

**THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO**



**DEPARTMENT OF RESEARCH  
AND DEVELOPMENT**

**REPORT NO. 84-11-B  
1982 ANNUAL SUMMARY REPORT  
WATER QUALITY WITHIN THE WATERWAYS SYSTEM OF  
THE METROPOLITAN SANITARY DISTRICT  
OF GREATER CHICAGO  
VOLUME 2  
BIOLOGICAL**

**February 1986**

1982 ANNUAL SUMMARY REPORT  
WATER QUALITY WITHIN THE WATERWAYS SYSTEM  
OF THE METROPOLITAN SANITARY DISTRICT  
OF GREATER CHICAGO

VOLUME II

BIOLOGICAL

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### Disclaimer

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

## SUMMARY

### Bacteria

At the three stations sampled in Thorn Creek during 1982, the geometric means of the total coliform counts ranged from  $4.3 \times 10^4$  to  $1.2 \times 10^5$  per 100 milliliters, the fecal coliform counts ranged from  $4.9 \times 10^3$  to  $1.5 \times 10^4$  per 100 milliliters, and the fecal streptococcus counts ranged from  $1.7 \times 10^3$  to  $2.4 \times 10^3$  per 100 milliliters. At the three stations sampled in the Little Calumet River during 1982, the geometric means of the total coliform counts ranged from  $1.2 \times 10^5$  to  $9.7 \times 10^5$  per 100 milliliters, the fecal coliform counts ranged from  $9.3 \times 10^3$  to  $7.5 \times 10^4$  per 100 milliliters, and the fecal streptococcus counts ranged from  $1.6 \times 10^3$  to  $2.9 \times 10^4$  per 100 milliliters. In general, these indicator bacteria counts were an order of magnitude greater in the Little Calumet River than in Thorn Creek. The "General Use" criterion, established by the Illinois Pollution Control Board (IPCB) of a geometric mean of 200 fecal coliform per 100 milliliters, based on a minimum of five samples taken over not more than a 30-day period, was not met in either Thorn Creek or the Little Calumet River during 1982.

Standard plate counts, as geometric means, ranged from  $4.2 \times 10^4$  to  $9.1 \times 10^4$  per milliliter in Thorn Creek and from  $8.4 \times 10^4$  to  $5.5 \times 10^5$  per milliliter in the Little

Calumet River. These counts were comparable to those found in the artificial deep-draft waterways in metropolitan Chicago in 1975, 1976, and 1977 and in the North Branch of the Chicago River in 1980 and 1981.

Pseudomonas aeruginosa counts, as geometric means, ranged from 370 to 680 per 100 milliliters in Thorn Creek and from 730 to 23,000 per 100 milliliters in the Little Calumet River. Salmonella counts, as geometric means, were less than 0.2 per 100 milliliters in Thorn Creek and ranged from less than 0.2 to 0.3 per 100 milliliters in the Little Calumet River.

In general, higher bacterial counts were encountered in the Little Calumet River, especially at Wentworth Avenue, than in Thorn Creek for all categories of bacteria measured.

#### Periphyton

In Thorn Creek the periphyton population density ranged from  $1.1 \times 10^3$  to  $1.3 \times 10^6$  organisms per square centimeter which was approximately the same as was found in the Little Calumet River,  $1.0 \times 10^3$  to  $2.2 \times 10^6$  organisms per square centimeter. The average periphyton population density in the two waterways was almost identical with  $3.9 \times 10^5$  organisms per square centimeter in Thorn Creek and  $4.0 \times 10^5$  organisms per square centimeter in the Little Calumet River.

The average number of periphyton species per sample in Thorn Creek ranged from 34 to 39. The overall aver-

age was 36 species per sample. In the Little Calumet River the average number of periphyton species per sample ranged from 32 to 40. The overall average was 35 species per sample. The total number of species found during the year at each station in Thorn Creek ranged from 99 to 113 species. A total of 174 species was found among the three stations during 1982. The total number of species found at each station in the Little Calumet River in 1982 ranged from 79 to 125 species with a total of 187 species found among the three stations.

The average Shannon-Weaver species diversity index in Thorn Creek ranged from 1.38 to 2.82, among the three stations, and in the Little Calumet River ranged from 1.67 to 2.80, among the three stations. The overall average Shannon-Weaver species diversity index was 2.68 in Thorn Creek and 2.78 in the Little Calumet River. In lakes, Margelef has defined trophic status in terms of species diversity as follows: oligotrophic, greater than 3.5; mesotrophic, 2.5 to 3.5; and eutrophic less than 2.5. According to these guidelines, the overall species diversity averages of Thorn Creek and the Little Calumet River indicate mesotrophic waters. Of 23 calculated species diversity indices from Thorn Creek 18 (78 percent) were less than 2.5 and in the Little Calumet River of 21 species diversities calculated 18 (86 percent) were less than 2.5. These data indicate eutrophy or nutrient enrichment occurring the majority of the time.

The equitability index, based on the Shannon-Weaver species diversity index and the number of species, ranged from 0.03 to 0.09 in Thorn Creek and 0.05 to 0.08 in the Little Calumet River. Equitability values less than 0.3 indicate moderate to severe pollution. Since all of the average values were less than 0.1, both waterways are severely polluted as measured by this parameter.

The autotrophic index is the ratio of the organic matter concentration to the chlorophyll a concentration and is based on the empirical observation that in relatively clean waters only one to two percent of the organic matter present is chlorophyll a. Values greater than 100 to 200 are indicative of the excessive growth of heterotrophic organisms resulting from organic pollutants. In Thorn Creek the autotrophic index ranged from 366 to 2,880, among the three stations, and in the Little Calumet River the autotrophic index ranged from 1,263 to 4,601. The average autotrophic index in Thorn Creek was 1,741 and in the Little Calumet River it was 1,960. Both waterways had values well above the 100 to 200 limit established for relatively clean water, and are considered to be polluted by this measurement.

The conclusion derived from the indicator bacteria data that Thorn Creek and the Little Calumet River were receiving large quantities of domestic wastes was confirmed by the periphyton data. The periphyton population densities ( $10^5$  organ-

isms per square centimeter) were similar to those found in the North Branch of the Chicago River in 1980 and 1981, and in the Des Plaines River, in 1979 and 1980. The Shannon-Weaver species diversity index (less than 2.5) indicated nutrient enrichment, the equitability index (less than 0.1) indicated severe pollution, and the autotrophic index (366 to 4,601) indicated organic pollution.

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### Fish

The number and weight of fish per ten minutes electrofishing were least in the Little Calumet River at the Wentworth Avenue location (2.5 and 17 grams, respectively) and in Thorn Creek at the Joe Orr Road location (5.5 and 32 grams, respectively) suggesting that water quality was poorest for fish at these locations.

The major fish species found in the Little Calumet River, in order of numerical abundance were: central mudminnow, fathead minnow, green sunfish, bluegill, and creek chub. In Thorn Creek, the major fish species found were: fathead minnow, green sunfish, central mudminnow, creek chub, and white sucker. The presence of these species, all tolerant of a wide range of ecological conditions, suggested that the water quality in both streams was relatively poor.

The abundance of fishes, in terms of number or weight per ten minutes electrofishing, places the Little Calumet River, including Thorn Creek (12 and 97 grams, respectively),



into the same category as the North Branch of the Chicago River (15.3 and 256 grams, respectively) and Salt Creek (11 and 262 grams, respectively) in terms of water quality as reflected by their fish population. An example of better water quality would be Hickory Creek with 322 fish weighing 1,921 grams per ten minutes electrofishing.

The percentage of omnivorous fish exceeded 45 percent, and the percentage of green sunfish was 20 percent or more in the Little Calumet River and Thorn Creek; suggesting that the water quality of both streams was poor for fish life.

On the basis of species collected, Wentworth Avenue (central mudminnow) on the Little Calumet River and Joe Orr Road (central mudminnow, fathead minnow, green sunfish, green x pumpkinseed hybrid) on Thorn Creek appear to be the locations of poorest water quality on the respective streams.

Overall, the Little Calumet River and its major tributary, Thorn Creek, were of poor water quality in terms of supporting a varied fish population. This conclusion was supported by the indicator bacteria data which approximated that found in Chicago's man-made waterways, as well as the Des Plaines River and the North Branch of the Chicago River. Furthermore, the periphyton population densities ( $10^5$  organisms per square centimeter), the large proportion of species diversities which were less than 2.5, the average equitabilities which were less than 0.1, and the autotrophic

indices all exceeding the 100 to 200 limit for relatively clean water indicated that the Little Calumet River and Thorn Creek were nutrient enriched by organic pollution and received large additions of domestic and industrial wastes from combined sewer overflows and effluents from treatment works outside the District's jurisdiction.

## CONCLUSIONS

1. Thorn Creek and the Little Calumet River were of poor water quality according to the magnitude and quality of the analyzed bacterial, algal, and fish populations.
2. The water quality was poorest in Thorn Creek at Joe Orr Road, downstream of the Thorn Creek Basin Sewage Treatment Plant (Bloom Township) before entering the District's jurisdiction.
3. The water quality was poorest in the Little Calumet River ~~at Wentworth Avenue, just downstream of where the river~~ crosses from Indiana into Illinois and enters the District's jurisdiction.

## INTRODUCTION

The Metropolitan Sanitary District of Greater Chicago (District) is responsible for the quality of the water in the streams and canals within its jurisdiction. In 1975, the District established its Ecosystematic Study Program to monitor these waterways. The monitoring activities under this program are carried out by the Biology Section of the Research Division Research and Development Department. The field monitoring activities are handled by the following groups within the Biology Section: Analytical Microbiology, Aquatic Biology, and Fisheries.

From 1975 to 1977, the deep-draft waterways of the Chicago and Calumet River Systems were studied (1, 2, 3). The monitoring efforts during 1978 and 1979 were concentrated in that portion of the Des Plaines River within Cook County (4, 5). In 1980 and 1981, that portion of the North Branch of the Chicago River within Cook County, and above its confluence with the North Shore Channel, was monitored (6, 7). During 1982, that portion of the Little Calumet River and its main tributary, Thorn Creek, within Cook County, were monitored.

According to the 1973 Water Quality Standards adopted by the Illinois Pollution Control Board (IPCB), the waters of Thorn Creek and the Little Calumet River were designated for "General Use". This means that the waters must meet the

general standards which are designed to protect the state's waters"... for aquatic life, agricultural use, primary and secondary contact use, and most industrial uses, and ensure the aesthetic quality of the State's aquatic environment."

The objectives of this study were to determine the water quality of the Little Calumet River and Thorn Creek by monitoring bacterial, periphyton, and fish populations of each stream. Evaluation of the existing biological community structure in a waterway is useful in detecting pollution and in quantifying the intensity of its effects. When a waterway is stressed due to pollutant additions, the more pollutant-tolerant organisms will increase in abundance and the less tolerant organisms will decrease. Effects of stress can be detected by examining population densities, species composition, and the species diversity of the aquatic community. The District's Biology Section monitored the bacteria, periphyton, and fish communities of Thorn Creek and the Little Calumet River during 1982 to establish the water quality conditions of these waterways.

## DESCRIPTION OF THE LITTLE CALUMET RIVER

The Little Calumet River basin is located in northeastern Illinois and northwestern Indiana. The watershed drains an area of 242 square miles, 151 square miles of which are in Illinois. The main channel flows in a westerly direction from the Indiana border, joining with the Calumet-Sag Channel and eventually the Chicago Sanitary and Ship Canal (8) (Figure 1).

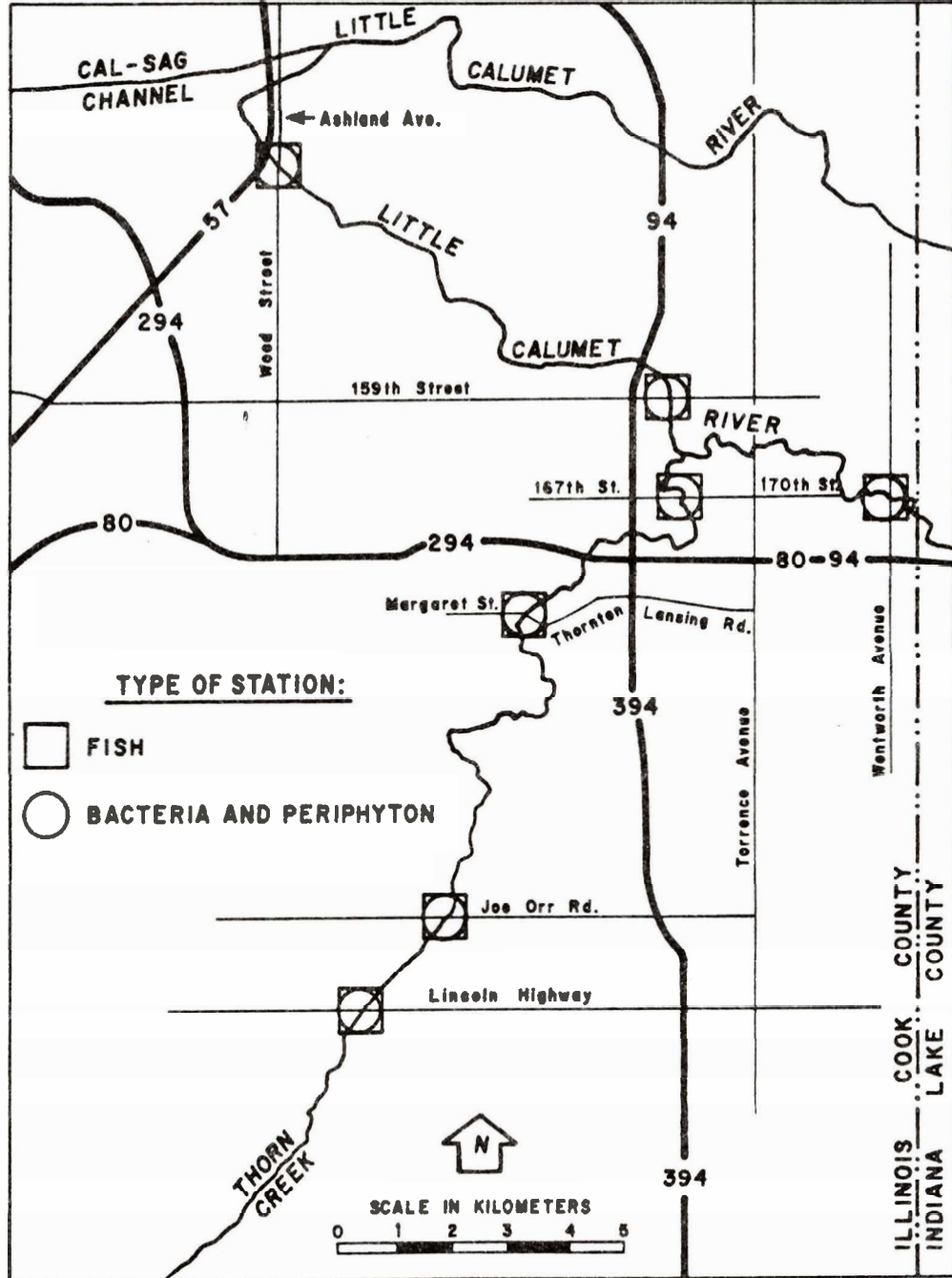
The Little Calumet River system is composed of the Little Calumet River and its most important tributaries: Thorn Creek, Deer Creek, Butterfield Creek, and the Calumet-Union Drainage Ditch. The system is divided into 14 reaches which are distributed as follows: Little Calumet River - 5 reaches, Thorn Creek - 4 reaches, and the Calumet-Union Drainage Ditch - 1 reach (Figure 2).

The 14 reaches of the Little Calumet River system drain an area of approximately 151.2 square miles (392 square kilometers) in Illinois. The drainage areas of Butterfield Creek and Deer Creek, major tributaries of Thorn Creek, are 25.8 square miles (66.82 square kilometers) and 26.7 square miles (71.5 square kilometers), respectively, or 49 percent of the drainage area of Thorn Creek. Thorn Creek drains 71 percent of the Illinois drainage area of the Little Calumet River and the Calumet-Union Drainage Ditch 15 percent. **The remaining** 14 percent is drained by the Little Calumet River (8).

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

Figure 1

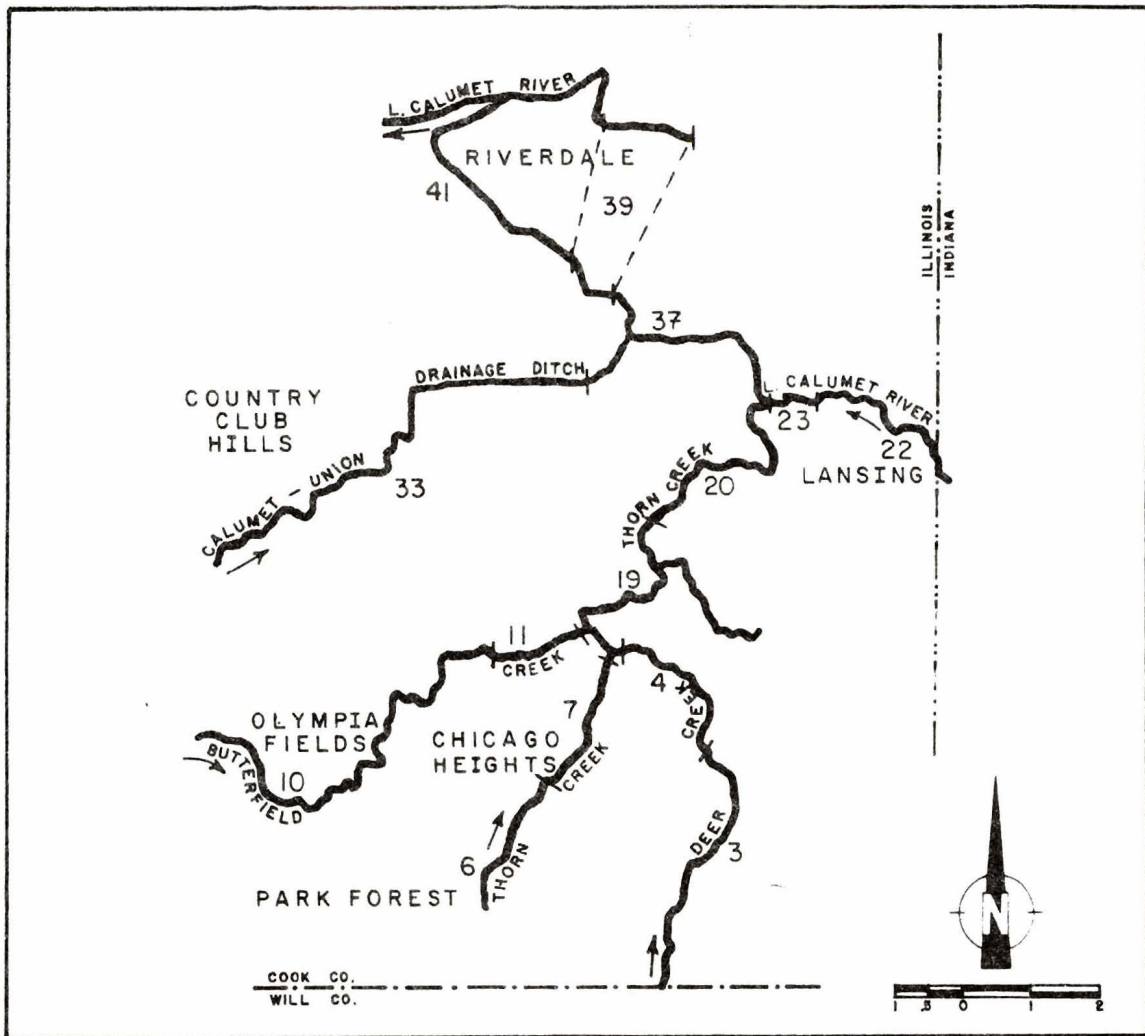
THORN CREEK AND LITTLE CALUMET RIVER  
BIOLOGICAL SAMPLING STATIONS



THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

FIGURE 2

LITTLE CALUMET RIVER WATERWAY SYSTEM REACHES\*



\*STAFF PAPER FEBRUARY 1981  
STREAM USE INVENTORY: LITTLE CALUMET RIVER  
NORTHEASTERN ILLINOIS PLANNING COMMISSION

LL,9/85



The Little Calumet River had a total flow measured in reach number 41, at the downstream side of the Cottage Grove Avenue bridge in South Holland, of 249 cubic feet per second (161.9 mgd) in water year 1981. The flow in Thorn Creek was 107 cubic feet per second (69.2 mgd) (9), at the downstream side of the Margaret Street bridge in Thornton.

In the northern part of the basin, there are extensive areas serviced by combined sewers which discharge mainly into the main channel of the Little Calumet River. In one reach of the Little Calumet River, flow originating from combined sewers comprises seven percent of the total (8). Numerous treatment plants are located on the tributary streams, notably the Bloom Township Sewage Treatment Plant on Thorn Creek. The high proportion of flow from point sources in Thorn Creek, Butterfield Creek, and Deer Creek, and the presence of many combined sewer overflows in the main channel indicate that a principal use of the Little Calumet River system is wastewater disposal (8).

Many areas of the drainage basin are highly urbanized, as evidenced by high percentages of impervious land cover in most reaches, so that the secondary use of the Little Calumet River system is for urban drainage (8). However, the headwaters of Butterfield Creek and the Calumet-Union Drainage Ditch have urban drainage as their principal stream use (8) and Deer Creek and the headwaters of Thorn Creek have agri-

cultural drainage as their secondary stream use (8). The agricultural areas are rapidly becoming urbanized.

The main channel of the Little Calumet River is dredged periodically to facilitate the rapid removal of storm water runoff. Existing flood control structures and proposed new ones indicate that flood control may become an important stream use.

DESCRIPTION OF THE BIOLOGICAL CHARACTERISTICS USED TO  
DETERMINE THE WATER QUALITY OF THORN CREEK AND THE  
LITTLE CALUMET RIVER

Bacteria

INDICATOR BACTERIA

Bacterial analyses such as total coliform (TC), fecal coliform (FC), and fecal streptococcus (FS) tests are used extensively by the District to indicate the sanitary quality of water.

STANDARD PLATE COUNT (SPC)

An empirical procedure which gives an estimate of the total bacterial population.

PSEUDOMONAS AERUGINOSA

This ubiquitous organism is a causative agent of outer and middle ear infections, chronic ulcerations of the skin, and many burn and wound infections.

SALMONELLA

The genus Salmonella contains a variety of species all of which are pathogenic for man or animals and usually for both. They are all facultative intestinal parasites.

Periphyton

PERIPHYTON POPULATION ANALYSIS

Algae are the base of all aquatic food chains by virtue of their ability to convert inorganic substances to organic

substances through the process of photosynthesis which is dependent on the availability of light (turbidity) and the presence of chlorophyll.

Periphyton are generally defined as microfloral growth on a substrate. This definition includes a variety of zoogeal and filamentous bacteria, protozoans, rotifers, algae, and associated trapped organisms (10). In this study only the algal fraction was analyzed. The periphytic algae were preferentially sampled and analyzed because they are the most numerous organisms under conditions in which the littoral zone approximates the surface area, such as in streams or rivers. Also periphytic algae are stationary and are thus exposed to all the variations in the concentrations of the constituents in the surface waters.

Periphytic algae have short generation times and are thus very responsive to their environment. A clean undisturbed water environment produces a great variety of periphytic algal species with none dominant in terms of population density. An environment rich in the major nutrients (nitrogen, phosphorus, and potassium), carbon dioxide, and trace elements produces a high density population of periphytic algae with one to several dominant species. Toxic levels of compounds in an environment tend to reduce both the density of periphytic organisms and the number of species.

## CHLOROPHYLL a

The concentrations of chlorophyll a are a measure of photosynthetic potential and biomass of chlorophyllous organisms. According to Weber (11) the chlorophyll a content of biomass grown in relatively clean waters is one to two percent of the ash-free dry weight.

## ORGANIC MATTER (ASH-FREE DRY WEIGHT)

The organic matter content of a sample is a measure of the total biomass. This biomass may be made up of chlorophyllous and non-chlorophyllous organisms and the latter may be significant in water degraded by dissolved or particulate organic enrichment (11).

## AUTOTROPHIC INDEX

The autotrophic index (AI) is a ratio of organic matter to chlorophyll a concentrations. If this ratio exceeds 100 to 200 (based on a chlorophyll a content of relatively clean water to one to two percent) the 'excess' organic matter is attributed to heterotrophic organisms responding to enrichment of the water by dissolved or particulate organic matter. Although the tendency is to rank waters according to their AI (the higher the AI the more contamination by organic matter) the work by Weber (11) does not claim this ability. The AI may be used as support for other data, but by itself purports only to separate relatively clean waters from those contami-

nated by organic matter such as sewage. The reasoning is that the responding heterotrophic organisms, in kind and numbers, are dependent on the properties of the contaminating organic matter as well as local properties of the waterways system.

#### EQUITABILITY

Equitability (e) is a comparison of the number of species actually found in a sample with the number of species expected from a lognormal distribution (few relatively abundant species and increasing numbers of species represented by only a few individuals). This lognormal distribution is one frequently observed in nature.

In order to calculate equitability, the Shannon-Weaver mean species diversity index ( $\bar{d}$ ) is used to determine the expected number of species from the tables of Lloyd and Ghelardi (11). While the  $\bar{d}$  in unpolluted waters is generally in the range from 3 to 4 and  $\bar{d}$  in polluted waters is generally less than one,  $\bar{d}$  lacks the sensitivity to demonstrate differences between these extremes (11). The equitability is, however, very sensitive in this region to very slight degrees of degradation.

Equitability may range from 0 to 1 where the distribution of species in a sample is the same or less equitable than the lognormal distribution (11). Very slight degrees of degradation reduce equitability values to less than 0.5.

## Fish

Fish collections and analyses give the most meaningful index of water quality to the public and have been performed on the District waterways since 1974 (1, 2, 3, 4, 5, 6, 7). Fish occupy the upper levels of the aquatic food chain as the ultimate aquatic consumer. Therefore, changes in water quality that significantly affect the other kinds of organisms within the aquatic community will also affect the species composition and abundance of the fish population.

A knowledge of the assemblage of fish species in a stream and the numerical relationships of these species provides an excellent biological picture of the watercourse and its well being. When such information is available over a long period of time, fishes can be one of the most sensitive indicators of the quality of the aquatic environment (12).

### Description of the Sampling Locations and Frequency of Sampling

Six sampling stations were chosen for the collection of bacteria and periphyton, three on Thorn Creek and three on the Little Calumet River. An additional sampling station was used for the collection of fish in Thorn Creek, upstream of the Thorn Creek Basin Treatment Plant, on Lincoln Highway (Route 30) in Wilson Woods. Figure 1 shows the location of these stations on Thorn Creek and the Little Calumet River in relation to major east-west and north-south roads as well

as the major townships. Table 1 identifies the stations according to the nearest major road crossing the waterway, and the types of samples collected.

Samples for bacterial analyses were collected April 20, June 21, September 21, and October 19, 1982. Fecal coliforms were also collected monthly on the routine Industrial Waste Division bridge run collections. Periphyton samples were collected every four weeks beginning with sampler emplacement at the stations on April 15 and terminating with the last collection of samples on December 16, 1982. The periphyton samplers were immersed in the waterways two weeks prior to collection for all but the last collection, which had been immersed for three weeks. Fish were collected at each station reach during the months of July and October using electrofishing techniques.



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TABLE 1

BIOLOGICAL SAMPLING SITES\* ON THORN CREEK  
AND THE LITTLE CALUMET RIVER

Name of Site	Biological Sample(s)
Thorn Creek**	
Lincoln Highway	Fish
Joe Orr Road	Bacteria, Periphyton, Fish
Margaret Street	Bacteria, Periphyton, Fish
167/170th Street	Bacteria, periphyton, Fish
Little Calumet River**	
Wentworth Avenue	Bacteria, Periphyton, Fish
159th Street	Bacteria, Periphyton, Fish
Ashland Avenue (near 140th Street)	Bacteria, Periphyton, Fish

\*Figure 1 is a map depicting the locations of these sites.

\*\*Order of sampling sites is from upstream to downstream for each waterway. Thorn Creek enters the Little Calumet River upstream of 159th Street.

## METHODS OF BIOLOGICAL ANALYSES OF WATERWAYS SAMPLES

### Bacteria

Water samples for bacterial analyses were placed into sterile containers with sufficient sodium thiosulfate to neutralize 15 milligrams per liter chlorine. All samples were taken with a bucket at the stream surface in the center of the waterway. The samples were transported on ice to the Research and Development Laboratory in Stickney, Illinois. Analyses were begun approximately six to 24 hours after sample collection began and from two to 20 hours after the last sample was collected.

#### INDICATOR BACTERIA (TC, FC, and FS)

Total coliform, FC, and FS analyses were performed according to Standard Methods (10).

#### STANDARD PLATE COUNT (SPC)

Standard plate counts were performed according to Standard Methods (10).

#### PSEUDOMONAS AERUGINOSA

P. aeruginosa analyses were performed and confirmed according to a most probable number (MPN) procedure described in Standard Methods (10).

## SALMONELLA

Salmonella were estimated using a modification of the MPN technique described by Kenner and Clark (13). Presumptive Salmonella were identified biochemically using the Analytical Profile Index (API-20<sup>®</sup>) system for identification of Enterobacteriaceae. Confirmation of isolates was performed with polyvalent Salmonella "O" antisera. Verification and further serotyping of the isolates was performed by the Illinois Department of Public Health.

## Periphyton

Samplers for periphyton consisted of a plastic cage with floats designed to immerse eight microscope slides one centimeter below the surface of the water in a vertical position and perpendicular to the flow. Periphyton were allowed to develop on the glass slides for a period of two weeks. The cages were then recovered, wrapped in aluminum foil, and kept iced until delivered to the laboratory. In the laboratory the slides were removed from the cages and randomly segregated for each analysis.

## DIATOMS

Organic matter in the diatom samples was removed by digestion with hydrogen peroxide followed by dichromate. The samples were washed until clean and then were concentrated, mounted in Hyrax<sup>®</sup>, and examined microscopically for identification and enumeration of diatoms (10).

## NON-DIATOMS

After fixation with glutaraldehyde the samples were concentrated, mounted on slides, and examined microscopically for identification and enumeration of the non-diatoms (10).

## CHLOROPHYLL a

Chlorophyll a was estimated in acetone extracts after clarification by centrifugation (10).

## ORGANIC MATTER

Organic matter was estimated by drying the slides at 105°C to constant weight and then ashing them in a muffle furnace for 30 minutes at 550 to 600°C. The difference in weight of the ash-free dry weight is, by definition, the organic matter.

## AUTOTROPHIC INDEX (AI)

The AI which relates the organic matter content of a sample to its chlorophyll a content was calculated using Weber's equation (11):

$$\text{AI} = \text{Ash-free weight (mg/m}^2\text{)} / \text{Chlorophyll a (mg/m}^2\text{)}$$

For convenience  $\mu\text{g/cm}^2$  was used instead of  $\text{mg/m}^2$  ( $\mu\text{g/cm}^2 = 10 \text{ mg/m}^2$ ): Since a constant is used in the numerator and denominator for this conversion, it cancels out and doesn't change the ratio.

## EQUITABILITY

Equitability was determined using the procedures detailed in Weber's Biological Field and Laboratory Methods (11). The procedure involves first the calculation of the Shannon-Weaver species diversity index ( $\bar{d}$ ) which provides the data to use the tables of Lloyd and Ghelardi to determine the expected number of species (11). Equitability (e) was then calculated.

## Fish

In the Little Calumet River, fish were collected by use of a direct current backpack electrofisher and dip nets, often operated from a small boat due to the deep deposits of bottom sediments. At the Ashland Avenue sampling reach, a 230 volt alternating current electrofishing boat and a 15 foot, 3/16 inch mesh, minnow seine were used to collect fish on separate occasions.

In Thorn Creek, fish were collected by use of a direct current backpack electrofisher and dip nets, often followed with a 15 foot, 3/16 inch mesh, minnow seine. The stream bottom of Thorn Creek was firm enough for wading at all collection locations.

Total stream shoreline distance sampled (in meters) and total electrofishing time required for each sample were noted for all collections. All fish collected were identified to species, measured for standard and total length to the nearest millimeter and weighed to the nearest gram or ounce.

## RESULTS

### Bacteria

Sampling runs for bacterial analyses occurred on April 20, June 21, September 21, and October 19, 1982. Geometric means of the resultant data are presented in Table 2.

#### INDICATOR BACTERIA

Total Coliform. The geometric means of the TC analytical results from the four samples are presented in Table 2 for each of the stations at which samples were collected (Figure 1). From the three stations on Thorn Creek, TC geometric means ranged from  $4.3 \times 10^4$  to  $1.2 \times 10^5$  per 100 milliliters and the three TC geometric means from the Little Calumet River ranged from  $1.2 \times 10^5$  to  $9.7 \times 10^5$  per 100 milliliters.

Colony confirmation data for TC are presented in Table 3. The colony confirmation rate for TC during 1982 was 63.8 percent compared to 60.5 percent reported in 1981 for TC colonies obtained from the North Branch of the Chicago River (7).

Fecal Coliform. Samples for FC analysis were collected from Thorn Creek and the Little Calumet River monthly beginning on January 19 and June 15, respectively. Sampling was terminated on December 21, 1982. These samples were part of the Industrial Waste Division's stream monitoring program (bridge-run) and were in addition to the FC samples collected

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TABLE 2

GEOMETRIC MEANS OF BACTERIAL COUNTS<sup>1</sup> FOR THORN CREEK  
AND THE LITTLE CALUMET RIVER DURING 1982

STATION	Total Coliform	Fecal Coliform	Fecal Streptococcus	SPC <sup>2</sup>	<u>Pseudomonas aeruginosa</u>	<u>Salmonella</u>
<u>THORN CREEK</u>	n <sup>3</sup> =4	n=16	n=4	n=4	n=4	n=4
Joe Orr Road	1.2 x 10 <sup>5</sup>	1.5 x 10 <sup>4</sup>	2.4 x 10 <sup>3</sup>	4.2 x 10 <sup>4</sup>	6.8 x 10 <sup>2</sup>	<2.0 x 10 <sup>-1</sup>
Margaret Street	4.3 x 10 <sup>4</sup>	4.9 x 10 <sup>3</sup>	1.7 x 10 <sup>3</sup>	4.2 x 10 <sup>4</sup>	3.7 x 10 <sup>2</sup>	<2.0 x 10 <sup>-1</sup>
167/170th Street	7.5 x 10 <sup>4</sup>	4.9 x 10 <sup>3</sup>	2.4 x 10 <sup>3</sup>	9.1 x 10 <sup>4</sup>	3.7 x 10 <sup>2</sup>	<2.0 x 10 <sup>-1</sup>
<u>LITTLE CALUMET RIVER</u>	n=4	n=11	n=4	n=4	n=4	n=4
Wentworth Avenue	9.7 x 10 <sup>5</sup>	7.5 x 10 <sup>4</sup>	2.9 x 10 <sup>4</sup>	1.2 x 10 <sup>5</sup>	2.3 x 10 <sup>4</sup>	3.0 x 10 <sup>-1</sup>
159th Street	1.2 x 10 <sup>5</sup>	2.0 x 10 <sup>4</sup>	5.0 x 10 <sup>3</sup>	5.5 x 10 <sup>5</sup>	8.8 x 10 <sup>2</sup>	<2.0 x 10 <sup>-1</sup>
Ashland Avenue	3.3 x 10 <sup>5</sup>	9.3 x 10 <sup>3</sup>	1.6 x 10 <sup>3</sup>	8.4 x 10 <sup>4</sup>	7.3 x 10 <sup>2</sup>	<2.0 x 10 <sup>-1</sup>

<sup>1</sup>All counts are per 100 milliliters except SPC which is in counts per milliliter; the geometric means resulted from analysis of samples collected April 20, June 21, September 21, and October 19, 1982

<sup>2</sup>SPC = STANDARD PLATE COUNT

<sup>3</sup>n = number of samples

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TABLE 3

TOTAL COLIFORM (TC), FECAL COLIFORM (FC), AND FECAL STREPTOCOCCUS (FS) COLONY CONFIRMATIONS FOR THORN CREEK AND THE LITTLE CALUMET RIVER DURING 1982

	TC		FC		FS	
	Typical*	Atypical**	Typical	Atypical	Typical	Atypical
Number of Colonies Tested	160	29	149	25	174	7
Number Confirmed	102	3	141	10	160	7
Percent Confirmed	63.8	10.3	94.6	40.0	92.0	100.0

\*Typical Colonies - T.C., red with greenish metallic sheen; F.C., blue; F.S., salmon to red

\*\*Atypical Colonies - Variations in color, size, or shape of typical colonies.



specifically as part of this study on April 20, June 21, September 21, and October 19, 1982.

On Thorn Creek 16 FC values were used to generate the geometric means presented in Table 2. On the Little Calumet River, since sampling started later in the year, only 11 FC values were available (Table 2). The FC geometric means for Thorn Creek ranged from  $4.9 \times 10^3$  to  $1.5 \times 10^4$  per 100 millimeters; for the stations located on the Little Calumet River the FC geometric means ranged from  $9.3 \times 10^3$  to  $7.5 \times 10^4$  per 100 milliliters (Table 2).

Colony confirmation data for FC are presented in Table 3. The colony confirmation rate for FC during 1982 was 94.6 percent compared with the 91.0 percent reported in 1981 for FC colonies obtained from the North Branch of the Chicago River (7).

Fecal Streptococcus. The geometric means of the FC analytical results from four samples are presented in Table 2 for each of the stations at which samples were collected (Figure 1). From the three stations on Thorn Creek the FS geometric means ranged from  $1.7 \times 10^3$  to  $2.4 \times 10^3$  per 100 milliliters and the three FS geometric means resulting from the Little Calumet River ranged from  $1.6 \times 10^3$  to  $2.9 \times 10^4$  per 100 milliliters.

Colony confirmation data for FS are presented in Table 3. The colony confirmation rate for FS during 1982 was 92

percent compared to the 97.6 percent reported in 1981 for FS colonies obtained from the North Branch of the Chicago River (7).

#### STANDARD PLATE COUNTS

The geometric means of the SPC from the four samples collected at each station are presented in Table 2. At the three stations on Thorn Creek the SPC geometric means ranged from  $4.2 \times 10^4$  to  $9.1 \times 10^4$  per milliliter, and the three SPC geometric means from the Little Calumet River stations ranged from  $8.4 \times 10^4$  to  $5.5 \times 10^5$  per milliliter.

#### PSEUDOMONAS AERUGINOSA

The geometric means of the P. aeruginosa results from the four samples collected at each station are presented in Table 2. From the three stations on Thorn Creek the P. aeruginosa geometric means ranged from  $3.7 \times 10^2$  to  $6.8 \times 10^2$  per 100 milliliters, and the three P. aeruginosa geometric means from the Little Calumet River stations ranged from  $7.3 \times 10^2$  to  $2.3 \times 10^4$  per 100 milliliters.

#### SALMONELLA

The geometric means of the Salmonella testing results from the four samples collected at each station are presented in Table 2. From the three stations on Thorn Creek the Salmonella geometric means were the same with a value of less than 0.2 per 100 milliliters and the three Salmonella geo-

metric means from the Little Calumet River stations ranged from 0.2 to 0.3 per 100 milliliters.

Results of the serotyping performed by the Illinois Department of Public Health are shown in Table 4.

Salmonella were isolated from one-third of the samples tested, all of which contained FC in excess of 200 per 100 milliliters. This result is consistent with those reported from the Des Plaines River (4, 5) and the North Branch of the Chicago River (6, 7), and may be typical of the District waterways. However, Geldreich (14) reported an 85.2 percent recovery rate of Salmonella from samples containing FC in excess of 200 per 100 milliliters.

#### Periphyton

Periphyton samples were collected from Thorn Creek and the Little Calumet River every four weeks from April 29 to December 16, 1982. Nine sampling runs were made and 44 out of a possible 54 samples were collected (81.5 percent recovery) and analyzed for periphyton populations, chlorophyll a, and organic matter. An Autotrophic Index and equitability factor were calculated from the results of these analyses and are presented in Tables 5, 6 and 7.

#### PERIPHYTON POPULATION ANALYSIS

In Thorn Creek the geometric means of the periphyton densities for each station sampled (Figure 1) ranged from

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 4

SALMONELLA SEROTYPING RESULTS FOR 1982 FROM  
THORN CREEK AND THE LITTLE CALUMET RIVER

STATION	DATE	SEROTYPE	NUMBER ISOLATED
Thorn Creek Joe Orr Road	9/21/82	Bietri	1
Little Calumet River Wentworth Avenue	9/21/82	New Brunswick Anatum	1 1
Total Number Isolated			3

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TABLE 5

PERIPHYTON POPULATION ANALYSES - THORN CREEK AND THE  
LITTLE CALUMET RIVER - 1982

Station	Geometric Mean of Periphyton Densities counts/cm <sup>2</sup>	Average Number of Species per Station	Average Shannon-Weaver Species Diversity Index ( $\bar{d}$ )	Equitability (e)	Total Number of Species found at each station	Number of Samples (n)
<u>Thorn Creek</u>						
Joe Orr Road	336,300	34.1	1.38	0.03	109	9
Margaret Street	306,300	39.0	2.82	0.09	113	7
167/170th Street	442,900	34.9	2.38	0.07	99	7
<u>Little Calumet River</u>						
Wentworth Avenue	724,100	40.3	2.48	0.06	125	8
159th Street	377,300	32.3	1.67	0.05	79	4
Ashland Avenue	116,100	33.4	2.80	0.08	123	9

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TABLE 6

PERIPHYTON SPECIES DATA, BY STATION, RELATED TO  
 FREQUENCY OF APPEARANCE AND THE PRESENCE  
 OF POLLUTANT-TOLERANT SPECIES IN THORN CREEK  
 AND THE LITTLE CALUMET RIVER DURING 1982

Station	Total Number of Species Per Station	Number of Persistent Species Per Station	Number of Pollutant- Tolerant Species Per Station	Number of Persistent Pollutant- Tolerant Species Per Station	Percent Pollutant- Tolerant Species Per Station	Percent Persistent Pollutant- Tolerant Species	Percent Persistent Pollutant- Tolerant Species of Persistent Species
<u>Thorn Creek</u>							
Joe Orr Road	109	20	22	8	20	7.3	40
Margaret Street	113	23	23	8	20	7.1	35
167/170th Street	99	23	18	7	18	7.1	30
<u>Little Calumet River</u>							
Wentworth Avenue	125	28	30	13	24	10.4	46
159th Street	79	35	19	12	24	15.2	34
Ashland Avenue	123	19	24	7	20	5.7	37

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TABLE 7

PERIPHYTON DERIVED DATA FROM THORN CREEK AND THE  
LITTLE CALUMET RIVER - 1982

Station	Organic Matter Concentration ( $\mu\text{g}/\text{cm}^2$ )	Chlorophyll a Concentration ( $\mu\text{g}/\text{cm}^2$ )	Autotrophic Index (AI)
<u>Thorn Creek</u>			
Joe Orr Road	98 <sup>1</sup>	0.623	2859 <sup>2</sup>
Margaret Street	206	0.736	480
167/170th Street	189	1.328	367
<u>Little Calumet River</u>			
Wentworth Avenue	1385	1.889	2219
159th Street	865	1.133	4601
Ashland Avenue	157	0.541	1263

<sup>1</sup>The values reported for each constituent were averaged from the individual values as given in APPENDIX A-II, Table AII-8.

<sup>2</sup>The AI values given are the averaged values of individual samples and not the result of calculation using averaged organic matter concentration and averaged chlorophyll a concentration.

306,000 to 443,000 organisms per square centimeter (Table 5) and the average number of species per sample ranged from 34 to 39 (Table 5) while the total number of species identified at each station ranged from 99 to 113 (Table 5). For these same samples the average Shannon-Weaver species diversity index ranged from 1.38 to 2.82 (Table 5).

In the Little Calumet River the geometric means for the periphyton population densities ranged from 116,000 to 724,000 organisms per square centimeter (Table 5) and the average number of species per sample ranged from 32 to 40 (Table 5) while the total number of species identified at each station ranged from 79 to 125 (Table 5). For these same samples the average Shannon-Weaver species diversity index ranged from 1.67 to 2.80 (Table 5).

Because many of the species identified were ephemerals or accidentals (appeared once or a very few times at a station), it was useful to examine those species which were found 50 percent or more of the time at a given station. These species were defined as persistent and their numbers are reported in Table 6. In Thorn Creek, the number of persistent species ranged from 20 to 23 and in the Little Calumet River, the number of persistent species ranged from 19 to 35.

Another subset of the population of species is that defined by Palmer (15, 16, 17) as pollutant-tolerant species. Their numbers found per station are reported in Table 6. For



the reasons given above, it was more useful to examine those species that were both persistent and pollutant-tolerant and the results of this segregation are presented in Table 6. The number of persistent pollutant-tolerant species in Thorn Creek ranged from 7 to 8, and in the Little Calumet River ranged from 7 to 14.

#### CHLOROPHYLL a

The results of periphyton chlorophyll a analyses are reported in Table 7 as averages for each station sampled (Figure 1). In Thorn Creek, the average chlorophyll a concentrations ranged from 0.7 to 1.3 micrograms per square centimeter and in the Little Calumet River the range was 0.5 to 1.9 micrograms per square centimeter.

#### ORGANIC MATTER

As with chlorophyll a, organic matter is a measure of the biomass of the sample. The average organic matter content found for each station sampled (Figure 1) is reported in Table 7. In Thorn Creek, the average organic matter content ranged from 98 to 206 micrograms per square centimeter and in the Little Calumet River, the range was from 157 to 1,385 micrograms per square centimeter.

## AUTOTROPHIC INDEX

The autotrophic index is the ratio of the organic matter concentration to the chlorophyll a concentration (11). When the ratio exceeds 100 the presumption is that soluble or particulate organic contamination is present resulting in the enhanced growth of non-chlorophyllous microorganisms. The average autotrophic index at each station is reported in Table 7. In Thorn Creek the average autotrophic index ranged from 367 to 2,859 and in the Little Calumet River the average autotrophic index ranged from 1,263 to 4,601.

## EQUITABILITY

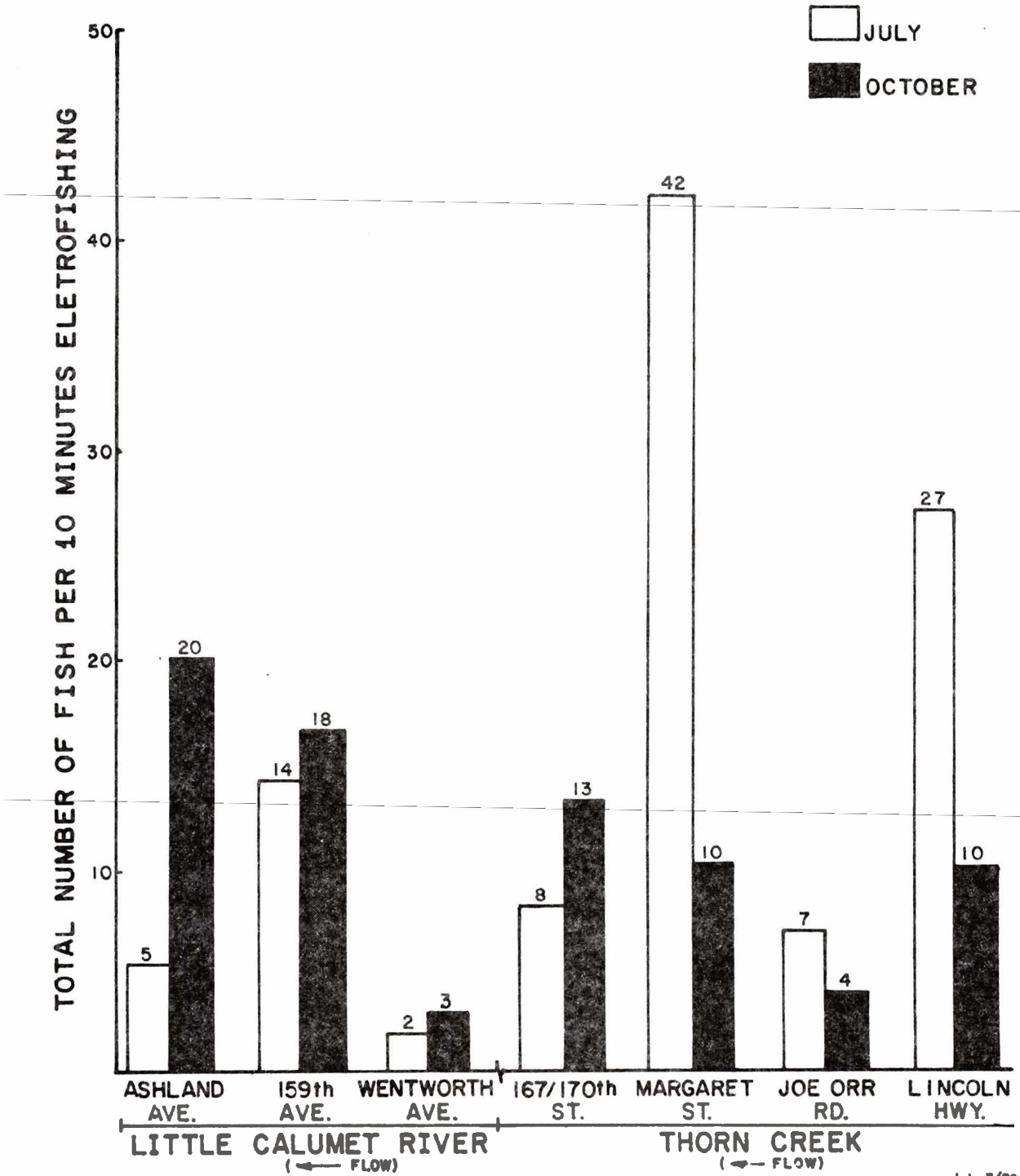
Equitability is a comparison of the distribution of species in a theoretical population with that actually found, using the average Shannon-Weaver species diversity index. The diversity index and the equitabilities for each station sampled are reported in Table 5. In Thorn Creek the average species diversity index ranged from 1.38 to 2.82 and the equitabilities ranged from 0.03 to 0.09. In the Little Calumet River the average species diversity index ranged from 1.67 to 2.80 and the equitabilities ranged from 0.05 to 0.08.

## Fish

Abundance of fish in terms of total numbers of fish per ten minutes electrofishing at each sampling location (Figure 1), along the Little Calumet River and Thorn Creek, collected

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO  
 FIGURE 3

TOTAL NUMBER OF FISH  
 PER 10 MINUTES ELECTROFISHING COLLECTED  
 FROM THE LITTLE CALUMET RIVER AND THORN CREEK  
 IN JULY AND OCTOBER 1982

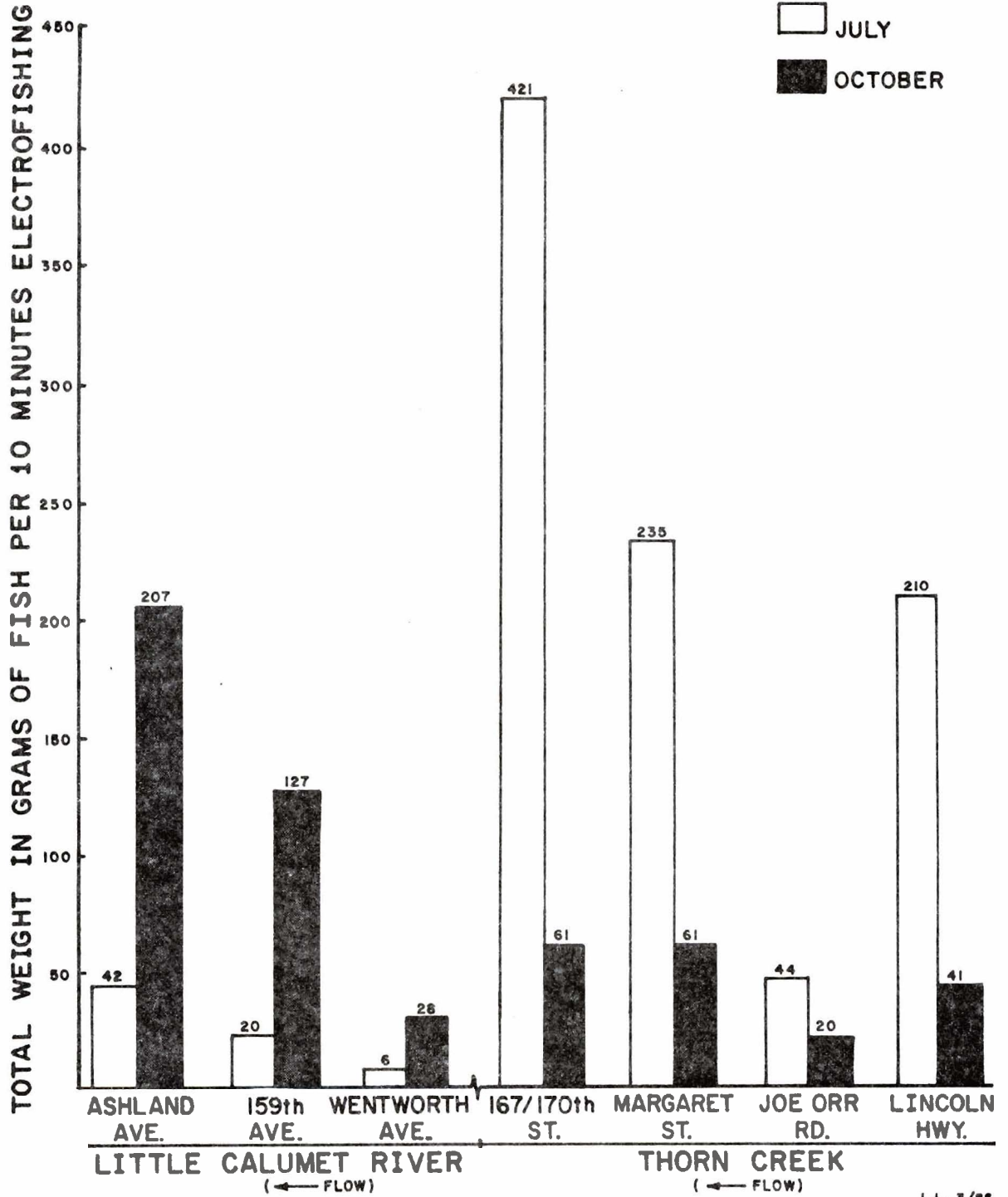


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FIGURE 4

TOTAL WEIGHT OF FISH  
PER 10 MINUTES ELECTROFISHING COLLECTED  
FROM THE LITTLE CALUMET RIVER AND THORN CREEK  
IN JULY AND OCTOBER 1982



L.L., 8/86

during July and October are depicted in Figure 3. Total weights of fish per ten minutes electrofishing during the July and October collections are shown in Figure 4. Individual species abundance for each sample within each stream location, as well as statistics for the lengths and weights of individual species, are listed in Appendix III.

Abundance of each species of fish as an annual average for each sampling location in terms of both numbers and weights per ten minutes electrofishing are given in Tables 8 and 9, respectively.

Total numbers of fish species, fish hybrids, percent composition of the catch composed of omnivorous fish and of green sunfish are listed in Table 10.

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TABLE 8

AVERAGE NUMBER OF VARIOUS SPECIES OF FISH COLLECTED PER TEN MINUTES ELECTROFISHING FROM THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

Fish Species	Little Calumet River			Thorn Creek			
	Ashland Ave.	159th St.	Wentworth Ave.	167/170th St.	Margaret St.	Joe Orr Rd.	Lincoln Hwy.
Gizzard shad	0.13	0.08	0	0	0	0	0
Central mudminnow	1.89	9.98	1.74	1.73	6.57	0.56	0
Central stoneroller	0.19	0	0	0	0	0	0
Goldfish	0.48	0.08	0	0.13	0	0	0
Carp	0.06	0	0	0.13	0	0	0
Carp x goldfish hybrid	0.13	0.08	0	0	0	0	0
Golden shiner	0.24	0	0	0	0	0	0
Bluntnose minnow	0	0.63	0	0	0.89	0	0
Fathead minnow	3.19	1.89	0.39	3.75	6.30	0.39	7.63
Creek chub	2.22	0	0	1.44	5.17	0	4.50
White sucker	0.11	0.15	0	0.26	1.17	0	0.55

Table continued on following page.

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TABLE 8 (continued)

AVERAGE NUMBER OF VARIOUS SPECIES OF FISH COLLECTED PER TEN MINUTES ELECTROFISHING FROM  
THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

Fish Species	Little Calumet River			Thorn Creek			
	Ashland Ave.	159th St.	Wentworth Ave.	167/170th St.	Margaret St.	Joe Orr Rd.	Lincoln Hwy.
Black bullhead	0.11	0.08	0	0	0.17	0	0
36 Green sunfish	2.70	0.87	0.52	2.59	5.50	4.20	5.67
Warmouth	0	0	0	0	0	0	0.23
Orange Spotted sunfish	0.06	0	0	0	0	0	0
Bluegill	0.55	1.81	0	0.15	0.15	0	0
Hybrid sunfish	0.13	0	0	0.30	0	0.15	0
White crappie	0.21	0.08	0	0	0	0	0
Largemouth bass	0.06	0.08	0	0.26	0	0	0
TOTAL	12.46	15.81	2.65	10.74	25.92	5.30	18.58

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TABLE 9

AVERAGE WEIGHT IN GRAMS OF VARIOUS SPECIES OF FISH COLLECTED PER TEN MINUTES ELECTROFISHING FROM  
FROM THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

Fish Species	Little Calumet River			Thorn Creek			
	Ashland Ave.	159th St.	Wentworth Ave.	167/170th St.	Margaret St.	Joe Orr Rd.	Lincoln Hwy.
-----Weight in Grams Per 10 Minutes Electrofishing-----							
Gizzard shad	0.70	0.47	0	0	0	0	0
37 Central mudminnow	11.32	33.80	8.68	12.51	40.98	5.57	0
Central Stoneroller	0.54	0	0	0	0	0	0
Goldfish	31.51	9.25	0	10.47	0	0	0
Carp x goldfish hybrid	0.56	0.41	0	0	0	0	0
Golden shiner	2.30	0	0	0	0	0	0
Bluntnose minnow	0	0.32	0	0	0.31	0	0
Fathead minnow	9.04	4.35	0.75	7.26	5.83	0.35	16.89
Creek chub	13.61	0	0	3.64	27.80	0	51.10
Carp	0.53	0	0	190.02	0	0	0

Table continued on following page.



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TABLE 9 (continued)

AVERAGE WEIGHT IN GRAMS OF VARIOUS SPECIES OF FISH COLLECTED PER TEN MINUTES ELECTROFISHING FROM  
FROM THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

Fish Species	Little Calumet River			Thorn Creek			
	Ashland Ave.	159th St.	Wentworth Ave.	167/170th St.	Margaret St.	Joe Orr Rd.	Lincoln Hwy.
	-----Weight in Grams per 10 Minutes Electrofishing-----						
White sucker	0.56	0.04	0	0.24	1.17	0	19.17
Black bullhead	15.29	14.34	0	0	22.48	0	0
Green sunfish	30.66	1.30	7.83	13.83	49.00	26.15	37.93
Warmouth	0	0	0	0	0	0	0.34
Orange spotted sunfish	0.78	0	0	0	0	0	0
Bluegill	0.63	1.33	0	0.12	0.18	0	0
Hybrid sunfish	0.08	0	0	2.46	0	0.25	0
White crappie	4.79	7.88	0	0	0	0	0
Largemouth bass	1.05	0.03	0	0.33	0	0	0
TOTAL	123.95	73.52	17.26	240.88	147.73	32.32	125.43

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TABLE 10

NUMBER OF FISH SPECIES AND OF HYBRIDS, PERCENT COMPOSITION OF OMNIVORES AND PERCENT OF GREEN SUNFISH  
IN THE CATCH OF FISH FROM LOCATIONS ON THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

Location	Number Collected		Percent Omnivores	Percent Green Sunfish
	Fish Species	Fish Hybrids		
<u>Little Calumet River</u>				
Wentworth Avenue	3	0	80	20
159th Street	11	1	82	6
Ashland Avenue	15	2	69	22
<u>Thorn Creek</u>				
Lincoln Highway	5	0	68	31
Joe Orr Road	3	1	18	79
Margaret Street	8	0	78	21
167/170th Street	9	1	69	24

## DISCUSSION

### Bacteria

#### INDICATOR BACTERIA

Total Coliform. In both Thorn Creek and the Little Calumet River the stations with the highest TC counts (Table 2) were those stations sampled farthest upstream, at Joe Orr Road ( $1.2 \times 10^5$  TC per 100 milliliters) and Wentworth Avenue ( $9.7 \times 10^5$  TC per 100 milliliters) (Figure 1). The Joe Orr Road station is just downstream of the Thorn Creek Basin Sewage Treatment Plant of the Bloom Township Sanitary District. The Wentworth Avenue station is only about one-half mile from the Illinois-Indiana border so most of the drainage into this segment of the Little Calumet River came from Indiana. By taking the geometric mean of the TC counts presented for each waterway in Table 2 it was found that Thorn Creek had  $7.3 \times 10^4$  TC per 100 milliliters compared to  $3.4 \times 10^5$  TC per 100 milliliters found in the Little Calumet River.

Fecal Coliform. In both Thorn Creek and the Little Calumet River the stations with the highest FC counts (Table 2) were those stations sampled farthest upstream, at Joe Orr Road ( $1.5 \times 10^4$  FC per 100 milliliters) and Wentworth Avenue, close to the Indiana border, ( $7.5 \times 10^4$  per 100 milliliters) (Figure 1). The order of magnitude for the FC counts found approximate those found in Chicago's man-made waterways, as well as the Des Plaines River and the North Branch of the

Chicago River. This indicated that the drainage basins of both Thorn Creek and the Little Calumet River were receiving significant inputs of domestic waste from Indiana.

Fecal Streptococcus. In Thorn Creek the highest FS counts (Table 2) were found at Joe Orr Road ( $2.4 \times 10^3$  FS per 100 milliliters) and at 167/170th Street ( $2.4 \times 10^3$  FS per 100 milliliters). These were, respectively, the farthest upstream and downstream stations sampled (Figure 1). In the Little Calumet River the highest FS counts were found at Wentworth Avenue ( $2.9 \times 10^4$  FS per 100 milliliters) the farthest upstream station sampled (Figure 1).

#### STANDARD PLATE COUNT

The highest SPC in Thorn Creek (Table 2) was found at 167/170th Street ( $9.1 \times 10^4$  SPC per milliliter) just above the confluence of Thorn Creek with the Little Calumet River (Figure 1) and the highest SPC in the Little Calumet River (Table 2) was found at 159th Street ( $5.5 \times 10^5$  SPC per milliliter) just below the confluence of the Little Calumet River with Thorn Creek. By taking the geometric mean of the values given for SPC in Table 2 for each station it was found that Thorn Creek contained  $5.4 \times 10^4$  SPC per milliliter and the Little Calumet River  $1.8 \times 10^5$  SPC per milliliter, almost an order of magnitude difference between the two waterways.

### PSEUDOMONAS AERUGINOSA

The highest P. aeruginosa counts in Thorn Creek (Table 2) were found at Joe Orr Road ( $6.8 \times 10^2$  per 100 milliliters) and in the Little Calumet River (Table 2) were found at Wentworth Avenue ( $2.3 \times 10^4$  per 100 milliliters). By taking the geometric mean of the values given in Table 2 for each station it was found that Thorn Creek contained  $4.5 \times 10^2$  P. aeruginosa per 100 milliliters and that the Little Calumet River contained  $2.5 \times 10^3$  P. aeruginosa per 100 milliliters, almost an order of magnitude difference between the two waterways.

### SALMONELLA

In Thorn Creek all of the stations contained less than 0.2 Salmonella per 100 milliliters, as a geometric average. In the Little Calumet River the highest Salmonella counts were found at Wentworth Avenue (0.3 Salmonella per 100 milliliters).

In general, the farthest upstream station sampled in Thorn Creek and in the Little Calumet River contained the highest bacterial counts for each parameter analyzed (the exception in both cases was SPC). Values for the bacterial analyses for individual stations collected each date are reported in Appendix I.

## Periphyton

### PERIPHYTON POPULATION ANALYSES

In Thorn Creek the mean periphyton population densities for each station were nearly identical (Table 5). In the Little Calumet River the mean periphyton population densities decreased from the upstream station, Wentworth Avenue ( $7.24 \times 10^5$  organisms per square centimeter), to the downstream station, Ashland Avenue ( $1.16 \times 10^5$  organisms per square centimeter). The average periphyton population values were almost identical in each river system with  $3.9 \times 10^5$  organisms per square centimeter found in Thorn Creek and  $4.0 \times 10^5$  organisms per square centimeter found in the Little Calumet River.

The average number of species found in Thorn Creek ranged from 34 at Joe Orr Road to 39 at Margaret Street (Table 5) with an overall average of 36 species per sample. The average number of species found in the Little Calumet River ranged from 32 at 159th Street to 40 at Wentworth Avenue (Table 5) with an overall average of 35 species per sample. Consideration of the total number of species for each waterway station showed a range of 99 to 113 in Thorn Creek (Table 5) with a total for the waterway of 174 species while in the Little Calumet River, the total number of species ranged from 79 to 125 (Table 5) with a total for the waterway of 187 species.

Palmer, in two publications (15, 16), lists 113 species which he considers pollutant tolerant. In Thorn Creek, the

number of pollutant-tolerant species ranged from 23 at Margaret Street to 18 at 167/170th Street (Table 6) or 20 to 18 percent, respectively, of the total number of species found at these stations. In the Little Calumet River, the number of pollutant-tolerant species ranged from 19 at 159th Street to 30 at Wentworth Avenue or 24 percent of the total number of species found for both of these stations. This would seem to indicate slightly poorer quality in the Little Calumet River than in Thorn Creek.

Examination of the persistent species in each waterway showed that in Thorn Creek the number of persistent species (Table 6) ranged from 20 to 23 and were composed of from 30 to 40 percent pollutant-tolerant species. In the Little Calumet River, the number of persistent species varied from station to station (Table 6) with 28 species at Wentworth Avenue, 35 species at 159th Street, and 19 species at Ashland Avenue of which 41, 34, and 37 percent, respectively, were pollutant-tolerant species. The higher numbers and proportion of persistent pollutant-tolerant species in the Little Calumet River indicated water of lesser quality than in Thorn Creek.

#### CHLOROPHYLL a

In Thorn Creek, the chlorophyll a concentrations (Table 7) increased from Joe Orr Road (0.623 micrograms per square centimeter) to 167/170th Street (1.328 micrograms per square

centimeter) indicating increasing production of chlorophyllous organisms from upstream to downstream (Figure 1). This is in contrast to the periphyton densities reported in Table 5 where all of the stations on Thorn Creek contained an average of  $3.5 \times 10^5$  organisms per square centimeter.

In the Little Calumet River, the chlorophyll a concentrations (Table 7) decreased from Wentworth Avenue (1.889 micrograms per square centimeter) to Ashland Avenue (0.541 micrograms per square centimeter) indicating decreased production of chlorophyllous organisms from upstream to downstream (Figure 1). This is supported by the periphyton densities reported in Table 5 where the average periphyton densities decreased from  $7.2 \times 10^5$  at Wentworth Avenue to  $1.2 \times 10^5$  organisms per square centimeter at Ashland Avenue.

The chlorophyll a data for Thorn Creek indicated that perhaps the tributaries to Thorn Creek, such as Deer Creek and Butterfield Creek, added sufficient nutrients to enhance the production of chlorophyllous organisms at Margaret Street and 167/170th Street.

#### ORGANIC MATTER

In Thorn Creek, the organic matter concentration (Table 7) increased from 98 micrograms per square centimeter at Joe Orr Road to 206 micrograms per square centimeter at Margaret Street and then decreased to 189 micrograms at 167/170th



Street. This pattern was similar to that found for chlorophyll a. The decreased concentration of organic matter or biomass found at 167/170th Street may be explained as a dilution effect on the organic constituents in Thorn Creek by the entering tributaries, Deer and Butterfield Creeks, thus reducing the concentration and growth of heterotrophic organisms.

In the Little Calumet River, the organic matter concentration (Table 7) decreased from 1,385 micrograms per square centimeter at Wentworth Avenue to 157 micrograms per square centimeter at Ashland Avenue. The accumulated biomass decreased from upstream to downstream, as did the chlorophyllous biomass (Table 7) and the periphyton densities (Table 5); this indicated that some condition present was inhibiting the production of biomass.

#### AUTOTROPHIC INDEX

In Thorn Creek, the autotrophic index (Table 7) decreased from Joe Orr Road (2,859) to 167/170th Street (367). This indicated a decreased concentration of soluble or particulate organic contamination.

In the Little Calumet River, the autotrophic index (Table 7) varied from 2,219 at Wentworth Avenue to 4,601 at 159th Street and to 1,263 at Ashland Avenue. This indicated a high level of pollution at Wentworth Avenue, which increased at 159th Street and decreased toward Ashland Avenue.

All of the autotrophic index values exceeded 200, which had been established as the point beyond which organic pollution was indicated (10, 11). Therefore, Thorn Creek and the Little Calumet River can be classed as polluted at all stations sampled.

#### EQUITABILITY

In Thorn Creek and the Little Calumet River, all equitabilities calculated (Table 5) were less than 0.1, indicating severe pollution (11).

In general, the magnitude of the periphyton densities, the low average number of species, the low number of persistent species, the high proportion of pollutant-tolerant species, the magnitude of the autotrophic index, and the very low equitabilities all indicated that Thorn Creek and the Little Calumet River were polluted. There was no clear cut basis on which to determine which river system was the cleaner of the two. The number and proportion of pollutant-tolerant species were higher in the Little Calumet River than in Thorn Creek. The autotrophic index was higher in the Little Calumet River than in Thorn Creek. The total number of species was also higher in the Little Calumet River than in Thorn Creek. There was essentially no difference between the two waterways in terms of the average number of species, the average periphyton density, the average species diversity index, or the average equitability.

## COMPARISON OF BACTERIAL AND PERIPHYTON DATA

The higher bacterial counts (Table 2) in every category analyzed, except for SPC, ( $1.2 \times 10^5$  TC per 100 milliliters,  $1.5 \times 10^4$  FC per 100 milliliters,  $6.8 \times 10^2$  P. aeruginosa per 100 milliliters, and less than 0.2 Salmonella per 100 milliliters) showed that the water in Thorn Creek at Joe Orr Road was of poorer quality than the water farther downstream. The periphyton data (Tables 5, 6, and 7) confirmed this conclusion with the lowest average number of species (34 species), the lowest average species diversity index (1.38), the lowest equitability (0.03), the highest percentage of pollutant-tolerant species in the population of persistent species (40 percent), and the highest autotrophic index (2,859) of the stations sampled in Thorn Creek.

In Thorn Creek, the Margaret and 167/170th Street stations had similar water quality as shown by the bacterial data in Table 2. There was little difference in the TC counts at Margaret Street ( $4.3 \times 10^4$  per 100 milliliters) and at 167/170th Street ( $7.5 \times 10^4$  per 100 milliliters). The FC counts were the same at both stations ( $4.9 \times 10^3$  per 100 milliliters) and the FS at Margaret Street ( $1.7 \times 10^3$  per 100 milliliters) and at 167/170th Street ( $2.4 \times 10^3$  per 100 milliliters) were essentially the same. The SPC count at Margaret Street ( $4.2 \times 10^4$  per milliliter) was one-half of the 167/170th Street count ( $9.1 \times 10^4$  per milliliter), but the P. aeruginosa and

Salmonella counts were the same for both stations,  $3.7 \times 10^4$  per 100 milliliters and less than 0.2 per 100 milliliters, respectively. Compared with the bacterial counts at Joe Orr Road, this downstream reach was of better quality than that at Joe Orr Road. The same conclusion was reached by examination of the periphyton data found in Tables 5, 6, and 7. In Thorn Creek, the station at Margaret Street had a higher average number of periphyton species (39 species) than at 167/170th Street (35 species) as well as a higher total number of species, 113 species at Margaret Street compared to 99 species at 167/170th Street. The average species diversity index was higher for Thorn Creek at Margaret Street (2.82) than at 167/170th Street (2.38). The equitability factors in Thorn Creek were marginally better at Margaret Street (0.09) than at 167/170th Street (0.07). These values show the Margaret Street station in Thorn Creek to have slightly better water quality than at 167/170th Street. However, the percentage of pollutant-tolerant species in Thorn Creek was greater at Margaret Street (35 percent) than at 167/170th Street (30 percent) and the autotrophic index was greater at Margaret Street (480) than at 167/170th Street (367). Therefore, as with the bacterial data, the periphyton data indicated similarity of water quality in Thorn Creek at Margaret Street and 167/170th Street and that it was better than was found at Joe Orr Road.

The higher bacterial counts (Table 2) in every category analyzed, except for SPC, ( $9.7 \times 10^5$  TC per 100 milliliters,  $7.5 \times 10^4$  FC per 100 milliliters,  $2.9 \times 10^4$  FS per 100 milliliters,  $1.2 \times 10^5$  SPC per milliliter,  $2.3 \times 10^4$  P. aeruginosa per 100 milliliters, and 0.3 Salmonella per 100 milliliters) showed that the water in the Little Calumet River at Wentworth Avenue was of lesser quality than the water farther downstream. The periphyton data (Tables 5, 6, and 7) showed that the highest productivity occurred at the Wentworth Avenue station compared with the downstream stations on the Little Calumet River. At Wentworth Avenue, were found the highest periphyton population density (724,100 organisms per square centimeter), the highest average number of species (40 species), the highest total number of species (125 species), and a high average species diversity index (2.48). The highest number of pollutant-tolerant species (30 species) and the highest percentage of pollutant-tolerant species in the population of persistent species (46 percent) were also found. The high productivity of the Little Calumet River at Wentworth Avenue was confirmed by the organic matter concentration (1,385 micrograms per square centimeter) and the chlorophyll a concentration (1,889 micrograms per square centimeter). The autotrophic index was also high (2,219).

In the Little Calumet River at 159th Street, the bacterial data (Table 2) showed an improvement in water quality compared

to that at Wentworth Avenue. At 159th Street, the TC counts were  $1.2 \times 10^5$  per 100 milliliters compared to  $9.7 \times 10^5$  per 100 milliliters at Wentworth Avenue and  $3.3 \times 10^5$  per 100 milliliters at Ashland Avenue. The FC counts at 159th Street were  $2.0 \times 10^4$  per 100 milliliters compared to  $7.5 \times 10^4$  per 100 milliliters at Wentworth Avenue and  $9.3 \times 10^3$  per 100 milliliters at Ashland Avenue. The FS counts were  $5.0 \times 10^3$  per 100 milliliters compared to  $2.9 \times 10^4$  per 100 milliliters at Wentworth Avenue and  $1.6 \times 10^3$  per 100 milliliters at Ashland Avenue. These indicator bacterial counts showed a decrease from those counts found at Wentworth Avenue, but were similar to those counts found at Ashland Avenue. These data showed a slight improvement in water quality from Wentworth Avenue to 159th Street with very little change to Ashland Avenue. The SPC at 159th Street were  $5.5 \times 10^5$  per milliliter which was slightly higher than that found at Wentworth Avenue ( $1.2 \times 10^5$  per milliliter) and Ashland Avenue ( $8.4 \times 10^4$  per milliliter). There was a significant decrease in P. aeruginosa from Wentworth Avenue ( $2.3 \times 10^4$  per 100 milliliters) to 159th Street ( $8.8 \times 10^2$  per 100 milliliters) and Ashland Avenue ( $7.3 \times 10^2$  per 100 milliliters). Salmonella were about the same concentration throughout the area studied ( $<2.0$  to  $3.0 \times 10^{-1}$  per 100 milliliters).

The periphyton data found in the Little Calumet River at 159th Street (Tables 5, 6, and 7) show decreased productivity

compared to Wentworth Avenue which continued to decrease to Ashland Avenue. The periphyton density at 159th Street (377,300 organisms per square centimeter) was approximately one-half that at Wentworth Avenue (724,100 organisms per square centimeter) and three times greater than that found at Ashland Avenue (116,100 organisms per square centimeter). The average number of species at 159th Street was 32 compared to 40 at Wentworth Avenue and 33 at Ashland Avenue. The total number of species at 159th Street was 79 species while at Wentworth Avenue, 125 species were found which was comparable to the 123 species found at Ashland Avenue. The percentage of pollutant-tolerant species of the population of persistent species was 34 percent at 159th Street, a sharp decrease from the 46 percent found at Wentworth Avenue, but comparable to the 37 percent found at Ashland Avenue. Organic matter concentration followed the decreasing trend found for the periphyton population densities with 1,385 micrograms per square centimeter found at Wentworth Avenue, followed by 865 and 157 micrograms per square centimeter at 159th Street and Ashland Avenue, respectively. Chlorophyll a concentrations, too, followed this trend with 1.889, 1.133, and 0.541 micrograms per square centimeter found at Wentworth Avenue, 159th Street, and Ashland Avenue, respectively. The autotrophic index did not follow this decreasing trend, instead the AI increased from 2,219 at Wentworth Avenue to 4,601 at 159th Street and then decreased to 1,263 at Ashland Avenue.

The decreased periphyton productivity (periphyton density, average number of species, total number of species, average species diversity index, organic matter, and chlorophyll a) combined with the decreased equitability and increased autotrophic index showed that organic contamination of the Little Calumet River occurred between Wentworth Avenue and 159th Street, producing a condition of nutrient enrichment and thereby eliminating those organisms whose upper tolerance limits had been exceeded.

In general, the bacterial and periphyton data showed Thorn Creek and the Little Calumet River to be of poor water quality. The equitability and autotrophic index confirmed that these waterways were polluted by organic substances presumably from sewage and combined sewer overflows. In both waterways, some improvement in water quality was shown at the farthest downstream station sampled.

### Fish

Fish were collected from the Little Calumet River during July and October, 1982. A total of 16 species of fish plus a carp x goldfish hybrid and a sunfish hybrid were collected from the entire watershed.

Abundance of fish in terms of number and weight of fish collected per ten minutes electrofishing are depicted in Figures 3 and 4 for the Little Calumet River and Thorn Creek. Total numbers of fish per ten minutes electrofishing ranged



from two at Wentworth Avenue to 13 at 159th Street during July and from three at Wentworth Avenue to 20 at Ashland Avenue during October in the Little Calumet River. In Thorn Creek, the total number of fish per ten minutes electrofishing ranged from seven at Joe Orr Road to 42 at Margaret Street during July and from four at Joe Orr Road to 13 at 167/170th Street during October.

Total weight of fish (in grams) per ten minutes electrofishing ranged from 6 grams at Wentworth Avenue to 42 grams at Ashland Avenue during July and from 28 grams at Wentworth Avenue to 207 grams at Ashland Avenue during October in the Little Calumet River. In Thorn Creek, the total weight of fish (in grams) per ten minutes electrofishing ranged from 44 grams at Joe Orr Road to 421 grams at 167/170th Street during July, and from 20 grams at Joe Orr Road to 61 grams at Margaret Street and 167/170th Street during October.

The number and weight of fish per ten minutes electrofishing were least, during both collection periods, at Wentworth Avenue on the Little Calumet River and at Joe Orr Road on Thorn Creek. This suggested that the water quality was poorest at these locations in each stream with fish being unable to reach very large numbers under existing conditions.

Both number and weight of fish per ten minutes electrofishing tended to increase at the downstream stations. This was most apparent for weight of fish per ten minutes electro-

fishing. This indicated that water quality was better downstream than upstream in each of these waterways.

The central mudminnow (which is known to tolerate low dissolved oxygen conditions and thrives in those areas of streams with a muddy bottom) was the most numerous fish in the 1982 Little Calumet River collection (Table 8) ranging from 1.74 to 9.98 mudminnows per ten minutes electrofishing (average of 4.53 mudminnows per ten minutes electrofishing). Next in order of abundance in the Little Calumet River were: fathead minnow (range 0.39 to 3.19 per ten minutes electrofishing, average of 1.82 per ten minutes electrofishing), green sunfish (range 0.52 to 2.70 per ten minutes electrofishing, average of 1.36 per ten minutes electrofishing), bluegill (range 0 to 1.81 per ten minutes electrofishing, average 1.18 per ten minutes electrofishing), and the creek chub (range 0 to 2.22 per ten minutes electrofishing, average 0.74 per ten minutes electrofishing).

The most numerous fish in the Thorn Creek collections was the fathead minnow, ranging from 0.39 to 7.63 fish per ten minutes electrofishing with an average of 4.52 per ten minutes electrofishing (Table 8). Next in order of abundance in Thorn Creek were: green sunfish (range 2.59 to 5.67 fish per ten minutes electrofishing, average 4.49 per ten minutes electrofishing), central mudminnow (range 0 to 6.57 per ten minutes electrofishing, average 2.95 per ten minutes electro-

fishing), creek chub (range 0 to 5.17 per ten minutes electrofishing, average 2.78 per ten minutes electrofishing), and the white sucker (range 0 to 1.17 per ten minutes electrofishing, average 0.49 per ten minutes electrofishing).

All of these species are tolerant of a wide range of ecological conditions (18), especially the central mudminnow, green sunfish, fathead minnow, and creek chub which are present in relatively great abundance in both the Little Calumet River and Thorn Creek. This dominance of tolerant fish suggested that the water quality conditions in both streams were stressful for intolerant fish; e.g., central stoneroller, bluegill sunfish, largemouth bass, and white crappie (18). These fish made up five percent of the 1982 fish catch. Evidence from cleaner streams in this area show they should be more abundant.

The central mudminnow, green sunfish, fathead minnow, and creek chub were also abundant in terms of weight of fish collected per unit of effort of electrofishing, as listed in Table 9, for both the Little Calumet River and Thorn Creek.

As compared with other waterways (Table 11), in the Chicago metropolitan area, with similar drainage areas, the Little Calumet River (including Thorn Creek) is similar in abundance of fishes, by number or by weight, to the North Branch of the Chicago River and to Salt Creek, and presumably similar in water quality to these other waterways.

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TABLE 11

AVERAGE CATCH PER TEN MINUTES ELECTROFISHING FOR BACKPACK/SEINE  
COLLECTIONS FROM THE CHICAGO WATERWAYS<sup>1</sup>

Waterway	Year	Number of Collections	Drainage Area (square miles)	Number of Species Per Collection		Fish Per Ten Minutes Electrofishing	
				Average	Maximum	Number	Weight (grams)
Jackson Creek <sup>2</sup>	1976	7	52.7	9.1	19	78	618
Mill Creek <sup>2</sup>	1976	5	65.3	8.4	10	87	856
Hickory Creek <sup>2</sup>	1976	9	109	10.1	20	322	1,921
North Branch Chicago River	1976	4	113	3.5	6	19	179
North Branch Chicago River	1980	16	113	2.6	6	12	330
North Branch Chicago River	1981	16	113	4.3	7	15	260
Salt Creek <sup>2</sup>	1976	6	150	4.0	13	11	262
Nippersink Creek <sup>3</sup>	1976	9	205	6.8	14	61	657
Little Calumet River	1976	13	291	1.9	5	15	235
Little Calumet River	1982	17	291	4.6	14	12	97
DuPage River <sup>2</sup>	1976	14	376	8.7	15	134	2,889

<sup>1</sup>All 1976 data from Reference 21

<sup>2</sup>Tributary to Des Plaines River

<sup>3</sup>Tributary to Fox River

Karr (19) has found that as a stream reach declines in water quality, the proportion of individuals that are omnivorous increases. An omnivorous fish eats both plant and animal matter. The common omnivores of small midwestern streams are the bluntnose minnow and the fathead minnow, while the carp is found over a wider range of stream sizes. The most degraded streams also commonly support large populations of goldfish. Generally, Karr (19) has found that samples with fewer than 20 percent of individuals as omnivores are indicative of good water quality, while those with over 45 percent omnivores are indicative of badly degraded water quality.

Another measure of water quality conditions is the abundance of green sunfish (19), often the dominant or only sunfish present at the sites of degraded water quality. An abundance of this species (greater than 20 percent of total individuals) indicates degraded conditions.

Using the criteria of the percentage of omnivores and the percentage of green sunfish in the catch, an investigation of the water quality of the Little Calumet River and of Thorn Creek can be made by an examination of Table 10, as well as by examination of the number of species of fish which a reach of stream can support, as evidenced by the catch.

Omnivorous fish in the catch exceeded 45 percent of all locations on the Little Calumet River, and at all but the Joe Orr Road location on Thorn Creek. At Joe Orr Road, 79 per-

cent of the catch was composed of the tolerant green sunfish which far exceeded the 20 percent figure which is indicative of degraded water quality conditions. In fact, all locations on the Little Calumet River and Thorn Creek had 20 percent or more green sunfish in the catch. The 159th Street location on the Little Calumet River had the highest proportion (82 percent) of omnivores. It would seem, based on these criteria, that all locations on the Little Calumet River and on Thorn Creek were of poor water quality as reflected by their fish populations.

From the total number of fish species collected, it would appear that among the sampling locations on each waterway, several relationships can be found (Table 10). On the Little Calumet River, the Wentworth Avenue location, with only three fish species collected, would appear to be of the poorest water quality along this river. Next higher in quality would be the 159th Street location, with 11 species collected, followed by Ashland Avenue, with 15 species collected.

On Thorn Creek, the sampling location at Joe Orr Road, from which only three fish species were collected, would appear to be of the poorest water quality among those locations sampled.

#### COMPARISON OF BACTERIAL, PERIPHYTON, AND FISH DATA

In Thorn Creek, the farthest upstream station sampled, Joe Orr Road (Figure 1), contained higher bacterial counts

(Table 2) in all categories tested, except SPC, ( $1.2 \times 10^5$  TC per 100 milliliters,  $1.5 \times 10^4$  FC per 100 milliliters,  $2.4 \times 10^3$  FS per 100 milliliters,  $4.2 \times 10^4$  SPC per milliliter,  $6.8 \times 10^2$  P. aeruginosa per 100 milliliters, and 0.2 Salmonella per 100 milliliters) than the stations located downstream, Margaret Street and 167/170th Street. This indicated that the water in Thorn Creek was of a poorer quality at Joe Orr Road than farther downstream. The periphyton analysis confirmed this conclusion with the lowest average number of species (34), the lowest average species diversity (1.38), the lowest equitability (0.03) (Table 5), the highest percentage of pollutant-tolerant species in the population of persistent species (40 percent) (Table 6), the lowest concentrations of organic matter (98 micrograms per square centimeter) and chlorophyll a (0.623 micrograms per square centimeter), and the highest autotrophic index (2,859) (Table 7) occurring at Joe Orr Road. In terms of number and weight of fish (Figures 3 and 4) per ten minutes electrofishing, the Joe Orr Road station on Thorn Creek contained less than the stations located farther downstream. In July, the seven fish per ten minutes electrofishing weighed 44 grams at Joe Orr Road, and in October the four fish per ten minutes electrofishing weighed 20 grams. This indicated that the water at Joe Orr Road was of lesser quality than at the stations farther downstream.

Furthermore, the high abundance (79 percent) of green sunfish also indicated degraded water quality at Joe Orr Road.

At Margaret Street, the TC ( $4.2 \times 10^5$  per 100 milliliters) and the FC ( $4.9 \times 10^3$  per 100 milliliters) counts were about an order of magnitude less than was found at Joe Orr Road, indicating an improvement in water quality. The remaining categories of bacterial analysis (Table 2) were the same as found at Joe Orr Road ( $1.7 \times 10^3$  FS per 100 milliliters,  $4.2 \times 10^4$  SPC per milliliter,  $3.7 \times 10^2$  P. aeruginosa per 100 milliliters, and 0.2 Salmonella per 100 milliliters). The bacterial analyses for the water found at 167/170th Street (Table 2) were the same as found at Margaret Street ( $7.5 \times 10^4$  TC per 100 milliliters,  $4.9 \times 10^3$  FC per 100 milliliters,  $2.4 \times 10^3$  FS per 100 milliliters,  $9.1 \times 10^4$  SPC per milliliter, 3.7 P. aeruginosa per 100 milliliters, 0.2 Salmonella per 100 milliliters). This suggested that the water quality downstream of Joe Orr Road, while still of poor quality, was an improvement over that found at Joe Orr Road.

The periphyton data from Thorn Creek at Margaret Street supported the conclusion based on the bacterial data of improved water quality downstream of Joe Orr Road. There was an increase in the average number of species to 39, an increase in the total number of species to 113, an increase in the average species diversity index to 2.82, and an increase in the equitability to 0.09 (Table 5). In Table 6 the decrease in



the percentage of pollutant-tolerant species in the population of persistent species to 35 percent also supported the conclusion of improved water quality. Although the organic matter concentration (206 micrograms per square centimeter) and the chlorophyll a concentration (0.736 micrograms per square centimeter) showed increased productivity compared to Joe Orr Road (Table 7), the autotrophic index (480) decreased sufficiently to indicate fewer heterotrophic organisms resulting from organic enrichment. Thus, the periphyton data collected from Thorn Creek at Margaret Street supported the bacterial data which indicated an improvement in water quality downstream of Joe Orr Road. At 167/170th Street, Thorn Creek showed a higher productivity than at Margaret Street [442,900 organisms per square centimeter compared to 306,300 organisms per square centimeter (Table 5) chlorophyll a concentration of 1.328 micrograms per square centimeter compared to 0.736 micrograms per square centimeter (Table 7)] indicating that water quality was deteriorating between Margaret Street and 167/170th Street. **This was further** supported by the decrease in average number of species from 39 at Margaret Street to 35 at 167/170th Street, the decrease in the total number of species from 113 at Margaret Street to 99 species at 167/170th Street, and the decrease in average species diversity from 2.82 at Margaret Street to 2.38 at 167/170th Street (Table 5). However these data were

offset by the decreased percentage of pollutant-tolerant species in the population of persistent species from 35 percent at Margaret Street to 30 percent at 167/170th Street (Table 6) and the decrease in the autotrophic index from 480 at Margaret Street to 367 at 167/170th Street (Table 7). In general, while the periphyton data showed better water quality in Thorn Creek at Margaret Street than at 167/170th Street, the water quality was similar at these stations as previously shown by the bacterial data.

The fish data from Thorn Creek at Margaret Street and 167/170th Street (Figures 3 and 4) also showed the similarity of water quality at these stations. In terms of numbers, 42 and 10 fish per ten minutes electrofishing were found at Margaret Street in July and October, respectively, compared to 8.5 and 13 fish per ten minutes electrofishing found at 167/170th Street in July and October, respectively. In terms of weight of fish, 240 grams and 420 grams per ten minutes electrofishing were found in July at Margaret Street and 167/170th Street, respectively. In October, 60 grams per ten minutes electrofishing were found at both stations. Thus, the similarity of water quality between Margaret Street and 167/170th Street was shown by the bacterial, periphyton, and fish data. Thorn Creek, in general, contains water of poor quality with the poorest quality of water shown to be at Joe Orr Road.

The bacterial data for Wentworth Avenue were the highest in all categories analyzed, except for SPC (Table 2) ( $9.7 \times 10^5$  TC per 100 milliliters,  $7.5 \times 10^4$  FC per 100 milliliters,  $2.9 \times 10^4$  FS per 100 milliliters,  $1.2 \times 10^5$  SPC per milliliter,  $2.3 \times 10^4$  P. aeruginosa per 100 milliliters, and 0.3 Salmonella per 100 milliliters). The periphyton data showed that the highest productivity occurred at Wentworth Avenue (Tables 5, 6, and 7) with 724,100 organisms per square centimeter, the highest concentrations of organic matter (1,385 micrograms per square centimeter) and chlorophyll a (1.889 micrograms per square centimeter), the equitability was low (0.06), and the autotrophic index was high (2,219). On the other hand, the average number of species was high (40 species) as was the total number of species (125 species) and the average species diversity index was high (2.48). These data showed that, although there was heavy organic pollution, the tolerance limits for most species of periphyton were not exceeded, producing no injurious effects on the periphyton population. Thus, the periphyton data supported the bacterial data in that the quality of water in the Little Calumet River was poor at Wentworth Avenue.

The numbers and weight of fish collected at Wentworth Avenue (Figures 3 and 4) showed Wentworth Avenue to have the poorest quality water in the Little Calumet River (the 2 and 3.25 fish per ten minutes electrofishing collected in July

and October, respectively, weighed 5 and 30 grams per ten minutes electrofishing, respectively.

In the Little Calumet River at 159th Street, the bacterial counts were generally lower than at Wentworth Avenue, all except SPC, which indicated some improvement in water quality (Table 2). The TC were  $1.2 \times 10^5$  per 100 milliliters at 159th Street compared to  $9.7 \times 10^5$  per 100 milliliters at Wentworth Avenue, the FC were  $2.0 \times 10^4$  per 100 milliliters at 159th Street compared to  $7.5 \times 10^4$  per 100 milliliters at Wentworth Avenue, and the FS were  $5.0 \times 10^3$  per 100 milliliters at 159th Street compared to  $2.9 \times 10^4$  per 100 milliliters at Wentworth Avenue. The SPC was higher at 159th Street,  $5.5 \times 10^5$  per milliliter, than at Wentworth Avenue,  $1.2 \times 10^5$  per milliliter. The counts of P. aeruginosa were much less at 159th Street,  $8.8 \times 10^2$  per 100 milliliters, and the Salmonella counts at 159th Street, less than 0.2 per 100 milliliters, were lower than at Wentworth Avenue, 0.3 per 100 milliliters. These data showed a slight improvement in water quality from Wentworth Avenue to 159th Street.

The periphyton data showed decreased productivity from Wentworth Avenue to 159th Street and also showed decreased diversity (Tables 5, 6, and 7). The periphyton density decreased from 724,000 to 377,300 organisms per square centimeter from Wentworth Avenue to 159th Street, respectively. The organic matter concentration at Wentworth Avenue, 1,385

micrograms per square centimeter, was reduced to 865 micrograms per square centimeter at 159th Street and the chlorophyll a concentration at Wentworth Avenue, 1.889 micrograms per square centimeter, was reduced to 1.133 micrograms per square centimeter at 159th Street. The total number of species declined from 125 to 79 species from Wentworth Avenue to 159th Street, respectively, and the average number of species declined from 40 at Wentworth Avenue to 32 at 159th Street. The average species diversity index decreased from 2.48 at Wentworth Avenue to 1.67 at 159th Street. These data showed a loss in number of organisms as well as a loss in number of kinds of organisms. The equitabilities were essentially the same for Wentworth Avenue (0.06) and 159th Street (0.05). However, the number of pollutant-tolerant species declined from 30 at Wentworth Avenue to 19 at 159th Street and the percentage of pollutant-tolerant species in the population of persistent species declined from 46 percent at Wentworth Avenue to 34 percent at 159th Street. Thus, a large percentage of the species lost between Wentworth Avenue and 159th Street were classed as pollutant-tolerant. The autotrophic index increased from 2,219 at Wentworth Avenue to 4,601 at 159th Street indicating that organic contaminants, from domestic sewage and combined sewer overflows, were added to the water between the stations. Thus, in contrast to the bacterial data, the periphyton data showed a decline in water quality between Wentworth Avenue and 159th Street.

The fish data, however, shows improvement of water quality between Wentworth Avenue and 159th Street. The number of fish increased from two per ten minutes electrofishing in July at Wentworth Avenue to 14 fish per ten minutes electrofishing at 159th Street, and from 3.25 per ten minutes electrofishing in October at Wentworth Avenue to 18 fish per ten minutes electrofishing at 159th Street. The weights of the fish collected also increased. At Wentworth Avenue, the fish weighed 5 grams per ten minutes electrofishing in July compared to 20 grams per ten minutes electrofishing at 159th Street. During the October collection, the fish weighed 30 grams per ten minutes electrofishing at Wentworth Avenue compared to 128 grams per ten minutes electrofishing at 159th Street. Due to the abundance of omnivorous fish (82 percent) the water at 159th Street was of poor quality, but since 11 species were collected compared to only three at Wentworth Avenue, the general conclusion must be of water quality improvement between Wentworth Avenue and 159th Street. Thus, the fish data supported the conclusion derived from the bacterial data and was in contrast to that for the periphyton. Since these organisms are at different trophic levels, it should not be surprising that the data do not agree.

In the Little Calumet River at Ashland Avenue, the bacterial data were the same as found at 159th Street (Table 2). At Ashland Avenue, the TC, FC, and FS were  $3.3 \times 10^5$  per 100

milliliters,  $9.3 \times 10^3$  per 100 milliliters, and  $1.6 \times 10^3$  per 100 milliliters, respectively. The SPC was  $8.4 \times 10^4$  per milliliter and the P. aeruginosa and Salmonella were  $7.3 \times 10^2$  and 0.2 per 100 milliliters, respectively. These data show the water quality at Ashland Avenue to be similar to that found at 159th Street.

The periphyton data in the Little Calumet River at Ashland Avenue show that the water quality improved downstream of 159th Street. The average number of species only increased from 32 at 159th Street to 33 at Ashland Avenue, but the Shannon-Weaver species diversity index increased from 1.67 at 159th Street to 2.80 at Ashland Avenue. This was due not only to the increased number of species, but also the decreased population density from 377,300 organisms per square centimeter at 159th Street to 116,100 organisms per square centimeter at Ashland Avenue (Table 5). The percentage of pollutant-tolerant species in the population of persistent species remained about the same, 34 percent at 159th Street and 37 percent at Ashland Avenue (Table 6). The production of organic matter and chlorophyll a decreased from 865 at 159th Street to 157 micrograms per square centimeter at Ashland Avenue and from 1.333 at 159th Street to 0.541 micrograms per square centimeter at Ashland Avenue, respectively. The autotrophic index decreased from 4,601 at 159th Street to 1,263 at Ashland Avenue. Thus, the periphyton data show improvement in water quality of the Little Calumet River between 159th Street and Ashland Avenue.

The fish data, too, show water quality improvement between 159th Street and Ashland Avenue (Figures 3 and 4). The number of fish collected in July increased from 18 fish per ten minutes electrofishing, weighing 128 grams at 159th Street to 20 fish per ten minutes electrofishing, weighing 218 grams at Ashland Avenue. In October, the number of fish decreased from 14 per ten minutes electrofishing at 159th Street to five fish per ten minutes electrofishing at Ashland Avenue, but the weight increased from 20 grams at 159th Street to 40 grams at Ashland Avenue. The number of species collected at Ashland Avenue (15 species) was greater than at 159th Street (11 species). Thus, the fish data support the periphyton data in showing improved water quality between 159th Street and Ashland Avenue.

Overall, the bacterial, periphyton, and fish data show the Little Calumet River and its major tributary, Thorn Creek, to be polluted with some improvement demonstrated with distance downstream in both systems.



## REFERENCES

1. Dennison, S., P. O'Brien, I. Polls, W. Schmeelk, and C. Spielman, "1975 Annual Summary Report, Water Quality Within the Waterways System of the Metropolitan Sanitary District of Greater Chicago, Volume 2, Biological," Research and Development Report No. 78-5-B, May 1978.
2. Spielman, C., S. Dennison, P. O'Brien, I. Polls, and W. Schmeelk, "1976 Annual Summary Report, Water Quality Within the Waterways System of the Metropolitan Sanitary District of Greater Chicago, Volume 2, Biological," Research and Development Report No. 78-18-B, December 1978.
3. Spielman, C., S. Dennison, P. O'Brien, and W. Schmeelk, "1977 Annual Summary Report, Water Quality Within the Waterways System of the Metropolitan Sanitary District of Greater Chicago, Volume 2, Biological," Research and Development Report No. 79-8-B, December 1979.
4. Dennison, S., P. O'Brien, M. Perrone, W. Schmeelk, and C. Spielman, "1978 Annual Summary Report, Water Quality Within the Waterways System of the Metropolitan Sanitary District of Greater Chicago, Volume 2, Biological," Research and Development Report No. 82-6-B, March 1982.
5. Schmeelk, W., S. Dennison, and P. O'Brien, "1979 Annual Summary Report, Water Quality Within the Waterways System of the Metropolitan Sanitary District of Greater Chicago, Volume 2, Biological," Research and Development Report No. 82-21-B, April 1983.
6. Schmeelk, W., S. Dennison, and P. O'Brien, "1980 Annual Summary Report, Water Quality Within the Waterways of the Metropolitan Sanitary District of Greater Chicago, Volume 2, Biological," Research and Development Report No. 83-14-B, March 1984.
7. Schmeelk, W., S. Dennison, and P. O'Brien, "1981 Annual Summary Report Water Quality Within the Waterways of the Metropolitan Sanitary District of Greater Chicago, Volume 2, Biological," Research and Development Report No. 84-2-B, June 1985.
8. Northeastern Illinois Planning Commission Staff Paper. Stream Use Inventory: Little Calumet River, February 1981.

## REFERENCES (Continued)

9. Water Resources Data for Illinois, Water Year 1981, Volume 2, Illinois River Basin, USGS-WDR-IL-81-2, United States Geological Survey, Water Resources Division, Urbana, IL 61801, 1982.
10. Standard Methods for the Examination of Water and Wastewater, American Public Health Association, Inc. 15th Edition, New York, New York, 1980.
11. Weber, C. I. (ed.), Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents, EPZ-670/4-73-001, 1973.
12. Smith, P. W., Illinois Streams: A Classification Based on Their Fishes and an Analysis of Factors Responsible for Disappearance of Native Species, Biological Notes No. 76, Illinois Natural History Survey, Urbana, Illinois, 1971.
13. Kenner, B. A. and H. P. Clark, "Detection and Enumeration of Salmonella and Pseudomonas aeruginosa," Journal Water Pollution Control Federation, Volume 46, Number 9, pp 2163-2171, 1974.
14. Geldreich, E. E., "Applying Bacteriological Parameters to Recreational Water Quality," Journal American Water Works Association, Volume 62, pp 113-120, 1970.
15. Palmer, C. Mervin, "The Effects of Pollution on River Algae," New York Academy of Sciences Annals, Volume 108, Article 2, pp 389-395, 1963.
16. Palmer, C. Mervin, "A Composite Rating of Algae Tolerating Organic Pollution," Journal Phycology, Volume 5, pp 78-82, 1969.
17. Palmer, C. Mervin, Algae and Water Pollution, EPA-600/9-77-036, 1977.
18. Smith, P. W., The Fishes of Illinois, University of Illinois Press, Urbana, Illinois, 314 pp, 1979.
19. Karr, J. R., "Assessment of Biotic Integrity using Fish Communities," Fisheries, Volume 6, Number 6, pp 15-21, 1981.

REFERENCES (Continued)

20. Roseboom, D. P. and D. L. Richey, "Acute Toxicity of Residual Chlorine on Bluegill and Channel Catfish in Illinois," Transactions Illinois State Academy of Science, Volume 69, Number 4, pp 385-398, 1977.
21. Dennison, S., Fish Survey of Northeastern Illinois Streams, Northeastern Illinois Planning Commission and Metropolitan Sanitary District of Greater Chicago-208 Project Contract, Work Item III - 5 c (2), 40 pp, Appendix, 1978.

APPENDIX I

BACTERIAL DATA COLLECTED FROM THORN CREEK AND THE  
LITTLE CALUMET RIVER DURING 1982

KEY TO APPENDIX I

Geo  $\bar{x}$  = geometric mean  
TC = Total Coliform  
FC = Fecal Coliform  
FS = Fecal Streptococcus  
SPC = Standard Plate Count  
PA = Pseudomonas aeruginosa  
Sal = Salmonella

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AI-1

BACTERIAL DATA FROM THORN CREEK DURING 1982 AT JOE ORR ROAD

Date	TC	FC	FS	SPC	PA	SAL
4/20/82	300,000	50,000	10,000	20,000	460	<0.2
6/21/82	140,000	21,000	3,100	17,000	9,000	L.E.
9/21/82	36,000	4,500	550	38,000	220	0.2
10/19/82	150,000	28,000	1,800	13,000	230	<0.2
Geo $\bar{x}$	120,000	19,000	2,400	20,000	680	<0.2

All counts expressed as counts per 100 mL except SPC which is counts per mL  
 L.E. = Laboratory error

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AI-2

BACTERIAL DATA FROM THORN CREEK DURING 1982 AT MARGARET STREET

Date	TC	FC	FS	SPC	PA	SAL
4/20/82	30,000	2,900	700	18,000	80	0.2
6/21/82	200,000	31,000	4,200	47,000	490	L.E.
9/21/82	39,000	3,100	3,500	78,000	3,500	<0.2
10/19/82	15,000	400	780	48,000	130	<0.2
Geo $\bar{x}$	43,000	3,200	1,700	42,000	370	<0.2

All counts are expressed as counts per 100 mL except SPC which is expressed as counts per mL.

L.E. = Laboratory error.

AI-4

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AI-3

BACTERIAL DATA FROM THORN CREEK DURING 1982 AT 167/170th STREET

Date	TC	FC	FS	SPC	PA	SAL
4/20/82	60,000	5,800	1,400	40,000	260	0 35
6/21/82	20,000	1,200	690	190,000	270	L E.
9/21/82	200,000	25,000	5,300	120,000	790	<0 2
10/19/82	130,000	23,000	7,000	74,000	330	<0 2
Geo $\bar{x}$	75,000	8,000	2,400	91,000	370	<0 2

All counts are expressed as counts per 100 mL except SPC which is expressed as counts per mL.

L.E. = Laboratory error.

AI-5



THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AI-4

BACTERIAL DATA FROM THE LITTLE CALUMET RIVER DURING 1982 AT WENTWORTH AVENUE

Date	TC	FC	FS	SP	PA	SAL
4/20/82	540,000	43,000	7,100	64,000	750	0.2
6/21/82	2,700,000	130,000	13,000	170,000	24,000	L.E.
9/21/82	7,900,000	1,900,000	3,600,000	1,400,000	9,200	0.45
10/19/82	77,000	13,000	2,100	16,000	170	<0 2
Geo $\bar{x}$	970,000	110,000	29,000	120,000	2,300	<0 3

All counts are expressed as counts per 100 mL except SPC which is expressed as counts per mL.

L.E. = Laboratory error.

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TABLE AI-5

BACTERIAL DATA FROM THE LITTLE CALUMET RIVER DURING 1982 AT 159th STREET

Date	TC	FC	FS	SPC	PA	SAL
4/20/82	130,000	27,000	5,100	52,000	1,700	<0.2
6/21/82	66,000	6,000	710	21,000	210	L.E.
9/21/82	200,000	12,000	4,600	180,000	5,400	<0.2
10/19/82	130,000	26,000	37,000	46,000	310	<0.2
Geo $\bar{x}$	120,000	15,000	5,000	55,000	880	<0.2

All counts are expressed as counts per 100 mL, except SPC which is expressed as counts per mL.

L.E. = Laboratory error.

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TABLE AI-6

BACTERIAL DATA FROM THE LITTLE CALUMET RIVER DURING 1982 AT ASHLAND AVENUE

Date	TC	FC	FS	SPC	PA	SAL
4/20/82	120,000	13,000	2,200	15,000	1,100	0.2
6/21/82	45,000	700	430	20,000	140	L.E.
9/21/82	80,000	3,000	3,500	220,000	2,400	<0.2
10/19/82	28,000,000	100,000	1,900	770,000	750	<0.2
Geo $\bar{x}$	330,000	7,200	1,600	84,000	730	<0.2

All counts are expressed as counts per 100 mL, except SPC which is expressed as counts per mL.

L.E. = Laboratory error.

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TABLE AI-7

FECAL COLIFORM RESULTS FOR ROUTINE WATERWAYS SAMPLES TAKEN FROM THORN CREEK  
AND THE LITTLE CALUMET RIVER MONTHLY FROM 1/19 to 12/21/82

Date	Location (See Figure 1)		
	Little Calumet River-Ashland Ave.	Little Calumet River-Wentworth Ave.	Thorn Creek Joe Orr Road
1/19/82	N.S. <sup>1</sup>	N.S. <sup>1</sup>	30,000
2/16/82	N.S. <sup>1</sup>	N.S. <sup>1</sup>	>60,000 <sup>2</sup>
3/16/82	17,000	30,000	37,000
4/20/82	4,700	36,000	46,000
5/18/82	1,000	>60,000 <sup>2</sup>	1,500
6/15/82	>60,000 <sup>2</sup>	>60,000 <sup>2</sup>	>60,000 <sup>2</sup>
7/20/82	580	34,000	32,000
8/17/82	600	45,000	2,300
9/21/82	2,700	310,000	3,900
10/19/82	30,000	5,500	6,000
11/23/82	90,000	220,000	22,000
12/21/82	25,000	330,000	4,800

<sup>1</sup>No sample - River frozen.

<sup>2</sup>Estimated count according to standard technique on highest dilution.

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AI-8

FECAL COLIFORM RESULTS FOR SPECIAL SAMPLES, ADDED TO THE ROUTINE SAMPLE COLLECTION IN JUNE 1982, TAKEN FROM THORN CREEK AND THE LITTLE CALUMET RIVER MONTHLY FROM 6/15 TO 12/21/82

Date	Location (See Figure 1)		
	Thorn Creek 167th/170th Street	Little Calumet River 159th St.	Thorn Creek Margaret St.
6/15/82	19,000	>60,000 <sup>1</sup>	13,000
7/20/82	1,600	11,000	1,600
8/17/82	1,500 <sup>2</sup>	1,500 <sup>2</sup>	1,500 <sup>2</sup>
9/21/82	15,000	13,000	2,700
10/19/82	16,000	21,000	520
11/23/82	37,000	80,000	140,000
12/21/82	400	120,000	260

<sup>1</sup> Estimated count according to standard technique on highest dilution .

<sup>2</sup> Triple checked data.

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APPENDIX II

PERIPHYTON AND ASSOCIATED DATA COLLECTED FROM THORN CREEK AND  
THE LITTLE CALUMET RIVER DURING 1982

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-1

PERIPHYTON SPECIES AND DENSITIES FOUND AT JOE ORR ROAD IN THORN CREEK DURING 1982

Species	Densities in Number ( $\text{Log}_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\text{Log}_{10}$	Sum	$N_i \text{Log}_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Achnanthes conspicua</u>			3.157	2.661	1.775		1.661				2.699	1,999	6,598
<u>A. hungarica</u>	2.005										2.005	101	202
<u>A. lanceolata</u>			3.157		1.857	2.888		2.153	1.679		2.694	2,470	8,380
<u>A. linearis</u>								1.676			1.676	47	79
<u>A. linearis, var. curta</u>	2.607										2.607	405	1,056
<u>A. saxonica</u>		1.689									1.689	49	83
<u>Amphiprora alata</u>					2.076			2.278			2.189	309	769
<u>Amphora delicatissima</u>					2.307		1.661	2.790			2.460	865	2,541
<u>A. perpusilla</u>				2.962							2.962	916	2,713
<u>A. veneta</u>			2.203		1.380	2.888					2.503	956	2,849
<u>Cocconeis pediculus</u>				2.661							2.661	458	1,219
<u>C. placentula</u>		1.689		2.962	2.356					1.679	2.491	1,240	3,836
<u>Cyclotella glomerata</u>			2.805		1.982			1.676	1.679		2.317	829	2,419
<u>C. kutzingiana</u>	2.005	1.689			2.076						1.953	269	654
<u>C. meneghiniana</u>	2.005		2.504	3.138	2.785		2.263	2.153			2.658	2,729	9,377
<u>C. pseudostelligera</u>				2.962							2.962	916	2,713
<u>Cymbella microcephala</u>		1.990									1.990	98	195
<u>C. ventricosa</u>								1.676			1.676	47	79
<u>Diploneis oculata</u>					1.681						1.681	48	81

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-1 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT JOE ORR ROAD IN THORN CREEK DURING 1982

AII-3

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Diploneis pseudovalis</u>										2.455	2.455	285	700
<u>D. puella</u>					2.223			1.661		1.676	1.938	260	628
<u>Epithemia sorex</u>		1.689									1.689	49	83
<u>Fragilaria brevistriata</u> var. capitata		1.689									1.689	49	83
<u>F. capucina</u>					2.076						2.076	119	247
<u>F. construens</u>					2.158						2.158	144	311
<u>F. intermedia</u>	2.783		2.504		2.679						2.670	1,403	4,415
<u>F. pinnata</u>				2.661							2.661	458	1,219
<u>F. vaucheriae</u>		1.689									1.689	49	83
<u>Frustulia vulgaris</u>					1.380						1.380	24	33
<u>Gomphonema brevistriata</u>							2.888				2.888	773	2,233
<u>G. gracile</u>					2.156		4.286				3.988	19,463	83,481
<u>G. novacula</u>				2.661							2.661	458	1,219
<u>G. olivaceum</u>	2.306	2.291									2.299	398	1,035
<u>Gomphonema parvulum</u>	4.383	3.613	4.029	4.868	3.933	5.398	3.536	2.955			4.672	395,680	2,214,757
<u>G. sphaerophorium</u>	2.704										2.704	506	1,368
<u>Gyrosigma kutzingii</u>								1.676			1.676	47	79
<u>Hantzschia amphioxys</u>		3.166	4.282								4.013	20,608	88,904
<u>H. amphioxys</u> , var. capitata		1.689									1.689	49	83

Table continued on following page



THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-1 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT JOE ORR ROAD IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$									Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23			
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16			
<u>Hantzschia elongata</u>					2.223		1.661	2.153		2.073	355	905
<u>H. unknown V</u>								1.676		1.676	47	79
<u>Melosira granulata</u>					2.076					2.076	119	247
<u>M. granulata, var. angustissima</u>	2.482	1.990		2.962	1.681			2.278	1.980	2.439	1,650	5,309
<u>M. varians</u>		1.990			2.775		1.661	1.676		2.294	787	2,279
<u>Meridian circulare</u>	2.005									2.005	101	202
<u>Navicula accomoda</u>			2.203	2.261	3.145		1.962			2.660	1,830	5,970
<u>N. capitata</u>			2.203							2.203	160	353
<u>N. cryptocephala</u>	2.306	2.388	2.203		2.492		1.661	2.278	1.980	2.251	1,248	3,864
<u>N. cryptocephala, var. veneta</u>	3.510	3.280	3.650	3.892	3.542	4.560	3.166	3.019		3.873	59,708	285,167
<u>N. exigua</u>	3.768	3.323	2.504					2.153		3.324	8,427	33,082
<u>N. gregaria</u>	3.753	3.624	3.407	3.138	2.357			2.278	1.679	3.309	14,261	59,242
<u>N. mutica, var. tropica</u>		1.990		2.119						2.059	229	540
<u>N. protracta</u>	3.046			3.439						3.286	3,860	13,844
<u>N. pupula</u>	2.306		3.106							3.170	1,479	4,688
<u>N. pygmaea</u>							1.661	1.676		1.669	93	183
<u>N. secura</u>				2.962	2.809	3.490	2.439	2.880		3.056	5,684	21,341
<u>N. tripunctata</u>		2.388			3.208	3.666	2.916	3.091		3.233	8,550	33,618

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-1 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT JOE ORR ROAD IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$									Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23			
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16			
<u>Nitzschia amphibia</u>	2.005									2.005	101	202
<u>N. clausii</u>					1.775		2.138	2.375		2.160	434	1,145
<u>N. communis</u> , var.												
<u>abbreviata</u>		2.534	3.349	3.360	3.393	3.189	2.865	3.300	2.156	3.167	11,755	47,845
<u>N. dissipata</u>	2.306	2.467	2.680		2.119			2.278		2.413	1,295	4,030
<u>N. filiformis</u>		1.689								1.689	49	83
<u>N. fonticola</u>		2.467	4.256	5.122	3.999	4.929	3.559	3.515	2.156	4.500	252,692	1,365,192
<u>N. frustulum</u>	2.005	2.291	2.805	2.962	3.278	3.587	2.263	2.790	2.156	2.978	8,554	33,636
<u>N. gracilis</u>	2.306									2.306	202	466
<u>N. hantzschiana</u>		1.689								1.689	49	83
<u>N. hungarica</u>	2.908		3.048	3.360	3.016	3.365	2.263	2.676	1.679	3.015	8,277	32,428
<u>N. linearis</u>		2.643	3.782	2.661	1.380				1.679	3.148	7,023	27,014
<u>N. longissima</u>			2.504				2.138	2.823	1.980	2.140	552	1,514
<u>N. palea</u>	2.482		2.504							2.493	623	1,741
<u>N. paleacea</u>	2.959	3.069	3.545							3.270	5,590	20,948
<u>N. thermalis</u>		2.643			2.540		1.962	2.153		2.407	1,020	3,069
<u>N. tryblionella</u> , var. <u>debilis</u>	2.005									2.005	101	202
<u>N. tryblionella</u> , var. <u>levidensis</u>					2.281			1.676		2.076	238	566

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-1 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT JOE ORR ROAD IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15 4/29	5/13 5/28	6/11 6/24	7/07 7/21	8/04 8/18	9/01 9/15	9/29 10/13	10/27 11/10	11/23 12/16				
<u>Nitzschia tryblionella</u> var. <u>victoriae</u>					1.380						1.380	24	33
<u>Pleurosigma elongatum</u>								1.977			1.977	95	188
<u>Rhoicosphenia curvata</u>	2.783	1.990	2.203	2.661	2.730		2.263	2.823			2.588	2,708	9,296
<u>Rhopalodia musculus</u>		1.689									1.689	49	83
<u>Stephanodiscus</u> <u>hantzschii</u>			2.203		2.076		1.661				2.034	325	816
<u>Surirella angustata</u>	2.005		2.981		1.380			1.977			2.469	1,177	3,614
<u>S. ovalis</u>	2.306	2.803	2.680	2.661	2.749	2.888	2.661	1.977			2.661	3,661	13,046
<u>S. ovata</u>	3.745	3.051	3.349	2.962	2.156			1.977	1.679		3.160	10,119	40,528
<u>Synedra affinis</u>		1.689	2.504				1.661	1.676			2.062	461	1,228
<u>S. gaillonii</u>		1.689			2.156						1.982	192	438
<u>S. ulna</u>					2.076						2.076	119	247
<u>S. ulna</u> , var. <u>contracta</u>					2.079						2.079	120	250
<u>Thalassiosira</u> <u>pseudonana</u>					1.380						1.380	24	33
<u>Ankistrodesmus</u> <u>braunii</u>	3.266		3.434	6.013	5.692	5.045	5.084	2.490	1.626		5.342	1,759,595	10,989,389
<u>A. falcatus</u>							2.376				2.376	238	566

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-1 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT JOE ORR ROAD IN THORN CREEK DURING 1982

Species	Densities in Number ( $\text{Log}_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\text{Log}_{10}$	Sum	$N_i \text{Log}_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Characium ambiguum</u>	2.771		2.537		2.573	3.187					2.855	2,864	9,901
<u>C. hookeri</u>							3.075				3.075	1,189	3,656
<u>Chlamydomonas mucicola</u>	2.646										2.646	443	1,172
<u>C. polypyrinofideum</u>	3.169										3.169	1,476	4,678
<u>C. sphagnicola</u>	1.547										1.547	35	54
<u>Oocystis parva</u>			1.583								1.583	38	60
<u>Planctonema</u>													
<u>lauterbornii</u>	2.713	3.353	2.361			4.288	3.376	2.910			3.630	25,599	112,846
<u>Scenedesmus bijuga</u>					3.075						3.075	1,189	3,656
<u>S. incrassatulus</u> , var. <u>mononae</u>					2.697						2.697	498	1,343
<u>Stigeoclonium nanum</u>									2.103		2.103	127	267
<u>Anabaena wisconsinense</u>			2.060	3.524							3.238	3,457	12,233
<u>Aphanothece nidulans</u>						2.966					2.966	925	2,744
<u>Chroococcus minutus</u>						4.428					4.428	26,792	118,635
<u>Oscillatoria subbrevis</u>			2.625								2.625	422	1,108
<u>Spirulina laxissima</u>	2.169										2.169	148	321
<u>Euglena minuta</u>			2.884		2.856						2.870	1,483	4,703
<u>Phacus pseudowirenkoi</u>	1.869										1.869	74	138
<u>Trachelomonas</u>													
<u>acanthostoma</u>										1.626	1.626	42	68
<u>T. playfairii</u>		1.547									1.547	35	54

$N_i \text{Log}_{10} N_i$  = sum of the densities multiplied by its  $\text{Log}_{10}$

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-2

PERIPHYTON SPECIES AND DENSITIES FOUND AT MARGARET STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Achnanthes conspicua</u>		2.638		NS		2.844	2.675		NS	2.729	1,606	5,148	
<u>A. exigua</u> , var. <u>heterovalvata</u>		1.683								1.683	48	81	
<u>A. lanceolata</u>	3.237	2.638	4.282		3.246	3.145	3.152	2.735		3.577	26,424	116,847	
<u>A. lanceolata</u> , var. <u>curta</u>	3.237									3.237	1,726	5,587	
<u>A. lapponica</u>								3.103		3.103	1,268	3,935	
<u>A. linearis</u>								2.860		2.860	724	2,070	
<u>A. montana</u>					3.069					3.069	1,172	3,597	
<u>A. stewartii</u>			3.759							3.759	5,741	21,580	
<u>Amphiprora alata</u>			2.805			3.145	3.152	2.860		3.019	4,178	15,128	
<u>A. paludosa</u>		1.984								1.984	96	190	
<u>Amphora delicatissima</u>					2.467	2.844		2.258		2.592	1,172	3,597	
<u>A. ovalis</u>		1.683								1.683	48	81	
<u>A. perpusilla</u>		1.683								1.683	48	81	
<u>A. veneta</u>			3.106		2.467	3.321	2.675	2.559		2.954	4,499	50,439	
<u>A. submontana</u>	3.237									3.237	1,726	5,587	
<u>Cocconeis fluviatilis</u>			2.805							2.805	638	1,789	
<u>C. pediculus</u>						2.844				2.844	698	1,985	
<u>C. placentula</u>		1.683	4.957		2.467			2.735		4.359	91,458	453,743	
<u>Cyclotella glomerata</u>			3.282		3.312		2.675	2.258		3.063	4,620	16,931	

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-2 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT MARGARET STREET IN THORN CREEK DURING 1982

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Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$				
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	4/29				5/28	6/24	7/21	8/18
<u>Cyclotella meneghiniana</u>	3.936	2.888	3.106	NS	3.882	4.187	3.789	2.957	NS	3.765	40,739	187,807					
<u>C. ocellata</u>								2.559		2.559	362	926					
<u>Cymatopleura solea</u>		1.683				2.844				2.572	746	2,143					
<u>Cymbella microcephala</u>	3.237		4.236		2.467					3.807	19,238	82,419					
<u>C. turgida</u>		1.984								1.984	96	190					
<u>Diatoma tenue</u>		1.683								1.683	48	81					
<u>Diploneis marginestriata</u>							2.976			2.976	946	2,815					
<u>D. oculata</u>					2.768					2.768	586	1,622					
<u>D. pseudovalis</u>								2.735		2.735	543	1,485					
<u>D. puella</u>						3.543	2.675	2.258		3.140	4,146	14,999					
<u>D. smithii</u>					3.246					3.246	1,762	5,719					
<u>Fragilaria capucina</u>	4.082	1.984								3.784	12,175	49,741					
<u>Gomphonema brevistriata</u>			2.805					2.735		2.771	1,182	3,632					
<u>G. clevei</u>		2.286								2.286	193	441					
<u>G. gracile</u>					2.944		2.976			2.960	1,825	5,952					
<u>G. olivaceum</u>	4.278		3.282							4.019	20,881	90,201					
<u>G. parvulum</u>	4.617	3.752	5.053		3.509	4.187	2.675	3.705		4.420	184,182	969,764					
<u>G. subcavatum, var. commutatum</u>		3.936								3.936	8,630	33,968					
<u>Gyrosigma kutzingii</u>	3.237									3.237	1,726	5,587					
<u>Hantzschia amphioxys</u>	4.140	2.638	3.759							3.823	19,980	85,926					

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-2 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT MARGARET STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Hantzschia elongata</u>				NS	3.422	3.446				NS	3.434	5,435	20,301
<u>H. unknown V</u>							2.675				2.675	473	1,265
<u>Melosira ambigua</u>		2.286									2.286	193	441
<u>M. granulata</u> , var. <u>angustissima</u>								2.559			2.559	362	926
<u>M. varians</u>		2.830				3.145					3.015	2,072	6,872
<u>Navicula capitata</u>		1.683					3.152	3.103			2.960	2,735	9,400
<u>N. cryptocephala</u>	4.082	2.860			3.069	3.923	3.629	3.161			3.670	28,055	124,789
<u>N. cryptocephala</u> , var. <u>veneta</u>		2.763			3.613		3.374	3.404			3.379	9,583	38,155
<u>N. exigua</u>	4.316	2.529				2.844		2.258			3.739	21,919	95,146
<u>N. gregaria</u>	4.918	3.447	3.106		3.312	3.622	3.578	3.911			4.176	105,040	527,443
<u>N. integra</u>		1.683						2.258			2.059	229	540
<u>N. minima</u>		1.683									1.683	48	81
<u>N. mutica</u>	3.237	1.984									2.960	1,822	5,941
<u>N. mutica</u> , var. <u>tropica</u>							3.520	2.735			3.285	3,855	13,824
<u>N. mutica</u> , var. <u>undulata</u>							2.675	2.860			2.777	1,198	3,688
<u>N. protracta</u>	3.237										3.237	1,726	5,587
<u>N. pupula</u>		1.984									1.984	96	190

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-2 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT MARGARET STREET IN THORN CREEK DURING 1982

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Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Navicula pygmaea</u>				NS		3.622				NS	3.622	4,188	15,169
<u>N. secura</u>		2.860	3.583		3.370	3.446	3.374	3.161			3.352	13,504	55,778
<u>N. tripunctata</u>	4.441	1.984			4.748	5.192	4.987	4.036			4.762	347,190	1,923,630
<u>Nitzschia apiculata</u>					2.944						2.944	879	2,588
<u>N. clausii</u>							3.277	2.258			3.016	2,073	6,875
<u>N. communis, var. abbreviata</u>		2.683	3.407		3.370		3.152	3.372			3.263	9,157	36,278
<u>N. dissipata</u>	3.237	2.286			2.467						2.868	2,212	7,399
<u>N. fonticola</u>	3.714	3.161	4.624		4.613	4.869	4.903	4.520			4.597	276,775	1,506,245
<u>N. frustulum</u>		2.914	3.583		3.643	3.844	3.374	2.860			3.503	19,117	81,848
<u>N. hungarica</u>	3.538	2.638			3.312	4.307	3.277	3.161			3.692	29,555	132,130
<u>N. linearis</u>	3.936	3.045	3.805		3.547	3.747	2.675				3.632	25,703	113,350
<u>N. longissima</u>	3.714				3.069		4.219	3.212			3.788	24,535	107,703
<u>N. palca</u>	3.237	2.382									2.993	1,967	6,479
<u>N. palceacea</u>	4.441	2.462									4.145	27,896	124,013
<u>N. thermalis</u>	4.191										4.191	15,524	65,061
<u>N. thermalis, var. minor</u>	3.714	2.382						2.258			3.271	5,598	20,981
<u>N. tryblionella</u>						2.844					2.844	698	1,985
<u>N. tryblionella, var. levidensis</u>					3.312	3.145		2.258			3.083	3,629	12,918

Table continued on following page



THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-2 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT MARGARET STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Nitzschia tryblionella</u> var. <u>victoriae</u>	3.237			NS		2.844	2.675			NS	2.985	2,897	10,029
<u>Pleurosigma elongatum</u>								<b>2.258</b>			<b>2.258</b>	<b>181</b>	<b>409</b>
<u>Rhoicosphenia curvata</u>	3.538	3.081	3.282		<b>3.246</b>	3.844	3.277	<b>3.673</b>			3.496	21,917	95,137
<u>Stephanodiscus</u> <u>hantzschii</u>	3.237	1.683									2.948	1,774	5,764
<u>Surirella angustata</u>	4.082						3.277	3.537			3.764	17,414	73,851
<u>S. ovalis</u>	3.714	2.382			2.467	4.099	3.152	2.860			3.532	20,414	87,983
<u>S. ovata</u>	5.696	3.215	3.282		3.509	3.446	3.152	3.689			4.865	512,474	2,926,058
<u>S. unknown II</u>								<b>2.559</b>			2.559	362	926
<u>Synedra acus</u>	3.237		2.805								<b>3.073</b>	<b>2,364</b>	<b>7,975</b>
<u>S. affinis</u>	3.237							<b>3.036</b>			3.148	2,812	9,699
<u>S. gaillonii</u>	3.538										3.538	3,451	12,209
<u>S. nana</u>		1.683									1.683	48	81
<u>S. parasitica</u> , var. <u>subconstricta</u>									2.559		2.559	362	926
<u>S. ulna</u>	<b>3.237</b>										3.237	1,726	5,587
<u>Thalassiosira</u> <u>pseudonana</u>			2.805								2.805	638	1,789
<u>Ankistrodesmus</u> <u>braunii</u>			1.858		3.586		2.459				3.148	4,215	15,279

Table continued on following page

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-2 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT MARGARET STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>Characium ambiguum</u>				NS			1.614		NS		1.614	41	66
<u>C. hookeri</u>								1.969			1.969	93	183
<u>Chlamydomonas mucicola</u>	2.509		1.557								2.254	359	917
<u>C. snowii</u>	2.111										2.111	129	272
<u>C. sphagnicola</u>	2.509		1.557				2.091				2.206	482	1,293
<u>Chlorella ellipsoidea</u>			3.238								3.238	1,730	5,602
<u>C. vulgaris</u>	2.713										2.713	516	1,400
<u>Closterium tumidum</u>					1.656						1.656	45	74
<u>Planctonema lauterbornii</u>	3.241	4.208	3.256		2.258	2.182	3,347	4,678			3.999	69,888	338,566
<u>Scenedesmus bijuga</u>			1.858								1.858	72	134
<u>Stigeoclonium nanum</u>		2.015									2.015	104	210
<u>Ulothrix unknown I</u>	2.810										2.810	646	1,815
<u>Anabaena wisconsinense</u>	2.588		1.858								2.361	459	1,222
<u>Lyngbia limnetica</u>			2.671		2,770						2.723	1,058	3,200
<u>Oscillatoria limnetica</u>						3.119					3.119	1,315	4,101
<u>O. nigra</u>								2.923			2.923	838	2,450
<u>O. subbrevis</u>						2.746					2.746	557	1,529
<u>O. tenuis</u>						2.881	2.568				2.752	1,130	3,450

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-2 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT MARGARET STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\text{Log}_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\text{Log}_{10}$	Sum	$N_i \text{Log}_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Spirulina laxa</u>				NS			1.915			NS	1.915	82	157
<u>S. laxissima</u>			1.557								1.557	36	56
<u>Euglena acus</u>						2.403					2.403	253	608
<u>E. minuta</u>			2.402								2.402	252	605
<u>E. proxima</u>	2.287				1.957		2.313				2.213	490	1,318

$N_i \text{Log}_{10} N_i$  = sum of the densities multiplied by its  $\text{Log}_{10}$

NS = No Sample

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-3

PERIPHYTON SPECIES AND DENSITIES FOUND AT 167/170th, STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. Log	Sum	$N_i \log_{10} N_i$	
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16				
<u>Achnanthes conspicua</u>	NS	2.981					3,166	2,834			NS	3,015	3,105	10,843
<u>A. lanceolata</u>		3.504	3.106	4.283	4.233			2,709	3,000			3.848	42,266	195,522
<u>A. lanceolata, var. rostrata</u>		2.504					3,865					3,582	7,647	29,697
<u>Amphiprora alata</u>							3,166		3,222			3,195	3,133	10,953
<u>Amphora delicatissima</u>				3.052			3,467		2,222			3,149	4,225	15,319
<u>A. perpusilla</u>				3.353								3,353	2,254	7,558
<u>A. veneta</u>				3.897	3.388			2,232	2,523			3,433	10,836	43,722
<u>Cocconeis fluviatilis</u>			3,282									3,282	1,914	6,282
<u>C. placentula</u>		3.282	4,747	4,515	4,592	3,643	4,245	2,921				4,338	152,388	789,820
<u>Cyclotella glomerata</u>			2,629					2,232	2,222			2,405	763	2,199
<u>C. kutzingiana</u>			2,327			3,166						2,924	1,678	5,411
<u>C. meneghiniana</u>		2,504		3,353	4,893	4,629	3,273	3,477				4,330	128,170	654,665
<u>C. oceolata</u>									2,222			2,222	167	371
<u>C. pseudostelligera</u>			2,805									2,805	638	1,789
<u>C. stelligera</u>			2,327									2,327	212	493
<u>Cymatopleura elliptica</u>							2,709					2,709	512	1,387
<u>C. solea</u>					3,388	3,166		2,232				3,133	4,080	14,731
<u>Cymbella brehmi</u>								2,232				2,232	171	382
<u>C. microcephala</u>			2,327					2,232	2,523			2,378	716	2,044
<u>C. perpusilla</u>						3,166						3,166	1,466	4,642

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-3 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 167/170th STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. Log	Sum	$N_i \log_{10} N_i$			
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16						
<u>Cymbella ventricosa</u>	NS															
<u>Denticula subtilis</u>			2.327						2.523	NS	2.523	333	840			
<u>Diatoma elongatum</u> , var. minor											2.327	212	493			
<u>D. tenue</u>			2.327						2.222		2.222	167	371			
<u>Diploneis marginestriata</u>											2.327	212	493			
<u>D. pseudovalis</u>							2.709				2.709	512	1,387			
<u>D. puella</u>									2.824		2.824	667	1,884			
<u>Fragilaria pinnata</u>									2.523		2.523	333	840			
<u>Frustulia vulgaris</u>									2.232		2.232	171	382			
<u>Gomphonema brevistriata</u>									2.222		2.222	167	371			
<u>G. gracile</u>					4.166				2.533		3.875	14,997	62,628			
<u>G. lanceolatum</u>					3.388		3.166		2.232		3.133	4,080	14,731			
<u>G. olivaceum</u>									2.523		2.523	333	840			
<u>Gomphonema parvulum</u>		5.076	4.590	5.121	5.746	3.944	3.408	3.544			5.091	862,192	5,117,630			
<u>Gyrosigma kutzingii</u>									2.222		2.222	167	371			
<u>Hantzschia amphioxys</u>		2.504	2.629								2.571	745	2,140			
<u>H. elongata</u>			2.327			3.689	3.166	2.533	2.824		3.180	7,572	29,373			
<u>Melosira granulata</u> , var. angustissima						3.353										
<u>M. varians</u>							3.388		2.523		3.112	2,588	8,833			
											3.388	2,443	8,277			

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-3 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 167/170th STREET IN THORN CREEK DURING 1982

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Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. Log	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Navicula angelica</u> , var. NS											NS		
<u>subsalsa</u>			2,327								2,327	212	493
<u>N. capitata</u>			2,327		3.865		2,533	2,699			3,321	8,382	32,886
<u>N. cincta</u>				5.498							5,498	314,775	1,730,633
<u>N. cryptocephala</u>			2,327	3.052	4.233	4.208	3,273	3,398			3,812	38,959	178,845
<u>N. cryptocephala</u> , var.													
<u>veneta</u>		2.805	3,026				2,709	3,501			3,129	5,381	20,076
<u>N. exigua</u>								2,699			2,699	500	1,349
<u>N. gregaria</u>		3,203	2,930	3,052			3,186	3,637			3,276	9,444	37,541
<u>N. mutica</u> , var.													
<u>cohnii</u>								2,222			2,222	167	371
<u>N. mutica</u> , var.													
<u>tropica</u>							2,232	2,699			2,525	671	1,897
<u>N. pygmaea</u>						3,768		2,222			3,479	6,028	22,787
<u>N. secura</u>			2,327	3,052	3,388		2,709	3,067			3,038	5,461	20,409
<u>N. tripunctata</u>					5,275	5,497	3,723	3,970			5,111	517,033	2,954,078
<u>Nitzschia clausii</u>							2,709	2,523			2,626	845	2,473
<u>N. communis</u> , var.													
<u>abbreviata</u>		2,981		3,654	4,291	3,467	2,931	3,176			3,703	30,292	135,748
<u>N. dissipata</u>								2,699			2,699	500	1,349

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-3 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 167/170th STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. Log	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Nitzschia fonticola</u>	NS	4.244	2.805	4.433	5.323	5.452	4.497	4.339	NS	4.927	592,028	3,417,388	
<u>N. frustulum</u>		3.805	3.106	3.751	4.166	3.768	2.834	3.125		3.709	35,828	163,169	
<u>N. hungarica</u>		2.981		3.897		3.768	3.232	3.620		3.615	20,582	88,780	
<u>N. linearis</u>					4.166			2.699		3.880	15,156	63,361	
<u>N. longissima</u>						4.467	4.038	3.263		4.147	42,056	194,460	
<u>N. obtusa</u> , var. <u>scalpelliformis</u>				3.530						3.530	3,388	11,959	
<u>N. thermalis</u>						3.467		2.699		3.234	3,431	12,130	
<u>N. tryblionella</u>			2.327			3.166				2.924	1,678	5,411	
<u>N. tryblionella</u> , var. <u>levidensis</u>				3.654	3.689	3.467		2.699		3.506	12,826	52,690	
<u>N. tryblionella</u> , var. <u>victoriae</u>				3.052			2.232	2.699		2.778	1,798	5,852	
<u>Rhoicosphenia curvata</u>		3.650		3.530	3.865	3.166	3.077	3.398		3.530	20,343	87,646	
<u>Stephanodiscus hantzschii</u>							2.232			2.232	171	382	
<u>Surirella angustata</u>				3.353	3.388	3.166	2.232	3.501		3.279	9,503	37,802	
<u>S. ovalis</u>			2.327	3.530	4.087	3.467	2.709	3.222		3.543	20,929	90,429	
<u>S. ovata</u>		2.981	2.805	3.353		3.166	2.709	3.824		3.319	12,495	51,189	
<u>S. robusta</u> , var. <u>splendida</u>					3.388					3.388	2,443	8,277	

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-3 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 167/170th STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\text{Log}_{10}$ ) Per $\text{cm}^2$										Arith. Avg. Log	Sum	$N_i \text{Log}_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>Synedra gallionii</u>	NS	2.504								NS	2.504	319	798
<u>S. parasitica</u> , var. subconstricta		2.805					2.709	2.523			2.694	1,483	4,703
<u>Ankistrodesmus braunii</u>				2.106							2.106	128	270
<u>Characium ambiguum</u>		1.530	2.260		2.493						2.245	527	1,434
<u>C. hookeri</u>				2.408							2.408	256	617
<u>Chlamydomonas mucicola</u>				1.629							1.629	43	70
<u>C. sphagnicola</u>							1.649				1.649	45	74
<u>Closterium tumidum</u>				1.629							1.629	43	70
<u>Planctonema lauterbornii</u>		2.809	1.959	2.833	2.736		3.709	4.647			3.933	51,438	242,339
<u>Protoderma viride</u>		2.852	3.198	2.231							2.914	2,459	8,338
<u>Scenedesmus quadricauda</u>				2.231			2.175				2.204	320	802
<u>Stigeoclonium nanum</u>		3.647	3.295	3.538	4.076	2.175					3.642	21,922	95,161
<u>Ulothrix Unknown II</u>					3.353						3.353	2,254	7,558
<u>Anabaena affinis</u>							2.552				2.552	356	908
<u>A. wisconsinense</u>						3.141					3.141	1,384	4,347
<u>Oscillatoria limnetica</u>							2.991				2.991	979	2,928
<u>O. nigra</u>					3.146						3.146	1,400	4,405
<u>O. subbrevis</u>						3.217					3.217	1,648	5,302
<u>O. tenuis</u>		2.644	2.084	2.532							2.478	902	2,666
<u>Spirulina laxissima</u>				1.930		2.351					2.190	310	772

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-3 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 167/170th STREET IN THORN CREEK DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. Log	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>Spirulina major</u>	NS				2,368	1.573			NS	2,132	271	659	
<u>Euglena minuta</u>		1.530				1.573	1.649			1,587	116	239	
<u>E. proxima</u>						1.874	1.950			1,914	164	363	
<u>Phacus caudata</u>					1.891					1,891	78	148	
<u>P. orbicularis</u>						1.874				1,874	75	141	
<u>Trachelomonas playfairii</u>								1.920		1,920	83	159	

$N_i \log_{10} N_i$  = sum of the densities multiplied by its  $\log_{10}$

NS = No Sample

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-4

PERIPHYTON SPECIES AND DENSITIES FOUND AT WENTWORTH AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>Achnanthes conspicua</u>					3.101		1.818	NS			2.822	1,328	4,148
<u>A. lanceolata</u>	3.370	2.770		3.467	3.578	2.719	2.119				3.235	10,304	41,350
<u>A. lapponica</u>							1.818				1.818	66	120
<u>A. linearis</u> , var. <u>curta</u>											1.818	66	120
<u>Amphora delicatissima</u>				2.990							2.990	977	2,921
<u>A. veneta</u>		2.469		2.990			1.818				2.649	1,337	4,180
<u>Caloneis amphisbaena</u>		2.770									2.770	589	1,632
<u>Cocconeis placentula</u>			2.232					2.295			2.265	368	944
<u>Cyclotella glomerata</u>		3.314		5.321	5.364		3.309				5.046	444,715	2,511,787
<u>C. kutzingiana</u>			3.010		3.101						3.058	2,285	7,675
<u>C. meneghiniana</u>	3.671	3.583	4.210	4.935	4.907	5.368	3.894		2.380		4.733	432,977	2,440,460
<u>C. stelligera</u>					3.578		1.818				3.284	3,850	13,804
<u>Cymbella microcephala</u>					3.402						3.402	2,523	8,583
<u>C. minuta</u>		2.469									2.469	294	726
<u>C. minuta</u> , var. <u>pseudogracilis</u>		2.469									2.469	294	726
<u>Diatoma elongatum</u>	3.069										3.069	1,172	3,597
<u>Epithemia smithii</u>		2.770									2.770	589	1,632
<u>Fragilaria capucina</u>	4.933										4.933	85,704	422,778
<u>F. intermedia</u>		3.583			3.402						3.176	6,352	24,156
<u>F. pinnata</u>		2.469									2.469	294	726

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-4 (continued)

. PERIPHYTON SPECIES AND DENSITIES FOUND AT WENTWORTH AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Frustulia vulgaris</u>					3.101				NS		3.101	1,262	3,914
<u>Gomphonema</u>													
<u>brevistriata</u>					3.101						3.101	1,262	3,914
<u>C. gracile</u>								2.818			2.818	658	1,854
<u>C. olivaceum</u>		2.469									2.469	294	726
<u>G. parvulum</u>	4.532	4.060	3.564	3.835	4.143	4.062	3.800			2.380	4.041	88,009	435,163
<u>G. subcavatum</u> , var. <u>commutatum</u>	3.069										3.069	1,172	3,597
<u>Gyrosigma kutzingii</u>		2.469									2.469	294	726
<u>C. scalproides</u>		2.469									2.469	294	726
<u>Hantzschia amphioxys</u>	3.370	3.071	2.408	2.990	3.101						3.080	6,017	22,741
<u>H. elongata</u>		3.372		2.990				2.119		1.681	2.943	3,512	12,452
<u>Melosira binderana</u>				4.246							4.246	17,620	74,815
<u>M. granulata</u>					3.800						3.800	6,310	23,978
<u>M. granulata</u> , var. <u>angustissima</u>		2.946						2.119			2.705	1,015	3,052
<u>M. varians</u>	4.069	3.960	3.757		3.879			2.295			3.837	34,322	155,670
<u>Meridian circulare</u>		2.770									2.770	589	1,632
<u>Navicula accomoda</u>		3.314	1.931								3.031	2,146	7,200
<u>N. capitata</u>		2.946	2.533				3.321	2.772		1.982	2.904	4,006	14,432
<u>N. cryptocephala</u>	3.848	4.060	3.010	3.592	3.703	3.196	2.897			1.681	3.587	30,914	138,809

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-4 (continued)

. PERIPHYTON SPECIES AND DENSITIES FOUND AT WENTWORTH AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>Navicula cryptocephala</u>													
var. <u>veneta</u>		3,724			3,578		2,420				NS	9,344	37,101
<u>N. exigua</u>	3,069	2,946	2,630	2,990	3,101	2,719	2,119				2,885	5,376	20,055
<u>N. gregaria</u>	4,348	4,225	2,885	2,990	4,056	3,020	2,596				3,884	53,635	253,664
<u>N. integra</u>							1,818				1,818	66	120
<u>N. mutica</u>			2,533	2,990							2,819	1,318	4,112
<u>N. mutica</u> , var. <u>cohnii</u>							1,818				1,818	66	120
<u>N. mutica</u> , var. <u>tropica</u>		3,314				3,196	2,596				3,128	4,025	14,509
<u>N. protracta</u>		2,469									2,469	294	726
<u>N. pupula</u>				3,291							3,291	1,954	6,430
<u>N. pygmaea</u>				2,990	3,703		1,818				3,307	6,090	23,048
<u>N. secura</u>		2,469			3,101		2,663				2,827	2,017	6,666
<u>N. tripunctata</u>			2,408	2,990			2,295				2,678	1,430	4,512
<u>Nitzschia communis</u> , var. <u>abbreviata</u>					3,101		1,818				2,822	1,328	4,148
<u>N. dissipata</u>		2,770									2,770	589	1,632
<u>N. fonticola</u>		4,838	3,750	5,221	5,373	3,865	4,008				4,916	494,392	2,815,103
<u>N. frustulum</u>	3,547	2,469	2,232				2,119				3,013	4,120	14,893
<u>N. hungarica</u>		3,469	3,487	3,291		2,719	2,663		2,158		3,181	9,096	36,010

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-4 (continued)

. PERIPHYTON SPECIES AND DENSITIES FOUND AT WENI WORTH AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$	
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16				
<i>Nitzschia linearis</i>	4.370				3.101						NS	4.092	24,704	108,519
<i>N. longissima</i>					3.101		1.818					2.822	1,328	4,148
<i>N. palea</i>	3.547											3.547	3,524	12,500
<i>N. paleacea</i>	4.723											4.723	52,845	249,587
<i>N. thermalis</i>	3.915	3.372	2.776	2.990			2.119					3.390	12,283	50,229
<i>N. tryblionella</i>		2.469		3.291								3.051	2,249	7,539
<i>Pinnularia gibba</i>									2.283			2.283	192	438
<i>P. subcapitata</i>		2.469	1.931									2.278	380	980
<i>Rhoicosphenia curvata</i>	3.069	3.314	2.776		3.101	3.020				1.681		3.013	6,187	23,458
<i>Stauroneis anceps</i>					3.101							3.101	1,262	3,914
<i>S. phoenicenteron</i>									1.681			1.681	48	81
<i>Stephanodiscus astraes</i>		2.770										2.770	589	1,632
<i>S. hantzschii</i>	4.216	3.511	2.533	3.689	4.101		2.517					3.761	34,619	157,147
<i>Surirella angustata</i>	3.973	2.469		2.990	3.101		1.818					3.380	11,997	48,937
<i>S. ovalis</i>	3.370		2.232		3.101		1.818					2.983	3,842	13,772
<i>S. ovata</i>	5.424	3.511	2.408	3.291	3.402		2.295					4.659	273,635	1,487,801
<i>Synedra acus</i>	3.069	2.770	2.232			2.719						2.788	2,455	8,323
<i>S. affinis</i>	3.370											3.370	2,344	7,899
<i>S. gaillonii</i>	4.501	3.916	2.834	2.990		3.020	1.818					3.852	42,710	197,770
<i>S. parasitica</i> , var. <i>subconstricta</i>							1.818					1.818	66	120

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-4 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT WENTWORTH AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Synedra ulna</u>		2.770							NS		2.770	589	1,632
<u>Actinastrum hantzschii</u>				2.736							2.736	545	1,491
<u>Ankistrodesmus convolutus</u>				3.476							3.476	2,992	10,400
<u>A. falcatus</u>		2.413	3.630		3.238	3.164					3.285	7,713	29,982
<u>A. fractus</u>						2.210					2.210	162	358
<u>Chlamydomonas mucicola</u>	2.759					2.210					2.566	736	2,110
<u>Closterium tumidum</u>				2.435							2.435	272	662
<u>Crucigenia crucifera</u>				3.338							3.338	2,178	7,270
<u>C. rectangularis</u>				3.037							3.037	1,089	3,307
<u>C. tetrapedia</u>								2.040			2.040	110	225
<u>Kirschneriella lunaris</u>						3.113					3.113	1,297	4,037
<u>Lagerheimia quadriseta</u>				2.435							2.435	272	662
<u>Micractinium</u>													
<u>perpusillum</u>					2.799						2.799	630	1,764
<u>Pediastrum duplex</u>				2.435							2.435	272	662
<u>Planctonema</u>													
<u>lauterbornii</u>	5.469		4.584	4.521	2.975	3.356	4.667				4.841	415,668	2,335,533
<u>Pteromonas angulosa</u>					2.197						2.197	157	345
<u>Scenedesmus</u>													
<u>abundans</u>					2.799	3.113					2.984	1,927	6,330
<u>S. bernardii</u>				3.213							3.213	1,633	5,247
<u>S. bijuga</u>					3.343		2.341				3.083	2,422	8,196

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-4 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT WENTWORTH AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Scenedesmus dimorphus</u>			3.630	3.338		2.988		NS			3,393	7,416	28,701
<u>S. incrassatulus</u>					3.401						3,401	2,518	8,564
<u>S. quadricauda</u>				3.037	3.498	2.511					3.182	4,561	16,689
<u>Selenastrum westii</u>				3.037							3.037	1,089	3,307
<u>Tetraedron regulare</u>					2.197						2.197	157	345
<u>Tetrastrum</u>													
<u>staurogeniaeform</u>		2.413									2,413	259	625
<u>Dinobryon setularia</u>							2.341				2,341	219	513
<u>D. sociale</u>						3.113					3,113	1,297	4,037
<u>Anabaena affinis</u>					2.498						2,498	315	787
<u>A. wisconsinense</u>				3.476	3.427						3,452	5,665	21,262
<u>Chroococcus dispersus</u>							2.943				2,943	877	2,581
<u>C. minor</u>					3.373						3,373	2,360	7,960
<u>Lyngbia limnetica</u>			5.612	4.248		3.625					5,158	431,179	2,429,546
<u>Merismopedia</u>													
<u>tenuissima</u>				2.912	3.539	4.337	3.040				3,831	27,099	120,129
<u>Oscillatoria limnetica</u>						3.414	3.455				3,435	5,445	20,343
<u>O. nigra</u>				3.611	3.577						3,594	7,859	30,614
<u>O. subbrevis</u>		4.205		4.753	4.381	4.489	2.517				4,408	127,861	652,953
<u>O. tenuis</u>			6.221	3.912	4.355	3.863					5,629	1,701,520	10,601,894
<u>Spirulina laxissima</u>				2.435		3.289					3,045	2,218	7,421

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Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-4 (continued)

. PERIPHYTON SPECIES AND DENSITIES FOUND AT WENTWORTH AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$												
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	4/29				5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>S. major</u>					3.151				NS												3.151	1,416	4,462		
<u>Euglena acus</u>														2.687									486	1,306	
<u>E. minuta</u>				4.107	2.912																		13,610	56,262	
<u>E. proxima</u>														2.799	3.055	3.362							4,066	14,675	
<u>Lepocinclis</u>																									
<u>sphagnophila</u>														2.197									157	345	
<u>Phacus acuminatus</u>					3.630																		4,914	18,140	
<u>P. curvicauda</u>																2.517							329	828	
<u>P. longicauda</u>														2.497									314	784	
<u>Trachelomonas</u>																									
<u>playfairii</u>														3.042		2.040								1,211	3,734
<u>T. volvocina</u>																								649	1,825
<u>T. westii</u>																								486	1,306

$N_i \log_{10} N_i$  = sum of the densities multiplied by its  $\log_{10}$

NS = No Sample



THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-5

PERIPHYTON SPECIES AND DENSITIES FOUND AT 159th STREET IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Achnanthes conspicua</u>	NS		NS		NS	NS	2.158	NS	1.989	2.082	241	574	
<u>A. lanceolata</u>				3.166					1.989	2.893	1,563	4,992	
<u>A. linearis</u>							2.635			2.635	432	1,139	
<u>Amphora veneta</u>							2.936			2.936	863	2,534	
<u>Cocconeis placentula</u>		2.049		4.069			2.760		1.688	3.493	12,458	51,021	
<u>Cyclotella glomerata</u>				3.768			2.459			3.488	6,149	23,297	
<u>C. meneghiniana</u>		2.827		3.944			3.971			3.717	20,862	90,110	
<u>C. stelligera</u>									1.688	1.688	49	83	
<u>Cymatopleura solea</u>									1.688	1.688	49	83	
<u>Cymbella sinuata</u>									1.688	1.688	49	83	
<u>C. ventricosa</u>									1.688	1.688	49	83	
<u>Fragilaria intermedia</u>									2.290	2.290	195	447	
<u>Frustulia vulgaris</u>									1.688	1.688	49	83	
<u>Gomphonema brevistriata</u>									2.290	2.290	195	447	
<u>G. gracile</u>				4.121			2.459			3.829	13,501	55,764	
<u>G. parvulum</u>		4.645		5.884			3.413		2.864	5.308	813,073	4,805,367	
<u>Gyrosigma distortum,</u> var. <u>Parkeri</u>									1.688	1.688	49	83	
<u>G. kutzingii</u>		2.049							2.165	2.157	287	705	
<u>Hantzschia amphioxys</u>		2.350							2.165	2.267	370	950	
<u>H. elongata</u>				3.166			3.003		2.290	2.949	2,667	9,137	
<u>H. unknown V</u>							2.158			2.158	144	311	

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-5 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 159th STREET IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>Melosira granulata</u>	NS		NS	3,467	NS	NS		NS			3,407	2,901	10,102
<u>M. granulata</u> , var. <u>angustissima</u>								2.158		2.729	2.531	680	1,926
<u>M. varians</u>				3.166				2.158		1.688	2.743	1,658	5,338
<u>Meridian circulare</u>										1.688	1.688	49	83
<u>Mavicula capitata</u>		2.049								2.387	2.250	356	908
<u>N. cryptocephala</u>		2.350		3.467				3.237		2.688	3.128	5,368	20,022
<u>N. cryptocephala</u> , var. <u>veneta</u>								3.605		2.533	3.339	4,368	15,901
<u>N. cuspidata</u>										1.989	1.989	97	193
<u>N. exigua</u>				3.166				2.158			2.906	1,609	5,159
<u>N. gregaria</u>		3.225		3.768				2.635		2.533	3.318	8,313	32,585
<u>N. mutica</u> , var. <u>cohnii</u>										1.688	1.688	49	83
<u>N. mutica</u> , var. <u>tropica</u>		2.350								1.688	2.135	273	665
<u>N. pupula</u>		2.350		3.865							3.577	7,552	29,287
<u>N. pygmaea</u>				3.467				3.003		1.688	3.123	3,987	14,356
<u>N. segura</u>								2.760			2.760	575	1,587
<u>N. tripunctata</u>								3.741		2.290	3.455	5,703	21,421
<u>Nitzschia clausii</u>								2.459			2.459	288	708

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-5 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 159th STREET IN LITTLE CALUMET RIVER DURING 1982

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Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$									Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23			
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16			
<u>Nitzschia communis</u> var. <u>abbreviata</u>	NS		NS		NS	NS	2.760	NS		2.760	575	1,587
<u>N. fonticola</u>		2.651		4.581			4.568		2.729	4.279	76,073	371,330
<u>N. frustulum</u>		2.350		3.467			2.459		2.165	2.953	3,589	12,759
<u>N. hungarica</u>		3.411		3.467			2.857		3.086	3.270	7,446	28,830
<u>N. linearis</u>		2.651					2.459		1.688	2.417	784	2,269
<u>N. longissima</u>							3.362			3.362	2,301	7,736
<u>N. thermalis</u>									1.989	1.989	97	193
<u>N. tryblionella</u> , var. <u>levidensis</u>									1.688	1.688	49	83
<u>Pinnularia microstauron</u>									1.688	1.688	49	83
<u>Rhoicosphenia curvata</u>		2.827		3.166			2.857		2.387	2.889	3,100	10,823
<u>Rhopalodia gibba</u>									1.688	1.688	49	83
<u>Stephanodiscus hantzschii</u>							2.158			2.158	144	311
<u>Surirella angustata</u>		2.049					2.158		1.989	2.071	353	899
<u>S. biseriata</u> , var. <u>bifrons</u>									1.688	1.688	49	83
<u>S. ovalis</u>		2.827							1.890	2.573	749	2,153
<u>S. ovata</u>		2.350		3.643			2.760		2.290	3.130	5,390	20,113
<u>Synedra acus</u>		2.350							1.688	2.135	273	665
<u>S. affinis</u>		2.049							1.688	1.905	161	355

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-5 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 159th STREET IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Synedra gaillonii</u>	NS	2.651	NS		NS	NS		NS	1.688	2.395	496	1,337	
<u>S. parasitica</u> , var. <u>subconstricta</u>		2.049								2.049	112	230	
<u>Ankistrodesmus</u> <u>convolutus</u>				2.124						2.124	133	282	
<u>A. falcatus</u>							2.149			2.149	141	303	
<u>Characium</u> <u>nringsheimi</u>				2.823						2.823	665	1,877	
<u>Closterium acutum</u>				2.124						2.124	133	282	
<u>Oedogonium</u> sp.				3.777						3.777	5,984	22,602	
<u>Planctonema lauterbornii</u>		3.173							5.324	5.026	212,352	1,131,211	
<u>Protoderma viride</u>		2.076		2.124						2.101	252	605	
<u>Pteromonas angulosa</u>		1.775								1.775	60	107	
<u>Spirogyra</u> sp.				4.436						4.436	27,290	121,059	
<u>Stigeoclonium nanum</u>		3.155		4,282						4.012	20,571	88,728	
<u>Ulothrix zonata</u>				3.747						3.747	5,585	20,927	
<u>U. unknown 1</u>		3.951								3.951	8,933	35,294	
<u>Merismopedia tenuissima</u>				2.124						2.124	133	282	
<u>Oscillatoria nigra</u>							3.279			3.279	1,901	6,233	
<u>O. subbrevis</u>		2.854		3.937			4.035			3.828	20,203	86,982	
<u>O. tenuis</u>				3.767			4.339			4.141	27,675	122,935	
<u>Spirulina laxissima</u>							1.847			1.847	70	129	

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-5 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT 159th STREET IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\text{Log}_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\text{Log}_{10}$	Sum	$N_i \text{Log}_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>Euglena minuta</u>	NS		NS	2.124	NS	NS		NS	NS		2.124	133	282
<u>E. proxima</u>		1.775									1.775	60	107
<u>Phacus curvicauda</u>							1.847				1.847	70	129

$N_i \text{Log}_{10} N_i$  = sum of the densities multiplied by its  $\text{Log}_{10}$

NS = No Sample

METROPOLITAN SANITARY DISTRICT GREATER CHICAGO

TABLE AII-6

PERIPHYTON SPECIES AND DENSITIES FOUND AT ASHLAND AVENUE IN LITTLE CALUMET RIVER DURING 1982

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Species	Densities in Number ( $\text{Log}_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\text{Log}_{10}$	Sum	$N_i \text{Log}_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Achnanthes conspicua</u>				2.834	3.189	2.865	2.683			2.047	2.852	3,554	12,619
<u>A. lanceolata</u>	3.046	1.969		2.834	2.888	2.564	2.462			2.591	2.724	3,706	13,226
<u>A. lapponica</u>				2.533		3.820	2.462			1.746	3.261	7,294	28,176
<u>A. linearis</u>								2.274			2.274	188	428
<u>A. linearis, var. curta</u>	2.347										2.347	222	521
<u>Amphiprora alata</u>				2.834				2.149			2.615	823	2,399
<u>Amphora delicatissima</u>								1.973	1.746	1.874	1.874	150	326
<u>A. ovalis</u>										2.047	2.047	111	227
<u>A. veneta</u>				2.533		3.041	1.984			2.348	2.643	1,759	5,708
<u>Caloneis amphisbaena</u>										1.746	1.746	56	98
<u>Cocconeis pediculus</u>		1.668						2.587	1.973	2.445	2.304	806	2,343
<u>C. placentula</u>		2.872	3.147	3.679	5.158	4.962	4.163	2.274	2.047	4.507	4.507	257,279	1,391,983
<u>Cyclotella glomerata</u>	2.347			3.574		2.564				2.445	3.062	4,617	16,918
<u>C. kutzingiana</u>	2.824	1.969									2.580	760	2,189
<u>C. meneghiniana</u>	2.347	2.947		3.913	2.587	4.342	3.131	2.994	3.780	3.699	3.699	40,021	184,188
<u>C. ocoolata</u>			1.699							1.699	1.699	50	85
<u>C. stelligera</u>	2.347									2.047	2.222	334	843
<u>Cymatopleura solea</u>										1.746	1.746	56	98
<u>Cymbella microcephala</u>		1.668				2.564					2.315	413	1,000
<u>Diatoma vulgare</u>	2.824										2.824	667	1,884
<u>Diploneis oculata</u>				2.834							2.834	682	1,933

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-6 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT ASHLAND AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>D. pseudovalis</u>				2.533			1.984				2.340	438	1,157
<u>D. puella</u>								1.672	2.047		1.899	158	347
<u>Eunotia curvata</u>	2.347										2.347	222	521
<u>E. unknown I</u>				2.533							2.533	341	864
<u>Fragilaria intermedia</u>	3.689	2.145									3.400	5,026	18,602
<u>F. pinnata</u>									2.047		2.047	111	227
<u>Gomphonema</u>													
<u>brevistriata</u>				2.533							2.533	341	864
<u>G. gracile</u>					4.018	3.342	3.189		1.746		3.551	14,222	59,063
<u>G. lanceolatum</u>							3.263				3.263	1,832	5,978
<u>G. olivaceum</u>	4.372	2.571					3.467	3.804	2.371	2.445	3.750	33,735	152,755
<u>G. parvulum</u>	4.679	3.765	4.358	4.753	4.199	4.108	3.971	3.240	3.161	4.287	174,178	912,866	
<u>G. sphaerophorium</u>	3.709									3.709	5,117	18,979	
<u>Gyrosigma scalproides</u>	2.347	1.668								1.746	2.034	325	816
<u>Hantzschia amphioxys</u>		2.709								1.746	2.453	567	1,561
<u>H. elongata</u>						3.263	1.984	1.672	2.223	2.729	2,143	7,138	
<u>H. unknown y</u>				3.135						3.135	1,365	4,279	
<u>Melosira granulata</u>									2.223	2,223	167	371	
<u>M. granulata,</u>													
<u>var. angustissima</u>									2.591	2.591	390	1,011	
<u>M. varians</u>		2.747		3.135		2.564		2.517	2.525	2.771	2,953	10,248	
<u>Meridian circulare</u>	3.250	1.668								2.960	1,825	5,952	

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-6 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT ASHLAND AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Navicula accomoda</u>									2.047	2.047	111	227	
<u>N. capitata</u>	2.347							2.149	2.348	2.291	586	1,622	
<u>N. cincta</u>				3.574						3.574	3,750	13,403	
<u>N. cryptocephala</u>	2.648	2.270		3.135		3.041	2.286	2.274	3.108	2.832	4,758	17,497	
<u>N. cryptocephala</u> , var. <u>veneta</u>		2.747		2.834			1.984	2.274	2.950	2.684	2,416	8,174	
<u>N. cuspidata</u> , var. <u>ambigua</u>									1.746	1.746	56	98	
<u>N. exigua</u>		3.010				2.564				1.746	1,445	4,566	
<u>N. gregaria</u>	3.523	3.048						2.517	3.108	3.181	6,062	22,930	
<u>N. minima</u>		1.668								1.668	47	79	
<u>N. muralis</u>	2.347								2.047	2.222	334	843	
<u>N. mutica</u> , var. <u>cohnii</u>									1.746	1.746	56	98	
<u>N. mutica</u> , var. <u>tropica</u>		2.145		2.533					2.223	2.334	648	1,822	
<u>N. mutica</u> , var. <u>undulata</u>		1.668								1.668	47	79	
<u>N. placentula</u>	2.648									2.648	445	1,179	
<u>N. pupula</u>		2.145								2.145	140	300	
<u>N. pupula</u> , var. <u>rostrata</u>		1.668								1.668	47	79	

Table continued on following page



THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-6 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT ASHLAND AVENUE IN LITTLE CALUMET RIVER DURING 1982

AII-35

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$				
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	4/29				5/28	6/24	7/21	8/18
<i>Navicula pygmaea</i>						2.564	2.286	2.274	2.223	2.359	915	2,710					
<i>N. secura</i>	2.347	2.571	1.699	2.533	2.587	2.865	2.683	2.274		2.540	2,775	9,555					
<i>N. tripunctata</i>					2.888	2.865	2.286	2.626		2.811	3,236	11,358					
<i>Nedium dubium</i>										1.746	56	98					
<i>Nitzschia amphibia</i>	2.347									2.347	222	521					
<i>N. clausii</i>				2.834						2.834	682	1,933					
<i>N. communis</i> , var. <i>abbreviata</i>		2.145		3,232	3.541	3.710	3.161	2.450	2.445	3.250	12,459	51,026					
<i>N. dissipata</i>	2.347							1.973	2.591	2.372	706	2,011					
<i>N. fonticola</i>	2.949	2.446	2.978	4.823	4.034	4.069	3.797	3.607	3.604	4.069	105,512	530,019					
<i>Nitzschia frustulum</i>		1.969		3.679	3.666	3.865	2.763	2.149	2.348	3.405	17,774	75,536					
<i>N. frustulum</i> , var. <i>subsalina</i>	2.347									2.347	222	521					
<i>N. hungarica</i>	2.648	2.814		2.834		3.041	1,984	2.517	3.238	2,857	5,033	18,631					
<i>N. linearis</i>		2.814				2.865		1.672		2,679	1,431	4,516					
<i>N. longissima</i>	2.347					2.865	2.286			2.583	1,148	3,513					
<i>N. palea</i>		2.145								2.145	140	300					
<i>N. paleacea</i>	3.125	2.270	1.699							2.719	1,570	5,018					
<i>N. recta</i>									2.348	2,348	223	524					
<i>N. thermalis</i>								1.672	1.746	1.711	103	207					
<i>N. tryblionella</i>		1 668							1.746	1.709	102	205					

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-6 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT ASHLAND AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\text{Log}_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\text{Log}_{10}$	Sum	$N_i \text{Log}_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Nitzschia tryblionella</u>													
var. levidensis				2.533				1.672	2.525	2.382	723	2,067	
<u>N. tryblionella</u> , var.													
victoriae		1.668							1.746	1.709	102	205	
<u>Pinnularia obscura</u>							1.984			1.984	96	190	
<u>Rhoicosphenia curvata</u>	2.648	2.668	2.545	2.533	3.541	4.096	3.215	3.285	3.194	3.401	22,683	98,800	
<u>Rhopalodia musculus</u>	2.347									2.347	222	521	
<u>Stauroneis montana</u>									1.746	1.746	56	98	
<u>Stephanodiscus</u>													
hantzschii	3.648	2.367				2.564				2.223	5,213	19,377	
<u>Surirella angustata</u>		2.145		2.533				2.149	2.525	2.383	967	2,887	
<u>S. ovalis</u>		1.969						1.672	2.348	2.083	363	929	
<u>S. ovata</u>	3.602	3.321		3.135				2.818	2.788	3.242	8,730	34,405	
<u>Synedra acus</u>	2.347	1.668							1.746	2.034	325	816	
<u>S. affinis</u>	3.125	2.145		3.311		3.041	1.984	3.135	2.649	2.969	6,525	24,890	
<u>S. gaillonii</u>	3.192	2.367		3.788					2.649	3.321	8,372	32,842	
<u>S. nana</u>	2.347								1.746	2.143	278	679	
<u>S. parasitica</u> , var.													
subconstricta	2.347								2.047	2.222	334	843	
<u>S. pulchella</u>	3.778	1.668				2.564				3.330	6,411	24,406	
<u>S. ulna</u>	2.347									2.347	222	521	

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-6 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT ASHLAND AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\log_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\log_{10}$	Sum	$N_i \log_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23	12/16			
<u>Tabellaria fenestrata</u>										1.746	1.746	56	98
<u>Thalassiosira pseudonana</u>	2.347										2.347	222	521
<u>Ankistrodesmus falcatus</u>				2.020							2.020	158	347
<u>Characium ambiguum</u>			2.531	3.061		2.871					2.872	2,233	7,478
<u>C. hookeri</u>					2.832	3.026	2.106				2.794	1,869	6,115
<u>Chlamydomonas mucicola</u>	2.157										2.157	144	311
<u>Chlamydomonas snowii</u>	1.856										1.856	72	134
<u>Cladophora sp.</u>			2.479		3.032						2.838	1,378	4,326
<u>Oedogonium sp.</u>					3.446						3.446	2,793	9,625
<u>Planctonema lauterbornii</u>	3.400	2.305		4.218	2.643		3.392	3.934	4.586		3.995	69,277	335,341
<u>Protoderma viride</u>			2.899	2.497	1.601	2.026					2.496	1,253	3,882
<u>Spirogyra sp.</u>				3.993	3.525						3.819	13,190	54,346
<u>Stigeoclonium nanum</u>			3.741	4.011	3.753						3.854	21,427	92,800
<u>Ulothrix zonata</u>				3.321							3.321	2,094	6,954

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-6 (continued)

PERIPHYTON SPECIES AND DENSITIES FOUND AT ASHLAND AVENUE IN LITTLE CALUMET RIVER DURING 1982

Species	Densities in Number ( $\text{Log}_{10}$ ) Per $\text{cm}^2$										Arith. Avg. $\text{Log}_{10}$	Sum	$N_i \text{Log}_{10} N_i$
	4/15	5/13	6/11	7/07	8/04	9/01	9/29	10/27	11/23				
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16				
<u>Ulothrix unknown II</u>					3.064					NS	3.064	1,159	3,551
<u>Chroococcus limneticus</u>					2.504	2.026					2.328	425	1,117
<u>Lyngbia limneticus</u>			2.807								2.807	641	1,799
<u>Merismopedia tenuissima</u>						2.026					2.026	106	215
<u>Oscillatoria limnetica</u>						3.406					3.406	2,547	8,675
<u>O. nigra</u>								2.822			2.822	664	1,874
<u>O. subbrevis</u>				3.525	2.504	3.441					3.331	6,429	24,483
<u>O. tenuis</u>				3.988	2.504	4.665		3.162			4.159	57,737	274,912
<u>Plectonema notatum</u>		2.974									2.974	942	2,802
<u>Rhabdoderma irregulare</u>							2.026				2.026	106	215
<u>Spirulina laxissima</u>							2.327				2.327	212	493
<u>Euglena minuta</u>		2.129	2.531	2.719							2.522	998	2,993
<u>E. proxima</u>	1.856							1.930			1.895	157	345
<u>Lepocinclis fusiformis</u>					1.601						1.601	40	64
<u>Trachelomonas pulcherrima</u>	1.856										1.856	72	134

$N_i \text{Log}_{10} N_i$  = sum of the densities multiplied by its  $\text{Log}_{10}$

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-7

PERIPHYTON DENSITIES<sup>+</sup> PER SQUARE CENTIMETER AND NUMBER OF SPECIES<sup>++</sup>

THORN CREEK AND THE LITTLE CALUMET RIVER

Sampling Stations	Dates of Samples - 1982										Avg. Density	Avq. No. Spp.
	4/15 4/29	5/13 5/28	6/11 6/24	7/7 7/21	8/4 8/18	9/1 9/15	9/29 10/13	10/27 11/10	11/23 12/16			
<u>Thorn Creek</u>												
Joe Orr Road	0.58 (37)	0.23 (37)	0.85 (37)	12.68 (25)	5.33 (52)	5.69 (18)	1.38 (28)	0.16 (39)	0.01 (16)	2.990	(32)	
Margaret Street	8.74 (45)	0.40 (44)	3.29 (33)		1.56 (35)	3.57 (33)	2.44 (39)	1.44 (44)		3.063	(39)	
167/170th Street		1.67 (25)	1.10 (29)	5.89 (33)	12.54 (31)	7.58 (36)	0.93 (43)	1.29 (47)		4.429	(35)	
<u>Little Calumet River</u>												
Wentworth Avenue	8.90 (26)	1.90 (46)	2.179 (33)	6.56 (44)	7.22 (52)	3.44 (33)	0.88 (48)		0.01 (9)	6.338	(36)	
159th Street		0.67 (29)		9.57 (31)			1.08 (37)		2.21 (45)	3.383	(36)	
Ashland Avenue	1.18 (45)	0.19 (43)	0.35 (14)	2.26 (41)	2.13 (24)	2.42 (38)	0.51 (29)	0.26 (34)	0.67 (60)	1.107	(36)	

Table continued on following page.

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO  
 TABLE AII-7 (Continued)  
 PERIPHYTON DENSITIES<sup>+</sup> PER SQUARE CENTIMETER AND NUMBER OF SPECIES<sup>++</sup>  
 THORN CREEK AND THE LITTLE CALUMET RIVER

Sampling Stations	Dates of Samples - 1982										Avg. No. Spp.
	4/15 4/29	5/13 5/28	6/11 6/24	7/7 7/21	8/4 8/18	9/1 9/15	9/29 10/13	10/27 11/10	11/23 12/16	Avg. Density	
Thorn Creek											
Average Density	4.66	0.77	1.75	9.28	6.48	5.61	1.58	0.96	0.01	3.494	
Average Number of Species	41	35	33	29	39	29	34	43	16		(35)
Little Calumet River											
Average Density	5.04	0.92	11.07	6.13	4.67	2.93	0.82	0.26	0.96	3.609	
Average Number of Species	36	39	24	38	38	36	38	34	38		(36)

<sup>+</sup>Clump count x 10<sup>5</sup> per cm<sup>2</sup>  
<sup>++</sup>Number of species in parentheses

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-8

ORGANIC MATTER<sup>+</sup>, CHLOROPHYLL a<sup>++</sup>, AND AUTOTROPHIC INDEX<sup>+++</sup>

THORN CREEK AND THE LITTLE CALUMET RIVER

Sampling Stations	Para-meters	Dates of Samples - 1982										Avg.
		4/15 4/29	5/13 5/28	6/11 6/24	7/7 7/21	8/4 8/18	9/1 9/15	9/29 10/13	10/27 11/10	11/23 12/16		
Thorn Creek	OM	84	124	74	271	130	72	34	32	63		
Joe Orr Road	Chl a	0.134	0.017	0.028	3.084	1.222	0.881	0.219	0.015	0.005		
	AI	627	7,294	2,643	88	106	82	155	2,133	12,600	2,859	
Thorn Creek	OM	364	48	66	NS	124	641	105	95	NS		
Margaret Street	Chl a	3.071	0.046	0.296		0.412	0.883	0.279	0.166			
	AI	121	1,043	223		301	726	376	570		480	
Thorn Creek	OM	NS	132	55	328	444	174	82	109	NS		
167/170th Street	Chl a		0.372	0.155	1.523	4.311	2.633	0.085	0.215			
	AI		355	355	215	103	66	965	507		367	

Table continued on following page.

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO  
 TABLE AII-8 (Continued)  
 ORGANIC MATTER<sup>+</sup>, CHLOROPHYLL a<sup>++</sup>, AND AUTOTROPHIC INDEX<sup>+++</sup>  
 THORN CREEK AND THE LITTLE CALUMET RIVER

Sampling		Dates of Samples - 1982									
Stations	Para- meters	4/15 4/29	5/13 5/28	6/11 6/24	7/7 7/21	8/4 8/18	9/1 9/15	9/29 10/13	10/27 11/10	11/23 12/16	Avg.
Little Calumet River	OM	1,043	2,696	2,176	605	1,857	867	347	NS	1,487	
Wentworth Avenue	Chl a	2.953	0.894	4.739	1.561	1.416	3.036	0.370		0.140	
	AI	353	3,020	459	388	1,310	286	938		11,000	2,219
Little Calumet River	OM	NS	1,053		481	NS	101	NS		1,823	
159th Street	Chl a		1.379		2.827		0.215			0.110	
	AI		764		170		470			17,000	4,601
Little Calumet River	OM	137	56	41	165	129	195	47	87	560	
Ashland Avenue	Chl a	0.746	0.115	0.182	1.477	0.768	0.995	0.224	0.305	0.059	
	AI	184	487	227	112	168	196	210	284	9.500	1,263

Table continued on following page.



THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-8 (Continued)

ORGANIC MATTER<sup>+</sup>, CHLOROPHYLL a<sup>++</sup>, AND AUTOTROPHIC INDEX<sup>+++</sup>

THORN CREEK AND THE LITTLE CALUMET RIVER

Sampling Stations	Para-meters	Dates of Samples - 1982										Avg.
		4/15 4/29	5/13 5/28	6/11 6/24	7/7 7/21	8/4 8/18	9/1 9/15	9/29 10/13	10/27 11/10	11/23 12/16		
Thorn Creek	OM	224	101	65	300	233	296	74	79	63		
Average	Chl a	1.603	0.145	0.160	2.304	1.982	1.466	0.194	0.132	0.005		
	AI	374	2,897	1,074	152	170	291	499	1,070	12,600	2,125	
Little Calumet River	OM	590	1,268	1,108	417	993	531	165	87	1,290		
Average	Chl a	1.850	0.796	2.460	1.955	1.092	2.016	0.270	0.305	0.103		
	AI	268	1,424	343	223	739	241	539	284	12,500	1,840	

+OM in ug/cm<sup>2</sup> = Organic Matter  
 ++Chl a in ug/cm = Chlorophyll a  
 +++AI =  $\frac{OM}{Chl a}$  = Autotrophic Index

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-9

PERIPHYTON SPECIES DIVERSITY<sup>+</sup> ( $\bar{d}$ )  
 THORN CREEK AND THE LITTLE CALUMET RIVER

Sampling Stations	Dates of Samples - 1982										
	4/15 4/29	5/13 5/28	6/11 6/24	7/7 7/21	8/4 8/18	9/1 9/15	9/29 10/13	10/27 11/10	11/23 12/16	Avg. Density	Avg. No. Spp.
<u>Thorn Creek</u>											
Joe Orr Road	2.2438	2.6545	2.5650	0.7274	0.4775	1.7160	0.6419	2.9960	2.6529	1.3830	109
Margaret Street	1.9629	2.4158	1.9877	NS <sup>++</sup>	2.2688	2.0648	1.9017	2.3993	NS	2.8201	113
167/170th Street	NS	1.2514	1.4010	1.6290	1.9136	1.6154	2.3798	2.5647	NS	2.3779	99
<u>Little Calumet River</u>											
Wentworth Avenue	1.9940	2.5737	0.7777	2.1163	2.0970	1.4532	1.9151	NS	1.9911	2.4846	125
159th Street	NS	1.4374	NS	1.0521	NS	NS	2.2586	NS	0.3152	1.6650	79
Ashland Avenue	2.2363	2.8295	1.2621	2.4116	1.4120	2.2026	2.2941	2.4586	1.9924	2.8049	123
Total Number of Species	84	100	78	91	100	84	85	63	79		

+Shannon Weaver Species Diversity Index  
 ++NS = No Sample

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AII-10

EQUITABILITIES (e)

THORN CREEK AND THE LITTLE CALUMET RIVER

Sampling Stations	Dates of Samples - 1982									
	4/15	5/13	6/11	7/7	8/4	9/1	9/29	10/27	11/23	Ave
	4/29	5/28	6/24	7/21	8/18	9/15	10/13	11/10	12/16	e
<u>Thorn Creek</u>										
Joe Orr Road	0.172	0.235	0.219	0.076	0.031	0.234	0.064	0.288	0.543	0.030
Margaret Street	0.114	0.165	0.158	NS	0.185	0.168	0.125	0.140	NS	0.087
167/170th Street	NS	0.116	0.113	0.119	0.159	0.108	0.164	0.151	NS	0.071
<u>Little Calumet River</u>										
Wentworth Avenue	0.202	0.178	0.059	0.131	0.109	0.102	0.103	NS	0.582	0.061
159th Street	NS	0.117	NS	0.080	NS	NS	0.174	NS	0.029	0.051
Ashland Avenue	0.135	0.230	0.209	0.160	0.138	0.161	0.228	0.221	0.087	0.079

NS = No Sample

AII-46

APPENDIX III

FISH DATA COLLECTED FROM THORN CREEK AND THE  
LITTLE CALUMET RIVER DURING 1982

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-1

ELECTROFISHING RESULTS (TOTAL NUMBERS AND WEIGHTS, PERCENTAGES AND CATCH PER TEN MINUTES) FOR FISH COLLECTED FROM LITTLE CALUMET RIVER AND THORN CREEK DURING 1982.

STATION NAME AND GEAR USED	RIVER MILE	DATE	SPECIES NAME	NO. FISH	NO. PER TEN MIN.	% TOT. NUMBER	TOTAL WT (g)	WT(g)PER TEN MIN.	% TOT. WEIGHT
Ashland Avenue Little Calumet River 3 Seine Hauls, 40 meters Total	0.6	6/15	Central mudminnow	1	Seine	6.25	3.19	Seine	2.43
			Golden shiner	1		6.25	0.73		0.56
			Fathead minnow	5		31.25	15.15		11.55
			White sucker	1		6.25	0.15		0.11
			Green sunfish	3		18.75	17.20		13.11
			Bluegill	1		6.25	0.98		0.75
			White crappie	4		25.00	93.81		71.50
			Total	16		100.00	131.21		100.00
Ashland Avenue Little Calumet River Backpack Electrofisher on Boat, 60 minutes	0.6	7/15	Central mudminnow	7	1.17	53.85	37.82	6.33	19.79
			Fathead minnow	2	0.33	15.38	6.48	1.08	3.39
			Black bullhead	1	0.17	7.69	94.07	15.75	49.22
			Green sunfish	3	0.50	23.08	52.75	8.83	27.60
			Goldfish approxi- mately 1/2 lb. missed			-			-
			Total	13	2.17	100.00	191.12	31.99	100.00

Table continued on following page

AIII-2

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-1 (Continued)

ELECTROFISHING RESULTS (TOTAL NUMBERS AND WEIGHTS, PERCENTAGES AND CATCH PER TEN MINUTES) FOR FISH COLLECTED FROM LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME AND GEAR USED	RIVER MILE	DATE	SPECIES NAME	NO. FISH	NO. PER TEN MIN.	% TOT. NUMBER	TOTAL WT (g)	WT (g) PER TEN MIN.	% TOT. WEIGHT
Ashland Avenue Little Calumet River Boat Electrofisher, 59 minutes	0.6	10/7	Gizzard shad	2	0.34	1.31	11.30	1.93	0.70
			Central mudminnow	2	0.34	1.31	12.82	2.19	0.79
			Central stoneroller	3	0.51	1.96	8.70	1.48	0.54
			Goldfish	7	1.19	4.58	510.92	87.19	31.64
			Carp	1	0.17	0.65	8.54	1.46	0.53
			Carp X Goldfish hybrid	2	0.34	1.31	9.10	1.55	0.56
			Golden shiner	3	0.51	1.96	36.74	6.27	2.28
			Fathead minnow	45	7.68	29.41	127.87	21.82	7.92
			Creek chub	36	6.14	23.53	220.68	37.66	13.67
			White sucker	1	0.17	0.65	8.91	1.52	0.55
			Black bullhead	1	0.17	0.65	170.00	29.01	10.53
			Green sunfish	38	6.48	24.84	437.47	74.65	27.09
			Orangespotted sunfish	1	0.17	0.65	12.60	2.15	0.78
			Bluegill	8	1.37	5.23	9.29	1.59	0.58
			Green X pumpkinseed hybrid	2	0.34	1.31	12.96	2.21	0.80
			Largemouth bass	1	0.17	0.65	17.00	2.90	1.05
						Total	153	26.09	100.00

Table continued on following page

AIII-3

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-1 (Continued)

ELECTROFISHING RESULTS (TOTAL NUMBERS AND WEIGHTS, PERCENTAGES AND CATCH PER TEN MINUTES) FOR FISH COLLECTED FROM LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME AND GEAR USED	RIVER MILE	DATE	SPECIES NAME	NO. FISH	NO. PER TEN MIN.	% TOT. NUMBER	TOTAL WT(g)	WT(g)PER TEN MIN.	% TOT. WEIGHT
Ashland Avenue (Roll Street) Little Calumet River Backpack Electrofisher, 38 minutes	1.0	7/13	Central mudminnow	17	4.45	89.47	89.49	23.43	96.68
			Fathead minnow	1	0.26	5.26	0.98	0.26	1.06
			Green sunfish	1	0.26	5.26	2.09	0.55	2.26
			Total	19	4.97	99.99	92.56	24.24	100.00
Ashland Avenue (Roll Street) Little Calumet River Backpack Electrofisher, 22 minutes	1.0	9/28	Central mudminnow	8	3.56	100.00	62.70	27.89	100.00
			Total	8	3.56	100.00	62.70	27.89	100.00
159th Street (Cottage Grove Ave.) Little Calumet River Backpack Electrofisher, 19 minutes	6.8	7/9	Central mudminnow	7	3.61	70.00	24.83	12.82	87.12
			Fathead minnow	1	0.52	10.00	3.10	1.60	10.88
			White sucker	2	1.03	20.00	0.57	0.29	2.00
			Total	10	5.16	100.00	28.50	14.71	100.00

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-1 (Continued)

ELECTROFISHING RESULTS (TOTAL NUMBERS AND WEIGHTS, PERCENTAGES AND CATCH PER TEN MINUTES) FOR FISH COLLECTED FROM LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME AND GEAR USED	RIVER MILE	DATE	SPECIES NAME	NO. FISH	NO. PER TEN MIN.	% TOT. NUMBER	TOTAL WT(g)	WT(g)PER TEN MIN.	% TOT. WEIGHT
159th Street (Calumet Expressway) Little Calumet River Backpack Electrofisher on Boat, 48 minutes	7.7	7/16	Central mudminnow	79	11.66	97.53	98.22	14.50	93.33
			Green sunfish	1	0.15	1.23	6.71	0.99	6.38
			Largemouth bass	1	0.15	1.23	0.31	0.05	0.29
			Total	81	11.96	100.00	105.24	15.54	100.00
159th Street Little Calumet River Backpack Electrofisher on Boat, 63 minutes	8.1	10/21	Gizzard shad	1	0.16	0.87	5.89	0.93	0.73
			Central mudminnow	46	7.25	40.00	313.81	49.43	38.85
			Goldfish	1	0.16	0.87	117.35	18.49	14.53
			Carp X Goldfish hybrid	1	0.16	0.87	5.21	0.82	0.65
			Bluntnose minnow	8	1.26	6.96	3.98	0.63	0.49
			Fathead minnow	23	3.62	20.00	52.30	8.24	6.48
			Black bullhead	1	0.16	0.87	182.00	28.67	22.53
			Green sunfish	10	1.58	8.70	10.24	1.61	1.27
			Bluegill	23	3.62	20.00	16.88	2.66	2.09
			White crappie	1	0.16	0.87	100.00	15.75	12.38
			Total	115	18.13	100.01	807.66	127.23	100.00

Table continued on following page

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-1 (Continued)

ELECTROFISHING RESULTS (TOTAL NUMBERS AND WEIGHTS, PERCENTAGES AND CATCH PER TEN MINUTES) FOR FISH COLLECTED FROM LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME AND GEAR USED	RIVER MILE	DATE	SPECIES NAME	NO. FISH	NO. PER TEN MIN.	% TOT. NUMBER	TOTAL WT(g)	WT(g) PER TEN MIN.	% TOT. WEIGHT
Wentworth Avenue Little Calumet River Backpack Electrofisher on Boat, 36 minutes	12.4	7/14	Central mudminnow	5	1.93	100.00	16.27	6.28	100.00
			Total	5	1.93	100.00	16.27	6.28	100.00
Wentworth Avenue Little Calumet River Backpack Electrofisher on Boat, 39 minutes	12.4	9/30	Central mudminnow	6	1.54	46.15	43.18	11.08	39.23
			Fathead minnow	3	0.77	23.08	5.86	1.50	5.32
			Green sunfish	4	1.03	30.77	61.04	15.66	55.45
			Total	13	3.34	100.00	110.08	28.24	100.00
167/170th Street Thorn Creek Backpack Electrofisher 38 minutes (17 minutes with seine following)	9.7	7/8	Central mudminnow	3	0.78	9.38	15.99	4.18	0.99
			Goldfish	1	0.26	3.13	80.02	20.93	4.97
			Carp	1	0.26	3.13	1,453.00	380.03	90.25
			Fathead minnow	15	3.92	46.88	23.78	6.22	1.48
			Creek chub	3	0.78	9.38	1.32	0.35	0.08
			White sucker	2	0.52	6.25	1.81	0.47	0.11
			Green sunfish	5	1.31	15.63	31.53	8.25	1.96
			Largemouth bass	2	0.52	6.25	2.50	0.65	0.16
Total	32	8.35	100.00	1,609.95	421.08	100.00			

Table continued on following page

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-1 (Continued)

ELECTROFISHING RESULTS (TOTAL NUMBERS AND WEIGHTS, PERCENTAGES AND CATCH PER TEN MINUTES) FOR FISH COLLECTED FROM LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME AND GEAR USED	RIVER MILE	DATE	SPECIES NAME	NO. FISH	NO. PER TEN MIN.	% TOT. NUMBER	TOTAL WT(g)	WT(g) PER TEN MIN.	% TOT. WEIGHT
167/170th Street Thorn Creek Backpack Electrofisher 34 minutes (18 minutes with seine following)	9.7	10/14	Central mudminnow	9	2.68	20.45	69.92	20.84	34.38
			Fathead minnow	12	3.58	27.27	27.82	8.29	13.68
			Creek chub	7	2.09	15.91	23.22	6.92	11.42
			Green sunfish	13	3.87	29.55	65.09	19.40	32.01
			Bluegill	1	0.30	2.27	0.81	0.24	0.40
			Green X pumpkin- seed hybrid	2	0.60	4.55	16.51	4.92	8.12
			Total	44	13.12	100.00	203.37	60.61	100.01
Margaret Street Thorn Creek Backpack Electrofisher 30 minutes	12.9	7/7	Central mudminnow	26	8.67	20.63	134.70	44.90	19.12
			Fathead minnow	36	12.00	28.57	33.26	11.09	4.72
			Creek chub	31	10.33	24.60	166.80	55.60	23.68
			White sucker	7	2.33	5.56	6.87	2.29	0.98
			Black bullhead	1	0.33	0.79	134.88	44.96	19.14
			Green sunfish	25	8.33	19.84	228.01	76.00	32.36
			Total	126	41.99	100.00	704.52	234.84	100.00

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-1 (Continued)

ELECTROFISHING RESULTS (TOTAL NUMBERS AND WEIGHTS, PERCENTAGES AND CATCH PER TEN MINUTES) FOR FISH COLLECTED FROM LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME AND GEAR USED	RIVER MILE	DATE	SPECIES NAME	NO. FISH	NO. PER TEN MIN.	% TOT. NUMBER	TOTAL WT(g)	WT(g) PER TEN MIN.	% TOT. WEIGHT
Margaret Street Thorn Creek Backpack Electrofisher 34 minutes (19 minutes with seine following)	12.9	10/5	Central mudminnow	15	4.46	45.45	124.73	37.05	61.17
			Bluntnose minnow	6	1.78	18.18	2.08	0.62	1.02
			Fathead minnow	2	0.59	6.06	1.87	0.56	0.92
			Green sunfish	9	2.67	27.27	74.03	21.99	36.30
			Bluegill	1	0.30	3.03	1.21	0.36	0.59
			Total	33	9.80	100.00	203.92	60.58	100.00
Joe Orr Road Thorn Creek Backpack Electrofisher 38 minutes (17 minutes with seine following)	18.6	7/6	Central mudminnow	2	0.52	7.69	10.66	2.77	6.23
			Fathead minnow	3	0.78	11.54	2.68	0.70	1.57
			Green sunfish	21	5.46	80.77	157.65	40.98	92.20
			Total	26	6.76	100.00	170.99	44.45	100.00
Joe Orr Road Thorn Creek Backpack Electrofisher 34 minutes (19 minutes with seine following)	18.6	10/13	Central mudminnow	2	0.59	15.38	28.45	8.37	41.45
			Green sunfish	10	2.94	76.92	38.48	11.32	56.06
			Green X pumpkin- seed hybrid	1	0.29	7.69	1.71	0.50	2.49
			Total	13	3.82	99.99	68.64	20.19	100.00

Table continued on following page

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-1 (Continued)

ELECTROFISHING RESULTS (TOTAL NUMBERS AND WEIGHTS, PERCENTAGES AND CATCH PER TEN MINUTES) FOR FISH COLLECTED FROM LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME AND GEAR USED	RIVER MILE	DATE	SPECIES NAME	NO. FISH	NO. PER TEN MIN.	% TOT. NUMBER	TOTAL WT(g)	WT(g) PER TEN MIN.	% TOT. WEIGHT
Route 30 Thorn Creek Backpack Electrofisher 28 minutes (23 minutes with seine following)	20.4	7/7	Fathead minnow	42	15.25	56.00	93.06	33.78	16.09
			Creek chub	21	7.62	28.00	245.41	89.08	42.44
			White sucker	3	1.09	4.00	105.62	38.34	18.27
			Green sunfish	9	3.27	12.00	134.17	48.70	23.20
			Total	75	27.23	100.00	578.26	209.90	100.00
Route 30 Thorn Creek Backpack Electrofisher 43 minutes; 2 seine hauls, 40 meters total	20.4	10/13	Creek chub	6	1.38	13.95	56.95	13.12	32.03
			Green sunfish	35	8.06	81.40	117.90	27.16	66.31
			Warmouth	2	0.46	4.65	2.94	0.68	1.65
			Total	43	9.90	100.00	177.79	40.96	100.00

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-2

MEAN, MINIMUM AND MAXIMUM TOTAL LENGTH (TL) AND WEIGHT (WT) FOR FISH COLLECTED FROM  
THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME	RIVER MILE	DATE	SPECIES NAME	NO. FISH	MEAN TL (mm)	MIN. TL (mm)	MAX. TL (mm)	MEAN WT (g)	MIN. WT (g)	MAX. WT (g)
Ashland Avenue Little Calumet River	0.6	6/15	Central mudminnow	1	60.00	60	60	3.19	3.19	3.19
			Golden shiner	1	45.00	45	45	0.73	0.73	0.73
			Fathead minnow	5	58.80	51	67	3.03	2.00	4.89
			White sucker	1	28.00	28	28	0.15	0.15	0.15
			Green sunfish	3	57.00	43	79	5.73	1.69	13.17
			Bluegill	1	39.00	39	39	0.98	0.98	0.98
			White crappie	4	118.25	91	153	23.45	9.31	46.08
Ashland Avenue Little Calumet River	0.6	7/15	Central mudminnow	7	64.71	35	83	5.40	0.85	8.80
			Fathead minnow	2	63.00	52	74	3.24	1.60	4.88
			Black bullhead	1	181.00	181	181	94.07	94.07	94.07
			Green sunfish	3	85.33	72	110	17.58	7.62	35.96
Ashland Avenue Little Calumet River	0.6	10/7	Gizzard shad	2	77.00	63	91	5.65	2.53	8.77
			Central mudminnow	2	72.50	70	75	6.41	5.78	7.04
			Central stoneroller	3	62.33	57	72	2.90	2.23	4.02
			Goldfish	7	98.57	33	240	72.99	0.56	338.00
			Carp	1	(76.00)	(76)	(76)	8.54	8.54	8.54
			Carp x goldfish hybrid	2	57.50	39	76	4.55	1.05	8.05
			Golden shiner	3	92.67	55	120	12.25	1.54	21.40

AIII-10

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-2 (Continued)

MEAN, MINIMUM AND MAXIMUM TOTAL LENGTH (TL) AND WEIGHT (WT) FOR FISH COLLECTED FROM  
THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME	RIVER MILE	DATE	SPECIES NAME	NO. FISH	MEAN TL (mm)	MIN. TL (mm)	MAX. TL (mm)	MEAN WT (g)	MIN. WT (g)	MAX. WT (g)
Ashland Avenue Little Calumet River	0.6	10/7	Fathead minnow	45	58.87	42	72	2.84	0.90	4.85
			Creek chub	36	76.31	50	101	6.13	1.54	14.00
			White sucker	1	96.00	96	96	8.91	8.91	8.91
			Black bullhead	1	222.00	222	222	170.00	170.00	170.00
			Green sunfish	38	73.84	41	129	11.51	1.36	38.00
			Orangespotted sunfish	1	84.00	84	84	12.60	12.60	12.60
			Bluegill	8	39.88	34	46	1.16	0.73	1.83
			Green X pumpkinseed hybrid	2	65.50	60	71	6.48	5.42	7.54
			Largemouth bass	1	107.00	107	107	17.00	17.00	17.00
Ashland Avenue (Roll Street) Little Calumet River	1.0	7/13	Central mudminnow	17	68.76	34	80	5.26	0.35	7.62
			Fathead minnow	1	46.00	46	46	0.98	0.98	0.98
			Green sunfish	1	50.00	50	50	2.09	2.09	2.09
Ashland Avenue (Roll Street) Little Calumet River	1.0	9/28	Central mudminnow	8	76.88	71	88	7.84	5.98	11.78

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THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-2 (Continued)

MEAN, MINIMUM AND MAXIMUM TOTAL LENGTH (TL) AND WEIGHT (WT) FOR FISH COLLECTED FROM  
THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME	RIVER MILE	DATE	SPECIES NAME	NO. FISH	MEAN TL (mm)	MIN. TL (mm)	MAX. TL (mm)	MEAN WT (g)	MIN. WT (g)	MAX. WT (g)
159th Street (Cottage Grove Ave.) Little Calumet River	6.8	7/9	Central mudminnow	7	57.57	31	80	3.55	0.29	7.51
			Fathead minnow	1	60.00	60	60	3.10	3.10	3.10
			White sucker	2	42.00	40	44	0.29	0.25	0.32
159th Street (Calumet Expressway) Little Calumet River	7.7	7/16	Central mudminnow	79	44.29	31	76	1.43	0.17	6.21
			Green sunfish	1	68.00	68	68	6.71	6.71	6.71
			Largemouth bass	1	39.00	39	39	0.31	0.31	0.31
159th Street Little Calumet River	8.1	10/21	Gizzard shad	1	81.00	81	81	5.89	5.89	5.89
			Central mudminnow	46	77.59	64	96	6.82	3.52	11.64
			Goldfish	1	178.00	178	178	117.35	117.35	117.35
			Carp X goldfish hybrid	1	64.00	64	64	5.21	5.21	5.21
			Bluntnose minnow	8	34.50	28	40	0.50	0.30	0.78
			Fathead minnow	23	53.57	25	67	2.27	0.23	3.51
			Black bullhead	1	231.00	231	231	182.00	182.00	182.00
			Green sunfish	10	35.60	27	45	1.02	0.55	2.00
			Bluegill	23	33.74	29	45	0.73	0.41	1.73
			White crappie	1	193.00	193	193	100.00	100.00	100.00

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-2 (Continued)

MEAN, MINIMUM AND MAXIMUM TOTAL LENGTH (TL) AND WEIGHT (WT) FOR FISH COLLECTED FROM  
THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION	RIVER MILE	DATE	SPECIES NAME	NO. FISH	MEAN TL (mm)	MIN. TL (mm)	MAX. TL (mm)	MEAN WT (g)	MIN. WT (g)	MAX. WT (g)
Wentworth Avenue Little Calumet River	12.4	7/14	Central mudminnow	5	61.20	41	68	3.25	0.77	4.48
Wentworth Avenue Little Calumet River	12.4	9/30	Central mudminnow	6	79.33	63	96	7.20	3.96	10.95
			Fathead minnow	3	57.33	56	58	1.95	1.89	1.99
			Green sunfish	4	87.75	69	105	15.26	7.12	23.40
167/170th Street Thorn Creek	9.7	7/8	Central mudminnow	3	70.00	69	71	5.06	4.87	5.45
			Goldfish	1	162.00	162	162	80.02	80.02	80.02
			Carp	1	459.00	459	459	1,453.00	1,453.00	1,453.00
			Fathead minnow	15	47.53	39	62	1.59	0.83	3.25
			Creek chub	3	26.67	21	32	0.44	0.26	0.67
			White sucker	2	40.00	39	41	0.91	0.87	0.94
			Green sunfish	5	60.60	53	86	6.31	3.32	16.17
			Largemouth bass	2	44.50	40	49	1.25	0.92	1.58
167/170th Street Thorn Creek	9.7	10/14	Central mudminnow	9	78.22	67	86	7.77	5.07	10.11
			Fathead minnow	12	54.67	40	63	2.32	0.88	3.46
			Creek chub	7	63.57	55	83	3.32	1.85	6.75
			Green sunfish	13	57.54	36	92	5.01	0.97	16.56
			Bluegill	1	36.00	36	36	0.81	0.81	0.81

AIII-13



THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

AIII-2 (Continued)

MEAN, MINIMUM AND MAXIMUM TOTAL LENGTH (TL) AND WEIGHT (WT) FOR FISH COLLECTED FROM  
THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME	RIVER MILE	DATE	SPECIES NAME	NO. FISH	MEAN TL (mm)	MIN. TL (mm)	MAX. TL (mm)	MEAN WT (g)	MIN. WT (g)	MAX. WT (g)
167/170th Street Thorn Creek	9.7	10/14	Green X pumpkinseed hybrid	2	73.50	73	74	8.26	8.17	8.34
Margaret Street Thorn Creek	12.9	7/7	Central mudminnow	26	71.62	45	86	5.18	1.01	8.86
			Fathead minnow	36	41.86	31	53	0.92	0.07	2.00
			Creek chub	31	49.58	24	168	5.38	0.18	62.37
			White sucker	7	43.57	39	50	0.98	0.70	1.43
			Black bullhead	1	199.00	199	199	134.88	134.88	134.88
			Green sunfish	25	70.60	47	120	9.12	1.80	27.59
Margaret Street Thorn Creek	12.9	10/15	Central mudminnow	15	83.07	61	95	8.32	3.18	11.89
			Bluntnose minnow	6	32.17	26	40	0.35	0.18	0.62
			Fathead minnow	2	52.50	50	55	3.73	1.64	2.09
			Green sunfish	9	68.00	41	94	8.23	1.36	18.63
			Bluegill	1	43.00	43	43	1.21	1.21	1.21
Joe Orr Road Thorn Creek	18.6	7/6	Central mudminnow	2	74.00	67	81	5.33	3.93	6.73
			Fathead minnow	3	46.67	42	51	0.89	0.50	1.18
			Green sunfish	21	67.24	51	95	7.51	2.87	20.61

AIII-14

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE AIII-2 (Continued)

MEAN, MINIMUM AND MAXIMUM TOTAL LENGTH (TL) AND WEIGHT (WT) FOR FISH COLLECTED FROM  
THE LITTLE CALUMET RIVER AND THORN CREEK DURING 1982

STATION NAME	RIVER MILE	DATE	SPECIES NAME	NO. FISH	MEAN TL (mm)	MIN. TL (mm)	MAX. TL (mm)	MEAN WT (g)	MIN. WT (g)	MAX. WT (g)
Joe Orr Road Thorn Creek	18.6	10/13	Central mudminnow	2	97.00	95	99	14.23	14.00	14.45
			Green sunfish	10	50.90	37	92	3.85	1.10	15.96
			Green X pumpkinseed hybrid	1	47.00	47	47	1.71	1.71	1.71
Route 30 Thorn Creek	20.4	7/1	Fathead minnow	42	51.60	31	70	2.22	0.67	4.49
			Creek chub	21	85.57	34	139	11.69	0.53	38.56
			White sucker	3	144.00	141	147	35.21	31.21	40.33
			Green sunfish	9	84.67	63	107	14.91	6.33	24.37
Route 30 Thorn Creek	20.4	10/13	Creek chub	6	87.17	59	117	9.49	2.15	21.66
			Green sunfish	35	47.63	29	97	3.37	0.54	19.62
			Warmouth	2	41.50	38	45	1.47	1.14	1.80

AIII-5