Mr. Doug Mundrick  
Chief, South Superfund Remedial Branch  
EPA Region 4  
345 Courtland Street, North East  
Atlanta, Georgia 30365  

Dear Mr. Mundrick:

Enclosed please find a copy of the Agency for Toxic Substances and Disease Registry (ATSDR) Petitioned Public Health Assessment—Public Comment Release for the Country Club Lake Estates Site, dated September 30, 1992. This document is ATSDR’s evaluation of data and information on the release of contaminants into the environment from the Country Club Lake Estates Site, Hattiesburg, Forrest County, Mississippi. The purpose of this document is to assess any current or future impact on public health.

The ATSDR will accept written comments from the public until December 8, 1992. Comments should be addressed to: Ms. Lydia Odgen Askew, Community Involvement Liaison, Division of Health Assessment and Consultation, ATSDR, Mailstop E-32, 1600 Clifton Road, N.E., Atlanta, Georgia 30333.

If you have any questions, please do not hesitate to call Ms. Ogden Askew, at (404) 330-9543 (24-hour message service).

Sincerely yours,

Margaret Stone  
Max M. Howie, Jr.  
Chief  
Records and Information Management Branch  
Division of Health Assessment and Consultation

Enclosure
Public Notice
Hattiesburg, Mississippi

The Agency for Toxic Substances and Disease Registry Public Health Assessment for Country Club Lake Estates will be available on November 9, 1992, at the following repository:

Hattiesburg Public Library
723 Main Street
582-4461

The Public Comment Period will run November 9-December 8, 1992. Comments postmarked after that time will not be considered for this revision of the document. Comments received during the public comment period will be logged and become part of the administrative record for the Public Health Assessment. Comments and responses will be included in an appendix to the final Public Health Assessment. Commenters’ names will not be included in the Public Health Assessment, however, they are subject to Freedom of Information Act requests. For that reason, individuals should exercise their own judgment concerning the inclusion of any personal health information or other confidential data in comments sent to ATSDR. Only written comments will be accepted. Comments should be directed to:
Lydia Ogden Askew
Community Involvement Liaison
ATSDR (E32)
1600 Clifton Road, NE
Atlanta, GA 30333

If sufficient public comments are received, a public meeting may be held. Please contact Bob Safay at 404/347-1847 or Ms. Ogden Askew at 404/330-9543 (24 hours) if you have questions.

To run in:
Hattiesburg American
Sun Nov 8
PO Box 1111
825 N. Main St
Hattiesburg, MS 39403
601/961-7000; x240 (fax)
PETITIONED PUBLIC HEALTH ASSESSMENT
COUNTRY CLUB LAKE ESTATES
HATTIESBURG, FORREST COUNTY, MISSISSIPPI
SEPTEMBER 30, 1992

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

Comment Period Ends:

DECEMBER 8, 1992
PETITIONED PUBLIC HEALTH ASSESSMENT

COUNTRY CLUB LAKE ESTATES
HATTIESBURG, FORREST COUNTY, MISSISSIPPI

UNITED STATES
DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY
DIVISION OF HEALTH ASSESSMENT AND CONSULTATION
ATLANTA, GEORGIA
THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release 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. This document represents the Agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited timeframe. To the extent possible, it presents an assessment of the potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30 day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude 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.

Comments regarding this report are welcome. Please address to:

Agency for Toxic Substances and Disease Registry
Attn: Director, Division of Health Assessment and Consultation (E-32)
1600 Clifton Road, N.E., Atlanta, Georgia 30333

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Emergency Response & Consultation Branch.........C. Harold Emmett, P.E., Chief

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 COMMENT RELEASE

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SUMMARY

The Davis Timber Company site is in a rural area of southeastern Mississippi, approximately six miles northwest of Hattiesburg, Mississippi. The facility has operated since 1966, using pentachlorophenol as a wood preservative between the years of 1972 and 1987. The state of Mississippi has documented intentional and accidental releases from the facility's wastewater treatment holding pond and the regulatory actions that resulted. Fish kills that occurred on the lakes downstream of the Davis Timber Company site have also been documented. The state of Mississippi petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) to conduct a public health assessment of Country Club Lake Estates, a lake and residential community directly downstream of the Davis Timber Company site.

Country Club Lake Estates is situated along Mineral Creek, approximately one mile downstream from the Davis Timber Company site. Mineral Creek, Country Club Lake, and a privately owned lake have been contaminated by chemical products similar to those found on site at the Davis Timber Company site.

Pentachlorophenol, polychlorinated dioxins, and polychlorinated furans were detected in surface water, sediment, and fish downstream from the timber company. Environmental media needing further investigation include off-site groundwater and fish downstream.

The residential community surrounding Country Club Lake, homes along Mineral Creek, and other lake and stream users are likely to have been exposed to those contaminants. The maximum concentration of contaminants found in fish samples is sufficient to cause disease, if consumed on a regular basis. ATSDR has classified the site a public health hazard because of concentrations of contaminants in fish samples.

The Agency for Toxic Substances and Disease Registry recommends, in this petitioned public health assessment, actions to reduce and prevent exposure to contaminants. ATSDR also recommends more in-depth site characterization. ATSDR’s Health Activities Recommendation Panel recommends community health education as a health follow-up action. ATSDR will implement community health education measures.
BACKGROUND

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal agency within the U.S. Department of Health and Human Services that has been authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to conduct health assessments of hazardous waste releases into the environment. ATSDR was petitioned in December of 1989 by the Mississippi Department of Environmental Quality (MDEQ) to evaluate Country Club Lake Estates.

For the purpose of this petitioned public health assessment, the former Davis Timber Company, the source of chemical contamination, is referred to as the site. Environmental media within the Davis Timber Company property boundaries have been referred to throughout the document as being on site. Country Club Lake Estates and other surrounding areas are referred to as off-site properties.

A. SITE DESCRIPTION AND HISTORY

The Davis Timber Company site is approximately six miles northwest of Hattiesburg, Mississippi, in Lamar County. The facility has been a timber processing and wood preserving operation. Operations included bark removal, treatment with pentachlorophenol, and product storage. The company began operations in 1966 as a producer of untreated poles at another nearby location. The plant began treating operations at the present location in 1972, using pentachlorophenol as a wood preservative (1). The treatment operations were discontinued in 1987 due to state regulatory actions (2). Davis Timber Company closed in 1990 and Lamar Wood Products continued previous operations, which did not include chemical wood treatment. The main source of contamination from the Davis Timber Company facility was a waste-water treatment holding pond that was designed as an evaporation pond. That pond intermittently released waste-water into Mineral Creek. There have been a number of fish kills associated with those releases and there have been follow-up enforcement actions taken by the state (documented fish kills are listed in Appendix C). Site access is unrestricted. The plant is located on a rise and drains into both east and west forks of Mineral Creek. Mineral Creek
discharges into the Bowie River. Figures 1 and 2 depict the local features (all figures are in Appendix A) (3).

The Country Club Lake Estates residential community is approximately one mile downstream from the Davis Timber Company site. The community consists of about 100 homes that surround a 66-acre impoundment identified as Country Club Lake (4).

The United States Environmental Protection Agency (USEPA) analyzed two fish tissue samples in response to a request from the state in 1988. The analysis identified the presence of dioxins (5). As a result of those tests, the state recommended that local residents not consume fish from the Country Club Lake. Signs were placed along the perimeter of the lake advising the public not to consume fish from the lake because of the levels of contamination. The Mississippi Department of Environmental Quality is concerned about potential health effects of residents of the Country Club Lake Estates, as well as other residents in the area (5). There is a privately owned lake approximately two miles downstream of Country Club Lake. There is evidence of contamination in that lake as well.

B. SITE VISIT

Mr. Robert Safay, ATSDR’s Region IV representative, and Mr. Donald Joe, representing the Division of Health Assessment and Consultation of ATSDR, visited the site on April 11, 1990. They met with representatives of MDEQ and representatives of the Forrest County Health Department.

They also held a meeting with an attorney representing homeowners whose properties might have been affected by the release of contaminants. The attorney also represents the owner of the private lake that is downstream from Country Club Lake. The owner of the private lake has collected data that he feels indicates his lake is also contaminated. During the visit with the attorney, photographs were presented that showed area children fishing and swimming in the lakes.

The Davis Timber Company and Country Club Lake Estates were visited for visual inspection. Observations were noted regarding nearby homes, wells, watershed, and other features of the area. Information was also collected concerning sensitive populations, use of the stream and lakes, fish sampling, and the local fish advisory and commercial fishing ban.

C. DEMOGRAPHICS, LAND USE, AND NATURAL RESOURCE USE

Demographics
The Davis Timber Company site is in Lamar County, while much of Mineral Creek and the downstream lakes, including Country Club Lake Estates, are in adjacent Forrest County. Based on 1990 census population data, Forrest County's population numbers 68,314; with Lamar County having a total population of 30,424. Hattiesburg, a city of 41,882, is approximately six miles southeast of the Davis Timber Company site (6). There are approximately 100 homes in the area surrounding and immediately downstream of the site. The actual number of residents in the area is not known. The homes observed during the site visit represent middle income housing (4). Rawls Springs Elementary School (k-5), which is located 2.5 miles northeast of the site, currently enrolls 224 children (7).

Land Use

The Country Club Lake Estates, roughly one mile downstream from the site, is a residential development with a golf course and a 66-acre lake which was used for boating, swimming, and sport fishing (4). The Country Club Lake is currently under a fishing advisory, prohibiting commercial fishing. Two miles downstream of Country Club Lake lies a privately owned lake, covering 62-acres, which has been used for recreational fishing and swimming (8).

Within one mile of the Davis Timber Company site are three residential subdivisions. One is approximately a half mile south, another is a quarter mile east, and one a mile northeast of the site. Currently, there are no zoning laws restricting development in this area of Forrest County (9).

The northwest area of Forrest County, around Country Club Lake Estates, is made up of forest, with timber being a major resource. Small cattle farms exist throughout the county. Some of the more popular recreational activities include hunting, fishing, swimming, and canoeing (10).

The area in northeast Lamar County, surrounding the site, is predominantly forest with some subdivisions and cattle farming. There is also some light industry in the area. Lamar County is expecting between seven and fifteen percent residential growth. No zoning laws exist; however, the county has subdivision regulations that govern the engineering of roads, septic tank use, and water systems (11).

Natural Resources Use

Both the Country Club Lake and the private lake further down Mineral Creek have been used for fishing. However, the
Mississippi Department of Environmental Quality issued a warning on Country Club Lake in May of 1990 advising the public not to consume fish from the lake. Hunting is known to have taken place in the area immediately surrounding the Davis Timber Company site (12). A variety of small and big game are being hunted for human consumption. The golf course, at Country Club Lake Estates, has been irrigated with water from the lake. Although there were no formal beaches or diving platforms, the lakes have been used for swimming (4).

The Mississippi Wildlife Department sold 4,158 fishing licenses in Forrest County and 4,935 in Lamar County during the 1990 year. Mississippi game laws require that a license be obtained to fish in public lakes or streams. Those laws do not apply to fishing on private lakes (13).

Groundwater in the area near the site is used for domestic purposes. There are some private wells in the area, particularly to the south and southeast of the site (4). A well survey has been conducted and most homes are supplied by wells operated by area utility companies (14). The Johnson Utility Company operates public wells approximately 1.5 miles from the site (15). The Johnson Utility Company wells obtain water from 750-feet deep wells (16). Arnold Line Water Association, another utility that supplies water to residents in the area, has water wells approximately two miles from the Davis Timber Company site (17). Arnold Line Water Association has three wells, with numbers one and three reaching a depth of 800 feet and number two, a depth of 770 feet (18). All of the wells are cased and tap into the Miocene aquifer (16). There is some uncertainty as to the actual direction of groundwater flow, possibly ranging from the southeast to the southwest. The groundwater, as monitored at the Davis Timber Company site during August 1987, flows southeast (19). Additional monitoring wells would provide a more accurate account of groundwater flow.

The local geology is defined by the Hattiesburg formation of Miocene age. That formation has thickly-bedded clays running 150-200 feet thick. Site specific data from monitoring well borings revealed clay, clayey silt, silty clay, and sandy clay (20).

Meteorological conditions such as rainfall and evaporation influence the area lakes. The average annual rainfall for this area of Mississippi is 60 inches, with an average annual lake evaporation of just under 46 inches (3).

D. HEALTH OUTCOME DATA

Health outcome data are not available. No data relevant to the
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site could be found at the county or state levels, or at the University of Mississippi Medical Center.

COMMUNITY HEALTH CONCERNS

The petitioner for this petitioned public health assessment is the Mississippi Department of Environmental Quality, who has petitioned on behalf of the residents of the Country Club Lake Estates near Hattiesburg, Mississippi.

1. The state is concerned about possible health effects from consumption of dioxin contaminated fish from Country Club Lake (5).

2. One community resident wrote MDEQ to voice concern about his health, his family’s health, and the health of others who have used the lake for recreational activities or who have eaten fish from the lake (21).

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

The chemical constituents named and referenced in this section are potential contaminants of concern. Contaminants of concern are those found on or off site and are at concentrations that might pose a threat to public health. The mere presence of a contaminant on or off site does not imply that a health threat exists. This petitioned public health assessment will evaluate all the contaminants of concern in an effort to determine if there is a threat to public health.

Samples have been collected from a variety of environmental media since 1974. However, all data have not been reported in this document. Data included in the following subsections are limited to data that indicate concentrations of concern. Data have been collected by private consultants, Mississippi Department of Environmental Quality, and the Mississippi Department of Natural Resources (MDNR).

In an effort to identify other sites that might be contributing additional environmental pollution near the Davis Timber Company site, ATSDR reviewed EPA’s National Priorities List. No sites are near the Davis Timber Company site although the Comprehensive Environmental Response, Compensation, and Liability Information System identifies other sites in the county (22).

ATSDR also examined the Toxic Chemical Release Inventory (TRI) to determine if there is any known information on sources of potential contamination in the vicinity of the site in question. The TRI contains information on estimated annual releases of
toxic chemicals to the environment (via air, water, soil or underground injection) which are voluntarily reported by companies to EPA. TRI data can be used to give a general idea of the current environmental emissions occurring at or near a site. TRI data may also be used to determine whether the on-going emissions from reporting facilities may be contributing additional environmental contamination. Examination of the Toxic Chemical Release Inventory (TRI) determined that within the counties encompassed by the site, a wood preservative processor is located in Hattiesburg; its releases into the environment are primarily metals, which are not contaminants of concern at the Davis Timber Company site (23).

A. ON-SITE CONTAMINATION

All data reported in this section refer to contamination found on Davis Timber Company property. Air monitoring has not been conducted on site. Because air data are not available and the contaminants found on site have low volatilities, air will not be discussed separately. Instead, air will be addressed as airborne particulates of soil in the Completed Exposure Pathways section.

Groundwater

In 1986, Law Environmental Services installed three groundwater monitoring wells around what was once a waste-water evaporation pond that has since been backfilled. Monitoring well number 1 was drilled to a depth of 39.5 feet and monitoring wells 2 and 3, to a depth of 15.0 feet (20). A map denoting the locations of the three monitoring wells is included in Figure 3 (19). Analysis of initial well samples did not exceed ATSDR comparison values (24).

Law Environmental Services installed a fourth monitoring well on July 30, 1987 (19). That well is also indicated in Figure 3. Samples were taken from each of the four wells by MDNR on August 3, 1987 (25). Data from monitoring wells 1, 2, and 3 exceeded the Cancer Risk Evaluation Guide (CREG) for pentachlorophenol. CREGs are estimated contaminant concentrations based on one excess cancer in a million persons exposed over a lifetime. A maximum concentration of 3.02 micrograms per liter (µg/L) exceeds the pentachlorophenol CREG of 0.292 µg/L. Samples were analyzed for other chlorophenol isomers and 4,6-dinitro-o-cresol, but such chemicals did not exceed detection levels.

On-site groundwater samples were taken on September 18, 1990, by the MDEQ. Those samples were collected from monitoring wells 2, 3, and 4 and were analyzed for specific polychlorinated dioxins and furans. Monitoring well 2 contained the most congeners (congeners define the different dioxins and furans by the
position of the chlorine atoms) and the highest concentrations of
dioxins and furans, ranging from 0.000032 to 0.081 \( \mu g/L \). A
summary of contaminant concentrations that were detected for each
well is in Table 1 (all tables can be found in Appendix B) (26).
A chart in Appendix B lists the names of the dioxins and furans
with their respective Toxicity Equivalency Factors (TEFs)
(27,28).

The most recent on-site groundwater sampling was conducted for
semi-volatile organic compounds on October 22, 1991, by MDEQ. No
compounds were detected at a lower detection level of
approximately 0.1 \( \mu g/L \) (29).

Soil

During July 1987, the Mississippi Department of Natural Resources
collected soil samples at a depth of 6 inches in the process
area. Pentachlorophenol was found in the on-site samples with
concentrations exceeding the CREG soil and sediment comparison
value of 5,800 \( \mu g/kg \). The two highest pentachlorophenol samples
were at 959,700 and 47,000 micrograms per kilogram (\( \mu g/kg \)) (30).

American Laboratories and Research Services, Inc., (ALRS) of
Hattiesburg, Mississippi, was contracted by a local resident to
develop a report to identify environmental contamination. ALRS
collected one soil sample from the east side of the Davis Timber
Company site. The sample was analyzed for polychlorinated
dioxins and furans. It revealed concentrations as high as 9.536
\( \mu g/kg \) for one of the dioxin isomers. ALRS also included in their
report data collected from the state of Mississippi through the
Freedom of Information Act. That data report includes a soil
sample collected from the chemical processing area on September
15, 1987. The highest dioxin concentration was 3,200 \( \mu g/kg \) (8).
A Toxicity Equivalency Factor (TEF) was applied to the isomers of
the above mentioned results (see the chart in Appendix B for
explanation of the TEF). The processing area had a 2,3,7,8-
tetrachlorodibenzo-\( p \)-dioxin (TCDD) toxicity equivalent of 3.5
\( \mu g/kg \) and the sample taken on the east side of the site 0.2911
\( \mu g/kg \). Both values exceed the Environmental Media Evaluation
Guide (EMEG) comparison value of 0.05 \( \mu g/kg \). EMEGs are based on
ATSDR minimal risk levels and factor in body weight and ingestion
rates. With the exception of the data reported by the state, the
information and data provided from the ALRS report are used for
discussion purposes only (see Quality Assurance and Quality
Control subsection for further explanation).

An additional surface soil sample was collected from beneath the
treatment cylinder during September 1990 by MDEQ. This sample
was analyzed for volatile organic compounds, semi-volatile
compounds, and metals. Pentachlorophenol was detected at 720,000
μg/kg, which exceeds the comparison value. There is no available comparison value for 2-methylnaphthalene, which was detected at 40,000 μg/kg; therefore it will be discussed as a contaminant of concern. Other compounds were detected at levels below comparison values (31).

The Mississippi Department of Environmental Quality collected one soil sample on February 19, 1991. That sample was analyzed for a number of specified polychlorinated dioxins and furans. The soil sample was collected from beneath (6 inch depth) the door of the wood treating cylinder and showed a range of concentrations of dioxins and furans from 0.95 to 8,500 μg/kg. The TEF was multiplied by the concentration of each isomer and congener, then the products were summed resulting in a total 2,3,7,8-TCDD toxicity equivalent (TEQ) of 42.46 μg/kg, which exceeds the EMEG comparison value of 0.05 μg/kg for 2,3,7,8-TCDD (32).

During October 1991 MDEQ collected one subsurface soil sample in the waste-water impoundment at a depth of 4 feet. This sample was analyzed for volatile organic compounds, semi-volatile organic compounds, and metals. Various metals, toluene, and methyl ethyl ketone were found at trace levels. Phenanthrene was detected at a concentration of 800 μg/kg. None of those contaminants exceeds comparison values, thus, none will be discussed as a contaminant of concern. Pentachlorophenol is a contaminant of concern and was detected at 26,000 μg/kg. Another subsurface soil sample, intended as a control sample, was taken north of the facility office at a depth of 4 feet. That sample was analyzed for volatile organic compounds, semi-volatile organic compounds, metals, cyanide, pesticides and polychlorinated biphenyls. No metals were detected at levels of health concern and none of the other analytes were detected at the detection limits (29).

Sediment

Two on-site sediment samples were collected by MDEQ during September 1990 and analyzed for volatile organic compounds, semi-volatile compounds, metals, dioxins and furans, and again in February 1991 for dioxins and furans. One sample was taken from West Mineral Creek just north of the skag mill and the other from East Mineral Creek about 20 feet west of Jackson Road. Sediment from West Mineral Creek revealed a total 2,3,7,8-TCDD toxicity equivalent (TEQ) of 2.20 μg/kg and pentachlorophenol at 13,400 μg/kg. Sediment in East Mineral Creek showed a total 2,3,7,8-TCDD TEQ of 1.76 μg/kg and pentachlorophenol at 6,200 μg/kg. Pentachlorophenol exceeds the CREG comparison value of 5,800 μg/kg and dioxins exceed the EMEG comparison value of 0.05 μg/kg (31,32).
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Two composite sediment samples were collected during October 1991 and analyzed for volatile organic compounds, semi-volatile compounds, and polychlorinated dioxins and furans. A sediment sample was collected from West Mineral Creek near the northwestern corner of the site boundary. This sample showed pentachlorophenol at a concentration of 16,000 μg/kg and a total 2,3,7,8-TCDD TEQ of 0.2426 μg/kg. The other sample was taken from West Mineral Creek, upstream of the waste-water impoundment, but in an area that could have been impacted by other facility operations. This sample did not reveal any volatile organic compounds or semi-volatile organic compounds, but a total 2,3,7,8-TCDD TEQ of 0.0124 μg/kg. Polychlorinated dioxins and furans and pentachlorophenol detected near the site boundary exceed comparison values (29).

The most recent on-site sediment samples were collected on March 20, 1992. A background sediment sample was taken upstream from the Davis Timber Company site and another sample taken from West Mineral Creek at the northwestern corner of the site boundary, downgradient of the waste-water impoundment and a broken dam which once formed a pond in the creek. Both samples were analyzed by two different labs for dioxins and furans. The background sample revealed concentrations below the comparison value. The sample collected below the old pond showed concentrations exceeding the comparison value with a maximum 2,3,7,8-TCDD TEQ concentration of 8.9291 μg/kg (33).

Surface Water

In the past, two bodies of surface water were identified on site. A portion of West Mineral Creek was dammed to form a small pond. Sometime in the past the dam broke and was left unrepaired; however, beavers have partially repaired the dam. This pond has likely received contaminated runoff and sediment. No surface water samples of this pond have been collected.

The other body of surface water was that which was contained in a waste-water impoundment area. The impoundment was used until 1980, when it was closed and backfilled. Existing documents report two separate occasions of waste-water from the impoundment being discharged into the west fork of Mineral Creek (34). No samples were taken of the impoundment waste-water or of the waste-water discharged into Mineral Creek.

Two samples of water runoff were collected on January 26, 1987. A surface-water sample was taken from runoff on the west end of the property and from the final holding tank of the controlled runoff discharge. An analysis of the samples indicated concentrations of 4,000 μg/L pentachlorophenol in the west end runoff and 239,000 μg/L pentachlorophenol from the final holding.
tank (35). Surface-water samples have not been analyzed for polychlorinated dioxins or furans.

B. OFF-SITE CONTAMINATION

No off-site air or soil sampling has been conducted. Off-site soil sampling is insufficient to determine the full extent of contamination.

Groundwater

The only off-site groundwater data available were taken from two wells owned by Johnson Utility Company and from a private well. The utility company wells are approximately 1.5 miles from the site and serve 72 homes in the area. The wells were sampled on December 5, 1988. Results of the analyses did not exceed the detection level of 0.5 μg/L for any of the chemicals tested (primarily chlorinated solvents). However, the samples were not tested for pentachlorophenol or dioxins and furans (36).

The private well was sampled for volatile organic compounds, semi-volatile organic compounds, and metals in September of 1990 and again sampled for semi-volatile organic compounds and lead in October 1991. This well is located about 4,000 feet southeast of the site and is used as a drinking water source (15). Pentachlorophenol was not detected at an approximate lower detection level of 0.1 μg/L. Metals were detected below one milligram per liter and will not be discussed in this public health assessment as contaminants of concern (29,31). Additional off-site groundwater data may be necessary to accurately assess any migration of site contaminants to off-site drinking water wells.

Sediment

A local resident contracted a lab in Florida to analyze samples. Sediment samples were taken on October 17-18, 1986, by Mote Marine Laboratory in Sarasota, Florida. Samples were collected from Country Club Lake and a private lake downstream, and a control sample was taken from Lake Serene. Lake Serene is in northeast Lamar County approximately 2.5 miles from the site. Both Lake Serene and Mineral Creek lie in separate watersheds. The samples were analyzed for both pentachlorophenol and Octachlorodibenzo-p-dioxin (OCDD). The concentrations of the sediment samples taken from the Country Club Lake ranged from 300 to 1,650 μg/kg for pentachlorophenol and 50 to 1000 μg/kg for OCDD. Results from the private lake ranged from 70 to 325 μg/kg for pentachlorophenol and 20 to 100 μg/kg OCDD. The analysis of the control sample collected from Lake Serene indicated concentrations of 2.0 μg/kg pentachlorophenol and <0.1 μg/kg
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OCDD. The level of pentachlorophenol did not exceed the comparison values in any of the samples. The highest concentrations of chemical constituents in both lakes appeared in leaf litter taken from the bottom of the lake. Results and comparison values for the 2,3,7,8-TCDD TEQ of OCDD are reported in Table 2 (37).

A variety of off-site sediment samples were collected by American Laboratories and Research Services, Inc., in 1988. The samples were analyzed for polycyclic aromatic hydrocarbons (PAHs) and polychlorinated dioxins and furans. The concentrations of PAHs did not exceed ATSDR's comparison values; therefore, they are not considered to be of health concern. Polychlorinated dioxins and furans were detected in the sediment just east of the Davis Timber Company site with a maximum concentration at 17.6 \( \mu g/kg \) for OCDD. Dioxins and furans were sampled and detected in the sediment as far downstream as the private lake; however, at much lower concentrations. The total 2,3,7,8-TCDD TEQ for the sediment just east of the Davis Timber Company site is 0.074 \( \mu g/kg \) which exceeds the EMEG comparison value of 0.05 \( \mu g/kg \). Other downstream sediment samples do not exceed comparison values (8). As noted previously, the ALRS data are used for discussion purposes only (see Quality Assurance and Quality Control subsection for further explanation).

Thirteen sediment samples were collected and analyzed for pentachlorophenol by the MDNR on November 19, 1987. The samples were collected from Country Club Lake, east fork of Mineral Creek, and west fork of Mineral Creek. Of the thirteen samples collected, the highest concentration (1,780 \( \mu g/kg \)) was detected on the east fork of Mineral Creek approximately a quarter of a mile downstream of the site. In the lake, concentrations ranged from 50 to 790 \( \mu g/kg \), with the highest concentration in sediment collected near the spillway. Those pentachlorophenol concentrations do not exceed comparison values (38).

One sediment sample was collected during September 1990 and analyzed for volatile organic compounds, semi-volatile compounds, and metals and another sample taken on February 19, 1991, and analyzed for polychlorinated dioxins and furans, by MDEQ. These samples were taken from the West Mineral Creek inlet to Country Club Lake. The total 2,3,7,8-TCDD TEQ for this sample was 0.21 \( \mu g/kg \). Acetone and some metals were detected at levels well below comparison values (31,32).

The Mississippi Department of Environmental Quality collected three sediment samples on March 20, 1992, and analyzed them for dioxins and furans. One sample was collected approximately 100 meters upstream from Highway 49 and revealed a total 2,3,7,8-TCDD TEQ of 0.00255 \( \mu g/kg \). The other two samples were taken from the
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Mineral Creek inlet to the private lake, approximately 500 meters apart. The upstream concentration revealed a TEQ concentration of 0.01102 μg/kg and the downstream sample 0.02231 μg/kg. None of the three sediment samples exceeds the EMEG comparison value of 0.05 μg/kg (33).

Surface Water

Since 1974, numerous surface-water samples have been collected from site runoff, east and west forks of Mineral Creek, Mineral Creek, Country Club Lake, and the private lake farther downstream (39). Much of the sampling was prompted by the eight reported fish kills on the lakes. Pentachlorophenol has been detected in over one hundred water samples. Those samples contained concentrations of pentachlorophenol ranging from <0.1 μg/L at the west fork of Mineral Creek (upstream of the Davis Timber Company site) to 68,500 μg/L at the east fork of Mineral Creek, approximately a half mile downstream (40,41). The concentration of pentachlorophenol exceeds the EPA comparison value, Ambient Water Quality Criteria for the Protection of Human Health, of 0.282 μg/L.

The most recent surface water samples collected and analyzed for pentachlorophenol were taken by the MDNR on January 26, 1987. Samples were collected from Country Club Lake, east and west forks of Mineral Creek and ranged from a concentration of 13 to 3,360 μg/L of pentachlorophenol. From those samples only the highest concentration, which was taken from surface scum behind a log jam on the west fork of Mineral Creek a half mile from the inlet, exceeds the comparison value (35). The sample taken from the surface scum is not considered to be representative of surface water.

Fish Tissue

Fish have been analyzed on eight occasions, five times for pentachlorophenol and three times for dioxins and furans. The Mississippi Department of Natural Resources collected fish on three occasions, subsequent to fish kills. Fish tissue sampled during normal conditions showed pentachlorophenol concentrations 100 times lower than tissue sampled after fish kills. Following fish kills, concentrations ranged from 4.7 to 7,036 μg/kg. The results of those analyses are listed in Table 3 (36,40,42,43).

In 1987, EPA analyzed two kinds of fish (hybrid Sunfish and Largemouth Bass), both collected from Country Club Lake, for dioxins and furans. The samples consisted of a composite of three Largemouth Bass fillets and three whole Sunfish. Both fish samples revealed dioxin and furan contamination. Concentrations ranged from no detection for certain congeners (at detection
levels from 0.002 to 0.0054 μg/kg) to a concentration of 0.7159 μg/kg. The total 2,3,7,8-TCDD TEQ for the hybrid Sunfish was 0.15669 μg/kg and 0.10328 μg/kg for the Largemouth Bass (44). Both fish tissue values exceed the EPA comparison value of 0.000021 μg/kg. This EPA comparison value is based on carcinogenic potency slopes that are combined with standard exposure scenarios to calculate chemical concentrations corresponding to a lifetime cancer risk of one in a million (45).

The Mississippi Department of Environmental Quality sampled Spotted Sunfish from Mineral Creek on April 18, 1990. These fish were analyzed for total dioxins and furans rather than analyzing for the 2,3,7,8 congeners; therefore, the TEQ may show a higher concentration than is actually present in the fish. One sample was a composite which revealed a total 2,3,7,8-TCDD TEQ of 0.007534 μg/kg and the other fish sample a TEQ of 0.003486 μg/kg (46). For further discussion of this data set see the Quality Assurance and Quality Control subsection.

The most recent fish samples were taken from the spillway below the Country Club Lake on June 12, 1991, by MDEQ. Three fish (a Bluegill, Brown Bullhead, and Largemouth Bass) were filleted and analyzed separately for polychlorinated dioxins and furans. The TEQ concentrations were 0.004693, 0.004907, and 0.004427 μg/kg for the Bluegill, Brown Bullhead, and the Largemouth Bass, respectively. All three samples exceed the EPA comparison value of 0.000021 μg/kg (47). A summary of the total 2,3,7,8-TCDD TEQ results for the fish tissue samples is found in Table 4.

C. QUALITY ASSURANCE AND QUALITY CONTROL

In preparing this petitioned public health assessment, ATSDR relies on the information provided in the referenced documents and assumes that adequate quality assurance and quality control measures were followed with regard to chain-of-custody, laboratory procedures, and data reporting. The validity of the analyses and conclusions for this petitioned public health assessment is determined by the completeness and reliability of the referenced information.

The ALRS laboratory was contacted for quality assurance/quality control (QA/QC) data to support its analytical results; however, ATSDR’s request was denied (48). Therefore, a full evaluation of the data could not be achieved. Further, dioxins and related compounds are very difficult to analyze at the low levels found in environmental samples. Given the failure to supply QA/QC documentation, the data supplied by American Laboratories and Research Services, Inc., are of limited use. The data are used for discussion of trends in this public health assessment.
Sediment samples were collected by MDEQ on March 20, 1992, and analyzed for polychlorinated dioxins and furans. Sample DT-SD-05 was collected on-site from West Mineral Creek, at the northwest corner of the site. This sample was diluted and reanalyzed due to dioxins and furans exceeding the calibration range. The internal quantitation standard recovery was outside the 40 to 120% range for the octachlorodibenzo-p-dioxins and octachlorodibenzofurans. The custody seal was broken on the sediment sample DT-SD-01, collected from Mineral Creek near Highway 49, when received by the lab. Both values will be used and evaluated by ATSDR.

The fish samples collected from Mineral Creek by MDEQ on April 18, 1990, were analyzed for polychlorinated dioxins and furans. The reported recovery for these analyses was low for the tetra and octa isomers. These fish were analyzed for total dioxins and furans rather than analyzing for the 2,3,7,8 congeners; therefore, the TEQ may show a higher concentration than is actually present in the fish. Based on the low recoveries and the limitations created by reporting only the total dioxin and furan isomers, these samples will not be evaluated as an accurate data set.

D. PHYSICAL AND OTHER HAZARDS

A timber processing facility is still in operation at the site, under the name Lamar Wood Products; however, there are currently no wood treating operations on-site. Although no conspicuous physical hazards were observed, hazards typical of an industrial facility were present. Access to the site is not controlled.

PATHWAYS ANALYSES

ATSDR, in an effort to determine potential human exposure, evaluates the pathways from the source of contamination to the receptor population. ATSDR considers five components necessary to represent a completed pathway: a source of contamination; transport through an environmental media; a point of exposure to the human body; a route of entry into the human body; and an exposed population. A completed pathway is one in which all five elements currently exist, have existed in the past, or are likely to exist in the future. A potential pathway is one that is missing one of the elements, but which could have existed in the past, could be existing at the present time (however, is undocumented), or may exist in the future. A pathway can be eliminated when at least one of the elements is absent, and is unlikely to have been present in the past or to be present in the future.

A. COMPLETED EXPOSURE PATHWAYS
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A table (Table 5) summarizing the completed exposure pathways is in Appendix B.

Food Chain

Sediments and downstream surface waters have been contaminated. Waste water from the site contained pentachlorophenol. Polychlorinated dioxins and furans are often technical contaminants of pentachlorophenol and are commonly found in commercial grades of pentachlorophenol wood preservative (49). Pentachlorophenol has been directly linked to four of the eight fish kills that have occurred since 1974 (34). Although the contaminated surface water is soon diluted and purged by natural stream flow, varying degrees of aquatic contamination have occurred. Thus, fish have been contaminated with pentachlorophenol, dioxins, and furans directly through water and sediment and indirectly through their aquatic food chain.

It is highly probable that some of fish that were caught from the contaminated lakes have been eaten. It is also possible that fish are currently being caught and eaten. The Mississippi Department of Environmental Quality issued a ban prohibiting commercial fishing; however, private fishing may still be occurring. Although current data show elevated concentrations of dioxins and furans in fish collected below Country Club Lake, it is not known how far downstream the fish are contaminated. Approximately 3.5 miles downstream from the site, Mineral Creek joins the Bowie River where canoeing and fishing are common. It is possible that fish being caught in the lower reaches of Mineral Creek or at the Bowie River are contaminated and are consumed by persons unaware of such potential contamination.

Current and comprehensive sampling data would greatly assist in evaluating fish. The current levels of pentachlorophenol and polychlorinated dioxins and furans in contaminated fish and the geographical area in which contaminated fish may exist are not known at this time.

Residents or fishermen who have consumed fish from Country Club Lake or the private lake represent the receptor population. Since most residents or Country Club Lake users and the owner of the private lake should be aware of the fish advisory, they are unlikely to eat any of the fish from the lakes in the future if the advisory is heeded. Currently, two populations are likely to take and consume fish from waters immediately downstream where there is no advisory/commercial fishing ban: resident fishermen who believe there are no contaminated fish below the lake and unsuspecting non-resident fishermen. It is also possible that some persons consume fish despite the fish advisory. The receptor population is not well enough defined to estimate the
numbers exposed or the magnitude of exposure that might have occurred.

Mineral Creek and Lake Sediment

A host of surface water and sediment samples track the migration of pentachlorophenol, polychlorinated dioxins, and furans off site via runoff, spills, and direct discharge. The Davis Timber Company site rests on a ridge running northeast to southwest, between east and west forks of Mineral Creek. The average slope of the site is approximately five percent, thus allowing ample runoff (3). Based on the most current sampling, dioxin appears to be quite persistent in the environment. A sediment sample from West Mineral Creek in March of 1992 revealed a total 2,3,7,8-TCDD TEQ of 8.9291, almost five years after chemical preservatives were last used on site (33). Pentachlorophenol was also detected in sediment in elevated concentrations (16,000 μg/kg) in October 1991 (29). Pentachlorophenol, dioxins, and furans still exist on site and may be carried off site with soils during storms.

Boating, fishing, and swimming have taken place on both Country Club Lake and the private lake. Sediments may be stirred up during swimming or wading near the shore; however, contaminants that bind tightly to sediments are not likely to be removed into the water. Ingestion or dermal contact with sediment is possible, but the quantity of sediment contacted or ingested, concentrations of contaminants bound to the sediment, and the frequency of occurrence are expected to be low.

Lake users make up the receptor population. It is difficult to estimate the size of the exposed population because non-residents also used the lakes. Frequent lake users, such as children and those who might be exposed via multiple routes (i.e., swimming and consuming contaminated fish), are at greater risk.

Surface Water

The surface water and sediment pathways are very similar. That is largely because surface runoff carries not only contaminants, but contaminants bound to sediments, into the surface water bodies. Off-site migration of contaminants is exemplified by the fact that pentachlorophenol has been documented as being the toxicant in four of the eight fish kills investigated by the MDNR (34).

It has been five years since chemical preservatives were used on site. Currently, it is not known what concentrations of pentachlorophenol exist on site or, more importantly, what concentrations might be migrating off site through surface
runoff. Because of the concentrations of pentachlorophenol identified on site (up to 959,700 µg/kg in 1987 and 720,000 µg/kg in 1990), concentrations of pentachlorophenol may still be migrating off site with heavy surface water runoff (30,31).

It has already been stated in the sediment pathway that residents and non-residents use the lakes for recreation, swimming and wading. As in the case of the sediment pathway, people who participated in water activities might have ingested or have been exposed dermally to pentachlorophenol contaminated waters. However, exposure is likely to be low and of an intermittent nature.

Lake users make up the receptor population. It is difficult to accurately estimate the size of the receptor population because many non-residents used the two lakes.

Process Area Soil

Samples revealed pentachlorophenol, 2-methylnaphthalene, and various polychlorinated dioxins and furans in the surface soil (0-6") on site. One subsurface soil sample was taken at the waste-water impoundment and showed pentachlorophenol at a depth of 4 feet from land surface after the impoundment had been backfilled. Those samples were collected in the processing and treating areas. The earliest soil samples were taken in 1987, the same year that Davis Timber Company discontinued chemical treating. Because of surface water runoff and the constant downward migration of contaminants since the company discontinued chemical wood treatment, it is likely that higher concentrations of pentachlorophenol and particularly dioxins and furans existed prior to 1987. No samples or analyses were conducted to verify downward migration of contaminants, but the presence of pentachlorophenol and polychlorinated dioxins and furans in groundwater strongly supports that migration has occurred.

A completed pathway exists for those who have worked in the immediate processing area where soil samples revealed the heaviest contamination. Employees working in the processing area may have come in contact with contaminated soil and possibly even direct contact with pentachlorophenol and polychlorinated dioxins and furans. However, contact with pure contaminant is no longer a concern since wood-treating operations have been discontinued. Dermal contact can lead to ingestion of contaminants through hand-to-mouth activity, such as eating and smoking. Inhalation of contaminants may have taken place via airborne dust stirred from the processing area by wind and machinery. Inhalation, ingestion, and dermal exposure routes are all plausible.

The exact number of persons who have worked at this site is not
known, but a report prepared by Davis Timber Company in 1986 listed the company as employing 32 people on site (1). It is likely that only a small percentage of those employees worked in the processing area on a regular basis. However, a number of employees may have worked in the processing area on a part-time or on an as-needed basis. Turnover of workers at Davis Timber Company was probably moderately low, given the relatively limited alternative employment opportunities in the area at that time. ATSDR assumed an average employment of five years to calculate the number of persons possibly employed. Since the plant used pentachlorophenol for 15 years, approximately 96 on-site workers were potentially exposed to levels of pentachlorophenol. The level of exposure would have varied by job positions in the company.

B. POTENTIAL EXPOSURE PATHWAYS

A table (Table 6) summarizing the potential exposure pathways is in Appendix B.

Groundwater

On-site groundwater contamination was first observed in 1986 and 1987 (20,25). Sampling in 1987 revealed concentrations of pentachlorophenol that exceeded comparison values; however, pentachlorophenol was not detected during 1991 sampling. Data from 1990 reveal polychlorinated dioxins and furans in monitoring wells.

Much of Lamar and Forrest Counties are served by rural water associations, such as Johnson Utility Company, which owns two wells near the site, and Arnold Line Water Association, which operates three wells and services most of the homes in the area (4,11,16). Currently, groundwater on site is not being used and does not represent a completed pathway. Routine drinking water samples taken from off-site wells at Johnson Utility Company did not exceed drinking water standards for the contaminants that were analyzed. However, none of the site-related contaminants (i.e., pentachlorophenol and polychlorinated dioxins and furans) are included among those listed for routine analyses.

Based on data from a limited number of monitoring wells, the groundwater flow direction is believed to be southeast (19). Of the known private wells, the majority are south and southeast of the site. The nearest private drinking water well, approximately 4,000 feet southeast of the site, was sampled for semi-volatile organic compounds and no contaminants were detected, although not all site-related contaminants were analyzed. Contaminated groundwater could migrate off site and be taken up through private wells or wells owned and operated by any of the local
water services. Typically, private wells are quite shallow and are therefore of greater concern than the deeper wells (750-800 feet) owned by Johnson Utility Company and Arnold Line Water Association (4).

The receptor population includes nearby residents who use groundwater supplied by private or service wells in the area. There are approximately 100 homes in subdivisions around Country Club Lake and the site. Although the exact number of residents is uncertain, the potential receptor population for the groundwater pathway is roughly estimated at 250 people.

Golf Course Soil

A potential off-site soil pathway exists at the Hattiesburg Country Club golf course. Potential exposures at the golf course are expected to be very low. The golf course has been in operation for twenty-seven years and is typically irrigated with water from a spring or a wet-weather pond. During drought, the pond would become dry, and water would be taken from Country Club Lake to fill the wet-weather pond. Golf course management drew water from Country Club Lake for irrigation purposes, for an unknown length of time until 1982. Between 1982-86, water was not drawn from the lake. In 1986, new management began to draw water from Country Club Lake for irrigation purposes. Only once since the 1990 fish advisory has lake water been used for irrigation.

Data show that water and sediment from the lake have been contaminated with pentachlorophenol in the past, and recent sediment samples reveal dioxin and furan contamination. There is a slight possibility that the golf course has been contaminated via irrigation; however, there are no sampling data to support this hypothesis. Further, contamination should be minimal due to additional settling of contaminants in the wet-weather pond.

If environmental media are contaminated, golf course users could be exposed through contact with soil, grass, or directly from irrigation water. Such contaminants could be absorbed by the skin or ingested through hand-to-mouth activity. Since contaminated media at the golf course are expected to be at low levels, exposure from golf course activities would be low.

The potential receptor population includes those working and playing on the golf course. Accurate estimates of that population cannot be made at this time.

Pond Sediment

A potential off-site sediment pathway exists for the Hattiesburg
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Country Club service pond. The pond is roughly 3.5 acres in size with a maximum depth of approximately 15 feet. The pond is used to irrigate the golf course and has been recharged with water from Country Club Lake. The number and volume of water transfers since the pond’s origin is not known.

It is likely that sediment in the service pond has become a sink for contaminants taken up in water from Country Club Lake; however, no sampling has been conducted. If sediment is contaminated, there would be potential for ingestion and dermal exposure through swimming and wading.

Access to the pond is not restricted, but there has not been any evidence or report of anyone having entered the pond or used it for recreational purposes. The nearest home is approximately 200 yards from the pond. There is a small potential receptor population, which includes neighborhood children.

PUBLIC HEALTH IMPLICATIONS

A. TOXICOLOGICAL EVALUATION

Introduction

The compounds of potential public health concern that have been identified on site and in the surrounding areas are the polychlorinated dioxins and furans, and pentachlorophenol.

Dioxins and furans

Dioxins and furans are related classes of compounds formed in manufacturing various chlorinated products, including herbicides like 2,4,5-T (a component of Agent Orange, used as a defoliant in the Vietnam War), other chlorinated cyclic hydrocarbons, and in paper bleaching. Dioxins and furans can also be formed by combustion of various chemicals, industrial wastes, and municipal wastes. They are formed naturally in most combustion processes, and forest fires have generated a low background level throughout the world. Dioxins and furans include compounds with various levels of chlorination. Isomers with four chlorine molecules include the most toxic forms, and congeners with chlorines in the 2,3,7 and 8 positions are the most toxic forms within each isomer group. The most toxic form is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), while the related furan is only slightly less toxic. Other dioxins and furans can range from slightly less toxic to 1000 times less toxic. In dealing with mixtures of dioxins and furans, a system has been developed to weigh concentrations of congeners and isomers by factors that relate their toxicity to that of 2,3,7,8-TCDD, generating TCDD equivalency factors (TEFs). These factors are used to assess the
health risks of a dioxin/furan mixture (50).

The concentration of total dioxins and furans in on-site groundwater is sufficient to be of concern if this water were to be consumed (total 2,3,7,8-TCDD toxicity equivalent [TEQ] = 295 ppq [parts per quadrillion] maximum, or 0.000295 parts per billion [ppb], compared to an environmental guideline of 0.00001 ppb). The guideline used is the ATSDR EMEG (Environmental Media Evaluation Guideline). The EMEG is used to screen contaminants in specific media and is based on models depicting chronic exposures to average children. Values below EMEGs are considered to have no public health significance whereas values above EMEGs may have significance and require further evaluation. We have considered on-site groundwater to be a potential route of human exposure, if private wells in the contaminated area are used for drinking water supplies. Off-site sediment (TEQ = 2.2 ppb) and on-site soil (42.5 ppb maximum TEQ) contain levels of total dioxins and furans that represent a potential health concern (environmental guideline for soil, for a child, is 0.05 ppb). Off-site surface water, and runoff (none detected) did not contain dioxins and furans at levels that merit concern. Contamination levels in fish (TEQ = 0.157 ppb) are high enough to pose an increased risk of cancer. Persons who consume fish on a regular basis (an entire fish three times a week) might have a dioxin exposure considerably higher than the FDA ingestion limit of 0.057 pg/kg/day and therefore an increased risk of cancer.

Dioxins and furans can cause an increase in the risk of cancer. Dioxins have caused liver cancer in laboratory animals. A rare form of cancer, called soft tissue sarcoma, has been associated with dioxin exposure in wood workers in Scandinavia, but the results are controversial due to the low number of workers exposed. Health effects other than cancer are uncertain. Industrial workers have developed a severe skin rash called chloracne, from exposure to dioxins and other chlorinated compounds. Some reproductive toxicity has been seen in laboratory animals (50).

Dioxins and furans at the site, in on-site groundwater, and in fish in Country Club Lake pose a public health threat, with the possibility of a slight risk of increased cancer in steady consumers of fish and in potential users of contaminated drinking water.

Pentachlorophenol

The concentrations of pentachlorophenol in fish, off-site sediment, off-site surface water, and on-site soil are a health concern. Concentrations of contaminants in fish fillets are lower than concentrations found in whole fish. Based on the
expected pattern of fish consumption, the concentrations found in fillets would not cause health effects. However, whole fish contain sufficient pentachlorophenol to present a health hazard. Compounds like pentachlorophenol tend to concentrate in the liver and fat of animals (51). A small portion of the population might use fish liver for food or medicinal purposes, and may therefore be at increased risk.

Pentachlorophenol in off-site sediment poses a health concern. Ingestion of off-site sediment might provide doses that increase the potential cancer rate. It is unlikely, however, that persons will ingest enough sediments for this to occur. Pentachlorophenol in on-site soils represents a health hazard and a cancer hazard to on-site workers who might ingest contaminated soils 8 hours a day over a long period of time. Such ingestion is most likely during dry periods when construction work or remediation is occurring, causing the generation of dust.

It is difficult to estimate the health effects from pentachlorophenol found in surface water. The data available may not be representative, and may relate to releases of pentachlorophenol rather than to steady concentrations. Human consumption of the surface water is likely to be low and infrequent. Because we do not know how well pentachlorophenol passes through the skin, we cannot estimate exposures caused by swimming in the lake.

Pentachlorophenol is a commonly used wood preservative. It has been released into soils, air, and water at numerous wood treatment sites. Pentachlorophenol can cause both cancer and non-cancerous health effects (birth defects, damage to liver, kidney, skin, blood, lungs, and the nervous system) in laboratory animals. Effects in humans are less well studied (51).

Levels of pentachlorophenol, on and off site, are sufficient to cause a potential for increased risk of cancer and other health effects.

2-methylnaphthalene

2-Methylnaphthalene was detected at 40,000 µg/kg in on-site soil. There are no environmental or health guidelines for this compound as it has received little study. Toxic effects from exposure to 2-methylnaphthalene have not been reported (52).

B. HEALTH OUTCOME DATA EVALUATION

No health outcome data were presented by the petitioner or community. The Mississippi Health Department, Mississippi Department of Environmental Quality, and the Lamar and Forrest
County Health Departments did not have any health data relevant to the site; nor did they know of any community health concerns.

C. COMMUNITY HEALTH CONCERNS EVALUATION

1. The state, (as petitioner) is concerned about possible health effects from the consumption of dioxin contaminated fish from Country Club Lake (5).

2. One resident from the community has voiced concern about his health and the health of his family and others who have used the lake for recreational purposes or have eaten fish from the lake (21).

Long term ingestion of fish at Country Club Lake, contaminated with the maximum levels of dioxins, furans, and pentachlorophenol, might result in an increased risk of cancer. Increased risk of cancer was calculated and represents one additional case in every 1000 people. Risk calculations are based on conservative figures and may be over-calculated. Nonetheless, ATSDR believes that fish contaminated with the levels of dioxins and furans found in the 1987 EPA survey are of public health concern.

It is difficult to assess health hazards from use of the lake for recreational purposes. Health risk in this case would be from pentachlorophenol, not dioxins and furans. Consumption of fish from the lake presents a definite health risk. Fishing without consumption of the catch, boating, and swimming without drinking the lake water would provide much less exposure to the contaminants.

CONCLUSIONS

1. The lakes on Mineral Creek near Hattiesburg, Mississippi, represent a public health hazard because the levels of pentachlorophenol, dioxins, and furans present in the fish exceed public health guidelines. Fish consumption is the most hazardous completed exposure pathway. Other possible exposures of health concern are exposures to contaminated off-site sediments and on-site soils.

2. Current data are insufficient to determine the extent of contamination in fish downstream of Country Club Lake or whether consumption of those fish presents an increased cancer risk.

3. Data inadequacies include the following:
   a. The actual extent of groundwater contamination has not been
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identified.

b. Off-site surface water samples have been analyzed for polychlorinated dioxins and furans; however, analytical detection limits were higher than current laboratory standards; thus ATSDR’s evaluation of the dioxin and furan data is limited for off-site surface water.

c. Additional monitoring of fish tissue downstream of Country Club Lake is necessary to determine the current geographical range of contaminated fish.

d. Additional sampling of on-site surface soil is needed to better characterize the extent of contamination.

e. Further research is needed to determine possible health effects and environmental and health guidelines for 2-methylnaphthalene.

RECOMMENDATIONS

Cease/Reduce Exposure Recommendations

1. Consumption of fish from Country Club Lake should be banned until additional analyses of fish indicate ingestion of fish is safe.

2. Public access should be restricted from the on-site contaminated soil and sediments.

3. Employee exposure to on-site contaminated soil should be minimized or prevented.

4. Off-site migration of contaminants, particularly surface-water runoff and erosion of soil, should be minimized.

Site Characterization Recommendations

1. A representative number of fish should be sampled from the waters of Mineral Creek, and near the confluence with Bowie River, to define the geographical range of pentachlorophenol and dioxin contaminated fish.

2. For future monitoring pentachlorophenol and polychlorinated dioxin and furan analyses of fish, collected from the defined geographical range, should be conducted to establish the existence or trend of contamination (e.g., decreasing number of contaminated fish, decreasing concentrations, etc.).

3. Fillet sampling should be conducted to evaluate the
edible portions.

4. Sediment samples should be collected from around the lakes and other popular stretches along Mineral Creek where human contact is most likely to occur. If concentrations are significant at the juncture of Mineral Creek and Bowie River, then sampling should be continued downstream to characterize the extent of contamination. All sediment samples should be analyzed for pentachlorophenol, polychlorinated dioxins and furans.

5. The two Johnson Utility Company wells near the site should be analyzed for pentachlorophenol and polychlorinated dioxins and furans. Similar sampling should be done for the Arnold Line wells, if groundwater characterization indicates off-site groundwater contamination near the Arnold Line wells.

6. On-site groundwater should be characterized to establish groundwater flow direction and any contamination plume that may exist. Off-site groundwater characterization should be conducted, if necessary, to define the extent of contamination.

7. The private drinking water well near the site should be analyzed for polychlorinated dioxins and furans. If contamination is detected, further work (sampling or modeling) to define the extent of contamination and closure of the well should be initiated.

8. Soil samples should be collected from areas of the golf course where irrigation from the pond was most widely used. The soil samples should be analyzed for pentachlorophenol and polychlorinated dioxins and furans.

9. A representative number of on- and off-site subsurface and surface soil samples surrounding the site should be analyzed for pentachlorophenol and polychlorinated dioxins and furans to define the depth and geographical range of contamination.

HEALTH ACTIVITIES RECOMMENDATION PANEL RECOMMENDATIONS

Data and information developed in the Country Club Lake Estates Petitioned Public Health Assessment have been evaluated by the Health Activities Recommendation Panel for appropriate public health actions. Possible exposures to contaminants pose a public health threat. The Health Activities Recommendation Panel believes that the potentially exposed population needs assistance in understanding their potential for exposure and in assessing any possible adverse health effects in their community. Therefore, the panel recommends community health education as a
health follow-up action. ATSDR should interact with the community and the state to provide needed information and to seek feedback from residents about their concerns and information needs. Because the population exposed is not well defined, and the levels and duration of exposure are not known, health studies are not indicated at this time. ATSDR will evaluate any new data or information it receives about this site to determine what public health actions, if any, might be appropriate.

**PUBLIC HEALTH ACTIONS**

The actions described in this section for Country Club Lake Estate are actions that will be taken by ATSDR. The purpose of this plan is to ensure that the petitioned public health assessment not only identifies public health hazards, but provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The public health actions to be implemented by ATSDR are as follows:

1. The Agency will provide environmental health education for the community to make them aware of the possible hazards present, the likelihood of exposure, and to assist the community in assessing possible adverse health outcomes associated with exposure to hazardous substances.

2. ATSDR will contact appropriate federal and state officials to obtain additional data or new data as it becomes available. ATSDR will ensure recommendations made in this petitioned public health assessment are forwarded to the appropriate agencies for action.

3. If any new data are found to be of significant public health concern, the Division of Health Assessment and Consultation will revise the Country Club Lake Estates Petitioned Public Health Assessment as appropriate.

4. The Mississippi Department of Environmental Quality proposes to conduct sampling of soil at the golf course, sediment at the golf course irrigation pond, and any utility wells within a mile radius of the site for pentachlorophenol, dioxins, and furans. The drinking water well closest to the site will be sampled for dioxins and furans.

ATSDR will reevaluate and expand its Public Health Actions when needed. New environmental, toxicological, or health outcome data, or the results of implementing the above proposed actions, might determine the need for additional actions at this site.
PUBLIC COMMENT RELEASE

PREPARERS OF THE REPORT

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Division of Health Assessment and Consultation

ATSDR Regional Representative:

Robert Safay
Environmental Health Specialist
EPA Region IV
REFERENCES


14. Agency for Toxic Substances and Disease Registry. Record of Activity for telephone communication with Forrest County


PUBLIC COMMENT RELEASE


40. Mississippi Department of Natural Resources. Mississippi Bureau of Pollution Control. Sample Request Form. January 24, 1979.
41. Mississippi Department of Natural Resources. Mississippi Bureau of Pollution Control. Sample Request Form. January 27, 1981.

42. Mississippi Department of Natural Resources. Memorandum to Mr. Richard H. Pierce, Jr. January 26, 1977.

43. Mississippi Department of Natural Resources. Memorandum to Mr. John Harper. February 15, 1982.


45. Environmental Protection Agency. Risk-Based Concentration Table. Roy L. Smith, EPA Region III. April 14, 1992


APPENDICES
APPENDIX A
SAMPLE LOCATIONS

1. Ponded sediment area
2. Ditch
3. Toe of closed Penta compound
4. Ponded sediment area
5. Process area
6. Treated products area
7. Monitoring well location
8. Location sampled

SOURCE: DRAWING PREPARED FROM SURVEY MAP BY SHOWS AND DEARMAN, INC., HATTIESBURG, MISSISSIPPI

DAVIS TIMBER COMPANY
HATTIESBURG, MISSISSIPPI

LAW ENVIRONMENTAL INC.

SITE SAMPLING AT:
GROUND-WATER MONITORING
WELL LOCATIONS

JOB NO. ED4343
PUBLIC COMMENT RELEASE

Toxicity Equivalency Factors for Polychlorinated Dioxins and Furans

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Name</th>
<th>Toxicity Equivalency Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCDFs</td>
<td>Tetrachlorodibenzo-furans</td>
<td>0</td>
</tr>
<tr>
<td>2,3,7,8-TCDF</td>
<td>Tetrachlorodibenzo-furan</td>
<td>0.1</td>
</tr>
<tr>
<td>PECDFs</td>
<td>Pentachlorodibenzo-furans</td>
<td>0</td>
</tr>
<tr>
<td>1,2,3,7,8-PECDF</td>
<td>Pentachlorodibenzo-furan</td>
<td>0.05</td>
</tr>
<tr>
<td>2,3,4,7,8-PECDF</td>
<td>Pentachlorodibenzo-furan</td>
<td>0.5</td>
</tr>
<tr>
<td>HxCDFs</td>
<td>Hexachlorodibenzo-furans</td>
<td>0</td>
</tr>
<tr>
<td>2,3,7,8-HxCDF</td>
<td>Hexachlorodibenzo-furan</td>
<td>0.1</td>
</tr>
<tr>
<td>HpCDFs</td>
<td>Heptachlorodibenzo-furan</td>
<td>0</td>
</tr>
<tr>
<td>2,3,7,8-HpCDF</td>
<td>Heptachlorodibenzo-furan</td>
<td>0.01</td>
</tr>
<tr>
<td>OCDF</td>
<td>Octachlorodibenzo-furan</td>
<td>0.001</td>
</tr>
<tr>
<td>TCDDs</td>
<td>Tetrachlorodibenzo-p-dioxins</td>
<td>0</td>
</tr>
<tr>
<td>2,3,7,8-TCDD</td>
<td>Tetrachlorodibenzo-p-dioxin</td>
<td>1</td>
</tr>
<tr>
<td>PeCDDs</td>
<td>Pentachlorodibenzo-p-dioxin</td>
<td>0</td>
</tr>
<tr>
<td>2,3,7,8-PeCDD</td>
<td>Pentachlorodibenzo-p-dioxin</td>
<td>0.5</td>
</tr>
<tr>
<td>HxCDDs</td>
<td>Hexachlorodibenzo-p-dioxins</td>
<td>0</td>
</tr>
<tr>
<td>2,3,7,8-HxCDD</td>
<td>Hexachlorodibenzo-p-dioxin</td>
<td>0.1</td>
</tr>
<tr>
<td>HpCDDs</td>
<td>Heptachlorodibenzo-p-dioxin</td>
<td>0</td>
</tr>
<tr>
<td>2,3,7,8-HpCDD</td>
<td>Heptachlorodibenzo-p-dioxin</td>
<td>0.01</td>
</tr>
<tr>
<td>OCDD</td>
<td>Octachlorodibenzo-p-dioxin</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Due to a wide range of isomers for dioxins and furans, a Toxicity Equivalency Factor (TEF) has been applied to the results in Table 1, those figures are then summed, producing a total 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxicity equivalent. The TEF is used to analyze isomers of dioxins and related compounds, multiplying the concentration of each dioxin or furan by a weighted value so that the toxicity of the isomer can be considered equal to that of an equivalent concentration of the most toxic isomer. The TEF has been calculated for isomers and congeners that are less toxic than 2,3,7,8-TCDD, the most toxic and most widely studied of the chlorinated dioxins. This procedure has been applied to data in Table 1 in order to calculate the 2,3,7,8-TCDD toxicity equivalent of groundwater in monitoring wells 2, 3, and 4.
### Table 1. Summary of Polychlorinated Dioxins and Furans Found in On-site Groundwater Monitoring Wells

**09/18/90**

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Concentrations in µg/L</th>
<th>MW-2</th>
<th>MW-3</th>
<th>MW-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCDFs (Total)</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>0.000036</td>
</tr>
<tr>
<td>PeCDFs (Total)</td>
<td>0.00004</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>HxCDFs (Total)</td>
<td>0.0019</td>
<td>0.000043</td>
<td>0.000058</td>
<td></td>
</tr>
<tr>
<td>1,2,3,4,7,8-HxCDF</td>
<td>0.000082</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>1,2,3,6,7,8-HxCDF</td>
<td><strong>0.000032</strong></td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>1,2,3,7,8,9-HxCDF</td>
<td>0.00008</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>2,3,4,7,8,9-HxCDF</td>
<td>0.000075</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>HpCDFs (Total)</td>
<td>0.0078</td>
<td>0.0016</td>
<td>0.00033</td>
<td></td>
</tr>
<tr>
<td>1,2,3,4,6,7,8-HpCDF</td>
<td>0.0013</td>
<td>0.00031</td>
<td>0.000085</td>
<td></td>
</tr>
<tr>
<td>1,2,3,4,7,8,9-HpCDF</td>
<td>0.0002</td>
<td>0.000049</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>OCDF</td>
<td>0.0084</td>
<td>0.0019</td>
<td>0.00039</td>
<td></td>
</tr>
<tr>
<td>PeCDDs (Total)</td>
<td>0.000078</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>HxCDDs (Total)</td>
<td>0.0011</td>
<td>0.000036</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>1,2,3,4,7,8-HxCDD</td>
<td>0.00012</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>1,2,3,6,7,8-HxCDD</td>
<td>0.00024</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>1,2,3,7,8,9-HxCDD</td>
<td>0.00018</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>HpCDDs (Total)</td>
<td>0.016</td>
<td>0.0033</td>
<td>0.0011</td>
<td></td>
</tr>
<tr>
<td>1,2,3,4,6,7,8-HpCDD</td>
<td>0.011</td>
<td>0.002</td>
<td>0.00066</td>
<td></td>
</tr>
<tr>
<td>OCDD</td>
<td><strong>0.081</strong></td>
<td>0.016</td>
<td>0.0069</td>
<td></td>
</tr>
<tr>
<td>Total 2,3,7,8-TCDD Tox. Equ.</td>
<td><strong>0.0002953</strong></td>
<td><strong>0.00004149</strong></td>
<td><strong>0.00001474</strong></td>
<td></td>
</tr>
<tr>
<td>*Comparison Values</td>
<td>0.00001</td>
<td>0.00001</td>
<td>0.00001</td>
<td></td>
</tr>
</tbody>
</table>

Note: Shading designates the high and low concentrations.

ND = Not Detected

* = Environmental Media Evaluation Guidelines for 2,3,7,8-TCDD

1 = Reference Used: 25
**Table 2. Octachlorodibenzo-p-dioxin in Off-site Sediment Samples 10/17/86-10/18/86**

<table>
<thead>
<tr>
<th>Sampling Location</th>
<th>OCDD Concentration µg/kg</th>
<th>2,3,7,8-TCDD* Toxicity Equivalent µg/kg</th>
<th>Comparison Value ** µg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fork of Mineral Creek Below Site - 1&quot;</td>
<td>60</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>Fork of Mineral Creek Below Site - 2-4&quot;</td>
<td>50</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Fork of Mineral Creek Below Site - Leaf Litter</td>
<td>1000</td>
<td>1.0</td>
<td>0.05</td>
</tr>
<tr>
<td>Country Club Lake, Mid-Lake - 1&quot;</td>
<td>80</td>
<td>0.08</td>
<td>0.05</td>
</tr>
<tr>
<td>Country Club Lake, Dam - 1&quot;</td>
<td>250</td>
<td>0.25</td>
<td>0.05</td>
</tr>
<tr>
<td>Country Club Lake, Dam - 2-4&quot;</td>
<td>70</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>Private Lake, Dam - 1&quot;</td>
<td>20</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>Private Lake, Dam - Leaf Litter</td>
<td>100</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>Private Lake, Dock - 1&quot;</td>
<td>50</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Private Lake, Dock - 2-4&quot;</td>
<td>70</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>***Lake Serene, Dam Near Road - 1&quot;</td>
<td>&lt;0.1</td>
<td>&lt;0.0001</td>
<td>0.05</td>
</tr>
</tbody>
</table>

* Reference Used: 33
* 2,3,7,8-Tetrachlorodibenzo-p-dioxin toxicity equivalent
** Environmental Media Evaluation Guides, values reflect a child’s dose
*** Control sample taken from control watershed
Table 3. Concentrations of Pentachlorophenol Detected in the Tissue of Fish From the Lakes on Mineral Creek

<table>
<thead>
<tr>
<th>Date</th>
<th>Species</th>
<th>Sample</th>
<th>Pentachlorophenol μg/kg</th>
<th>Comparison Value μg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/03/87</td>
<td>Largemouth Bass</td>
<td>Fillet</td>
<td>4.7</td>
<td>26</td>
</tr>
<tr>
<td>12/03/87</td>
<td>Hybrid Sunfish</td>
<td>Fillet</td>
<td>11.6</td>
<td>26</td>
</tr>
<tr>
<td>12/03/87</td>
<td>Hybrid Sunfish</td>
<td>Whole</td>
<td>19.4</td>
<td>26</td>
</tr>
<tr>
<td>01/26/87*</td>
<td>Hybrid Sunfish</td>
<td>Whole</td>
<td>7,036</td>
<td>26</td>
</tr>
<tr>
<td>01/26/87*</td>
<td>Green Sunfish</td>
<td>Whole</td>
<td>2,840</td>
<td>26</td>
</tr>
<tr>
<td>01/15/82*</td>
<td>Unknown</td>
<td>Unknown</td>
<td>301</td>
<td>26</td>
</tr>
<tr>
<td>01/24/79*</td>
<td>Warmouth</td>
<td>Livers</td>
<td>4.4</td>
<td>26</td>
</tr>
<tr>
<td>01/24/79*</td>
<td>Chubsuckers</td>
<td>Whole</td>
<td>17</td>
<td>26</td>
</tr>
<tr>
<td>01/24/79*</td>
<td>Chubsuckers</td>
<td>Whole</td>
<td>17</td>
<td>26</td>
</tr>
<tr>
<td>12/28/76*</td>
<td>Unknown</td>
<td>Unknown</td>
<td>5,200</td>
<td>26</td>
</tr>
</tbody>
</table>

*References Used: 36, 38, 39, 41
* EPA comparison value
* Denotes samples that were taken on or within a few days following a documented fish kill

Table 4. Concentrations of Total 2,3,7,8-Tetrachlorodibenzo-p-dioxin Detected in the Tissue of Fish From Mineral Creek and Country Club Lake

<table>
<thead>
<tr>
<th>DATE</th>
<th>SPECIES</th>
<th>SAMPLE</th>
<th>TOTAL 2,3,7,8-TCDD TEQ μg/kg</th>
<th>COMPARISON VALUE μg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/87</td>
<td>Hybrid Sunfish</td>
<td>Whole Composite</td>
<td>0.15669</td>
<td>0.000021</td>
</tr>
<tr>
<td>12/87</td>
<td>Largemouth Bass</td>
<td>Fillet Composite</td>
<td>0.10328</td>
<td>0.000021</td>
</tr>
<tr>
<td>04/18/90*</td>
<td>Spotted Sunfish</td>
<td>Composite</td>
<td>0.007534</td>
<td>0.000021</td>
</tr>
<tr>
<td>04/18/90*</td>
<td>Spotted Sunfish</td>
<td>Unknown</td>
<td>0.003486</td>
<td>0.000021</td>
</tr>
<tr>
<td>06/12/91</td>
<td>Bluegill</td>
<td>Fillet</td>
<td>0.004693</td>
<td>0.000021</td>
</tr>
<tr>
<td>06/12/91</td>
<td>Brown Bullhead</td>
<td>Fillet</td>
<td>0.004907</td>
<td>0.000021</td>
</tr>
<tr>
<td>06/12/91</td>
<td>Largemouth Bass</td>
<td>Fillet</td>
<td>0.004427</td>
<td>0.000021</td>
</tr>
</tbody>
</table>

*References used: 44, 46, 47
* EPA comparison value
* Quality Assurance/Quality Control problems
### Table 5. Completed Exposure Pathways

<table>
<thead>
<tr>
<th>Pathway Name</th>
<th>Source</th>
<th>Environmental Media</th>
<th>Point of Exposure</th>
<th>Route of Exposure</th>
<th>Exposed Population</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOD CHAIN</td>
<td>DAVIS TIMBER COMPANY</td>
<td>FISH</td>
<td>RESIDENCE</td>
<td>INGESTION</td>
<td>MINERAL CREEK AND ITS LAKES' FISHEATERS</td>
<td>PAST PRESENT FUTURE</td>
</tr>
<tr>
<td>MINERAL CREEK AND LAKE SEDIMENT</td>
<td>DAVIS TIMBER COMPANY</td>
<td>SEDIMENT</td>
<td>MINERAL CREEK AND ITS LAKES</td>
<td>SKIN CONTACT, INGESTION</td>
<td>USERS OF MINERAL CREEK AND ITS LAKES</td>
<td>PAST PRESENT FUTURE</td>
</tr>
<tr>
<td>SURFACE WATER</td>
<td>DAVIS TIMBER COMPANY</td>
<td>SURFACE WATER</td>
<td>MINERAL CREEK AND ITS LAKES</td>
<td>SKIN CONTACT, INGESTION</td>
<td>USERS OF MINERAL CREEK AND ITS LAKES</td>
<td>PAST</td>
</tr>
<tr>
<td>PROCESS AREA SOIL</td>
<td>DAVIS TIMBER COMPANY</td>
<td>SURFACE SOIL</td>
<td>DAVIS TIMBER COMPANY SITE</td>
<td>SKIN CONTACT, INGESTION, INHALATION</td>
<td>ON-SITE WORKERS</td>
<td>PAST PRESENT FUTURE</td>
</tr>
</tbody>
</table>
## Table 6. Potential Exposure Pathways

<table>
<thead>
<tr>
<th>Pathway Name</th>
<th>Source</th>
<th>Environmental Media</th>
<th>Point of Exposure</th>
<th>Route of Exposure</th>
<th>Exposed Population</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUNDWATER</td>
<td>DAVIS TIMBER COMPANY</td>
<td>GROUNDWATER</td>
<td>RESIDENCE</td>
<td>SKIN CONTACT, INGESTION</td>
<td>USERS OF GROUNDWATER SOURCES NEAR THE DAVIS TIMBER COMPANY SITE</td>
<td>PAST PRESENT FUTURE</td>
</tr>
<tr>
<td>GOLF COURSE SOIL</td>
<td>DAVIS TIMBER COMPANY</td>
<td>SURFACE SOIL</td>
<td>HATTIESBURG COUNTY CLUB GOLF COURSE</td>
<td>SKIN CONTACT, INGESTION</td>
<td>GOLF COURSE EMPLOYEES AND USERS</td>
<td>PAST PRESENT FUTURE</td>
</tr>
<tr>
<td>POND SEDIMENT</td>
<td>DAVIS TIMBER COMPANY</td>
<td>SEDIMENT</td>
<td>HATTIESBURG COUNTY CLUB GOLF COURSE IRRIGATION POND</td>
<td>SKIN CONTACT, INGESTION</td>
<td>NEIGHBORHOOD CHILDREN</td>
<td>PAST PRESENT FUTURE</td>
</tr>
</tbody>
</table>
Appendix C
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 16, 1974</td>
<td>Country Club Lake</td>
</tr>
<tr>
<td>December 28, 1976</td>
<td>Country Club Lake</td>
</tr>
<tr>
<td>February 2, 1978</td>
<td>Country Club Lake</td>
</tr>
<tr>
<td>January 24, 1979</td>
<td>Country Club Lake</td>
</tr>
<tr>
<td>January 28, 1979</td>
<td>Downstream Private Lake</td>
</tr>
<tr>
<td>January 14, 1982</td>
<td>Downstream Private Lake</td>
</tr>
<tr>
<td>February 15, 1983</td>
<td>Country Club Lake</td>
</tr>
<tr>
<td>January 24, 1987</td>
<td>Country Club Lake</td>
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</tbody>
</table>