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Metropolitan Water Reclamation District of Greater Chicago

RESEARCH AND DEVELOPMENT DEPARTMENT

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AMBIENT WATER QUALITY MONITORING IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS: A SUMMARY OF BIOLOGICAL, HABITAT, AND SEDIMENT QUALITY DURING 2005

June 2008

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AMBIENT WATER QUALITY MONITORING IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS: A SUMMARY OF BIOLOGICAL, HABITAT, AND SEDIMENT QUALITY DURING 2005

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DISCLAIMER

Mention of proprietary equipment and chemicals in this report does not constitute endorsement by the Metropolitan Water Reclamation District of Greater Chicago.

SUMMARY AND CONCLUSIONS

During 2005, biological and habitat monitoring focused on the northern portion of the Chicago River System, as well as the 15 annual Ambient Water Quality Monitoring (AWQM) Program stations located throughout the Chicago, Calumet, and Des Plaines River Systems. Sediment chemistry and toxicity analyses were also performed on samples from the northern Chicago River System. Chlorophyll samples were collected at each of the 59 AWQM stations monthly.

Chlorophyll

Chlorophyll *a* concentrations decreased directly downstream of water treatment plants due to dilution of the waterway with effluent. In the Chicago River System, chlorophyll *a* means ranged from 2 µg/L at Touhy and Foster Avenues on the North Shore Channel to 36 µg/L at Albany Avenue on the North Branch Chicago River. The maximum recorded chlorophyll *a* concentration in the Chicago River System during 2005 was also at Albany Avenue on the North Branch Chicago River (157 µg/L).

Mean chlorophyll *a* values in the Calumet River System ranged from 1 (Ewing Avenue, Calumet River) to 58 µg/L (Burnham Avenue, Grand Calumet River). The maximum concentration measured 207 µg/L at Burnham Avenue.

The range of mean chlorophyll *a* concentrations in the Des Plaines River System was 2 (Wille Road, Higgins Creek) to 60 µg/L (Springinsguth Road, West Branch DuPage River). The maximum concentration measured in this system was 266 µg/L also at Springinsguth Road in the West Branch DuPage River.

Habitat

During the biological collection events, staff biologists assessed physical habitat at the beginning and end of each sampling reach and completed a corresponding data sheet. Qualitative Habitat Evaluation Index (QHEI) scores were calculated using this information and assigned to each waterway reach. The QHEI was developed for wadeable streams and may not be appropriate for deep-draft channels in the Chicago and Calumet River Systems. However, no alternate physical habitat index is currently available for such waterways.

The habitat ratings assigned to stations assessed during 2005 ranged from very poor at Grand Avenue in the North Branch Chicago River and Wille Road in Higgins Creek, to good at Glenview Avenue in the North Branch Chicago River, Lake-Cook Road in the Skokie River, and Material Service Road in the Des Plaines River. QHEI scores ranged from 25 to 62 throughout all three river systems. Negative habitat features in this system included channelization, limited flow, limited instream cover, and excess silt in sediments.

Fish

A total of 4,632 fish composed of 36 species were collected from Chicago area waterways in 2005, including 14 game species. The most abundant fish species collected from the shallow portion of the Chicago River System included carp and green sunfish, while carp and gizzard shad were the most frequently collected species in the deep-draft portion.

Benthic Invertebrates

Benthic invertebrates were collected from side and center locations using two methods at 27 AWQM stations during 2005. Total species richness for ponar and Hester Dendy samplers combined was 135 species, while total Ephemeroptera, Plecoptera, and Trichoptera (EPT) richness was 23 species (EPT taxa are considered relatively sensitive to pollution). Comprehensive benthic invertebrate data have been posted on the District Website (www.mwrd.org) under the "Biological Reports" heading. The report is entitled, "A Study of the Benthic Macroinvertebrate Community in Selected Chicago Metropolitan Area Waterways During 2005."

Sediment Chemistry

During 2005, sediment samples were collected from the side and center of the waterway at 15 stations. Sediment samples were analyzed for 8 general chemistry constituents, 11 trace metals, and a total of 111 total organic priority pollutants. In addition, a contracted laboratory performed acid volatile sulfide/simultaneously extracted metals (AVS/SEM), total organic carbon (TOC), and particle size determinations.

Sediment Toxicity

Ten-day *Chironomus tentans* toxicity testing was performed using sediment from side and center locations at 15 stations. Four out of the 30 samples elicited percent survival rates that were significantly less than the control sites indicating that the sediment was unsuitable for *Chironomus* survival. Three additional sites sampled showed ash-free dried weight that was significantly less than control sites, indicating that these sediments were unsuitable for optimal *Chironomus* growth.

INTRODUCTION

The Metropolitan Water Reclamation District of Greater Chicago (District) began monitoring for the AWQM Program at 59 sampling stations on 21 waterways in 2001. While water samples were collected monthly at these stations to assess water quality, this report focuses on the biological, habitat, and sediment quality during 2005. The biological monitoring portion of the AWQM Program operates on a 4-year cycle, with a primary focus each year on a different river system in the Chicago area. Fifteen of the 59 stations located across all of the waterways are monitored annually, based on their proximity to District water reclamation plants (WRPs) or municipal boundaries. During 2005, biological monitoring focused on the northern portion of the Chicago River System.

Characterization of physical habitat, fish, and benthic invertebrate populations, along with sediment toxicity and chemistry, are among the most crucial components for a comprehensive evaluation of a waterway. Each parameter represents a piece of the overall picture that is necessary to identify problem areas, make regulatory decisions, and determine plausible attainable uses for a waterway.

In addition to analyzing the AWQM Program data in order to assess and manage the impact of the District's WRPs, our data are often shared with other government agencies, non-governmental organizations (NGOs), and academic institutions. For instance, the AWQM Program data are shared with the Illinois Environmental Protection Agency (IEPA) to support their efforts to make regulatory decisions, prepare the 305 (b) report in accordance with the Clean Water Act, and perform Use Attainability Analyses (UAA).

DESCRIPTION OF THE STUDY AREA

Chicago, Calumet, and Des Plaines River Systems

The Chicago area waterways consist of man-made canals as well as natural streams which have been altered to varying degrees. Some natural waterways have been deepened, straightened, and/or widened to such an extent that reversion to their natural state would be impossible. The waterways serve the Chicago area by draining urban storm water runoff and treated municipal wastewater effluent and allowing commercial navigation in the deep-draft portions.

The primary man-made waterways are the North Shore Channel connecting Lake Michigan at Wilmette to the North Branch Chicago River; the Chicago Sanitary and Ship Canal (CSSC) extending from Damen Avenue to the Lockport Powerhouse; and the Calumet-Sag Channel connecting the Little Calumet River with the CSSC. The primary natural waterways include the wadeable branches of the Chicago River System flowing south from Lake County into the deep-draft portion of the North Branch Chicago River, which joins the Chicago River and South Branch Chicago River; the Des Plaines River System flowing south from Lake County and joining with the discharge from the CSSC downstream of the Lockport Powerhouse; and the Calumet River System which flows south and west into the Calumet-Sag Channel.

Sampling Stations

The sampling stations for the AWQM Program are located on natural and man-made waterways throughout the District's service area. A map of the Chicago area waterways including the 59 sampling stations and the District's WRPs is shown in Figure 1. Stations were primarily selected such that there was at least one monitoring station on the lower end of an IEPA 303 (d) impaired waterway segment. Secondary criteria for selecting sampling locations included: (1) above and below major point sources of pollution, (2) below Lake Michigan diversion points, (3) above junction of two major waterways, (4) below county municipal boundaries, and (5) in areas of environmental concern. Fifteen of the 59 stations were chosen for annual biological monitoring.

In addition to the 15 annual stations, biological sampling was focused in the northern portion of the Chicago River System during 2005, including the North Shore Channel, West Fork North Branch Chicago River, Middle Fork North Branch Chicago River, Skokie River, and North Branch Chicago River. Table 1 displays the 2005 field monitoring schedule for biological, physical habitat, and sediment quality assessments.

FIGURE 1: AMBIENT WATER QUALITY MONITORING PROGRAM
SAMPLE STATIONS

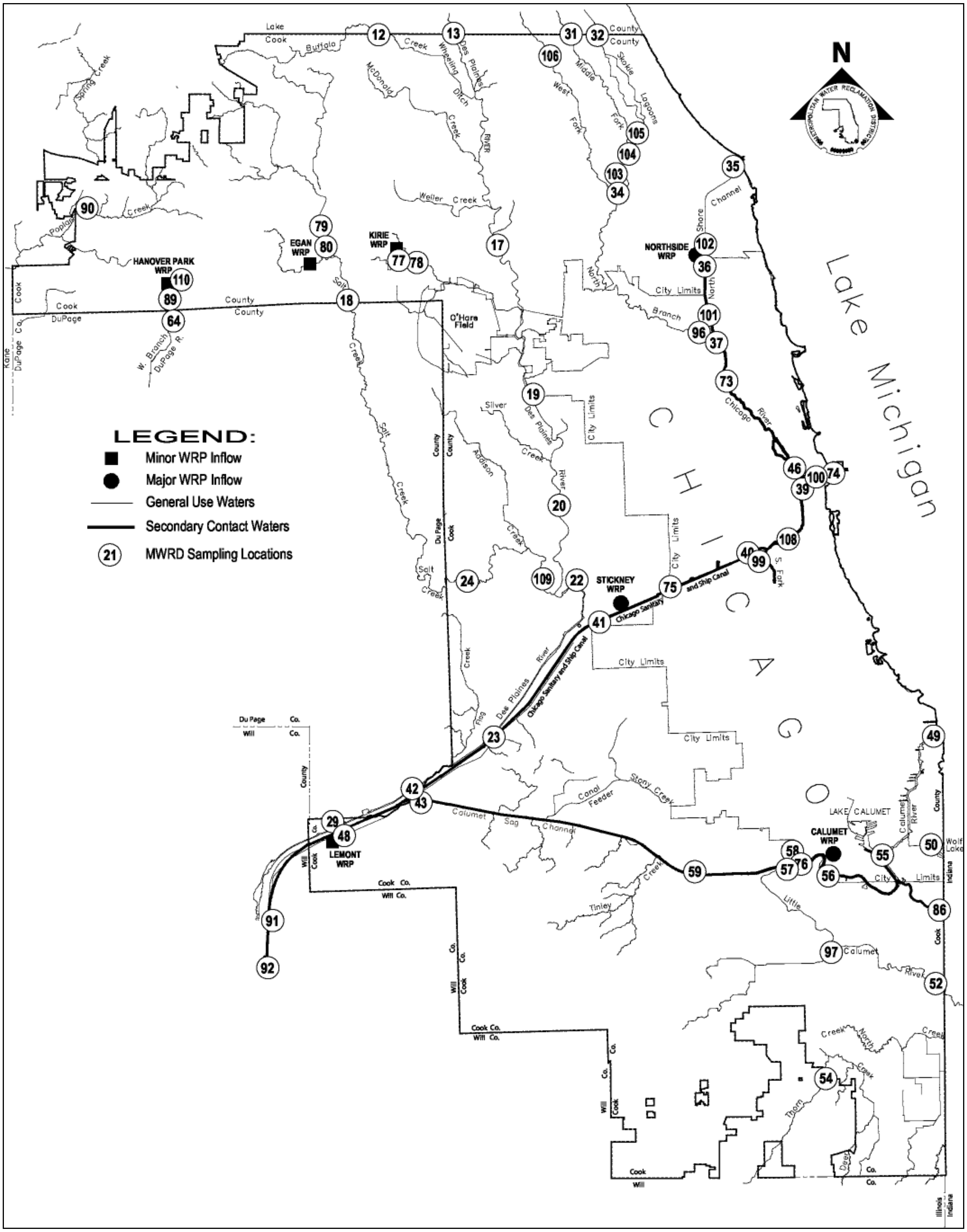

TABLE 1: SCHEDULE OF AMBIENT WATER QUALITY PROGRAM STATIONS SAMPLED DURING 2005

Station No.	Sampling Station	Waterway	Date Sampled
106	Dundee Road	West Fork North Branch	6/23/05
103	Golf Road	West Fork North Branch	6/28/05
31	Lake-Cook Road	Middle Fork North Branch	6/21/05
32	Lake-Cook Road	Skokie River	6/22/05
105	Frontage Road	Skokie River	6/29/05
104	Glenview Road	North Branch Chicago River	6/30/05
34	Dempster Street	North Branch Chicago River	7/13/05
96	Albany Avenue*	North Branch Chicago River	7/19/05
35	Central Street	North Shore Channel	7/7/05, 7/20/05[a]
102	Oakton Street	North Shore Channel	7/20/05
36	Touhy Avenue*	North Shore Channel	7/21/05
101	Foster Avenue	North Shore Channel	7/27/05, 9/8/05[b]
37	Wilson Avenue	North Branch Chicago River	7/27/05, 9/7/05[b]
73	Diversey Parkway	North Branch Chicago River	7/28/05, 9/6/05[b]
46	Grand Avenue*	North Branch Chicago River	7/18/05
75	Cicero Avenue*	Chicago Sanitary & Ship Canal	8/22/05
41	Harlem Avenue*	Chicago Sanitary & Ship Canal	8/26/05
92	Lockport*	Chicago Sanitary & Ship Canal	9/15/05
55	130th Street*	Calumet River	9/28/05
76	Halsted Street*	Little Calumet River	9/27/05
59	Cicero Avenue*	Calumet-Sag Channel	8/29/05, 9/29/05[a]
64	Lake Street*	West Branch DuPage River	7/6/05
18	Devon Avenue*	Salt Creek	7/15/05
78	Wille Road*	Higgins Creek	7/14/05
13	Lake-Cook Road*	Des Plaines River	6/20/05
22	Ogden Avenue*	Des Plaines River	7/26/05
91	Material Service Rd.*	Des Plaines River	8/18/05

*Annual sampling station.
[a]Electrofishing conducted on this later date due to equipment failure.
[b]Electrofishing and Habitat Assessment conducted on this later date due to equipment failure.

MATERIALS AND METHODS

Chlorophyll

Water samples for chlorophyll analysis are collected monthly at each AWQM station along with the water samples for various chemical analyses.

Sample Collection. Surface water grab samples for chlorophyll analysis were collected using a stainless steel bucket. The bucket was lowered into the waterway generally from the upstream side of the bridge at the most central location. The bucket was submerged, filled, and then raised to the top of the bridge. An aliquot was poured into an amber, plastic one-liter sample bottle containing 1-mg magnesium carbonate as preservative, and a 1/2-inch airspace was left at the top of the bottle. Samples were then placed in a cooler with ice and returned to the lab for processing.

Laboratory Analysis. *Filtration.* Prior to filtering samples, water was mixed by rapidly inverting sample bottles 25 times before the first pour. Samples were filtered through Whatman type GF/F glass-fiber filters (0.7 micrometers) using Millipore filtration equipment and vacuum pressure. Water samples were filtered until the rate of flow decreased, but before it became clogged. Following filtration, sample filters were folded and wrapped with aluminum foil and extracted the following day.

Extraction. Filters were placed in glass extraction tubes with 5 mL of 90 percent aqueous acetone solution. Using a motorized tissue grinder set at 500 rpm and a pestle, the top layer of the filter was separated. Samples were then transferred to centrifuge tubes and additional acetone was added until the total volume equaled 10 mL. These tubes were inverted 5 times and then placed at 4°C for approximately 24 hours to steep.

Spectrophotometric Analysis. After removing samples from refrigeration, they were centrifuged for 20 minutes at 2,500 rpm. Three mL of the supernatant was transferred into a spectrophotometric cell and the absorbance read at 750, 664, 647, and 630 nm. To correct for the degradation product, pheophyton, 0.1 mL of 1 percent hydrochloric acid was added and after one minute, absorbance was read again at 750 and 665 nm. The spectrophotometer was programmed to calculate corrected chlorophyll *a, b,* and *c* values based on the volumes filtered and used to extract samples.

Quality Control. A reagent blank of 90 percent acetone was placed in the spectrophotometer every tenth sample and read between -0.1 and 0.1 ug/L. A method blank of distilled water was prepared for each group of samples and run through the entire laboratory procedure. One duplicate sample was chosen randomly for each group of samples and would have to be within 20 relative percent difference of the original sample. Chlorophyll *a* and *b* standards from spinach were also analyzed every 20 samples and displayed at least a 90 percent recovery.

Habitat

Data Collection. Physical habitat assessment data sheets (Figure 2) were completed by a staff biologist in the field at each station. Assessments made in the field included weather conditions, channel morphology, bank erosion, shore cover, aquatic vegetation, man-made structures, floatable materials, riparian land-use, sediment composition, sediment color and odor, depth of fines, and presence of oil in sediment. Channel width was determined using a Yardage Pro 800 rangefinder in the non-wadable waterways. A fiberglass telescoping leveling rod was used to measure water depth and depth of fines (in sediment). The smallest extension of the round leveling rod (1" diameter) was pushed into the sediment with reasonable force as far as possible to determine depth of fines in feet. A 6- X 6-inch petite Ponar grab sampler was used to collect sediment for analysis. Staff biologists estimated the percent composition of plant debris, clay, inorganic silt, organic sludge, sand (0.06-2 mm diameter), gravel (<2-64 mm diameter), cobble (>64-256 mm diameter), boulder (>256 mm diameter), or bedrock/concrete in the sediment. Sediment color and odor were recorded, as well as the appearance of oil in the sample.

Assessment Locations. Physical habitat was evaluated at the beginning and end of the fishing range in the center and on one side of the waterway at each station. The range was 40 meters for wadeable sites, 100 meters for sites in which the small boat electrofisher was employed, and 400 meters for deep-draft waterways.

Calculating Qualitative Habitat Evaluation Index. The QHEI was created by the Ohio Environmental Protection Agency (OEPA) to determine the suitability of a stretch of waterway to fish and macroinvertebrates based on physical habitat characteristics (Rankin, 1989). The index was developed to assess wadeable streams, not deep-draft channels such as those in the Chicago area. However, no appropriate index was available for these waterways. Habitat scores were calculated for each of the stations using the Ohio QHEI procedures. Sites were then classified as excellent, good, fair, poor, or very poor based on their ability to support aquatic life in reference to habitat (Rankin, 2004). The classification ranges were as follows:

<=75	Excellent
60-74	Good
46-59	Fair
30-45	Poor
<30	Very Poor

Fish

Boatable Stream Sampling. Fish were collected at each sample station using a boat mounted electrofisher. The electrofisher was powered by a direct current (dc) generator.

FIGURE 2: METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO PHYSICAL HABITAT ASSESSMENT

Date ________________ **Time** ______________ **Station Number** ____________

Station Name ______________________________ **Latitude** ____________________

Waterbody ______________________________ **Longitude** ____________________

Assessment Observer (s) ____

Weather Conditions SUNNY CLOUDY RAIN (circle one)

Stream Order ________ **Assessment Location** BEGINNING END (circle one)

Assessment Location Facing Upstream LEFT CENTER RIGHT (circle one)

Channel Habitat POOL RUN RIFFLE (circle one)

Water Depth (ft) ________________________ **Channel Width** (ft) ____________________

Water Level LOW NORMAL HIGH FLOODED (circle one)

Man-made Structures DAM RIPRAP BRIDGE LEVEE ISLAND
OUTFALL SHEET PILING OTHER ______________ (Specify) (circle all applicable)

Channelization YES NO (circle one)

Bank Erosion NONE SLIGHT MODERATE SEVERE (circle one)

Floatable Materials YES NO (circle one)
If YES, characterize (circle all applicable)
STREET LITTER SANITARY SEWAGE VEGETATIVE MATERIAL

Aquatic Vegetation YES NO (circle one)
If YES, is vegetation (circle all applicable)
ROOTED EMERGENT ROOTED SUBMERGENT ROOTED FLOATING
ATTACHED ALGAE FLOATING ALGAE OTHER ____________________ (Specify)

Instream Cover for Fish (circle all applicable)
AQUATIC VEGETATION BOULDERS BRUSH-DEBRIS JAMS LOGS
SUBMERGED TREE ROOTS SUBMERGED TERRESTRIAL VEGETATION
UNDER CUT BANK ROCK LEDGE OTHER ____________________ (Specify)

Canopy Cover OPEN PARTLY SHADED SHADED (circle one)

Immediate Shore Cover	**Riparian Land Use**
DENUDED ________ %	GRASSLAND ______ %
GRASSES ________ %	URBAN RESIDENTIAL ______ %
SHRUBS ________ %	URBAN COMMERCIAL/INDUSTRIAL ______ %
TREES ________ %	WETLAND ______ %
OTHER (Specify)	FOREST ______ %
____________ ________ %	ROW CROPS ______ %
	OTHER ________________ (Specify) ______ %

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FIGURE 2 (Continued): METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO PHYSICAL HABITAT ASSESSMENT

Station Number ____________

Sediment Compostion	Plant Debris	_______	%
	Clay	_______	%
	Inorganic Silt	_______	%
	Organic Sludge	_______	%
	Sand (0.06 mm to 2 mm diameter)	_______	%
	Gravel (>2 mm to 64 mm diameter)	_______	%
	Cobble (>64 mm to 256 mm diameter)	_______	%
	Boulder (>256 mm diameter)	_______	%
	Bedrock or Concrete	_______	%

Sediment Color ______________________ **Sediment Odor** __________________

Oil in Sediment	NONE	LIGHT	MODERATE	HEAVY	(circle one)
Embeddedness	NONE	NORMAL	MODERATE	EXTENSIVE	(circle one)
Sinuosity	NONE	LOW	MODERATE	HIGH	(circle one)

Depth of Fines (In feet using 1 inch diameter probe) ____________________

Photo Numbers Looking Upstream ______________ Looking Downstream ____________

Site Location/Map (Draw a map of the site and indicate the area assessed)

Additional Remarks ____

____

____

____

____

____

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Stunned fish were picked out of the water with long handled dip nets by either of two netters who were positioned on the bow of the boat.

In most cases, the section of canal sampled extended for 400 meters. Whenever possible, both sides of this canal section were electrofished.

Wadeable Stream Sampling. Fish were collected at each sample station using a backpack electrofisher and a bag seine. Conductivity and temperature (°C) were recorded before each sample collection. A DC backpack electrofisher was employed to electrify the water with 0.7 to 1.0 amps of current, stunning the fish. In most instances, two 40-meter long backpack electrofisher collections were conducted at each station. A 40-meter reach of the creek was electrified by moving upstream parallel to the bank. Additional personnel followed the electrofisher collecting the stunned fish with dip nets. Following the first collection, a second 40-meter electrofishing survey was conducted on the opposite bank. If the creek was less than five meters wide, electrofishing occurred only once along a 40-meter reach. The total electrofishing time during each 40-meter collection was noted.

A 15-foot bag seine with 3/16-inch mesh was also used to collect fish. Staff pulled the seine for 40 meters traveling upstream parallel to the bank. In most instances, a separate 40-meter seine collection occurred along each bank.

Fish Processing. In the field, most fish were identified to species, weighed to the nearest gram or nearest 0.1 gram (depending on size), measured for standard and total length to the nearest millimeter, and examined for the incidence of disease, parasites, or other anomalies. Following processing, these fish were returned live to the river. Minnows and other small fish that were difficult to identify were preserved in 10 percent (v/v) formalin and returned to the laboratory for further analysis. These fish were processed in a similar manner to the field-measured fish, except that they were weighed to the nearest 0.01 gram.

Index of Biotic Integrity. Biological integrity of aquatic ecosystems has been defined as the ability to support and maintain a balanced, integrated, and adaptive community having a species composition, diversity, and a functional organization comparable to that of a natural habitat (Karr et al., 1986). Karr's 1986 Index of Biotic Integrity (IBI) was used to analyze fish data from 2005.

The limitations of using this tool, which was meant to apply to wadable streams, for some of the man-made, channelized waterways in the Chicago area should be recognized.

Karr's IBI integrates information from 12 fish community metrics that fall into three major categories: (1) species richness and composition, (2) trophic composition, and (3) fish abundance and condition. Each metric is scored as a 1, 3, or 5 based on whether its evaluation deviates strongly, deviates somewhat, or approximates expectations, respectively, as compared to an undisturbed site located in a similar geographical region and on a stream of comparable size. Individual metrics are added to calculate a total IBI score. A high IBI indicates high biological integrity or health and low disturbance or lack of perturbations. A low IBI indicates low biological integrity and high disturbance or degradation. Separate IBI metric scores were determined based on the relative abundance of fish collected with each fishing gear. IBI categories of good (IBI 41-60), fair (IBI 21-40) or poor (IBI <21), as derived by the IEPA (IEPA, 1996) were determined and reported.

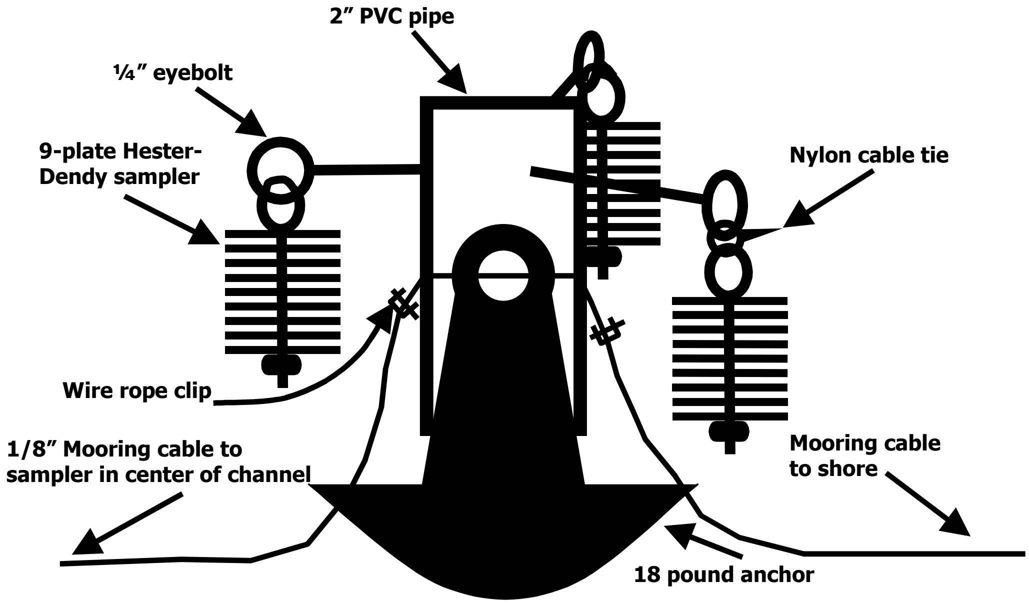
Benthic Invertebrates

Ponar Sediment Sampling. Triplicate sediment samples were collected with a petite Ponar Grab (0.023 m^2) from the center and one side of the deep-draft and wadeable waterway stations. Grab samples were taken at locations upstream from any prior sampling disturbance, such as Hester Dendy retrievals (see description in next section) to avoid collecting disturbed sediment. An appropriate area for ponar sampling was chosen by a staff biologist to avoid any obvious obstructions such as large rocks or plants. The sediment samples were sieved in the field using a field sieving bucket with 250 micrometer (µm) openings. The sieved material was poured into one-gallon plastic containers, preserved to 10 percent formalin concentration, and brought back to the laboratory for analysis. All samples were stored at 4°C until processed.

Artificial Substrate Sampling. Hester Dendy artificial substrate samplers were deployed at each station between May and early June of 2005. <u>Figure 3</u> shows a diagram of the plate configuration that was assembled prior to deployment in the waterways. In all, 27, 3- X 3-inch sampling plates were attached to 2, 18-pound river anchors, connected to an object on shore (usually a tree) by a cable, and then placed on the bottom of the waterway in the center and on one side. These substrates were left in the waterway between 7 and 14 weeks and then retrieved concurrent to other biological sampling. Hester Dendy set-ups were located and the anchors were lifted out of the waterway with a 250 micron mesh plankton net underneath to avoid organism loss. Then, plates were cut from the anchors and placed into a one-gallon bucket with a secure leak-proof lid. Invertebrates from the plankton net reservoir were also rinsed into the buckets, which were then filled with river water and brought to a 10 percent final concentration of formalin.

Benthic Invertebrate Processing. In the laboratory, the ponar sediment samples were gently washed and screened through a U.S. Standard number 60 mesh sieve (250 µm openings). The formalin mixture in which the Hester Dendy plates were immersed was also sieved through a number 60 mesh sieve, and then the sampling bucket was filled with tap water to cover the plates. Each plate was removed from the sampler and gently brushed with a paintbrush on both sides while running under a slow stream of water in order to rinse the attached invertebrates into the sieve. Rinsings from both ponar and Hester Dendy sampling containers were thoroughly sieved. The sieved material was examined in small batches under a compound microscope in a 100- X 50-mm glass crystallizing dish filled about 1 cm high. Laboratory technicians then counted oligochaete worms and removed all other invertebrates from the finer residual material. In situations where large numbers of any one taxon (usually worms) were encountered (>3000), estimates of their abundance were made by using a sub-sampling device. Invertebrates other

FIGURE 3: CONFIGURATION OF HESTER DENDY LARVAL PLATE SAMPLER



than worms were sent to a consultant (EA Engineering) for identification to genus or species when possible.

Sediment Chemistry

Sample Collection. Prior to sample collection the Ponar grab sampler and the metal and plastic pans and scoops were cleaned with hot water and lab detergent, rinsed with de-ionized water and allowed to air dry. The ponar and metal pans and scoops were then rinsed with acetone, allowed to air dry, and dried in an oven at 105°C for one hour. When dry and cool, each set was placed in a plastic bag and sealed to prevent contamination until ready for use. Sediment samples were collected from the center and side of the waterway using separate cleaned 6- X 6-inch Ponar grab samplers. The sediment samples were either transferred into plastic or metal pans and then put into the appropriate container using plastic or metal scoops. The constituents analyzed in sediment, sample containers used, and preservation methods are summarized in Table 2. Metal scoops and pans were used for samples collected in glass containers, whereas plastic scoops and pans were used for sediment collected in plastic containers. After being filled, sample containers were placed on ice until they could be refrigerated.

Sample Analyses. The sediment samples were analyzed for total solids (TS), total volatile solids (TVS), ammonia nitrogen (NH3-N), nitrate plus nitrite nitrogen (NO2+NO3), total Kjeldahl nitrogen (TKN), total phosphorus (TP), total cyanide (TCN), phenols, total metals (including arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc), and Organic Priority Pollutants (OPPs) (listed in Table 3) by the District's Analytical Laboratory Division (ALD). Sediment samples were sent on ice to a contractor laboratory for acid volatile sulfide/simultaneously extractable metals (AVS/SEM), total organic carbon (TOC), and particle size. In the laboratory, all constituents were analyzed using procedures established by the USEPA or described in Standard Methods for the Examination of Water and Wastewater (19^{th} edition, 1998).

Sediment Toxicity

Sediment samples were collected using a 6- X 6-inch Ponar grab sampler from the center and side of the waterways, and scooped into 1-gallon plastic buckets (at least ½ full). Buckets were kept on ice until they could be refrigerated. These samples were sent in coolers on ice to a contractor for ten-day *Chironomus tentans* toxicity testing (USEPA, Test Method 100.2, 2000). Tests were performed within 14 days of sediment collection.

TABLE 2: CONSTITUENTS ANALYZED, SAMPLE CONTAINERS, AND PRESERVATION METHODS FOR SEDIMENT SAMPLES COLLECTED FOR THE AMBIENT WATER QUALITY MONITORING PROGRAM

Constituents	Units of Measure[1]	Sample Container	Preservative
Total Solids	percent	Glass	Cool, 4°C
Total Volatile Solids	percent	Glass	Cool, 4°C
Un-ionized Ammonia	mg/kg	Glass	Cool, 4°C
Nitrite plus Nitrate Nitrogen	mg/kg	Glass	Cool, 4°C
Total Kjeldahl Nitrogen	mg/kg	Glass	Cool, 4°C
Total Phosphorus	mg/kg	Glass	Cool, 4°C
Phenols	mg/kg	Glass	Cool, 4°C
Total Cyanide	mg/kg	Glass	Cool, 4°C
Acid Volatile Sulfide	µmoles/g	Plastic	Cool, 4°C
Simultaneously Extracted Metal	µmoles/g	Plastic	Cool, 4°C
Total Organic Carbon	mg/kg	Glass	Cool, 4°C
Particle Size	percent	Plastic	Cool, 4°C
Toxicity (survival)	percent	Plastic	Cool, 4°C
Toxicity (growth)	mg/org[2]	Plastic	Cool, 4°C
Total Metals (Arsenic, Cadmium, Chromium Copper, Iron, Lead, Manganese, Mercury, Nickel, Silver, and Zinc)	mg/kg	Glass	Cool, 4°C
Organic Priority Pollutants (Volatile Organic Compounds, Polynuclear Aromatic Hydrocarbons, Polychlorinated Biphenyls, Pesticides)	µg/kg	Glass	Cool, 4°C

[1]Expressed on a dry weight basis.
[2]Org = organism.

TABLE 3: LIST OF ORGANIC PRIORITY POLLUTANTS ANALYZED IN SEDIMENT SAMPLES COLLECTED FOR THE AMBIENT WATER QUALITY MONITORING PROGRAM DURING 2005

Volatile Organic Compounds	Acid Extractables	Base/Neutral Extractables	Pesticides and PCBs
Acrolein	2-Chlorophenol	Acenaphthene	Aldrin
Acrylonitrile	2,4-Dichlorophenol	Acenaphthylene	a-BHC-alpha
Benzene	2,4-Dimethylphenol	Anthracene	b-BHC-beta
Bromoform	4,6-Dinitro-o-cresol	Benzidine	BHC-gamma
Carbon tetrachloride	2,4-Dinitrophenol	Benzo(a)anthracene	BHC-delta
Chlorobenzene	2-Nitrophenol	Benzo(a)pyrene	Chlordane
Chlorodibromomethane	4-Nitrophenol	3,4-Benzofluoranthene	4,4'-DDT
Chloroethane	Parachlorometacresol	Benzo(ghi)perylene	4,4'-DDE
2-Chloroethylvinyl ether	Pentachlorophenol	Benzo(k)fluoranthene	4,4'-DDD
Chloroform	Phenol	Bis(2-chloroethoxy)methane	Dieldrin
Dichlorobromomethane	2,4,6-Trichlorophenol	Bis(2-chloroethyl)ether	a-Endosulfan-alpha
1,1-Dichloroethane		Bis(2-chloroisopropyl)ether	b-Endosulfan-beta
1,2-Dichloroethane		Bis(2-ethylhexyl)phthalate	Endosulfan sulfate
1,1-Dichloroethylene		4-Bromophenyl phenyl ether	Endrin
1,2-Dichloropropane		Butylbenzyl phthalate	Endrin aldehyde
1,3-Dichloropropene		2-Chloronaphthalene	Heptachlor
Ethyl benzene		4-Chlorophenyl phenyl ether	Heptachlor epoxide
Methyl bromide		Chrysene	PCB-1242
Methyl chloride		Dibenzo(a,h)anthracene	PCB-1254
Methylene chloride		1,2-Dichlorobenzene	PCB-1221
1,1,2,2-Tetrachloroethane		1,3-Dichlorobenzene	PCB-1232
Tetrachloroethylene		1,4-Dichlorobenzene	PCB-1248
Toluene		3,3-Dichlorobenzidine	PCB-1260

TABLE 3 (Continued): LIST OF ORGANIC PRIORITY POLLUTANTS ANALYZED IN SEDIMENT SAMPLES COLLECTED FOR THE AMBIENT WATER QUALITY MONITORING PROGRAM DURING 2005

Volatile Organic Compounds	Acid Extractables	Base/Neutral Extractables	Pesticides and PCBs
1,2-trans-Dichloroethylene		Diethyl phthalate	PCB-1016
1,1,1-Trichloroethane		Dimethyl phthalate	Toxaphene
1,1,2-Trichloroethane		Di-n-butyl phthalate	
Trichloroethylene		2,4-Dinitrotoluene	
Vinyl chloride		2,6-Dinitrotoluene	
Trichlorofluoromethane		Di-n-octyl phthalate	
		1,2-Diphenylhydrazine	
		Fluoranthene	
		Fluorene	
		Hexachlorobenzene	
		Hexachlorobutadiene	
		Hexachlorocyclopentadiene	
		Hexachloroethane	
		Indeno(1,2,3-cd)pyrene	
		Isophorone	
		Naphthalene	
		Nitrobenzene	
		N-Nitrosodimethylamine	
		N-Nitrosodi-n-propylamine	
		N-Nitrosodiphenylamine	
		Phenanthrene	
		Pyrene	
		1,2,4-Trichlorobenzene	

RESULTS AND DISCUSSION

Chlorophyll

As a photosynthetic component of all algae cells, the determination of chlorophyll *a* is an accepted way of quantifying algal biomass in lakes and streams. Chlorophyll *a* values are of interest to regulatory agencies since it is also widely accepted that high algae concentrations may indicate nutrient impairment. The IEPA is cooperating with other state and local agencies to develop regional water quality criteria for nutrients and possibly chlorophyll. In light of this consideration, the District began monitoring chlorophyll on a monthly basis in August 2001 as part of the AWQM Program. Results from 2005 are shown in Table 4.

During 2005, the highest mean chlorophyll *a* values in the Chicago area waterways were at Burnham Avenue on the Grand Calumet River (58 µg/L), and Springinsguth Road on the West Branch DuPage River (60 µg/L). The lowest mean chlorophyll *a* concentration throughout the system was 1 µg/L at Ewing Avenue on the Calumet River.

Habitat

Habitat is one of the most crucial factors limiting aquatic life in urban environments. Channelization, limited instream and canopy cover, siltation, erosion, and lack of adequate flood plain area are some of the physical characteristics that challenge waterways in the Chicago area. The QHEI was developed by OEPA as a method to quantify and assess wadeable aquatic habitats for their ability to support aquatic life. Since this metric was designed to analyze wadeable streams, the limitations to its application in man-made channel portions of the Chicago and Calumet River Systems should be considered. Metrics include: substrate, instream cover, channel quality, riparian zone/erosion, pool and riffle quality, and stream gradient. Narrative designations were assigned to QHEI score ranges so that waterway reaches could be categorized as excellent, good, fair, poor, or very poor based on the ability of the habitat to support aquatic life. Table 5 displays the QHEI score and rating for each of the stations assessed in 2005.

In the northern Chicago River System, QHEI ratings ranged from very poor to good (25-62). The limiting factors in this system were a lack of in-stream cover, silty substrates, and channelization throughout reaches of the North Shore Channel and the deep-draft portion of the North Branch Chicago River. The stations with the best habitat scores were located at Lake-Cook Road on the Skokie River and Glenview Road on the North Branch Chicago River. These locations had more in-stream cover, less silt in the sediment, and better pool/run development than the other stations in the northern Chicago River System. Located in downtown Chicago in the channelized portion of the North Branch Chicago River, Grand Avenue received the lowest QHEI rating (very poor). This site had poor riparian zone habitat, low to no in-stream cover, and the sediment was embedded with oily silt.

Of the stations sampled annually, the lowest habitat rating was assigned to Wille Road on Higgins Creek. Downstream of the John C. Kirie WRP, this section of the waterway is

TABLE 4: RANGE AND MEAN CHLOROPHYLL *a* VALUES IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS DURING 2005

Station No.	Station Name	Waterway	N*	Mean µg/L	Minimum µg/L	Maximum µg/L	Standard Deviation µg/L
106	Dundee Road	W Fork N Branch Chicago River[1]	4	15	4	22	8
103	Golf Road	W Fork N Branch Chicago River[1]	10	29	5	123	36
31	Lake-Cook Road	M Fork N Branch Chicago River[2]	10	8	1	19	5
32	Lake-Cook Road	Skokie River	11	12	2	55	17
105	Frontage Road	Skokie River	12	15	1	34	11
104	Glenview Road	North Branch Chicago River	12	10	1	30	10
34	Dempster Street	North Branch Chicago River	11	24	3	96	27
96	Albany Avenue	North Branch Chicago River	11	36	3	157	47
35	Central Street	North Shore Channel	8	4	1	21	7
102	Oakton Street	North Shore Channel	12	8	1	40	12
36	Touhy Avenue	North Shore Channel	12	2	<1	16	2
101	Foster Avenue	North Shore Channel	12	2	<1	16	3
37	Wilson Avenue	North Branch Chicago River	12	3	1	6	1
73	Diversey Avenue	North Branch Chicago River	12	3	1	6	1
46	Grand Avenue	North Branch Chicago River	12	4	2	8	2
74	Lake Shore Drive	Chicago River	10	3	<1	16	5
100	Wells Street	Chicago River	12	3	1	11	3
39	Madison Street	South Branch Chicago River	12	4	1	11	3
108	Loomis Street	South Branch Chicago River	10	5	1	13	4
99	Archer Avenue	South Fork South Branch Chicago River	11	21	2	130	37
40	Damen Avenue	Chicago Sanitary and Ship Canal	12	14	1	76	22
75	Cicero Avenue	Chicago Sanitary and Ship Canal	12	6	2	21	5
41	Harlem Avenue	Chicago Sanitary and Ship Canal	12	4	1	9	3
42	Route 83	Chicago Sanitary and Ship Canal	11	6	1	20	7
48	Stephen Street	Chicago Sanitary and Ship Canal	11	5	1	18	5
92	Lockport	Chicago Sanitary and Ship Canal	52	5	1	19	4

TABLE 4 (Continued): RANGE AND MEAN CHLOROPHYLL *a* VALUES IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS DURING 2005

Station No.	Station Name	Waterway	N*	Mean µg/L	Minimum µg/L	Maximum µg/L	Standard Deviation µg/L
49	Ewing Avenue	Calumet River	11	1	<1	1	<1
55	130th Street	Calumet River	11	3	1	6	2
50	Burnham Avenue	Wolf Lake	12	7	3	18	4
86	Burnham Avenue	Grand Calumet River	10	58	5	207	70
56	Indiana Avenue	Little Calumet River	9	16	2	38	12
76	Halsted Street	Little Calumet River	12	7	<1	16	7
52	Wentworth Avenue	Little Calumet River	9	6	2	13	4
54	Joe Orr Road	Thorn Creek	8	12	2	59	19
97	170th Street	Thorn Creek	11	8	3	18	5
57	Ashland Avenue	Little Calumet River	11	9	4	20	6
58	Ashland Avenue	Calumet-Sag Channel	12	10	1	29	10
59	Cicero Avenue	Calumet-Sag Channel	12	8	1	19	6
43	Route 83	Calumet-Sag Channel	11	9	2	29	9
90	Route 19	Poplar Creek	11	13	2	31	8
110	Springinsguth Road	West Branch DuPage River	11	60	4	266	91
89	Walnut Lane	West Branch DuPage River	12	9	1	31	10
64	Lake Street	West Branch DuPage River	12	25	6	53	16
79	Higgins Road	Salt Creek	9	31	17	44	9
80	Arlington Heights Road	Salt Creek	12	12	2	34	10
18	Devon Avenue	Salt Creek	12	15	4	36	10
24	Wolf Road	Salt Creek	12	11	1	33	10
109	Brookfield Avenue	Salt Creek	12	11	1	31	10
77	Elmhurst Road	Higgins Creek	4	14	9	19	4
78	Wille Road	Higgins Creek	12	2	<1	16	1
12	Lake-Cook Road	Buffalo Creek	7	31	15	51	14

TABLE 4 (Continued): RANGE AND MEAN CHLOROPHYLL *a* VALUES IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS DURING 2005

Station No.	Station Name	Waterway	N*	Mean µg/L	Minimum µg/L	Maximum µg/L	Standard Deviation µg/L
13	Lake-Cook Road	Des Plaines River	12	28	8	92	28
17	Oakton Street	Des Plaines River	12	34	1	150	54
19	Belmont Avenue	Des Plaines River	12	23	1	108	33
20	Roosevelt Road	Des Plaines River	12	23	2	99	36
22	Ogden Avenue	Des Plaines River	12	19	2	69	22
23	Willow Springs Road	Des Plaines River	12	29	4	176	49
29	Stephen Street	Des Plaines River	12	49	4	225	64
91	Material Services Road	Des Plaines River	12	35	6	164	43

*N = Number of Observations.
[1]West Fork North Branch Chicago River.
[2]Middle Fork North Branch Chicago River.

TABLE 5: QUALITATIVE HABITAT EVALUATION INDEX SCORES IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS MEASURED DURING 2005

Station No.	Station Name	Waterway	QHEI[1] Score	Habitat Rating
106	Dundee Road	West Fork North Branch	46	Fair
103	Golf Road	West Fork North Branch	51	Fair
31	Lake-Cook Road	Middle Fork North Branch	32	Poor
32	Lake-Cook Road	Skokie River	62	Good
105	Frontage Road	Skokie River	36	Poor
104	Glenview Road	North Branch Chicago River	62	Good
34	Dempster Street	North Branch Chicago River	47	Fair
96	Albany Avenue*	North Branch Chicago River	33	Poor
35	Central Street	North Shore Channel	39	Poor
102	Oakton Street	North Shore Channel	39	Poor
36	Touhy Avenue*	North Shore Channel	44	Poor
101	Foster Avenue	North Shore Channel	46	Fair
37	Wilson Avenue	North Branch Chicago River	42	Poor
73	Diversey Parkway	North Branch Chicago River	30	Poor
46	Grand Avenue*	North Branch Chicago River	25	Very Poor
75	Cicero Avenue*	Chicago Sanitary & Ship Canal	32	Poor
41	Harlem Avenue*	Chicago Sanitary & Ship Canal	35	Poor
92	Lockport*	Chicago Sanitary & Ship Canal	40	Poor
55	130^{th} Street*	Calumet River	51	Fair
76	Halsted Street*	Little Calumet River	55	Fair
59	Cicero Avenue*	Calumet-Sag Channel	37	Poor
64	Lake Street*	West Branch DuPage River	49	Fair
18	Devon Avenue*	Salt Creek	55	Fair
78	Wille Road*	Higgins Creek	27	Very Poor
13	Lake-Cook Road*	Des Plaines River	49	Fair
22	Ogden Avenue*	Des Plaines River	53	Fair
91	Material Service Rd.*	Des Plaines River	64	Good

[1]QHEI=Qualitative Habitat Evaluation Index.
*Annual sampling station.

essentially a concrete conveyance for treated effluent. The annual station with the most favorable habitat according to the QHEI rating was Material Services Road on the Des Plaines River. The river is wide along this reach and it had development of riffle, run, and pool habitats. Embeddedness was low and there was ample in-stream cover.

Fish

Table 6 lists the common and scientific names of the fish species collected from the Chicago, Calumet, and Des Plaines River Systems during 2005. The number of individuals, total species, and game species collected, as well as catch weight from each station, can be referenced in Table 7. The most abundant fish species collected from the shallow portion of the Chicago River System included carp and green sunfish, while carp and gizzard shad were the most frequently collected species in the deep-draft portion. During 2005, 4,632 fish comprised of 36 total species, 14 game species, and 3 hybrids were collected from AWQM stations. Table 8 shows the IBI scores calculated for each station and collection method. All of the stations rated "fair" according to the IBI except for 130th Street on the Calumet River which would be considered "good." Comprehensive fish data for each sampling station is available on the District Website at www.mwrd.org under the *Biological Data* heading.

Benthic Invertebrates

Table 9 contains a list of benthic invertebrate taxa collected by each of the two sampling methods. Taxa that are underlined in the table are considered highly tolerant based on literature sources examined by EA Engineering, Science, and Technology, the District's consultant for benthic invertebrate identification. A report entitled, "A Study of the Benthic Macroinvertebrate Community in Selected Chicago Metropolitan Area Waterways During 2005" has been posted on the District Website at www.mwrd.org under the *Biological Reports* heading. Total species richness for ponar and Hester Dendy samplers combined was 135 species, while total Ephemeroptera, Plecoptera, and Tricoptera (EPT) richness was 23 species. These indices are both slightly higher than the 2001 collection at the same stations, which yielded 100 total species, 20 of which were EPT.

North Branch Chicago River System. In 2005, biological sampling focused on the North Branch Chicago River System, so benthic invertebrate samples were collected at 15 stations therein. Tolerant invertebrate taxa dominated Hester Dendy and ponar samples throughout this system. Total and EPT taxa richness varied considerably within each waterway. Highest total taxa richness occurred in the Hester Dendy sample from Dempster Street in the North Branch Chicago River (37 taxa), while the lowest (4) was found at Grand Avenue in the deep-draft portion of the same waterway. The Hester Dendy sample from Albany Avenue on the North Branch Chicago River contained the highest EPT taxa richness with 5 taxa, while several samples throughout the watershed contained no EPT taxa. Head capsule deformities in Chironomidae specimens occurred at a higher rate than in other Chicago area river systems during 2005, and were found in a majority of the samples. This does not necessarily indicate a more

TABLE 6: COMMON AND SCIENTIFIC NAMES OF FISHES COLLECTED IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS DURING 2005

Common Name	Scientific Name
HERRING FAMILY	CLUPEIDAE
Skipjack herring	*Alosa chrysochloris*
Gizzard shad	*Dorosoma cepedianum*
MINNOW FAMILY	CYPRINIDAE
Goldfish	*Carassius auratus*
Central mudminnow	*Umbra limi*
Common carp	*Cyprinus carpio*
Carp x Goldfish Hybrid	*Cyprinus carpio x Carrassius auratus*
Spotfin shiner	*Cyprinella spiloptera*
Golden shiner	*Notemigonus crysoleucas*
Emerald shiner	*Notropis atherinoides*
Bigmouth shiner	*Notropis dorsalis*
Spottail shiner	*Notropis hudsonius*
Sand shiner	*Notropis stramineus*
Bluntnose minnow	*Pimephales notatus*
Fathead minnow	*Pimephales promelas*
Creek chub	*Semotilus atromaculatus*
SUCKER FAMILY	CATOSTOMIDAE
White sucker	*Catostomus commersonii*
Black buffalo	*Ictiobus niger*
CATFISH FAMILY	ICTALURIDAE
Black bullhead*	*Ameiurus melas*
Yellow bullhead*	*Ameiurus natalis*
Brown bullhead*	*Ameiurus nebulosus*
Channel catfish*	*Ictalurus punctatus*
KILLIFISH FAMILY	*FUNDULIDAE*
Blackstripe topminnow	*Fundulus notatus*
LIVEBEARER FAMILY	POECILIIDAE
Western mosquitofish	*Gambusia affinis*
TEMPERATE BASS FAMILY	MORONIDAE
White perch*	*Morone americana*
Yellow bass*	*Morone mississippiensis*

TABLE 6 (Continued): COMMON AND SCIENTIFIC NAMES OF FISHES COLLECTED IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS DURING 2005

Common Name	Scientific Name
GOBY FAMILY	GOBIIDAE
Round goby	*Neogobius melanostomus*
SUNFISH FAMILY	*CENTRARCHIDAE*
Rock bass*	*Ambloplites rupestris*
Green sunfish*	*Lepomis cyanellus*
Pumpkinseed*	*Lepomis gibbosus*
Orangespotted sunfish*	*Lepomis humilis*
Bluegill*	*Lepomis macrochirus*
Green sunfish x Bluegill Hybrid	*L. cyanellus x L. macrochirus*
Pumpkinseed x Bluegill Hybrid	*L. gibbosus x L. macrochirus*
Smallmouth bass*	*Micropterus dolomieu*
Largemouth bass*	*Micropterus salmoides*
Black crappie*	*Pomoxis nigromaculatus*
PERCH FAMILY	*PERCIDAE*
Johnny darter	*Etheostoma nigrum*
Blackside darter	*Percina maculata*
DRUM FAMILY	*SCIAENIDAE*
Freshwater drum	*Aplodinotus grunniens*

*Game fish species.

TABLE 7: NUMBER, WEIGHT, AND NUMBER OF SPECIES FOR FISH COLLECTED IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS DURING 2005

Station No.	Location	Waterway	Sample Gear	Number of Fish	Weight (grams)	Number of Species		Most Abundant Species
						Total	Game	
106	Dundee Road	W Fork N Branch Chicago River[1]	BP/Seine	5	14	3	1	Carp
103	Golf Road	W Fork N Branch Chicago River[1]	BP/Seine	6	118	4	3	Green sunfish
31	Lake-Cook Road	M Fork N Branch Chicago River[2]	BP	14	260	4	2	Green sunfish
32	Lake-Cook Road	Skokie River	BP/Seine	34	5,621	4	2	Bluegill, Green sunfish
105	Frontage Road	Skokie River	BP/Seine	39	722	3	2	Green sunfish
104	Glenview Road	North Branch Chicago River	BP	10	657	3	2	Green sunfish
34	Dempster Street	North Branch Chicago River	BP/Seine	13	399	5	2	Carp
96	Albany Avenue*	North Branch Chicago River	BP	6	17	3	1	Carp
35	Central Street	North Shore Channel	Large EF Boat	139	159,512	10	5	Carp
102	Oakton Street	North Shore Channel	Large EF Boat	151	21,056	17	9	Golden shiner
36	Touhy Avenue*	North Shore Channel	Large EF Boat	276	102,744	9	4	Gizzard shad
101	Foster Avenue	North Shore Channel	Large EF Boat	273	48,926	16	7	Gizzard shad
37	Wilson Avenue	North Branch Chicago River	Large EF Boat	122	169,620	11	5	Carp
73	Diversey Parkway	North Branch Chicago River	Large EF Boat	164	70,776	12	6	Golden shiner
46	Grand Avenue*	North Branch Chicago River	Large EF Boat	77	14,020	5	3	Gizzard shad
75	Cicero Avenue*	Chicago Sanitary & Ship Canal	Large EF Boat	184	59,470	7	3	Gizzard shad
41	Harlem Avenue*	Chicago Sanitary & Ship Canal	Large EF Boat	758	96,426	13	4	Gizzard shad
92	Lockport*	Chicago Sanitary & Ship Canal	Large EF Boat	179	20,337	9	3	Gizzard shad
55	130th Street*	Calumet River	Large EF Boat	380	102,346	16	7	Largemouth bass
76	Halsted Street*	Little Calumet River	Large EF Boat	913	125,321	18	9	Gizzard shad

TABLE 7 (Continued): NUMBER, WEIGHT, AND NUMBER OF SPECIES FOR FISH COLLECTED IN THE CHICAGO, CALUMET, AND DES PLAINES RIVER SYSTEMS DURING 2005

Station No.	Location	Waterway	Sample Gear	Number of Fish	Weight (grams)	Number of Species		Most Abundant Species
						Total	Game	
59	Cicero Avenue*	Calumet-Sag Channel	Large EF Boat	453	85,424	10	5	Emerald shiner
64	Lake Street*	West Branch DuPage River	BP/Seine	64	1,633	7	3	Green sunfish
18	Devon Avenue*	Salt Creek	BP/Seine	49	2,985	8	4	Green sunfish
78	Wille Road*	Higgins Creek	BP	30	214	6	1	White sucker
13	Lake-Cook Road*	Des Plaines River	BP/Seine	125	2,284	10	5	Green sunfish
22	Ogden Avenue*	Des Plaines River	BP	39	1,522	10	3	White sucker
91	Material Service Road*	Des Plaines River	BP/Seine	129	454	12	3	Bluntnose minnow
TOTAL				4,632	1,093 kg.	36	14	

[1]West Fork North Branch Chicago River.
[2]Middle Fork North Branch Chicago River.
*Annual sampling station.

TABLE 8: INDEX OF BIOTIC INTEGRITY SCORE AND CATEGORY BY STATION DURING 2005

Station No.	Location	Waterway	Sample Gear	IBI* Score	IBI* Category
106	Dundee Road	West Fork North Branch Chicago River	BP	26	Fair
106	Dundee Road	West Fork North Branch Chicago River	Seine	24	Fair
103	Golf Road	West Fork North Branch Chicago River	BP	28	Fair
103	Golf Road	West Fork North Branch Chicago River	Seine	28	Fair
31	Lake-Cook Road	Middle Fork North Branch Chicago River	BP	22	Fair
31	Lake-Cook Road	Middle Fork North Branch Chicago River	Seine	ND	ND
32	Lake-Cook Road	Skokie River	BP	26	Fair
32	Lake-Cook Road	Skokie River	Seine	30	Fair
105	Frontage Road	Skokie River	BP	22	Fair
105	Frontage Road	Skokie River	Seine	ND	ND
104	Glenview Road	North Branch Chicago River	BP	22	Fair
104	Glenview Road	North Branch Chicago River	Seine	ND	ND
34	Dempster Street	North Branch Chicago River	BP	24	Fair
34	Dempster Street	North Branch Chicago River	Seine	24	Fair
96	Albany Avenue	North Branch Chicago River	BP	22	Fair
96	Albany Avenue	North Branch Chicago River	Seine	ND	ND
35	Central Street	North Shore Channel	Large EF Boat	28	Fair
102	Oakton Street	North Shore Channel	Large EF Boat	36	Fair
36	Touhy Avenue	North Shore Channel	Large EF Boat	32	Fair
101	Foster Avenue	North Shore Channel	Large EF Boat	32	Fair
37	Wilson Avenue	North Branch Chicago River	Large EF Boat	30	Fair
73	Diversey Parkway	North Branch Chicago River	Large EF Boat	30	Fair
46	Grand Avenue	North Branch Chicago River	Large EF Boat	28	Fair
75	Cicero Avenue	Chicago Sanitary and Ship Canal	Large EF Boat	28	Fair
41	Harlem Avenue	Chicago Sanitary and Ship Canal	Large EF Boat	30	Fair
92	Lockport	Chicago Sanitary and Ship Canal	Large EF Boat	30	Fair

TABLE 8 (Continued): INDEX OF BIOTIC INTEGRITY SCORE AND CATEGORY BY STATION DURING 2005

Station No.	Location	Waterway	Sample Gear	IBI* Score	IBI* Category
55	130th Street	Calumet River	Large EF Boat	42	Good
76	Halsted Street	Little Calumet River	Large EF Boat	36	Fair
59	Cicero Avenue	Calumet-Sag Channel	Large EF Boat	36	Fair
13	Lake-Cook Road	Des Plaines River	BP	28	Fair
13	Lake-Cook Road	Des Plaines River	Seine	34	Fair
78	Wille Road	Higgins Creek	BP	28	Fair
78	Wille Road	Higgins Creek	Seine	ND	ND
18	Devon Avenue	Salt Creek	BP	24	Fair
18	Devon Avenue	Salt Creek	Seine	34	Fair
22	Ogden Avenue	Des Plaines River	BP	26	Fair
22	Ogden Avenue	Des Plaines River	Seine	ND	ND
91	Material Services Road	Des Plaines River	BP	28	Fair
91	Material Services Road	Des Plaines River	Seine	26	Fair
64	Lake Street	West Branch DuPage River	BP	28	Fair
64	Lake Street	West Branch DuPage River	Seine	32	Fair

*IBI = Index of Biotic Integrity.
ND = No fish were caught in the seine or conditions were unfavorable for seining.

TABLE 9: BENTHIC INVERTEBRATE TAXA COLLECTED BY PONAR AND HESTER DENDY SAMPLERS DURING 2005

Taxa	Hester Dendy	Petite Ponar
PORIFERA (Sponges)	X	
COELENTERATA (Hydroids)		
Hydra	X	X
PLATYHELMINTHES (Flat worms)		
Turbellaria	X	X
ENTOPROCTA (Moss Animalcules)		
Urnatella gracilis	X	X
ECTOPROCTA (Bryozoans)		
Plumatella	X	X
ANNELLIDA		
Oligochaeta (Aquatic Worms)	X	X
Hirudinea (Leeches)		
Glossiphoniidae[1]		
Desserobdella phalera	X	
Helobdella[1]	X[1]	
Helobdella stagnalis	X	X
Helobdella triserialis	X	X
Placobdella montifera	X	
Erpobdella punctata punctata	X	X
Mooreobdella microstoma	X	X
CRUSTACEA		
Isopoda (Sow Bugs)		
Caecidotea	X	X
Amphipoda (Side Swimmers)		
Crangonyx	X	
Gammarus[1]	X	X
Hyalella azteca	X	X
Decapoda (Crayfish)		
Orconectes[1]	X	X
Procambarus acutus	X	
ARACHNOIDEA		
Hydracarina (Water Mites)	X	X

TABLE 9 (Continued): BENTHIC INVERTEBRATE TAXA COLLECTED BY PONAR AND HESTER DENDY SAMPLERS DURING 2005

Taxa	Hester Dendy	Petite Ponar
INSECTA		
Collembola (Springtails)	X	X
Ephemeroptera (Mayflies)		
Isonychia	X	
Baetis intercalaris	X	X
Centroptilum	X	X
Heptagenia	X	
Maccaffertium integrum	X	
Maccaffertium terminatum	X	
Stenacron	X	X
Stenonema femoratum	X	
Caenis		X
Tricorythodes	X	X
Anthopotamus myops grp.		X
Odonata (Damselflies and Dragonflies)		
Zygoptera[1]		X[1]
Coenagrionidae[1]	X[1]	
Argia	X	
Enallagma	X	X
Hemiptera (True Bugs)		
Rheumatobates	X	
Corixidae	X	
Neuroptera (Spongillaflies)		
Sisyridae	X	
Trichoptera (Caddisflies)		
Cyrnellus fraternus	X	
Ceratopsyche morosa	X	
Cheumatopsyche	X	X
Hydropsyche	X	
Hydropsyche betteni	X	
Hydropsyche bidens	X	
Hydropsyche orris	X	
Hydropsyche simulans	X	

TABLE 9 (Continued): BENTHIC INVERTEBRATE TAXA COLLECTED BY PONAR AND HESTER DENDY SAMPLERS DURING 2005

Taxa	Hester Dendy	Petite Ponar
INSECTA		
Trichoptera (Caddisflies) (Continued)		
Hydroptila	X	X
Oxyethira		X
Ceraclea maculata	X	
Ocecetis	X	X
Lepidoptera (Aquatic Moths)		
Noctuidae		X
Petrophila	X	
Coleoptera (Beetles)		
Dubiraphia	X	X
Macronychus glabratus	X	
Stenelmis	X	X
Berosus		X
Enochrus	X	
Diptera (True Flies)		
Chaoborus		X
Ceratopogonidae	X	X
Hemerodromia	X	
Muscidae		X
Psychoda	X	
Simulium	X	
Chironomidae (Midges)[1]		
Alotanypus	X	
Procladius	X	X
Tanypus	X	X
Psectrotanypus		X
Coelotanypus		X
Ablabesmyia	X	
Ablabesmyia annulata	X	
Ablabesmyia janta	X	X
Ablabesmyia mallochi	X	X
Labrundinia neopilosella		X

TABLE 9 (Continued): BENTHIC INVERTEBRATE TAXA COLLECTED BY PONAR AND HESTER DENDY SAMPLERS DURING 2005

Taxa	Hester Dendy	Petite Ponar
INSECTA		
Diptera (True Flies) (Continued)		
Larsia		X
Pentaneura	X	X
Chironomidae (Midges)[1]		
Thienemannimyia grp.	X	X
Corynoneura	X	
Cricotopus		X
Cricotopus bicinctus grp.	X	X
Cricotopus sylvestris grp.	X	X
Cricotopus tremulus grp.	X	X
Cricotopus trifascia grp.		X
Nanocladius[1]	X[1]	
Nanocladius crassicornus/rectinervis	X	
Nanocladius distinctus	X	X
Nanocladius spiniplenus	X	
Parakiefferiella	X	X
Psectrocladius		X
Rheocricotopus robacki	X	X
Thienemanniella similis	X	X
Thienemanniella xena	X	X
Chironomus	X	X
Cladopelma	X	X
Cryptochironomus	X	X
Cryptotendipes	X	X
Dicrotendipes[1]		X[1]
Dicrotendipes fumidus	X	X
Dicrotendipes modestus	X	X
Dicrotendipes neomodestus	X	X
Dicrotendipes simpsoni	X	X
Endochironomus nigricans	X	
Glyptotendipes	X	X

TABLE 9 (Continued): BENTHIC INVERTEBRATE TAXA COLLECTED BY PONAR AND HESTER DENDY SAMPLERS DURING 2005

Taxa	Hester Dendy	Petite Ponar
INSECTA		
Diptera (True Flies) (Continued)		
Harnischia	X	X
Microtendipes	X	
Parachironomus	X	X
Chironomidae (Midges)[1]		
Paralauterborniella nigrohalteralis		X
Paratendipes	X	X
Phaenopsectra		X
Phaenopsectra obediens grp.	X	X
Phaenopsectra punctipes	X	X
Polypedilum fallax grp.	X	
Polypedilum flavum	X	X
Polypedilum halterale grp.	X	X
Polypedilum illinoense	X	X
Polypedilum scalaenum grp.	X	X
Pseudochironomus	X	X
Stenochironomus	X	X
Stictochironomus		X
Xenochironomus xenolabis	X	
Cladotanytarsus mancus grp.	X	X
Cladotanytarsus vanderwulpi grp.	X	X
Paratanytarsus	X	X
Rheotanytarsus	X	
Tanytarsus	X	X
Tanytarsus glabrescens grp.	X	
Tanytarsus guerlus grp.	X	X
GASTROPODA (Snails)		
Ferrissia	X	X
Bithynia tentaculata	X	X
Amnicola	X	X
Physa	X	X
Gyraulus	X	

TABLE 9 (Continued): BENTHIC INVERTEBRATE TAXA COLLECTED BY PONAR AND HESTER DENDY SAMPLERS DURING 2005

Taxa	Hester Dendy	Petite Ponar
GASTROPODA (Snails) (Continued)		
Helisoma	X	X
<u>*Menetus dilatatus*</u>	X	X
Pleurocera	X	X
PELECYPODA (Mussels and Clams)[1]		
Corbicula fluminea	X	X
Dreissena polymorpha	X	X
Musculium[1]	X	X
Pisidium[1]	X	X
Sphaerium[1]	X	X
TOTAL SPECIES RICHNESS BY SAMPLE TYPE	118	94
EPT[2] SPECIES RICHNESS BY SAMPLE TYPE	20	10
TOTAL SPECIES RICHNESS FOR 2005	135	
EPT[2] SPECIES RICHNESS FOR 2005	23	

Underlined taxa are considered highly tolerant.
[1]Not counted as a discreet taxon.
[2]Ephemeroptera, Plecoptera, and Tricoptera are considered relatively sensitive taxa.

stressed benthic community than other watersheds. Sediments in other watersheds may be more toxic to these organisms, so that overall survival is lower, resulting in overall lower incidence of head capsule deformities. The greatest proportion of head capsule deformities in *Chironomus* were found in the West Fork North Branch Chicago River Hester Dendy and ponar samples (30 and 14 percent, respectively), Skokie River Hester Dendy samples (9-22 percent), and the North Branch Chicago River ponar samples (7-19 percent).

South Branch Chicago River System. During 2005, benthic samples were collected from three stations in the CSSC. Total taxa richness ranged from 11 at Cicero and Harlem Avenues to 29 at Lockport, in the Hester Dendy samples. EPT taxa richness for these samples, on the other hand, ranged from 1 at both Cicero and Harlem Avenues to 3 at Lockport. Total taxa richness from ponar samples was lower (3-5 taxa), and no EPT taxa were collected in these samples. Head capsule deformities were found in 2 Hester Dendy samples, and only constituted 1 and 5 percent of examined Chironomidae.

Calumet River System. Benthic samples were collected from single stations in the Calumet River, Little Calumet River, and Calumet-Sag Channel during 2005. The Little Calumet River station's Hester Dendy sample exhibited the highest total and EPT taxa richness (30 and 2 taxa, respectively), while the Calumet-Sag Channel ponar sample had the lowest total taxa richness (5) and no EPT taxa. In the Calumet River, zebra mussels represented 93 percent of the total density in the Hester Dendy sample. Oligochaeta and other tolerant taxa dominated all of the samples from the Calumet River System. Head capsule deformities were absent, except in the Calumet River, where they were rare.

Des Plaines River System. Benthic invertebrate samples were collected from eight AWQM stations in the Des Plaines River System during 2005. There was substantial spatial variability throughout the watershed, as well as within individual waterways. The highest total and EPT taxa richness in the Des Plaines River System occurred at the furthest upstream station in the Des Plaines River. In the Hester Dendy and ponar samples from this station, there was a combined taxa richness of 79, and an EPT taxa richness of 17. Both of these richness metrics decreased in the downstream direction. The incidence of chironomid deformities was low among stations in this system.

Sediment Chemistry

Sediment quality can considerably impact overlying water quality, benthic community structure, food chain dynamics, and other elements of freshwater ecosystems. Since sediment acts as a reservoir for persistent or bioaccumulative contaminants, sediment data reflects a long-term record of quality. It should be noted that grab sample sediment data can be difficult to interpret, as samples may reflect a "hot spot," or an area with an unusually high concentration of a specific pollutant. This can be caused by an accidental release or spill of a contaminant that sinks down through the water column and resides in the sediment. Similarly, sediment chemistry can vary widely between side and center samples from the same station.

General Chemistry. The concentrations of the eight general chemistry constituents measured in sediment from the side and center at each of the 15 sample stations are presented in Table 10. Sediment samples from the side and center of Diversey Parkway exhibited elevated concentrations of phenols (0.700 and 0.448 mg/kg, respectively). The sediment taken from the side channel at Diversey Parkway and Grand Avenue also contained a very high concentration of total cyanide, which was more than ten times the concentration of cyanide present at other sediment sampling stations (9.665 and 9.294 mg/kg, respectively).

Trace Metals. The 11 measured trace metal concentrations for these same stations are presented in Table 11.

Acid Volatile Sulfide, Simultaneously Extracted Metals, Total Organic Carbon, and Particle Size. Table 12 presents the AVS, SEM, TOC, and particle size data for these 15 sampled sites. The ratio of SEM to AVS can affect the bioavailability of divalent metals, for which sulfide ions have a high affinity. For instance, if AVS is greater than SEM concentration, it is less likely that metals are available for biological uptake, thus rendering them less toxic to organisms. As a measure of oxidizable organic material, the TOC concentration in sediment affects nonionic organic chemical, as well as metal bioavailability. Particle size is a useful analysis since it influences chemical reactions that take place in the sediment and the type of invertebrate taxa able to colonize the substrate (USEPA, 2001).

Organic Priority Pollutants. There were 111 total organic priority pollutants analyzed for each sample collected (listed in Table 3). Tables 13-17 present the concentrations of 24 OPPs that were detected in sediment samples during 2005. The most elevated concentrations of OPPs in the wadeable portion of the northern Chicago River System were found at Lake-Cook Road on the Middle Fork North Branch Chicago River, in which 16 OPPs were detected. In the deep draft, sediment from the center of the North Branch Chicago River at Diversey Parkway had extremely high values of OPPs compared to other sampling stations. Sediment from the side at Diversey Parkway, the center and side sediment from Grand Avenue on the North Branch Chicago River, and the center of the North Shore Channel at Touhy Avenue also had relatively high OPP concentrations.

Sediment Toxicity

The toxicity data resulting from the *Chironomus tentans* 10-day toxicity tests for each sediment sample collected are presented in Table 18. Sites with a significant difference in *Chironomus* survival compared to the control sediment indicate that the sediment constitutes an unsuitable habitat for *Chironomus* survival. Sites with a significant difference in *Chironomus* dried

TABLE 10: CHEMICAL CHARACTERISTICS OF SEDIMENT COLLECTED DURING 2005

Station. No.	Location	Waterway	Segment	Constituents (Expressed on a dry weight basis) TS (%)	TVS (%)	NH_3-N (mg/kg)	NO_2+NO_3 (mg/kg)	TKN (mg/kg)	TP (mg/kg)	Phenols (mg/kg)	TCN (mg/kg)
106	Dundee Road	W Fork N Branch Chicago River[1]	Side	59.9	5	37	7.64	1,100	769	0.037	0.017
106	Dundee Road	W Fork N Branch Chicago River[1]	Center	64.9	3	19	3.58	393	384	0.039	0.028
103	Golf Road	W Fork N Branch Chicago River[1]	Side	56.9	4	20	5.48	632	395	0.058	0.040
103	Golf Road	W Fork N Branch Chicago River[1]	Center	34.3	25	20	7.93	1,192	554	0.128	0.079
31	Lake-Cook Road	M Fork N Branch Chicago River[2]	Side	46.8	9	51	7.33	2,558	649	0.126	0.385
31	Lake-Cook Road	M Fork N Branch Chicago River[2]	Center	56.4	4	30	7.14	949	407	0.066	0.044
32	Lake-Cook Road	Skokie River	Side	51.2	6	59	7.70	1,360	396	0.051	0.105
32	Lake-Cook Road	Skokie River	Center	62.3	2	15	4.80	329	140	0.067	0.010
105	Frontage Road	Skokie River	Side	54.0	6	43	5.99	910	916	0.035	0.061
105	Frontage Road	Skokie River	Center	55.7	6	18	4.53	951	1,798	0.061	0.083
104	Glenview Road	North Branch Chicago River	Side	61.8	4	25	6.55	669	451	0.015	0.006
104	Glenview Road	North Branch Chicago River	Center	80.9	2	5	3.15	300	344	0.045	0.015
34	Dempster Street	North Branch Chicago River	Side	50.2	4	35	6.36	1,881	942	0.114	0.126
34	Dempster Street	North Branch Chicago River	Center	15.3	20	43	20.39	6,373	1,404	0.150	0.183
96	Albany Avenue[3]	North Branch Chicago River	Side	63.3	5	14	4.10	847	148	0.035	0.014
35	Central Street	North Shore Channel	Side	38.7	7	21	4.44	2,044	425	0.147	0.145
35	Central Street	North Shore Channel	Center	31.7	9	21	6.33	2,523	572	0.145	0.117
102	Oakton Street	North Shore Channel	Side	32.9	11	12	2.89	422	159	0.398	0.040
102	Oakton Street	North Shore Channel	Center	41.0	15	156	6.66	1,248	559	0.120	0.093
36	Touhy Avenue	North Shore Channel	Side	76.8	5	30	1.88	642	381	0.049	0.022
36	Touhy Avenue	North Shore Channel	Center	70.0	7	37	1.68	433	123	0.051	0.026
101	Foster Avenue	North Shore Channel	Side	81.1	2	20	3.47	336	136	0.027	<0.003
101	Foster Avenue	North Shore Channel	Center	65.6	5	12	2.60	981	514	0.064	<0.003

TABLE 10 (Continued): CHEMICAL CHARACTERISTICS OF SEDIMENT COLLECTED DURING 2005

Station No.	Location	Waterway	Segment	Constituents (Expressed on a dry weight basis) TS (%)	TVS (%)	NH_3-N (mg/kg)	NO_2+NO_3 (mg/kg)	TKN (mg/kg)	TP (mg/kg)	Phenols (mg/kg)	TCN (mg/kg)
37	Wilson Avenue	North Branch Chicago River	Side	55.4	10	18	2.72	745	355	0.083	0.108
37	Wilson Avenue	North Branch Chicago River	Center	72.7	2	5	1.15	128	227	0.059	0.127
73	Diversey Parkway	North Branch Chicago River	Side	20.9	34	215	21.38	12,311	7,092	0.700	9.665
73	Diversey Parkway	North Branch Chicago River	Center	13.6	19	519	35.99	16,617	7,981	0.448	0.816
46	Grand Avenue	North Branch Chicago River	Side	41.2	13	186	11.83	4,021	4,174	0.129	9.294
46	Grand Avenue	North Branch Chicago River	Center	28.8	18	285	13.43	6,087	3,988	0.163	0.979

[1]West Fork North Branch Chicago River.
[2]Middle Fork North Branch Chicago River.
[3]No sediment sample was taken from the center of the waterway at Albany Avenue because there is a concrete bottom throughout the sampling reach.

TABLE 11: TRACE METALS IN SEDIMENT COLLECTED FROM THE CHICAGO RIVER SYSTEM DURING 2005

Station No.	Location	Waterway	Segment	As	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn
				(mg/kg dry weight)										
106	Dundee Rd.	W Fork N Branch Chgo. River[1]	Side	2.6	<0.1	12	13	15,537	15	371	0.0568	15	<0.3	56
106	Dundee Rd.	W Fork N Branch Chgo. River[1]	Center	1.1	<0.1	6	8	9,21	16	474	0.0933	7	<0.3	75
103	Golf Rd.	W Fork N Branch Chgo. River[1]	Side	1.2	0.3	14	9	6,79	13	155	0.6923	7	<0.3	53
103	Golf Rd.	W Fork N Branch Chgo. River[1]	Center	2.6	0.4	42	12	11,982	15	468	0.1178	21	<0.3	95
31	Lake-Cook Rd.	M Fork N Branch Chgo. River[2]	Side	3.3	<0.1	19	31	16,080	33	382	0.0987	17	<0.3	111
31	Lake-Cook Rd.	M Fork N Branch Chgo. River[2]	Center	5.3	<0.1	11	11	17,270	28	645	0.0633	12	<0.3	40
32	Lake-Cook Rd.	Skokie River	Side	3.4	0.3	19	36	10,964	86	296	0.2368	13	<0.3	258
32	Lake-Cook Rd.	Skokie River	Center	3.6	<0.1	3	6	3,58	12	125	0.1197	4	<0.3	73
105	Frontage Rd.	Skokie River	Side	2.2	0.3	25	20	20,441	20	927	0.0445	20	<0.3	68
105	Frontage Rd.	Skokie River	Center	1.5	0.5	19	32	15,870	63	432	0.0734	13	<0.3	130
104	Glenview Rd.	N Branch Chicago River[3]	Side	3.2	0.5	25	20	21,360	29	698	0.0384	27	<0.3	94
104	Glenview Rd.	N Branch Chicago River[3]	Center	2.5	0.3	14	10	12,742	25	564	0.0431	11	<0.3	67
34	Dempster St.	N Branch Chicago River[3]	Side	1.6	0.3	13	13	9,81	16	427	0.0408	11	<0.3	55
34	Dempster St.	N Branch Chicago River[3]	Center	9.8	2.4	51	61	27,237	158	306	0.1369	30	<0.3	341
96	Albany Ave.[4]	N Branch Chicago River[3]	Side	7.0	0.3	15	22	13,372	12	509	<0.00002	17	<0.3	41
35	Central St.	North Shore Channel	Side	1.5	0.9	23	72	13,613	63	367	0.1174	16	<0.3	188
35	Central St.	North Shore Channel	Center	2.8	1.0	23	84	13,828	66	364	0.4357	16	1.0	189
102	Oakton St.	North Shore Channel	Side	5.2	1.4	41	36	21,512	40	516	<0.00002	36	<0.3	224
102	Oakton St.	North Shore Channel	Center	2.0	2.4	42	120	16,720	130	381	0.5775	25	1.4	360
36	Touhy Ave.	North Shore Channel	Side	1.3	5.0	31	64	7,73	59	183	0.1180	17	<0.3	212
36	Touhy Ave.	North Shore Channel	Center	1.7	5.5	34	92	10,915	80	273	0.0188	24	<0.3	252

TABLE 11 (Continued): TRACE METALS IN SEDIMENT COLLECTED FROM THE CHICAGO RIVER SYSTEM DURING 2005

Station No.	Location	Waterway	Segment	As	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn
				(mg/kg dry weight)										
101	Foster Ave.	North Shore Channel	Side	10.3	0.3	26	37	21,906	21	419	0.0287	27	<0.3	64
101	Foster Ave.	North Shore Channel	Center	6.0	3.4	23	66	10,247	65	220	0.0361	13	<0.3	246
37	Wilson Ave.	N Branch Chicago River[3]	Side	4.6	1.9	17	38	7,580	48	191	0.2586	13	<0.3	125
37	Wilson Ave.	N Branch Chicago River[3]	Center	4.0	3.3	20	143	4,219	145	98	0.1355	8	1.2	267
73	Diversey Pkwy.	N Branch Chicago River[3]	Side	<0.9	35.6	117	234	13,822	432	226	0.5612	91	20.3	742
73	Diversey Pkwy.	N Branch Chicago River[3]	Center	<0.9	4.7	64	195	17,811	142	334	0.7335	30	5.7	504
46	Grand Ave.	N Branch Chicago River[3]	Side	1.9	121.9	581	453	20,608	883	329	1.4527	205	15.6	2,384
46	Grand Ave.	N Branch Chicago River[3]	Center	1.2	11.2	118	261	20,386	244	336	0.7912	45	8.5	967

[1]West Fork North Branch Chicago River.
[2]Middle Fork North Branch Chicago River.
[3]North Branch Chicago River.
[4]No sediment sample was taken from the center of the waterway at Albany Avenue because there is a concrete bottom throughout the sampling reach.

TABLE 12: ACID VOLATILE SULFIDE, SIMULATANEOUSLY EXTRACTED METALS, TOTAL ORGANIC CARBON, AND PARTICLE SIZE SEDIMENT DATA FROM THE CHICAGO RIVER SYSTEM DURING 2005

Station No.	Location	Waterway	Segment	AVS[1] (µmoles/g)	SEM[2] (µmoles/g)	SEM/AVS	TOC[3] (mg/kg)	Particle Size (Percent) Gravel	Sand	Silt	Clay
106	Dundee Rd.	W Fork N Branch Chgo. River[4]	Side	0.514	0.983	1.91	46,200	9.1	70.5	14.3	6.1
106	Dundee Rd.	W Fork N Branch Chgo. River[4]	Center	1.42	1.63	1.15	15,400	0.0	95.6	4.1	0.2
103	Golf Rd.	W Fork N Branch Chgo. River[4]	Side	5.63	0.598	0.106	9,740	0.7	93.3	6.0	0.0
103	Golf Rd.	W Fork N Branch Chgo. River[4]	Center	6.30	0.618	0.098	13,300	24.1	73.4	2.5	0.0
31	Lake-Cook Rd.	M Fork N Branch Chgo. River[5]	Side	1.67	2.77	1.66	32,800	0.0	80.8	16.1	3.1
31	Lake-Cook Rd.	M Fork N Branch Chgo. River[5]	Center	8.63	0.727	0.084	20,600	2.6	89.1	6.0	2.3
32	Lake-Cook Rd.	Skokie River	Side	0.527	2.75	5.22	46,800	0.4	79.1	16.2	4.3
32	Lake-Cook Rd.	Skokie River	Center	0.785	1.06	1.34	19,300	0.0	85.8	14.2	0.0
105	Frontage Rd.	Skokie River	Side	2.53	0.403	0.159	52,900	1.1	63.2	31.7	4.0
105	Frontage Rd.	Skokie River	Center	33.6	1.06	0.031	36,000	0.0	85.8	14.2	0.0
104	Glenview Rd.	North Branch Chicago River	Side	5.32	1.83	0.343	43,900	60.8	36.9	2.4	0.0
104	Glenview Rd.	North Branch Chicago River	Center	1.73	0.325	0.188	19,300	9.8	86.8	2.5	1.0
34	Dempster St.	North Branch Chicago River	Side	35.7	0.595	0.017	19,400	0.0	81.5	13.6	4.9
34	Dempster St.	North Branch Chicago River	Center	117	4.33	0.037	106,000	4.8	85.7	0.0	9.5
96	Albany Ave.[6]	North Branch Chicago River	Side	0.893	0.374	0.550	47,300	1.1	61.6	34.8	2.5
35	Central St.	North Shore Channel	Side	0.642	2.12	0.954	43,300	7.9	67.0	22.1	3.0
35	Central St.	North Shore Channel	Center	39.7	1.47	0.037	25,400	0.0	62.8	33.5	3.7
102	Oakton St.	North Shore Channel	Side	28.4	0.387	0.014	8,630	24.6	74.1	0.0	1.5
102	Oakton St.	North Shore Channel	Center	0.409	2.61	6.39	87,400	0.0	54.1	39.9	5.9
36	Touhy Ave.	North Shore Channel	Side	58.5	1.98	0.034	51,000	13.1	85.7	0.0	1.2
36	Touhy Ave.	North Shore Channel	Center	0.456	0.180	0.370	44,200	6.7	90.9	0.0	2.4

TABLE 12 (Continued): ACID VOLATILE SULFIDE, SIMULATANEOUSLY EXTRACTED METALS, TOTAL ORGANIC CARBON, AND PARTICLE SIZE SEDIMENT DATA FROM THE CHICAGO RIVER SYSTEM DURING 2005

Station No.	Location	Waterway	Segment	AVS[1]	SEM[2] (µmoles/g)	SEM/AVS	TOC[3] (mg/kg)	Particle Size (Percent) Gravel	Sand	Silt	Clay
101	Foster Ave.	North Shore Channel	Side	27.7	1.72	0.062	34,400	14.6	78.1	2.7	4.6
101	Foster Ave.	North Shore Channel	Center	28.6	1.70	0.059	29,000	0.1	97.8	0.0	2.0
37	Wilson Ave.	North Branch Chicago River	Side	95.2	3.73	0.039	35,500	2.0	95.2	0.5	2.3
37	Wilson Ave.	North Branch Chicago River	Center	0.400	0.917	2.29	6,170	0.0	89.4	9.7	0.8
73	Diversey Pkwy.	North Branch Chicago River	Side	104	22.2	0.213	66,500	0.0	89.4	9.7	0.8
73	Diversey Pkwy.	North Branch Chicago River	Center	1.98	7.23	3.65	103,000	0.0	76.2	21.5	2.3
46	Grand Ave.	North Branch Chicago River	Side	6.68	17.4	2.60	126,000	1.0	70.6	22.4	6.0
46	Grand Ave.	North Branch Chicago River	Center	75.4	5.74	0.076	125,000	1.0	68.2	22.5	8.3

[1]Acid Volatile Sulfide.
[2]Simultaneously Extracted Metals.
[3]Total Organic Carbon.
[4]West Fork North Branch Chicago River.
[5]Middle Fork North Branch Chicago River.
[6]No sediment sample was taken from the center of the waterway at Albany Avenue because there is a concrete bottom throughout the sampling reach.

TABLE 13: ORGANIC PRIORITY POLLUTANTS DETECTED IN SEDIMENT COLLECTED FROM THE WEST FORK NORTH BRANCH CHICAGO RIVER DURING 2005

Compound[1]	West Fork North Branch Chicago River			
	106 center	106 side	103 center	103 side
Methylene chloride	ND	ND	ND	ND
Toluene	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND
Benzo(a)anthracene	647	607	ND	ND
Benzo(a)pyrene	964	568	ND	271
3,4-Benzofluoranthene	1,468	598	ND	339
Benzo(ghi)perylene	564	ND	ND	ND
Benzo(k)fluoranthene	1,356	555	ND	389
Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND
Butylbenzyl phthalate	ND	ND	ND	ND
Chrysene	1,222	741	ND	372
Dibenzo(a,h)anthracene	ND	ND	ND	ND
Fluoranthene	2,680	2,113	414	697
Fluorene	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	488	281	ND	ND
Naphthalene	ND	ND	ND	ND
Phenanthrene	897	1,066	ND	ND
Pyrene	2,085	1,593	340	551
4,4'-DDT	11	ND	ND	176
4,4'-DDE	16	8	20	25
4,4'-DDD	ND	8	122	96
Endrin aldehyde	ND	ND	ND	ND

[1]Concentrations expressed as µg/kg dry weight.
ND = Not Detectable.

TABLE 14: ORGANIC PRIORITY POLLUTANTS DETECTED IN SEDIMENT COLLECTED FROM THE MIDDLE FORK NORTH BRANCH CHICAGO RIVER AND SKOKIE RIVER DURING 2005

Compound[1]	Middle Fork North Branch Chicago River		Skokie River			
	31 center	31 side	32 center	32 side	105 center	105 side
Methylene chloride	25	22	ND	27	ND	ND
Toluene	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND
Anthracene	ND	570	ND	ND	ND	ND
Benzo(a)anthracene	1,030	4,057	ND	1,426	885	556
Benzo(a)pyrene	1,314	4,969	232	1,840	1,045	714
3,4-Benzofluoranthene	1,700	7,536	356	2,424	1,402	987
Benzo(ghi)perylene	713	2,847	ND	ND	433	ND
Benzo(k)fluoranthene	1,437	6,210	269	1,871	1,385	748
Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND	ND	ND
Butylbenzyl phthalate	ND	ND	ND	ND	ND	ND
Chrysene	1,447	6,258	361	2,353	1,327	901
Dibenzo(a,h)anthracene	ND	333	ND	ND	ND	ND
Fluoranthene	3,211	13,466	917	5,505	2,654	1,700
Fluorene	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	711	3,320	ND	1,115	461	ND
Naphthalene	ND	ND	ND	ND	ND	ND
Phenanthrene	932	3,864	490	1,899	756	488
Pyrene	2,480	9,895	672	4,195	2,068	1,373
4,4'-DDT	8	13	ND	15	44	32
4,4'-DDE	18	29	13	35	120	53
4,4'-DDD	40	86	44	66	703	220
Endrin aldehyde	ND	ND	ND	ND	ND	ND

[1]Concentrations expressed as µg/kg dry weight.
ND = Not Detectable.

TABLE 15: ORGANIC PRIORITY POLLUTANTS DETECTED IN SEDIMENT COLLECTED FROM THE NORTH BRANCH CHICAGO RIVER DURING 2005

Compound[1]	North Branch Chicago River			
	104 center	104 side	34 center	34 side
Methylene chloride	ND	ND	ND	ND
Toluene	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND
Benzo(a)anthracene	450	1,018	478	1,219
Benzo(a)pyrene	437	1,159	505	1,793
3,4-Benzofluoranthene	476	1,607	531	2,799
Benzo(ghi)perylene	ND	555	251	1,006
Benzo(k)fluoranthene	508	1,341	579	1,975
Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND
Butylbenzyl phthalate	ND	ND	ND	ND
Chrysene	494	1,389	617	2,193
Dibenzo(a,h)anthracene	ND	ND	ND	ND
Fluoranthene	1,358	3,078	1,456	4,313
Fluorene	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	590	295	1,138
Naphthalene	ND	ND	ND	ND
Phenanthrene	707	1,187	764	1,239
Pyrene	1,097	2,426	1,140	3,285
4,4'-DDT	9	70	ND	281
4,4'-DDE	23	38	15	82
4,4'-DDD	125	156	49	209
Endrin aldehyde	ND	ND	ND	ND

[1]Concentrations expressed as µg/kg dry weight.
ND = Not Detectable.

TABLE 16: ORGANIC PRIORITY POLLUTANTS DETECTED IN SEDIMENT COLLECTED FROM THE NORTH SHORE CHANNEL DURING 2005

Compound[1]	North Shore Channel						
	35 center	35 side	102 center	102 side	36 center	36 side	101 center
Methylene chloride	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	1,438	ND	ND
Acenaphthylene	ND	ND	ND	ND	1,119	ND	ND
Anthracene	ND	ND	902	ND	3,562	417	497
Benzo(a)anthracene	1,446	677	3,859	ND	9,924	1,488	1,977
Benzo(a)pyrene	1,492	817	4,595	257	9,500	1,455	1,887
3,4-Benzofluoranthene	1,923	1,115	6,360	315	10,066	1,761	1,936
Benzo(ghi)perylene	564	ND	2,347	ND	4,474	474	660
Benzo(k)fluoranthene	1,713	1,030	5,743	273	8,632	1,409	1,901
Bis(2-ethylhexyl)phthalate	ND	ND	15,571	ND	8,549	ND	ND
Butylbenzyl phthalate	ND	ND	ND	ND	ND	ND	799
Chrysene	1,873	1,016	5,503	394	10,809	1,663	2,402
Dibenzo(a,h)anthracene	ND	ND	ND	ND	1,246	ND	ND
Fluoranthene	4,269	2,026	10,563	840	21,963	2,738	4,389
Fluorene	ND	ND	ND	ND	1,709	ND	ND
Indeno(1,2,3-cd)pyrene	689	424	2,301	ND	4,416	464	636
Naphthalene	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	2,057	777	4,914	599	14,871	1,355	2,136
Pyrene	3,425	1,637	8,310	711	18,566	2,522	4,282
4,4'-DDT	36	23	46	12	ND	ND	8
4,4'-DDE	94	86	225	31	87	32	25
4,4'-DDD	97	96	387	109	276	82	36
Endrin aldehyde	ND	ND	ND	ND	71	ND	ND

[1]Concentrations expressed as µg/kg dry weight.
ND = Not Detectable.

TABLE 17: ORGANIC PRIORITY POLLUTANTS DETECTED IN SEDIMENT COLLECTED FROM THE NORTH BRANCH CHICAGO RIVER DURING 2005

Compound[1]	North Branch Chicago River					
	37 center	37 side	73 center	73 side	46 center	46 side
Methylene chloride	ND	ND	ND	ND	ND	ND
Toluene	ND	21	ND	ND	ND	ND
Acenaphthene	ND	ND	75,687	902	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND
Anthracene	922	ND	135,456	2,390	3,393	2,420
Benzo(a)anthracene	3,393	674	198,987	9,490	9,948	7,255
Benzo(a)pyrene	3,454	679	182,236	10,734	10,498	8,054
3,4-Benzofluoranthene	4,456	992	197,214	12,884	10,331	7,936
Benzo(ghi)perylene	1,435	ND	58,575	5,025	7,530	3,353
Benzo(k)fluoranthene	3,828	589	164,255	9,804	10,328	9,367
Bis(2-ethylhexyl)phthalate	8,895	ND	31,889	18,549	73,846	45,886
Butylbenzyl phthalate	ND	ND	ND	4,943	ND	ND
Chrysene	4,290	883	215,557	12,097	13,129	9,649
Dibenzo(a,h)anthracene	328	ND	20,315	1,407	ND	561
Fluoranthene	10,760	1,924	632,417	26,705	17,050	16,124
Fluorene	555	ND	74,240	1,103	1,823	1,333
Indeno(1,2,3-cd)pyrene	1,546	ND	65,412	5,704	5,863	3,191
Naphthalene	ND	ND	48,372	ND	ND	ND
Phenanthrene	7,155	698	691,027	13,954	15,762	10,936
Pyrene	8,060	1,606	523,517	21,507	16,151	16,473
4,4'-DDT	ND	ND	ND	58	95	ND
4,4'-DDE	12	16	75	79	91	754
4,4'-DDD	17	22	230	131	131	333
Endrin aldehyde	ND	ND	ND	ND	ND	ND

[1]Concentrations expressed as µg/kg dry weight.
ND = Not Detectable.

TABLE 18: TEN-DAY *CHIRONOMUS TENTANS* TOXICITY DATA FOR SEDIMENT COLLECTED FROM THE CHICAGO RIVER SYSTEM DURING 2005

Station No.	Location	Waterway	Segment	(*Chironomus tentans* 10-Day Test Data) Survival (Percent)	Ash-free Dried Weight (mg/org)
106	Dundee Road	W Fork N Branch Chicago River[1]	Side	90	0.73[a]
106	Dundee Road	W Fork N Branch Chicago River[1]	Center	93	1.42
103	Golf Road	W Fork N Branch Chicago River[1]	Side	96	0.19
103	Golf Road	W Fork N Branch Chicago River[1]	Center	95	1.20
31	Lake-Cook Road	M Fork N Branch Chicago River[2]	Side	80	0.96
31	Lake-Cook Road	M Fork N Branch Chicago River[2]	Center	86	1.20
32	Lake-Cook Road	Skokie River	Side	90	0.72[a]
32	Lake-Cook Road	Skokie River	Center	93	1.22
105	Frontage Road	Skokie River	Side	96	1.28
105	Frontage Road	Skokie River	Center	99	1.23
104	Glenview Road	North Branch Chicago River	Side	97	1.09
104	Glenview Road	North Branch Chicago River	Center	94	1.01
34	Dempster Street	North Branch Chicago River	Side	95	0.95[a]
34	Dempster Street	North Branch Chicago River	Center	94	1.19
96	Albany Avenue[3]	North Branch Chicago River	Side	80[a]	1.08[b]
35	Central Street	North Shore Channel	Side	96	1.47
35	Central Street	North Shore Channel	Center	96	1.35
102	Oakton Street	North Shore Channel	Side	80	1.62
102	Oakton Street	North Shore Channel	Center	79	1.16
36	Touhy Avenue	North Shore Channel	Side	95	1.25
36	Touhy Avenue	North Shore Channel	Center	94	1.23
101	Foster Avenue	North Shore Channel	Side	51[a]	0.17[b]
101	Foster Avenue	North Shore Channel	Center	94	1.40
37	Wilson Avenue	North Branch Chicago River	Side	93	1.44
37	Wilson Avenue	North Branch Chicago River	Center	84	0.93
73	Diversey Parkway	North Branch Chicago River	Side	49[a]	0.43[b]
73	Diversey Parkway	North Branch Chicago River	Center	86	0.98
46	Grand Avenue	North Branch Chicago River	Side	13[a]	0.13[b]
46	Grand Avenue	North Branch Chicago River	Center	93	0.88

[a]Significantly different than the West Bearskin Lake control results.
[b]Not formally compared since survival data were statistically different.
[1]West Fork North Branch Chicago River.
[2]Middle Fork North Branch Chicago River.
[3]No sediment sample was taken from the center of the waterway at Albany Avenue because there is a concrete bottom throughout the sampling reach.

weight and or *Chironomus* ash-free dried weight compared to the control sediment indicate that those sediments constitute an unsuitable habitat for optimal *Chironomus* growth.

Four out of the 30 sites sampled (15 stations, side and center) had percent survival rates that were significantly different than the control sites indicating that the sediment was unsuitable for *Chironomus* survival. Decreased survival rates occurred in side sediments from Diversey Parkway, Grand Avenue, and Albany Avenue on the North Branch Chicago River, and Foster Avenue on the North Shore Channel. Three additional sites sampled showed ash-free dried weight that was significantly different than control sites, indicating that these sediments are unsuitable for optimal *Chironomus* growth. Notably, all sediments that elicited decreased survival or growth during 2005 were from the side channel sediments. None of the center sediment samples showed a significant difference from the control.

Sediment chemistry analysis revealed that the side samples from Grand Avenue and Diversey Avenue contained very elevated cyanide concentrations of 9.294 and 9.665 mg/kg, respectively. Both stations also exhibited high OPP concentrations. None of the other sediments which elicited *Chironomus* toxicity showed any unusual chemical characteristics.

REFERENCES

American Public Health Association, American Water Works Association, and Water Environment Federation (publishers). Standard Methods for the Examination of Water and Wastewater, 19^{th} ed. 1998.

Illinois Environmental Protection Agency, "Illinois Water Quality Report 1994-1995, Volume I," Illinois Environmental Protection Agency Report No. IEPA/BOW/96-060a, September, 1996.

Karr, J.R., K.D. Faush, P.L. Angermeier, P.R. Yant, and I.J. Schlosser, Assessing Biological Integrity in Running Waters, A Method and Its Rationale. Special Publication 5, Illinois Natural History Survey, Champaign, Illinois, 1986.

Rankin, E. T. "The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application." Ohio Environmental Protection Agency – Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio, 1989.

Rankin, E. T. "Analysis of Physical Habitat Quality and Limitations to Waterways in the Chicago Area." Prepared for USEPA Region V, 2004.

USEPA Report No. EPA-600-R-99-064, "Methods for Measuring the Toxicity and Bioaccumulation of Sediment – Associated Contaminants with Freshwater Invertebrates," Second Ed. Office of Research and Development. March 2000.

USEPA Report No. EPA-823-B-01-002, "Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses." October, 2001.