Health Consultation

ARCO QUARRY FISH TISSUE SAMPLING

BRUNSWICK, GLYNN COUNTY, GEORGIA

FEBRUARY 4, 2008

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 30333

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 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.

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HEALTH CONSULTATION

ARCO QUARRY FISH TISSUE SAMPLING

BRUNSWICK, GLYNN COUNTY, GEORGIA

Prepared By:

Glynn County Health Department and
Georgia Department of Human Resources
Division of Public Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

FOREWORD

The Chemical Hazards Program of the Georgia Department of Human Resources, Division of Public Health (GDPH), has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. The health consultation allows GDPH to respond quickly to a request from concerned residents for health information on hazardous substances. It provides advice on specific public health issues. GDPH evaluates environmental sampling and health outcome data and community concerns, and determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

For more information or questions regarding GDPH, ATSDR or the contents of this health consultation, please contact:

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SUMMARY

In June 2004, residents living in Brunswick, GA requested that the Agency for Toxic Substances and Disease Registry (ATSDR) investigate whether fish consumed from Arco Quarry contained contaminants from a nearby hazardous waste site. Over the last century, areas of the Brunswick peninsula and Turtle River Basin have been impacted by industrial operations that released toxic chemicals into the environment. The Arco neighborhood is one such area located adjacent to a former chlor-alkali facility, LCP Chemicals, currently listed on the National Priority List (NPL) under the U.S. Environmental Protection Agency's (EPA) "Superfund" list.

The Arco Quarry is a man-made borrow pit dug in the 1970's, which has since filled with water and evolved into a recreational fishing site. Arco Quarry is approximately six acres in size and hosts a diverse array of both fresh and marine fishes. There are few visitors to the area, and most fishers at Arco Quarry reside in the Arco neighborhood.

This document contains information about the environmental transport and extent of human exposure to hazardous chemicals, conclusions about the health risks posed to residents, and recommendations intended to protect public health. A health consultation is designed to provide the community with information about the public health implications from exposure to hazardous substances at a specific site, and to identify populations for which further health actions are needed. It is not intended to serve the purpose of addressing liability, zoning, or other non-health issues.

GDPH has determined that this site poses **a public health hazard to sensitive populations** who should restrict consumption of certain species. Human exposure to contaminated fish has occurred, is occurring, and may occur in the future, but the exposures are below levels of health concern for the general population. One contaminant, mercury, is present in catfish and pan fish at levels that suggest that pregnant and nursing women, young children, and women of childbearing age should limit their consumption of these species according to the fish consumption guidelines issued for the area.

GDPH recommends that sensitive populations limit their consumption of catfish to one meal per month and for pan fish, one meal per week. The Glynn County Health Department will provide consumption guidance brochures to residents of the Arco Neighborhood and the general public. GDPH will review additional data if it becomes available and provide documents, including a follow-up health consultation, if appropriate.

STATEMENT OF ISSUES

In June 2004, residents living in Brunswick, GA requested that the Agency for Toxic Substances and Disease Registry (ATSDR) investigate whether fish consumed from Arco Quarry contained contaminants from a nearby hazardous waste site. In response, this health consultation was prepared by the Glynn County Health Department (GCHD) and the Georgia Division of Public Health (GDPH), under a cooperative agreement with ATSDR. The GCHD collected and reviewed fish tissue samples from Arco Quarry to determine whether they contained contaminants at levels of health concern.

SITE DESCRIPTION

The Arco Quarry is a man-made impoundment in Brunswick, Georgia (Figure 1). The Quarry is located off Ross Road and bordered to the west by the Altamaha Canal, to the North by the former LCP Chemicals facility, and by the Arco neighborhood to the South and East (Figure 2). Formerly a gravel quarry dug in the 1970s, it has since filled with water and evolved into a recreational fishing site. Arco Quarry is approximately six acres in size and hosts a diverse array of both fresh and marine fishes. Measurements using a salinity meter show the Quarry to be fresh water (≤ 5 parts per thousand salinity). It is fed primarily by ground and storm water, but is also prone to periodic mixing with brackish water from the Turtle River during flood conditions and/or high tidal surges from the Altamaha Canal. This mixing is the source of salt and brackish water fish in the Quarry. Fresh water fish are from natural ecological deposition (e.g., birds transporting eggs). Seasonal fish catches reported by anglers include bluegill, catfish, mullet and a variety of croaker [1].

SITE HISTORY

Over the last century, areas of the Brunswick peninsula and Turtle River Basin have been impacted by industrial operations that released toxic chemicals into the environment. Identifying and minimizing human exposure to residual industrial contamination is an ongoing activity for targeted areas around Brunswick by federal, state, and local environmental and public health agencies, and the public.

The Arco neighborhood is one such area located adjacent to a former chlor-alkali facility, LCP Chemicals. LCP Chemicals is currently listed on the National Priority List (NPL) under the U.S. Environmental Protection Agency's (EPA) "Superfund" list. Currently, EPA and ATSDR are analyzing environmental sample results to determine the extent of off-site contamination in the Arco neighborhood from past facility operations [2]. Since 1991, more than 700 composites of fish and shellfish have been collected from the Turtle River near LCP Chemicals, and tested for over 40 chemicals [3]. Total mercury and total polychlorinated byphenyls (PCBs) are the chemicals of concern because they have been found in sufficient quantity to contribute to fish consumption restrictions near the site [3]. In addition, ATSDR and GCHD conducted a community-based health study of residents who consume fish and seafood from the area. The study concluded that there is evidence that people consumed fish from the restricted area, but that there is no evidence that they have ingested mercury at levels of health concern [4]. A detailed description of historical fish tissue sampling and analyses conducted in the area as part of the LCP Chemicals NPL site investigation can be found in Appendix A.

During a Public Availability Session conducted by ATSDR in October 2004, residents requested that ATSDR also investigate whether fish caught for consumption from the Arco Quarry contain contamination from LCP Chemicals. Under a cooperative agreement, ATSDR requested that the GDPH conduct a health consultation for the fish in Arco Quarry.

GDPH, with technical and funding assistance from GCHP and a local environmental advocacy group, the Glynn Environmental Coalition, fish tissue samples were collected and analyzed for mercury, lead and PCBs. Staff from the GCHD, the Glynn Environmental Coalition, and the Georgia Department of Natural Resources (GDNR) collected representative specimens of edible fish from the Quarry in spring 2005 using scientifically accepted methods [6]. The samples were sent to the University of Georgia Agricultural Services Laboratory for analyses. The objective was to determine if fish caught from the Quarry contained contaminants at levels of health concern for people eating fish from the Quarry, including sensitive populations (e.g., pregnant woman; children).

Note: on October 5, Tropical Storm Tammy deposited 15 to 20 inches of rain in the area, and on October 7 or 8, there was a fish kill in the Altamaha Canal and Arco Quarry. Sampling conducted concurrently by representatives from GEPD and the local advocacy group, Altamaha Riverkeeper, confirmed that raw sewage had been released into the Quarry, but results showed varying amounts. Debate continues about whether a sewage spill, or a sewage spill and natural events, resulted in the fish kill.

At this time, there is little active fishing from Arco Quarry.

Fish Specimen Collection

A complete Field Data Summary is in Appendix B.

Attempts were made to capture fish from Arco Quarry in fall 2004 and winter 2005, but these were unsuccessful because the fish were inactive/dormant. In late April 2005, representatives from the GCHD, GDNR, and the Glynn Environmental Coalition caught pan fish, catfish and mullet from Arco Quarry. Seven bluegill and one catfish were captured using light tackle/hook and line techniques from the quarry embankment. Eleven mullet were caught using 300 feet of 2.5-inch gill net that was deployed from a small gasoline powered aluminum boat. Whole fish were measured, tagged, individually wrapped in aluminum foil, placed in sealed plastic bags and packed in wet ice pending transport to the designated location for tissue collection. Bluegill specimens ranged in size from 4.0 to 6.75 inches in length. The catfish was 14.25 inches. Mullet specimens ranged from 7.25 to 11.75 inches in length. The four largest mullet collected were used to prepare the tissue composite for this species. All specimens measuring less than 5.5 inches or that were injured were released. Table 1 summarizes the type of fish retained for tissue collection, specimen length and the techniques used for capture.

Table 1. Retained Whole Fish Specimen Field Data

Date	Common Name	Length (inches)	Weight (grams) [1]	Capture Method
04-28-05	Bluegill	5.50	62.2	Hook and Line
04-28-05	Bluegill	6.25	85.1	Hook and Line
04-28-05	Bluegill	5.50	59.2	Hook and Line
04-28-05	Bluegill	5.75	69.4	Hook and Line

04-28-05	Bluegill	5.50	55.7	Hook and Line
04-28-05	Catfish (Blue)	14.25	706.5	Hook and Line
04-29-05	Striped Mullet	11.75	357.4	Gill Net
04-29-05	Striped Mullet	10.50	327.2	Gill Net
04-29-05	Striped Mullet	9.25	341.0	Gill Net
04-29-05	Striped Mullet	9.00	269.3	Gill Net

[1] Specimen weights were recorded prior to tissue sample collection on the day of capture**.**

Tissue Sample Collection and Storage

Composite tissue samples were collected from bluegill and mullet specimens using cross sections from both the thoracic and caudal regions after scaling and gulleting. The viscera were removed along with heads in a manner taking care not to disrupt the organs. One composite for each species was collected submitted in aggregate proportions with instructions for the laboratory to combine all submitted tissue for each sample prior to homogenization. Bluegill and mullet samples included tissue from the skin, muscle and fins. Catfish samples were comprised of sagital sections that included the skin, but omitted the main skeletal bones. One catfish roe sample, comprised of the entire egg mass and sac, was also submitted.

Pre-cooled tissue samples were wrapped in protective plastic sheeting to prevent breakage, placed in a cooler, iced (wet ice in plastic bags), and the cooler sealed prior to overnight shipment to the laboratory.

DISCUSSION

Exposure Pathways

This section presents data from fish tissue analyses. GDPH determines exposure to environmental contamination by examining exposure pathways. An exposure pathway is generally classified by environmental medium (e.g., water, soil, air, food). A completed exposure pathway exists when people are actually exposed through ingestion or inhalation of, or by skin contact with a contaminated medium. An exposure pathway consists of five elements: a source of contamination; transport through an environmental medium; a point of exposure; a route of exposure; and a receptor population.

In completed exposure pathways, all five elements are evident and indicate that exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future. GDPH considers people as exposed if they come into contact with contamination and an exposure pathway is completed. For example, people who reside in an area with contaminants in air, or who drink water known to be contaminated, or who work or play in contaminated soil are considered to be exposed to contamination.

Identification of an exposure pathway does not immediately imply health effects will occur. Exposures to contamination may or may not be at levels of concern. Thus, even if exposure has occurred, human health effects may not necessarily result [7].

Exposures to contaminants from consumption of fish from Arco Quarry have occurred and are occurring, and the potential for future exposures exists. The completed exposure pathway for the Arco Quarry is in Table 2.

Table 2. Completed Exposure Pathway

Pathway	Exposure Pathway Elements					Time
	Source	Transport	Point of Exposure	Route of Exposure	Exposed Population	
Food (Fish)	Industrial Effluent, Air Deposition	Biota and Sediment	Fish from Arco Quarry	Ingestion	Fish Consumers	Past, Present, and Future

Tissue Analyses Results

Fish tissue samples were analyzed for lead, mercury, and PCBs using EPA methods [6]. The highest level of a contaminant detected was mercury. However, the highest level of mercury found, 0.579 parts per million (ppm) in catfish fillet, is well below the U.S. Food and Drug Administration's action level[1] of 1 ppm [8]. This level of mercury found in catfish is nearly twice as high as the next highest level of mercury found (0.35 ppm in pan fish).Lead and one PCB (1268) were found well below action levels. Table 3 summarizes the results of fish tissue sampling.

Table 3. Arco Quarry Fish Tissue Sample Results [6]

	Contaminant Level in Parts per Million (ppm)								
Description	Lead	Mercury	PCB 1016	PCB 1221	PCB 1242	PCB 1248	PCB 1254	PCB 1260	PCB 1268
Pan Fish Comp # 1	**0.011**	**0.347**	ND	ND	ND	ND	ND	ND	**0.02 ***
Mullet Comp # 2	**0.029**	**0.054**	ND	ND	ND	ND	ND	ND	**0.037**
Catfish Fillet # 005	**0.016**	**0.579**	ND	ND	ND	ND	ND	ND	**0.06**
Catfish Roe: Catalog II	ND	**0.016**	ND	ND	ND	ND	ND	ND	**0.20**
Detection Limit (DL)	*0.01*	*0.01*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
*Action Level***	1.5	1.0	--	--	--	--	--	--	0.2 - 3

Bold type: > DL
* Trace
** U.S. Food and Drug Administration

Mercury is a contaminant of concern in fish throughout Georgia and throughout much of the world. This is due to the various sources that include discharge to water bodies and air deposition from industries such as coal-fired electric power plants. Mercury occurs naturally in several different forms. The most toxic form of mercury in fish is organic methylmercury. Methylmercury is converted from inorganic (metallic) mercury by microorganisms that are present in the environment. While the mercury results presented in Table 3 represent total mercury, it has been established that more than 99 percent of all mercury in fish is methylmercury.

[1] Action levels for poisonous or deleterious substances are established by the U.S. Food and Drug Administration (FDA) to control levels of contaminants in human food and animal feed. Action levels and tolerances represent limits at or above which FDA will take legal action to remove products from the market. The action levels are established and revised according to criteria specified in Title 21, Code of Federal Regulations, Parts 109 and 509.

State and Federal Fish Consumption Guidelines

Recommendations for fish consumption at Arco Quarry are consistent with both federally- and state-issued consumption guidelines. Review and comparison of data on fish tissue contamination that EPA has assembled nationally shows the quality of fish in Georgia is similar to that in surrounding southeastern states [9]. In 2004, the EPA and U.S. Food and Drug Administration issued advice for sensitive populations on eating fish and shellfish, "What You Need to Know about Mercury in Fish and Shellfish" *(www.epa.gov/waterscience/fish)*. These federal agencies recommend that sensitive populations should eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are low in mercury, including catfish and pan fish.

In addition, Georgia has one of the most extensive fish monitoring programs in the southeastern United States and is highly committed to evaluating fish quality and providing detailed information to the people of Georgia. Information about the approach used by Georgia that leads to the "risk-based" fish consumption guidelines is available on the Georgia Department of Natural Resources' wesbsite, *www.gadnr.org*, under the Environmental Protection Division, fish consumption guidelines section.

Briefly, Georgia's guidelines are based on the use of EPA's slope factors for chemicals that cause cancer[2] and reference doses[3] (RfD) for noncancer toxicity, whichever is most restrictive. Therefore, when both types of toxicity indices are available, the recommendations should be protective for both endpoints. The intake value for a person eating fish with the levels of contamination found over 30 years is then compared to a scale that equates to meals per week or month.

Extensive studies of fish and seafood have been performed for the Turtle River Basin adjacent to Arco Quarry. Since 1991, more than 2600 fish and shellfish have been collected in the Turtle River near LCP [3]. Most of the samples have been analyzed for a large number of chemicals (> 40), but total mercury and total PCBs (in this area almost exclusively PCB 1268) are the only two chemicals have been found in sufficient quantity to contribute to fish consumption guidelines [3]. A detailed description of historical fish tissue sampling and analyses conducted

Calculated Intake (grams/day)	**Equates to**	**Guidance**
≤ 3		do not eat
> 3 - 10		limit consumption to 1 meal/month
> 10 - 30		limit consumption to 1 meal/week
> 30		no restrictions

[2] Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. EPA's Cancer Slope Factors are an upper bound, approximating a 95% confidence limit, on the increased cancer risk from a lifetime exposure to an agent.

[3] An EPA Reference Dose is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It is derived from a calculated dose, with uncertainty factors generally applied to reflect limitations of the data used. EPA's Cancer Slope Factor and Reference Dose for methylmercury are available at www.epa.gov/iris/subst/0073.htm.

Under the state's approach, the levels of mercury found in fish tissue samples from Arco Quarry fall within the guidelines for limiting consumption of catfish to 1 meal/month, and for pan fish to 1 meal/week, for sensitive populations, based on a consumption level of between three and 10 grams of fish per day. For more information about the state's risk-based approach, see Appendix A.

Georgia's Fish Consumption Guidelines

Fish and seafood are excellent sources of protein, minerals, and vitamins, and play a role in maintaining a healthy, well-balanced diet. Fish is the best source of Omega-3 fatty acids, which are essential for the development of a fetus. But over time, the body can build up harmful levels of toxic chemicals. The recommendations in "Guidelines for Eating Fish from Georgia Waters" were designed to protect people from experiencing health problems associated with eating contaminated fish

The Georgia fish consumption guidelines are not intended to discourage people from eating fish, but should be used as a guide for choosing which types (species), and size of fish to eat.

Contaminated fish may not look, smell, or taste different, but sensitive populations should follow the Georgia fish consumption guidelines available from various locations and in many formats. The booklet is produced annually for release through numerous outlets, including GDNR regional offices, District and County Health Departments, and popular fishing-related outlets. Information targeting the sport angler is placed in the annual *Georgia Fishing Regulations*. Both of these are available on the GDNR website: *www.ganet.org/dnr/environ*.

Recently, GDPH partnered with the GDNR, University of Georgia Cooperative Extension Service, and an advocacy group, the Chatahoochee Riverkeeper, to develop four regional fish consumption guidance brochures in English and Spanish. They were developed using an entirely different evaluation approach of grouping fish species by trophic level (feeding habits; i.e., bottom feeder, top of food chain), and developing advice based on the higher trophic level fish. This approach is more conservative than previous state guidelines. They also present recommendations in a larger area (regional) format instead of water body specific, so comparing them to oher guidelines is not appropriate. One of these brochures targets coastal Georgia and, specifically, the Turtle River Basin. The English version can be found in Appendix D.

These guidance brochures are designed so that people can still get the benefits of eating fish by wisely choosing:

- **Safer types of fish**. Eat a variety of fish. Fish with more fatty flesh (bluefish, striped bass, etc.) tend to collect more contaminants because many contaminants are stored in fat. Eat smaller-sized fish (within state size regulation), because older or bigger fish tend to build up contaminants in their bodies.
- **Safer ways to prepare fish**. Since many contaminants are stored in fat, trimming fatty areas before cooking, and cooking in a manner that allows fat to drip away can eliminate most of the contamination. One exception to this rule is mercury, which is stored in muscle tissue and cannot be eliminated by cooking and trimming methods.
- **How often you eat fish**. While most fish in Georgia waters are safe to eat, some fish are not safe for pregnant or nursing women or young children to eat in large quantities.

- **How much fish you eat**. If you catch a big fish, freeze part of the catch (mark container or wrapping with species and location), and space the meals from this fish over a period of time. Vary the kinds of fish you eat. Contaminants build up in large predators and bottom-feeding fish, like bass and catfish. Substitute some of these fish meals with pan fish to reduce your risk.

CHILD HEALTH CONSIDERATIONS

The ATSDR Child Health Initiative recognizes the unique vulnerabilities of young children exposed to chemicals in the environment. Because of their size, body weight, frequent hand to mouth activity, and developing systems, children require special emphasis in communities faced with contamination. They receive higher doses of exposure because children's growing bodies absorb more contamination and can sustain permanent damage if exposures occur during critical growth stages.

Young Children and Other Sensitive Populations

The population most at risk for adverse health effects from repeated consumption of contaminated fish and seafood is young children. Therefore, pregnant and nursing women, women who may become pregnant, and small children who live in the Arco neighborhood are sensitive populations that should avoid eating certain fish species from Arco Quarry in large quantities. Georgia's *Guidelines for Eating Fish from Georgia Waters,* are designed to help people understand the fish species that sensitive populations should avoid eating, those that they can eat in limited amounts, and fish that they can eat in unlimited amounts [9].

In early 2001, EPA issued a national advisory recommending that these sensitive groups limit consumption of all freshwater fish to one meal per week due to mercury. People may wish to follow EPA's recommendation, especially in areas where GDNR has not tested fish and offered detailed guidelines. For most other healthy adults, GDNR's recommendations may actually be overly conservative.

CONCLUSIONS

GDPH has determined that this site poses **a public health hazard to sensitive populations** who should restrict consumption of certain species. Human exposure to contaminated fish has occurred, is occurring, and may occur in the future, but the exposure is below a level of health concern for the general population. One contaminant, mercury, is present in catfish and pan fish at levels that suggest that pregnant and nursing women, young children, and women of childbearing age should limit their consumption of these species according to the fish consumption guidelines issued for the area.

RECOMMENDATIONS

GDPH recommends that:

1. Sensitive populations limit their consumption of catfish to one meal per month and for pan fish, one meal per week.
2. Consumers should exercise caution and assure that children follow the fish consumption guidelines for sensitive populations.

3. The Glynn County Health Department should provide fish consumption guidance brochures to residents of the Arco Neighborhood and the general public.

PUBLIC HEALTH ACTION PLAN

Actions Completed

GDPH and GCHD developed and distributed fact sheets, *Health Consultations: Arco Quarry* and *Eating Fish from Coastal Georgia* (Appendix D) to residents in the Arco neighborhood.

Actions Planned

ATSDR will publish this health consultation and GDPH and GCHD will distribute it among residents and other concerned citizens. As part of the publication of this health consultation, GDPH will develop and distribute a fact sheet, *Mercury in Fish* (Appendix D). The Glynn Environmental Coalition, a local advocacy group, will publish the results of this health consultation and the fish consumption guidance brochure on their website at *www.glynnenvironmental.org*.

No further public health actions are planned. The GCHD will review additional data if it becomes available and provide documents, including a follow-up health consultation, if appropriate.

REFERENCES

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7. Agency for Toxic Substance and Disease Registry, *Comparison Values for Water,* January 10, 2005.

8. Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Mercury*, 3/99.

9. Georgia Department of Natural Resources, *Guidelines for Eating Fish from Georgia Waters*, 2005 Update.

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CERTIFICATIONS

The Georgia Division of Public Health prepared this Arco Quarry, Glynn County, Georgia health consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, CAT, CAPEB, DHAC

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

Team Leader, CAT, CAPEB, DHAC

FIGURES

FIGURE 1. SITE DEMOGRAPHIC MAP

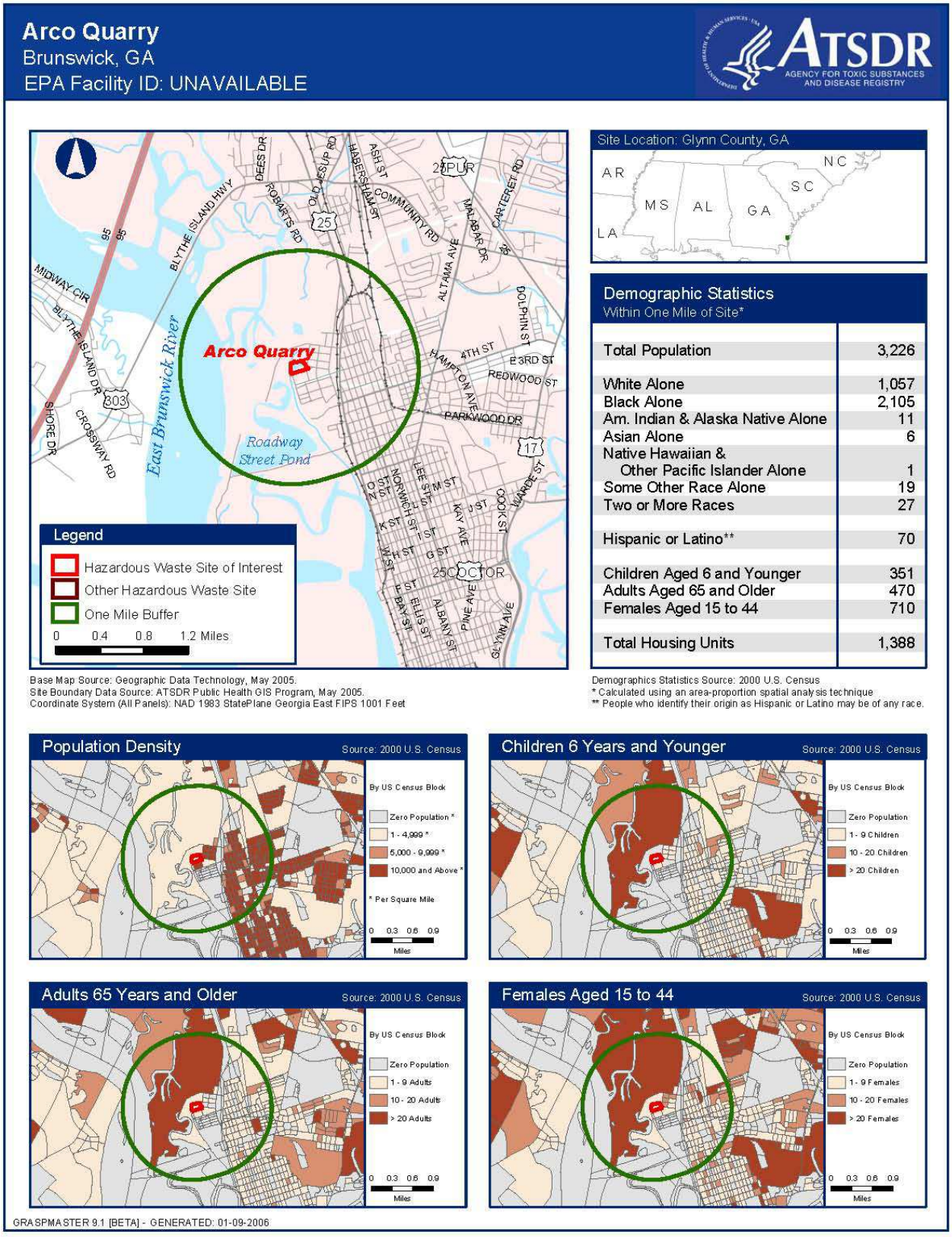
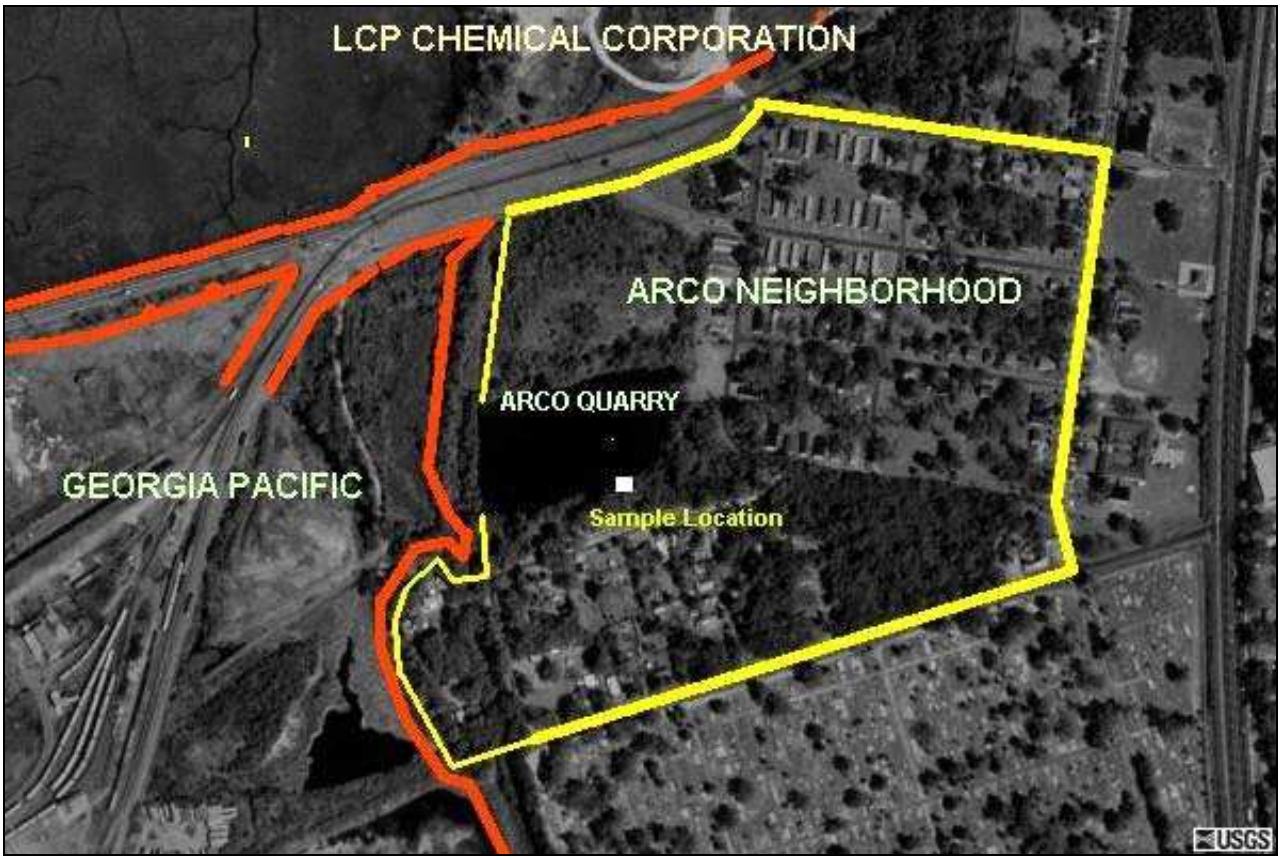


FIGURE 2. FISH SPECIMEN SAMPLE LOCATION



APPENDICES

APPENDIX A. DATA SUMMARY FOR THE TURTLE RIVER

Georgia Department of Natural Resources

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Environmental Protection Division
404/656-4713

M E M O R A N D U M

TO: Jim McNamara

FROM: Randall O. Manning, Ph.D., DABT
Environmental Toxicology Coordinator

DATE: February 9, 2004

RE: Data summary for the Turtle River

Samples of shellfish and/or finfish have been collected in the Turtle River near LCP in 1991, 1992, 1993, 1995, 1997, and 2002. While most of the samples have been analyzed for a large number of chemicals (> 40), my summary will deal only with total mercury and total PCBs (in this area almost exclusively Arochlor 1268) because those two chemicals have been found in sufficient quantity to contribute to fish consumption restrictions. In all instances, samples are edible composites, and numbers of composites (not individuals) are referred to as N. Composites of fish are created using fillet tissue from five individuals of the same species and size class. In rare instances composites may be created using less than five fish, but the majority of data summarized herein are for 5 fish composites. For shellfish, compositing is not based on specific numbers of organisms, but composites are created based on tissue volume (or amount) needed for laboratory analysis. All results are in mg/kg or ppm.

Since 1991, more than 700 composites of fish and shellfish have been collected in the Turtle River near LCP. About 75% of those composites (535) represent tissues from 5 individual fish. More that 2600 individual fish have been collected from the area.

The data is evaluated on a yearly basis for development of fish consumption guidelines. Those guidelines are developed using U.S. EPA's potency factors for carcinogenicity and reference doses for non-cancer toxicity, whichever is most restrictive. Inputs used in the risk calculation include a risk level of 1×10^{-4} for cancer, a 30-year exposure duration for both carcinogens and toxics, 70 kg as the body weight for an adult, and 70 years as the lifetime duration. A U.S. EPA algorithm is used, and solved for intake (gm/day). By making intake the dependant variable, the difficult issue of determining what are appropriate intake values for different subpopulations is avoided.

The intake value (which is really how much one can eat to keep theoretical lifetime cancer risk less than 1×10^{-4}, or to keep the daily intake below the RfD for non-cancer toxicity) is then compared to a scale equating to meals per week or month.

The scale is:

Calculated intake (gm/day)	equates to	guidance
≤ 3		do not eat
> 3 - 10		limit consumption to 1 meal/month
> 10 - 30		limit consumption to 1 meal/week
> 30		no restrictions

The scale is based on a range of meal sizes from ¼ to ½ lb. For practical purposes, the tissue concentrations for total PCBs and total mercury that bound the different consumption recommendations are shown below.

Chemical	No Restriction	One Meal/ Week	One Meal/ Month	Do Not Eat	FDA Action Level
PCBs (mg/kg)	≤ 0.10	> 0.10	> 0.30	> 1.0	2.0
mercury (mg/kg)	≤ 0.23	> 0.23	> 0.71	> 2.0	1.0

1991

In 1991 five composites of oysters and five composites of crab were collected in Purvis Creek and the Turtle River. Ranges and averages are shown below.

Sample	Contaminant	Conc. Range (ppm)	Mean Conc. (ppm)
Oysters, N=5	Mercury	0.1 to 1.2	0.4
	PCBs	0.1 to 0.4	0.2
Crab, N=5	Mercury	0.1 to 0.5	0.5
	PCBs	0.1 to 9.9	3.1

1992

In 1992 three composites of shrimp, three composites of crab, and seven composites of finfish were collected in the Turtle River area. Data is summarized below.

Sample	Contaminant	Mean Conc. (ppm)
Shrimp, N=3	Mercury	1.5
	PCBs	<0.1
Crab, N=3	Mercury	6.5
	PCBs	<0.1
Finfish by species		
Croaker, N=3	Mercury	2.2
	PCBs	0.2

Red Drum, N=2	Mercury	4.7
	PCBs	0.1
		Individual values
Black Drum, N=1	Mercury	8.5
	PCBs	0.2
Sheepshead, N=1	Mercury	3.7
	PCBs	0.4

1993

In 1993 21 composites of shrimp, 21 composites of crab, and 45 composites of fish were collected in the Turtle River. The fish composites represent a collection of approximately 225 fish. Detailed site-specific analyses of the data are available elsewhere. A brief summary of composites averaged over the entire study area is included below.

Sample	Contaminant	Conc. Range (ppm)	Mean Conc. (ppm)
Shrimp, N=21	Mercury	0.04 – 0.08	0.06
	PCBs	< 0.05	
Crab, N=21	Mercury	0.10 – 0.83	0.29
	PCBs	<0.05 - 0.23	0.08
Finfish by species			
Croaker, N=10	Mercury	0.03 - 0.23	0.09
	PCBs	<0.05 - 0.07	0.05
Red Drum, N=10	Mercury	<0.01 - 0.87	0.35
	PCBs	<0.05 - 0.24	0.09
Spot, N=9	Mercury	<0.01 – 0.36	0.10
	PCBs	<0.05 – 0.29	0.15
S.S. Trout, N=8	Mercury	0.10 – 0.86	0.27
	PCBs	<0.05 – 0.22	0.08
Black Drum, N=5	Mercury	0.11 - .018	0.15
	PCBs	<0.05 – 0.27	0.12
Sheepshead, N=1	Mercury	0.15	
	PCBs	<0.05	
Summer Flounder, N=1	Mercury	<0.01	
	PCBs	<0.05	
Blue Fish, N=1	Mercury	<0.01	
	PCBs	<0.05	

1995

In 1995 a large study was undertaken in the vicinity of LCP. Nine zones (A through I) were established to cover the Turtle River. Zones began in the upper reaches of the Turtle and Buffalo Rivers, and continued through the mouth of the Turtle River (St. Simon Sound) and also incorporated Purvis and Gibson Creeks immediately adjacent to the site. A large number of composite samples (131 fish composites, 31 shellfish composites) were collected and analyzed for > 40 contaminants. The composite fish samples represented more that 650 individual fish collected. The table below shows data grouped into 3 main geographic regions that correspond roughly to "above, adjacent to, and below" the site. The resulting fish consumption restrictions were based on the "3 zone" analyses.

Location	Species	Composites (N)	Mean Mercury conc. (ppm)	Mean PCBs conc. (ppm)
A, B, C	S.S. Trout	8	0.42	0.25
	Red Drum	8	0.31	0.04
	Black Drum	5	0.39	0.81
	Spot	5	0.04	ND
	Croaker	3	0.19	0.23
	Mullet	4	0.09	0.40
	Flounder	5	0.30	0.06
	Blue Crab	5	0.36	ND
	Shrimp	3	0.08	ND
D, H, I	S.S. Trout	6	0.39	0.71
	Red Drum	8	0.37	0.27
	Black Drum	3	0.24	0.09
	Spot	4	0.10	0.36
	Croaker	8	0.15	0.63
	Mullet	6	0.04	0.95
	Flounder	5	0.29	0.06
	Whiting	4	0.38	0.20
	Blue Crab	9	1.71	0.16
	Shrimp	4	0.09	ND
E, F, G	S.S. Trout	8	0.26	0.34
	Red Drum	9	0.15	0.03
	Black Drum	3	0.29	0.22
	Spot	4	0.06	0.07
	Croaker	8	0.11	0.13
	Mullet	6	0.12	0.16
	Flounder	4	0.14	ND
	Whiting	5	0.13	0.11
	Sheepshead	1	0.22	0.04
	Yellow Tail	1	0.32	0.04
	Blue Crab	5	0.27	ND
	Shrimp	3	0.03	0.04

1997

U.S. EPA and EPD conducted a joint study in 1997 to reassess contaminants in fish and seafood in the Turtle River. The study followed the basic protocol of the '95 study, with the exception that EPD collected and analyzed samples from three zones (D, H, I) while U.S. EPA collected and analyzed samples from the other six zones (A, B, C, E, F, G). Six fish species and two shellfish species were targeted in each zone, and data generated by EPD was transferred to U.S.

EPA for evaluation and incorporation into a report. A copy of that report is available upon request. Exact numbers of composites collected can't be determined from the report, and the raw data from U.S. EPA were not made available to EPD. However, the two agencies combined collected approximately 170 composites, with 75% (128) of those representing finfish and 25% (32) representing shellfish. The report concluded that while contaminant levels of PCBs and mercury were different in some zones and species between the two years, there was no clear pattern of change. That is, in some instances concentrations were higher, in others lower. The report also noted that mercury was detected in four species (Spot, Black Drum, S.S. Trout, and Blue Crab) at concentrations exceeding EPD's minimum concentration for issuing consumption guidance. Likewise, several species (Spot, Black Drum, Mullet, and S.S. Trout) were noted as containing concentrations of PCBs well above EPD's minimum concentration for issuing consumption guidance. Concentrations of mercury and PCBs for some species are shown below.

Location	Species	Mean Mercury conc. (ppm)	Mean PCBs conc. (ppm)
A, B, C	Spot	0.16	0.42
	Black Drum	0.11	0.18
	Mullet	0.02	1.14
	S.S. Trout	0.34	0.21
	Blue Crab	0.26	0.02
D, H, I	Spot	0.44	0.58
	Black Drum	0.32	0.40
	Mullet	ND	1.84
	S.S. Trout	0.26	0.46
	Blue Crab	1.27	0.14
E, F, G	Spot	0.11	0.36
	Black Drum	0.09	0.08
	Mullet	0.06	0.51
	S.S. Trout	0.19	0.11
	Blue Crab	0.29	0.02

2002

In the fall of 2002, GeoSyntec Consultants collected samples in the Turtle River system. The consultants worked with EPD personnel in developing a Sampling and Quality Assurance Plan for the survey. The samples were collected in the same zones used by EPD and EPA in the '95 and '97 studies. Severn Trent Laboratories analyzed the samples. The Fletcher Group performed an independent, third party Level IV data quality assessment on all samples following U.S. EPA guidance. A total of 277 composites were collected. Data from 223 fish composites, representing approximately 1100 individual fish, and 54 shellfish composites are summarized below. Zones have been combined to correspond to the major advisory areas.

While concentrations appear to decline in some locations compared to '95 and '97 data, they continue to remain sufficiently elevated near the site to require significant limitations on consumption recommendations. After reviewing the data collected in 2002, the pre-existing consumption guidelines were not modified significantly.

Location	Species	Composites (N)	Mean Mercury conc. (ppm)	Mean PCBs conc. (ppm)
A, B, C	Blue Crab	9	0.51	0.16
	Croaker	9	0.15	0.82
	Black Drum	10	0.11	0.41
	Red Drum	5	0.27	0.25
	Flounder	9	0.27	0.25
	Mullet	10	0.02	1.38
	Southern Kingfish	8	0.34	0.63
	S.S. Trout	9	0.39	0.20
	Sheepshead	9	0.30	0.45
	Shrimp	9	0.05	0.10
	Spot	9	0.09	0.65
D, H, I,	Blue Crab	9	0.68	.021
	Croaker	7	0.22	0.96
	Black Drum	9	0.16	0.26
	Red Drum	3	0.32	0.14
	Flounder	9	0.23	0.16
	Mullet	9	0.02	2.60
	Southern Kingfish	8	0.39	0.52
	S.S. Trout	10	0.4	0.48
	Sheepshead	7	0.35	0.50
	Shrimp	9	0.09	0.23
	Spot	9	0.10	1.2
E, F, G	Blue Crab	9	0.31	0.10
	Croaker	3	0.14	0.40
	Black Drum	10	0.12	0.4
	Red Drum	7	0.15	0.11
	Flounder	9	0.19	0.10
	Mullet	9	0.01	0.36
	Southern Kingfish	9	0.29	0.43
	S.S. Trout	9	0.26	0.18
	Sheepshead	9	0.22	0.19
	Shrimp	9	0.04	0.10
	Spot	9	0.07	0.31

APPENDIX B. FIELD SUMMARY

ARCO QUARRY
Field Data Summary

April, 2005

Specimen Collection

On April 28th and April 29th, 2005, specimens of pan fish, catfish and mullet were captured from a quarry located in the Arco neighborhood adjacent to LCP Chemicals (Arco Quarry) in Brunswick, Georgia. Fish tissue samples were collected from selected specimens and shipped to a laboratory for chemical analyses of mercury (Hg), lead (Pb) and polychlorinated biphenyl (PCB). Representatives of the Georgia Department of Natural Resources, Coastal Resources Division (CRD), Glynn County Health Department (GCHD) and Glynn Environmental Coalition (GEC) were responsible for collecting whole fish specimens. Captured fish specimens were measured, tagged, individually wrapped in aluminum foil, placed in Zip-Lock plastic bags and packed in wet ice upon collection pending transport to the designated residential facility for tissue collection. A total of seven (7) bluegill and one (1) catfish were captured on April 28th using light tackle/hook and line techniques from the quarry embankment between the hours of 9:30 a.m. and 12:00 p.m. Bluegill captures ranged in size from 4.0 to 6.75 inches in length. All specimens measuring less than 5.5 inches in length were released. A total of eleven (11) striped mullet were caught on April 29th between 10:00 a.m. and 10:25 a.m. using 300 feet of 2.5 inch gill net that was deployed from a small gasoline powered aluminum boat. Mullet specimens that were retrieved ranged from 7.25 to 11.75 inches in length. Several other mullet and miscellaneous species were also caught on April 29th. All of the fish, except the largest mullet specimens and/or injured fish were released. The four largest mullet collected were used to prepare the tissue composite for this species. Table 1 summarizes the type of fish retained for tissue collection, specimen length and the techniques used for capture.

Table 1. Retained Whole Fish Specimen Field Data

Date	Common Name	Length (inches)	Weight (grams) [1]	Capture Method
04-28-05	Blue Gill	5.50	62.2	Hook and Line
04-28-05	Blue Gill	6.25	85.1	Hook and Line
04-28-05	Blue Gill	5.50	59.2	Hook and Line
04-28-05	Blue Gill	5.75	69.4	Hook and Line
04-28-05	Blue Gill	5.50	55.7	Hook and Line
04-28-05	Catfish (Blue)	14.25	706.5	Hook and Line
04-29-05	Striped Mullet	11.75	357.4	Gill Net
04-29-05	Striped Mullet	10.50	327.2	Gill Net
04-29-05	Striped Mullet	9.25	341.0	Gill Net
04-29-05	Striped Mullet	9.00	269.3	Gill Net

[1] Specimen weights were recorded prior to tissue sample collection on the day of capture.

A Personnel Task Summary for the participants involved is provided in Table 2.

Table 2. Personnel Task Summary

Date	Name	Affiliation	Task/Procedure/Technique
04-28-05	Duane Robertson	CRD	Hook and Line Capture
04-28-05	Jimmy Page	CRD	Hook and Line Capture
04-28-05	Daniel Parshley	GEC	Hook and Line Capture
04-28-05	Gary Hummel	GCHD	Fish Specimen handling, Transport and Custody
04-28-05	Gary Hummel	GCHD	Tissue Sample Collection, Storage, and Custody
04-29-05	Duane Robertson	CRD	Gill Net Deployment and Specimen Retrieval
04-29-05	Paul Medders	CRD	Gill Net Deployment and Specimen Retrieval
04-29-05	Bill Reddick	CRD	Gill Net Deployment and Specimen Retrieval
04-29-05	Daniel Parshley	GEC	Photo Documentation
04-29-05	Gary Hummel	GCHD	Fish Specimen handling, Transport and Custody
04-29-05	Gary Hummel	GCHD	Tissue Sample Collection, Storage and Custody
05-02-05	Gary Hummel	GCHD	Tissue Sample Transport and Shipment to Laboratory

Tissue Sample Collection and Storage

Whole fish specimens were transported on ice to a residence on Saint Simons Island, Georgia for tissue collection operations under semi-controlled conditions. Composite samples were collected from bluegill and mullet specimens using cross sections from both the thoracic and caudal regions after scaling and gulleting. The viscera were removed along with heads in a manner taking care not to disrupt the organs. One composite for each species was submitted in aggregate proportions with instructions for the laboratory to combine all submitted tissue for each sample prior to homogenization. Bluegill and mullet samples included tissue from the skin, muscle and fins. Catfish samples were comprised of sagital sections that included the skin, but omitted the main skeletal bones. One catfish roe sample, comprised of the entire egg mass and sac was also submitted. Extra tissue from bluegill and catfish were submitted for future analyses if deemed necessary. No additional mullet tissue was shipped. All collection equipment was pre-cleaned prior to use and routinely decontaminated through out the procedure. Working surfaces were covered aluminum foil and replaced for each specimen. Disposable latex gloves were used to handle fish and tissues.

All specimens were first weighed, then scaled and washed under running cold tap water (PWS), rinsed with Deionized Water (DI) then headed in a manner that also allowed for the viscera to be removed intact without a ventral longitudinal incision. The carcasses were again rinsed with PWS and DI water. Sections of tissue were removed from the thoracic region just behind the pectoral fins and included portions of dorsal fin (bluegill and mullet). Caudal sections for both mullet and bluegill were collected from behind the vent, and included portions of the anal and dorsal fin. Bluegill composites also included the entire caudal fin; mullet did not. Approximately

10 grams of thoracic and 10 grams of caudal section from each of the five (5) bluegill were used to conclude the pan fish composite with roughly 100 grams of tissue. Approximately 15 grams from each section from the four (4) mullet was used to proportion a total sample size of approximately 120 grams. Catfish filets and roe were submitted intact and were not proportioned for a composite determination. All tissue samples were collected on the day the fish were captured. Aliquots were containerized, packed in wet ice and stored in a cooler inside the residence until shipped to the laboratory. A list of equipment, construction materials and source are provided in Table 3.

Table 3. Equipment, Construction Materials and Source

Description	Construction Material	Use	Source
Scaling Knife	Stainless Steel, wood handle	Scale & Head Fish	Residential Kitchen
#11 Surgical blade	Carbide Surgical Steel	Tissue collection	Local Hospital
Working Surfaces	Aluminum Foil	Work Surface, wrap whole fish specimens and pre-cleaned sampling equipment	Grocery Store
Baking Dish	Pyrex Glass	Hold tissue samples prior to containerization	Residential Kitchen
Sample Containers	4 oz. Glass, Wide Mouth, Screw Cap, Teflon lined septa	Store and ship samples	Certified Laboratory
DI Water	Stored in 1L Plastic Bottles [1]	Equipment Decontamination and Whole fish specimen rinse	UGA Marine Extension Lab
Isopropanol	Stored in 1L Plastic Bottles [1]	Sample Equipment Decontamination	UGA Marine Extension Lab
Liquinox	Stored in 100ml Plastic Bottles	Sample Equipment Decontamination	UGA Marine Extension Lab
Tap Water	NA	Equipment Decontamination Wash and Whole Fish Specimen Rinse	Ga. DNR Permitted PWS
Latex Gloves	Latex	Personal Protection and Prevention of Cross Contamination	Scientific Supply
Ohaus Scale	NA	Weigh Fish & Tissue	Scientific Supply
Bagged Ice	NA	Sample Preservation	Grocery Store
Cooler	Styrofoam	Sample Preservation, Storage & Shipping	Commercial Supplier

[1] Reagent Container material is not approved for PCB sample analyses.

Tissue Sample Shipment

Tissue samples were stored on wet ice and shipped to the University of Georgia, Agricultural Services Laboratory for analysis. Pre-cooled tissue samples were placed in a cooler wrapped in protective plastic sheeting to prevent breakage, iced (wet ice in plastic bags) and the cooler sealed prior to shipment via Federal Express. Samples were shipped on May 02, 2005 at approximately 4:00 p.m. and received by the laboratory intact on May 03, 2005 mid day.

APPENDIX C. EXPLANATION OF TOXICOLOGICAL EVALUATION

Step 1--The Screening Process

In order to evaluate the available data, GDPH used comparison values (CVs) to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, soil, or water that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the public health assessment process where substances found in amounts greater than their CVs might be selected for further evaluation. CVs are not intended to be environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Non-cancer CVs are calculated from ATSDR's minimal risk levels, EPA's reference doses, or EPA's reference concentrations for ingestion and inhalation exposure. When a cancer and non-cancer CV exist for the same chemical, the lower of these values is used as a conservative measure. The chemical and media-specific CVs used in the preparation of this public health assessment are:

An **Environmental Media Evaluation Guide (EMEG)** is an estimated comparison concentration for exposure that is unlikely to cause adverse health effects, as determined by ATSDR from its toxicological profiles for a specific chemical.

A **Cancer Risk Evaluation Guide (CREG)** is an estimated comparison concentration that is based on an excess cancer rate of one in a million persons exposed over a lifetime (70 years), and is calculated using EPA's cancer slope factor.

Step 2--Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. Usually little or no information is available for a site to know exactly how much exposure is actually occurring, so assessors assume that maximum exposure is taking place. That assumption would include any worse case scenarios where someone received a maximum dose. Actual exposure is likely much less than the assumed exposure.

An explanation of the calculation of estimated exposure doses used in this public health assessment are presented below. Calculated doses are reported in units of milligrams per kilogram per day (mg/kg/day).

Ingestion of contaminants present in fish

Dose Calculations from Fish Consumption

Exposure doses for ingestion of contaminants present in fish were calculated using the maximum detected concentrations of contaminants in milligrams per kilogram (mg/kg [mg/kg = ppm]). The dose varies depending upon several factors, including:

- age;
- gender;
- the amount of fish eaten at each meal (e.g., 2, 4, 8, 12, 16 ounces); and
- the frequency of fish meals.

1 ounce (oz) = 28.3495 grams (gm)

EF = number of fish meals per time period
1/wk, 3/wk
1/month, 2/month, 4/month
12/month for 4 months followed by 1, 2, or 4/month for 8 months (seasonal variation)

BW = body weight (based on averages in kg)

Prsechool child	10
Elementary child	35
Teenager	55
Adult female	60
Adult male	70

Dose = concentration of chemical in milligrams per kilogram (mg/kg) of fish x ounces of fish/meal x 28.26 gm/oz x 0.001 kg fish/gm fish x EF / BW

Non-Cancer Health Risks

The doses calculated for exposure to individual chemicals are then compared to an established health guideline, such as an ATSDR minimal risk level (MRL) or an EPA reference dose (RfD), in order to assess whether adverse health impacts from exposure are expected. Health guidelines are chemical-specific values that are based on available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice to derive health guidelines is to identify, usually from animal toxicology experiments, a no observed adverse effect level (NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The known toxicological values are doses derived from human and animal studies that are summarized in ATSDR's *Toxicological Profiles (www.atsdr.cdc.gov/toxpro2.html).* The NOAEL is modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (e.g., children, pregnant women, the elderly), extrapolation from animals to humans, and the completeness of the available data. Thus, exposure doses at or below the established health guideline are not expected to cause adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies.

For non-cancer health effects, the following health guidelines were used in this health consultation

A **minimal risk level (MRL)** is an estimate of the daily human exposure to a chemical that is likely to be without a significant risk of harmful effects over a specified period of time. MRLs are developed for ingestion and inhalation exposure, and for lengths of exposures; acute (less than 14 days), intermediate (between 15-364 days), and chronic (365 days or greater). ATSDR has not developed MRLs for dermal exposure (absorption through skin).

If the estimated exposure dose to an individual is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the public health assessment. A direct comparison of site-specific exposure and doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur.

It is important to consider that the methodology used to develop health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer risk evaluation is necessary for potentially cancer-causing contaminants detected at this site.

Cancer Risks

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific doses by EPA's chemical-specific cancer slope factors (CSFs) available at *www.epa.gov/iris*. This calculation estimates a theoretical excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer over background in a population of 1 million. An increased lifetime cancer risk is not a specified estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a particular contaminant under specific exposure scenarios. For children, the theoretical excess cancer risk is not calculated for a lifetime of exposure, but from a fraction of lifetime; based on known or suspected length of exposure, or years of childhood.

Because of conservative models used to derive CSFs, using this approach provides a theoretical estimate of risk; the true or actual risk is unknown and could be as low as zero. Numerical risk estimates are generated using mathematical models applied to epidemiologic or experimental data for carcinogenic effects. The mathematical models extrapolate from higher experimental doses to lower experimental doses. Often, the experimental data represent exposures to chemicals at concentrations orders of magnitude higher than concentrations found in the environment. In addition, these models often assume that there are no thresholds to carcinogenic effects--a single molecule of a carcinogen is assumed to be able to cause cancer. The doses associated with these estimated hypothetical risks might be orders of magnitude lower that doses reported in toxicology literature to cause carcinogenic effects. As such, a low cancer risk estimate of 1×10^{-6} and below may indicate that the toxicology literature supports a finding that no excess cancer risk is likely. A cancer risk estimate greater than 1×10^{-6}, however, indicates that a careful review of toxicology literature before making conclusions about cancer risks is in order.

APPENDIX D. SITE FACT SHEETS

For more Information...

GA Division of Public Health
Chemical Hazards Program
http://www.ph.dhr.state.ga.us
Phone: (404) 657-6534

The University of Georgia
Cooperative Extension Service
College of Family and Consumer Sciences
http://www.gafamilies.com
Phone: (706) 542-8866

GA Department of Natural Resources
Environmental Protection Division
http://www.dnr.state.ga.us/dnr/environ
Phone: (706) 369-6376 or (404) 656-4713

To receive a copy of the complete "Guidelines for Eating Fish from Georgia Waters," contact GA EPD or visit:

http://www.dnr.state.ga.us/dnr/environ

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A WOMAN'S GUIDE TO EATING FISH AND SEAFOOD FROM COASTAL GEORGIA

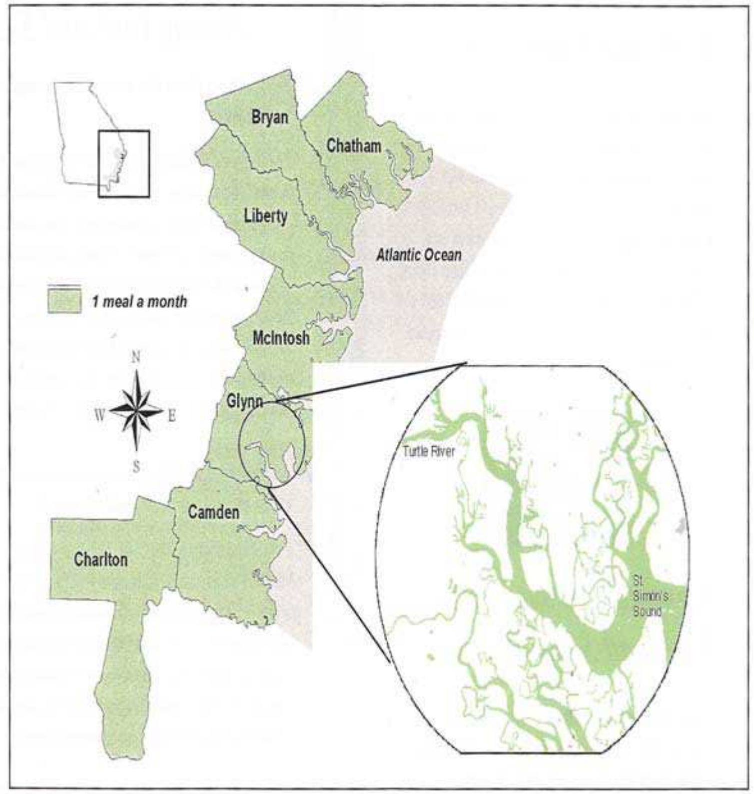
What you should know if you are pregnant, planning to be pregnant, or nursing a child

DHR
Georgia Department of Human Resources

The University of Georgia
Cooperative Extension Service
College of Family and Consumer Sciences

Department of Natural Resources
Environmental Protection Division

Coastal Georgia Fish and Seafood Consumption Guidelines for Nursing and Pregnant Women, and Children



How to Read this Map

Locate the county where you live and fish on the above map. Women who are pregnant or nursing, or may become pregnant, and children under seven should limit meals of fish caught in these counties to one meal per month.

Remember--

Some types of fish and seafood have high levels of mercury that should not be eaten by women of childbearing age and young children. According to the FDA, the fish and seafood that should be avoided include shark, swordfish, king mackerel, and tilefish.

The Benefits of Eating Fish and Seafood

Fish and seafood are excellent sources of protein, minerals, and vitamins, and play a role in maintaining a healthy, well-balanced diet. Fish is also an excellent source of Omega-3 fatty acids, which are essential for the development of a healthy baby. According to the American Heart Association, Omega-3 fatty acids in fish and seafood are also essential for good cardiovascular health for adults.

Concerns About Eating Fish and Seafood

Some fish contain contaminants, such as mercury or polychlorinated biphenyls (PCBs) that can be harmful if you eat them too often.

Over time, your body may build up harmful levels of toxic chemicals that can affect your pregnancy and the health of your baby.

Contaminated fish may not look, smell, or taste different, but they can still harm you and your child. Women who are or may become pregnant should contact their local health department or the Georgia Environmental Protection Division for more detailed information.

Frequently Asked Questions about the Safety of Eating Fish and Seafood from Coastal Georgia

Q. Is seafood from the coast of Georgia safe to eat?

A. Some types of seafood are safe for pregnant women and young children to eat. Others may have high levels of contaminants and should not be eaten by pregnant women and children. Women who are pregnant or nursing, or may become pregnant, and children under seven should follow the general recommendations on the map and choose fish that are likely to contain minimal amounts of contaminants.

Q. Are there specific types of saltwater fish or seafood that I should not eat?

A. Yes. According to the U.S. Food and Drug Administration (FDA), long-lived, large fish such as **shark, swordfish, king mackerel, and tilefish** should not be eaten. Striped mullet and bivalves (oysters, clams, etc.) should not be eaten from areas of known contamination, such as the Turtle River System and Terry and Dupree Creeks.

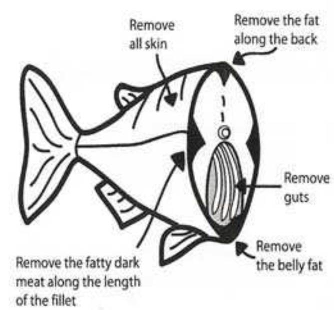
Q. How can I clean and cook the fish to reduce contaminants?

A. Exposure to PCBs and toxaphene-like chemicals may be reduced by removing the skin and the fat, as indicated in the diagram to the right, before cooking the fish. Also, grilling or cooking the fish such that the fat drips away, may reduce the levels of these chemicals. **Mercury can not be removed by cooking or cleaning the fish.**

Q. What can I do to protect myself and my child from chemicals found in fish?

A. Follow the suggestions below:

- Eat safer <u>types</u> of fish and seafood
  - Eat a variety of fish and seafood
  - Avoid eating fish and seafood known to have high levels of contamination
- Find safer ways to <u>prepare</u> fish and seafood
  - Before cooking, remove organs, skin and fat as shown in the diagram below
  - Cook the fish in a way that the fat can drip away from the fish, such as grilling
  - Avoid deep frying fish and seafood
- Limit <u>how much</u> fish and seafood you eat
  - Nationally, the U.S. Food and Drug Administration (FDA) recommends that pregnant women should eat only a couple of servings of fish and seafood each week
  - Follow the guidelines in this brochure when eating locally caught fish in your area



Brunswick, Georgia

Extensive studies have been performed on the Turtle River System, and Terry and Dupree Creeks. Assessment of contaminants in the species sampled suggests **striped mullet** and **bivalves (oysters, clams, etc.)** from this area should not be eaten. Consumption of all other **finfish** and **blue crabs** should be limited to once a month for women of childbearing age. However, there is no restriction on the amount of **shrimp** that can be eaten from these waters.

Remember: **Don't stop eating fish and seafood.** They provide one of the best sources of protein and Omega-3 fatty acids. Women of childbearing age who are pregnant, planning to be pregnant, or nursing a child, and young children can still get the benefits of eating fish and seafood by making wise choices and eating fish in moderation.

APPENDIX D. (CONT.)

Mercury in Fish

This fact sheet provides general information about mercury and its presence in fish, and how to reduce exposure to mercury in fish.

What is mercury? (pronounced "merk-your-ee")

Mercury is a naturally occurring metal that exists in several forms. It is a heavy, silver-gray element that is liquid at room temperature and will evaporate into the air. When it enters soil and water, mercury becomes methylmercury (also called organic mercury) and can accumulate in plants, animals, fish and shellfish. It has no special smell, but can leave a metallic taste. Consuming fish and shellfish with high levels of methylmercury may have serious adverse health effects. Bioammumulation of low levels of methylmercury may be a health risk to persons eating contaminated fish and shellfish over a long period of time.

Most mercury waste comes from human activities like mining and smelting, manufacturing, and burning fossil fuels or solid waste. Elemental mercury is used in the home for barometers, thermometers, batteries, electrical switches, fluorescent lights, and some medicines. It is also used for herbal remedies and religious practices in some cultures. Medical professions use mercury in blood pressure devices and metal dental fillings, and paper bleaching companies use mercury in the bleaching process.

How did the Georgia Division of Public Health get involved in investigating my neighborhood?

During a public meeting in 2004, residents of Glynn County requested that fish tissue samples be collected from a pond located near the LCP Chemicals Superfund site. There was concern that fish from the pond may be contaminated with unsafe levels of mercury, lead, and polychlorinated byphenyls (PCBs) from previous activities associated with LCP. In response, the Georgia Division of Public Health arranged for samples to be collected and analyzed to assess the levels of these contaminants in fish from the pond. Results show that although some fish may have low levels of mercury, it is not considered to be at levels of health concern. However, residents, especially women who are pregnant, planning to become pregnant, or nursing a child, should follow the consumption guidelines for the area when eating fish from the pond.

Is seafood from the coast of Georgia safe to eat?

Some types of seafood are safe for pregnant women and young children to eat. Others may have high levels of contaminants and should not be eaten by pregnant women and children. Women who are pregnant or nursing, or may become pregnant, and children under seven should follow the general recommendations on the map and choose fish that are likely to contain minimal amounts of contaminants.

How can mercury in air affect my health?

If individuals eat fish and shellfish contaminated with methylmercury at levels of health concern, they may exhibit effects similar to those from exposure to metallic mercury such as kidney damage, but are more likely to have nervous system effects. This is especially true of children born of mothers who were exposed to methylmercury during pregnancy. The central nervous system can allow effects such as aberrant motor development and coordination or visual perception problems, or peripheral nervous system affects system such as parasthesia.

Mercury poisoning does not always show symptoms if exposure occurs at low levels; however, if exposed to high enough levels or low levels over a period of time, symptoms include respiratory problems, headache, tremors, changes in vision or hearing, weakness, personality changes (shyness, nervousness, irritability), and difficulty with memory and learning. If you think you may have been exposed to mercury, contact your health care provider for testing. Mercury exposure can be diagnosed by testing urine, blood, or hair. Blood tests are appropriate for analyses to measure exposure to organic mercury and can be used to accurately determine recent exposure to methylmercury.

How can I reduce my exposure to methylmercury in fish and shellfish?

Don't stop eating fish and seafood. They provide one of the best sources of protein and Omega-3 fatty acids. Women of childbearing age who are pregnant, planning to be pregnant, or nursing a child, and young children can still get the benefits of eating fish and seafood by making wise choices and eating fish in moderation.

Exposure to PCBs and toxaphene-like chemicals may be reduced by removing the skin and the fat, as indicated in the diagram to the right, before cooking the fish. Also, grilling or cooking the fish such that the fat drips away, may reduce the levels of these chemicals. Mercury can not be removed by cooking or cleaning the fish. * Pregnant women should eat only a couple of servings of fish and seafood each week. Follow the guidelines in this brochure when eating locally caught fish in your area.

For More Information, Contact:

GEORGIA DEPARTMENT OF HUMAN RESOURCES
Division of Public Health
Environmental Health and Injury Prevention Branch
Chemical Hazards Program
2 Peachtree Street, 13th Floor
Atlanta, Georgia 30303
(404) 657-6534
www.health.state.ga.us/programs/hazards

Other websites:
www.atsdr.cdc.gov
www.epa.gov/mercury

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APPENDIX E. ATSDR PUBLIC HEALTH HAZARD CATEGORIES

No Public Health Hazard

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances

No Apparent Public Health Hazard

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects

Indeterminate Public Health Hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Public Health Hazard

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects

Urgent Public Health Hazard

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.