Final
Total Maximum Daily Load
for the Monongahela River, Greene County
PCBs and Chlordane

Point Marion Lock and Dam to Grays Landing Lock and Dam
March 1, 1999

Table of Contents

Introduction
Background
TMDL Development
TMDL Implementation
Monitoring

Introduction

Pennsylvania has conducted monitoring of fish tissue contaminants since 1976. Early efforts were comprised of special studies in major water bodies as well as smaller waters with suspected sources of contaminants. Routine sampling for tissue contaminants began in 1979 with implementation of the EPA "CORE" monitoring network that mandated collection of whole fish samples. Because Pennsylvania wanted the fish tissue monitoring program to focus on protection of public health, we began sampling both the edible portion and whole body at one-half of the stations. In 1987, Pennsylvania began sampling the edible portion almost exclusively. In order to increase spatial coverage, we also began rotating sampling through our routine ambient monitoring network and provided both Department of Environmental Protection (DEP) and Fish and Boat Commission field biologists the opportunity to sample suspected problem

areas.

Fishing is a wholesome, relaxing pastime, and fish are nutritious and good to eat. Some fish, however, may accumulate contaminants to levels that may be harmful to those who eat them over a long period of time. In an attempt to protect public health, the Commonwealth periodically (at least annually) issues fis consumption advisories based on monitoring data from a number of sources. Advisories are issued jointly by the Department of Health, the Fish and Boat Commission, and DEP. The list of advisories is published in the "Pennsylvania Summary of Fishing Regulations and Laws" which is provided to each fishing license buyer, and is also available from the Department in hard copy and through the Internet. In addition, the annual list and any individual advisories needed between lists are issued using press releases.

A number of Pennsylvania waterbodies with fish consumption advisories were listed on the Clean Water Act Section 303(d) List of Impaired Waters for 1996. They were listed because long-term, unrestricted consumption of these fish could potentially lead to human health problems. This document addresses contamination of fish tissue in the Monongahela River, Greene County, by PCB and chlordane.

Background

This Total Maximum Daily Load (TMDL) applies to the main stem of the Monongahela River (Stream Code 37185) from the Point Marion Lock and Dam (River Mile 90.8) to the Grays Landing Lock and Dam (River Mile 82.0). This segment was apparently inadvertently omitted from the 1996 Section 303(d) list. It was included on the 1998 303(d) list in State Water Plan Watershed 19-G (Segment ID 9919) as a high priority for TMDL development.

The "Do Not Eat" advisory for white bass was issued January 19, 1990 due to a chlordane concentration of 0.32 ppm. The advisory was reissued in 1991 and 1992, and remains in place. Relatively recent sampling indicated values less than the FDA Action Level, but difficulties in obtaining samples of white bass have kept us from obtaining the two consecutive samples needed to lift the advisory. When the 1998 advisory was developed using the PCB-based Great Lakes protocol, carp were added to the advisory at this location as one meal per month (Group 3).

TMDL Development

Endpoint Identification

The overall goal of a TMDL is to achieve the "fishable/swimmable" goal of the federal Clean Water Act. Because consumption advisories are in place for white bass due to chlordane and for carp due to PCB, these goals are not being met in this segment of the Monongahela River.

The specific goal of a TMDL is to outline a plan to achieve water quality standards in the water body. For this segment of the Monongahela River, the TMDL goal is for levels of PCB and chlordane in the water column to be equal to or less than the Commonwealth's water quality criteria. The criteria, found in the "Water Quality Toxics Management Strategy– Statement of Policy" (Chapter 16 of the Department's rules and regulations), are 0.00004 µg/L (micrograms per liter, equivalent to parts per billion) for PCB and 0.0005 µg/L for chlordane. Both of these compounds are probable human carcinogens, and these are human health criteria developed to protect against excess cancer risk. Specifically, the Department's water quality toxics management program controls carcinogens to an overall risk management level of one excess case of cancer in a population of 1 million (1×10^{-6}). Expressing this another way, the probability of an individual getting cancer is increased by a factor of 1 in 1 million.

Two means were employed in an effort to obtain readily available data on instream PCB and chlordane levels for comparison to the criteria. First, the

Department's Southwest Field Office was asked to search for PCB or chlordane data in or upstream from the Monongahela River fish consumption advisory segment. That search failed to produce any instream data. Second, data from the EPA Storage and Retrieval System (STORET) was obtained. An "Inventory" retrieval that would include data collected by all agencies using STORET was run for an area with a five-mile radius around the Department's fish tissue sampling station. That location is Water Quality Network (WQN) Station 725 – Monongahela River downstream of Lock and Dam 8 (recently renamed the Point Marion Lock and Dam). Five PCB data points were found, but they were from 1975. This data does not represent current conditions. No instream chlordane data was found.

As a means to compare current conditions to the water quality criteria, estimated water column concentrations were calculated based on the fish tissue concentrations and bioconcentration factors. The calculation involves dividing the average fish tissue concentration by the bioconcentration factor to obtain a projected water column concentration. The equation is:

$$\frac{TC}{BCF} = WC \times 1000$$

TC = Tissue Concentration in mg/kg (equivalent to mg/L)
BCF = EPA Bioconcentration Factor in L/kg
WC = Water Column Concentration (estimated) in mg/L
Multiply by 1000 to obtain µg/L

The average fish tissue concentration is the mean of all samples. The average concentration is used for two main reasons. First, the fish tissue samples are composites. This means that the sample result represents the average tissue concentration in two to five individuals, and not an exact value. Second, use of an average value considers the natural variation in tissue burden found in wild fish populations. The PCB Bioconcentration factor (BCF) of 31,200 from the EPA criteria development document (EPA 440/5-80-068, October 1980) was used. The chlordane BCF of 14,100 from the EPA criteria development document (EPA 440/5-80-027, October 1980) was also applied. These BCFs were used because no Bioaccumulation Factors (BAFs) are available for statewide use. The use of the BCFs is consistent with the provisions of the Department's water quality toxics management strategy

The average PCB level in carp from this segment of the Monongahela River is 0.447 mg/kg. The estimated concentration of PCB in the water column based on that level and the EPA bioconcentration factor is 0.01433 µg/L. The average chlordane concentration in white bass samples is 0.166 mg/kg and the estimated chlordane water column concentration is 0.01177 µg/L. These estimated concentrations exceed the applicable water quality criteria. These values most likely do not represent the actual existing instream concentrations due to the basis for the back-calculation. The back-calculations from tissue levels to water column concentrations were performed using data on species for which consumption advisories have been issued, i.e., fish with elevated tissue levels of these contaminants. While the actual concentrations in the water column are not known, they are likely to be lower than the calculated estimates.

Source Assessment

The production and use of PCB in the United States was banned in July of 1979. While it is now illegal to manufacture, distribute, or use PCB in the United States, these synthetic oils were used in the past as insulating fluids in electrical transformers and other products, as cutting oils, and in carbonless paper. PCB was introduced into the environment while their use was unrestricted, and occasional releases still occur. In addition, some permitted discharges and

Superfund sites contribute PCB to surface water. PCB is very resistant to breakdown and thus remains in river and lake sediments for many years.

Chlordane is a man-made organochlorine compound that was widely used as a broad-spectrum agricultural pesticide before its use was restricted to termite control around building foundations. All uses of chlordane have been banned since April 1988. Chlordane may be introduced to surface waters through contaminated ground water or surface runoff, i.e., it is a nonpoint source contaminant. Once in a waterbody, both PCB and chlordane become associated with solids particles and enter the sediments. Fish are exposed to and accumulate these compounds from the water, through contact with or ingestion of sediments, and in the food they eat.

Three methods were employed in order to locate known sources of PCB or chlordane to the Monongahela River. First, the Southwest Field Office was asked to provide information on known existing or historical sources that might contribute PCB or chlordane in or upstream from the fish consumption advisory reach. For any known sources, they were requested to provide the name and location as well as flow rate and the long-term discharge concentration (to help establish load). Second, the EPA Permit Compliance System (PCS) database was searched for any major discharge permits containing PCB or chlordane as an effluent limitation. Third, the West Virginia Division of Environmental Protection was contacted to determine if there are known sources in the West Virginia portion of the watershed. No known existing or historic sources of PCB or chlordane to the Monongahela River were found.

TMDL Calculation

Development of TMDLs includes consideration of background pollutant contribution, appropriate and/or critical stream flow, and seasonal variation. The natural instream background concentration of both PCB and chlordane is assumed to be zero because they are man-made compounds and there are no natural sources.

PCB and chlordane are probable human carcinogens. Carcinogenesis is a nonthreshold effect, an adverse impact that may occur at any exposure greater than zero. Such an effect is often related to long-term exposure to low levels of a particular chemical or compound, rather than an immediate effect due to a short duration exposure to a high level. As noted earlier, the Department's water quality toxics management program uses a cancer risk level of 1×10^{-6} to protect human health. Attainment of this risk level is predicated on exposure that includes drinking 2 liters of water and ingesting 6.5 grams of fish per day over a 70-year lifetime. The Department uses harmonic mean flow as the appropriate design condition for dealing with exposure to carcinogens. This is a long-term flow condition that will, when applied to the Total Maximum Daily Load, represent long-term average exposure. Because seasonal increases and decreases in concentration are less important than the long-term exposure to a carcinogen, use of harmonic mean flow adequately considers seasonal variations in chlordane concentrations.

The calculation of the Monongahela River TMDLs uses the water quality criteria and flow data from the U.S. Geological Survey surface water discharge station at Lock and Dam 8 at Point Marion, PA (03063000, recently renamed the Point Marion Lock and Dam). The harmonic mean flow was calculated using the low flow yield method found in the Department's "Implementation Guidance - Design Stream Flows" (Document No. 391-2000-023, p 4). This method requires that the harmonic mean flow (Qhm) from the USGS gage used be divided by the gage drainage area to arrive at a Unit Qhm that is multiplied by the drainage area of the segment to produce a Segment Qhm in cubic feet per second (cfs). The Segment Qhm for the Monongahela River is 1406.77 cfs.

The Segment Qhm is used in calculating the Total Daily Maximum Load (TMDL) by multiplying it by the water quality criterion and a multiplier to convert

from cfs x µg/L to lbs/day (pounds per day). The PCB TMDL is calculated as follows:

1406.77 cfs x 0.00004 µg/L = 0.056271 cfs x µg/L x 0.00539 = 0.0003033 lbs/day.

The chlordane TMDL is calculated as follows:

1406.77 cfs x 0.0005 µg/L = 0.703385 cfs x µg/L x 0.00539 = 0.0037912 lbs/day.

The Total Maximum Daily Load of PCB for this Monongahela River segment is 0.0003033 pounds per day. The chlordane TMDL is 0.0037912 lbs/day.

Percent Reduction

The goal of this TMDL is to achieve the water quality criteria in order to protect public health. In order to achieve this, the instream concentrations must be reduced from the estimated current levels to the criteria. Percent reduction is calculated using the following formula:

% Reduction = (1 - TMDL Goal/ Existing Concentration) x 100

The percent reduction for PCB is calculated as follows:

% Reduction = (1 – 0.00004/0.01433 x 100
% Reduction = (1 – 0.00280) x 100 = 99.7%

Percent reduction for chlordane is:

% Reduction = (1 – 0.0005/0.01177 x 100
% Reduction = (1 – 0.04248) x 100 = 95.8%

Overall reductions of 99.7% for PCB and 95.8% for chlordane are needed to achieve the TMDL goal.

Margin of Safety (MOS)

Achievement of the TMDLs will generally ensure achievement of the water quality criteria. To account for uncertainties that may be associated with the TMDL calculation, the Department proposes to hold 10% of the TMDL in reserve. Applying this 10% margin of safety results in a PCB TMDL of 0.0002730 pounds per day and a chlordane TMDL of 0.0034121 pounds per day for allocation to all sources.

Wasteload Allocations (WLAs) and Load Allocations (LAs)

No data is available on PCB or chlordane concentrations in this segment of the Monongahela River. For this reason, and because these are man-made compounds, natural and background concentrations are assumed to be zero.

No known existing or historic sources of PCB or chlordane to this segment of the Monongahela River were found during development of this TMDL. As a result, the Wasteload Allocations (WLAs) for both compounds, the portion of the load contributed by point source discharges, are set to zero.

Because there are no known sources of either PCB or chlordane, both are treated as nonpoint source contaminants that may be introduced to surface water through contaminated ground water or surface runoff. As a result, the entire TMDLs for both PCB and chlordane in the Monongahela River segment are assigned to the Load Allocations (LAs), that portion of the load contributed by nonpoint sources. The Source Assessment notes that once in a water body, both compounds become associated with soil particles and enter the sediments. Fish tissue contamination results from this sediment load. Because of this, the entire TMDLs for PCB and chlordane in this reach of the Monongahela River are assigned to Load Allocations for the instream sediment.

TMDL Summary
The TMDLs for the Monongahela River from the Point Marion Lock and Dam (RM 90.8) to the Grays Landing Lock and Dam (RM 82.0) can be summarized as follows:

TMDL Summary				
Pollutant	**TMDL**	**WLA**	**LA**	**MOS**
PCB	0.0003033 lbs/day	0	0.0002730 lbs/day	0.00003033 lbs/day
Chlordane	0.0037912 lbs/day	0	0.0034121 lbs/day	0.00037912 lbs/day

TMDL Verification
The stated goal of this TMDL is to meet the PCB and chlordane water quality criteria for the protection of public health in this reach of the Monongahela River. Another way to state the goal is to reach a point where fish consumption advisories are no longer needed because tissue levels of these compounds are no longer above the levels of concern.

The three agencies involved with the issuance of fish consumption advisories in Pennsylvania currently apply the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" (commonly referred to as the Great Lakes protocol) for issuance of consumption advisories due to PCB. Following this method, meal-specific consumption advice is issued by species. The first level of consumption advice, eat no more than one meal per week, is issued when the tissue PCB concentration is 0.06 to 0.20 mg/kg. The upper limit for unrestricted consumption is 0.05 mg/kg. In order to verify the protectiveness of the PCB TMDL, the estimated fish tissue concentration that would be expected to accumulate at a water column concentration of 0.00004 µg/L was calculated. Reaching the PCB criterion would result in an estimated tissue concentration of 0.001 mg/kg, well below the 0.05 mg/kg level for unrestricted consumption.

Fish consumption advisories for chlordane are issued using the U.S. Food and Drug Administration (FDA) Action Level of 0.3 mg/kg. To verify the

protectiveness of the proposed chlordane TMDL, the estimated fish tissue concentration that would be expected to accumulate at a water column concentration of 0.0005 µg/L was determined. Achievement of the chlordane water quality criterion would result in an estimated fish tissue concentration of 0.007 mg/kg, much lower than the Action Level. The consumption advisory could be lifted at that level.

TMDL Implementation

The use of both PCB and chlordane has been banned in the United States, so there should be no new point sources to which controls can be applied. There are no known current sources of PCB or chlordane to this Monongahela River segment. PCB and chlordane present in the system are believed to reside primarily in the sediment due to historical use.

Generally, the levels of PCB and chlordane are expected to decline over time due to the bans on use through natural attenuation. Examples of processes in natural attenuation are covering of contaminated sediments with newer, less contaminated materials, and flushing of sediments during periods of high stream flow. Natural attenuation may be the best implementation method because it involves less habitat disturbance/destruction than active removal of contaminate sediments. Mechanical or vacuum dredging removes the habitat needed by certain benthic macroinvertebrates. In addition, some of these organisms will be killed during the dredging process. Suspension of sediments during dredging may also cause abrasive damage to the gills and/or sensory organs of benthic macroinvertebrates or the gills of fish. Suspended sediments can also affect the prey gathering ability of sight-feeding fish. In addition, active removal may cause resuspension of contaminated materials thus making PCB available for additional uptake. This alternative is, of course, also the least costly option.

Monitoring

Pennsylvania will continue to monitor PCB and chlordane levels in white bass and carp tissue in this reach of the Monongahela River. Samples will be collected once every five years. The data will be used to evaluate the possible threat to public health and to determine progress toward meeting the TMDLs. The consumption advisories will remain in place until the water quality criteria are achieved and advisories are no longer needed.