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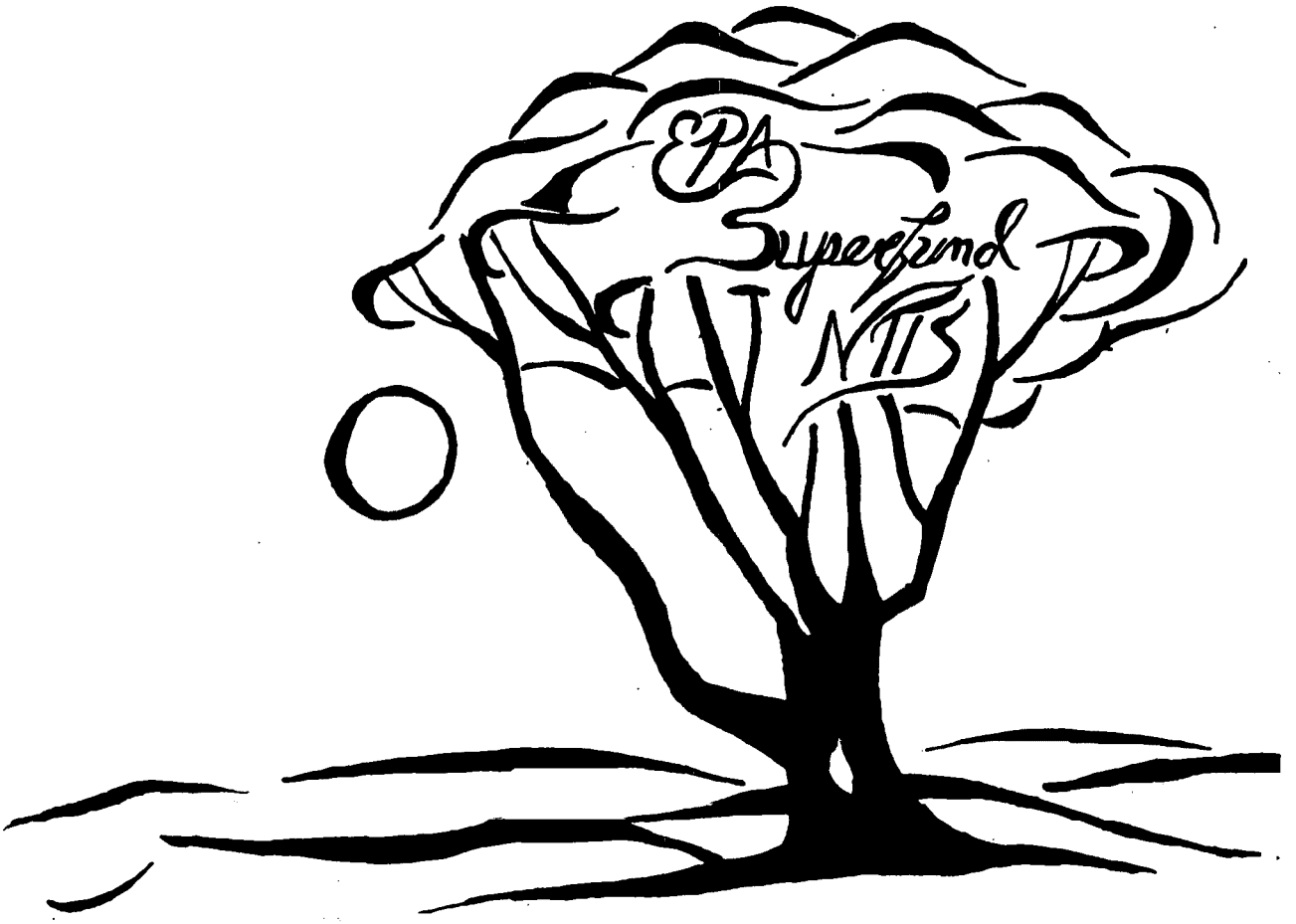
February 1995

EPA Superfund Record of Decision:

Strother Field Industrial Park (O.U. 1), Winfield, KS 3/31/1994



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

19A

MEMORANDUM

SUBJECT: Record of Decision for the Strother Field Industrial Park Superfund Site, Winfield, Kansas

FROM: Michael J. Sanderson, Acting Director
Waste Management Division

TO: Dennis Grams, P.E
Regional Administrator

The attached Record of Decision presents the proposed remedy for the final remedial action for the ground water and soils at the subject site. This remedy will address the principal threat posed by the contaminants in the ground water by preventing the further migration of contaminants off the Strother Field Industrial Park Site and by eventually restoring the ground water to acceptable quality (Safe Drinking Water Act Maximum Contaminant Levels-MCLs) by the extraction and treatment of contaminated ground water. The remedy will further reduce the threat of continued contamination of the ground water from the treatment of the soil source areas.

The selected remedy in this Record of Decision has been coordinated with the Office of Regional Counsel, the Office of Public Affairs, the Congressional and Intergovernmental Liaison, the Agency for Toxic Substances and Disease Registry and the Kansas Department of Health and Environment.

On December 27, 1990, the remedy selection authority for the Strother Field Industrial Park Site was delegated to you by Don R. Clay, Assistant Administrator. I recommend approval of the proposed remedy.

Attachment

RECYCLE

STROTHER FIELD INDUSTRIAL PARK SUPERFUND SITE
RECORD OF DECISION DECLARATION

SITE NAME AND LOCATION

Strother Field Industrial Park Site
Winfield, Kansas (Cowley County)

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected final remedial action for the ground water and soils at the Strother Field Industrial Park Site, Winfield, Kansas, chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. Section 9601 et seq., and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300.

This decision is based on the administrative record for the Strother Field Industrial Park Site, in Winfield, Kansas.

The United States Environmental Protection Agency (EPA) and the Kansas Department of Health and Environment (KDHE) agree on the selected remedy.

ASSESSMENT OF THE SITE

The actual or threatened release of hazardous substances at or from this site, if not addressed through the implementation of the response actions selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Remedial Investigation/Feasibility Study (RI/FS), conducted by the General Electric Company from March, 1990 to July 1993 at the Strother Field Industrial Park Site, identified the primary route of exposure for future use as domestic use of water from existing or new water wells either at, or downgradient, of the site.

In addition, available data shows elevated concentrations of volatile organic compounds in soils as a principal threat to the ongoing contamination of ground water.

Detectable levels of trichloroethene (TCE), carbon tetrachloride,

cis 1,2 dichloroethylene (c-1,2-DCE), trans 1,1-dichloroethylene (t-1,2-DCE), 1,1-dichloroethane (1,1-DCA), 1,1 dichloroethylene (1,1-DCE) and perchloroethylene (PCE) have been detected in the ground water. Most of these organics, including toluene, have been detected in the soil at various locations on the site.

This remedy will address the principal threat posed by the contaminants in the ground water by preventing the migration of contaminants off the Strother Field Industrial Site and by restoring the ground water to acceptable quality (Safe Drinking Water Act Maximum Contaminant Levels-MCLs) by the extraction and treatment of contaminated ground water. The remedy will further reduce the threat of continued contamination of the ground water through the treatment of the soil source areas.

The major components of the selected remedy for the affected ground water and soil include the following:

- Enhancement of the existing ground water extraction and treatment system by changing the location of one existing withdrawal well to an existing monitoring well location and converting three existing monitoring wells to extraction wells with dedicated air strippers.

- Monitoring of the ground water collection/treatment system and the ground water contaminant plume during ground water remediation activities.

- Performing a pilot study of soil vapor extraction (SVE) to determine its ability to remediate the subsurface soil contamination areas.

- Monitoring of the SVE system to determine performance and establish its maximum attainable goals.

- Monitoring of the emissions from the ground water treatment system and the soil vapor extraction system to ensure the health and safety of on-site personnel and determine if additional treatment of emissions is necessary.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that permanently and significantly reduces toxicity, mobility, or volume as a principal element. Because this remedy may result in hazardous

substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted no less often than every five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

3-31-94

Dennis Grams, P.E. Date
Regional Administrator
U.S. EPA - Region VII

RECORD OF DECISION

STROTHER FIELD INDUSTRIAL PARK SUPERFUND SITE

COWLEY COUNTY, KANSAS

MARCH, 1994

U.S. Environmental Protection Agency
Region VII
726 Minnesota Avenue
Kansas City, Kansas 66101

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1.0 SITE BACKGROUND

1.1 SITE LOCATION

The Strother Field Industrial Park is located between Winfield and Arkansas City in Cowley County, Kansas. The Field covers an area of approximately 2 1/4 square miles and is occupied by about 23 separate businesses. The site is located adjacent, and to the west of U.S. Highway 77 and the Santa Fe railroad. It is bounded by agricultural lands to the north, south, and west; while the village of Hackney (population 51) and the Hackney Agricultural Cooperative (a farmers' cooperative) are on the eastern side of the property. Area-wide and site-specific maps are included as Attachments II and III.

Strother Field is typical of an industrial park. The Field consists of rectangular parcels divided by roads running north-south and east-west. Much of the land is undeveloped. Many of the structures built by the Army during its World War II tenancy still stand and most are still in use by the current tenants.

1.2 PHYSICAL SETTING

All of the Strother Field site is located within the Posey Creek watershed. The basin covers an area of 19.5 square miles and receives about 33 inches of precipitation per year. Where Posey Creek enters the site, it is an intermittent stream and has no flow for much of the year. Originally, the creek flowed through the site from the northwest to the southeast. However, in the early 1940s, the Army re-routed the flow around the site. The creek currently enters the site from the northwest, turns to the east, flows along the northern property boundary to the northeast corner, then turns south along the eastern property boundary, intercepting its original channel southeast of the site. All storm waters and treated sanitary sewage from the site eventually discharge into Posey Creek. The creek flows to the Walnut River, which is located approximately four miles east of the site.

The Strother Field Sewage Treatment Plant, an industrial cooling tower, and two groundwater remediation wells supply water to Posey Creek at a combined rate of 0.5 cubic feet per second (cfs). As a result, Posey Creek becomes an artificial perennial stream as it passes through Strother Field. It is the only perennial surface water at the site. Posey Creek becomes a natural perennial stream approximately 1.5 miles downstream of the site, where it begins to intersect an alluvial aquifer which contributes baseflow to the creek. At this point, the stream discharge is about 1.5

cfs, which continues to increase in the downstream direction to its confluence with the Walnut River.

While the general topography of the site slopes from north to southeast, a swale (low area) intersects the site from the vicinity of the General Electric Corporation's (GE) north test cell to the area just north of the property used by the Cessna Aircraft Company. At this point, the swale turns about 45 degrees in the direction of the point where Posey Creek turns away from the site toward the Walnut River. The swale appears to conform to what was the original channel of Posey Creek. For the most part, the swale is located west of any industrial operations, in the aircraft parking area. Surface runoff from much of GE, Struthers Thermo-Flood, and the other aircraft related industries at the site either flows into this swale, to an open drainage ditch parallel to the railroad spur, or to storm sewer inlets. The swale, drainage ditches, and the storm sewer all flow to Posey Creek at the southeastern corner of the site.

1.3 HISTORY

The land now occupied by Strother Field was farm land before 1940 when the cities of Arkansas City and Winfield purchased it to build a municipal airport. Work had already begun on the air strip when, in 1942, the U.S. Army Air Force asked the cities to purchase additional land and to lease the property to the federal government to be used as a military base. The Army constructed an air base, which it operated as a basic training school from 1942 to 1945. The Army returned the land, with improvements, to Arkansas City and Winfield in 1946. Gradually, the cities developed the Field into an industrial park. Many of the buildings and airfield runways existing today were constructed by the U.S. Army Air Force during the early 1940s. The Strother Field Industrial Park is managed by the Strother Field Commission, which represents Arkansas City and Winfield.

Much of the past activity has been related to aircraft construction and maintenance. Similarly, land use during the Army's tenancy was typical of a military air base. It included aircraft maintenance and support activities, as well as housing/barracks and related personnel facilities. Most of the Army's industrial activities centered around the aircraft parking apron and the area to the south of the current GE operations. The Army used the land in the central part of the Field, currently occupied by GE, for hangars, barracks, classrooms, and offices. The land to the south was used by the Army for aircraft repair, hangars, vehicle maintenance (i.e., motor pool) and for grounds and facilities maintenance (i.e., civil engineering shops). The

Army constructed a dump at the north end of the Field.

Other properties at the Field have accommodated office buildings, an auto repair shop, oil field servicing, warehousing, and manufacturing industries. Presently, there are 23 industries located at the Field, including the Strother Field Commission and the Sewage Treatment Plant.

Since 1986, five of the site tenants have stored hazardous materials on-site and/or generated hazardous waste. These include pesticides, fuels and solvents, fuels, oils, solvents, acid, and antifreeze. During 1983 and 1984 inspections of the Field, the Kansas Department of Health and Environment (KDHE) discovered that ten site tenants were using, or had used, organic solvents. The solvents identified by KDHE were used as paint thinners and strippers, degreasers, and cleaning compounds. Specific compounds included toluene, xylene, methyl ethyl ketone, lacquer thinner, 1,1,1-trichloroethane, carbon tetrachloride, methylene chloride, orthodichlorobenzene, perchloroethylene, trichloroethylene, and proprietary materials containing chlorinated solvents.

Some tenants either have or have had underground or above-ground storage tanks used for fuel storage.

Strother Field originally obtained its water from a series of wells located along the eastern boundary of the Field. Following the discovery of VOCs in these wells in 1983, new wells were drilled on the western and northeastern boundaries of the site. The nearby community of Hackney and the Hackney Agricultural Cooperative also obtain water from wells in the area east of the Field. An underground sewage system conveys wastewater from the Field to a treatment plant located southeast of the site, across U.S. Highway 77. There are no septic fields on the site. However, residential areas outside the industrial park probably have septic systems, as Cowley County does not supply sewage treatment in the area. The Field manages storm water through a network of ditches and underground pipes, most of which run adjacent to the roads and eventually discharge into Posey Creek, east of the Field.

Natural gas and electricity are available to tenants of the Field from the City of Winfield. Tenants are responsible for their own solid waste disposal. The nearest municipal landfill is located approximately one and one-half miles southeast of the Field. In the past, two areas were used as landfills by the tenants. One of these is north of the Field and dates back to the Army's tenancy in the early 1940s. It was taken out of service in 1975. The other is across Highway 77, near the wastewater treatment plant. It

was taken out of service in 1971. A third possible dump site was identified as a potential source area of VOCs. It is located east of GE's north test cell and is the former location of the Army's small arms firing range. Tenants of the Field may have disposed of bulk liquids in a trench at this location.

1.4 PAST INVESTIGATIONS AND RESPONSE ACTIVITIES

In August of 1982, KDHE detected dissolved organic solvents in water supply wells at Strother Field during a Synthetic Organic Chemical Survey. The predominant compounds detected in the groundwater samples were trichloroethylene (TCE), 1,2-dichloroethylene (1,2-DCE), 1,1,1-trichloroethane (TCA), tetrachloroethylene (PCE), and 1,1-dichloroethylene (1,1-DCE). In 1983, KDHE attempted to verify these findings and to learn more about the extent and potential sources of these constituents.

KDHE also received reports that unknown quantities of spent chlorinated solvents had been disposed of at two inactive landfills located northwest and southeast of the active industrial park. Further, a third disposal site may have been located in the vicinity of GE's north test cell.

These factors led KDHE to require that the Strother Field Commission develop alternative drinking water supplies for the tenants. Two of the original wells which had been found to contain dissolved organic solvents were subsequently converted to recovery/remediation wells as part of an overall groundwater containment and treatment system. Presently, wells REM-1, SFW-2, and SFW-8 are extracting groundwater at rates of 100, 100, and 150 gallons per minute (gpm), respectively, for the purpose of cleanup and containment. The contaminated groundwater recovered from these wells is processed through air-stripping towers and the treated effluent is discharged to Posey Creek (through the Publicly Owned Treatment Works (POTW) in the case of well REM-1) in accordance with existing State discharge permits. Over the next several years, KDHE directed numerous additional investigations and monitoring programs.

On March 28, 1990, GE entered into a consent agreement with KDHE to conduct a Remedial Investigation and Feasibility Study (RI/FS) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Attachment IV presents a chronological summary of events beginning with KDHE's initial investigations, through the present time. Since much of the information presented in

the table refers to sampling events from groundwater monitoring wells, a well location map has been provided as Attachment V.

1.5 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Community participation was provided in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National Contingency Plan (NCP). Community participation highlights include the availability of several key documents in the administrative record, a public comment period and a public hearing.

A community relations plan for the Strother Field Industrial Park Site was completed by KDHE and approved by EPA in of May of 1991. This document lists contacts and interested parties throughout government and the local community and specifies the community relations activities expected to be undertaken during the remedial process. It also establishes communication pathways to ensure dissemination of pertinent information.

The administrative record for Strother Field Industrial Park Site was released in February of 1991. The records have been made available to the public at the following addresses:

Kansas Department of Health and Environment
Bureau of Environmental Remediation
Forbes Field, Building 740
Topeka, Kansas 66620-7500
913-296-3393

Strother Field Commission
Terminal Building, 4th and A
Strother Field Industrial Park
P. O. Box 747
Winfield, Kansas 67156
316-221-9280

United States Environmental Protection Agency
Region VII
726 Minnesota Avenue
Kansas City, Kansas 66101
913-551-7000

A press release was issued on November 17 announcing the release of the Proposed Plan, commencement of the public comment period and notice of the Public Hearing for the Strother Field Industrial Park Site.

The Public Hearing was held on December 14, 1993 to present the Proposed Plan and to receive comments. The extension of the comment period through January 21, 1994, was also announced as a result of a request to extend the period to comment. At this meeting representatives of EPA and KDHE were available to answer questions and record comments concerning the Proposed Plan.

All comments received by EPA and KDHE throughout the comment period are addressed in the Responsiveness Summary in this Record of Decision.

1.6 SUMMARY OF THE REMEDIAL INVESTIGATION

Although previous studies had provided a great deal of information on the distribution of constituents in the groundwater, less was known about the sources of these substances. Therefore, the first task of the RI was to examine the available data and develop a strategy to locate source areas. Twelve potential source areas were identified based on their proximity to known areas of contamination, as well as upon historical information about chemical and waste management practices. One of these areas, near the Hackney Agricultural Cooperative, is not part of the Strother Field Industrial Park. The contamination associated with the Hackney Coop is being addressed by KDHE and monitoring wells will continue to be sampled to characterize that plume of contamination. A soil gas survey was completed on each of those areas on the Strother Field Industrial Park to locate zones of elevated VOCs. Soil samples from the vertical zone which exhibited the highest concentration of VOCs in the soil gas survey were then obtained and subsequently analyzed. These results were compared to historical records of past chemical use practices and a high correlation was found between zones of contamination and specific activities conducted by the tenant or property owner at those locations (see Attachment VI).

From north to south, these source areas include:

Northern Groundwater Plume:

- the inactive north landfill (Area 1),
- the ditch located north of GE's north test cell (Area 10), and
- the third suspected dump (Area 11).

North-Central Groundwater Plume:

- two former drum storage areas and a loading area at Struthers Thermo-Flood (Area 8).

Eastern Groundwater Plume:

- the vicinity of the Hackney Agricultural Cooperative (no source investigations conducted at this location).

Central Groundwater Plume:

- former discharge lines from GE's hangar building 9 (Area 3), and
- GE's former solvent tank and supply lines to the former vapor degreaser in building 5 (Area 3).

Southern Groundwater Plume:

- Greif Brothers' paint waste treatment operation (Area 4),
- Greif Brothers' loading dock (Area 4),
- Greif Brothers' degreasing operations and associated solvent storage tank (Area 4),
- Gordon Piatt's property next to Greif Brothers' hazardous waste drum storage area (Area 4), and
- the inactive south landfill (Area 2).

At each of these source areas, VOCs appear to have been released onto or into the soil. The soils in the northern plume area were relatively free of VOCs, with the exception of a sample obtained near GE's north test cell (Area 10), which contained degradation products of TCE and TCA. The soil gas survey results for the north-central plume (Area 8) revealed elevated levels of DCE, a degradation product of PCE, TCE, and TCA. Additionally, one shallow soil sample in the north-central area was found to contain elevated levels of toluene. In the central plume area, TCE and its degradation product were found in a boring near the former location of GE's building 5 vapor degreaser; the soil gas survey revealed elevated levels of DCE in this area, as well as in the vicinity of GE's building 9 hangar (Area 3). Soils in the southern portion of the site (Area 4) contain PCE, TCE, TCA, and their degradation products, with one exception. Toluene and methyl ethyl ketone were the predominant VOCs found at the Greif Brothers' paint waste treatment operation. Insufficient data was obtained from the Hackney area to characterize soil contamination.

The concentration of VOCs in the soils within the source areas increases with depth, indicating that the predominant pathway for past and future migration would likely be vertically into the groundwater. Consequently, additional groundwater monitoring wells were installed to learn more about the geology and hydrogeology of the site, and to more

accurately predict the distribution and movement of contaminants in the groundwater. The data obtained from these wells was used to prepare isoconcentration maps, potentiometric surface maps, and to calibrate a groundwater model.

The groundwater data show five distinct plumes of VOCs, as indicated above. These plumes correlate well with respect to the location and the composition of the contamination from each of the corresponding source areas. The primary constituents in the north, north-central, and central plumes are TCE, TCA, and their degradation products. The major constituents in the southern plume are PCE, TCA, TCE, and their degradation products. The major constituents in the Hackney area are carbon tetrachloride and chloroform, a degradation product of carbon tetrachloride.

According to the groundwater model prepared by GE's consultant, these constituents are, to some extent, being captured by the current groundwater recovery system. Three areas were identified where contaminant migration in groundwater is potentially progressing beyond the recovery capabilities of the present system. These include the southern-most portion of the site, a localized "hot spot" near well DM-15 at GE's north test cell, and the Hackney area. Well RI-7, located southeast of the site, showed elevated levels of TCE, suggesting that some constituents at the south end of the site may have escaped the capture zone of recovery well SFW-8. This is supported by the piezometric surface contours which show that the influence of SFW-8 is weak in this area. In the north, well DM-15 has consistently shown high levels of VOCs, inconsistent with its proximity to recovery well REM-1. This suggests that localized geologic conditions may pose a barrier to flow from DM-15 to the recovery well. Contaminants that appear to originate from the Hackney area (carbon tetrachloride and chloroform) are migrating toward the site due to the influence of recovery wells SFW-2 and SFW-8.

2.0 SUMMARY OF RISKS PRESENTED BY THE STROTHER FIELD INDUSTRIAL PARK SUPERFUND SITE

As part of the RI/FS, a Baseline Risk Assessment (BLRA) for the Strother Field site was performed. The objectives of the BLRA were to assess the magnitude and potential of actual or potential harm to public health and the environment resulting from the release of hazardous substances from the site in the absence of remedial action (i.e. the "no-action" alternative). To conduct the BLRA, numerous tasks were performed, including identification of contaminants contributing to potential risk, assessing potential exposure pathways, assessing the toxicity of the constituents of concern, and characterizing/quantifying the risk. The BLRA report was based predominantly on data collected during the remedial investigation.

2.1 CONTAMINANTS OF CONCERN

The initial phase of the BLRA included compiling a list of hazardous constituents which were present at the site based on the results of the various sampling activities. Volatile organic compounds have been identified in groundwater, surface water, and soils at or near Strother Field. The chemicals that contribute most significantly to human health risk are: vinyl chloride, PCE, TCE, DCE, TCA, and DCA. The contaminants of concern (COCs) detected in groundwater either on-site or off-site and the maximum concentrations detected of the COCs are illustrated in Attachment VII. The corresponding MCLs and KALs, or regulatory levels of concern of the COCs are presented in Attachment VIII.

2.2 EXPOSURE ASSESSMENT

This BLRA focused on potential or actual risks to human health posed by contaminants at, or released from the Strother Field Site. The human population most likely to be exposed to contaminated groundwater and air are those individuals living and working in the vicinity. It should be noted that the BLRA for Strother Field focused on those exposures with the highest probability of occurrence.

The BLRA centered on the potentially significant release mechanisms of the known contaminants including the leaching of contaminants into and subsequent movement with the groundwater and the discharge of contaminants into surface soils. In its evaluation of the potential release mechanisms, the BLRA identified several scenarios with a high probability for exposure to populations living and working in the vicinity of the site. These scenarios, evaluated for current and future conditions included the ingestion of groundwater and the potential for ingestion of ground water leaching from contaminated soils.

2.3 TOXICITY ASSESSMENT

Potential carcinogenic and non-carcinogenic effects associated with the major chemicals of concern detected at Strother Field are described qualitatively in the following discussion.

1,1 Dichloroethane (1,1-DCA), also known as ethylidene dichloride, is classified as a group C carcinogen (possible human carcinogen). Very high doses produce some liver and kidney lesions. Acute exposures produce local irritation and central nervous system depression.

1,1 Dichloroethene (1,1-DCE) commonly known as vinylidene chloride, is classified as a group C carcinogen. 1,1 Dichloroethene is absorbed through all routes and is extensively metabolized in the liver, primarily by oxidation

and conjugation. There are numerous known interactions with other compounds that cause toxic effects.

1,2 Dichloroethene (1,2-DCE) and its cis-dichloroethene and trans-dichloroethene isomers are not demonstrated human carcinogens. The major effect of acute doses of 1,2 DCE is central nervous system depression. Repeated inhalation causes lesions in the lungs, liver and kidney.

Trichloroethene (TCE) is classified as a group B2 carcinogen (a probable human carcinogen). Trichloroethene is well absorbed after inhalation and ingestion, and to some extent through the skin. It tends to accumulate in fat cells. It has been shown to cause pulmonary adenocarcinoma, lymphoma, and hepatocellular carcinoma in multiple strains of mice. Subchronic and chronic exposures of animals to TCE appears to result in liver and kidney toxicity.

Tetrachloroethene, commonly known as perchloroethene (PCE), is a group C carcinogen. Mouse and rat studies have indicated that PCE is a teratogen and reproduction toxin. In addition, both oral and inhalation exposure of laboratory animals to PCE for intermediate and long-term exposure leads to liver, kidney and spleen toxicity.

Vinyl Chloride is a group A carcinogen (a known human carcinogen). It is virtually completely absorbed following ingestion, but dermal absorption is negligible. Repeated low doses in workers produce scleroderma-like skin changes, lung toxicity, thrombocytopenia, liver toxicity and x-rays show evidence of bone destruction of the distal finger bones.

2.4 RISK CHARACTERIZATION

The BLRA evaluated potential non-carcinogenic and carcinogenic risks posed by the indicator contaminants in the various exposure media at the site. Carcinogenic risks were characterized in terms of upperbound excess lifetime cancer risks and non-carcinogenic risks were characterized in terms of a hazard index and hazard quotients.

Under future conditions, the BLRA identified potentially significant risks to human populations using groundwater at the site as a drinking water source. The carcinogenic risk was estimated to be in excess of 1 in 1,000 from ingestion of groundwater. EPA considers this level of risk to be significant. The contaminants that contributed major portions of the risk are 1,1 DCE and vinyl chloride. USEPA guidance suggests that target carcinogenic risks resulting from exposure at Superfund sites may range between 1 in 10,000 to 1 in 1,000,000. Using this range as a baseline, a risk level greater than 1 in 10,000 is considered to be "significant" and a risk level less than 1 in 10,000 is

considered "insignificant". Usually, remediation goals (the point of compliance) for groundwater are the Maximum Contaminant Level (MCL), Kansas Action Level (KAL) or the established clean up level for individual contaminants to reach and/or maintain an acceptable risk level.

3.0 SCOPE AND ROLE OF RESPONSE ACTION

As discussed in Section 3.0, the BLRA indicates that the greatest risk to human health could occur from future ingestion of contaminated groundwater. The primary route of exposure for future use would be through domestic use of water from existing or new water wells. The point of ingestion may be either at, or downgradient, of Strother Field. The contaminants of concern (COCs) detected in groundwater either on-site or off-site and the maximum concentrations detected of the COCs are illustrated in Attachment VII. The corresponding MCLs and KALS, or regulatory levels of concern of the COCs are presented in Attachment VIII.

Based upon the findings of the RI/FS, the following remedial response objectives have been established for Strother Field.

1. To prevent ingestion and direct contact with soil which contains one or more of the constituents listed in Attachment IX, at levels which exceed the target levels for soils.

2. To prevent the migration of hazardous constituents from soils at levels which would cause previously non-impacted groundwater to become impacted by one or more of the constituents listed in Attachment IX, at levels which exceed the target levels for groundwater.

3. To restore soil quality within the boundaries of the Strother Field Industrial Park such that it no longer contains any of the constituents listed in Attachment IX, at levels which exceed the target levels for soils.

4. To prevent human consumption of groundwater containing one or more of the constituents listed in Attachment IX, at levels which exceed the target levels for groundwater.

5. To prevent the off-site migration of any groundwater containing one or more of the constituents listed in Attachment IX, at levels which exceed the target levels for groundwater.

6. To restore groundwater quality within the boundaries of the Strother Field Industrial Park such that it no longer contains any of the constituents listed in Attachment IX, at levels which exceed the target levels for groundwater.

The conclusions of the BLRA and the identification of response objectives provide the basis for selection of a preferred alternative. The preferred alternative will address groundwater contamination through extraction and treatment (air-stripping) to acceptable levels (MCLs or KALs). Soils will be remediated through in-situ treatment (soil vapor extraction), consistent with the goal to reduce contaminant toxicity, mobility, and volume and to minimize potential future releases to groundwater. The preferred alternative will reduce the threat of continued groundwater contamination by minimizing the potential impact of active source areas and will reduce the potential for groundwater contaminant migration in the downgradient direction.

4.0 SUMMARY OF ALTERNATIVES

4.1 SCREENING AND FORMULATION OF ALTERNATIVES

The feasibility study evaluates five general response actions which could be applied to the contaminated media and conditions known to exist at the Strother Field site. The general response categories include: (1) no action; (2) institutional controls; (3) containment; (4) removal; and (5) treatment. The feasibility study identified and screened remedial action technologies associated with each general response action. The screening criteria used for the analysis included effectiveness, implementability and cost of the remedial action technology.

Remedial action technologies were screened for applicability to the specific affected media types - soil and groundwater.

The remedial action technologies evaluated for soil included: (1) containment through technologies such as capping or hydrologic barriers and controls; (2) excavation and treatment; (3) fixation and stabilization; and (4) soil vapor extraction (SVE).

The remedial action technology evaluated for groundwater was groundwater extraction and treatment by various technologies or combinations of technologies such as air-stripping, carbon adsorption, and UV photolysis.

The remedial alternatives selected for further evaluation are presented below. The alternatives described are media-specific, thus requiring a combination for the final site-wide remedial alternative to address both soil and groundwater. These alternatives are numbered to correspond to those presented in the Final FS report (October, 1993).

REMEDIAL ACTION ALTERNATIVES FOR GROUNDWATER

The FS identified eight (8) alternatives for groundwater (numbered 1-8 below):

Alternative 1. This is the "no action" Alternative required by the NCP. It is the baseline against which the effectiveness of the other Alternatives will be judged. Under the no-action Alternative, no institutional controls would be implemented and no monitoring, control, or remediation of the groundwater contamination would be conducted. By definition, this would require that the existing groundwater recovery and treatment system and the quarterly monitoring program be discontinued.

Alternative 2. This is a limited-action Alternative which consists primarily of institutional controls. It includes land title covenants (deed restrictions) to prevent future use of contaminated groundwater for human consumption. These covenants would preclude the construction of new potable water supply wells and the conversion of existing wells for use as potable water supplies in areas that are or may be impacted by the groundwater contamination. This Alternative also includes the posting of warning signs and continued operation of the existing groundwater monitoring program. These institutional controls would serve to reduce the likelihood that persons on- or off-site would be exposed to contaminated groundwater before natural processes (e.g., biodegradation and dilution) have reduced the concentration of constituents to acceptable levels. This Alternative would also require that the existing groundwater recovery and treatment system be discontinued. However, the quarterly groundwater monitoring program would be retained and modified, as necessary, to serve as an early warning system for potential off-site migration of contamination at levels above the cleanup standards.

Alternative 3. This Alternative most closely represents the current site status, but includes institutional controls as described for Alternative 2, with the exception of warning signs. Groundwater monitoring would continue on a quarterly basis. Wells REM-1, SFW-2, and SFW-8 would continue to remove groundwater at current rates (100, 100, and 150 gpm respectively) for the purpose of cleanup and containment. The contaminated groundwater recovered from wells REM-1, SFW-2, and SFW-8 would continue to be processed through the existing air-stripping towers and the treated effluent would continue to be discharged to Posey Creek (through the POTW in the case of REM-1) in accordance with existing State discharge permits.

Alternative 4. The remaining Alternatives, including Alternative 4, emphasize accelerated cleanup of the groundwater plumes. In general, the strategy for each of these Alternatives would be to extract groundwater from the zone of highest VOC concentration within the four plume areas. Existing recovery well REM-1 would be moved to the location of monitoring well DM-15. Monitoring wells DM-14, DM-5, and GGP-2 would be converted to extraction/recovery wells. Wells SFW-2 and SFW-8 would continue to operate primarily to prevent off-site migration, serving to extract and remove groundwater contaminants in the process. The contaminated groundwater recovered from wells DM-15 (using the existing "REM-1" tower), SFW-2, and SFW-8 would continue to be

processed through the existing air-stripping towers and the treated effluent would continue to be discharged to Posey Creek (through the POTW in the case of DM-15) in accordance with existing discharge permits. For Alternative 4, the VOCs in the water recovered from wells DM-14, DM-5, and GGP-2 would be removed through the use of dedicated air-stripping towers located in the vicinity of each well. Effluent from the towers would discharge to Posey Creek and would require State discharge permits. The towers would be designed to achieve an effluent quality that is consistent with the current State standards for discharges from SFW-2 and SFW-8 to Posey Creek. Alternative 4 would include all of the institutional controls described for Alternative 3.

Alternative 5. This Alternative would include identical features as Alternative 4, except that the treated groundwater effluent from the five of the six air-stripping towers would be further processed through carbon adsorption units. Recovery well DM-15 would not require a carbon adsorption system since discharge from this system is to a water treatment system (POTW). Each of the five air-stripping towers would be outfitted with a dedicated carbon treatment unit, requiring slight modifications to the existing units. The air-strippers would provide primary treatment and the carbon units would serve as a polishing step and safety factor against possible VOC surges at levels above the design capacity of the stripping towers. The carbon treatment units would thereby provide assurance against potential exceedances of NPDES discharge criteria. The spent activated carbon would be transported as a hazardous waste to an off-site reprocessing or disposal facility, depending on economic considerations.

Alternative 6. This Alternative would be identical to Alternative 5, except that the treated effluent from each activated carbon adsorption unit would be reinjected into the groundwater at a point up-gradient of the plume from which it was extracted. The oxygen-enriched injection water should promote more rapid bio-degradation. In addition, the injection water should help "flush" contaminants from the aquifer, increase the hydraulic head across the plume area, and maintain the design water level for efficient operation of the extraction system. Therefore, reinjection is not a disposal technology, but a means of improving the efficiency/rate of the cleanup process.

Alternative 7. This Alternative would be similar to Alternative 4, however, UV photolysis units would be added as a pre-treatment process on the six groundwater recovery wells prior to treatment through the air-stripping towers. The UV systems would serve as the pre-treatment step and the air-stripping towers would constitute the polishing step. UV photolysis would serve to "mineralize" VOCs to inorganic compounds, thus reducing the quantities of hazardous substances which would require treatment through the air-stripping towers. Since the incoming concentration of contaminants in groundwater feeding the air-strippers would be effectively reduced, this Alternative would

result in lower air emissions compared to other Alternatives. The UV photolysis units are more expensive and require greater operator attention than the carbon adsorption units; however, they do not produce a residue (such as the contaminated activated carbon) that must be managed as a hazardous waste and disposed of off-site.

Alternative 8. This Alternative would be identical to Alternative 4, except that the groundwater removed from the extraction wells would be used for non-contact cooling in various industrial processes before passing through the air-stripping towers. The efficiency of the air-stripping towers would be improved since VOCs are more effectively removed from warm water. In addition, since potable water is currently being used as the sole source of process cooling water, aquifer draw-down would be reduced. Further, by combining the groundwater recovery and process cooling water systems, greater emphasis would be placed on maintaining the recovery systems. The systems would have to include provisions for by-passing a portion of the groundwater around the cooling water system to maintain an optimum thermal balance in the plant.

REMEDIAL ACTION ALTERNATIVES FOR SOILS

The FS identified nine (9) alternatives for soils (numbered 9-17 below):

Alternative 9. This is the "no action" Alternative required by the NCP. It is the baseline against which the effectiveness of the other Alternatives will be judged. Under the no-action Alternative, no funds would be expended for monitoring, control, or remediation of the soil contamination.

Alternative 10. This is a limited-action Alternative which consists primarily of institutional controls. It would include land title covenants (deed restrictions) to warn future owners of the property and to provide a means of controlling future construction in areas that have been impacted by the contamination. It would also include access restrictions to reduce the likelihood of accidental exposure to soil containing hazardous constituents, by both site personnel and trespassers. These access restrictions would consist of warning signs and a training program to educate Site personnel of the risks and the need to monitor sensitive areas. Finally, this Alternative would include an asphalt cap to retard migration of the hazardous constituents into the underlying groundwater, combined with annual soil sampling and semi-annual groundwater monitoring to document the effectiveness of the process. These measures are designed to prevent human contact and to discourage migration while the concentrations of VOCs are reduced by biodegradation.

Alternative 11. This Alternative would employ soil excavation to reduce the concentrations of VOCs in the soil to below the cleanup levels. The excavated soil would be managed as a RCRA

hazardous waste, if necessary, and transported to a RCRA-permitted treatment/disposal facility. No other soil measures would be necessary, since the soil would have achieved all three Remedial Action Objectives.

Alternative 12. In this Alternative, the soil would be excavated, treated on-site, then returned to the excavation or to a suitable borrow area. The treatment process would consist of placing the soil in a pile and removing VOCs by aeration/soil venting. The institutional controls would be the same as Alternative 10 and the excavated soils would have to be managed as a RCRA hazardous waste until analysis verified that the cleanup levels had been achieved.

Alternative 13. This Alternative would employ in-situ soil vapor extraction to remove VOCs from the contaminated soil without excavation. The institutional controls would be the same as Alternative 10 until soil monitoring revealed that the performance criteria had been achieved. A pilot study would be completed during the remedial design to determine the technical feasibility of the SVE system, develop performance criteria and provide information to expand the SVE system at the location of the pilot study area as well as to design systems at other source areas.

Alternative 14. This Alternative would be similar to Alternative 12, except that the soil would be treated ex-situ by soil drying, then returned to the excavation.

Alternative 15. This Alternative would employ in-situ soil stabilization to immobilize the VOCs. Although the process has the potential to eliminate migration and to prevent direct contact with the contaminants, the Alternative would include the same institutional controls as Alternative 10 until soil monitoring/sampling revealed that the constituents had been effectively immobilized.

Alternative 16. This Alternative would consist of a combination of several other Alternatives, including institutional controls, limited excavation, and ex-situ thermal drying. It would begin with excavation of "hot spots" (i.e., soils in which the level of contamination represents an excess cancer risk of 1 in 10,000 or greater). The VOCs would be removed from the excavated soil using a mobile dryer, then the clean soil would be returned to the excavation. Next, the area would be regraded and the storm-water system modified as necessary to redirect run-on and run-off around the area of concern. Finally, the area would be capped with asphalt. This Alternative would also include all of the institutional controls described for Alternative 10.

Alternative 17. This Alternative would be the same as Alternative 13, except that the vapors from the soil vapor extraction system would pass through a carbon adsorption unit to remove the VOCs. The spent activated carbon would be transported as a hazardous waste to an off-site reprocessing or disposal

facility, depending on economic considerations.

4.2 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

Groundwater alternatives:

The "No Action" alternative provides that the three existing groundwater extraction wells and associated air-stripping units would be removed from service. All other remedial action alternatives considered for Strother Field include a number of common components. Alternatives 3 - 8 provide a similar approach to addressing groundwater remediation, with Alternatives 4 - 8 similar in scope regarding groundwater treatment. Alternatives 4 - 8 include continued operation of the existing groundwater remediation system (with one extraction well slightly relocated) with the addition of three additional extraction wells and accompanying air-stripping units. The additional wells would provide further groundwater containment and would expedite the eventual restoration of groundwater to acceptable quality. The systems would be similar in design to those currently operating, which have demonstrated effectiveness. Alternative 7 would include the addition of a UV photolysis pre-treatment component prior to the air-stripper units to minimize air emissions from the stripper units, if necessary. Alternative 5 includes post-stripper granular activated carbon treatment units to assure that treated groundwater discharge would fall within the NPDES permitted limits. The determination regarding the need for these pre- and post-treatment systems would be based upon monitoring data collected from the existing systems during the design of the additional systems.

Soil alternatives:

Alternatives 9 - 17 differ in their approach to soil remediation. Alternative 9 is the statutorily mandated "no action" alternative, used as the baseline for comparison. Institutional controls, such as deed restrictions, along with containment techniques (capping) would be utilized to prevent human exposures in Alternative 10. Alternatives 11, 12, and 14 would include the excavation of approximately 10,000 cubic yards of contaminated soil near the Grief Brothers facility. The means of disposal of the soils would differ among the three Alternatives, with landfilling, soil venting, and soil drying the respective treatment/disposal options. Alternatives 13 and 15 would utilize in-situ treatment methods to remove or immobilize volatile contaminants in place. Alternative 13 would utilize SVE, similar to the treatment method proposed in Alternative 12, but would not require excavation to implement. Alternative 15 would leave contamination in-place, but would solidify/stabilize the affected soils to restrict the

potential for contaminant migration or release to the environment. Elements from Alternatives 10 and 14 would be combined to implement Alternative 16. Reduced soil volumes would be excavated (approximately 1000 cubic yards near the Grief Brothers facility) and subsequently treated through thermal drying. Alternative 16 would add an asphalt cap over the entire area where contaminated soils have been detected at levels which may contribute to additional groundwater contamination.

Attachments XII, XIII and XIV summarize the evaluation of the alternatives for groundwater, soil and their costs at the Preliminary Screening stage, respectively. Capital costs, operational costs, and maintenance costs were evaluated for each remedial action alternative. A discount factor of seven percent (7%) was used to calculate present worth costs.

5.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

5.1 SUMMARY OF EPA EVALUATION CRITERIA

The following section presents a summary of the criteria that USEPA uses to evaluate remedial action alternatives.

5.1.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

5.1.2 COMPLIANCE WITH ARARs

Addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of Federal and State environmental statutes and regulations and/or provides grounds for invoking a waiver.

5.1.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

5.1.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Reviews the anticipated performance of the treatment technologies a remedy may employ.

5.1.5 SHORT-TERM EFFECTIVENESS

Addresses the period of time needed to achieve protection,

and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

5.1.6 IMPLEMENTABILITY

Refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

5.1.7 COST

Evaluates the estimated capital cost, operation and maintenance costs, and net present worth costs.

5.1.8 STATE AND SUPPORT AGENCY ACCEPTANCE

Discusses whether, based on their review of the RI/FS and Proposed Plan, the agencies concur with, oppose, or have no comment on the preferred alternative at the present time.

5.1.9 COMMUNITY ACCEPTANCE

This criteria is assessed in the Record of Decision following a review of the public comments received on the RI and FS reports, the administrative record, and the Proposed Plan. It is embodied in the Responsiveness Summary attached hereto.

5.2 EVALUATION OF THE ALTERNATIVES

This section profiles the performance of the preferred alternative against the nine criteria, noting how it compares to the other options under consideration. The tables included (Attachments X, XI, XII, XIII) summarize the screening information of the various remedial action alternatives for both groundwater and soil.

5.2.1 OVERALL PROTECTION

The preferred alternatives for groundwater and soil media provide suitable protection of human health and the environment by eliminating, reducing, and controlling risk through treatment, engineering controls, and institutional controls. The preferred alternative for groundwater, Alternative 4 provides hydraulic control to minimize the possible migration of VOC contaminants and utilizes treatment to remediate groundwater to acceptable quality. The preferred soils alternative, Alternative 13, with the contingency of Alternative 14, would serve to reduce the risk of further migration of soil contaminants into groundwater through treatment (in-situ SVE, or the contingent, excavation, treatment and capping). Implementation of

the soils alternative is dependent, as noted in section 6, upon the successful completion of a pilot study to demonstrate the technical feasibility of the SVE system to remove VOCs from site soils. The overall concentration of VOCs in the soil and groundwater at the site would decrease over time with implementation of the preferred alternative.

Groundwater Alternative 3 is not comparable in scope to the other groundwater alternatives, and would offer less protection from possible off-site contaminant migration. Groundwater Alternatives 5 - 8 offer equivalent protection of human health and the environment as the preferred alternative. Alternatives 5 and 7 may offer additional risk reduction based on reduced VOC discharge levels (Alternative 5) or reduced air emissions (Alternative 7). Additional data gathering is planned to evaluate potential incremental risk reduction which may accrue as a result of implementation of the additional treatment options offered by Alternatives 5 and 7. If significant risk reduction is noted as a result of this analysis, these Alternatives may be implemented, as appropriate, as part of the preferred alternative for groundwater.

Soil Remedial Alternatives 11 - 15 offer equivalent protection of human health and the environment. However, the primary factor requiring soil remediation was based on the preference to reduce the toxicity, mobility, and the volume of contaminants at the site, thereby minimizing the possibility of future releases to groundwater and expediting the overall groundwater cleanup.

Alternatives 1 and 9, the "no action" alternatives do not meet the criteria for protection of human health and the environment. The institutional controls alternatives may be useful in tandem with other alternatives, but alone are not sufficiently protective of human health and the environment.

5.2.2 COMPLIANCE WITH ARARs

Applicable or Relevant and Appropriate Requirements (ARARs) are defined as clean-up standards, standards of control, or other environmental protection standards that are used to address problems or situations at a contaminated site. ARARs are classified within three categories: 1) Chemical Specific Requirements - health or risk based numerical values, which represent an acceptable concentration in the media of concern in the absence of consideration of site-specific exposure conditions; 2) Location-Specific Requirements - limitations on allowable concentrations of hazardous

substances due to impacts in special locations, such as critical habitats; and 3) Performance, Design, or Other Action-Specific Requirements - technology based requirements or limitations or actions taken with respect to hazardous wastes.

Primary ARARs considered for the Strother Field site include:

1) Maximum Contaminant Levels (MCLs) as promulgated under the Safe Drinking Water Act are the relevant and appropriate standards for remediation of contaminated groundwater (Chemical-Specific).

2) Effluent limitation guidelines as governed by the Clean Water Act through the National Pollutant Discharge Elimination System (NPDES) are ARARs for any discharge resulting from site remediation, such as pump and treat (Chemical-Specific).

3) No specific ARARs exist for contaminated soils at Strother Field, therefore, additional guidelines will be evaluated. Risk-based remediation goals for soils have been established to determine if any significant exposures to surficial soils may be occurring. Analyses indicate that no significant threat is posed by VOC levels found in surface soil samples which are likely exposure routes. Performance standards will be developed during the pilot study of the SVE system of the remedial design of the preferred alternative. These performance standards will be established to prevent further degradation of the groundwater. In the event that the contingent alternative for the soils is implemented, performance standards will be developed for the treatment of excavated soils and the risk-based remediation goals for soils will be used for those soils at the surface after the placement of treated soils.

There are no location or action specific ARARS.

The "no-action" alternatives for both soil and groundwater would not satisfy ARARs, nor would the institutional controls alternatives, without additional measures or combinations of alternatives. The remaining alternatives would meet their respective ARARs.

5.2.3 LONG TERM EFFECTIVENESS AND PERMANENCE

Groundwater Alternatives 4 - 8 would actively remove VOCs from known contaminant plumes. Groundwater modeling indicates that each of these alternatives would be able to reach remediation goals for site groundwater in an acceptable time frame (10 - 15 years)

and would yield a permanent, non-reversible cleanup. Alternative 3 provides fewer groundwater recovery wells (three wells - Alternative 3; six wells - Alternatives 4-8), and therefore would not be comparable in scope to the other alternatives. Consequently, Alternative 3 may not be capable of achieving groundwater remediation goals for all areas of the site.

Soil Alternatives 11, 12, and 14 would reduce contaminant levels in source areas to comparable levels which would meet remediation goals. The preferred alternative, Alternative 13, would require pilot scale testing to validate its effectiveness. It is anticipated that the preferred alternative would be equally effective in reducing VOC levels at the site, assuming appropriate system design features are incorporated following the pilot study. Alternatives 10 and 15 would not remove contamination from the source areas. The asphalt cap proposed in Alternative 10 may present long-term maintenance problems, should other actions not be taken in tandem to reduce soil contaminant levels. Similar problems may result from the soil stabilization associated with Alternative 15. Alternatives 10 and 15 are not viewed as sufficiently permanent, stand-alone alternatives in comparison to the other options.

5.2.4 REDUCTION IN TOXICITY, MOBILITY, AND VOLUME

All of the action alternatives proposed for groundwater remediation, Alternatives 3 - 8, would permanently remove contaminants from the groundwater, thereby reducing the volume of contaminants in the aquifer. In addition, the mobility of the contaminants in the groundwater would also be influenced through hydraulic control. Alternative 3 would not offer equivalent reduction in volume compared to the other groundwater action alternatives, since less comprehensive groundwater treatment would be provided. Alternatives 5 and 7 may offer additional reductions in toxicity and volume of contaminants contained in effluent and exhaust discharges. Health risks associated with these discharges will be evaluated during the design phase of the preferred alternative to determine if the additional costs associated with Alternatives 5 and 7 are justifiable based upon commensurate reduction of risk.

Soil Remedial Alternatives would offer varying degrees of reduction in toxicity, mobility, and volume of site contaminants. The excavation alternatives (Alternatives 11, 12, and 14) would offer more complete treatment of soils, however, from a more limited area

than that proposed in the preferred alternative. It is felt that the preferred alternative offers the most significant reduction of contaminants from active source areas which have the potential to continue to impact groundwater at the site.

The preferred alternative, the combination of Alternative 4 for groundwater and Alternative 13 for soil, provides for a reduction of contaminants from the soil and groundwater through treatment and recovery (volume), provides control of the migration of contaminants from the site (mobility), and treats contaminated groundwater and soil to acceptable levels as determined by USEPA and KDHE (toxicity). Reduction of VOC contaminants in the soil (volume and mobility) greatly increases the overall efficiency of the cleanup by decreasing the time needed to achieve groundwater remediation.

5.2.5 SHORT TERM EFFECTIVENESS

As discussed previously, an interim remedial system consisting of three groundwater extraction and air-stripping systems is presently in operation at Strother Field. Minimal risks to the community and on-site workers were observed during construction and implementation of the interim system. Therefore, since the preferred groundwater alternative is an expansion of the interim system, minimal risk is expected.

The additional treatment options associated with Groundwater Alternatives 5 - 8 should pose no additional risks during implementation relative to the preferred alternative. Alternative 8 may increase the possibility of exposures to groundwater during the operational lifetime, due to the presence of contaminated groundwater in process equipment in various facilities at the site, and the potential for failures within these systems.

Soil Remedial Alternatives 11, 12, and 14 - 16 would pose potential exposure risks during the soil excavation associated with each alternative. The preferred soil alternative, Alternative 13, would require less intrusive activity into contaminated soils relative to the excavation options. The risks associated with implementation of the preferred alternatives appears to be manageable, assuming that appropriately trained personnel and operating procedures are utilized during construction.

5.2.6 IMPLEMENTABILITY

Few administrative difficulties are anticipated which would delay implementation of any of the proposed Groundwater Remedial Alternatives, including the preferred alternative. The Groundwater Alternatives contain a common element, the continued utilization of the existing groundwater recovery and treatment system. No problems are anticipated with the continued operation of this system, or the addition of similar systems at other locations on the site to enhance overall groundwater treatment and recovery. The additional groundwater treatment options provided in Alternatives 5 and 7 are rather straightforward, proven technologies and would require only minor modifications to the existing systems and those additional systems offered by the preferred alternative. No problems are envisioned with implementation of the enhanced groundwater alternatives, if risk analysis indicates that they are necessary, since these technologies have been used extensively. Skilled workers needed to construct the enhanced groundwater recovery and treatment system are available in this area. All

permits for such systems are in place and regulated by KDHE. Operating personnel are familiar with this type of groundwater treatment system since they have been in operation at the site for several years.

A pilot study is required to implement the preferred alternative, SVE, for soil remediation. This is a proven technology for remediation of VOCs in soils. The pilot study is proposed to assist in providing appropriate data for system design, pertinent to soil conditions at the site. Each of the potential soil Remedial Alternatives may encounter technical difficulties due to the proximity of source areas in relation to on-site buildings and operations. This problem most seriously impacts the excavation alternatives, due to potential structural problems associated with extensive excavation near buildings.

5.2.7 COST

Attachment XIV includes a summary of present worth costs for each alternative evaluated in this Proposed Plan during the Preliminary Alternative Screening stage in the FS. This was used to compare costs among the Alternatives at that stage of the FS. The Alternatives were then analyzed in greater detail and refinements in duration, capital costs, annual O&M costs and present worth costs were made.

Groundwater:

The range for Preliminary Screening of estimated capital cost was from $0 for Alternative 1 to $1,222,000 for Alternative 6. The preferred Alternative 4 had an estimated capital cost of $312,000. As refined the estimated capital cost of Alternative 4 is $541,600.

The range for Preliminary Screening of estimated annual operation and maintenance (O&M) costs was from $0 for Alternative 1 to $440,000 for Alternative 7. The preferred Alternative 4 had an estimated annual operation and maintenance (O&M) cost of $220,000. As refined the estimated annual O&M cost of Alternative 4 is $280,000.

The range for Preliminary Screening of estimated present worth costs was from $0 for Alternative 1 to $5,777,426 for Alternative 6. The preferred Alternative 4 had an estimated present worth of $2,642,683. As refined the estimated present worth of Alternative 4 is $3,511,000.

Soil:

The range for Preliminary Screening of estimated capital cost was from $0 for Alternative 9 to $1,430,000 for Alternative 11. The preferred Alternative 13 had an estimated capital cost of $850,200. As refined the estimated capital cost of Alternative 13 is $541,600.

The range for Preliminary Screening of estimated annual operation and maintenance (O&M) costs was from $0 for Alternative 9 to $166,100 for Alternative 17. The preferred Alternative 13 had an estimated annual operation and maintenance (O&M) cost of 53,100. As refined the estimated annual O&M cost is $180,000.

The range for Preliminary Screening of estimated present worth costs was from $0 for Alternative 9 to $2,051,242 for Alternative 17. The preferred Alternative 13 had an estimated present worth of $1,067,920. As refined the estimated present worth is $3,207,000. The present worth of the Pilot Study is $60,000.

5.2.8 STATE AND SUPPORT AGENCY ACCEPTANCE

Both the Kansas Department of Health and Environment and the U.S. Environmental Protection Agency support the preferred alternative.

5.2.9 COMMUNITY ACCEPTANCE

Comments were received during the comment period and reviewed. Summaries of those comments and EPA's responses are in Section 8.0.

6.0 SELECTED REMEDY

The selected remedy includes both cleanup of the groundwater plumes and a sequence by which the cleanup of the contaminated soils can be determined during the Remedial Design.

Groundwater:

Alternative 4. This alternative will emphasize the cleanup of the groundwater by extracting groundwater from the zone of highest VOC concentration within the four plume areas - no actions are planned at this point for the fifth plume area, the Hackney area plume, which is not considered a part of the Strother Field site. However, monitoring will continue to determine if the existing recovery system is affecting the movement of that fifth plume area. Existing recovery well REM-1 would be moved to the location of monitoring well DM-15.

Monitoring wells DM-14, DM-5 and GGP-2 would be converted to recovery wells. Recovery wells SFW-2 and SFW-8 would continue to operate primarily to prevent off-site migration, although they would also continue to remove contaminants in the process. In addition, the contaminated groundwater recovered from wells DM-15 (using the existing "REM-1" tower), SFW-2 and SFW-8 would continue to be processed through the existing air-stripping towers and the treated effluent would continue to be discharged to Posey Creek (through the POTW in the case of DM-15) in accordance with existing discharge permits. For Alternative 4, the VOC's in the water recovered from wells DM-14, DM-5 and GGP-2 would be removed through the use of dedicated air-stripping towers located in the vicinity of each well. Effluent from the towers would be discharged to Posey Creek and would require State discharge permits. The towers would be designed to achieve an effluent quality that is consistent with the current State standards for discharges from SFW-2 and SFW-8 to Posey Creek. Institutional controls will include land title covenants (deed restrictions) to prevent future use of contaminated groundwater for human consumption on those properties under which the groundwater is contaminated. These covenants would preclude the construction of new potable water supply wells and the conversion of existing wells for use as potable water supplies in areas that are or may be impacted by the groundwater contamination.

In addition to Alternative 4, an air sampling program will be implemented during the Remedial Design to determine the levels of contaminants in the exhaust vapors being discharged from one of the new air-strippers. A health based evaluation of the data will be made to determine if additional treatment is necessary to minimize emissions from the air-strippers. Additionally, analysis of effluent data will be performed to determine if further treatment, such as activated carbon, is necessary to meet discharge requirements.

Soil:

Alternative 13. Alternative 13 would employ in-situ soil vapor extraction to remove VOCs from the contaminated soils at the northeast and northwest corners of the Grief Brothers facility and at Building 5 of General Electric. A "Pilot Study" during the Remedial Design is needed to evaluate whether Alternative 13 can be implemented for remediation of soils to reduce the overall toxicity, volume, and mobility of on-site contaminants. This treatment and reduction of the contamination would reduce the potential for additional contaminant migration into groundwater. The pilot study will be completed at the northeast corner of the Grief Brothers facility. The pilot study will determine the technical feasibility of the SVE system, develop performance criteria and provide design information to expand the SVE system at that location and to design systems at both the other source areas. The pilot study will include monitoring of exhaust vapors from the SVE system for a health based evaluation of the contaminants to determine if treatment of

the emissions from the system is necessary.

In the contingency that the pilot study determines that the SVE system may not be technically feasible, Alternative 14 will be implemented. Alternative 14 proposes excavation of the contaminated soils in the area of the northeast and northwest corners of the Grief Brothers facility, treating the soil by soil drying, and placing the treated soil back into the excavation in controlled lifts. The areas at the northeast and northwest corners of the Grief Brothers facility that overlie the contaminated soil that cannot be excavated due to interference with structures, etc., will then be capped with asphaltic concrete to prevent direct infiltration by percolation of water from precipitation and surface runoff.

Estimation of Costs:

The following capital and operation and maintenance costs were obtained from Appendix D (Attachment XV) of the Feasibility Study. Appendix D has been attached since the proposed alternative has used separate components in assessing costs associated with the groundwater remediation plan and the soil remediation plan. The present worth calculations were completed by using the BEN computer model as directed by EPA Guidance. The model assumptions included a discount rate of 7%, a start date of December of 1994 and an annual inflation rate of 1.3% for comparative purposes.

Groundwater:

Alternative 4:

Capital:	$ 541,000
O & M:	$ 280,000
Present Worth:	$3,511,000
Implementation Time:	10 years

Note: Additional costs may be incurred if treatment of exhaust vapors from the air-strippers is required. Costs for the monitoring, signs & alarms and land & title covenants are included for both groundwater and soil alternatives since they are consistent independent of which soil alternative is used.

Soils:

Pilot Study:	$60,000

Alternative 13:

Capital:	$1,380,000
O & M:	$ 180,000
Present Worth:	$3,207,000
Implementation Time:	2 years

Note: Pilot Study cost estimates are based on a recent study at similar site. Additional costs may be incurred if treatment of exhaust vapors is required.

In the contingency that the Pilot Study determines that the SVE system is not technically feasible:

Alternative 14:

Present Worth (soil excavation)	$1,200,000
Capital (Asphalt cap):	$ 51,000
O&M (Asphalt cap):	$ 13,000
Present Worth (Asphalt cap):	$ 180,700
Implementation Time of cap:	10 years
Total (soil excavation plus asphalt cap)	$1,380,000

7.0 STATUTORY DETERMINATIONS

Under its legal authorities, the Environmental Protection Agency's primary responsibility at Superfund sites is to undertake remedial actions that achieve protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this site must comply with applicable or relevant and appropriate environmental laws unless a statutory waiver is justified. The selected remedy also must be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

1. Protection of Human Health and the Environment

The selected remedies for groundwater and soil media provide suitable protection of human health and the environment by eliminating, reducing, and controlling risk through treatment, engineering controls, and institutional controls. The selected remedy for groundwater, Alternative 4 provides hydraulic control to minimize the possible migration of VOC contaminants and utilizes treatment to remediate groundwater to acceptable quality. The selected remedy for soils, Alternative 13, with the contingency of Alternative 14, would serve to reduce the risk of further migration of soil contaminants into groundwater through treatment (in-situ SVE, or the contingent, excavation, treatment and capping). Implementation of the soils alternative 13 is dependent, as noted in section 6, upon the successful completion of a pilot study to demonstrate the technical feasibility of the SVE system to remove VOCs from site soils. The overall

concentration of VOCs in the soil and groundwater at the site would decrease over time with implementation of the selected remedy.

2. Compliance with Applicable or Relevant and Appropriate Requirements

The Applicable or Relevant and Appropriate Requirements (ARARs) are defined as clean-up standards, standards of control, or other environmental protection standards that are used to address problems or situations at a contaminated site. ARARs are classified within three categories: 1) Chemical Specific Requirements - health or risk based numerical values, which represent an acceptable concentration in the media of concern in the absence of consideration of site-specific exposure conditions; 2) Location-Specific Requirements - limitations on allowable concentrations of hazardous substances due to impacts in special locations, such as critical habitats; and 3) Performance, Design, or Other Action-Specific Requirements - technology based requirements or limitations or actions taken with respect to hazardous wastes.

Primary ARARs considered for the Strother Field site include:

A) Maximum Contaminant Levels (MCLs) as promulgated under the Safe Drinking Water Act are the relevant and appropriate standards for remediation of contaminated groundwater. Attachment IX displays the ARARs for the groundwater at the site. For compounds without a MCL, proposed MCL or state ground water standard, a risk based cleanup level corresponding to an excess lifetime cancer risk of 1 x 10(-6) will be calculated using slope factors for carcinogens (Chemical-Specific).

B) Effluent limitation guidelines as governed by the Clean Water Act through the National Pollutant Discharge Elimination System (NPDES) are ARARs for any discharge resulting from site remediation, such as pump and treat (Chemical-Specific).

C) No specific ARARs exist for contaminated soils at Strother Field, therefore, additional guidelines will be evaluated. Risk-based target levels for remediation goals for soils have been established (Attachment IX) to determine if any significant exposures to surficial soils may be occurring. Analyses indicate that no significant threat is posed by VOC levels found in surface soil samples which are likely exposure routes. Performance standards will be developed during the pilot study of the SVE system of the remedial design of the preferred alternative. These performance standards will be established to prevent further degradation of the groundwater. In the event that the contingent alternative for the soils is implemented, performance standards will be developed for the treatment of

excavated soils and the risk-based remediation goals for soils will be used for those soils at the surface after the placement of treated soils.

There were no location or action specific ARARs.

3. Cost Effectiveness

The selected remedy for both ground water and soils provides the best balance among the evaluation criteria. It provides a higher degree of overall protection than the less costly alternatives by treating known source areas and preventing the migration of contaminated ground water from the area.

4. Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable.

EPA has determined that the selected remedy for both ground water and soils represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost effective manner for the site. Of those alternatives that are protective of human health and the environment and comply with applicable standards, EPA has determined that this selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost, while also considering the statutory preference for treatment as a principal element and considering State and community input.

5. Preference for Treatment as a Principal Element

The selected remedy uses technology for ground water treatment and active soil vapor extraction for source control and thus satisfies the statutory preference for remedies that employ treatment of the principal threat which permanently and significantly reducess the toxicity, mobility, or volume of hazardous substances as a principal element.

8.0 RESPONSIVENESS SUMMARY

8.1 Overview

In the proposed plan released for public comment, EPA and KDHE presented a preferred alternative which set forth the proposed final remedy for the ground water contamination and the soils contamination (which includes a contigency for an alternate remedy) at the Strother Field Industrial Park Superfund Site.

After receiving public comments on the preferred alternative, EPA has selected the alternative set forth in this Record of Decision (ROD).

8.2 Summary of comments received during Public Comment Period

Comments received during the public comment period from November 19, 1993 through January 21, 1994 are **summarized** below with the EPA response for each.

A. The following comments were received from Mr. David Tripp of the law firm of Stinson, Mag & Fizzell, on behalf of the Strother Field Commission at the Public Hearing on December 14, 1993. A written comment letter was received from Mr. Mark Krusor of the law firm of Mathews, Taylor & Krusor, on behalf of Energy Plus, Inc., d/b/a Strother Manufacturing Company dated January 3, 1994. Energy Plus, Inc. stated they wished to incorporate by reference the comments of the Strother Field Commission on EPA's "Proposed Plan for Strother Field Industrial Park Superfund Site," submitted at the public hearing on December 14, 1993, at Strother Field.

1. Strother Field Commission and Energy Plus, Inc. submitted three general comments: the first relating to title history of the site; the second relating to the status of the municipality under the Superfund; the third relating to the preferred alternatives addressed by EPA in its proposed plan. Only the third comment will be addressed since the purpose of the comment period is to record, review and consider comments on the poroposed action that EPA intends to take at the site. The other comments relate to the potential liability of parties and is not relevant to EPA's selection of a remedy that is protective of human health and the environment and pursuant to the NCP and CERCLA. The comments on the proposed action can be briefly summarized into four sections and will be responded to below:

    a. The Strother Field Commission and Energy Plus, Inc. are of the opinion that the hypothetical scenarios and risk models as considered in the baseline risk assessment do not reflect the actual health risks at the site. They state that the hypothetical ingestion of ground water and contaminated soils by persons living and working in the vicinity of the site do not exist at the site. They state that none of the tenants, employees, visitors or guests to Strother

Field are exposed to drinking water contaminated by elevated levels of VOC's. They also state that EPA appears to assume that visitors or workers may breathe vapors or ingest soil particles at limited locations within the Strother Field site.

EPA Response: The objectives of the Baseline Risk Assessment (BLRA) that was completed during the Remedial Investigation (RI) were to assess the magnitude and potential of actual or potential harm to public health and the environment resulting from the release of hazardous substances from the site in the absence of remedial action (i.e. the "no-action" alternative). The BLRA focused on potential or actual risks to human health posed by contaminants at, or released from Strother Field. As stated in the RI report, section 5.1, paragraph #3 - "...the risk assessment is intended primarily to be used as a guide in determining the need for, and selecting remedial alternatives and not as a comprehensive scientific estimation of actual risk."

The BLRA indicates that the greatest risk to human health could occur from future ingestion of contaminated ground water. The primary route of exposure would be through domestic use of water from existing or new water wells. The point of ingestion may be either at, or downgradient, of Strother Field Industrial Park. The affected aquifer is the principal drinking water aquifer in the area. The Strother Field Commission relocated its water supply wells to upgradient areas in the 1980's after KDHE discovered the elevated levels of volatile organic contaminants (VOC's) in the drinking water. Ground water is extracted from the same aquifer immediately downgradient from the Strother Field Industrial Park for drinking purposes for both water district and private well users. The conclusions of the BLRA and the direct threat to ground water users directly downgradient of the contamination support the need for remedial action as described in the selected remedy.

The Feasibility Study (FS) further examined the threat posed by contaminated soils at the site and determined that although there does not appear to be a direct threat to human health from exposure at the surface, the levels at depth will continue to be a source of contamination by continuing to leach contaminants to the ground water in the three areas mentioned and that some action was needed to reduce contaminant toxicity, mobility and volume. The treatment and reduction of contamination in the soils will tend to reduce the length of time necessary to remediate the ground water.

b. The Strother Field Commission and Energy Plus, Inc. are of the opinion that the costs associated with the preferred alternatives are excessive in response to the identified problems. They stated that EPA could have selected more limited response actions, achieved virtually equivalent environmental results at substantially lower costs.

EPA Response: EPA uses the following criteria to evaluate remedial action alternatives: Overall protection of human health and the environment; Compliance with ARARs; Long-term effectiveness and permanence; Reduction of toxicity, mobility, or volume; Short-term effectiveness; Implementability; Cost; State and support agency acceptance; and Community acceptance. Section 6.2 of the Proposed Plan for the Strother Field Industrial Park Superfund Site profiles the performance of the preferred alternative against eight of the nine criteria. The selected remedy as described in this Record of Decision (ROD) was determined after reviewing the comments submitted to the EPA on the Proposed Plan during the comment period. The EPA determined that the selected ground water remedy was the most protective of human health and environment based on all the above listed criteria, not just on cost. The EPA determined that the selected soils remedy was the most effective method to reduce the toxicity, mobility and volume of the contamination as well as to aid in reducing the time necessary to clean up the ground water.

c. The Strother Field Commission and Energy Plus, Inc. is of the opinion the Proposed Plan is not as good as it could be due to lack of technical support to the parties by EPA. They state that the traditional pump and treat technology that is being proposed to contain and treat the ground water at the site has been found to be ineffective, and therefore more expensive, to clean up contaminated aquifers to achieve the ARARs (maximum contaminant levels (MCLs) per the Safe Drinking Water Act (SWDA). They propose that a consortium of universities (such as Kansas State University), engineering firms, state agencies and EPA be formed to review proposed alternatives (to derive alternatives to currently applied treatment technologies), review the findings of the baseline risk assessment and the cost effectiveness of the proposed system in order to determine whether a different result could be reached. They suggest that this review be limited to a discrete time period and involve several meetings among all parties that are practically available.

EPA Response: The RI and FS were completed under a state administrative order with both KDHE and EPA reviewing the ongoing work. Access to published documents concerning clean up technologies were available during the work through government, industry and private publications. The references cited in both RI and FS documents indicate that the contractor reviewed available literature. Both EPA and KDHE are of the opinion that the contractor made an adequate attempt at researching existing and developing technologies during the review of workplans, reports and technical discussions. EPA has made the determination that the selected remedial action is necessary to contain and treat the contamination of the drinking water aquifer with the best available technology at this time. The pump and treat technology has been proven effective at the site after reviewing performance of existing systems. Time is of the essence to implement the selected remedy since it has been determined that the current system needs to be adjusted and an additional extraction well is needed at the southern end of the Industrial Park. The Rural Water District wells and other private wells that are immediately downgradient of the site would be adversely effected if the existing system would fail to contain the entire plume of contamination. The soil vapor extraction (SVE) technology selected to address the three source areas has been used extensively and is considered to be a proven technology in reducing the amount of contamination in the soil so that it does not leach into the ground water. The selected remedy has provided for a full scale pilot study in one of the source areas to ensure the effectiveness of the technology and to provide performance data and design information for the expansion of the SVE at that location as well as the two other source areas. In the event that the SVE Pilot Study provides information that the technology may not be technically feasible or provide inadequate performance results, a different response action has been provided for.

It is expected that the Remedial Design (RD) and Remedial Action (RA) will be completed under a Consent Decree (CD) between the EPA and the Potentially Responsible Parties (PRPs). It will provide for review and oversight of all work to ensure that the implementation of the selected remedy is completed according to the approved workplans in addition to providing for a review of the remediation systems in 5 years.

d. The Strother Field Commission and Energy Plus, Inc. state that the limited action alternatives identified in the proposed plan are more consistent

with the goals of the Superfund. They ask that EPA reconsider the available alternatives and select the alternative that would allow the existing pump and treat system to operate and thus allow time for new or emerging technologies to be identified should additional response actions be warranted at the site. They state that this would be most applicable to the site since there is no immediate threat to human health or the environment.

EPA Response: The EPA has responded to this comment in detail in the above sections of the Record of Decision (ROD) and in the responses to comments A, B and C above. Due to the potential risk posed to users of the ground water immediately downgradient of the site resulting from the contaminated ground water and the continued leaching of contamination from the soils to the ground water at the site, EPA has made the determination that the selected remedy as described in Section 6.0 in this ROD is necessary to protect human health and environment at the Strother Field Industrial Park Superfund Site.

B. The following comments were received from Mr. James H. Andreasen of the law firm of Spencer Fane Britt & Browne, on behalf of General Electric Aircraft Engine Maintenance Center (GE-AEMC), in a letter dated January 17, 1994. The GE-AEMC letter commented on the statements that the Strother Field Commission made concerning site history and the position of the Commission's liability under CERCLA. The GE-AEMC also stated "While GE-AEMC might not have made all the same choices that EPA did, GE-AEMC believes the proposed remedy is appropriate and consistent with the National Contingency Plan.". The GE-AEMC also stated that the Strother Field Commission's comment requesting a joint agency/academic consortium may have been appropriate at an earlier stage in the project but they do not support that request at this time since it would delay the cleanup of the property.

EPA Response: The above comments from GE-AEMC are supportive of the Proposed Plan and thus of the Selected Remedy as described above.

C. The following comments were received from Mr. Paul S. McCausland of the law firm of Young, Bogle, McCausland, Wells & Clark, on behalf of the Greif Brothers Corporation, in a letter dated January 19, 1994. The Greif Brothers Corporation (Greif) stated that they were not satisfied with the limited scope of the RI, the inaccuracy of the computer model cost estimates and EPA's proposal of an unstudied remedy. Greif engaged Allied Environmental Consultants (AEC) to complete an investigation of the source areas at their facility. The report "Environmental Site Investigation: Greif Brothers Strother Field Facility;

Winfield, Kansas" was enclosed with the letter. The two major areas of disagreement and comments will be described and responded to below:

1. Greif stated that the AEC report provided a realistic appraisal of the nature and extent of the soil contamination and rejects the use of Soil Vapor Extraction (SVE) because of the physical characteristics of the soil and contaminants are not conducive to that technology. They recommend that the removal by excavation of the contaminated soil at the northwest and northeast corners of their building and treating it will be more acceptable and already has been acknowledged to be acceptable by Donley and the EPA.

EPA Response: EPA has reviewed the report submitted by Greif and completed by AEC. The EPA Region VII Quality Assurance Management Office reviewed the data contained in the AEC Report. Since only data summaries were included a complete review of data quality could not be made. A total of twenty soil borings (16 outside and 4 inside the Greif Brothers, Inc. plant) were drilled and two monitoring wells were installed. The geology of the site on page 7 describes the upper soils as dense, fat highly plastic clays, which remain very consistent throughout the investigation area. The cross sections in Appendix B refer to the same soils as silty low plasticity clays. The boring logs in Appendix C refer to the same soils as silty clay, stiff, moist with caliche. Appendix F presents a summary table for the two soil samples, BH615 and BH620, that were tested for certain properties in the geotechnical laboratory.

There are discrepancies in the description of the same soil lithologic unit as described above. The description of the soil as to its plasticity is normally confirmed by a laboratory test called Atterberg Limits (ASTM D4318). That test, along with field determinations of an experienced geotechnical technician logging the materials according to their engineering characteristics, can produce an accurate determination of the soil lithologic unit. Only two samples were tested in the geotechnical laboratory out of the 20 borings completed during the investigation. The permeability test referenced was an in-liner falling head permeabilty test. That laboratory test is normally run on pervious soils since a relatively higher permeability is required to obtain good precision. One of the objectives of the investigation was to determine the charateristics and suitability of the soils for a Soil Vapor Extraction (SVE) remediation system to be considered. The boring logs indicate caliche seams, increasing with depth. This indicates movement of water in the capillary zone above the water table. A laboratory permeability test such as the falling head permeability test does not give a good indication of the insitu (in place) permeability of the soil strata. A few constant head field permeability tests (as

referenced in Bulletin No. 36 of the Waterways Experiment Station, Corps of Engineers) would have given a more accurate range of field permeability values. Soil structure (both in the micro and macro structure of the soil) is extremely important in determining the field permeability of a soil unit and in determining if SVE can be applied. The borings did show the contamination at depth, indicating that the soil lithologic unit permeability would be greater than the laboratory value since the contamination had been transported downward through the soil column by some leaching mechanism or combination of mechanisms.

The AEC report shows that the contamination of the soils above the preliminary remediation goals (PRGs) at the northwest and northeast corners of the Greif Bros. main building are at depth and are very close to the building structure. Excavation to the depths required to remove the contaminated soil would probably require considerable shoring and underpinning of the building foundation, which would have to be designed by a structural and geotechnical engineer. There will need to be additional investigation during the remedial design to characterize the areal extent of the contamination.

EPA has determined that the AEC report submitted with Greif's comments does not provide the information needed to change the selected remedy concerning the contaminated soils at the Strother Field Industrial Park Superfund Site. Field testing to determine the insitu permeability of the upper soil lithologic unit and additional laboratory tests to determine the material classification of the soil unit would have been helpful in the assessment of the remediation determination and design of the Pilot SVE system. The isoconcentration maps of the PCE and Toluene contamination in Figures 7 and 9, respectively, support the proposed use of SVE to extract as much contamination as possible since the areas of highest concentrations appear to be at the building perimeter and to extend under the building structure. The SVE can be designed to extract the contamination with minimal disturbance to the building structure and operations within the building. The location of the SVE Pilot Study will remain at the northeast corner of the Greif Bros. main building. The contingency for soil excavation and treatment at the northeast and northwest corners of the Greif Brothers main building in the event the SVE Pilot Study does not determine the system to be technically feasible remains as part of the Selected Remedy.

2. Greif has commented that they believe the existing ground water remediation efforts instituted by GE (General Electric) are adequate to contain and remove VOCs from the Strother Field Site without the addition of an extraction well and air stripping unit at the GGP-2 location. They state that this position agrees with computer modeling studies reported on by Woodward-Clyde Consultants in a

report to EPA dated July 31, 1987, as well as a KDHE Study in March of 1984. They refer to Section 6.0, page 8, Figures 31 and 32 of the Woodward-Clyde Report and to pages 1 and 2 of the KDHE report. They state that they believe that the excavation of the PCE hot spot at the northeast corner of their facility and the capping of the impacted soil areas will help assure the continued effectiveness of SW-8 to remediate ground water contamination on the south end of Strother Field. They also state that the RI and FS reports suggest that the primary source of the ground water contaminants at the south end is related to the soil contamination at Greif's facility. They feel that the AEC data and Greif's historical use of VOCs refute the implication that Greif's facility is the primary source of TCE in the ground water.

EPA Response: EPA has reviewed the RI/FS and the referenced Woodward-Clyde and KDHE reports. Greif's reference to the 1987 Woodward-Clyde report included only to one section of that report and to only Figures 31 and 32. Greif also referenced to only the first two pages of the 1984 KDHE report. The 1984 KDHE Report stated that, based on the available information, the migration of the contamination from the GE Test Cell area was caused by the continued pumping of the Strother Water Supply Wells rather than a second pollution source.

The recommendations on page 3 of the KDHE 1984 Report were that the Strother Field Commission should continue to pump PWS #8 until such time as a final pollution management system is implemented. On page 7 of Section 6.0 of the 1987 Woodward-Clyde Report the assumptions were stated. Assumption number 3 was as follows: "Assuming the sources of ground water contamination have been removed in 1986.". All of the scenarios that were run for that report included that assumption. Scenario H represents the current locations of extraction wells. Scenario J represents an additional extraction well very close to the proposed GGP-2 extraction well location but without the DM-14 and DM-5 pumping locations.

The RI and FS have taken into consideration all previous reports as well as information gathered during those investigations. Additional modeling utilizing the most recent data has been completed and reviewed by both KDHE and EPA. The results of the latest modeling indicate that VOC contamination will be contained and treated as described in the FS, the Proposed Plan and the Selected Remedy of this ROD. The Selected Ground Water Remedy closely resembles Scenario J of the Woodward-Clyde Report with implementation of the SVE at the three locations of soil contamination will serve as the "Assumption number 3 that the sources of ground water contamination have been removed" and the conversion of monitoring wells DM-14 and DM-5 will enhance the removal of contaminants from the ground water that were not as evident

during the time that the modeling runs were made for that report in 1987. The results of the Greif Brothers sampling of Monitoring Well 10A in 1993 submitted with their comment letter reinforces the need for monitoring well GGP-2 to be converted to an extraction well and treated to ensure that the ground water contamination does not migrate to the drinking water wells immediately downgradient of the site.

The EPA has determined that the Ground Water Remedy as was described in the Proposed Plan will be implemented as described above in the Selected Remedy.

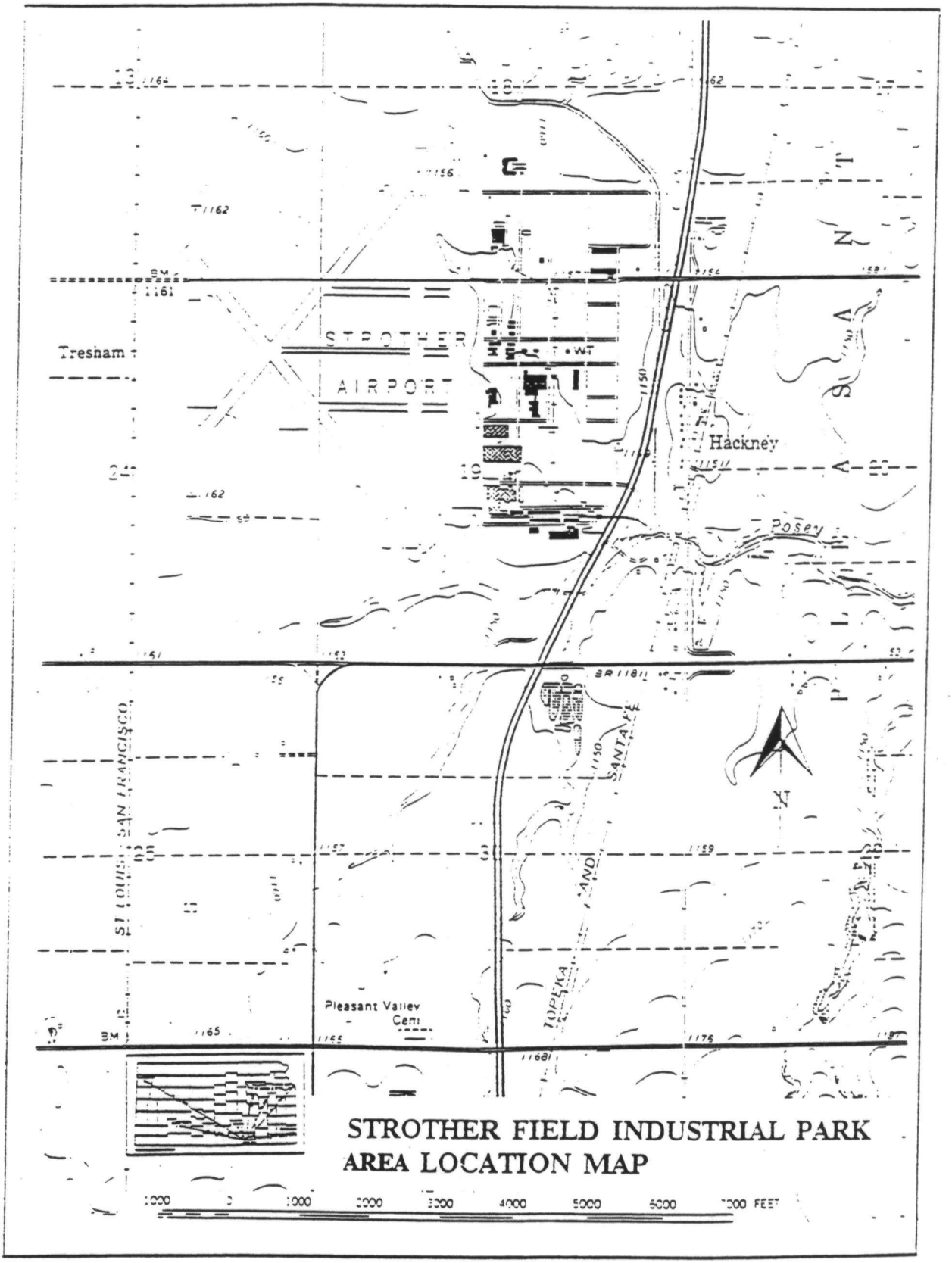
ATTACHMENTS

ATTACHMENT I

Glossary of Terms

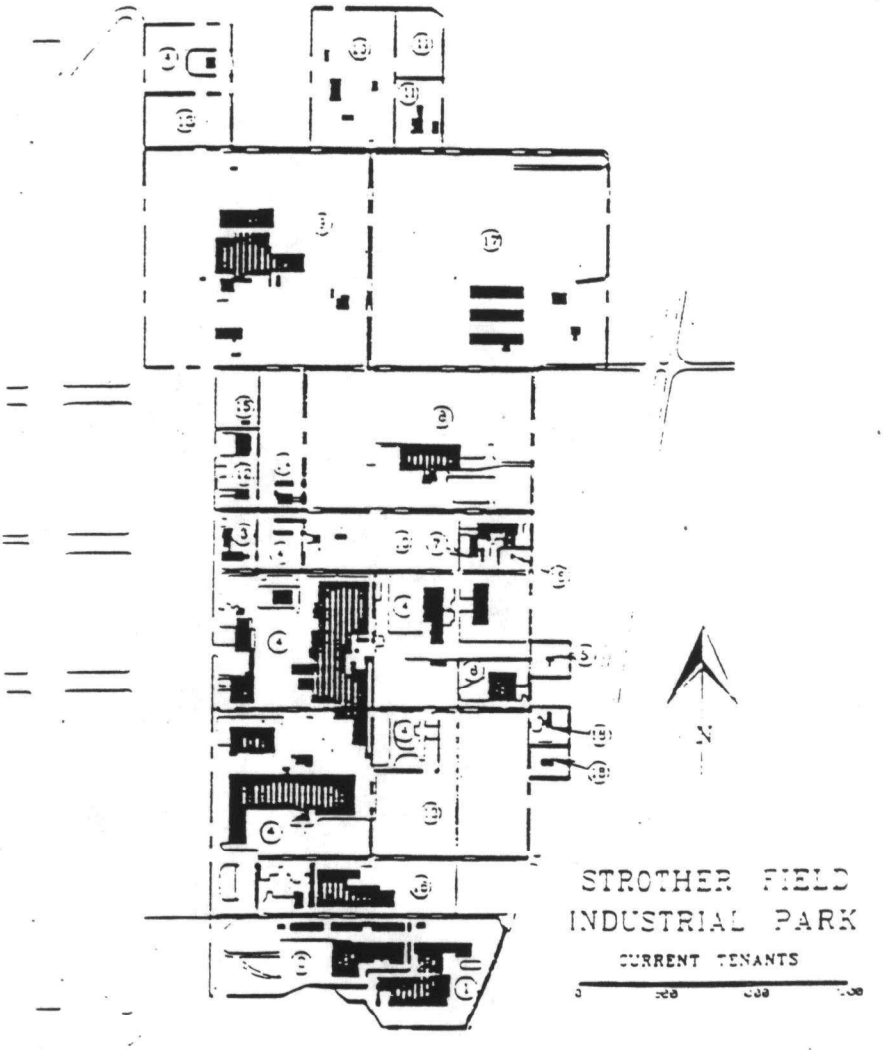
ARARS	-	Applicable or Relevant and Appropriate Requirements - Clean up standards, standards of control or other environmental protection requirements.
BLRA	-	Baseline Risk Assessment - Provide an evaluation of the potential threat to human health and the environment in the absence of remedial action.
AR File	-	Administrative Record File - includes all pertinent documents and site information which forms the basis and rationale for selection of a remedial alternative.
CERCLA	-	Comprehensive Environmental Response, Compensation and Liability Act of 1980. The federal "Superfund" law.
FS	-	Feasibility Study. The study used to evaluate various alternatives to clean up contamination.
KAL	-	Kansas Action Level is a concentration that could produce chronic health effects after long term consumption of water. If a contaminant is detected at or above the KAL in a public water supply, the well must not be used for drinking water purposes.
KDHE	-	Kansas Department of Health and Environment. The lead government agency for the Strother Field site.
MCL	-	Maximum Contaminant Level - The maximum amount of contaminant allowed in groundwater by USEPA.
NPDES	-	National Pollutant Discharge Elimination System - a permit that sets standards for the discharge of potentially contaminated water.
NCP	-	National Oil and Hazardous Substances Pollution Contingency Plan. The procedures used to address the response powers and responsibilities created by the federal Superfund law.
NPL	-	National Priorities List. A list of most contaminated sites as determined pursuant to Section 105 of CERCLA.
OU	-	Operable Unit - An action taken as part of an overall site clean-up. A number of operable units can be incorporated in the overall plans for a site clean-up.

PRP	-	Potentially Responsible Party - The party identified by the U.S. EPA which is potentially responsible for contamination.
RI	-	Remedial Investigation - The report which identifies site conditions, extent of contamination, and site risks.
ROD	-	Record of Decision - The official document by U.S. EPA which selects the remedy to clean up a Superfund site.
SARA	-	Superfund Amendments and Reauthorization Act of 1986. The federal law which amended and extended authorization of the original Superfund law (CERCLA).
USEPA	-	United States Environmental Protection Agency - The support government agency for the Strother Field site.
VOCs	-	Volatile Organic Compounds - Man-made chemicals (normally) that are found in many household, commercial, and industrial products. They are used widely in industrial processes. VOCs in groundwater are a concern due to their potential health effects.



STROTHER FIELD INDUSTRIAL PARK
AREA LOCATION MAP

ATTACHMENT II



1. GORDON-PRATT ENERGY GROUP
2. GREIF BROTHERS CORP
3. COWLEY COUNTY COMMUNICATIONS
   STROTHER FIELD COMMISSION
   IDM
   K-PAGE
   ARK VALLEY CREDIT UNION
4. GENERAL ELECTRIC
5. I U E LOCAL NO 1004
6. ARK VALLEY DISTRIBUTORS
7. COWLEY COUNTY DEVELOPMENT SERVICES
8. MONTGOMERY ELEVATOR
9. STROTHER MANUFACTURING
10. HALLIBURTON SERVICES
11. RANGE OIL COMPANY
12. CURRENT AIRCRAFT
13. VACANT
14. CONSUMER PRODUCTS INC.
15. BROWN AERIAL SPRAY
16. KSQUARE INC.
    HOME NATIONAL BANK ATM MACHINE
17. MORTON BUILDINGS
18. GUY'S FOODS, INC. (BORDEN, INC.)
19. WASTE WATER TREATMENT PLANT (NOT SHOWN)

ATTACHMENT III

ATTACHMENT IV

Chronology of Events Leading to the RI/FS

DATE	EVENT
August 1982	KDHE detected volatile organic compounds in samples from water supply wells at Strother Field Industrial Park as part of U.S. EPA's Synthetic Organic Chemical Survey.[26]
1983	KDHE conducted a water quality assessment of Posey Creek watershed. They found low DO, high nutrients, high BOD, and detectable levels of TCE, TCA, and DCE. They concluded that water quality had deteriorated since 1969 due to discharges from the Site and runoff from the County Landfill and that the greatest effects were from conventional pollutants.[31]
May-June 1983	KDHE confirmed the 1982 ground-water findings. KDHE directed Strother Field to cease using the well water for human consumption.[26]
June 2, 1983	KDHE conducted a preliminary survey of industries at Strother Field to identify users of chlorinated solvents.[21]
June 15, 1983	KDHE presented a "Report on Preliminary Problem Assessment and Abatement Guidelines for Strother Field Industrial Park Ground Water Contamination Investigation." KDHE recommended ground-water monitoring, investigations at all industrial facilities on-site, as well as the preparation of plans for source control and cleanup.[25]
September 1983	The Strother Field Commission agreed to drill six monitoring wells (MW-1 through MW-6) in locations designated by KDHE. KDHE sampled the wells and analyzed the samples. The investigation identified two suspected plumes, one located just southeast of GE's north test cell and another located adjacent to property leased by GE in the center of Strother Field.[39,42]
January 1984	Based on the proximity to GE's operations, KDHE requested that GE determine the source of the VOCs at the Site. GE hired Geraghty & Miller (G&M) to investigate ground-water conditions and to develop a remedial strategy.[11,28]
March 1984	KDHE issued a report entitled "Strother Field Study." The report concluded: the highest concentrations of VOCs are at GE's north test cell; VOCs on the east side of the Site migrated in response to pumping and did not represent a separate source; PCE contaminants were solely from the vicinity of Greif Brothers and Gordon-Piatt.[96]
May 16, 1984	KDHE issued an Administrative Order (84-E-21) to GE to submit a plan for reducing VOC levels in the vicinity of the north test cell.[42]
May 18, 1984	KDHE and EPA Region VII nominated the Strother Field Site to the NPL.[41]
May 24, 1984	GE appealed Administrative Order 84-E-21.

Chronology of Events Leading to the RI/FS

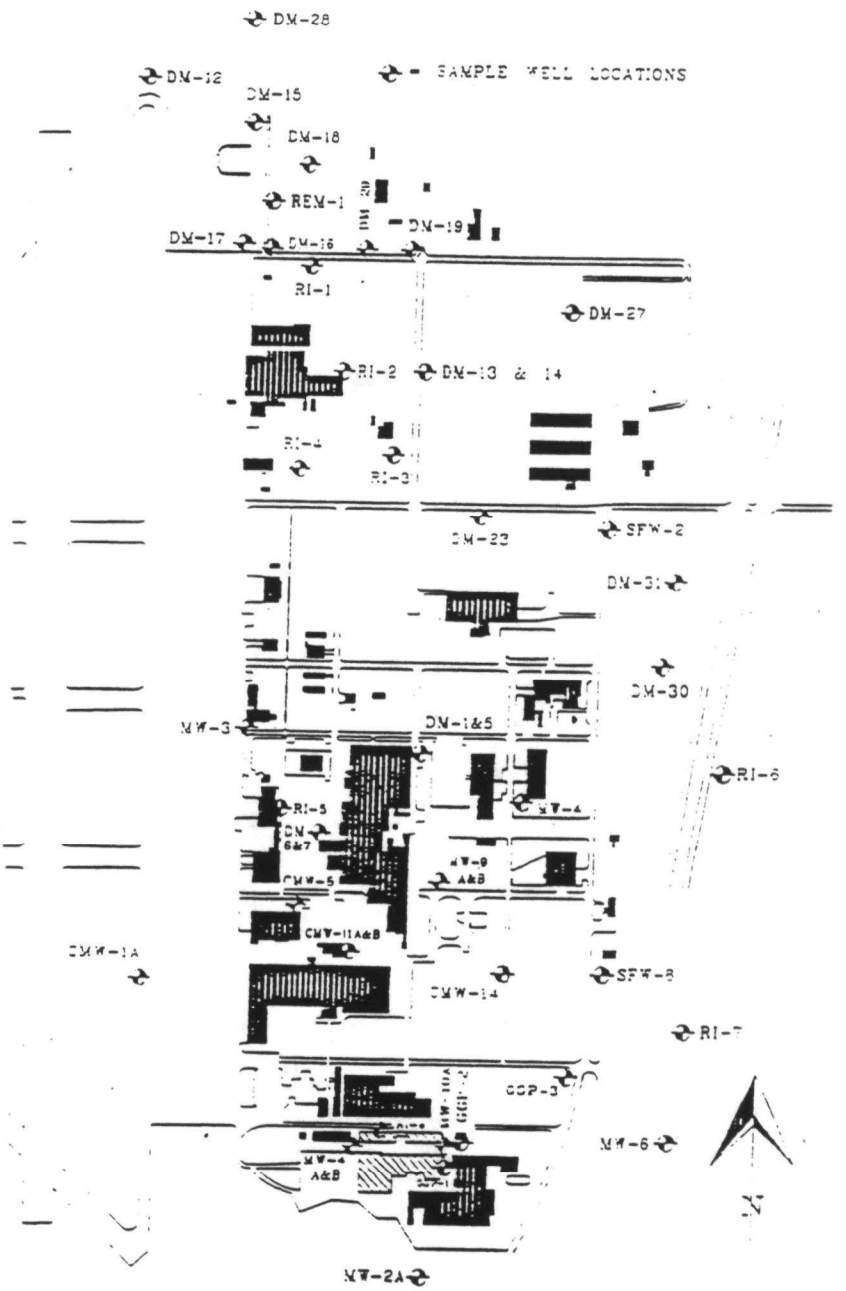
DATE	EVENT
October 3, 1985	KDHE approved GE's revised plan.[39,45]
October 9, 1985	In accordance with the Consent Order of April 9, 1985, GE submitted a document entitled "Long-Term Remedial Program at the GE Engine Test Cell" to KDHE.[45]
November 1985	GE began operating two air stripping columns at wells SFW-2 and REM-1.[39,45,48]
January 17, 1986	KDHE issued additional Administrative Orders (86-E-4, 86-E-6, and 86-E-7) to PRPs (GE, Cessna Aircraft, Greif Brothers, and Gordon-Piatt Energy Group, Inc.). These orders addressed constituents found at the southern end of the Site. All of the orders were appealed; however, GE installed a third air stripping column (SFW-8) as a result of the draft Order 86-E-4.[47] The other three PRPs conducted a limited ground-water investigation at the south end of the Site.[46]
March 1986	The Strother Field Commission installed two new water supply wells (SFW-10 and SFW-11) in a portion of the Field where ground water had not been impacted by organic solvents.[98]
May 1986	Strother Field was officially added to the NPL.[58]
July-August 1986	Tracer Research Corporation performed a soil gas survey of the Site for KDHE. They obtained and analyzed 75 samples. The results indicated two distinct plumes: in the central and southern portions of the Site. VOC concentrations in the vicinity of the north test cell were all below 0.01 ppb.[62]
December 22, 1986	GE signed a consent order (86-E-4) with KDHE to pump and treat ground water from wells REM-1, SFW-2, and SFW-8 for a period of ten years.[47]
May 1987	The Strother Field Commission installed a new water supply well (SFW-12) in a portion of the Field where ground water had not been impacted by organic solvents.[25]
June 8, 1987	KDHE released a report entitled "Preliminary Assessment for Potential Hazardous Waste Site" to EPA. The report described the presence of VOC constituents in ground water and cited Greif Brothers, Gordon-Piatt, and GE as PRPs.[67]

Chronology of Events Leading to the RI/FS

DATE	EVENT
July 26, 1984	GE submitted a G&M report to KDHE, entitled "Ground Water Quality Conditions at the Strother Field Industrial Park." The report proposed monitoring wells MW-1 through MW-6 and DM-1 through DM-14. Well clusters DM-1/DM-5, DM-6/DM-7, DM-10/DM-11, and DM-13/DM-14 were installed at the top and bottom of the aquifer to determine the vertical extent of the constituents. G&M concluded that the two old landfill sites were the major sources and that constituents were confined to the upper portions of the aquifer.[28]
August 1984	KDHE unofficially rejected the G&M report. KDHE was not in complete agreement with G&M's findings. KDHE surmised that the data indicate a JP-4 fuel spill in 1981 may have contributed to ground-water conditions at the north test cell.[48]
May 30-31, 1984 October 25, 1984	KDHE conducted a second survey to identify users of chlorinated solvents at Strother Field. KDHE identified four companies who used chlorinated solvents: Cessna, GE, Peabody Gordon-Piatt Inc., and Greif Brothers Corporation.[19,20]
January 29, 1985	KDHE issued two Administrative Orders (85-E-11 and 85-E-12) to GE. Order 85-E-11 required GE to construct a series of monitoring wells sufficient to delineate the areal extent of the ground-water plume. Order 85-E-12 directed GE to revise the plan submitted pursuant to Administrative Order 84-E-21 to include soil sampling, construction of ground-water withdrawal wells, a pumping program, and treatment and disposal of the withdrawn fluids.[43]
February 1985	GE appealed orders 85-E-11 and 85-E-12.[39,43]
March 9, 1985	G&M completed a site assessment for GE of property leased by Cessna. G&M concluded that no major contamination exists on the property, although they detected TCE at a concentration of 2,400 ug/l in one well (CMW-4) and low levels of VOCs in four other wells.[36]
March 13, 1985	During a hearing regarding GE's appeal of the administrative orders, GE agreed to develop a localized ground-water flow model to establish the location and construction of withdrawal wells to address the plume at the north test cell. GE was ordered to develop a remedial action plan and a ground-water monitoring plan to include monthly monitoring of water supply wells at the Site.[43]
April 9, 1985	KDHE finalized the Administrative Orders (84-E-21, 85-E-11, 85-E-12). They combined the three previous orders into a single document which limited the investigation to the north test cell area.[42,43,44]
July 18, 1985	GE sent a revised work plan to KDHE in response to the Administrative Order. The plan called for the installation of two recovery wells (SFW-2 and REM-1) with air stripping columns.[39]

Chronology of Events Leading to the RI/FS

DATE	EVENT
July 31, 1987	Woodward-Clyde consultants submitted a document to EPA entitled "Report on Hydrogeologic and Ground-Water Contamination Investigation for Strother Field." The report included the results of a solute transport model and concluded that the air-stripping columns were successfully removing the VOCs from the ground water in the northern and central areas. However, further investigation was suggested for the southern portion of the Site.(25)
January 19, 1989	The Office of Health Assessment completed its report to EPA, "Preliminary Health Assessment. Strother Field Industrial Park."(68)
September 1989	The Strother Field Commission installed a new water supply well (SFW-13) in a portion of Strother Field where ground water had not been impacted by organic solvents.(31)
February 6, 1990	KDHE released a draft Administrative Order calling for a formal RI/FS of the Strother Field Site.(38) The Order was presented to GE, Greif Brothers, Gordon-Piatt, and Montgomery Elevator in a meeting with EPA and KDHE [Cessna and Range Oil were not asked to attend the meeting]. The order called for the PRPs to jointly conduct a RI/FS. After consulting with the PRPs, GE elected to proceed as sole signatory to the Order, provided the other PRPs agreed to cooperate in the investigation.(40)
March 28, 1990	KDHE and GE signed a Consent Agreement to conduct a RI/FS at the Strother Field Site.(63)
March 29, 1990	GE signed a Settlement Agreement with Greif Brothers, Gordon-Piatt, and Montgomery Elevator. GE agreed to conduct the RI/FS and the other parties agreed to provide information and access to the Site.(54)
July 1, 1990	GE submitted its draft RI work plan to KDHE for review.(29)
November 15, 1990	KDHE approved the RI work plan. The work plan objectives were to: 1) determine the nature and extent of constituents detected in ground water, surface water, soil, and sediment; 2) characterize the ground-water flow regime; 3) identify and delineate the sources of the constituents; 4) model the fate of these constituents in the ground water; and 5) prepare a risk assessment.(29)
February 28, 1991	KDHE and EPA conducted a Public Meeting and established an Administrative Record for the Strother Field Superfund Site.(65)
April 1991	Field activities for the RI commenced.(66)



STROTHER FIELD INDUSTRIAL PARK

WELLS SAMPLED FOR CHEMICAL ANALYSIS

ATTACHMENT VI

ATTACHMENT VII

Maximum Concentrations Detected in the Ground Water in Each Area

AREA	1,1,1-TCA	TCE	PCE	Vinyl Chloride	1,2-DCE	Carbon Tetra-Chloride	1,1-DCE	1,1-DCA	Methylene Chloride	1,2-DCA
North	4900	73000	200	7400	15000	3.1	2100	360	1.4	53
Central	130000	6600	461	39	5680	1 8	22000	4400	116	830
South	7400	28000	6700	23	9700	1 8	8300	137	32	62
Maximum	130000	73000	6700	7400	15000	3.1	22000	4400	116	830
Hackney*	ND	ND	ND	ND	ND	19	ND	ND	ND	0.6

AREA	Chloro-form	Bromo-form	Benzene	Chloro-dibromo-methane	1,1,2-TCA	Chloro-benzene	Toluene	Xylene	Chloro-ethane	Ethyl-benzene
North	180	50	1300	15	5.0	ND	11000	49200	66	5000
Central	64	30	470	12 6	6.0	2 5	2200	8100	50	890
South	8.4	36	100	11	6 0	1.3	1 3	2.3	ND	ND
Maximum	180	50	1300	15	6.0	2 5	11000	49200	66	5000
Hackney*	8.4	ND	ND	ND	ND	ND	0.4	ND	ND	1.1

* The Hackney area is not part of Strother Field

ATTACHMENT VIII

Standards, Criteria and Guidelines for Constituents Detected in Soil and Ground Water at Strother Field[90]

COMPOUND	STANDARDS, CRITERIA AND/OR GUIDELINES						
	MCL (ug/L)	P-MCL (ug/L)	LHA (ug/L)	WQC Freshwater Acute (ug/L)	WQC Freshwater Chronic (ug/L)	RfD (mg/kg/day)	Carcinogenic Slope Factor (CSF) $(mg/kg/day)^{-1}$
Benzene	5	--	0.7	5,300	--	--	2.9E-2
Bromoform	**	--	--		--	2E-2	7.9E-3
Ethylbenzene	--	700	--	32,000	--	1E-1	--
Carbon tetrachloride	5	--	--	35,200	--	7E-4	1.3E-1
Chlorobenzene	--	--	3,150	250	50	2E-2	--
Chloroform	**	--	200	28,900	1,240	1E-2	6.1E-3
Chlorodibromomethane	--	--	--	11,000	--	2E-2	8.4E-2
Chloroethane	--	--	--		--	1E+1*	--
1,1-Dichloroethane (DCA)	--	--	--	--	--	--	9.1E-2
1,2-Dichloroethane	5	--	--	118,000	20,000	--	9.1E-2
1,1-Dichloroethene (DCE)	7	--	0.015	11,600	--	9E-3	6E-1
1,2-Dichloroethene	--	--	350	11,600	--	2E-2	--
Methylene chloride	5	--	--	11,000	--	6E-2	7.5E-3
Methyl ethyl ketone (MEK)	--	--	860	--	--	5E-2	--
Tetrachloroethylene (PCE)	--	5	0.7	5,290	840	1E-2	5.1E-2
Toluene	--	2,000	10,100	17,500	--	2E-1	--
Trichloroethylene (TCE)	5	--	2.8	45,000	21,900	--	1.1E-2
1,1,1-Trichloroethane (TCA)	200	--	200	--	--	9E-2	--
1,1,2 Trichloroethane	--	5		18,000	9,400	4E-3	5.7E-2
Vinyl chloride	2	--	0.015	--	--	--	2.3E+0
Xylene	--	10,000	2,200		--	2.0E+0	--

MCL = Maximum Contaminant Level (50 Federal Register 46880); P-MCL = Proposed Maximum Contaminant Level (Office of Drinking Water Update, 12-15-88); LHA = Lifetime Health Advisory (USEPA 1988); RfD = Reference Dose (EPA, 1988); WQC = Water Quality Criteria

* Value represents Reference Concentration (RfC) for chemical via inhalation.

** The MCL for total trihalomethanes is 100 ug/L.

ATTACHMENT IX

Target Levels for Remedial Action Objectives

CHEMICAL	[1]SOIL mg/kg	[2]GROUNDWATER ug/L
Trichloroethylene (TCE)	6.0	5
1,1,1 Trichloroethane (TCA)	260	200
Perchloroethylene (PCE)	20	5
Benzene	1.0	5
1,1 Dichloroethane	100	[3]5
1,2 Dichloroethane	0.50	5
1,1 Dichloroethylene	0.2	7
cis 1,2 Dichloroethylene	1600	70
trans 1,2 Dichloroethylene	3100	100
Methyl Ethyl Ketone	900	[3]170
Toluene	150	1000
Vinyl Chloride	0.1	2
Ethylbenzene	650	700

1. Risk based levels - see "Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) - section 3.2, equations 6' and 7'.
2. Maximum Contaminant Levels except as noted.
3. Kansas Action Levels.

ATTACHMENT X

Preliminary Remedial Action Alternatives for Groundwater

GENERAL RESPONSE ACTION	PROCESS OPTION	ALTERNATIVE IDENTIFICATION							
		1	2	3	4	5	6	7	8
No Action	No Action	◆							
Institutional Controls	Land Title Covenants		◆	◆	◆	◆	◆	◆	◆
	Signs		◆						
	Groundwater Monitoring		◆	◆	◆	◆	◆	◆	◆
Removal	Install Liquid or Blower Pumps in New Recovery Wells				◆	◆	◆	◆	◆
Treatment	Air Stripping			◆	◆	◆	◆	◆	[1]
	Carbon Adsorption					◆	◆		
	UV Photolysis							◆	
Disposal Actions	Reinjection						◆		
	Discharge to Surface Water			◆	◆	◆	◆	◆	◆

[1] Includes the addition of a process heat exchanger to the air-stripping system

ATTACHMENT XI

Preliminary Remedial Action Alternatives for Soil

GENERAL RESPONSE ACTION	PROCESS OPTION	ALTERNATIVE IDENTIFICATION								
		9	10	11	12	13	14	15	16	17
No Action	No Action	◆								
Institutional Controls	Land Title Covenants		◆		◆	◆	◆	◆	◆	◆
	Signs and Alarms		◆		◆	◆	◆	◆	◆	◆
	Monitoring by Site Personnel		◆		◆	◆	◆	◆	◆	◆
	Soil Monitoring		◆		◆	◆	◆	◆	◆	◆
Containment	Clay, Pavement, or Multi-Media Caps		◆						◆	
	Grading								◆	
	Storm Sewer Modifications								◆	
	Stabilization							◆		
Removal	Soil Removal			◆	◆		◆		◆	
Treatment	Soil Venting				◆	◆				◆
	Carbon Adsorption									◆
	Thermal Drying						◆		◆	
Disposal	RCRA TSD Facility			◆						

ATTACHMENT XII

Screening of Preliminary Groundwater Alternatives

ALTERNATIVES	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
Alternative 1: no action	Would not protect human health and the environment from future risk; mobility and volume would increase	Not a factor	No cost	Retain as required by the NCP to compare against other Alternatives
Alternative 2: limited action; implement institutional controls, continue existing groundwater monitoring system, but discontinue existing groundwater recovery system	Limited protection for on-site workers only; mobility and volume would increase	Easy; requires installation of signs and continued operation of existing groundwater monitoring system	Capital -- $13,000 O & M -- $70,000 Present Worth -- $707,037	Reject; ineffective
Alternative 3: implement institutional controls and maintain existing groundwater monitoring and recovery system	Potentially effective over long time periods for north, north-central, and central plumes; may not prevent off-site migration of southern plume	Easy to moderate; requires continued operation of existing groundwater monitoring and recovery system	Capital -- $13,000 O & M -- $145,000 Present Worth -- $1,430,962	Reject; inability to achieve Remedial Action Objectives in reasonable time frames
Alternative 4: implement institutional controls and expand existing groundwater recovery system by adding new recovery wells with air-stripping towers discharging to Posey Creek	Effective for all plumes	Moderate; requires installation of well-pumping systems, construction of air-stripping towers, and application for State discharge permit(s)	*Capital -- $312,000 O & M -- $220,000 Present Worth -- $2,184,984	Retain; effective and proven capacity to implement

ATTACHMENT XII (cont.)

Screening of Preliminary Groundwater Alternatives

ALTERNATIVES	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
Alternative 5: implement institutional controls and expand existing groundwater recovery system by adding new recovery wells with air-stripping towers and carbon adsorption units discharging to Posey Creek	Effective for all plumes	Moderate; requires installation of well-pumping systems, installation of carbon adsorption units, construction of air-stripping towers, application for State discharge permit(s), and hazardous waste management of treatment residues	*Capital -- $1,092,000 O & M -- $430,000 Present Worth -- $4,752,832	Retain; improved effectiveness over Alternative 4; could be used in conjunction with other measures
Alternative 6: implement institutional controls and expand existing groundwater recovery system by adding new recovery wells with air-stripping towers and carbon adsorption units, reinjecting treated effluent back into aquifer	Effective for all plumes; would improve/secure efficiency of recovery systems	Moderate to difficult; requires installation of well-pumping systems, installation of carbon adsorption units, construction of air-stripping towers, construction of reinjection system, hazardous waste management of treatment residues, and careful coordination with State and Federal regulatory agencies	*Capital -- $1,222,000 O & M -- $430,000 Present Worth -- $4,882,832	Reject; difficulty in implementing not offset by improved effectiveness
Alternative 7: implement institutional controls and expand existing groundwater recovery system by adding new recovery wells with UV photolysis units and air-stripping towers discharging to Posey Creek	Effective for all plumes	Moderate; requires installation of well pumping systems, installation of UV photolysis units, construction of air-stripping towers, and application for State discharge permit(s)	*Capital -- $687,000 O & M -- $440,000 Present Worth -- $4,432,968	Retain; improved effectiveness over Alternative 4; could be used in conjunction with other measures

ATTACHMENT XII (cont.)

Screening of Preliminary Groundwater Alternatives

ALTERNATIVES	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
Alternative 8: implement institutional controls and expand existing groundwater recovery system by adding new recovery wells, preheat water, and remove VOCs via air-stripping towers discharging to Posey Creek	Effective for all plumes	Moderate to difficult; requires installation of well-pumping systems, construction of air-stripping towers, construction of heat-exchanger system, and application for State discharge permit(s)	*Capital -- $387,000 O & M -- $235,000 Present Worth -- $2,387,687	Retain; increased effectiveness with similar costs to Alternative 4; limited to areas with process cooling water needs (e.g., central plume)

* Capital costs for these Alternatives assume that a permit will not be required under Title V of the Clean Air Act Amendments

ATTACHMENT XIII

Screening of Preliminary Soil Alternatives

ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
Alternative 9: no action	Based on RI data, may not protect human health and environment at two locations on Greif Brothers' property; may not prevent migration into groundwater; relatively slow cleanup via natural processes	Not a factor	No cost	Retain as required by the NCP to compare against other Alternatives
Alternative 10: implement institutional controls and construct an asphalt cap	Would provide limited protection against accidental exposure and discourage migration into groundwater; relatively slow cleanup via natural processes	Easy; many critical areas are already paved; requires installation of signs and implementation of a soil monitoring program	Capital -- $115,200 O & M -- $37,100 Present Worth -- $431,053	Retain; particularly suitable in areas where access constraints limit treatment options, such as GE building 5
Alternative 11: excavate soil above cleanup levels and transport to an off-site TSD facility	Would be effective to the extent that soil containing VOCs above cleanup levels is accessible and can be excavated	Moderate; may not be possible to excavate all contaminated soil; possible new liabilities during transportation and off-site management	Capital -- $1,430,000 O & M -- $0 Present Worth -- $1,430,000	Reject; high relative cost compared to on-site Alternatives; risk of contaminating new areas
Alternative 12: implement institutional controls, excavate soil above cleanup levels, treat on-site by soil venting, return treated soil to excavation	Would be effective to the extent that soil containing VOCs above cleanup levels is accessible and can be excavated	Difficult; may not be possible to excavate all contaminated soil; may require RCRA land disposal or treatment permit for waste pile	* Capital -- $1,070,200 O & M -- $68,100 Present Worth -- $1,239,555	Reject; difficulty to implement not offset by improved effectiveness compared to other Alternatives
Alternative 13: implement institutional controls and treat *in-situ* by soil venting	Potentially effective but unreliable under certain conditions; more time required to complete remedy than some other Alternatives unless natural attenuation is significant	Moderate; technology is easy to implement but may require pilot studies or additional field work during remedial design phase	* Capital -- $850,200 O & M -- $53,100 Present Worth -- $1,051,491	Retain; useful in areas where excavation is not practical (e.g., GE building 5); higher cost partially offset by natural attenuation mechanisms

ATTACHMENT XIII (cont.)

Screening of Preliminary Soil Alternatives

ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
Alternative 14: implement institutional controls, excavate soil above cleanup levels, treat on-site by thermal drying, return treated soil to excavation	Would be effective to the extent that soil containing VOCs above cleanup levels is accessible and can be excavated	Moderate; may not be possible to excavate all contaminated soil; may require RCRA permit for treatment process	* Capital -- $640,200 O & M -- $52,100 Present Worth -- $730,621	Retain; useful in areas with good access (e.g., Greif Brothers) if permitting can be avoided
Alternative 15: implement institutional controls and treat *in-situ* by stabilization	Potentially effective to prevent migration and reduce exposure risks, but leaves waste in place and inhibits natural attenuation through biodegradation	Difficult; technology is available from experienced contractors, but access constraints limit utility in most areas of the Site	Capital -- $925,200 O & M -- $44,100 Present Worth -- $1,034,870	Reject; less effective than other Alternatives
Alternative 16: implement institutional controls, implement surface controls, excavate hot spots and treat on-site by thermal drying, and construct an asphalt cap	Potentially effective if properly designed; access constraints may require leaving some waste in place above cleanup levels to be treated through natural biodegradation	Moderate; may not be possible to excavate all contaminated soil; may require RCRA permit for treatment process	* Capital -- $292,200 O & M -- $56,100 Present Worth -- $504,863	Retain; good overall effectiveness at a reasonable cost if permitting can be avoided
Alternative 17: implement institutional controls, treat *in-situ* by soil venting, recover VOCs by carbon adsorption	Potentially effective but unreliable under certain conditions; more time required to complete remedy than some other Alternatives	Moderate; technology is easy to implement but may require pilot studies or additional field work during remedial design phase	* Capital -- $1,370,200 O & M -- 166,100 Present Worth -- $1,999,850	Reject; use limited to areas with poor access; higher cost not offset by increased efficiency over Alternative 13

* Capital costs for these Alternatives assume that a permit will not be required under Title V of the Clean Air Act Amendments

ATTACHMENT XIV

Present Worth Analysis at 7% Discount Rate

ALTERNATIVE		DURATION (years)	CAPITAL COSTS	ANNUAL O&M COSTS	PRESENT WORTH
Ground Water:	1	50	$0	$0	$0
	2	50	13,000	70,000	979,052
	3	40	13,000	145,000	1,946,097
	4	20	312,000	220,000	2,642,683
	5	20	1,092,000	430,000	5,647,426
	6	20	1,222,000	430,000	5,777,426
	7	20	687,000	440,000	5,348,366
	8	20	387,000	235,000	2,876,593
Soil:	9	20	0	0	0
	10	20	115,200	37,100	508,238
	11	1	1,430,000	0	1,430,000
	12	3	1,070,200	68,100	1,248,915
	13	5	850,200	53,100	1,067,920
	14	2	640,200	52,100	734,398
	15	3	925,200	44,100	1,040,932
	16	5	292,200	56,100	522,221
	17	5	1,370,200	166,100	2,051,242

D.1. Assumptions

Costs for each Final Site-Wide Alternative were determined using EPA's Cost of Remedial Actions (CORA™) software, except as noted [the costs for Alternative I were supplied by the authors as discussed in sections D.2 and D.3]. The following table lists the input parameters for Alternatives II, III, and IV.

VARIABLE	VALUE	SOURCE/RATIONALE
Common Assumptions		
Duration of Ground-Water Removal and Treatment	10 yrs	calculated by MOC™ ground-water model; average value using retardation factors between 2 and 5.5 for TCE
Average Temperature	85°F	worst-case assumption from the CORA™ user's manual; all field work to be completed during the summer
Personal Protection Levels	action-specific	from CORA™ User's Manual (examples); personal experience
Confidence Levels	medium	personal experience
Asphalt Cap (Alternatives II, III, and IV)		
Affected Area	0.32 acres (14,000 ft^2)	approximate size of soil-gas plume at the northeast corner of Greif Brothers (the only location where soil target cleanup levels are exceeded)
Soil Excavation (Alternatives II, III, and IV)		
Soil Type	silty clay	RI report, section 3.2
Depth of Excavation	Alternative II = 20 feet Alternatives III and IV = 2 feet	for Alternative II, assumes excavation to water table, based on soil sampling and soil vapor readings; for Alternatives III and IV, assumes excavation of upper two feet as described in Section 9.0 of the FS report
Steel Sheeting or Side Slope	side slope	personal judgement based on site conditions
Horizontal Components	1:1 slope	CORA™ default value

VARIABLE	VALUE	SOURCE/RATIONALE
Length of Excavation	200 feet	approximate size of soil-gas plume at the northeast corner of Greif Brothers (the only location where soil target cleanup levels are exceeded)
Width of Excavation	70 feet	approximate size of soil-gas plume at the northeast corner of Greif Brothers (the only location where soil target cleanup levels are exceeded)
Depth of Cover Above Contaminated Materials	None	excavation under Alternatives II, III, and IV begins at the soil surface
Depth of Continuous Sampling to Characterize Excavated Soil	Alternative II = 20 feet Alternatives III and IV = 2 feet	for Alternative II, assumes sampling from the surface to the water table, based on RI soil sampling and soil vapor readings; for Alternatives III and IV, assumes sampling within the upper two feet as described in Section 9.0 of the FS report
Thickness of Lifts	Alternative II = 24" Alternatives III and IV = 12"	professional judgement
Base Air Monitoring Required	Yes	air monitoring recommended to ensure safe working conditions
Percent of Backfill Available On-Site	100%	treated soil to be used as backfill
Soil Vapor Extraction (Alternative IV)		
Soil Type	silty clay	RI report, section 3.2
Affected Area	0.32 acres (14,000 ft^2)/area (three areas total)	approximate size of soil-gas plume at the northeast corner of Greif Brothers (same size area assumed for other two locations)
Well Spacing	20 feet	CORA™ default value
Average Length of Well Screen	15 feet	depth to water table, less five feet to prevent short-circuiting
Vapor Flow per Well per Length of Well Screen	1 scfm/ft	CORA™ default value

VARIABLE	VALUE	SOURCE/RATIONALE
Quantity of VOCs in Soil On-Site	5,800 lbs.	rough calculation, based on soil gas and PID data from RI
Ground-Water Extraction (Alternatives II, III & IV)		
Number of Wells	4 wells to be installed	see Section 9.1 of the FS report
Pumping Rate per Well	100 gpm	see Section 9.1 of the FS report
Well Diameter	10"	from CORA™ recommendations for pumping rates between 100 and 499 gpm
Will Wells be Gravel Packed	yes	acceptable practice for wells constructed in aquifer materials found on-site
Average Well Depth	30 feet	based on average depth to water table and thickness of aquifer from RI report
Transfer Piping Length	200 feet	estimated distance between proposed recovery wells and air-stripping towers
Pumping Water Level per Well	25 feet	approximation representing 2/3 of difference between the bottom of proposed wells and the average static water level
Air Stripping (Alternatives II, III & IV)		
Flow Rate	100 gpm	see Section 9.1 of the FS report
Discharge to POTW or Surface Water	surface water	see Section 9.1 of the FS report
Contaminant Concentrations	recent maximum values for each constituent of concern (excluding short-term "spikes")	quarterly monitoring data from 1991 and 1992
Vapor Phase Carbon (option for Alternatives II, III & IV)		
Loading	DM-5 = 9 lb/day GGP-2 = 3 lb/day DM-14 = 3 lb/day	calculated by CORA™ air-stripping cost module
Air Flow	1,005 cfm	calculated by CORA™ air-stripping cost module
Discharge to Surface Water (Alternatives II, III & IV)		
Transmission	gravity	knowledge of site characteristics and preliminary system design
Flow Rate	100 gpm	see Section 9.1 of FS report

VARIABLE	VALUE	SOURCE/RATIONALE
Length of Pipe	2,000 feet	sum of estimated distances from proposed and existing air-stripping tower locations to nearest storm-sewer/receiving stream
Depth of Trench	6 feet	common depth for similar systems
Is a Diffuser Required	no	not a component of current system design; see Section 9.1 of FS report
Is a NPDES Permit Required	yes	assumes a single new permit for the entire site
Ground-Water Monitoring (Alternatives II, III & IV)		
Number of Wells to be Installed	2 new wells	see Section 9.1 of FS report
Average Well Depth	30 feet	based on geotechnical data from RI report
Number of Wells to be Monitored	23 (quarterly chemical analysis) 90 (semi-annual water level) 90 (5-year chemical analysis)	see Section 9.1 of FS report
Monitoring Frequency	quarterly (chemical analysis) semi-annual (water levels) 5-years (chemical analysis)	see Section 9.1 of FS report
Monitoring Tests/Parameters	VOA GC/MS	adequate to monitor constituents of concern at this site

D.2. User-Supplied Costs

The CORA™ software did not include modules to calculate the cost for some components of each Alternatives. Therefore, the following costs were supplied by the authors, based primarily on personal experience and information supplied by vendors.

VARIABLE	VALUE	SOURCE/RATIONALE
Alternative I		
Close 90 Wells	90 wells x $650/well = $58,500	past experience closing other wells on-site
Dismantle 3 Towers	3 towers x $1,500/tower = $4,500	personal experience
Alternatives II, III & IV		
Thermal Drying	**Alternative II:** 10,000 yd^3 soil x $20/$yd^3$ = $200,000 **Alternatives III & IV:** 1,000 yd^3 x $20/$yd^3$ = $20,000	personal experience and information supplied by vendors
Monitoring by Site Personnel	3 training sessions/yr @ $1,200/session = $3,600	personal experience
Signs and Alarms	**Soil:** 8 signs x $200/sign = $1,600 4 alarms x $1,000/alarm = $4,000 **Ground water:** 2 signs x $3,000/sign = $6,000 **Annual O&M:** $1,500	professional judgement
Land Title Covenants	**Soil:** 2 deeds x $500/deed = $1,000 **Ground water:** 14 deeds x $500/deed = $7,000	professional judgement
Relocate 1 Tower	$10,000	professional judgement
UV Photolysis	3 UV units x $125,000/unit = $375,000 Annual O&M = $220,000	information supplied by vendors
Monitor 90 Wells Semi-Annually for Water Levels	2 events/yr x $2,800/event = $5,600/yr	past experience contracting for these services at this site

D.3. Costs for Alternative I

Following are the costs for Alternative I:

ACTION	CAPITAL COST	ANNUAL O&M COST	Source
Close 90 Wells	$58,500	0	user
Dismantle 3 Towers	4,500	0	user
Total Cost	63,000	0	user
Total Present Worth Cost			**63,000**

D.4. Costs for Alternative II

Following are the costs calculated by the CORA™ software for Alternative II:

COMPONENT	COST		DURATION (years)	SOURCE
	CAPITAL	ANNUAL O&M		
Soil Excavation	$1,000,000	0	N/A	CORA™
Thermal Drying	200,000	0	N/A	user
Capping	N/A	N/A	N/A	N/A
Soil Vapor Extraction	N/A	N/A	N/A	N/A
Monitoring by Site Personnel	3,600	3,600	10	user
Signs & Alarms	12,000	1,500	10	user
Land Title Covenants	8,000	0	N/A	user
Extraction Wells:				
(4) new extraction wells	69,000	30,000	10	CORA™
(2) existing extraction wells	0	15,000	10	CORA™
Air-Stripping Towers:				
GGP-2	82,000	31,000	10	CORA™
DM-5	81,000	31,000	10	CORA™
DM-14	83,000	32,000	10	CORA™
relocate (1) tower	10,000	0	N/A	user
(3) existing wells	0	94,000	10	CORA™
Discharge to Surface Water	176,000	470	10	CORA™
Ground-Water Monitoring:				
water levels in 90 wells semi-annually	0	5,600	10	user
VOAs in 90 wells @ 5-year review	0	31,000	5 (one-time)	CORA™
VOAs in 23 wells quarterly	17,000	36,000	10	CORA™
Base System Subtotals	**1,741,600**	**280,170 (plus $31,000 @ 5-yr review)**	**10**	**N/A**

COMPONENT	COST		DURATION (years)	SOURCE
	CAPITAL	ANNUAL O&M		
Vapor Phase Carbon Adsorption:				
GGP-2	78,000	77,000	10	CORA™
DM-5	78,000	150,000	10	CORA™
DM-14	78,000	77,000	10	CORA™
Vapor Phase Carbon Subtotals	**234,000**	**304,000**	**10**	**CORA™**
UV photolysis (three wells)	**380,000**	**220,000**	**10**	**user**

SYSTEM	TOTAL PRESENT WORTH COST*
Basic Alternative II System	$3,700,000
Basic System w/ Vapor Phase Carbon Adsorption	6,100,000
Basic System w/ UV Photolysis	5,700,000

* Present worth costs based a discount rate of 7% (current yield of 30-year T-bonds)
N/A = not applicable to this component or Alternative

D.5. Costs for Alternative III

Following are the costs calculated by the CORA™ software for Alternative III:

COMPONENT	COST		DURATION (years)	SOURCE
	CAPITAL	ANNUAL O&M		
Soil Excavation	340,000	0	N/A	CORA™
Thermal Drying	20,000	0	N/A	user
Capping	51,000	13,000	10	CORA™
Soil Vapor Extraction	N/A	N/A	N/A	N/A
Monitoring by Site Personnel	3,600	3,600	10	user
Signs & Alarms	12,000	1,500	10	user
Land Title Covenants	8,000	0	N/A	user
Extraction Wells:				
(4) new extraction wells	69,000	30,000	10	CORA™
(2) existing extraction wells	0	15,000	10	CORA™
Air Stripping Towers:				
GGP-2	82,000	31,000	10	CORA™
DM-5	81,000	31,000	10	CORA™
DM-14	83,000	32,000	10	CORA™
relocate (1) tower	10,000	0	N/A	user
(3) existing wells	0	94,000	10	CORA™
Discharge to Surface Water	176,000	470	10	CORA™
Ground-Water Monitoring:				
water levels in 90 wells semi-annually	0	5,600	10	user
VOAs in 90 wells @ 5-year review	0	31,000	5 (one-time)	CORA™
VOAs in 23 wells quarterly	17,000	36,000	10	CORA™
Base System Subtotal	**952,600**	**293,170 (plus 31,000 @ 5-yr review)**	**10**	**N/A**

ATTACHMENT XV (CONT.)

COMPONENT	COST		DURATION (years)	SOURCE
	CAPITAL	ANNUAL O&M		
Vapor Phase Carbon Adsorption:				
GGP-2	78,000	77,000	10	CORA™
DM-5	78,000	150,000	10	CORA™
DM-14	78,000	77,000	10	CORA™
Vapor Phase Carbon Subtotals	**234,000**	**304,000**	**10**	**CORA™**
UV Photolysis (three wells)	**380,000**	**220,000**	**10**	**user**

SYSTEM	TOTAL PRESENT WORTH COST*
Basic Alternative III System	$3.000,000
Basic System w/ Vapor Phase Carbon Adsorption	5,400,000
Basic System w/ UV Photolysis	5,000,000

* Present worth costs based a discount rate of 7% (current yield of 30-year T-bonds)
N/A = not applicable to this component or Alternative

D.6. Costs for Alternative IV

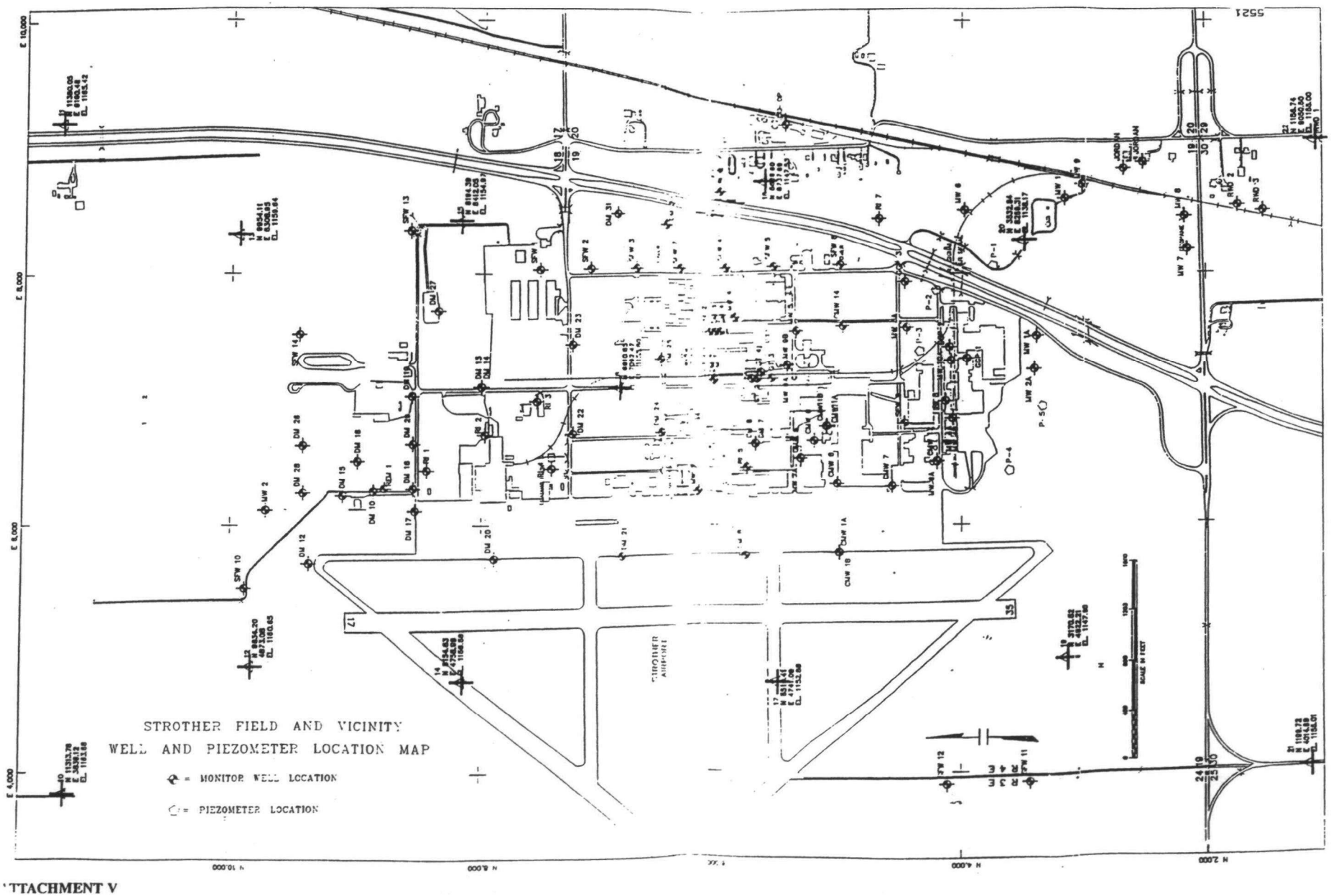
Following are the costs calculated by the CORA™ software for Alternative IV:

COMPONENT	COST		DURATION (years)	SOURCE
	CAPITAL	ANNUAL O&M		
Soil Excavation	340,000	0	N/A	CORA™
Thermal Drying	20,000	0	N/A	user
Capping	51,000	13,000	10	CORA™
Soil Vapor Extraction	1,380,000	180,000	2	CORA™
Monitoring by Site Personnel	3,600	3,600	10	user
Signs & Alarms	12,000	1,500	10	user
Land Title Covenants	8,000	0	N/A	user
Extraction Wells:				
(4) new extraction wells	69,000	30,000	10	CORA™
(2) existing extraction wells	0	15,000	10	CORA™
Air Stripping Towers:				
GGP-2	82,000	31,000	10	CORA™
DM-5	81,000	31,000	10	CORA™
DM-14	83,000	32,000	10	CORA™
relocate (1) tower	10,000	0	N/A	user
(3) existing wells	0	94,000	10	CORA™
Discharge to Surface Water	176,000	470	10	CORA™
Ground-Water Monitoring:				
water levels in 90 wells semi-annually	0	5,600	10	user
VOAs in 90 wells @ 5-year review	0	31,000	5 (one-time)	CORA™
VOAs in 23 wells quarterly	17,000	36,000	10	CORA™
Base System Subtotals	**2,332,600**	**293,170**	**10**	**N/A**
	0	**180,000**	**2**	**N/A**
	0	**31,000**	**5-yr review**	**N/A**

COMPONENT	COST		DURATION (years)	SOURCE
	CAPITAL	ANNUAL O&M		
Vapor Phase Carbon Adsorption:				
GGP-2	78,000	77,000	10	CORA™
DM-5	78,000	150,000	10	CORA™
DM-14	78,000	77,000	10	CORA™
Vapor Phase Carbon Subtotals	**234,000**	**304,000**	**10**	**CORA™**
UV Photolysis (three wells)	**380,000**	**220,000**	**10**	**user**

SYSTEM	TOTAL PRESENT WORTH COST*
Basic Alternative IV System	$4,700,000
Basic System w/ Vapor Phase Carbon Adsorption	7,100,000
Basic System w/ UV Photolysis	6,700,000

* Present worth costs based a discount rate of 7% (current yield of 30-year T-bonds)
N/A = not applicable to this component or Alternative



ATTACHMENT V