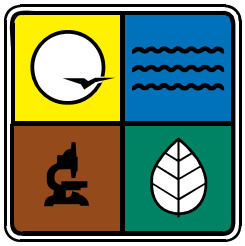


Missouri Department of Natural Resources
Water Protection Program

Total Maximum Daily Loads (TMDLs)

for

Blue River
Jackson County, Missouri

Completed: September 11, 2001
Approved: November 19, 2001

Four Phased Total Maximum Daily Loads (TMDLs)
For Blue River
Pollutant: Chlordane

Name: Blue River

Location: In Kansas City in Jackson County, Missouri

Hydrologic Unit Code (HUC): 100300101

Water Body Identifications (WBID): 417, 418, 419, 421

Missouri Stream Class: WBID 421 of the impaired segment of Blue River is a Class C stream[1]. WBIDs 417, 418, and 419 of the impaired segments of Blue River are Class P streams.[2]

Beneficial Uses[3]:

- 417: Livestock and Wildlife Watering, Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption, and Industrial Use
- 418: Livestock and Wildlife Watering, Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption, Boating and Canoeing, and Industrial Use
- 419: Livestock and Wildlife Watering, Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption, Boating and Canoeing, and Whole Body Contact
- 421: Livestock and Wildlife Watering, Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption, and Boating and Canoeing

Size of Impaired Segment:	WBID 417	4 miles
	418	9 miles
	419	9 miles
	421	2 miles
Location of Impaired Segments:	417	SW 20, 50N, 32W to 1, 49N, 33W
	418	1, 49N, 33W to 31, 49N, 32W
	419	31, 49N, 32W to SE 28, 48N, 33W
	421	SE28, 48N, 33W to E4, 47N, 33W

Pollutants: Chlordane

[1] Class C streams may cease flow in dry periods but maintain permanent pools, which support aquatic life. See 10 CSR 20-7.031(1)(F)
[2] Class P streams maintain permanent flow even in drought periods. See 10 CSR 20-7.031(1)(F)
[3] For Beneficial uses see 10 CSR 20-7.031()(C) and Table (H)

Pollutant Source: Urban nonpoint sources

TMDL Priority Ranking: Low

1. Background and Water Quality Problems

The Blue River is formed by the confluence of Wolf Creek and Coffee Creek in eastern Kansas. The area of the watershed is 270 square miles. The original length of the Blue River was approximately 43.3 miles. Past channelization has shortened the river by approximately 2.6 miles and an ongoing channelization project will shorten it by another 1.6 miles. These channelization activities primarily impact the lower part of the river. The primary soil types are Kennebec silt loam, Colo silty clay loam and Bremer silt loam, plus other silt loam soils higher in the watershed. These soils exhibit moderate erodibility, and moderately slow permeability and runoff. In heavily developed areas, these soils contribute to very rapid runoff. The average gradient for the Blue River is four feet per mile. Average annual precipitation for the region is 36 inches. Flooding has always been a problem on the Blue River due to urban development, dense soils, and the configuration of the Blue River basin. The lower part of the watershed is primarily industrial. The middle and upper part are rapidly being converted to residential areas.

The Blue River has a long history of use. Daniel Morgan Boone arrived in the area in 1787 and trapped beaver on the "Big Blue" River for twelve years. Land was purchased from the Osage Indians in 1808 and settlements were established. The Battle of Big Blue River was a skirmish between Union and Confederates forces on October 22, 1864 and led to the control of the state by the Union Army. In more recent years, the Blue River has become severely polluted, especially in the lower part of the river. In 1967, the Missouri Clean Water Commission designated the Blue River as a "Metropolitan No-Discharge Stream." This designation prevents any new point sources from being permitted to discharge into the river, although the existing dischargers continue to be permitted. A large sewage treatment facility discharges treated effluent into Indian Creek, which flows into the Blue River close to Route W. Upstream, much of the river is considered to be unique, in that the channel hasn't been altered significantly and the riparian corridor is in fairly good condition due to being part of the county and city park systems. The streambed is mostly bedrock and gravel, and the stream has a good network of riffles and pools. Ongoing tree planting projects to improve the riparian corridor have been undertaken by volunteers on public property since 1990.

The Blue River supports populations of carp, channel catfish, largemouth bass, crappie, bluegill and green sunfish. Fishing pressure is unknown, but is considered to be moderate. The Missouri Department of Conservation (MDC) samples fish in the Blue River on a three-year rotation. MDC reports it will reduce sampling for chlordane in the future because of the decline in chlordane problems in fish in recent years.[4]

Missouri Department of Health (DOH) has issued fish consumption advisories for the Blue River since 1985 warning anglers of chlordane contamination in fish, and has probably reduced fishing

[4] Karen Bataille, Missouri Department of Conservation, e-mail correspondence, 6/11/01.

pressure in recent years.[5] In the fish advisories in the past, the DOH advisory instructed anglers to limit consumption of fatty fish (carp, catfish, buffalo, drum, suckers and paddlefish) to one meal per week. In the 2001 Fish Advisory released in July, DOH discontinued the warning on fatty fish due to the reduction of chlordane in fish tested from the Blue River. DOH, however, did not retain the advisory for metropolitan streams as they had in past years.

Chlordane is a pesticide that was commonly used in the past for termite control and in agriculture. The substance was applied both in dwellings and around foundations to repel and kill termites, ants and a variety of other insects. Although chlordane was banned in 1988, it degrades very slowly in the environment and bio-accumulates in fish tissue. Chlordane is not soluble and is not found in the water column of waterbodies, but attaches to sediments and through erosion moves into streams and accumulates in streambed sediments. Bottom feeding fish such as carp become exposed to chlordane due to their feeding or dwelling preferences near chlordane-contaminated sediments. The current standard for acceptable concentration limit in fish tissue is 0.3 milligrams per kilogram (mg/kg). Note: 1 kilogram equals approximately 2.2 pounds. Fish tissue concentration varies among fish species. The data reveal that the compound is most persistent in carp and catfish. Data from the Blue River indicate that chlordane contamination has been decreasing for a number of years. See data at the end of this document for a discussion of results. Human exposure to chlordane has been associated with liver cancer.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Targets

Beneficial Uses

The Blue River has the following beneficial uses on all four impaired waterbody segments:

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life and Human Health associated with Fish Consumption

The four waterbody segments addressed by this TMDL also have unique beneficial uses, which are identified below.

Waterbody segment 417 includes the uses listed above and:

- Industrial Use

Waterbody segment 418 includes the uses listed above and:

- Boating and Canoeing
- Industrial Use

[5] Missouri Department of Conservation Web site, "Missouri's Rivers and Their Watersheds", Blue River.

Waterbody segment 419 includes the uses listed and:

- Boating and Canoeing
- Whole Body Contact

Waterbody segment 421 includes the uses listed and:

- Boating and Canoeing

Anti-degradation Policy

Missouri's Water Quality Standards include the EPA "three-tiered" approach to anti-degradation, and may be found at 10 CSR 20-7.031(2).

Tier I defines baseline conditions for all waters and it requires that existing beneficial uses are protected. TMDLs would normally be based on this tier, assuring that numeric criteria (such as dissolved oxygen and ammonia) are met to protect uses.

Tier II requires that no degradation of high-quality waters occur unless limited lowering of quality is shown to be necessary for "economic and social development." A clear implementation policy for this tier has not been developed, although if sufficient data on high-quality waters are available, TMDLs could be based on maintaining existing conditions, rather than the minimal Tier I criteria.

Tier III (the most stringent tier) applies to waters designated in the water quality standards as outstanding state and national resource waters; Tier III requires that no degradation under any conditions occurs. Management may prohibit discharge or certain polluting activities. TMDLs would need to assure no measurable increase in pollutant loading.

These TMDLs will result in the protection of existing beneficial uses, which conform to Missouri's Tier I anti-degradation policy.

Specific Criteria

The specific criteria for chlordane are found in Missouri's Water Quality Standards, 10 CSR 20-7.031, Table A, under Persistent, Bioaccumulative, Man-made Toxics. The limit for chlordane *in water* related to human health protection associated with fish consumption is 0.00048 micrograms per liter (µg/L or parts per billion). However, elevated chlordane levels in water have never been a problem. Because chlordane tends to bioaccumulate in fish, this TMDL will be based on fish tissue chlordane levels. Fish tissue levels refer to the amount of chlordane in the fillet, or edible portion, of fish. The U.S. Food and Drug Administration (FDA) developed a fish tissue action level of 0.3 milligrams per kilogram (mg/kg or parts per million) for technical grade chlordane.[6] Note: 1 kilogram equals approximately 2.2 pounds. If the level of a toxic

[6] Data can be collected as sum-of-the-isomers chlordane and in that case the action level is 0.1 mg/kg sum-of-the-isomers chlordane. This is usually comparable to FDA's action level of 0.3 mg/kg technical grade chlordane when the contamination is recent because there is a lot of the technical chlordane still present. However, after a few years the chlordane all breaks down to the isomers, so the comparison no longer works well. For the purposes of this TMDL, 0.3 mg/kg technical grade chlordane will be used.

contaminant exceeds the action level, a fish consumption advisory is issued regarding the potential health risk associated with long-term consumption of contaminated fish. The first documented exceedence for chlordane in the Blue River was in 1985 and a fish consumption advisory was issued. Missouri's protocol for removing or down grading an advisory requires at least two years of chlordane data below 0.3 mg/kg. Since this requirement has been met, the advisory was discontinued July 9, 2001.

3. Calculation of Load Capacity, Load Allocation and Waste Load Allocation

Load capacity is defined as the maximum pollutant load that a waterbody can assimilate and still attain water quality standards. EPA banned the use of chlordane in 1988, so no additional chlordane is being introduced into the environment. Thus, the Load Capacity, Load Allocation and Waste Load Allocation for this TMDL are zero.

4. Margin of Safety

Chlordane was banned in 1988, so no more inputs into the Blue River will be occurring. The Missouri Department of Health has issued fish consumption advisories for the Blue River since 1985, but in the July, 2001 Fish Advisory, the Department of Health discontinued the warning on fatty fish due to the reduction of chlordane in fish tested from the Blue River. Further reductions in chlordane in fish are expected to continue, but if monitoring shows a need to resume the fish consumption advisory due to chlordane contamination, the advisory will be put back into effect.

5. Seasonal Variation

No Seasonal Variation is associated with this TMDL.

6. Monitoring Plan For TMDLs Developed Under the Phased Approach

The Department of Natural Resources will continue making routine requests to the Missouri Department of Conservation to collect fish tissue samples from the Blue River for chemical analysis.

7. Implementation Plans

Since chlordane has been banned, there is no specific remediation plan for this impairment. The fish consumption advisory for chlordane has been discontinued since the data confirm that chlordane has declined to below the FDA action level. This is a phased TMDL in that if future data indicates fish tissue chlordane levels are not continuing to decline, this TMDL will be re-opened and re-evaluated. This TMDL will be incorporated into Missouri's Water Quality Management Plan.

8. Public Participation

This waterbody is included on the approved 1998 303(d) list for Missouri. Six public meetings on impaired waters to allow input from the public were held between August 18 and September 22, 1998. No comments pertaining to the Blue River were received during the public meetings. This TMDL document was sent to EPA for examination and then the edited draft placed on public notice. This TMDL was placed on public notice from August 3 through September 2, 2001. No comments were received. Groups receiving the public notice announcement include the Missouri Clean Water Commission, the affected facility, the Water Quality Coordinating Committee, the TMDL Advisory Committee, Stream Team volunteers in the watershed, and the others that routinely receives the public notice of NPDES permits. A copy of the notice was included in the Blue River TMDL file.

9. Administrative Record and Supporting Documentation:

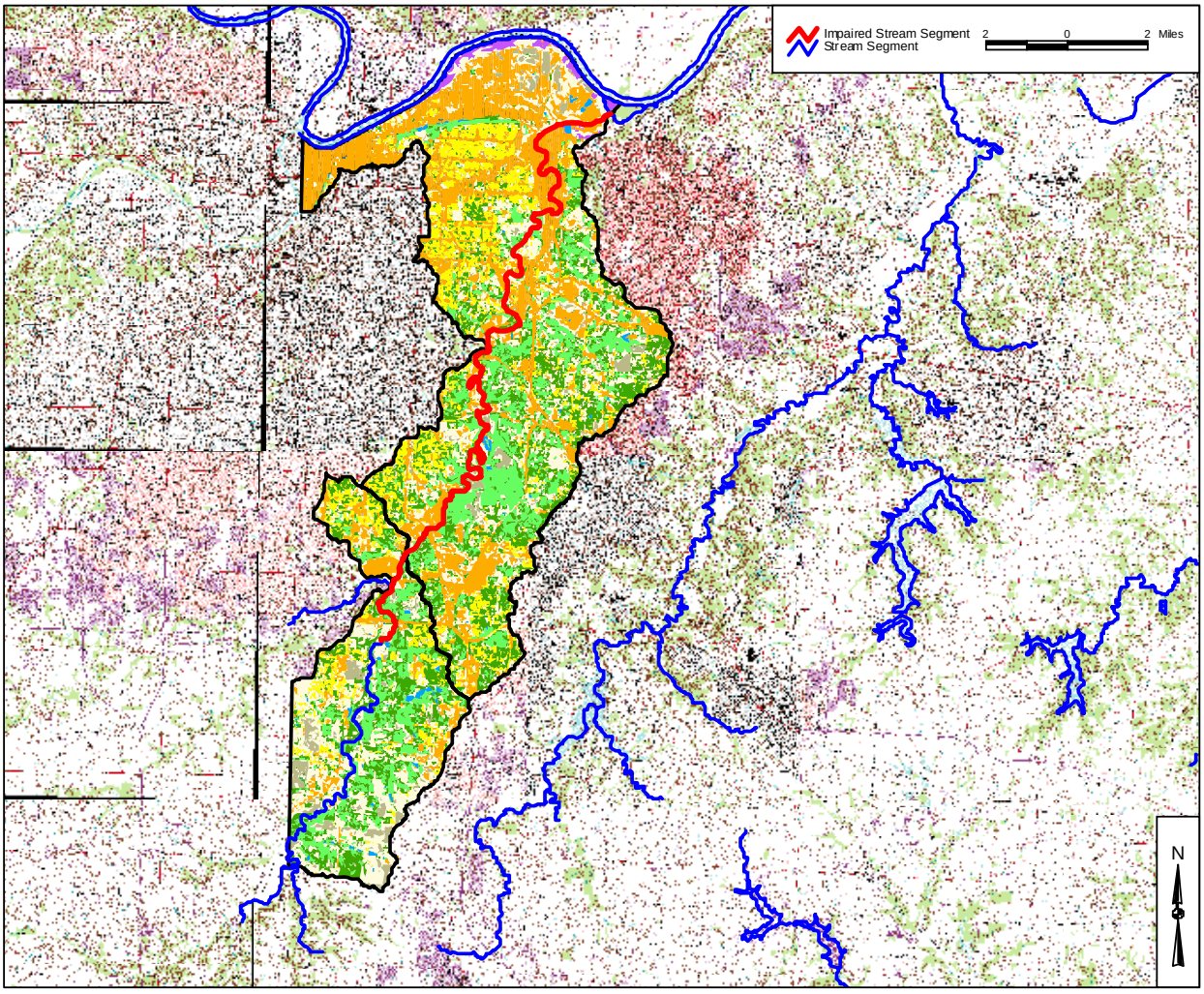
An administrative record on the Blue River TMDL has been assembled and is being kept on file with the Missouri Department of Natural Resources, including the following:

Appendix A: Land use map
Appendix B: Topographical map of impaired segment with Sampling Station Number
Appendix C: Data

Other Information on File:

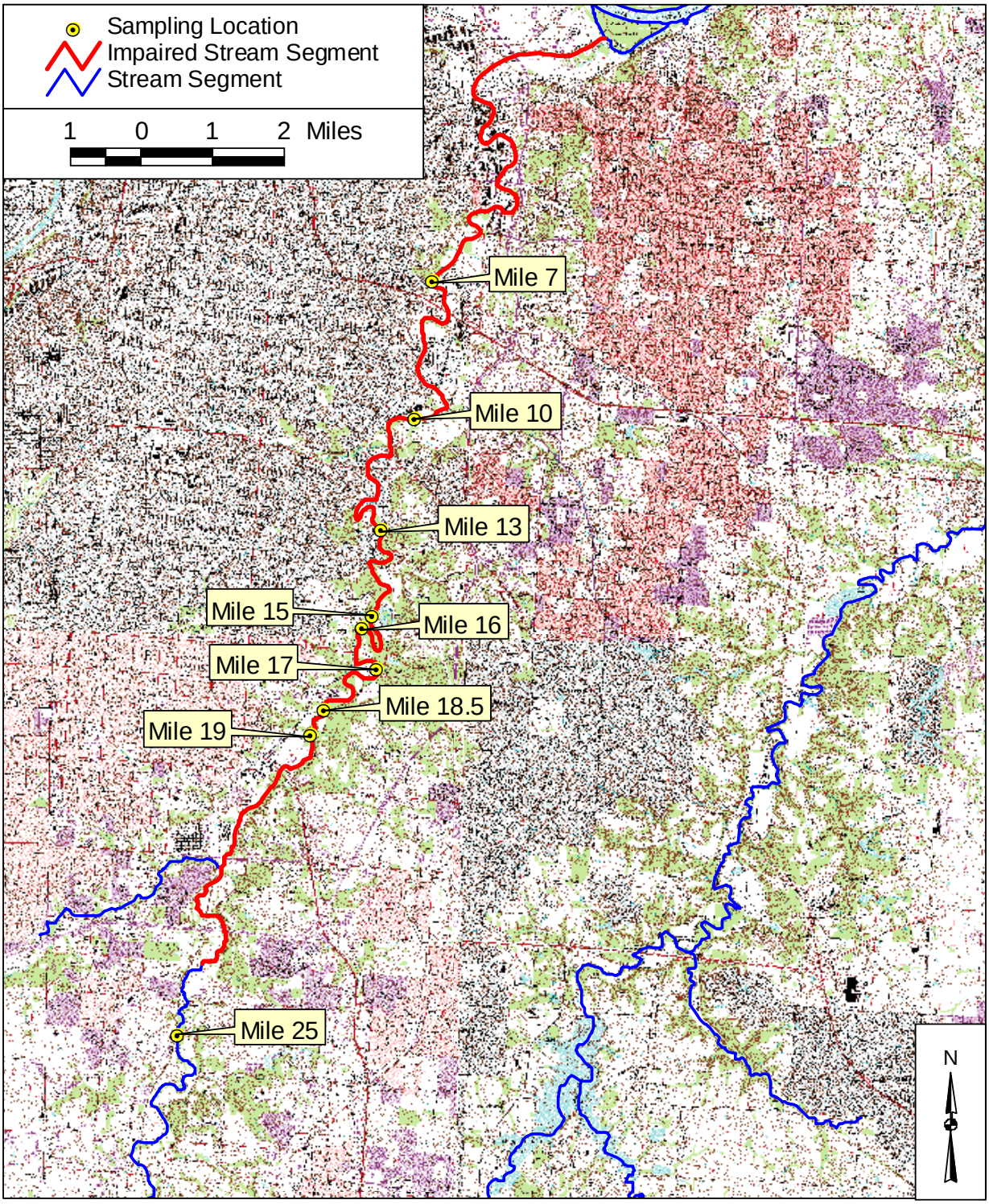
- Fish Advisories to anglers from 1985 to the present outlining safe consumption of fish.
- "Relationship Between Fish Consumption and Serum Chlordane Levels" by Evans, et al, 6/94, *Journal of Environmental Health.* This paper studied the appropriateness of fish consumption advisories in Missouri rivers. It concluded health advisories based upon fish sampling techniques do not reflect the risk of exposure to chlordane. After this study, the Missouri Department of Health changed its fish advisories from restricting consumption of fish from certain waterbodies to advising anglers to limit consumption of fatty fish that could be contaminated.

Appendix A. Land Use Types for Blue River Watersheds (10300101-010030, -010070)



Land Use Type	Area (acres)
Urban Impervious	14193
Urban Vegetated	7425
Barren or Sparsely Vegetated	0
Row and Close Grown Crops	2021
Cool-season Grassland	12934
Warm Season Grassland	0
Glade Complex	0
Eastern Redcedar and Redcedar-Deciduous Forest and Woodland	0
Deciduous Woodland	11576
Upland Deciduous Forest	8981
Shortleaf Pine-Oak Forest and Woodland	0
Shortleaf Pine Forest and Woodland	0
Bottomland Deciduous Forest and Woodland	545
Swamp	0
Marsh and Wet Herbaceous Vegetation	0
Open Water	544

Appendix B. Impaired Stream Segment and Sampling Locations
Blue River, Jackson County, Missouri



APPENDIX C

CHLORDANE IN FISH IN BLUE RIVER

Elevated levels of chlordane in fish tissue have prompted monitoring for several years. Only bottom feeders such as carp and catfish appear to routinely exceed the FDA 0.3 mg/kg guideline for chlordane. Exponential decay functions provided the best fit of declining chlordane levels in fish tissue over time.

TABLE 1. AVAILABLE DATA ON CHLORDANE IN FISH TISSUE IN BLUE RIVER, JACKSON COUNTY, MO.

(MO. DEPT. OF NATURAL RESOURCES/USEPA AND MO. DEPT. OF CONSERVATION)

SITE NAME	YEAR	SPECIES	CHLORDANE (MG/KG)
BLUE R. MI. 16	1984	CARP	11
BLUE R. MI. 25	1985	CHANNEL CATFISH	1.572
BLUE R. MI. 25	1985	BULLHEAD CATFISH	0.718
BLUE R. MI. 25	1985	CARP	0.368
BLUE R. MI. 10	1985	CRAPPIE	0.129
BLUE R. MI. 10	1985	BULLHEAD CATFISH	0.591
BLUE R. MI. 10	1985	CARP	1.392
BLUE R. MI. 07	1985	CARP	2.5
BLUE R. MI. 17	1985	CARP	10
BLUE R. MI. 16	1985	CARP	3.5
BLUE R. MI. 10	1987	CHANNEL CATFISH	1.756
BLUE R. MI. 25	1987	LARGEMOUTH BASS	0.042
BLUE R. MI. 25	1987	CHANNEL CATFISH	0.162
BLUE R. MI. 10	1987	WHITE CRAPPIE	0.176
BLUE R. MI. 10	1987	CARP	0.909
BLUE R. MI. 25	1987	CARP	0.741
BLUE R. MI. 10	1988	CARP	5.56
BLUE R. MI. 25	1988	CARP	1.34
BLUE R. MI. 25	1989	CARP	1.91
BLUE R. MI. 25	1989	CHANNEL CATFISH	0.284
BLUE R. MI. 10	1989	CARP	6.21
BLUE R. MI. 25	1990	CARP	0.514
BLUE R. MI. 25	1990	CHANNEL CATFISH	0.13
BLUE R. MI. 16	1991	GREEN SUNFISH	0.001
BLUE R. MI. 18.5	1991	SUNFISH	0.001
BLUE R. MI. 15	1991	CATFISH	0.006

BLUE R. MI. 13	1991	GREEN SUNFISH	0.002
BLUE R. MI. 16	1991	CHANNEL CATFISH	0.006
BLUE R. MI. 25	1991	CHANNEL CATFISH	0.343
BLUE R. MI. 25	1991	CARP	1.46
BLUE R. MI. 15	1991	SUNFISH	0.001
BLUE R. MI. 16	1991	SUNFISH	0.077
BLUE R. MI. 16	1991	GREEN SUNFISH	0.077
BLUE R. MI. 18.5	1991	CATFISH	0.01
BLUE R. MI. 19	1991	GREEN SUNFISH	0.001
BLUE R. MI. 15	1992	CHANNEL CATFISH	0.14
BLUE R. MI. 15	1992	GREEN SUNFISH	0.016
BLUE R. MI. 16	1992	GREEN SUNFISH	0.014
BLUE R. MI. 18.5	1992	GREEN SUNFISH	0.01
BLUE R. MI. 18.5	1992	CHANNEL CATFISH	0.085
BLUE R. MI. 16	1993	GREEN SUNFISH	0.014
BLUE R. MI. 18.5	1993	CHANNEL CATFISH	0.049
BLUE R. MI. 18.5	1993	GREEN SUNFISH	0.003
BLUE R. MI. 15	1993	GREEN SUNFISH	0.011
BLUE R. MI. 25	1994	CARP	0.376
BLUE R. MI. 25	1994	CARP	0.515
BLUE R. MI. 25	1994	CARP	0.871
BLUE R. MI. 23	1998	CHANNEL CATFISH	0.079
BLUE R. MI. 16	1999	CARP	0.63
BLUE R. MI. 23	2000	CARP	0.33

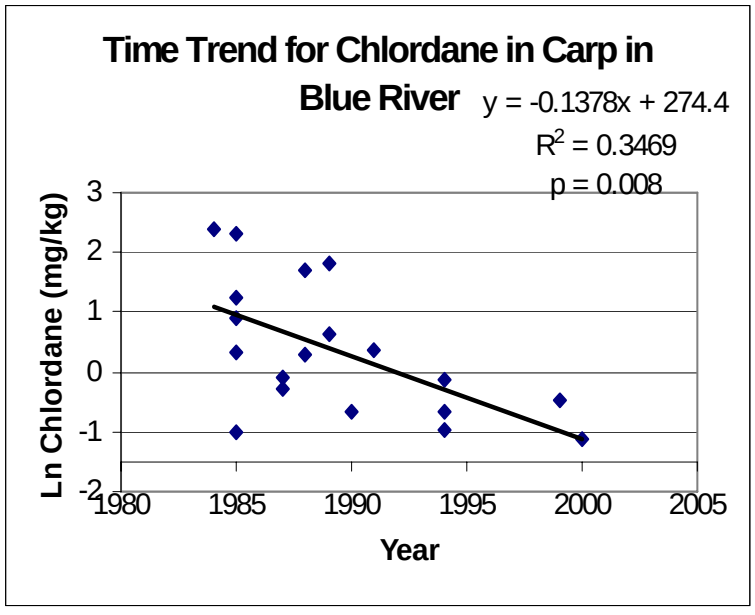
TABLE 2. AVERAGE CHLORDANE IN FISH BY SPECIES (MG/KG)

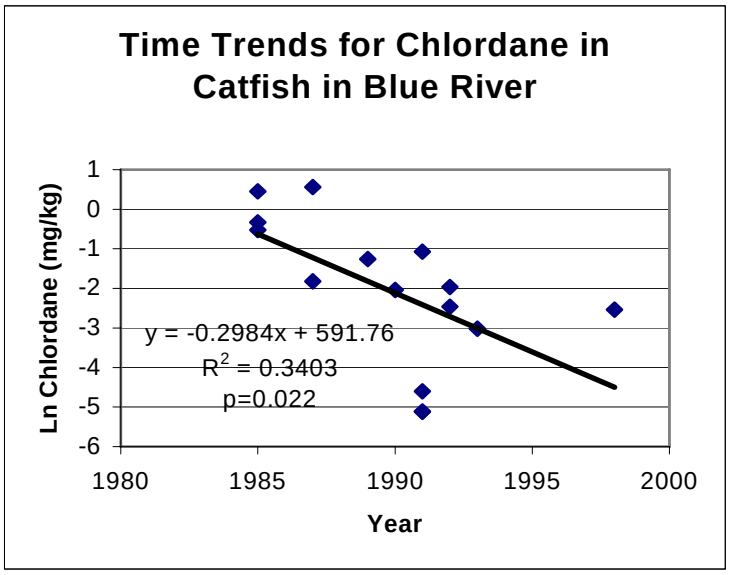
CARP	2.766
CATFISH	0.395
CRAPPIE	0.152
SUNFISH	0.018
BASS	0.042

TABLE 3. TIME TRENDS IN CHLORDANE IN CARP IN BLUE RIVER (MG/KG)			
SPECIES	**YEAR**	**CHLORDANE**	**NATURAL LOG (Ln) CHLORDANE**
CARP	1984	11	2.397895273
CARP	1985	0.368	-0.999672341
CARP	1985	1.392	0.330741562
CARP	1985	2.5	0.916290732
CARP	1985	10	2.302585093
CARP	1985	3.5	1.252762968
CARP	1987	0.741	-0.299754654
CARP	1987	0.909	-0.095410185
CARP	1988	1.34	0.292669614
CARP	1988	5.56	1.715598108
CARP	1989	1.91	0.647103242
CARP	1989	6.21	1.826160896
CARP	1990	0.514	-0.665532014
CARP	1991	1.46	0.378436436
CARP	1994	0.871	-0.138113302
CARP	1994	0.515	-0.663588378
CARP	1994	0.376	-0.978166136
CARP	1999	0.63	-0.462035460
CARP	2000	0.33	-1.108662625

TABLE 4. PREDICTED CHLORDANE IN CARP IN BLUE RIVER (MG/KG)	
YEAR	CHLORDANE
1985	2.6261004
1990	1.3191664
1995	0.6626555
2000	0.3328711
2005	0.1672108
2010	0.0839948

TABLE 5. TIME TRENDS FOR CHLORDANE IN CATFISH IN BLUE RIVER (MG/KG)			
SPECIES	**YEAR**	**CHLORDANE**	**Ln CHLORDANE**
BULLHEAD CATFISH	1985	0.591	-0.525939262
BULLHEAD CATFISH	1985	0.718	-0.331285710
CHANNEL CATFISH	1985	1.572	0.452348694
CHANNEL CATFISH	1987	0.162	-1.820158944
CHANNEL CATFISH	1987	1.756	0.563038495
CHANNEL CATFISH	1989	0.284	-1.258781041
CHANNEL CATFISH	1990	0.130	-2.040220829
CATFISH	1991	0.006	-5.115995810
CATFISH	1991	0.010	-4.605170186
CHANNEL CATFISH	1991	0.343	-1.070024832
CHANNEL CATFISH	1991	0.006	-5.115995810
CHANNEL CATFISH	1992	0.140	-1.966112856
CHANNEL CATFISH	1992	0.085	-2.465104022
CHANNEL CATFISH	1993	0.049	-3.015934981
CHANNEL CATFISH	1998	0.079	-2.538307427





Analyses were performed for carp and catfish to determine if the chlordane concentrations are decreasing with time. The result was that the data changes cannot be explained by chance alone, instead, it is apparently decreasing with time. Further monitoring will determine whether this trend continues.