
3. Injuries to Surface Water

Surface water resources are defined in the DOI regulations to include both surface water and sediments suspended in water or lying on the bank, bed, or shoreline [43 C.F.R. § 11.14(pp)]. This chapter presents the Stage I Injury Assessment for surface water, and Chapter 4 presents the assessment for bed sediment. Bed sediment is addressed in a separate chapter for several reasons: (1) there is a large amount of data specific to sediments, (2) sediments can be a principal and ongoing exposure pathway to other natural resources, and (3) some PCB cleanup actions for the Kalamazoo River may focus on sediments.

Ecosystem services provided by surface water include habitat for fish, migratory birds, benthic macroinvertebrates, and aquatic, semiaquatic, and amphibious animals; water, nutrient and sediment transport to riparian vegetation; nutrient cycling; geochemical exchange processes; primary and secondary productivity and transport of energy (food) to downstream and downgradient organisms; growth media for aquatic and wetland plants; and a migration corridor. Human use services may include drinking water, swimming, boating, industrial water supply, other water-based recreation, and assimilative capacity (i.e., the ability of a resource to “absorb low levels of [contaminants] without exceeding standards or without other effects)” [51 Fed. Reg. 27716, Aug. 1, 1986].

3.1 Injury Definitions

In this chapter, injuries to surface water resources are determined using the following injury definitions:

- ▶ Concentrations and duration of substances in excess of drinking water standards as established by Sections 1411-1416 of the Safe Drinking Water Act (SDWA), or by other federal or state laws or regulations that establish such standards for drinking water, in surface water that was potable before the hazardous substance release [43 C.F.R. § 11.62(b)(1)(i)].
- ▶ Concentrations and duration of substances in excess of applicable water quality criteria established by Section 304(a)(1) of the CWA, or by other federal or state laws or regulations that establish such criteria, in surface water that before the . . . release met the criteria and is a committed use . . . as a habitat for aquatic life, water supply, or recreation. The most stringent criterion shall apply when surface water is used for more than one of these purposes [43 C.F.R. § 11.62(b)(1)(iii)].

In addition, injury to surface water can be evaluated with the following definition:

- ▶ Concentrations and duration of substances sufficient to have caused injury . . . to ground water, air, geologic, or biological resources, when exposed to surface water; suspended sediments; or bed, bank, or shoreline sediments [43 C.F.R. § 11.62(b)(1)(v)].

However, application of this injury definition requires evaluation of other natural resources, which is not included in this chapter. Injury to bed sediment is assessed in Chapter 4, and injuries to aquatic biota are assessed in Chapters 5 and 6.

3.2 Stage I Injury Assessment Approach

Table 3.1 outlines the approach taken in this chapter to assess injury to surface water, which consists of comparing measured concentrations of PCBs in surface water to appropriate water quality standards and criteria. As described in Chapter 1, the focus is on available surface water data from approximately the past 20 years.

Table 3.1. Approaches to evaluate injury to surface water

Injury definition	Stage I injury assessment approach	Chapter section
Concentrations and duration of substances in excess of drinking water standards . . . in surface water that was potable before the release [43 C.F.R. § 11.62(b)(1)(i)]	Compare measured surface water PCB concentrations to state and federal drinking water standards.	3.3
Concentrations and duration of substances in excess of applicable water quality criteria or standards, in surface water that before the . . . release met the criteria and is a committed use . . . as a habitat for aquatic life, water supply, or recreation [43 C.F.R. § 11.62(b)(1)(iii)]	Compare measured surface water PCB concentrations to federal water quality criteria and state water quality standards. Evaluate committed uses.	3.4

3.3 Drinking Water Standard Exceedences

3.3.1 Data sources

The following sources of data on PCB concentrations in surface water are used in this evaluation:

- ▶ Surface water PCB concentrations measured by MDNR in Portage Creek and the Kalamazoo River (including upstream reference areas) in 1985 to 1987 (MDNR, 1987b)

- ▶ Surface water PCB concentrations measured by Blasland, Bouck & Lee in Portage Creek and the Kalamazoo River (including upstream reference areas) in 2000 and 2001 (Blasland, Bouck & Lee, 2001; methods in Blasland, Bouck & Lee, 2000c).

Surface water samples discussed in this report were analyzed as unfiltered samples for PCBs. For this evaluation, samples in which no PCBs were detected were plotted as one half of the detection limit and identified with a hollow symbol.

The PCB surface water sampling locations in Portage Creek and the Kalamazoo River were organized by the Trustees into reaches (Table 3.2 and Figure 3.1). These reaches are based on the reaches used in the draft Remedial Investigation/Feasibility Study (RI/FS) prepared by the PRPs (Blasland, Bouck & Lee, 2000a).

Table 3.2. Reach designations for surface water samples

Reach designation	Reach description	Reference or assessment
Kalamazoo River (upstream)	Upstream of Morrow Dam	Reference
Portage Creek (upstream)	Portage Creek upstream of PRPs	Reference
Reach A1	Morrow Dam to Portage Creek confluence	Assessment
Portage Creek (downstream)	Portage Creek downstream of PRPs	Assessment
Reach A2	Portage Creek confluence to Main Street, Plainwell	Assessment
Reach B	Main Street, Plainwell to Plainwell Dam	Assessment
Reach C ^a	Plainwell Dam to Otsego City Dam	Assessment
Reach D	Otsego City Dam to Otsego Dam	Assessment
Reach E ^a	Otsego Dam to Trowbridge Dam	Assessment
Reach F	Trowbridge Dam to the Allegan City line	Assessment
Reach G	Allegan City line to Allegan City Dam	Assessment
Reach H	Allegan City Dam to Lake Allegan Dam	Assessment
Reach I	Lake Allegan Dam to Lake Michigan	Assessment

a. No water samples were available for RI/FS reaches C and E.

3.3.2 Regulatory criteria and standards

Table 3.3 lists applicable PCB drinking water standards that have been established to protect drinking water supplies and that may be used to evaluate injury to surface waters, as defined in 43 C.F.R. § 11.62(b)(1)(i). The SDWA establishes a Maximum Contaminant Level (MCL) for PCBs of 0.5 µg/L [40 C.F.R. § 141]. This value is the maximum permissible concentration of

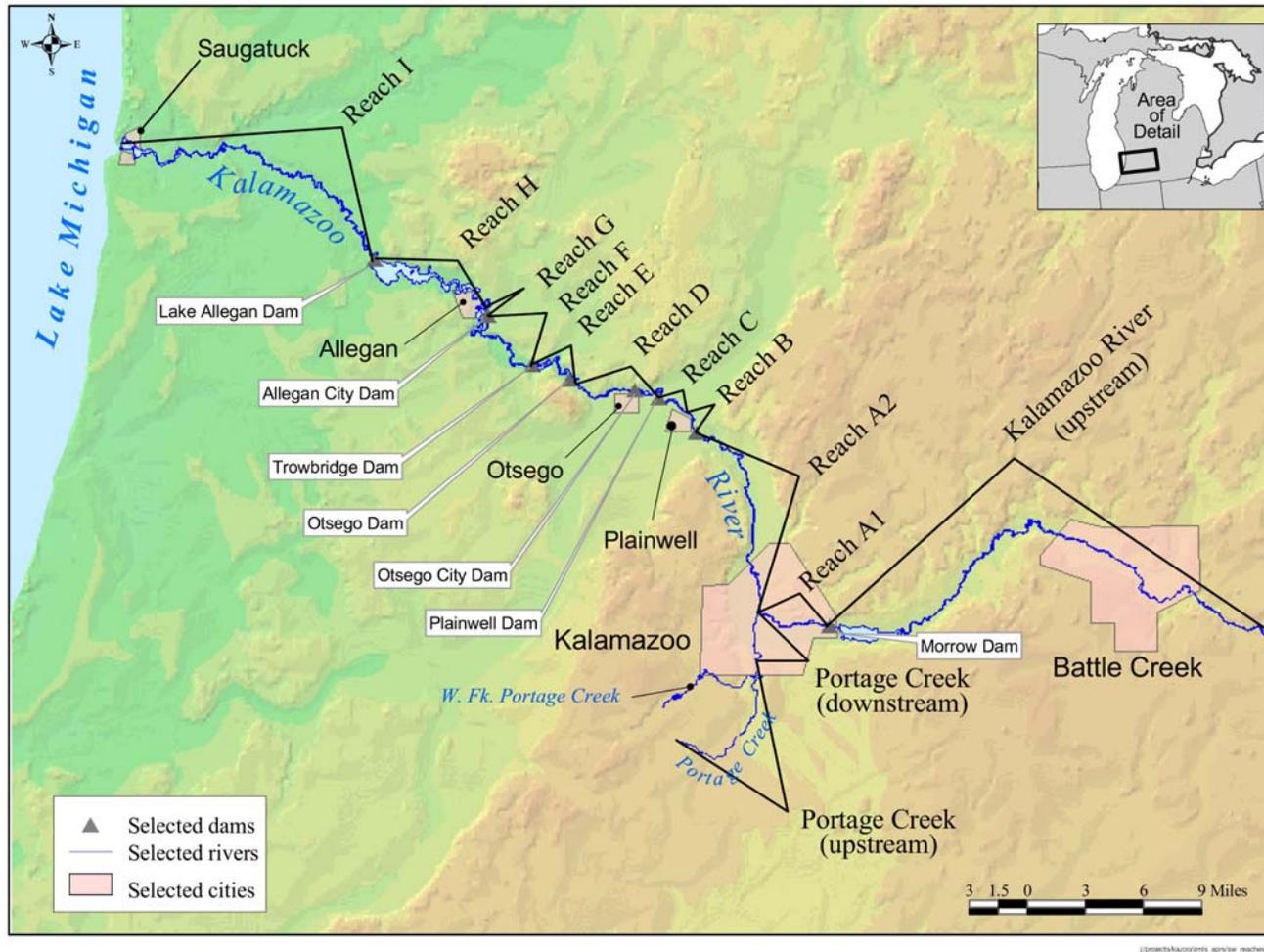


Figure 3.1. Locations of reach designations for surface water samples.

Table 3.3. Drinking water standards for determining injury to surface water

Source	Drinking water standard (µg/L)
SDWA MCL ^a	0.5
Michigan Safe Drinking Water Act MCL ^b	0.5

a. 40 C.F.R. § 141.
b. Michigan Act 399 of 1976, Section 325.1006.

PCBs in water which is delivered to any user of a public water system. Additionally, EPA established a Maximum Contaminant Level Goal (MCLG) for PCBs of 0 (U.S. EPA, 1995). This value is a nonenforceable concentration that is protective of human health effects and allows an adequate margin of safety. The State of Michigan has also incorporated MCLs for contaminants by reference to the federal SDWA, and thus the state MCL for PCBs is 0.5 µg/L (Michigan Act 399 of 1976, Section 325.1006). The state and federal MCL of 0.5 µg/L PCBs will be used to determine injury to surface water according to this definition of injury.

3.3.3 Results

Exceedences of drinking water standards

No surface water PCB concentrations measured in Portage Creek or the Kalamazoo River downstream of PRP facilities in 1985 to 1987 (Figure 3.2) or 2000 to 2001 (Figure 3.3) exceeded the state and federal MCL of 0.5 µg/L. Therefore, the Trustees conclude that surface water is not injured according to the injury definition described in 43 C.F.R. § 11.62(b)(1)(i).

Nevertheless, PCB concentrations were much more elevated downstream of PRP facilities than in upstream reference locations in 1985 to 1987 (Figure 3.2) and 2000 to 2001 (Figure 3.3). For example, the maximum PCB concentration measured downstream of PRP facilities in 1985-1987, 0.34 µg/L, was 20 times higher than the maximum concentration observed upstream of PRP facilities. The maximum PCB concentration measured downstream of PRP facilities in 2000-2001, 0.22 µg/L, was 29 times higher than the highest concentration observed upstream of PRP facilities (Figure 3.3).

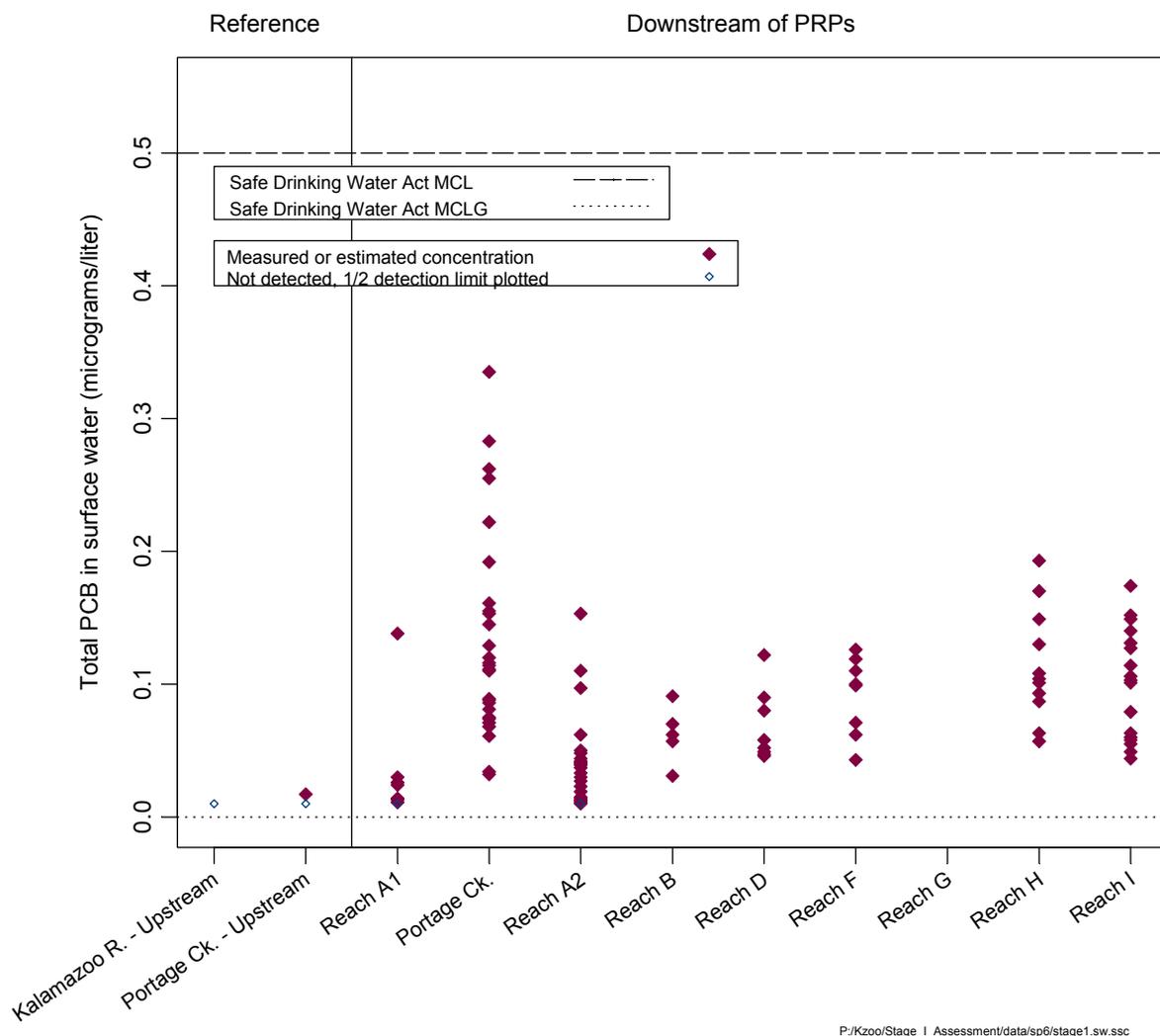


Figure 3.2. Surface water total PCB concentrations in Portage Creek and the Kalamazoo River from 1985 to 1987 compared to drinking water standards.

Source: MDNR, 1987b.

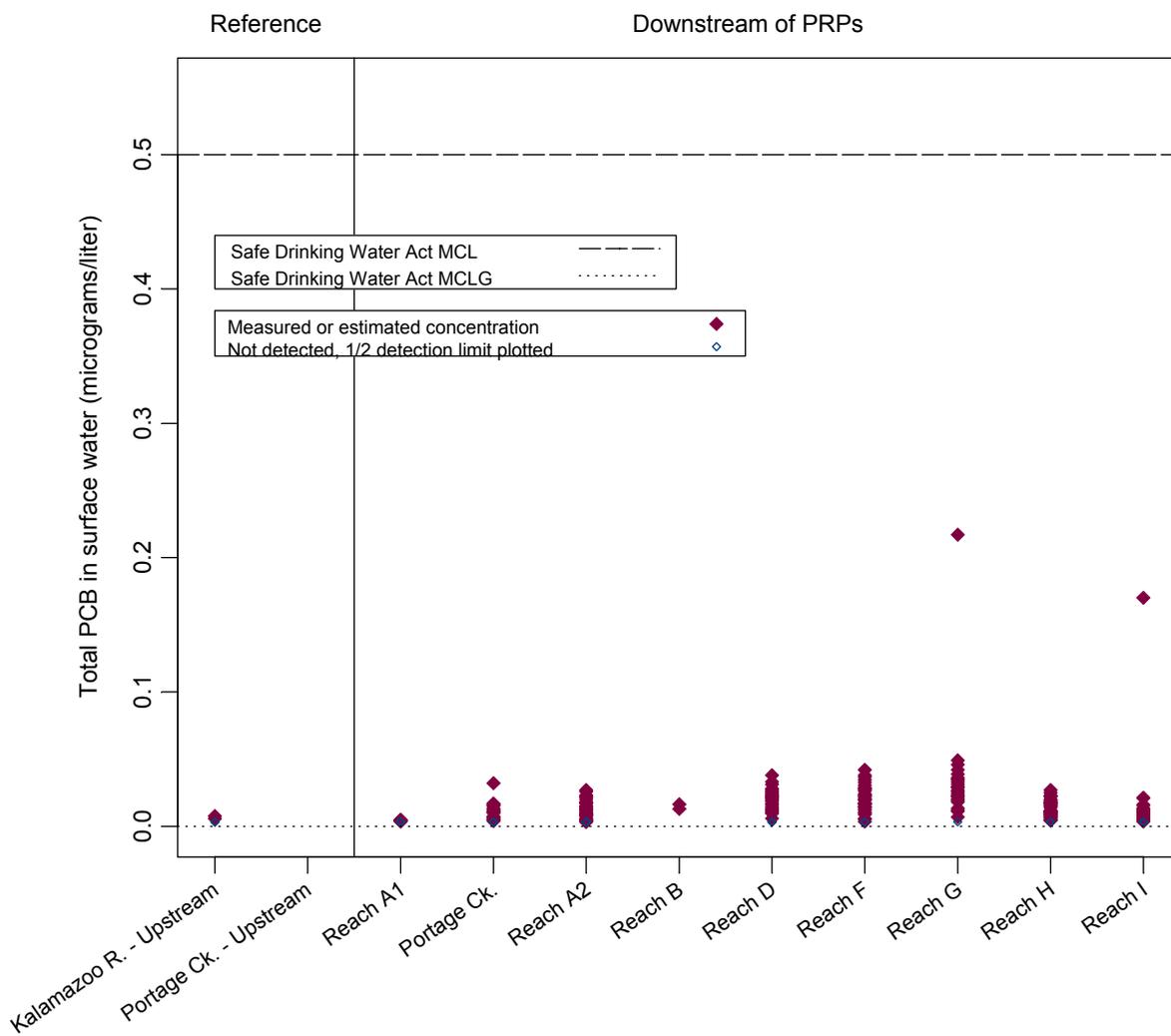


Figure 3.3. Surface water total PCB concentrations in Portage Creek and the Kalamazoo River from 2000 and 2001 compared to drinking water standards.

Source: Blasland, Bouck & Lee, 2001.

Because of the timing of PCB uses and releases from PRP facilities, surface water PCB concentrations most likely were higher before 1985 than those that were measured by the MDNR from 1985-1987. Limited data from the 1970s suggest that this was the case, with PCB concentrations in Portage Creek of 100-200 µg/L (Blasland, Bouck & Lee, 1992). PCB concentrations in surface water were higher in 1985-1987 than in 2000-2001. The decrease from 1985-1987 was particularly notable in Portage Creek, most likely related to the excavation of the former Bryant Mill Pond and the backfilling of lagoons at the Allied facility on Portage Creek in 1999 (Blasland, Bouck & Lee, 2000d).

3.4 Water Quality Criteria Exceedences

3.4.1 Data sources

The data that are compared to water quality criteria are the same data that were used to evaluate injury with drinking water standards. A description of data sources is in Section 3.3.1.

3.4.2 Regulatory criteria and standards

Table 3.4 lists specific regulatory criteria and standards that may be used to evaluate injury to surface water, as defined in 43 C.F.R. § 11.62(b)(1)(iii). Applicable criteria include levels of PCB concentrations established to protect aquatic life, wildlife, and human health. For example, EPA has established chronic Ambient Water Quality Criteria (AWQC) for the protection of aquatic biota (Table 3.4).

Table 3.4. Water quality criteria (in µg/L) for determining injury to surface water

Source	Protection endpoint		
	Human cancer risk	Aquatic life (chronic)	Piscivorous wildlife
EPA AWQC ^a		0.014	
National Toxics Rule ^b	0.00017	0.014	
Michigan Water Quality Standard (Rule 323.1057) ^c	0.000026		0.00012
Great Lakes Water Quality Guidance (GLWQG) (40 C.F.R.Part 132) ^d	0.000026		0.00012

a. U.S. EPA, 1999.

b. 57 Fed. Reg. 60915; 63 Fed. Reg. 61181-61196; 62 Fed. Reg. 42159-42208.

c. MDEQ, 1994b.

d. 62 Fed. Reg. 11723-11731; 62 Fed. Reg. 52921-52924.

DOI regulations indicate that “the most stringent criterion shall apply when surface water is used for more than one of these purposes” (habitat for aquatic life, water supply, or recreation) [43 C.F.R. § 11.62(b)(1)(iii)]. For this Stage I Assessment, PCB concentrations in the Kalamazoo River and Portage Creek are compared to the Michigan Water Quality Standards for human cancer risk of 0.000026 µg/L and for protection of piscivorous wildlife of 0.00012 µg/L, which are equivalent to the GLWQG values. Additionally, surface water data are compared to the EPA chronic AWQC for aquatic life of 0.014 µg/L, which is equivalent to the National Toxics rule criteria.

3.4.3 Results

Exceedences of PCB standards

PCB concentrations in samples collected in Portage Creek and the Kalamazoo River downstream of PRP facilities exceed the Michigan Water Quality Standard for the protection of wildlife (Figures 3.4 and 3.5) and the Michigan Water Quality Standard for human cancer risk (not plotted). Additionally, the EPA chronic AWQC was exceeded downstream of PRP facilities (Figures 3.4 and 3.5).

PCB concentrations measured in 1985-1987 were highest in Portage Creek downstream of PRP facilities (Figure 3.4). In this reach, the maximum observed concentration of 0.34 µg/L is 2,800 times higher than the Michigan Water Quality Standard for the protection of wildlife, 13,000 times higher than the Michigan Water Quality Standard for human cancer risk, and 24 times higher than the EPA chronic AWQC. Concentrations in mainstem reaches of the Kalamazoo River were also as much as four orders of magnitude greater than the Michigan Water Quality Standards. Concentrations did not decrease in downstream reaches and were up to 0.17 µg/L between Lake Allegan Dam and Lake Michigan (Reach I). In contrast, PCBs were detected in 1 of 26 samples (4%) collected in upstream reference reaches of the Kalamazoo River and Portage Creek at a concentration of 0.02 µg/L.

Although concentrations in Portage Creek and the Kalamazoo River downstream of PRP facilities measured in 2000 and 2001 were lower than those measured in 1985-1987, concentrations remained several times greater than water quality criteria (Figure 3.5). The Michigan Water Quality Criteria for the protection of wildlife and human health were exceeded in all assessment reaches in Portage Creek and the Kalamazoo River, and the EPA AWQC was exceeded in all of the assessment reaches, except for Reach A1. In reaches D, F, and G, the percentages of all samples exceeding the EPA AWQC were 58%, 66%, and 73%, respectively. The maximum measured concentration, in Reach G, was 0.22 µg/L, which is 1,800 times higher than the Michigan Water Quality Standard for the protection of wildlife, 8,300 times higher than the Michigan Water Quality Standard for human cancer risk, and 16 times higher than the EPA

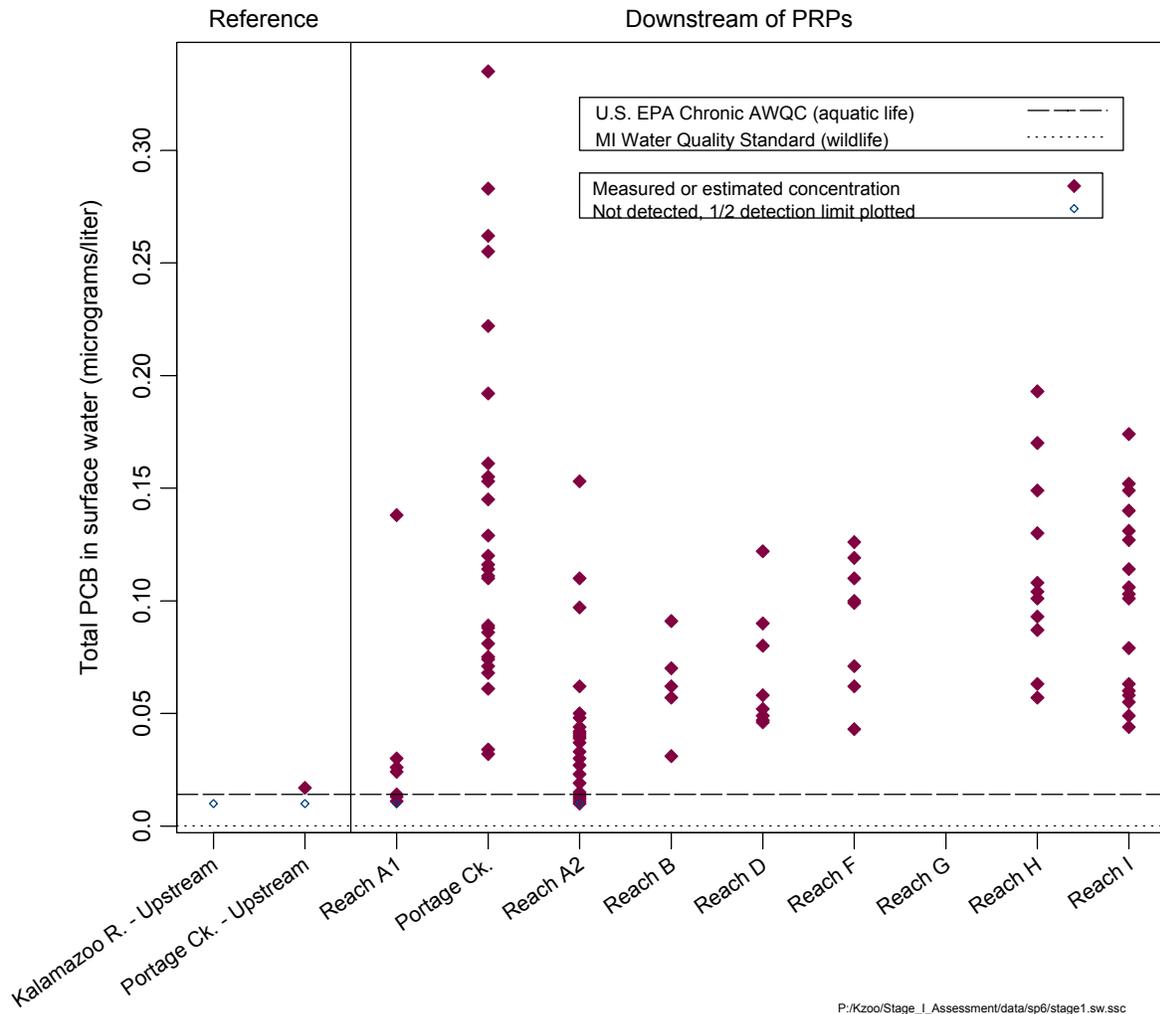


Figure 3.4. Surface water total PCB concentrations in Portage Creek and the Kalamazoo River from 1985 to 1987 compared to water quality criteria.

Source: MDNR, 1987b.

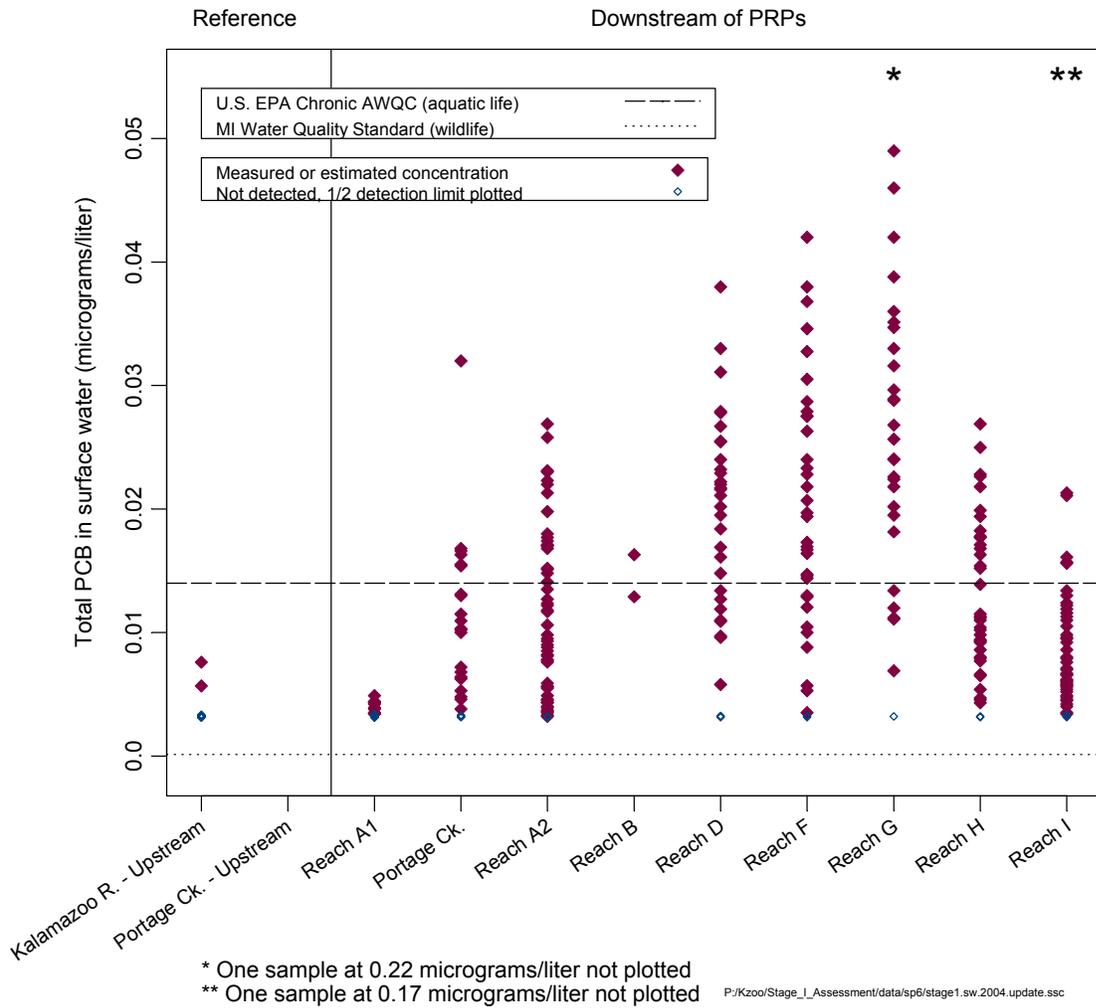


Figure 3.5. Surface water total PCB concentrations in Portage Creek and the Kalamazoo River in 2000 and 2001 compared to water quality criteria.

Source: Blasland, Bouck & Lee, 2001.

chronic AWQC. Only 2 of 33 samples (6%) from the Kalamazoo River upstream of PRP facilities had detectable concentrations of PCBs, and the maximum concentration was 0.008 µg/L.

Conditions before release

There are no surface water data from Portage Creek and the Kalamazoo River available to evaluate PCB concentrations relative to water quality criteria before the initial releases of PCBs from the recycling of carbonless copy paper in the mid-1950s. However, the releases began when PCB use for all purposes in the United States was low relative to its peak use (Carr et al., 1977). Thus it is reasonable to expect that, before the releases, PCB concentrations in the Kalamazoo River would not have exceeded water quality standards.

Spatial and temporal extent

Exceedences of the EPA chronic AWQC have been measured throughout the assessment reaches of Portage Creek and the Kalamazoo River as far downstream as Lake Michigan. PCB concentrations in surface water exceeded water quality criteria in 1985, well after PCBs were no longer used in carbonless copy paper. Therefore, PCB concentrations in surface water are expected to have exceeded water quality criteria for decades prior to 1985, as well. PCB concentrations in excess of water quality standards have persisted through available data collected in 2001.

Committed use

All waters of Michigan are designated for all of the following uses: agriculture, navigation, industrial water supply, public water supply at the point of water intake, warm water fishery, other indigenous aquatic life and wildlife, and partial body contact recreation and total body contact recreation from May 1 to October 31 (MDEQ, 1994a). The Trustees conclude that Portage Creek and the mainstem of the Kalamazoo River have a committed use and qualify as injured under 43 C.F.R. § 11.62(b)(1)(iii).

3.5 Conclusions

Available data from the mid-1980s and from 2000 to 2001 indicate that surface water PCB concentrations in Portage Creek and the Kalamazoo River downstream of PRP facilities are much higher than those observed in upstream reference locations (see Figures 3.2-3.5). PCBs have most likely been elevated since the initial releases from the PRP facilities, and concentrations were probably much higher in the past than those measured in 1985.

Surface water PCB concentrations in Portage Creek and the Kalamazoo River do not exceed the Safe Drinking Water Act MCL of 0.5 µg/L. The Trustees thus conclude that surface water is not injured according to the injury definition in 43 C.F.R. § 11.62(b)(1)(i).

However, surface water PCB concentrations downstream of PRP facilities have exceeded applicable water quality criteria established by the State of Michigan and EPA for human cancer risk and for the protection of aquatic life and piscivorous wildlife by nearly an order of magnitude. Based on the sources and timing of the releases of PCBs from PRP facilities, it is highly unlikely that PCBs would have been present before the initial releases of PCBs from the recycling of carbonless copy paper in the mid-1950s from the PRP facilities, and thus it is reasonable to conclude that water did not exceed criteria before this time. Additionally, the Kalamazoo River and Portage Creek have designated committed uses which are relevant to the exceedence of water quality criteria. The Trustees thus conclude that surface water is and has been injured according to the injury definition in 43 C.F.R. § 11.62(b)(1)(iii).