

Public Comment Release

Public Health Assessment

For
PCB Contaminated Sediment
in the
Lower Fox River
and
Green Bay

Northeastern Wisconsin

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Prepared for:
The Citizens of Northeastern Wisconsin, and the
Agency for Toxic Substances and Disease Registry

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SUMMARY

The Lower Fox River from Lake Winnebago down stream to the bay of Green Bay in Lake Michigan contains sediments contaminated with polychlorinated biphenyls (PCBs). PCBs were released into the river from seven pulp and paper companies located along its banks. The pulp and paper industries stopped releasing PCBs into the river in the early 1970's. However, much of the PCB contamination remains in the river today. PCBs that have been diluted in the environment have reconcentrated in the aquatic food chain. Fish consumption advisories have been issued for fish in the Fox River and Green Bay since they were first monitored in the 1970s.

Exposure to PCBs has been associated with a wide variety of health problems including some types of cancer, impaired intelligence, and problems with the physical development and behavior in young children. Many of the non-cancer health effects have been associated with human exposure to contaminated fish in the diet.

The Lower Fox River and Green Bay are used many ways by the residents living in northeastern Wisconsin. However, eating fish from these waters is the primary use that poses a health hazard. To a lesser extent, eating other wildlife such as waterfowl and turtles also pose a health hazard. Direct exposure to contaminated sediments from other uses, such as swimming and wading, does not pose a health hazard. The Wisconsin Department of Health and Family Services (DHFS) recommends that cleanup actions be taken to reduce the amount of PCBs accumulating into the food chain. Consistent with this recommendation, **DHFS concurs with and fully supports the Wisconsin Department of Natural Resources (DNR) Proposed Plan for the cleanup of the Lower Fox River** (DNR, 2001).

Two demonstration projects on the Lower Fox River have shown that contaminated sediment can be removed without causing increased risks to the public. This practice does not pose a public health hazard because of the many precautions that are taken during handling, transport, and disposal. **DHFS recommends that the DNR continue to provide information on these precautions to residents near proposed dredging, transport, and disposal locations.**

Since 1976, fish consumption advisories had some success in reducing exposure to PCBs for many anglers using the Lower Fox River and Green Bay. In spite of continued efforts, many people still are not aware of the advisory. Language and cultural barriers have made it difficult to raise awareness of the advisories among some minority populations. Even with an aggressive cleanup of the river sediments, PCB levels in fish tissue will remain above safe levels for many years. **DHFS recommends that cleanup remedies be selected based on their ability to most effectively reduce reliance on fish consumption advisories.** The fish consumption advisories will continue to serve a major public health function during that period. The public health implications are most severe for women, children, and minorities. Several studies have shown that these groups are least likely to be aware of fish consumption advisories. DHFS will continue to work with other agencies and community groups to increase advisory awareness.

Additional health information about PCBs can be found on the DHFS Web Site at:
<http://www.dhfs.state.wi.us/eh/HlthHaz/fs/PCBlink.HTM>

PURPOSE AND HEALTH ISSUES

The purpose of this public health assessment is to describe the existing health issues related to PCB-contaminated sediments in the Lower Fox River and Green Bay, and to recommend actions to reduce risks to human health. The health effects of concern from fish consumption exposures to PCBs include, but are not limited to, cancer, reproductive and endocrine effects, impaired physical and mental development in young children. Children are most sensitive to many of the non-cancer health effects associated with PCB exposures. Women and minorities are least likely to be aware of fish consumption advisories thus placing them at greater risk of exposure.

The primary public health issues are related to PCB contamination in the fish people eat. Because of concerns raised by community members, this public health assessment also discusses a number of specific topics including landfill disposal of PCB-contaminated sediments, air releases and volatilization, and regional health statistics.

The public health action plan for this project focuses on reducing risks by reducing contaminant concentrations in fish tissue, and by working towards healthier fish consumption habits among families who eat fish from the Lower Fox River and Green Bay.

BACKGROUND



Figure 1: Location of the Lower Fox River between Lake Winnebago and Green Bay in Northeastern Wisconsin.

History and Description of the Project Area

The Lower Fox River flows from Lake Winnebago to the northeast, 39 miles to its mouth at the base of Green Bay (Figure 1). The river's watershed is more than 6,330 square miles and is Wisconsin's largest tributary to Lake Michigan (Figure 2).[1]

Approximately 270,000 people live in communities along the river. The river flows through portions of Winnebago, Outagamie, and Brown Counties. Land use along the river is both urban and rural and includes industrial, commercial, agricultural, and residential properties. Several large and small communities are found along the shores of the river, including: Neenah, Menasha, Appleton, Kimberly, Little Chute, Combined Locks, Kaukauna, Wrightstown, De Pere,

Ashwaubenon, and Green Bay. Many more communities line the shores of Green Bay.

The Lower Fox River has a long history of industrial use. This river has the highest concentration of pulp and paper mills in the world. As a result of the recycling of carbonless copy paper, area mill operations discharged polychlorinated biphenyls (PCBs), contaminating sediments in the Lower Fox River. The Lower Fox River is the largest source of PCBs to Lake Michigan. Between 1957 and 1971, approximately 600,000 pounds of PCBs were released, contaminating 11 million tons of sediment. An estimated 160,000 pounds of PCBs have already left the Fox River and entered Green Bay and Lake Michigan, and on average, 300 to 500 additional pounds are flushed from the Lower Fox River sediments each year. Floods would flush additional thousands of pounds into the bay.

Once PCBs are released into Green Bay and Lake Michigan, they are extremely difficult to remove. [1]

PCBs

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs appear as either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor. PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and cause harmful health effects. Products made before 1977 that may contain PCBs include fluorescent lighting fixtures and electrical devices containing PCB capacitors, and microscope and hydraulic oils. PCBs resist breaking down, instead they concentrate in the environment and the food chain. Through a process called biomagnification, PCB levels in top predators, such as bald eagles and lake trout, can be millions of times higher than levels found in surface water. Concentrations in top predator fish are high enough to cause health hazards to humans, fish, and wildlife. Because of these dangers, the U.S. Congress banned the manufacture of new PCBs in 1976, and PCBs still in use are strictly regulated.[2]

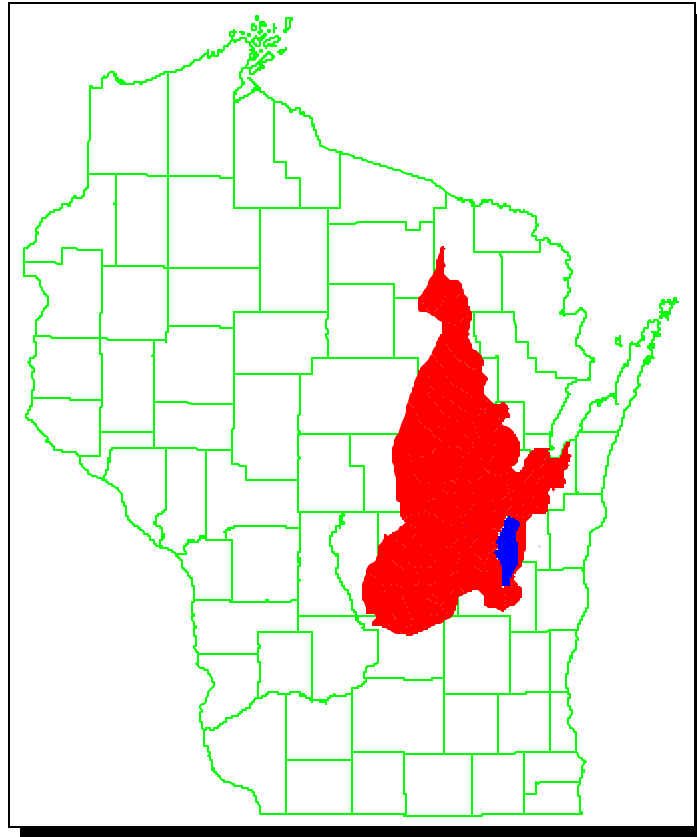


Figure 2: *Map of the watershed feeding the Fox River to Green Bay.*

Health Effects of PCBs

The Agency for Toxic Substances and Disease Registry and the EPA have conducted extensive reviews of the hundreds of health studies involving PCB exposures. A comprehensive summary of this review can be found on the following web site: <http://www.atsdr.cdc.gov/DT/pcb007.html> This web site contains more information on each of the human health effects discussed in this section.[3]

Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs. The people who are most sensitive to the effects of PCBs are children. Their developing bodies are easily damaged. Women who eat a lot of contaminated fish store PCBs in their bodies. When these women get pregnant, the PCBs are released into their blood and may reach and enter the developing baby. When children eat fish themselves, they are also exposed to PCBs. This exposure may cause them to learn and grow more slowly, as well as cause them to have behavioral problems. The developmental and learning difficulties children have early in life, can have significant impacts throughout their lives.

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. These babies also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs nor of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

Wisconsin's fish consumption advisory was developed specifically to discourage high level exposure to PCBs in fish, and thus to protect pregnant women and children from these risks. The advisory awareness strategy summarized in the *Public Health Action Plan* section of this document focuses a great deal of attention at reducing the unsafe exposures of children.

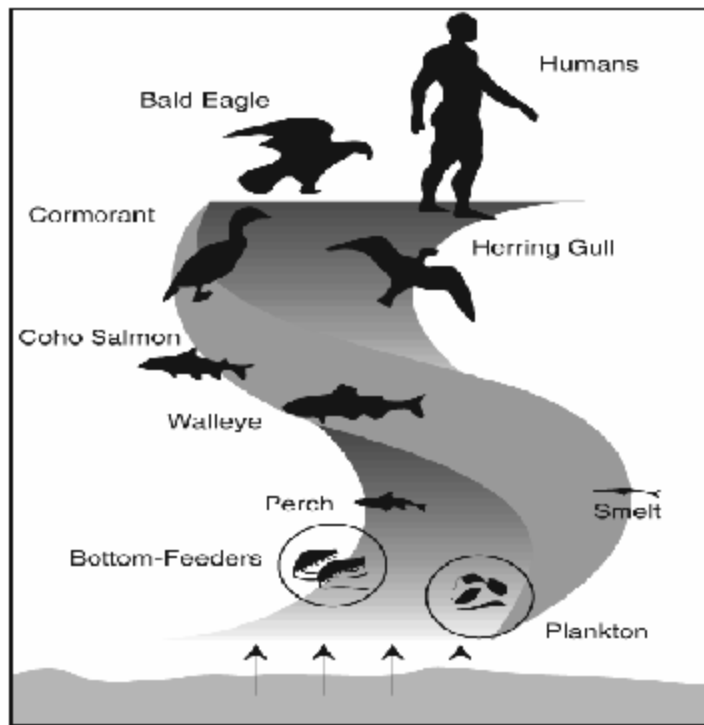


Figure 3: Through a process called biomagnification, PCB levels in top predators, such as bald eagles and walleye, can be millions of times those found in surface water.

In addition to the studies of people exposed to PCBs, many studies conducted on animals have also found PCBs to cause health problems. Laboratory animals that were fed large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction.[3]

Some studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The U.S. Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.[4]

Fox River Sediments

The Lower Fox River varies in character as it moves from Lake Winnebago to its mouth at Green Bay. Shortly after it leaves Lake Winnebago through the Neenah and Menasha Channels, the river widens to form Little Lake Butte des Morts, an impoundment controlled by the Upper Appleton Dam. Because the river slows in this area, fine grained sediment has been deposited on the bottom. From Appleton to the De Pere Dam the river is generally narrow, faster flowing, and sediment deposits are sandier. Approximately 90% of the PCB mass and a large percentage of of the contaminated sediments are found in the final stretch of river from the De Pere Dam downstream to the mouth at Green Bay. From the De Pere dam to the mouth, the Lower Fox River is channelized and wider.

Sedimentation

The sediment in a river is the result of solid material washed into the river from erosion, waste water discharges, and other materials carried with rainfall runoff. Sediment is composed largely of soil, decaying vegetation and other organic matter. The faster a river flows the more energy it has to carry sediment downstream. As a river slows, the heavier sediment (sand and gravel) fall to the bottom and are no longer moved downstream. The slower it moves, the smaller the sediments that are dropped out and deposited on the bottom. These smallest sediment particles consist of the fine grains of silt and clay, and often contain most of the organic material as well. Because the flow in any river is complex there are both major sediment deposits where the whole river slows, and more discrete deposits where only a part of the river slows (e.g. behind a bend or man made structure in the river). Changes in water flow from rainfall or snow melt changes the pattern of deposition of sediments and re-mobilize existing deposits.

Distribution of Contaminants in Sediment

Chemicals released into a river behave in a variety of ways. Some chemicals are very water soluble and will move down stream with the water. Some chemicals evaporate easily and move from the river into the air. Other chemicals, such as PCBs, are less water soluble and bond to the sediments. These chemical contaminants move downstream with the sediments to which they've bonded. The fine grained sediment containing the greatest amount of organic material tends to have the highest contaminant levels. Contaminated sediment locations are determined by where the chemicals enter the river and then by where the rivers current slows. A very small fraction of the PCBs will dissolve in the water and concentrate in the food chain.

From the mouth to three miles up the river, the channel is maintained for commercial navigation.

Samples of water, sediment, and fish tissue have been collected from the Lower Fox River for more than the past 30 years. More than 300,000 analyses have been done of Fox River sediments and other media including surface water and fish tissue. A more detailed review of the sample results can be found in the remedial investigation report for the site on the DNR Fox River Cleanup website (<http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html>).

In 1976, the Wisconsin Department of Health and Social Services and Department of Natural Resources issued fish consumption advisories on the Lower Fox River, Green Bay, and Lake Michigan. This was in recognition of the unsafe levels of PCBs found in fish tissue in those waters. [5]

Many other chemicals have been found in surface water, sediments, and even in fish tissue over the years. However, the risks from PCBs were believed to be the greatest and became the basis of our health concerns. In the draft risk assessment issued for this site in 1999, other contaminants of potential concern were evaluated and found not to contribute a significant risk relative to that posed by PCBs. Many of the contaminants remaining in the sediments share similar properties to PCBs and are found in the same areas. Some of the other contaminants identified in the sediments of the river include: dioxin and furan, dichlorodiphenyltrichloroethane (DDT), dieldrin, mercury, lead, and arsenic. For this reason, addressing the sediments with the highest PCB levels also serves to address some of the highest concentrations of other contaminants. [6]

Thousands of sediment samples have been taken from Lake Winnebago to the mouth of the Lower Fox River. Many more samples have been taken from sediments in Green Bay as well. These sediment samples have been taken over the past ten years as part of several individual investigations. The sediment sample results are summarized in Table 1.

Table 1
PCB Distribution in the Lower Fox River [1,7]

| Location | Low Level (ppb) | High Level (ppb) | PCBs (Kg)* | Sediment volume (yd³) | % PCBs in River |
|-------------------------------|------------------------|-------------------------|-------------------|---|------------------------|
| Lake Winnebago (background) | Not Detected | 36 | NA | NA | NA |
| Little Lake Butte des Morts | 2.0 | 222,722 | 1,849 | 2,200,400 | 5.4 |
| Appleton to Little Rapids | Not Detected | 185,560 | 109 | 339,200 | 0.2 |
| Little Rapids to De Pere Dam | 3.0 | 54,000 | 1,250 | 3,030,100 | 3.5 |
| De Pere Dam to mouth of River | 4.0 | 710,000 | 26,647 | 8,491,400 | 90.9 |

* Estimates based on sediments with over 50 parts per billion (ppb) total PCBs
NA - Not Applicable

People may come in contact with the sediments in the Lower Fox River in a variety of ways. The risk assessment conducted by DNR and their contractor considered both swimmers using the river frequently during the summer months and marine construction workers who may have more infrequent, yet high opportunity for exposure. The nature of these activities and the contaminated sediments is such that exposure frequency, duration of exposure, and dose would be too low to result in an increased health risk. Other uses of the river involving direct contact with contaminated sediments (e.g., wading) would result in even lower exposures to PCBs.[6]

PCBs can enter a person's body in a number of ways: when the person swallows materials contaminated with PCBs (such as eating contaminated fish); when the person breathes in volatilized PCBs from the air or that are attached to dust

particles in the air; or when the person comes in skin contact with the PCBs, a very small amount of PCBs could be absorbed into the body. Absorption through the skin is the least likely route of exposure for PCBs to enter a person's body at the Lower Fox River. Only a very small amount of PCBs in contact with the skin will be absorbed, and the PCBs attached to sediments are unlikely to be released. In this case significant inhalation exposures are also unlikely because the amount of PCBs expected to volatilize is extremely low. Therefore, ingestion or swallowing contaminated material is the remaining route of exposure to the PCB contaminated sediments. This route is plausible because while swimming a person may stir up sediments and accidentally swallow water containing suspended sediments. The amount of contaminated sediments that would actually be ingested would still be quite low.[6]

PCB levels in Lower Fox River and Green Bay fish have declined significantly since the late 1970s. However, levels have not shown a significant decline since the late 1980s (Figure 4). PCB levels may be dropping by 50% in some fish every 10-30 years. If these rates of decline were to continue, it would take from 50 to more than 100 years for PCB levels to decline to a level so that fish could be safely eaten. However, recent evaluations of some Great Lakes' fish show that PCB levels may no longer be declining.[8]

PCB water levels at the mouth of the Lower Fox River have not declined since 1989 and are from 100 to 10,000 times greater than safe levels set by the State to protect human and ecological health. In this case the human health criteria is based on bioaccumulation in sport fish.

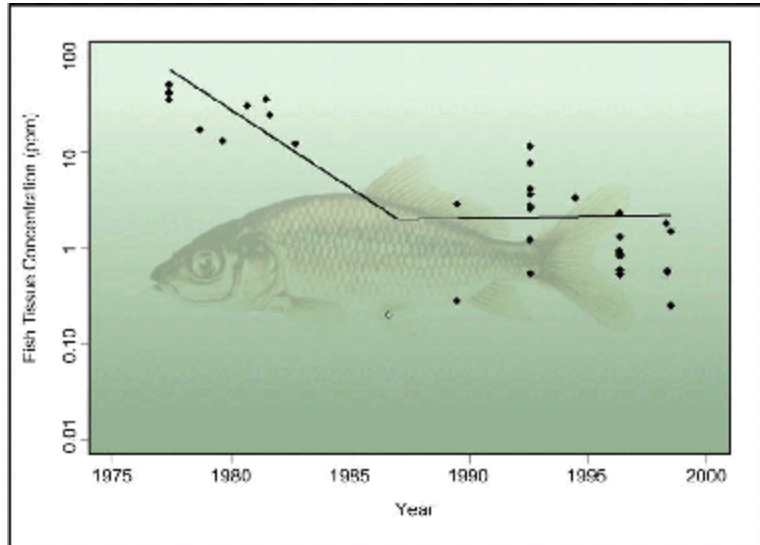


Figure 4: *Fish Tissue PCB Levels Over Time.*

PROPOSED CLEANUP PLAN

The Proposed Remedial Action Plan for the Lower Fox River and Green Bay was released by the DNR and EPA for public comment on Tuesday, October 2nd, 2001. The proposed plan consists of a combination of sediment removal and monitored natural recovery to reduce the concentration of PCBs in fish tissue. Fish consumption advisories will remain in place until acceptable levels of PCBs are achieved in fish tissue. The plan is tailored to the individual segments of the river in order to most effectively reduce PCB concentrations based on varying conditions within the river. A detailed copy of the plan and accompanying documents can be found at the following DNR website:

<http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html> .

The proposed plan targets the removal of approximately 7.25 million cubic yards (cy) of contaminated sediment containing over 29,259 kilograms (kg) of PCBs from the Lower Fox River using environmental dredging techniques that minimize adverse environmental impacts, including the resuspension of sediment during dredging. The proposed plan also incorporates Monitored Natural Recovery (MNR) of the residual PCB contamination remaining in dredged areas and undisturbed areas until the concentrations of PCBs in fish tissue are lowered to an acceptable level. Fish consumption advisories and fishing restrictions will remain in place until acceptable levels are achieved. The proposed alternative calls for dewatering and stabilizing the dredged sediment and disposing of it off site at licensed solid waste disposal facilities, including existing licensed facilities and possibly new facilities yet to be constructed and licensed in the Fox River Valley. The Proposed Plan seeks to define a set of remedial alternatives that, if implemented, will result in the cleanup of sediments that lead directly to the protection of human health and the environment. DNR and EPA's goal is for the cleanup action to result in the removal of all fish consumption advisories, and the protection of the fish and wildlife that use the Fox River and Green Bay. DNR and EPA (Figure 6) are also considering thermal treatment of contaminated sediment.[7]

Public Health Basis of the Proposed Cleanup Plan

The goal of the proposed plan is to reduce the risks to human health and the environment posed by the PCBs that remain in river sediments today. To achieve this goal the DNR and EPA studied how the PCBs move throughout the river and ecosystem. Then they studied how the PCBs threatened human health and the environment. These studies of the PCB threats (risk assessments) are used to help determine how much of a cleanup is needed to be protective of public health.

For the Lower Fox River, the risks were assessed separately for each of the four reaches (or segments) of the River, and for four zones of Green Bay. The assessment found that reducing the levels of PCBs in sediment is the most effective way to reduce health risks. While fish consumption advisories result in some reduced PCB exposure, many fish consumers are unaware of fish consumption advisories. Without the removal of contaminated sediments, it would take over 100 years before fish consumption advisories would be eliminated.

DNR and EPA have set a Cleanup Action Level for PCBs in sediment at 1.0 parts per million (ppm). Lower cleanup levels were not found to significantly reduce the time required to eliminate fish advisories or to achieve ecological protection. Cleanup levels higher than 1 ppm would not permit human health and ecological goals to be met for many decades. In river reaches where the proposed cleanup remedy calls for dredging, the dredging would remove all sediment with concentrations above 1 ppm.[7]

INCREASING COMMUNITY AWARENESS

Due to PCB contamination and human health concerns, fish consumption advisories have been in-place for the Lower Fox River and Green Bay since 1976. Some species and sizes of fish (i.e., large walleye, crappie, small mouth bass, and channel catfish) are not to be eaten at all or only a few meals per year. These advisories, published regularly by the Wisconsin Department of Natural Resources (DNR), warn residents to limit or eliminate locally-caught fish from their diet. They also provide tips on how to properly clean and cook fish to reduce the risk of PCB exposure. However, not all people follow the fish consumption advisories.

In 1997, DHFS conducted a study of health advisory awareness in the Great Lakes region. Approximately fifty percent of anglers who had eaten sport caught fish were aware of the consumption advisories on those fish. However, there was a wide discrepancy in awareness between men and women and between white and minority anglers. Sixty percent of women were unaware of the advisories while only forty percent of men were unaware. Likewise, only twenty-two percent of minority anglers were aware of the advisories compared to fifty-two percent of white anglers. These findings have directed consumption advisory promotion efforts over the past several years towards women and minority populations. [9]

Fish Consumption Advisory Promotion
DHFS has worked with DNR since the mid-1970s to develop recommendations for consumption of sport-caught fish. Almost every year, a state-wide advisory is printed with information on all bodies of water that have mercury and PCB advisories. The booklet is available as a separate document from the



Figure 5: Example fish advisory brochure containing health recommendations for fish from the Fox River and other specific Wisconsin waters.

fishing regulations booklet. In 1998, 40,000 advisories were printed and 1.25 million licenses were sold. There are approximately 47,000 licensed anglers in the counties bordering the Lower Fox River. These same booklets have been posted on the DNR web site over the past few years as well.[5,10]

DHFS provided advisories, informational brochures (English, Spanish, and Hmong), and offered a poster to primary care physicians in Green Bay. DHFS staff wrote articles for newsletters intended for health professionals who serve women, infants, and children in the Green Bay area. The Brown, Outagamie, and Winnebago County Health Departments are engaged in providing health advisories and support for promotion of the advisory in the Fox River Valley.[11]

Medical Grand Rounds

In the mid 1990s, DHFS gave medical education presentations to physicians in Green Bay and Appleton. Medical grand rounds were again presented on this topic in Green Bay and Appleton in 1999. The subject of those medical education presentations pertained to the importance of taking an environmental health history. By assessing lifestyle environmental factors, the physician is better able to make recommendations for reduction of exposure and more accurately treat the disease.

Minority Involvement

DHFS has developed relationships with American Indian and Southeast Asian populations in the Fox River Valley while assessing this and other environmental health hazards. In 1993 and 1994, DHFS participated in public meetings regarding the Fort Howard Sludge Lagoons (also a PCB problem).

Early in the 1990s, DHFS recognized a particular need to provide information to Hmong residents of the state. Many Hmong people use fish as a major source of food and have more than average difficulty obtaining understandable information. The majority of Hmong in Wisconsin immigrated to this country in the last 20 years, and many speak only their native language. Because their written language was only recently developed (1960s), many Hmong adults over age 40 cannot read Hmong. In response to their need, staff worked with other agencies to provide unique educational workshops for Hmong communities.

Staff first contacted the local Hmong associations regarding the fish advisory in 1992. Then later, in 1995, a workshop was held to verbally communicate the fish advisory (in Hmong) to Green Bay residents. The workshop included presentation of the concepts of good nutrition that includes fish, bioaccumulation of chemicals, fish identification, the fish advisory, and cooking and cleaning fish to reduce contaminants. To reinforce the messages in the workshop, DHFS produced with DNR a simple color-coded map showing advisory waters, single issue cards for individual water bodies, and translated advisories.

Staff worked with the Appleton Hmong Association to obtain an EPA Environmental Justice Grant to produce a fish consumption video in 1999. The purpose was to give the same type of information as the workshop in a 10-15 minute video. The video is now available for use throughout the state with a number of Hmong communities. It may be shown in community centers, in homes, and on cable access television.

Since 1991, workshops have been conducted for Hmong communities in Green Bay, Sheboygan, Menomonie, Eau Claire and Manitowoc. Each workshop consists of a discussion about chemicals, food chain, fish identification, fish consumption recommendations, cooking methods, and filleting.

Additional advisory promotion activities have included developing a clear and simple public health message for fish consumption. This message was created to address both PCB and mercury contamination issues. The message and some recognizable graphics have been printed on the following: growth charts, sippy cups, stadium cups, T-shirts, coffee mugs, bandage dispensers, refrigerator magnets, and grocery list note pads. These materials were distributed to local WIC (Women Infants and Children Program) clinics, health fairs, and local health departments.

During the summer of 2000, signs were posted in English, Spanish, and Hmong at popular fishing locations on the Lower Fox River.

COMMUNITY HEALTH CONCERNS

In 1998, DHFS worked with the US Environmental Protection Agency (EPA) to conduct community involvement interviews. To further understand community health concerns. The following list of health concerns were expressed in the interviews and during interaction with citizens at public meetings:

- **Some anglers complained that they were not notified sooner about PCB-contaminated fish in the Lower Fox River and are worried that their families are being slowly poisoned as they eat contaminated fish.** DNR and DHFS began telling the public about the health concerns of contaminated fish in the Lower Fox River when we first learned of the problem. The health risks, while unacceptable, do not warrant significant fear about past exposures. More importantly, once people are aware of the advisory, they can take control over unnecessary future exposures.
- **Some residents expressed frustration in a cultural sense that recommendations to avoid eating the entire fish, and to only eat fillets, conflicted with their cultural traditions.** Unfortunately for some, the most effective cleaning methods for reducing PCB exposures involves removal of some parts of the fish that had been eaten in the past.
- **Some residents believe that the health risks of eating PCB-contaminated fish from the Lower Fox River have been over stated.** DNR and DHFS have always stressed that while the health risks of eating PCB-contaminated fish are unacceptable, those risks warrant cleanup rather than alarm. In any project like this, it is not possible to control the health information that is passed among community members. There are many sources of health information available to residents. Much of that information is provided without balance based on the predisposition of the source. This report provides what State and Federal health officials believe is a balanced discussion of the risks from PCB exposures.

- **Concerns were expressed that the health effects demonstrated by PCB studies on animals and people from outside the Fox River area may not be applicable to the Fox River system.** No health studies will perfectly match this or any other site. However, many of the most compelling studies are of people demonstrating health effects associated with eating contaminated fish (very relevant to this project). DHFS relied on a large number of studies and considered the weight of evidence from those studies before developing the health recommendations in this document.
- **There was a sense that the health of everyone in the lower Fox River Valley was at risk because of the PCB contamination in the river.** This was a common concern raised at both interviews and public meetings. The health risks from the PCB-contaminated sediments are primarily related to fish consumption. DHFS will continue to work to make people aware of this and the fact that they can take control of their risks by following the fish consumption advisory.
- **Concerns were raised regarding the algae and associated odors in Lake Winnebago that seem to be getting worse in recent years.** Algae problems on Lake Winnebago are not related to the PCB contamination on the Lower Fox River and Green Bay. These algae problems have been the result of nutrient runoff problems in combination with unusual weather events. This is a separate project within DHFS, DNR, and local health agencies. These agencies have been working cooperatively to address these concerns and have provided information to the public.

In addition to the community involvement interviews, DHFS has participated in several public meetings over the past year related to the contaminated sediments in the Fox River. During those meetings, a number of health questions have been raised. The following questions are some that were posed that were not mentioned in the previously presented interview questions:

- **Several concerns were raised about the safety of landfill disposal of dredged sediments as part of a cleanup option. These concerns were echoed by physicians from the Winnebago County Medical Society who formally opposed the landfill disposal of PCB-contaminated sediments.** A section has been added to this report describing the safety built into the landfill disposal of PCB contaminated sediments.
- **Some residents expressed concerns that PCBs would volatilize during dredging and disposal activities and that the public would be exposed to unsafe levels of PCBs. In addition to their own exposure, some people were concerned that, through volatilization, some PCBs could end up in the milk coming from area dairy farms.** Extensive air sampling was done during the demonstration projects which confirmed that PCB releases were minimal and would not result in a risk to public health. Additional discussion has been added to the section “*Managing PCBs During Cleanup*” later in this document.
- **Residents who live on the Fox River were concerned because they and their children occasionally swim in the river.** The possible exposures from swimming in affected portions of the lower Fox River have been evaluated and found not to pose a

health hazard. DHFS is now providing that information to people to maintain the focus on the primary exposure pathway of fish consumption.

- **People who live around the river are concerned about the health effects from coming in direct contact with PCBs in river sediments.** There are a wide variety of ways that people use the river; uses that involve the most contact with the sediments were evaluated. Health professionals considered recreational activities such as wading, swimming, and water skiing. They also considered nearby residents' breathing the air, drinking river water, and workers involved in actively moving the sediments. Other than eating contaminated fish and wildlife, none of the remaining exposure pathways represent a significant exposure to PCBs.

DISCUSSION

Several exposure pathways have been evaluated as part of the draft risk assessment conducted by DNR with assistance from DHFS and EPA in early 1999, as well as in other evaluations in the past. Of all the exposure pathways with the greatest potential for PCB exposure, only fish consumption, and to a lesser extent eating waterfowl, have been found to be of health concern. This public health assessment does not attempt to quantify risks, as that has been done in the risk assessment conducted by DNR. [6,12]

Fish Consumption Advisories

When properly prepared, fish provide a diet high in protein and low in saturated fats. Many doctors suggest that eating a half-pound of fish each week is helpful in preventing heart disease. Almost any kind of fish may have real health benefits when it replaces a high-fat source of protein in the diet. Wisconsin's year 2000 fish consumption advisory is based on the work of public health, water quality, and fisheries experts from eight Great Lakes states and the Canadian province of Ontario. Based on the best available scientific evidence, these scientists have determined how much fish is safe to eat. In developing the recommendations presented in the Great Lakes Consortium fish advisory, health officials considered a range of possible health risks linked to contaminants, but placed the most weight on reproductive and child development effects. [10]

A fact sheet covering the current fish consumption advisories for the Lower Fox River and Green Bay, along with a picture identification chart of the fish included in those advisories, is available on the DHFS web site. The advisories are different for the different parts of the water bodies. There is a separate advisory covering the segment from Little Lake Butte des Morts to the DePere dam; the segment from the DePere dam to the mouth of the river at Green Bay; and for the bay of Green Bay from the mouth of the Fox River to the northern end of the bay.

Fish Consumption Advisory Awareness

A number of surveys have been done of anglers who fish the Lower Fox River and Green Bay in order to get a better understanding of the amount of fish people actually eat. Still other studies have been conducted to find out how effective the fish consumption advisories have been. The conclusions of these studies indicate that many people are aware of the fish consumption

advisories and have adjusted their behavior appropriately. However, these same studies have identified some groups of people who nevertheless eat a lot of sport caught fish from these waters and because of cultural and language reasons, are not aware of the fish consumption advisories.[9,18,19]

As part of the process of conducting this public health assessment the DHFS Great Lakes Fish program assessed exposure with an angler survey on the Lower Fox River. The study titled "Fish Consumption Habits and Advisory Awareness Among Fox River Anglers" was published in the November, 2000 issue of the Wisconsin Medical Journal. The study consisted of a face-to-face survey administered to 104 anglers fishing along the Fox River. It indicates that 17% of anglers eat some or all of the fish they catch and that 83% practice "catch and release." Almost none of the anglers were familiar with Wisconsin's fish advisory booklet but many had heard of the health risks from their local newspaper and TV. As a follow-up, a health advisory brochure specific to the Fox River was developed. The study also found that there continues to be a discrepancy between white and minority anglers in their awareness of consumption advisories. A full copy of the published report is included at the following internet site of the Wisconsin Medical Journal: <http://www.wismed.org/wmj/nov2000/fish.html> [11]

A similar survey was conducted in July and August of 1997 by the US Fish and Wildlife Service. Of 102 anglers surveyed, 70 were identified as Southeast Asian (Hmong or Laotian), 25 as white (non-Hispanic), and 7 as African-American or Hispanic. Over 50% of anglers reported eating fish with included in the fish consumption advisories. Only 20% of Hmong and Laotian anglers reported not eating fish from the river, 88% of white anglers did not eat the fish, and 28% of the African-American and Hispanic anglers reported not eating fish from the river. All of the white anglers reported hearing of contamination problems. While 68% of Laotian and Hmong, and only 28% of African-American or Hispanic anglers knew about contamination problems.[20]

Other Wildlife

Less is known about the health risks from eating other wildlife that may be impacted by PCBs from the Lower Fox River. In 1987, DHFS and DNR issued a waterfowl consumption advisory for mallard ducks taken from the Lower Fox River and nearby portions of Green Bay. Studies of wildlife since that time have found that waterfowl continue to be impacted by PCBs, and the DNR risk assessment identified a increased health risk related to waterfowl consumption. In addition to waterfowl, snapping turtles are also known to accumulate PCBs from the river sediments. Less is known about the frequency at which people eat waterfowl or snapping turtles in the region. The migratory nature of the waterfowl in this area during the hunting season complicates our ability to establish consumption rates of the contaminated birds. [12,10]

Managing PCBs During Cleanup

During the dredging, de-watering, handling, and disposal of contaminated sediments, very small amounts of PCBs may evaporate or volatilize, enabling PCBs to return to water ways. Once back in water, they might once again enter the food chain. The very small amount of PCBs that could potentially volatilize during dredging and disposal would not be measurable in the air and would not contribute to an increased health risk. An evaluation of the risks from volatilization was done by DNR air experts and toxicologists in DNR to answer these questions. In addition, during the remediation of a large sediment deposit in the City of Green Bay, an extensive air

monitoring project was conducted. The monitoring project confirmed that exposure to PCBs in air during remediation activities (dredging, dewatering, transport, and disposal) is not a significant source of health risk. During that same period, the water quality was monitored to demonstrate that contaminated sediments would not be re-suspended and carried downstream of a dredge project.[13,14,15,16]

Landfill Disposal

Landfill disposal of PCB-contaminated sediments was part of the two demonstration projects near Kimberly and Green Bay. These projects were located on different parts of the Lower Fox River to learn from working in different environments that the river provides. Deposit N is located near Kimberly, in a stretch of the river with fewer and smaller sediment deposits. Deposit 56/57 is located in the last stretch of river, in the City of Green Bay, in an area of highly contaminated sediments surrounded by large tracts of sediment deposits. Landfill disposal will be a significant part of the solution for the total river cleanup.[17]

Given the messages about the public health concerns of PCBs in the Fox River sediments, people reasonably question the safety of PCBs in a landfill that may be located closer to their communities. Some physicians in the Fox River Valley took a formal stand against the disposal of PCB-contaminated sediments in area landfills. Their strong statement supports the State's opinion that PCBs pose a significant public health threat. It also shows the need to continue to provide physicians and other community members additional information about landfill disposal of PCB-contaminated sediments. Discussion of landfill disposal issues was subsequently added to the medical education presentations that followed.

Concentrations of PCBs in sediments are not high enough to be a health concern from occasional or incidental human contact. However, fish tend to build up high levels of PCBs from relatively low levels of sediment contamination. This build up, combined with people eating a considerable amount of contaminated fish in their diet becomes a health concern.

PCBs cling to soil particles and do not move into and with groundwater. PCBs were a common part of the waste stream into all of Wisconsin's landfills. However, even in our older, leaking landfills, PCBs have not threatened drinking water wells. Today's engineered landfills are designed to contain wastes that otherwise could move easily into groundwater. Landfill design has improved significantly from the practices of the 1950s, 1960s, and 1970s that had resulted in contaminated groundwater. Liquids that results from waste decomposition or precipitation on a landfill are collected and treated.

CONCLUSIONS

- Exposure to PCBs from eating contaminated fish from the Fox River and Green Bay poses a public health hazard.
- PCBs also accumulate in other wildlife such as waterfowl and turtles. Regularly eating these animals from the Lower Fox River is also a source of PCB exposure and a health concern.

- Exposure to PCBs may cause a wide variety of health problems including adverse reproductive and endocrine effects, lower IQ, problems with physical development and behavior in young children, and some types of cancer.
- Pregnant women and children are particularly sensitive to the effects of PCB exposures. Women and ethnic minority populations are least likely to be aware of fish consumption advisories.
- The existing fish consumption advisories have reduced the rate that many residents eat PCB-contaminated fish from the Lower Fox River and Green Bay.
- Exposures to contaminated sediments from other uses of the river and Green Bay (swimming, boating, etc.) do not pose a public health hazard.
- The landfill disposal of PCB-contaminated sediments is safe and does not pose a health hazard to nearby residents.

RECOMMENDATIONS

- The Wisconsin Department of Health and Family Services (DHFS) recommends that cleanup actions be taken to reduce the amount of PCBs available for uptake into the food chain. Consistent with this recommendation, DHFS concurs with and fully supports the Wisconsin Department of Natural Resources (DNR) Proposed Plan for the cleanup of the Lower Fox River and Green Bay.
- DHFS recommends continued effort to promote awareness of the fish consumption advisories, with special emphasis on women and minority groups.
- DHFS recommends continued monitoring of PCB levels in fish from the Lower Fox River and Green Bay. DHFS will work with DNR to adjust the advisory accordingly.

PUBLIC HEALTH ACTION PLAN

DHFS has developed a public health action plan for addressing the health hazards related to environmental contamination that affects the safety of Wisconsin's sport fishery. Contamination in the Lower Fox River and bay of Green Bay has been a primary reason for developing this plan. The plan provides a conceptual framework for public health involvement with the management of this and similar water resources.

It is the goal of DHFS to reduce risks posed to families from eating contaminated sport fish in Wisconsin. To achieve this goal, DHFS will:

- 1) actively support efforts to reduce contaminants in Wisconsin's sport fishery. DHFS will

provide this support by:

- assisting with the **assessment** of public health risk posed by contaminants in the fishery,
- showing public support for the efforts of others to **reduce contaminant concentrations** in the fishery,
- recommending and supporting continued **monitoring** of contaminant concentrations in the fishery, to ensure that cleanup activities continue to effectively reduce risks to the public.

DHFS has been providing technical assistance to DNR and EPA on the risk assessment for the Lower Fox River project. DHFS will continue to provide similar support as appropriate as this project moves into the remedial design and remedial action phases. DHFS is currently supporting the efforts of DNR and EPA to reduce contaminant concentrations in the fishery by concurring with and supporting the proposed cleanup plan.

- 2) increase healthy eating habits among families who eat sport caught fish,
- provide **education** to families on the importance of eating sport caught fish low in contamination,
 - **identify families** eating sport caught fish who are unaware of the relevant consumption advisories to those fish,
 - **tailor/target** advisory promotion activities towards those families most at risk,
 - **evaluate** and continuously **improve** advisory promotion activities.

DHFS has worked for many years on each of these activities. However, DHFS recognizes that these must be on-going activities, involving continual reevaluation and refocusing of advisory awareness efforts. DHFS will continue to work to evaluate and improve advisory effectiveness on for the Fox River. This work will involve collaboration with local community groups in the Lower Fox River Valley.

To address these objectives DHFS will partner with community members, organizations and other government agencies who share a common interest in this important public health issue. Health officials recognize that the fish consumption advisories are not perfect. However, they are currently our strongest tools for reducing the risks posed to our families from a contaminated fishery. Our overall goal is to have a fishery resource free of contamination that causes us to rely upon fish consumption advisories. Until that goal has been met the threat to our families will not be completely eliminated.

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