Public Health Assessment for

LEMBERGER TRANSPORT AND RECYCLING LANDFILL INC.
FRANKLIN TOWNSHIP, MANITOWOC COUNTY, WISCONSIN
CERCLIS NO. WID056247208
FEBRUARY 14, 1994
THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104 (i) (6) (F) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risks assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, this Health Assessment has been conducted using available data. Additional Health Assessments may be conducted for this site as more information becomes available.

The conclusions and recommendations presented in this Health Assessment are the result of site specific analyses and are not to be cited or quoted for other evaluations or Health Assessments.

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.
PUBLIC HEALTH ASSESSMENT

LEMBERGER TRANSPORT AND RECYCLING LANDFILL INC.
FRANKLIN TOWNSHIP, MANITOWOC COUNTY, WISCONSIN
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Prepared by

Wisconsin Department of Health and Social Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry
THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations 42 C.F.R. Part 90). In preparing this document ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30 day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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ATSDR and its Public Health Assessment

ATSDR is the Agency for Toxic Substances and Disease Registry, a federal public health agency. ATSDR is part of the Public Health Service in the U.S. Department of Health and Human Services. ATSDR is not a regulatory agency. Created by Superfund legislation in 1980, ATSDR's mission is to prevent or mitigate adverse human health effects and diminished quality of life resulting from exposure to hazardous substances in the environment.

The Superfund legislation directs ATSDR to undertake actions related to public health. One of these actions is to prepare public health assessments for all sites on or proposed for the Environmental Protection Agency's National Priorities List, including sites owned or operated by the federal government.

During ATSDR assessment process the author reviews available information on

- the levels (or concentrations) of the contaminants,
- how people are or might be exposed to the contaminants, and
- how exposure to the contaminants might affect people's health

to decide whether working or living nearby might affect peoples' health, and whether there are physical dangers to people, such as abandoned mine shafts, unsafe buildings, or other hazards.

Four types of information are used in an ATSDR assessment.

1) environmental data; information on the contaminants and how people could come in contact with them

2) demographic data; information on the ethnicity, socioeconomic status, age, and gender of people living around the site,

3) community health concerns; reports from the public about how the site affects their health or quality of life

4) health data; information on community-wide rates of illness, disease, and death compared with national and state rates

The sources of this information include the Environmental Protection Agency (EPA) and other federal agencies, state, and local environmental and health agencies, other institutions, organizations, or individuals, and people living around and working at the site and their representatives.
ATSDR health assessors visit the site to see what it is like, how it is used, whether people can walk onto the site, and who lives around the site. Throughout the assessment process, ATSDR health assessors meet with people working at and living around the site to discuss with them their health concerns or symptoms.

A team of ATSDR staff recommend actions based on the information available that will protect the health of the people living around the site. When actions are recommended, ATSDR works with other federal and state agencies to carry out those actions.

A public health action plan is part of the assessment. This plan describes the actions that will be taken at and around the site to prevent or stop exposure to site contaminants that could harm people’s health. ATSDR may recommend public health actions that include these:

- restricting access to the site,
- monitoring,
- surveillance, registries, or health studies,
- environmental health education, and
- applied substance-specific research.

ATSDR shares its initial release of the assessment with EPA, other federal departments and agencies, and the state health department to ensure that it is clear, complete, and accurate. After addressing the comments on that release, ATSDR releases the assessment to the general public. ATSDR notifies the public through the media that the assessment is available at nearby libraries, the city hall, or another convenient place. Based on comments from the public, ATSDR may revise the assessment. ATSDR then releases the final assessment. That release includes in an appendix ATSDR’s written response to the public’s comments.

If conditions change at the site, or if new information or data become available after the assessment is completed, ATSDR will review the new information and determine what, if any, other public health action is needed.

For more information about ATSDR’s assessment process and related programs please write to:

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# TABLE OF CONTENTS

**PREFACE: THE PURPOSE OF HEALTH ASSESSMENTS** ........................................ iii

**SUMMARY** ........................................................................................................ 1

**BACKGROUND** .................................................................................................. 2
  A. Site Description and History ........................................................................... 2
  B. Site Visit ........................................................................................................... 3
  C. Demographics, Land Use, and Natural Resource Use ..................................... 4
  D. Health Outcome Data ...................................................................................... 4

**COMMUNITY HEALTH CONCERNS** ................................................................. 5

**ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS** ....................... 6
  A. On-Site Contamination ................................................................................... 6
     Soils ................................................................................................................... 7
     Waste/Subwaste Soil ......................................................................................... 8
     Surface Water .................................................................................................... 8
     Sediment .......................................................................................................... 8
     Groundwater ..................................................................................................... 8
  B. Off-site contamination ...................................................................................... 9
     Groundwater ..................................................................................................... 9
     Surface Water .................................................................................................. 11
     Sediment .......................................................................................................... 12
  C. Toxic Chemical Release Inventory ................................................................... 12
  D. Quality Assurance and Quality Control .......................................................... 12
  E. Physical and Other Hazards .............................................................................. 12

**PATHWAYS ANALYSES** .................................................................................... 13
  A. Completed Human Exposure Pathways .......................................................... 13
     Residential Drinking Water .............................................................................. 13
  B. Potential Exposure Pathways .......................................................................... 14
     Residential Drinking Water .............................................................................. 14

**PUBLIC HEALTH IMPLICATIONS** .................................................................... 15
  A. Toxicological Evaluation ................................................................................ 15
     Past Completed Exposures .............................................................................. 16
     Potential Future Exposures ............................................................................. 18
  B. Health Outcome Data Evaluation .................................................................... 19
  C. Community Health Concerns Evaluation ....................................................... 20

**CONCLUSIONS** .................................................................................................. 21

**RECOMMENDATIONS** ....................................................................................... 21
PREFACE: THE PURPOSE OF HEALTH ASSESSMENTS

The federal "Superfund" law requires the Agency for Toxic Substances and Disease Registry (ATSDR) to conduct a public health assessment of all toxic waste sites that the U. S. Environmental Protection Agency (EPA) proposes for inclusion on the list of the nation's most hazardous waste sites. This list formally is called the National Priorities List. The Wisconsin Division of Health (DOH) works with ATSDR to prepare public health assessments. The purposes of health assessments are:

1. To evaluate whether contaminants at the site pose a current or future threat to public health;
2. To recommend any steps needed to protect the public from exposure to toxic substances, and
3. To recommend long-term health studies, when appropriate.

For each assessment health professionals look at the types of contamination present, including each chemical's toxicity; ability to move through soil, water or air; persistence in the environment; and ability to accumulate in the food chain. They look at ways that people could be exposed to contaminants such as eating, breathing, or touching the chemicals. Investigators check relevant health records when appropriate to see if there may be increases in health effects related to public exposure to contaminants from the site. Finally, an assessment identifies the health hazards that a site may pose and recommends actions to protect public health now and in the future.

The DOH and ATSDR may conduct a "preliminary" public health assessment after EPA proposes to include a site on the National Priorities List. The preliminary public health assessment relies on whatever data are available at the time. It also identifies sampling to be addressed by the remedial investigation conducted as part of the Superfund clean-up of the site. The DOH, in cooperation with ATSDR, completed the Preliminary Health Assessment of the Lemberger Transport and Recycling Landfill in 1989. Now that the remedial investigation of this site is completed, DOH conducted a public health assessment using the more complete set of data that the investigation provided. Local, state and federal agencies and the local community will have an opportunity to comment on this assessment before the DOH and ATSDR approve the final version.

This health assessment was released on May 21, 1993 and public comments were solicited until June 21, 1993. One public comment was received during this period (Appendix D).
SUMMARY

The Lemberger Transport and Recycling Landfill (LTR) is a former landfill, located in Franklin Township of Manitowoc County, and is one of three landfills situated within 1,000 feet of each other. The 16-acre LTR site received approximately 865,000 gallons of solid and liquid waste between 1970 and 1976.

Groundwater in the vicinity of and under the site has been found to contain a number of volatile and semivolatile organic compounds. In 1985, 7 of 45 wells tested near the site were found to contain up to six volatile organic compounds (VOCs), some at concentrations above state groundwater standards. These wells were subsequently replaced by deeper wells. Fifteen of these wells were sampled between 1989 and 1991 and no VOCs or metals were found at levels of health concern. No hazardous constituents have been found in surface water at the site. Waste at the site has not been analyzed.

At present the site poses no apparent public health hazard. Some nearby residential wells are contaminated, but at low levels which are not a health concern. The site was a public health hazard in the past because approximately 19 people were exposed to as many as six VOCs originating from the site. These levels of exposures, which occurred over a period of up to 17 years and ended in 1987, are associated with a low excess cancer risk. One family was worried that contaminated groundwater was the cause of health problems they were experiencing, but their reported effects are not known to be associated with low levels of contamination found in their well. If the site is not cleaned-up, higher levels of contaminants present in on-site groundwater and waste may migrate off-site, affect residential wells with contamination at a level of health concern, and present a public health hazard in the future.

The Wisconsin Division of Health (DOH) recommends characterization of waste materials at the site to evaluate how it may be affecting local groundwater and to estimate the potential health effects posed to workers at the site. The regular monitoring of nearby residential wells should be continued. All nearby residents and health care providers should be provided with names of staff at the Department of Natural Resources and the Division of Health who are the contacts for the site.

Some local residents have expressed concern that the site may be affecting their health and DOH has been in contact with these individuals. The DOH will continue to inform nearby residents, health care providers, and local public health officials about health-related issues concerning the site as new information becomes available. The DOH will review and comment on the public health aspects of sampling and other activities conducted at the site. The Department of Natural Resources and the U.S. Environmental Protection Agency will be consulted and advised by DOH on public health concerns that may arise as new information become available about the site.
BACKGROUND

A. Site Description and History

The 16-acre Lemberger Transport and Recycling (LTR) Landfill is a former gravel quarry which was used for disposal of industrial wastes between 1970 and 1976. The site is located at the intersection of Hempton Lake Road and Sunny Slope Road in Franklin Township, Wisconsin, 9 miles northwest of the City of Manitowoc. The LTR site is approximately 1,000 feet south of two other landfills. USEPA proposed the LTR site for inclusion on the National Priorities List (NPL, also known as "Superfund") in 1983 and placed it on the list in 1984.

The 21-acre Lemberger Flyash Landfill (LL) also operated between 1970 and 1976 under a Wisconsin Department of Natural Resources (WDNR) license. The LL site accepted unknown types and quantities of municipal and industrial wastes, including between 42,000 and 60,000 cubic yards of fly ash. The LL site, which is discussed in a separate health assessment, was placed on the National Priorities List in 1986. The Ridgeview Landfill, which also accepted both industrial and municipal solid wastes, was purchased by Waste Management of Wisconsin, Inc. in 1981. The Ridgeview Landfill is composed of two units: the 10-acre original area and the 60-acre expansion. Waste Management installed a leachate collection system and a cover with a gas venting system. The expansion is currently licensed and operational.

Records from the operators of the LTR site indicate that, of the roughly 865,000 gallons of waste, 55.1% consisted of wood tar distillates, 35.1% were aluminum dust and 5.5% were oil and waste mixtures. Wastes, composed mostly of liquids, were deposited in unlined trenches located in the northeast and southwest portion of the landfill. When the LTR site was closed in 1977, it was covered with 1 foot of clay-containing soil. Between 1977 and 1980, various improvements were made on the site, including placement of additional cover material and filling and grading of low areas on and around the site.

In 1980, WDNR received complaints regarding the appearance of leachate seeps on the west side of LL. As a result, the Lemberger Landfills Inc. consented to conduct an investigation of the source of the leachate seeps and to attempt to control the seeps. The resulting report, issued in 1982, concluded that inadequate cover soil and poor drainage on and adjacent to the site were the primary factors responsible for leachate generation. At that time, one nearby family began to complain that their livestock had been unusually unproductive during the preceding few years. WDNR subsequently analyzed water from the wells of forty-five residences near the LL and LTR sites. Seven of these wells were found to contain volatile organic compounds (VOCs).

In 1984, USEPA contracted with B&V Waste Science and Technology Corp. to perform a "Remedial Investigation/Feasibility Study" (RI/FS) on the Lemberger Flyash Landfill and Lemberger Transport and Recycling sites. The objectives of the RI were to determine the extent of hazardous contaminant release from the landfill and, if necessary, to identify potential action that could be taken at the site to mitigate any hazards. The RI was
completed in January 1991. The Wisconsin Division of Health (DOH) completed preliminary health assessments on the two sites in September, 1989.6

On September 23, 1991, USEPA and the potentially responsible parties signed a "Record of Decision" (ROD). Under the ROD, the parties agreed to remove waste-containing drums from the LTR site and to a specific schedule of groundwater and private well testing. These activities were scheduled to begin in December, 1993.7 In addition, water extracted from the site will be treated and discharged to the Branch River, and the water will be monitored to determine concentrations of contaminants during the extraction procedure.

The area in the vicinity of the LTR site is characterized by rolling hills, rocky soil and wetlands in low-lying areas. The terrain at the site slopes gradually toward the west and northwest toward the Branch River, located less than one mile northwest of the site (see Appendix A: Map 1), and an unnamed tributary to the Branch River approximately one-half mile west of the site. Surface soils in the area are glacial in origin and vary between sandy loam and silty clay. Surface water in the area drains into the river, which flows north-northeast into Lake Michigan approximately 10 miles to the east. During periods of high rainfall, surface water accumulates in depressions in areas with soils that have high clay content. Low-lying depressions on the northwest corner of the site are occupied by cattails and other wetland vegetation.8

Two aquifers underlie the LTR site: a glacial, sand-and-gravel aquifer in unconsolidated sediments from 0 to about 20 feet below the surface and a bedrock aquifer, in dolomitic limestone, between 20 and 1,000 feet below the surface, and a sandstone aquifer, extending to depths below 1,000 feet. There is no confining unit between the glacial aquifer and the bedrock aquifer.9

Recharge to the upper glacial aquifer occurs from infiltration of precipitation and possibly through upward migration from the bedrock aquifer. The upper glacial aquifer is very localized and undefined (See Appendix A: Map 2). Flow in the glacial aquifers is irregular; during periods of high recharge flow may converge in the LL and LTR sites from the surrounding area but flow may also occur in other directions. Standing water at the LL site and nearby wetlands indicates that the upper and possibly the lower aquifer penetrate the surface at many locations near the LTR.10 Flow in the bedrock aquifer under the LTR site is from a "groundwater ridge" east of the site. Flow of the bedrock aquifer is to north and west toward the Branch River. Flow of the bedrock aquifer may also possibly be to the southwest.11 Flow of the sandstone aquifer appears to be generally to the east.

B. Site Visit

On September 15, 1988, a representative from DOH met with two representatives of the WDNR Lake Michigan District at the LL and LTR sites. The DOH representatives noted leachate seeps, stained soil and vegetation and uncovered refuse in the eastern portion of the LL site.
On April 19, 1991, representatives from DOH and WDNR visited the LL and LTR sites. The LTR site is an unfenced area on the corner of Hempton Lake and Sunny Slope Roads. The eastern portion of the site is flat while the western portion slopes downward toward the Branch River. The site was vegetated primarily with grasses although we observed many patches of bare ground throughout the site. Standing water was observed in the western portion of the site and in the wetland across Sunny Slope Road to the north. Trees along Sunny Slope Road had been recently removed. DOH representatives visited the site again on May 13, 1992, and conditions had not changed since 1991.

The site is in an area primarily used for dairy farming. Hay fields and wetlands border the site and an active quarry is located approximately 500 feet southwest of the site boundary. One residence is located approximately 100 feet south of the boundary and four others are within 1,000 feet. The Ridgeview Landfill, approximately 1/4 mile north of the site, is an active waste disposal facility and during the time of our visit waste trucks arrived at a rate of approximately one per minute.

The area is not fenced and the borders of the site are not signed to prevent public access. In 1992, a nearby farmer was found to be tilling the land east of an in very close proximity to the site. A WDNR representative noted black fist-sized clumps of a charcoal-like material. The material appeared to be waste from a nearby smoke-flavoring producer.

C. Demographics, Land Use, and Natural Resource Use

The LTR site is located in an agricultural area approximately two miles northwest of the Village of Whitelaw, Wisconsin (pop. 741, 1988 est.). According to 1980 census data, 27% of the 200 people living within one mile of the site are under 14 years of age, and approximately 10% are over 65 years of age. 99.2% of these people are Caucasian and the median income is significantly above the national average. Most nearby residences are at farms.

Approximately fifty residences within one-half mile of the LTR site have private wells. Of these, eleven are hydraulically downgradient from the site. The Whitelaw water supply well is the closest municipal system to the LTR and LL sites.

The Branch River is used for canoeing and fishing. Water from the river is not used for irrigation or drinking within a three mile radius of the LL and LTR sites.

D. Health Outcome Data

"Health Outcome Data" refers to records of death and illness. When there is evidence that people living near a site have been exposed to contaminants at levels that could lead to an increase in rates of death or disease, a review of health outcome data may be appropriate. A review also may be appropriate if there are reports of unusual clusters of disease near the site or due to specific community health concerns. As discussed in the Pathways Analysis section, despite a completed exposure pathway in the past, there is no evidence of significant public exposure to chemicals from the site which might plausibly result in deaths or illness.
The Wisconsin Department of Health and Social Services, Division of Health, is not aware of any reports of clusters of chronic disease or cancers in the vicinity of this site.

State data available to study the health effects of this site include the Cancer Reporting System (CRS), the Hospital Discharge Database and birth certificates. The CRS lists the name and address of everyone in the state who has contracted cancer since 1978. The Hospital Discharge Database lists the zip code of the patient’s residence and a coded case identifier for all hospital discharges since 1989. The Hospital Discharge Database was not used in this assessment.

COMMUNITY HEALTH CONCERNS

Community concerns about the landfills first became evident in 1980 when Lemberger Landfill Inc. wanted to expand to the current Ridgeview site. Local residents formed a community group called "Concerned Citizens for the Town of Franklin" in an unsuccessful bid to block the expansion. The group has not been active since Waste Management Inc. began operating the Ridgeview Landfill in 1981.

In late 1984, residents of one farm northwest of the LTR site complained of stomach problems, nasal congestion, dry skin and frequent illness which they associated with consuming water from their well. Medical records obtained by the Division of Health indicate that one son was born in 1975 with a minor bone deformity. Analyses by WDNR in 1985 revealed that the water contained a number of VOCs. The family stated that the problems ceased when the well was replaced in 1985. The family also complained that an excessive number of animals on the farm were dying, were not growing at a normal rate, or did not produce milk. Goat and rabbit carcasses were analyzed by veterinarians at the Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP). One rabbit liver was found to contain 7.19 ppm lead (dry weight).

WDNR testing of 45 residential wells in February 1985 revealed VOC contamination in the wells of seven residences near the landfill site. Following notification of these results, 30 residents petitioned the Franklin Town Board to explore options for cleaning up the landfill. The board called a meeting in March 1985, which was attended by town officials, representatives of WDNR, DOH, WDATCP, USEPA and over 300 town residents. At the meeting one woman, whose well was contaminated, complained of burning sensations when she showered or bathed.

In September 1988, a representative of DOH met with local officials and health professionals to discuss their concerns about the Lemberger sites. In March, 1989, representatives of DOH, WDNR and USEPA met with 70 town residents prior to the initiation of Remedial Investigation (RI) activities for both the LL and LTR sites. In May, 1991, another meeting was held to discuss the results of the RI, health concerns, and options for remediation. This meeting was attended by approximately 70 residents who voiced concerns regarding the effects of contaminated drinking water in both people and livestock. No other organized
community activities have occurred to date. The Manitowoc County Health Department has not reported receiving any additional health complaints relating to the site.18

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

This section of the health assessment describes how "chemicals of concern" are distributed in soil, sediment, water, and biota in and near the site. "Chemicals of concern" are those that occur above a level where the maximum plausible exposure to the contaminated material might affect human health. This assessment addresses only those contaminants that the authors judge to be present at levels of concern. For chemicals suspected of causing cancer, a level of health concern refers to a concentration where a lifetime of exposure to the most contaminated material might result in a upper-level estimated risk of one cancer for every one million people exposed. The term "Comparison Values" appears in some tables and provides guidance in determining if a chemical poses a potential health concern. These values frequently differ from regulatory standards or health advisory levels. Following sections of this health assessment examine whether chemicals of concern do pose a significant threat to public health.

A. On-Site Contamination

This section discusses the chemicals that are present on the LTR property "on-site" and off the LTR property "off-site" at levels of health concern. A chemical is considered to be of health concern if concentrations are above a level that might affect human health and if people are likely to contact those chemicals now or in the future. In many cases, levels of health concern are not published standards. Health assessors use comparison values to decide whether chemicals are of health concern at a site. For cancer-causing chemicals (carcinogens), health concern exists when a lifetime exposure to the most contaminated material at a site might result in at least one additional cancer for every one million people exposed.
Table 1: Summary of On-site Sampling
Lemberger Transport and Recycling Landfill

<table>
<thead>
<tr>
<th>Medium</th>
<th>Date</th>
<th>Sampler</th>
<th>Parameters*</th>
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<td>Soils</td>
<td>1989</td>
<td>B&amp;V</td>
<td>VOC, SVOC, PCB, Pest., Metals</td>
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<tr>
<td></td>
<td>1992</td>
<td>B&amp;V</td>
<td>VOC, SVOC, PCB, Pest., Metals</td>
</tr>
<tr>
<td>Waste/Subwaste Soil</td>
<td>1992</td>
<td>B&amp;V</td>
<td>VOC, SVOC, PCB, Pest., Metals</td>
</tr>
<tr>
<td>Sediment</td>
<td>1989</td>
<td>B&amp;V</td>
<td>VOC, BEHP, Metals</td>
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<td>Surface Water</td>
<td>1989</td>
<td>B&amp;V</td>
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<tr>
<td></td>
<td>1989</td>
<td>B&amp;V</td>
<td>Metals</td>
</tr>
</tbody>
</table>

1 B&V Environmental Science and Technology Corp., under contract to USEPA.
2 Foth & Van Dyke Inc., under contract to Lemberger Landfills Inc.
3 Ecology and Environment, Inc., under contract to USEPA.
4 Soils Exploration Corporation, under contract to WDNR.

* See Appendix B for the list of compounds analyzed during the RI and for definitions of abbreviations.

Soils

Soil samples from up to one foot below the surface were collected at the LTR site as part of the RI in July 1989. One sample was collected on one from each of eight on-site locations. Two samples taken from one location were analyzed concurrently (duplicate samples). For each sample, the upper two inches of soil were removed over an area approximately two feet in diameter and additional soil was collected to a depth of one foot. On-site samples were collected in a grid pattern with spacings of approximately 400 feet in the eastern portion of the landfill.

Some polychlorinated dibenzofurans, polyaromatic hydrocarbons, phenol derivatives, aldrin and dieldrin were found at two sites in the central portion of the landfill. No contaminants of concern were detected in these soil samples at concentrations exceeding comparison values.19

Soil samples were also taken from greater depths as part of the remedial investigation in July 1989 from two locations, RB-3 and RB-4 (Appendix A: Map 3). Chemical analyses were performed on soil taken from both locations at 5-10 feet below the surface; at RB-3, an additional sample from 1-5 feet was analyzed and at RB-4, a sample taken from 10-12 feet was analyzed. Methylene chloride was at both locations but not at levels exceeding the comparison value. No other VOCs, SVOCs, or metals of concern were detected.20 In 1992, soil samples were taken from seven locations throughout the landfill. No contaminants were found in these samples at concentrations exceeding soil comparison values.21
Waste/Subwaste Soil

Waste and subwaste soil from under 2 feet below the surface was analyzed in 1992 from six locations throughout the landfill. Liquid-filled drums were encountered at two of these locations (TP-12 and TP-13) but their contents were not analyzed. Both waste and subwaste samples contained a number of solvents and pesticides which were also found in groundwater (Table 2) including 1,2-dichloroethylene and trichloroethylene. Toluene and xylenes were also found. The most heavily contaminated waste is from TP-5 in the central portion of the landfill (Appendix A, Map3).

Surface Water

Three surface water samples were taken from the LTR site in July 1989 and April 1990 as part of the RI: one from the northwest portion and two along the northern border. Surface water at these sites indicates penetration of the surface by the upper glacial aquifer which does not flow in defined directions. No metals were found in these samples at concentrations exceeding drinking water comparison values, and no VOCs or SVOCs were detected.

Sediment

Sediment samples were taken from the same locations as the surface water samples, also in July 1989 and April 1990. No VOCs or SVOCs were detected in this sample, and no metals were present at concentrations exceeding soil comparison values.

Groundwater

Prior to initiation of the RI in 1989, groundwater was sampled from six monitoring wells throughout the LTR site on three occasions (Table 1). All of these wells are screened into the dolomite aquifer between 64 and 81 feet deep. During the RI, the same wells were sampled on one more occasion in August 1989. In addition, during the RI, one new monitoring well cluster consisting of one well in the upper glacial aquifer (11.5 feet deep), one in the upper portion of the bedrock aquifer (45.8 feet) and one deeper (108.2 feet deep), was installed and sampled in the northern portion of the site (not an area of waste disposal; see Appendix A: Map 3).

The one well screened in the upper glacial aquifer contained 1,2-dichloroethane (140 μg/L; comparison value, 0.058 μg/L). No other VOCs, SVOCs, or metals were found in this well at concentrations exceeding comparison values. Groundwater monitoring results from the six existing monitoring wells and the newly installed wells in the bedrock aquifer are summarized in Table 2.
Table 2: Chemicals of Potential Health Concern
On-Site Bedrock Aquifer
Lemberger Transport and Recycling Landfill
(All concentrations are in µg/L)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Maximum Concentrations</th>
<th>Comparison Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-RI</td>
<td>RI</td>
</tr>
<tr>
<td>VOC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td>30</td>
<td>ND</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>340</td>
<td>2,200</td>
</tr>
<tr>
<td>Total 1,2-dichloroethylene</td>
<td>2,093</td>
<td>2,600</td>
</tr>
<tr>
<td>Chloroethane</td>
<td>4,368</td>
<td>4,300</td>
</tr>
<tr>
<td>1,1-Dichloroethylene</td>
<td>336</td>
<td>200</td>
</tr>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>3,513</td>
<td>2,700</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>1,728</td>
<td>330</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>8</td>
<td>ND</td>
</tr>
<tr>
<td>SVOC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bis(2-ethylhexyl)phthalate</td>
<td>NA</td>
<td>140</td>
</tr>
<tr>
<td>Pesticides/PCB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lindane</td>
<td>NA</td>
<td>0.47</td>
</tr>
<tr>
<td>Aldrin</td>
<td>NA</td>
<td>0.46</td>
</tr>
</tbody>
</table>

<sup>1</sup> Pre-RI results are from F&VD (1982), WDNR (1984) and SEC (1985).
<sup>2</sup> ND: Not detected; NA: Not Analyzed
<sup>3</sup> Compound detected in blank.
<sup>4</sup> ATSDR Environmental Media Evaluation Guide
<sup>5</sup> USEPA Lifetime Health Advisory
<sup>6</sup> USEPA 10<sup>6</sup> Cancer Risk Level
<sup>7</sup> USEPA Maximum Contaminant Level
<sup>8</sup> USEPA Child Longer Term Health Advisory

Source: Remedial Investigation Report, Tables 1-6, 1-15 and 4-8 to 4-11.

In general, the highest VOC concentrations were detected in monitoring well OW-2B in the central portion of the landfill. This well is 65 feet deep and extends into the bedrock aquifer. Most VOCs, SVOCs, and pesticides were found in samples taken from throughout the landfill area.

A. Off-site contamination

Groundwater

Private Wells

Forty-five residential wells within one-half mile of the LL, LTR and Ridgeview sites were analyzed by WDNR for VOC contamination between 1984 and 1988.<sup>22</sup> These analyses were performed in response to complaints from residents about well water quality. One or more VOCs were detected in six wells north of the LTR site (between the site and the Branch River) and one south of the LTR site (see Appendix
A: Map 5 and Table 4). The wells are located between one-quarter and one-half mile from the site boundaries. Of the six wells north of the site, three extend into the bedrock and three into the lower glacial aquifer. The southern well extends into bedrock and contained trichloroethylene. Wells with contaminants were subsequently replaced with deeper wells by WDNR. No temporal trends are evident since wells were abandoned after contaminants were detected. A summary of the WDNR well monitoring results is presented in Table 3.

### Table 3: Contaminants of Concern
Residential Wells, 1984-1987
Lemberger Transport & Recycling Landfill
(All concentrations in \(\mu g/L\))

<table>
<thead>
<tr>
<th>Compound</th>
<th>Concentration by Well Number, Location/Depth</th>
<th>Comparison Value</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8, N/U           9, N/U           10, N/B          11, N/B          12, N/B          17, N/U          30, S/B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1-Dichloroethylene</td>
<td>ND              2               7               1               12              27              26</td>
<td>0.06(^a)</td>
<td>7</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>ND              2               2               ND              5               3               3</td>
<td>-</td>
<td>850</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>ND              3               13              3               24              29              8</td>
<td>0.38(^a)</td>
<td>5</td>
</tr>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>ND              ND             29              9               56              54              43</td>
<td>200(^a)</td>
<td>200</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>ND              2               7               3               15              12              20</td>
<td>5(^a)</td>
<td>5</td>
</tr>
<tr>
<td>Chloroform</td>
<td>ND              ND             ND              ND              2               ND              ND</td>
<td>5.7(^a)</td>
<td>6</td>
</tr>
</tbody>
</table>

1. Location of the highest concentration detected: N=north of the LTR site, S=south, etc.
   Depth: U=screened into the unconsolidated aquifer, B=into bedrock
2. Wisconsin Groundwater Enforcement Standard
3. U.S. Environmental Protection Agency 10*-Cancer Risk Level
4. U.S. Environmental Protection Agency Reference Dose
5. U.S. Environmental Protection Agency Maximum Contaminant Level

In January, 1989, WDNR collected samples from fifteen residential wells in the vicinity of the LL and LTR sites and one hand pump located approximately 1000 feet west of the site to the Wisconsin State Laboratory of Hygiene for VOC analysis.\(^2\) Seven of these wells and the hand pump were sampled for inorganics.\(^2\) No VOCs or metals were found in any of the residential wells tested above background levels. However, the irrigation hand pump (a pit well) located on a farm southwest of the LL site was found to contain lead (120 \(\mu g/L\)), arsenic (40 \(\mu g/L\)), cadmium (9.0 \(\mu g/L\)), 1,1,1-trichloroethane (2.9 \(\mu g/L\)) and 1,1-dichloroethane (1.6 \(\mu g/L\)). Lead was found at a maximum of 6.9 \(\mu g/L\) in subsequent analyses of the well by WDNR in April and May, 1989 and USEPA in Dec. 1989 and Dec. 1990. These results, in addition to other information provided to WDNR, indicated that a gasoline tank recently removed from the pit and not the LTR site may have been the source of the high metal concentrations.\(^2\)
As part of the RI, ten residential wells were sampled twice for VOCs, SVOCs, and inorganic chemicals (see Appendix A: Map 4) during August and December 1989. Six of these wells are located north and west of the site between the site and the Branch River (one of which was a replacement for a previously contaminated well), two wells are to the south, and two are to the east. Three of these wells are screened into bedrock and no screening information is available for the remaining wells. Phenol was found in all samples (maximum concentration 3 μg/L), and 1,1-dichloroethane (estimated conc. 0.8 μg/L) and 1,1,1-trichloroethane (1 μg/L) in one sample each. BEHP was found in five samples from wells during round 1 (max. conc. 30 μg/L) but not in the same samples during round 2.  

Due to the high concentrations of BEHP found during the RI, DOH sent samples from five residential wells in the vicinity of the LL and LTR sites and the one irrigation pump located approximately 1000 feet west of the site to the Wisconsin State Laboratory of Hygiene in 1991 for BEHP analysis. No BEHP was found in any of these wells at that time.

Monitoring Wells

Eight new monitoring well clusters (three wells in each cluster) were installed during the RI in the vicinity of the Lemberger sites. These wells were sampled in August and December 1989 for the same VOCs, SVOCs, and metals as the soil and leachate. Each cluster consists of one well in the upper portion of the unconsolidated aquifer, one in the lower portion and one in bedrock. One of these wells is in the northern portion of the LL site, four north of the LL site between the site and the Branch River, one to the west, two south of the LTR site and one to the east (see Appendix A: Map 4). The only contaminant found at a concentration above a comparison value in these wells was trichloroethylene (22 μg/L, USEPA Maximum Contaminant Level, 5 μg/L), which was found in a well drilled into bedrock south of the site. Four other VOC, including 1,1-dichloroethylene and 1,1,1-trichloroethylene, and one SVOC were also found in one or more of these wells.

Surface Water

Surface water was sampled in July 1989 and April 1990 from two locations approximately 1000 and 2000 feet west of the LL site boundary, from one location about 50 feet north of the LTR site boundary, and one location in a tributary of the Branch River. Acetone, methylene chloride and two phthalates were detected in the sample taken from 2000 feet west of the LL site and in the tributary of the Branch River in April 1990, but these compounds are common laboratory contaminants, and the levels found were below comparison values. No contaminants were found in the other surface water samples.
Sediment samples were taken from the same locations as the surface water samples and the same times. The sample taken from about 1000 feet west of the LL site in July 1989 contained a number of VOC and SVOC. However, these compounds were found in only one of two samples taken from that location and concentrations were not of health concern. No VOCs or SVOCs were found at the other locations nor were metals found at concentrations above comparison values.²⁸

C. Toxic Chemical Release Inventory

A Toxic Chemical Release Inventory (TRI) search was conducted by the Division of Health for the Whitelaw, Wisconsin, zip code (54247). The TRI is searched in order to investigate any other sources of the same type of environmental contamination as that found on the Superfund site. Certain manufacturers are required to report to the U.S. EPA of releases to the environment of over 300 hazardous chemicals. This reported information is entered into the automated TRI system.

A TRI search of Whitelaw for the years 1987-1990 did not reveal any facilities releasing the chemicals of concern at this site.

D. Quality Assurance and Quality Control

Quality assurance/quality control (QA/QC) in the RI was provided by USEPA Region V Central Regional Laboratory. These QA/QC procedures consisted of a review of the sampling holding times, instrument calibration and detection limits, adequate blanks and contaminants identifiable in blanks.²⁹ Some of the results in the RI are difficult to interpret due to laboratory problems. Similar concentrations of arsenic and chloroform were detected in many of the residential well samples but also in the trip and sample blanks, and lead was detected at similar concentrations in both leachate samples and blanks. Thus, arsenic and chloroform cannot be considered to be contaminants in residential well samples nor can lead be considered to be present in leachate samples.

Locations of groundwater contamination are consistent between the remedial investigation and two previous reports. This consistency indicates that any differences between them are not necessarily due to differences in laboratory techniques. One possible explanation is that the contaminants have moved between the time these investigations were performed.

E. Physical and Other Hazards

No physical hazards were noted on the LTR site during any of the site visits. Methane production is unlikely because: (1) the site was not used to dispose of municipal waste, (2) the site has been inactive for 15 years, and (3) the site is not properly capped.
PATHWAYS ANALYSES

People may be exposed to the chemicals of concern in a number of ways. The pathways analysis examines five elements: the source of the chemicals, where they are found (soil, water, air), the ways the chemicals may move from the site, ways by which people could be exposed to the chemicals (touch, ingestion, inhalation), and the groups of people that might be exposed.

Pathways are referred to as completed, potential or eliminated. A completed pathway is one in which there is a clear indication that people were exposed to chemicals from the site and when there is sufficient information to evaluate that exposure. All five of the elements must exist for a completed pathway to exist (a description of these five elements is found in Appendix A: Map 2). Completed pathways include exposures that occurred in the past and current exposures.

A potential pathway exists when there is insufficient information to link a chemical to a known level of exposure among an identified population. A potential pathway may refer to a past, present or future exposure. An exposure pathway can be eliminated if the five elements are missing and will never be present.

A. Completed Human Exposure Pathways

Residential Drinking Water

Exposure to site-related contaminants has occurred via drinking water in the past, but no present drinking water exposure pathways have been identified since all nearby wells are presently free of contaminants. In the past, seven residential wells located near the LTR site contained a number of VOCs from between 1970 at the earliest and 1987 at the latest. Six of the seven wells are in homes north of both sites, between the sites and the Branch River. Since flow in the glacial aquifer is irregular, whether the contaminants in the northern wells originated from the LL or LTR sites cannot be determined. However, groundwater flow patterns in the area indicate that contamination in the well to the south probably resulted from transport from the LTR site.

Since the average number of persons per household in the Whitelaw zip code is 3.1, approximately 19 people used contaminated groundwater during this time. The possibility that other wells in the area were contaminated prior to 1985 but uncontaminated in 1985 is remote since contaminant release from the landfill appears to be continuous.

Most VOCs evaporate quickly and are fat soluble; therefore, exposure occurred through ingestion, inhalation and dermal absorption. Inhalation exposure to VOCs evaporating from drinking water can be roughly estimated to equal ingestion exposure.
The chemicals to which the individuals were exposed, the number of people affected and the estimated maximum daily ingestion and inhalation doses from ingesting each chemical are listed in Table 5. Indoor air contaminant concentrations were not been measured in homes with contaminated water so inhalation doses cannot be estimated. In addition, there is currently no widely accepted method for calculating dermal exposures.

As described in the "Background" section, flow of the bedrock aquifer is generally to the north and west. At present, of the wells screened into bedrock, the eleven located north and west of the site (between the site and the Branch River) are in the path of groundwater flow and are possibly most susceptible to site-related contamination. Nine of these eleven wells have been sampled since 1985 (see Appendix A: Map 5). These nine wells, which were sampled in 1989, 1990 and 1991, did not contain VOCs, metals or BEHP at those times.

Exposure to site-related contaminants via groundwater is probably not occurring in homes south and east of the site or on the other side of the Branch River since these areas are not in the path of groundwater flow. Ten of these wells were sampled in 1989, 1990 and 1991. No VOCs, SVOCs, or metals were found in these wells at concentrations above comparison values.

**B. Potential Exposure Pathways**

**Residential Drinking Water**

Since no nearby residential wells are presently contaminated, residential drinking water is not an exposure pathway at present. However, if the site is left unremediating, contaminants present at the site could migrate to off-site residences and contaminate nearby wells in the future. The eleven wells located between the site and the Branch River are the most susceptible to contamination. Since some contaminants from the unconsolidated aquifer have entered the fractured bedrock, similar flow of other contaminants is possible. Under one "worst-case scenario," contaminants at concentrations present in well OW-2B may flow into the bedrock aquifer and migrate to one or more off-site wells to the west. Contaminants present in waste may also migrate to groundwater.

During past sampling episodes, groundwater under the LTR site was found to contain a number of VOCs, SVOCs, and metals at concentrations exceeding present Wisconsin Groundwater Enforcement Standards (see Table 2). The one well in the unconsolidated aquifer contained 1,2-dichloroethane; other VOCs were found in the bedrock aquifer throughout the site.

At present, 45 homes with private wells are located within the RI study area, roughly within one-half mile of the LTR site boundaries (see Appendix A: Map 5). Of these, two extend into the upper aquifer, 20 extend into bedrock, and information is not available for 23 others. As described above, eleven wells extending into bedrock are
located between the LTR site and the Branch River and may be most susceptible to site-related contamination. No metals or VOCs were detected in the nine of these wells sampled between 1989 and 1991.

Individuals whose water contains volatile organic compounds may be exposed through ingestion, inhalation or dermal absorption. The risks associated with ingesting or inhaling this water are summarized in the "Public Health Implications: Potential Completed Exposure Pathways" section.

The Whitelaw water supply well is approximately two miles southeast of the site and is not in the path of groundwater flow. The well is cased into bedrock to a depth of 130 feet and is drilled to 450 feet.

Desorption from waste into groundwater is probably occurring since groundwater under the site contains a number of solvents. However, the available data are not sufficient for identifying specific areas from which contaminant transport is occurring. Two subsurface soil samples were taken at the LL site, and both were taken from the western portion of the landfill in an area where only small amounts of waste, if any, were deposited. Results from analysis of these samples did not indicate any site-related contaminants at concentrations of concern.

Remediation Workers

Remediation of the site could cause any volatile chemicals present in the waste to be volatilized and workers at the site could inhale these contaminants. Since waste at the site has not been characterized, this exposure pathway cannot be evaluated.

PUBLIC HEALTH IMPLICATIONS

This section discusses the health effects associated with exposure to chemicals which were found at this Superfund site, the health data bases available to do long-term health studies, and the community's health concerns about the site. One resource are the ATSDR-developed Minimal Risk Levels (or MRLs) for chemicals found at the site. Other resources, also developed by ATSDR, are the Toxicological Profiles on specific chemicals. These profiles provide information on health effects, environmental transport, human exposure, and regulatory status.

A. Toxicological Evaluation

As described in "Pathways Analyses" above, approximately 19 people were exposed to VOCs via drinking water for up to 17 years. Due to the presence of 1,1-dichloroethylene and 1,2-dichloroethane, these individuals have a low increased cancer risk. In addition, inhalation of solvents may be associated with short-term nonspecific health effects such as headaches and stomach disturbances. The potential health effects of contaminants found in drinking water are discussed in the "Past Completed Exposures" section.
Under a "worst-case scenario," contaminants found in Well OW-2B in the bedrock aquifer could migrate to one or more off-site wells. The health impacts of this scenario are discussed in the "Potential Future Exposures" section.

**Past Completed Exposures**

1,1-Dichloroethylene

Approximately 19 individuals living near the LTR site consumed 1,1-dichloroethylene at a maximum concentration of 27 µg/L for up to 17 years. The Environmental Protection Agency classifies 1,1-dichloroethylene as an possible (class "C") human carcinogen. The basis for this classification is that kidney tumors were observed in one strain of mice upon inhalation exposure. Based upon this study, estimates of cancer risk associated with specific ingestion and inhalation doses have been published. Use of these estimates indicates a low excess cancer risk for individuals living near the site who may have ingested and inhaled water containing this compound (Table 5).

**Table 5: Estimated Maximum Exposures of Residents Using Contaminated Well Water Originating from the Lemberger Landfills 1970 to 1987**

(Doses are µg/day per person)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Estimated Number of People Exposed*</th>
<th>Maximum Inhalation/Ingestion Dose**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroform</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>1,1-Dichloroethylene</td>
<td>19</td>
<td>108</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>19</td>
<td>106</td>
</tr>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>19</td>
<td>224</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>19</td>
<td>112</td>
</tr>
</tbody>
</table>

* Estimated by multiplying the number of households (in which the chemical was detected) by 3.1 persons/household.

** Estimated by multiplying the water concentration by 2 Liters per day and the resulting amount was doubled to account for inhalation (see text).

1,1-Dichloroethane

Approximately 16 individuals living near the LTR site consumed 1,1-dichloroethane at a maximum concentration of 5.2 µg/L for up to 17 years. The Environmental Protection Agency has classified 1,1-dichloroethane as a "possible human carcinogen"
but no quantitative estimates of carcinogenicity are presently available. Consumption of this compound at 5.2 μg/L is equivalent to 0.15 μg/kg/day. No health effects are expected to result from consumption of this compound at this concentration since no this concentration is lower than the MRL for any other chlorinated solvent.\textsuperscript{32}

1,2-Dichloroethane

Approximately 19 individuals living near the LTR site consumed 1,2-dichloroethane at a maximum concentration of 29 μg/L for up to 17 years. The Environmental Protection Agency classifies 1,2-dichloroethane as a probable (class "B2") human carcinogen and the U.S. Department of Health and Human Services (DHHS) classification of the chemical states it is "Reasonably Anticipated to be a Carcinogen." Tumors have been noted in animals at multiple sites following oral exposure. Exposure to water at the highest concentration found near the LTR site for 17 years would be associated with a low increased cancer risk (Table 5). Immunological abnormalities were also noted in mice consuming much higher amounts of the compound than those obtained from drinking water near the LTR site but the relevance of these effects for human exposure and whether they could occur in humans is not known. This concentration is equivalent to 0.8 μg/kg/day, a level at which no other health effects would be expected.\textsuperscript{33}

1,1,1-Trichloroethane

Approximately 19 individuals living near the LTR site consumed 1,1,1-trichloroethane at a maximum concentration of 56 μg/L for up to 17 years. Neither the Environmental Protection Agency nor DHHS has classified the carcinogenicity of 1,1,1-trichloroethane. Those ingesting and inhaling the compound may have an increased risk of developmental problems since exposure to the compound was associated with birth abnormalities in both an animal study and in an epidemiologic study with concentrations similar to those found near the LTR site. No other health effects are expected since the ingested doses are below the MRL for any other chlorinated VOC.\textsuperscript{34}

Trichloroethylene

Approximately 19 individuals living near the LTR site consumed trichloroethylene at a maximum concentration of 20 μg/L for up to 17 years. The Environmental Protection Agency has withdrawn its former classification of trichloroethylene as a probable human (class "B2") carcinogen while the agency is reviewing additional data. Those whose water was contaminated with trichloroethylene may be at an increased risk of cancer development since oral exposure to the compound caused increases in liver cancer (hepatocellular carcinomas) in mice. Other health effects of chronic oral exposure have not been studied, although one recent human epidemiologic study suggested that consumption of contaminated drinking water at a level comparable to that found in residential wells near the LTR site is associated with increased incidence of birth abnormalities (see Health Outcome Data Evaluation.
However, this conclusion remains controversial since extensive studies in lab animals show that TCE may decrease fetal body weight but does not cause birth defects at concentrations toxic to the mother.\textsuperscript{35}

**Potential Future Exposures**

**Trans-1,2-Dichloroethylene**

The Environmental Protection Agency has not classified the carcinogenicity of trans-1,2-dichloroethylene. In animals, inhalation exposure has been associated with liver damage and changes in blood enzymes and cytology and this effect may occur in humans exposed to the compound at the concentration occurring in OW-2B.\textsuperscript{36}

**Chloroethane**

The U.S. Environmental Protection Agency has not classified the carcinogenicity of chloroethane. The effects of chloroethane ingestion have not been studied. The Wisconsin Groundwater Standard of 400 \( \mu g/L \) is based upon acute effects in animals which are unlikely at the concentration found in Monitoring Well OW-2B. Chronic effects of chloroethane exposure are not known.\textsuperscript{37}

**Tetrachloroethylene**

The Environmental Protection Agency is reevaluating its carcinogenicity classification of tetrachloroethylene. DHHS categorizes tetrachloroethylene as "reasonably anticipated to be a carcinogen." Ingesting or inhaling tetrachloroethylene may cause cancer in humans because such exposures to laboratory animals cause cancer of the liver and kidney. There are only limited data linking exposure with cancer in humans. A low excess cancer risk would be expected from lifetime exposure to the concentration found in OW-2B. No other health risks would be expected.\textsuperscript{38}

**Bis(2-ethylhexyl)phthalate (BEHP)**

The Environmental Protection Agency classifies BEHP as a probable human (class "B2") carcinogen. Long-term BEHP exposure causes cancer of the liver in rodents but no human data is available. As a component of many types of food packaging, BEHP is also present in the diet. As a result, humans consume approximately 0.27 mg of BEHP per day from food and water. BEHP is also a common laboratory contaminant. Consuming water at the maximum concentration of BEHP found in OW-5 would approximately double an individual's BEHP intake. Such an exposure over a lifetime would be associated with a low increased cancer risk. No other health effects would be expected from such an exposure.\textsuperscript{39}
Lindane [gamma-hexachlorocyclohexane]

The Environmental Protection Agency carcinogenicity classification of lindane is under review but the weight of evidence supports classification as a possible or probable human carcinogen. As a result of the review, no quantitative risk assessment is presently available for lindane. Long-term administration of lindane has been reported to cause liver cancer and other liver and kidney damage in rats. Consuming lindane at the maximum concentration found in well OW-4 for a lifetime may be associated with a low increased risk of cancer or other liver or kidney damage. Since the concentration found in well OW-4 is below the EPA Lifetime Health Advisory, no other health effects would be expected.40

Aldrin

The Environmental Protection Agency classifies aldrin as a probable human (class "B2") carcinogen. Long-term administration of aldrin has been reported to cause liver cancer in mice. Consuming aldrin at the maximum concentration found in well OW-4 for a lifetime would be associated with a low increased risk of cancer. No other health effects would be expected.41

B. Health Outcome Data Evaluation

"Health outcome data" is a phrase referring to records of death and disease. When there is evidence that people near a site have been exposed to contaminants at levels that could lead to an increase in rates of death or disease, a review of health outcome data may be appropriate. A review also may be appropriate if there are reports of unusual clusters of diseases near a site.

Although exposure to a number of VOCs has occurred, DOH is not aware of any reports of clusters of chronic disease near this site. Based on existing data, levels of exposure are too low and the numbers of people exposed are too small to initiate any studies of tumor incidence or of liver or kidney abnormalities. However, if subsequent testing reveals contamination in any of the wells screened into the upper aquifer, a study of cancer or liver or kidney abnormalities may be appropriate.

Two recent studies indicate that consuming trichloroethylene (TCE)-contaminated water might be associated with congenital cardiac malformations. In the first study, infants of mothers exposed to TCE-contaminated water during the first trimester of pregnancy were significantly more likely to have a congenital heart disease than did infants from mothers with first-trimester exposure to uncontaminated water.42 In the second study, which was performed in rats, a dose-dependent relation between fetal exposure to TCE and dichloroethylene and various congenital cardiac defects was noted.43 Another study indicates a similar effect from consumption of 1,1,1-trichloroethane.

Consequently, the Division of Health surveyed births to families living near the LTR site to determine if such defects were associated with the presence of contaminants in drinking water.
wells. Between 1975 and 1985, nine births occurred among families with contaminated wells. Birth weights were in a normal range and one of these births was diagnosed with a congenital anomaly. The number of births and anomalies is too small to make any conclusions about associations between exposure to TCE and adverse birth outcomes.

As explained in the Toxicological Evaluation section, ingestion of many of the compounds found in the water of homes near the LTR site is also associated with excess cancer risks. The magnitude of the risk is too small to detect excess cancer incidence among the exposed population. Therefore, no analysis of cancer rates among exposed individuals is anticipated.

C. Community Health Concerns Evaluation

Health concerns have been expressed by one family with a contaminated well (see "Community Health Concerns" above) who had nonspecific health complaints such as headaches, stomach problems and dry skin. These effects are unlikely to be associated with the low concentrations found in the family's well. The concentration of 1,2-dichloroethane found in the family's well is unlikely to be associated with immunological abnormalities. In addition, the concentration was too low to result in abnormally frequent illnesses in the family. The landfill began operations at approximately the same time as the birth of the child the bone abnormality. Therefore, solvent exposure is unlikely as a cause for this congenital defect.

No records on livestock production at the farm where complaints occurred is presently available. Therefore, potential reasons for the alleged decreased production cannot be evaluated.

In 1991 and 1992, a number of local residents expressed health concerns related to the Lemberger sites to the local public health agency. The public health agency has provided these individuals with Division of Health fact sheets and the names of contact people from whom they can get more information.

This health assessment was released on May 21, 1993 and public comments were solicited until June 21, 1993. One public comment was received during this period (Appendix D).
CONCLUSIONS

The site represents a public health hazard in the past because nearby residents were exposed to groundwater carrying contamination from the site. These past exposures to chemicals in groundwater may be associated with a low excess cancer risk because VOCs from the site migrated into groundwater and were consumed by approximately 19 nearby residents for an approximately 17 year period ending in approximately 1987. One nearby family expressed worry that contamination of their well was the cause of health problems they were experiencing and might be affecting their livestock, but their reported health effects are not known to be associated with low levels of contamination found in their well.

Presently some nearby residential wells are contaminated with low levels of VOCs and SVOCs, though these are not at levels of health concern. Therefore, the site currently poses no apparent public health hazard. Some community members remain concerned that the site may be affecting their health. No community concerns have been raised about livestock since 1985.

However, if the site is left unremediated, contaminants located in waste and groundwater on the site may migrate off-site and individuals may be exposed to these compounds in the future. Therefore, the site presents a potential public health hazard in the future. Waste at the site has not been analyzed so the magnitude of this future hazard cannot be determined.

RECOMMENDATIONS

1. Nearby residential wells, and off-site and on-site monitoring should continue to be monitored for VOCs, SVOCs, and metals at appropriate intervals.

2. The perimeter of the site should be marked so that nearby residents know the area which should not be tilled.

3. Names, addresses and telephone numbers of DNR and DOH personnel familiar with the site should be provided to local residents.

A. Need for Follow-Up Health Activities

The ATSDR Health Activities Recommendation Panel and the Wisconsin Division of Health evaluated the data on this site to determine what needs exist for additional research and/or local education about health related concerns. Such activities could include further studies on cases of disease in the vicinity of the site or providing residents with additional information about the health effects of exposures to specific toxic chemicals coming from the site.

Some people living near the site were exposed to contaminants in groundwater and there is evidence that these people have a low increased cancer risk. The risk is too low to detect
any increase in cancer incidence among the 19 individuals exposed. Therefore, no more studies of the site’s impact on public health are needed now. Community health education is indicated for those who consumed water containing VOCs. These individuals should be informed of the magnitude of their excess cancer risks and the possibility for liver or kidney abnormalities.

In addition, DOH and ATSDR will evaluate the need for more health activities if levels of groundwater contamination increases or if new information reveals that public exposure to contamination from the site is greater than expected.

B. Public Health Action

The DOH, in cooperation with ATSDR, will conduct the following activities to respond to the recommendations of this assessment:

1. Provide continuing public health education as new information related to public health issues becomes available. A public meeting has been scheduled for October 1992 at which a DOH representative will record and respond to public health concerns;

2. Continue to solicit the health concerns about the site of Manitowoc County citizens, directly and through the DNR, local public health agencies, and during public meetings;

3. Review and comment on public health aspects of sampling and subsequent activities to be done pursuant to the Record of Decision, after the lead agency overseeing the investigation provides copies of the plans to the DOH;

4. Advise and consult with the Wisconsin Department of Natural Resources and the EPA on public health concerns that may arise as new information about the site becomes available.

5. The local public health agency will post the names and addresses of DOH and WDNR personnel who will answer questions about the site in easily accessible locations.
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CERTIFICATION

The Lemberger Transport and Recycling Landfill public health assessment was prepared by the Wisconsin Division of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun.

[Signature]
Technical Project Officer, SPS, RPB, DHAC

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with the findings.

[Signature]
Director, DHAC, ATSDR
REFERENCES

1. Wisconsin Department of Health and Social Services. 1992. Health Assessment, Lemberger Landfill, Manitowoc County, WI. Madison, WI.


3. Remedial Investigation Report, p. 3-1.


20. Remedial Investigation Report, Figure 2-3 and Table 4-5.


27. Remedial Investigation Report, Tables 4-22 to 4-24.

28. Remedial Investigation Report, Tables 4-29 to 4-21.


APPENDIX A: Figures

Map 1: General Site Map, Lemberger Transport and Recycling.
APPENDIX A: Figures (continued)


[Map showing approximate site boundary, limits of waste disposal, and plowed area as of May, 1992.]
APPENDIX A: Figures (continued)

APPENDIX A: Figures (continued)

Map 4: Soil Sampling Locations, Lemberger Transport and Recycling.

Legend
- Surface Soil Sampling Locations
- Subsurface Soil Sampling Locations (RI, 1989)
- Waste Sampling Locations (1992)
APPENDIX A: FIGURES

MAP 5: PRIVATE WELL SAMPLING LOCATIONS
HAS BEEN REDACTED – ONE PAGE

CONTAINS POTENTIAL PERSONALLY-IDENTIFYING INFORMATION
APPENDIX B: Chemical List

Compounds Analyzed for in Groundwater During the Remedial Investigation

<table>
<thead>
<tr>
<th>VOC (Volatile Organic Compounds)</th>
<th>SVOC (Semivolatile Organic Compounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloromethane</td>
<td>Phenol</td>
</tr>
<tr>
<td>Bromomethane</td>
<td>bis(2-Chloroethyl)Ether</td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td>2-Chlorophenol</td>
</tr>
<tr>
<td>Chloroethane</td>
<td>1,3-Dichlorobenzene</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>1,4-Dichlorobenzene</td>
</tr>
<tr>
<td>Acetone</td>
<td>Benzyl Alcohol</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>1,2-Dichlorobenzene</td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td>2-Methylphenol</td>
</tr>
<tr>
<td>1,2-Dichloroethene (total)</td>
<td>bis(2-chloroisopropyl)Ether</td>
</tr>
<tr>
<td>Chloroform</td>
<td>4-Methylphenol</td>
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<tr>
<td>1,2-Dichloroethane</td>
<td>n-Nitroso-di-n-propylamine</td>
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<tr>
<td>2-Butanone (MEK)</td>
<td>Hexachloroethane</td>
</tr>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>Nitrobenzene</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>Isophorone</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>2-Nitrophenol</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td>2,3-Dimethylphenol</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>Benzoic Acid</td>
</tr>
<tr>
<td>cis-1,3-Dichloropropene</td>
<td>bis(2-Chloroethoxy)Methane</td>
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<tr>
<td>Trichloroethene</td>
<td>2,3-Dichlorophenol</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
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<td>1,1,2-Trichloroethane</td>
<td>Naphthalene</td>
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<tr>
<td>Benzene</td>
<td>4-Chloroaniline</td>
</tr>
<tr>
<td>trans-1,2-Dichloropropene</td>
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<tr>
<td>Bromoform</td>
<td>4-Chloro-3-Methylphenol</td>
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<tr>
<td>4-Methyl-2-Pentanone</td>
<td>2-Methylnaphthalene</td>
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<tr>
<td>2-Hexanone</td>
<td>Hexachlorocyclopentadiene</td>
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<tr>
<td>Tetrachloroethene</td>
<td>2,4,6-Trichlorophenol</td>
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<td>1,1,2,2-Tetrachloroethane</td>
<td>2-Chloronaphthalene</td>
</tr>
<tr>
<td>Toluene</td>
<td>2-Nitroaniline</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>Dimethyl Phthalate</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>Acenaphthylene</td>
</tr>
<tr>
<td>Styrene</td>
<td>2,6-Dinitrotoluene</td>
</tr>
<tr>
<td>Xylene (total)</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B: Chemical List (continued)

Pesticide/PCB (Polychlorinated Biphenyls)
- Alpha-BHC
- Beta-BHC
- Delta-BHC
- Lindane
- Heptachlor
- Aldrin
- Heptachlor Epoxide
- Endosulfan I
- Dieldrin
- 4,4'-DDE
- Endrin
- Endosulfan II
- 4,4'-DDD
- Endosulfan Sulfate
- 4,4'-DDT
- Methoxychlor
- Endrin Ketone
- Alpha-Chlordane
- Gamma-Chlordane
- Toxaphene
- Aroclor-1016
- Aroclor-1221
- Aroclor-1232
- Aroclor-1242
- Aroclor-1248
- Aroclor-1254
- Aroclor-1260

Metals and Cyanide (continued)
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc
- Cyanide

Indicators
- pH
- Conductance
- Odor
- Color
- Turbidity
- Chemical Oxygen Demand
- Dissolved Iron
- Hardness
- Alkalinity
- Chloride
- Boron
- Sulfates
APPENDIX C: Pathways Evaluation

Pathways are evaluated to determine whether nearby residents have been exposed to contaminants originating from the site. A pathway is a route along which contaminants can move away from a site and enter the bodies of people living nearby. There are five elements in a completed pathway:

1) **Contaminant Source**: The place where contaminants entering the environment are coming from.

2) **Media**: a media that the contamination is found in (soil, sediment, groundwater, air, surface water, fish, and game animals).

3) **Exposure Point**: the location at which human contact is made with the contamination. The Exposure Point is specific to each type of media (e.g. - groundwater, surface water, soil, etc.)

4) **Exposure Route**: the process by which the contaminated media gets inside of people (eating/drinking, skin/dermal contact, or inhaling).

5) **Receptor Population**: groups of people who are or may be exposed.
APPENDIX D: Public Comments

COMMENT: Individuals who were exposed to contaminants from the LL and LTR sites may develop cancer later in life.

RESPONSE: Approximately 19 individuals were exposed to potentially carcinogenic contaminants from the two sites through their drinking water. The cancer risks associated with consuming these concentrations of contaminants are too low to be able to detect any increase in cancer rates among these individuals.

COMMENT: Consumption of these chemicals in the past may lead to birth defects in the future.

RESPONSE: Approximately 19 individuals were exposed to potentially teratogenic (birth defect-causing) chemicals through their drinking water. The teratogenic compounds present at the Lemberger sites are thought to exert their effects only when exposure occurs during pregnancy. Drinking water-related exposure to these compounds has ceased so no related birth defects are expected in the future.

COMMENT: The plan for cleanup is inadequate. The wastewater should be treated before it’s returned to the Branch River. If the cleanup takes 10, 20 or 50 years many individuals will contract chronic diseases.

RESPONSE: The U.S. Environmental Protection Agency has reviewed the cleanup plans and feels that there is no risk of contaminating the Branch River. Local residents are not expected to be exposed to site-related contaminants during the time of cleanup operations.
APPENDIX E: Definitions

ATSDR: The Agency for Toxic Substance Disease Registry, a federal agency.
BEHP: Bis (2-ethylhexyl) phthalate, a Volatile Organic Compound.
Cancer Risk Evaluation Guide (CREG): An estimate of the excess upper-bound lifetime probability (at or less than 1 in 1,000,000) of an individual developing cancer from an exposure to a concentration of a specific chemical or substance.
Cancer Slope Factor (CSF): The upper limit on the lifetime probability (at or less than 1 in 1,000,000) that a cancer causing chemical will cause cancer at a dose of 1.0 mg/kg/day.
Carcinogen: A substance which has been proven to cause cancer in humans or animals.
CERCLA: The Comprehensive Environmental Response, Compensation, and Environmental Liability Act. Also known as "Superfund", this program is administered by the U.S. Environmental Protection Agency.
DOH: Division of Health, Wisconsin Department of Health & Social Services.
Drinking Water Lifetime Health Advisory: That portion of an individual's total exposure to a chemical that is attributed to drinking water, and is considered protective of noncarcinogenic health effects during a lifetime exposure.
EPA: United States Environmental Protection Agency
Environmental Media Evaluation Guideline (EMEG): Expressed in either µg/L or µg/m³. Derived from ATSDR’s Minimal Risk Level (expressed in mg/kg/day), which is an estimate of the daily human exposure to or dose of a chemical that is likely to be without an appreciable risk of deleterious, noncancerous effects over a specified duration of exposure. EMEGs are categorized by timeframes of exposure: acute (≤ 14 days); intermediate (15 - 365 days); and chronic (≥ 365 days).
Groundwater Enforcement Standards (and Preventive Action Standards): Health-based groundwater goals set by the Wisconsin DNR that when exceeded prompt regulatory action.
mg/kg/day: Milligrams per Kilogram of Body Weight per Day
Minimal Risk Level (MRL): see definition of Environmental Media Evaluation Guideline (above).
National Priorities List (NPL): U.S. EPA's list of top priority hazardous waste sites that are eligible for investigation and cleanup under Superfund.
PCB: Poly-Chlorinated Biphenyls.
PPB: Parts Per Billion or Micrograms per Liter (µg/L)
PPM: Parts Per Million or Milligrams per Liter (mg/L)
Reference Dose (RfD): An estimate of a daily exposure level to a substance for the human population that is likely to be without an apparent risk of causing damaging health effects during a lifetime of exposure.
Remedial Investigation and Feasibility Study (RI/FS): Two parts of the Superfund process. The Remedial Investigation includes the collection and evaluation of data to define site conditions, including the nature of hazardous substances found at a site and the extent that those hazardous substances were released from the site. These releases
are evaluated to assess the effect on public health and the environment. The Feasibility Study defines a range of likely alternatives for cleaning up a site.

SVOC: Semi-Volatile Organic Compounds
µg/L: Micrograms per Liter or Parts Per Billion
µg/m³: Micrograms per Cubic Meter
µg/kg: Micrograms per Kilogram
mg/kg: Milligrams per Kilogram
VOC: Volatile Organic Compounds
WDATCP: Wisconsin Department of Agriculture, Trade and Consumer Protection:
WDNR: Wisconsin Department of Natural Resources
This considers exposures that likely occurred in the past and exposures that are currently occurring. A "Potential Completed Pathway" is when there is insufficient information to link a contaminant or chemical to a known level of exposure among an identified population. A "Potential Completed Pathway" refers to when an exposure may have occurred in the past, is probably occurring, or may occur in the future. An exposure pathway can be eliminated from consideration if at least one of the five elements is missing and will never be present.