REPORT TO THE ENVIRONMENTAL QUALITY COMMISSION
AND THE CITY COUNCIL, NORTHFIELD, MINNESOTA

Water Quality of the Cannon River, 1984

By Timothy Vick and Gary Spessard

October 15, 1984

ACKNOWLEDGEMENT

The authors of this report and the Environmental Quality Commission of the City of Northfield would like to extend sincere thanks to Professor C.E. Buchwald of the Carleton College faculty for his assistance in this project. Dr. Buchwald was one of the original designers of the project, participated in the sampling, reviewed this report, and has generously given his time and advice to help it move forward.

Since late 1977 the Environmental Quality Commission (EQC) has conducted its own monitoring program of the Cannon River. The goal has been to have measurements, on a continuing basis, of what the water quality of the Cannon is and what effects the city is having on it.

In the past few years we have continued the practice established by the authors of the original 1978 EQC water study (Mohrig, 1980) of sampling periodically at three points within the city: near the Safety Center Highway 3 bridge (site 1), above the Waste Water Treatment Plant (WWTP) (site 2) and below the WWTP outfall (site 3). We also gathered some past studies done by various government agencies and Joel Schilling (then a student) from the libraries of the Minnesota Department of Health and the Minnesota Pollution Control Agency and the Federal Government's "STORET" data storage bank. We used Minnesota standards for Intrastate Waters in deciding whether particular readings which we obtained were favorable or not.

This study is an attempt to assess only the general condition of the river water. It makes no attempt to monitor specific chemical pollutants such as PCB's, petroleum or other organic compounds, heavy metals, or any other potentially dangerous substances. Detection of those substances is expensive and is beyond the scope of this project, although there may well be some such substances in the Cannon River water.

No doubt the Cannon River was quite clean and clear before its watershed was populated by white people who cultivated the land intensively and brought industry to the area. With essentially no pollution control, the water quality of the river degraded over the decades as the population density and local economy grew. From the information we gathered it appears that the river's quality reached its lowest point during the middle years of the 20th century. In the past few years, however, the city has completed a major addition to the WWTP which has substantially improved the quality of the city's discharges into the river.

Fecal coliform counts in the river water appear to have increased to clearly objectionable and unsafe levels by the 1930's, and by the 1950's the river was comparable to an open sewer. In recent years, however, the coliform counts have declined so that the river is safe to be around, although not of drinking water quality. Most important to the city administration, the city's impact on the river has been minimized by the new WWTP addition. While there are occasionally some noticable impacts by the city, they are minor and represent a vast improvement over what was the case a few years ago.

The density of suspended solids (soil particles, etc.) varies tremendously, depending on weather events prior to sampling times, but usually the city has little impact on the clarity of the water. The city has a slight impact on the river in terms of dissolved solids (salinity). This impact is usually negligible but does, on occasion, reach significant levels. The city sometimes has a noticeable effect in terms of temperature and phosphates, but not to an alarming degree. We found no negative impact in terms of nitrate or dissolved oxygen levels.

DETAILS OF RESULTS

- Coliform bacteria: When reading the results of tests for fecal coliform bacteria, the reader must bear in mind that the nature of these tests is such that there can be considerable variation between samples. Even if the testor takes two samples side by side simultaneously, the results of the coliform test on the two samples could be different. In addition to variability induced by the nature of the test, there are a number of factors related to the sampling which would cause variations in results from day to day or month to month. These factors include condition and quantity of the effluent from the city's WWTP, amount of flow in the river, and distance from the sewage outflow to the sampling location. The flow from the sewage treatment plant varies on a daily cycle so time of day is an important consideration. Variation of 50 percent, for example, between two

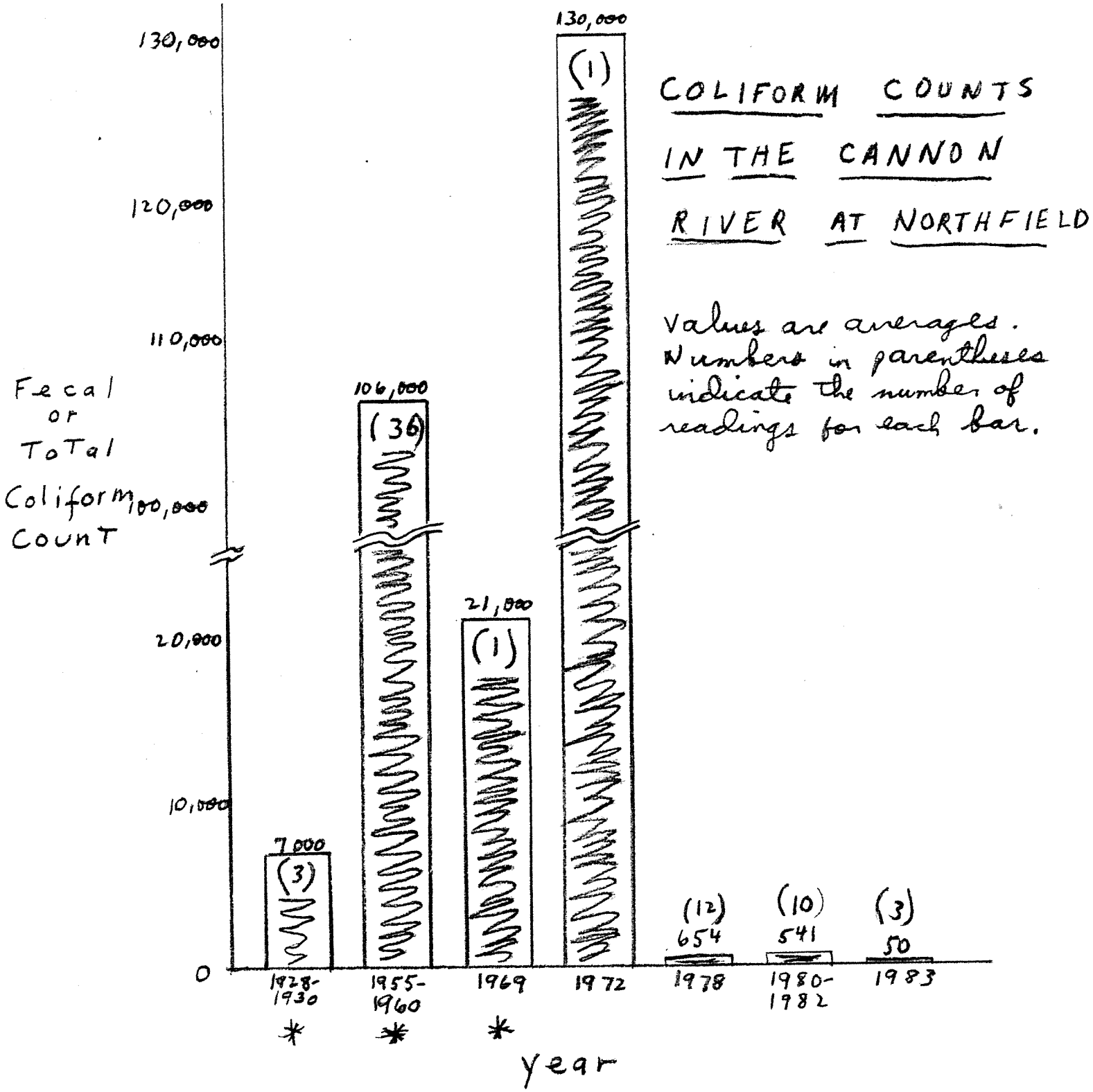
samples may or may not indicate a noteworthy change in the condition of the river water. However a variation of on the order of 1,000 times such as between the average for 1955-60 and the average for 1983 certainly is important.

The picture is further complicated by the difference in coliform tests before and after 1970. The data we have available for the years prior to 1970 are all test results for total coliform, whereas for the years after 1970 we have results for fecal coliform. Joel Schilling's report of 1972 lists both values. From examining his results a rough relationship between fecal bacteria and coliform bacteria can be drawn. There is wide variation in the percentage of total coliform bacteria which is composed of fecal coliform bacteria, but as a general rule total coliform is at least twice the fecal coliform.

While historical information on coliform bacteria tests on the Cannon River at Northfield is spotty, it does give us at least a glimpse of what has transpired (Figure 1, Table 1). Early in the century the river was contaminated, even though some years swimming in the river was popular, according to Jerry Mohrig's 1980 report to the city council. By the 1950's, however, the river was unsafe for recreational use. Since then progressive improvements, both within Northfield's waste water system and upstream on the river, have made the river much cleaner. The state standard for the Cannon River is an average of 200 fecal coliform colonies per 100 milliliters of water, and our 1983 average count of 50 was well below that figure. (All the data presented in the graph were collected below the WWTP or city outfalls).

From the graphs representing 1980-1984 (Figures 2-5, Table 2), it is evident that during 1981 and 1982 the WWTP contributed to the river's coliform count consistently, however that was a period in which major work was being done on the WWTP addition. In the most recent year the coliform contribution from the WWTP has been reduced to almost nothing.

FIGURE 1.



* Total Coliform, usually at least Twice the fecal Coliform Value.

TABLE 1

	Average Coliform Count	Number of data	Authors
1928-1930	7000(T)	6	Minnesota Board of Health
1955	61,000*(T)		Minnesota Pollution Control Agency
1956	109,000*(T)	36 readings over six years averaging 106,000	Minnesota Pollution Control Agency
1957	302,000*(T)		Minnesota Pollution Control Agency
1958	111,000*(T)		Minnesota Pollution Control Agency
1959	36,000*(T)		Minnesota Pollution Control Agency
1960	17,000*(T)		Minnesota Pollution Control Agency
1969	21,000(T)	1	Turner, Hall & Ebersole
1972	130,000*	1	Schilling
1978	654	12	Buchwald & Mohrig
1980-1982	541	10	Buchwald, Vick & Spessard
1983	50	3	Buchwald, Vick & Spessard

(T) = Total coliform, which is often about twice the fecal col. value.

* At Waterford Bridge

Figure 2

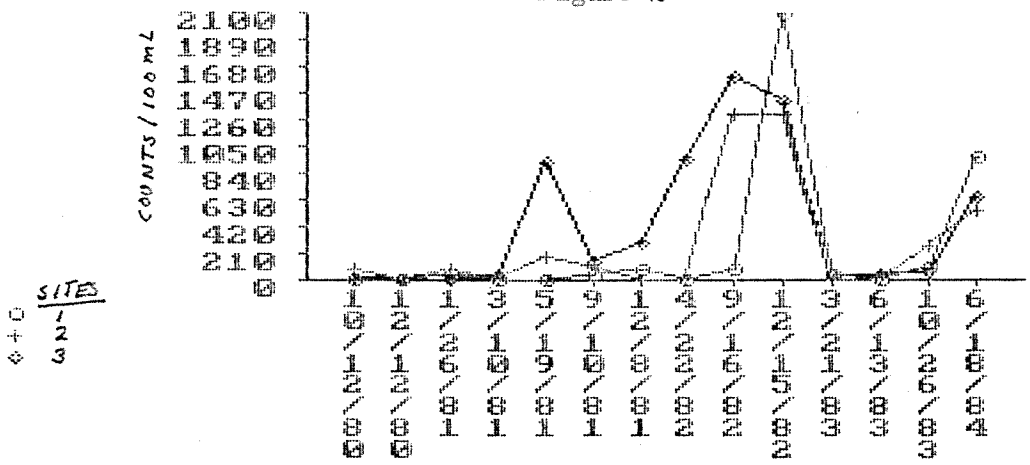


TABLE 2: FECAL COLIFORM

DATE	SITE 1	SITE 2	SITE 3
10/12/80	NA	90	30
12/12/80	<10	<10	<10
1/26/81	51	77	<1
3/10/81	<10	10	50
5/19/81	<10	180	930
9/10/81	40	100	150
12/8/81	80	10	300
4/22/82	10	<10	940
9/16/82	90	1300	1600
12/15/82	2100	1300	1400
3/21/83	40	10	40
6/13/83	<10	<10	40
10/26/83	110	270	70
6/18/84	960	550	650

FECAL COLIFORM VALUES ARE IN UNITS OF COUNTS/100mL.

SITE 1: NEAR SAFETY CENTER
SITE 2: ABOVE WASTEWATER TREATMENT PLANT (WWTP)
SITE 3: BELOW WWTP

SAMPLE SITES FOR SUBSEQUENT TABLES ARE THE SAME AS ABOVE.

Figure 3

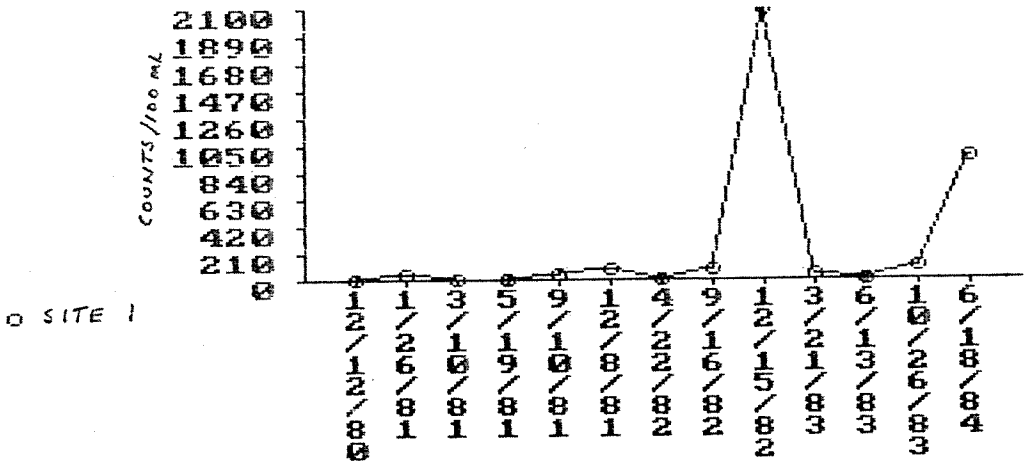


Figure 4

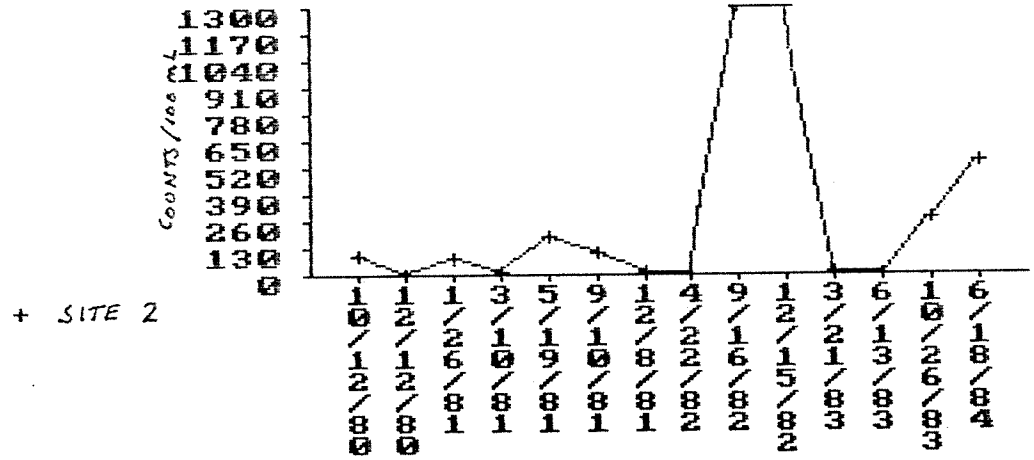
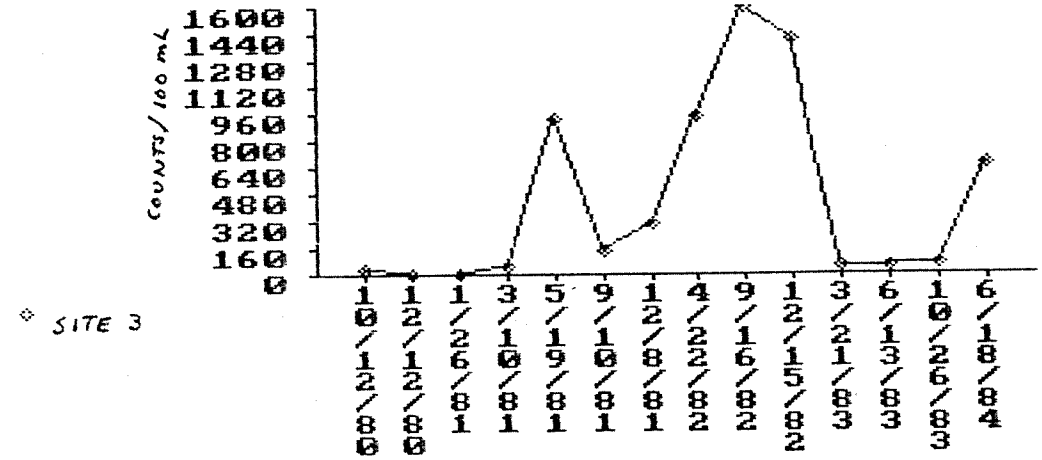


Figure 5



- Suspended Solids: In the past several decades there has been a transition in the Cannon River's watershed toward more intensive row-crop farming, with heavy concentrations of crops such as corn and soybeans. Row crops provide poor soil cover. The soil is essentially uncovered from harvest time through the winter until the plants are several inches tall in early summer, and even when the plants are full grown they provide minimal soil holding ability and protection from pelting by rain compared to grasses or forests. We therefore see great variations in our suspended solids data, caused by influxes of soil particles following heavy rainfall or snow-melt events. These influxes are of concern to us in that they periodically make the river unattractive looking and may limit the species of game fish that will inhabit the water by modifying the temperature, chemical and light regimes of the water. The source of the problem is both nonpoint and outside the city's jurisdiction, however, so we are quite limited in what responses we can make to the problem. The contribution of suspended solids within the city usually is negligible (Table 3).

TABLE 3: SUSPENDED SOLIDS

Date	Site 1	Site 2	Site 3	Average of 3 sites
10/21/80	2	5	10	6
12/12/80	3	8	8	6
1/26/81	14	11	13	13
3/10/81	8	7	8	8
5/19/81	14	16	12	14
9/10/81	54	55	56	55
12/ 8/81	9	10	7	9
4/22/82	30	33	33	32
9/16/82	69	109	112	97
12/15/82	4	6	4	5
3/21/83	14	20	22	
6/13/83	38	40	28	39
10/26/83	14	14	8	12
6/18/84	235	188	140	188
Average 1980-1984:	36	36	33	

VALUES FOR SUSPENDED SOLIDS ARE IN PARTS PER MILLION.

- Dissolved oxygen: Ed Buchwald examined the dissolved oxygen data for 1980 and 1981 and found that the values ranged between 73 and 98 percent of saturation, averaging 88 percent. Dissolved oxygen has remained comfortably high for a healthy fish population (Table 4).

TABLE 4: DISSOLVED OXYGEN CONTENT

DATE	SITE 1	SITE 2	SITE 3	AVE. OF 3 SITES
10/21/80	10.1	11.2	10.8	10.7
1/26/81	9.9	11.6	11.5	11
3/10/81	12.4	12.8	12.4	12.5
12/8/81	12.1	12.6	12.8	12.5
4/22/82	11.2	12.1	12.2	11.8
12/15/82	12.9	13.8	14.5	13.7
3/21/83	13.3	13.8	12.8	13.3
10/26/83	10.2	11	10.6	10.6
6/18/84	7.5	8.5	8.5	8.2

DISSOLVED OXYGEN VALUES IN PPM.

- Nitrates: Nitrates come from soil minerals, fertilizer, feed lots, and septic systems. The WWTP discharge has no effect on nitrate concentration (Table 5). Moreover, the level of nitrates is below the Public Health Service standard of 10 ppm for drinking water. Nitrates are important to monitor because they can indicate impact of septic systems and perhaps the WWTP. According to some data Gary Spessard looked at earlier, the level of nitrates on the river used to be much higher.

TABLE 5: NITRATE CONCENTRATION

DATE	SITE 1	SITE 2	SITE 3	AVE. OF 3 SITES
12/8/81	5.3	5.1	7	5.8
4/22/82	6.4	6.2	6.2	6.2
9/16/82	6.8	6.5	6.3	6.5
12/15/82	7.2	7	7.3	7.2
6/13/83	4.3	4.3	4.3	4.3
AVE. AT A SITE:	6	5.82	6.22	

CONCENTRATIONS ARE IN PPM

- Dissolved solids: The natural level of dissolved solids in Northfield's ground water account for the base level of 300 to 500 micromhos in the river water (Table 6). Undiluted water pumped from river gravels along the bank of the Cannon on the Carleton campus usually have a conductance of 500 micromhos or so, and the local flow is from the ground water into the river. The ground water is diluted by rainfall runoff (which usually has less dissolved solids and therefore would give a lower salinity reading), thus accounting for the readings less than 500 micromhos in our data. The point of significance here is not the fluctuations in readings, but the differences on a given day between site 1 and site 3 which show that the city often has contributed to the dissolved material in the river. Sources of the contribution probably are mainly sewage and discharges from flushing of water softening equipment.

TABLE 6: CONDUCTANCE (SALINITY)

Date	Site 1	Site 2	Site 3
10/21/80	NA	NA	NA
12/12/80	490	490	580
1/26/81	450	550	625
3/10/81	390	400	465
5/19/81	600	590	610
9/10/81	NA	NA	NA
12/ 8/81	430	420	440
4/22/82	428	430	435
9/16/82	525	550	550
12/15/82	400	400	430
3/21/83	320	330	330
6/13/83	500	520	560
10/26/83	385	400	418
6/18/84	475	500	500
Average 1980-1984:	449	465	495

UNITS OF CONDUCTANCE: MICROMHOS

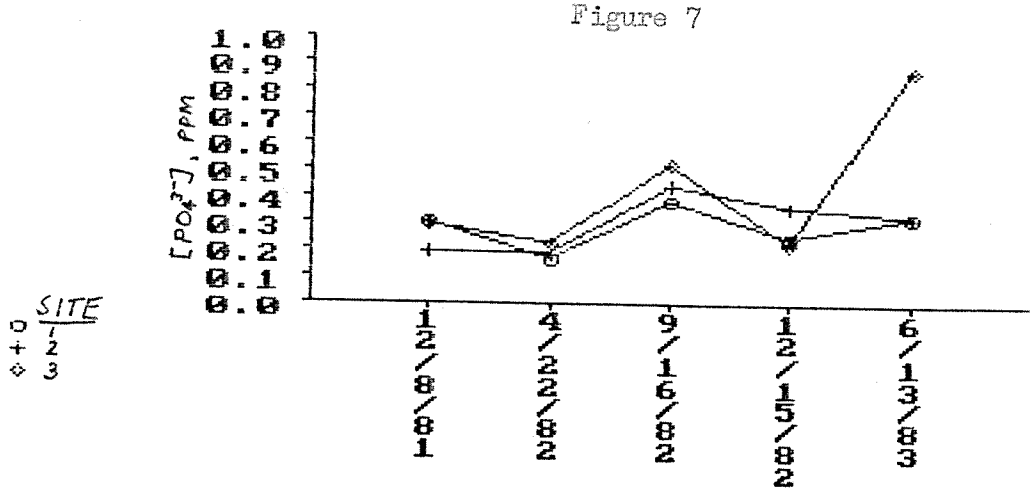
- Phosphates: There are very low levels of phosphates in the river. Interestingly, the WWTP does make a contribution to the level of phosphates in the river (Table 7, Figure 7). We are not sure why this is unless there are still phosphate-based detergents being used for some purposes other than household laundry.

TABLE : PHOSPHATE CONCENTRATION

DATE	SITE 1	SITE 2	SITE 3	AVE. OF 3 SITES
12/8/81	.3	.19	.29	.26
4/22/82	.16	.18	.22	.19
9/16/82	.38	.44	.52	.45
12/15/82	.24	.36	.22	.27
6/13/83	.32	.32	.87	.5
AVE. AT A SITE:	.28	.3	.42	

PHOSPHATE CONCENTRATION IS REPORTED IN UNITS OF PPM AND REPRESENTS TOTAL PHOSPHATE.

Figure 7



Phosphates

- Temperature: The temperature varies with the seasons, and appears to be following normal patterns.

Conclusion

While the Cannon River is still not as clean as one might like to see it, the City of Northfield has made great strides in reducing its contribution to the water contamination. Almost all the pollution in the river below Northfield comes from sources upstream of the city. We must keep in mind, however, that if every city or farm along the river added just a little bit of contamination, the cumulative result on the water which flows all the way through the system could still be extremely dirty water at the mouth of the river. We must continue efforts to maintain the quality of the discharge at the WWTP and ensure that discharges from other sources within the city such as surface runoff and storm sewers remain as clean as possible. We can feel good about what we have done, but we should not feel that we don't have to worry about the river's water quality anymore.

REFERENCES

Minnesota State Board of Health, "Report of the Investigation of the Pollution of the Straight and Cannon Rivers," 1930.

Minnesota Pollution Control Agency, via Environmental Protection Agency, printout of 1955-1963 Cannon River test results from the STORET computer data storage facility in Washington, D.C.

J. Turner, J. Hall and R. Ebersole at the Northfield Sewage Treatment Plant, in "Nitrate Tests On The Cannon River, Summer 1969," obtained from the library of the Minnesota Pollution Control Agency.

"Minnesota Pollution Control Agency Memorandum on Investigation of the Cannon River and Sources of Wastes In and Near Northfield," 1972, by Dennis Anderson and Mike R. Carroll; Attachment A, "Comprehensive Survey of the Cannon River," by Joel G. Schilling.

Mohrig, Jerry R., "Report to the Environmental Quality Commission and the City Council, Northfield, Minnesota" on the "Water Quality of the Cannon River, 1978," 1980.

SERCO
1931 West County Road C2
St. Paul, Minnesota 55113 (612) 636-7173

LABORATORY ANALYSIS REPORT NO 2155 PAGE 1
10/26/84

Carlton College
Geology Department
Northfield, MN 55057

Mr. Tim Vick

DATE COLLECTED:
DATE RECEIVED: 10/17/84
COLLECTED BY: CLIENT
PICKED UP BY: CLIENT
SAMPLE TYPE: SURFACE WATER

SERCO SAMPLE NO:	5699	5700	5701
SAMPLE DESCRIPTION:	#1 HWY 3 BRIDGE	#2 ABOVE WWTP	#3 BELOW WWTP
ANALYSIS:			
Fecal Coliform Bacteria, no./100 mL (Membrane Filter)	20	60	180
Suspended Solids, mg/L	12	11	15
pH	7.3	7.1	7.1

All analyses were performed using EPA or other recognized methodologies.

Report submitted by,

Chris M. Wilker
Project Manager

< means "not detected at this level"