

**Stage I Assessment Report,
Volume 2 – Economic Assessment:
Kalamazoo River Environment.
Recreational Fishing Update
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Prepared for:

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This report provides updated estimates of recreational fishing damages due to polychlorinated biphenyl (PCB) releases into the Kalamazoo River Environment (KRE) as previously described in the 2005 Stage I Report (Stratus Consulting, 2005). This report describes the calculation of current damage estimates that were derived by combining recent data on fishing activity and fish consumption advisories (FCAs) in the KRE using the methods described in the Stage I Assessment. The analysis also incorporates current inflation and discounting factors to develop 2009 present-value damage amounts.

1. Approach

The Trustees evaluated recreational fishing damages using an economic valuation method known as *benefit transfer* (Garrod and Willis, 1999; Navrud and Ready, 2007). Benefit transfer refers to methods that value an environmental good using previous research on similar environmental goods. Benefit transfer has frequently been applied in natural resource damage assessments (NRDAs) (Byrd et al., 2001; Chapman and Hanemann, 2001; GDNR et al., 2006).

Since the late 1970s, the State of Michigan has issued FCAs because of the presence of PCB contamination in the Kalamazoo River and nearby areas of Lake Michigan. FCAs provide the public with information about contamination in sport-caught fish and advise people to limit consumption of certain types of fish taken from certain water bodies. Numerous literature studies have examined the response of anglers to FCAs and the impact of FCAs on the value of recreational fishing. This benefit-transfer analysis relies on previous literature studies to estimate the decline in recreational fishing days and the loss in value of recreational fishing due to FCAs on the Kalamazoo River and nearby areas of Lake Michigan.

The damage-assessment approach involves two steps. The first step is an analysis of recreational fishing days, including days spent fishing at the assessment area that were impacted by contamination, or “actual fishing days,” and days that would have been spent at the assessment area in the absence of contamination, or “forgone fishing days.” The second step is an evaluation of the lost value associated with recreational fishing, including losses associated with a decline in the quality of actual fishing days (i.e., reduced enjoyment of days spent fishing in the assessment area), as well as losses associated with fishing days forgone due to contamination.

1.1 Recreational Fishing Days

Three sources of data describe actual fishing activity in the assessment area. The data sources are (1) annual surveys of recreational fishing on Lake Michigan available for selected years from 1985 to 2005 from Michigan Department of Natural Resources (MDNR); (2) surveys of recreational fishing on the Kalamazoo River conducted by MDNR for the years 1985 through

1987 and 2004; and (3) a survey of Kalamazoo River fishing conducted in 2001 by natural resource Trustees for the KRE NRDA. Based on these sources, the Trustees developed estimates of fishing days spent at the assessment area from 1981 to 2048. For years in which data were not available, fishing days were extrapolated based on prior or subsequent years. The most recent data available were extrapolated to future years, as described below. Additional details on the estimation of actual fishing days in past years are described in Stratus Consulting (2005).

The analysis of recreational fishing days also includes an estimate of days that would have been spent at the assessment area in the absence of contamination. These estimates were developed based on literature studies investigating the decline in recreational fishing days attributable to a decline in resource quality. Literature sources include a study examining the effects of the removal of contamination and FCAs on Green Bay, located partly in Wisconsin and partly in Michigan (Brefle et al., 1999), and a study investigating angler responses to FCAs in eight counties near the Kalamazoo River (Atkin, 1995). These and other literature sources are described in greater detail in Stratus Consulting (2005). Based on these literature sources, the percentage change in fishing days due to FCAs was estimated. For the Kalamazoo River, forgone fishing days were estimated to be between 15% and 50% of actual fishing days. Both limits of this range were incorporated into the range of potential damage estimates. For Lake Michigan, forgone fishing days were estimated to be 15% of actual fishing days. The lower rate of forgone fishing days for Lake Michigan reflects the lack of alternative substitute sites where anglers can go to find an experience similar to Great Lakes fishing. These percentage changes were applied to estimates of actual fishing activity in the assessment area to estimate the number of additional fishing days that would have been spent at the assessment area in the absence of contamination.

1.2 Lost Value of Recreational Fishing

To calculate monetary damages, the Trustees developed estimates for the lost value associated with actual fishing days spent at the assessment area and the lost value associated with forgone fishing days that would have been spent at the assessment area in the absence of FCAs. Estimates of the per-day loss in value for actual fishing days were obtained from a study of anglers fishing in Green Bay, Wisconsin, under contaminated conditions (Brefle et al., 1999). The study asked anglers their willingness to pay (WTP) for the removal of contamination and FCAs in Green Bay. The Green Bay study includes per-day loss estimates for several species and FCA levels, including estimates corresponding to species and FCA levels present in the Kalamazoo River assessment area. Values in the Green Bay study were adapted to the assessment area by accounting for the particular FCA levels that apply to species targeted by anglers in the Kalamazoo River and Lake Michigan. Specifically, the percentage of fishing days associated with each particular target species was estimated for the Kalamazoo River between Morrow Dam and Allegan Dam, for the Kalamazoo River between Allegan Dam and Lake Michigan, and for Lake Michigan. Each species targeted in each segment of the assessment area

was matched to the corresponding per-day loss estimated in Breffle et al. (1999) for fishing days by Green Bay anglers targeting the same species subject to the same FCA level. Species-specific, per-day losses were then combined to form a weighted-average, per-day loss for each segment of the assessment area. The averaging procedure used weights corresponding to the percentage of total angler days targeting each species in each segment of the assessment area. Additional detail on the calculation of per-day loss estimates for actual fishing days is provided in Stratus Consulting (2005).

The per-day loss associated with forgone days was estimated based on numerous literature studies of the per-day value of fishing, including Milliman et al. (1992), Boyle et al. (1999), and Herriges et al. (1999). These studies calculated the average WTP for a day of fishing at a variety of freshwater fishing sites. Based on a synthesis of these and other sources described in Stratus Consulting (2005), the value of a forgone day was estimated to be \$23.73 for the Kalamazoo River and \$59.32 for Lake Michigan, in 2009 dollars. The difference in value between forgone days for the Kalamazoo River and forgone days for Lake Michigan accounts for the higher value of Great Lakes fishing relative to most river fishing, according to literature sources.

Total losses due to FCAs in the KRE were calculated on an annual basis by multiplying fishing days by per-day losses. Specifically, the per-day loss for actual fishing days was multiplied by the estimated number of actual fishing days impacted by contamination in the assessment area. The per-day loss for forgone fishing days was multiplied by the estimated number of forgone days in the assessment area. The aggregation of annual damage estimates into total damage amounts for selected time periods is described in Section 3, below.

2. Recent Data on Fishing and FCAs

Since the publication of the Stage I Assessment report (Stratus Consulting, 2005), additional information on FCAs and fishing activity has become available. This section describes the more recent information and provides citations to the relevant sources.

A study was conducted by MDNR in 2004 that surveyed anglers on the Kalamazoo River below Allegan Dam. The study estimated that 19,092 fishing days were spent on the Kalamazoo River below the Allegan Dam in 2004 (Jay Wesley, MDNR Fisheries Division, personal communication, February 19, 2009). This compares to an estimate of between 19,416 and 20,193 angler days spent on the Kalamazoo River below the Allegan Dam in 2001, according to the angler surveys conducted by natural resource Trustees for the KRE (Stratus Consulting, 2005). More recent data on Lake Michigan fishing days are also available from surveys conducted by MDNR. According to the Lake Michigan surveys, fishing days in the vicinity of the mouth of the Kalamazoo River on Lake Michigan totaled 28,908 in 2002, 27,004 in 2003, and 24,994 in 2005 (Tracy Kolb, Charlevoix Fisheries Research Station, MDNR, personal

communication, February 25, 2009). These figures apply specifically to the Town of Holland, Michigan, one of the interview sites in the Lake Michigan survey. This compares to 20,851 fishing days reported by MDNR for the same area in 2001 (Stratus Consulting, 2005). These recent estimates of fishing activity on the Kalamazoo River and Lake Michigan were incorporated in the analysis of damages. Specifically, the number of fishing days in the assessment area on Lake Michigan in 2002, 2003, and 2005 was set equal to the MDNR estimates for those years. The number of fishing days on Lake Michigan in 2004 was assumed to equal the MDNR estimate for 2003, and the number of fishing days on Lake Michigan after 2005 was assumed to equal the MDNR estimate for 2005. Fishing days on the Kalamazoo River below the Allegan Dam for the years 2004 and after were assumed to equal the MDNR estimate for 2004.

FCA levels prior to 2001 were described in the Stage I Assessment (Stratus Consulting, 2005). However, the State of Michigan has continued to issue FCAs for water bodies in the assessment area since 2001 (MDCH, 2001, 2002, 2003, 2004, 2007, 2008).¹ Advisories for the general population have remained the same throughout the period from 2001 to the present. Advisory levels for the primary species targeted within each segment of the Kalamazoo River and Lake Michigan are summarized in Table 1. These advisories for the general population are used in this analysis; however, the Trustees note that the advisories for sensitive populations (women of childbearing age and children) are more restrictive.

Table 1. FCAs for the general population for targeted species, 2001–2008

Segment	Species	Advisory
Kalamazoo River: Morrow Dam to Allegan Dam	Smallmouth bass	Do not eat
	Walleye	Eat no more than one meal per week
	Pike	Eat no more than one meal per week
Kalamazoo River downstream of Allegan Dam	Smallmouth bass	Eat no more than one meal per week
	Walleye	< 22 inches: Unlimited consumption > 22 inches: Eat no more than one meal per week
	Steelhead	Unlimited consumption
	Salmon	Unlimited consumption
Lake Michigan	Steelhead	Unlimited consumption
	Salmon	Unlimited consumption
	Trout	< 22 inches: Unlimited consumption > 22 inches: Do not eat ^a

a. Based on advisory for brown trout.

1. According to the Michigan Department of Community Health, new advisory publications were not issued in 2005 and 2006, but 2004 advisories applied in those years (Kory Groetsch, Michigan Department of Community Health, personal communication, March 13, 2009).

These advisory levels were converted to per-day loss estimates as described above using methods developed in Stratus Consulting (2005). The resulting loss in 2009 dollars for the 2001 to 2008 period is \$15.20 per actual fishing day for the Kalamazoo River above Allegan Dam, \$0.44 per fishing day for the Kalamazoo River below Allegan Dam, and \$5.58 per fishing day for Lake Michigan.

3. Estimated Recreational Fishing Damages

In addition to incorporating recent information on fishing activity and advisories, this estimate of recreational fishing damages includes present-value amounts that account for inflation and the effect of economic discounting. Fishing-day values are expressed in 2009 dollars using the Consumer Price Index (FRED, 2009) and all calculations were expressed in 2009 present value using a 3% discount rate. Past damages were calculated from 1981 to 2008. Future damages were calculated for two of the scenarios described in the Stage I Report. Under “intensive remediation,” FCAs are assumed to remain in place for 20 years. Under the “intermediate remediation” scenario, FCAs are assumed to remain in place for 40 years. Following the methods used in the Stage I Assessment (Stratus Consulting, 2005), advisory levels are assumed to decline in severity at the midpoint of each of the future scenarios. The magnitude of the decline is represented by a decrease from the current advisory level to one advisory level lower, as defined by the Green Bay study that was used to develop the per-day FCA losses. The results are presented in Table 2.

Table 2. Recreational fishing damages (2009 present value, millions of dollars)

Damage estimate ^a	Past damages	Future damages	Total damages
Intensive remediation (1981–2028)			
Kalamazoo River	\$8.2 to \$17.8	\$1.9 to \$2.9	\$10.1 to \$20.7
Lake Michigan	\$7.1 to \$13.4	\$1.5 to \$2.3	\$8.6 to \$15.8
Total	\$15.3 to \$31.2	\$3.4 to \$5.2	\$18.7 to \$36.5
Intermediate remediation (1981–2048)			
Kalamazoo River	\$8.2 to \$17.8	\$3.1 to \$4.7	\$11.3 to \$22.6
Lake Michigan	\$7.1 to \$13.4	\$2.5 to \$3.9	\$9.6 to \$17.3
Total	\$15.3 to \$31.2	\$5.6 to \$8.6	\$20.9 to \$39.8

Note: Damage estimates are based on the methods described above and the analysis contained in the Stage I Assessment (Stratus Consulting, 2005). Past damages are through 2008. Totals may not match the sum of individual components due to rounding.

a. Damage estimates are expressed as a range based on alternative approaches to calculating affected fishing days, following methods in the Stage I Assessment (Stratus Consulting, 2005).

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