HEALTH CONSULTATION

FISH IN RICE CREEK AT THE GEORGIA-PACIFIC SITE

PALATKA, PUTNAM COUNTY, FLORIDA

Prepared by:

Florida Department of Health
Bureau of Community Environmental Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Summary and Statement of Issues

In March 2002, the federal Agency for Toxic Substances and Disease Registry (ATSDR) received a petition including fishing, health and environmental concerns about Rice Creek, St. Johns River, and Etonia Creek, all of which are near the Palatka (Putnam County) Georgia-Pacific paper mill. The Florida Department of Health (DOH) and the Florida Department of Environmental Protection (DEP) worked together to address these concerns.

Because Rice Creek is directly downstream of Georgia Pacific, this is the water body we would expect to find the highest levels of contaminants in fish. Therefore, Florida DOH, ATSDR and Florida DEP agreed only fish from Rice Creek would be collected, evaluated and summarized in this health consultation.

Georgia-Pacific has an industrial wastewater permit with the Florida DEP, which requires fish testing in Rice Creek. In July 2003, Georgia-Pacific contractors, with the oversight of the Florida DEP and the Florida DOH, collected 48 bluegill and white catfish from Rice Creek. Because of the low dioxin levels found in the fish, in December 2003 the Florida DOH determined a fish consumption advisory is not necessary for Rice Creek. Thus the conclusions and recommendations in this health consultation are only applicable to those who eat fish caught from Rice Creek near the Georgia-Pacific paper mill.

Purpose

This health consultation addresses the petitioner's concern about people eating fish from Rice Creek. Because the petitioner was already notified in December 2003 that a fish advisory is not necessary for Rice Creek, this health consultation summarizes and validates Florida DOH's reasoning for not issuing a fish advisory.

Site Background and History

The Georgia-Pacific site is on Highway 216 near US 17, in the vicinity of Palatka, Putnam County, Florida. At this site Georgia-Pacific operates a pulp and paper mill, from which Rice Creek receives effluent (Figures 1, 2, and 3). Rice Creek flows west to east, north of the Georgia-Pacific facility. Etonia Creek is a tributary of Rice Creek. Rice Creek flows into the St. Johns River east of the Georgia-Pacific facility.

In 1999 and 2000, Georgia-Pacific's contractors collected largemouth bass and bluegill from Rice Creek and sent the fish to Alta Analytical Perspectives laboratories for dioxin analysis. The Florida DOH concluded, however, that the contractors collected too few fish of each species. The Florida DOH recommended they collect between seven and 10 fish of each species.

In October 2001, Georgia-Pacific's contractor collected more fish from Rice Creek. However, Florida DOH was unable to make a health determination because the fish samples were contaminated in the laboratory, thus rendering the data invalid.

In addition to the Rice Creek fish data, Georgia-Pacific's contractor also submitted fish data from the St. Johns River. The Florida DOH only considered fish collected from Rice Creek because they best represent the health risk to persons who eat fish from Rice Creek. Fish from Rice Creek represent the 'worst case' because Rice Creek is the most likely to be impacted by the site. In the future, assessment of fish from St. Johns River and Etonia Creek may be warranted if other sources are identified or if fish in Rice Creek represent an exposure concern.

In its March 2002 correspondence, the petitioner requested that ATSDR:

1. advise people not to eat fish from Rice or Etonia Creeks,
2. test fish in the St. John's River,
3. ensure Georgia-Pacific keeps dioxin-containing sludge in their wastewater lagoon, and
4. assess and remediate dioxin-containing sediments in Rice Creek, Etonia Creek, and St. Johns River.

In June 2002, ATSDR notified the petitioner they would research site information and address the petitioner's concerns. In November 2002, ATSDR contacted the Florida DOH for assistance with the petitioner's request. The Florida DOH agreed to coordinate fish collection from Rice Creek, evaluate fish results, and prepare a report (Appendix A). In February 2003, the Florida DOH received a copy of the petitioner's correspondence from ATSDR and began coordination of fish testing from Rice Creek with the Florida DEP.

In October 2003, the Florida DOH received a request from the Natural Resources Defense Council (NRDC) to post fish consumption advisories on the St. Johns River and on Rice Creek. The NRDC, a national environmental organization, claimed fish were contaminated with dioxin and posed a public health risk. The NRDC claimed deficiencies with fish sampling methods and with past results from Georgia-Pacific's contractor.

In November 2003, the Florida DOH stated they would evaluate new fish data received in October 2003 and determine whether any detected contamination levels warranted issuing a fish advisory (Appendix B). Florida DOH reviewed the fish test results and found no apparent public health hazard from persons who consumed fish containing the levels of dioxins/furans found in fish taken from Rice Creek near the Georgia-Pacific site.

In December 2003, the Florida DOH sent a letter to the petitioner stating a fish advisory was not necessary (Appendix C). The Florida DOH also informed the petitioner that a written health consultation would be forthcoming. Also in December 2003, the Florida DOH explained the use of the 7 parts per trillion (ppt) dioxin standard to the petitioner . The Florida DOH also explained that further fish testing in Rice Creek is unnecessary (Appendix D). At this same time, a nearby resident voiced concerns about lesions on fish. The Florida Fish and Wildlife Conservation Commission (FFWCC) offered to test collected fish for fungus, bacteria, parasites, brevetoxin and saxitoxin. To date, the resident has not contacted the Florida FWCC, and the FFWCC has not performed fish testing.

Demographics

According to the 2000 Census, approximately 15,000 Palatka residents could potentially fish in Rice Creek. Access is, however, only available upstream, given that Rice Creek is fenced downstream of Georgia-Pacific.

Discussion

Georgia-Pacific's contractor and Florida DOH collected one species of water-column-dwelling predator game fish (bluegill, *Lepomis macrochirus*), and one species of bottom feeder (white catfish, *Ameiurus catus*). Both are freshwater species. Bluegill is a middle of the food chain predator and a good indicator of persistent pollutants that could biomagnify through several tropic levels of the food web. Bluegills eat, insects, crustaceans, fish eggs, small fish, mollusks and snails. White catfish are bottom feeders, eating crustaceans, fish eggs and aquatic plants. See Attachment A for photos and detailed descriptions of these fish.

From November 2002 through July 2003, the Florida DOH Bureau of Community Environmental Health reviewed fish plans and sampling plans, participated in numerous teleconferences, and coordinated fish collection with the Florida DEP and Georgia-Pacific's contractor. In June 2003, the Florida DEP finalized their Fish Tissue Collection and Analysis Plan of Study (Appendix E).

On July 11 and 12, 2003, volunteer students working with Florida DEP interviewed 22 persons fishing along Rice Creek. The purpose of these interviews was to determine what type of fish people eat and how they prepared those fish. Twelve of the 22 persons interviewed reported eating fish from Rice Creek. Six reported eating catfish, and six reported eating bluegill. Most filleted their fish and cooked them with the skin on.

Fish Evaluation

Fish Collection and Shipment

In July 2003, using electro-fishing equipment at locations both upstream and downstream of the Georgia-Pacific discharge, Georgia-Pacific's contractor collected bluegill and white catfish from Rice Creek. Of all the fish observed, the most numerous were bluegill and white catfish. The contractor and DOH also observed speckled catfish, redbreast and red-ear sunfish. The downstream location was west of the railroad bridge. The upstream location was at that point closest to the mill's discharge which was still accessible by boat. Fish collection and sampling time both upstream and downstream was adequate.

Georgia-Pacific's contractor sent the largest and oldest bluegill and white catfish (48 fish) to the laboratory for dioxin analyses. Georgia-Pacific's contractor weighed and measured the fish. They rinsed the fish with deionized water, wrapped them individually in heavy-duty aluminum foil, and secured them with a taped label.

Then, to prevent cross-contamination, the contractor placed each fish in a labeled Ziploc bag and transported them—on ice—to the laboratory. The shipment included the proper transportation labels and forms as well as chain of custody and laboratory forms. Alta Analytical Perspectives Laboratories filleted, composited, homogenized and analyzed four samples (12 upstream catfish, 12 downstream catfish, 12 upstream bluegill, and 12 downstream bluegill).

Fish Laboratory Methods and Analyses

Alta Analytical resected (i.e., cut) and filleted all 48 fish, leaving skins and scales intact. Using standard operating procedures, the laboratory composited the fish by species. Alta Analytical analyzed four separate composite samples, then analyzed for dioxins/furans using EPA Method 1613B. This analysis included preparation (resection and filleting), homogenizing, compositing, and two quality assurance (QA) samples (one procedure blank and one duplicate).

Interpretation of Fish Results

In October 2003, the Florida DOH received the Annual Fish Tissue Dioxin Monitoring report and fish data from the Florida DEP and Georgia-Pacific. Figure 3 shows the fish sampling locations. Table I summarizes the fish data from upstream and downstream locations in Rice Creek.

After reviewing these fish data, the Florida DOH determined the calculated dioxin/furan toxicity equivalents (TEQ) levels found in the bluegill and catfish are well below its guideline of 7 parts per trillion (ppt), and are, therefore, not likely to cause illness. Consequently, Florida DOH is not recommending additional fish sampling and is not issuing a fish consumption advisory for Rice Creek.

A TEQ is the mean concentration of the total dioxin/furan toxic equivalents. The Florida DOH assumed that on average, adults eat 30 grams of fish per day and children eat 15 grams per day. These rates may overestimate average fish consumption, but err on the side of protecting human health.

The levels of dioxins/furans in the fish collected from Rice Creek near the Georgia-Pacific site do not appear to be a health risk. Florida DOH does not expect any illness from eating bluegill or white catfish containing the levels of dioxins found in Rice Creek near the Georgia-Pacific site. The calculated doses for dioxins and furans for each fish species were less than the Agency for Toxic Substances and Disease Registry (ATSDR's) Minimum Risk Level (MRL) for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD) the standard for comparing all congeners of dioxins. An MRL is an estimate of daily human exposure to a dose of a chemical that is likely to be without an appreciable risk of adverse noncancerous effect over a specified duration of exposure. The potential toxicity of all the congeners of dioxins and furans were converted to TCDD equivalents to determine the risk of adverse human effects. This number is called the TEQ (Toxicity Equivalency Value). Using the highest TEQ value in the four fish species (0.51 parts per trillion or ppt), our estimate of a child's and an adult's maximum acute (1–14 days) exposure to 2,3,7,8-TCDD from eating the fish from Rice Creek is slightly higher than the ATSDR's MRL. Our estimate of a child's and an adult's maximum intermediate (15–364 days) exposure to 2,3,7,8-TCDD from eating fish from the creek is 17 times less than the ATSDR's MRL. Our estimate of a child's and an adult's maximum long-term (≥365 days) exposure to 2,3,7,8-TCDD from eating fish from the creek is 510 times less than the ATSDR's MRL.

The calculated dose for dioxins and furans for each fish species was also less than ATSDR's Cancer Effect Level (CEL) in animals for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). A CEL establishes levels of exposure associated with carcinogenic effects. There are CELs for long-term (≥365 days) exposure but none for acute (1–14 days) or intermediate (15–364 days) exposure. The Florida DOH used the CELs for 2,3,7,8-TCDD as this congener is the standard for comparison of all congeners of dioxins and furans. Using the highest TEQ value in the four fish species (0.51 parts per trillion or ppt), the Florida DOH estimate of a child's and an adult's maximum long-term (≥365 days) exposure to 2,3,7,8-TCDD from eating fish from the creek is two times less than the ATSDR's CEL.

Other Health-Based Standards

Currently, the U.S. Food and Drug Administration (USFDA) does not have action levels for dioxins or furans in human food (DHHS 1998). Because dioxin analysis is costly and time-consuming, available data on background levels in most foods are limited. FDA is expanding its monitoring program to obtain more comprehensive data on background levels. The FDA is also working to identify opportunities to reduce human exposure to dioxins (USFDA 2002).

Consideration of Biological Testing

The Florida DOH also considered biological testing (urine or blood) for people eating the fish from Rice Creek. The dioxin levels found in the fish do not, however, warrant a biological investigation.

Child Health Initiative and Other Susceptible Populations (Women)

Because this health consultation involves children who eat fish from Rice Creek near the Georgia-Pacific site, children are a concern. Dioxins/furans in fish can affect pregnant women, nursing mothers and children. It is important to remember children are not small adults. Children are more sensitive to the effects of dioxins/furans than are adults. Few studies have looked at how dioxins/furans can affect a child's health. However, in one such study where children exposed to higher-than-current background levels of 2,3,7,8-TCDD; the children appeared more sensitive than adults. Florida DOH has no information showing any differences between children and adults in terms of how much dioxin enter one's body, where dioxins can be found in one's body, and how fast dioxins leave one's body (ATSDR 1998). Children drink more fluids, eat more food, and breathe more air per kilogram of body weight than do adults. Children have a larger skin surface in proportion to their body volume. A child's diet—that often differs from that of an adult's—and a child's behavior and lifestyle can also influence exposure. Children, especially small children, are closer to the ground than are adults. They crawl on the floor, put things in their mouths, and might ingest inappropriate items such as dirt or paint chips. Children also spend more time outdoors than do adults. Finally and perhaps most importantly, children do not have the judgment of adults for avoiding hazards (ATSDR 1998).

Thus, DOH reviewed the results of the fish sample analysis aware that sensitive populations such as pregnant women, nursing mothers and children are a particular concern. Still, we conclude that the dioxin/furans found in bluegill and white catfish from Rice Creek near the Georgia-Pacific site are not likely to cause illness in adults or children.

Conclusions

1 There is no apparent public health hazard from eating fish containing the levels of dioxin/furan found in fish taken from Rice Creek near the Georgia-Pacific site.

2. The concentrations of dioxins/furans in fish from Rice Creek near the Georgia-Pacific site do not warrant biological testing of persons who eat these fish.

Recommendations

At this time and for this health consultation only, the Florida DOH does not offer any recommendations for this site.

Public Health Action Plan

In December 2003, Florida DOH sent a letter to the petitioner stating a fish consumption advisory for Rice Creek was not necessary (Appendix C).

DOH is currently re-evaluating the criteria used for evaluating the potential for adverse human health effects for exposure to dioxin-like compounds. This evaluation will be completed no later than June 2005. The risk of human health effects will be re-examined when the new criteria are finalized.

Authors, Technical Advisors

Susan Bland

Biological Scientist IV
Florida Department of Health
Bureau of Community Environmental Health

ATSDR Technical Project Officer

Jennifer Freed

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

Florida DOH Designated Reviewer

Randy Merchant

Program Administrator
Florida Department of Health
Bureau of Community Environmental Health

ATSDR Designated Reviewer

Bobbie Erlwein

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

Certification

The Florida DOH, Bureau of Community Environmental Health, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) prepared the Fish in Rice Creek at the Georgia-Pacific Site Health Consultation. The health consultation was prepared in accordance with approved methodology and procedures existing at the time.

Jennifer Freed
Technical Project Officer,
SPS, SSAB, DHAC

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

Roberta Erlwein
Team Leader,
CAT, SSAB, DHAC, ATSDR

References

[ATSDR] Agency for Toxic Substances and Disease Registry. 1998. Toxicological profile for chlorinated dibenzo-p-dioxins. Atlanta: US Department of Health and Human Services.

[DHHS] Department of Health and Human Services. 1998. Action levels for poisonous or deleterious substances in human food and animal feed. Washington, DC: US Food and Drug Administration.

[USFDA] US Food and Drug Administration Center for Food Safety and Applied Nutrition, Office of Plant and Dairy Foods and Beverages. 2002. Available at: http://www.cfsan.fda.gov/~lrd/dioxstra.html. Last accessed June 8, 2004.

Figures

MAP OF FLORIDA

FIGURE 1
COUNTY MAP
RICE CREEK, PALATKA

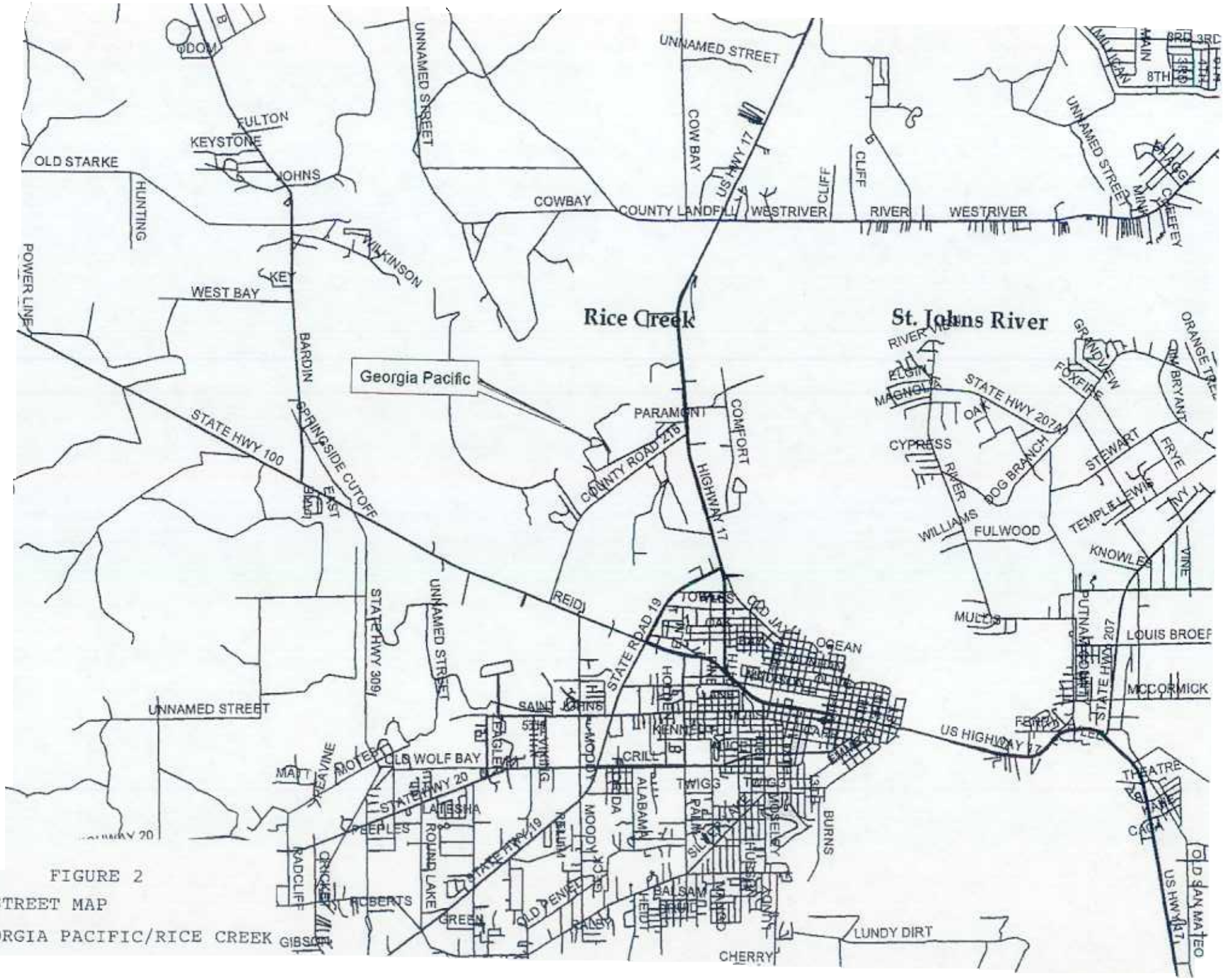


FIGURE 2

STREET MAP

GEORGIA PACIFIC/RICE CREEK

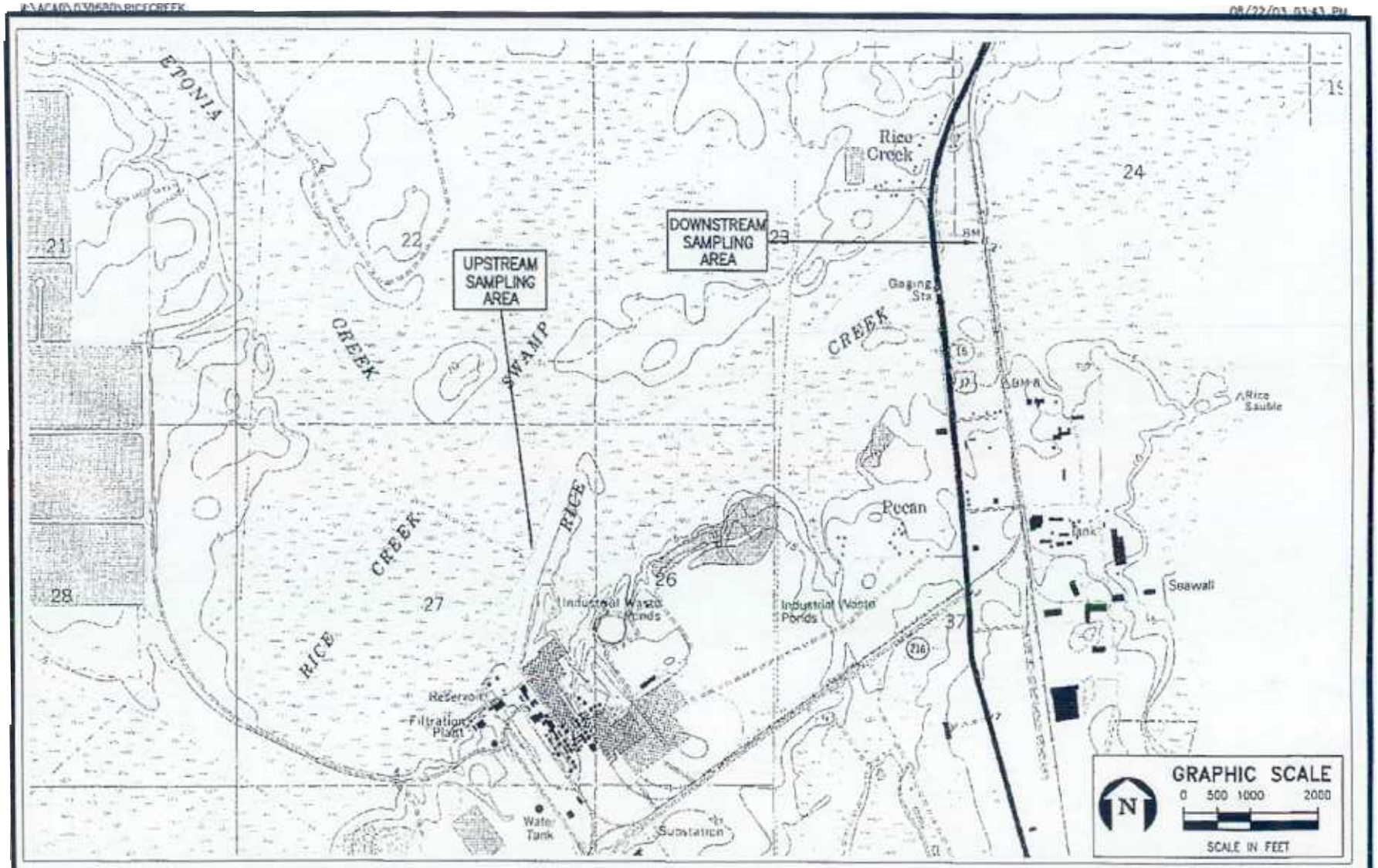


FIGURE 3
SAMPLING AREAS IN RICE CREEK
PALATKA, FLORIDA

ANNUAL FISH TISSUE DIOXIN AND FURAN MONITORING
JULY, 2003

ECT
Environmental Consulting & Technology, Inc.

Table I - Rice Creek Fish Data

TABLE I
RICE CREEK FISH DATA
JULY 2003
Toxicity Equivalents (TEQs)*

Dioxin Congeners	TEF**		Bluegill upstream	White Catfish upstream	Bluegill downstream	White Catfish downstream
Polychlorinated dibenzodioxins						
2,3,7,8-TCDD	1		0.39	0.16	0.17	<0.15
1,2,3,7,8-PeCDD	1		<0.07	<0.07	<0.09	<0.09
1,2,3,4,7,8-HxCDD	0.1		<0.04	<0.05	<0.04	<0.07
1,2,3,6,7,8-HxCDD	0.1		0.07	0.12	<0.04	0.13
1,2,3,7,8,9-HxCDD	0.1		<0.04	<0.05	<0.04	<0.08
1,2,3,4,6,7,8-HpCDD	0.01		0.07	0.12	<0.06	0.15
OCDD	0.0001		<0.21	<0.20	<0.15	<0.16
Polychlorinated dibenzofurans						
2,3,7,8-TCDF	0.1		0.43	0.18	0.21	0.16
1,2,3,7,8-PeCDF	0.05		<0.11	0.04	<0.11	0.05
2,3,4,7,8-PeCDF	0.5		<0.10	<0.06	<0.10	<0.11
1,2,3,4,7,8-HxCDF	0.1		<0.02	<0.01	<0.02	0.03
1,2,3,6,7,8-HxCDF	0.1		<0.02	<0.01	<0.02	<0.02
2,3,4,6,7,8-HxCDF	0.1		<0.02	<0.01	<0.02	<0.02
1,2,3,7,8,9-HxCDF	0.1		<0.02	<0.02	<0.03	<0.03
1,2,3,4,6,7,8-HpCDF	0.01		<0.02	<0.03	<0.03	<0.04
1,2,3,4,7,8,9-HpCDF	0.01		<0.03	<0.04	<0.04	<0.06
OCDF			<0.11	<0.12	<0.06	<0.09
TOTAL TEQ			**0.51**	**0.25**	**0.27**	**0.2**
*Wet fish filets with skin and scales analyzed, not dried						
*All levels are in parts per trillion (ppt)						
*For non-detects, 1/2 of the detection limit was used to calculate TEQs						
*Levels are rounded to two significant figures						
**TEF = Toxic Equivalency Factor						
**World Health Organization TEF values were used to calculate the TEQs						

Appendix A

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

NOV 19 2002

DEC - 9

Dear

In May 2002, you wrote to the Agency for Toxic Substances and Disease Registry (ATSDR) regarding the Rice Creek and Etonia Creek tributaries to the St. Johns River near Palatka, Florida. ATSDR acknowledged your letter to be a petition for a public health assessment. The following describes ATSDR's response to your petition.

Because of community concerns about the Rice Creek and Etonia Creek tributaries, ATSDR has asked the Florida Department of Health (FDOH) to prepare a public health consultation to address those concerns. ATSDR maintains a cooperative agreement with FDOH to conduct public health assessments and other public health activities that address hazardous substances concerns in Florida. The purpose of the public health consultation will be to evaluate health concerns associated with current exposures to fish caught in the tributaries, review and evaluate the other health concerns identified in your petition, and make follow-up recommendations, if warranted. The public health consultation will review and summarize the existing environmental data for the facility available from the U.S. Environmental Protection Agency, the Florida Department of Environmental Protection, and other sources. For your information, we have enclosed a fact sheet about public health consultations. We believe that the public health consultation is an appropriate response, as it will evaluate the concerns about the potential human health hazards associated with fish consumption and will allow a more timely response to those concerns.

FDOH plans to initiate the public health consultation during the current federal fiscal year, and anticipates completing the work in June 2003.

In conducting the public health consultation, FDOH will follow the same ATSDR technical guidelines used for all ATSDR health assessment products. Ms. Debra Gable, ATSDR's technical project officer for FDOH, will provide technical oversight, review, and certification of the document before it is released to the public. FDOH will make a public comment draft available to you and other interested parties as part of the public health consultation process.

APPENDIX A
Letter
November 2002
GEORGIA PACIFIC/RICE CREEK

Appendix B

Jeb Bush
Governor

John O. Agwunobi, M.D., M.B.A.
Secretary

November 5, 2003

Linda Greer, Ph.D.
Senior Scientist
Environment and Health Program
Natural Resources Defense Council
Suite 400
1200 New York Avenue, Northwest
Washington, DC 20005

Dear Dr. Greer:

Thank you for your October 21 letter concerning the levels of dioxin in fish taken from Rice Creek and the Saint Johns River. I share your desire to assure that diseases of environmental origin are prevented, and that the health of Florida's citizens and visitors is protected. I am providing the following comments to address each of the issues raised in your letter. The comments are based on the best available scientific data provided by our staff in the Division of Environmental Health. Quotes from your letter are followed by our response.

"Key deficiencies in the data collection and sampling;"

1. "Method of collection of fish samples:" The samples collected in 2001 and 2002 must be addressed separately. In 2001, the Georgia Pacific samples were collected without incorporating Department of Health (DOH) recommendations. As a result, the number of fish collected was not adequate to determine whether or not the dioxin concentration in the fish was above acceptable levels. In 2002, the number of fish collected was sufficient, but analytical problems rendered the collected data unusable (see answer 3 below). The number and size of fish included in the composite sample may vary from the Environmental Protection Agency (EPA) guidelines, if it still is representative of the fish that will be consumed by recreational anglers.

2. "Method of Preparing fish samples for analysis:" We found no statements in the references cited that indicate Florida anglers consume the heads and skin of fish. In the 1992-93 Florida Fish Consumption study, data was collected on the method of preparing fish consumed in Florida households. The preparation method used in samplings of different types of fish for dioxin testing reflects the usual preparation procedure for that region of Florida; that is, in this sampling catfish were skinned and bluegill were scaled, but not skinned.

APPENDIX B
Dr. Greer Letter
November 5, 2003
GEORGIA PACIFIC/RICE CREEK

3. "Method of selecting sampling sites:" In 2001, a Georgia-Pacific contractor collected bluegill and catfish from a two-mile area of the Rice Creek, because adequate numbers of fish could not be collected from a smaller area. For the 2002 sampling, all the bluegill in a quarter mile area at the distal end of the 2001 sampling zone were collected. The DOH did not accept the 2002 sampling area as sufficient to characterize all of Rice Creek, since the usual range of bluegill is about one-quarter to one-half mile. To characterize all the populations of bluegill that could be present in Rice Creek, the creek should have been divided into one-quarter to one-half mile sections with samples collected from each area. Alternatively, bluegill could have been collected from the two extremes of the creek. An advisory would then be based on the higher of the dioxin values. Because they migrate in and out of the creek, Largemouth Bass are not an appropriate species to determine the risk from consuming fish from Rice Creek.

4. "Failure to sample the same species consistently over time:" The DOH only considered fish collected from Rice Creek during its evaluation. The dioxin concentrations in fish from other water bodies have no impact on determining the risk from consuming fish collected in Rice Creek. Unfortunately, none of the data collected from Rice Creek in 2002 could be used, because the lab blank was contaminated with levels of dioxin congeners greater than the levels found in the "test" samples.

"Despite Skewed Data Collection and Analysis, Risks Found are Still Significant"

The evaluation of DOH data in 2001 did not conclude that the dioxin content in fish from Rice Creek presented a significant risk to human health. The uncertainty associated with the assumptions and methods used by EPA to establish their current 1.2 parts per trillion (p.p.t.) dioxin advisory level resulted in the DOH undertaking an independent evaluation of the acceptable level of dioxin in fish. Until this evaluation is completed, the DOH will continue to recommend that fish with dioxin levels of higher than 7 p.p.t. not be consumed. This Florida cut-off value (7 p.p.t.) is below the value used by other southeastern states to prohibit consumption of fish due to dioxin contamination. parts per trillion

The 2001 samples were all below the DOH cut-off value, but there were not enough fish collected to adequately characterize the population of bluegill and catfish in Rice Creek. As previously mentioned, this resulted in the re-sampling of Rice Creek in June 2002. These samples also were not adequate for any type of evaluation, because some or all of the samples were contaminated with dioxin congeners at the laboratory. The only data on fish collected from the Saint Johns River, itself, were included in the 2002 sampling, and therefore, were not evaluated.

In July 2003, a Georgia Pacific contractor collected fish from Rice Creek using a protocol developed in cooperation with DOH as part of a petition evaluation to the Agency for Toxic Substances and Disease Registry (ASTDR). The DOH Health Assessment staff monitored the collection of the sampling nearest the discharge point into Rice Creek. The DOH recently received, and is currently evaluating, the results of this sampling. Based on the results of this evaluation, the DOH will determine if the fish consumption advisory is warranted. These data

will also be used to prepare a Health Consultation report as part of the cooperative agreement between the DOH and the ATSDR.

Again, thank you for your interest and for sharing your concerns with me. If you have any additional questions or comments, please contact Dr. Joe Sekerke in the Bureau of Community Environmental Health at (850) 245-4248.

Sincerely,

John O. Agwunobi, M.D., M.B.A.
Secretary, Department of Health

JOA/is

Appendix C

Jeb Bush
Governor

FLORIDA DEPARTMENT OF HEALTH

John O. Agwunobi, M.D., M.B.A.
Secretary t00P

APPENDIX C
Letter
December 5, 2003 Letter
GEORGIA PACIFIC/RICE CREEK

December 5, 2003

Dear

This letter is in response to your letter dated March 18, 2002 petitioning ATSDR to conduct a public health assessment for fish testing from Rice Creek near the Georgia Pacific site in Palatka, Florida. To expedite our response, we will share the most recent fish results with you now. A health consultation report will be forthcoming. However, it will take several more months to prepare, go through reviews and finalize.

From November 2002 through July 2003, the Florida Department of Health's (DOH) Bureau of Community Environmental Health reviewed and approved fish protocols and sampling plans, attended numerous teleconferences and coordinated the fish collection with the Florida Department of Environmental Protection (DEP) in Jacksonville and Georgia Pacific's contractor.

In July 2003, Georgia Pacific's contractor collected bluegill and white catfish from Rice Creek at both upstream (at the point of discharge) and downstream sites. The Florida DOH attended some of the upstream fish sampling. The contractor's fish collection and sampling time from the creek was adequate. Only the largest and oldest fish were sent to the laboratory for analyses (48 total). Alta Analytical Perspectives Laboratories in North Carolina filleted, composited, homogenized and analyzed four samples of the collected fish (12 upstream catfish, 12 downstream catfish, 12 upstream bluegill and 12 downstream bluegill).

In October 2003, the Florida DOH received the Annual Fish Tissue Dioxin Monitoring report and fish data from DEP and Georgia Pacific. Please see the enclosed map showing the fish sampling locations. Also, a table summarizing the fish data from upstream and downstream locations of Rice Creek is enclosed.

After reviewing these fish data, the Florida DOH determined the calculated dioxin toxicity equivalents (TEQ) levels found in the bluegill and catfish are well below our guideline of 7 parts per trillion (ppt) and are therefore not likely to cause illness. Therefore, we are not recommending additional fish sampling at this time and are not issuing a fish advisory for Rice Creek.

Your other concerns regarding a fish-sampling program for the St. Johns River, disposal of dioxin sludges and remediation of dioxin sediments are all environmental issues handled by the Florida DEP. If you are still awaiting a response to these concerns, please contact Kim Pearce at DEP in Jacksonville at (904) 807-3327.

If you have any questions or need additional information, please call me at (850) 245-4444 ext. 2310.

Sincerely,

Susan A. Bland

Susan Ann Bland
Biological Scientist
Bureau of Community Environmental Health

SAB
Enclosures
cc: Leslie Campbell, ATSDR
Debra Gable, ATSDR
Allen Robinson, ATSDR
Linda Greer, NRDC
Kim Pearce, DEP/Jacksonville
Bob Safay, ATSDR
Laurey Gauch, Putnam CHD

Appendix D

Jeb Bush
Governor

FLORIDA DEPARTMENT OF HEALTH

John O. Agwunobi, M.D., M.B.A.
Secretary

APPENDIX D
Letter
December 2003
GEORGIA PACIFIC/RICE CREEK

December 29, 2003

Dear

This letter is in response to your emails dated December 9,10 and 11, 2003 regarding the July 2003 fish testing from Rice Creek near the Georgia Pacific site in Palatka, Florida. As stated in our December 5 letter to you, the Florida Florida Department of Health (DOH) will not issue a fish advisory for Rice Creek or post signs limiting consumption. The levels found in the fish are not a public health threat.

As we discussed on the phone on December 9, 2003, the Florida DOH uses the Toxicity Equivalent (TEQ) of 7 parts per trillion (ppt) for dioxins in fish. This number is protective of human health. The Florida DOH issues fish advisories when the dioxin TEQ exceeds 7 ppt. We are aware of the Environmental Protection Agency's (EPA) draft proposed guidance dated September 1999 including 1.2 ppt TEQ for dioxins in fish.

In your emails you asked why the Florida DOH currently uses 7 ppt as our dioxin standard. This is not a Food and Drug Administration (FDA) guideline. FDA does not have an action level for dioxins in fish. The 7 ppt dioxin standard was the EPA standard in 1990 when HRS (now DOH) set its current level for dioxin. The Florida DOH will continue to use 7 ppt until our re-evaluation of the dioxin standard is completed late in 2004. The EPA Scientific Advisory Panel has questioned the scientific basis of the EPA guidelines. EPA has requested the National Academy of Science do a detailed review of the EPA dioxin toxic equivalent and risk assessment documents. This is expected to take until late 2005.

The highest TEQ found in tested fish from the July 2003 sampling event was 0.51 ppt. This level is significantly less than DOH's 7 ppt guideline. Anything less than 7 ppt is protective of human health. In addition, the calculated doses for dioxins and furans for each fish species were less than the Agency for Toxic Substances and Disease Registry (ATSDR's) Minimum Risk Level (MRL) for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). An MRL is an estimate of daily human exposure to a dose of a chemical that is likely to be without an appreciable risk of adverse noncancerous effect over a specified duration of exposure. The Florida DOH used the MRL for 2,3,7,8-TCDD as this congener is the most toxic of all the dioxins and furans. Using the highest

TEQ value of the two fish species (0.51 parts per trillion or ppt), our estimate of a child's and an adult's maximum acute (1-14 days) exposure to 2,3,7,8-TCDD from eating the fish from Rice Creek is 150,000 times less than the ATSDR's MRL. Our estimate of a child's and an adult's maximum intermediate (15-364 days) exposure to 2,3,7,8-TCDD from eating fish from the creek is 150 times less than the ATSDR's MRL. Our estimate of a child's and an adult's maximum long-term (≥ 365 days) exposure to 2,3,7,8-TCDD from eating fish from the creek is slightly less than the ATSDR's MRL.

In your December 10, 2003 email, you requested FDOH evaluate dioxins in bass if collected using another contractor. We do not think this is necessary for several reasons. First, largemouth bass were not analyzed from Rice Creek because they only come into the creek intermittently. Therefore, bluegill is the better predator for analyses for this creek. The dioxin level found in Rice Creek bluegill from earlier testing was higher than the dioxins found in Rice Creek largemouth bass.

Secondly, the July 2003 fish-sampling event collecting bluegill and catfish from Rice Creek was complete. The amount and types of fish collected and the sampling times were adequate for this creek. The Florida DOH did not see any fisherpersons while the contractors were collecting fish. The electro-fishing procedure stuns fish to the surface so fish are collected more easily than for a regular fisherperson. Therefore, for these above reasons, we do not recommend any further fish testing (including bass) for dioxins from Rice Creek at this time.

In response to your December 11, 2003 email, we do not have a deadline or address for public comment for the EPA's latest dioxin document. Please call Jeff Bigler with EPA in Washington, D.C. at (202) 566-0389 for this information.

Also in response to your December 11, 2003 email, it is common for fish in Florida to contain low levels of dioxins. Dioxins build up over time as they age. During the July 2003 investigation older fish were collected specifically for this reason.

Please contact Kim Pearce with the Department of Environmental Protection (DEP) at (904) 807-3327 to address sediment concerns. However, please keep in mind that if sediment samples are collected, and the FDOH evaluates dioxins in sediments, the evaluation may be indeterminant. For a public health determination, dioxin testing in fish is more meaningful as people are likely to eat the fish, but not likely to make contact with the sediments.

If you have any questions or need additional information, please call me at (850) 245-4444 ext. 2310.

Sincerely,

Susan Ann Bland
Biological Scientist
Bureau of Community Environmental Health

SAB
cc: Leslie Campbell, ATSDR
Debra Gable, ATSDR
Allen Robinson, ATSDR
Linda Greer, NRDC
Kim Pearce, DEP/Jacksonville
Bob Safay, ATSDR
Laurey Gauch, Putnam CHD

Appendix E

FISH TISSUE COLLECTION AND ANALYSIS

PLAN OF STUDY

Georgia-Pacific Corporation
Palatka Operations

Revised
July 17, 2003

APPENDIX E
FISH COLLECTION &
ANALYSIS
GEORGIA PACIFIC/RICE CREEK

Fish Tissue Collection and Analysis
Plan of Study

TABLE OF CONTENTS

1.0 INTRODUCTION

This plan of study has been prepared pursuant to the National Pollutant Discharge Elimination System (NPDES) Permit Number FL0002763, that requires Georgia-Pacific Corporation to assess concentrations of 17 chloro-p-dibenzodioxins and furans (later referred to as dioxin in this report) in ambient fish and shellfish tissue in Rice Creek, Florida. These 17 congeners are listed in Table 1. In preparing this plan, Georgia-Pacific Corporation has relied on experience gained in the field in previous sampling efforts as well as the following guidance: EPA, Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 1, Fish Sampling and Analysis, Third Edition. EPA 823-B-00-007, November 2000. The toxic equivalency factors (TEF) for these congeners represent the most recent toxicological information for this chemical. In-field modifications to the Plan of Study are permissible if they meet the intent of the study and are approved by the Florida Department of Environmental Protection.

Table 1. Dioxin Congeners and Relevant Toxicity Equivalency Factors (TEF)

Congener	TEF	Congener	TEF
2,3,7,8-TCDD	1.0	2,3,7,8-TCDF	0.10
1,2,3,7,8-PeCDD	1.0	1,2,3,7,8-PeCDF	0.05
		2,3,4,7,8-PeCDF	0.50
1,2,3,4,7,8-HxCDD	0.10	1,2,3,4,7,8-HxCDF	0.10
1,2,3,7,8,9-HxCDD	0.10	1,2,3,7,8,9-HxCDF	0.10
1,2,3,6,7,8-HxCDD	0.10	1,2,3,6,7,8-HxCDF	0.10
		2,3,4,6,7,8-HxCDF	0.10
1,2,3,4,6,7,8-HpCDD	0.01	1,2,3,4,6,7,8-HpCDF	0.01
		1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,6,7,8,9-OcDD	0.0001	1,2,3,4,6,7,8,9-OcDF	0.0001

Source: EPA, Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Vol. 1, Fish Sampling and Analysis, Third Edition. EPA 823-B-00-007, November 2000.

2.0 SAMPLING LOCATION

The target sampling area is Rice Creek, Florida, as designated by permit condition. Two sampling locations have been selected: (1) on the upstream side of the railroad bridge; and (2) at the point closest to the mill's discharge that is still accessible by boat. Reference sample(s), uninfluenced by the Palatka mill effluent, may also be collected from one or several locations. These locations include St. Johns River near Lundy, Green Cove Springs, Deep Creek, Julington/Durbin Creek, and Trout Creek southeast of the Shands Bridge.

3.0 FISH SPECIES SELECTION

The EPA guidance document recommends the selection of one predator and one bottom-feeding finfish. It also suggests that all species sampled be representative of those caught for human consumption in the waterway.

The predator and bottom-feeding finfish targeted for sampling are in order of preference as listed in Table 2.

Table 2. Priority for Freshwater Fish Species Collection

Predator	Bottom-Feeders
Bluegill (*Lepomis macrochirus*)	Brown bullhead (aka speckled catfish) (*Ictalurus nebulosus*)
Redbreast sunfish (*Lepomis auritus*)	White catfish (*Ictalurus catus*)
Redear sunfish (*Lepomis microlophus*)	

Shellfish are not taken for human consumption from Rice Creek, based on knowledge from government and University of Florida scientists; and, as such, will not be included in the collection effort.

4.0 SAMPLING METHOD

Fish must be collected at each site by one or a combination of the following methods: electrofishing, trawling, seining, hook and line, trot-line, or gillnet. Apparatus for electrofishing will be capable of producing a low pulse rate (15 or 20 pps) to collect catfish. Scale fish are susceptible to typical pulse rates of 60-120 pps, whereas catfish are particularly vulnerable to pulsed DC current below 30 pps. If high conductivity is relevant in any location, a GPP 9.0-type electrofishing rig will be used.

If the quest for 12 fish initially has low yields, then a collection time of two 3-hour periods in a one day timeframe will be considered the maximum time to demonstrate diligence in that sampling effort. If this effort exhausts the possibility of collecting 12 fish of each species, Georgia-Pacific Corporation will consult with DEP to document those efforts.

SAMPLING TIME

The target time period for collection is mid June to mid July. The lipid content of many species (which represents an important reservoir for dioxin) is generally highest at this time.

SAMPLE COLLECTION AND HANDLING

Twelve oldest fish of the same size **and species**, that will allow a composite sample of 200 grams, will be collected from predator and bottom-feeding finfish for analysis. Full documentation of fish species, length, weight, morphological abnormalities if observed, and GPS location will be included in the field log and included in the final report.

After collection, all fish will be individually weighed and measured. Measured fish length will be the maximum length as determined from the tip of the caudal fin (tail) to the anterior-most part of the fish. This information will be logged on a field collection record, and each fish will be inventoried on a Chain-of-Custody record with a unique sample identification, collection

location including GPS, and collection date. Collection and Chain-of Custody records will be included with the final report.

All fish composites will contain the same number of fish to allow numerically unbiased data comparisons, where possible. Fish for the composites will be collected from the same area of the water body and represent the oldest (largest) subpopulation of a single species. The collected oldest fish should be approximately the same size and length. The results will be used to determine and verify previous results and assess the magnitude of tissue contamination. One composite sample for each target species at all collection areas will be analyzed. A replicate composite may be collected; however, this replicate is not required by DEP or DOH. Archived composites will be maintained at the analytical laboratory for back-up analysis until such time as Georgia-Pacific Corporation determines they are no longer needed.

Clean sampling methodologies are paramount to the collection process to insure that no contamination of samples occurs during collection, transport, and processing of the samples. All surfaces used to weigh fish will be covered with new aluminum foil (shiny side out). Sample nets will be pre-cleaned and kept near the front of the boat away from the motor and any exhaust gases. Fish will be collected and wrapped whole in pre-cleaned aluminum foil (shiny side out), then butcher wrapping paper in an envelope format to prevent leakage, sealed in a waterproof plastic bag, placed on ice in pre-cleaned coolers, bound using duct or strapping tape, and shipped via overnight courier service using appropriate Chain-of-Custody forms.

7.0 SAMPLE PROCESSING

Analytical samples will consist of a composite of edible tissue (fillets). Fish will have scales removed prior to filleting and fish without scales (catfish) will be skinned prior to filleting. After filleting, individual fish fillets will be homogenized into uniform subsamples. Approximately equal portions from each individual subsample will be used to make up the composite sample. The composite sample will then be homogenized to form a uniform composite sample of which twenty-five grams will be solvent extracted for analysis.

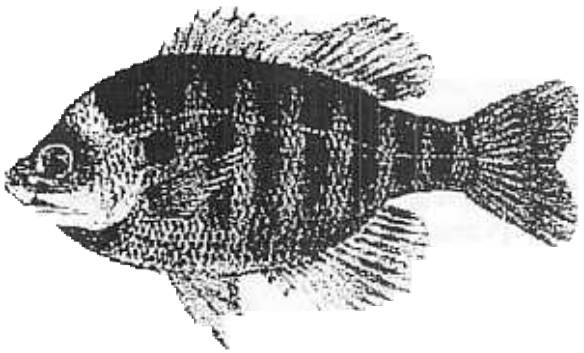
8.0 SAMPLE ANALYSIS

The samples will be analyzed for dioxin and lipid content. Dioxin analyses will be preformed using EPA method 1613B. Results will be reported as wet weight in parts per trillion (ppt).

9.0 REPORTS

The final report will include copies of all sample handling and processing data sheets including field data sheets, Chain-of-Custody receipts, and laboratory processing sheets. Moreover, it will include information of results of all analytical quality assurance results including analysis of duplicates, standard reference materials, matrix spike samples, and laboratory blanks. Any deviations from laboratory data quality objectives will be indicated.

Attachment A: Photos and Fish Descriptions



BLUEGILL

(*Lepomis macrochirus*)

Common Names - bream, blue bream, sun perch, blue sunfish, copperhead, copperbelly, roach.

Description - Bluegills have small mouths and oval-shaped, almost rounded, bodies. Body coloration is highly variable with size, sex, spawning, water color, bottom type, and amount of cover. In general, they are somewhat lavender and bronze with about six dark bars on their sides. Males tend to have a copper-colored bar over the top of the head behind the eyes. The breast is silver to slightly blue most of the year, with some yellow or orange during spawning season. Females are generally lighter colored than males. Two distinctive characteristics are the prominent black spot on the rear edge of the gill-cover and a black spot at the base of the posterior portion of the dorsal fin.

Subspecies - Two are recognized: the northern bluegill (*Lepomis macrochirus macrochirus*), found in northwest Florida; and the Florida bluegill (*Lepomis macrochirus mystacalis*), found throughout Florida except the panhandle. The bluegill also hybridizes with other members of the sunfish family.

Range - Found naturally throughout Florida, and across the United States because of widespread stocking.

Habitat - Bluegills prefer the quiet, weedy waters where they can hide and feed. They inhabit lakes and ponds, slow-flowing rivers and streams with sand, mud, or gravel bottoms, near aquatic vegetation.

Spawning Habits - Bluegills are well known for "bedding" in large groups, with their circular beds touching one another. Bedding occurs in water two to six feet deep over sand, shell or gravel, and often among plant roots when the bottom is soft. Spawning occurs from April through October with the peak in May and June, when water temperature rises to about 78-80 degrees. A female may lay 2,000 to 63,000 eggs, which hatch 30 to 35 hours after fertilization.

Feeding Habits - Insects, insect larvae and crustaceans are the dominant foods of bluegills, with vegetation, fish eggs, small fish, mollusks, and snails being of secondary importance, although they may dominate their diet during certain times of the year.

Age and Growth - Growth is rapid in Florida. A one-year-old fish may be four inches long. Spawning may occur the first year. Bluegills can live up to 11 years, but most are less than 7 years old. The rate of growth varies considerably in different bodies of water. However, a six-inch bluegill in Florida is typically two to four years old.

Sporting Qualities - Because of its willingness to take a variety of natural baits (e.g., crickets, grass shrimp, worms) and artificial lures (e.g., small spinners or popping bugs) during the entire year, its gameness when hooked, and its excellent food qualities, the bluegill is one of the more important sport fish in Florida and the eastern United States. As a sport fish, specific bag and size limit regulations apply, and you can register a qualifying catch as part of the Florida Fish and Wildlife Conservation Commission's "Big Catch" program.

Eating Quality - Excellent; the flesh is white, flaky, firm and sweet. They are generally rolled in cornmeal or dipped in pancake batter before frying. Many rank the bluegill as the most delicious of all freshwater fish.

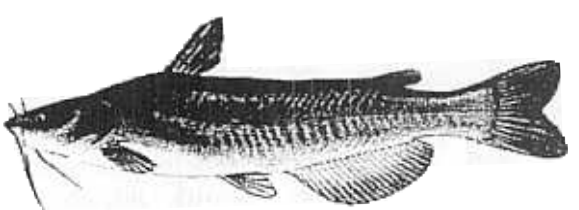
World Record - 4 pounds, 12 ounces, caught in Ketona Lake, Alabama, in 1950.

State record - 2 pounds 15.25 ounces, caught in Crystal Lake, Washington County, Florida, in 1989. (Please check link for updates)

http://www.floridaconservation.org/fishing/fishes

WHITE CATFISH

(*Ameiurus catus*)



Common Names - forked-tail cat, catfish

Description - The sides are blue-gray to blue-black and may be mottled. The tail is moderately forked, and the anal fin is shorter and rounder than that of channel or blue catfish. Whites have only 19-22 anal fin rays. The chin barbels are white or yellow. They have a blunt, more-rounded head, and they lack black spots on their body.

Subspecies - None

Range - In Florida, they are found statewide in rivers and steams and in slightly brackish coastal waters.

Habitat - Usually found in slow-moving streams, river backwaters, reservoirs and ponds. They will tolerate a siltier bottom and higher salinity, and prefer water temperatures of 80 to 85 degrees.

Spawning Habits - As with other members of its family, they are nest builders, and the male guards the young for some time after they hatch. Both parents help excavate the large nest, usually on a sand or gravel bar. Spawning occurs in the early summer when waters reach about 70 degrees.

Feeding Habits - Although fish are their major food, whites also eat larval aquatic insects, small crustaceans, fish eggs and aquatic plants. They may feed at night, but are not as nocturnal as other catfish.

Age and Growth - Whites grow more slowly than other catfish species. Fish as old as 11 years have been documented. They seldom exceed a weight of three pounds.

Sporting Qualities - Among the catfishes found in Florida, the white is second only to the channel catfish in popularity. Live bait, especially minnows and worms, accounts for most caught whites, but they also will take cut and prepared baits. Since they can also be taken by commercial fishermen, no specific regulations currently apply but they are eligible for the "Big Catch" program.

Eating Quality - An excellent food fish, whites are prized for their firm, white flesh.

Records - World and State Record: 18.88 pounds, caught in the caught in the

Withlacoochee River, Marion County, Florida, in 1991.

http://www.floridaconservation.org/fishing/fishes

ATTACHMENT B
PHOTOS OF RICE CREEK & GEORGIA PACIFIC

Photo 1: Netted Bluegill on electro-fishing boat in Rice Creek

Photo 2: Rice Creek Discharge Area - Upstream Location

Photo 3: Close-up of Rice Creek Along Creek's Edge

ATTACHMENT B
PHOTOS OF RICE CREEK & GEORGIA PACIFIC

Photo 4: Georgia Pacific Site

Photo 5: Georgia Pacific Site

Attachment B: Chlorinated Dibenzo-p-dioxins: General Information

Chlorinated dibenzo-p-dioxins (CDDs) are a family of 75 different compounds with varying harmful effects. CDDs are divided into eight groups of chemicals based on the number of chlorine atoms in the compound. A few examples are di-chlorinated dioxin (DCDD), tri-chlorinated dioxin (TrCDD) and tetra-chlorinated dioxin (TCDD). 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) has four chlorine atoms, one each in the 2, 3, 7, and 8 positions. 2,3,7,8-TCDD is odorless. Whether the other CDDs are also odorless is unknown. CDDs occur naturally; but human activities also produce them. They occur naturally from the incomplete combustion of organic material, such as from forest fires or volcanic activity. Industry does not purposefully manufacture CDDs, except in small amounts for research purposes. However, they are unintentionally produced by industrial, municipal, and domestic incineration and combustion processes (ATSDR 1998).

Many factors determine whether harm will occur or not to someone exposed to CDDs. These factors include the dose (how much), the duration (how long) and how the exposure occurred. Additional factors include whether or not a person was exposed to other chemicals, as well as that person's age, sex, diet, family traits, lifestyle and state of health (ATSDR 1998).

CDDs are found everywhere in the environment, albeit at generally low levels. Most people are exposed to very small background levels of CDDs when they breathe air, consume food or milk, or have skin contact with materials contaminated with CDDs (ATSDR 1998). CDDs enter the environment as mixtures containing a variety of individual components and impurities. They tend to be associated with ash, soil, or any surface with a high organic content, such as plant leaves. CDDs adhere strongly to soils and sediments. Estimates of the half-life of 2,3,7,8-TCDD on the soil surface range from 9 to 15 years, whereas the half-life in subsurface soil might range from 25 to 100 years (Paustenback et al. 1992). Sunlight and atmospheric chemicals break down only a small portion of the CDDs.

Of the 126 waste sites on the EPA National Priorities List that contain CDDs, 91 include sites where 2,3,7,8-TCDD was detected.(ATSDR 1998). People living around these sites could be exposed to above-background levels of 2,3,7,8-TCDD and other CDDs. CDDs can enter the body when one breathes contaminated air, eats contaminated food, or has skin contact with contaminated soil or other materials. The most common way CDDs can enter the body is by eating food contaminated with CDDs.

Chlorinated Dibenzofurans: General Information

Chlorinated dibenzofurans (CDFs) are a family of chemicals containing 1 to 8 chlorine atoms attached to the carbon atoms of the parent chemical, dibenzofuran. The CDF family contains 135 individual compounds (known as congeners) with varying harmful health and environmental effects. Of the 135 compounds, those that contain chlorine atoms at the 2,3,7,8 positions are

especially harmful. Other than for research and development purposes, industry does not deliberately produce these chemicals. Industry produces small amounts of CDFs as unwanted impurities of certain products, and during processes utilizing chlorinated compounds. Only a few of the 135 CDF compounds have been produced in large enough quantities that their properties, such as color, smell, taste, and toxicity could be studied. Those few CDF compounds are colorless solids. They do not dissolve in water easily. There is no known use for these chemicals. Most commonly, CDFs enter the body when one eats food contaminated with CDFs—in particular, fish and fish products, meat and meat products, and milk and milk products. Exposure to CDFs from drinking water is less than that from food (ATSDR 1994).

Like the CDDs, many factors determine whether harm will occur to a person exposed to CDFs. These factors include the dose (how much), the duration (how long) and how a person is exposed to the chemicals. Other factors include exposures to other chemicals, their age, sex, diet, family traits, lifestyle and state of health (ATSDR 1994).

Chlorinated Dibenzo-p-dioxins and Chlorinated Dibenzofurans

Chlorinated dibenzodioxins (CDDs) occur in the environment together with structurally related chlorinated dibenzofurans (CDFs). 2,3,7,8-TCDD is one of the most toxic and extensively studied of the CDDs and serves as a prototype for the toxicologically relevant or "dioxin-like" CDDs and CDFs. Based on results from animal studies, scientists have learned they can express the toxicity of dioxin-like CDDs and CDFs as a fraction of the toxicity attributed to 2,3,7,8-TCDD. For example, the toxicity of dioxin-like CDDs and CDFs can be ½ or $^1/_{10}$ or any fraction of 2,3,7,8-TCDD. Scientists call that fraction a Toxicity Equivalent Factor (TEF). Toxicity Equivalency Factors (TEFs) usually report CDD and CDF exposures. CDDs and CDFs are highly persistent compounds—they have been detected in air, water, soil, sediments, animals and foods. (ATSDR 1998).

The concentration of chlorinated dibenzo dioxins (CDDs) in samples of air, water, or soil is often reported as parts per trillion. One part per trillion (ppt) is one part CDD per trillion parts of air, water, or soil. For the general population, more than 90% of the daily intake of CDDs, chlorinated dibenzofurans (CDFs), and other dioxin-like compounds comes from food—primarily meat, dairy products, and fish. That said, however, the actual intake of CDDs from food for any one person would depend on the amount and type of food consumed and the level of contamination.

As stated, CDDs remain in the environment for a long time. Because CDDs do not dissolve easily in water, most will attach strongly to small particles of soil sediment or organic matter and eventually settle to the bottom. CDDs might also attach to microscopic plants and animals (plankton). In turn, larger animals eat these plants and animals, and then yet even larger animals eat them. We call this process a "food chain." Concentrations of chemicals such as the most toxic, 2,3,7,8-chlorine-substituted CDDs, which are difficult for the animals to break down, usually increase at each step in the food chain. This process, referred to as "biomagnification," is

the reason why undetectable levels of CDDs in water can result in measurable concentrations in aquatic animals. The food chain is the main route by which CDD concentrations build up in larger fish, although some fish can accumulate CDDs by eating particle-containing CDDs directly off the bottom (ATSDR 1998). Concentrations of dioxins in aquatic organisms can be hundreds to thousands of times higher than the concentrations found in the surrounding waters or sediments (EPA 1999). Bioaccumulation factors vary among the congeners and generally increase with chlorine content up through the tetracongeners and then generally decrease with higher chlorine content (EPA 1999).

Elevated levels of CDDs have been reported in fish, shellfish, birds, and mammals collected in areas surrounding chemical production facilities, hazardous waste sites, and pulp and paper mills using the chlorine bleaching process. Sometimes these findings have resulted in closure of these areas to both commercial and recreational fishing. People who eat food from these contaminated areas are at risk of increased exposure to CDDs (ATSDR 1998).

Individuals who could be exposed to higher than average levels of dioxins include those who ingest food containing higher concentrations of dioxins than are found in the commercial food supply. These groups specifically include recreational and subsistence fishers who routinely consume large amount of locally caught fish (EPA 1999).

Lipophilic (fat-loving) chemicals—such as dioxins—accumulate mainly in fatty tissues of fish (e.g., belly, flap, lateral line, subcutaneous and dorsal fat, dark muscle, gills, eye, brain and internal organs). Therefore, removal of fish internal organs and skin and trimming the fat before cooking will decrease exposure.

References

[ATSDR] Agency for Toxic Substances and Disease Registry. 1998. Toxicological profile for chlorinated dibenzo-p-dioxins. Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1994. Toxicological profile for chlorodibenzofurans. Atlanta: US Department of Health and Human Services.

[EPA] Environmental Protection Agency. 1999. Fact sheet on polychlorinated dibenzo-p-dioxins and related compounds update: Impact on fish advisories. Washington, DC: Office of Water.