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**WATER QUALITY OF THE WEST BRANCH OF  
THE DUPAGE RIVER AND KLINE CREEK, ILLINOIS,  
AS EVALUATED USING THE ARTHROPOD FAUNA  
AND CHEMICAL MEASUREMENTS**

Chris E. Petersen<sup>1</sup>

ABSTRACT

The water quality of the West Branch of the DuPage River (W. Branch) and Kline Creek, a tributary of the W. Branch, were examined. Both streams are located in rapidly developing DuPage County, IL. Using Hilsenhoff's biotic index of the arthropod fauna and selected chemical measurements, the W. Branch was found to be moderately polluted and Kline Creek moderately to severely polluted. High mean biotic index measurements ranging from 6.28 to 7.97, ammonia-nitrogen readings of 1.0-3.9 ppm, nitrate-nitrogen readings of 0.4-1.6 ppm, chloride readings of 231-313 ppm, and orthophosphate readings of 0.3-0.5 ppm reflect organically polluted waters in both streams. Stream channelization and modification may also be contributing to the less than optimal water quality at the headwater of the W. Branch.

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From 1980 through 1988 the population of DuPage County, Illinois, grew from 658,858 to 760,800 people (DuPage County Planning Department, personal communication). As a result of the urbanization, the county has experienced a reduction and fragmentation of open space. As a means to estimate the impact of development on the natural environment, the water qualities of the West Branch of the DuPage River (W. Branch) and a tributary were examined using stream arthropod and chemical indicators. Stream analysis is practical for estimating human impacts because streams, receive anthropogenic inputs through surface runoff, ground water, and direct discharge. Also, arthropods inhabiting streams show species specific tolerances to these inputs (Hilsenhoff 1977, Paine and Gaufin 1956, Wilson and McGill 1977). The W. Branch is an ideal stream to survey in DuPage County because it transects the county by flowing north to south.

The 40 km W. Branch is part of the 3553 km<sup>2</sup> Des Plaines River drainage basin located mostly in Northeastern Illinois (Illinois Environmental Protection Agency 1988). The average gradient of the W. Branch is about 1.1 m/km. Over 70% of the first 30 km of the stream surveyed in this study is bordered by seven DuPage County Forest Preserves which encompass 2340 hectares of mostly mesophytic forests. However, this section directly, or indirectly via tributaries, receives discharges from nine waste water treatment plants that service many of the more than 215,000 people living in the residential areas along the W. Branch. One such tributary which was examined is Kline Creek, a 5 km long stream originating just

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Table 1. — Sampling stations and their locations along the West Branch of the DuPage River (W. Branch) and Kline Creek, IL. Distance of a station from the headwater area is listed beside the stream's name in the parentheses.

Station	Location
Mallard Lake (W. Branch—1.9 km)	50 m upstream from the Hanover Park Waste Water Treatment Plant, Hanover Park
Timber Ridge (W. Branch—13.6 km)	Timber Ridge Forest Preserve, West Chicago
McDowell Grove (W. Branch—30.0 km)	McDowell Grove Forest Preserve, Naperville
Kline Creek (Kline Creek—4.5 km)	100 m upstream from the junction with the W. Branch, West Chicago

above a waste water treatment plant in Carol Stream, IL. The stream has an average gradient of about 3.3 m/km and joins with the W. Branch 14 km from the W. Branch's head-water.

Since the 1970's, channelization and modification of the W. Branch above the Mallard Lake Station has been ongoing. New single-family homes and a bridge were built within this time about the station. The disturbance to the W. Branch at the station is apparent by the fragments of concrete and other construction material that compose most of the larger substrate (> 10cm diameter).

The Hilsenhoff Biotic Index (Hilsenhoff 1977, 1982, 1987) was used to evaluate water quality in reference to arthropods. Hilsenhoff's index is designed to measure water quality in organically enriched waters such as what was anticipated with the W. Branch and Kline Creek. The index is also standard procedure used by the Illinois Environmental Protection Agency (1988).

## MATERIALS AND METHODS

Three sampling stations were established along the West Branch and a fourth along Kline Creek (Table 1). The procedure for collecting stream arthropods at these stations followed that described by Hilsenhoff (1987). Stations were located in riffle areas having depths of < 10 cm. A D-frame aquatic net facilitated collections taken from October 1989 through April 1990 at two week intervals when not interrupted by high water and icing over. When possible, sampling continued until it was obvious that more than 100 arthropods were collected. Only 50 from Kline Creek and 55 from the McDowell Grove station could be collected on 14 October, 1989, and 5 March, 1990, respectively. Arthropods were preserved in 70% ethanol. The first randomly selected 100 arthropods for samples consisting of  $\geq 100$ , or all for samples of < 100, were identified to species if possible and to genus if not.

Selected chemical measurements were taken monthly from each of the four sampling stations using Lamotte Chemical kits (LaMotte Chemical Products Company). Chemicals measured were those commonly associated with organic pollution: ammonia-nitrogen, nitrate-nitrogen, chloride, and orthophosphate. During each sampling day, measurements were taken at all four stations within an 8 hour period.

Table 2. — Arthropods collected from the West Branch of the DuPage River and Kline Creek according to pollution tolerance value (PTV) and sampling station. Symbols: ML = Mallard Lake station, TR = Timber Ridge station, MG = McDowell Grove station, and KC = Kline Creek station.

Order	Species	PTV	ML	TR	MG	KC
Amphipoda	<i>Hyallela azteca</i> Saussure	8		X		
Isopoda	<i>Asellus intermedius</i> Forbes	8	X	X	X	X
Odonata	<i>Argia</i> spp.	6	X	X	X	
	<i>Enallagma</i> spp.	9	X	X		X
	<i>Hetaerina americana</i> Fabricius	6		X	X	
Ephemeroptera	<i>Baetis intercalaris</i> McDunnough	6		X	X	X
	<i>Caenis</i> spp.	6		X	X	X
	<i>Potamanthus</i> spp.	4			X	
	<i>Stenacron interpunctum</i> (Say)	7		X	X	
	<i>Stenonema terminatum</i> (Walsh)	4			X	
	<i>Tricorythodes</i> spp. Ulmer	4			X	
Megaloptera	<i>Sialis</i> spp.	4			X	
Coleoptera	<i>Dubiraphia vittata</i> (Melsheimer)	6		X	X	
	<i>Stenelmis crenata</i> (Say)	5		X	X	
	<i>S. vittipennis</i> Zimmerman	5		X	X	
Trichoptera	<i>Ceratopsyche bronta</i> Ross	6			X	X
	<i>Cheumatopsyche</i> spp.	6	X	X	X	X
	<i>Hydropsyche betteni</i> Ross	6	X	X	X	X
Diptera	<i>Tipula</i> spp.	4				X
	<i>Chironomis</i> spp.	10	X	X	X	X
	<i>Cricotopus</i> spp.	7	X	X	X	X
	<i>Eristalis</i> spp.	10				X
	<i>Guttipelopia</i> spp.	6	X	X	X	X
	<i>Micropsectra</i> spp.	7		X	X	X
	<i>Polypedilium</i> spp.	6	X	X	X	X
	<i>Simulium vittatum</i> Zetterfield	8	X	X	X	X

## RESULTS AND DISCUSSION

Table 2 provides a faunal list of arthropods according to sampling station and pollution tolerance values assigned to each species. Except for the caddisfly, *Cheumatopsyche* (Trichoptera), arthropod pollution tolerance values used in the computation of biotic indices (BI's) were taken from Hilsenhoff (1987).

*Cheumatopsyche* was reassigned a value of 6 instead of Hilsenhoff's 5. Justification for the reassignment came from the degree of chemical pollution and the identification of adult *Cheumatopsyche* that were trapped along the W. Branch and Kline Creek with an ultraviolet light during April-October, 1990. Only *C. pettiti* (Banks) and *C. campyla* Ross, which are known to be pollution tolerant (Ross 1944), were collected.

Mean biotic indices from each sampling station (Table 3) reflect fair to poor water

Table 3. — Mean biotic index values  $\pm$  standard deviations ( $\bar{x}$  BI  $\pm$  calculated from the West Branch of the DuPage River and Kline Creek sampling stations. The biotic indices are interpreted as follows: 0–3.50 indicates excellent water quality; 3.51–4.50 very good water quality; 4.51–5.50 good water quality; 5.51–6.50 fair water quality; 6.51–7.50 fairly poor water quality; 7.51–8.50 poor water quality; and 8.51–10.00 very poor water quality. Symbol: n = the sample size.

Location	$\bar{x}$ BI $\pm$ s	n
Mallard Lake	7.97 $\pm$ 0.14	16
Timber Ridge	7.04 $\pm$ 0.44	14
McDowell Grove	6.28 $\pm$ 0.71	15
Kline Creek	7.43 $\pm$ 0.53	16

Table 4. — LaMotte chemical analyses from four sampling stations along the West Branch of the DuPage River and Kline Creek. Mean concentrations  $\pm$  standard deviations ( $\bar{x}$   $\pm$  s) are given in ppm (parts per million). All sample sizes = 5. Also included are concentrations that can be expected from relatively unpolluted waters (Clark 1977, Klein 1962). Symbols: PO<sub>4</sub> = orthophosphate; ML = Mallard Lake station; TR = Timber Ridge station; MG = McDowell Grove stations; and KC = Kline Creek station.

Location	Chemical			
	Ammonia-nitrogen	Nitrate-nitrogen	Chloride	PO <sub>4</sub>
ML	1.4 $\pm$ 0.9	0.7 $\pm$ 0.4	244 $\pm$ 82	0.4 $\pm$ 0.6
TR	1.2 $\pm$ 0.4	0.5 $\pm$ 0.4	231 $\pm$ 63	0.3 $\pm$ 0.3
MG	1.0 $\pm$ 0.0	0.4 $\pm$ 0.4	294 $\pm$ 91	0.4 $\pm$ 0.4
KC	3.9 $\pm$ 1.3	1.6 $\pm$ 2.5	313 $\pm$ 51	0.5 $\pm$ 0.6
Concentration that can be expected from relatively unpolluted waters	<0.2	Virtually absent	<250	

quality in the W. Branch and fairly poor water quality in Kline Creek. The W. Branch readings suggest an improvement downstream. However, this improving pattern was not obvious from the selected chemical measurements (Table 4). The measurements suggest moderate pollution all along the sampled stretch of the W. Branch. The high mean biotic index measured at Mallard Lake may also reflect the continued anthropogenic disturbance upstream from the site.

Chemical measurements along Kline Creek suggest more severe organic pollution than the W. Branch. The Carol Stream Waste Water Treatment Plant, which is located near the headwater of the stream, was suspected as being a major source of the pollution. Supplementary chloride readings taken during February–April, 1990, just below the plant averaged 436  $\pm$  144 ppm ( $\bar{x}$   $\pm$  s, n = 3). A high reading of 576 ppm was taken on 23 February, 1990. This value exceeds the 500 ppm general use water quality maximum set by the Illinois Environmental Protection Agency. Other sources of the organic pollution may include infiltration from septic fields serving single-family homes downstream from the plant.

In conclusion, biotic indices from both the W. Branch and Kline Creek reveal arthropod communities characteristic of moderately to severely polluted waters.

Stream channelization and modification may also be contributing to the apparent less than optimal water quality, especially at the headwater of the W. Branch.

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