICS (mg/kg)	***CRDL***										
Aluminum	40	**3000**	384	6590	158	**10400**	1050	190	2760	2900	7800
Antimony	12	R	R	R	R	R	R	R	R	27.5L	31
Arsenic	2	2.3B	4.3J	9.8	1.4K	7.7	2.5J	1.2J	4.6J	**57.5**	23
Barium	40	**35.1L**	1020L	550L	122L	67.0L	821L	119L	391L	365L	5500
Beryllium	1	**0.27B**	U	**0.28B**	U	**0.28B**	**0.16B**	**0.19B**	**0.27B**	**0.64B**	0.15c
Cadmium	1	U	U	U	U	U	U	U	U	U	39
Calcium	1000	91100	147000	21100	125000	7010	116000	135000	35400	8890	NA
Chromium	2	6.3L	216L	43.6L	2.2J	38.4L	4B	1.2B	8.8L	53.5L	390
Cobalt	10	2.1L	1.4B	1.3B	U	3.7B	1.6B	U	1.2B	19.3L	470
Copper	5	12	34.6	24.2	5.4	26.7	13.8	5.2B	14.2	155	3100
Iron	20	5820	17900	**33500**	250B	**28400**	3670	321B	11400	**351000**	23000
Lead	0.6	10.9	101	118	54.3	229	40.6	70.4	26.1	211	600
Magnesium	1000	15700	17.6B	275	6.8	2300	153B	21.9B	147B	251B	NA
Manganese	3	85.8	66.6	55.8	3.7B	180	37.8	2.7B	28.9	**955**	390
Mercury	0.1	0.16	U	U	0.12B	0.06B	U	U	0.08B	U	23
Nickel	8	2.5L	1.7B	2.9B	U	7.3B	2.7B	2.4B	2.9B	71.3	1600
Potassium	1000	429B	3840	1650	159B	1830	370B	160B	879B	2100	NA
Selenium	1	U	U	1.5J	U	U	U	U	U	U	390
Silver	2	U	1.9B	1.4B	0.9B	U	1.2B	0.89B	U	U	390
Sodium	1000	105B	74.9B	362J	76.0B	368B	70.3B	38.0B	43.8B	494J	NA
Thallium	2	U	U	1.9L	U	U	U	U	U	19.4	NA
Vanadium	10	12.9	27.9	67.4	0.9B	53.3	6.1B	19.2	23.1	54.4	550
Zinc	4	16.3L	12.8J	10.5J	1.8B	61.5J	5.4B	2.2B	7.2J	51.4J	23000
Cyanide	2	U	0.37B	U	U	U	U	U	U	1.9	1600

Notes:
U = Not detected.
B = Not detected substantially above the level reported in laboratory or field blanks.
R = Unreliable result. Analyte may or may not be present in the sample.
K = Analyte present. Reported value may be biased high.
J = Analyte present. Reported value may not be accurate or precise.
[] = Analyte present. As values approach the IDL the quantitation may not be accurate.
NA = not available
[1] EPA Region III Risk-Based ConcentrationTable, August 1996

Concentrations three times or greater than background
"The EPA Quick Reference Fact Sheet, Using Qualified Data to Document an Observed Release and Observed Contamination", dated November 1996, was used to determine whether concentrations were three times or greater than background.
c = carcinogen
Numbers in bold are concentrations above those limits established by risk based standards.

Table 5
Stauffer Chemical - Summary of Source Sediment Sample Analysis
(Page 1 of 2)

Sample Identification		SD-7	SD-1	SD-2	SD-3	NOAA Screening Guidelines[1]
Sample Locations		Flint Run	Drainage Ditch	Drainage Ditch	Drainage Ditch	
Date		9/11/96	9/11/96	9/11/96	9/11/96	
Time		1117	1545	1542	1615	
Organic Traffic Report No.		CQC52	CQC58	CQC73	CQC63	
Inorganic Traffic Report No.		MCMR71	MCMR77	MCMR86	MCMR37	
Sample Type		Background	Waste	Waste	Waste	
ORGANIC COMPOUNDS (ug/kg)						
VOLATILE ORGANIC COMPOUNDS	***CRQL***					
Methylene Chloride	10	21B	21B	27B	42B	NA
Acetone	10	7B	6B	8B	7B	NA
Chloroform	10	U	U	U	U	NA
2-Butanone	10	U	U	U	U	NA
Bromodichloromethane	10	U	U	U	U	NA
SEMIVOLATILE ORGANIC COMPOUNDS	***CRQL***					
Naphthalene	330	U	U	U	50J	NA
2-Methylnaphthalene	330	U	U	U	67J	70[a]
Dibenzofuran	330	U	U	U	47J	NA
Pentachlorophenol	330	U	U	U	U	NA
Phenanthrene	330	U	110J	U	180J	NA
Di-n-butylphthalate	330	U	U	U	U	NA
Fluoranthrene	330	U	160J	U	130J	600[a]
Pyrene	330	U	81J	U	89J	665[a]
Benzo(a)anthracene	330	U	U		53J	261[a]
Chrysene	330	U	46J	U	130J	384[a]
bis (2-Ethyhexl)phthalate	330	72B	170B	93B	97B	1300[b]
Benzo(b)fluoranthrene	330	U	U	U	110J	3200[b]
PESTICIDES/PCB COMPOUNDS	***CRQL***					
4,4'-DDD	3.3	U	U	6.8	U	<16[b]

Table 5
Stauffer Chemical - Summary of Source Sediment Sample Analysis
(Page 2 of 2)

Sample Identification		SD-7	SD-1	SD-2	SD-3	NOAA Screening Guidelines[1]
Sample Locations		Flint Run	Drainage Ditch	Drainage Ditch	Drainage Ditch	
Date		9/11/96	9/11/96	9/11/96	9/11/96	
Time		1117	1545	1542	1615	
Organic Traffic Report No.		CQC52	CQC58	CQC73	CQC63	
Inorganic Traffic Report No.		MCMR71	MCMR77	MCMR86	MCMR37	
Sample Type		Background	Waste	Waste	Waste	
INORGANICS COMPOUNDS (mg/kg)	***CRDL***					
Aluminum	40	6120	13800	8240	4470	NA
Arsenic	2	2.5B	**8.4**	7.5	5.7	8.2[a]
Barium	40	55.0L	289L	139L	68.0L	NA
Beryllium	1	0.8B	0.61B	0.34B	0.84B	NA
Calcium	1000	1870	14600	771B	328B	NA
Chromium	2	23.4L	**110L**	**94.9L**	21.9L	81.0[a]
Cobalt	10	15.8	3.5 B	1.5B	13.9	NA
Copper	5	22.5	24.3	27.5	16.7	34.0[a]
Iron	20	23,200	31300	12300	15900	NA
Lead	0.6	9.3	40.3	**118**	16	46.7[a]
Magnesium	1000	1480	600B	405B	258B	NA
Manganese	3	519	63.8	42.3	44.6	NA
Mercury	0.1	U	U	0.14	U	0.150[a]
Nickel	8	10.1B	6.1B	2.3L	14.4	20.9[a]
Potassium	0	672B	2370	1900	892B	NA
Selenium	1	U	1.2J	1.3J	U	NA
Sodium	1000	58.5B	659J	460J	171B	NA
Thallium	2	U	U	U	U	NA
Vanadium	10	59.4	70.1	30	28.2	NA
Zinc	4	37.1J	23.0J	11.8J	20.5J	150.0[a]

Notes:
U = Not detected.
B = Not detected substantially above the level reported in laboratory or field blanks.
R = Unreliable result. Analyte may or may not be present in the sample.
K = Analyte present. Reported value may be biased high.
J = Analyte present. Reported value may not be accurate or precise.
NA = Not available
Concentrations three times or greater than background; "The EPA, Quick Reference Fact Sheet, Using Qualified Data to Document an Observed Release and Observed Contamination", dated November 1996, was used to determine whether concentrations were three times or greater than background.
[1] National Oceanic and Atmospheric Administration Screening Guidelines
a = Effective Range - Low (ER-L) value, Long and Morgan (1990)
b = Apparent Effects Threshold (AET) value
Numbers in bold are concentrations above those limits established by risk-based standards.

ORIGINAL (Red)

Table 6
Stauffer Chemical - Summary of Source Aqueous Sample Analysis
(Page 1 of 3)

Sample Identification		SW-7	SW-1	SW-2	SW-3	SW-8	SW-9	Ambient Water Quality Criteria[1]
Sample Location		Flint Run	drainage ditch	drainage ditch	drainage ditch	concrete sump	concrete sump	
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/10/96	9/10/96	
Time		1108	1537	1531	1610	1255	1315	
Organic Traffic Report No.		CQC51	CQC57	CQC65	CQC62	CQC46	CQC47	
Inorganic Traffic Report No.		MCMR70	MCMR76	MCMR78	MCMR36	MCMR65	MCMR66	
Sample Type		Background	Surface Water	Surface Water	Surface Water	Dup of SW-9	Dup of SW-8	
ORGANIC COMPOUNDS (ug/L)								
VOLATILE ORGANIC COMPOUNDS	***CRQL***							
Methylene Chloride	10	5B	15B	4B	14B	3B	10B	NA
Acetone	10	U	24B	13B	U	14B	U	NA
Carbon disulfide	10	U	U	U	U	3J	2J	NA
Chloroform	10	U	U	U	U	U	U	NA
Bromomethane	10	U	U	U	U	U	U	NA
SEMIVOLATILE ORGANIC COMPOUNDS	***CRQL***							
bis(2-Ethylhexyl)phthalate	10	2B	U	2B	U	U	1B	NA
PESTICIDES/PCB COMPOUNDS	***CRQL***							
INORGANICS(ug/L)	***CRDL***							
Aluminum	200	97.2B	120000	421000	153000	16400	18000	NA
Antimony	60	11L	17.6L	60.6L	13.0L	76.1L	90L	NA
Arsenic	10	U	62.6	64.8	37.7	69.3	71.6	190
Barium	200	29.5J	1260J	103J	24.6J	202	200	NA
Beryllium	5	U	6.2	22.6	12.5	.94B	0.46B	NA
Cadmium	5	U	1B	8	2.7B	6.2	6.4	1.1
Calcium	5000	22000J	167000J	494000J	366000J	419000	452000	NA
Chromium	10	U	1090J	9330J	2190J	402	445	11
Cobalt	50	U	45.6B	39.3B	66.1	44.0B	44.0B	NA
Copper	25	3.3B	231J	410J	274J	711	975	12
Iron	100	188B	263000J	580000J	203000J	975000	960000	1000
Lead	3	U	389	170	91.8	317	284	3.2
Magnesium	5000	5330J	35300J	126000J	66300J	48000	49400	NA
Manganese	15	16.3B	6850J	35200J	13600J	8560	9010	NA
Mercury	0.2	U	0.32	U	U	0.36	0.43	0.012
Nickel	40	U	97.6	326	193	607	853	160
Potassium	5000	1550B	52500	110000	36700	86000	84700	NA
Silver	10	U	U	U	3.9B	U	U	4.1
Sodium	5000	3670B	242000	97200	160000	9870J	9750J	NA
Thallium	10	U	17.3L	31.3L	7.5L	45.2	37.3	NA
Vanadium	50	3B	390J	1080J	318J	78.3	74.8	NA
Zinc	20	9.1J	531J	5260J	1350J	3770	3200	110
Cyanide	10	U	U	U	4.3	21.5	18.7	5.2

Table 6
Stauffer Chemical - Summary of Source Aqueous Sample Analysis
(Page 2 of 3)

Sample Location		SW-7	SW-10	SW-11	SW-12	SW-13	SW-14	SW-19	Field Blank	TB911	TB910
		Flint Run	brick vault	round structure	water reservoir	pit	pit				
Date		9/11/96	9/10/96	9/10/96	9/10/96	9/10/96	9/10/96	9/11/96	9/10/96		
Time		1108	1335	1053	1255	1113	1155	1245			
Organic Traffic Report No.		CQC51	CQC42	CQC40	CQC45	CQC43	CQC44	CQC69	CQC50	CQC70	CQC49
Inorganic Traffic Report No.		MCMR70	MCMR61	MCMR59	MCMR64	MCMR62	MCMR63	MCMR83	MCMR69		
Sample Type		Background	Water Sample	Water Sample	Water Sample	Water Sample	Water Sample	Dup of SW-4	Field Blank	Trip Blank	Trip Blank
ORGANIC COMPOUNDS (ug/L)											
VOLATILE ORGANIC COMPOUNDS	*CRQL*										
Methylene Chloride	10	5B	4B	4B	4B	4B	4B	5B	5	16	7J
Acetone	10	U	U	U	U	U	22B	7B	U	U	U
Carbon disulfide	10	U	U	U	U	U	U	U	U	U	U
Chloroform	10	U	U	U	U	U	U	U	12	11	12
Bromomethane	10	U	U	U	U	U	U	U	2J	1J	2J
SEMIVOLATILE ORGANIC COMPOUNDS	*CRQL*										
bis(2-Ethylhexyl)phthalate	10	2B	U	U	U	U	U	U	U	U	U
PESTICIDES/PCB COMPOUNDS	*CRQL*										
INORGANICS(ug/L)	*CRDL*										
Aluminum	200	97.2B	1880	202B	194B	46.3B	237B	80000	49.4	N/A	N/A
Antimony	60	11L	U	U	U	U	U	13.9L	U	N/A	N/A
Arsenic	10	U	U	U	U	U	U	15.7K	U	N/A	N/A
Barium	200	29.5J	679	43.1B	43.1B	100B	15.0B	91.3J	U	N/A	N/A
Beryllium	5	U	0.54B	U	U	U	U	7	U	N/A	N/A
Cadmium	5	U	U	U	U	U	U	1.4B	U	N/A	N/A
Calcium	5000	22000J	24100	34400	34400	71600	14800	213000J	159B	N/A	N/A
Chromium	10	U	37.4	U	U	U	U	999J	U	N/A	N/A
Cobalt	50	U	14.3B	U	U	U	U	6701	U	N/A	N/A
Copper	25	3.3B	92	26.8	26.8	U	3.3B	156J	U	N/A	N/A
Iron	100	188B	146000	2060	2060	4370	3060	103000J	310	N/A	N/A
Lead	3	U	93.3	13.2	13.2	2.3K	2.2K	45.6	U	N/A	N/A
Magnesium	5000	5330J	5200	4380B	4380B	4580B	1800B	48400J	U	N/A	N/A
Manganese	15	16.3B	1210	171	171	3260	1860	6920J	4.2B	N/A	N/A
Mercury	0.2	U	U	U	U	U	U	U	U	N/A	N/A
Nickel	40	U	52	U	U	U	U	106	U	N/A	N/A
Potassium	5000	1550B	4460B	8490	8490	6100	2400B	19600	U	N/A	N/A
Silver	10	U	U	U	U	U	U	U	U	N/A	N/A
Sodium	5000	3670B	14300J	3260J	3260J	3090J	1060B	72600	219B	N/A	N/A
Thallium	10	U	5.8B	U	U	U	U	6.1L	U	N/A	N/A
Vanadium	50	3B	24.4B	2.4B	2.4B	U	3.6B	141J	U	N/A	N/A
Zinc	20	9.1J	175	195	195	50.6B	U	710J	U	N/A	N/A
Cyanide	10	U	U	U	U	U	U	U	U	N/A	N/A

Table 6

Stauffer Chemical - Summary of Source Aqueous Sample Analysis

(Page 3 of 3)

Sample Location		SW-7	SW-10	SW-11	SW-12	SW-13	SW-14	SW-19	Field Blank
		Flint Run	brick vault	round structure	water reservoir	pit	pit		
Date		9/11/96	9/10/96	9/10/96	9/10/96	9/10/96	9/10/96	9/11/96	9/10/96
Time		1108	1335	1053	1255	1113	1155	1245	
Organic Traffic Report No.		CQC51	CQC42	CQC40	CQC45	CQC43	CQC44	CQC69	CQC50
Inorganic Traffic Report No.		MCMR70	MCMR61	MCMR59	MCMR64	MCMR62	MCMR63	MCMR83	MCMR69
Sample Type		Background	Water Sample	Water Sample	Water Sample	Water Sample	Water Sample	Dup of SW-4	Field Blank
INORGANICS(ug/	*CRDL*								
Aluminum	200	97.2B	1880	202B	194B	46.3B	237B	80000	49.4
Antimony	60	11L	U	U	U	U	U	13.9L	U
Arsenic	10	U	U	U	U	U	U	15.7K	U
Barium	200	29.5J	679	43.1B	43.1B	100B	15.0B	91.3J	U
Beryllium	5	U	0.54B	U	U	U	U	7	U
Cadmium	5	U	U	U	U	U	U	1.4B	U
Calcium	5000	22000J	24100	34400	34400	71600	14800	213000J	159B
Chromium	10	U	37.4	U	U	U	U	999J	U
Cobalt	50	U	14.3B	U	U	U	U	6701	U
Copper	25	3.3B	92	26.8	26.8	U	3.3B	156J	U
Iron	100	188B	146000	2060	2060	4370	3060	103000J	310
Lead	3	U	93.3	13.2	13.2	2.3K	2.2K	45.6	U
Magnesium	5000	5330J	5200	4380B	4380B	4580B	1800B	48400J	U
Manganese	15	16.3B	1210	171	171	3260	1860	6920J	4.2B
Mercury	0.2	U	U	U	U	U	U	U	U
Nickel	40	U	52	U	U	U	U	106	U
Potassium [1]	5000	1550B	4460B	8490	8490	6100	2400B	19600	U
Silver	10	U	U	U	U	U	U	U	U
Sodium	5000	3670B	14300J	3260J	3260J	3090J	1060B	72600	219B
Thallium	10	U	5.8B	U	U	U	U	6.1L	U
Vanadium	50	3B	24.4B	2.4B	2.4B	U	3.6B	141J	U
Zinc	20	9.1J	175	195	195	50.6B	U	710J	U
Cyanide	10	U	U	U	U	U	U	U	U

Notes:

U = Not detected.

B = Not detected substantially above the level reported in laboratory or field blanks.

R = Unreliable result. Analyte may or may not be present in the sample.

K = Analyte present. Reported value may be biased high.

J = Analyte present. As the reported value approachs the IDL, the quantitation limit may not be accurate.

NA = Not available.

Concentrations three times or greater than background. "The EPA, Quick Reference Fact Sheet, Using Qualified Data to Document an Observed Release and Observed Contamination", dated November 1996, was used to determine whether concentrations were three times or greater than background.

[1] EPA. 1995. *Water Quality Criteria-Draft (the Silver Book).* Office of Water, Washington, DC

Numbers in bold are concentrations above those limits established by risk-based standards.

dump. The acid pond was so named because of the low pH of the water in the pond. The low pH may be caused by the presence of acidic soils in the area or by the reaction of waste sulfur in the brick dump with water which produces sulfuric acid. Figure 4 shows the locations of the samples collected from the brick dump and the drainage ditch.

Soil (waste) samples (SS-1, SS-2, and SS-3) were collected from the brick dump to characterize the wastes disposed of in the dump. Surface water and sediment samples (SW-1/SD-1, SW-2/SD-2, and SW-3/SD-3) were collected from the drainage ditch adjacent to the brick dump to determine whether hazardous substances were migrating from the dump and to determine if the drainage ditch was a potential source of contamination. Surface water and sediment samples also were collected to determine whether the drainage ditch is a migration pathway for contaminants to the perennial surface water into which the drainage ditch discharges. Tables 4, 5, and 6 summarize the concentrations of contaminants detected in soil, sediment, and surface-water samples, respectively. The shaded areas of the tables indicate the concentrations of those contaminants that were detected in samples at concentrations at or above three times background levels.

The soil samples collected from the brick dump revealed carbon disulfide at an estimated concentration of 7 micrograms per kilogram (μg/kg). The concentration was estimated because carbon disulfide was detected in concentrations lower than the contract required quantitation limit (CRQL), but higher than the instrument detection limit (IDL). Polycyclic aromatic hydrocarbons (PAH) were detected in samples of soil from the brick dump at concentrations at or above three times background levels. The PAHs detected include:

- naphthalene, as high as 470 μg/kg
- phenanthrene, as high as 1,600 μg/kg
- fluoranthene, as high as 2,400 μg/kg
- pyrene, as high as 2,200 μg/kg
- benzo(a)anthracene, as high as 1,200 μg/kg
- chrysene, as high as 1,300 μg/kg
- benzo(b)fluoranthene, as high as 1,100 μg/kg
- benzo(a)pyrene, as high as 380 μg/kg

The following inorganic compounds were detected in the samples of soil from the brick dump at concentrations at or above three times background levels:

- arsenic, as high as 9.8 mg/kg
- barium, as high as 1,020 mg/kg
- chromium, as high as 216 mg/kg
- iron, as high as 33,500 mg/kg
- lead, as high as 118 mg/kg
- selenium, as high as 1.5 mg/kg
- thallium, as high as 1.9 mg/kg
- vanadium, as high as 67.4 mg/kg

The sediment samples collected from the drainage ditch did not contain any PAHs above the CRDLs. Inorganic compounds that may be related to the operation of the retort house and that were detected in other sources areas, such as the brick dump, include:

- arsenic, as high as 8.4 mg/kg
- chromium, as high as 110 mg/kg
- lead, as high as 118 mg/kg
- selenium, as high as 1.3 mg/kg

Although not detected in the samples collected from the brick dump, mercury (0.14 mg/kg) was detected in one sediment sample at a level that exceeded the background level. Samples of surface water collected from the drainage ditch did not contain any PAHs at concentrations above background levels. Inorganic compounds that may be related to the operation of the retort house and that were detected in other sources areas, such as the brick dump, include:

- arsenic, as high as 62.6 μg/L
- barium, as high as 1,260 μg/L
- chromium, as high as 9,330 μg/L
- iron, as high as 580 μg/L
- lead, as high as 389 μg/L
- thallium, as high as 17.3 μg/L
- vanadium, as high as 1,080 μg/L

Table 6 summarizes numerous other inorganic compounds that also were detected in the surface-water samples at concentrations at or above three times background levels. Mercury was detected in one surface-water sample at a concentration of 0.32 μg/L.

Retort House

The retort house contained the retorts in which carbon disulfide was produced and related equipment, such as boilers. The floor of the retort house is earthen. One soil sample (SS-5) was collected from inside the retort house (Figure 4). Table 4 summarizes the concentrations of contaminants detected in the soil sample (SS-5), with levels at or above three times background levels shaded. Inorganic compounds were the only contaminants detected in the soil sample at concentrations at or above three times background levels. Those detected are:

- arsenic, at 7.7 mg/kg
- chromium, at 38.4 mg/kg
- iron, at 28,400 mg/kg
- lead, at 229 mg/kg
- vanadium, at 53.3 mg/kg
- zinc, at 61.5 mg/kg

Barren Areas

Two soil samples (SS-6 and SS-15) were collected from a barren area located on the southwest portion of the site (Figure 5). Aerial photographs indicate that the barren area may have been used for disposal of wastes. Those wastes may have included waste ash and sulfur, the major waste streams produced from the production of carbon disulfide. Table 4 summarizes the concentrations of contaminants detected in the soil (waste) samples (SS-6 and SS-15), with levels at or above three times background levels shaded. Two VOCs, 1,1-dichloroethene and toluene, were detected in both soil samples at estimated concentrations of 5 μg/kg. The concentrations were estimated because the concentrations detected were lower than the CRDLs but higher than IDLs.

Several PAHs were detected in SS-15, obtained from the southwest corner of the barren area, at concentrations at or above three times background levels. The PAHs detected include:

- naphthalene, at 700 μg/kg
- phenanthrene, at 950 μg/kg
- fluoranthene, at 1,000 μg/kg
- pyrene, at 1,000 μg/kg
- benzo(a)anthracene, at 560 μg/kg
- chrysene, at 800 μg/kg

- benzo(b)fluoranthene, at 730 μg/kg
- benzo(k)fluoranthene, at 440 μg/kg

No inorganic compounds were detected in SS-15 at concentrations at or above three times background levels. Soil sample SS-6, collected from the southeast barren area, revealed barium (at 821 mg/kg) and lead (at 40.6 mg/kg) at concentrations at or above three times background levels. No other contaminants were detected at concentrations at or above three times background levels in sample SS-6.

Contaminated Soil Area Outside of the Retort House

One soil sample (SS-7) was collected from an area of stained soil outside the retort house (Figure 4). The soil consisted of green and white sulfur waste and black ash, with a strong sulfur odor. Table 4 summarizes the concentrations of contaminants detected in the soil sample (SS-7), with concentrations at or above three times background levels shaded. Several PAHs were detected in the soil sample at concentrations at or above three times background levels. They are:

- phenanthrene, at 970 μg/kg
- fluoranthene, at 1,400 μg/kg
- chrysene, at 1,100 μg/kg

Five pesticides were also detected in the sample; however, the concentrations of pesticides are probably the result of the normal application of pesticides, rather than disposal of wastes. The only inorganic compound detected in the soil sample at a concentration at or above three times the background level is lead, at 70.4 mg/kg.

Contaminated Soil - Tank Foundations

One soil sample (SS-7) was obtained from soils underlying the tank foundations on the northern boundary of the site (Figure 4). Table 4 summarizes the concentrations of contaminants detected in the soil sample (SS-7), with concentrations at or above three times background level shaded. Aroclor-1254 was detected in the sample at a concentration of 490 μg/kg, which is at or above three times background levels. Numerous inorganic compounds were also detected in the soil sample at concentrations at or above three times background levels. They are:

- arsenic, at 57.5 mg/kg
- chromium, at 53.5 mg/kg
- cobalt, at 19.3 mg/kg
- copper, at 155 mg/kg
- iron, at 351,000 mg/kg
- lead, at 211 mg/kg
- manganese, at 955 mg/kg
- nickel, at 71.3 mg/kg
- thallium, at 19.4 mg/kg
- vanadium, at 54.4 mg/kg
- cyanide, at 1.9 mg/kg

Concrete Sump

Two aqueous samples (SW-8 and SW-9), including a duplicate sample, were collected from the concrete sump located along the eastern wall of the retort house (Figure 4). The purpose of the sump has not been determined; however, during earlier sampling events, carbon disulfide was detected in aqueous samples collected from it. The eastern side of the retort house, where the concrete sump is located, appears to be the area where raw products, such as coal and sulfur, were brought by train and dumped in storage bins.

Table 6 summarizes the concentrations of contaminants detected in the aqueous samples, SW-8 and SW-9, with concentrations at or above three times background level shaded. The background sample is a surface-water sample collected from Flint Run. As was the case during pervious investigations, carbon disulfide was detected in the aqueous samples from the sump at estimated concentrations of 2 and 3 μg/L. The concentrations are estimated because the concentrations detected were lower than the CRDL and higher than the IDLs.

Numerous inorganic compounds were detected in the aqueous sample in concentrations at or above three times background levels. The inorganic compounds that may be related to the operations of the retort house and that were detected in other sources areas, such as the brick dump, are:

- arsenic, at 71.5 μg/L
- barium, at 202 μg/L
- chromium, at 445 μg/L
- iron, at 975,000 μg/L
- thallium, at 45.2 μg/L
- vanadium, at 78.3 μg/L

Other inorganic contaminants detected in the sample at concentrations at or above three times background levels are summarized and shown in the shaded areas of Table 6.

Brick Vault

The purpose of the brick vault has not been determined, however, it appears to have been a storage area. One aqueous sample (SW-10) was collected from the rain water (standing water) in the brick vault. The only contaminants detected in the sample at concentrations at or above three times background levels are inorganic compounds. The inorganic compounds that may be related to the operation of the retort house and that were detected in other sources areas, such as the brick dump, are:

- barium, at 679 μg/L
- chromium, at 37.4 μg/L
- iron, at 146,000 μg/L
- lead, at 93.3 μg/L

Other inorganic contaminants detected in the sample at concentrations at or above three times background levels are summarized and shown in the shaded areas of Table 6.

Round Steel Structure

One aqueous sample (SW-11) was collected from a round steel structure located on the west side of the retort. It is not known what the structure was used for, however, a strong sulfur odor was detected while determining the depth of standing water in the structure. The only contaminants detected in the sample at concentrations at or above three times background levels are inorganic compounds. The inorganic compounds that may be related to the operation of the retort house and that were detected in other sources areas, such as the brick dump, are:

- chromium, at 6.3 μg/L
- iron, at 72,400 μg/L
- lead, at 19.1 μg/L

Other inorganic contaminants detected in the sample at concentrations at or above three times background levels are summarized and shown in the shaded areas of Table 6.

Water Reservoirs

One aqueous sample (SW-12) was collected from the water reservoirs located on the northwest portion of the site (Figure 5). A cooling tower is located in the center of the reservoirs indicating that the reservoirs may have stored cooled water from the operations of the retort house and might have contained wastes from the process. The only contaminants detected in the sample at or above three times background levels are inorganic compounds. The inorganic compounds that may be related to the operation of the retort house and that were detected in other sources areas, such as the brick dump, are iron, at a concentration of 2,060 μg/L, and lead, at a concentration of 13.2 μg/L. Other inorganic contaminants detected in the sample at concentrations at or above three times background levels are summarized and shown in the shaded areas of Table 6.

Carbon Disulfide Pits

Two carbon disulfide pits were used for storing liquid carbon disulfide under water until it was shipped off site in railroad cars from a railroad spur adjacent to the carbon disulfide pits (EPA undated). It is not known whether the carbon disulfide was stored in tanks located under water in the carbon disulfide pits or stored directly in the pits. One aqueous sample (SW -13 and SW-14) was collected from each pit (Figure 5). The inorganic compounds that may be related to the operation of the retort house and that were detected in other sources areas, such as the brick dump, include iron, at a concentration of 4,370 μg/L and lead, at a concentration of 2.3 μg/L. Other inorganic contaminants detected in the sample at or above three times background levels are summarized and shown as shaded areas in Table 6.

3.1.3 Conclusions Based on Sampling of Waste and Sources

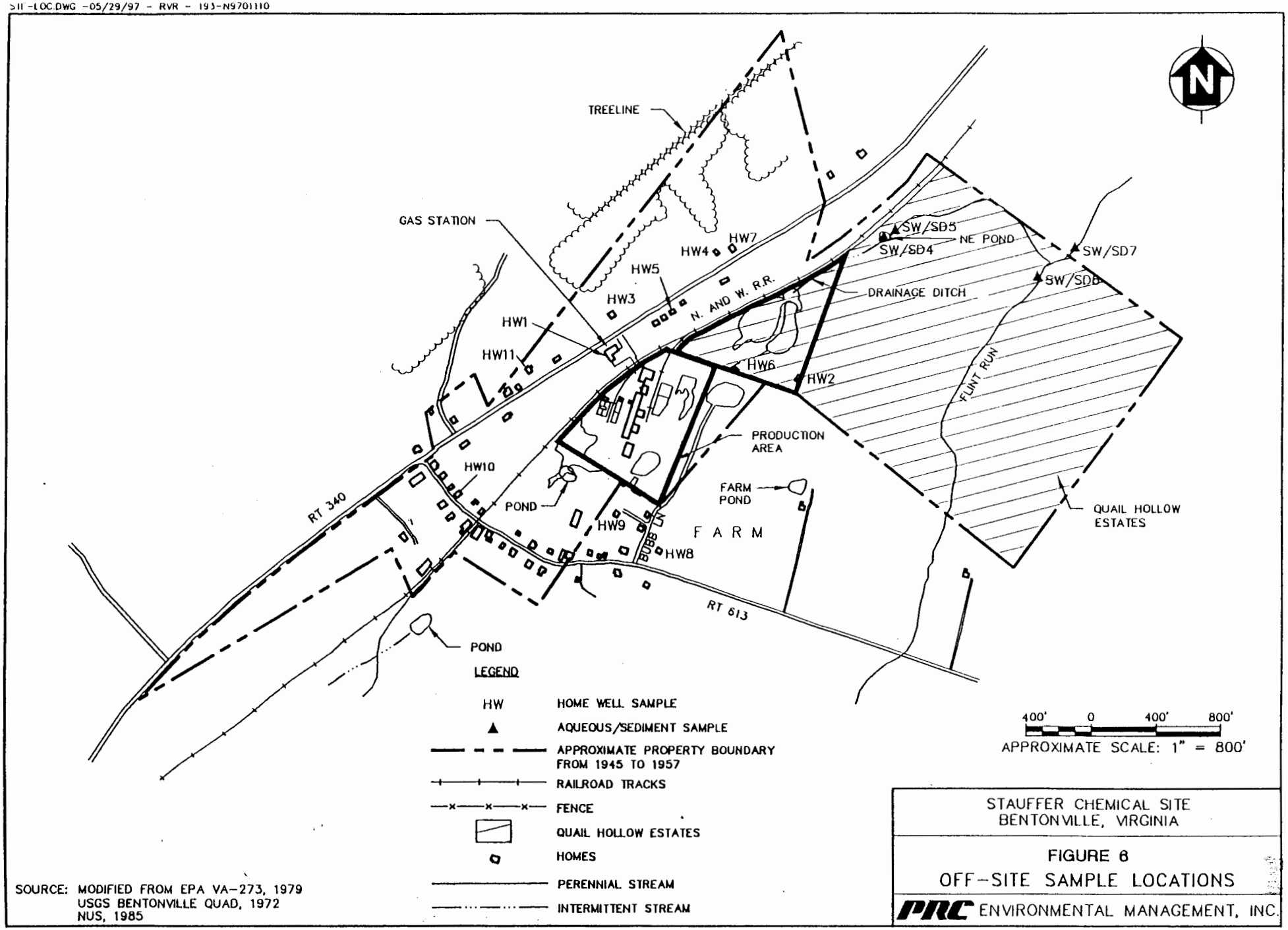
Results for analysis of waste, source, and background sampling indicate that several sources of soil contamination exist on the site. Those sources include the brick dump; the retort house; the barren area, located on the southwest portion of the site; the contaminated soil area outside the retort house; and the soil underlying the tank foundations. Beryllium was detected in the soil samples at concentrations above background levels; however, the concentration of beryllium detected is qualified with a B, not detected at a concentration substantially above the level detected in laboratory blanks. Concentrations of carcinogenic PAHs, including benzo(a)anthracene, benzo(b)fluoranthene, and

benzo(a)pyrene, and of noncarcinogenic iron exceed EPA risk-based concentrations (RBC) for residential use in soil samples collected from the brick dump. Table 4 shows the concentrations detected and the RBCs for residential use. The brick dump is located within 200 feet of the Fugatt residence and children are known to play in the area.

The soil in the retort house contained concentrations of aluminum and iron above residential RBCs. Analysis of soil underlying the tank foundations revealed arsenic, magnesium, and iron above residential RBCs. Aroclor 1254, a PCB, also was detected in the soil underlying the tank foundations, however, the concentration did not exceed residential RBCs. The source of Aroclor 1254 may be the power house, located southeast of the tank foundations. Its detection indicates that there may be an unidentified source of contamination with Aroclor 1254 on the site.

Results of analysis of sediment and surface water samples from the drainage ditch adjacent to the brick dump indicate that contaminants in the brick dump have migrated to the drainage ditch. The drainage ditch is a migration pathway to surface water. Analysis of the surface-water samples obtained from the drainage ditch revealed inorganic compounds in concentrations above the limits established under EPA's ambient water quality criteria (AWQC) for cadmium, chromium, copper, iron, lead, magnesium, zinc, and cyanide, and above the National Oceanic and Atmospheric Administration (NOAA) Screening Guidelines for sediments for arsenic, chromium, and lead. Analysis of samples from the northeast pond, which receives the flow from the drainage ditch, revealed cadmium, copper, iron, lead, and zinc in concentrations above the AWQC, and revealed arsenic in concentration greater than NOAA Screening Guidelines for sediment. Analysis of samples taken from the unnamed tributary of Flint Run Creek that drains the northeast pond revealed similar concentrations of inorganic compounds that exceeded AWQC, including copper, iron, lead, and zinc, and exceeded NOAA Screening Guidelines for arsenic in sediment. Although analysis of surface-water samples from Flint Run Creek did not reveal concentrations of inorganic compounds above the AWQCs, the drainage ditch, northeast pond, and the tributary that drains the northeast pond, all flow to Flint Run Creek, indicating that the brick dump is discharging to Flint Run Creek inorganic compounds at concentrations above AWQC. The surface-water sample collected from Flint Run Creek was taken from a point fairly far, 1,000 feet, from the northeast pond (Figure 6). The selection of that location may account for failure to detect inorganic compounds in surface-water samples from Flint Run Creek.

SIT-LOC.DWG -05/29/97 - RVR - 193-N9701110



SOURCE: MODIFIED FROM EPA VA-273, 1979
USGS BENTONVILLE QUAD, 1972
NUS, 1985

STAUFFER CHEMICAL SITE
BENTONVILLE, VIRGINIA

FIGURE 6
OFF-SITE SAMPLE LOCATIONS

PRC ENVIRONMENTAL MANAGEMENT, INC.

The detection of carbon disulfide in the surface-water sample from the concrete sump indicates that the concrete sump is a potential source of contamination of soil and groundwater underlying the sump. Numerous inorganic compounds were detected in surface-water samples obtained from the concrete sump, the brick vault, the round steel structure, the reservoir, and the carbon disulfide pits. Concentrations of the compounds were at or above three times background levels and their presence may be related to the draining of unidentified sources of contaminated soil by surface-water runoff. The source of water in those sources is precipitation and surface-water runoff.

3.2 GROUNDWATER MIGRATION PATHWAY

The subsections below provide a description of the geology and the hydrogeology in the vicinity of the site.

3.2.1 Geology and Soils

The area of concern is overlain by the Lodi soil series, which includes silt loam soils, with slopes ranging from two to seven percent. This soil is deep, well drained, gently sloping on narrow to broad, gently convex side slopes. In most areas, this soil follows the strike of the limestone bedrock. Typically, the surface is a dark brown silt loam about six inches deep and the subsoil, approximately 35 inches thick, is a yellowish red clay. The clay soils have moderate permeability [Soil Conservation Service (SCS) 1979]. This clay was observed in soil borings taken on site within six inches of the ground surface (PRC 1996a). The substratum, to a depth of 60 inches or more, consists of a multicolored clay. Permeability of the Lodi soil series is moderate. The surface and subsurface soil layer are strongly acid; that acidity may account for the low pH readings recorded for the surface-water samples collected from the site (SCS 1979).

Bedrock underlies the soils at depths greater than 60 inches. Information about the depth of bedrock in the area of the site was obtained from details of a construction well located less than 1,000 feet south of the site. The well is reported to be 400 feet deep and has been cased 8 feet into the limestone bedrock (Virginia Department of Conservation and Economic Development 1963).

The site is located within the Valley and Ridge Physiographic Province of Virginia. The Valley and Ridge Province consists of a series of northeast to southwest trending anticlines and synclines. Major thrust faults are common. The terrain is characterized by narrow valleys underlain by shale, limestone, and dolomite and ridges formed by resistant sandstones, quartzites, and conglomerates (Virginia Department of Conservation and Economic Development 1963).

The geology underlying the site is stratigraphically and structurally complex, a result of extensive deformation, as indicated by a cross section of a northwest to southeast transect that traverses the Stauffer Chemical site and the adjacent area (Virginia Department of Conservation and Economic Development 1963).

The cross section shows that the site is underlain by near-vertical limestones and dolomites belonging to the Beekmantown Group at the nose of a near-vertical anticlinal fold. Cropping out northwest of the limestone and dolomites are shales and limestones. To the southeast are dolomites, limestone, and shale. Overlying those rocks are scattered, more recent surficial deposits that are reportedly composed of sand, silt, and gravel. The thickest accumulations of these surficial deposits shown in the cross section is approximately 100 feet (Virginia Department of Conservation and Economic Development 1963). An aerial photograph of the Stauffer Chemical site and the surrounding area, prepared by the Environmental Photographic Interpretation Center (EPIC), shows the site to be underlain by sand, clay, and cobbles (EPA 1993).

3.2.2 Hydrogeology

Groundwater recharges to geologic units in the area through the infiltration of that portion of precipitation that is not lost through runoff or evapotranspiration and through infiltration from surface water. The depth to groundwater underlying the site has not been determined adequately; however, shallow home wells at depths ranging from 20 to 30 feet below ground surface (bgs) are located within a 0.25-mile radius of the site. Some home wells have depths of up to 400 feet bgs (NUS 1985; VADEQ 1994).

Groundwater in the Valley and Ridge Province occurs within voids, bedding plains, fractures, and solution channels. Carbonates in valleys frequently contain solution channels through which large

volumes of water are transmitted and stored. Sandstones on the ridges contain water within pore spaces between individual grains. Because much of the area is underlain by carbonates subjected to extensive structural deformation, hydraulic conductivity between the rocks may be well developed through interconnected fractures and solution channels (NUS 1984; VADEQ 1994). Shallow groundwater is expected to occur unconfined within the overburden above bedrock and within the upper part of the bedrock (VADEQ 1994).

Regionally, groundwater is expected to flow northwest toward the South Fork of the Shenandoah River. Direction of groundwater flow would be affected locally by the complex subsurface geohydrololgic conditions described above, as well as the influence of intervening topography and drainage ways (VADEQ 1994).

3.2.3 Groundwater Targets

No public water supply system serves the immediate vicinity of the site. The depths of the drinking-water wells within a one-mile radius of the site are from 20 to 30 feet bgs. Some residents within a one-mile radius of the site use cisterns for their drinking-water supplies; the source is water trucked in from the from the city of Front Royal water system. The drinking-water well nearest the site is located less than 200 feet southwest of the brick dump at the Fugatt residence (VADEQ 1994; PRC 1996a).

3.2.4 Sample Locations

During the ESI, 12 home well samples, including a duplicate sample, were obtained from wells within a one-mile radius of the site to evaluate the groundwater pathway. Table 3 presents sample numbers, medium sampled, locations, and descriptions for all samples collected during the ESI. Figure 6 depicts the locations from which the off-site samples were taken. Because data related to the direction of groundwater flow at the site and the nature of the underlying geology are lacking, a background groundwater sample location cannot be identified adequately. However, on the basis of the topography and the location of surface water, home well 7 (HW-7) was selected as the background.

3.2.5 Groundwater Analytical Results

Table 7 summarizes the concentrations of contaminants detected in the home well samples. Results of the analysis of the background sample also are presented in the table. The shaded areas in the table indicate the contaminants detected in samples at concentrations at or above three times background levels. No organic compounds were detected in the groundwater samples in concentrations at or above three times background levels. Numerous inorganic compounds were detected in the groundwater samples in concentrations at or above three times background levels including:

- aluminum, as high as 439 μg/L
- iron, as high as 1980 μg/L
- lead, as high as 5.7 μg/L
- magnesium, as high as 40,700 μg/L
- manganese, as high as 291 μg/L
- selenium, as high as 4.4 μg/L
- zinc, as high as 1,290 μg/L

3.2.6 Conclusions Related to Groundwater

The results of analyses from the home well samples indicate the presence of numerous inorganic compounds in concentrations above background levels. They include aluminum, copper, iron, lead, magnesium, manganese, selenium, and zinc. Many of those inorganic compounds, including aluminum, copper, iron, lead, manganese, and selenium, also were detected in on site source soil samples at concentrations above background levels, indicating that the site may be releasing inorganic contaminants to groundwater. No organic compounds were detected in the home well samples at concentrations above maximum contaminant levels (MCL).

3.3 SURFACE-WATER MIGRATION PATHWAY

The subsections below present a description of the surface-water migration pathway and the targets associated with that pathway. The subsections include a discussion of the samples collected from the surface-water pathway and the results of analysis of those samples.

Table 7
Stauffer Chemical - Summary of Home Well Sample Analysis
(Page 1 of 3)

Sample Location		HW-7	HW-1	HW-2	HW-3	HW-4	HW-5	HW-6	HW-8	Maximum Contaminant Level - Maximum Contaminant Level Goals
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	
Time		1725	1420	1055	1215	1645	1630	1125	1845	
Organic Traffic Report No.		CQC32	CQC26	CQC27	CQC28	CQC29	CQC30	CQC31	CQC33	
Inorganic Traffic Report No.		MCMR45	MCMR58	MCMR40	MCMR41	MCMR42	MCMR43	MCMR44	MCMR46	
Sample Type		Background	Dup of HW-14	Home Well	Home Well	Home Well	Home Well	Home Well	Home Well	
ORGANIC COMPOUNDS (ug/L)										
VOLATILE ORGANIC COMPOUNDS	***CRQL***									
Methylene Chloride	2	**7B**	**15B**	**13B**	**15B**	**14B**	**15B**	**5B**	**8B**	5
Acetone	5	U	U	U	U	U	8B	U	U	NA
Chloroform	1	U	U	U	U	U	U	U	U	100
Bromodichloromethane	1	U	U	U	U	U	U	U	U	100
SEMIVOLATILE ORGANIC COMPOUNDS	***CRQL***									
bis(2-Ethylhexyl)phthalate	5	U	**2B**	U	U	U	U	U	U	6
PESTICIDES/PCB COMPOUNDS	***CRQL***	U	U	U	U	U	U	U	U	
INORGANICS (ug/L)	***CRDL***									
Aluminum	200	24.3B	38.3B	439	41.9B	70.8B	37.3B	27.2B	U	NA
Antimony	60	U	U	U	U	U	U	U	U	6
Arsenic	10	U	U	U	U	U	U	U	U	50
Barium	200	15.0B	118B	19.0B	24.0B	12.0B	46.1B	38.1B	41.1B	2000
Beryllium	5	U	U	U	U	U	U	U	U	4
Cadmium	5	U	U	U	U	U	U	U	U	5
Calcium	5000	46600	94400	24500	48700	42000	53800	64100	55900	NA
Chromium	10	U	U	U	U	U	U	U	U	100
Cobalt	50	U	U	U	U	U	U	U	U	NA
Copper	25	9.4B	5.8B	22.2B	5.0B	U	8.3B	5.5B	13.8B	1300
Iron	100	71.5B	1980	929B	171B	1510B	115B	99.5B	64B	NA
Lead	3	1.8K	U	4.4K	U	U	5.7K	1.5K	2.3K	15
Magnesium	5000	7110	40700	10400	20500	6580	13400	26000	25300	NA
Manganese	15	1.9B	291	12.1B	7.0B	26.4	2.4B	1.2B	1.8B	NA
Mercury	0.2	U	U	U	U	U	U	U	U	2
Nickel	40	U	U	5.3B	U	U	U	U	U	NA
Potassium	5000	146B	467B	605B	392B	146B	299B	239B	919B	NA
Selenium	5	U	U	U	U	U	U	U	4.4J	50
Silver	10	U	U	U	U	U	U	U	U	NA
Sodium	5000	1380J	18200J	1080B	4740J	12900J	4430J	6790J	3570J	NA
Thallium	10	U	U	U	U	U	U	U	U	0.5
Vanadium	50	U	2.0B	3.4B	2.2B	U	U	U	2.2B	NA
Zinc	20	U	2.6B	U	22.7L	1.8L	1290	6.8L	5.2B	NA
Cyanide	10	U	U	U	U	U	U	U	U	200

Table 7
Stauffer Chemical - Summary of Home Well Sample Analysis
(Page 2 of 3)

Sample Location		HW-7	HW-9	HW-10	HW-11	HW-14	Field Blank	TB911	TB910	Maximum Contaminant Level - Maximum Contaminant Level Goals
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	9/10/96	9/10/96	9/10/96	
Time		1725	1845	1815	1500	1430	906	800	906	
Organic Traffic Report No.		CQC32	CQC34	CQC35	CQC36	CQC39	CQC50	CQC70	CQC49	
Inorganic Traffic Report No.		MCMR45	MCMR47	MCMR54	MCMR55	MCMR63	MCMR69			
Sample Type		Background	Home	Home	Home	Dup of HW-1	Field Blank	Trip Blank	Trip Blank	
ORGANIC COMPOUNDS (ug/L)										
VOLATILE ORGANIC COMPOUNDS	***CRQL***									
Methylene Chloride	2	**7B**	**6B**	**8B**	**14B**	**15B**	**5J**	**16**	**7J**	5
Acetone	5	U	U	U	U	U	U	U	U	NA
Chloroform	1	U	U	U	U	U	12	11	12	100
Bromodichloromethane	1	U	U	U	U	U	2J	1J	2J	100
SEMIVOLATILE ORGANIC COMPOUNDS	***CRQL***									
bis(2-ethylhexyl)phthalate	5	U	U	**26B**	U	U	U	N/A	N/A	6
PESTICIDES/PCB COMPOUNDS	***CRQL***									
INORGANICS	***CRDL***									
Aluminum	100	24.3B	U	U	143B	U	49.4B	N/A	N/A	NA
Antimony	5	U	U	U	U	U	U	N/A	N/A	6
Arsenic	2	U	U	U	U	U	U	N/A	N/A	50
Barium	20	15.0B	38.1B	121B	34.1B	115B	U	N/A	N/A	2000
Beryllium	1	U	U	U	U	U	U	N/A	N/A	4
Cadmium	1	U	U	U	U	U	U	N/A	N/A	5
Calcium	500	46600	64300	61300	31700	93200	159B	N/A	N/A	NA
Chromium	10	U	U	U	U	U	U	N/A	N/A	100
Cobalt	10	U	U	U	U	U	U	N/A	N/A	NA
Copper	10	9.4B	U	30.3	34.7	U	U	N/A	N/A	1300
Iron	100	71.5B	108B	195B	400B	1930	310	N/A	N/A	NA
Lead	2	1.8K	1.6K	2.5K	2.5K	U	U	N/A	N/A	15
Magnesium	500	7110	28700	33000	7020	40300	U	N/A	N/A	NA
Manganese	10	1.9B	1.9B	0.72B	27.7	288	4.2B	N/A	N/A	NA
Mercury	0.2	U	U	U	U	U	U	N/A	N/A	2
Nickel	20	U	U	U	U	U	U	N/A	N/A	NA
Potassium	750	146B	680B	1990B	4320B	399B	U	N/A	N/A	NA
Selenium	3	U	U	U	U	U	U	N/A	N/A	0.5
Silver	10	U	U	U	U	U	U	N/A	N/A	NA
Sodium	500	1380J	4.30J	4330J	7480J	18000	219B	N/A	N/A	NA
Thallium	10	U	U	U	U	U	U	N/A	N/A	0.5
Vanadium	10	U	U	U	2.2B	U	U	N/A	N/A	NA
Zinc	20	U	4.4B	14.4B	151	1.7B	U	N/A	N/A	NA
Cyanide	10	U	U	U	U	U	U	N/A	N/A	200

Table 7
Stauffer Chemical - Summary of Home Well Sample Analysis
(Page 3 of 3)

Notes:
U = Not detected.
B = Not detected substantially above the level reported in laboratory or field blanks.
R = Unreliable result. Analyte may or may not be present in the sample.
K = Analyte present. Reported value may be biased high.
J = Analyte present. Reported value may not be accurate or precise.
NA = Not available.
[1] EPA. 1995b. *Drinking Water Regulations and Health Advisories.* Office of Water, Washington, DC.
Numbers in bold are concentrations above those limits established by risk-based standards.
Concentrations three times or greater than background.
"The EPA Quick Reference Fact Sheet, Using Qualified Data to Document an Observed Release and Observed Contamination", dated November 1996, was used to determine whether concentrations were three times or greater than background.

3.3.1 Surface-Water Hydrology

Surface-water runoff from the site discharges to either the southwest or the northeast migration pathway. Surface-water runoff from the southwest portion of the site flows to a pond and wetland area adjacent to the barren area in the southwest portion of the site. The surface-water collected in the pond and wetland either evaporates or infiltrates into the ground (USGS 1972; PRC 1996a).

Surface-water runoff from the northeast portion of the site flows to the drainage ditch adjacent to the brick dump. The drainage ditch flows to the northeast, along the railroad tracks, and discharges into the northeast pond. The northeast pond discharges into a perennial unnamed tributary of Flint Run Creek. Flint Run Creek flows approximately 4.7 miles to the northeast to converge with the South Fork of the Shenandoah River. The South Fork of the Shenandoah completes the 15-mile surface-water migration pathway (USGS 1972; PRC 1996a). The USGS maintains a gaging station on the South Fork Shenandoah at Front Royal. There, the river's annual mean discharge is 1,595 cubic feet per second for a drainage area of 1,642 square miles (VADEQ 1994).

3.3.2 Surface-Water Targets

No drinking-water intakes are located within 15 downstream miles of the site. Residents are served by private drinking water wells. Some residents within a one-mile radius of the site use cisterns for their drinking-water supplies; the source is water trucked by the City of Front Royal water system. Flint Run Creek is a small, shallow-running creek. It is not known to be used for any particular purpose (NUS 1985; PRC 1996b). However, during the ESI, numerous hunting cabins were observed near the creek; access roads to the creek are maintained. The creek, therefore, may be used for some recreational purpose. Several deep areas, capable of supporting fish life, were observed in the creek. Also, the SWCB indicated during the 1983 surface water investigation that drainage from the site was adversely impacting the fish species in Flint Run Creek (SWCB 1983c). The South Fork of the Shenandoah River is used for a variety of recreational purposes, particularly for rafting and canoeing. No sensitive environments are known to exist in the area of the site (NUS 1986b).

3.3.3 Sample Locations

During the ESI, seven surface-water aqueous and sediment samples were collected to evaluate the surface-water pathway. Table 3 presents sample numbers, medium sampled, locations, and descriptions for all samples collected during the ESI. The seven samples were collected as described below:

- Three from the drainage ditch that drains the brick dump: two adjacent to the brick dump (SW-1/SD-2 and SW-2/SD-2) and one adjacent to the railroad tracks (SW-3/SD-3)
- One from the northeast pond (SW-4/SD-4)
- One at the discharge point of the northeast pond (SW-5/SD-5)
- One downstream in Flint Run Creek (SW-6/SD-6)
- One upstream in Flint Run Creek (background) (SW-7/SD-7)

Figures 4 and 6 show the locations from which the samples were collected. Tables 8 and 9 summarize the concentrations of contaminants detected in the aqueous and sediment samples, respectively. The tables also present the analytical results of the background samples.

3.3.4 Surface Water Analytical Results

Tables 8 and 9 summarize the analytical results of all surface-water samples. In the tables, concentrations at or above three times background levels are shaded. As discussed in Section 3.1.3, Conclusions Based on Sampling Waste and Sources, inorganic contamination from the brick dump has migrated to the adjacent drainage ditch, into the northeast pond, and into the unnamed perennial tributary of Flint Run.

No organic compounds were detected in the surface-water samples at concentrations at or above three times background levels. Numerous inorganic compounds were detected at concentrations at or above three times background levels in surface-water samples from the northeast pond and unnamed tributary to Flint Run Creek. They are:

- aluminum, as high as 549 μg/L
- arsenic, as high as 16.8 μg/L
- beryllium, as high as 7.7 μg/L
- calcium, as high as 216,000 μg/L
- chromium, as high as 995 μg/L

Table 8
Stauffer Chemical - Summary of Surface Water Sample Analysis
(Page 1 of 2)

Sample Identification		SW-7	SW-4	SW-19	SW-5	SW-6	Field Blank	TB911	TB910	Ambient Water Quality Criteria[1]
Sample Location		Flint Run	northeast pond		tributary Flint Run	Flint Run				
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/10/96	9/10/96			
Time		1108	1245	1245	1200	1122				
Organic Traffic Report No.		CQC51	CQC55	CQC69	CQC67	CQC53	CQC50	CQC70	CQC49	
Inorganic Traffic Report No.		MCMR70	MCMR74	MCMR83	MCMR81	MCMR72	MCMR69			
Sample Type		Background	Surface Water	Dup of SW-4	Surface Water	Surface Water	Field Blank	Trip Blank	Trip Blank	
ORGANIC COMPOUNDS (ug/L)										
VOLATILE ORGANIC COMPOUNDS	***CRQL***									
Methylene Chloride	10	5B	6B	5B	4B	6B	5	16	7J	NA
Acetone	10	U	U	7B	15B	U	U	U	U	NA
Carbon disulfide	10	U	U	U	U	U	U	U	U	NA
Chloroform	10	U	U	U	U	U	12	11	12	NA
Bromomethane	10	U	U	U	U	U	2J	1J	2J	NA
SEMIVOLATILE ORGANIC COMPOUNDS	***CRQL***									
bis(2-Ethylhexyl)phthalate	10	2B	U	U	U	19B	U	U	U	NA
PESTICIDES/PCB COMPOUNDS	***CRQL***									
INORGANICS(ug/L)	***CRDL***									
Aluminum	200	97.2B	81100	80000	78800	549	49.4	N/A	N/A	NA
Antimony	60	11L	12.3L	13.9L	U	U	U	N/A	N/A	NA
Arsenic	10	U	16.8K	15.7K	10.8K	U	U	N/A	N/A	190
Barium	200	29.5J	99.2J	91.3J	31.4J	30.4J	U	N/A	N/A	NA
Beryllium	5	U	7.7	7	7.4	U	U	N/A	N/A	NA
Cadmium	5	U	1.5B	1.4B	U	U	U	N/A	N/A	1.1
Calcium	5000	22000J	216000J	213000J	197000J	22500J	159B	N/A	N/A	NA
Chromium	10	U	995J	999J	919J	8.1B	U	N/A	N/A	11
Cobalt	50	U	68.3	6701	73	U	U	N/A	N/A	NA
Copper	25	3.3B	159J	156J	150J	7.8	U	N/A	N/A	12
Iron	100	188B	105000J	103000J	86200J	446	310	N/A	N/A	1000
Lead	3	U	45.4	45.6	27.8	U	U	N/A	N/A	3.2
Magnesium	5000	5330J	48700J	48400J	45100J	5550J	U	N/A	N/A	NA
Manganese	15	16.3B	7040J	6920J	6990J	95.0J	4.2B	N/A	N/A	NA
Mercury	0.2	U	U	U	U	U	U	N/A	N/A	0.012
Nickel	40	U	110	106	103	U	U	N/A	N/A	160
Potassium	5000	1550B	20200	19600	16900	1580B	U	N/A	N/A	NA
Silver	10	U	U	U	U	U	U	N/A	N/A	4.1
Sodium	5000	3670B	73400	72600	66300	4080B	219B	N/A	N/A	NA
Thallium	10	U	6.5L	6.1L	U	U	U	N/A	N/A	NA
Vanadium	50	3B	144J	141J	127J	4.5B	U	N/A	N/A	NA
Zinc	20	9.1J	720J	710J	703J	13.0J	U	N/A	N/A	110
Cyanide	10	U	U	U	U	U	U	N/A	N/A	5.2

Table 8

Stauffer Chemical - Summary of Surface-Water Sample Analysis

(Page 2 of 2)

Notes:

U = Not detected.
B = Not detected substantially above the level reported in laboratory or field blanks.
R = Unreliable result. Analyte may or may not be present in the sample.
K = Analyte present. Reported value may be biased high.
J = Analyte present. As the reported value approachs the IDL, the quantitation may not be accurate.
NA = Not available.

Concentrations three times or greater than background. "The EPA, Quick Reference Fact Sheet, Using Qualified Data to Document an Observed Release and Observed Contamination", dated November 1996, was used to determine whether concentrations were three times or greater than background

[1] EPA. 1995. *Water Quality Criteria-Draft (the Silver Book).* Office of Water, Washington, DC.

Numbers in bold are concentrations above those limits established by risk-based standards.

ORIGINAL (Red)

Table 9
Stauffer Chemical - Summary of Surface-water Sediment Sample Analysis
(Page 1 of 2)

Sample Identification		SD-7	SD-4	SD-5	SD-6	SD-19	NOAA Screening Guidelines[1]
Sample Locations		Flint Run	Northeast Pond	Tributary Flint Run	Flint Run	Dup of SD-19	
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	
Time		1117	1300	1215	1125	1800	
Organic Traffic Report No.		CQC52	CQC56	CQC71	CQC54	CQC41	
Inorganic Traffic Report No.		MCMR71	MCMR75	MCMR84	MCMR73	MCMR60	
Sample Type		Background	Sediment	Sediment	Sediment	Dup of SD-4	
ORGANIC COMPOUNDS (ug/kg)							
VOLATILE ORGANIC COMPOUNDS	***CRQL***						
Methylene chloride	10	21B	21B	35B	23B	32B	NA
Acetone	10	7B	7B	310	3B	U	NA
Chloroform	10	U	U	U	U	9B	NA
2-Butanone	10	U	U	40	U	U	NA
Bromodichloromethane	10	U	U	U	U	9B	NA
SEMIVOLATILE ORGANIC COMPOUNDS	***CRQL***						
Naphthalene	330	U	U	U	U	U	NA
2-Methylnaphthalene	330	U	U	U	U	U	70[a]
Dibenzofuran	330	U	U	U	U	U	NA
Pentachlorophenol	330	U	U	U	U	U	NA
Phenanthrene	330	U	55J	U	U	U	NA
Di-n-butylphthalate	330	U	U	U	U	U	NA
Fluoranthrene	330	U	52J	U	U	U	600[a]
Pyrene	330	U	U	U	U	U	665[a]
Benzo(a)anthracene	330	U	U		U	U	261[a]
Chrysene	330	U	45J	U	U	U	384[a]
bis (2-Ethyhexl)phthalate	330	72B	U	U	58B	U	1300[b]
Benzo(b)fluoranthrene	330	U	U	U	U	U	3200[b]
PESTICIDES/PCB COMPOUNDS	***CRQL***						
4,4'-DDD	3.3	U	U	7.3J	U	U	<16[b]

Table 9
Stauffer Chemi... - Summary of Surface-water Sedimen... ample Analysis
(Page 2 of 2)

Sample Identification		SD-7	SD-4	SD-5	SD-6	SD-19	NOAA Screening Guidelines[1]
Sample Locations		Flint Run	Northeast Pond	Tributary Flint Run	Flint Run	Dup of SD-19	
Date		9/11/96	9/11/96	9/11/96	9/11/96	9/11/96	
Time		1117	1300	1215	1125	1800	
Organic Traffic Report No.		CQC52	CQC56	CQC71	CQC54	CQC41	
Inorganic Traffic Report No.		MCMR71	MCMR75	MCMR84	MCMR73	MCMR60	
Sample Type		Background	Dupe of SD	Sediment	Sediment	Dupe of SD-4	
INORGANICS COMPOUNDS (mg/kg)	***CRDL***						
Aluminum	40	6120	5470	7820	13900	5450	NA
Arsenic	2	2.5B	**9.9**	**14.8**	1.6B	8.2	8.2[a]
Barium	40	55.0L	43.8L	122L	70.1L	54.7L	NA
Beryllium	1	0.8B	0.76B	0.67B	1.3	0.55B	NA
Calcium	1000	1870	194B	322B	1720	215B	NA
Chromium	2	23.4L	24.6L	40.4L	30.5L	22.6L	81.0[a]
Cobalt	10	15.8	9.8B	3.4B	6.0B	8.0B	NA
Copper	5	22.5	21.9	29.5	31.1	19.6	34.0[a]
Iron	20	23,200	25300	27500	10700	22100	NA
Lead	0.6	9.3	15.7	**33.4**	10	16.6	46.7[a]
Magnesium	1000	1480	197B	298B	1450	209B	NA
Manganese	3	519	55.2	46.8	69.4	44.2	NA
Mercury	0.1	U	U	U	U	U	0.150[a]
Nickel	8	10.1B	14.6	10.6L	13.1	11.8	20.9[a]
Potassium	0	672B	607B	838B	825B	659	NA
Selenium	1	U	U	**1.4J**	**1.1J**	U	NA
Sodium	1000	58.5B	90.3B	122B	53.3B	86.3B	NA
Thallium	2	U	U	U	U	**1.6B**	NA
Vanadium	10	59.4	40.8	48.3	82.9	35.9	NA
Zinc	4	37.1J	24.7J	22.1J	28.4J	21.6J	150.0[a]

Notes:
U = Not detected.
B = Not detected substantially above the level reported in laboratory or field blanks.
R = Unreliable result. Analyte may or may not be present in the sample.
K = Analyte present. Reported value may be biased high.
J = Analyte present. Reported value may not be accurate or precise.
[] = Analyte present. As values approach the IDL the quantitation may not be accurate.
NA = Not available
Concentrations three times or greater than background. "The EPA, Quick Reference Fact Sheet, Using Qualified Data to Document an Observed Release and Observed Contamination", dated November 1996, was used to determine whether concentrations were three times or greater than background.
[1] National Oceanic and Atmospheric Administration Screening Guidelines
a = Effective Range - Low (ER-L) value, Long and Morgan (1990)
b = Apparent Effects Threshold (AET) value
Numbers in bold are concentrations above those limits established by risk-based standards.

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- cobalt, as high as 73 μg/L
- copper, as high as 159 μg/L
- iron, as high as 105,000 μg/L
- lead, as high as 45.4 μg/l
- magnesium, as high as 48,700 μg/L
- manganese, as high as 7,040 μg/L
- zinc, as high as 720 μg/L

Inorganic compounds detected at concentrations at or above three times background levels in surface-water samples from Flint Run Creek include aluminum, at 549 μg/L, and manganese, at 95 μg/L.

Inorganic compounds were detected at concentrations at or above three times background levels in sediment samples from the northeast pond and unnamed tributary to Flint Run Creek. They are:

- arsenic, as high as 14.8 mg/kg
- lead, as high as 33.4 mg/kg
- selenium, as high as 1.4 mg/kg

Selenium, at 1.1 mg/kg, was detected at concentrations at or above three times background levels in the sediment sample (SD-6) collected from Flint Run Creek.

3.3.5 Conclusions Related to Surface-Water

The concentrations of inorganic compounds detected in the surface-water aqueous samples obtained from the drainage ditch adjacent to the brick dump, the northeast pond, and the unnamed tributary of Flint Run Creek exceed the limits established under the AWQCs. The drainage ditch, northeast pond, and the tributary that drains the northeast pond flow to Flint Run Creek. This circumstance indicates that the brick dump is discharging inorganic compounds at concentrations above the AWQC to surface-waters that flow into Flint Run Creek. The surface-water sample collected from Flint Run Creek was taken from a location fairly far, 1,000 feet, from the northeast pond (Figure 6). Selection of that location may account for failure to detect those inorganic compounds in the downstream surface-water samples taken from Flint Run Creek. The results of earlier investigations support evidence that indicates that the brick dump is releasing inorganic compounds into the surface-water migration pathway. In 1983 when SWCB conducted a survey of the surface-waters of the site, SWBC concluded that the surface-water runoff from the site was impacting the diversity and density of a sensitive group

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of organisms, including fish species in Flint Run Creek. In 1984 and in 1986, analyses of surface-water samples collected from the northeast pond and the perennial tributary of Flint Run Creek, that drains the northeast pond, revealed high concentrations of numerous inorganic compounds. The toxicological report indicated that concentrations of chromium, zinc, iron, aluminum, copper, and nickel in the surface-water samples exceeded levels established under criteria protective of aquatic life.

Concentrations of numerous inorganic compounds detected in the sediment samples collected during the 1996 ESI from the drainage ditch, northeast pond, and unnamed tributary exceed background levels. Results of analysis of sediment reveal that concentrations of arsenic, chromium, and lead are above NOAA Screening Guidelines in the drainage ditch, northeast pond, and unnamed tributary.

3.4 SOIL EXPOSURE AND AIR PATHWAYS

The soil exposure and air migration pathways are described in the following sections.

3.4.1 Physical Conditions

A fence surrounds the 13-acre production area; however, holes have been cut in the fence for access. Structures located in the production area, formerly used in the manufacturing of carbon disulfide, such as the retort house, are deteriorating. Evidence, such as skateboard tracks, that children play in the brick warehouse was observed during the site reconnaissance and the ESI. The majority of the production area is covered with structures and asphalt. The barren area, the area of contaminated soil outside the retort house, and the brick dump are not vegetated, and wastes can be observed on the surface. Access to the brick dump is not restricted. The following table displays the number of persons residing within a four-mile-radius of the site (VADEQ, 1994).

Distance From Site (miles)	Number of Persons
0 - ¼	151
¼ - ½	73
½ - 1	243
1 - 2	244
2 - 3	355
3-4	478
Total	1,544

3.4.2 Soil and Air Targets

There are no workers at the Stauffer Chemical site. The Fugatt residence is located within 200 feet of the brick dump and is owned by Mr. Fugatt. Mr. Fugatt indicated that his grandchildren play in the brick dump. A residential development is adjacent to the southeast boundary of the site. Approximately 151 residences are within 0.25 mile of the site; the total population within 4 miles of the site, as determined by topographic maps and data from the 1990 U.S. Census, is 1,544 people (USGS 1972; VADEQ 1972).

3.4.3 Soil and Air Sampling

The analytical results from the soil samples are discussed in Section 3.1.2, Waste and Source Analytical Results. No air samples were collected during the ESI. Analytical results of soil samples indicate that surface soil at the Stauffer Chemical site is contaminated. The areas of contaminated soil include the brick dump, the barren area, the retort house, the area of contaminated soil outside the retort house, and soils underlying the tank foundations. The area of contaminated soil in the brick dump is approximately 90,000 square feet or 2.07 acres, and lies within 200 feet of the Fugatt residence. The area of contaminated soil at the other sources cannot be determined because only one soil sample was collected from each of those areas.

3.4.4 Conclusions Related to Soil and Air

The site is located in a rural area. The Fugatt residence is located within 200 feet of contaminated soil. Access to the site is not restricted and children have access to it. There is potential that trespassers and the Fugatt residence will be exposed to inorganic contaminants at concentrations above residential RBC. Mr. Fugatt indicated that his grandchildren play in the brick dump. During the site reconnaissance and ESI, a construction made with bricks from the brick dump was observed in the brick dump, indicating that children play in that area.

4.0 CONCLUSIONS

The ESI at the Stauffer Chemical site was conducted to gather data necessary to evaluate the site as a candidate for the NPL. Waste and environmental samples were collected and analyzed to characterize the types and concentrations of substances deposited at the site and to identify potential migration pathways. In addition, information was collected to confirm target populations and environments potentially at risk because of the site.

The Stauffer Chemical site was a carbon disulfide manufacturing plant. Waste generated from the process included waste sulfur, residual ash from the reaction, filter sludge from sodium hydrosulfide, and furnace debris. Those wastes were disposed of in the barren area and the brick dump. Product storage areas were used to store coal, sulfur, other raw materials and carbon disulfide.

The ESI indicated that soil contamination is present in the brick dump and the adjacent drainage ditch, the retort house, the barren area, the soil outside the retort house, and the soil underlying the tank foundations.

The inorganic contaminants detected in the brick dump and the drainage ditch also were detected in the northeast pond, into which the drainage ditch flows, and the unnamed perennial tributary of Flint Run Creek, into which the northeast pond flows. Therefore, a release to the surface-water migration pathway from the brick dump has been documented. Inorganic contaminants were detected at levels above the AWQC in the surface-water samples collected from the drainage ditch, the northeast pond, and the perennial tributary. Also, inorganic contaminants were detected at levels above NOAA Screening Guidelines in the sediment samples taken from the drainage ditch, the northeast pond, and the perennial tributary.

The brick dump contains inorganic contaminants in concentrations above residential RBCs and is located within 200 feet of the Fugatt residence. There is evidence that children play in the brick dump.

Analysis of samples from home wells revealed numerous inorganic compounds at concentrations at or above three times background levels. No inorganic compounds were detected at concentrations above

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the MCLs. Many of the inorganic compounds detected in the samples of soil from the site were also detected in the home well samples at concentrations at or above three times background levels. However, because of the complex geology underlying the site and lack of specific information about the hydrogeology of the site, it cannot be determined reliably whether those metals are attributable to releases from the site. Recommendations for further action at the site are presented in the Preliminary Hazard Ranking System Score (PREscore) summary for the Stauffer Chemical site. The PREscore is predecisional in nature; therefore, the conclusions and recommendations based on the score are not presented in this document.

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APPENDIX A

Data Validation Reports

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION III
CENTRAL REGIONAL LABORATORY
201 DEFENSE HIGHWAY
SUITE 200
ANNAPOLIS, MARYLAND 21401

QUALITY
ASSURANCE
BRANCH

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DATE : January 7, 1997

SUBJECT: Region III Data QA Review

FROM : Cynthia E. Caporale C. Caporale
Region III ESAT RPO (3EP20)

TO : Kevin Wood
Regional Project Manager (3HW33)

Attached is the inorganic data validation report for the Stauffer Chemical Site (Case 24986) completed by the Region III Environmental Services Assistance Team (ESAT) contractor under the direction of Region III ESD.

If you have any questions regarding this review, please call me at (410) 573-2732.

Attachment

cc: Alicia Schultz, PRC/GMT

WA: 0396004 TDF File: 1151

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Lockheed Martin Services Group
Environmental Services & Technologies Region 3
1419 Forest Drive, Suite 104 Annapolis, MD 21403
Telephone 410-268-7705 Facsimile 410-268-0331

LOCKHEED MARTIN

DATE: DECEMBER 24, 1996

SUBJECT: INORGANIC DATA VALIDATION (IM1 LEVEL)
SITE: STAUFFER CHEMICAL
CASE 24986 SDGs MCMR36, MCMR59, MCMR67

FROM: HARI PRASAD HP MAHBOOBEH MECANIC MM
DATA REVIEWER SENIOR OVERSIGHT CHEMIST

TO: CYNTHIA E. CAPORALE
ESAT REGIONAL PROJECT OFFICER

THROUGH: DALE S. BOSHART DSB
ESAT TEAM MANAGER

OVERVIEW

Case 24986 [Sample Delivery Groups (SDGs) MCMR36, MCMR59, and MCMR67] consisted of a total of twenty-seven (27) aqueous and eighteen (18) soil samples analyzed for metals and cyanide (CN). The analyses were performed by Thermo Analytical, Inc. (SKINER) according to the Contract Laboratory Program (CLP) Routine Analytical Services (RAS) Statement of Work (SOW) ILM04.0. The sample set included four (4) field duplicate pairs and one (1) field blank.

The Ten Day Chemical Health Advisory Limits were exceeded for the arsenic (As), cadmium (Cd), chromium (Cr), and lead (Pb) analytes in several aqueous samples. The Regional Project Manager (RPM) was notified by fascimile (attached).

SUMMARY

All analytes, with the exception of antimony (Sb) in SDG MCMR67, were successfully analyzed for all samples. The data were validated according to the Innovative Approaches to Data Validation, IM1 Level, which includes the review of all QA/QC forms and excludes the review of the raw data. Areas of concern with respect to data usability are given below.

MAJOR PROBLEM

The matrix spike recovery was extremely low (< 30%) for the Sb analyte in SDG MCMR67. The quantitation limits for this analyte are unusable and have been qualified

"R". The reported results for this analyte may be biased extremely low and have been qualified "L".

MINOR ISSUES

The continuing calibration (CCB), preparation (PB), and field (FB) blanks had concentrations greater than the Instrument Detection Limits (IDLs) for the analytes listed below. The reported results for these analytes in the affected samples which are less than five times (< 5X) the blank concentrations may be biased high and have been qualified "B".

SDG	Blank	Analyte(s)
MCMR36	CCB	Aluminum (Al), Copper (Cu)
	PB	Cr, Vanadium (V)
	FB	Iron (Fe), Manganese (Mn)
MCMR59	CCB	Al, Beryllium (Be), Calcium (Ca), Cu, Mn, Sodium (Na), Zinc (Zn)
	PB	Barium (Ba), V
	FB	Al, Fe, Mn, Na
MCMR67	CCB	Be, Cr, Mg, Zn
	PB	Zn
	FB	Ca, Fe, Mn, Na

The ICP serial dilution results were outside the control limit (> 10% D) for the analytes listed below. The reported results and quantitation limits for these analytes are estimated and have been qualified "J" and "UJ", respectively, unless superseded by the "B" qualifier.

SDG	Analyte(s)
MCMR36	Ba, Ca, Cr, Cu, Fe, Magnesium (Mg), Mn, V, Zn
MCMR59	Na
MCMR67	Na, Zn

The matrix spike recoveries were low (30%-75%) for the Cr and selenium (Se) analytes in SDG MCMR67. The Contract Required Detection Limit (CRDL) standard recoveries were high (> 110%) for these analytes. The reported results for these analytes in the affected samples which are less

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than 2XCRDL are estimated due to opposing bias effects and have been qualified "J", unless superseded by the "B" qualifier.

The CRDL standard recoveries were mixed for the Se analyte in SDG MCMR59 and the As analyte in SDG MCMR67. The reported results for these analytes in the affected samples which are less than 2XCRDL and the quantitation limits are estimated due to opposing bias effects and have been qualified "J" and "UJ", respectively.

The matrix spike recoveries were low for the Sb and thallium (Tl) analytes in SDG MCMR36, and the Ba, Cr, and Se analytes in SDG MCMR67. The reported results and the quantitation limits for these analytes may be biased low and have been qualified "L" and "UL", respectively, unless superseded by the "B" qualifier.

The CRDL standard recoveries were low (< 90%) for the analytes listed below. The reported results for these analytes in the affected samples which are less than 2X CRDL and the quantitation limits may be biased low and have been qualified "L" and "UL", respectively, unless superseded by the "B" or "R" qualifier.

SDG	Analytes
MCMR36	Sb, Tl
MCMR59	Sb, As, Cr, Ni, Se, Silver (Ag), Zn
MCMR67	Sb, Cd, Cobalt (Co), Ni, Tl

The CRDL standard recoveries were high for the analytes listed below. The reported results for these analytes in the affected samples which are less than 2X CRDL may be biased high and have been qualified "K", unless superseded by the "B" qualifier.

SDG	Analyte(s)
MCMR36	As, Cr, Cu
MCMR59	Pb
MCMR67	As

The laboratory blanks had negative results with an absolute value > IDL for the analytes listed below. The reported results for these analytes in the affected samples which are < 2X the absolute value of the blank and the quantitation limits may be biased low and have been qualified "L" and "UL", respectively, unless superseded by the "B" qualifier.