Health Consultation

LCP CHEMICALS

BRUNSWICK, GLYNN COUNTY, GEORGIA

CERCLIS NO. GAD099303182

OCTOBER 2, 1996

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members.

This document has previously been 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 health consultation has now been reissued. This concludes the health consultation 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.

HEALTH CONSULTATION

LCP CHEMICALS

BRUNSWICK, GLYNN COUNTY, GEORGIA

CERCLIS NO. GAD099303182

Prepared by

Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Superfund Site Assessment Branch

PURPOSE

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared a petitioned health consultation for Linden Chemical and Plastics (LCP Chemicals), Brunswick, Georgia in August 1994 [1]. Removal and containment actions and extensive seafood sampling have taken place at the site since that health consultation. Also, LCP was proposed to the Environmental Protection Agency's (EPA) National Priorities List (NPL) on June 17, 1996. This health consultation is a follow-up to the previous ATSDR health consultation.

FINDINGS

In 1994, ATSDR identified LCP in the health consultation as a public health hazard because the uncontrolled release of mercury into the environment posed a imminent threat to people's health. We are now identifying the site as an indeterminate health hazard because we do not have adequate exposure information to either support or deny that exposures to contaminants at levels of health concern are occurring. When we have evaluated additional data, we may change the classification. Studies in progress, such as the Emory University Former LCP Workers Health Study and the Brunswick Area Fish Consumption Study, will answer many questions: e.g., are adverse health effects likely for people who worked in the Former Mercury Cell buildings, and who eats seafood caught from the waters surrounding Brunswick, and at what frequency do they consume seafood?

Meanwhile, the State of Georgia has emphasized the need for caution concerning fish consumption by releasing a new seafood consumption advisory and has restricted all fishing in the most-contaminated areas, Purvis and Gibson creeks. The state has determined safe seafood intake rates for contaminated species found in the unrestricted areas and, because the EPA has conducted on-site contaminant containment and removal actions, contaminants are probably not migrating off site.

Consumption of seafood and other foods (i.e., clapper rails) is a potential exposure pathway because people may have consumed contaminated seafood in the past; they may be ignoring the postings warning people not to enter the area or to collect or eat seafood from Gibson and Purvis creeks; or they may be consuming more fish than the state of Georgia recommends.

The nature and extent of the surface water, soil, sediment, and groundwater contamination require further characterization.

Contaminants in off-site air do not appear to be a problem at this time. In the past when LCP was operational, contaminant levels may have been higher and may have been of health concern.

BACKGROUND

LCP Chemicals is immediately northwest of the city of Brunswick, Glynn County, Georgia, at 65 Ross Road. Glynn County is in the southeastern part of the state on the St. Simons Sound and the Atlantic Intracoastal Waterway. Brunswick is a commercial fishing port. Large areas of tidal marshes in the area provide a feeding and breeding habitat for several species of animals [2]. Naval stores, pulp and wood products, and tourism based on the nearby Golden Isles[1] are an integral part of the Brunswick/Glynn County economy.

LCP Chemicals is no longer operational; the plant was closed in 1994. The site covers 550 acres, 480 of which are tidal marshland. The former LCP industrial area is on 70 acres upland of the tidal marshes [3]. LCP is bordered by the Turtle River and its marshes on the west, a county disposal facility and pistol range on the north, Ross Road on the east, and the Palmetto-Selden Park-Greenwood Cemetery on the south (Figure 1). There is a buffer zone to the east along Ross Road. The area to the north and east is mostly residential but has some light industry. Except for the cemetery, the area to the south is mostly residential.

In the past, several different industries have occupied the area now occupied by LCP. The first was the Atlantic Richfield Company (ARCO), formerly known as the Atlantic Refining Company. ARCO purchased parcels of land from 1918 to 1935 during which the company built and operated an oil refinery on the area upland of the marsh. From 1937 to 1950, Georgia Power Company obtained portions of the site property, including two parcels from ARCO. The Dixie Paint and Varnish Company manufactured paint and varnish on a portion of site property south of the Georgia Power parcel. By the mid-1950s, Allied Chemical and Dye Corporation (Allied Chemical) acquired most of the property that comprises the site. Allied Chemical conducted a chlor-alkali chemical manufacturing process to produce chlorine gas, hydrogen gas, and caustic solution at the site. The current owner of the majority of the property is LCP Chemicals-Georgia, a division of the Hanlin Group, Inc. Georgia Power retained a 2.9-acre parcel of land.

Commercial and recreational fishing took place in both Purvis Creek and the Turtle River until fishing was banned in 1992 because of high levels of mercury and polychlorinated biphenyls (PCBs) detected in fish tissue [4].

Past Operations

LCP received a National Pollution Discharge Elimination System (NPDES) permit that allowed the plant to discharge treated process wastewater [1]. The NPDES discharge outlet, the outfall pond on Figure 2, is near a tributary that feeds into Purvis Creek. The

---

[1]Four islands comprise the Golden Isles; they are Jekyll, St. Simons, Sea, and Little St. Simons islands.

wastewater was contaminated with metals and organic chemicals. In 1994, after a period of severe decline, the State of Georgia revoked the facility's NPDES permit because of noncompliance [5]. The Georgia Environmental Protection Division (EPD) reports that LCP was in violation of its water permit about one-third of the time it was in operation [1]. The state referred the site to the EPA, and the Emergency Response and Removal Branch issued a Unilateral Administrative Order (UAO) to Allied Signal and LCP Chemicals in April 1994. Allied was issued a Notice of Noncompliance on March 17, 1995. This notice cited numerous health and safety violations and failure to comply with the conditions of the UAO issued in April [5]. Later the UAO was amended to include ARCO, Dixie Paints, and the Georgia Power Company.

On-Site Contamination

The contaminants of greatest concern at LCP are mercury, PCBs, and lead. The source of the mercury is the past chlor-alkali process. Mercury is found in soil, groundwater, and air. PCBs are prevalent on the site. PCBs will be analyzed in all media sampled during the remedial investigation [3]. The predominant PCB congener found on site is Aroclor-1268. Lead is found in soil, groundwater, and sediments. Georgia EPD believes that the lead and PCB contamination resulted from operations of Georgia Power and the Dixie O'Brien Paint Company [6]. Little is known about the nature of past refinery operations and waste disposal practices [6].

The primary source areas correspond to the former solid waste management units and other on-site areas that once contained hazardous substances and are being removed as part of the ongoing removal action. Former hazardous waste handling areas are shown on Figure 2. EPA will conduct a remedial investigation/feasibility study (RI/FS) to identify and characterize the secondary source areas.

DISCUSSION

Biota

Contaminants that can bioaccumulate and bioconcentrate in the food chain have been released into the marsh. The food chain is the series of organisms that are consumed by each other, beginning with single-celled animals and increasing in size to multi-celled animals such as birds and then to man, the highest trophic or predator level. Chemicals in the environment can pass through the food chain to man. Bioaccumulation is the process by which toxic chemicals, etc. gradually accumulate in living tissue. Bioconcentration is the process by which tissue concentrations of a bioaccumulated chemical increase as the chemical passes through the food chain. Contaminants are bioaccumulating at various levels of the food chain in the LCP marsh.

Seafood

Georgia EPD has recently issued its 1996 Revised Fishing Advisory [4]. Appendix B contains a listing of species-specific advisories. The state sampled seafood at the nine arbitrarily assigned geographic areas labeled A-I on Figure 3. The state sampled a variety of fin fish, blue crabs, and shrimp. Methods the state toxicologist used to determine seafood intake can be found in Appendix B.

Results of Seafood Sampling

PCBs and mercury are the contaminants of concern in seafood. *The state is advising that no one collect or consume seafood from Purvis or Gibson creeks because of PCB and mercury contamination in areas H and I on Figure 3.* The state's recommended intake limits are one of the following for each species sampled: do not eat, eat once per month, eat once per week, or no restrictions on intake. These recommendations are based on the species location and species specific contaminant levels. Appendix B contains a list of the recommended intakes for each species sampled. For simplification, the state also combined sampling areas (e.g., areas A, B, and C, Table B-7) because people may catch and consume fish from more than one area at a time.

PCBs were generally the drivers for restricting fin fish intake limits. Mercury generally was the driver for shellfish.

Area H (Table B-8), which is closest to LCP, had more stringent restrictions on seafood consumption than the other areas sampled. Because of the proximity of Areas H and I to LCP and the higher contaminants levels found there, the state has maintained the restriction on all fishing in those two areas. Even though the recommended intake limits for species sampled in Areas H and I are listed in Appendix B, those areas are closed to fishing. Collection of clams, oysters, and mussels is prohibited in the entire area because of National Shellfish Program standards.

ATSDR has examined the seafood contamination data and reviewed the methodology the Georgia EPD staff members used at LCP to determine safe seafood intake limits. ATSDR believes that the seafood intake limits set by the state are protective of people's health for cancerous and noncancerous outcomes.

Past Sampling

The recommendations and advisories issued by the state have changed over the years as additional sampling has been conducted and new data have become available. Seafood sampling has been conducted in 1992, 1993, and 1995. Appendix B has a discussion of the sampling that took place prior to 1995.

Clapper Rails

The Georgia EPD raised the issue of consumption of clapper rails *(Rallus longirostris)*, sometimes called marsh hens. Rails live in salt marshes like the one on the LCP property. Clapper rails feed at low tide on mudflats and along the banks of creeks and marshes. They eat crabs, crayfish, mollusks, worms, and other marine animals, fish, insects, and amphibians.

Because contaminants that can bioaccumulate and bioconcentrate in the food chain have been released into the marsh and clapper rails feed on animals at the lower end of the food chain, it is possible that the clapper rails could have high levels of contaminants in their tissues. Appendix A (Figure 4) contains a schematic of the LCP food chain. State investigators analyzed clapper rails breast tissues and found high levels of mercury. People have been known to consume clapper rails. Persons who consume clapper rail breast tissue could be adversely affected by the mercury-contaminated tissues.

Surface Water, Sediments, and Stormwater and Surface Water Run-Off

LCP is drained by Purvis Creek and its tributaries, which empty into the Turtle River (Figure 1). Tides influence the Turtle River and Purvis Creek and its tributaries. Purvis Creek starts in a residential area about 1 mile north-northwest of the intersection of the main site road with the railroad tracks at the loading dock area. The creek is 2 miles long and winds through the marsh to the west of the site and empties into the Turtle River. The LCP outfall pond empties through a narrow channel into the Purvis Creek. The industrial portion of LCP lies within the 100-year flood plain. The waste handling areas (Figure 2), the canal leading from the LCP outfall pond to Purvis Creek, and the marsh are areas of concern. Surface water sediments in the initial sampling showed that canal sediments contained 78 ppm mercury and 85 ppm PCBs near the pond and 17 ppm mercury and 10 ppm PCBs further down the canal **[9]**. Mercury contaminant levels in marsh surface sediments ranged from 45 to 350 ppm. Marsh water mercury levels ranged from 0.4 to 43 parts per billion (ppb).

EPA is conducting an ecological risk assessment to determine appropriate remedial measures, to gather additional biota samples for the evaluation of advisories, to determine whether threats to endangered species exist, and to evaluate the distribution of specific contaminants in the adjacent salt marsh **[9]**. When they become available, ATSDR will review the results of the ecological risk assessment to determine the public health implications if any exist.

A network of stormwater diversion berms and ditches has been constructed on site to contain the stormwater run-off. Stormwater is diverted, treated, and released into the marsh. Contaminated sediments and surface water should not pose a health threat to people because entry to the area around LCP is restricted. In the past, people may have been exposed to

contaminants because people fished in the area before entry was restricted.

Groundwater

Three aquifer systems exist in the Brunswick area: the shallow, the Miocene, and the Floridian. The nearest well used for potable water is 1/2 mile southeast of the LCP site **[6]**. Groundwater movement is toward Purvis Creek and the Turtle River. The shallow aquifer is contaminated and may be discharging into the marshland west of the site **[3]**.

The shallow aquifer underneath LCP is highly contaminated and is not used for drinking water. Aroclor-1268 was detected as high as 3,918 ppb, mercury was detected up to 290,350 ppb, and lead was detected up to 26,243 ppb in the shallow aquifer.

The City of Brunswick supplies potable water to most of its residents. The city wells draw groundwater from the Upper Floridian Aquifer and the Miocene Aquifer. Eight municipal wells are within and north of the city **[6]**.

Some residents north of the site are reported to use private wells. Since the private wells are upgradient of the site, it is unlikely that contaminants found on site are affecting private wells. The private wells draw water from the Miocene Aquifer.

EPA representatives sampled several private wells during 1994 and 1995. They tested private wells on Blythe Island as well as at the homes surrounding the marsh to ensure that the wells were not contaminated. No contaminants were detected in any of the private wells sampled. EPA staff members are tentatively planning to conduct further off-site groundwater sampling at Blythe Island. Blythe Island is directly across the Turtle River and southwest of the site and may potentially be affected by the LCP contaminants.

In April 1996 while pretesting a newly installed Miocene Aquifer monitoring well drilled near the Canal Road (Figure 2), EPA detected lead in the groundwater **[10]**. The sample was not a true monitoring well sample like the ones that will be taken for the RI/FS. EPA resampled the monitoring well and no lead was detected. The presence of lead may have been the result of cross contamination (i.e., sediments in the monitoring well). The Miocene Aquifer supplies potable water to homes along the marsh and on Blythe Island. Nine hundred homes draw water from the aquifer.

Contaminants in the shallow aquifer do not pose a health concern because the water in the aquifer is not potable and there are no private wells drawing water from the shallow aquifer. The RI/FS will provide a better definition of the extent of the groundwater contamination.

Soil

Preliminary soil sampling results indicate that high levels of mercury, lead, and PCBs are present in on-site soils. The highest levels of mercury in soil were found underneath and near the Cell Buildings (3,700 ppm dry weight). Lead was detected at the North Separator at 160,000 ppm and PCBs at the Removal Stockpile Area at 1,700 ppm (Figure 2). The RI/FS will provide a better definition of the extent of the on-site soil contamination.

In 1994 and 1995, EPA representatives sampled off-site soil at several areas surrounding LCP. They detected low levels of pesticides along Ross Road, but the pesticides are not associated with LCP contamination. LCP contaminants do not appear to have migrated off site. Soil contamination does not pose a health concern to people off site.

Air

From April 18 to June 22, 1995, EPA representatives conducted on-site air sampling to determine whether contaminants were migrating off site. They evaluated ambient air levels of mercury, PCBs, barium, lead, polynuclear aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and particulates. They conducted stationary and mobile air monitoring downwind of the work zone areas and at selected air sampling locations **[11]**.

ATSDR reviewed the 1995 EPA air sampling data. Mercury consistently appeared above background levels near and downwind of the cell buildings. The highest level of mercury in air, 94.4 micrograms per cubic meter ($\mu g/m^3$), was detected on April 18, 1995, at a sampling station between the cell buildings and the area downwind of the demolition activities (Figure 2). The particulate sampling was inconclusive because of problems with the monitor. VOCs were not detected above background levels **[11]**. Barium and PAHs were not detected. Wind direction during the sampling events was predominantly from the southwest.

All of the 1995 perimeter contaminant levels were low. Low levels of both lead and various PCBs were detected at the perimeter monitors. The highest perimeter mercury level was 3.3 $\mu g/m^3$. Upwind of that monitor, levels were lower: 0.47 $\mu g/m^3$ and nondetectable.

Off-site migration of contaminants in ambient air does not appear to be a problem based on the 1995 data but may have been a problem in the past when the plant operation and maintenance was poor. Most of the mercury has been removed from the cell buildings; therefore, present air mercury levels should be even lower, but we do not have past air monitoring data to compare to the 1995 monitoring data.

Georgia EPD conducts routine air monitoring as required by federal law. There is an air sampling station near Brunswick, and the state has been in continuous compliance at that station. As part of the Brunswick Initiative, the state is planning to conduct extensive air

monitoring in the Brunswick area to determine the nature and extent of any possible air contamination resulting from the presence of numerous hazardous waste sites in the area [12]. See Appendix C for the list of the target analytes.

The final results of the air monitoring study will not be available until 1998. ATSDR will review the air monitoring workplan when it becomes available. State investigators will be testing for all air contaminants except mercury, which will be tested by Region IV EPA representatives.

Ozone is one of the compounds the state is required to monitor. An anomaly in the ozone readings at the Brunswick station appeared during the summer of 1995 when site remediation was taking place. An unusually high ozone level was detected at 2 AM. The ozone reading appeared to be in violation of federal law, but contaminants such as mercury vapors can interfere with ozone monitors. The ozone monitor was checked and found to be fully functional. The summer of 1995 was the only time the Brunswick ozone level was in violation of the law. When ambient ozone levels are high, the highest levels are normally detected during the day. It is unclear why the monitor gave a false positive and whether the substance that interfered with the accuracy of the reading was mercury or another contaminant.

FUTURE LAND USE

According to EPA, there are plans to reuse the site once remediation is complete. If risk-based clean-up standards are met after soil remediation is complete, future construction and utility workers will not be at health risk if exposed to subsurface soil contamination during excavation or construction. However, institutional controls may be necessary to restrict future uses in areas where contamination remains.

OFF-SITE CONTAMINATION

ATSDR searched the Toxic Chemical Release Inventory (TRI) to determine whether other facilities have released into the environment chemicals that may have contributed to the contamination of the air, water, or land. Operators of industrial facilities submit data to the EPA in compliance with Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986. TRI data have been compiled for years 1987 through 1993. We searched TRI for releases in Glynn County. There are many hazardous material handling sites within Glynn County, (Figure 5) and numerous releases have occurred over the years. EPA representatives have been conducting cleanups under Superfund at Escambia Wood Treating Plant (Brunswick Wood Preserving) and the Hercules 009 Landfill (Figure 3). CERCLIS and the Georgia Hazardous Site Inventory have identified 20 potentially hazardous waste sites, which have released VOCs, metals, acids, and bases into the environment (Figure 5).

TRI does not identify all toxic substance releases. Releases that are not reported include unknown releases or spills, those releases that happened before 1987, releases at landfills through surface run-off or groundwater migration, and releases from facilities with less than 1,000 pounds of hazardous materials.

PUBLIC HEALTH IMPLICATIONS

This section describes the possible health effects associated with exposure to PCBs, mercury, and lead. Fish consumption is a potential pathway because people may have engaged in subsistence fishing in the past or may continue to consume fish above the recommended Georgia EPD intake limits. Former workers or trespassers may have been exposed to contaminants.

An exposure dose for seafood consumption was calculated. The assumptions ATSDR used to calculate an exposure dose for seafood consumption are listed in Appendix B.

PCBs

If people consume fish from the restricted areas, particularly from Purvis Creek or if people consume seafood above the recommendations of the state, adverse health effects could possibly occur. Also, if people consumed certain seafood species from the area near LCP prior to 1991 when the first advisory was issued, adverse health effects could possibly occur. Information on contaminant levels in seafood prior to 1991 does not exist. The first year seafood was sampled was 1991. Seafood PCB levels in the past may have been higher than levels seen from 1991 to 1995. The highest PCB level detected in seafood was found in blue crab collected in a tributary to Purvis Creek, downstream of LCP during the first sampling event.

EPA has classified PCBs as probable human carcinogens. Health assessors calculated the cancer risks of consuming seafood caught near LCP. Several of the cancer risk numbers exceed the 1×10^{-4} risk level. If people consume or consumed the species listed in Table 1 with cancer risk values that exceed 1×10^{-4}, then adverse health effects are possible.

The chlor-alkali industry and Georgia Power were on site in the mid 1950s. We do not know how long the seafood near LCP has been contaminated. Therefore we can not say for sure that people have had longterm exposure to contaminants or whether adverse health effects will occur.

PCB exposure should be minimized, because these chemicals can cause adverse effects on skin, liver, and developmental processes and may cause adverse reproductive effects in humans. We do not know the lowest concentrations of PCBs that produce these adverse health effects **[13]**. We also do not know whether these kinds of health effects could result

from eating PCB-contaminated seafood, because studies of the health effects of consuming PCB-contaminated food are inconclusive [13].

We do know that fetuses, nursing infants, and people with compromised liver function are particularly susceptible to the toxic effects of PCB contamination. Fetuses can be exposed to PCBs when these chemicals are transported across the placenta. Infants can also be exposed to PCBs that accumulate in breast milk. Infants and fetuses lack liver enzymes necessary to metabolize and excrete PCBs, and human breast milk contains a compound that inhibits infants' metabolism and excretion of PCBs [14]. Persons with compromised liver function and others taking medications potentially toxic to the liver may also be more sensitive to the toxic effects of PCBs [14].

For this health consultation, ATSDR health assessors and the State of Georgia used 1×10^{-4} for acceptable risk level when calculating intake values. Exposures that exceed 1×10^{-4} are not exceptable.

Table 1
Maximum PCB Concentration for Each Species Collected From 1991 to 1995

Species	Location	Year	PCB Concentration	Cancer Risk
Spotted Sea Trout	Purvis Creek	1995	1.04	6×10^{-3}
Red Drum	Purvis Creek	1995	0.4	2.4×10^{-3}
Black Drum	Turtle River from Highway 303 to Buffalo River	1995	1.31	7.9×10^{-3}
Spot	Purvis Creek	1995	0.47	2×10^{-3}
Croaker	Purvis Creek	1995	1.23	7.4×10^{-3}
Mullet	Purvis Creek	1995	1.38	8.3×10^{-3}
Flounder	Gibson Creek	1995	0.08	4×10^{-4}
Whiting	Turtle River from Georgia Highway 303 to Channel Marker 9	1995	0.25	1.5×10^{-3}
Yellow Tail	Brunswick River from US Highway 17 to Channel Marker 27	1995	0.04	2.4×10^{-4}
Sheepshead	Turtle River from Georgia 303 to Channel Marker 9	1992	0.41	2.4×10^{-3}
Shrimp	South Brunswick River from Hillery Creek and Fancy Bluff Creek	1995	0.38	2.2×10^{-3}
Blue Crab	Tributary to Purvis Creek, Downstream of LCP	1991	9.9	6.6×10^{-2}
Oysters	Tributary to Purvis Creek, Downstream of LCP	1991	0.44	2.7×10^{-3}

Mercury

Mercury is a naturally occurring element that exists in various forms: metallic, inorganic,

gaseous, and organic. Most of the inorganic mercury has been removed from the soil and the former cell buildings (Figure 2).

Organic Mercury

We are most concerned about organic mercury at LCP. When mercury bonds with carbon, it becomes organic mercury. Methylmercury is the usual organic form of mercury created by these natural processes. Methylmercury is of concern at LCP because it can build up in certain fish to levels that are many times greater than concentrations in the surrounding water **[15]**.

The highest mercury levels detected in seafood was found in black drum and blue crab collected in the Turtle River from Georgia 303 to Channel Marker 9 (Area D). Several of the exposure doses listed in Table 2 exceed the EPA's oral reference dose[2] (RfD) for methylmercury, 0.0003 mg/kg/day. ATSDR does not have a MRL[3] for methylmercury. Adverse health effects may occur if in the past people consumed species of fish with high levels of mercury that were caught in the areas listed in Table 2. Also if people consume fish from the restricted areas adverse health effects are possible. Mercury levels were particularly high in red drum, black drum, sheepshead, and blue crab (Table 2). Very high mercury levels were not detected during the latest round of sampling that took place in 1995 (Appendix B). Shrimp was the only species where the mercury concentration increased in 1995. Shrimp spawn near LCP. While the shrimp found near LCP are too small for human consumption, the shrimp may retain some of the mercury as adults.

Fetuses, nursing infants, and children are at greatest risk of adverse health effects resulting from methylmercury exposure **[15]**. All of the LCP mercury exposure doses calculated for children exceed the RfD of 0.0003 mg/kg/day. Persons with liver, kidney, lung, or nerve disease may be sensitive to the toxic effects of mercury. The central nervous system is the primary target of methylmercury toxicity. Methylmercury exposure has resulted in pronounced adverse neurological and developmental effects in fetuses **[15]**. The exact amount of methylmercury in fish (or food) that pregnant women would have to ingest for neurological and developmental effects to develop has not been determined. Mercury in pregnant women's hair is used as an indicator of neurological and developmental effects in children. An estimated maternal exposure of 0.0012 mg/kg/day corresponding to a hair level of 14 ppm has lead to adverse health effects for fetuses **[15]**.

---

[2]RfD is an estimate of the daily exposure to a contaminant below which adverse noncancer health effects are not expected.

[3]MRL is an estimate of the daily human exposure to a contaminant that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure.

Table 2
Maximum Mercury Concentration for Each Species Collected From 1991 to 1995

Species	Location	Year	Mercury Concentration (ppm)	Exposure Dose Child (mg/kg/day)	Exposure Dose Adult (mg/kg/day)
Spotted Sea Trout	Gibson Creek	1995	0.58	0.044	0.0001
Red Drum	Turtle River from Georgia 303 to Channel Marker 9	1992	6.8	0.0523	0.0117
Black Drum	Turtle River from Georgia 303 to Channel Marker 9	1992	8.5	0.0654	0.0149
Spot	Purvis Creek	1995	0.11	0.0008	0.00019
Croaker	Turtle River from Georgia 303 to Channel Marker 9	1992	2.4	0.0185	0.0042
Mullet	Buffalo River Upstream of the Turtle River	1995	0.27	0.0021	0.0005
Flounder	Turtle River from Georgia Hwy. 303 to Channel Marker 9	1995	0.36	0.0028	0.0006
Whiting	Purvis Creek	1995	0.45	0.0035	0.0008
Yellow Tail	Brunswick River from US Highway 17 to Channel Marker 27	1995	0.32	0.0025	0.0006
Sheepshead	Turtle River from Georgia 303 to Channel Marker 9	1992	3.7	0.0285	0.0065
Blue Crab	Turtle River from Georgia 303 to Channel Marker 9	1992	8.5	0.065	0.015
Shrimp	Turtle River from Georgia 303 to Channel Marker 9	1995	2.4	0.0185	0.004
Oysters	Tributary to Purvis Creek, Downstream of LCP	1991	1.2	0.009	0.002

Mercury in Air

Metallic mercury is liquid at room temperature, but it can vaporize into the air and be carried long distances before returning to water or soil in rain or snow. Exposure to mercury in air could have taken place in the past. Inhalation is the most toxic route of exposure to metallic mercury. The primary route of exposure to metallic mercury in soil is inhalation of mercury vapors. When mercury vapors are inhaled, absorption into the bloodstream can be substantial [15]. Human tissue retains approximately 74% to 80% of inhaled elemental mercury vapor. Inhaled mercury is distributed throughout the human body, and it accumulates primarily in the kidneys. Metallic mercury can enter the body by way of inhalation, then enter the blood stream, and cross the blood-brain barrier and accumulate in the central nervous system. If a pregnant woman inhales mercury vapors, mercury may cross the placenta and accumulate in fetal tissues.

People working in and around the mercury cell buildings would have had the highest exposure to mercury in air. Exposure to high levels of inorganic mercury vapors can permanently damage the brain, kidneys, and developing fetus. The nervous system is most sensitive to mercury's effects. The neurological effects include personality changes, tremors, changes in vision or hearing, and difficulties with memory. Short-term effects to high levels of metallic mercury vapor can damage the lungs, cause nausea, vomiting, or diarrhea, cause increases in blood pressure or heart rate, and cause skin rashes or eye irritation [15]. Mercury Cell Building workers are the only population that may have experienced any of these adverse health effects.

Lead

Exposure to lead by the general population is unlikely at this time because entry to LCP is restricted. In the past, people did fish near LCP and trespass. They may have been exposed to lead in the surface soil and sediments.

Adverse health effects resulting from lead exposure in children are well documented [16]. These effects include impaired mental and physical development, decreased heme biosynthesis, elevated hearing threshold, and decreased serum levels of vitamin D [17]. To help prevent adverse health effects, a child's blood lead level should be kept below 10 μg/dL (micrograms/deciliter), and an adult's below 40 μg/dL [16]. Health guidelines (i.e., cancer slope factors and an RfD) have not been established for lead. Persons with sickle cell anemia may be especially sensitive to the neurological effects of lead exposure. Middle-aged men are at risk for increased blood pressure resulting from lead exposure. In addition, those with dietary deficiencies in calcium, iron, and zinc may be susceptible to the adverse effects of lead [16]. It is not very likely that people would experience these adverse health effects unless they worked with and frequently ingested large amounts of LCP soil or sediment.

Health Outcome Data

Staff members of the Glynn County Health Department and the Southeastern Georgia Regional Medical Center studied the cancer rate in Glynn County for the period from 1979 to 1992. The health department found that the cancer rate was slightly higher, but the increased rate could be the result of the older age of the residents in Glynn County, since the chance of developing cancer increases with age. Jekyll and St. Simons islands are popular retirement areas. County investigators compared Glynn County cancer rates with those for other counties across Georgia and across the nation. The Glynn County cancer rates are not greatly out of line with rates for other communities **[18]**. The county does not maintain a registry for either cancer or birth defects. County- or city-level investigations of cancer and birth defects in people living near the site would be unlikely to detect a statistically significant increase in disease in the potentially affected population because the population size is too small to give valid results.

Health Studies and Community Education

In Glynn County, EPA's Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) and Georgia's Hazardous Site Inventory have identified a total of 20 potential hazardous waste sites. The Brunswick/Glynn County Community Based Environmental Project, also known as the Brunswick Initiative, is a program to assess the Glynn County area by crossing media-specific lines in a coordinated effort that protects the ecosystem while building partnerships with other federal, state, and local agencies, community organizations, and the business community **[2]**. The Brunswick Initiative is being funded jointly by the state and EPA. This study should yield valuable data (e.g., the Brunswick area air study, refer to Air section on page 7).

Glynn County representatives are conducting an area fish consumption study, as well as, community involvement activities. The Study of Adverse Health Effects Due to Consumption of Seafood Contaminated with Mercury will investigate the extent of potential adverse health effects related to consumption of locally caught seafood contaminated as a result of hazardous releases from LCP **[19]**. The study is being funded for one year through a cooperative agreement with ATSDR and the Centers for Disease Control and Prevention.

The study began on September 30, 1995, and will conclude on September 27, 1997. The study is designed to accomplish several objectives: (1) determine the mercury exposure levels of individuals who consumed contaminated seafood from the coastal river, creeks, and tidal marsh adjacent to LCP; (2) determine whether it is possible to detect adverse health effects related to such contamination; (3) provide an assessment of the accuracy of self reporting of seafood consumption; and (4) provide a basis for developing sound recommendations for seafood consumption advisories **[19]**.

The study will include a questionnaire, a dietary survey, urine mercury/creatinine clearance

testing, health history, physical examination, review of individual medical records, and medical referrals for neurological and renal diagnostic procedures indicated by abnormal values and/or symptoms **[19]**.

Emory University has received a grant to conduct a health study to determine whether workers at LCP while the plant was operating experienced adverse health effects **[20]**. The National Institute for Occupational Safety and Health (NIOSH) and Duke University studied LCP worker exposure in the mid-1980s. Both studies reveled significant worker exposure to various toxic substances: chlorine gas, mercury vapor, and hydrochloric acid **[5]**. When operational, the plant was in violation of the Occupational Safety and Health Administration Permissible Exposure Limit, the NIOSH Recommended Exposure Limit, and the American Conference of Governmental Industrial Hygienists Threshold Value for mercury vapor concentration. The Duke study identified cell-room workers having the potential for excessive exposure to mercury vapor **[5]**. The Emory study will be a continuation of the previous worker health studies.

The Glynn County Health Department has received a grant from the National Association of County and City Health Officials (NACCHO) and ATSDR to conduct an Environmental Health Education Needs Assessment (EHENA) Project. The project is designed to help local health officials identify community health education needs, create a process for involving community residents in Superfund site decision-making, and conduct community health education.

Conclusions

1. We are identifying LCP is an indeterminate public health hazard for purposes of this consult because we do not have adequate exposure information to support identification in any other available classification. When we have evaluated additional data (i.e., the fish consumption study data), we may change the classification. The seafood intake values calculated by Georgia EPD are protective of the public's health. People should consume seafood at the recommended intake limits only. People should not consume clapper rails.

2. The food chain in LCP marsh, the Turtle River, and Purvis Creek and its tributaries is contaminated with mercury and PCBs because of past disposal practices at LCP.

3. On-site removal and containment have stopped the movement of contaminants into the marsh.

4. Marsh sediments are contaminated because of past disposal practices.

5. We do not know the nature and extent of the groundwater contamination in the shallow aquifer. The water that people use for drinking is not contaminated.

6. On-site surface and subsurface soils are contaminated but do not pose a health threat to people off site.

7. Off-site soils are not contaminated from past LCP disposal practices.

8. Several data gaps will be filled when the health studies are complete.

Recommendations

1. People, especially pregnant women, women planning to become pregnant, and people with health conditions such as alcoholism and liver disease, should obey the guidelines set by the state and should not either consume seafood from restricted areas or consume seafood above the recommended intake limits.

2. The state should continue the Brunswick seafood advisory until new studies indicate it should be revised.

3. When the studies become available, ATSDR should review new data, such as the EPA's Ecological Risk Assessment and EPA's Remedial Investigation/Feasibility Study, to determine whether there are any public health implications.

4. ATSDR should review the Brunswick Initiative air sampling workplan when the state provides the document. The state should provide ATSDR with the air monitoring data when they become available.

5. ATSDR should review the Glynn County Fish Consumption Study and the Emory University Worker Health Study when they become available.

6. The state and EPA should inform ATSDR about plans for future land use so ATSDR may determine whether those uses are safe for the public.

Concurrence:

Joan Davis
Environmental Health Scientist

Branch Chief, SSAB, DHAC (32)
Chief, SSAB-Section B, DHAC (E32)

REFERENCES

1. Agency for Toxic Substances and Disease Registry. Health Consultation for LCP Chemicals, Brunswick, Georgia. August 1994.

2. Workplan, Brunswick/Glynn County Community Based Environmental Project. Brunswick, Glynn County, Georgia. November 1995.

3. GeoSyntec Consultants. Work Plan for Remedial Investigation and Feasibility Study, Upland Soils and Groundwater. LCP Chemicals-Georgia Site Brunswick, Georgia. February 1996.

4. Georgia Department of Natural Resources. Guideline for Eating Fish from Georgia Waters. 1996.

5. Britt, J P. Environmental Health Education Needs Assessment Project: Community Involvement at the LCP Superfund Site in Brunswick, Georgia. July 24 - December 31, 1995.

6. GeoSyntec Consultants. Phase I Removal Action Work Plan. LCP Chemicals Site Brunswick, Georgia. July 1994.

7. US Environmental Protection Agency. Risk-Based Concentration Table, January - June 1995.

8. Georgia Environmental Protection Division. Final Study Plan for the Analyses of Seafood from the Turtle River, Brunswick River, and Several Tributaries. April 1995.

9. US Environmental Protection Agency. LCP Ecological Assessment Work Plan. Environmental Response Team NJ Findlay and MD Sprenger.

10. Atlanta Journal and Constitution. High levels of lead found in aquifer near LCP site. April 6, 1996.

11. Environmental Protection Agency. Final Report, Air Monitoring and Sampling June 1995. LCP Chemical, Brunswick, Georgia. Volumes 1 and 2. August 1995.

12. Agency for Toxic Substances and Disease Registry. Record of Activity with Susan Zimmer-Dauphinee, Georgia Department of Natural Resources. February 1996.

13. Agency for Toxic Substances and Disease Registry. Toxicological profile for selected

PCBs (Aroclor -1260, -1254, -1248, -1242, -1232, -1221, and -1016). Atlanta: US Department of Health and Human Services, Public Health Service, 1993.

14. Agency for Toxic Substances and Disease Registry. Case study for polychlorinated biphenyl (PCB) toxicity. Atlanta: US Department of Health and Human Services, Public Health Service, 1990.

15. Agency for Toxic Substances and Disease Registry. Toxicological profile for mercury. Atlanta: US Department of Health and Human Services, Public Health Service, 1994.

16. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead. Atlanta: US Department of Health and Human Services, Public Health Service, 1993.

17. Agency for Toxic Substances and Disease Registry. Impact of lead-contaminated soil on public health. May 1992.

18. The Brunswick News. Brunswick Commission Hears Cancer Rate Report. February 22, 1996.

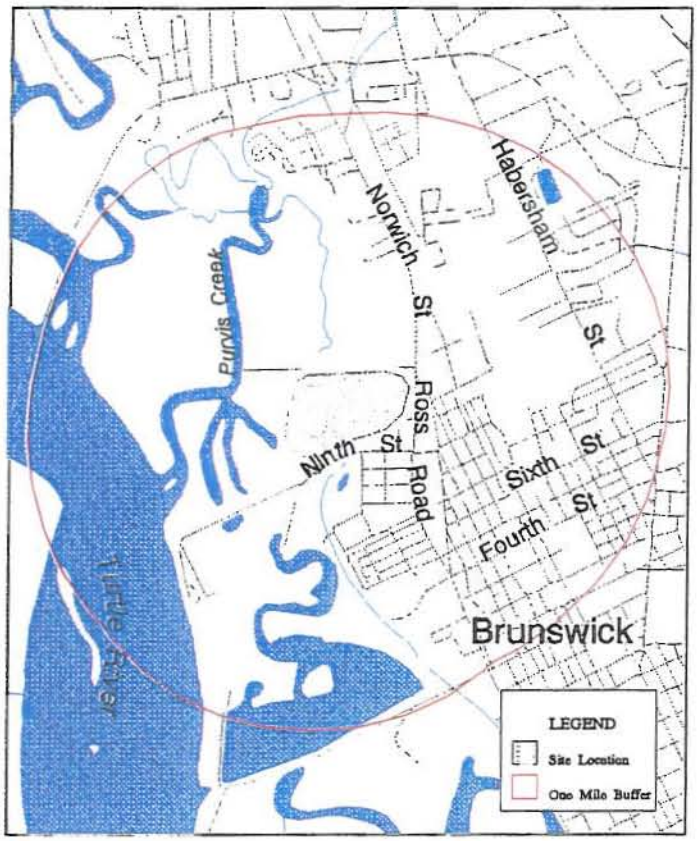
19. Britt, Jane Perry. Guideline for Fish Consumption Study. 1996.

20. Agency for Toxic Substances and Disease Registry. Trip Report for LCP Site Visit. March 1996.

APPENDIX A

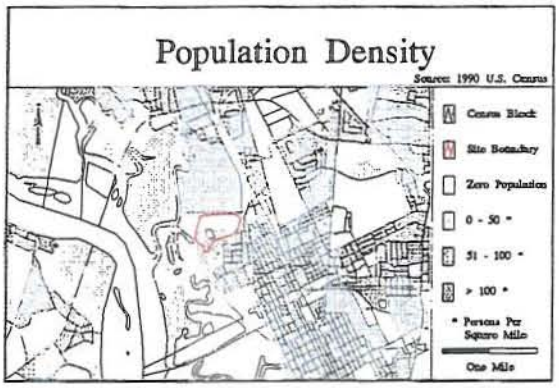
Figures

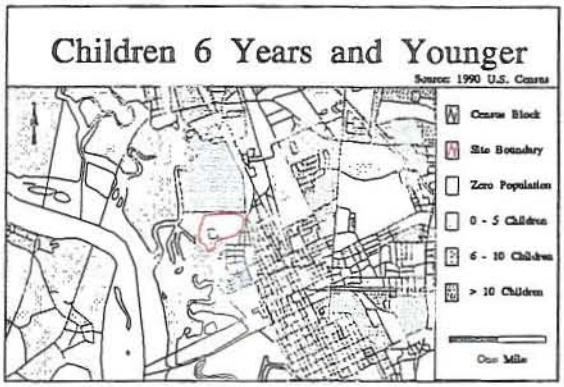
LCP Chemicals Site, Brunswick, Georgia
CERCLIS No. GAD099303182

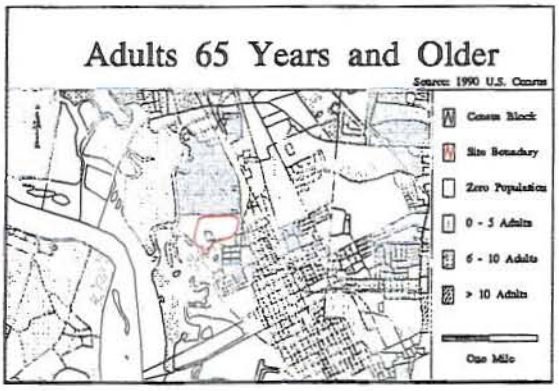


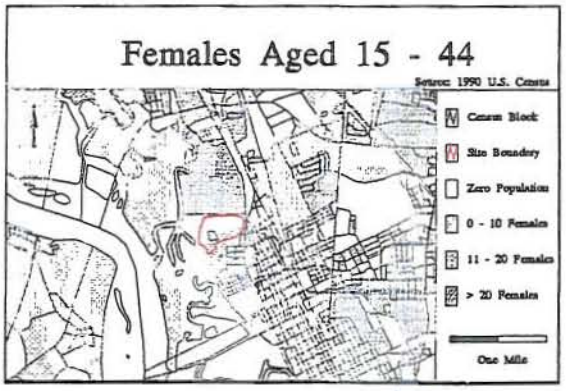
Summary Statistics Within One Mile of the Site*	
Total Number of People	4,669
Children Aged 6 and Younger	497
Adults Aged 60 and Older	573
Females Aged 15 - 44	1,063
Younger Than 18 Years	1,345
18 Years and Older	3,308
White	2,272
Black	2,375
Asian or Pacific Islander	13
American Indian, Eskimo, Aleut	5
Other race	10
Hispanic origin	21

* Calculated using an area-proportion spatial analysis technique









ATSDR GIS Spatial Analysis Activity

Figure 1. Brunswick, Georgia Population Map

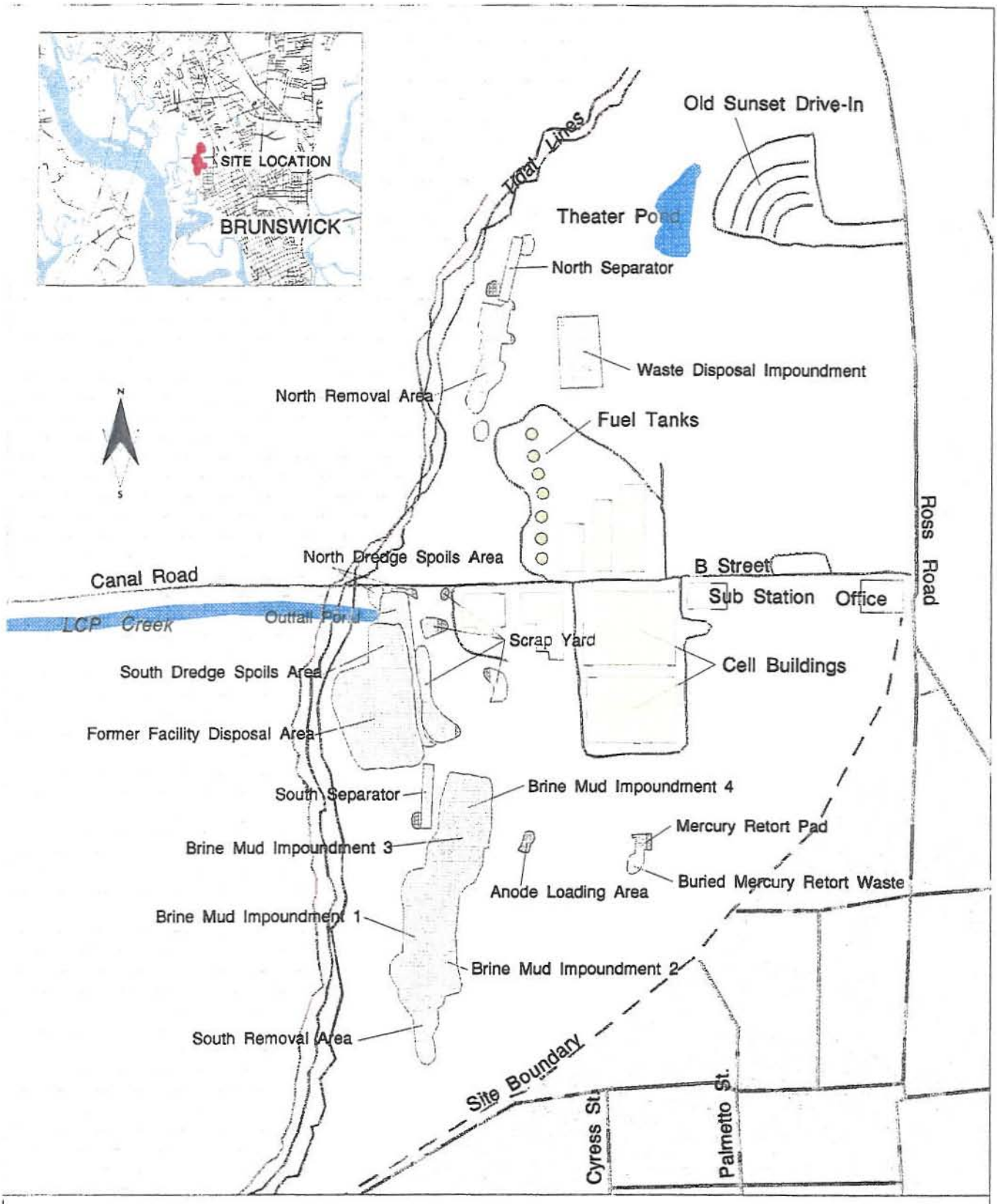


FIGURE 2. LCP Hazardous Waste Areas

ATSDR GIS Spatial Analysis Activity

Brunswick, Georgia
Seafood Sampling Areas
Glynn County

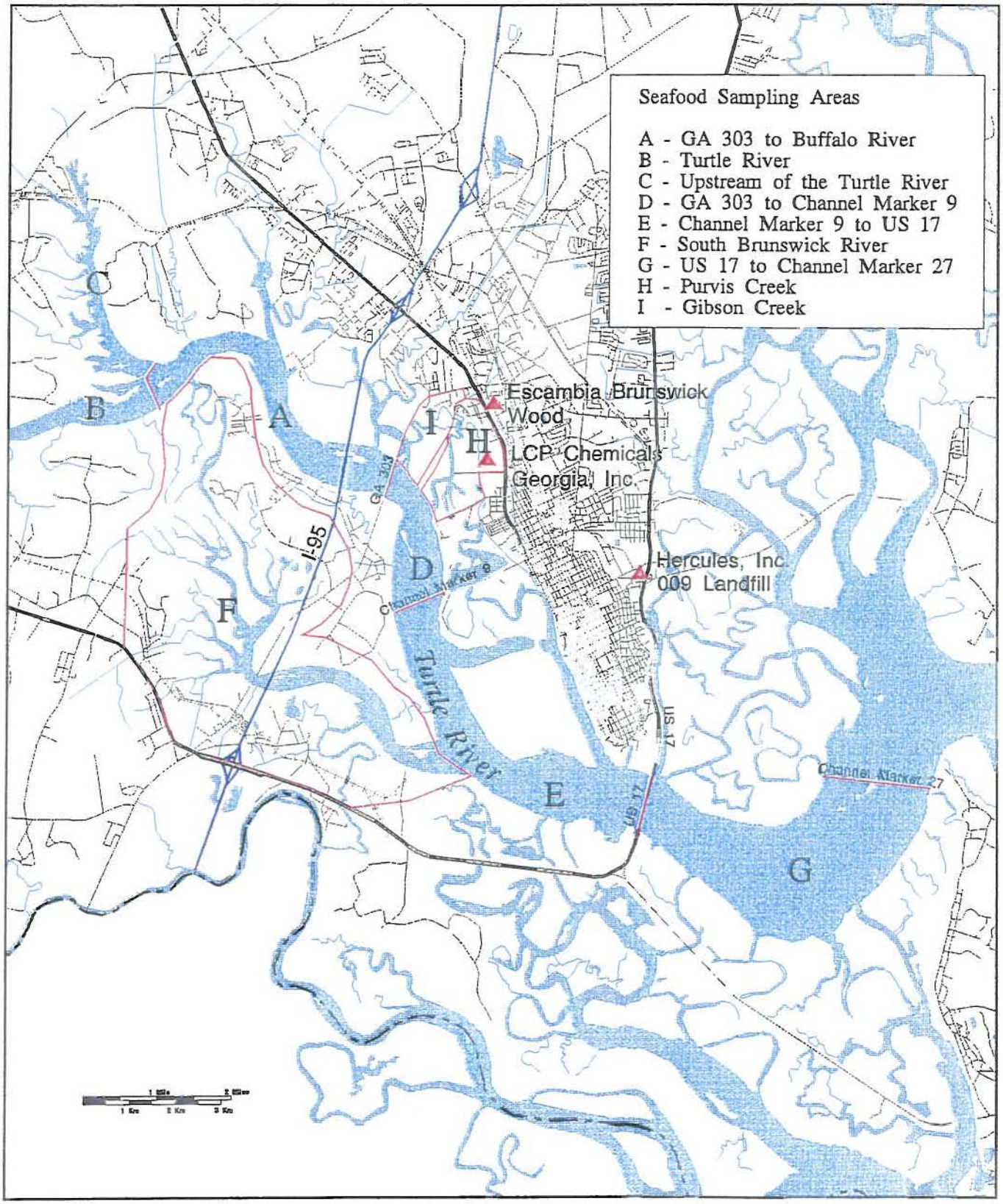


Figure 3. Seafood Sampling Areas

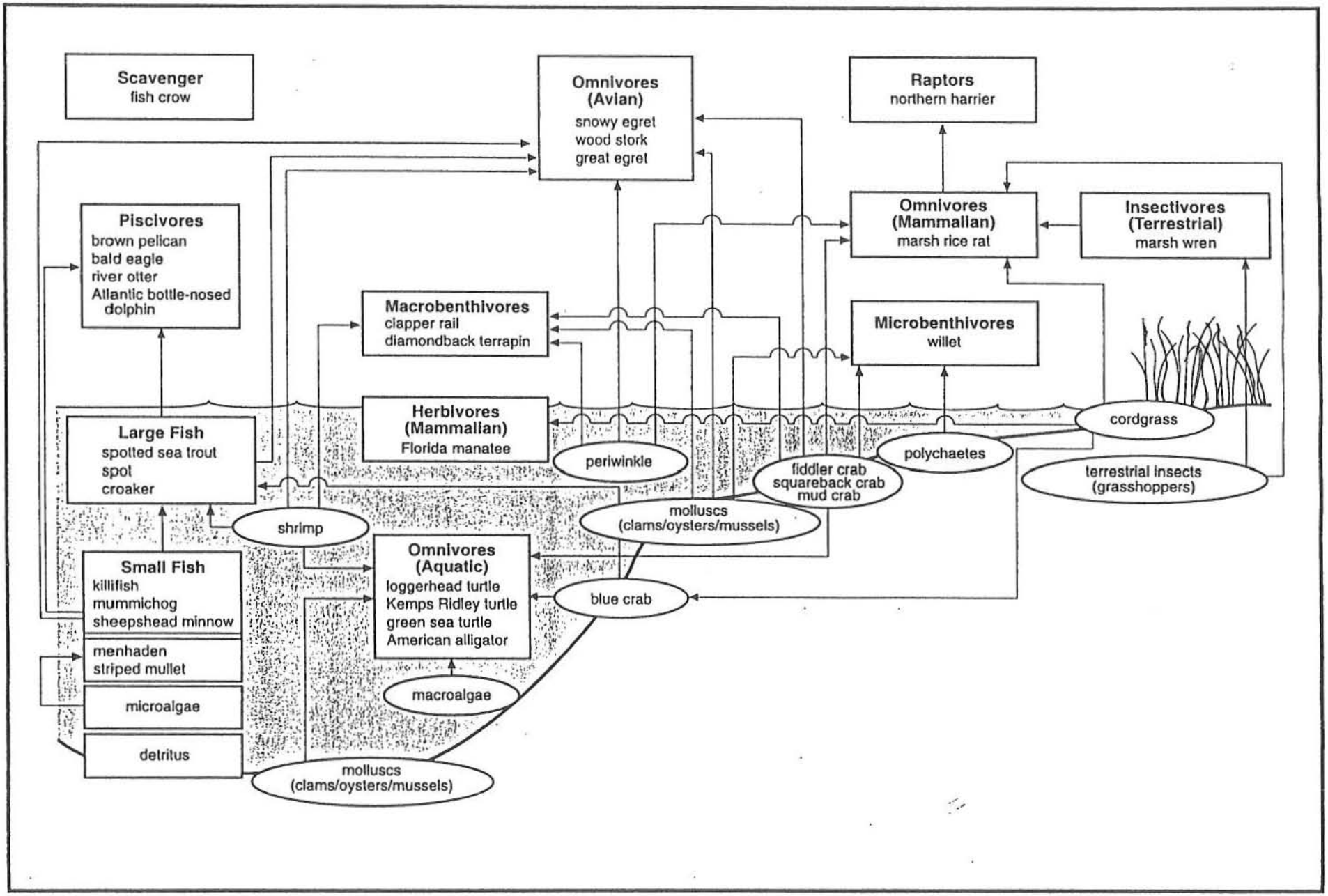
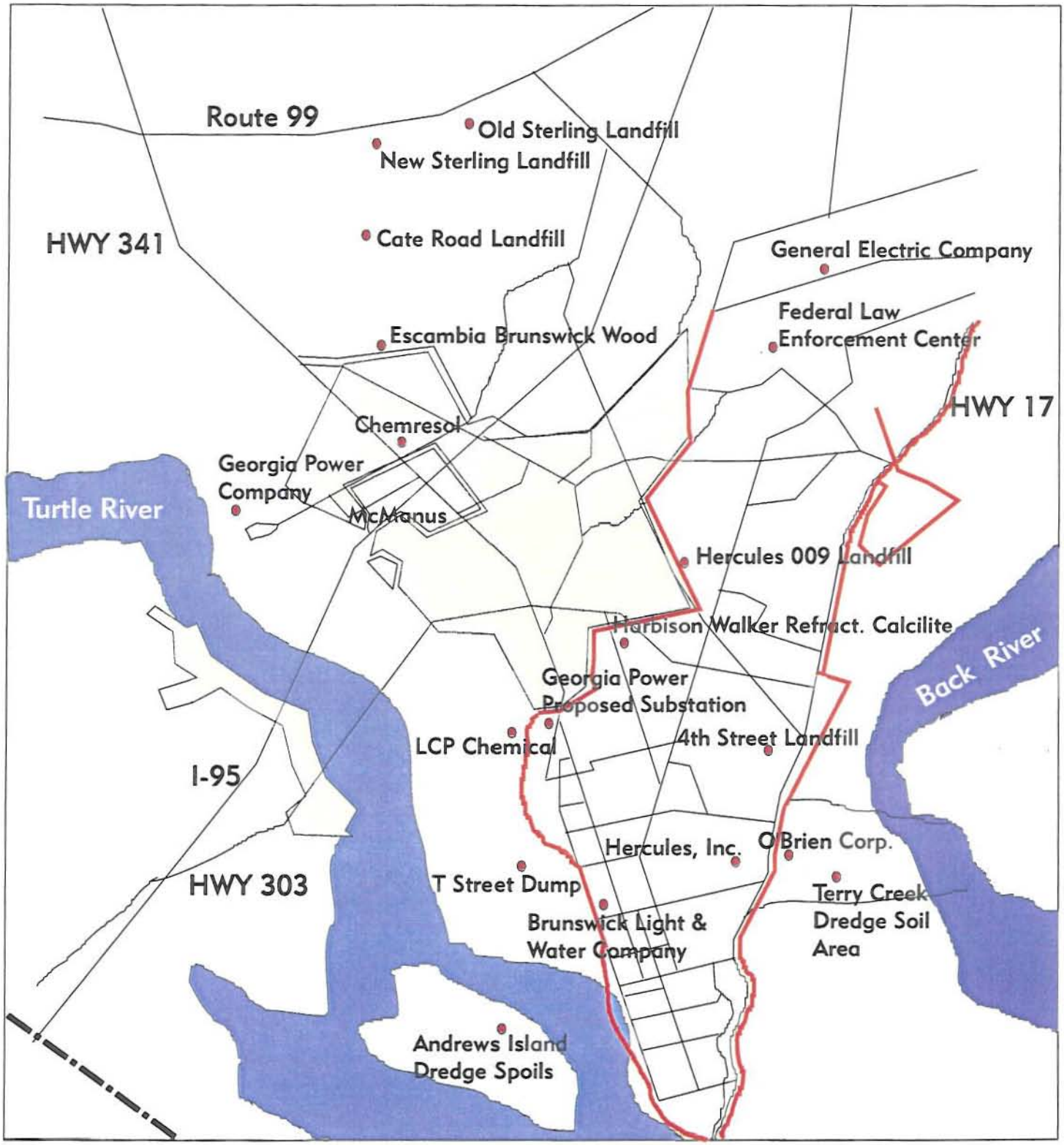


Figure 4. Food Web for Ecological Receptors in the LCP Estuary

CA6T-05-01 04/03/96

Figure 5.
Brunswick Community Based Environmental Study



APPENDIX B

Recommended Seafood Intake Limits Methods and Results

Methods Used to Determine Intake - State of Georgia

The State of Georgia uses a risk-based method of assessing seafood intake values [7]. Intake values are definitions of how much of a substance a person can eat to keep the theoretical lifetime cancer risk at less than 1 X 10^{-4}, or to keep the daily intake below the reference dose for noncancer toxicity. They are based on the more restrictive of EPA's potency factors for carcinogenicity or reference doses for noncancer toxicity [7]. Therefore, the recommendations should be protective for both types of endpoints. The state uses the following assumptions to develop the risk level of 1 X 10^{-4} for cancer: the cancer slope factor, 30-year exposure for both carcinogens and toxins, 70 pounds as body weight for an adult, and 70 years as the lifetime duration [8]. Investigators put all those assumptions into the standardized exposure algorithm, and the result is their recommended intake in grams per day (g/day). The intake values calculated by the state should be safe for different subpopulations (e.g., Asians).

The recommended intake value is then compared to a scale which equates to the number of meals an individual should consume. The scale is:

Calculated Intake (g/day)	=	Guidance for Non-Sensitive Populations	Guidance for Sensitive Populations
≤ 3	→	Do not eat	Do not eat
> 3-10	→	Limit consumption to one meal per month	Do not eat
> 10-30	→	Limit consumption to one meal per week	Limit consumption to one meal per month
> 30	→	No restrictions on intake	No restrictions on intake

The scale is based on a range of meal sizes from ¼ to ½ pounds. Sensitive populations, including children and pregnant women, should consume less than the general population (see above table).

Past Sampling

Seafood investigations near LCP began in 1991 when representatives of the U.S. Fish and Wildlife Service conducted sediment sampling in Purvis Creek because of suspected contamination. High levels of PCBs and methylmercury were detected in sediment. Also, EPD found elevated levels of mercury and PCBs in Purvis Creek sediments. Because the sediment contamination indicated that biota might be affected, EPD sampled crabs and oysters in Purvis Creek, the Turtle River, and a Purvis Creek tributary downstream of LCP.

Mercury and PCBs were found in oysters and crabs collected from all three areas. The highest levels were found in Purvis Creek and the LCP tributary near the boardwalk ruins. Some of the levels exceeded Food and Drug Administration (FDA) action levels (2 ppm for PCBs and 1 ppm for mercury) [8].

In 1992, EPD issued a precautionary advisory recommending that people not consume seafood harvested from Gibson Creek downstream from the Highway 303 bridge, from the Turtle River between the Highway 303 bridge and channel marker number 9, or from Purvis Creek or its tributaries [8]. The advisory area included a buffer approximately 1 mile-long to allow for the effect of the tide. EPD also posted closure signs and signs warning people not to consume fish. The Department of Natural Resources (DNR) also closed the area to all commercial seafood harvesting.

In the summer of 1992, EPD began a monitoring plan to determine whether pollutants from LCP were accumulating in shellfish and fin fish. They sampled the Turtle River between Highway 303 bridge and channel marker 9. Results showed mercury in every composite sample of every species tested from the Turtle River, with all but one sample at or above the FDA action level of 1 part per million (ppm). Purvis River shrimp samples showed mercury above FDA action levels. The state investigators took samples in 1993 and found no need to expand the advisory area. In 1995, the state stopped using the FDA action levels and began using a risk-based triggering mechanism to determine when to issue consumption guidance.

Table B-1
Site A - Turtle River from Highway (Hwy.) 303 to Buffalo River

Species	PCBs (ppm*)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.20	0.39	One meal per week
Red Drum	0.07	0.32	One meal per week
Black Drum	1.31	0.48	Do not eat
Spot	ND	0.04	No restrictions on intake
Croaker	0.25	0.27	One meal per month
All Fish*	0.41	0.29	One meal per month
Blue Crab	ND	0.32	One meal per week
Shrimp	ND	0.04	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-2
Location B - Turtle River Upstream of Buffalo River

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.32	0.49	One meal per month
Mullet	0.21	0.03	One meal per month
Flounder	0.06	0.28	One meal per week
Croaker	0.22	0.15	One meal per month
Red Drum	0.05	0.32	One meal per week
All Fish*	0.16	0.30	One meal per week
Blue Crab	ND	0.28	One meal per week
Shrimp	ND	0.04	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-3
Location C - Buffalo River Upstream of Turtle River

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.21	0.38	One meal per month
Red Drum	0.02	0.31	One meal per week
Black Drum	0.07	0.26	One meal per week
Spot	ND	0.03	No restrictions on intake
Mullet	0.46	0.27	One meal per month
All Fish*	0.41	0.11	One meal per month
Flounder	0.06	0.32	One meal per week
All Fish	0.15	0.25	One meal per week
Blue Crab	ND	0.55	One meal per week
Shrimp	ND	0.09	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-4
Location D - Turtle River from Georgia Hwy. 303 to Channel Marker 9

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.21	0.12	One meal per week
Red Drum	0.23	0.35	One meal per month
Spot	0.08	0.03	One meal per week
Croaker	0.22	0.09	One meal per month
Flounder	0.04	0.36	One meal per week
Whiting	0.25	0.35	One meal per week
All Fish*	0.18	0.24	One meal per week
Blue Crab	0.38	1.99	One meal per month
Shrimp	ND	0.06	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-5
Location E - Turtle River from Channel Marker 9 to US Hwy. 17

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.25	0.30	One meal per month
Red Drum	0.02	0.18	No restrictions on intake
Black Drum	0.48	0.46	One meal per month
Mullet	0.20	0.02	One meal per week
Flounder	ND	0.20	No restrictions on intake
Croaker	0.11	0.10	One meal per week
Whiting	0.09	0.16	One meal per week
Spot	0.22	0.15	One meal per month
All Fish*	0.16	0.17	One meal per week
Blue Crab	ND	0.32	One meal per week
Shrimp	ND	0.03	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-6
Location F - South Brunswick River from Hillery Creek and Fancy Bluff Creek to US Hwy. 17

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.23	0.35	One meal per month
Red Drum	0.03	0.14	No restrictions on intake
Black Drum	0.09	0.19	One meal per week
Croaker	0.16	0.12	One meal per week
Whiting	0.08	0.12	One meal per week
All Fish*	0.11	0.18	One meal per week
Blue Crab	ND	0.40	One meal per month
Shrimp	0.08	0.04	One meal per month

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-7
Location G - Brunswick River from US Hwy. 17 to Channel Marker 27 (Parsons Creek)

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.49	0.17	One meal per month
Red Drum	ND	0.14	No restrictions on intake
Spot	0.02	0.03	No restrictions on intake
Sheephead	0.05	0.22	No restrictions on intake
Mullet	0.12	0.22	One meal per week
Flounder	ND	0.12	No restrictions
Yellow Tail	0.04	0.32	One meal per week
Croaker	0.11	0.12	One meal per week
Whiting	0.14	0.12	One meal per week
All Fish*	0.13	0.15	One meal per week
Blue Crab	ND	0.12	No restrictions on intake
Shrimp	ND	0.03	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-8
Location H - Purvis Creek
(This area is closed to fishing.)

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	1.04	0.35	Do not eat
Red Drum	0.40	0.46	One meal per month
Spot	0.47	0.11	One meal per month
Mullet	1.38	0.04	Do not eat
Whiting	ND	0.45	One meal per week
Croaker	1.23	0.21	Do not eat
All Fish*	0.87	0.26	Do not eat
Blue Crab	0.08	1.45	One meal per month
Shrimp	ND	0.08	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-9
Location I - Gibson Creek East of Georgia Hwy 303
(This area is closed to fishing.)

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.48	0.58	One meal per month
Red Drum	0.16	0.29	One meal per week
Black Drum	0.09	0.24	One meal per week
Mullet	0.51	0.03	One meal per month
Flounder	0.08	0.25	One meal per week
Croaker	0.36	0.17	One meal per month
Spot	0.41	0.15	One meal per month
All Fish*	0.27	0.24	One meal per month
Blue Crab	ND	1.69	One meal per month
Shrimp	ND	0.15	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-10
Locations A, B, and C

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.25	0.42	One meal per month
Red Drum	0.04	0.31	One meal per week
Black Drum	0.81	0.39	Do not eat
Spot	ND	0.04	No restrictions on intake
Croaker	0.23	0.19	One meal per month
Mullet	0.40	0.09	One meal per month
Flounder	0.06	0.30	One meal per week
All Fish*	0.31	0.27	One meal per month
Blue Crab	ND	0.36	One meal per week
Shrimp	ND	0.08	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Table B-11
Locations E, F, and G

Species	PCBs (ppm)	Mercury (ppm)	Recommended Intake Limit
Spotted Sea Trout	0.34	0.26	One meal per month
Red Drum	0.03	0.15	No restrictions on intake
Black Drum	0.22	0.28	One meal per month
Spot	0.07	0.06	One meal per week
Croaker	0.13	0.11	One meal per week
Mullet	0.16	0.12	One meal per week
Flounder	ND	0.14	No restrictions on intake
Whiting	0.11	0.13	One meal per week
Sheephead	0.05	0.22	No restrictions on intake
Yellow Tail	0.04	0.32	One meal per week
All Fish*	0.14	0.16	One meal per week
Blue Crab	ND	0.27	One meal per week
Shrimp	0.04	0.03	No restrictions on intake

Shaded areas indicate the contaminant that drives the recommendation.
ND - contaminant not detected
All Fish - For mixed fin fish meals, all the fin fish contaminant levels from a particular sampling location were averaged to determine a safe consumption limit.

Methods Used to Determine Exposure Dose - ATSDR

ATSDR health assessors use the following assumptions for calculating an exposure dose for seafood consumption.

PCBs

- 4 8-ounce meals per week
- a 70 kilogram (kg) adult
- EPA's cancer slope factor, 7.7 1/milligram per kilogram per day $(mg/kg/day)^{-1}$
- a 30 year exposure duration
- 1×10^{-4} risk level*

*Cancer risks are not calculated separately for children because cancer risk is based on a 70 year life span.

Mercury

- 4 8-ounce meals a week
- a 70 kg adult or a 16 kg child
- EPA's oral reference dose (RfD), 0.0003 mg/kg/day

APPENDIX C

Air Target Analyte List for the Brunswick Initiative

Acetaldehyde
Acetone
Ammonia
Benzene
Carbon Tetrachloride
Chloroform
Chloromethane
Dichloromethane
Formaldehyde
Hydrazine
Methanol
Methyl Ethyl Ketone
Methyl Isobutyl Ketone
Tetrachloroethylene
1,1,2-Trichloroethane
Xylene
Mercury
Toxaphene
PCBs
Ethylbenzene
Chlorobenzene
Lead
Arsenic
Cadmium
Total Chromium
Nickel
Zinc