

STATE OF CONNECTICUT

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THRU: Jim Vannoy, Section Chief
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SUBJ: EVALUATION OF TOTAL CHLORDANE CONCENTRATIONS IN FISH FROM UNION POND, MANCHESTER AND SHENIPSIT LAKE, VERNON, TOLLAND, AND ELLINGTON

DATE: December 5, 2023

This Letter Health Consultation (LHC) was prepared to document our evaluation of total chlordane concentrations in fish species from Union Pond in Manchester, CT and Shenipsit Lake in Vernon, Tolland, and Ellington, CT. Fish tissue analysis data in this LHC were obtained from Connecticut Department of Energy and Environmental Protection (CTDEEP).

This document also details the rationale for a site-specific target total chlordane¹ concentration for finfish and shellfish from Union Pond and Shenipsit Lake based on a cancer slope factor of $((0.35 \text{ (mg/kg/day)})^{-1})$ (EPA 1998).

Background and Statement of Issues

Union Pond is an impoundment of the Hockanum River and is located in Manchester, Connecticut. In 1998, a University of Connecticut study found elevated levels of total chlordane in fish species from Union Pond. After evaluating this fish tissue data, CTDPH issued a 'Do not eat' advisory in 1999 for carp, catfish, and bass caught from Union Pond due to concern over elevated total chlordane levels. A 'Do not eat' advisory was subsequently

¹ Total chlordane was calculated as the sum of oxychlordane, trans (gamma)-chlordane, and cis (alpha)-chlordane (Lally 2022).



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issued for all fish species from Union Pond in April 2022, based on high perfluorooctane sulfonic acid (PFOS) levels in fish from the Hockanum River System, which includes Union Pond.

In June 2022, fish species were sampled by the DEEP Fisheries Program and analyzed for total chlordane to observe whether total chlordane concentrations had decreased enough to allow safe consumption (Lally 2022). For comparison, fish species from nearby Shenipsit Lake, located in Vernon, Tolland and Ellington, a local drinking water source with no history of chlordane contamination, were also sampled and analyzed for total chlordane.

The Fisheries Program and the Remediation Program at CTDEEP requested that Connecticut Department of Public Health (CTDPH) evaluate data from fish tissue (collected in 2022) from Union Pond and Shenipsit Lake. This LHC documents the data evaluation process for Union Pond and Shenipsit Lake.

Health Comparison Values and Fish Contaminant Levels

Site-Specific Target Concentration for Total Chlordane

A. Target Concentration Based on Cancer Health Risk Effects

Connecticut, like most states and tribal governments, develops risk-based fish consumption guidance following the *United States Environmental Protection Agency's (EPA) Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 2 Risk Assessment and Fish Consumption Limits* (EPA, 2000). The method uses species-specific data on concentrations of a contaminant in fish tissue to determine how often it is safe to eat a particular finfish or shellfish species.

The target cancer health risk based concentration of total chlordane (C_m) in fish is derived using the following formula:

$$C_m = \frac{ARL \times BW \times T_{ap}}{CSF \times CR_{mm} \times MS}$$

Where:

- ARL = Maximum acceptable individual lifetime risk level (unitless) (1×10^{-5})
- BW = Body Weight (80 kg) (EPA 2011)
- C_m = Target concentration of total chlordane in fish species (mg/kg)
- CR_{mm} = Maximum allowable fish consumption rate (8 meals/month)
- CSF = Cancer slope factor of technical chlordane² ($0.35 \text{ (mg/kg/day)}^{-1}$) (EPA 1998)
- MS = Meal size (0.227 kg fish/meal) (EPA 2011)
- T_{ap} = Time averaging period (30.44 d/month)

Using the above assumptions, the target cancer health risk-based concentration of total chlordane in a fish species, C_m , is **0.038 µg/kg or 38 ppb**

² The EPA considers technical chlordane (CAS No. 12789-03-6) to be composed of 60% octachloro-4,7-methanotetrahydroindane (the cis and trans isomers) and 40% related compounds (1998).

B. Target Concentration Based on Noncancer Health Risk Effects-Adult and Child

The noncancer health risk based target concentration was calculated using a health-based reference dose (RfD) using the equation below:

$$C_m = \frac{RfD \times BW \times T_{ap}}{MS \times CR_{mm}}$$

Where:

BW=	=body weight, adult (80 kg) (ATSDR 2023)
C _m	=Concentration of total chlordane in fish species (target concentration) (mg/kg)
CR _{mm}	=Maximum allowable fish consumption rate (8 meals/month or 2 meal/week)
MS	= Meal size (0.227 kg fish/meal) (EPA 2011)
RfD	= Reference dose of technical chlordane (0.5 µg/kg/day) (EPA 1998)
T _{ap}	= Time averaging period (30.44 d/month)
µg/kg/-day	= micrograms per kilogram per day

Using the above assumptions, the noncancer health risk-based target concentration of total chlordane in a fish species is **0.670 µg/g (ppm) or 670 ppb**.

It is also important to derive a target concentration in fish that is protective of children as well as adults eating 2 meals per week. Using a health-based reference dose (RfD), and assuming 17 kg for a body weight for a child, aged 2-6 years old and a 85.0486 g fish meal (USEPA 2011 and ATSDR 2023) for a child, a noncancer based target concentration for total chlordane for children was calculated to be **0.380 µg/g (ppm) or 380 ppb**.

Body Weight and Meal Size

When deriving a target concentration for total chlordane exposure, Connecticut uses EPA's 2011 guidance which recommends an average fish meal size of 227 grams (8 ounces) for an 80 kg for an adult, (USEPA 2011 and ATSDR 2023). CTDPH considers more than 8 fish meals per month or 2 fish meals per week, 'unlimited consumption.' Therefore, a fish tissue concentration lower than the target concentration of 38 ppb, would be associated with an unlimited consumption recommendation.

CTDPH chose to use 38 ppb (cancer health risk based) as it is more conservative than the target chlordane concentrations calculated based on noncancer health risk for adults and child fish consumers. In summary, using the US EPA Cancer Slope Factor of (0.35 (mg/kg/day),⁻¹ a body weight of 80 kg and an assumed meal size of 227 grams, CTDPH has derived a site-specific target concentration for total chlordane of **38 (g/kg) ppb** for Union Pond and Shenipsit Lake. This site-specific target concentration is protective of people who eat unlimited fish meals as defined previously and is also protective of children who eat fish from both waterbodies since it is approximately an order of magnitude lower than the target concentration for total chlordane for children.

Fish Contaminant Levels

Union Pond

A total of 45 fish consisting of 3 species (largemouth bass, common carp, and white sucker), each made up of three, 5-fish composite samples (with the exception of largemouth bass which had one discrete sample, one, 4-

fish composite sample and one, 5-fish composite sample) were collected for analysis in June 2022 from Union Pond in Manchester (Lally 2022). As shown in Table 1, average total chlordane levels for largemouth bass, common carp and white sucker were 3.86, 17.07 and 13.08 ppb respectively.³ It is important to note that during 1998 sampling event for Union Pond, maximum total chlordane levels in common carp and largemouth bass were significantly higher (516 and 191 ppb, respectively).

Table 1. Total Chlordane Concentrations in Fish Collected in June 2022 from Union Pond, Manchester

Fish Species	Number of Samples	Number of Fish per Sample	Total Chlordane Range (ppb*)	Mean Total Chlordane Level (ppb)
Largemouth Bass	3	1-5	0.286-5.92	3.86
Common Carp	3	5	7.90-23.21	17.07
White Sucker	3	5	8.91-15.99	13.08

*Parts per billion

Shenipsit Lake

A total of 62 fish consisting of 5 species (largemouth bass, pumpkinseed, yellow perch, bluegill, and brown bullhead), each made up of three, 5-fish composite samples (with the exception of brown bullhead which consisted of one, 2-fish composite) were collected for analysis in June 2022 from Shenipsit Lake in Vernon, Tolland and Ellington (Lally 2022). As shown in Table 2, average total chlordane levels for largemouth bass, yellow perch, and bluegill were 0.44, 0.73, and 0.43 ppb respectively.⁴ The total chlordane concentration in brown bullhead was 2.6 ppb. Total chlordane was not detected in pumpkinseed. As expected, total chlordane levels in all fish species sampled from Shenipsit Lake were very low and much lower than total chlordane levels from fish species sampled from Union Pond.

Table 2. Total Chlordane Concentrations in Fish Collected in June 2022 From Shenipsit Lake, Vernon, Tolland, and Ellington

Fish Species	Number of Samples	Number of Fish per Sample	Total Chlordane Range (ppb*)	Mean Total Chlordane Level (ppb)
Largemouth Bass	3	5	0.18-0.97	0.44
Pumpkinseed	3	5	ND [^]	ND
Yellow Perch	3	5	0.18-1.43	0.73
Bluegill	3	5	0.18-0.93	0.43
Brown Bullhead	1	2	--	2.6

*Parts per billion

[^] Not Detectable

³ Since there was a sufficient number of fish samples, CTDPH used the average total chlordane concentration (instead of a 95% Upper Confidence Limit) found in the fish tissue analysis results to estimate whether the site-specific target concentration for total chlordane has been exceeded in Union Pond

⁴ Since there was a sufficient number of fish samples, CTDPH used the average total chlordane concentration (instead of a 95% Upper Confidence Limit) found in the fish tissue analysis results to estimate whether the site-specific target concentration for total chlordane has been exceeded in Shenipsit Lake.

Discussion

Exposure Pathway Analysis

To determine if community members are exposed to chlordane through contaminated fish in Union Pond and Shenipsit Lake, CTDPH evaluated the environmental and human components that lead to human exposure. CTDPH evaluated fish tissue data and considered how people may be exposed to chlordane in fish. Chlordane was the only contaminant of concern in 1998 based on the site characterization of Union Pond (Lally 2022). However, because Union Pond is connected to the Hockanum River, PFOS is also a contaminant of concern as of April 2022 and there is a ‘Do not eat’ Advisory for Union Pond that is based on both PFOS and total chlordane levels in fish tissue.

An exposure pathway consists of five elements (ATSDR 2022):

1. A source of contamination;
2. Transport through an environmental medium;
3. A point of exposure;
4. A route of human exposure; and
5. A receptor population.

ATSDR categorizes an exposure pathway as either completed, potential, or eliminated. In a completed pathway, all five elements exist and indicate that exposure to a contaminant has occurred in the past, is occurring, or will occur in the future. In a potential exposure pathway, at least one of the five elements has not been confirmed, but it may exist. Exposure to a contaminant may have occurred in the past, may be occurring, or may occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present (ATSDR 2022).

Environmental data show that fish from Shenipsit Lake and Union Pond have detectable levels of chlordane and individuals would be exposed to chlordane if they eat the fish. Thus, the only complete pathway of exposure is via ingestion (ATSDR 2022).

Public Health Implications for Adults and Children and Conclusion

When determining the public health implications of exposure to hazardous contaminants, CTDPH considers how people might come into contact with contaminants and compares contaminant concentrations with health protective levels. When contaminant levels are below health-based comparison values, health impacts from exposure to those levels are unlikely. Contaminant levels exceeding comparison values do not indicate that health impacts are likely, but instead warrant further investigation. In this health consultation, CTDPH used the updated site-specific target concentration for total chlordane that is derived in this document to evaluate whether unlimited consumption of fish would pose a public health concern.

Ingestion of fish from Union Pond and Shenipsit Lake which contain total chlordane are completed exposure pathways and are evaluated in this health consultation.

A comparison of the average total chlordane levels in fish tissue from either waterbody with the health-based comparison value (site-specific target concentration) shows that neither exceeds the health-based comparison concentration.

CTDPH has decided to remove the advisory of ‘Do not eat’ for fish from Union Pond due to total chlordane because total chlordane concentrations have decreased significantly over time, and do not remain elevated enough to warrant restricting consumption (are well below the site-specific target concentration). **However, a ‘Do not eat’ advisory remains on fish from Union Pond due to elevated PFOS levels in fish from the Hockanum River system, which includes Union Pond.** In the past, total chlordane levels from fish from Union Pond could harm people’s health if they did not follow the consumption advisory. However, since total chlordane levels have decreased to a level in fish where consumption restrictions are no longer necessary due to chlordane, CTDPH believes that this specific consumption advisory due to chlordane is no longer necessary to protect public health.

CTDPH has decided not to issue an advisory on Shenipsit Lake because one round of fish tissue sampling data has indicated very low levels of total chlordane in this waterbody and average total chlordane levels in fish from Shenipsit Lake are not elevated enough to warrant restricting consumption (are well below the site-specific target concentration).

It is important to note that there is a statewide fish consumption advisory based on mercury concentrations on all fresh waterbodies of ‘one fish meal per week’ for the general population and ‘one fish meal per month’ for the high-risk population which includes pregnant women, women planning on becoming pregnant, breastfeeding women, and children under 6 years old.

Recommendation

1. CTDEEP Fisheries Division should continue to work with CTDPH to educate fishing populations about the statewide freshwater fish consumption advisory which includes Union Pond and Shenipsit Lake as well as the waterbody specific fish consumption advisories.

References

ATSDR 2022. Public Health Assessment Guidance Manual. Agency for Toxic Substance and Disease Registry, Available at <http://www.atsdr.cdc.gov/hac/PHAManual/ch2.html#2.5.4>. Accessed on September 15, 2023.

ATSDR 2023. Exposure Dose Guidance for Body Weight. Agency for Toxic Substances and Disease Registry. January 31 2023. Available at: <https://www.atsdr.cdc.gov/pha-guidance/resources/ATSDR-EDG-Body-Weight-508.pdf>.

Lally, Meghan. 2022. Analysis of Chlordane Levels in Fish Tissue Collected from Union Pond and Shenipsit Lake. CT DEEP Fish Tissue Contaminant Monitoring Project. Connecticut Department of Energy and Environmental Protection December 28, 2022.

US EPA 1998. United States Environmental Protection Agency, Integrated Risk Information System (IRIS). IRIS Summary for Chlordane. Available at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://iris.epa.gov/static/pdfs/0142_summary.pdf. Accessed on: October 19, 2023.

US EPA 2000. United States Environmental Protection Agency. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2. Risk Assessment and Fish Consumption Limits, Third Edition. U.S. Environmental Protection Agency, Washington, DC, Available at: <https://www.epa.gov/sites/default/files/2015-06/documents/volume2.pdf>.

US EPA 2011. United States Environmental Protection Agency Exposure Factors Handbook 2011 Edition (Final Report). Chapter 8, Body Weight Studies. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, 2011.

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