United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R07-91/045
March 1991

EPA

# Superfund Record of Decision:

## Lee Chemical, MO

50272-101

| REPORT DOCUMENTATION PAGE | 1. REPORT NO. EPA/ROD/R07-91/045 | 2. | 3. Recipient's Accession No. |
|---|---|---|---|
| 4. Title and Subtitle<br>SUPERFUND RECORD OF DECISION<br>Lee Chemical, MO<br>First Remedial Action - Final | | | 5. Report Date<br>03/21/91<br>6. |
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| 12. Sponsoring Organization Name and Address<br>U.S. Environmental Protection Agency<br>401 M Street, S.W.<br>Washington, D.C. 20460 | | | 13. Type of Report & Period Covered<br>800/000<br>14. |

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 2.5-acre Lee Chemical site is a former water treatment plant and chemical repacking and distributing facility in Liberty, Clay County, Missouri. Land use in the area is commercial and rural. The estimated 17,000 people who reside in Liberty obtain drinking water from municipal water wells located approximately 2,000 feet southeast of the site. These wells draw water from the alluvial aquifer underlying the site. From 1920 to 1962, the city of Liberty used the site as the city's water treatment plant. From 1965 until 1975, when the city repossessed the property, the site was leased to Lee Chemical Company for packaging and distributing commercial and industrial cleaning solvents and other chemicals, some of which were reprocessed onsite in 55-gallon drums. In 1977, as required by EPA, the city removed and disposed of approximately three hundred 55-gallon drums of waste offsite. In 1979, low levels of TCE were detected in the public water supply wells. Subsequent EPA and State investigations revealed contaminated ground water and soil, and deteriorated drums and chemical containers, and in 1982 the city and State identified the site as a source of TCE contamination in the public water supply. In 1983, the onsite water plant building and its contents were demolished and disposed of offsite. In 1984, in

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Lee Chemical, MO
First Remedial Action - Final
Contaminated Media: soil, gw
Key Contaminants: VOCs (TCE)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

| 18. Availability Statement | 19. Security Class (This Report)<br>None | 21. No. of Pages<br>52 |
|---|---|---|
| | 20. Security Class (This Page)<br>None | 22. Price |

(See ANSI-Z39.18) *See Instructions on Reverse*

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

Abstract (Continued)

an effort to contain the contaminated ground water plume and reduce TCE levels in the water supply, the city discharged water from the most highly contaminated of its municipal water wells through an abandoned sewer line to the Missouri River and Shoal Creek. Later that year, an abandoned municipal well onsite was added to the plume control measure and the discharge was diverted to an abandoned water main to nearby Town Branch Creek. Currently, no detectable levels of TCE are found in wells connected to the water supply system. This Record of Decision (ROD) addresses soil and ground water contamination, and provides a final remedy for the site. The primary contaminants of concern affecting the soil and ground water are VOCs including TCE.

The selected remedial action for this site includes installing an in-situ aqueous soil washing system consisting of infiltration trenches to enhance the flushing of contaminants from onsite soil to the underlying aquifer; pumping ground water to flush contaminants from the underlying aquifer to the extraction system and to control ground water movement away from the site, followed by onsite discharge to surface water; implementing a contingency phase ground water treatment project consisting of air stripping or other treatment methods, if additional treatment of discharge water becomes necessary to meet health based risk levels, existing NPDES permit limits, or other ARARs; and monitoring ground water and air. The estimated present worth cost for this remedial action is $550,000, which includes an annual O&M cost of $52,000 for 5 years. If treatment is deemed necessary, the revised present worth cost for this remedial action is $670,000, which includes an annual O&M cost of $67,000 for 5 years.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific goals for soil were not provided. Chemical-specific ground water clean-up goals are based on SDWA MCLs and include 1,1,2-TCE 5 ug/l (MCL).

# RECORD OF DECISION

# DECLARATION

## LEE CHEMICAL SITE

## LIBERTY, MISSOURI

Prepared by:

Missouri Department of Natural Resources

Waste Management Program

Jefferson City, Missouri

And

U.S. Environmental Protection Agency

Region VII

Kansas City, Kansas

March 1991

# DECLARATION FOR THE RECORD OF DECISION

## SITE NAME AND LOCATION

Lee Chemical Site
Liberty, Missouri

## STATEMENT OF PURPOSE AND BASIS

This decision document presents the selected remedial action for the Lee Chemical Site in Liberty, Missouri, 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) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP); 40 CFR Part 300 (1990). The Regional Administrator has been delegated the authority to approve this Record of Decision.

This decision is based upon the contents of the Administrative Record for the Lee Chemical Site which was developed in accordance with Section 113(k) of CERCLA, 42 U.S.C. 9613(k). The Administrative Record is available for public review at the Mid-Continent Library, 1000 South Kent, Liberty, Missouri and at the Environmental Protection Agency (EPA) Regional Office, 726 Minnesota Avenue, Kansas City, Kansas.

The State of Missouri has concurred with the selected remedy and determined that the selected remedy is consistent with Missouri laws and regulations.

## ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

## DESCRIPTION OF THE REMEDY

This final remedy addresses the principal threat at the Site through the remediation of soil contamination and mobile contaminants released into the groundwater thus reducing the risks posed by the Site.

The major components of the selected remedy include:

- Extraction of contaminated groundwater to remove contaminants from the aquifer of concern and to control groundwater movement away from the Site;

- Installation of an in-situ aqueous soil washing system consisting of infiltration trenches to enhance the flushing of contaminants from Site soils;

- Discharge of the extracted groundwater to Town Branch Creek under the terms of an NPDES permit; and

- In the event that additional treatment of the discharge water becomes necessary to meet health based risk levels, existing NPDES permit limits, or other applicable or relevant and appropriate requirements; a contingency phase project consisting of air stripping or other treatment methods will be implemented to bring the discharge into compliance.

These response actions would prevent future exposures to hazardous substances from this Site in the City of Liberty's drinking water supply by containing the contaminated groundwater plume. These actions will also remove the contaminants from the soil and groundwater and restore the aquifer to acceptable levels for unrestricted use.

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 technologies to the maximum extent practicable for this Site, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Morris Kay
Regional Administrator
U.S. Environmental Protection Agency
Region VII

3-21-91
Date

JOHN ASHCROFT
Governor

G. TRACY MEHAN III
Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE DIRECTOR
P.O. Box 176
Jefferson City, MO 65102
314-751-4422

Division of Energy
Division of Environmental Quality
Division of Geology and Land Survey
Division of Management Services
Division of Parks, Recreation, and Historic Preservation

February 21, 1991

Mr. Morris Kay
Regional Administrator
U.S. Environmental Protection
Agency, Region VII
726 Minnesota Avenue
Kansas City, KS 66101

Dear Mr. Kay:

The Missouri Department of Natural Resources has reviewed the Record of Decision (ROD) for the Lee Chemical site in Liberty, Missouri. The Department concurs with the selected remedy for the site detailed in the ROD.

If you have any questions regarding this matter, please do not hesitate to contact me.

Very truly yours,

DEPARTMENT OF NATURAL RESOURCES

G. Tracy Mehan, III
Director

GTM:jkh

c: Mr. Robert Morby, USEPA

# RECORD OF DECISION

# DECISION SUMMARY

## LEE CHEMICAL SITE

## LIBERTY, MISSOURI

Prepared by:

Missouri Department of Natural Resources

Waste Management Program

Jefferson City, Missouri

And

U.S. Environmental Protection Agency

Region VII

Kansas City, Kansas

March 1991

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## SECTION 1.0 SITE NAME, LOCATION, AND DESCRIPTION

The Lee Chemical Site (Site) is located along Missouri Highway 210, approximately 0.7 mile east of Missouri Highway 291 in the City of Liberty, Clay County, Missouri, approximately 15 miles east of Kansas City, Missouri as shown on Figure 1. Liberty's population is approximately 17,000. The City is accessible by Interstate 35 and Missouri State Highway 291 as illustrated in Figure 2.

Currently, the Site is a lot of approximately 2.5 acres enclosed within a chain link fence. There are no permanent buildings currently located on the Site. An old water plant building located on the Site was demolished in 1983 and its foundation and a concrete tank that originally was used as storage while the water treatment facility was in operation remain. Six abandoned municipal water supply wells known as Existing Wells 0 through 5 (EW-0 through EW-5) developed in the alluvial aquifer also remain onsite.

The surrounding land use is commercial/rural. A single family dwelling exists to the northeast, cropland to the south, and commercial properties to the north and west. The general slope of the area is to the southwest toward Shoal Creek. The City of Liberty obtains its drinking water from seven municipal wells, Water Supply Wells Number 1 through 7 (WSW1 through WSW7), drawing from the alluvial aquifer underlying the entire area. The municipal wells are located approximately 2,000 feet east-southeast of the site. Municipal Water Supply Well Number 2 (WSW2) has been taken off the water supply system because of 1,1,2-trichloroethene (TCE) contamination and is being discharged to surface waters as part of an interim response action implemented by the City. The location of the Site in relation to the municipal well supply field is shown on Figure 3.

## SECTION 2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

### 2.1 Site History

The Lee Chemical Site is located on property owned by the City of Liberty that was utilized from about 1920 until 1962 as the City's water treatment plant. In 1965, the City of Liberty leased the property to the Lee Chemical Company. The Lee Chemical Company packaged and distributed commercial and industrial cleaning solvents and other chemicals. In addition, Lee Chemical accepted for disposal chemicals from various commercial companies. Some of these chemicals were reprocessed onsite but many were stored onsite in 55 gallon drums. In 1975, the City of Liberty filed suit against the Lee Chemical Company for nonpayment of rent. Upon settlement of the suit, the City of Liberty was able to retake possession of its property and gain access to the Site.

FIGURE 1

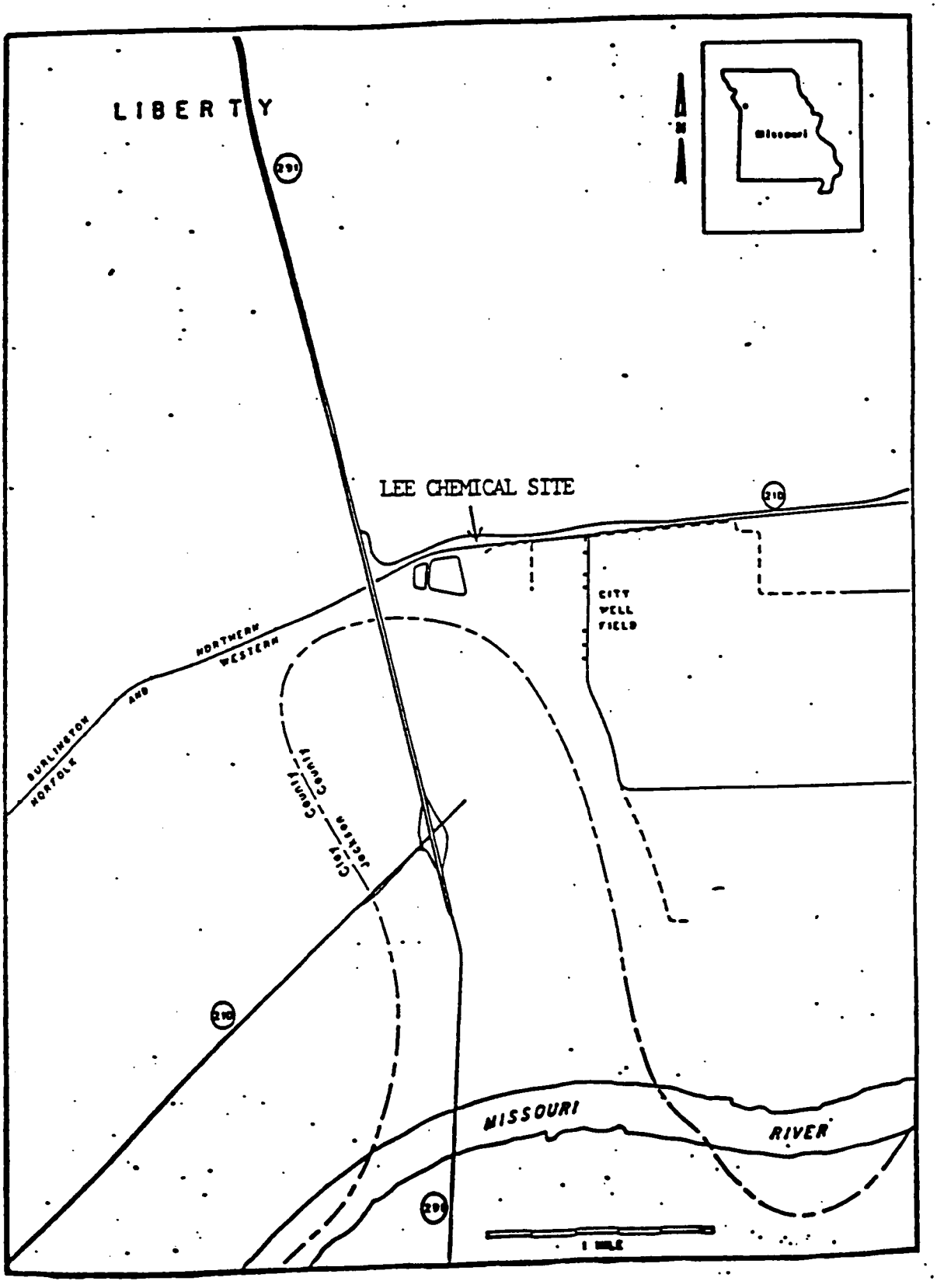
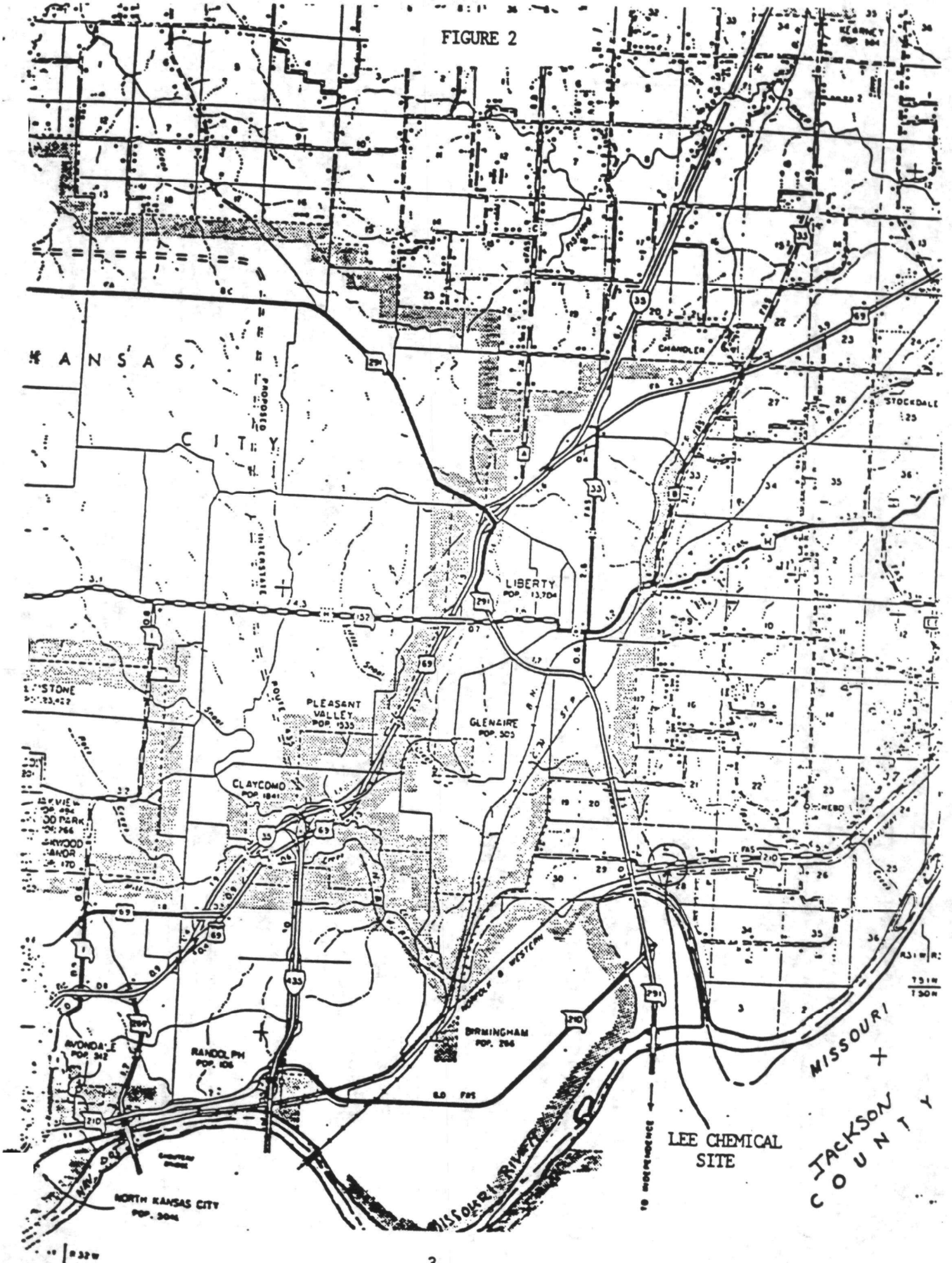

LIBERTY
291
Missouri
LEE CHEMICAL SITE
210
CITY WELL FIELD
BURLINGTON AND NORTHERN NORFOLK WESTERN
City / County
Jackson / Clay
210
MISSOURI RIVER
291
1 MILE

FIGURE 2


KANSAS CITY
LIBERTY
POP. 13,704
PLEASANT VALLEY
POP. 1333
GLENAIRE
POP. 303
CLAYCOMO
POP. 1841
RANDOLPH
POP. 105
BIRMINGHAM
POP. 284
NORTH KANSAS CITY
POP. 3044
LEE CHEMICAL SITE
MISSOURI RIVER
MISSOURI
JACKSON COUNTY
CHANDLER
STOCKDALE

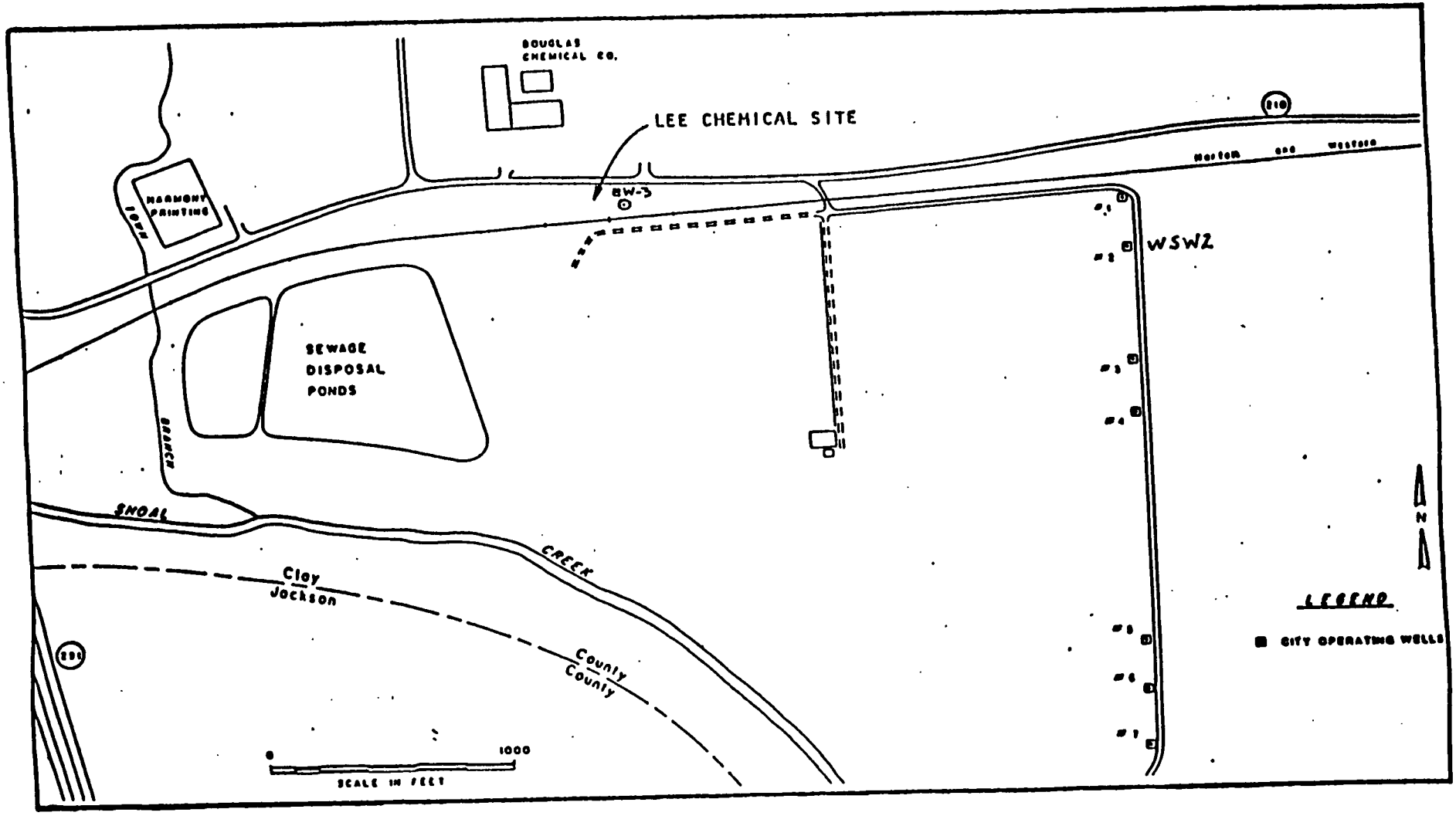

DOUGLAS CHEMICAL CO.
LEE CHEMICAL SITE
HARMONY PRINTING
BW-3
WSW2
SEWAGE DISPOSAL PONDS
BRANCH
SHOAL
CREEK
Clay
Jackson
County
County
1000
SCALE IN FEET
N
LEGEND
CITY OPERATING WELLS

FIGURE 3

## 2.2 Removal History

In 1976, the U.S. Environmental Protection Agency (EPA) notified the City of Liberty that the chemicals stored on the property had to be properly disposed of. Approximately three hundred 55 gallon drums of wastes were removed from the abandoned site and properly disposed of in July 1977. In 1979, low levels of TCE were detected in the raw water from the City of Liberty's public water supply wells.

In the years following 1979, groundwater and soil samples collected by the EPA and the Missouri Department of Natural Resources (MDNR) were found to be contaminated. MDNR inspected the Site in September 1982, and found deteriorated drums and chemical containers plus an empty 55-gallon drum labeled 1,1,1-trichloroethane. Subsequently the City of Liberty and MDNR identified the abandoned Site as a source of TCE contamination in the City's water supply wells. In April 1983, the old water plant building on the Site was demolished and only its foundation and adjacent concrete storage tank remain. Hazardous materials found in the structure were disposed of offsite. Clean soil was used to restore the surface of the Site.

In May 1983, MDNR recommended that the City of Liberty implement specific actions to reduce the TCE levels in the drinking water supply. In January 1984, the City of Liberty began discharging water from a municipal water supply well, WSW2, to the Missouri River through an abandoned sewer line. In July 1984, the City began discharging water from an onsite abandoned municipal supply well, EW-3, and the water from WSW2 to Town Branch of Shoal Creek through a segment of abandoned water line. Both of these actions were taken to contain the plume of groundwater contamination and reduce the levels of TCE in the water supply. This discharge was authorized by a National Pollutant Discharge Elimination System (NPDES) permit issued by MDNR on August 3, 1984.

Monitoring of the TCE levels in the City of Liberty's water supply wells indicated that contamination was present in all wells as late as June 1986. Levels in WSW1, WSW4, WSW5, and WSW6 were approximately 5 parts per billion (ppb) while levels in WSW2 and WSW3 were as high as 330 ppb and 75 ppb, respectively.

Since March 1987, the concentration of TCE in the finished supply water has been at or below the drinking water standard of 5 ppb. By June 1987, levels of TCE had decreased to below detection limits in WSW1, WSW4, WSW5, and WSW6; to 3 ppb in WSW3; and 97 ppb in WSW2. Since 1987, only WSW2 and WSW3 have shown detectable levels of TCE. In early 1988, a new, uncontaminated well, WSW7, was placed in service to compensate for the loss of WSW2 as a source of drinking water. Currently, no detectable levels of TCE are found in wells connected to the City of Liberty's water supply system.

From 1989 to 1990, the City of Liberty conducted Remedial Investigation and Feasibility Study (RI/FS) activities to identify the types, quantities, and locations of contaminants. The RI identified the following:

- TCE contamination is present in the soil at depths ranging from 1 to 20 feet below ground level, the highest concentration was 11,000 micrograms per kilogram (ug/kg) at a depth of 20 feet, east of the old water plant building foundation;

- A plume of TCE contamination suspended in and moving with groundwater in the aquifer underlying the Site;

- TCE contamination in the now out-of-production WSW2 and abandoned onsite well EW-3; and

- No present contamination in WSW1, WSW3, WSW4, WSW5, WSW6, and WSW7.

Currently, the City of Liberty is continuing the implementation of the interim response action of discharging WSW2 and EW-3 to Town Branch Creek and the remaining municipal wells (WSW1, WSW3, WSW4, WSW5, WSW6, and WSW7) do not show detectable levels of TCE. However, should the interim response action cease, it is estimated that the plume of contamination in the alluvial aquifer will reach the remaining municipal wells in a relatively short period of time.

## 2.3 Enforcement History

The City of Liberty was initially notified by MDNR on August 26, 1983 of its intent to propose the Lee Chemical Site for inclusion on the Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri. On January 1, 1984, the property was placed on the Registry pursuant to Section 260.440, RSMo. The EPA added this Site to the National Priorities List (NPL) on May 20, 1986. On August 5, 1988, the State of Missouri and the City of Liberty entered into an Agreement which provided for the City to conduct an RI/FS. This agreement was subsequently modified on October 20, 1989, and the City completed the RI/FS in August 1990.

In May 1988, EPA and the City of Liberty entered into an administrative consent order which required the City to continue the interim response action described in the previous section.

# SECTION 3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI/FS and Proposed Plan for the Lee Chemical Site were released to the public on December 24, 1990. These two documents were included in the administrative record file maintained at the MDNR, in Jefferson City, Missouri, the EPA Region VII Docket Room, in Kansas City, Kansas, and the Mid-Continent Library in

the City of Liberty, Missouri. The notice of availability for these two documents was published in the KANSAS CITY STAR on December 24 and 31, 1990 and the LIBERTY TRIBUNE on January 2 and 9, 1991. A public comment period was held from December 24, 1990 through January 23, 1991. In addition, a public hearing was held on January 9, 1991. At this meeting, representatives from the MDNR and EPA answered questions about problems at the Site and the remedial alternatives under consideration. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision. This decision document presents the selected remedial action for the Lee Chemical Site, in Liberty, Missouri, 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) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan of 1990 (NCP). The decision for this Site is based on the Administrative Record.

## SECTION 4.0 SCOPE OF RESPONSE ACTION

The selected remedial actions represent the final remedy for the site. The principal threat at the site is the highly mobile Volatile Organic Compounds (VOC) contamination that moves from the source of contamination in the Site soils to the groundwater and the mobile VOCs within the groundwater migrating toward the City of Liberty's water supply. To address potential risks from such exposure, the following remedial objectives were identified:

* Prevent potential exposure to contaminated groundwater;

* Protect uncontaminated groundwater for future use by preventing further migration of the contaminated groundwater plume;

* Restore the contaminated aquifer for future use as a drinking water source by reducing the contaminant concentrations to regulated or health based levels (for example 5 ppb or less for TCE); and

* Remediate contaminated soils onsite such that no further groundwater contamination can occur.

## SECTION 5.0 SUMMARY OF SITE CHARACTERISTICS

As a result of prior removal actions at the Site, all drums and containers have been removed and the buildings have been demolished. Clean soil was used to restore the Site surface and the Site is fenced.

A groundwater extraction system to confine the spread of the plume of contaminants and protect the remaining City supply wells has been in operation since 1984. The extracted water is currently being discharged under an NPDES permit through an

abandoned water main to Town Branch of Shoal Creek. TCE concentrations had been as high as 330 ppb and 851 ppb in WSW2 and EW-3, respectively; and all of the rest of the City wells have shown TCE concentrations, but at lower levels.

As a result of this interim response action, the levels of TCE have dropped below detection limits in all of the City's supply wells and the concentrations of TCE in the extraction wells has dropped to 45.30 ppb in WSW2 and 116.3 ppb in EW-3, in 1990.

The remedial investigation (RI) field work, conducted by the City of Liberty under MDNR oversight from early 1989 to mid 1990, included activities to define the bedrock surface, groundwater flow regime, potential groundwater contaminant migration pathways, and the extent of soil and groundwater contamination.

The discovery of containers, barrels, and visible contamination in and around the Lee Chemical Site was the initial indication of potential contamination. Further investigation in the immediate area provided additional information to delineate the source of contamination. The predominant data that confirms that the Lee Chemical Site and immediate surrounding area as the source of contamination is the analytical results from soil and soil gas samples collected around the Site. Groundwater sampling conducted at monitoring wells installed during the RI, at EW-3, and at Liberty supply wells also provides evidence that the Lee Chemical Site area is the origination of contamination. Greater detail as to the extent of contamination in the soil and groundwater is provided below.

Soil contamination was found at the highest levels immediately adjacent to the demolished water plant building foundation, with decreasing levels away from the foundation. Soil contamination extends from approximately 1 foot below ground level to the water table (approximately 20 feet). The shallow depths of contamination detected indicates that surface disposal or spillage of contaminants occurred. TCE, the most common constituent, was reported at consistently greater values than other volatile organic compounds (VOCs).

The highest subsurface soil TCE concentration, 11,000 micrograms per kilogram (ug/kg) was found 20 feet below ground level in the area east of the demolished water plant building foundation. Soil gas data obtained during the RI generally corresponds to the areal extent of soil contamination detected which is summarized as follows:

- Soil contamination is present in samples collected in the immediate area of the Lee Chemical Site at depths from 1 to 20 feet.

- Soil contamination at shallow depths (1 to 10 feet below ground level) is greatest surrounding the demolished building foundation with levels decreasing away from the foundation.

- Soil contamination at depths up to 20 feet below ground level are greatest around the demolished building foundation and just east of that location with decreasing levels further east.

Groundwater samples and corresponding analytical data obtained from monitoring wells, extraction well EW-3 located on the Lee Chemical Site, and Liberty supply wells were evaluated to determine the source and extent of contamination.

Groundwater contamination is currently restricted to the area immediately surrounding the Lee Chemical Site with a pathway extending east to Liberty supply well WSW2. Sampling conducted at the monitoring wells located south of the adjacent Norfolk and Western railroad showed no contamination above detection limits following the initiation of the interim response action.

When the analytical data were evaluated in conjunction with the hydrogeologic data, the following conclusions were drawn:

- Pumping of EW-3 is controlling the migration of groundwater contamination at the identified source.

- Pumping of WSW2 has effectively decreased the contamination originally present in the other Liberty supply wells.

## 5.1 Topography and Drainage

The City of Liberty's municipal well field is located in extreme south central Clay County, Missouri. Physiographically, it lies in the flood plain of the Missouri River. The uplands, north of the area, consist of highly dissected glacial fill plains covered by loess of varying thicknesses. The flood plain includes extensive coarse grained outwash materials. The general slope of the area is to the southwest toward Shoal Creek. There are meander scars locally that include oxbow lakes or depressions that collect local runoff. Shoal Creek traverses the flood plain through an oxbow meander of the Missouri River, discharging into the Missouri River approximately 1.5 miles south of the well field.

## 5.2 Geology

The geology consists of Pennsylvanian aged bedrock strata overlain by unconformed Pleistocene and Recent unconsolidated alluvial deposits. The topographic relief of the outcropping bedrock upland area can be as high as 200 feet. The topographic relief of the flood plain is approximately 30 feet. The Site lies entirely on the Missouri River flood plain. Portions of upland area are covered by various thicknesses of loess and glacial drift. Boulder zones have been encountered at the base of the valley fill that are believed to be glacially derived and may be Pleistocene in age.

The bedrock formations that outcrop and subcrop in the vicinity of the Site are, in ascending order, the Pleasanton Group and Kansas City Group. Except for possible minor local structural features, the formations dip gently to the west. The Kansas City and Pleasanton Groups are composed of interbedded layers of limestone, sandstone and shale. The unconformed surface that separates the bedrock from the alluvium dips sharply to the east from the Lee Chemical Site to the well field.

The Missouri River Valley is a partially filled trough incised into the bedrock formations. The grain size generally becomes finer upward through the sequence. The thickness of the alluvium is controlled by irregularities in the bedrock surface. Regional studies indicate that the maximum thickness encountered east of Kansas City is 143 feet. The average thickness is approximately 85 feet. The alluvium in the Site area is composed of fine to coarse sand, gravel, silt and clay. The distribution of these sediment types generally conforms to a three-fold classification system. The "boulder zone" is composed of coarse gravel and rocks and lies at the base of the alluvium. The "bottom stratum" is composed of gravel and sand and lies at intermediate depths. The "top stratum" is composed of fine sand, silt and clay and is at shallow depths.

5.3 Soils and Surface Water Hydrology

Surface soil in the area consists primarily of the Haynie, Mondale, and Gillam silt loams. These soils are moderately well drained, moderately permeable soils. They formed in calcareous, silty, or loamy alluvium. Slopes range from 0 to 2 percent. They have a Unified Soil Classification of CL-ML, CL, and a clay content of 15 to 35 percent. Permeability ranges from 0.6 to 2.0 inches per hour ($4.23 \times 10^{-4}$ to $1.41 \times 10^{-3}$ centimeters per second). The loess is thickest on the highly dissected hills close to the flood plain. It gradually thins to the northeast, where the ridge-tops are loess covered and glacial till is on the side slopes.

Surficial water within the Site area flows to the south and empties into Shoal Creek as evidenced by the local topography. The ground elevation at the Site area is approximately 730 feet above sea level while the approximate elevation of Shoal Creek in the vicinity of the Site is 720 feet. Town Branch empties into Shoal Creek on the western edge of the area.

5.4 Hydrogeology

The principle aquifer in the area is the Missouri River alluvium. The regional flow of the aquifer within the Site area is to the east. The groundwater flow in the Site area is heavily influenced by the pumping of the City of Liberty's water supply well field. The depth of groundwater in the Site area is approximately twenty feet.

Hydraulic conductivity of the aquifer material has been estimated to range from 2,000 to 5,000 gallons per day per square foot. This is based on constant head permeameter tests from samples of the aquifer material. Estimates of the aquifer transmissivity based on pumping test data range from 95,000 to 250,000 gallons per day per foot. The values are typical for alluvial aquifers. The storage coefficient (specific yield) of the aquifer is estimated to range from 0.10 to 0.20 for the sediments encountered.

Yields from wells completed in the Missouri River Alluvium have been reported to be as high as 1,250 gallons per minute. Yields from the City of Liberty's wells range approximately 500 to 1,000 gallons per minute when pumping at full capacity. Specific capacity of these wells average approximately 110 gallons per minute per foot.

Recharge to the alluvial aquifer comes primarily from infiltration of rainfall and, to a lesser extent, from the bedrock. Discharge from the aquifer can be attributed to seepage into the Missouri River, pumping wells, and evaportranspiration. Pumping wells may cause infiltration of water from the river to the aquifer by reversing the hydraulic gradient.

## SECTION 6.0 SUMMARY OF SITE RISKS

As part of the RI/FS process, a risk evaluation was conducted to estimate the human health and environmental risks associated with possible exposures to contaminants detected at the Lee Chemical Site. Both carcinogenic and noncarcinogenic adverse health effects were analyzed using a reasonable maximum exposure estimate. This risk analysis shows that an unacceptable excess cancer risk for a reasonably maximum exposed (RME) individual would result if the City of Liberty discontinued the current interim response action to control the plume of contamination coming from the Site and returned the wells currently pumping as part of this action to use as supply wells for the community. The noncarcinogenic risks analyzed were below levels of concern.

The risk evaluation also analyzed the potential short-term adverse health effects associated with air emissions from the discharge of contaminated groundwater. This discharge is part of an interim response action which began in 1984 to remove contaminated groundwater from the aquifer and to capture the plume of groundwater contamination thus protecting the City of Liberty's remaining water supply wells. The interim action, described as Alternative II, utilizes WSW2 and EW-3 as extraction wells and discharges the extracted water through an old water main to Town Branch Creek. As a result of this action, contaminants are no longer detected in the remaining City supply wells. This part of the risk analysis assumed a worst case exposure and found that the risks from the air emissions at the outfall were insignificant.

The excess lifetime carcinogenic risk level is expressed in scientific notation, e.g., $1 \times 10^{-6}$. An excess lifetime cancer risk of $1 \times 10^{-6}$ indicates that as a plausible upper bound the risk of developing cancer as a result of site related exposure to a carcinogen over a 70-year lifetime under specific exposure conditions at a site is approximately one in one million. Cumulative risk levels of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ can be used to determine the environmental significance of the risk incurred and is a target range for remedial actions. A cumulative risk greater than $1 \times 10^{-4}$ is considered to be unacceptable. Risks between $1 \times 10^{-6}$ and $1 \times 10^{-4}$ are considered to be potentially unacceptable, and risks less than $1 \times 10^{-6}$ are considered to be insignificant.

Noncarcinogenic effects were analyzed using hazard indices and hazard quotients. The hazard index is the comparison of estimated exposure (chronic dose) with reference doses (i.e. acceptable daily intake). The hazard quotient is the sum of the hazard indexes for a specific pathway. If the hazard index is less than one for an exposure pathway, no adverse health effects would be expected.

The contaminated media considered in the risk evaluation were soil and groundwater onsite and groundwater offsite. Soil sampling data in the RI indicates that no quantifiable concentrations of hazardous substances exist in the near surface (0 to 1 foot) Site soils. However, deeper (5 to 20 feet) soil samples did contain concentrations of contaminants which could lead to potential exposures during construction activities at those depths. Both the depth to significant levels of soil contamination and the Site fencing limit public access to contaminated soil. As a result, this pathway of exposure was not included in the calculation of the overall site risks. However, the migration of contaminants from the deeper soils to the groundwater is expected to be a continuing source of groundwater contamination.

The principal threat at the Site is the highly mobile VOC contamination that moves from the source of contamination in the Site soils to the groundwater and the mobile VOCs within the groundwater migrating toward the City of Liberty's water supply. Before the interim response action was taken, samples from all of the existing Water Supply Wells (WSW numbers 1 through 6) showed 1,1,2-trichloroethene (TCE) contamination. Samples from WSW2 contained concentrations as high as 330 parts per billion (ppb), and sampling of an abandoned City supply well (EW-3) on the Lee Chemical Site showed concentrations of TCE as high as 851 ppb.

A review of the data in the RI lead to the identification of five indicator chemicals to be considered in the risk evaluation.

The five contaminants of concern are as follows:

a) 1,1,2-trichloroethene (TCE),
b) 1,1-dichloroethane,
c) 1,1-dichloroethene,
d) trans-1,2-dichloroethene, and
e) 1,1,1-trichloroethane (TCA).

TCE was the indicator chemical detected most frequently and in the highest concentrations. TCE is a probable human carcinogen, and two other indicator chemicals (1,1-dichloroethane and 1,1-dichloroethene) are potential human carcinogens. All of the indicator chemicals are capable of causing acute and chronic noncarcinogenic health effects in humans. Vinyl chloride has not been detected in any of the samples taken at the Site.

Concern over the potential impacts of hazardous substances released from the Lee Chemical Site focuses on the residential populations served by the City of Liberty's water system. The City of Liberty's water system serves 6,280 households or places of business, which is approximately 20,000 people. The exposure pathways considered in the risk evaluation were ingestion and inhalation of VOCs from contaminated groundwater. Table 1 summarizes the exposure pathways and exposed populations used in the risk calculations, and Table 2 summarizes the exposure parameter values.

Another exposure scenario considered in the risk evaluation is related to VOC emissions from the interim pump and discharge action which is ongoing at the Site. The selected alternative uses this same discharge method. Potential risk to industrial workers and residential populations near the discharge point on Town Branch were evaluated. Risks, based on air modeling, associated with the extraction well discharge point on Town Branch were found to be insignificant.

Exposure due to direct contact with or ingestion of contaminants from Site soils were not considered in the risk evaluation, because the lack of contaminants in shallow Site soils and the Site fencing combined to make the likelihood of these routes of exposure remote. Exposures from the ingestion of surface water from Town Branch or Shoal Creek were also very unlikely and not included in the computation of site risks due to the limited access the public has to these creeks, their low flow rates, and the low concentrations of contaminants that enter these streams.

The carcinogenic risk based on a reasonable maximum exposure (RME) associated with the use of contaminated groundwater from the Lee Chemical Site as a source of drinking water for the City of Liberty is $2 \times 10^{-4}$. This estimate combines the exposures from ingestion and inhalation of Site contaminants and indicates that as a probable upper bound there would be two additional cancers in a population of 10,000. Therefore, the carcinogenic risk from this exposure scenario is unacceptable pursuant to the risk levels identified in the NCP. The carcinogenic risk

## TABLE 1

## SUMMARY OF EXPOSURE PATHWAYS AND EXPOSED POPULATIONS

## EVALUATED IN THE RISK EVALUATION OF THE LEE CHEMICAL SITE

| EXPOSURE MEDIUM | EXPOSURE POINT | EXPOSURE ROUTE | POTENTIALLY EXPOSED | COMMENTS |
|---|---|---|---|---|
| Groundwater | Lee Chemical Site Well Area | Ingestion | Residential: Children and adults using potable water supplied from well EW-3. | Assuming that the City of Liberty will install a supply well at the site, in the area of concern, or will resume use of well EW-3 as a supply well. For purposes of the risk assessment this area includes wells EW-3, 1-83, 2-83, 3-83, 4-83, MW-2-86, MW-3-86. Evaluated risks to adults only. |
| Groundwater | Lee Chemical Site Well Area | Inhalation | Residential: Children and adults being exposed to volatiles while showering with water from well EW-3. | Assuming that the City of Liberty will install a supply well at the site, in the area of concern, or will resume use of well EW-3 as a supply well. For purposes of the risk assessment this area includes wells EW-3, 1-83, 2-83, 3-83, 4-83, MW-2-86, MW-3-86. Evaluated risks to adults only. |
| Groundwater | Liberty Well #2 | Ingestion | Residential: Children and adults using water supplied from Well #2. | Assuming that the City of Liberty will install a supply well at the site in the area of concern or will resume use of Well #2 as a supply well. Evaluated risks to adults only. |
| Groundwater | Liberty Well #2 | Inhalation | Residential: Children and adults being exposed to volatiles while showering with water from Well #2. | Assuming that the City of Liberty will install a supply well at the site in the area of concern or will resume use of Well #2 as a supply well. Evaluated risks to adults only. |
| Surface Water Contaminated by Groundwater Discharge | Town Branch Discharge Point | Inhalation | Residential: Children and adults residing at the mini - warehouse facility downwind of the extraction wells discharge point. | Assuming that the indoor air concentration is the same as the outdoor level. Evaluated risks to adults only. |
| Surface Water Contaminated by Groundwater Discharge | Town Branch Discharge Point | Inhalation | Industrial/Commercial: Workers at business downwind of the extraction well discharge point. | Assuming that the indoor air concentration is the same as the outdoor level. |

TABLE 2

SUMMARY OF PARAMETER VALUES USED TO ESTIMATE EXPOSURE

| VARIABLE | VALUE USED | BRIEF RATIONALE |
|---|---|---|
| Chemical Concentration | Please refer to Tables 2-1 to 2-2 | |
| Exposure Frequency (days/year) | | |
| Residential | 365 | Daily (by convention) |
| Industrial/Commercial | 260 | Assuming 5 work days/week for 52 weeks/year |
| Exposure Duration (year) | | |
| Residential (Average Exposure) | 9 | National median time (50th percentile) at one residence (b) |
| Residential (RME) (a) | 30 | National upper-bound, time (90th percentile) |
| Industrial/Commercial | 40 | Upper-bound workers exposure duration used by ACGIH/OSHA |
| Contact Rate | | |
| Groundwater Ingestion (L/day) | 2 | Adult, 90th percentile (b) |
| Air Inhalation Rate ($m^3$/day) | | |
| Residential | 20 | Adult, average (b) |
| Industrial/Commercial | 8.8 | Assuming 1.1 $m^3$/hour for 8 hours/day |
| Body Weight (kg) | 70 | Adult, average (b) PRC did not evaluate risks to children. |
| Averaging Time (year) | | |
| For Carcinogenic Effects | | |
| Residential/Industrial/Commercial | 70 | Lifetime (by convention) |
| For Non-carcinogenic Effects | | |
| Residential (Average Exposure) | 9 | National median time (50th percentile) at one residence (b) |
| Residential (RME) | 30 | National upper-bound time (90th percentile) |
| Industrial/Commercial | 40 | Upper-bound workers' exposure duration used by ACGIH/OSHA |
| Time Conversion Factor for Averaging Time (day/year) | 365 | Daily |

sheet

(a) RME = Reasonable Maximum Exposure

(b) U.S. EPA (1989a), Exposure Factors Handbook, EPA 600/8-89/043, 1989

calculations for the ingestion and inhalation of VOCs from contaminated groundwater are summarized in Tables 3 and 4. The basic toxicity information used in these calculations is listed in Table 5. This risk level represents the baseline risk which would remain if no action was taken at the Site. The value of $2 \times 10^{-4}$ is based on the data in the RI which was collected after the interim action was taken at the Site. The risk level would be approximately an order of magnitude higher if data from before the interim action was used in the risk calculations.

Groundwater from the Lee Chemical Site is not currently used to supply drinking water to the City. Under current Site conditions, with the interim response action operating, no detectable levels of contaminants were found in samples taken from the Liberty supply wells, and risks associated with the extraction well discharge point on Town Branch are insignificant.

The noncarcinogenic risks associated with all of the indicator chemicals in all the exposure scenarios considered do not represent any significant concern for adverse health effects. The noncarcinogenic risk calculations are also summarized in Tables 3 and 4 and the basic toxicity information used in the calculations is listed in Table 6.

Cleanup goals for the groundwater will be based on Applicable or Relevant and Appropriate Requirements (ARARs), in particular, state and federal drinking water standards and state water quality standards for groundwater (Table 7).

No rare, threatened, or endangered wildlife species were identified in the vicinity of the Site during the RI. There have been no samples taken of sediments or organisms from Town Branch or Shoal Creek to assess the environmental impact of the discharge. There have been in-stream water quality samples collected at the confluence of Town Branch and Shoal Creek, but none of these samples has shown significant concentrations of VOCs. The concentration of TCE entering Town Branch at the outfall has consistently been below 90 ppb since the beginning of the RI. Based on that data, it would appear that almost complete volatilization of the TCE occurs between the point of discharge and the confluence. However, further investigation of the need to sample the creek sediments and organisms will be considered as part of the design of the remedial action.

Actual or threatened releases of hazardous substances from the Site, if not addressed by the preferred alternative or one of the other alternatives besides Alternative I (the no-action alternative), may present an imminent and substantial endangerment to public health, welfare, or the environment.

TABLE 3

SUMMARY OF EXPOSURE DOSES VIA GROUND WATER INGESTION AND HEALTH RISK CALCULATIONS

| EXPOSURE PARAMETERS: | Exposure Duration (yr) | Exposure Freq. (day/yr) | Contact Rate (L/day) | Wt. Conv. Factor (mg/ug) | Adult Weight (kg) | Ave. Time Cancer (yr) | Time Conv. Factor (day/yr) |
|---|---|---|---|---|---|---|---|
| Average Exposure | 9 | 365 | 2 | 0.001 | 70 | 70 | 365 |
| Reasonable Max. Exposure | 30 | 365 | 2 | 0.001 | 70 | 70 | 365 |

EXPRESSION FOR INTAKE DOSE: (Carcinogenic) (Non-carcinogenic) = $\frac{\text{Exp. Duration} * \text{Exp. Frequency} * \text{Contact Rate} * \text{Unit Conversion Factor}}{\text{Body Weight} * \text{Averaging Time} * \text{Time Conversion Factor}}$

| | | |
|---|---|---|
| Ground water ingestion (average) | 3.7E-06 | 2.9E-05 |
| Ground water ingestion (RME) | 1.2E-05 | 2.9E-05 |

| CHEMICALS OF CONCERN (BY LOCATION - PRESENT/FUTURE) IUPAC Name | CAS No. | CONCENTRATIONS Average (ug/L) | RME (ug/L) | TOXICITY VALUES FOR ORAL ROUTE Wt. of Evidence | SF (a) 1/(mg/kg-d) | RfD (b) (mg/kg-d) | GROUND WATER INGESTION (AVERAGE) Cancer Dose (mg/kg-d) | Cancer Risk | N/C Dose (mg/kg-d) | Hazard Quotient | GROUND WATER INGESTION (RME) Cancer Dose (mg/kg-d) | Cancer Risk | N/C Dose (mg/kg-d) | Hazard Quotient |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEE CHEMICAL SITE WELLS (FUTURE) | | | | | | | | | | | | | | |
| dichloroethane (1,1-) | 75-35-3 | 1.6E+00 | 1.6E+00 | C | 9.1E-02 | 1.0E-01 | 5.9E-06 | 5.3E-07 | 4.6E-05 | 4.6E-04 | 2.0E-05 | 1.8E-06 | 4.6E-05 | 4.6E-04 |
| dichloroethene (1,1-) | 75-35-4 | 4.3E+00 | 5.5E+00 | C | 6.0E-01 | 9.0E-03 | 1.6E-05 | 9.5E-06 | 1.2E-04 | 1.4E-02 | 6.7E-05 | 4.0E-05 | 1.6E-04 | 1.7E-02 |
| dichloroethene (t-1,2-) | 540-59-0 | 2.0E+00 | 2.3E+00 | | | 2.0E-02 | 7.3E-06 | | 5.7E-05 | 2.9E-03 | 2.8E-05 | | 6.6E-05 | 3.3E-03 |
| trichloroethane (1,1,1-) | 71-55-6 | 3.9E+01 | 1.5E+02 | | | 9.0E-02 | 1.4E-04 | | 1.1E-03 | 1.3E-02 | 1.8E-03 | | 4.1E-03 | 4.6E-02 |
| trichloroethene | 79-01-6 | 5.3E+01 | 1.3E+02 | B2 | 1.1E-02 | | 1.9E-04 | 2.1E-06 | 1.5E-03 | | 1.6E-03 | 1.7E-05 | 3.6E-03 | |
| TOTAL CANCER RISK/HAZARD INDEX | | | | | | | | 1.2E-05 | | 2.9E-02 | | 5.9E-05 | | 6.7E-02 |
| LIBERTY EXTRACTION WELL #2 (FUTURE) | | | | | | | | | | | | | | |
| dichloroethane (1,1-) | 75-35-3 | 1.8E+00 | 2.0E+00 | B2 | 9.1E-02 | 1.0E-01 | 6.6E-06 | 6.0E-07 | 5.1E-05 | 5.1E-04 | 2.4E-05 | 2.2E-06 | 5.7E-05 | 5.7E-04 |
| dichloroethene (1,1-) | 75-35-4 | 1.4E+00 | 1.6E+00 | C | 6.0E-01 | 9.0E-03 | 5.1E-06 | 3.1E-06 | 4.0E-05 | 4.4E-03 | 2.0E-05 | 1.2E-05 | 4.6E-05 | 5.1E-03 |
| dichloroethene (t-1,2-) | 540-59-0 | 7.5E+00 | 8.8E+00 | | | 2.0E-02 | 2.8E-05 | | 2.1E-04 | 1.1E-02 | 1.1E-04 | | 2.5E-04 | 1.3E-02 |
| trichloroethane (1,1,1-) | 71-55-6 | 1.7E+00 | 1.8E+00 | | | 9.0E-02 | 6.2E-06 | | 4.9E-05 | 5.4E-04 | 2.2E-05 | | 5.1E-05 | 5.7E-04 |
| trichloroethene | 79-01-6 | 6.9E+01 | 7.8E+01 | B2 | 1.1E-02 | | 2.5E-04 | 2.8E-06 | 2.0E-03 | | 9.5E-04 | 1.0E-05 | 2.2E-03 | |
| TOTAL CANCER RISK/HAZARD INDEX | | | | | | | | 6.5E-06 | | 1.6E-02 | | 2.4E-05 | | 1.9E-02 |
| LIBERTY FIELD SUPPLY WELLS (PRESENT) | | | | | | | | | | | | | | |
| dichloroethane (1,1-) | 75-35-3 | 1.5E+00 | 1.5E+00 | B2 | 9.1E-02 | 1.0E-01 | 5.5E-06 | 5.0E-07 | 4.3E-05 | 4.3E-04 | 1.8E-05 | 1.7E-06 | 4.3E-05 | 4.3E-04 |
| dichloroethene (1,1-) | 75-35-4 | 1.5E+00 | 1.6E+00 | C | 6.0E-01 | 9.0E-03 | 5.5E-06 | 3.3E-06 | 4.3E-05 | 4.8E-03 | 2.0E-05 | 1.2E-05 | 4.6E-05 | 5.1E-03 |
| dichloroethene (t-1,2-) | 540-59-0 | 1.8E+00 | 2.1E+00 | | | 2.0E-02 | 6.6E-06 | | 5.1E-05 | 2.6E-03 | 2.6E-05 | | 6.0E-05 | 3.0E-03 |
| trichloroethane (1,1,1-) | 71-55-6 | 1.5E+00 | 1.5E+00 | | | 9.0E-02 | 5.5E-06 | | 4.3E-05 | 4.8E-04 | 1.8E-05 | | 4.3E-05 | 4.8E-04 |
| trichloroethene | 79-01-6 | 1.6E+00 | 1.8E+00 | B2 | 1.1E-02 | | 5.9E-06 | 6.5E-08 | 4.6E-05 | | 2.2E-05 | 2.4E-07 | 5.1E-05 | |
| TOTAL CANCER RISK/HAZARD INDEX | | | | | | | | 3.9E-06 | | 8.2E-03 | | 1.4E-05 | | 9.0E-03 |

FOOTNOTE:

(a) Slope Factor (b) Chronic Reference Dose

N/C Non-carcinogenic

TABLE 4.

SUMMARY OF EXPOSURE DOSES VIA INHALATION OF VOLATILIZED VOCs FROM GROUND WATER AND HEALTH RISK CALCULATIONS (a)

| EXPOSURE PARAMETERS: | Exposure Duration (yr) | Exposure Freq. (day/yr) | Contact Rate (L/day) | Wt. Conv. Factor (mg/ug) | Adult Weight (kg) | Ave. Time Cancer (yr) | Time Conv. Factor (day/yr) |
|---|---|---|---|---|---|---|---|
| Average Exposure | 9 | 365 | 2 | 0.001 | 70 | 70 | 365 |
| Reasonable Max. Exposure | 30 | 365 | 2 | 0.001 | 70 | 70 | 365 |

EXPRESSION FOR INTAKE DOSE: (Carcinogenic) (Non-carcinogenic) = $\frac{\text{Exp. Duration} * \text{Exp. Frequency} * \text{Contact Rate} * \text{Unit Conversion Factor}}{\text{Body Weight} * \text{Averaging Time} * \text{Time Conversion Factor}}$

| | | |
|---|---|---|
| Ground water inhalation (average) | 3.7E-06 | 2.9E-05 |
| Ground water inhalation (RME) | 1.2E-05 | 2.9E-05 |

| CHEMICALS OF CONCERN (BY LOCATION - PRESENT/FUTURE) IUPAC Name | CAS No. | CONCENTRATIONS Average (ug/L) | RME (ug/L) | TOXICITY VALUES - INHALATION Wt. of Evidence | SF (a) 1/(mg/kg-d) | RfD (b) (mg/kg-d) | GROUND WATER INHALATION (AVERAGE) Cancer Dose (mg/kg-d) | Cancer Risk | N/C Dose (mg/kg-d) | Hazard Quotient | GROUND WATER INHALATION (RME) Cancer Dose (mg/kg-d) | Cancer Risk | N/C Dose (mg/kg-d) | Hazard Quotient |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEE CHEMICAL SITE WELLS (FUTURE) | | | | | | | | | | | | | | |
| dichloroethane (1,1-) | 75-35-3 | 1.6E+00 | 1.6E+00 | | | 1.0E-01 | 5.9E-06 | | 4.6E-05 | 4.6E-04 | 2.0E-05 | | 4.6E-05 | 4.6E-04 |
| dichloroethene (1,1-) | 75-35-4 | 4.3E+00 | 5.5E+00 | C | 1.2E+00 | | 1.6E-05 | 1.9E-05 | 1.2E-04 | | 6.7E-05 | 8.1E-05 | 1.6E-04 | |
| dichloroethene (t-1,2-) | 540-59-0 | 2.0E+00 | 2.3E+00 | | | | 7.3E-06 | | 5.7E-05 | | 2.8E-05 | | 6.4E-05 | |
| trichloroethane (1,1,1-) | 71-55-6 | 3.9E+01 | 1.5E+02 | | | 3.0E-01 | 1.4E-04 | | 1.1E-03 | 3.8E-03 | 1.8E-03 | | 4.1E-03 | 1.4E-02 |
| trichloroethene | 79-01-6 | 5.3E+01 | 1.3E+02 | B2 | 1.7E-02 | | 1.9E-04 | 3.3E-06 | 1.5E-03 | | 1.6E-03 | 2.7E-05 | 3.6E-03 | |
| TOTAL CANCER RISK/HAZARD INDEX | | | | | | | | 2.2E-05 | | 4.2E-03 | | 1.1E-04 | | 1.4E-02 |
| LIBERTY EXTRACTION WELL #2 (FUTURE) | | | | | | | | | | | | | | |
| dichloroethane (1,1-) | 75-35-3 | 1.8E+00 | 2.0E+00 | | | 1.0E-01 | 6.6E-06 | | 5.1E-05 | 5.1E-04 | 2.4E-05 | | 5.7E-05 | 5.7E-04 |
| dichloroethene (1,1-) | 75-35-4 | 1.4E+00 | 1.6E+00 | C | 1.2E+00 | | 5.1E-06 | 6.2E-06 | 4.0E-05 | | 2.0E-05 | 2.4E-05 | 4.6E-05 | |
| dichloroethene (t-1,2-) | 540-59-0 | 7.5E+00 | 8.8E+00 | | | | 2.8E-05 | | 2.1E-04 | | 1.1E-04 | | 2.5E-04 | |
| trichloroethane (1,1,1-) | 71-55-6 | 1.7E+00 | 1.8E+00 | | | 3.0E-01 | 6.2E-06 | | 4.9E-05 | 1.6E-04 | 2.2E-05 | | 5.1E-05 | 1.7E-04 |
| trichloroethene | 79-01-6 | 6.9E+01 | 7.8E+01 | B2 | 1.7E-02 | | 2.5E-04 | 4.3E-06 | 2.0E-03 | | 9.5E-04 | 1.6E-05 | 2.2E-03 | |
| TOTAL CANCER RISK/HAZARD INDEX | | | | | | | | 1.0E-05 | | 6.8E-04 | | 4.0E-05 | | 7.4E-04 |
| LIBERTY FIELD SUPPLY WELLS (PRESENT) | | | | | | | | | | | | | | |
| dichloroethane (1,1-) | 75-35-3 | 1.5E+00 | 1.5E+00 | | | 1.0E-01 | 5.5E-06 | | 4.3E-05 | 4.3E-04 | 1.8E-05 | | 4.3E-05 | 4.3E-04 |
| dichloroethene (1,1-) | 75-35-4 | 1.5E+00 | 1.6E+00 | C | 1.2E+00 | | 5.5E-06 | 6.6E-06 | 4.3E-05 | | 2.0E-05 | 2.4E-05 | 4.6E-05 | |
| dichloroethene (t-1,2-) | 540-59-0 | 1.8E+00 | 2.1E+00 | | | | 6.6E-06 | | 5.1E-05 | | 2.4E-05 | | 6.0E-05 | |
| trichloroethane (1,1,1-) | 71-55-6 | 1.5E+00 | 1.5E+00 | | | 3.0E-01 | 5.5E-06 | | 4.3E-05 | 1.4E-04 | 1.8E-05 | | 4.3E-05 | 1.4E-04 |
| trichloroethene | 79-01-6 | 1.6E+00 | 1.8E+00 | B2 | 1.7E-02 | | 5.9E-06 | 1.0E-07 | 4.6E-05 | | 2.2E-05 | 3.7E-07 | 5.1E-05 | |
| TOTAL CANCER RISK/HAZARD INDEX | | | | | | | | 6.7E-06 | | 5.7E-04 | | 2.4E-05 | | 5.7E-04 |

FOOTNOTE:

(a) Intake doses via inhalation of volatized VOCs from ground water are assumed to be equivalent to ingestion doses of 2 liters/day

(b) Slope Factor (c) Chronic Reference [illegible] N/C Non-carcinogenic

SLOPE FACTORS FOR CARCINOGENIC EFFECTS OF CHEMICAL CONTAMINANTS AT THE LEE CHEMICAL SITE

| CHEMICAL | CAS NO. | SLOPE FACTOR (SF) (a) 1/(mg/kg-d) | WEIGHT-OF-EVIDENCE CLASSIFICATION (b) | TYPE OF CANCER | SF BASIS/ SF SOURCE (c) | COMMENTS |
|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | 75-34-4 | 9.1E-02 (Oral) | C | Hemangiosarcoma | Gavage/ HEAST | -- |
| 1,1-Dichloroethene | 75-35-4 | 6.0E-01 (Oral) | C | Adrenal tumors | Oral gavage/ IRIS | -- |
| | | 1.2E+00 (Inhalation) | C | Kidney adenocarcinoma | Inhalation/ IRIS | -- |
| t-1,2-Dichloroethene | 540-59-0 | -- | | -- | | Not located in IRIS or HEAST |
| 1,1,1-Trichloroethane | 71-55-6 | -- | D | -- | IRIS | No quantitative estimate of oral or inhalation SF appeared in IRIS or HEAST |
| Trichloroethene | 79-01-6 | 1.1E-02 (Oral) | B2 | Liver | Oral gavage/ HEAST | -- |
| | | 1.7E-02 (Inhalation) | B2 | Lung | Inhalation/ HEAST | -- |

FOOTNOTES

(a) IRIS was the first source consulted for SF values. If no SF was available in IRIS, HEAST was consulted. Only the most current SF values are used.

(b) The EPA classification system for weight-of-evidence is as follows:

A = Human carcinogen
B1 = Probable human carcinogen; limited human data
B2 = Probable human carcinogen; sufficient evidence in animals and inadequate or no evidence in humans
C = Possible human carcinogen
D = Not classifable as to human carcinogenicity
E = Evidence of noncarcinogenicity for humans

(c) IRIS= Integrated Risk Information System (EPA, 1990a);
HEAST= Health Effects Assessment Summary Tables, Fourth Quarter 1989 (EPA,1990b).

TABLE 6

CHRONIC REFERENCE DOSES (RfDs) FOR NONCARCINOGENIC EFFECTS OF CHEMICAL CONTAMINANTS AT THE LEE CHEMICAL SITE

| COMPOUND | CAS NO. (a) | CHRONIC RfD (b) (mg/kg-day) | CONFIDENCE LEVEL | CRITICAL EFFECT | RfD BASIS/ RfD SOURCE | UNCERTAINTY AND MODIFYING FACTORS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | 75-34-4 | 1E-01 (Oral) | -- | None | Inhalation/HEAST (c) | UF= 1000 for H,A,S (e) | -- |
| | | 1E-01 (Inhalation) | -- | Kidney damage | Inhalation/HEAST | UF= 1000 for H,A,S | -- |
| 1,1-Dichloroethene | 75-35-4 | 9E-03 (Oral) | Medium | Hepatic lesions | Water/IRIS (d) | UF= 1000 for H,A,L MF= 1 | -- |
| 1,2-t-Dichloroethene | 540-59-0 | 2E-02 (Oral) | Low | Increased serum alkaline phospate | Water/IRIS | UF= 1000 for H,A,S MF= 1 | -- |
| 1,1,1-Trichloroethane | 71-55-6 | 9E-02 (Oral) | Medium | No adverse effects; slight growth retardation | Inhalation/IRIS | UF= 1000 for H,A,S MF= 1 | -- |
| | | 3E-01 (Inhalation) | -- | Hepatotoxicity | Inhalation/HEAST | UF= 1000 for H,A,S | -- |
| Trichloroethene | 79-01-6 | -- | -- | -- | -- | -- | No RfD was located for TCE in IRIS or HEAST |

FOOTNOTES

(a) Chemical Abstract Service number - a unique identification number for a chemical compund.
(b) Only the most current RfD values appearing in IRIS or HEAST were selected for this table.
(c) HEAST= Health Effects Assessment Summary Tables First/Second Quarters 1990 (EPA, 1990b).
(d) IRIS= Integrated Risk Information System (EPA, 1990a).
(e) Uncertainty adjustment used to represent combined H,A,S, and L extrapolations.
Uncertainty adjustments: H= Variation in human sensitivity;
A= Animal to human extrapolation;
S= Extrapolation from subchronic to chronic No Observable Adverse Effect Level (NOAEL).
L= Extrapolation from Lowest Observable Adverse Effect Level (LOAEL) to NOAEL.
Modifying factors are applied to reflect professional judgement regarding additional uncertainties in the study and the entire database.

**TABLE 7**

**NUMERICAL VALUES FOR CONTAMINANT-SPECIFIC ARARS FOR THE LEE CHEMICAL SITE**

**SAFE DRINKING WATER ACT**

| CONTAMINANT | MCL ug/l | MCLG ug/l |
|---|---|---|
| 1,1-Dichloroethane | -- | -- |
| 1,1-Dichloroethene | 7 | 7 |
| t-1,2-Dichloroethene | 100 | 100 |
| 1,1,1-Trichloroethane (TCA) | 200 | 200 |
| 1,1,2-Trichloroethene (TCE) | 5 | 0 |

EPA 304(a) WATER QUALITY CRITERIA

| CONTAMINANT | Freshwater Criterion Concentrations | | $10^{-6}$ Risk for Carcinogens from Consumption of: | |
|---|---|---|---|---|
| | Acute ug/l | Chronic ug/l | Water & Organisms ug/l | Organisms Only ug/l |
| 1,1-Dichloroethane | -- | -- | -- | -- |
| 1,1-Dichloroethene | -- | -- | 0.057 | 3.2 |
| t-1,2-Dichloroethene | -- | -- | -- | -- |
| 1,1,1-Trichloroethane (TCA) | -- | -- | 3094 | 173077 |
| 1,1,2-Trichloroethene (TCE) | -- | -- | 2.7 | 80.7 |

## SECTION 7.0 DESCRIPTION OF ALTERNATIVES

Alternative I:

Alternative I is a no action alternative required by the National Contingency Plan (NCP) and SARA. It is the baseline against which the effectiveness of other alternatives are judged. Under this alternative, monitoring, control, or remediation of contamination will not take place. Site perimeter fencing is required and is already in place. Groundwater contamination will spread throughout the area making new water wells at a distant location a requirement for the City of Liberty's water supply. Currently uncontaminated supply wells will, in time, become contaminated at levels above Maximum Contaminant Levels (MCLs).

Alternative II:

The remediation that has been taking place at the Lee Chemical Site and the Liberty well field is pumping EW-3 and WSW2 to Town Branch Creek. Under this alternative, the site perimeter needs to be fenced and it is already in place. The City of Liberty will need to restrict any new well construction in close proximity to the Lee Chemical Site. If this alternative is chosen, groundwater monitoring will be required. Air and surface water monitoring at the Town Branch outfall is also a requirement to meet the ARARs.

Groundwater quality data from the RI showed that between 1982 and 1989, TCE concentration generally decreased at WSW2 from 330 ppb to approximately 65 ppb with a temporary low of 20 ppb. EW-3 also showed a declining trend of TCE between 1984 and 1989. The TCE concentration in 1984 was over 851 ppb and reduced to 81.6 ppb in 1989.

The level of groundwater contamination suggests that both of these wells will continue to produce groundwater above the MCL for TCE and other constituents for an extended period of time. Although the decline of contamination is fairly slow, the contaminant plume within the aquifer is contained within approximate limits described in Section 1. All other supply wells in the Liberty well field are producing groundwater below MCL levels. This alternative is estimated to require 25 years for site restoration at a present worth cost of $814,000.

Alternative III:

Alternative III follows all basic requirements of Alternative II. In this alternative, well EW-3 will be replaced by a high capacity well, a more efficient well penetrating the full saturated thickness of the aquifer and located near the center of the contamination source. By constructing an extraction well to Missouri public water supply standards, the following goals will be achieved:

a) Radius of influence within the Lee Chemical Site will be further increased so that the entire contaminant plume can be captured and limited to the site boundaries.

b) Water withdrawal from all depth levels will enhance clean up of the aquifer.

c) Groundwater produced by Liberty well No. 2 will decrease below MCL levels and all other wells in the Liberty well field will remain free of contamination.

Liberty well No. 2 will be pumped continuously until the MCL concentration of 5 ppb of TCE and 200 ppb of TCA is reached at this location.

In this alternative, the transport of contaminants through soil will be inducted by local precipitation. Although the contaminant plume will be contained within the radius of influence of this high capacity well, an extended period of time will be required to meet groundwater health based standards within the aquifer at the Lee Chemical Site.

Groundwater monitoring will be required for monitoring wells at or in the vicinity of the Lee Chemical Site. More stringent monitoring programs for air and water samples will be required at Town Branch outfall locations. This alternative is estimated to require 25 years for site restoration at a present worth cost of $767,000.

Alternative IV:

Alternative IV is the addition of a soil flushing system to Alternative II. All monitoring requirements explained in Alternatives II and III will be applicable to this alternative. Fencing the perimeter of the site is a requirement and is already fulfilled.

The soil flushing system will cover an area of approximately 800 feet in length (east to west) and 200 feet in width (north to south). Two foot wide trenches dug to a depth of approximately 3 feet below ground level will be constructed at approximately 10 foot centers throughout the area described above. At the bottom of the trenches, flexible perforated tubing will be emplaced and the excavation will be backfilled with permeable material. The system will be connected to a clean water supply from the Liberty well field.

The RI identified the vadose zone, the soils above the water table, within the Lee Chemical Site area as the principal source of contamination. This alternative will enhance the flushing of contaminants through the vadose zone, thereby reducing the level of contamination at the source. Contamination flushed from the vadose zone and escaping the influence of EW-3 will travel to Liberty well No. 2.

A relatively extended period of time will be required to bring groundwater within the Lee Chemical Site within acceptable levels.

Withdrawal from Liberty well No. 2 will continue to contain the contaminated groundwater plume offsite. This alternative is estimated to require 15 years for site restoration at a present worth cost of $860,000.

Alternative V:

This alternative is a combination of gravity induced soil flushing and Alternative III. The alternative will follow all monitoring requirements and restrictions as explained in Alternative IV. Due to the elimination of limiting conditions stated in Alternative IV, the cleanup of the Lee Chemical Site contamination will be expedited. The extraction well constructed to Missouri public water supply standards will be strategically located at the center of the zone of contamination so the radius of influence of the well will extend fully over the contaminated area. Full control will be exerted by the new extraction well so that the City of Liberty well field will be protected. After the new extraction well is operational, the contaminant level at WSW2 will decline to below MCLs and can be retired from the extraction operation and return to its normal water supply status.

The groundwater aquifer is expected to meet MCL water quality standard within five (5) years after initiating this process at a present worth cost of $550,000.

Alternative VI:

This alternative is the addition of bioremediation to Alternative IV once the residual concentration level of Alternative IV is reached. Bioremediation is the enhancement of the activity of naturally occurring microorganisms. The introduction of proper nutrients to the system will increase their consumption of contaminants and will allow an increased population growth of microorganisms. Bioremediation will be implemented using the same infrastructure of Alternative IV. This alternative is estimated to require 15 years for site restoration at a present worth cost of $950,000.

Alternative VII:

This alternative is the addition of bioremediation to Alternative V once the residual concentration level of Alternative V is reached. Bioremediation will be implemented using the same infrastructure of Alternative V. This alternative is estimated to require 5 years for site restoration at a present worth cost of $640,000.

## 7.1 Applicable or Relevant and Appropriate Requirements (ARARs)

The selected remedy will comply with all federal and state applicable or relevant and appropriate requirements (ARARs). Applicable requirements are those state or federal requirements legally applicable to the release or remedial action contemplated that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at the Site. If it is determined that a requirement is not applicable, it may still be relevant and appropriate to the circumstances of the release. Requirements are relevant and appropriate if they address problems or situations sufficiently similar to the circumstances of the release or remedial action contemplated and are well-suited to the Site.

Numerical values for the chemical-specific ARARs identified for the Site are listed in Table 7. No federal or state location-specific ARARs were identified for the Site. The major chemical-specific and action-specific ARARs for the Lee Chemical Site are listed below:

Chemical-specific ARARs

Federal Maximum Contaminant Levels for volatile organics in drinking water supplies (40 CFR Part 141).

- Establishes health-based standards, maximum contaminant levels (MCLs), for public water systems.
- MCLs for organic contaminants are applicable to groundwater.

State Maximum Volatile Organic Chemical Contaminant Levels for public water systems (10 CSR 60-4.100).

- Establishes maximum chemical contaminant levels for volatile organic chemicals in public water systems.
- Maximum contaminant levels may be applicable to groundwater at the Site.

Federal Water Quality Criteria (40 CFR Part 131) Quality Criteria for water.

- Establishes criteria for water quality based on toxicity to aquatic organisms and human health.
- Ambient water quality criteria may be relevant and appropriate for the discharge to Town Branch.

State Water Quality Standards for volatile organics in groundwater (10 CSR 20-7.031).

- Establishes maximum contaminant levels and monitoring requirements.
- Requirements may be applicable if more stringent than federal requirements.

Action-specific ARARs

National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50).

- Establishes primary (health based) and secondary (welfare based) standards for air quality.
- Standards may be relevant and appropriate to emissions from discharge to Town Branch.

National Pollution Discharge Elimination System (NPDES) (40 CFR Part 125)

- Requires permits for the discharge of pollutants into the waters of the United States.
- NPDES permit is in effect for discharge to Town Branch.

State Air Quality DeMinimis Emission Levels 10 CSR 6.060(7)(A).

- Establishes requirements for new source emission permits.
- Requirements may be relevant and appropriate to emissions from discharge to Town Branch.

State Water Quality Standards for Aquatic Life Protection (10 CSR 20-7.031).

- Promulgates standards and rules to protect the quality of lakes and streams.
- Standards and rules may be relevant and appropriate to the discharge to Town Branch.

## SECTION 8.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Alternatives were developed to respond to the groundwater contamination in the aquifer. The alternatives described in the preceding section were evaluated using evaluation criteria presented in OSWER Directive 9355.3-02, "Interim Final Guidance on Preparing Superfund Decision Documents: The Proposed Plan, the Record of Decision, Explanation of Significant Differences, and the Record of Decision Amendment, June 1989" and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. These criteria relate to factors mandated in Section 121 of CERCLA/SARA and consideration of the overall feasibility and acceptability of the remedy. The nine criteria are as follows:

Threshold Criteria

- Overall Protection of Human Health and Environment addresses whether or not a remedy provides adequate protection and describes how risks through each pathway are eliminated,

reduced or controlled through treatment, engineering controls, or institutional controls;

- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes and/or provide grounds for invoking a waiver;

Primary Balancing Criteria

- Long-Term Effectiveness and Permanence refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met;

- Reduction of Toxicity, Mobility, or Volume through Treatment is the anticipated performance of the treatment technologies that may be employed in a remedy;

- Short-Term Effectiveness refers to the speed with which the remedy achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment that may result during the construction and implementation period;

- Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution;

- Cost includes capital and operation and maintenance costs;

Modifying Criteria

- State Acceptance indicates whether, based on its review of the RI/FS and Proposed Plan, the State concurs with, opposes, or has no comment on the preferred alternative;

- Community Acceptance which is assessed in the Responsiveness Summary which is attached to this Record of Decision (ROD), and which reviews the public comments received during the public comment period.

Each alternative was evaluated against the specific criteria described above to assess the relative performance of each alternative. The comparative analysis is summarized below and in Tables 8a and 8b:

THRESHOLD CRITERIA

-<u>Overall Protection of Human Health and the Environment</u>:

Alternative I, the no action alternative, will not be protective of human health and the environment. The contaminant plume will

TABLE 8a.

Screening of Alluvial Aquifer Alternatives

| ALTERNATIVE | EFFECTIVENESS | IMPLEMENTABILITY | COST | SCREENING STATUS |
|---|---|---|---|---|
| Alternative I<br><br>No Action | Does not protect human health and the environment from future risk. Toxicity, mobility and volume of contaminant plume unchanged. Plume would spread over a larger area. | No technologies implemented. No technical or administrative feasibility considerations. | Zero cost | Retain as required by the NCP to compare the effects of other alternatives. |
| Alternative II<br><br>Extended pumping of EW-3 and Liberty No. 2. Discharge to Town Branch. | Protects human health by removing contamination. Aquifer contamination remediation in 25 years. | No new facilities required. Existing discharge line and permit to Town Branch in place. | Capital $25,000<br>O&M $56,000<br>Present worth $814,000 | Retain because remedial technologies in place. |
| Alternative III<br><br>Extended pumping of new well and Liberty well No. 2 | Protects human health by removing contamination. Aquifer contamination remediation in 25 years. Increased control of plume with containment within site. | Construction of new high capacity well. Discharge line and permit in place. | Capital $175,000<br>O&M $42,000<br>Present worth $767,000 | Retain because of proven technologies and wells in place. |
| Alternative IV<br><br>Extended pumping of EW-3 and Liberty No. 2. Construct soil flushing system. | Protects human health by removing contamination. Aquifer contamination remediation in 15 years. Increases rate of soil contamination removal. | Construction of soil flushing system required. EW-3, Liberty No. 2, and discharge line in place. | Capital $175,000<br>O&M $66,000<br>Present worth $868,000 | Retain because of proven technology and wells in place. |

TABLE 8b.

Screening of Alluvial Aquifer Alternatives

| ALTERNATIVE | EFFECTIVENESS | IMPLEMENTABILITY | COST | SCREENING STATUS |
|---|---|---|---|---|
| Alternative V<br><br>Extended pumping of new well and constructing soil flushing system. | Protects human health by removing contamination. Increased control of plume at site. Increased rate of soil contamination removal. Remediation in 5 years. | Construction of new high capacity well and soil flushing system. Discharge line and permit in place. Reliable processes. | Capital $325,000<br>O&M $52,000<br>Present worth $550,000 | Retain because of proven technologies and expedited remedial method. |
| Alternative VI<br><br>Bioremediation through soil flushing system. EW-3 and Liberty No. 2 in operation. | Protects human health by removing contamination and addressing residual soil contamination. Aquifer contamination remediation in 15 years. | Construction of soil flushing system with the addition of bioremediation. Groundwater wells and discharge line in place. | Capital $263,000<br>O&M $66,000<br>Present worth $950,000 | Retain because of remedial technologies in place and enhanced reduction of contaminants in soil at residual levels. |
| Alternative VII<br><br>Pumping of new well, and Liberty No. 2, construct soil flushing system, and introduce bioremediation. | Protect human health by removing contamination and addressing residual soil contamination. Aquifer contamination remediation in 5 years. | Construction of new high capacity well and soil flushing system are reliable technologies. Liberty well No. 2 and discharge line in place. | Capital $419,000<br>O&M $52,000<br>Present worth $640,000 | Retain because of enhanced effectiveness of alternative and technologies in place. |

migrate toward the currently uncontaminated municipal wells and present future health risks to groundwater users. The existing contamination in the groundwater already exceeds state and federal drinking water standards and state water quality standards for groundwater.

Alternatives II, III, IV, V, VI and VII will all be equally protective of human health and the environment by extracting the contaminated groundwater. The contaminants will be permanently removed from the groundwater. At the completion of the remediation, the TCE concentration in the aquifer will be reduced to 5 ppb or less, thereby bringing the exposure levels within an acceptable risk range.

- Compliance with ARARs:

Alternative I will not meet ARARs since the contaminant concentrations will not be reduced. Alternatives II, III, IV, V, VI and VII will meet their respective Applicable or Relevant and Appropriate Requirements (ARARs) of federal and state environmental laws. Specifically, they will reduce the groundwater contamination to meet Maximum Contaminant Levels for drinking water supplies and Missouri water quality standards for groundwater. No waiver from ARARs is required to implement any of the active cleanup options. Since Alternative I does not meet the threshold criteria, it will not be discussed in depth in the following discussion of the other selection criteria.

PRIMARY BALANCING CRITERIA

- Long-term Effectiveness and Permanence:

For Alternative I, the no action alternative, the plume will continue to migrate and could eventually contaminate the rest of the City of Liberty's water supply wells.

All other Alternatives will involve long term pump and permitted discharge remedies requiring from 5 to 25 years to complete. Reviews no less than every five years will be required because the remedies will result in hazardous substances remaining onsite above health-based levels during the remediation. At the completion of the remediation, the groundwater in the aquifer will be restored for future unrestricted use by reducing the Site contaminants to their respective ARAR levels.

All Alternatives, except Alternative I, use discharge under the terms and conditions of an NPDES permit as their means of ultimate removal of the contaminated groundwater. This method is currently being used at the Site under the remediation plan now in effect. None of the Alternatives will produce residuals such as a sludge. Stringent monitoring to insure the NPDES limits are met will be required.

- Reduction of Toxicity, Mobility, and Volume:

Alternative I will not reduce the toxicity or mobility of the contaminants, and the volume of contaminated groundwater will increase as the plume migrates.

All of the other Alternatives equally reduce the mobility and volume of the contaminants. All other Alternatives will irreversibly reduce contaminant levels in the soil and groundwater to levels which satisfy ARARs. Future use of onsite and offsite groundwater from the aquifer could pose unacceptable health risks at present contaminant levels. Dermal contact/ingestion of onsite groundwater poses the greatest health threat. The permitted discharge processes employed by all of the Alternatives will reduce the inherent hazards posed by the principal threats at the Site.

-Short-term Effectiveness:

Alternatives I and II will not increase short-term risks to the community, environment, or workers since no construction activities are planned.

All other Alternatives provide adequate and approximately equal protection to the community and workers during construction and implementation. Alternatives III, V and VII will require construction of an onsite extraction well and Alternatives IV through VII will require construction of an in-situ aqueous soil washing system consisting of infiltration trenches. Any release of VOCs during well construction or the construction of the soil washing system will rapidly disperse and are not likely to pose a public health risk. The Site perimeter fence and backfill covering the Site will minimize risks to the community posed by onsite construction of the new extraction well required for Alternatives III, V and VII. The vegetation already covering the Site will minimize dust emissions. Construction of the extraction well will pose normal risks associated with the construction of any well.

Drawdown of the aquifer, which is normal during groundwater extraction, will not create any significant environmental impacts from Alternatives II through VII. The increased flow in Town Branch from all Alternatives will not create any significant environmental impacts.

- Implementability:

Alternative I does not use any controls or technologies which will require coordination with other agencies.

All other Alternatives will involve long term pump and permitted discharge remedies requiring from 5 to 25 years to complete and are approximately equal in terms of technical feasibility, administrative feasibility, and availability of services and

materials. All of the implementation time frames are based on contaminant concentration trends as a result of the interim response action or sound engineering judgment. Alternative II is slightly more feasible technically and administratively, since it is currently being implemented. None of the remaining Alternatives should be difficult to implement. The services and required materials are readily available. The technologies used in all Alternatives involve tested and widely used processes which have proven very effective in removing VOCs from groundwater. For all Alternatives except Alternative I, air toxic regulations may necessitate new air permits for the volatile organics being volatilized as a result of the NPDES discharge. Alternative II will require the least coordination with MDNR, EPA, and the City of Liberty since no additional construction is planned.

Alternatives III, IV, V, VI and VII will all require additional construction. A NPDES permit will also need to be retained for the discharge to Town Branch. No permits will be required for soils remediation under Alternatives IV, V, VI or VII.

Costs:

Alternative I will have $0 cost.

Alternative II will have an estimated capital cost of $25,000, an estimated annual operation and maintenance (O&M) cost of $56,000, and an estimated implementation time frame of 25 years. Assuming a 10 percent discount rate, the present worth is $814,000.

Alternative III will have an estimated capital cost of $175,000, an estimated annual O&M cost of $42,000, and an implementation time frame of 25 years. Assuming a 10 percent discount rate, the present worth is $767,000.

Alternative IV will have an estimated capital cost of $175,000, an estimated annual O&M cost of $66,000, and an estimated implementation time frame of 15 years. Assuming a 10 percent discount rate, the present worth is $860,000.

Alternative V will have an estimated capital cost of $325,000, an estimated annual O&M cost of $52,000, and an estimated implementation time frame of 5 years. Assuming a 10 percent discount rate, the present worth is $550,000.

Alternative VI will have an estimated capital cost of $265,000, an estimated annual O&M cost of $66,000, and an estimated implementation time frame of 15 years. Assuming a 10 percent discount rate, the present worth is $950,000.

Alternative VII will have an estimated capital cost of $415,000, an estimated annual O&M cost of $52,000, and an estimated implementation time frame of 5 years. Assuming a 10 percent discount rate, the present worth is $640,000.

MODIFYING CRITERIA

- State Acceptance:

Representing the State of Missouri, the MDNR selected Alternative V in the Proposed Plan as its preferred alternative. The State is the lead agency for this Site. However, under the Superfund law, it is the EPA which must make the decision, in consultation with the State, on what the final remedy will be. MDNR has concurred with EPA's final remedy selection.

- Community Acceptance:

The reservations, concerns, and supporting or opposing comments of the community on the RI/FS, the Proposed Plan, and other information in the Administrative Record were made known to the MDNR and EPA during the thirty day comment period and the public hearing with the community on January 9, 1991. The public's comments are addressed in the Responsiveness Summary, which is a component of this Record of Decision for the Site.

8.1 Conclusion on the Comparative Analysis

All Alternatives, except Alternative I, the no-action Alternative, meet the threshold criteria. All of these other Alternatives are substantially equivalent under the balancing criteria of the long-term effectiveness and permanence, the reduction of toxicity, mobility and volume, and the short-term effectiveness. With respect to the balancing criteria of implementability, all of these Alternatives are substantially equivalent, except that the estimated implementation time frame for Alternatives V and VII are substantially shorter, estimated at 5 years. Also, with respect to the balancing criteria of costs, Alternatives V and VII are the two lowest cost alternatives that also meet the threshold criteria. Alternative V, the lowest cost alternative, which is also one of the two alternatives with the lowest implementation time frames, is therefore the most cost effective alternative. Additionally, Alternative V has been accepted by the State of Missouri as its preferred alternative and the responsiveness summary shows community acceptance of Alternative V.

## SECTION 9.0 THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives, and public comments, both the EPA and the State of Missouri have determined that Alternative V, installation of an extraction well and an in-situ aqueous soil washing system, discharge under the terms and conditions of a NPDES permit to Town Branch Creek; is the most appropriate remedy for the Lee Chemical Site in Liberty, Missouri. This remedy is an enhancement of the ongoing interim response action (Alternative II) at the Site as described in Sections 2.2 and 5.0. In the event that additional treatment of

the discharge water becomes necessary to meet either the NPDES permit limits or other applicable or relevant and appropriate requirements, a contingency phase project consisting of air stripping or other treatment methods will be implemented to bring the discharge into compliance.

The selected remedy will transfer the VOCs from the subsurface soils and groundwater to surface water as well as to the air as volatiles are off-gassed during the discharge process. Air modeling predicts that the potential cancer risk and the hazard index ratios of airborne VOCs from the discharge are acceptable. However, continued ambient air monitoring will be required as a part of this Site remediation.

The extraction system for Alternative V consists of using one existing and one new well for the remediation. These extraction wells, WSW2 and the new onsite well, will be used for collection of contaminated groundwater from the aquifer. Several other wells, both on and offsite, are available for use as extraction wells, should they be needed.

However, it is not anticipated that any other wells will be needed unless the plume of contamination spreads beyond the existing known areas of contamination. The new onsite extraction well will be constructed in the southeast corner of the property. The exact well design and location will be determined during remedial design. A well design similar to a normal water supply well would accomplish the remedial objectives and could be utilized as a future supply well for the City of Liberty once remediation is complete.

The current site conditions indicate that a pumping rate of 1,000 to 1,300 gallons per minute is controlling groundwater flow and is limiting contamination in the well field to only WSW2. The remedial pumping rate may need to be modified as other factors influencing the aquifer are identified. The actual pumping rate required will be based on the evaluation of conditions as the remediation gets underway. It is anticipated that the new onsite extraction well will effectively produce a hydraulic barrier that will prevent further contaminant migration from the Site.

Contaminated groundwater from both extraction wells will be piped through the existing discharge system to Town Branch Creek. If the TCE level in the groundwater extracted from these wells is found to exceed the discharge limitations set forth in the NPDES permit or if ambient air monitoring indicates an unacceptable health risk resulting from air emissions at the point of discharge, then it will be necessary to invoke the contingency phase of this project consisting of further treatment prior to discharge. Periodic monitoring of ambient air quality along with water quality monitoring, in accordance with the NPDES permit, will be performed. If needed, the additional treatment will remove the volatile organic contaminants from the groundwater.

An existing pipeline will carry the extracted groundwater from the Site to Town Branch Creek, where additional aeration and mixing occurs as the water flows down over riprap to the creek proper. The discharge operates under a state NPDES permit which stipulates a TCE monthly average discharge limit of 1,000 ug/l. Subsurface soil contamination at the Site, further contributing to the groundwater contamination, is to be addressed by the installation of a series of parallel trenches to be located above the contaminated soil on the Lee Chemical Site. Uncontaminated raw water from the City's well field will be utilized to flood these trenches, allowing water to saturate the contaminated soils below and thereby flushing contaminants to the groundwater to subsequently be picked up by the groundwater extraction system. The number and depth of the trenches and the operational parameters will be determined during the remedial design and modified as site conditions warrant once actual remediation begins.

The estimated capital cost of the remedy is $325,000, with annual O&M costs estimated to be $52,000. Assuming a 5 year operation and a 10% discount rate, the present worth is $550,000. Some changes may be made to the remedy as a result of the remedial design and construction processes, thereby affecting the estimated costs. Such changes, in general, reflect modifications resulting from the engineering design process or the use of the contingency phase air stripper. For the air stripper, an additional capital cost of $50,000 has been estimated, with annual O&M costs estimated at $15,000. Assuming a 5 year operation and a 10% discount rate, the present worth is approximately $120,000 for this contingency phase.

9.1 Remediation Goals

The purpose of this response action is to prevent potential exposure to contaminated groundwater; protect uncontaminated groundwater for future use by preventing further migration of the contaminated groundwater plume; restore the contaminated aquifer for future use as a drinking water source by reducing the contaminant concentrations to regulated or health-based levels, for example, 5 ppb or less for TCE, and remediate contaminated soils onsite such that no further groundwater contamination with VOCs above action levels can occur. Existing conditions at the Site have been determined to pose an excess lifetime cancer risk as high as $2 \times 10^{-4}$. The lifetime non-carcinogenic risk from exposure to site contaminants is insignificant. These risks relate to the VOC concentrations in groundwater which were found to be as high as 130 ug/l during the RI.

The acceptable exposure levels at this site that are protective of human health and the environment were developed by considering the ARARs identified in Section 10.2. Attainment of the chemical specific ARARs will result in cumulative carcinogenic risks at the Site within the acceptable $10^{-4}$ to $10^{-6}$ risk range for carcinogens, considering all contaminants and exposure pathways at the Site.

## SECTION 10.0 STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate 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 standards established under Federal and State 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 substances as their principal element. The following subsections discuss how the selected remedy meets these statutory requirements.

### 10.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment through extraction of the VOC-contaminated groundwater. The contaminants will be permanently removed from onsite soils and the groundwater. Extraction of the VOC-contaminated groundwater and remediation of contaminated site soils will eliminate the threat of exposure to the most mobile contaminants at the Site. The current carcinogenic risks associated with the exposure pathways identified in the risk assessment are as high as $2 \times 10^{-4}$. The selected remedy will reduce the cancer risks at the Site to within the acceptable $10^{-4}$ to $10^{-6}$ risk range for carcinogens, and the Hazard Index for non-carcinogens will be less than one. There are no unacceptable short-term threats associated with the selected remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

### 10.2 Compliance Applicable or Relevant and Appropriate Requirements (ARARs)

The selected remedy will comply with all federal and state applicable or relevant and appropriate requirements (ARARs). Applicable requirements are those state or federal requirements legally applicable to the release or remedial action contemplated that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at the Site. If it is determined that a requirement is not applicable, it may still be relevant and appropriate to the circumstances of the release. Requirements are relevant and appropriate if they address problems or situations sufficiently similar to the circumstances of the release or remedial action contemplated and are well-suited to the Site.

Numerical values for the chemical-specific ARARs identified for the Site are listed in Table 7. No federal or state location-specific ARARs were identified for the Site. The major chemical-specific and action-specific ARARs for the Lee Chemical Site are listed below:

Chemical-specific ARARs

Federal Maximum Contaminant Levels for volatile organics in drinking water supplies (40 CFR Part 141).

- Establishes health-based standards, maximum contaminant levels (MCLs), for public water systems.
- MCLs for organic contaminants are applicable to groundwater.

State Maximum Volatile Organic Chemical Contaminant Levels for public water systems (10 CSR 60-4.100).

- Establishes maximum chemical contaminant levels for volatile organic chemicals in public water systems.
- Maximum contaminant levels may be applicable to groundwater at the Site.

Federal Water Quality Criteria (40 CFR Part 131) Quality Criteria for water.

- Establishes criteria for water quality based on toxicity to aquatic organisms and human health.
- Ambient water quality criteria may be relevant and appropriate for the discharge to Town Branch.

State Water Quality Standards for volatile organics in groundwater (10 CSR 20-7.031).

- Establishes maximum contaminant levels and monitoring requirements.
- Requirements may be applicable if more stringent than federal requirements.

Action-specific ARARs

National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50).

- Establishes primary (health based) and secondary (welfare based) standards for air quality.
- Standards may be relevant and appropriate to emissions from discharge to Town Branch.

National Pollution Discharge Elimination System (NPDES) (40 CFR Part 125)

- Requires permits for the discharge of pollutants into the waters of the United States.

- NPDES permit is in effect for discharge to Town Branch.

State Air Quality DeMinimis Emission Levels 10 CSR 6.060(7)(A).

- Establishes requirements for new source emission permits.
- Requirements may be relevant and appropriate to emissions from discharge to Town Branch.

State Water Quality Standards for Aquatic Life Protection (10 CSR 20-7.031).

- Promulgates standards and rules to protect the quality of lakes and streams.
- Standards and rules may be relevant and appropriate to the discharge to Town Branch.

10.3 Cost Effectiveness

The selected remedy is cost effective because it has been determined to provide overall effectiveness proportional to its costs, the net present worth value being $550,000.

10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The State of Missouri and EPA have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost effective manner for the Lee Chemical Site. Of those Alternatives that are protective of human health and the environment and comply with ARARs, the State of Missouri and EPA have 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, also considering the statutory preference for treatment as a principal element and considering State and community input.

Alternative V reduces the toxicity, mobility, and volume of the contaminants in the groundwater and soil; complies with ARARs; provides short-term effectiveness; and protects human health and the environment equally as well as all other Alternatives. In terms of implementability, Alternative V is more reliable than other Alternatives because the combination of a new extraction well and soil washing system should result in a much quicker removal of the contamination thus helping to prevent further migration of the contaminants. Alternative V will be easy to implement technically because it requires only normal construction activities and administratively because it will require little additional coordination with relevant agencies. The major trade-offs that provide the basis for this selection decision are implementability and cost effectiveness. The

selected remedy is an enhancement of the interim response action currently operating at the Site and thus is known to be reliable. The basic improvements to the existing process provided for in Alternative V can be implemented quickly and with more confidence that they will protect the City's remaining water supply wells from contamination. Therefore, Alternative V is the most appropriate permanent solution for the contaminated soil and groundwater at the Lee Chemical Site.

### 10.5 Preference for Treatment as a Principal Element

The selected remedy removes the VOC contamination from the soils at the Site as well as capturing and removing contaminated groundwater. Thus, the selected remedy addresses the principal threats posed by the Site through the use of proven treatment methods. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied. The contingency phase project for additional treatment of the extracted groundwater also incorporates treatment as a principal element.

## SECTION 11.0 DOCUMENTATION OF SIGNIFICANT DIFFERENCES

No significant changes were made to the recommended alternative in the Proposed Plan.

# RECORD OF DECISION

# THE RESPONSIVENESS SUMMARY

## LEE CHEMICAL SITE

## LIBERTY, MISSOURI

Prepared By:

Missouri Department of Natural Resources

Waste Management Program

Jefferson City, Missouri

And

U.S. Environmental Protection Agency

Region VII

Kansas City, Kansas

March 1991

# RESPONSIVENESS SUMMARY

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## SECTION 1.0 OVERVIEW

In the Proposed Plan released to the public, the Missouri Department of Natural Resources (MDNR), with U.S. Environmental Protection Agency concurrence, made a preliminary selection for the preferred Alternative. MDNR's recommended Alternative addressed the groundwater and soil contamination problem at the Site. The preferred alternative involved extraction and containment of the contaminant plume using existing and new wells, implementing an in-situ aqueous soil washing system consisting of infiltration trenches to enhance the flushing of contaminants from Site soils, and discharge of the purged groundwater to Town Branch Creek under the terms and conditions of a NPDES permit.

In the event that additional treatment of the discharge water becomes necessary to meet either the NPDES permit limits or other applicable or relevant and appropriate requirements, a contingency phase project consisting of air stripping or other treatment methods will be implemented to bring the discharge into compliance.

No comments were received during the public comment period opposing the preferred alternative as presented. One Liberty resident asked for an analysis of the effects of 1,1,2-trichloroethene (TCE) on Town Branch and Shoal Creeks and the possibility of bioaccumulation occurring. This resident also asked what the impacts resulting from the release of TCE into the air, either through the outfall from the wells or through an air stripper if required, will have on the people who work down in the bottoms near the Site.

The Potentially Responsible Party supported the preferred Alternative as described in the Proposed Plan.

## SECTION 2.0 BACKGROUND ON COMMUNITY INVOLVEMENT

Community interest in the Site dates back to 1979 when contamination of the public water supply wells in Liberty was first discovered. The major issues expressed at that time were concerned with providing the community with a safe drinking water supply. This issue was addressed by the interim response action taken by the City of Liberty which effectively returned levels of TCE in the public water supply to below levels of concern. The RI/FS process was performed with regular reports to the City Council on its progress and findings.

The public comment period on the preferred Alternative as outlined in the Proposed Plan began on December 24, 1990 and ended January 23, 1991. A public hearing was held in Liberty on January 9, 1991. The responsiveness summary addresses comments received during this period.

## SECTION 3.0 SUMMARY OF COMMENTS RECEIVED DURING PUBLIC COMMENT PERIOD

Comments received during the public comment period on the Remedial Investigation, Feasibility Study, and Proposed Plan for the Lee Chemical Site are briefly summarized below. Only two comments were received.

Question 1.

Considering that purged groundwater has been discharged into Town Branch Creek for several years, has anyone looked at the effects of the TCE on the creek itself, i.e., buildup in the sediment or the benthic organisms (the organisms living on the creek bottoms) or anything of that nature?

MDNR/EPA Response:

There have been no samples of sediments or of the organisms living on the creek bottoms collected/analyzed from Town Branch or Shoal Creek to date. There have been in-stream water quality samples collected at the confluence of Town Branch and Shoal Creek none of which showed significant concentrations of TCE.

Laboratory studies have demonstrated that TCE volatilizes rapidly from water. Although volatilization is rapid, actual volatilization rates are dependent upon temperature, water movement and depth, associated air movement, and other factors. Because neither biodegradation nor other fate processes occur at a rapid rate, most TCE present in surface waters can be expected to volatilize into the atmosphere.

The biological process of bioaccumulation is generally reported in terms of a bioconcentration factor (BCF), the ratio of the concentration of a substance in a living organism to the equilibrium concentration in the medium in which the organism lives. Bioconcentration factors reported in the literature generally range from one to one million. Experimental BCF data measuring TCE concentrations in fish, seawater, and associated aquatic organisms supports a low bioaccumulation potential for benthic organisms (i.e. BCF of 17 in fish). Although evidence of bioaccumulation potential exists, the process for TCE is probably not important in comparison to other removal mechanisms, such as volatilization.

The level of TCE concentrations entering Town Branch at the outfall has consistently been below 90 parts per billion (ppb) since the RI commenced. Based on that data, it would appear there is an almost complete volatilization of the TCE in the water between the point of discharge and the confluence of Shell Creek (approximately 1600 feet).

However, in response to this concern, MDNR will further investigate the need to sample and analyze the creek sediments and benthic organisms for TCE bioaccumulation.

Question 2.

What are the air impacts of TCE being released, either through the outfall from the wells or an air stripper if implemented, on people who work in the bottoms near the Site?

MDNR/EPA RESPONSE:

As part of the Risk Evaluation prepared for the Lee Chemical Site, inhalation of VOCs by residents and industrial workers downwind of the extraction well discharge point on Town Branch was examined.

The purged water flows through a discharge line to Town Branch where it continues over a dispersion plate and then cascades down the embankment approximately 20 to 30 feet over riprap and enters the Town Branch. Although the VOCs in this water will partially volatilize and potentially expose those downwind of the discharge point, we studied the exposure of workers and residents closest to the Site and found negligible risks. The extent of exposure was calculated based on employees working at the closest facility to the discharge point (100 yards) and on the closest permanent residents (200 yards), because they would have the potential for the highest exposure duration.

Should discharge concentrations increase to levels that would represent a significant risk to resident and worker populations, monitoring of ambient air quality will be performed to verify these risks. If this monitoring indicates that an unacceptable health risk is resulting from air emissions at the point of discharge, it will then be necessary to invoke the contingency phase of this project consisting of further treatment prior to discharge.