POLYCHLORINATED BIPHENYLS IN MICHIGAN WATERS

Report to WRC Comm

June 1973

MAY 28 1974

The Bureau of Water Management's last progress report to the Commission on the PCB situation was in December, 1971. Some of you have requested an updating. That is the purpose of this report today.

Since the last briefing to you, EPA has come out with a recommendation that receiving waters should not contain PCB's in excess of 0.01 ppb. Such a low level was deemed necessary in view of the fact that research has demonstrated biomagnification of PCB's in fish can be as high as 200,000 times the concentration in water to which they are exposed. There is an indication now that EPA may even lower their recommended level by adopting the recommendation of 0.002 ppb made in the upcoming edition of Water Quality Criteria (NAS, 1972), commonly referred to as the "Blue Book". Anyway, the EPA recommendation of 0.01 ppb for receiving waters has provided us with a guideline to use in reference to our monitoring programs.

As you may recall, Michigan instituted a monitoring program for polychlorinated biphenyls (PCB's) early in 1971. The initial program consisted of a state-wide water sampling survey for determination of concentrations in inland waters and tributaries to the Great Lakes. Supplementary sampling has since been conducted on stream sediments, municipal raw water intakes, groundwater drinking supplies, sanitary landfill runoffs, municipal wastewater treatment plants, industrial discharges, and fish from both inland and Great Lakes waters. Sampling is being continued in tributary streams, wastewater treatment plants, and in fish on a periodic basis as a means of following the effectiveness of control and reduction programs.

Water sampling in thirty Michigan tributaries during 1971 and 1972 showed that about 60 percent of the samples exceeded the 0.01 ppb guideline with one stream, the Saginaw River, having a high concentration of 2.9 ppb (Table 1). It is interesting to note that fish from the Saginaw River were found to have PCB concentrations as high as 165 ppm (Table 2). Five Michigan streams had mean concentrations in water samples over 0.10 ppb, 10 times higher than the EPA guideline. These were the Saginaw, Tittebawassee, Clinton, Raisin and Rouge Rivers, all located in the populous southeastern lower peninsula which drains into lower Lake Huron, Lake St. Clair and Lake Erie. Of the Lake Michigan streams, the Grand and Kalamazoo rivers consistently showed the highest concentrations with means of 0.041 and 0.065 ppb, respectively.

In May, 1973 (just last month) we sampled the water in the Lower Peninsula tributaries again and found just 8 (36 percent) exceeding the 0.01 ppb guideline (Table 3). This is an apparent improvement over previous years which we hope is the beginning of a downward trend. Improvements were especially noted in the Saginaw, Tittabawassee, and Raisin Rivers.

Sampling of municipal wastewater treatment plant (WWTP) effluents throughout Michigan in 1971 and 1972 indicated that many WWTP's represent major point sources of PCB loss to surface waters (Table 4). The average PCB concentration of 60 effluents sampled was 2.55 ppb. While only seven of the WWTP effluents exceeded 1 ppb, the Bay City WWTP located on the Saginaw River had an average effluent concentration of 170 ppb (high of 340 ppb), skewing the overall average for all plants sharply upward. The average concentration excluding the Bay

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were, with one exception, located on rivers already identified as having levels of PCB contamination. One would tend to believe that if industrial has been decreased, it would be reflected first in reduced concentrations charges from wastewater treatment plants. Sampling of 58 WWTP effluents however, continues to show high PCB levels with an average concentration ppb (Table 5), including the Bay City plant. Although still high, clear that the PCB discharge from the Bay City WWTP has been greatly reduced.

pling of sewage sludge from 57 of the 58 WWTP's tested in 1973 showed city to have the highest concentration of PCB's in the sludge being removed treatment process. The PCB concentration in the sludge from the Bay plant was 352 ppm (dry weight basis) compared to a state-wide average of ppm (Table 6).

In an attempt to identify major contributors of PCB's within municipal systems, sampling at key points in the interceptor systems has been ected within the municipalities of Bay City, Mt. Clemens, Saginaw, Adrian, elt and Kalamazoo. This program has been very successful in that it has tified numerous PCB sources. In most cases, our agency has contacted the tries identified and have asked for corrective action. The City of Detroit, ever, has taken its own initiative and is getting good cooperation. Two of major sources identified in the Detroit system have completed a changeover on-PCB products and the other two are underway.

A broad scale sampling of industrial discharges throughout Michigan has shown sults indicative of the widespread usage of PCB's. Nearly half of the industrial charges sampled have contained more than 0.1 ppb with many in excess of 1 ppb. highest concentration detected in an industrial discharge in Michigan has 7,200 ppb and this was just found recently. Automotive plants, chemical nches, and paper product manufacturers are among the types of industries with st concentrations. Also industries and building complexes, including some ols and hospitals, with heat transfer systems appear to be another major source. tries identified as sources of PCB pollution have been encouraged to change placement compounds or to clean up their operation so that discharges of be eliminated. Our sampling of industries generally has shown that even h Monsanto Company (the only U.S. manufacturer of PCB's) has stopped the of PCB's for all uses except electrical transformers and capacitors, many tries apparently have large enough stock piles of PCB for replacement that have not yet been forced into switching to substitute compounds. We view ontinuing search for sources as a necessity so that we can speed up the geover process. There are some indications that even after an industry the use of PCB's a residual is going to continue in their effluent for siderable length of time until the sewers can be completely flushed out.

We are encouraged that some rivers are starting to show reductions in PCB trations. An example of one location in Michigan where monitoring and quent control measures have resulted in a marked reduction in PCB contamination Saginaw River basin. Monitoring of major Great Lakes tributaries during 1972 identified the Saginaw River as having the highest concentrations of of any tributary within Michigan boundaries. Intensive sampling throughout iver basin in search of point sources successfully isolated ten major points discharge to the river system. Each of the industrial sources were asked ntify the cause of their losses and to take corrective action. The following iting of the point sources and corrective actions taken to this date:

Chevrolet Bay City Parts Plant - PCB's had been used as hydraulic fluids in the die-cast machines. Losses were occurring both in the cooling

Our last report from General Motors showed conversion to a phosphate-ester based compound about 50 percent completed.

Bay City WWTP - Interceptor sampling identified the Chevrolet Parts Plant as the major contributor to this sytem. Since the initial steps of the General Motors plant conversion away from PCB fluids, the PCB levels in the WWTP effluent have dropped to about 1 percent of the previous highs.

General Motors Grey Iron and Nodular Iron Foundries, Saginaw - The problem here was also related to losses of hydraulic fluids. Conversion to phosphate ester fluids is reported to be complete.

Saginaw WWTP - Concentrations of PCB's in the effluent were not nearly as high as in the Bay City Plant. The Grey Iron and Nodular Iron Foundries were identified as the major contributors to the systen. Concentrations in the WWTP effluent have declined to about 50 percent of their previous levels.

Buick Motors, Flint - This plant was using PCB's as hydraulic fluids in 13 die cast machines. Conversion to a phosphate ester-glycol product was completed November 1, 1972.

Chevrolet Van Slyke Engine Plant, Flint - A coolant containing PCB's has been replaced with a substitute product.

Flint WWTP - Concentrations have steadily declined since our 1st sampling period in the fall of 1971 and now are considered very low.

Dow Corning Company, Midland - PCB's have been used in the heat transfer systems at this plant. Conversion to a substitute fluid is 50 percent complete.

Dow Corning Semiconductor Products Plant, Hemlock - Conversion of heat transfer fluids was completed in January, 1973.

Voluntary conversion to non-PCB containing products is proving to be very effective toward lowering the PCB concentrations in the Saginaw River. If you will refer to Table 7 of your written report you will note a sharp decline at our monitoring site near the river mouth in October, 1972. Concentrations have remained fairly low ever since that date with the exception of the sample from last month which indicated an increase back up to 0.2 ppb. Overall the situation appears to have improved considerably and we hope that a corresponding decline in PCB concentrations in fish from the river and the Saginaw Bay will soon be observed.

You may recall that in May, 1972 we reported to you about a PCB situation in the Kalamazoo River. During our intensive water quality and biological survey of the Kalamazoo watershed we discovered sharp increases in PCB's in fish below the municipalities of Battle Creek and Kalamazoo. Follow up surveys were unsuccessful at identifying any major sources in Battle Creek but in the Kalamazoo vicinity surveys have pointed the finger at both past and present wastepaper recycling operations by the paper industry. Certain sediment deposits in an impoundment on Portage Creek, a tributary to the Kalamazoo River, were found to contain PCB's at concentrations exceeding 350 ppm (dry weight basis). Leaching

from these PCB enriched sediments appears to be significant. During a drawdown of the impoundment last summer, scouring of the bottom sediments occurred and a sharp rise in PCB levels in river water was observed as the sediments moved downstream. As a result of sampling within the WWTP interceptor system, it is apparent to us that the remaining de-inking operations are still contributing to the PCB contamination problem. We are not sure what the solution to this problem might be because it would obviously involve a policy decision at the National level about the merits of recycling paper.

In 1972 Michigan developed a cooperative State-Federal study of contaminant levels in Great Lakes fish species including lake trout, salmon, whitefish, chubs, menominee, yellow perch, alewife, carp, and suckers. Fish from Lakes Michigan, Huron, Erie, and Superior are systematically being sampled on an annual basis to obtain information on areas where contaminants approach or exceed FDA guidelines for consumer protection. The project, developed by the State agencies in cooperation with the U.S. Food and Drug Administration and the Bureau of Sport Fisheries and Wildlife Great Lakes Laboratory, will establish patterns of residues of mercury, PCB's, DDT and dieldrin in Great Lakes fish. Table 8 shows the concentrations of PCB's detected in fish from Lake Michigan during the first year of this study. PCB's in Salmonids (lake trout, steelhead, coho salmon, and chinook salmon) and chubs were shown to exceed the FDA guideline of 5.0 ppm while concentrations in other species did not exceed this guideline. Sampling will be continued on an annual basis.

One area in which we have very little information so far is the potential for loss of PCB's from electrical transformers (one of the two remaining uses) through leakage, servicing, and replacement of worn-out or damaged units. We hear rumors that many of the small transformer maintenance companies, apparently unaware of the potential hazards of PCB's, are dumping PCB-based transformer fluids down the nearest drain or giving them to waste oil haulers rather than returning them for incineration. We intend to make a questionnaire survey followed up by an educational type letter with guidelines for safe disposal.

In summary, we think we have made considerable progress in the past 2 years toward getting rid of the PCB problem. On the other hand, while we have some indications of environmental reductions, we are afraid the contamination problems are not going to disappear as rapidly as we would like because of the slow transition to substitute products and the tremendous capacity for biological communities to magnify this type of persistent compound.

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Basin	River	PCB's (ppb as 1254)	Range (ppb as 1254)
igan	St. Joseph	0.013	<0.010-0.039
	Kalamazoo	0.065	0.019-0.097
	Grand	0.041	0.011-0.080
	Muskegon	0.010	<0.010-0.037
	Manistee	0.014	<0.010-0.039
	Boardman	0.017	<0.010-0.044
	Elk	0.012	<0.010-0.039
n	Saginaw	1.100	0.450-2.900
	Cass[1]	0.014	<0.010-0.048
	Flint[1]	0.078	0.010-0.150
	Shiawassee[1]	0.029	<0.010-0.073
	Tittabawassee[1]	0.140	<0.022-0.230
	Au Sable	<0.010	<0.010-0.010
	Thunder Bay	0.023	<0.010-0.037
	Cheboygan	0.032	<0.010-0.053
lair	Clinton	0.150	<0.039-0.430
	Black	0.043	<0.010-0.110
	St. Clair	0.010	<0.010-0.029
	Raisin	0.210	<0.068-0.500
	Huron	0.012	<0.010-0.039
	Rouge[2]	0.470	0.058-1.500
	Detroit	0.020	<0.010-0.053

utary to Saginaw River
tary to Detroit River downstream from Detroit River sampling station

Table 2. Concentrations of poly-chlorinated biphenyls (PCB's) in fish from Saginaw River, December 7, 1971. (ppm, wet weight).

Species	Location	Length	Percent fat	PCB's based upon 1242 standard
Perch	Karn-Weadock Discharge Channel	9.0	1.3	16.3
Carp	" " " "	21.0	0.9	8.8
Catfish	" " " "	8.0	7.0	37.1
Catfish	" " " "	7.5	4.9	47.9
Carp	U.S. Coast Guard Station	23.0	---	48.0
Carp	" " " "	24.0	10.5	20.4
Carp	" " " "	20.0	6.5	15.5
Carp	" " " "	24.0	5.9	45.8
Carp	" " " "	21.0	4.6	30.2
Pike	" " " "	27.0	1.6	16.6
Pike	" " " "	23.0	1.1	6.9
Gizzard Shad	" " " "	14.0	17.5	165.3
Gizzard Shad*	" " " "	6.0	15.3	32.5
Gizzard Shad*	" " " "	4.5	15.0	161.9
Gizzard Shad*	" " " "	5.0	17.0	77.0
Gizzard Shad*	Zilwaukee Bridge	4.5	15.7	24.1
Gizzard Shad*	" "	5.0	9.6	52.0
Gizzard Shad*	" "	5.0	8.7	10.4

* Concentration based upon analysis of whole fish. All others based upon edible portion only.

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Table 3. PCB Concentrations in Michigan Tributaries to the Great Lakes, May - June, 1973. Concentrations in parts per billion.

Lake Basin	River	Collection Date	PCB's as Aroclor 1254
Michigan	St. Joseph	5-11-73	< 0.010
	Kalamazoo	5-11-73	0.040
	Grand	5-11-73	0.033
	Muskegon	5-11-73	< 0.010
	Manistee	5-11-73	0.037
	Boardman	5-17-73	0.018
	Elk	5-17-73	< 0.010
Huron	Saginaw	5-24-73	0.210*
	Cass	5-24-73	< 0.010
	Flint	5-24-73	< 0.010
	Shiawassee	5-24-73	< 0.010
	Tittabawassee	5-24-73	< 0.010
	AuSable	5-17-73	0.013
	Thunder Bay	5-17-73	< 0.010
	Cheboygan	5-17-73	< 0.010
St. Clair	Clinton	6-8-73	0.200*
	Black	6-8-73	0.052
	St. Clair	6-8-73	< 0.010
Erie	Raisin	6-8-73	< 0.010
	Huron	6-8-73	< 0.010
	Rouge	6-8-73	0.460*
	Detroit	6-8-73	< 0.010

*Aroclor 1242

of Municipal Wastewater Treatment Plants throughout Michigan 1971-1972. Unless specified, all samples are 8 hr. composites.

CITY	DATE	PCB's as Aroclor 1254 (ppb)	Mean Conc. (ppb)
Adrian	3-30-72	1.80	4.60
	6-13-72	14.00	
	6-14-72	6.90	
	9-6-72	0.41	
Albion	3-28-72	0.44	0.44
Ann Arbor	10-14-71	0.14	0.12
	3-30-72	<0.10	
Battle Creek	10-5-71	0.39	0.39
	3-28-72	0.16	
	2-21-72	0.92	
	6-6-72	0.28	
	6-7-72	0.21	
Bay City	11-4-71	340.00	120.00
	11-22-71	210.00	
	11-23-71	60.00	
	3-2-72[a]	200.00	
	4-4-72	19.00	
	6-13-72	11.00	
	6-14-72	25.00	
	9-14-72	5.70*	
Benton Harbor - St. Joseph	10-20-71	0.99	0.65
	4-4-72	0.31	
Brighton	10-5-71	0.38	0.38
Charlotte	7-20-72	0.61	0.61
Constantine	4-4-71	0.85	0.85
Detroit	10-14-71	2.20	1.95
	12-20-72[c]	3.00	
	1-20-72	0.92	
	3-9-72	2.40	
	4-17-72[b]	1.80	
	6-1-72	0.88	
	10-19-72	2.50**	
Dexter	10-14-71	<0.10	0.10

CITY	DATE	PCB's Aroclor 1254 (ppb)	Mean Conc. (ppb)
. Lansing	11-15-71	0.69	0.51
	4-3-71	0.35	
scanaba	12-16-71	0.29	0.29
ssexville	11-4-71	0.21	0.24
	3-31-72	0.28	
lint	10-5-71	1.30	0.68
	3-31-72	0.92	
	6-7-72	0.47	
	6-8-72	0.30	
	10-5-72	< 0.10	
lushing	10-5-72	0.52	0.52
ladstone	7-21-72	0.19	0.19
rand Haven	4-4-72	< 0.50	<0.50
rand Rapids	11-15-71	0.37	0.52
	3-30-72	0.68	
olland	10-20-71	0.79	0.60
	3-29-72	0.42	
oughton- ncock	3-21-72	<0.10	0.10
Mc ingsford	3-21-72	0.55	0.87
	4-4-72	1.20	
ronwood	3-20-72	0.16	0.16
ckson	11-16-71	<0.10	<0.10
	2-21-72	<0.10	
	3-28-72	<0.10	
alamazoo	10-5-71	1.30	0.66
	3-28-72	0.83	
	6-6-72	0.48	
	6-7-72	0.53	
	12-6-72	0.19	
Anse	4-21-72	<0.10	<0.10
nsing	10-7-71	0.23	0.18
	4-4-72	0.13	

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ITY	DATE	PCB/s Aroclor 1254 (ppb)	Mean Conc. (ppb)
unistique	12-15-72	<0.20	<0.20
arquette	12-14-71	0.35	0.35
arshall	3-28-72	<0.10	<0.10
enominee	12-15-71	0.35	0.35
idland	2-2-72	0 29	0.23
	3-31-72	C 10	
	4-14-72	0 .3	
	[d]10-2-72	0 13	
ilford	10-14-71	<0.10	<0.10
onroe	11-15-71	0.60	0.46
	3-30-72	0.33	
t. Clemens	11-15-71	1.40	5.21
	3-30-72	2.90	
	6-7-72[c]	4.50	
	6-8-72[c]	3.10	
	7-26-72	9.40	
	8-2-72	10.00	
t. Pleasant	3-31-72	<0.10	<0.10
uskegon	11-15-71[c]	0.28	0.28
uskegon Heights	11-15-71[c]	0.37	0.37
iles	4-4-72	0.68	0.68
orway	4-5-72	0.40	0.40
ntonagon	4-21-72	<0.10	<0.10
osso	9-14-72	<0.10	<0.10
rchment	4-20-72	<0.10	<0.10
ntiac (Auburn Rd.)	11-17-71	<0.10	0.35
	3-30-72	0.61	
ntiac (E. Blvd.)	11-17-71	0.20	0.45
	3-30-72	1.30	
	6-6-72	0.15	
	6-7-72	0.16	
rtage	11-15-71[d]	1.90	1.90

TY	DATE	PCB's as Aroclor 1254 (ppb)	Mean Conc. (ppb)
rt Huron	11-15-71	0.28	0.40
	3-30-72	0.52	
ginaw	10-6-71	1.10	1.80
	3-31-72	3.80	
	6-7-72	2.00	
	6-8-72	1.50	
	10-4-72[d]	0.74	
. Ignace	12-15-72	<0.20	<0.20
uth Haven	4-4-72	<0.10	<0.10
rtz Creek	10-5-72	<0.10	<0.10
ree Rivers	4-4-72	<0.30	<0.30
enton	11-16-71	0.14	0.53
	3-30-72	1.10	
	6-6-72	0.47	
	6-7-72	0.91[e]	
rren	11-15-71	0.16	0.13
	3-30-72	0.10	
yne County yandotte)	11-16-71	0.64	0.40
	3-30-72	0.17	
ite Pine	4-21-72	0.2	0.20
oming	11-30-72[c]	0.44	0.49
	3-30-72	0.55	
ylanti	11-16-71	0.22	0.21
	4-2-72	0.21	
ilanti Twp #1	11-16-71	0.12	0.11
	4-2-72	<0.10	
ilanti Twp #2	11-16-71	0.19	0.17
	4-2-72	0.16	

roclor 1242 Standard
roclor 1242 and 1254 in 1:1 ratio

hr [b]10 hr [c]24 hr [d]Grab [e]hexane lost GRAND MEAN 2.55