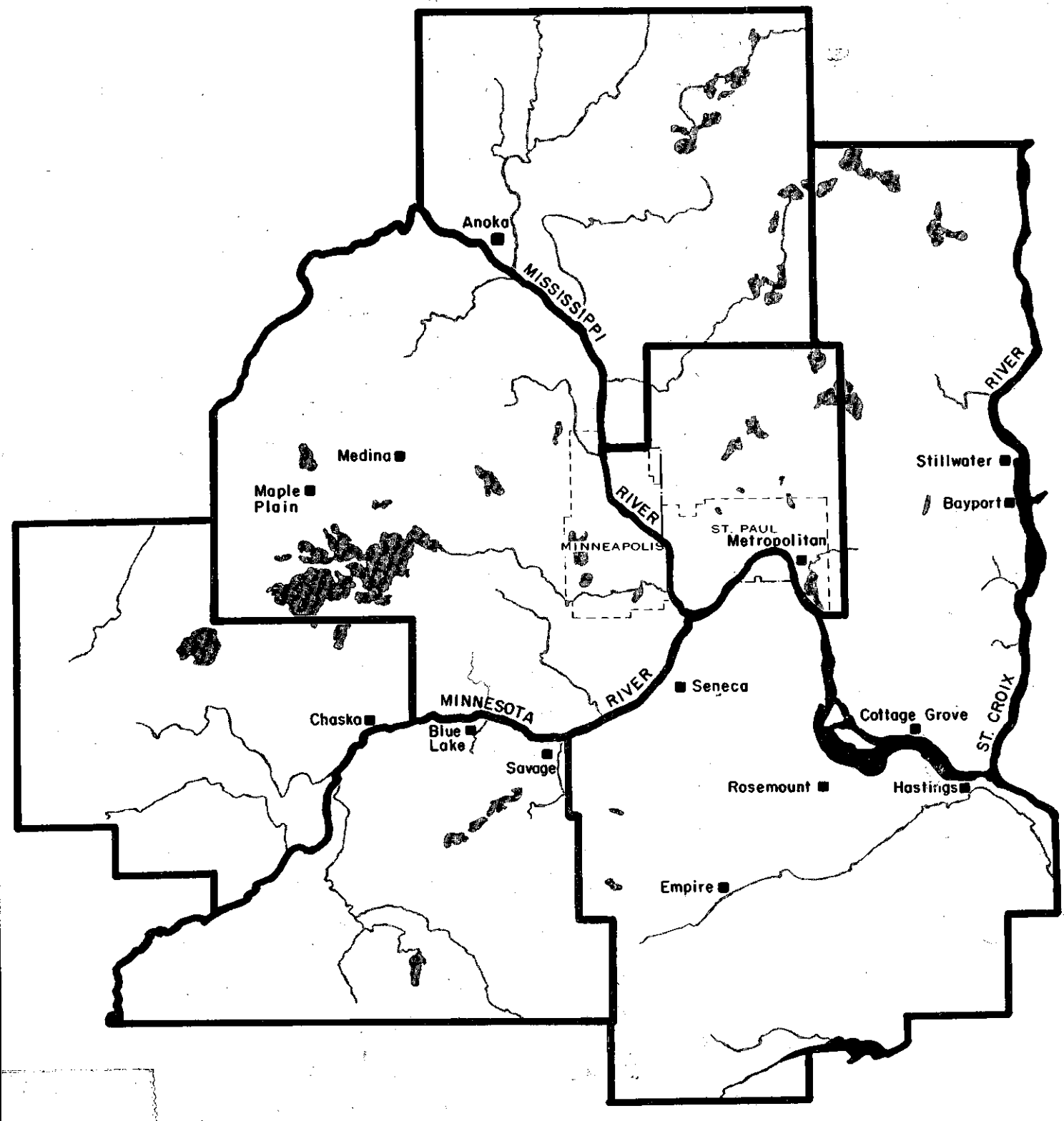
Treatment Plant Report



METROPOLITAN WASTE CONTROL COMMISSION

1984 ANNUAL WASTEWATER TREATMENT PLANT REPORT

prepared by the

Quality Control & Operations Department
Metropolitan Waste Control Commission
350 Metro Square Building
Saint Paul, Minnesota 55101

Report No. QC 84-94

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ABBREVIATIONS AND SYMBOLS

As	Arsenic
Avg.	Average
BOD	Biochemical oxygen demand (generally means BOD_5, or five day biochemical oxygen demand)
CBOD	Carbonaceous biochemical oxygen demand
Cd	Cadmium
cfs	Cubic feet per second
cfm	Cubic feet per minute
Cn	Cyanide
COD	Chemical oxygen demand
Cr	Chromium
Cu	Copper
cu. ft.	Cubic feet
DO	Dissolved oxygen
dss	Dry sludge solids
dtpd	dry ton/day
dtph	dry ton/hour
EFF	Effluent
°F	Degrees Fahreneit
F:M	Food to microorganism ratio
$FeCl_3$	Ferric chloride
fps	Feet per second
g	Grams
gpd	Gallons per day
gpm	Gallons per minute
gr/dscf	Grains/dry standard cubic foot
Hg	Mercury
hor.	Horizontal
hr.	Hour
ID	Identification
INF	Influent
KJN	Kjeldahl nitrogen
lb.	Pound
lin. ft.	Lineal feet
mg/kg	Milligram per kilogram
mg/L	Milligrams per liter
MGD or mgd	Million gallons per day
MLSS	Mixed liquor suspended solids
MMBtu	Million british thermal units
NH_3 (NH_3-N)	Ammonia (nitrogen)
Ni	Nickel
No.	Number
NO_2	Nitrite (nitrogen)
NO_3	Nitrate (nitrogen)
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric turbidity units

ABBREVIATIONS AND SYMBOLS CONT.

ocu	Odor concentration unit
P	Phosphorus
Pb	Lead
PCB	Polychlorinated biphenyl
pH	Indicates acidity/alkalinity
SCFM	Standard cubic feet per minute
Sn	Tin
sq. ft.	Square feet
Std.	Standard
TBOD	Total biochemical oxygen demand
tds	Tons dry solids
tpd	Tons per day
TS	Total solids
TSS	Total suspended solids
Turb.	Turbidity
ug/l	Micrograms per liter
VS	Volatile solids
Zn	Zinc
>	Greater than
<	Less than

DEFINITION OF PARAMETERS

Biochemical Oxygen Demand (BOD) is a measure of the dissolved oxygen required by organisms for the aerobic decomposition of organic matter present in wastewater. A low BOD in the plant discharge is desirable because this would cause the least amount of oxygen depletion in the receiving body of water. This test normally takes five days before results are available.

Chemical Oxygen Demand (COD) is a measure of the oxygen equivalent required to chemically oxidize the organic matter present in wastewater. A low COD is desirable in plant effluent discharges. This test takes approximately three hours to complete and the results can be used to estimate BOD values. It is, therefore, extremely useful as a process control tool.

Total Suspended Solids (TSS) is a measure of the amount of particulate matter found suspended in a given amount of wastewater. Suspended solids adversely affect receiving waters by exerting an oxygen demand during decomposition or filtering out available sunlight needed by aquatic organisms for photosynthesis.

pH is a measure of the hydrogen ion concentration in a given sample of water. It is used as an indication of acidity or alkalinity. A pH of 7 is neutral - neither acid or alkaline. pH values below 6 or above 9 are usually harmful to aquatic life.

Dissolved Oxygen (DO) is a measure of the concentration of oxygen dissolved in a given sample of water. A sufficient DO level in plant effluent discharges is important because dissolved oxygen is required for the life processes of aquatic organisms.

Fecal Coliform organisms are a group of bacteria present in wastewater and are used as indicators of the possible presence of pathogenic or disease producing bacteria. Monitoring of fecal coliform organisms is also done to determine the efficiency of effluent disinfection processes.

Ammonia (NH_3), Nitrate (NO_3), and Nitrite (NO_2) are nitrogenous compounds found in wastewater. Excessive discharges of these compounds can adversely affect the receiving body of water. Degradation of NH_3 to NO_3 is an oxygen demanding reaction. Monitoring of nitrogenous compounds is also useful for controlling secondary treatment processes.

Phosphorus (P) is monitored because it also can have adverse effects on the receiving body of water. When discharged in sufficient quantities it aids in stimulating excessive and undesirable algal growth.

Heavy Metals covered in this report include the following: copper (Cu), chromium (Cr), zinc (Zn), lead (Pb), cadmium (Cd), mercury (Hg), nickel (Ni), arsenic (As), and tin (Sn). Close monitoring of heavy metals is necessary due to their possible toxicity to aquatic organisms present in the receiving waters.

1.0 SUMMARY

During 1984, the Commission operated fourteen wastewater treatment plants. The performance of these facilities is related to: (1) the effluent quality of each plant and the record of compliance with NPDES permit conditions; (2) the quality of air emissions from sludge incineration at two regional plants; and (3) management of sludge generated at each plant as a result of wastewater treatment. The purpose of this report is to summarize the performance of Commission treatment plants during 1984 by presenting and analyzing data generated to monitor these major areas.

1.1 Effluent Quality

Table 1-1 is a summary of average annual effluent quality at each plant. Annual average effluent CBOD was below permitted discharge limitations at all plants. Annual average effluent TSS was below permitted discharge limitations at all plants except the Hastings Plant. At Bayport, Rosemount, and Stillwater, annual average effluent phosphorus was below the limit of 1 mg/L. At Empire, annual average effluent ammonia was below the limit of 1 mg/L.

One of the most important indicators of performance of individual treatment plants, and performance of the Commission in the operation of all plants, is compliance with NPDES permit limitations. Table 1-2 summarizes the trend in NPDES permit compliance for the period of NPDES administration, 1974-1984. During this period, the number of plants operated by the Commission was reduced from 21 in 1974 to its present number of 14. The total number of violations has ranged from a high of 163 in 1974 to a low of 20 in 1983. NPDES Permit violations totalled 33 in 1984. Overall percent compliance with NPDES permit limitations improved from 86.4% in 1974 to 99% in 1983. Percent compliance with NPDES Permit limitations was 98.4% in 1984.

Individual NPDES compliance records of the fourteen plants currently in operation are given for the period 1978-1984 in Table 1-3. In general, performance at each plant improved significantly through the period 1978-1980, and remained relatively constant from 1980-1983. The number of permit violations increased from 20 in 1983 to 33 in 1984.

Trends in plant performance can also be evaluated by examining the two major effluent parameters, BOD and TSS, in the form of a single performance indicator (BOD + TSS). Figure 1-1 shows these trends for the Metropolitan Plant alone, and for all other plants combined. Performance at the Metropolitan Plant has been somewhat erratic in the past, with particularly poor performance in 1976 and 1979. NPDES permit limitation levels were eased in 1977 and in 1978 in recognition of reduced plant performance capabilities. During the period of 1980-1984, NPDES permit limitations for the Metropolitan Plant approached and equaled secondary treatment levels (BOD = 25 mg/L and TSS = 30 mg/L or BOD + TSS = 55 mg/l) while performance was consistently better than secondary treatment.

TABLE 1-1

1984 ANNUAL SUMMARY OF TREATMENT PLANT EFFLUENT QUALITY

Treatment Plant	Wastewater Flow mgd		1984 Percent Removal		BOD mg/l			TSS mg/l		Fecal Coli. Geometric Mean MPN/100 ml		Nutrients, mg/l Phosphorus		Ammonia		Turbidity NTU		Dissolved Oxygen mg/l	
	Design[1]	1984 Avg.	BOD	TSS	NPDES Limit	1984 CBOD Avg.	1984 TBOD Avg.	NPDES Limit	1984 Avg.	NPDES Limit	1984 Avg.	NPDES Limit	1984 Avg.	NPDES Limit	1984 Avg.	NPDES Limit	1984 Avg.	NPDES Limit	1984 Avg.
Anoka	2.46	2.49	93	93	25	13	19	30	11	200	78	---	3.8	---	11.8	25	7	----	1.9
Bayport	0.65	0.50	97	96	25	6	10	30	8	200	8	1.0	0.4	---	3.5	25	3	----	4.8
Blue Lake	20.00	19.5	95	97	25	9	26	30	7	200	24	---	3.1	---	9.0	25	8	----	9.5
Chaska	1.40	1.09	92	93	25	9	15	30	11	200	18	---	0.9	---	7.7	25	5	----	9.2
Cottage Grove	1.80	1.30	95	94	25	9	22	30	9	200	101	---	4.7	---	18.6	25	5	----	5.5
Empire	6.00	5.19	99	99	10	2	3	10	2	200	4	---	4.3	1.0	0.3	25	1	>4.0	8.0
Hastings	1.83	1.64	89	83	25	22	43	30	32	200	33	---	6.7	---	16.8	25	12	----	5.8
Maple Plain	0.22	0.40	91	93	25	10	13	30	10	200	7	---	1.9	---	5.9	--	9	----	7.1
Medina Surface Discharge[3]	0.10	0.28	92	85	25	8	--	30	20	200	9	---	1.1	---	2.2	25	6	----	7.9
Medina Intermediate Discharge[4]	-----	----	89	86	--	10	15	--	16	---	--	---	1.8	---	6.0	--	10	----	2.6
Metropolitan	250	222	94	95	24	10	20	30	11	200	43	---	2.0	---	9.9	--	6	7[2]	4.4
Rosemount	0.60	0.37	96	98	25	18	20	30	3	200	5	1.0	0.2	---	25.7	25	6	----	6.6
Savage	0.86	0.62	93	98	25	7	8	30	3	200	53	---	7.3	---	1.2	25	4	----	8.9
Seneca	24.00	17.6	92	90	25	17	23	30	21	200	18	---	4.2	---	16.6	25	9	----	9.0
Stillwater	3.02	2.95	93	93	25	8	14	30	9	200	7	1.0	0.4	---	8.0	25	4	----	4.8

(1) Represents NPDES permitted flow. See text of report for discussion of design flow capacity.
(2) Dissolved Oxygen limitation of 7 mg/l for river flows less than 7,000 cfs and river D.O. values less than 6.0 mg/l upstream or less than 5.5 mg/l downstream for two consecutive sample days, during the period June - September.
(3) Flow presented is total to plant. Effluent quality presented represents surface discharge (0.17 mgd).
(4) Effluent quality presented represents remainder of flow discharged to ground water via seepage ponds.

TABLE 1-2

TRENDS IN NPDES PERMIT COMPLIANCE

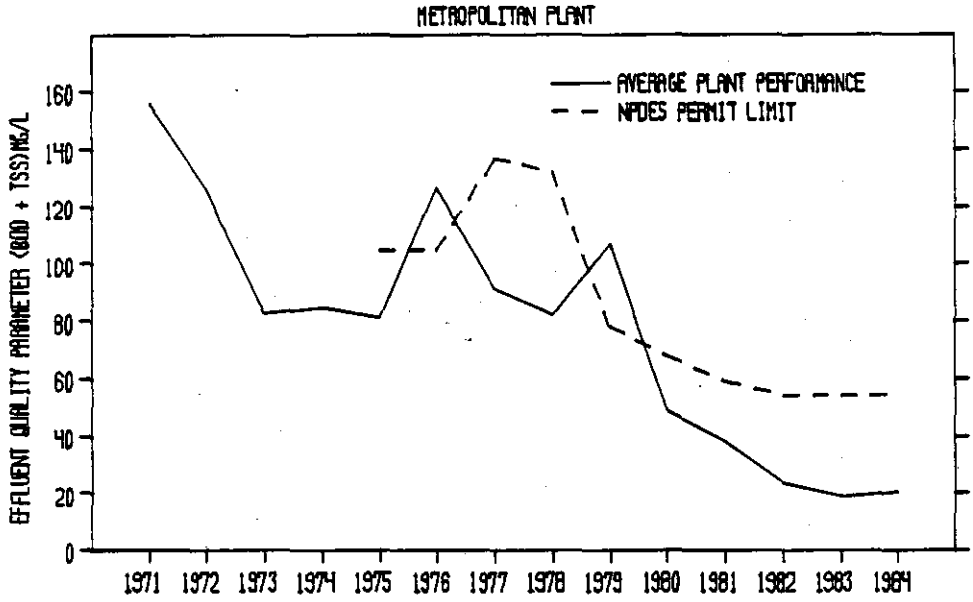
Year	Number of Plants In Operation (at Year-End)	Number of Violations	Percent Compliance
1974	21	163	86.4
1975	20	81	94.5
1976	20	109	92.7
1977	20	101	93.6
1978	18	94	94.5
1979	16	109	93.8
1980	14	36	98.0
1981	14	35	98.0
1982	14	30	98.3
1983	14	20	99.0
1984	14	33	98.4

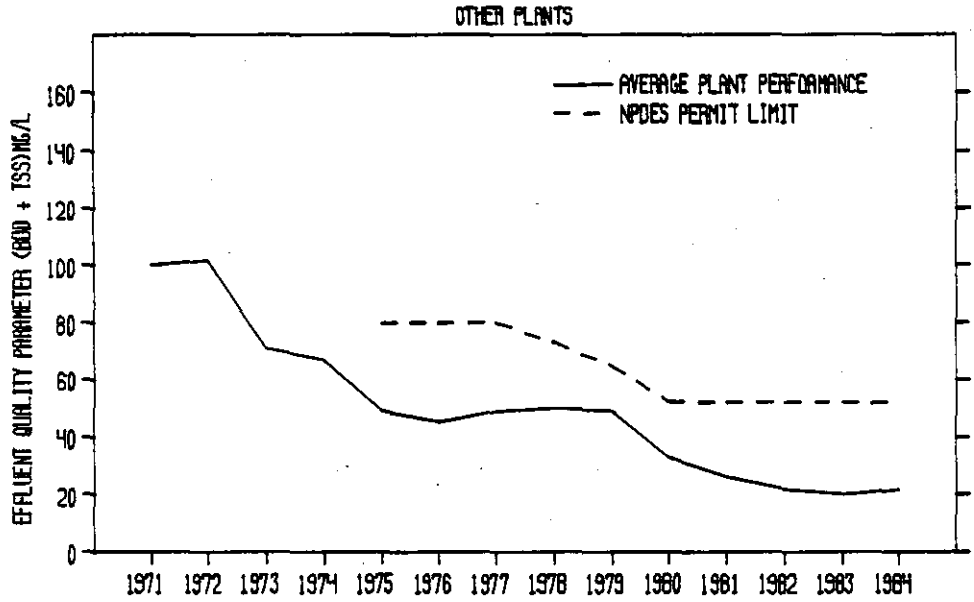
TABLE 1-3

NPDES PERMIT COMPLIANCE AT EXISTING PLANTS

TREATMENT PLANT	ANNUAL NUMBER OF VIOLATIONS (V) AND PERCENT COMPLIANCE (C)													
	1978		1979		1980		1981		1982		1983		1984	
	V	C	V	C	V	C	V	C	V	C	V	C	V	C
ANOKA	27	90	3	97	3	99	8	97	2	99	2	99	4	98
BAYPORT	0	100	0	100	0	100	0	100	0	100	0	100	0	100
BLUE LAKE	1	99	0	100	0	100	0	100	0	100	1	99	0	100
CHASKA	15	69	25	58	4	96	3	98	1	99	1	99	5	96
COTTAGE GROVE	3	94	4	95	1	99	4	96	1	99	1	99	0	100
EMPIRE	--	---	1	90	1	99	0	100	3	98	0	100	1	99
HASTINGS	2	98	2	99	5	97	8	94	18	87	7	95	16	88
MAPLE PLAIN	2	97	--	95	3	95	1	99	2	96	0	100	0	100
MEDINA	0	100	1	92	0	100	2	83	0	100	4	92	4	94
METROPOLITAN	6	88	15	69	2	96	5	89	0	100	0	100	0	100
ROSEMOUNT	1	99	1	99	1	99	0	100	1	99	3	98	2	99
SAVAGE	2	96	6	92	0	100	0	100	1	99	0	100	1	99
SENECA	5	97	8	94	0	100	2	99	1	99	1	99	0	100
STILLWATER	0	100	0	100	2	99	2	99	0	100	0	100	0	100
TOTAL AVERAGE	64	94	74	95	22	99	35	98	30	98	20	99	33	98

FIGURE 1
TRENDS IN PLANT PERFORMANCE
1971 - 1984





Other plants show a trend of improved performance throughout 1971-1981, with marked improvement in 1971-1975, and 1979-1981. NPDES permit limitations became more stringent between 1975-1980. In 1984, NPDES permit limits were at the secondary treatment level (BOD = 25 mg/L and TSS = 30 mg/L) or better at all plants while performance was better than secondary treatment.

1.2 Air Emissions

There are four major sources of air emissions at the Metropolitan and Seneca Plants: Metropolitan F & I No. 1 sludge incinerators, Metropolitan F & I No. 2 sludge incinerators, Metropolitan scum incinerator, and Seneca sludge incinerators. Each source is limited in discharge of particulates, opacity and odors. Sludge incinerators also have a limit on mercury emission.

Table 1-4 is a summary of sludge and scum incinerator emissions quality measured during 1984. The Metropolitan and Seneca Solids Processing Buildings demonstrated compliance with particulate, opacity, and mercury emission standards. The Metropolitan Scum Incinerator exceeded particulate emission standards due to gas scrubber problems occurring when the incinerator was operated at or near rated capacity.

1.3 Sludge Management

Each of the fourteen plants operated by the Commission produces sludge as a result of wastewater treatment, and with the exception of Medina, each plant provides some form of sludge processing. Ultimate disposal of sludge generated at Commission plants involves either landspreading or incineration. The Metropolitan Plant and the Seneca Plant represent major points of final sludge disposal. At the Metropolitan Plant, sludge is either landspread or incinerated; at Seneca, sludge is incinerated. The Empire Plant has on-site sludge landspreading facilities; all other plants transport sludge to the Metropolitan or Seneca Plant, or directly to landspreading sites. Table 1-5 is a summary of sludge generated at Commission plants.

TABLE 1-4

SUMMARY OF 1984 INCINERATOR EMISSION QUALITY

Source	Mercury				Particulate				Opacity			
	Emission std. g/24 hr.	Annual Avg. g/24 hr.	No. of Tests	Percent of Tests Mtg. Stds.	Emission std.	Annual Avg.	No. of Tests	Percent of Tests Mtg. Stds.	Opacity Std., %	Annual Avg. Opacity, %	No. of Tests	Percent of Tests Mtg. Stds.
Metro, Solids Processing Bulding	3200	630	2	100	1.3(1)	1.0(1)	5	100	20	7	105	100
Metro Scum Incinerator	----	---	-	---	0.2(2)	0.47(2)	1	0	20	--	0	---
Seneca Solids Processing Building	3200	60	2	100	0.2(2)(3)	0.002(2)	2	100	20	14	45	87

(1)Metro Solids Processing Bulding particulate standard and testing results expressed in lbs particulate/ton dry solids.

(2)Grains/dry standard cubic foot corrected to 12% CO_2.

(3)Emission standard of 0.2 gr/dscf @ 12% CO_2 applies to incinerator operation on vacuum filter cake at derated capacity of 2000 lbs./hr. Emission standard of 0.1 gr/dscf @ 12% CO_2 applies to incinerator operation on belt press cake at full capacity of 3,100 lbs/hr.

TABLE 1-5

1984 SUMMARY OF SLUDGE GENERATED

TREATMENT PLANT	ANNUAL WASTEWATER FLOW Daily Average MGD	ANNUAL WASTEWATER FLOW Annual Total MG	ANNUAL SLUDGE PRODUCTION MG	ANNUAL SLUDGE PRODUCTION % SOLIDS	ANNUAL SLUDGE PRODUCTION DRY TONS	SLUDGE DISPOSAL METHOD
ANOKA	2.49	911	4.14	2.07	360	(1)
BAYPORT	0.50	183	1.30	2.20	120	(1)
BLUE LAKE*	19.5	7,137	40.70	4.58	7,775	(1) (2)
CHASKA	1.09	399	3.15	2.10	275	(3) (4)
COTTAGE GROVE	1.30	476	3.27	1.81	245	(1) (4)
EMPIRE	5.19	1,900	-----	----	789	(4)
HASTINGS	1.64	600	2.09	3.02	260	(1) (4)
MAPLE PLAIN	0.40	146	0.04	4.30	8	(1)
MEDINA	0.28	102	-----	----	------	-------
METROPOLITAN*	222	81,252	-----	----	68,241	(4) (5)
ROSEMOUNT	0.37	135	1.88	9.61	750	(1)
SAVAGE	0.62	227	0.67	3.34	95	(1) (2) (4)
SENECA*	17.6	6,442	-----	23.8	11,266	(5)
STILLWATER	2.95	1,080	5.35	2.79	620	(1) (4)

SLUDGE DISPOSAL METHODS:

(1) Transported to Metropolitan Plant for further processing.

(2) Transported to Seneca Plant for futher processing.

(3) Transported to Blue Lake Plant for further processing.

(4) Landspreading.

(5) Incineration.

NOTES:

*Annual Sludge Production includes sludge transported from other plants for further processing. Chemicals added for sludge conditioning are included for only the Seneca Plant.

2.0 INTRODUCTION

The Metropolitan Waste Control Commission was established as the areawide operational water pollution control agency by the Minnesota State Legislature, through the Metropolitan Sewer Act in 1969. This Act gives the Commission formal charge to prevent, abate, and control water pollution in lakes, rivers, and streams of the seven county Metropolitan area. The accomplishment of these responsibilities required that the Commission acquire, construct, operate, and maintain all interceptors and treatment works necessary for the collection, treatment, and disposal of wastewater in the area.

The Commission originally acquired 33 existing wastewater treatment plants in 1970. Through a ten year regionalization program, the Commission eliminated 22 old and outdated plants which could not comply with recent and more stringent effluent limitations. Three new and modern plants were designed and constructed to economically meet required effluent limitations, and provide for expansion to accomodate future growth in the area. Completion of this regionalization program left the Commission with the existing 14 treatment plants. The number of plants in operation at the end of each year is shown graphically in Figure 2-1. A history of each plant is summarized in Table 2-1.

The 14 plants currently operated by the Commission include the Metropolitan Plant. This is the largest plant in the system and serves the greater Minneapolis-St. Paul area. Three other regional plants, Blue Lake, Empire, and Seneca, each serve several suburban communities. The remaining ten smaller plants generally serve communities in each of their immediate areas.

Throughout each year, the performance of each plant is monitored, recorded, and reported to regulatory agencies, Commission administrators, and Commission program managers, in order to insure consistently good performance and indicate areas where additional effort is necessary to improve performance. At the end of each year, the performance of each treatment plant is summarized. This report is a summary of treatment plant performance during 1984.

The purposes of this report are as follows:

(1) To provide a summary of 1984 treatment plant performance data for future reference;

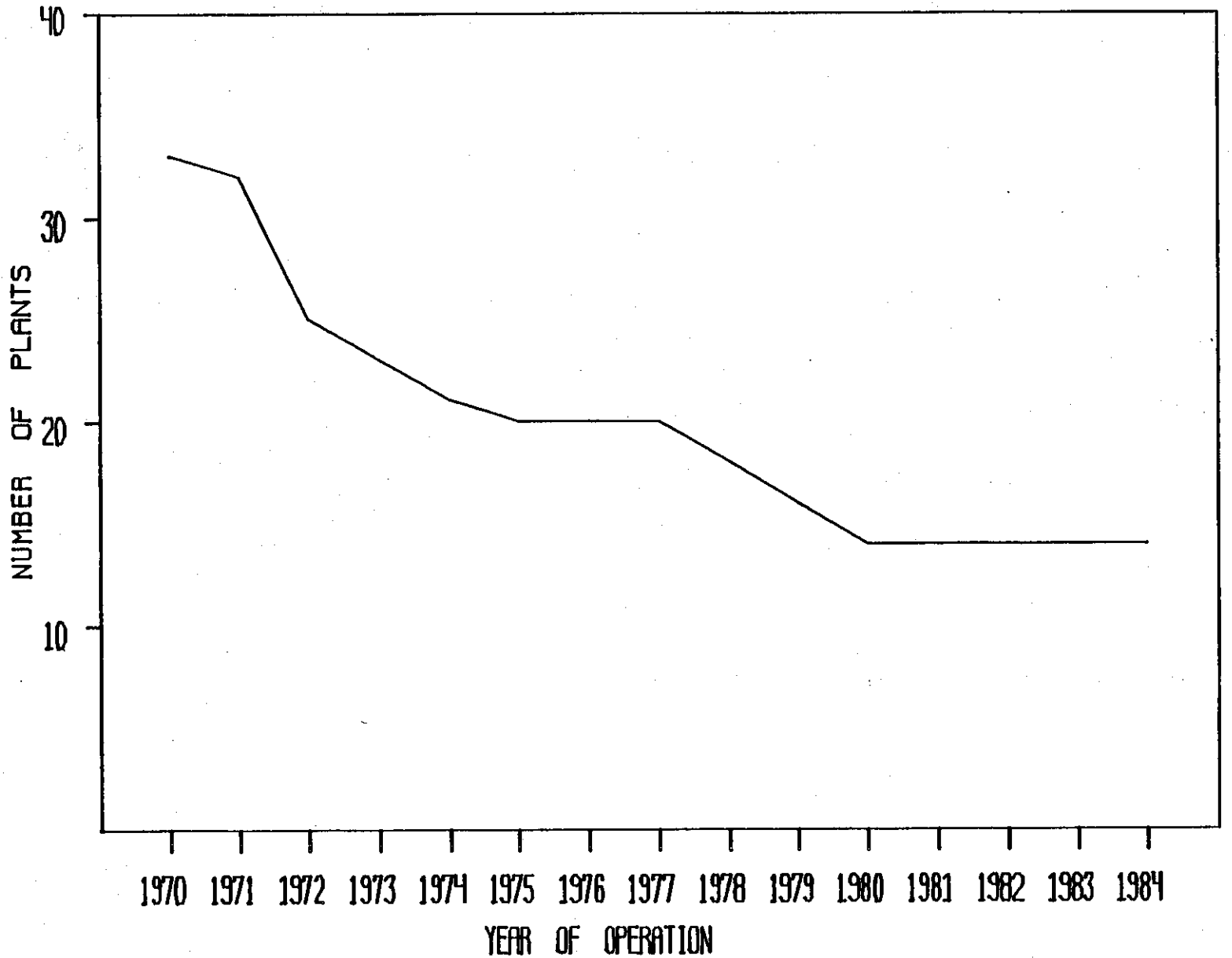
(2) To compare plant effluent quality to NPDES permit effluent limitations;

(3) To compare effluent quality to plant program performance goals;

(4) To compare major air emissions to emission standards;

(5) To summarize quantity and quality of sludge production, and methods of sludge treatment and disposal at each plant;

1970 - 1984


40
30
20
10
NUMBER OF PLANTS
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
YEAR OF OPERATION

TREATMENT PLANTS IN OPERATION DURING THE

	1970	1971	1972	1973	1974	1975	1976
ANOKA	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
APPLE VALLEY	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
BAYPORT	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
BLUE LAKE	(Plant Start-up 8/71)XXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
BURNSVILLE	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXX (Flow diverted to Blue Lake 9/22/72)				
CHASKA	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
CHANHASSEN	XXXXXXXXXXX	XXXXXXXXXXX	X (Flow diverted to Blue Lake Plant 1/10/72)				
COTTAGE GROVE	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
EAGAN TOWNSHIP I	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXX (Flow diverted to Seneca Plant, 7/21/72)				
EAGAN TOWNSHIP II	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXX (Flow diverted to Seneca Plant, 7/21/72)				
EMPIRE							
EXCELSIOR	XXXXXXXXXXX	XXXXXXXXXXX	XX (Flow diverted to Blue Lake Plant 2/28/72)				
FARMINGTON	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
FOREST LAKE TOWNSHIP	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXX (Flow diverted to Metropolitan Plant 9/28/72)				
FOREST LAKE VILLAGE	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXX (Flow diverted to Metropolitan Plant 9/28/72)				
HASTINGS	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
INVER GROVE HEIGHTS	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXX (Flow diverted to Metropolitan Plant 11/8/72)				
LAKEVILLE	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
LONG LAKE	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
MAPLE PLAIN	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
MEDINA	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
METROPOLITAN	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
MOUND	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXX (Flow diverted to Blue Lake Plant		
NEWPORT	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXX (Flow diverted to	
OAK PARK HEIGHTS	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXX (Flow diverted to Stillwater Plant 7/11/73)			
ORONO	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
PRIOR LAKE	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
ROSEMOUNT I	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXX (Flow diverted to Rosemount II 11/20/73)			
ROSEMOUNT II			(Plant Start-up 11/73) XX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	
ST. PAUL PARK	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXX (Flow diverted to	
SAVAGE	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
SENECA		(Plant Start-up 7/72) XXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
SHAKOPEE	XXXXXXXXXXX	XXXXXX (Flow diverted to Blue Lake Plant 7/71)					
SOUTH ST. PAUL	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXX (Flow diverted to Metropolitan		
STILLWATER	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX
VICTORIA	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXXX	XXXXXXXXXX (Flow diverted to Blue Lake Plant 11/7/73)			
WACONIA					(Plant acquired 11/75) XX	XXXXXXXXXXX	
WAYZATA	XXXXXXXXXXX	XXXXXXXXX (Flow diverted to Blue Lake Plant 10/71)					

PERIOD IN 1970-1984

1977	1978	1979	1980	1981	1982	1983	1984
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXX (Flow diverted to Empire Plant 9/79)					
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
	(Plant Start up 9/79) XXXX		XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXX (Flow diverted to Empire Plant 9/79)					
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXX (Flow diverted to Empire Plant 9/79)					
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXX (Flow diverted to Blue Lake Plant 6/80)				
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
5/74)							
Metropolitan Plant 6/11/75)							
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXX (Flow diverted to Blue Lake Plant 6/80)				
XXXXXXXXXXXX	XXXXX (Flow diverted to Blue Lake Plant 5/78)						
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
Metropolitan Plant 6/18/75)							
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
Plant 6/24/74)							
XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXX	X (Flow diverted to Blue Lake Plant 1/78)						

(6) To summarize activities related to plant performance at each plant; and

(7) To compare 1984 plant performance data to historical performance data.

This report is divided into seven major sections. Sections 1 and 2 are a summary and introduction, respectively. Section 3 discusses plant effluent quality relative to NPDES effluent limitations and performance goals. Section 4 discusses air emissions from sources at the Metropolitan and Seneca Plants. Section 5 summarizes plant sludge production and sludge quality. Section 6 consists of individual treatment plant reports giving details of plant treatment processes, plant efficiencies, plant loadings, and 1984 activities at each plant. Section 7 is an appendix which presents additional data and data analyses in several forms.

3.0 EFFLUENT QUALITY

3.1 Water Pollution Control Regulations

Current federal regulations on water pollution control are based primarily on the Water Pollution Control Act Ammendments of 1972 (Public Law 92-500), which was passed by Congress in October, 1972. The purpose of the Act was to enhance the quality and value of water resources and to establish a national policy for the prevention, control, and abatement of water pollution. The national goal established by this Act is to make all surface waters, i.e. lakes and rivers, fishable and swimmable.

The federal law has taken an approach to water pollution control regulation that follows two complementary strategies. First, all publicly owned treatment works have been required to comply with technology-based limits on effluent quality, or what is commonly known as secondary treatment. Second, all states are required to establish use classifications for its surface waters, to adopt water quality standards necessary to assure attainment of the designated use, and to require more stringent treatment than secondary treatment when necessary to insure compliance with water quality standards.

As a result, secondary treatment is required as a minimum for all Commission wastewater treatment plants. Certain treatment plants (basically the larger, regional plants) are currently, will be, or may be subject to more stringent effluent limits as water quality standards are revised in the future.

Congress has amended the 1972 Act twice, by the Clean Water Act of 1977, and the Municipal Wastewater Treatment Construction Grant Amendments of 1981. These amendments have recognized the magnitude of the federal water pollution control program and have set a compliance date of July 1, 1988, for publicly owned treatment works to meet secondary treatment limits and, where applicable, water quality related effluent limits. The federal agency which administers the law and regulates dischargers is the U.S. Environmental Protection Agency (EPA).

The corresponding state regulatory agency, the Minnesota Pollution Control Agency (MPCA), has established rules regarding water use classifications and water quality standards, as required by federal law. These rules include the definition of secondary treatment, as presented in Table 3-1.

TABLE 3-1

DEFINITION OF SECONDARY TREATMENT EFFLUENT (MINNESOTA RULES CHAPTER 7050)

Substance or Characteristic	Limiting Concentration or Range	
	30 Day Mean	7 Day Mean
5-Day Carbonaceous Biochemical Oxygen Demand (1)	25	40
Fecal Coliform Group Organisms, Number/100 mL(2)	200	---
Total Suspended Solids, mg/L(1)	30	45
Phosphorus, mg/L(3)	1	---
Turbidity, NTU(1)	25	---
pH Range(4)	6.0-9.0	---
Unspecified Toxic or Corrosive Substances(5)	---	---

(1) Arithmetic Mean
(2) Geometric Mean; No more than 10% of samples shall exceed 400 organisms/100 mL: Disinfection required from March 1 through October 31.
(3) In effect where discharge is directly to lake or reservoir.
(4) Not subject to averaging.
(5) None at levels acutely toxic to humans or other animals or plant life.

TABLE 3-2

WATER QUALITY BASED EFFLUENT STANDARDS (MINNESOTA RULES CHAPTER 7065)

Substance or Characteristic	Limiting Concentration or Range
5-Day Biochemical Oxygen Demand, mg/L(1)	10
Fecal Coliform Group Organisms, Number/100 mL(2)	200
Total Suspended Solids, mg/L(1)	10
Turbidity, NTU(1)	25
pH Range(4)	6.0-9.0
Ammonia as Nitrogen, mg/L(1)	1
Dissolved Oxygen, mg/L(1)	4
Unspecified Toxic or Corrosive Substances(4)	---

(1) Arithmetic Mean
(2) Geometric Mean; No more than 10% of samples shall exceed 400 organisms/100 mL; Disinfection required from March 1 through October 31.
(3) Not subject to averaging.
(4) None at levels acutely toxic to humans or other animals or plant life.

During 1974, the National Pollutant Discharge Elimination System (NPDES) was established as the major regulatory tool to be used in implementing the requirements of Public Law 92-500. Under this system, each individual wastewater discharged to state or federal waters is required to have an NPDES permit. The NPDES permit places limitations on the quantity and quality of the wastewater discharge. After establishment of initial policies and procedures, the EPA transferred the responsibility for issuing permits to individual state governments.

3.2 Effluent Limitations

In 1974, all Commission Plants were issued discharge permits by the MPCA. The permits stipulated interim effluent quality standards to be achieved for compliance with permit conditions. Effluent quality standards were determined using water quality standards of the receiving waters and the practicability of a facility to attain certain levels of treatment under existing operating conditions. The interim effluent quality standards established for each plant were the same as, more stringent than, or less stringent than those of secondary treatment. These standards have been revised in the past and will be revised in the future as receiving water quality standards change, and as facilities are upgraded or constructed capable of achieving higher levels of treatment.

The Metropolitan Plant for example, will be required to meet effluent limits more stringent than secondary treatment beginning in 1985, consistent with completion of the secondary treatment expansion at the plant. The current NPDES permit for the Metropolitan Plant expires in 1987, reflecting the five-year duration of most NPDES permits. The next NPDES permit is expected to contain final water quality related effluent limits for the Metropolitan Plant.

Several plants' NPDES permits have expired and need to be reissued by MPCA in the near future. As such, the conditions of these expired permits have been assumed to remain in effect until new NPDES permits are issued by MPCA. Table 3-3 summarizes the NPDES permit effluent limitations for the Commission's 14 treatment plants.

3.3 Plant Performance

During 1984, the Commission's network of treatment plants had available capacity to treat 114 billion gallons of wastewater (312 mgd). The actual volume of wastewater treated during 1984 was approximately 100 billion gallons (276 mgd). Wastewater treated during 1984 represented 88 percent of the Commission's total treatment capacity on an average basis. Volume during 1984 slightly exceeded the volume treated during 1983.

Of the 100 billion gallons of wastewater received during 1984, 80 percent was treated at the Commission's largest facility, the Metropolitan Wastewater Treatment Plant. Approximately 15 percent of the total flow was treated by the other three regional treatment plants, Blue Lake, Empire, and Seneca.

During 1984, the Commission's laboratories continued to measure and report both carbonaceous BOD (CBOD) and total BOD (TBOD). Measurement of the CBOD eliminates misleading test results which are sometimes affected by nitrification occurring in the TBOD test. Nitrification is an oxygen consuming process and,

TABLE 3-3

NPDES EFFLUENT LIMITATIONS - 1984

TREATMENT PLANT (a)	Standards Applicable	5-Day BOD mg/l 7-Day Avg.	5-Day BOD mg/l 30-Day Avg.	TSS, mg/l 7-Day Avg.	TSS, mg/l 30-Day Avg.	Fecal Coliform number/100 ml Geometric Mean(f) 7-Day Mean	Fecal Coliform number/100 ml Geometric Mean(f) 30-Day Mean	Turbidity NTU 30-Day Mean	Phosphorus mg/l 30-Day Mean	Ammonia mg/l 30-Day Mean	Dissolved Oxygen mg/l 30-Day Mean
ANOKA (b)	At All Times	45	25	45	30	400	200	25	---	---	---
BAYPORT	At All Times	45	25	45	30	400	200	25	1.0	---	---
BLUE LAKE	At All Times	45	25	45	30	400	200	25	---	---	---
CHASKA	At All Times	45	25	45	30	400	200	25	---	---	---
COTTAGE GROVE	At All Times	45	25	45	30	400	200	25	---	---	---
EMPIRE	At All Times	--	10	--	10	400	200	25	---	1.0	>4.0
HASTINGS	At All Times	45	25	45	30	400	200	25	---	---	---
MAPLE PLAIN	At All Times	--	25	--	30	---	200	25	---	---	---
MEDINA(c)	At All Times	45	25	45	30	400	200	25	---	---	---
METROPOLITAN(d)	At All Times	44	24	45	30	400	200	--	---	---	7.0(e)
ROSEMOUNT	At All Times	45	25	45	30	400	200	25	1.0	---	---
SAVAGE	At All Times	45	25	45	30	400	200	25	---	---	---
SENECA	At All Times	45	25	45	30	400	200	25	---	---	---
STILLWATER	At All Times	45	25	45	30	400	200	25	1.0	---	---

(a) General Requirements for Essentially All Plants:
1) The pH shall not be less than 6.5 nor greater than 8.5. These upper and lower limitations are not subject to averaging and shall be met at all times.
2) There shall be no discharging of floating solids or visible foam in other than trace amounts.
3) The discharge shall not contain oil or other substances in amounts sufficient to create a visible color or film.

(b) Additional 30-day mean permit standards for Anoka: chromium - 0.4 mg/l; copper - 0.3 mg/l; lead - 0.5 mg/l; zinc - 0.5 mg/l; cyanide - 0.5 mg/l.

(c) Applies only when Medina Plant discharges from absorption ponds - Must be authorized by MPCA.

(d) Additional 30-day median permit standards for the Metropolitan Plant: copper - 0.14 mg/l; cadmium - 0.03 mg/l; mercury - 4.0 ug/l; cyanide - 0.193 mg/l.

(e) Dissolved oxygen limitation of 7 mg/L for river flows less than 7,000 cfs and river D.O. values less than 6.0 mg/l upstream or less than 5.5 mg/L downstream for two consecutive sample-days, during the period June through September.

(f) Disinfection required from March 1 through October 31 except for the Anoka Plant where disinfection is required year round.

therefore, tends to increase the BOD value. Comments made regarding 1984 treatment plant performance, for the most part, draw upon CBOD data and should be viewed with consideration for the fact that there are differences between the test procedures. TBOD and CBOD effluent data are tabulated for each plant in Section 6 of this report. The EPA and MPCA have revised their regulations during 1984 to allow use of CBOD in place of TBOD as the measurement of wastewater organic strength.

Figure 1-1, located in the first section of the report, illustrates the trend in NPDES compliance for the years 1971 through 1984, for both the Metropolitan Plant and other plants. It can be seen from Figure 1-1, that excellent plant performance continued during 1984. The annual average effluent concentration (CBOD and TSS) has been below permissible NPDES discharge limits for the Metropolitan Plant during the past five years, while the annual average effluent concentration (CBOD and TSS) for all other plants has been consistently below permissible NPDES discharge limits since 1975.

During 1984, the Metropolitan Plant average effluent CBOD and TSS concentrations were 10 mg/L and 11 mg/L, respectively as compared to 1983 average effluent CBOD and TSS values of 10 mg/L and 9 mg/L, respectively. Removal efficiencies for CBOD and TSS were 94 percent and 95 percent, respectively. This is approximately the same removal efficiency as that achieved during 1983. The Metropolitan Plant effluent quality, as expressed in CBOD and TSS, has reached a level that is difficult to surpass with a conventional secondary treatment facility.

Effluent quality for plants other than the Metropolitan Plant was excellent during 1984. Annual average effluent CBOD and TSS concentrations during 1984 were 11 mg/L and 11 mg/L respectively, as compared to 1983 annual average CBOD and TSS values of 10 mg/L and 10 mg/L, respectively. The annual average CBOD removal efficiency for all plants decreased from 94 percent in 1983 to 93 percent in 1984, and the TSS removal efficiency decreased from 95 percent in 1983 to 94 percent in 1984.

Annual performance and monthly variations in performance, at each treatment plant, are summarized in Table 3-4. Plant flow and major effluent quality parameters are included in the summary.

Nominal design flow for each plant is included in each NPDES permit, and is listed in Table 3-4. When relating current plant operation to plant capacity, it is normal practice to compare average annual flow to nominal design flow. However, this practice is often deceiving. To obtain an accurate indicator of plant capacity, nominal design flow must be adjusted to reflect unique flow variation factors, organic loading, organic load variation, and individual process capacities. These flow and loading variations can vary from year to year, depending on changes in infiltration/inflow and activities of local industries.

It is not within the scope of this report to analyze and define, in detail, realistic current plant capacities. Treatment plant capacities will be evaluated on an ongoing basis and periodically summarized in separate reports. However, the following summary of realistic capacity versus nominal design capacity of several plants is necessary in order to understand subsequent discussions of plant performance in 1984.

TABLE 3-4

SUMMARY OF PLANT PERFORMANCE
1984

Treatment Plant	Permit Limitation		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Avg.
	Flow	2.46	2.34	2.47	2.74	2.49	2.53	2.72	2.58	2.62	2.30	2.39	2.34	2.39	2.49
	CBOD	25	15	11	15	12	14	9	12	13	18	13	12	16	13
Anoka	TSS	30	15	9	13	8	10	10	10	11	12	10	9	13	11
	Flow	0.65	0.46	0.48	0.46	0.54	0.53	0.76	0.51	0.49	0.46	0.45	0.43	0.39	0.50
	CBOD	25	7	6	5	6	6	6	4	5	6	6	7	6	6
Bayport	TSS	30	10	9	6	9	8	9	5	8	7	8	9	9	8
	Flow	20.0	16.2	19.5	19.0	20.9	22.5	23.9	19.8	19.3	17.6	19.0	17.4	18.4	19.5
	CBOD	25	11	12	11	12	9	8	7	6	8	8	8	12	9
Blue Lake	TSS	30	7	8	9	10	6	5	6	9	5	6	4	6	7
	Flow	1.40	0.84	1.03	0.99	1.38	1.38	1.32	1.16	1.15	0.92	1.04	0.92	0.92	1.09
	CBOD	25	8	7	8	8	8	6	20	6	7	11	7	10	9
Chaska	TSS	30	10	4	6	7	5	5	31	6	7	28	8	12	11
	Flow	1.80	1.28	1.37	1.22	1.26	1.29	1.31	1.31	1.29	1.32	1.37	1.27	1.28	1.30
	CBOD	25	14	11	12	8	10	8	7	6	6	6	11	12	9
Cottage Grove	TSS	30	16	9	12	6	10	7	5	8	6	7	9	9	9
	Flow	6.00	4.38	4.69	4.92	5.76	6.36	5.89	5.09	5.51	4.73	4.98	4.99	4.95	5.19
	CBOD	10	2	2	2	3	2	1	2	2	3	2	2	2	2
Empire	TSS	10	1	1	2	3	2	2	2	2	2	2	2	2	2
	Flow	1.83	1.64	1.58	1.63	1.64	1.72	1.66	1.59	1.63	1.68	1.67	1.59	1.63	1.64
	CBOD	25	23	66	14	16	16	13	14	15	15	29	21	25	22
Hastings	TSS	30	38	105	32	26	21	16	20	21	23	35	24	26	32
	Flow	0.22	0.25	0.44	0.51	0.45	0.45	0.60	0.35	0.33	0.28	0.48	0.33	0.33	0.40
	CBOD	25	8	10	22	19	12	12	7	4	6	4	6	9	10
Maple Plain	TSS	30	13	13	15	12	12	22	9	8	4	4	6	8	10
	Flow	0.10	0.14	0.34	0.32	0.44	0.37	0.37	0.27	0.18	0.20	0.29	0.24	0.18	0.28
	CBOD	25*	26	11	14	9	10	10	6	5	7	5	8	17	10
Medina	TSS	30*	28	22	12	12	18	18	8	7	7	12	36	29	16
	Flow	250	186	231	221	230	239	285	223	226	215	231	191	190	222
	CBOD	24	12	9	10	9	10	16	9	8	9	11	10	11	10
Metropolitan	TSS	30	9	8	8	9	7	14	13	11	16	14	9	10	11
	Flow	0.60	0.37	0.40	0.39	0.37	0.37	0.34	0.34	0.36	0.39	0.38	0.37	0.35	0.37
	CBOD	25	14	11	14	20	21	14	21	19	29	20	17	15	18
Rosemount	TSS	30	4	2	1	2	2	3	5	2	2	2	4	3	3
	Flow	0.86	0.48	0.61	0.60	0.64	0.71	0.89	0.64	0.61	0.53	0.59	0.60	0.59	0.62
	CBOD	25	6	7	5	5	8	8	6	7	8	5	7	10	7
Savage	TSS	30	2	1	4	1	3	5	9	5	2	4	3	2	3
	Flow	24.0	15.4	17.0	18.1	18.3	17.7	19.3	18.6	18.1	17.4	17.9	16.6	16.9	17.6
	CBOD	25	24	16	11	13	14	19	16	18	13	16	18	24	17
Seneca	TSS	30	28	24	15	14	14	21	20	23	23	22	22	30	21
	Flow	3.02	2.67	2.84	2.77	3.38	3.38	3.41	3.00	2.85	2.75	2.92	2.78	2.68	2.95
	CBOD	25	13	12	8	9	8	7	6	6	8	5	8	10	8
Stillwater	TSS	30	12	12	9	9	8	11	7	6	8	8	8	13	9

*Only at time of discharge.

Anoka: Current plant capacity has been determined to be slightly less than design (2.46 mgd), due to existing activated sludge aeration and raw sewage pumping limitations.

Bayport: Plant capacity is somewhat less than design capacity (0.65 mgd), due to chemical feed which was added for phosphorus removal subsequent to the original plant construction. This addition has reduced activated sludge aeration and sludge processing capabilities.

Chaska: Plant capacity is somewhat less than design capacity (1.4 mgd) due to high inflow/infiltration, and high and variable organic loadings, which stress the activated sludge oxygenation capacity.

Hastings: Current plant capacity has been determined to be approximately 1.44 mgd (instead of 1.83 mgd), due to final clarification and sludge processing limitations.

Rosemount: Plant capacity is somewhat less than design capacity (0.60 mgd), due to increasing maintenance requirements. As the plant ages, one process train cannot handle peak flow at the rated design capacity.

Stillwater: Plant capacity is somewhat less than design capacity (3.02 mgd), due to the addition of a phosphorus removal system. This addition has reduced activated sludge aeration and sludge processing capabilities.

Annual average flow data included in Table 3-4 indicates that Maple Plain and Medina are currently operating beyond their design capacity, and the Blue Lake, Empire, and Savage Plants are also nearing design capacity. Based on realistic plant capacities discussed above, Anoka, Bayport, Chaska, Hastings, Rosemount, and Stillwater are also currently operating at or near plant capacity.

Table 3-5 is a complete summary of NPDES permit violations which occurred in 1984. Violations of weekly and monthly mass limitations on CBOD and TSS, not shown in Table 3-3, are included in Table 3-5. Also shown are pH, ammonia, cyanide, metals, and fecal coliform violations. A total of 33 violations occurred in 1984, ranging from sixteen at Hastings to none at Bayport, Blue Lake, Cottage Grove, Seneca, Maple Plain, Metropolitan, and Stillwater. A maximum of nine violations occurred in February, while no violations occurred in April or August.

The distribution of violations among effluent parameters and major problem areas are presented in Table 3-6. As shown in Table 3-6, most of the violations occurred in the first and fourth quarters of the year, which generally reflects the seasonally oriented capacity problems at the Hastings and Medina treatment plants.

Plant capacity problems account for the sixteen permit violations at Hastings, the four permit violations at Medina, and one of the TSS violations at Chaska. Three TSS violations at Chaska are attributable to an unidentified material in the influent wastewater that upset the activated sludge process.

TABLE 3-5

SUMMARY OF NPDES PERMIT NON-COMPLIANCE IN 1984

TREATMENT PLANT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL BY: NUMBER	TOTAL BY: MONTH
ANOKA	WFC				WFC	WFC					WFC		4	4
BAYPORT													0	0
BLUE LAKE													0	0
CHASKA							MS, WS, $\overline{WS}$			WS, $\overline{WS}$			5	2
COTTAGE GROVE													0	0
EMPIRE										MAm			1	1
HASTINGS	MS, WS	(1)	MS, WS							MB, MS WS			16	4
MAPLE PLAIN													0	0
MEDINA			WFC								WS	MS, WS	4	3
METROPOLITAN													0	0
ROSEMOUNT									MB			pH	2	2
SAVAGE						WFC							1	1
SENECA													0	0
STILLWATER													0	0
VIOLATION TOTALS	3	9	3	0	1	2	3	0	1	6	2	3	33	17

Symbols: MB,WB= Monthly and Weekly CBOD Conc; MS,WS= Monthly and Weekly TSS Conc; $\overline{MB}$,$\overline{WB}$,$\overline{MS}$,$\overline{WS}$= Mass Limits; MFC,WFC= Monthly and Weekly Fecal Coliform; pH; MP= Monthly Phosphorus Conc; T= Turbidity; MAm= Monthly NH_3-N.

(1) MB, WB, $\overline{MB}$, $\overline{WB}$, MS, WS, $\overline{MS}$, $\overline{WS}$, T

TABLE 3-6

NPDES PERMIT VIOLATION DISTRIBUTION
1984

Distribution of Violations Among Effluent Parameters

EFFLUENT PARAMETER	NUMBER OF VIOLATIONS 1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	TOTAL
CBOD	4	0	1	1	6
TSS	8	0	3	7	18
FECAL COLIFORM	2	3	0	1	6
pH	0	0	0	1	1
AMMONIA	0	0	0	1	1
CYANIDE	0	0	0	0	0
HEAVY METALS	0	0	0	0	0
TURBIDITY	1	0	0	0	1
TOTAL	15	3	4	11	33

Distribution of Violations Among Problem Areas

PROBLEM AREA	NUMBER OF VIOLATIONS 1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	TOTAL
PROCESS CONTROL	1	3	1	2	7
MAINTENANCE	0	0	0	2	2
INDUSTRIAL WASTES	0	0	3	0	3
PLANT CAPACITY	14	0	0	7	21
TOTAL	15	3	4	11	33

These violations are presented as an industrial waste problem area. Maintenance problems account for the remaining TSS violation at Chaska and the pH violation at Rosemount. Seven permit violations have been attributed to process control problems. These include four weekly fecal coliform violations at Anoka, one BOD violation at Empire, one BOD violation at Rosemount, and one weekly fecal coliform violation at Savage.

The increase in permit violations from 1983 to 1984 can be attributed to an increased number of violations related to plant capcity problems (increased from 9 in 1983 to 21 in 1984), primarily at the Hastings Plant. The Hastings Plant is currently being expanded, so that plant capacity limitations should be eliminated after Phase I of the construction has been placed into operation. The Medina Plant is scheduled for phaseout in early 1985, which will eliminate the other major plant capacity problem. The Chaksa Plant is scheduled for plant expansion by 1988.

The effluent limitation violations caused by process control, maintenance, and industrial waste problems have remained fairly stable since 1982, and account for an average of one violation per month, or one violation per treatment plant per year as an average for Commission treatment facilities.

The following is a plant-by-plant summary of non-compliance problems during 1984.

Anoka: The Anoka Plant experienced four weekly fecal coliform violations. One violation resulted when partial nitrification occurred in the activated sludge process, producing nitrite nitrogen, which exerts a high chlorine demand. One violation occurred because the automatic sampler intake line, which is located in the chlorine contact tank, had a break that led to unrepresentative sampling. Two violations occurred because consistent attempts were made to minimize effluent chlorine residual, such that variations in effluent quality may have caused a higher chlorine demand that cannot be met at the normal chlorine residual concentration.

Chaska: The Chaska Plant experienced five suspended solids violations. Three suspended solids violations in July are attributable to an unidentified material in the influent wastewater that upset the biological treatment process, resulting in poor sludge settleability. The two suspended solids violations in October were caused by a combination of high infiltration/inflow, process control problems, and an equipment failure. A rainfall event caused high inflow to the plant, while the solids concentration in the activated sludge system was higher than normal and while a return sludge pump control system failed. Consequently, solids were washed out of the final clarifier.

Empire: The Empire Plant experienced a monthly ammonia nitrogen violation in October. Increased ammonia loading from centrate, recycled to the plant during sludge dewatering operation, temporarily overloaded the nitrification activated sludge process. Process control procedures have been revised to minimize the chance of reoccurrence of this problem.

Hastings: The Hastings Plant experienced five BOD, ten suspended solids, and one turbidity violation. The violations are caused by the need to operate the plant at flows and loadings that exceed it's capacity. A plant expansion is under construction to correct this problem.

Medina: The Medina Plant experienced one weekly fecal coliform and three suspended solids violations. The fecal coliform violation occurred in March, when high infiltration/inflow necessitated a surface water discharge, while ice cover on the seepage ponds inhibited fecal coliform destruction. The suspended solids violations appeared to be caused by unrepresentative sampling during surface water discharge, since effluent BOD was very low.

Rosemount: The Rosemount Plant experienced one monthly BOD and one daily pH violation. The BOD violation was caused by a combination of delays in lime and activated carbon deliveries, that resulted in reduced treatment efficiency. The pH violation was caused by a plugged sample line, that resulted in inadequate acid feed following the solids-contact clarification process.

Savage: The Savage Plant experienced one weekly fecal coliform violation. The failure occurred when chlorine feed was not increased sufficiently to handle the increased chlorine demand of a recycle stream from a digester cleaning operation.

The following comments on 1984 treatment plant performance are also significant:

1. All Commission treatment facilities consistently met federal and state secondary treatment limits of 25 mg/L BOD and 30 mg/L TSS, except that compliance at the Hastings Plant is marginal.

2. Metropolitan Plant performance has improved during the past five years, such that its effluent quality has equalled or exceeded that of most other Commission treatment plants during 1982-1984. During summer, 1984, the west secondary facilities were operated to achieve nitrification. The plant met the seasonal BOD and ammonia limits which take effect in 1985.

3. Commission treatment facilities are performing as well as can be expected, given current influent flows and loadings, and the type and capacity of available treatment facilities. Except for the Hastings Plant, overall plant performance has stabilized at an excellent level during 1982-1984. Performance during 1985 is expected to be similar to that during 1982-1984. However, performance at some plants may deteriorate as plant capacity is approached or exceeded, or as equipment reaches the end of its useful life and becomes subject to more frequent downtime.

4. Treatment plants which currently are operating beyond plant capacity are Hastings, Maple Plain, and Medina. Hastings is currently being expanded with completion scheduled for late 1985 or early 1986. Maple Plain is scheduled for phaseout by interceptor construction to the Blue Lake Plant interceptor system in late 1986. Medina is scheduled for phaseout in early 1985 by construction of an interceptor to the Metropolitan Plant interceptor system.

3.4 Program Goals

Initially developed in 1976, the Commission continues to utilize a criteria which rapidly assesses plant performance. The assessment is made in terms of four parameters: Compliance (C) Frequency (F), Severity, (S), and Noncompliance Index (NCI).

Compliance (C) is the percentage compliance with NPDES effluent limitations as listed in each plant's NPDES permit. The nearer the compliance number is to 100 percent, the better the plant performance.

Frequency (F) is the frequency of compliance with NPDES effluent limitations. It is calculated by dividing the total number of CBOD and TSS analyses complying with effluent standards by the total number of CBOD and TSS analyses performed and expressing the result as a percentage. The nearer the frequency number is to 100 percent, the better the plant performance as related to effluent quality standards.

Severity (S) is the deviation from the standard for those CBOD and TSS analyses which exceed NPDES effluent limitations. It is determined by locating the median value of those values exceeding the standards and expressing the deviation as a percentage of the NPDES limit. The larger the severity number, the greater the magnitude of violation of effluent standards.

In judging the performance of plants, both frequency and severity must be considered; therefore, noncompliance index was developed to allow a rapid, single-number assessment of plant performance. The noncompliance index is determined by multiplying the percent severity by the noncompliance (100-frequency) and by dividing by 100. A low noncompliance index indicates better overall compliance with effluent quality standards.

Performance objectives in terms of compliance, frequency, and severity were defined for each individual treatment plant at the beginning of 1984. A summary of 1984 goals and actual performance at each plant is provided in Table 3-7. Twelve plants met their compliance goals, 12 plants met their frequency goals and 10 plants met their severity goals. Individual goal attainment is summarized as follows:

All Goals	Two Goals	One Goal
Anoka	Medina (C, F)*	Chaska (F)*
Bayport**	Rosemount (C, F)*	Hastings (S)*
Blue Lake	Seneca (C, S)*	
Cottage Grove	Stillwater (C, F)*	
Empire		
Maple Plain		
Metropolitan		
Savage		

* Letter in parenthesis indicates goals met.
**This plant had a perfect record of 100% compliance, 100% frequency, and no severity.

TABLE 3-7

SUMMARY OF TREATMENT PLANT PERFORMANCE PARAMETERS

Compliance, Frequency, Severity, and Noncompliance Index Values for 1981-1984

Treatment Plant	Compliance					Frequency					Severity					Noncompliance Index				
	Actual 1981	Actual 1982	Actual 1983	Goal 1984	Actual 1984	Actual 1981	Actual 1982	Actual 1983	Goal 1984	Actual 1984	Actual 1981	Actual 1982	Actual 1983	Goal 1984	Actual 1984	Actual 1981	Actual 1982	Actual 1983	Goal 1984	Actual 1984
Anoka	97	99	99	97	98	94	98	99	93	97	16	4	8	33	12	1.0	0.1	0.1	2.3	0.3
Bayport	100	100	100	98	100	100	100	100	93	100	0	0	0	33	0	0.0	0.0	0.0	2.3	0.0
Blue Lake	100	100	99	99	100	97	100	99	95	99	40	0	4	33	15	1.2	0.0	0.1	1.6	0.1
Chaska	98	99	99	98	96	89	96	95	93	97	32	24	60	33	62	3.5	0.9	2.7	2.3	2.0
Cottage Grove	96	99	99	97	100	97	99	100	93	99+	32	36	0	35	20	1.0	0.4	0.0	2.4	0.1
Empire	100	98	100	97	99	99	99	99	95	99	30	80	40	25	20	0.3	0.3	0.2	1.2	0.1
Hastings	94	87	95	95	88	80	64	81	80	73	24	37	23	33	33	4.8	13.1	4.4	6.6	8.9
Maple Plain	99	96	100	95	100	94	93	99	85	95	37	12	16	45	8	2.2	0.8	0.2	6.8	0.4
Medina	83	100	92	92	94	74	90	96	70	92	60	32	42	50	73	15.6	3.3	11.7	15.0	5.6
Metropolitan	89	100	100	97	100	81	93	97	90	97	40	36	13	40	20	7.6	2.5	0.4	4.0	0.6
Rosemount	100	99	98	98	99	97	97	96	95	95	48	36	28	25	28	1.4	1.0	1.2	1.2	1.5
Savage	100	99	100	98	99	98	97	100	93	100	36	43	0	33	0	0.7	1.1	0.0	2.3	0.0
Seneca	99	90	99	97	100	91	94	92	93	87	27	16	17	33	23	2.4	0.9	1.3	2.3	3.0
Stillwater	99	100	100	98	100	90	99	98	95	99	32	37	24	33	47	3.2	0.2	0.4	1.6	0.3
Average	98	98	99	97	98	92	94	96	90	95	32	28	19	35	25	2.8	1.6	0.7	3.4	1.3

4.0 INCINERATOR EMISSION QUALITY

Sludge generated at Commission Treatment Plants is handled either by land application or incineration and ash disposal. Most of the sludge generated by Commission treatment plants receives final processing and disposal at the Metropolitan or Seneca Plant. These two plants use incineration and ash landfilling for sludge management.

The incineration process produces exhaust gas, which discharges to the atmosphere through stacks and, as such, is subject to air quality emissions limitations. The purpose of these limitations is to prevent deterioration of existing ambient air quality. Incinerator emission limitations or standards are contained in MPCA's Air Quality Rules and Regulations.

4.1 Emission Standards

APC-9 of MPCA's Air Quality Rules and Regulations deals with the control of odors by limiting odor emission rates from defined odor sources and by establishing odor standards for ambient air based upon local zoning.

Odor standards are expressed as odor concentration units. The odor concentration unit is defined as the number of standard cubic feet of odor free air needed to dilute each cubic foot of contaminated air to a point where at least 50 percent of the individuals comprising the odor test panel do not detect an odor in the diluted mixture.

The odor emission rate is the product of the number of standard cubic feet per minute of air or other gases emitted from a suspected odor pollution source, and the number of odor concentration units determined for that source.

The following odor limitations are contained in APC-9:

1. Sources emitting odors from well defined stacks, 50 feet or more above grade elevation, with adequate dispersion characteristics, as determined by the MPCA, shall not emit odors greater than 150 odor concentration units.

2. Sources emitting odors less than 50 feet above grade elevation or otherwise failing to create good dispersion conditions, as determined by the MPCA, shall not emit more than 25 odor concentration units.

3. No odor source shall have an odor emission rate in excess of 1,000,000 odor concentration units per minute.

Additional incinerator emission standards are contained in APC-7 and APC-28 of MPCA's Air Quality Rules and Regulations. APC-28 specifies limits for opacity and particulate matter for new and existing sewage sludge incinerators while APC-7 specifies opacity and particulate matter limits for various types of solid waste incinerators. At the Metropolitan Plant, Incinerator Nos. 1-4 (F & I No. 1) and the Scum Incinerator are classified as existing incinerators while Incinerator Nos. 5-10 are classified as new incinerators. Particulate and opacity standards are summarized in Table 4-1.

TABLE 4-1

EMISSION STANDARDS FOR NEW AND EXISTING SLUDGE INCINERATORS (APC-28) AND FOR SOLID WASTE INCINERATORS (APC-7)

Incinerator Burning Capacity (lbs/hour)	Classification	Particulate Emission Standard		Percent Opacity	
		lbs/ton	grain/dscf at 12% CO_2	Average	Maximum[1]
<200	Existing	---	0.3	20	40
200-2000	Existing	---	0.2	20	40
>2000	Existing	---	0.1	20	40
ALL	New	1.3	---	20	--

[1] A maximum of 40 percent is permissible for four minutes in any 60 minute period.

An additional discharge standard applying to sewage sludge incinerators is found in APC-31 of MPCA's Air Quality Rules and Regulations. This regulation limits the quantity of mercury that is discharged from the incinerator into the atmosphere during a twenty-four hour period to 3200 grams.

Table 4-2 summarizes air emission standards applicable to the Commission's incineration facilities.

TABLE 4-2

SUMMARY OF AIR EMISSION STANDARDS FOR COMMISSION INCINERATORS

Air Emission Standard	Metropolitan Plant[1] F & I No. 1 Sludge Incin. Nos. 1-4	Metropolitan Plant[1] Solids Processing Building Sludge Inc. Nos. 5-10	Metropolitan Plant[1] Scum Incin.	Seneca Plant Sludge Inc. Nos. 1-2
Particulate Matter				
grain/dscf @ 12% CO_2	0.1	---	0.2	0.2/0.1[2]
lb./ton sludge solids	---	1.3	---	---
Opacity, percent	20[3]	20	20[3]	20[3]
Odors, Odor Concentration Units (O.C.U.)	25	150	25	150
Odor Emission rate, odor concentration units/min. (O.C.U./min.)	1,000,000	1,000,000	1,000,000	1,000,000
Mercury Emissions grams/24 hr. period	3,200	3,200	---	3,200

1 Figure 4-1 illustrates the stack identification number for each corresponding incinerator.

2 Emission standard of 0.2 grains/dscf @ 12% CO_2 applies to incinerator operation on vacuum filter cake at derated capacity of 2,000 lb/hr. Emission standard of 0.1 grain/dscf @ 12% CO_2 applies to incinerator operation on belt press cake at full capacity of 3,100 lb/hr.

3 A maximum of 40 percent opacity is permissible for four minutes in any 60 minute period.

4.2 Summary of 1984 Air Emissions Monitoring

During 1984, stack gases from incinerators at the Metropolitan and Seneca Plants were sampled and analyzed for particulate matter, opacity, and mercury. During this time, the new sludge incineration facilities (incinerators Nos. 5-10) at the Metropolitan Plant were in the operation optimization stage while existing incineration facilities (incinerator Nos. 1-4) were shutdown.

Opacity testing conducted at the Metropolitan and Seneca Plants during 1984, is summarized in Table 4-3. All opacity tests conducted at the Metropolitan Plant met opacity standards. At the Seneca Plant 87% of the tests conducted met opacity standards.

FIGURE 4-1

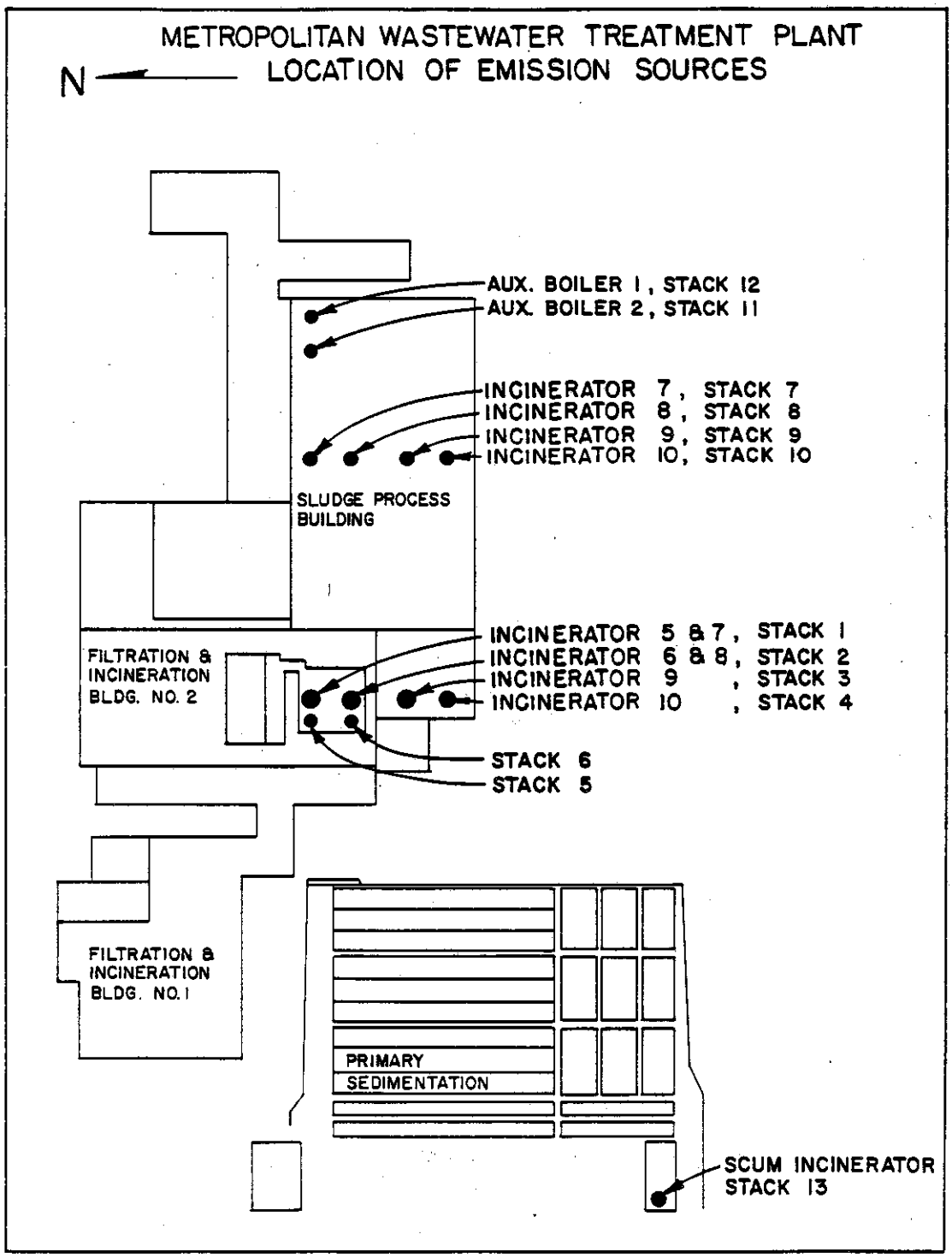

METROPOLITAN WASTEWATER TREATMENT PLANT
N
LOCATION OF EMISSION SOURCES
AUX. BOILER 1, STACK 12
AUX. BOILER 2, STACK 11
INCINERATOR 7, STACK 7
INCINERATOR 8, STACK 8
INCINERATOR 9, STACK 9
INCINERATOR 10, STACK 10
SLUDGE PROCESS BUILDING
INCINERATOR 5 & 7, STACK 1
INCINERATOR 6 & 8, STACK 2
INCINERATOR 9, STACK 3
INCINERATOR 10, STACK 4
FILTRATION & INCINERATION BLDG. NO. 2
STACK 6
STACK 5
FILTRATION & INCINERATION BLDG. NO. 1
PRIMARY SEDIMENTATION
SCUM INCINERATOR STACK 13

TABLE 4-3

SUMMARY OF 1984 OPACITY MEASUREMENTS
SENECA AND METROPOLITAN PLANTS

	Incinerator No.										Seneca Plant
	1	2	3	4	5	6	7	8	9	10	Common Stack
Total Test Measurements	*	*	*	*	0	0	28	32	21	24	45
Number of Tests Meeting Stds.	*	*	*	*	---	---	28	32	21	24	39
Number of Tests Exceeding Stds.	*	*	*	*	---	---	0	0	0	0	6
Percent of Tests Meeting Stds.	*	*	*	*	---	---	100	100	100	100	87
Average Opacity, %	*	*	*	*	---	---	6	7	8	6	14

*Incinerator taken out of operation, October 1982.

Table 4-4 summarizes results of particulate emission testing conducted at the Metropolitan and Seneca Plants during 1984. The particulate emission from the Scum Incinerator at the Metropolitan Plant was 0.37 grain/dscf. Annual average particulate emission from the Solids Processing Building (Inc. Nos. 5-10) was 1.0 lbs/dry ton sludge solids. Annaul average particulate emission at the Seneca Plant was 0.02 grain/dscf.

As was mentioned previously, the incineration process at the Metropolitan Plant was in a refinement or operational optimization stage through 1984. A portion of this optimization program dealt with achieving compliance with odor limits and, as such, many odor tests were conducted to document success or failure of the various experimental modes of incinerator operation. Since these tests do not accurately reflect routine incinerator operation, odor test results are not included in this report.

Mercury emission testing conducted during 1984 show that both the Metropolitan and Seneca Plants were well below the emission standard of 3200 grams for a twenty-four hour period. Annual average mercury emissions were 60 and 630 grams/24 hrs., respectively for the Seneca and Metropolitan Plants.

TABLE 4-4

SUMMARY OF 1984 PARTICULATE EMISSION TESTING
METROPOLITAN AND SENECA PLANTS

A. Metropolitan Plant, Scum Incineration

Date	Stack ID	Burning Rate % of Design Capacity	Stack Gas Flow Rate, SCFM	Particulate(1) grain/dscf at 12% CO2
12/20	Scrubber Stack	--	3,907	0.373

B. Metropolitan Plant, Solids Processing Building

Date	Stack ID	Burning Rate % of Design Capacity	Stack Gas Flow Rate, SCFM	Particulate(2) lbs/dry ton solids
3/1	10	75	13,875	0.49
7/25	7	71	21,651	1.31
8/6	10	50	15,923	1.13
10/23	9	78	19,678	0.91
11/1	8	74	21,743	1.18
Average		70	18,574	1.00

C. Seneca Plant, Solids Processing Building

Date	Stack ID	Burning Rate % of Design Capacity	Stack Gas Flow Rate, SCFM	Particulate(3) grain/dscf at 12% CO2
4/1	Common	61	10,116	0.0131
4/17	Common	56	10,864	0.0221
Average		58	10,490	0.0176

(1)MPCA Standard for Scum Incinerator = 0.2 g/dscf
(2)MPCA Standard for Metro Plant New Incinerators = 1.3 lbs particulate/ton dry solids
(3)MPCA Standard for Seneca Plant Incinerators = 0.2 g/dscf

5.0 SLUDGE MANAGEMENT

Each of the Commission's treatment plants produce sludge as a result of wastewater treatment. At Medina, sludge settles and decomposes in treatment ponds, and removal of this sludge has not been required. At all other plants, sludge treatment may include thickening, stabilization, conditioning, and dewatering. Final disposal of sludge is accomplished either by landspreading or incineration and ash landfilling.

5.1 Sludge Processing

Table 5-1 is a summary of sludge processing and disposal methods utilized at Commission Plants. As shown in Table 5-1, most plants provide sludge thickening in either primary tanks or independent thickener units. At the Metropolitan and Seneca Plants, gravity thickening is provided for primary sludge, while air flotation thickening is provided for secondary (waste activated) sludge. At the Empire and Cottage Grove Plants, gravity thickening is provided for combined primary and secondary sludge.

Most of the smaller outlying plants provide sludge digestion to reduce and stabilize sludge solids. One exception is the Rosemount Plant, where sludge produced by physical-chemical treatment of wastewater is concentrated and transported to the Metropolitan Plant for disposal.

Roll and filter presses are used for dewatering sludge at the Metropolitan Plant, replacing the aging vacuum filters in F & I No. 1. The presses rely on polymer conditioning, rather than lime and ferric chloride, as was used for the vacuum filters. It is also possible to dewater a blend of primary and thermally conditioned sludge with the new roll presses. The presses produce a drier sludge cake than vacuum filters, which reduces and nearly eliminates auxiliary fuel use in the sludge incineration process. This sludge processing approach is part of the overall concept of energy recovery and energy conservation at the Metropolitan Plant.

During 1984, the Metropolitan Plant new sludge incineration facilities were in the operational refinement or optimization stage. As a result of this, some of the dewatered sludge generated during the year was landspread. Lime was added to this sludge for stabilization prior to landspreading.

In mid-1983, a new belt filter press for sludge dewatering at the Seneca Plant was installed. Like the roll presses at the Metropolitan Plant, the belt press uses polymer conditioned sludge. The belt press produces a drier sludge cake than the vacuum filters, reducing the fuel requirements for the sludge incineration process. The vacuum filters continue to be used at the Seneca Plant, in combination with the belt press.

TABLE 5-1

SUMMARY OF SLUDGE PROCESSING AND DISPOSAL METHODS
1984

TREATMENT PLANT	THICKENING	STABILIZATION	CONDITIONING	DEWATERING	SLUDGE DISPOSAL METHOD
Anoka	In Primaries	Anaerobic Digestion	None	None	(1)
Bayport	None	Aerobic Digestion	None	None	(1)
Blue Lake	In Primaries	None	None	None	(1) (2)
Chaska	None	Aerobic Digestion	None	None	(3) (4)
Cottage Grove	Gravity	Anaerobic Digestion	None	None	(1) (4)
Empire	Gravity	Anaerobic Digestion	Polymer	Centrifuging	(4)
Hastings	In Primaries	Anaerobic Digestion	None	None	(1) (4)
Maple Plain	In Primaries	Anaerobic Digestion	None	None	(1)
Medina	None	None	None	None	-------
Metropolitan*	Gravity (Primary) Air Flotation (Secondary)	Lime Lime Thermal	Polymer Lime/$FeCl_3$ Thermal	Roll Press Vacuum Filters Filter Presses	(4) (5) (4) (5) (4) (5)
Rosemount	In Holding Tank	None	None	None	(1)
Savage	In Holding Tank	Anaerobic Digestion	None	None	(1)(2)(4)
Seneca	Air Flotation (Secondary)	None	Lime/$FeCl_3$ Polymer	Vacuum Filters Belt Press	(5) (5)
Stillwater	In Primaries	Anaerobic Digestion	None	None	(1) (4)

SLUDGE DISPOSAL METHODS:

(1) Transported to Metropolitan Plant for further processing
(2) Transported to Seneca Plant for further processing
(3) Transported to Blue Lake Plant for further processing
(4) Landspreading
(5) Incineration

*Various combinations of stabilization, conditioning, dewatering, incineration, and landspreading are used. The listing shows the conditioning method associated with each dewatering method. Thermal conditioning also accomplishes stabilization, as does lime addition for conditioning prior to vacuum filtration. If polymer conditioned, roll press cake is to be landspread, lime is added to the cake for stabilization.

5.2 Sludge Disposal

During 1984, 90,804 dry tons of sludge were processed at Commission plants. A summary of sludge quantities produced at each of the Commission plants is shown in Table 5-2.

Sludge disposal methods presently utilized by the Commission include: (1) transporting of sludge to the Blue Lake, Seneca, or Metropolitan Plants for further processing; (2) landspreading; and (3) incineration with ash landfilling.

Digested sludge from the Chaska Plant is transported to the Blue Lake Plant. Sludge from the Blue Lake Plant is transported by tanker truck to either the Seneca or Metropolitan Plant. Digested sludges from the Anoka, Bayport, Cottage Grove, Hastings, Maple Plain, and Stillwater Plants and undigested sludge from the Rosemount Plant are transported through the interceptors to the Metropolitan Plant for further processing. Digested sludge from the Hastings, Chaska, Cottage Grove, Stillwater, and Savage Plants is also landspread. Table 5-3 lists the annual volume of sludge transported from each of the outlying plants, the interim disposal location, and the final disposal location.

At the Empire, Metropolitan, and Seneca Plants, sludge conditioning and dewatering are provided. At the Empire Plant, dewatered sludge is landspread; at the Metropolitan Plant, dewatered sludge is either incinerated or landspread; at the Seneca Plant, dewatered sludge is incinerated.

5.3 Sludge Quality

During 1984, digested sludge from the outlying plants and dewatered sludge or sludge cake from the Metropolitan and Seneca Plants were analyzed routinely for solids, nutrients, and metals. Results of analyses are summarized in Table 5-4. Total solids are shown as percent; volatile solids are shown as percent of total solids; nutrients (KJN, NH3-N, P) are shown as percent (dry weight basis); and metals and PCB are shown as mg/kg (dry weight basis). A more extensive summary of the quantity and quality of sludges from the various plants is listed in the Appendix of this report.

5.4 Landspreading

As shown in Tables 5-2 and 5-3, a portion of sludge generated at Commission treatment plants is landspread as a fertilizer supplement and soil conditioner. Prior to 1978, landspreading was limited to utilizing sludges generated at the smaller treatment plants for application to adjacent farm land. All other sludges were ultimately dewatered and disposed of by incineration.

In 1978, a sludge application program was initiated at the Metropolitan Plant. Because solids processing facilities at the plant were limiting the removal of solids from the sewage, the plant could not consistently meet NPDES discharge limitations. The land application program was developed as a means of disposing sludge solids generated in excess of the existing capacity of sludge handling facilities. This land application program was continued throughout

TABLE 5-2

SUMMARY OF SLUDGE PRODUCTION AND DISPOSAL METHODS
1984

Treatment Plant	Annual Sludge Production MG	Annual Sludge Production Dry Tons	Sludge Disposal Method
Anoka	4.144	360	(1)
Bayport	1.296	120	(1)
Blue Lake	40.702	7,775	(1) (2)
Chaska	3.151	275	(3) (4)
Cottage Grove	3.272	245	(1) (4)
Empire	------	789	(4)
Hastings	2.088	260	(1) (4)
Maple Plain	0.044	8	(1)
Medina	------	------	-------
Metropolitan			
b) Filter Presses	------	8,771	(4) (5)
c) Roll Presses	------	59,470	(4) (5)
Rosemount	1.881	750	(1)
Savage	0.674	95	(1) (2) (4)
Seneca	------	11,266	(5)
Stillwater	5.351	620	(1) (4)

(1) Transported to Metropolitan Plant for further processing.
(2) Transported to Seneca Plant for further processing.
(3) Transported to Blue Lake Plant for further processing.
(4) Landspreading
(5) Incineration

NOTE: Annual sludge production includes sludge transported from other plants for further processing. Chemicals added for sludge conditioning are included for only the Seneca Plant.

TABLE 5-3

SUMMARY OF 1984 SLUDGE HAULING

Treatment Plant	Interim Disposal Location	Final Disposal Location	Amount Hauled During 1983 (MG)
Anoka	Coon Rapids Interceptor	Metropolitan Plant	4.144
Bayport	Oakdale Interceptor	Metropolitan Plant	0.888
	South St. Paul Interceptor	Metropolitan Plant	0.408
Blue Lake	Seneca Plant	Seneca Plant	23.824
	3rd and Commercial Interceptor	Metropolitan Plant	16.878
Chaska	Blue Lake Plant	Seneca Plant or Metropolitan Plant	2.637
	Farm Land	Landspread	0.514
Cottage Grove	U of M Experimental Ag. Station	Landspread	0.150
	So. St. Paul Interceptor	Metropolitan Plant	3.122
Empire	U of M Experimental Ag. Station	Landspread	1.419
Hastings	U of M Experimental Ag. Station	Landspread	0.922
	Farm Land	Landspread	0.208
	South St. Paul Interceptor	Metropolitan Plant	0.959
Maple Plain	Plymouth Interceptor	Blue Lake/Metropolitan	0.044
Rosemount	3rd and Commerical Interceptor	Metropolitan Plant	1.881
Savage	Farm Land	Landspread	0.070
	Sludge Drying Beds	Landspread	0.024
	Seneca Plant	Seneca Plant	0.281
	3rd and Commercial Interceptor	Metropolitan Plant	0.299
Stillwater	Oakdale Interceptor	Metropolitan Plant	3.689
	Farm Land	Landspreading	1.097
	South St. Paul Interceptor	Metropolitan Plant	0.565

TABLE 5-4

1984 SLUDGE QUALITY SUMMARY

Treatment Plant Type of Sludge		Total Solids %	Volatile Solids %	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	Cd mg/kg	Cr mg/kg	Hg mg/kg	pH	NH3-N %	KJN %	K %	P %	NO_3-N %	PCB mg/kg
Anoka	Avg.	2.07	64.4	1,769	284	581	1,869	9.6	1,145	9.00	7.7	3.93	10.07	0.39	2.85	0.01	0.2
	Range	1.50-	58.1-	1,498-	208-	406-	1,382-	7.4-	555-	0.4-	7.5-8.1	2.8-	5.9-	0.3-	2.6-	0.01-	----
Anaerobic digested		2.69	73.5	1,944	454	832	2,663	12.2	1,710	29.0		5.0	12.2	0.6	3.1	0.02	
Bayport	Avg.	2.20	61.2	305	21	232	760	6.3	48	6.66	6.9	0.06	4.38	0.27	3.06	0.02	1.1
	Range	1.68-	54.8-	232-	18-	136-	634-	3.9-	35-	0.9-	6.7-7.1	0.03-	2.6-	0.2-	2.5-	0.01-	----
Aerobic digested		2.84	67.7	367	28	569	904	9.3	57	19.9		0.12	6.1	0.3	3.5	0.03	
Chaska	Avg.	1.61	63.5	522	34	106	742	6.1	270	7.70	7.0	0.09	5.67	0.97	2.80	0.04	0.7
	Range	1.05-	49.6-	382-	25-	70-	598-	5.0-	212-	4.4-	6.7-7.4	0.03-	3.1-	0.9-	2.0-	0.01-	----
Aerobic digested		2.39	70.4	644	46	137	1,015	6.9	391	17.2		0.20	9.6	1.1	3.6	0.2	
Cottage Grove	Avg.	1.81	68.1	471	71	153	1,011	7.4	33	4.33	7.8	3.50	8.87	0.44	2.54	0.01	1.1
	Range	1.08-	60.5-	357-	62-	112-	823-	6.0-	21-	1.2-	7.5-8.2	0.4-	7.1-	0.3-	2.0-	0.01-	----
Anaerobic digested		3.98	85.8	535	81	182	1,098	10.6	38	10.7		5.7	11.3	0.6	2.9	0.02	
Empire																	
Centrifuge Cake	Avg.	12.9	59.3	749	34	155	1,028	8.0	147	3.2	7.9	1.47	5.9	0.28	2.6	0.01	----
Digester Sludge	Avg.	2.1	61.2	717	30	133	1,066	7.5	141	4.3	8.0	5.52	11.2	0.96	3.3	0.02	2.1
Hastings	Avg.	3.02	62.5	1,100	28	178	739	5.0	3,317	3.41	7.5	2.30	6.87	0.37	2.52	0.01	1.1
	Range	1.25-	59.5-	728-	23-	135-	534-	2.9-	1,749-	1.2-	7.2-7.9	1.8-	5.1-	0.3-	1.7-	----	----
Anaerobic digested		4.37	68.5	1,808	34	261	1,126	6.6	6,123	7.8		2.7	7.9	0.5	3.5		
Metropolitan																	
Roll Press Cake	Avg.	32.8	70.4	1,223	212	301	2,022	67	919	1.7	-------	0.09	2.6	0.11	1.2	----	0.9
Filter Press Cake	Avg.	39.7	66.1	1,720	221	388	2,684	107	1,664	2.0	-------	0.12	3.2	0.12	2.8	----	2.2
Load Out Cake	Avg.	28.4	67.3	973	154	239	1,355	48	1,064	1.2	-------	0.09	2.4	0.11	1.0	----	0.6
Savage	Avg.	3.34	44.4	908	50	795	2,978	45.3	91	50.47	7.5	1.81	4.54	0.41	2.35	0.01	1.9
	Range	3.17-	42.9-	898-	47-	735-	2,817-	44-	90-	-----	7.3-7.6	1.80-	4.5-	-----	2.2-	----	----
Anaerobic digested		3.44	45.7	918	52	855	3,140	46	91			1.83	4.6		2.4		
Seneca																	
Vacuum Filter Cake	Avg.	23.7	42.7	1,127	509	241	456	11.6	466	1.4	-------	0.07	3.1	0.09	1.1	----	1.75
Belt Filter PC	Avg.	24.0	71.6	1,445	92	297	679	13.0	286	2.2	-------	0.95	4.6	0.17	1.5	----	1.44
Stillwater	Avg.	2.79	51.0	598	29	167	1,123	6.4	94	5.48	7.5	2.15	4.90	0.24	3.16	0.01	0.8
	Range	0.91-	46.2-	473-	19-	118-	911-	4.1-	71-	1.9-	7.1-7.7	1.4-	4.0-	0.2-	2.2-	0.01-	----
Anaerobic digested		4.23	69.9	763	38	289	1,455	9.4	117	13.2		3.0	6.2	0.3	3.8	0.02	

(1) Metals, nutrient, and PCB analysis listed as dry weight.

1984. However, as the new incinerators were gradually put into service, the portion of the dewatered sludge disposed of on land decreased accordingly. By the end of 1984, land application of dewatered sludge was used only as a backup method to sludge incineration.

At the Metropolitan Plant, sludges are conditioned and dewatered to produce sludge cake. Two types of sludge cake are produced: filter cake and press cake. The filter cake is produced by treating sludge with chemicals and removing water with a vacuum filter. Dewatered press cake is produced by either thermally or chemically conditioning the sludge followed by dewatering. Both chemical addition of lime and heat treatment conditioning have been shown to reduce pathogenic organisms to an acceptable level.

Since the initiation of landspreading as a disposal method at the Metropolitan Plant, portions of the dewatered sludge that is suitable for soil incorporation has been landspread. Table 5-5 presents a summary of sludge quantities disposed of by the landspreading program since 1978.

TABLE 5-5

SUMMARY OF QUANTITIES OF METROPOLITAN PLANT
DEWATERED SLUDGE DISPOSED OF BY LANDSPREADING PROGRAM

Year	Agricultural Land (wet tons)	Other (wet tons)	Total wet tons disposed by landspreading
1978	13,700	------	13,700
1979	18,700	15,500	34,200
1980	75,600	29,600	105,200
1981	189,600	9,900	199,500
1982	184,600	11,145	195,745
1983	134,350	14,880	149,230
1984	35,680	490	36,170

All land application of sludge is done under permits from MPCA. Each permit is granted for an individual parcel of land and specifies the maximum sludge application rate per acre. These application rates are based upon maximum allowable application rates of the various chemical constituents of the sludge (NH_3, Cd, etc.). All sludge is analyzed before applications to insure meeting conditions of each permit.

During 1984, approximately 36,000 wet tons of dewatered sludge were applied to permitted sites in seven area counties. The dewatered sludge was applied to land used for crop production. During the last half of 1984, the Metropolitan Plant incinerated all dewatered sludge produced. As such, it is anticipated that the dewatered sludge available for land application will be a minimum quantity to maintain land application as a viable backup method for incineration.

In addition to landspreading of dewatered sludge from the Metropolitan Plant, approximately three million gallons of liquid sludge generated at the Chaska, Cottage Grove, Hastings, Savage, and Stillwater Plants were applied to farm lands during 1984. Approximately 790 dry tons of digested dewatered sludge from the Empire Plant were applied to adjacent farm land owned by the Commission. Because of the demand for sludge application to agricultural land and the close proximity of the land to the above treatment plants, it is anticipated that the use of liquid sludge generated at the smaller treatment facilities will gradually increase.

6.0 INDIVIDUAL TREATMENT PLANT REPORTS

This section contains the individual treatment plant reports for 1984. For each plant report there is an introduction briefly describing the background of the plant, its design basis, 1984 performance and activities, and a statement regarding the future of the plant. The introduction is followed by a listing of 1982 through 1984 unit process loadings and a liquids and solids flow diagram of the treatment process. In addition, a graphical presentation of flows for individual months of 1984 and annual average flows for 1971-1984 is included. Monthly flow data are shown as a vertical bar corresponding to the range of flow for that month with the top cross bar representing the maximum flow and the bottom cross bar the minimum flow. A solid line connects the vertical bars and is drawn to the average wastewater flow for that month. Flow data are followed by 1984 monthly influent and effluent summaries. These tables contain monthly and annual average data on virtually all of the parameters for which the influent and effluent of that plant are analyzed.

Graphs of BOD and TSS for 1984 show a vertical bar which encompasses the maximum and minimum parameter range for that month. The solid line connects the monthly averages. Fecal coliform data are also presented graphically with the 1971-1984 annual averages (arithmetic average of monthly geometric means) shown on one graph and the 1984 monthly geometric means shown on another graph. Finally, plots of effluent BOD and TSS are shown illustrating the percent of the time the effluent concentrations were less than or equal to a given value. On these graphs, data from 1974-1983 are compared to data obtained during 1984.

ANOKA WASTEWATER TREATMENT PLANT

Plant History and Description

The Anoka Plant was designed by Toltz, King, Duvall, Anderson and Associates and built in two stages. The original plant was constructed in 1954-55, with a design capacity of 1.4 mgd. The plant was expanded in 1969 to its present design capacity of 2.46 mgd. The Anoka Plant serves the communities of Anoka, Champlin, and Ramsey in Service Area No. 3.

Liquid treatment consists of screening, grit removal, influent pumping, primary sedimentation, primary effluent pumping, conventional activated sludge aeration, final clarification, chlorination, and discharge to the Mississippi River.

Solids processing consists of combined thickening in primary tanks, anaerobic digestion, and sludge hauling for disposal in the Metropolitan Plant Interceptor System.

The plant is presently operating at about 100 percent of its rated capacity and provides good BOD and TSS removal. Significant flow increases are anticipated in the next two years which may exceed the capacity of certain process units. These additional flow sources are from the construction of the Anoka Interceptor and a Champlin Station expansion. The plant is subject to secondary treatment limits and additional limits on heavy metals and cyanide.

Performance

Plant flow averaged 2.49 mgd in 1984, up slightly from 2.33 mgd in 1983. Average plant effluent quality was 13 mg/L BOD and 11 mg/L TSS. Plant performance was good throughout the year, although four NPDES Permit violations occurred due to weekly fecal coliform failures. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/L

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	15	10	10	12	20	14	14	16	26	19	17	21
TSS	12	7	9	10	18	10	12	13	24	15	16	16

*1982 through 1984 values represent CBOD.

Future

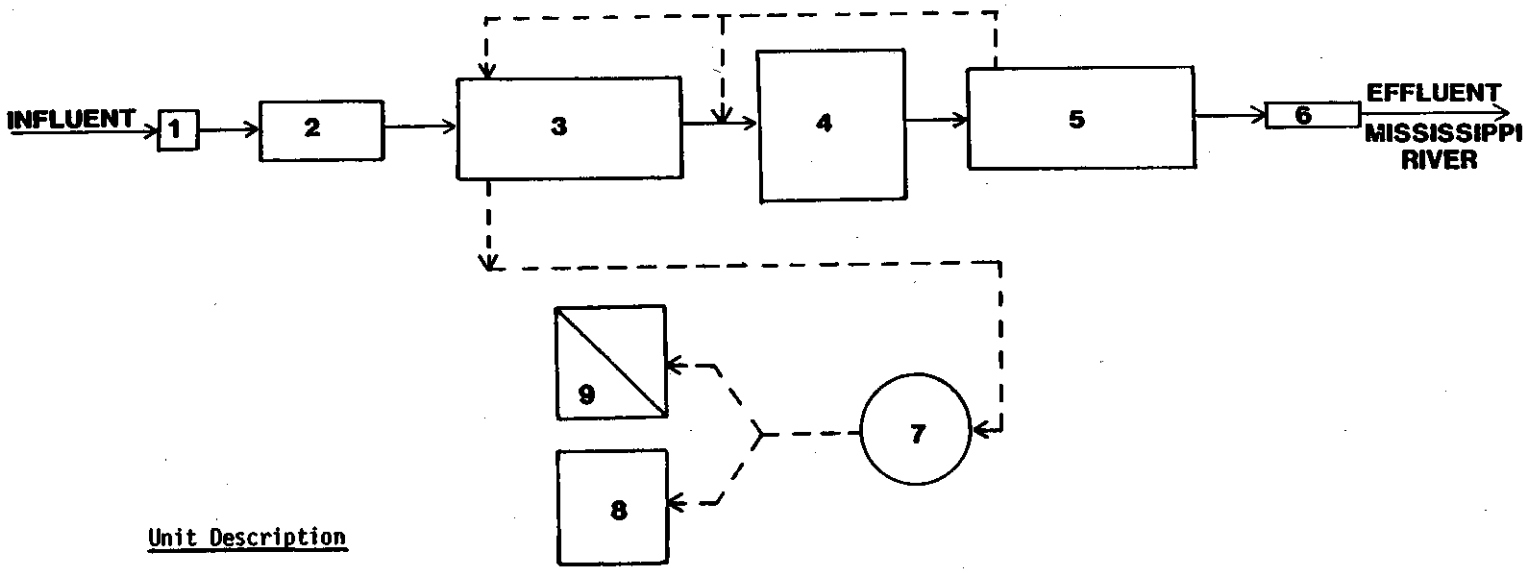
The plant will continue to serve Service Area No. 3 until the late 1980's, when it is scheduled for phase-out, with flow transported to the Metropolitan Plant. Plant phase-out is contingent upon completion of the Champlin-Anoka-Brooklyn Park (CAB) and Minneapolis East Interceptor. In the interim period prior to phase-out limited capital improvements will be necessary to insure adequate capacity.

ANOKA PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	2.14	2.33	2.49	2.34	2.48	2.74
BOD Loading, lb/day	3,980	4,000	4,010	4,500	4,200	4,900
TSS Loading, lb/day	2,770	3,400	3,300	3,160	4,100	4,380
COD Loading, lb/day	6,350	7,800	8,350	7,120	8,700	10,170
Sludge Production, lb/day	1,500	1,800	1,970	1,970	3,000	3,130
Grit Removal						
Overflow Rate, gpd/sq. ft.	41,150	45,000	47,900	45,000	48,000	52,700
Primary Sedimentation						
Detention Time, hr.	2.0	1.9	1.8	1.9	1.8	1.6
Weir Overflow Rate, gpd/lin. ft.	7,980	8,700	9,300	8,730	9,300	10,200
Surface Overflow Rate, gpd/sq. ft.	715	780	830	780	830	910
Aeration Tanks						
Detention Time, hr.	7.9	7.2	6.7	7.2	6.8	6.1
BOD Loading, lb/day/1000 cu. ft.	43	43	43	48	46	52
Final Sedimentation						
Detention Time, hr.	3.6	3.3	3.1	3.3	3.1	2.8
Weir Overflow Rate, gpd/lin. ft.	6,560	7,100	3,640	7,180	7,600	8,400
Surface Overflow Rate, gpd/sq. ft.	500	550	590	550	580	650
Chlorination						
Contact Time, minutes	37	34	32	34	12	29
Chlorine Use, lb/day	123	110	113	146	130	131
Anaerobic Digestion (Primary Digester Only)						
Volatile Solids Loading, lb/cu. ft./day	0.08	0.06	0.06	0.10	-----	0.10
Detention Time, days	20	22	22	15.8	-----	16
Volatile Solids Reduction, %	-----	55.0	50	-----	-----	------
Sludge Transport						
Volume, gpd	10,930	9,100	11,300	14,040	12,000	15,900

ANOKA WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

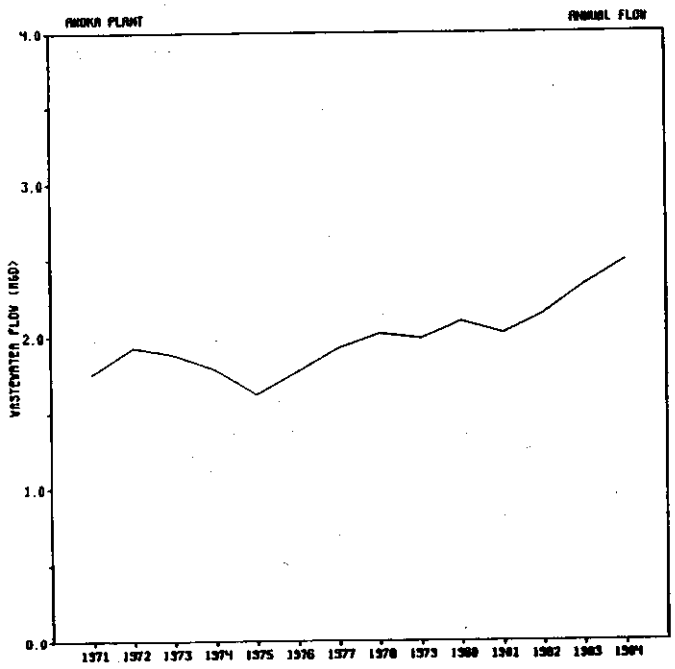
1. Screening
2. Grit Removal
3. Primary Sedimentation
4. Activated Sludge
5. Final Sedimentation
6. Chlorination

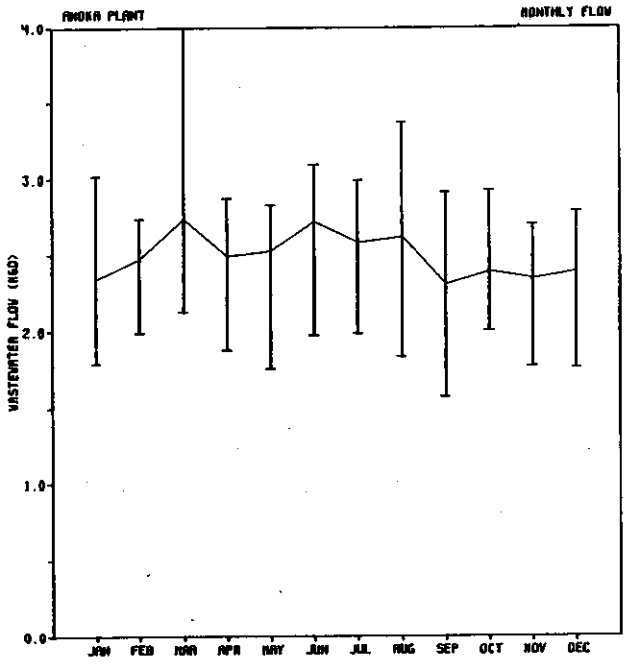
Solids Phase

7. Anaerobic Digestion
8. Landspreading
9. Disposal at Metro Plant

Legend

- Liquid Flow
- Solids Transfer
- Existing Processing Units
- Future Process Units





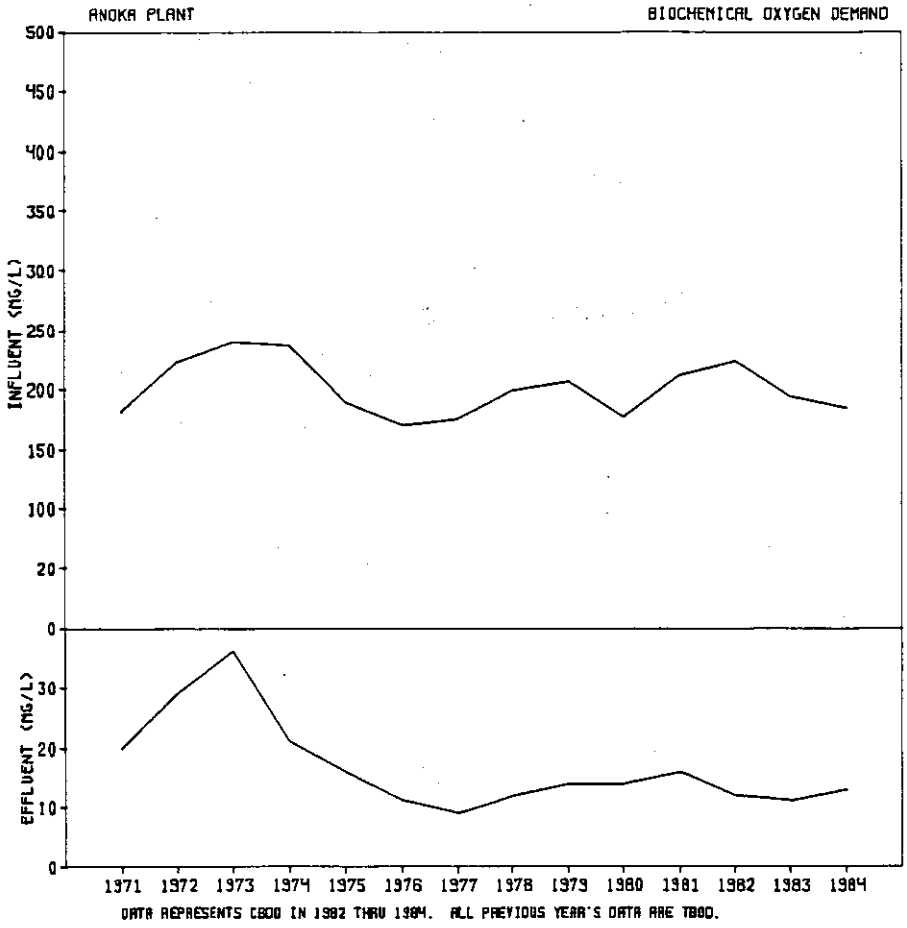
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Anoka

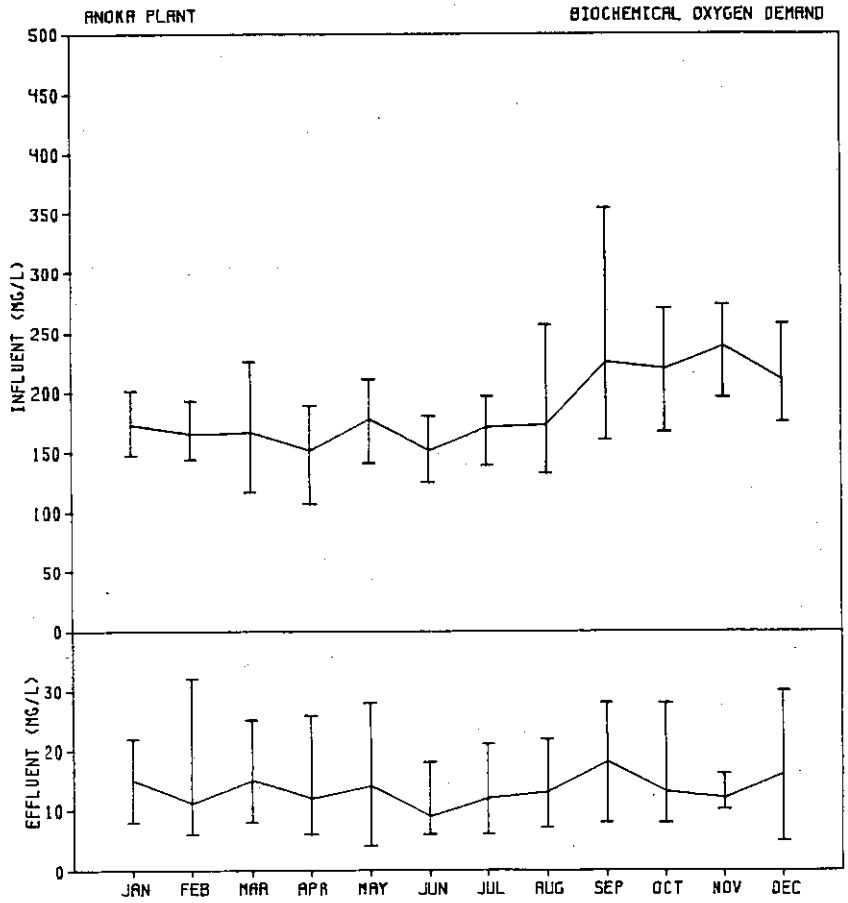
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	2.34	15	172	147	7.2-8.7	39.2	8.7	19.6	364
FEBRUARY	2.47	16	165	140	7.2-8.4	36.3	7.9	16.3	338
MARCH	2.74	15	166	159	7.1-8.8	33.9	6.8	17.9	413
APRIL	2.49	17	151	115	7.3-8.2	37.4	7.3	20.4	347
MAY	2.53	18	177	132	6.9-8.5	34.3	6.0	15.2	393
JUNE	2.72	21	151	116	6.5-8.2	27.0	5.4	12.1	323
JULY	2.58	23	170	159	6.6-8.2	28.3	6.2	10.7	367
AUGUST	2.62	23	172	147	7.1-8.1	28.0	5.3	11.9	342
SEPTEMBER	2.30	23	224	173	6.9-8.3	33.5	8.9	11.3	422
OCTOBER	2.39	23	219	167	6.7-8.1	37.8	7.5	17.9	415
NOVEMBER	2.34	22	238	151	6.7-8.2	34.1	6.8	14.8	464
DECEMBER	2.39	17	209	212	6.8-8.5	38.5	9.4	20.6	388
1984 AVERAGE	2.49	19	184	150	6.5-8.8	34.1	7.2	15.7	381
1983 AVERAGE	2.33	17	193	165	6.0-9.2	37.4	7.2	19.5	379

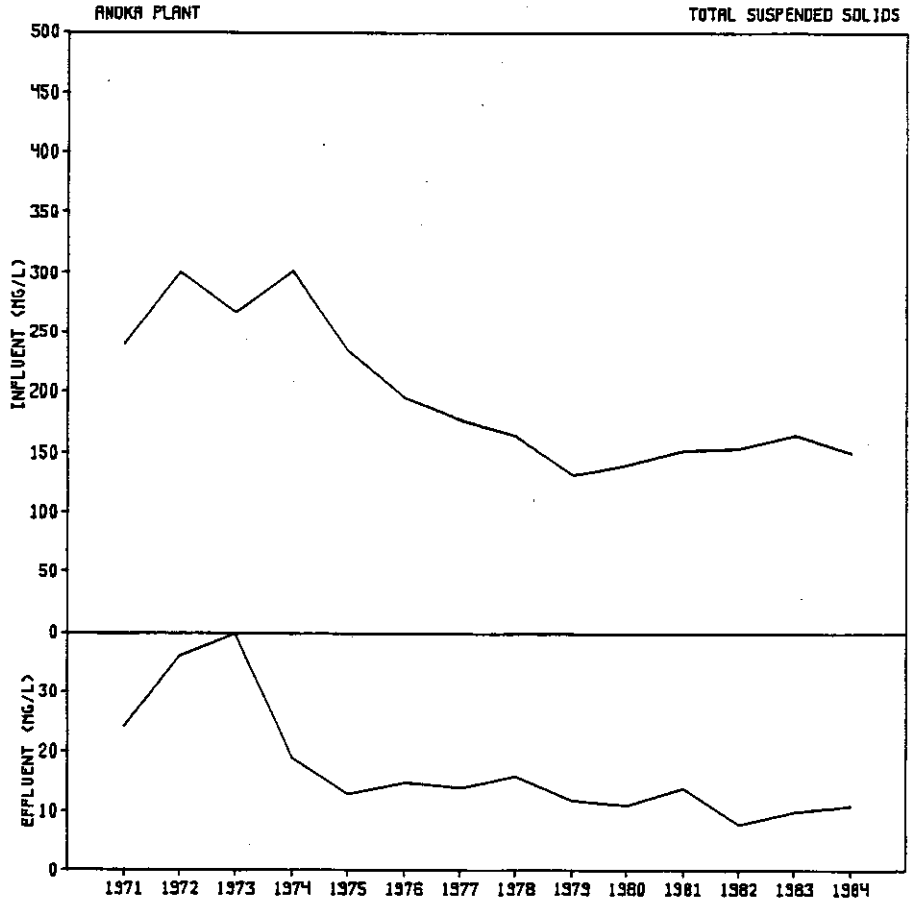
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Anoka

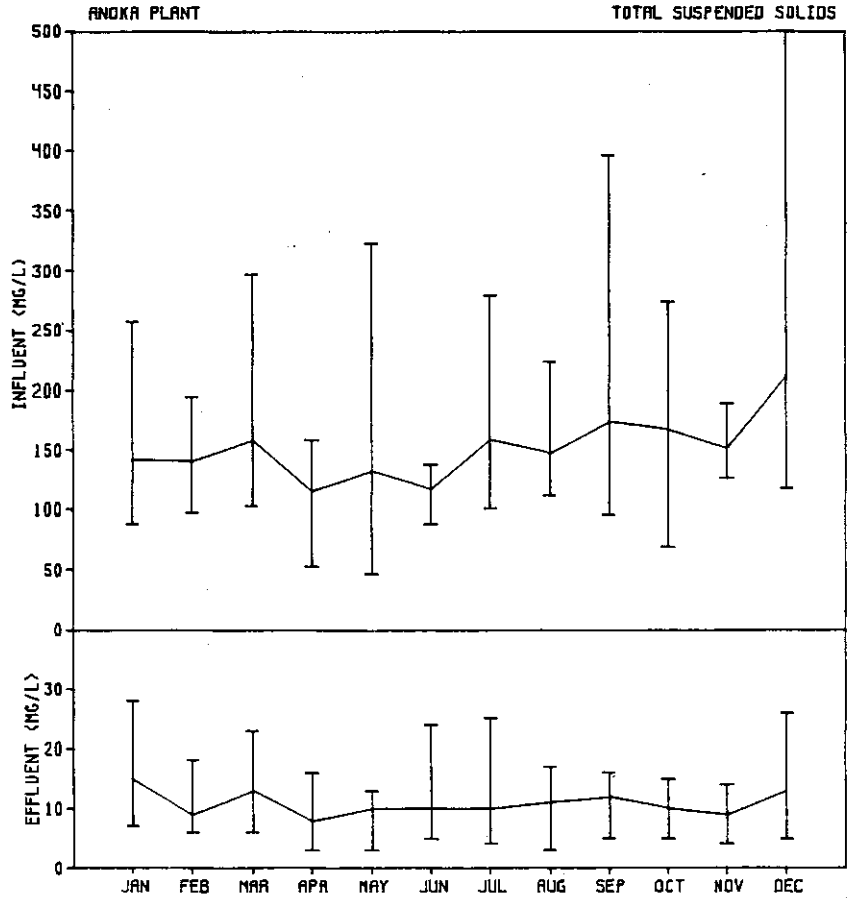
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	----	----	----	---	---	---	---	6.5-8.5	--	--
JANUARY	22	15	90	15	59	8	24.8	16.4	0.26	0.25	5.1	122	4.9	1.8	7.1-7.5	91	89
FEBRUARY	16	11	82	9	47	5	20.4	14.0	0.18	0.33	4.1	98	4.5	1.9	7.1-7.4	93	94
MARCH	20	15	103	13	33	8	22.0	15.0	0.13	0.45	3.7	105	4.2	2.0	7.1-7.4	91	92
APRIL	15	12	77	8	71	6	18.5	13.1	0.17	0.62	4.7	104	4.1	1.8	7.1-7.4	92	93
MAY	21	14	78	10	122	7	18.3	9.4	1.40	0.80	3.2	128	4.5	2.1	7.2-7.4	92	93
JUNE	12	9	74	10	127	5	16.9	11.9	0.07	0.15	2.9	131	5.8	1.6	7.2-7.5	94	91
JULY	18	12	80	10	59	7	19.3	9.6	0.36	0.25	3.8	116	5.4	1.6	7.1-7.4	93	94
AUGUST	18	13	84	11	49	7	19.6	9.3	0.21	0.23	3.4	108	6.0	1.7	7.3-7.5	93	93
SEPTEMBER	25	18	84	12	36	8	21.9	11.4	0.11	0.19	4.6	116	5.4	2.0	7.2-7.4	92	93
OCTOBER	18	13	72	10	76	6	23.2	12.3	0.04	0.19	3.9	111	5.1	1.8	7.1-7.3	94	94
NOVEMBER	15	12	70	9	199	5	18.4	9.0	0.02	0.24	3.1	117	6.1	1.9	7.1-7.4	95	94
DECEMBER	21	16	72	13	58	10	14.3	10.2	0.03	0.21	2.7	105	5.3	2.1	7.1-7.3	92	94
1984 AVG.	19	13	80	11	78	7	19.9	11.8	0.27	0.33	3.8	114	5.1	1.9	7.1-7.5	93	93
1983 AVG.	15	11	80	10	67	6	21.9	15.6	0.58	0.24	4.2	115	4.7	1.8	7.0-7.5	94	94

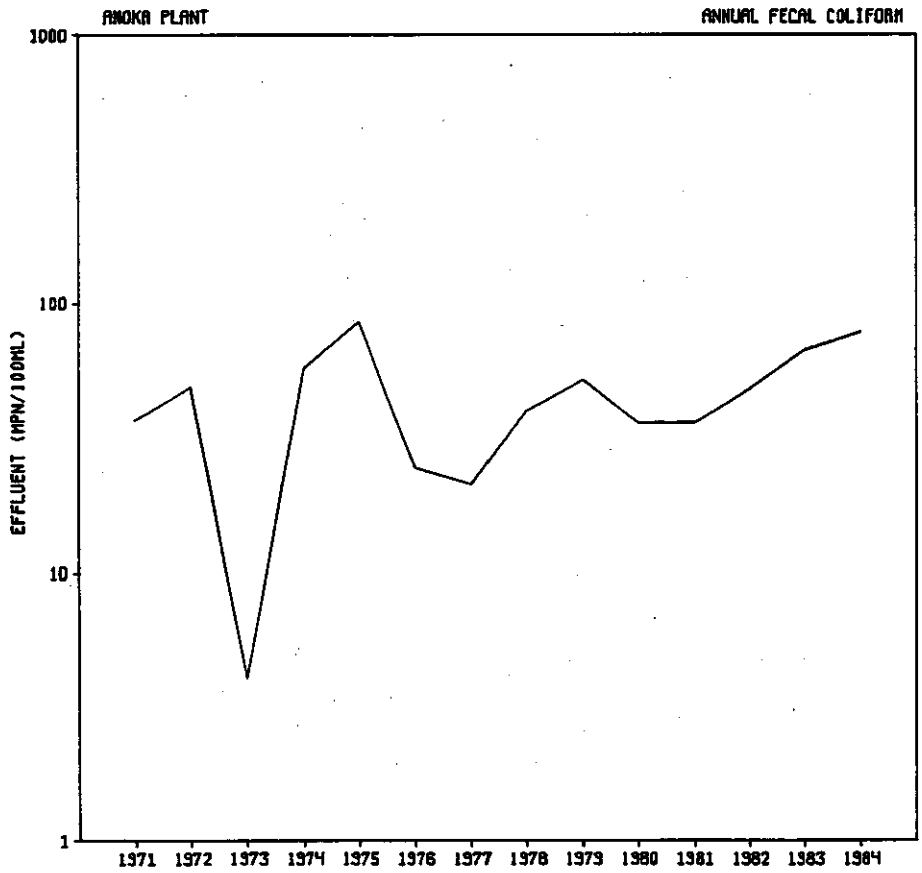
*For disinfection only.

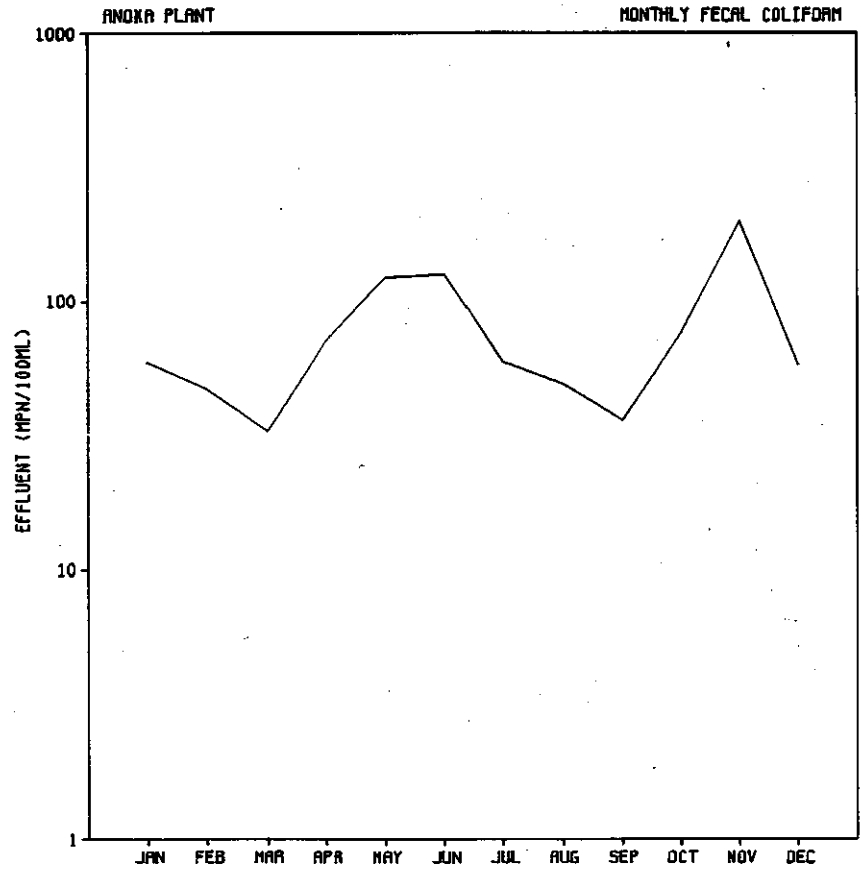

ANOKA PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
20
0
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.

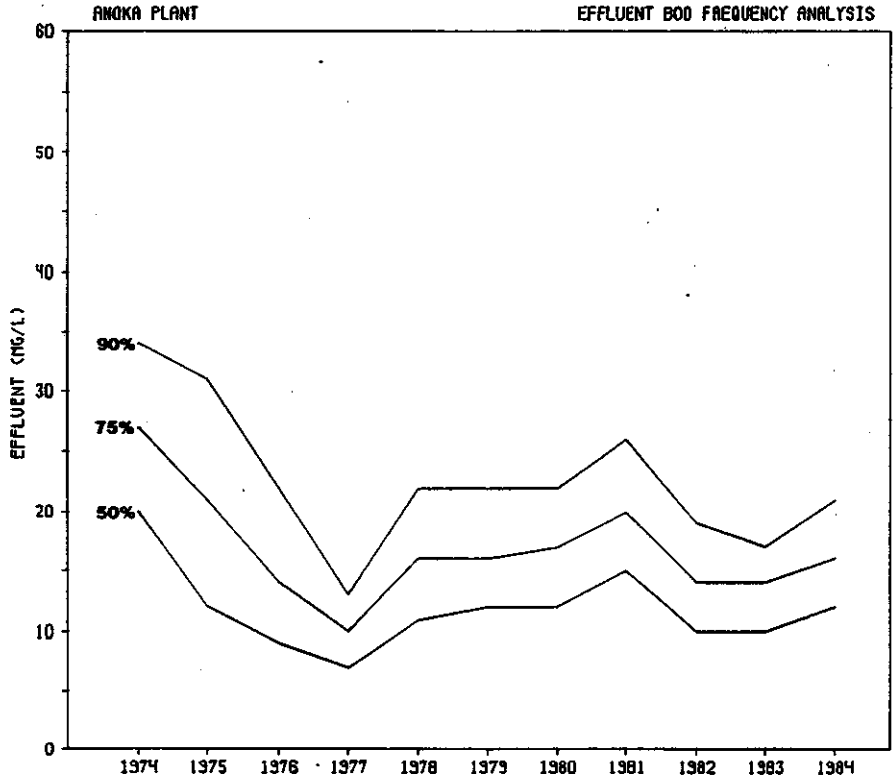

ANOKA PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

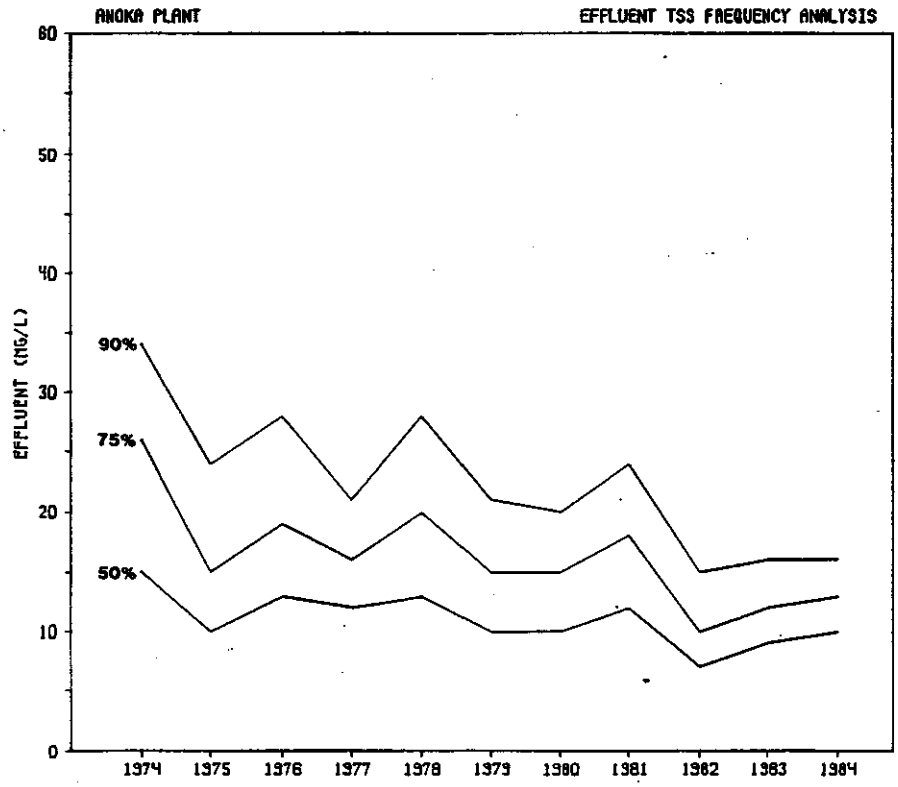

ANOKA PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


ANOKA PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


ANOKA PLANT
ANNUAL FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


ANOKA PLANT
MONTHLY FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


ANOKA PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


ANOKA PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

1984 EFFLUENT DATA
TREATMENT PLANT Anoka

MONTH	Cu mg/l	Cr mg/l	Zn mg/l	Pb mg/l	Cd mg/l	Hg ug/l	CN mg/l	As ug/l	PCB ug/l	Ni mg/l	Phenol ug/l	Fe mg/l
NPDES Limit	0.30	0.40	0.50	0.50			0.500					
January	0.04	<0.05	0.16	<0.05			0.043					
February	0.05	<0.05	0.13	<0.05			0.047					
March	0.05	<0.05	0.16	<0.05			0.032					
April	0.04	<0.08	0.19	<0.05			0.043					
May	0.06	<0.05	0.20	<0.05			<0.030					
June	0.08	<0.05	0.06	<0.05			<0.047					
July	0.07	<0.05	0.14	<0.05			<0.026					
August	0.03	<0.05	0.08	<0.05			<0.030					
September	0.03	<0.05	0.12	<0.05			<0.050					
October	0.03	<0.05	0.08	<0.05			0.036					
November	0.04	<0.05	0.19	<0.05			0.042					
December	0.16	<0.05	0.28	<0.05			<0.032					
1984 Avg.	0.06	<0.05	0.15	<0.05			<0.038					
1983 Avg.	0.03	<0.05	0.09	<0.05			<0.219					

BAYPORT WASTEWATER TREATMENT PLANT

Plant History and Description

The original Bayport Wastewater Treatment Plant was built in 1939, consisting of a primary clarifier, two mechanical aeration tanks, final clarifier, chlorine contact tank, heated anaerobic digester, drying beds, and a control and pumping building. In 1956, the digester was converted to external heating, and a sludge recirculating pump added. In 1958, the plant was expanded by addition of a chlorine contact tank, an aeration tank, a final settling tank, an anaerobic digester, a barminutor, and a drying bed.

In 1964, extensive plant remodeling and additions, designed by Banister, Short, Elliot, Hendrickson, and Associates were completed. In 1973, chemical feed for phosphorus removal was provided and in 1982, mechanical screening was replaced by a stationary hydrasieve fine screening mechanism.

Liquid treatment consists of screening, influent pumping, contact stabilization, activated sludge aeration, alum addition for phosphorus removal, final clarification, chlorination, and discharge to Lake St. Croix (the St. Croix River).

Solids processing consists of aerobic digestion and sludge hauling to the Metropolitan Plant Interceptor System.

The Bayport Plant is presently operating at about 80 percent of its design capacity, and is subject to secondary treatment limits and a phosphorus limit of 1 mg/L.

Performance

Plant flow averaged 0.50 mgd in 1984, slightly lower than 0.54 mgd in 1983. Average plant effluent quality was 6 mg/L BOD, 8 mg/L TSS, and 0.4 mg/l P. Plant performance was excellent throughout the year, with no NPDES Permit violations. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	7	7	6	5	8	9	7	7	10	13	8	8
TSS	7	7	6	7	9	9	7	9	10	12	9	10

*1982 through 1984 values represent CBOD.

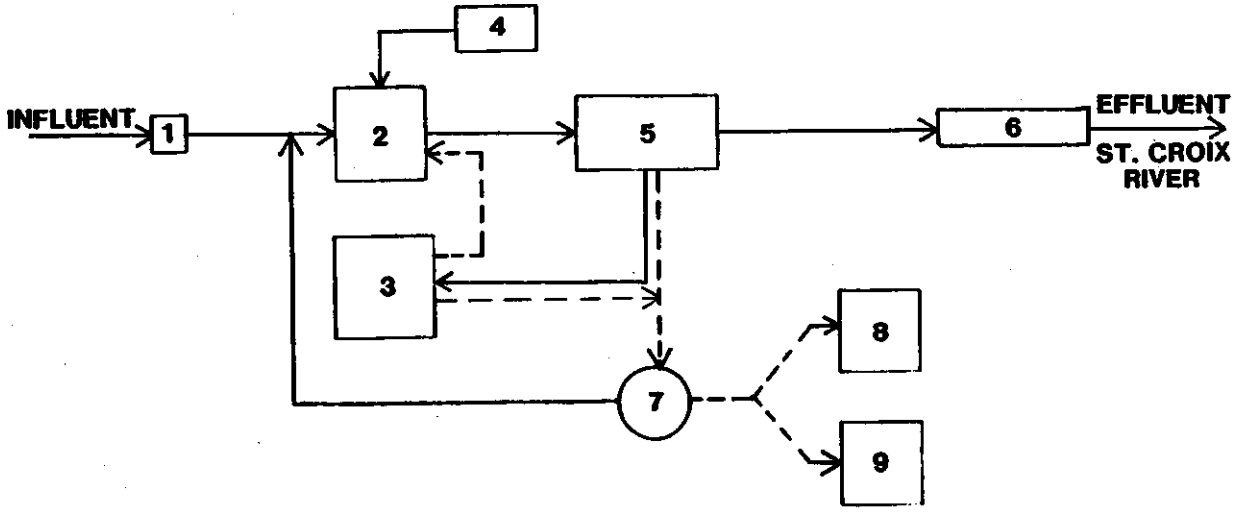
Future

The long-term plan for this plant is to phase it out of service and divert flows to the Stillwater Plant. This is projected to occur in the late 1980's or early 1990's, when the plant is expected to reach its capacity, and also will be nearing the end of its useful life.

BAYPORT PLANT PROCESS LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	0.52	0.54	0.50	0.65	0.66	0.76
BOD Loading, lb/day	698	720	717	968	1,060	914
TSS Loading, lb/day	664	800	877	999	1,380	1,378
COD Loading, lb/day	1,227	1,330	1,432	1,453	2,020	1,799
Aeration Basin						
BOD Loading, lb/day/1000 cu. ft.	21	22	22	29	32	28
Alum Feed Rate, gal/day	100	140	110	133	165	145
Final Sedimentation						
Weir Overflow Rate, gpd/lin. ft.	4,260	4,430	4,100	5,330	5,410	6,230
Surface Overflow Rate, gpd/sq. ft.	430	450	420	540	550	630
Chlorination						
Contact Time, minutes	60	57	62	48	47	41
Chlorine Use, lb/day	29	34	27	34	35	30
Aerobic Digestion						
Solid Retention Time, day	31	31	35	26	26	30
Sludge Transport						
Volume, gpd	3,400	4,000	3,540	4,040	4,700	4,170
Mass, lb/day	610	660	650	749	820	790

BAYPORT WASTEWATER TREATMENT PLANT
FLOW DIAGRAM



Unit Description

Liquid Phase

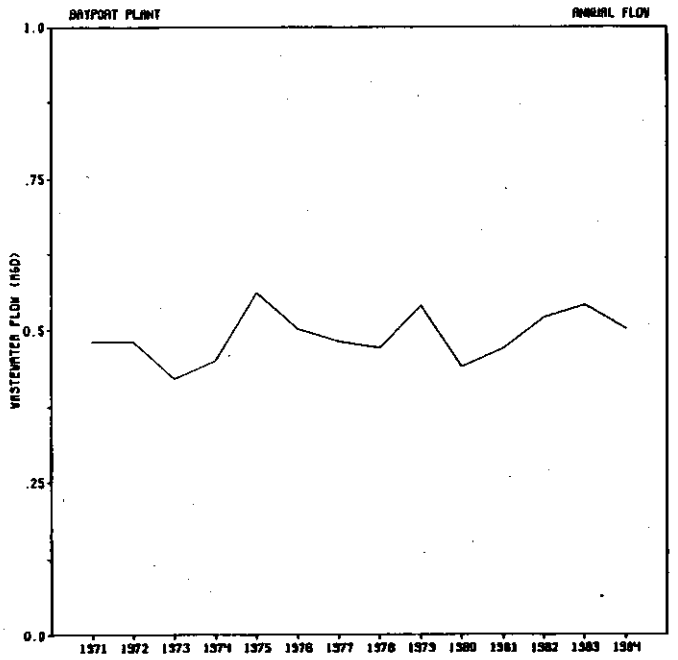
1. Screening
2. Activated Sludge
3. Sludge Reaeration
4. Chemical Addition
5. Final Sedimentation
6. Chlorination

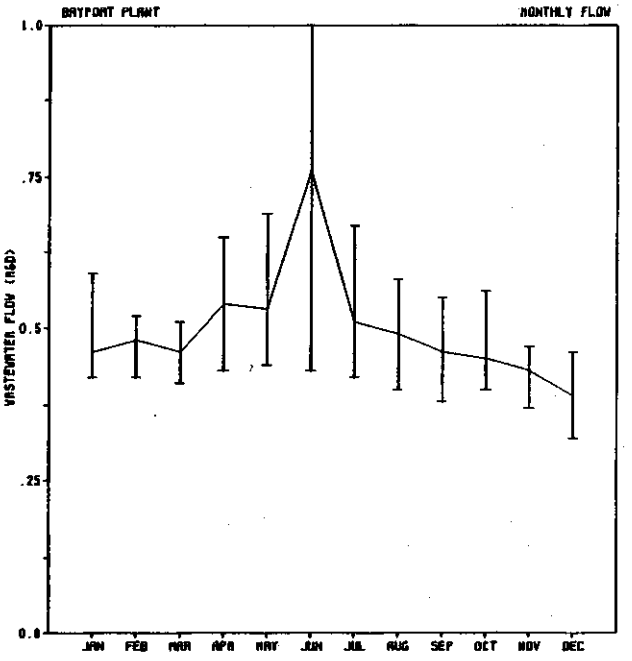
Solids Phase

7. Aerobic Digestion
8. Sand Drying Beds
9. Land Spread

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





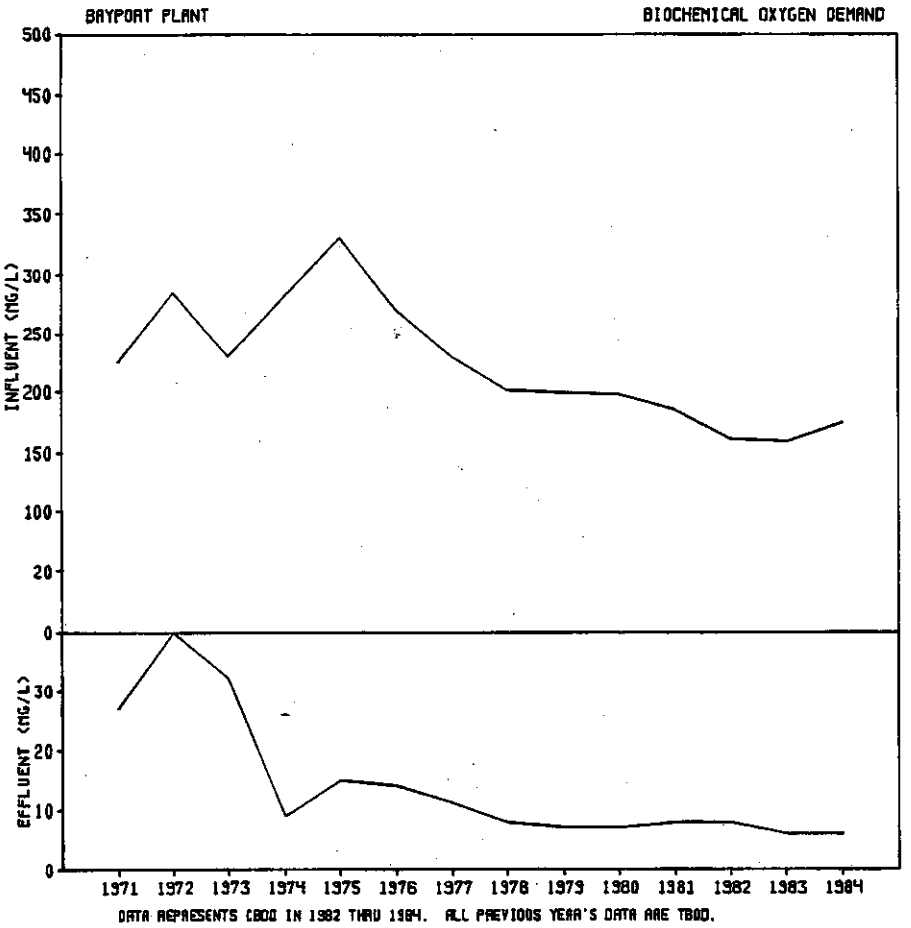
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Bayport

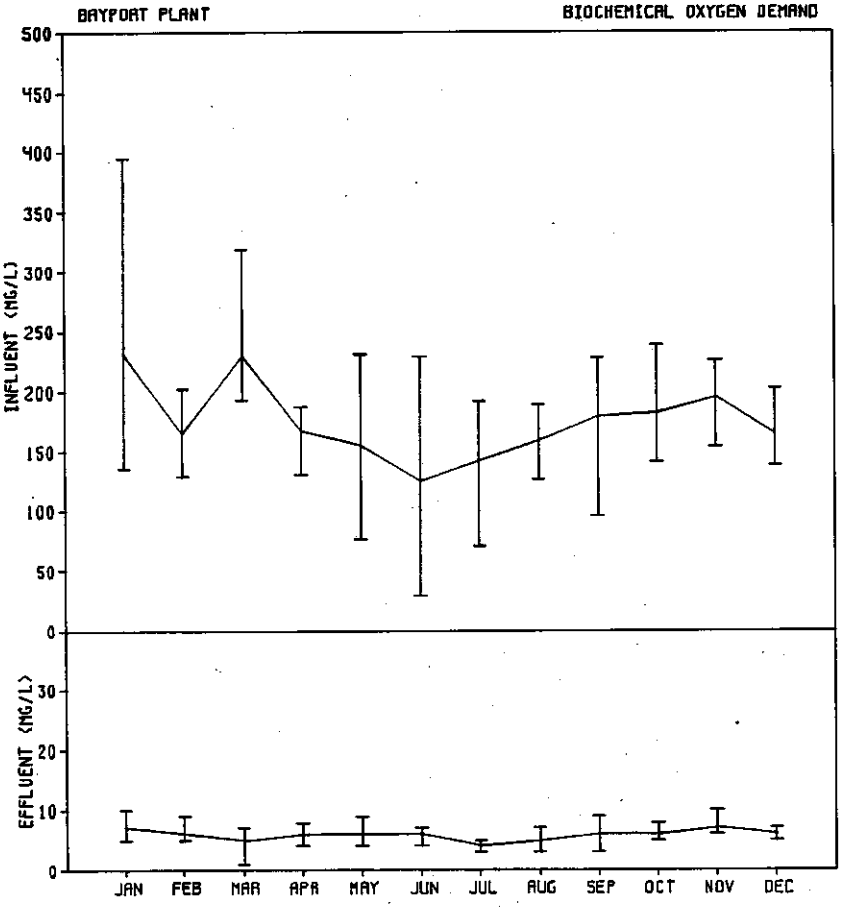
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	0.46	18	231	211	6.4-9.0	33.0	5.5	18.2	367
FEBRUARY	0.48	18	165	147	6.6-8.6	28.4	5.5	14.6	303
MARCH	0.46	16	229	249	6.6-9.0	33.8	7.0	18.7	449
APRIL	0.54	16	167	189	7.0-9.2	26.4	6.2	14.4	383
MAY	0.53	16	154	154	6.9-9.4	28.2	5.5	14.4	337
JUNE	0.76	18	125	148	5.8-9.0	20.0	4.6	9.1	259
JULY	0.51	21	142	232	6.6-8.0	27.4	6.5	10.6	318
AUGUST	0.49	22	158	319	6.0-7.8	32.9	7.6	13.5	328
SEPTEMBER	0.46	21	179	214	6.0-7.8	30.8	7.0	13.5	340
OCTOBER	0.45	20	182	204	6.2-8.4	32.0	7.2	15.8	348
NOVEMBER	0.43	18	194	183	6.2-8.8	30.9	6.0	15.4	358
DECEMBER	0.39	16	164	274	6.2-8.6	31.1	5.7	17.3	310
1984 AVERAGE	0.50	18	174	210	5.8-9.4	29.6	6.2	14.6	339
1983 AVERAGE	0.54	20	158	178	5.2-9.7	29.4	5.7	16.4	293

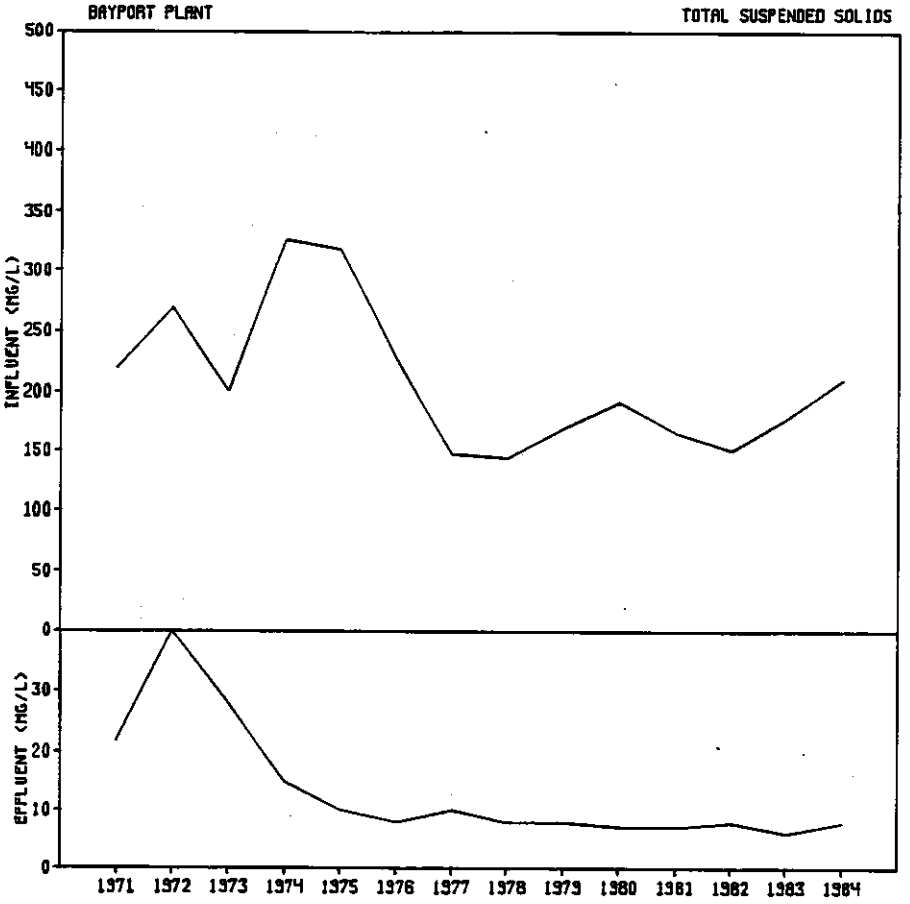
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Bayport

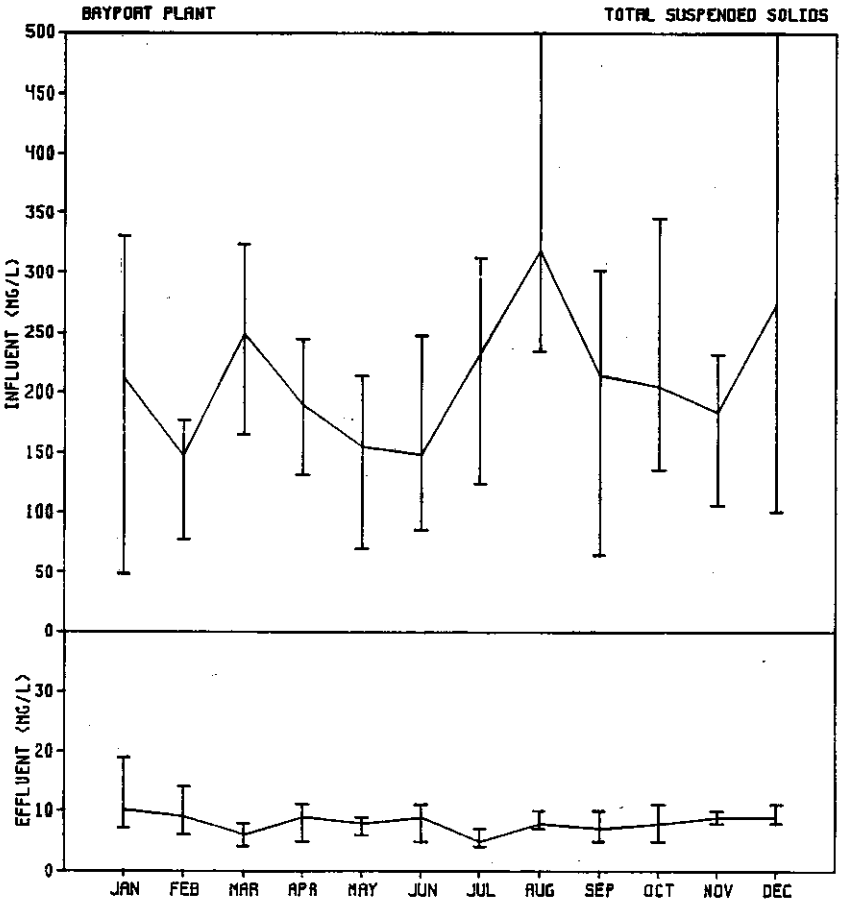
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	C12* Used lbs	C12 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	---	---	-----	-----	1.0	--	---	---	6.5-8.5	--	--
JANUARY	13	7	31	10	---	3	6.2	4.0	0.38	6.54	0.4	--	---	4.4	6.9-7.1	97	95
FEBRUARY	14	6	36	9	---	3	5.8	2.6	0.39	11.49	0.4	18	2.1	3.2	6.7-7.4	96	94
MARCH	6	5	32	6	4	3	5.4	4.3	0.09	9.51	0.4	28	4.3	4.3	6.6-7.0	98	98
APRIL	7	6	38	9	5	4	6.4	4.0	0.21	8.16	0.4	28	3.2	3.4	6.7-7.0	97	95
MAY	7	6	34	8	2	4	6.6	3.1	0.24	12.45	0.3	25	4.0	3.9	6.8-7.2	96	95
JUNE	9	6	35	9	35	4	4.9	2.9	0.64	7.20	0.3	23	2.1	3.6	6.7-7.4	95	94
JULY	8	4	29	5	4	3	4.3	1.5	1.08	10.70	0.2	30	2.3	3.9	6.8-7.4	97	98
AUGUST	9	5	33	8	4	3	5.3	3.0	1.11	11.76	0.4	28	2.3	3.4	6.6-7.8	97	98
SEPTEMBER	8	6	28	7	6	4	5.0	3.0	0.90	12.35	0.5	25	3.1	3.3	6.6-7.6	97	97
OCTOBER	8	6	31	8	4	4	5.8	4.9	0.79	10.52	0.6	25	2.7	3.4	6.6-7.0	97	96
NOVEMBER	14	7	35	9	---	3	7.3	4.6	0.51	11.99	0.4	--	---	4.1	6.7-7.0	96	95
DECEMBER	14	6	38	9	---	4	7.4	4.1	0.50	10.50	0.5	--	---	4.0	6.7-7.0	96	97
1984 AVG.	10	6	33	8	8	3	5.8	3.5	0.58	10.25	0.4	26	3.0	3.8	6.6-7.8	97	96
1983 AVG.	9	6	29	6	10	2	5.4	3.0	0.41	10.71	0.4	34	2.5	3.8	6.8-7.4	96	96

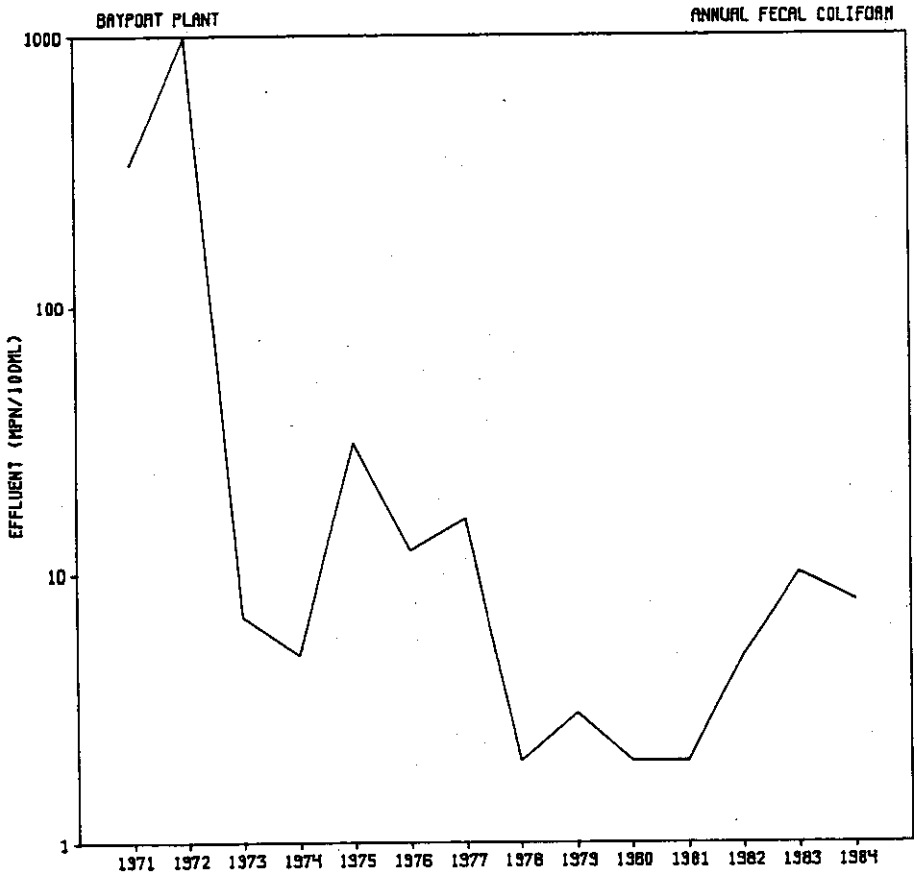
*For disinfection only.

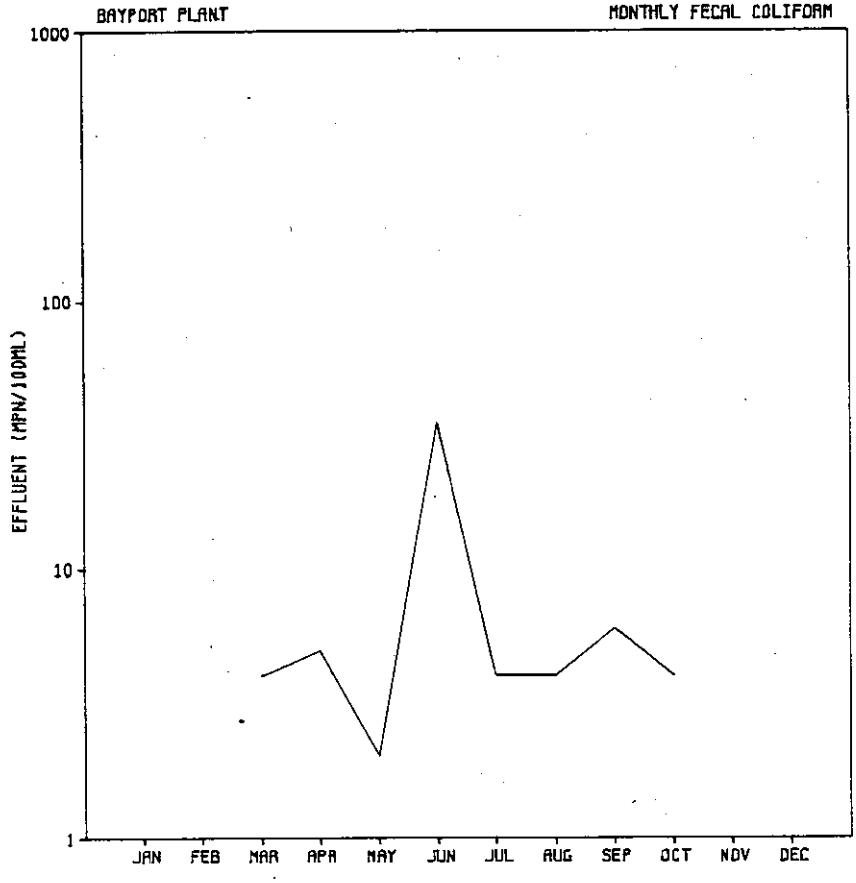

BAYPORT PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.

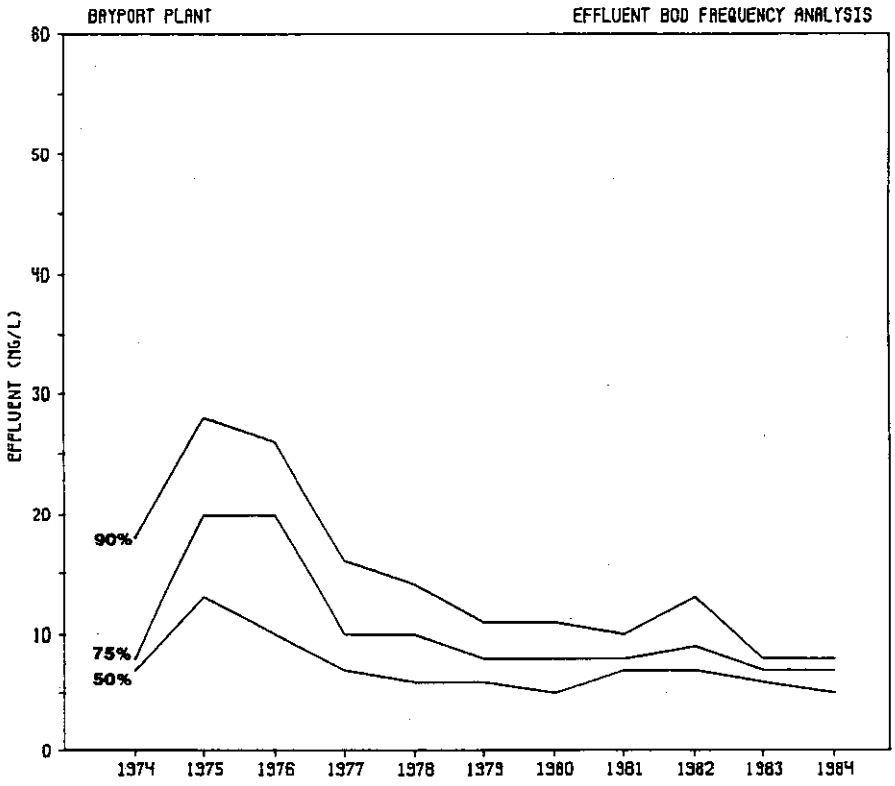

BAYPORT PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

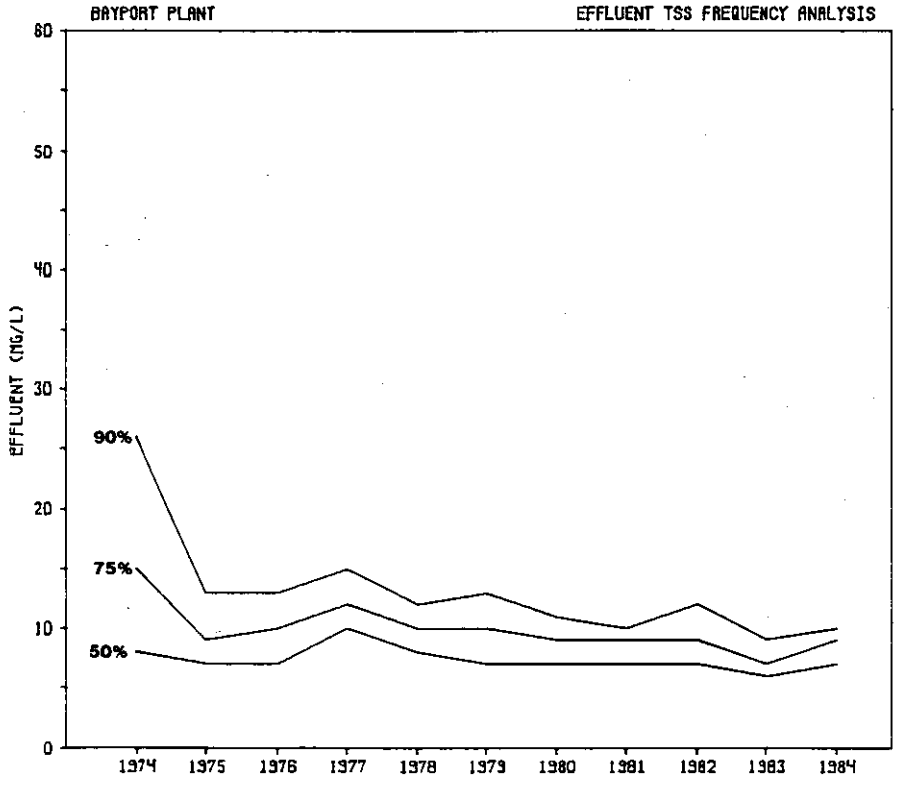

BAYPORT PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


BAYPORT PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


BAYPORT PLANT
ANNUAL FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


BAYPORT PLANT
MONTHLY FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


BAYPORT PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


BAYPORT PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

BLUE LAKE WASTEWATER TREATMENT PLANT

Plant History and Description

The Blue Lake Wastewater Treatment Plant was designed by Rieke-Carroll-Muller and Associates to be built in several stages and treat wastewater contributed by Sewer Service Area No. 4. Stage I, placed in operation in July, 1971, consisted of an aerated pond and chlorination facilities to provide temporary wastewater treatment. Stage II, consisting of the liquid treatment portion of a secondary treatment activated sludge plant, utilizing the existing aerated pond as an effluent polishing pond was constructed in 1973. Stage III, consisting of sludge processing facilities has not yet been constructed.

Liquid treatment consists of screening, primary sedimentation, complete mix activated sludge aeration with integral final clarification, an effluent polishing pond, chlorination, and discharge to the Minnesota River.

Solids processing consists of sludge thickening in primary clarifiers and sludge hauling to either the Seneca or Metropolitan Plant.

The Blue Lake Plant is operating at approximately 95 percent of its rated capacity and is subject to secondary treatment limits.

Performance

Plant flow averaged 19.5 mgd in 1984, considerably higher than 18.1 mgd in 1983. Average plant effluent quality was 9 mg/L BOD and 7 mg/L TSS. Plant performance was good throughout the year with no NPDES permit violations. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	9	10	8	9	13	13	11	11	19	16	13	14
TSS	6	6	7	5	7	8	9	7	19	10	11	10

*1982 through 1984 values represent CBOD.

Future

The Blue Lake Plant is one of the Commission's permanent regional treatment plants. Space is available for future expansions to serve Sewer Service Area No. 4. The first phase of Stage III, gravity thickeners and sludge loadout facilities, has been designed and is awaiting construction funding. The remainder of Stage III is planned to include anaerobic digestion, dewatering and land application. The timing of implementing these facilities is uncertain. A liquid treatment plant expansion is planned for the late 1980's.

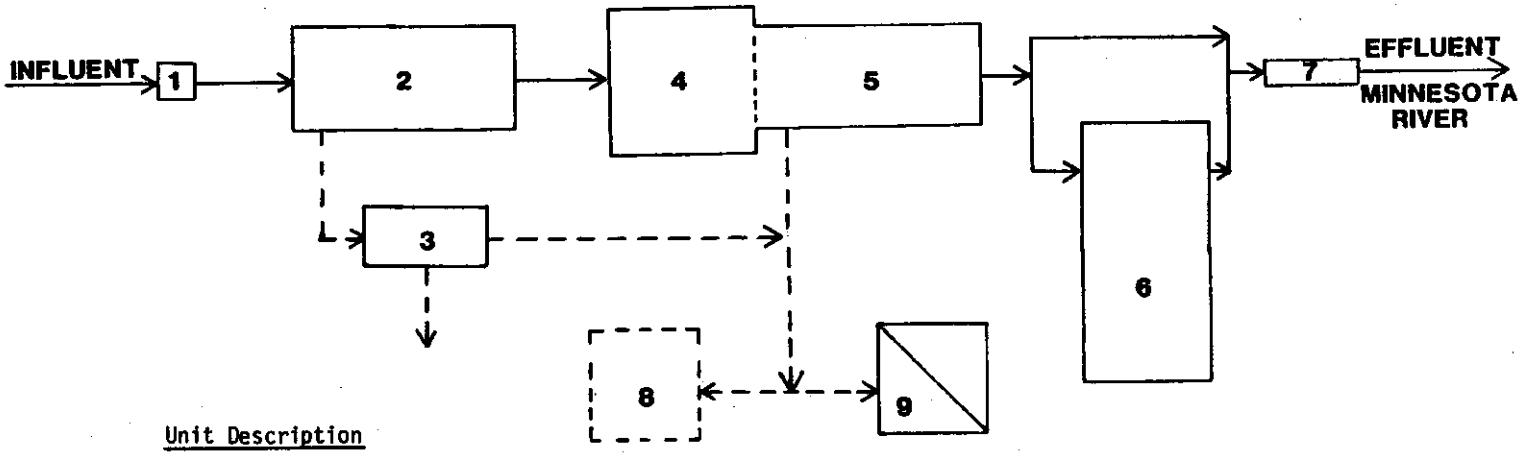
BLUE LAKE PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	16.1	18.1	19.5	18.2	24.2	23.9
BOD Loading, lb/day	30,600	29,300	28,800	36,100	35,000	31,600
TSS Loading, lb/day	30,800	33,800	33,200	44,500	48,400	37,000
Primary Sedimentation[1]						
Surface Overflow Rate, gpd/sq. ft.	800	905	975	910	1,210	1,190
Weir Overflow Rate, gpd/lin. ft.	16,100	18,100	19,500	18,200	24,200	23,900
Aeration Tanks						
BOD Loading, lb/day/1000 cu. ft.	82	56	57	91	75	62
Detention Time, hr.	3.3	3.3	3.7	2.9	2.9	2.8
Final Sedimentation						
Surface Overflow Rate, sq. ft.	620	530	570	710	710	700
Weir Overflow Rate, gpd/lin. ft.	12,000	10,900	11,700	14,000	14,500	14,300
Aerated Pond						
BOD Loading, lb/day	3,800	2,300	2,200	5,600	3,600	2,500
Detention Time, days	3.2	2.8	2.5	2.9	2.1	2.1
Total Air Flow, cfm	12,400	13,100	13,000	14,700	14,400	14,400
Chlorine Use, lb/day	210	250	190	260	274	225
Thickened Sludge						
Production, lb/day	42,000	47,500	42,600	48,000	53,600	47,000
Volume, gpd	99,000	116,000	111,000	114,000	125,600	130,000
Concentration, %TSS	4.9	4.9	4.6	5.6	5.7	5.6
Volatile Solids, %	72	71	71	71	74	76

[1]Two clarifiers are used for combined settling and gravity sludge thickening. These clarifiers normally receive less flow than the other two clarifiers, but flow to each pair of clarifiers is not measured. Overflow rates shown are based on equal flow to all clarifiers.

BLUE LAKE WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

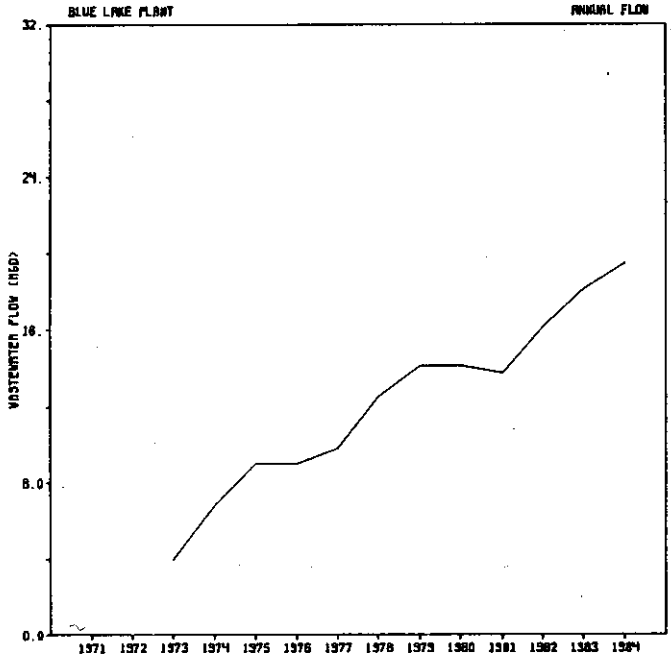
1. Screening
2. Primary Sedimentation
3. Grit Removal
4. Activated Sludge
5. Final Sedimentation
6. Aerated Effluent Pond
7. Chlorination

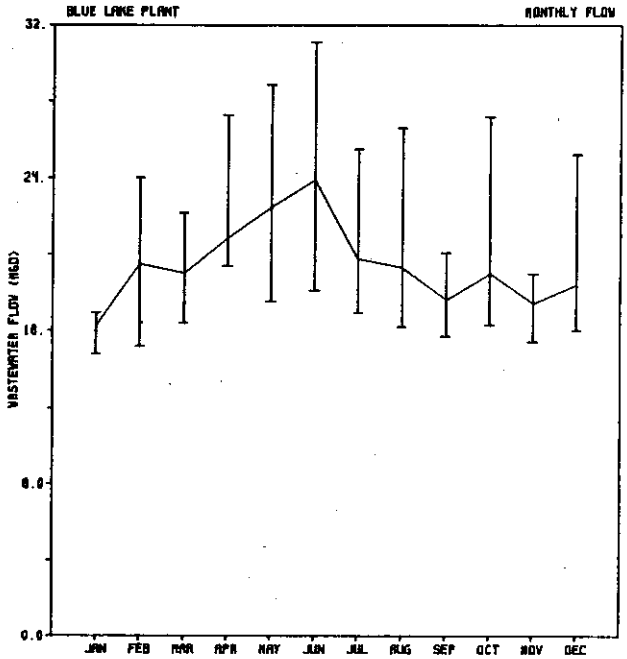
Solids Phase

8. Stage III (Future)
9. Disposal at Metro or Seneca Plant

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





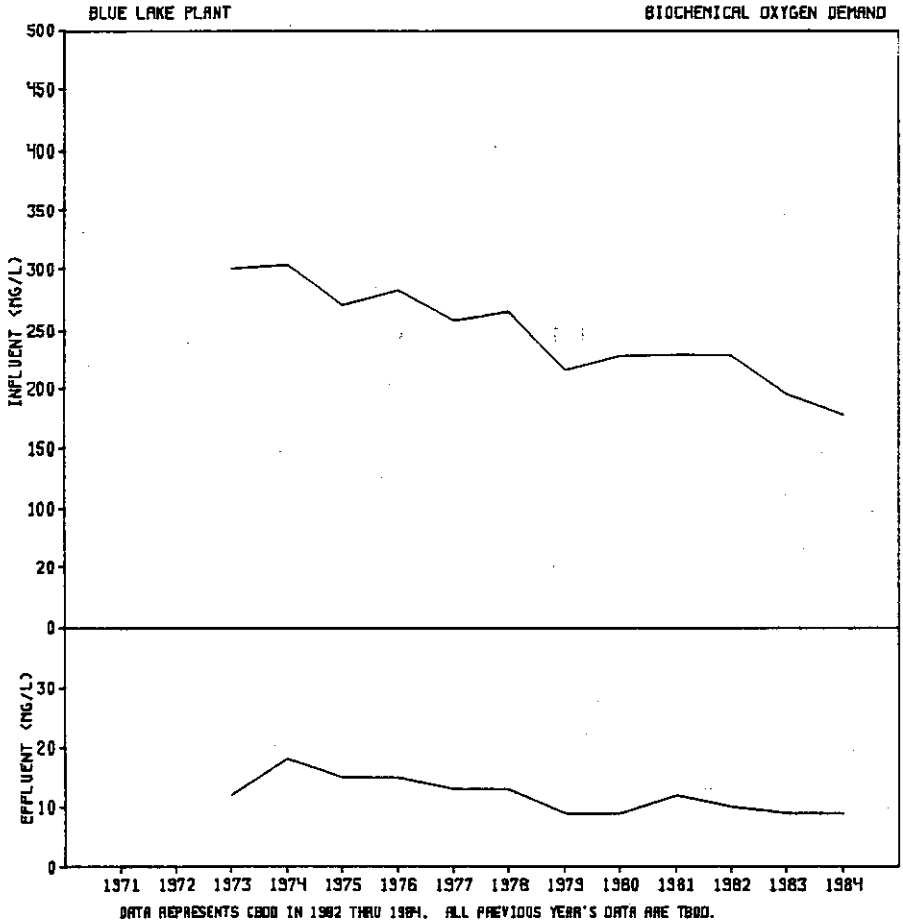
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Blue Lake

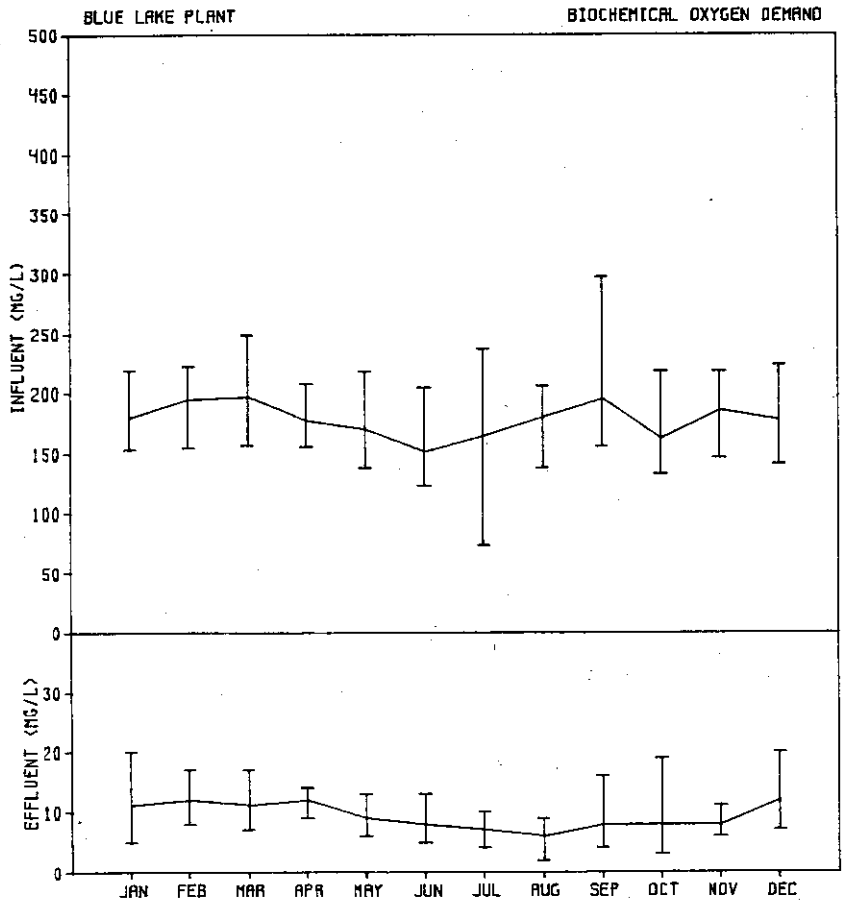
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	16.2	12	180	205	6.9-7.5	34.2	6.7	14.4	439
FEBRUARY	19.5	11	194	203	6.9-7.3	27.9	6.3	9.9	475
MARCH	19.0	11	197	194	6.7-7.2	28.5	6.1	13.4	483
APRIL	20.9	11	177	204	6.9-7.4	26.5	6.2	12.4	456
MAY	22.5	12	169	182	6.9-9.4	23.1	5.1	7.5	396
JUNE	23.9	14	151	217	6.8-7.4	21.5	4.9	7.6	395
JULY	19.8	16	164	224	6.9-7.4	27.6	6.2	8.1	428
AUGUST	19.3	17	180	224	6.7-7.3	28.5	6.7	10.6	440
SEPTEMBER	17.6	17	195	227	6.9-7.5	28.5	6.2	8.4	447
OCTOBER	19.0	16	162	192	6.4-9.0	28.2	6.3	10.5	408
NOVEMBER	17.4	14	185	203	4.3-9.2	30.4	6.1	12.4	417
DECEMBER	18.4	13	176	181	6.4-9.2	28.6	5.8	14.4	419
1984 AVERAGE	19.5	14	177	204	4.3-9.4	27.8	6.1	10.7	434
1983 AVERAGE	18.1	14	194	224	6.5-7.8	28.9	6.2	12.4	461

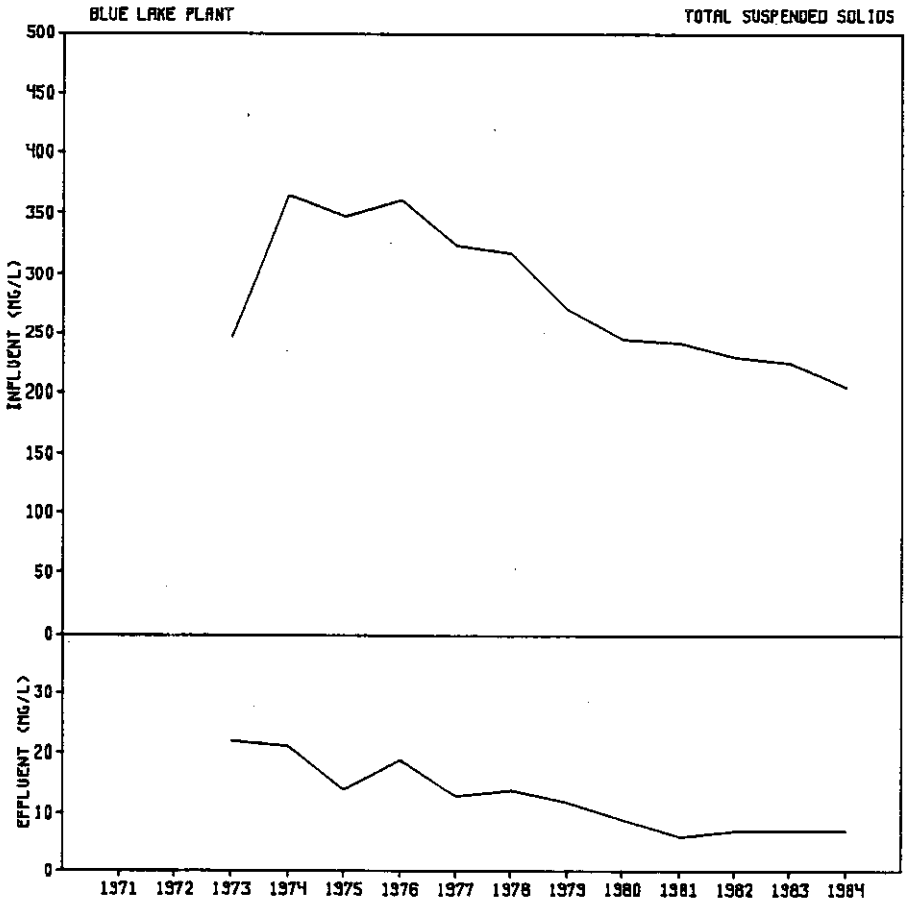
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Blue Lake

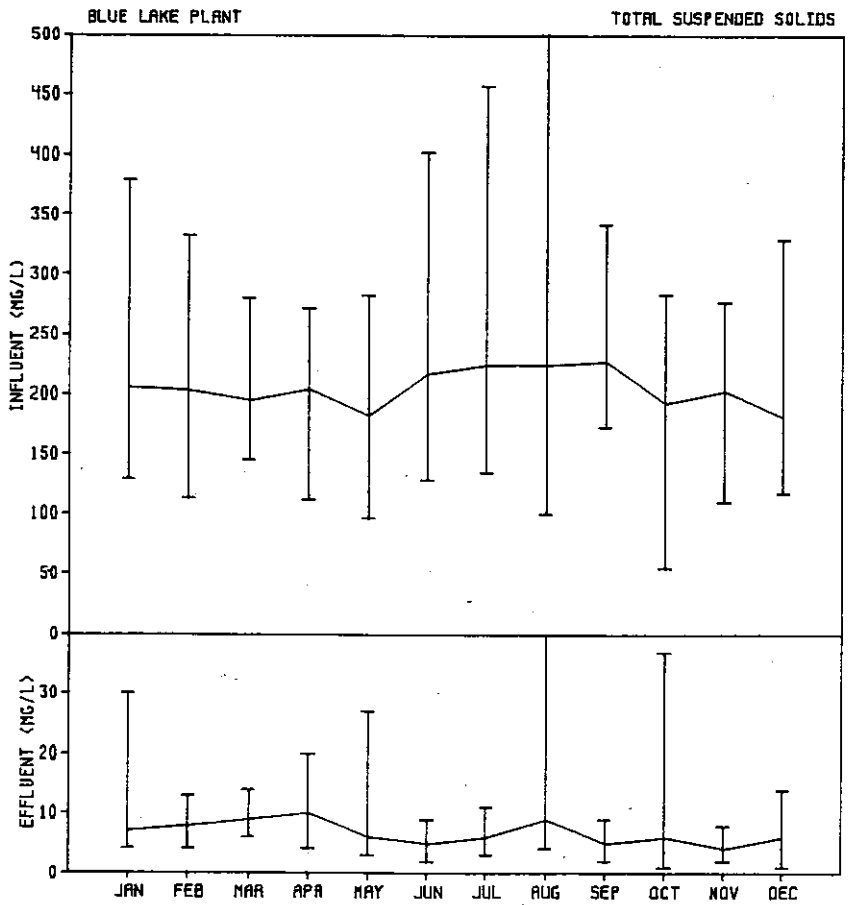
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	----	----	----	---	---	---	----	6.5-8.5	--	--
JANUARY	15	11	74	7	---	8	19.9	13.7	0.28	1.94	3.8	---	---	12.5	7.1-7.6	94	96
FEBRUARY	22	12	83	8	---	7	14.5	9.2	0.14	1.58	3.0	---	---	11.8	7.1-7.7	94	96
MARCH	34	11	83	9	5	10	14.1	10.2	0.34	2.21	3.0	168	0.6	12.5	7.1-7.5	95	96
APRIL	31	12	81	10	33	11	12.8	7.8	0.44	2.21	3.0	175	0.4	11.4	7.0-7.3	94	95
MAY	26	9	71	6	6	7	11.8	6.5	0.88	1.41	2.3	187	0.5	10.2	7.0-7.6	95	97
JUNE	28	8	67	5	37	6	8.9	5.8	1.49	1.88	2.2	154	0.4	8.6	6.5-7.5	95	98
JULY	23	7	95	6	38	8	13.5	7.3	1.82	1.61	3.1	177	0.5	8.3	7.0-7.8	95	97
AUGUST	32	6	87	9	16	9	13.5	8.2	2.05	1.76	3.3	225	0.6	6.9	7.0-7.4	97	96
SEPTEMBER	36	8	61	5	32	6	13.5	7.5	2.00	2.74	3.6	217	0.7	6.7	7.0-7.5	96	98
OCTOBER	23	8	74	6	25	7	14.2	9.5	1.10	1.78	2.8	218	0.6	7.1	6.9-7.3	95	97
NOVEMBER	23	8	62	4	---	5	16.9	11.0	0.88	1.94	3.4	---	---	8.3	7.0-7.9	95	98
DECEMBER	18	12	74	6	---	7	15.4	11.3	0.22	2.25	3.0	---	---	10.2	7.0-7.3	93	97
1984 AVG.	26	9	76	7	24	8	14.1	9.0	0.97	1.92	3.1	190	0.5	9.5	6.5-7.9	95	97
1983 AVG.	25	9	61	7	8	8	13.9	9.2	0.94	2.28	3.1	236	0.6	10.2	7.0-8.0	96	97

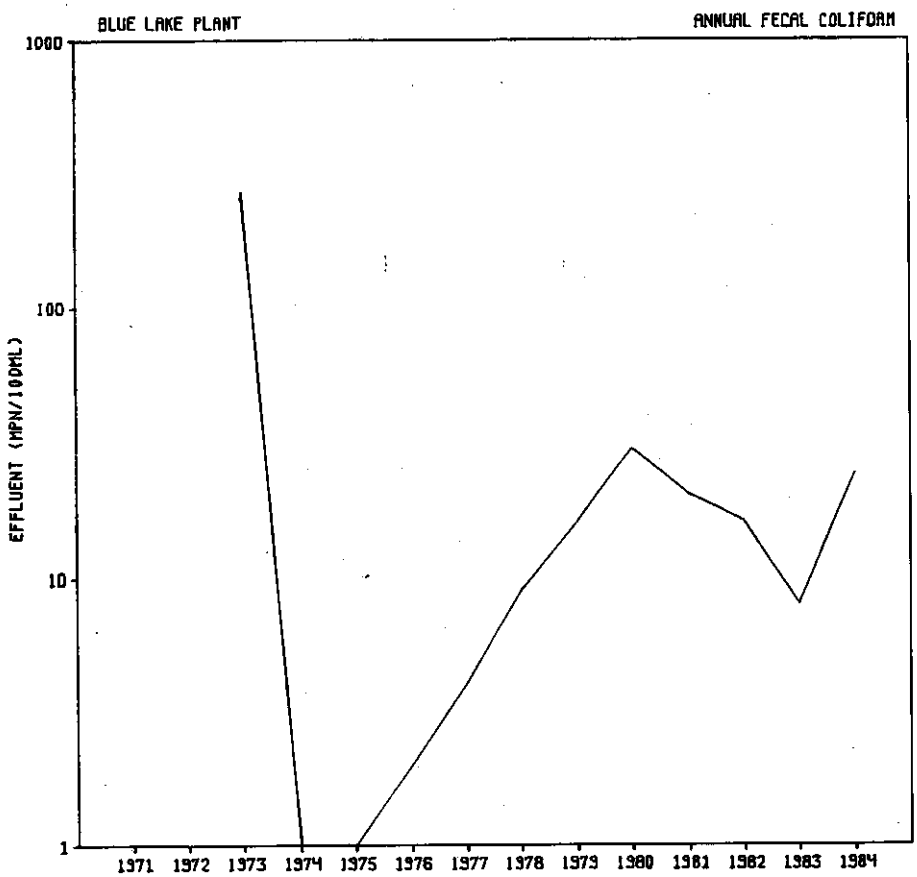
* For disinfection only.

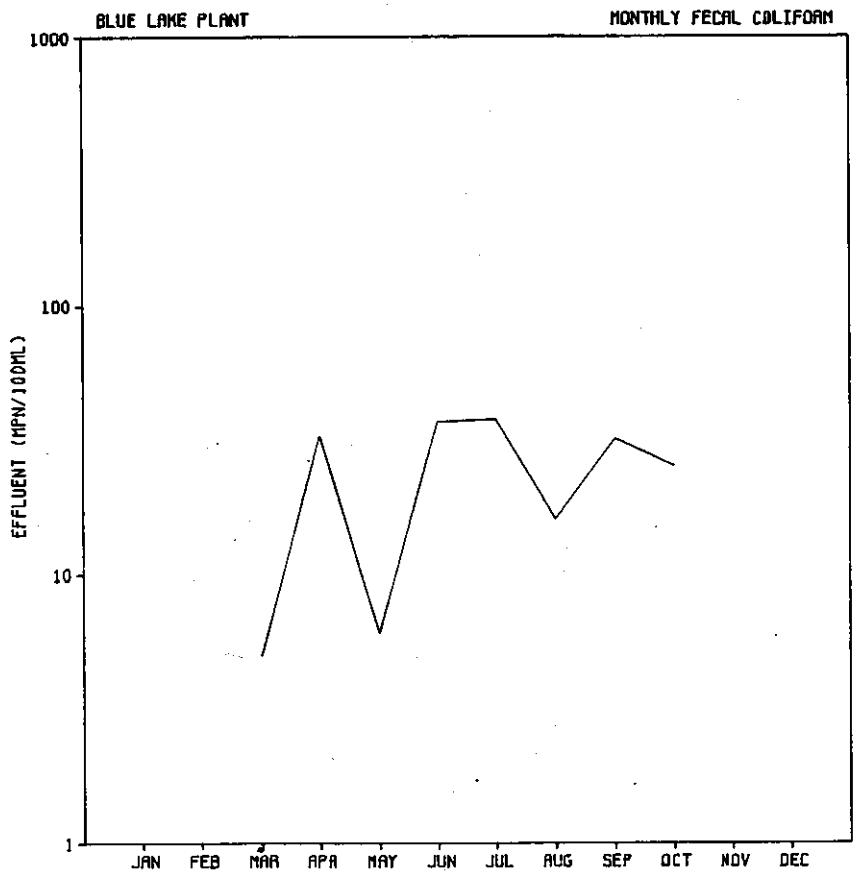

BLUE LAKE PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
20
0
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.


BLUE LAKE PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


BLUE LAKE PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
0
50
100
150
200
250
300
350
400
450
500
0
10
20
30
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


BLUE LAKE PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
0
50
100
150
200
250
300
350
400
450
500
0
10
20
30
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


BLUE LAKE PLANT
ANNUAL FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984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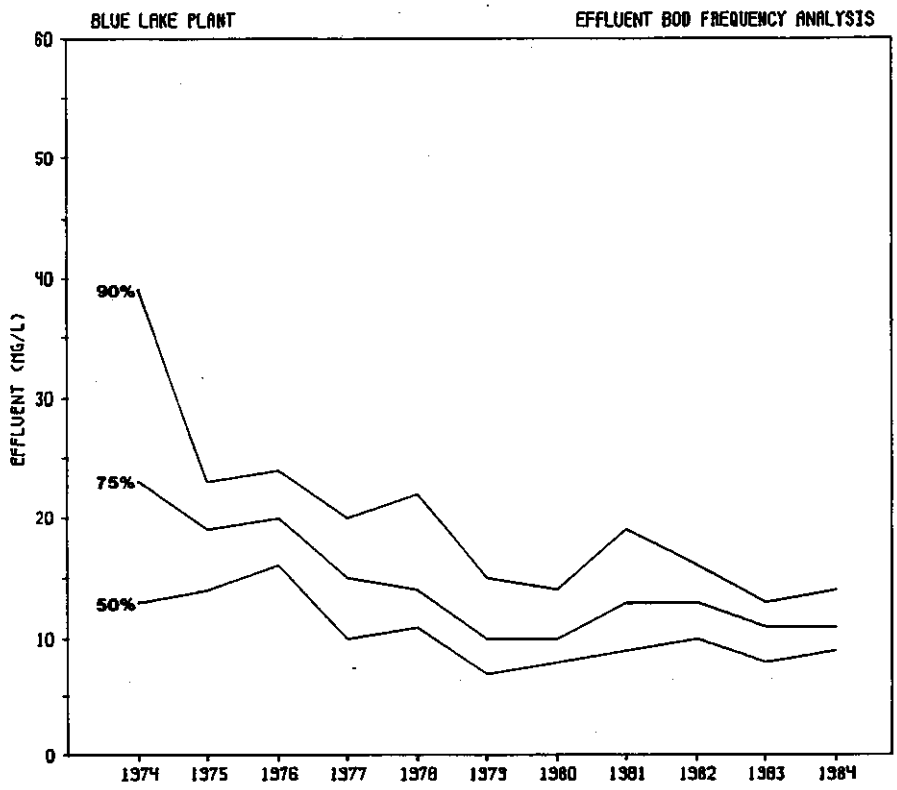
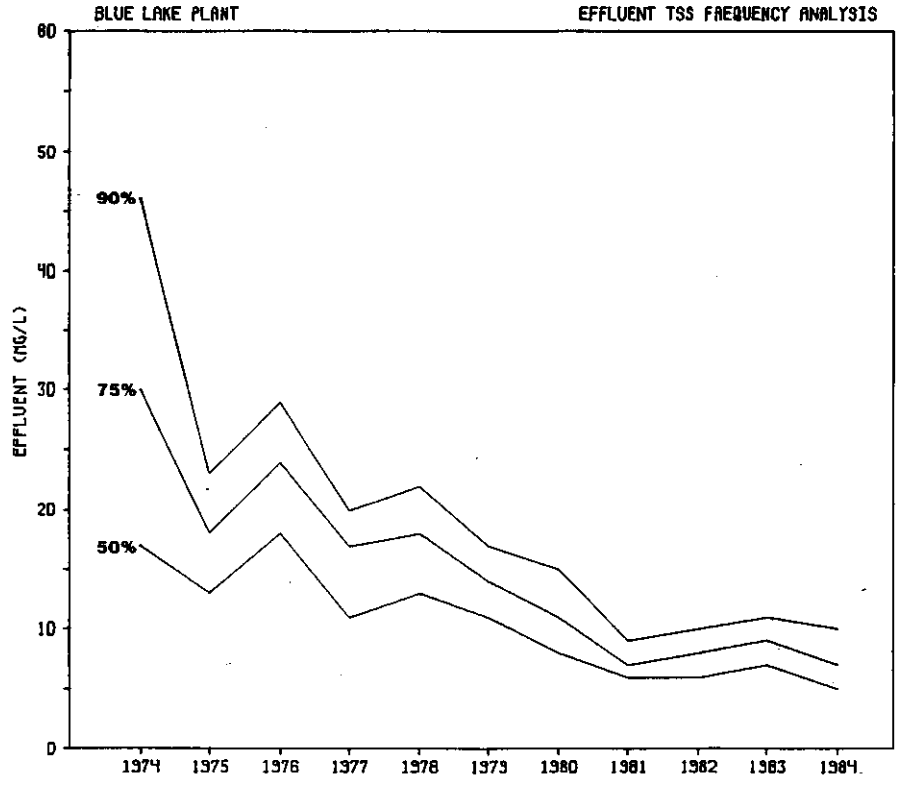
MONTHLY FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC


BLUE LAKE PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


BLUE LAKE PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

CHASKA WASTEWATER TREATMENT PLANT

Plant History and Description

The original Chaska Plant was designed by Lindsey Engineering Co. and constructed in 1963, with a design capacity of 0.75 mgd. The plant was converted to a pure oxygen activated sludge process in 1973, and final effluent filters were added in 1974. A plant expansion designed by McCombs-Knutson was constructed in 1980, increasing plant design capacity to 1.4 mgd. Actual operating capacity is somewhat less, due to high and widely variable organic loadings.

Liquid treatment consists of screening, grit removal, influent pumping, pure oxygen activated sludge aeration, final clarification, final effluent pumping, chlorination, and discharge to the Minnesota River.

Solids processing consists of aerobic digestion, and hauling to the Blue Lake Plant for further treatment and disposal.

The Chaska Plant is presently operating at about 80 percent of its rated hydraulic capacity and is subject to secondary treatment limits.

Performance

Plant flow averaged 1.09 mgd in 1984, slightly higher than 1.02 mgd in 1983. Average plant effluent quality was 9 mg/L BOD and 11 mg/L TSS. Plant performance was fair, as there were five NPDES Permit violations related to suspended solids. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	14	12	9	6	24	16	13	10	34	22	17	14
TSS	13	10	8	5	16	14	14	9	22	19	22	18

*1982 through 1984 values represent CBOD.

Future

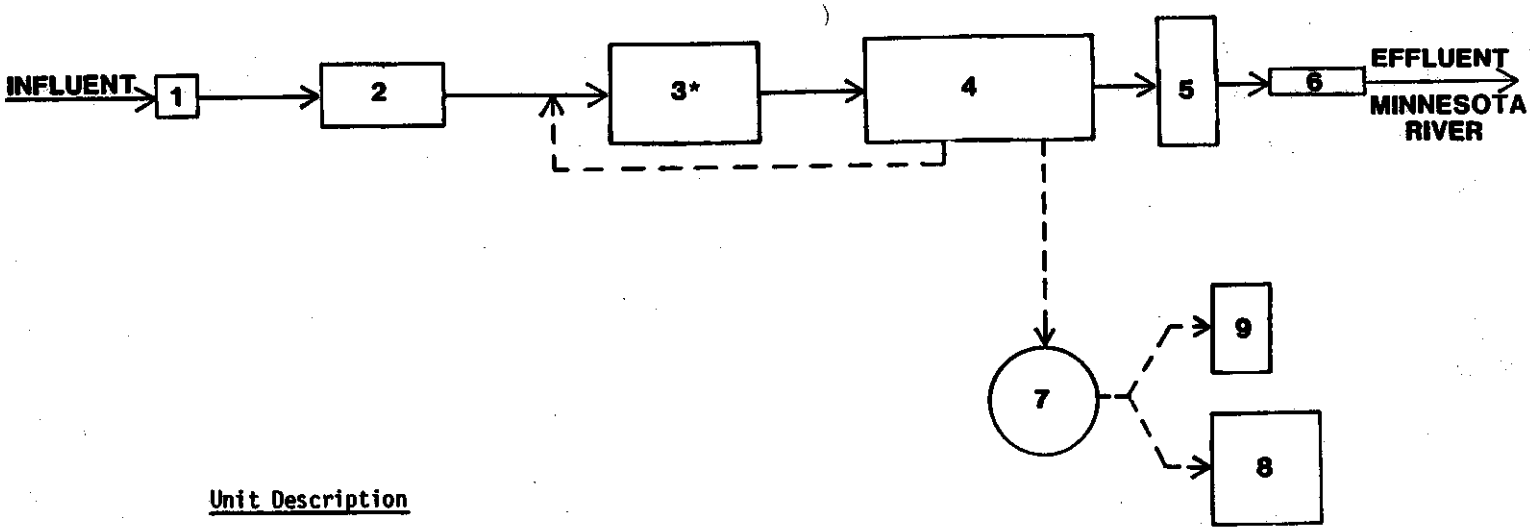
This plant is one of the Commission's permanent treatment plants. A plant expansion is scheduled for the mid-1980's.

CHASKA PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	0.80	1.02	1.09	1.06	1.78	1.38
BOD Loading, lb/day	1,260	1,200	1,010	1,490	1,500	1,190
TSS Loading, lb/day	1,120	1,100	1,440	1,520	1,300	5,150
COD Loading, lb/day	2,380	2,500	2,330	2,940	2,900	3,450
Sludge Production, lb/day	960	800	1,500	1,510	1,110	2,100
Grit Removal						
Overflow Rate, gpd/sq. ft.	17,780	23,000	24,000	23,560	30,000	30,700
Aeration Tanks						
Detention Time, hr.	3.0	2.4	2.2	2.3	1.4	1.8
BOD Loading, lb/day/1000 cu. ft.	93	90	70	110	110	90
Oxygen Utilization, lb/day as O_2	1,870	------	1,900	------	---	------
Final Sedimentation						
Detention Time, hr.	7.0	5.5	5.1	5.3	3.1	4.0
Weir Overflow Rate, gpd/lin. ft.	4,260	5,400	5,800	5,640	9,500	7,300
Surface Overflow Rate, gpd/sq. ft.	280	360	390	380	640	490
Chlorination						
Contact Time, minutes	147	110	108	111	60	85
Chlorine Use, lb/day	29	70	48	33	130	84
Aerobic Digestion						
Volatile Solids Loading, lb/cu. ft./day	0.025	0.01	0.025	------	------	------
Detention Time, days	53	60	43	36	------	------
Sludge Transport						
Volume, gpd	7,220	6,000	8,600	10,650	8,600	10,700

CHASKA WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

1. Screening
2. Grit Removal
3. Activated Sludge
4. Final Sedimentation
5. Effluent Filtration
6. Chlorination

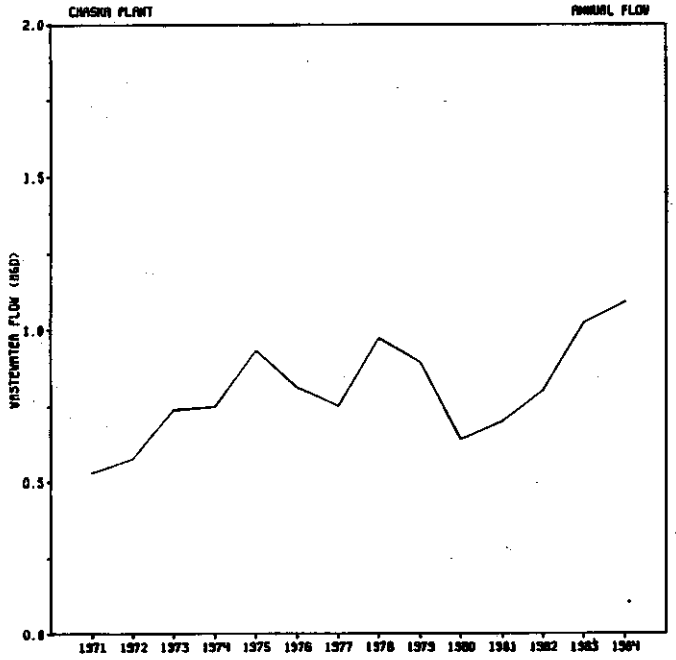
Solids Phase

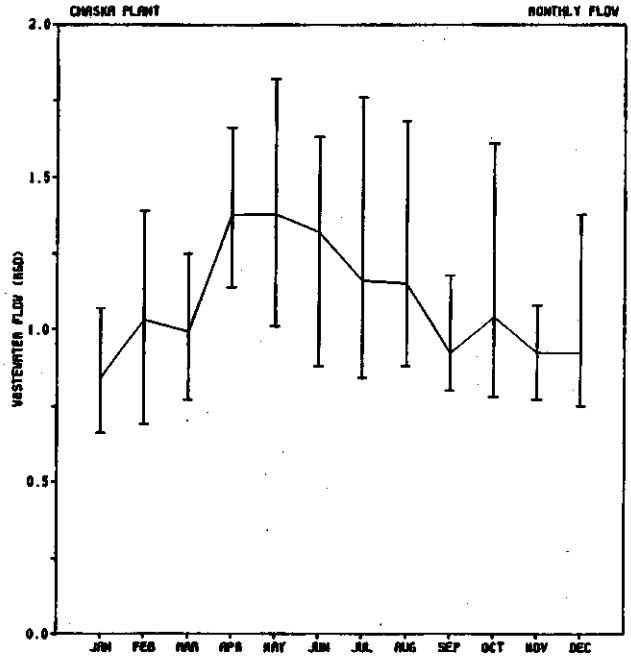
7. Two Stage Aerobic Digestion
8. Land Spread
9. Haul to Blue Lake System

* Pure Oxygen

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





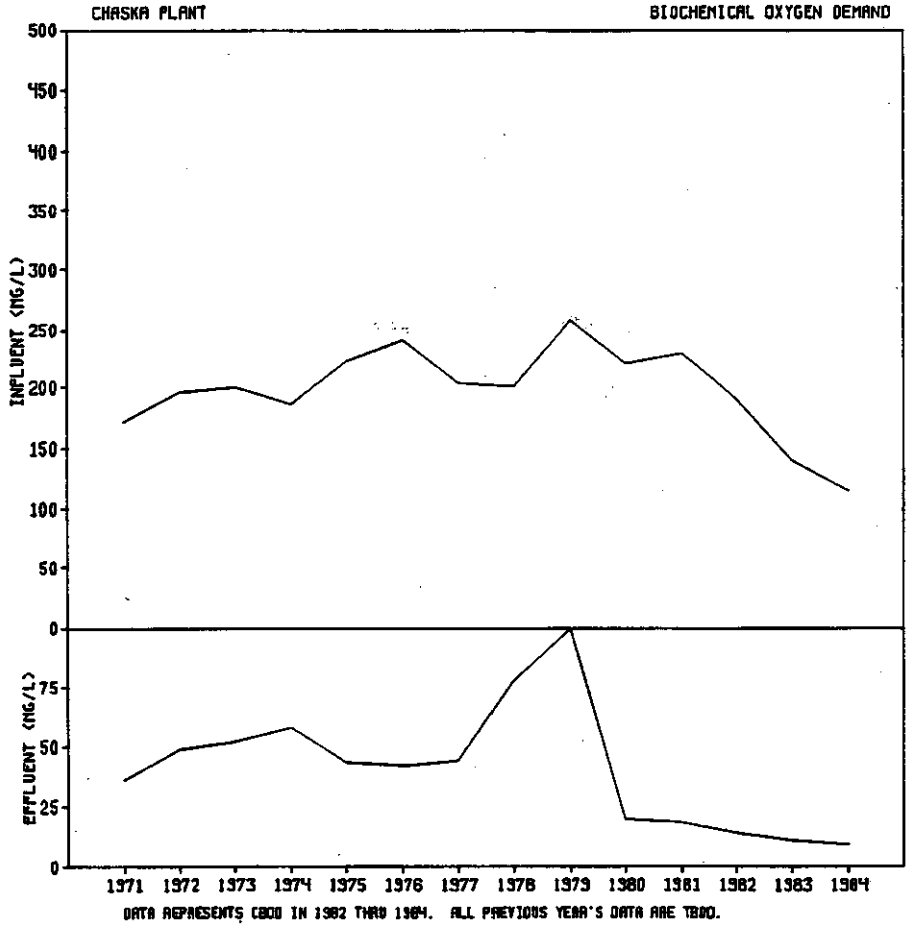
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Chaska

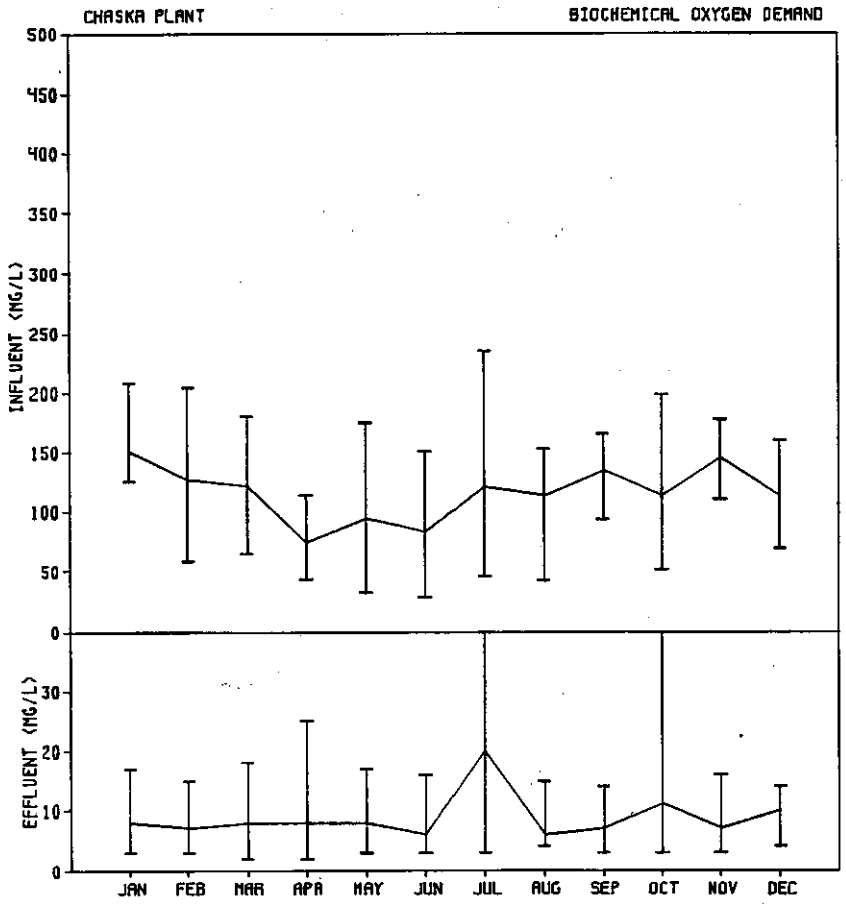
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	0.84	11	150	147	6.6-9.9	32.4	5.7	16.7	319
FEBRUARY	1.03	10	127	119	4.0-9.8	22.5	3.7	11.4	272
MARCH	0.99	10	121	128	6.0-8.8	67.5	5.6	35.8	271
APRIL	1.38	10	74	78	6.8-9.2	16.0	3.0	9.1	168
MAY	1.38	12	94	89	4.0-8.4	28.5	3.6	18.4	197
JUNE	1.32	14	82	115	6.1-10.0	51.0	3.8	25.1	202
JULY	1.16	16	120	387	6.6-9.9	16.8	3.3	6.4	283
AUGUST	1.15	18	113	157	6.8-9.2	21.0	3.9	8.0	362
SEPTEMBER	0.92	18	134	162	5.2-9.4	34.3	5.1	17.0	282
OCTOBER	1.04	17	113	142	6.0-8.6	23.4	4.1	11.6	248
NOVEMBER	0.92	15	145	139	3.0-9.2	27.1	4.4	12.8	320
DECEMBER	0.92	13	113	117	6.8-9.2	35.9	4.7	21.0	241
1984 AVERAGE	1.09	14	115	148	3.0-10.0	31.2	4.2	16.1	263
1983 AVERAGE	1.02	14	141	127	4.2-12.0	35.1	5.9	19.5	291

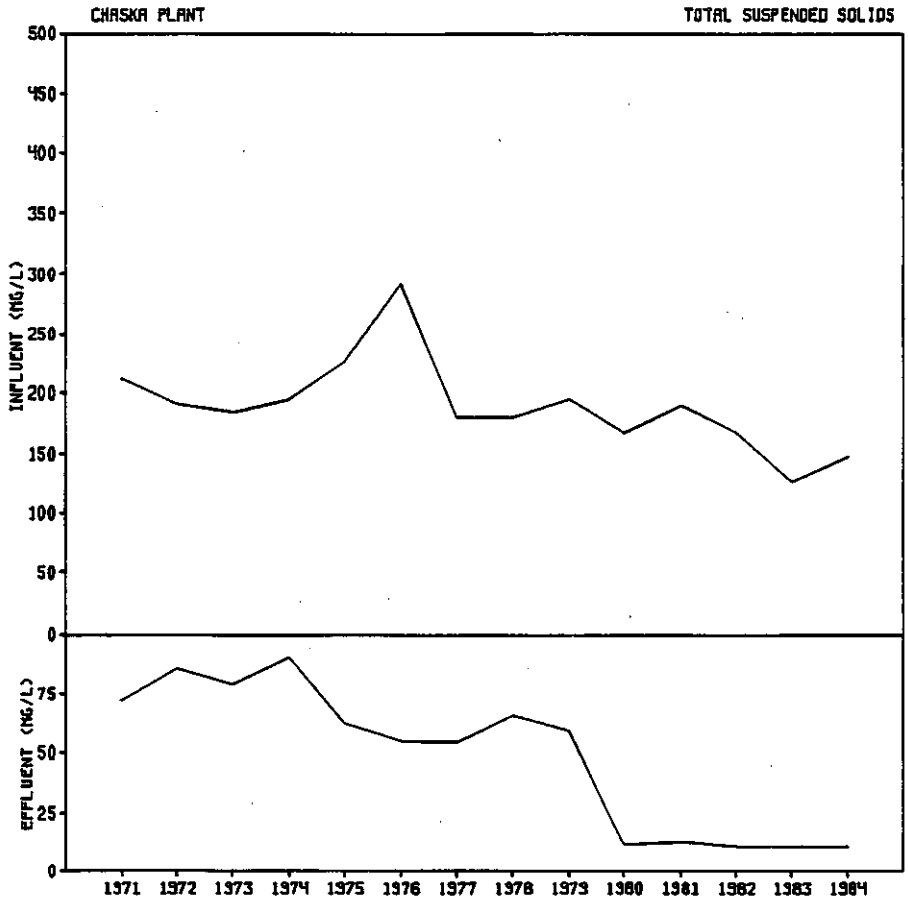
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Chaska

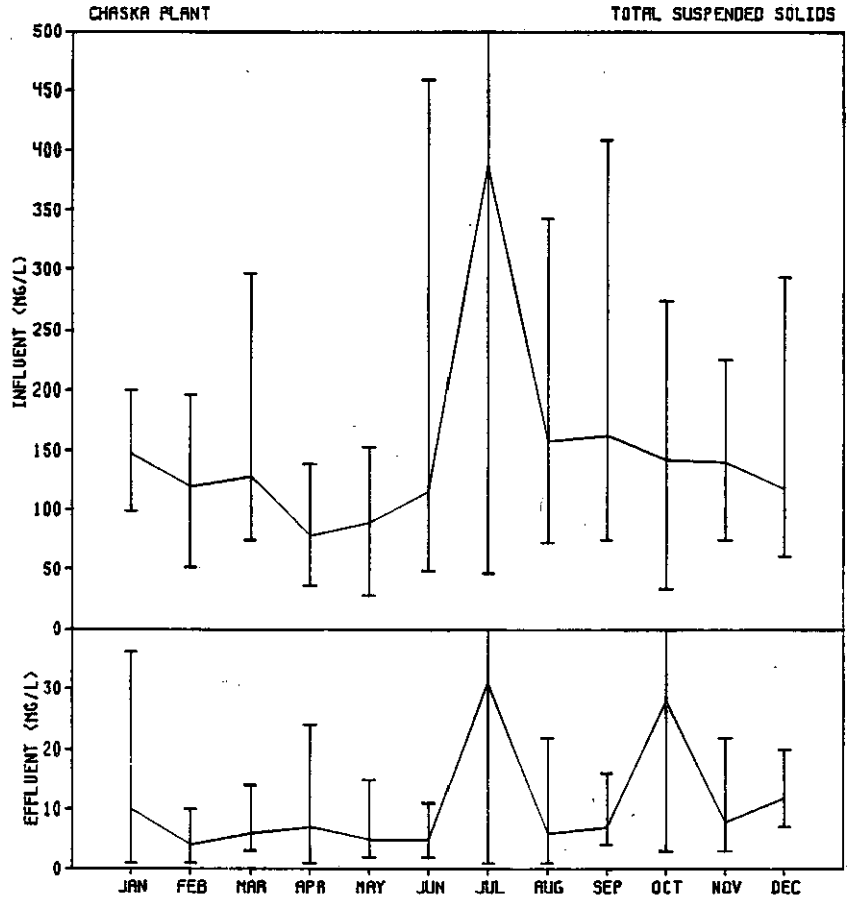
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	---	----	---	---	--	---	----	6.5-8.5	--	--
JANUARY	27	8	57	10	---	4	15.9	10.6	0.55	1.65	1.7	--	---	8.3	7.0-7.9	95	93
FEBRUARY	15	7	60	4	---	2	9.4	4.5	0.45	2.74	0.5	--	---	9.1	7.0-7.8	94	97
MARCH	24	8	70	6	5	4	13.3	11.0	1.15	1.14	0.7	25	1.8	10.3	7.2-7.7	93	95
APRIL	9	8	46	7	6	4	10.3	7.3	0.19	1.49	0.4	84	4.9	11.4	7.2-7.9	90	90
MAY	9	8	47	5	11	3	10.5	5.9	0.11	1.18	0.5	34	2.1	10.8	6.6-7.8	91	95
JUNE	8	6	47	5	22	3	9.1	5.1	0.18	1.04	0.8	53	2.6	8.7	7.1-7.7	92	96
JULY	22	20	92	31	31	10	11.6	5.9	0.36	0.70	1.0	56	2.3	9.6	7.2-7.7	84	92
AUGUST	8	6	61	6	15	4	10.6	5.9	0.24	0.51	0.3	51	2.3	8.1	7.0-7.7	95	96
SEPTEMBER	11	7	49	7	21	5	13.9	7.6	0.69	0.54	0.6	36	1.8	7.7	7.2-7.7	95	95
OCTOBER	15	11	68	28	31	10	15.1	8.7	0.40	0.67	1.3	45	2.1	8.0	7.5-7.8	90	81
NOVEMBER	14	7	66	8	---	4	14.8	9.6	0.69	1.31	1.0	--	---	8.6	7.1-7.7	95	94
DECEMBER	19	10	61	12	---	5	12.5	10.3	0.42	3.01	1.2	--	---	9.4	7.2-7.8	91	90
1984 AVG.	15	9	60	11	18	5	12.3	7.7	0.45	1.32	0.9	48	2.5	9.2	6.6-7.9	92	93
1983 AVG.	17	11	68	11	8	5	11.8	7.3	0.92	1.97	1.8	70	3.8	9.2	6.8-7.9	92	91

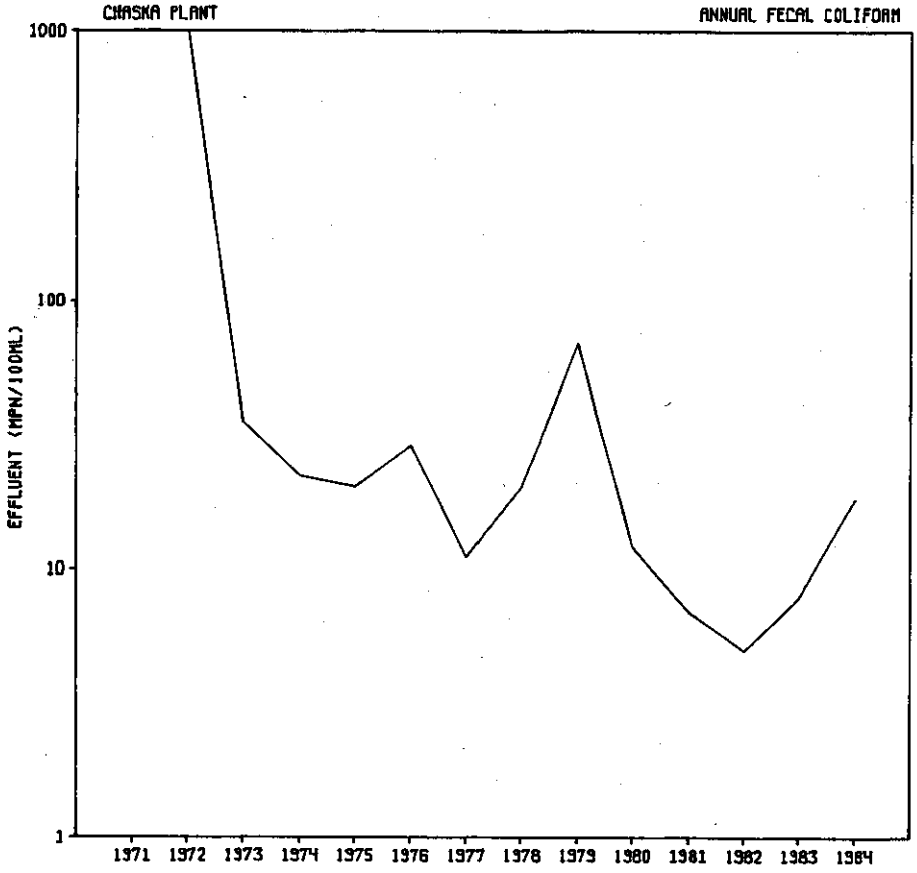
*For disinfection only.

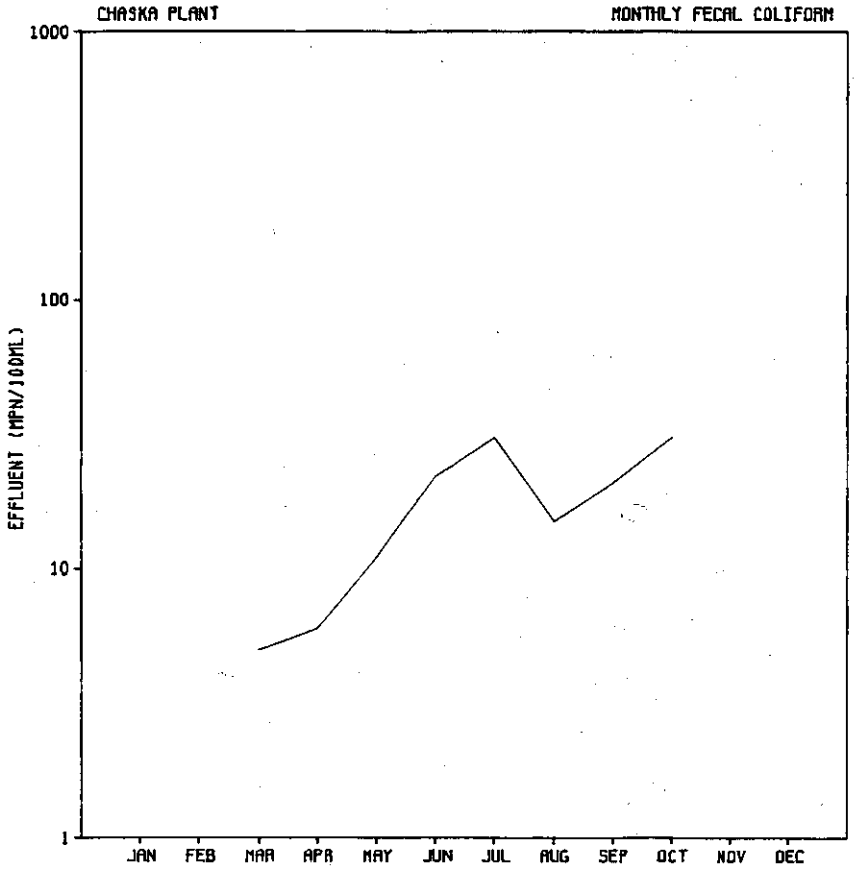

CHASKA PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
75
50
25
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.

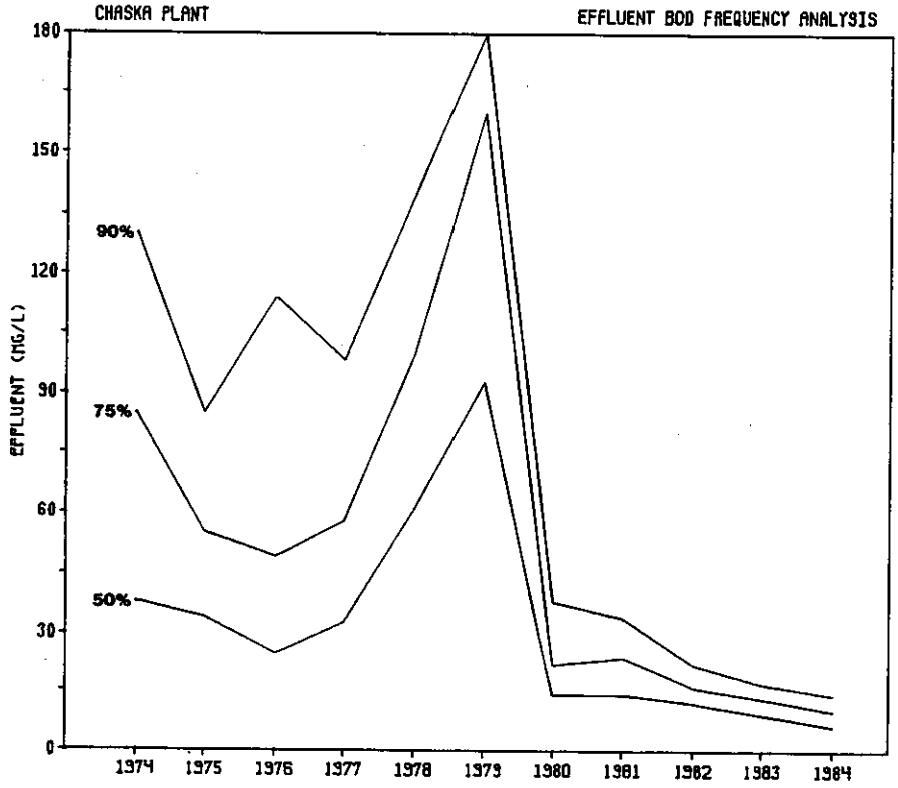

CHASKA PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

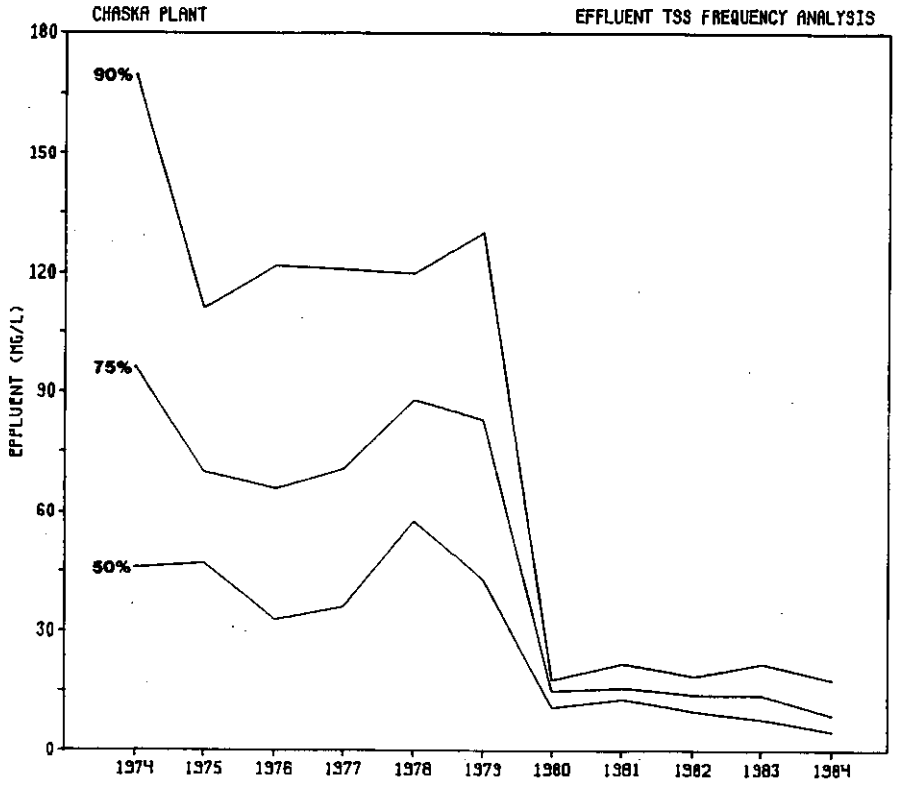

CHASKA PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
75
50
25
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


CHASKA PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


CHASKA PLANT
ANNUAL FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


CHASKA PLANT
MONTHLY FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


CHASKA PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
180
150
120
90
60
30
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


CHASKA PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
180
150
120
90
60
30
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

COTTAGE GROVE WASTEWATER TREATMENT PLANT

Plant History and Description

The Cottage Grove Plant, designed by Bonestroo, Rosene, Anderlik, and Associates, was originally constructed in 1962 and expanded in 1963 and 1968. In 1975, effluent polishing filters were added to the plant. In 1976, primary anaerobic digester volume was increased and a new cover was installed. In 1979, the plant was expanded to its current design capacity of 1.8 mgd.

Liquid treatment consists of screening, primary sedimentation, activated sludge aeration, final clarification, chlorination, and discharge to the Mississippi River.

Solids processing consists of combined sludge gravity thickening, anaerobic digestion with ultimate disposal by landspreading or to the Metropolitan Plant Interceptor System.

The plant is presently operating at about 70 percent of its design capacity and is subject to secondary treatment limits.

Performance

The plant flow averaged 1.30 mgd in 1984, the same flow as in 1983. Average plant effluent quality was 9 mg/L BOD and 9 mg/L TSS. Plant performance was good throughout the year with no NPDES Permit violations. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	9	8	8	8	15	13	11	11	20	18	14	14
TSS	5	6	10	7	8	10	14	11	14	14	18	14

*1982 through 1984 values represent CBOD.

Future

The Cottage Grove facility is considered a permanent plant. The plant is expected to be expanded in the late 1980's or early 1990's.

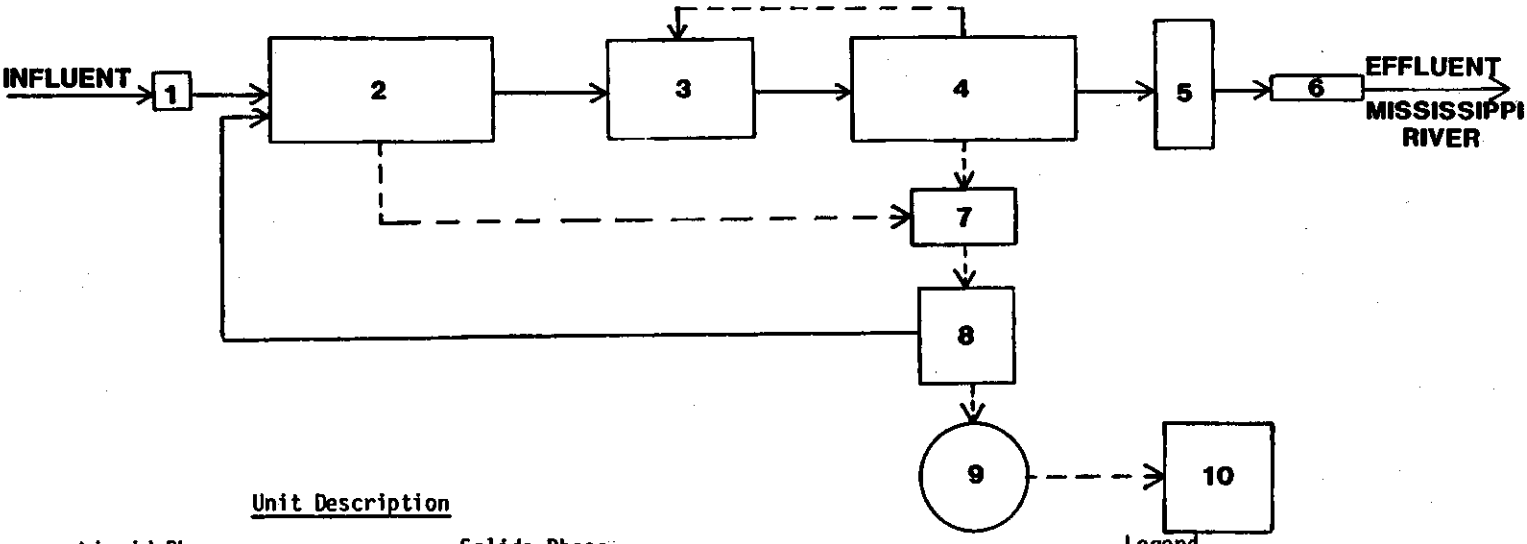
COTTAGE GROVE PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	1.26	1.30	1.30	1.32	1.37	1.37
BOD Loading, lb/day	2,186	1,900	1,900	2,528	2,380	2,190
TSS Loading, lb/day	1,829	1,680	1,670	2,245	2,520	1,980
COD Loading, lb/day	4,174	3,960	4,110	------	4,700	4,900
Primary Sedimentation						
Detention Time, hr.-North	2.5	2.5	2.5	2.4	2.4	2.4
Detention Time, hr.-South	3.8	3.7	3.7	3.6	3.5	3.5
Weir Overflow Rate, gpd/lin. ft.-North	6,680	6,900	6,900	7,000	7,260	7,260
Weir Overflow Rate, gpd/lin. ft.-South	4,320	4,460	4,460	4,520	4,700	4,700
Surface Overflow Rate, gpd/sq. ft.-North	530	550	550	550	575	575
Surface Overflow Rate, gpd/sq. ft.-South	530	550	550	550	575	575
Aeration Basin						
BOD Loading, lb/day/1000 cu. ft.[1]	43	37	30	50	47	34
Final Sedimentation						
Detention Time, hr.	2.7	5.3	5.3	2.6	5.0	5.0
Weir Overflow Rate, gpd/lin. ft.	4,470	4,600	4,600	4,680	4,860	4,860
Surface Overflow Rate, gpd/sq. ft.	396	410	410	415	430	430
Polishing Filtration						
Average Filtration Rate, gpm/sq. ft.	2.9	------	------	3.1	------	------
Chlorination						
Chlorine Use, lb/day	86	69	86	108	80	77
Gravity Thickener						
Surface Loading Rate, gpd/sq. ft.	730	725	725	------	------	------
Mass Loading Rate, lb/sq. ft./day	6	3	3	------	------	------
Anaerobic Digestion						
Solid Retention Time, day	48	62	62	39	41	41
Sludge Transport						
Volume, gpd	9,528	6,260	8,960	13,000	9,500	15,110
Mass, lb/day	1,295	960	1,300	1,890	1,000	1,600

[1]Assumes 20% BOD removal in primary basins.

COTTAGE GROVE WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

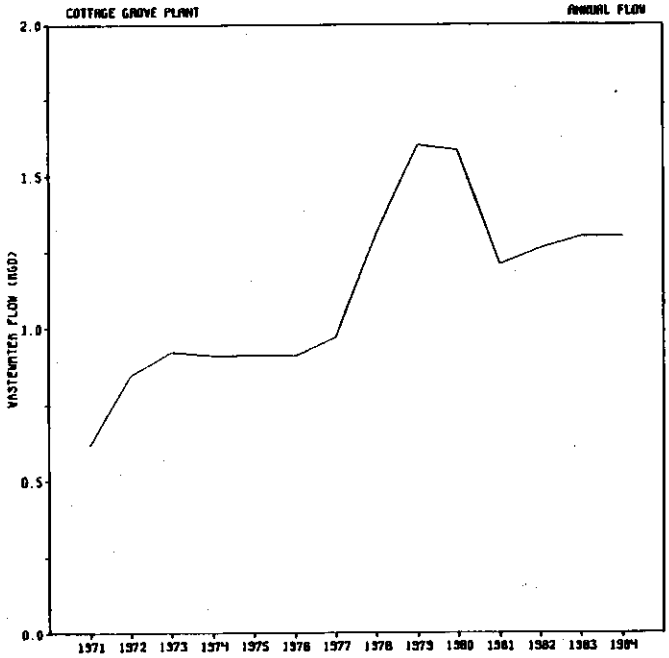
1. Screening
2. Primary Sedimentation
3. Activated Sludge
4. Final Sedimentation
5. Effluent Filtration
6. Chlorination

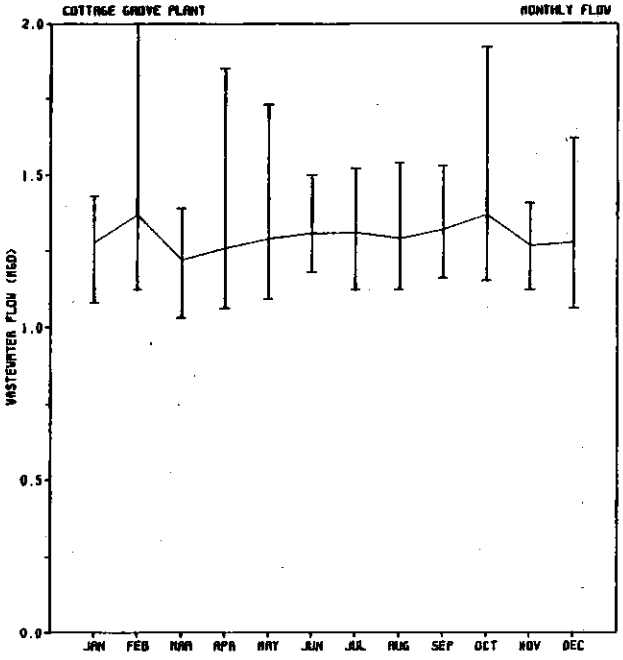
Solids Phase

7. Sludge Blend Tank
8. Sludge Thickener
9. Anaerobic Digestion
10. Haul to Land Spreading

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





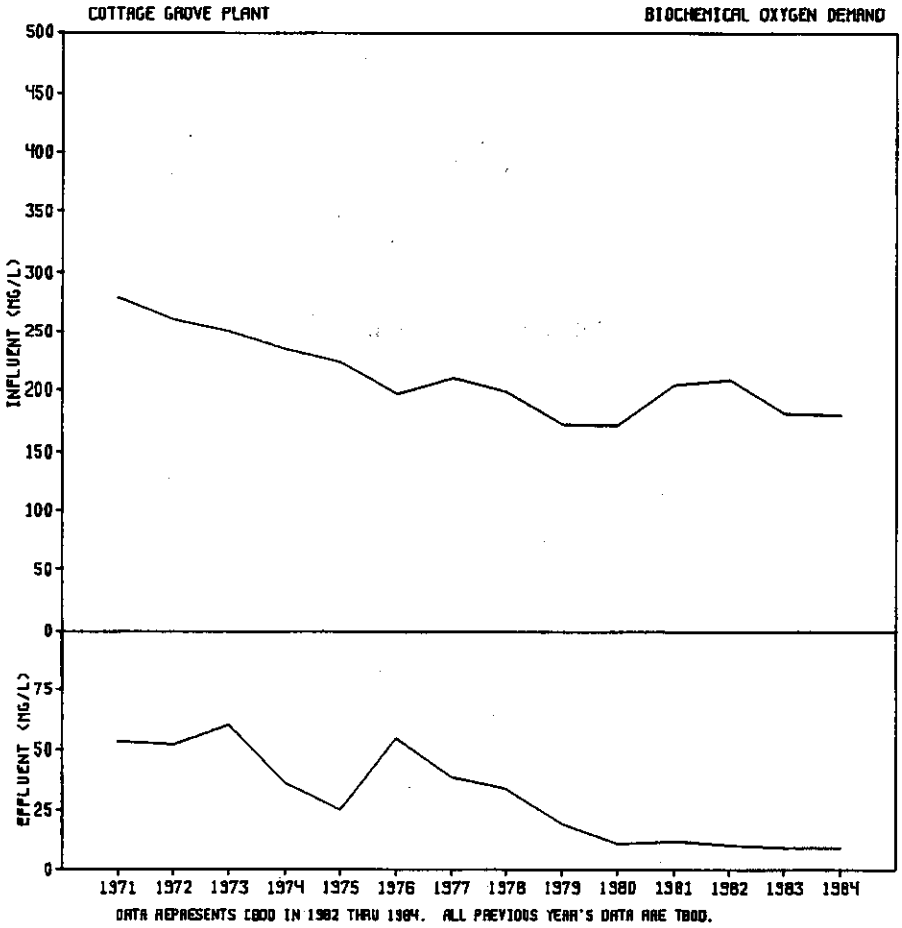
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Cottage Grove

Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	1.28	11	185	151	7.5-8.4	45.9	7.5	26.1	385
FEBRUARY	1.37	11	155	128	7.3-8.5	38.1	5.4	19.8	311
MARCH	1.22	10	175	154	7.3-8.2	43.5	7.1	26.6	379
APRIL	1.26	12	177	143	7.5-8.5	41.1	7.1	24.5	372
MAY	1.29	14	188	158	7.2-8.4	40.5	6.5	22.2	402
JUNE	1.31	17	176	168	7.4-8.1	36.5	7.0	20.9	400
JULY	1.31	19	162	147	7.3-8.0	37.4	6.5	19.4	377
AUGUST	1.29	21	177	168	7.2-8.0	43.1	7.0	26.4	381
SEPTEMBER	1.32	20	185	177	7.2-8.0	38.1	6.8	21.0	407
OCTOBER	1.37	18	181	167	7.4-8.2	40.0	6.9	20.9	400
NOVEMBER	1.27	15	208	170	7.6-8.3	43.0	7.0	23.3	467
DECEMBER	1.28	13	194	167	7.2-8.4	40.1	6.5	23.5	391
1984 AVERAGE	1.30	15	180	158	7.2-8.5	40.6	6.8	22.8	389
1983 AVERAGE	1.30	15	181	160	7.0-8.5	41.9	7.7	25.9	378

MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Cottage Grove

Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	----	----	-----	---	--	---	---	6.5-8.5	--	--
JANUARY	33	14	70	16	---	6	29.7	20.3	0.72	3.70	5.2	--	---	5.2	7.1-7.6	93	90
FEBRUARY	24	11	76	9	---	5	24.5	19.2	0.93	2.71	4.3	22	1.9	5.7	7.0-7.7	93	93
MARCH	23	12	98	12	65	6	29.9	21.3	0.84	2.66	4.7	80	3.7	6.2	7.1-7.5	93	92
APRIL	18	8	59	6	33	4	30.6	26.1	0.62	2.45	4.9	86	3.4	5.7	7.1-7.5	96	96
MAY	22	10	64	10	67	6	28.6	21.2	0.57	2.16	4.3	97	5.5	5.3	7.0-7.6	95	94
JUNE	22	8	68	7	100	5	19.5	16.2	4.10	2.17	4.7	97	4.5	5.5	7.1-7.4	95	96
JULY	21	7	76	5	85	4	21.6	14.0	1.53	2.99	4.8	77	3.7	4.8	7.0-7.4	96	96
AUGUST	17	6	77	8	105	5	22.1	14.0	1.28	1.89	5.2	88	4.3	4.7	7.1-7.4	96	95
SEPTEMBER	18	6	48	6	168	4	18.3	11.5	1.16	3.50	4.8	84	4.1	4.9	7.0-7.5	97	96
OCTOBER	24	6	61	7	187	5	26.0	17.0	0.73	1.44	4.5	78	5.9	5.5	7.1-7.6	97	96
NOVEMBER	26	11	70	9	---	3	27.3	20.2	0.97	2.55	4.5	--	---	5.8	7.3-7.6	95	95
DECEMBER	20	12	67	9	---	4	27.6	22.4	0.32	2.50	4.4	--	---	6.3	7.0-7.9	94	95
1984 AVG.	22	9	69	9	101	5	25.5	18.6	1.13	2.56	4.7	85	4.4	5.5	7.0-7.9	95	94
1983 AVG.	19	9	62	11	53	5	16.7	13.5	1.21	9.15	5.0	68	3.5	5.1	6.8-7.7	95	93

*For disinfection only.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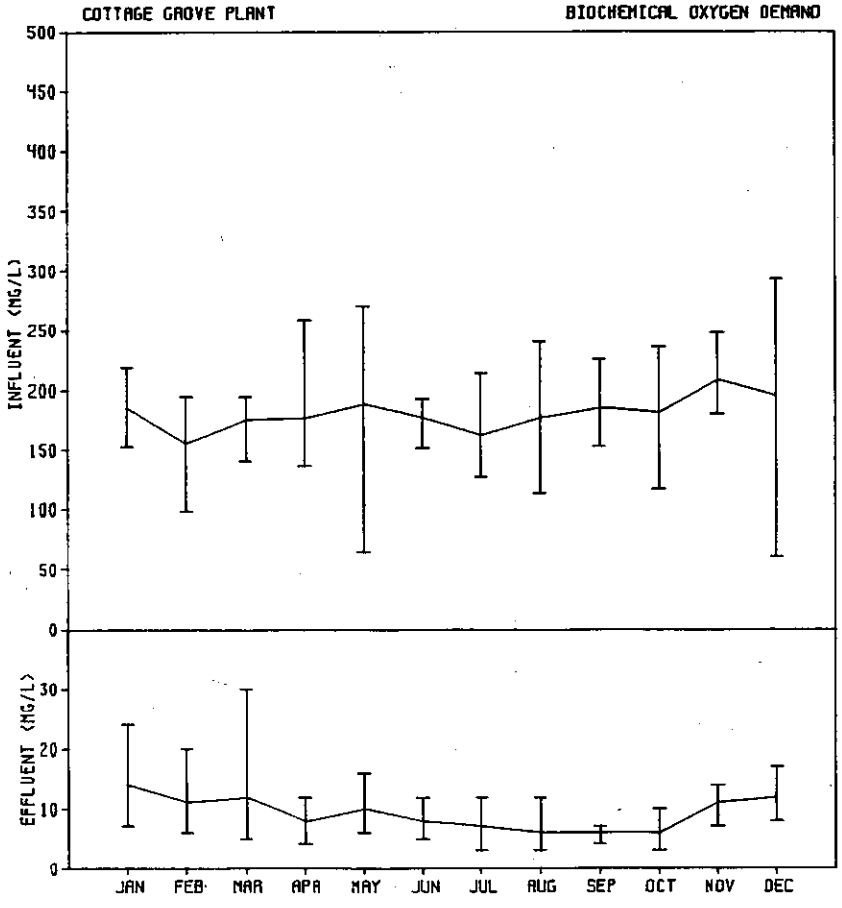
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.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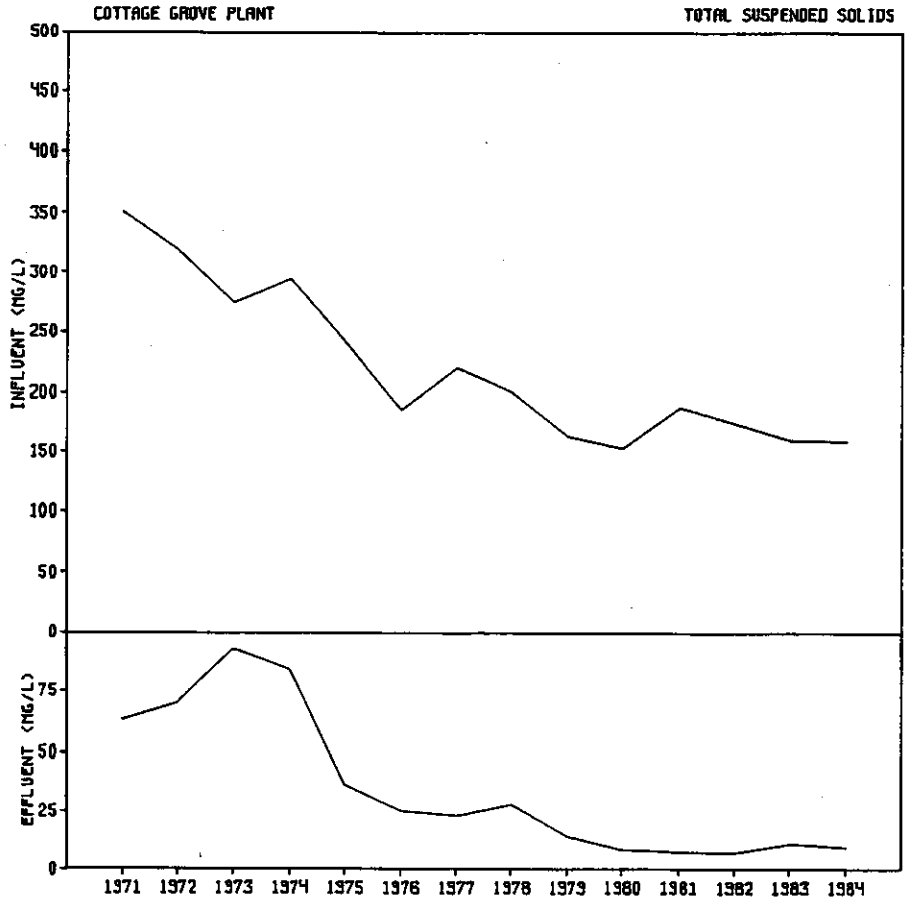
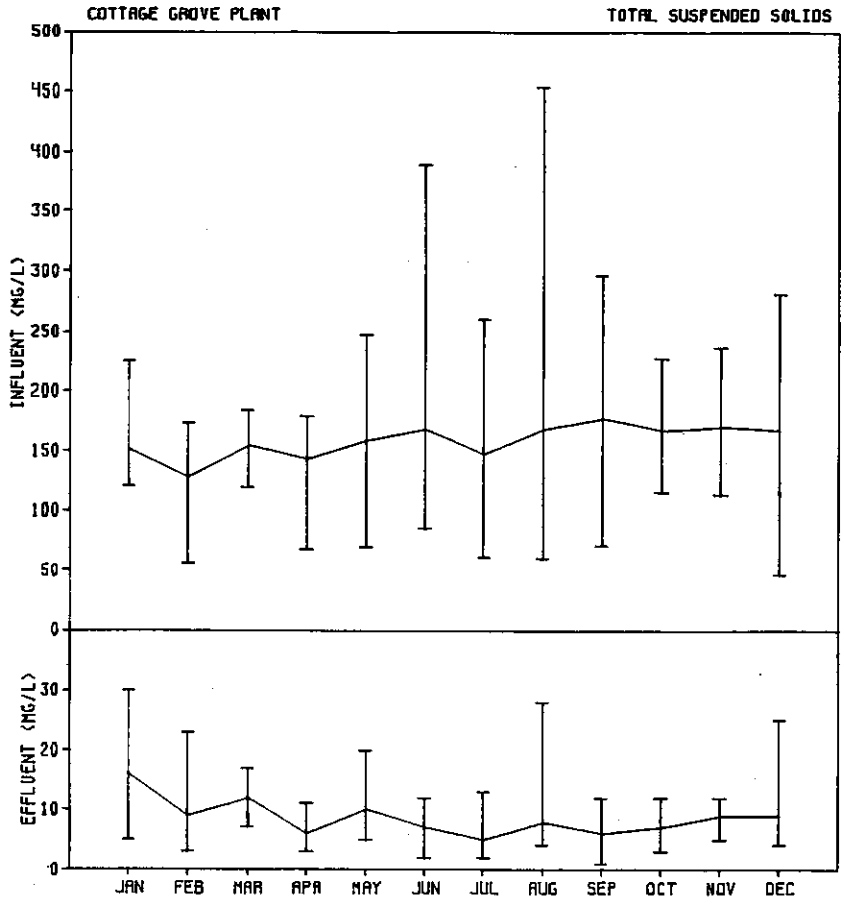
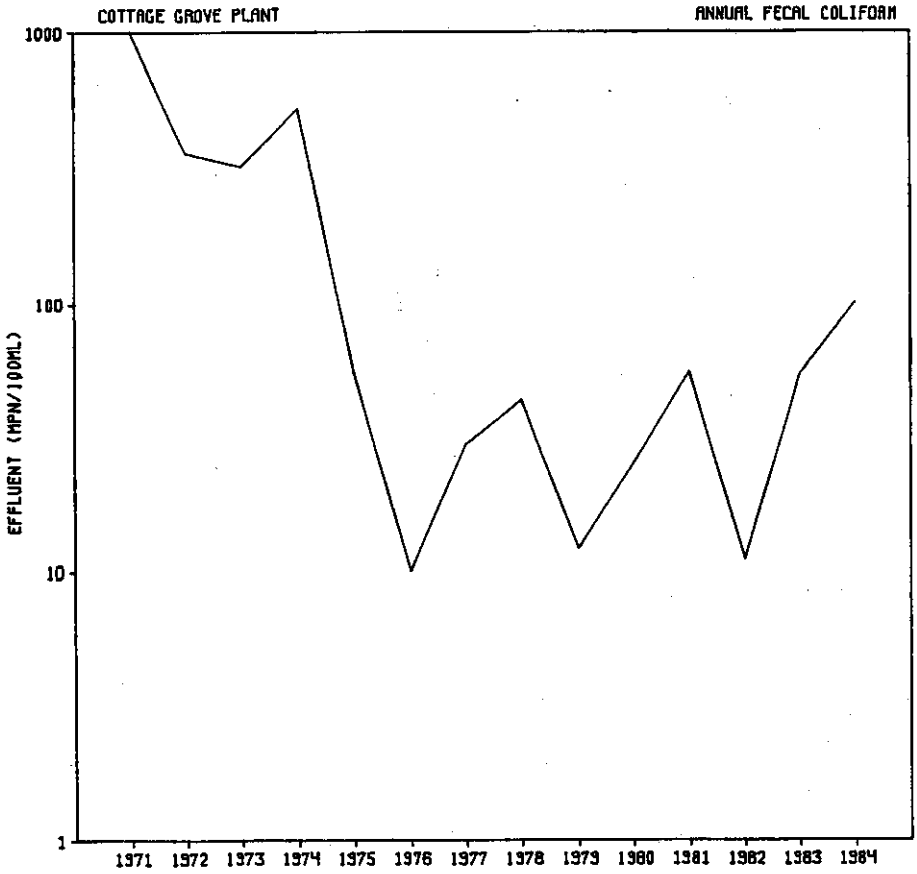
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


COTTAGE GROVE PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
75
50
25
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


COTTAGE GROVE PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC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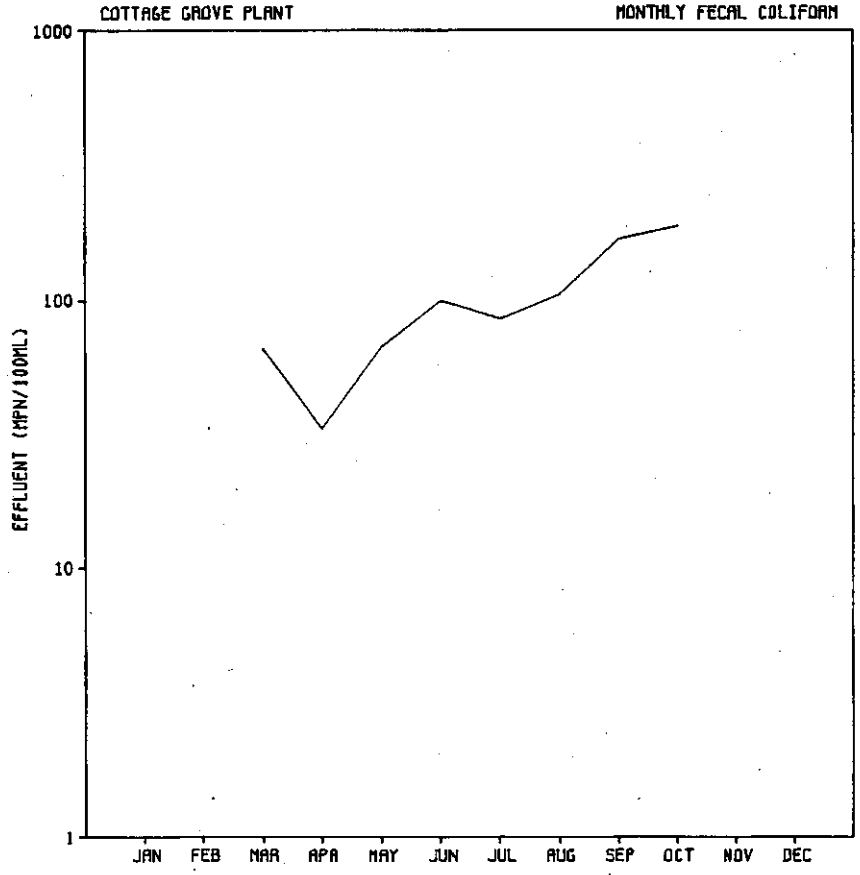
ANNUAL FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984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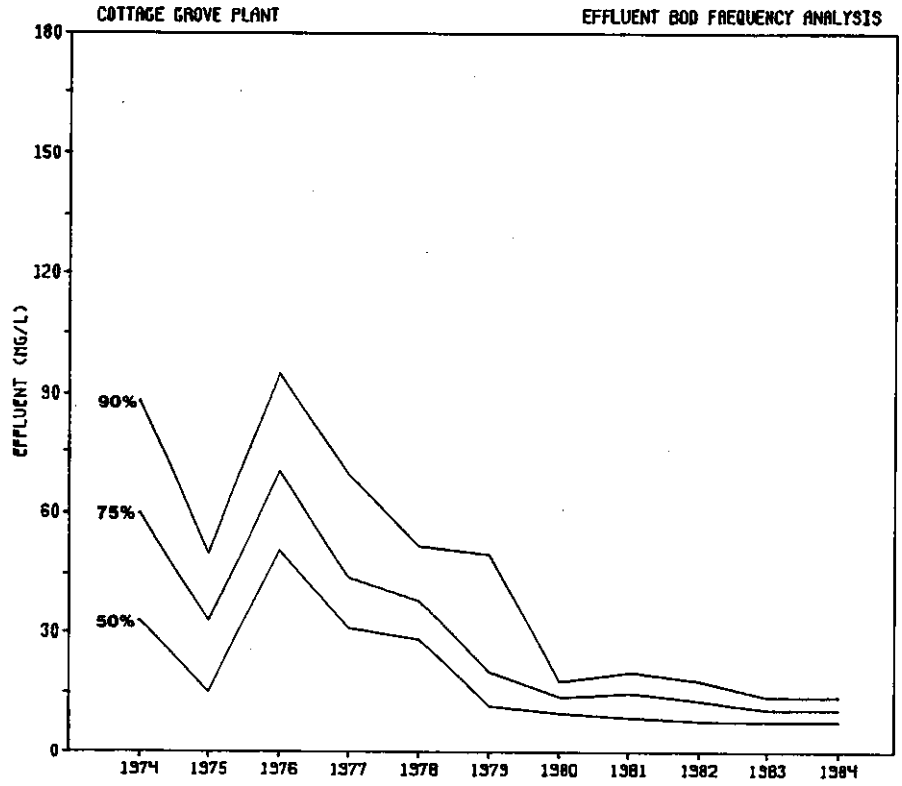
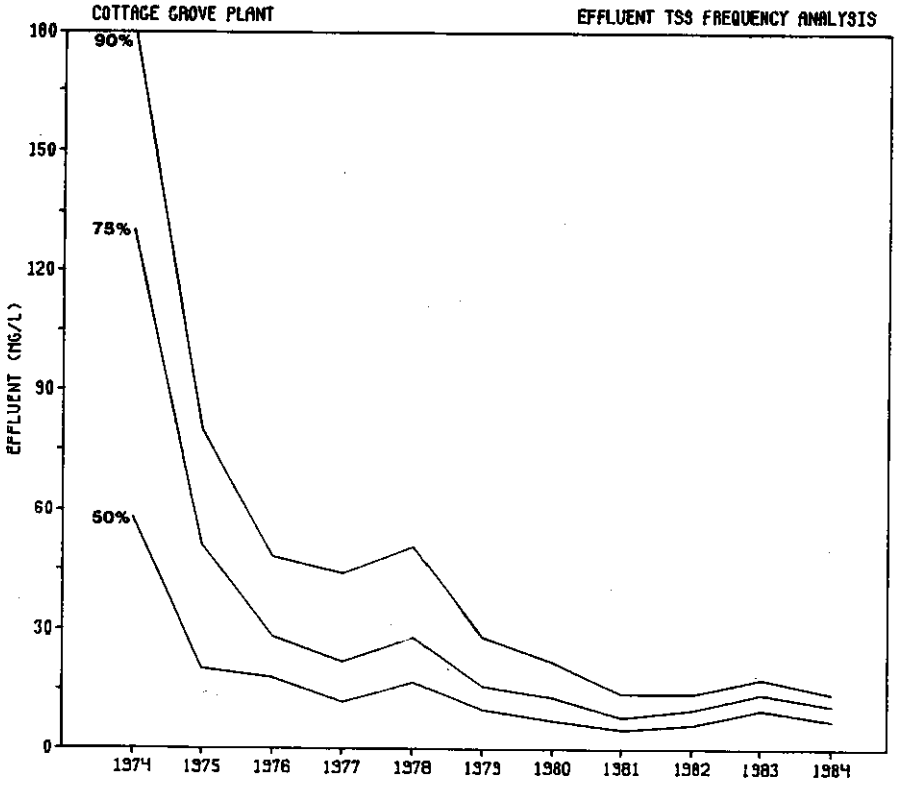
MONTHLY FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


COTTAGE GROVE PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
180
150
120
90
60
30
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


COTTAGE GROVE PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
180
150
120
90
60
30
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

EMPIRE WASTEWATER TREATMENT PLANT

Plant History and Description

The Empire Plant was designed by Short, Elliot, Hendrickson and Associates and was constructed in 1977-1979. The Empire Plant began operation in the fall of 1979. The plant replaced three treatment plants (Lakeville, Farmington, and Apple Valley) which were overloaded and required upgrading to meet water quality based effluent standards. The Empire Plant serves Apple Valley, Empire Township, Farmington, and Lakeville in Service Area No. 6 and has a design capacity of 6.0 mgd.

Liquid treatment consists of screening, influent pumping, grit removal, primary sedimentation, high rate activated sludge aeration, intermediate sedimentation, nitrification activated sludge aeration, final clarification, effluent filtration, chlorination, and discharge to the Vermillion River.

Solids processing consists of combined sludge gravity thickening, anaerobic digestion, centrifuge dewatering, sludge storage and sludge landspreading. The plant is operating at about 85 percent of design capacity and is subject to effluent limits of 10 mg/L BOD and TSS, and 1 mg/L ammonia.

Performance

Plant flow averaged 5.19 mgd in 1984, somewhat higher than 4.81 mgd in 1983. Average plant effluent quality was 2 mg/L BOD, 2 mg/L TSS and 0.3 mg/L ammonia. Plant performance was excellent throughout the year with one NPDES permit violation of the ammonia limit. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	3	2	2	1	4	3	3	2	4	4	4	3
TSS	1	1	1	1	1	1	1	2	2	2	2	3

*1982 through 1984 values represent CBOD.

Future

The Empire Plant is one of the Commission's permanent regional plants. Provisions have been made for doubling the plant's capacity when the area's growth requires plant expansion. A plant expansion is planned for the late 1980's.

EMPIRE PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	4.05	4.81	5.19	4.89	6.57	6.36
BOD Loading, lb/day[1]	6,900	8,500	11,200	7,600	13,300	20,900
TSS Loading, lb/day[1]	7,200	9,900	11,100	9,500	13,200	16,000
Ammonia Loading, lb/day[1]	740	650	810	1,000	800	1,100
COD Loading, lb/day[1]	------	17,900	------	------	23,800	------
Kj-N Loading lb/day[1]	------	------	1,870	------	------	2,700
Aerated Grit Chamber (All in Use)						
Flow Through Velocity, fps	0.05	0.03	0.046	0.06	0.04	0.054
Detention Time, minutes	12	20	14	10	15	12
Primary Clarifiers						
Surface Overflow Rate, gpd/sq. ft.	400	480	685	490	650	800
Weir Overflow Rate, gpd/lin. ft.	8,000	9,600	13,700	9,800	13,100	16,000
Detention Time, hr.	5.3	4.5	------	4.4	3.3	------
Removal Efficiency, %BOD	31	------	------	32	------	------
Removal Efficiency, %TSS	58	------	------	70	------	------
High Rate Aeration						
Mixed Liquor Suspended Solids, mg/L	1,600	1,900	------	1,900	2,000	------
F:M Ratio, lb. BOD/day/lb. MLSS	0.72	0.21	------	0.87	0.40	------
BOD Loading, lb./day/1000 cu. ft.[2]	66	25	62	79	39	76
Detention Time, hr.	3.0	3.8	------	2.5	2.7	------
High Rate Clarifiers						
Surface Overflow Rate, gpd/sq. ft.	400	480	685	490	650	800
Weir Overflow Rate, gpd/lin. ft.	8,000	9,600	13,700	9,800	13,100	16,000
Detention Time, hr.	5.3	4.5	------	4.4	3.3	------
Mass Loading Rate, lb/day/sq. ft.	------	------	15	------	------	16
Nitrification Aeration						
BOD Loading, lb/day/1000 cu. ft.[2]	------	------	16	------	------	29
Mixed Liquor Suspended Solids, mg/L	2,400	2,700	------	2,100	3,200	------
Ammonia: Mass Ratio, lb. NH_3/day/lb. MLSS	0.024	0.021	------	0.04	0.038	------
Ammonia Loading, lb. NH_3/day/1000 cu. ft.	3.8	3.6	3.1	5.8	3.9	4.4
Detention Time, hr.	6.8	6.3	------	4.9	4.6	------

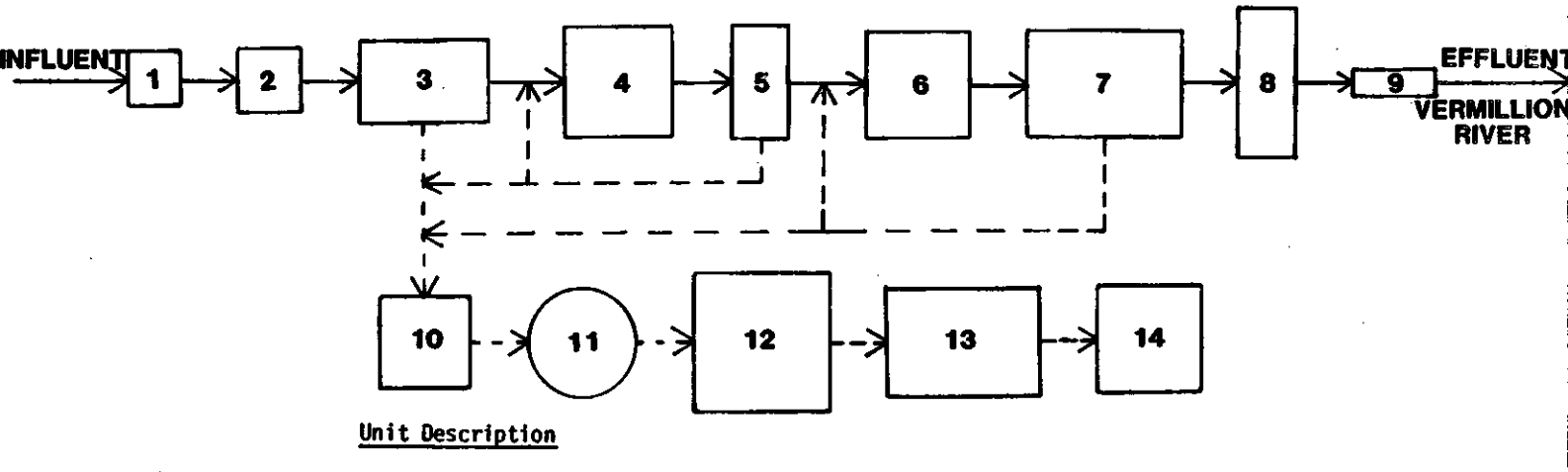
EMPIRE PLANT PROCESS UNIT LOADINGS (cont.)

Parameter	Annual Average 1982	Annual Average 1983	Annual Average 1984	Maximum Month 1982	Maximum Month 1983	Maximum Month 1984
Nitrification Final Clarifiers						
Surface Overflow Rate, gpd/sq. ft.	320	380	485	390	520	580
Weir Overflow Rate, gpd/lin. ft.	7,200	8,500	10,900	8,700	11,600	13,000
Detention Time, hr.	6.5	5.7	------	5.4	4.2	------
Mass Loading Rate lb/day/sq. ft.	------	------	18	------	------	25
Dual Media Filters						
Filtration Rate, gpd/sq. ft.	1.9	2.2	2.8	2.3	2.9	3.3
Chlorination						
Chlorine Dose, mg/L	3.6	2.9	------	3.9	3.3	------
Chlorine Use, lb./day	130	125	105	140	145	150
Contact Time, minutes	38	32	------	32	23	------
Cascade Aeration						
Effluent Dissolved Oxygen, mg/L	8.9	10.0	8.0	9.8	1.6	10.9
Gravity Thickener						
Solids Loading, lb/sq. ft./day	4	------	------	5	------	------
Surface Overflow Rate, gpd/sq. ft.	600	------	------	600	------	------
Sludge Concentration, % TS	3.8	------	------	4.9	------	------
Anaerobic Digesters (Primary)						
Voltile Solids Loading, lb/cu. ft./day	0.04	------	------	0.05	------	------
Detention Time, days	40	------	------	30	------	------
Dewatered Sludge						
Mass, lb/day	3,000	------	------	5,600	------	------
Cake Solids, % TS	13	------	------	14	------	------

[1]Includes loading from plant return flow.
[2]No intermediate effluent BOD data. Assumes BOD/COD ratio = 0.4.

EMPIRE WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

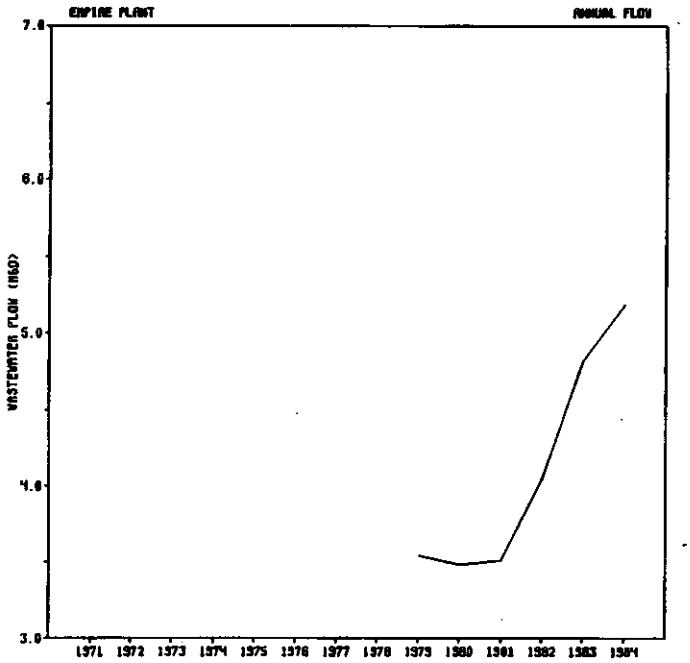
1. Screening
2. Grit Removal
3. Primary Sedimentation
4. Hi-Rate Activated Sludge Aeration
5. Intermediate Clarification
6. Nitrification Activated Sludge Aeration
7. Final Clarification
8. Effluent Filtration
9. Chlorination

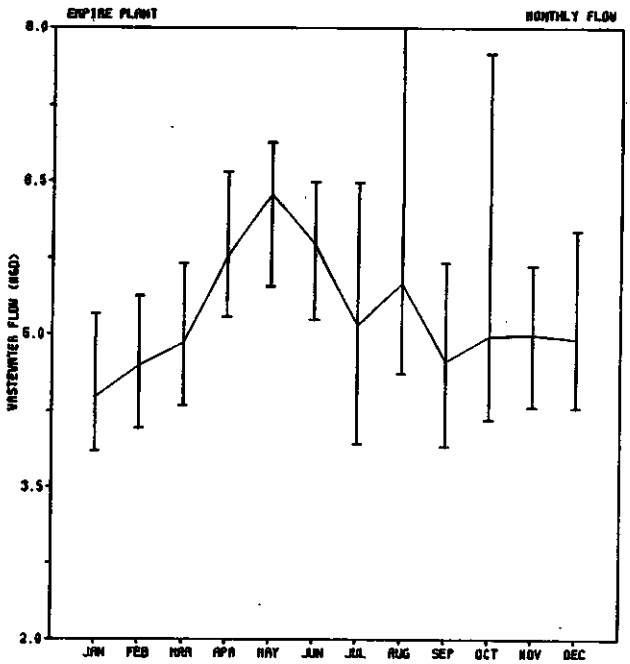
Solids Phase

10. Gravity Thickening
11. Anaerobic Digestion
12. Centrifuge Dewatering
13. Cake Storage
14. Sludge Landspreading

Legend

——— Liquid Flow
- - - - Solids Transfer
▭ Existing Process Units
[- - -] Future Process Units



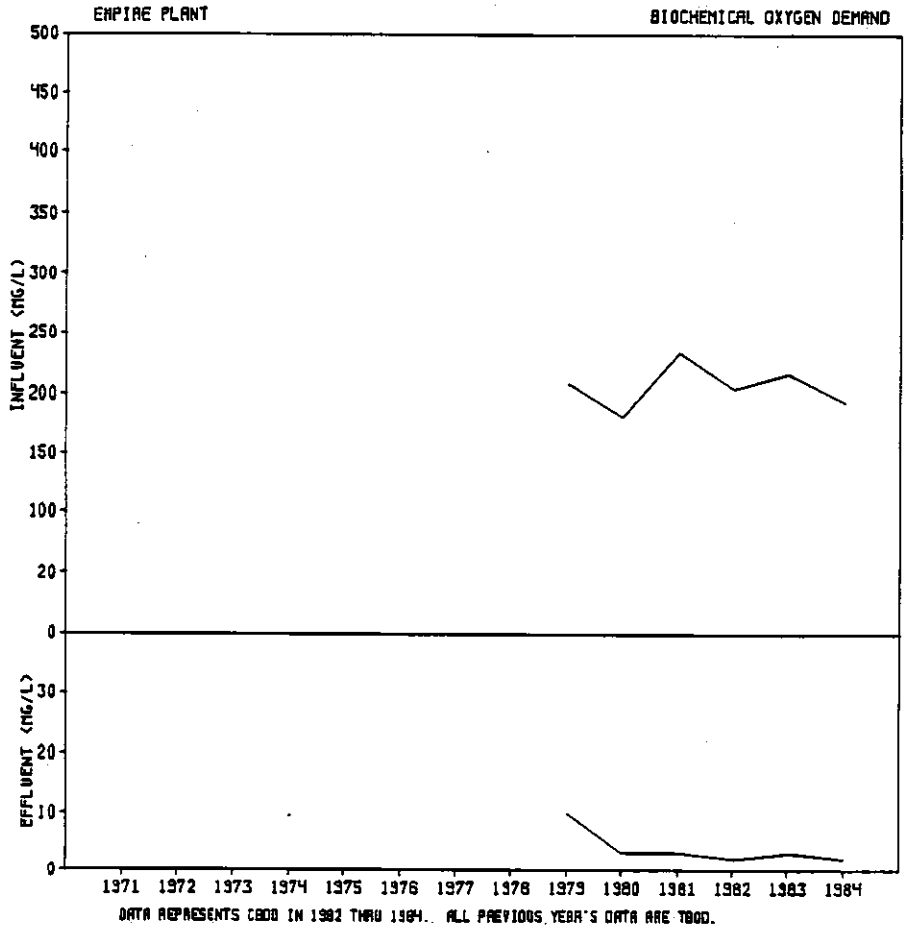


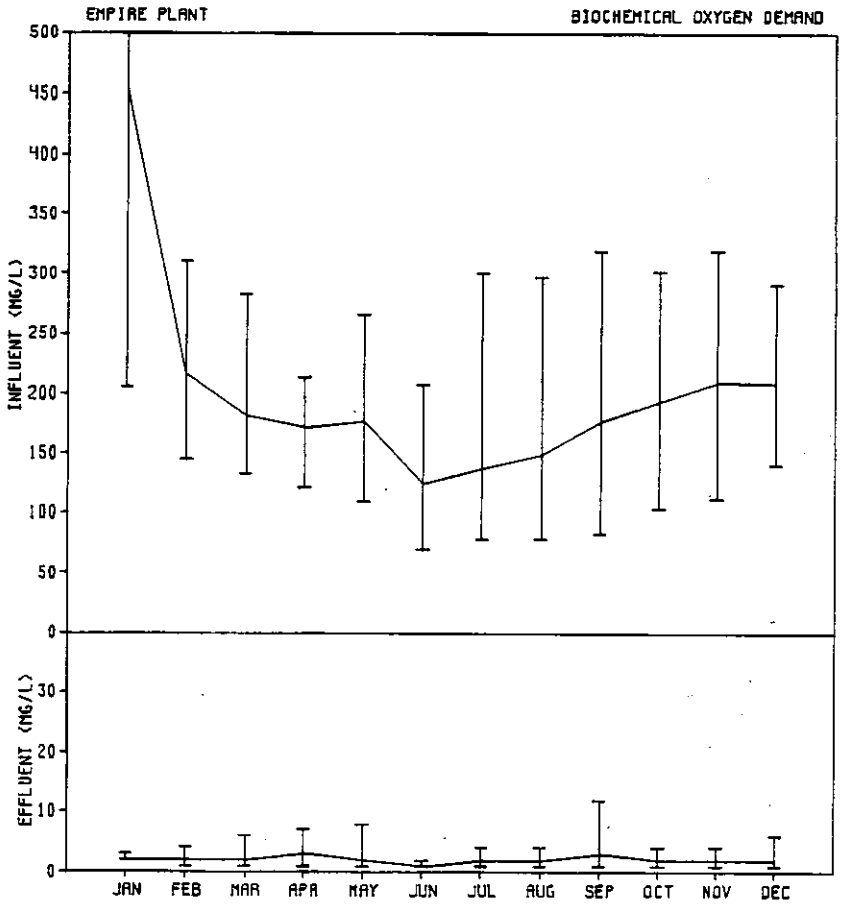
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Empire

Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	4.38	12	454	346	6.3-9.8	59.0	14.0	23.5	657
FEBRUARY	4.69	11	216	168	6.0-8.8	36.7	11.3	16.2	440
MARCH	4.92	11	181	145	6.4-8.3	26.2	10.0	12.3	367
APRIL	5.76	12	171	157	6.1-8.4	24.9	8.4	10.0	331
MAY	6.36	13	177	156	6.3-7.9	22.9	8.0	8.7	306
JUNE	5.89	15	125	158	6.2-7.2	30.9	9.2	15.6	309
JULY	5.09	17	137	177	7.0-7.5	28.2	7.5	10.9	316
AUGUST	5.51	18	149	175	6.7-8.7	29.4	7.8	13.0	336
SEPTEMBER	4.73	18	176	186	6.6-8.4	33.8	8.2	14.1	336
OCTOBER	4.98	18	193	204	6.4-8.3	36.5	9.3	15.3	380
NOVEMBER	4.99	16	209	204	6.2-10.5	35.7	9.9	18.0	401
DECEMBER	4.95	14	208	170	5.9-9.0	30.7	6.0	14.4	359
1984 AVERAGE	5.19	15	193	189	5.9-10.5	32.9	9.1	14.3	387
1983 AVERAGE	4.81	14	217	250	6.0-9.0	35.3	11.1	17.0	457

MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Empire

Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2 Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	10	10	--	10	200	25	---	1.0	----	-----	---	---	---	>4.0	6.5-8.5	--	--
JANUARY	2	2	35	1	---	1	1.9	0.4	0.08	19.05	7.2	---	---	8.3	6.7-7.4	99	99
FEBRUARY	3	2	34	1	---	1	1.7	0.1	0.07	16.40	7.0	100	0.8	7.9	6.8-7.4	99	99
MARCH	2	2	30	2	2	1	1.5	0.2	0.02	9.45	6.3	86	1.0	7.6	6.5-8.3	99	99
APRIL	4	3	36	3	2	2	1.8	0.1	0.02	6.33	5.3	84	0.7	6.5	6.7-7.4	98	98
MAY	3	2	32	2	4	1	1.9	0.1	0.17	7.66	4.5	112	0.7	6.1	6.6-7.4	99	99
JUNE	2	1	33	2	7	2	1.4	0.2	0.54	17.97	4.1	139	1.4	8.6	6.6-7.4	99	99
JULY	2	2	30	2	5	2	2.0	0.2	0.03	15.77	2.5	146	0.9	7.6	6.7-7.3	99	99
AUGUST	3	2	29	2	5	2	2.3	0.3	0.06	14.33	2.8	150	0.8	7.5	6.5-7.2	99	99
SEPTEMBER	3	3	17	2	2	1	1.7	0.6	0.02	15.36	2.7	135	0.9	8.2	7.0-7.2	98	99
OCTOBER	2	2	24	2	2	1	3.2	1.6	0.03	15.50	3.8	107	0.9	7.4	6.9-7.5	99	99
NOVEMBER	3	2	38	2	---	1	1.9	0.1	0.01	17.23	2.9	105	0.8	9.3	7.0-7.4	99	99
DECEMBER	3	2	40	2	---	1	1.4	0.1	0.01	12.19	2.3	---	---	10.9	6.9-7.4	99	99
1984 AVG.	3	2	32	2	4	1	1.9	0.3	0.09	13.83	4.3	120	0.9	8.0	6.5-8.3	99	99
1983 AVG.	3	3	28	1	3	1	1.6	0.4	0.16	16.41	4.6	123	1.4	10.0	6.5-8.4	99	99


EMPIRE PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984.. ALL PREVIOUS YEAR'S DATA ARE TBOD.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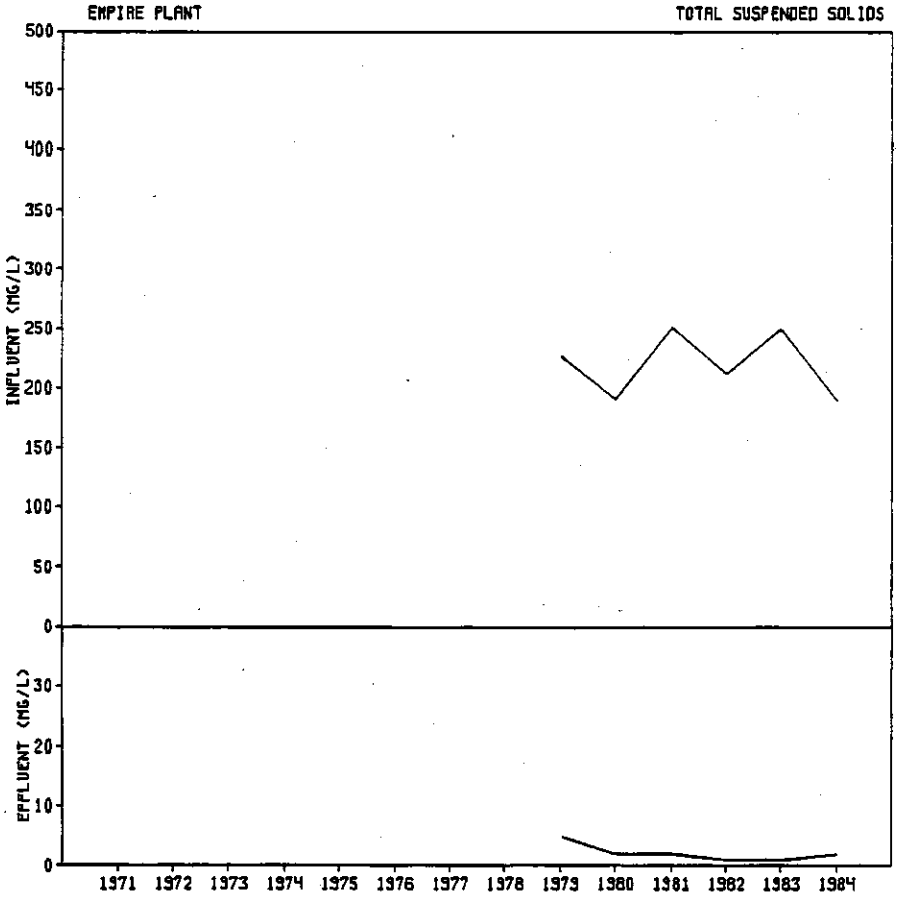
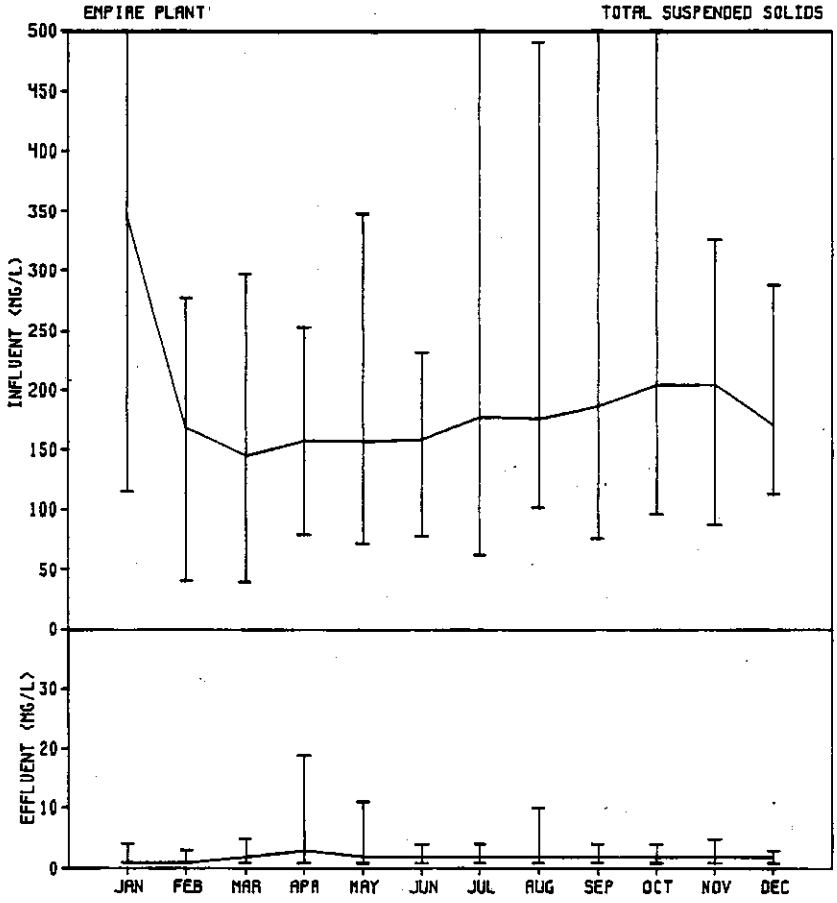
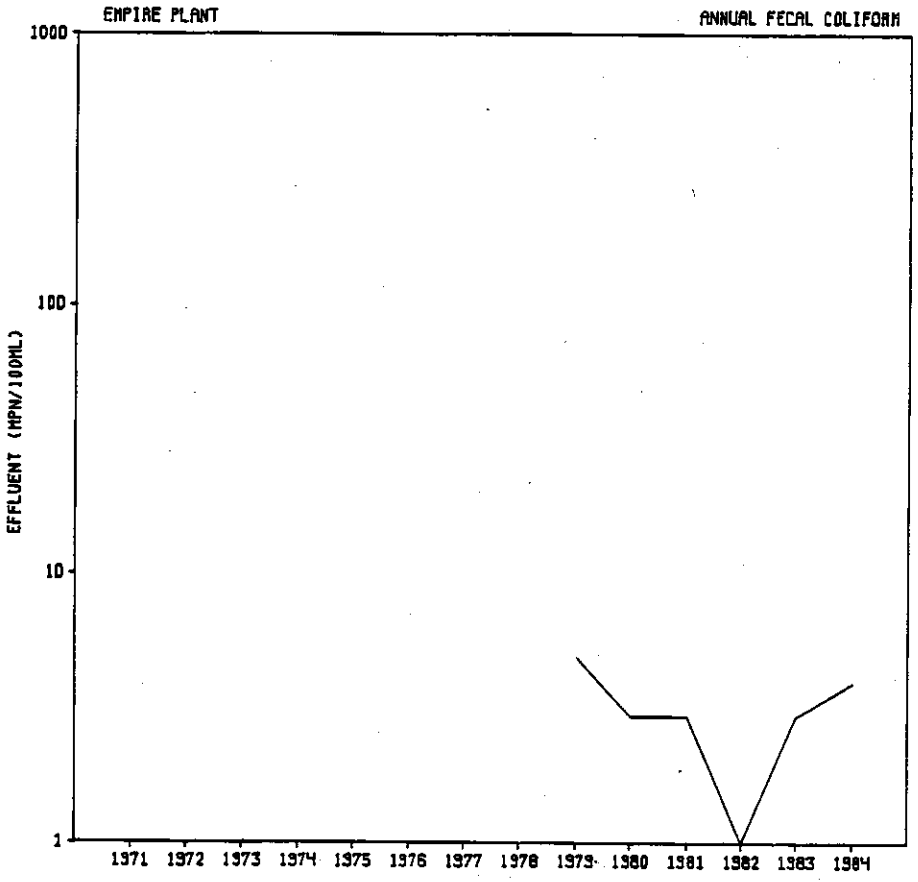
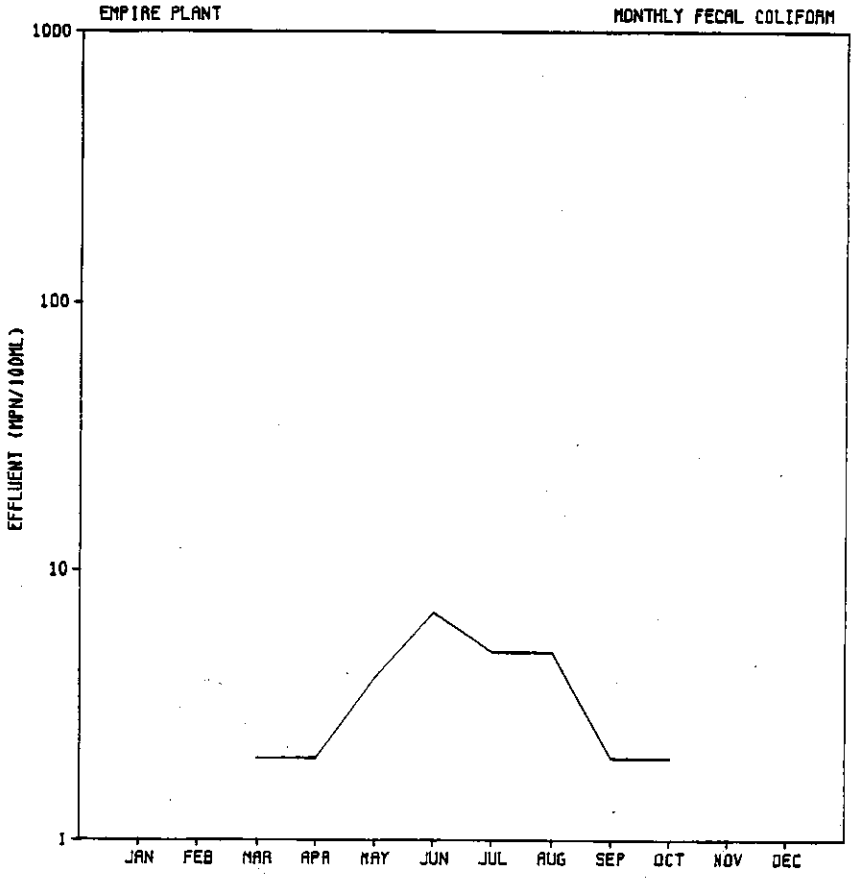
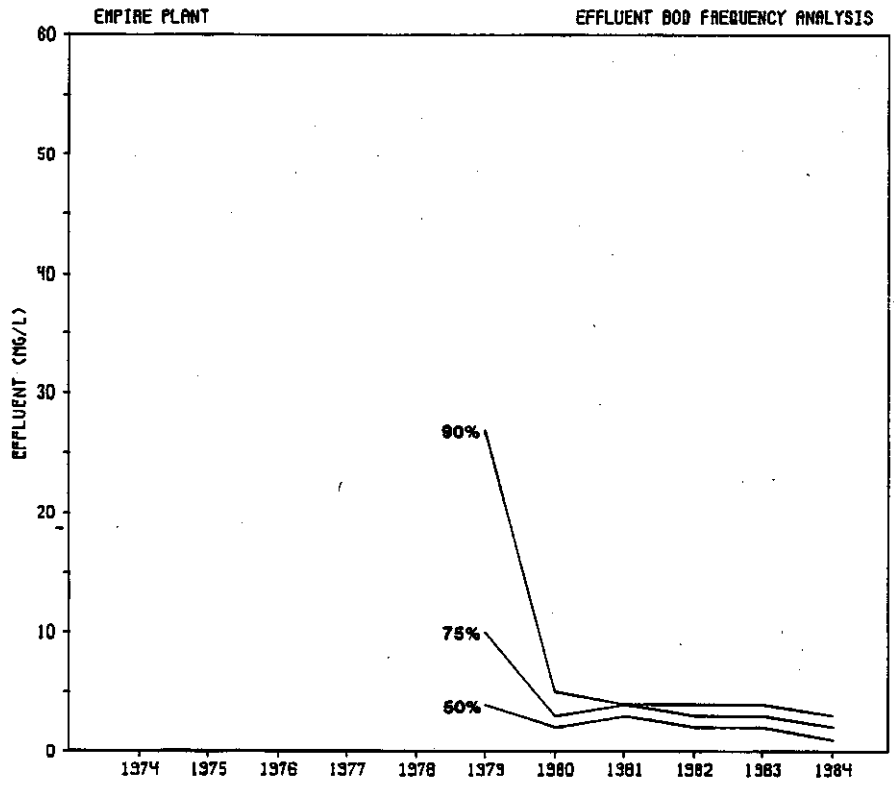
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

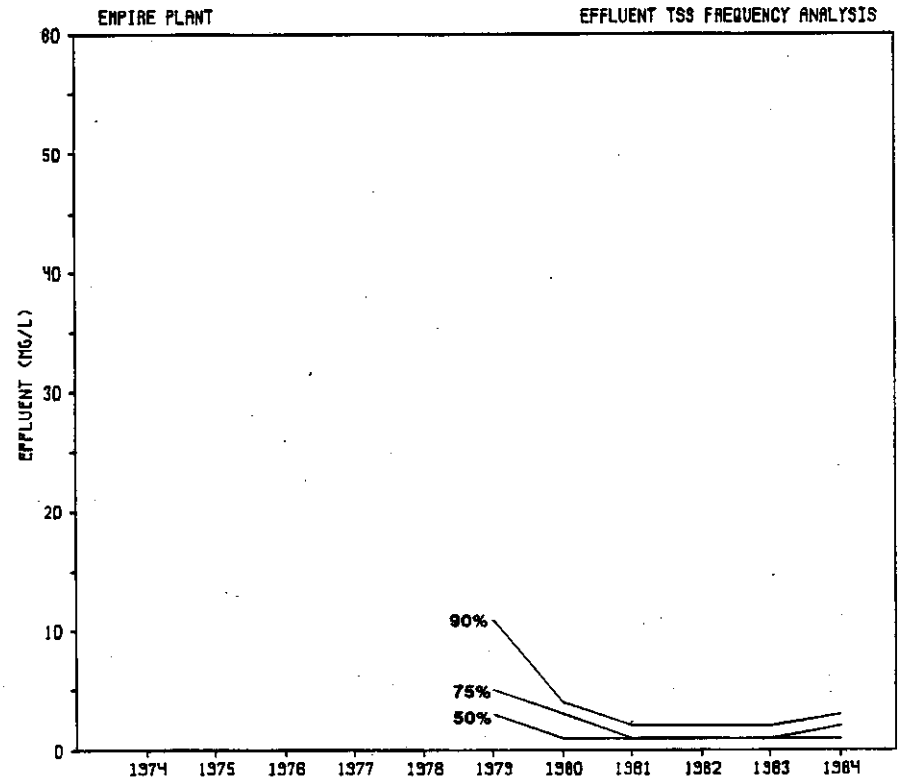

EMPIRE PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


EMPIRE PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


EMPIRE PLANT
ANNUAL FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


EMPIRE PLANT
MONTHLY FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


EMPIRE PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


EMPIRE PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

HASTINGS WASTEWATER TREATMENT PLANT

Plant History and Description

The Hastings Plant was designed by Toltz, King, Duvall, Anderson, and Associates and built in 1955 as a "primary treatment" plant. Principal items included a primary control building, primary settling and chlorination tanks, anaerobic digester, and sludge drying beds. In 1967, the plant was modified to include secondary treatment facilities. Major additions included one four-pass aeration tank, two final settling tanks, a chlorine contact tank and a secondary sludge digester. After 1967 modifications, the plant's design capacity was 1.83 mgd. Actual operating capacity is somewhat less, estimated to be about 1.44 mgd.

Liquid treatment consists of screening, grit removal, primary sedimentation, primary effluent pumping, activated sludge aeration, final clarification, chlorination, and discharge to the Mississippi River.

Solids processing consists of combined thickening in primary tanks, anaerobic digestion with ultimate disposal by landspreading or through the Metropolitan Plant Interceptor System. The Hastings Plant is operating beyond its effective capacity and is subject to secondary treatment limits.

Performance

Plant flow averaged 1.64 mgd in 1984, similar to 1.65 mgd in 1983. Average plant effluent quality was 22 mg/L BOD and 32 mg/L TSS. Plant performance was marginal due to operation near plant capacity. A total of 16 NPDES violations occurred throughout the year. Statistical analysis of data show the following trend in effluent quality from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	18	17	14	16	24	27	20	23	33	37	26	35
TSS	19	28	22	24	28	38	32	32	36	48	41	59

*1982 through 1984 values represent CBOD.

Future

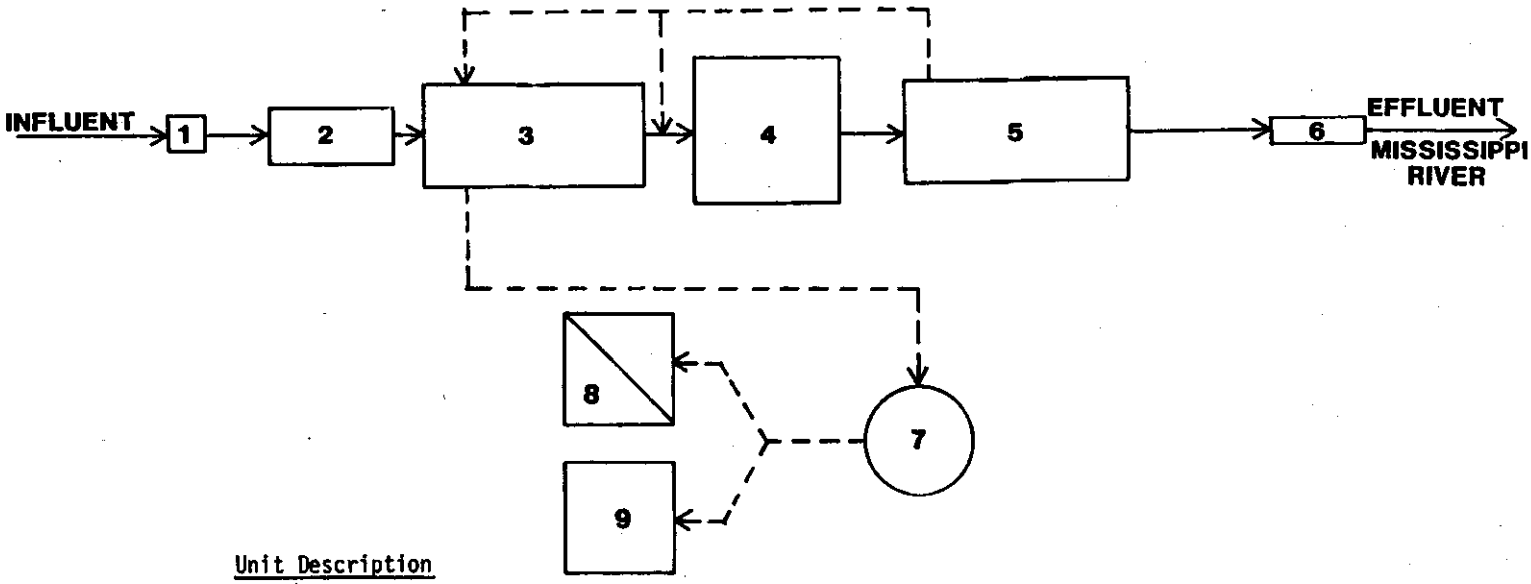
The Hastings Plant is being expanded to a capacity of 2.34 mgd. Construction grants for a plant expansion were received and construction began in late 1983. The first phase of the plant expansion is scheduled for completion in June 1985, with overall completion by December, 1985.

HASTINGS PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	1.50	1.65	1.64	1.63	1.75	1.72
BOD Loading, lb/day	3,140	3,260	2,770	3,550	4,150	3,900
TSS Loading, lb/day	2,930	2,620	2,780	3,820	3,670	4,200
COD Loading, lb/day	6,770	7,430	6,670	8,120	8,750	9,500
Primary Sedimentation						
Surface Overflow Rate, gpd/sq. ft.	1,330	2,500	2,500	1,390	2,600	2,600
Aeration Tanks						
BOD Loading, lb/day/1000 cu. ft.	45	47	40	51	60	56
Final Sedimentation						
Weir Overflow Rate, gpd/lin. ft.	9,100	10,100	10,000	9,900	10,700	10,500
Surface Overflow Rate, gpd/sq. ft.	625	690	680	680	730	720
Chlorination						
Contact Time - Primary, minutes	37	------	------	34	------	------
Contact Time - Secondary, minutes	10	------	------	10	------	------
Chlorine Use, lb/day	126	116	93	185	130	165
Sludge Transport						
Volume, gpd	7,560	8,100	5,700	9,810	11,800	12,600
Mass, lb/day	2,000	1,900	1,400	2,550	2,100	2,400

HASTINGS WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

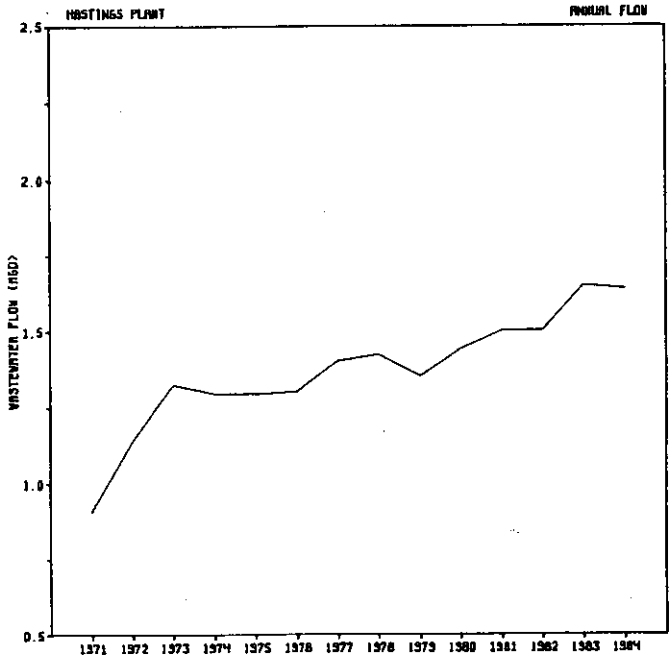
1. Screening
2. Grit Removal
3. Primary Sedimentation
4. Activated Sludge
5. Final Sedimentation
6. Chlorination

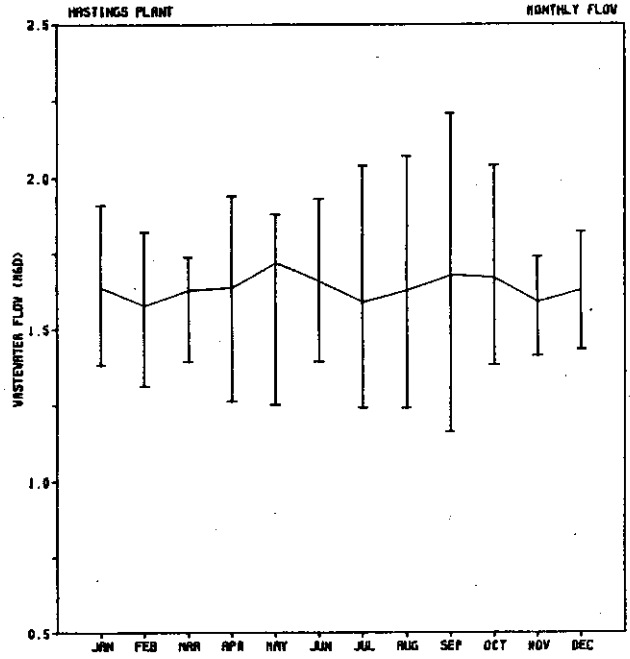
Solid Phase

7. Anaerobic Digestion
8. Solids Disposal at Metro Plant
9. Land Spreading

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





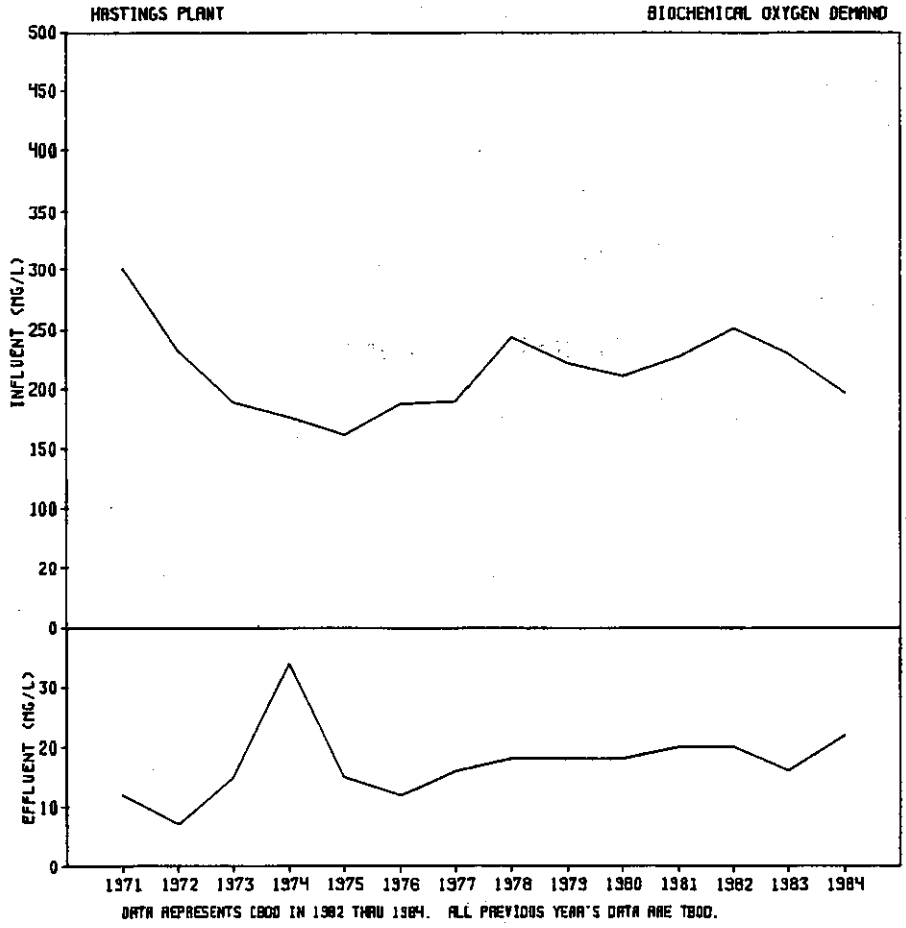
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Hastings

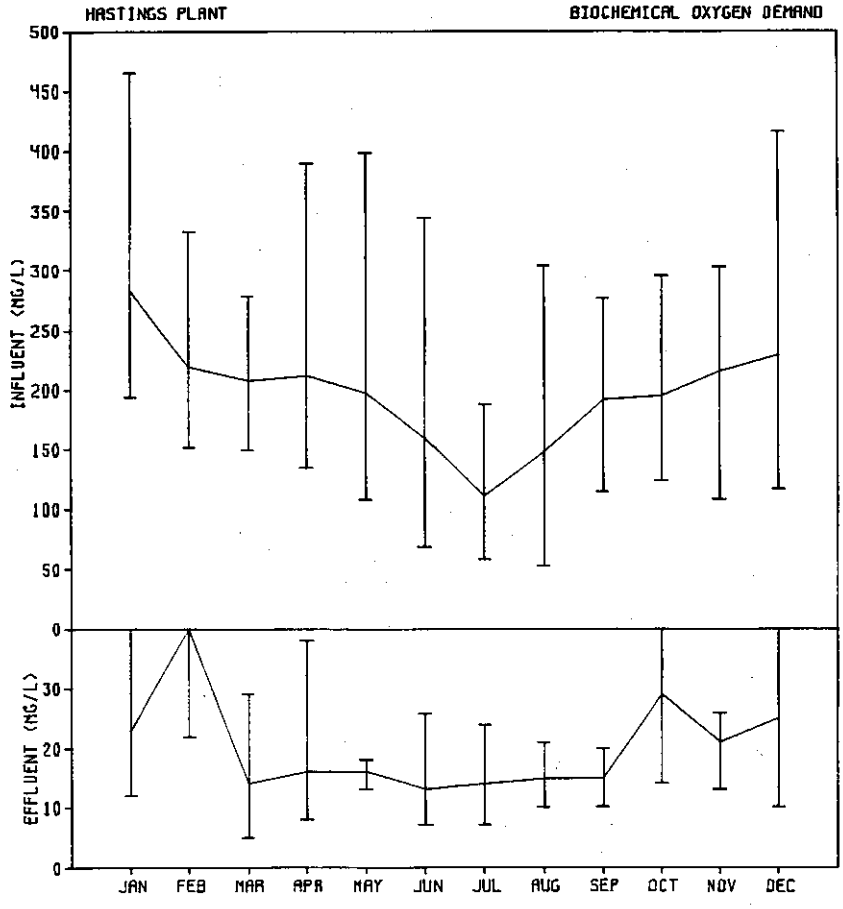
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	1.64	15	282	303	6.1-9.2	55.0	14.6	24.8	684
FEBRUARY	1.58	13	219	214	6.4-11.0	44.5	12.4	18.1	487
MARCH	1.63	12	207	211	5.4-9.4	51.9	10.3	29.4	554
APRIL	1.64	13	211	189	6.2-9.0	41.8	10.1	24.4	492
MAY	1.72	14	197	204	6.8-10.2	41.8	8.4	20.7	466
JUNE	1.66	18	158	222	6.2-9.8	39.6	9.3	20.5	420
JULY	1.59	20	111	103	6.0-10.9	36.2	9.2	19.5	304
AUGUST	1.63	22	148	153	4.4-10.4	34.4	8.1	16.5	357
SEPTEMBER	1.68	20	191	156	5.0-10.6	40.5	10.0	19.6	436
OCTOBER	1.67	19	194	158	5.0-11.2	57.8	12.5	23.2	461
NOVEMBER	1.59	17	216	239	5.0-10.6	45.9	10.0	25.9	531
DECEMBER	1.63	16	229	213	6.5-11.2	57.4	11.9	35.5	513
1984 AVERAGE	1.64	17	196	196	4.4-11.2	45.7	10.6	23.1	472
1983 AVERAGE	1.65	17	230	187	4.5-12.0	45.9	12.2	25.0	523

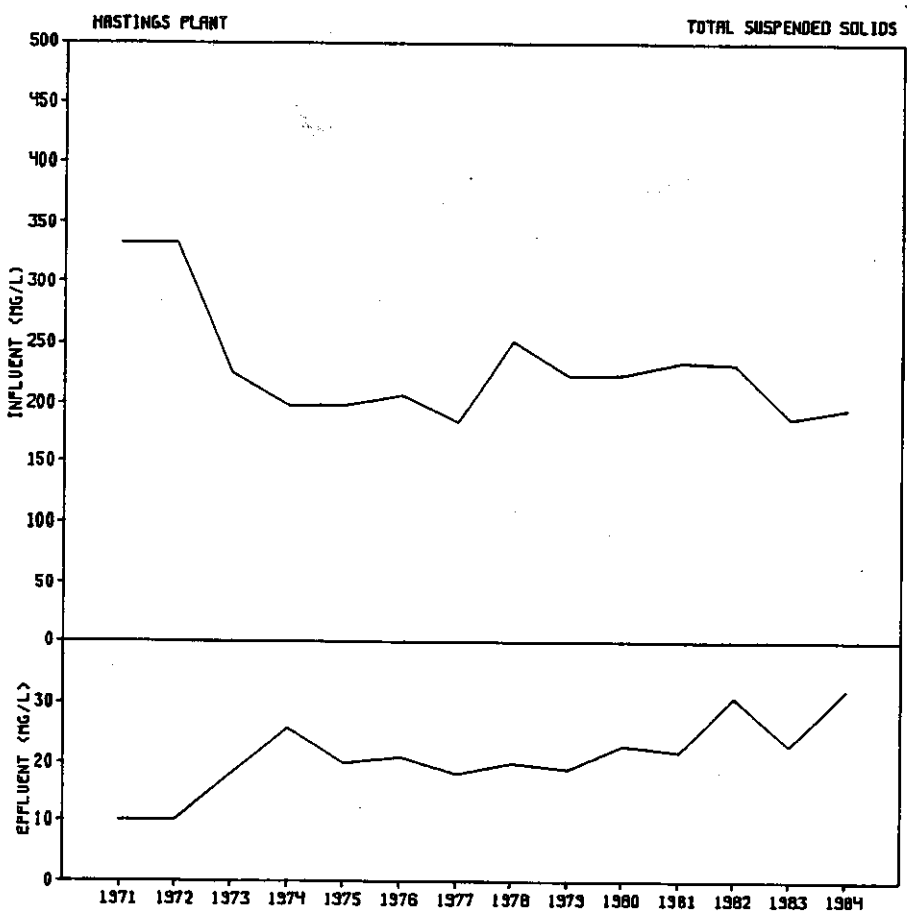
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Hastings

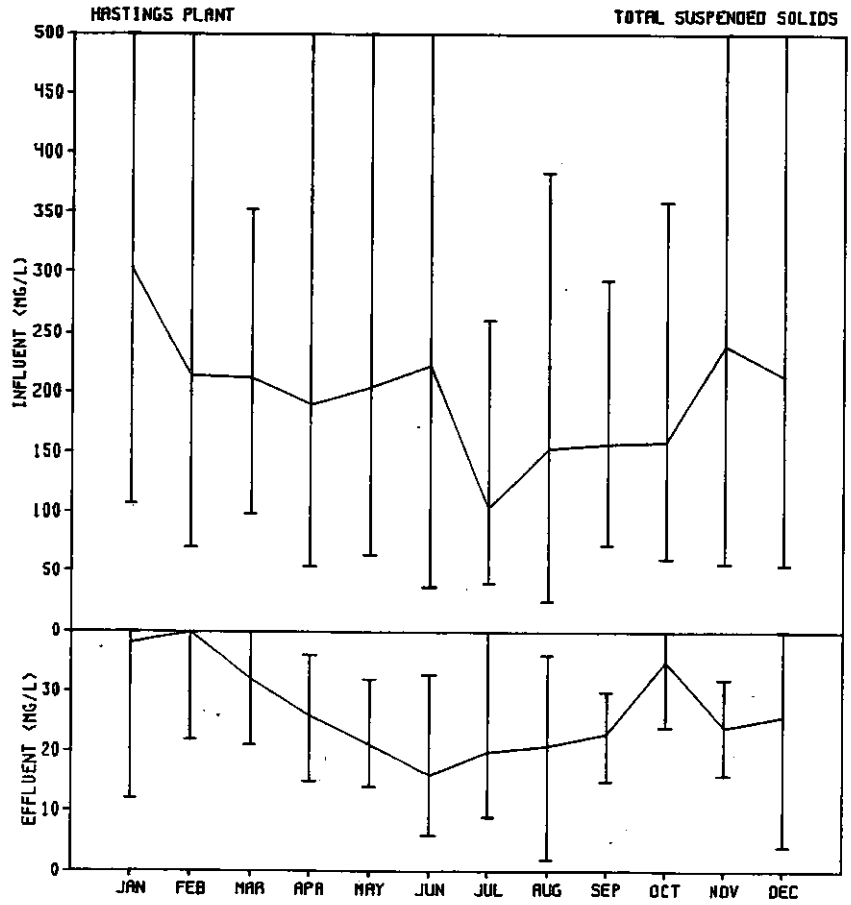
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TS
NPDES LIMIT	25	25	---	30	200	25	----	----	----	----	---	---	---	---	6.5-8.5	--	--
JANUARY	46	23	134	38	---	11	33.8	21.8	0.57	1.99	9.7	--	---	6.3	6.8-7.2	92	87
FEBRUARY	87	66	258	105	---	28	37.6	21.5	0.28	0.37	9.8	27	0.0	6.1	6.6-7.4	70	51
MARCH	35	14	132	32	5	13	33.6	25.0	1.12	1.82	2.0	77	5.5	6.1	7.1-7.5	93	85
APRIL	24	16	90	26	22	12	25.8	19.0	0.90	0.94	4.3	71	5.6	6.1	7.0-7.5	92	86
MAY	43	16	95	21	39	10	23.5	13.8	2.68	4.17	5.7	65	4.4	6.1	7.1-7.6	92	90
JUNE	45	13	97	16	49	8	22.0	14.6	4.30	3.27	6.0	65	5.0	5.9	7.0-7.7	92	93
JULY	38	14	93	20	49	9	12.9	6.3	4.30	11.00	7.1	65	3.7	5.9	7.0-7.5	87	81
AUGUST	33	15	111	21	66	10	13.5	6.8	3.35	12.02	6.9	123	4.0	5.3	7.0-7.4	90	86
SEPTEMBER	40	15	89	23	14	9	9.9	4.5	2.85	12.13	6.1	165	5.9	5.0	7.2-7.5	92	86
OCTOBER	35	29	153	35	21	17	32.7	21.8	0.33	0.50	7.8	115	9.6	4.8	7.2-7.7	85	78
NOVEMBER	43	21	112	24	---	8	32.6	22.5	1.42	1.93	6.9	---	---	6.1	7.2-7.5	91	90
DECEMBER	47	25	112	26	---	11	32.3	24.8	0.35	2.21	6.9	---	---	6.3	7.1-7.4	89	88
1984 AVG.	43	22	123	32	33	12	25.8	16.8	1.88	4.37	6.7	92	5.4	5.8	6.6-7.7	89	83
1983 AVG.	27	16	120	23	44	10	24.0	16.0	1.23	2.32	6.9	115	6.4	6.0	6.4-7.8	93	87

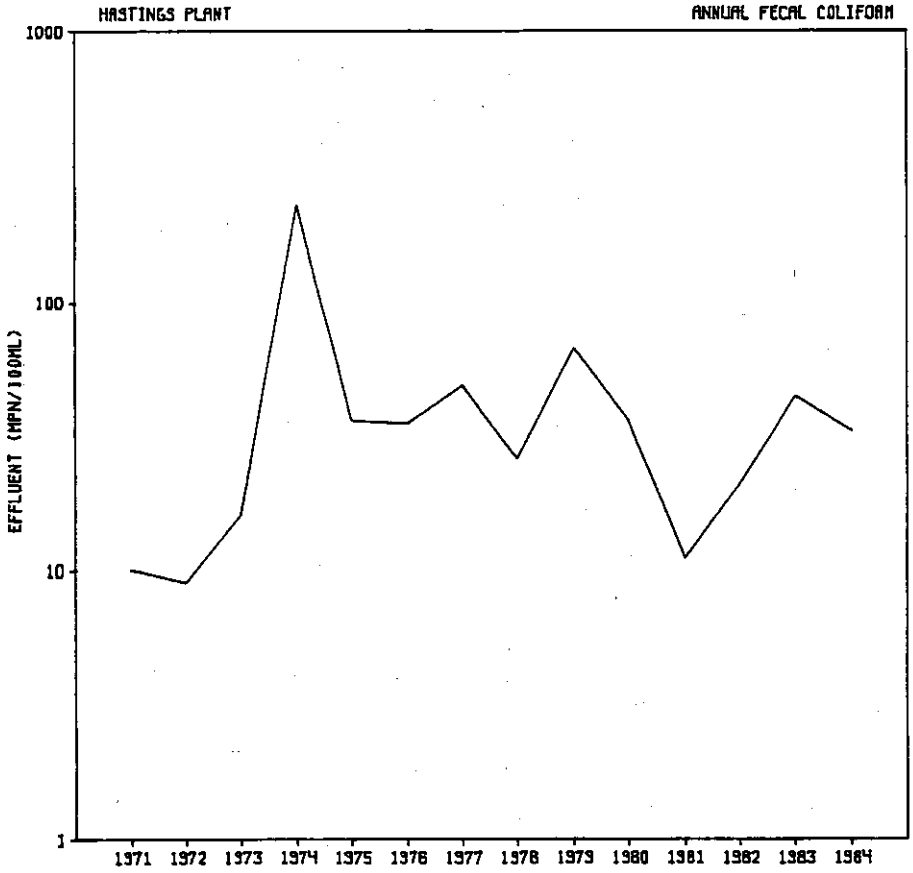
*For disinfection only.

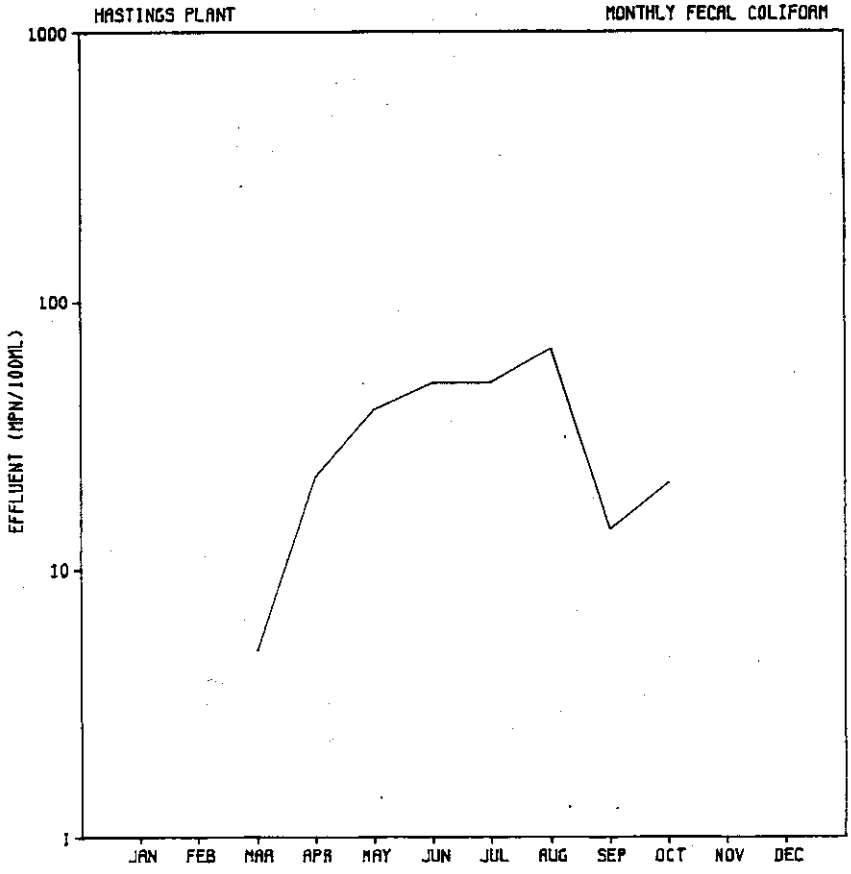

HASTINGS PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
20
0
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.

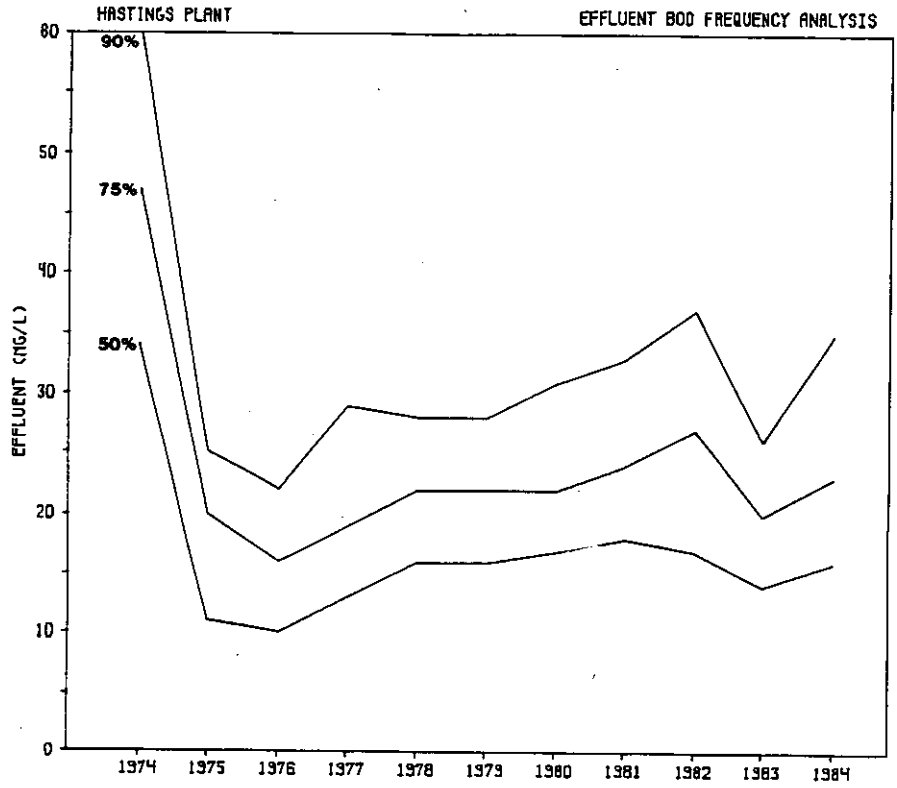

HASTINGS PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

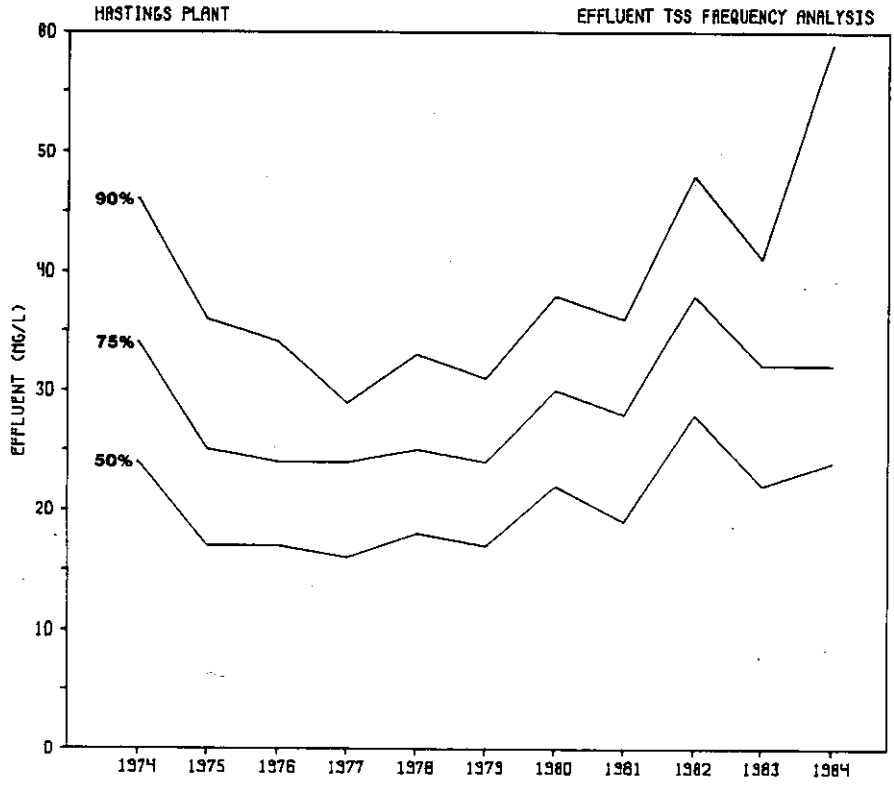

HASTINGS PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


HASTINGS PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


HASTINGS PLANT
ANNUAL FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


HASTINGS PLANT
MONTHLY FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


HASTINGS PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
90%
75%
50%
EFFLUENT (MG/L)
60
50
40
30
20
10
0
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


HASTINGS PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
90%
75%
50%
EFFLUENT (MG/L)
60
50
40
30
20
10
0
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

1984 EFFLUENT DATA
TREATMENT PLANT Hastings

MONTH	Cu mg/l	Cr mg/l	Zn mg/l	Pb mg/l	Cd mg/l	Hg ug/l	CN mg/l	As ug/l	PCB ug/l	Ni mg/l	Phenol ug/l	Fe mg/l
January	0.01	0.13	0.09			<0.20	<0.020				17.7	
February	0.06	0.26	0.14			<0.20	<0.020				12.5	
March	0.03	<0.07	0.09	0.06	<0.008	<0.20	<0.020			<0.04	12.4	1.01
April	0.07	<0.06	0.10			<0.20	<0.020				11.1	
May	0.08	0.09	0.10			<0.20	<0.020				11.1	
June	0.03	<0.08	0.11	<0.05	<0.008	<0.30	<0.020			<0.04	9.0	0.92
July	0.02	<0.05	0.10			<0.30	<0.020				<7.3	
August	0.05	0.11	0.10			<0.20	<0.020				7.4	
September	0.03	<0.11	0.06	<0.05	<0.008	<0.20	<0.020			<0.04	5.7	0.35
October	0.04	0.24	0.15			<0.20	<0.020				10.6	
November	0.02	0.16	0.08			<0.20	<0.020				5.9	
December	0.02	<0.13	0.08	<0.05	<0.008	<0.20	<0.020			<0.04	10.3	0.75
1984 Avg.	0.04	<0.12	0.10	<0.05	<0.008	<0.22	<0.020			<0.04	10.1	0.76
1983 Avg.	<0.05	<0.20	0.11	<0.05	<0.008	<0.23	<0.062			<0.04	9.9	0.32

MAPLE PLAIN WASTEWATER TREATMENT PLANT

Plant History and Description

The original Maple Plain Plant was designed by Toltz, King, Duvall, Anderson and Associates and constructed in 1952. A plant expansion was designed by W.T. Mills, and constructed in 1965. Current plant design capacity is 0.22 mgd.

Liquid treatment consists of grit removal, screening, influent pumping, primary sedimentation, roughing trickling filter, complete mix activated sludge aeration, final clarification, chlorination, effluent polishing pond, and discharge through a swamp to Lake Minnetonka.

Solids processing consists of combined thickening in primary tanks, anaerobic digestion, and sludge hauling to other plants for processing or to landspreading sites.

The plant is presently operated well beyond its rated hydraulic capacity and is subject to secondary treatment limits.

Performance

Plant flow averaged 0.40 mgd in 1984, slightly higher than 0.35 mgd in 1983. Average plant effluent quality was 10 mg/L BOD and 10 mg/L TSS. Although the flow was in excess of plant capacity, plant performance was excellent throughout the year with no violations of its NPDES Permit. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	10	11	8	6	15	18	12	12	21	26	17	22
TSS	6	6	6	8	8	10	12	15	16	16	16	19

*1982 through 1984 values represent CBOD.

Future

The long-term plan is to phase out the Maple Plain Plant by constructing an interceptor to Long Lake. The existing plant flow will then be conveyed to the Blue Lake Plant for treatment. Completion of interceptor construction is scheduled for late 1986.

MAPLE PLAIN PLANT PROCESS UNIT LOADINGS

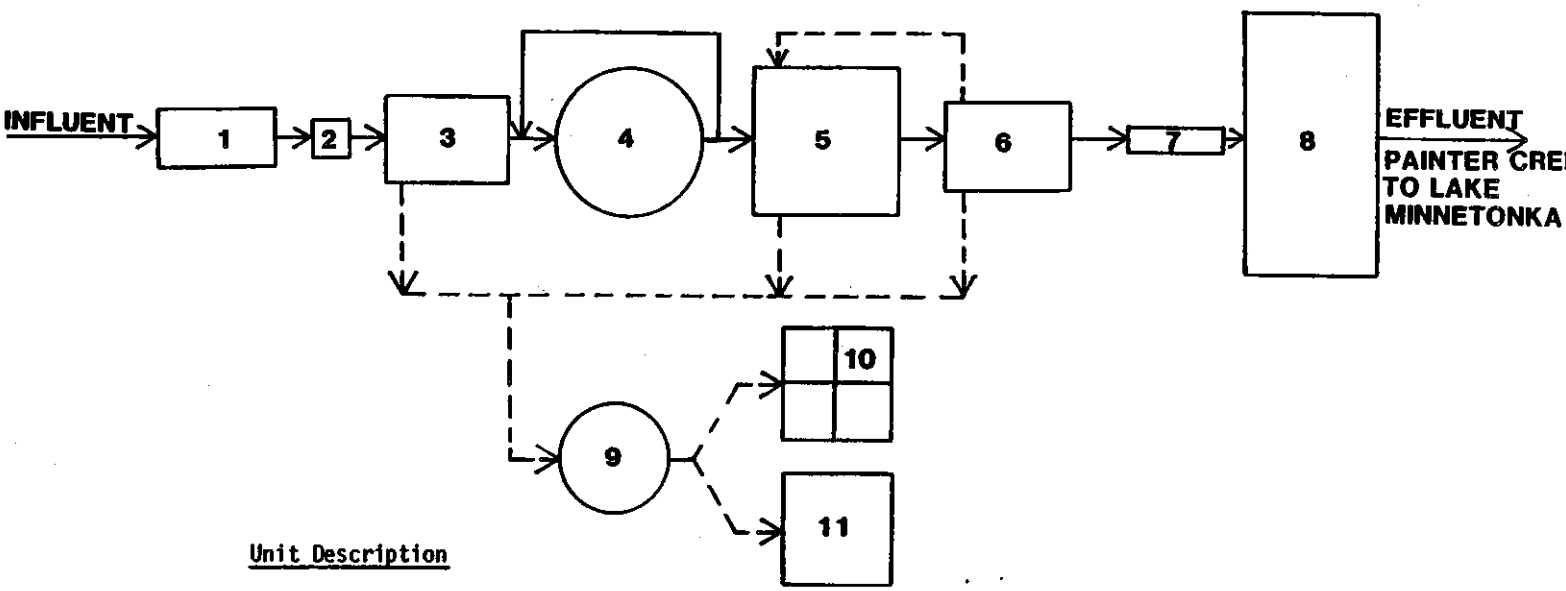
Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, MGD	0.35	0.35	0.40	0.59	0.75	0.60
BOD Loading, lb/day	425	7,360	350	490	460	500
TSS Loading, lb/day	580	500	600	1,080	700	1,300
COD Loading, lb/day	860	800	870	1,090	1,100	1,400
Sludge Production, lb/day	80	60	45	------	------	------
Grit Removal						
Overflow Rate, gpd/sq. ft.	21,880	22,000	25,000	36,880	47,000	37,500
Primary Sedimentation						
Detention Time, hr.	0.7	0.75	0.7	0.4	0.35	0.4
Weir Overflow Rate, gpd/lin. ft.	9,270	9,700	11,100	16,390	21,000	16,700
Surface Overflow, gpd/sq. ft.	1,440	1,400	1,600	2,430	3,100	2,500
Trickling Filters						
Hydraulic Loading, gpd/sq. ft.	220	220	250	370	470	380
BOD Loading, lb/day/1000 cu. ft.	41	35	34	47	45	48
Aeration Tanks						
Detention Time, hr.	7.1	7.1	6.2	4.2	3.3	4.2
BOD Loading, lb/day/1000 cu. ft. (Assume 50% trickling filter reduction)	±15	13	13	±18	17	18
Final Sedimentation						
Detention Time, hr.	2.0	2.0	1.8	1.2	1.0	1.2
Weir Overflow Rate, gpd/lin. ft.	8,970	9,000	10,300	15,130	19,000	15,400
Surface Overflow Rate, gpd/sq. ft.	1,030	1,000	1,200	1,730	2,200	1,800
Chlorination						
Contact Time, minutes	15	15	13	9	7	9
Chlorine Use, lb/day	36	31	24	50	43	30
Polishing Pond						
Detention Time, days	2.9	2.9	2.5	1.7	1.3	1.4
BOD, lb/acre/day	59	40	50	150	210	130

MAPLE PLAIN PLANT PROCESS UNIT LOADINGS (cont.)

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Anaerobic Digestion (Prim. Dig. Only)						
Solids Loading, lb/cu. ft./day	0.08	0.08	0.08	------	------	------
Detention Time, days	29	30	30	------	------	------
Sludge Transport						
Volume, gpd	160	180	120	------	------	------

MAPLE PLAIN WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

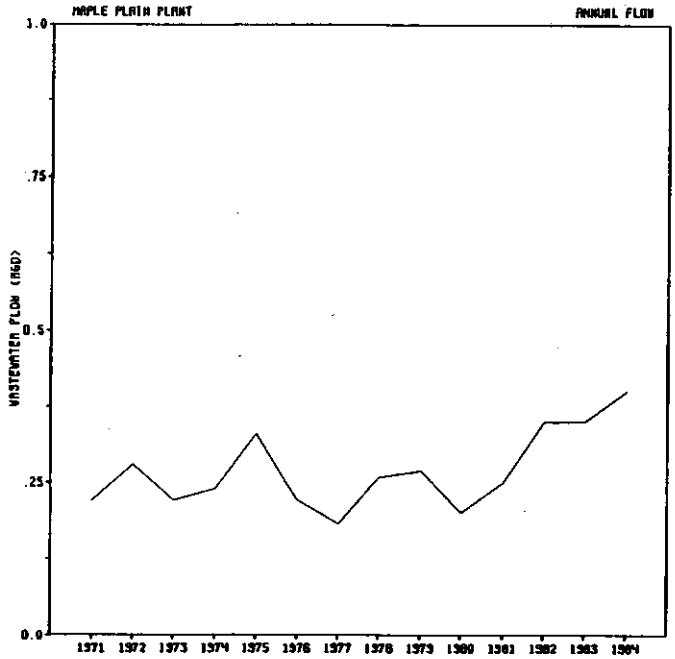
1. Grit Removal
2. Screening
3. Primary Sedimentation
4. Trickling Filter
5. Activated Sludge
6. Final Sedimentation
7. Chlorination
8. Effluent Pond

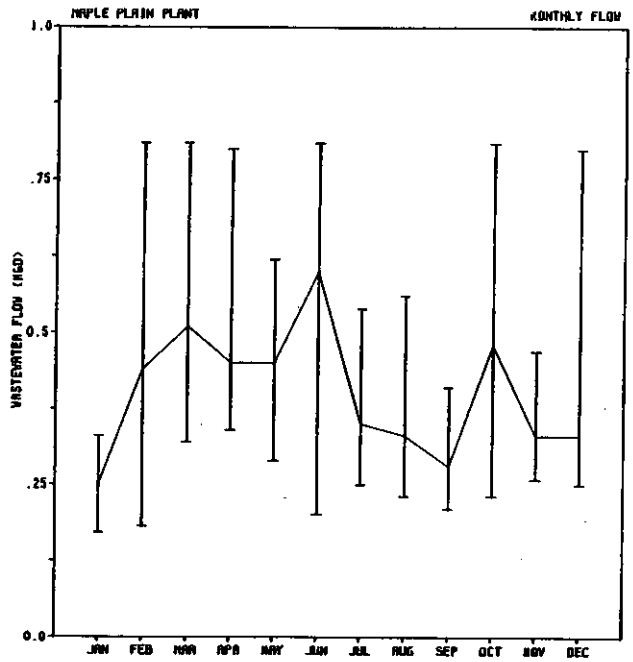
Solid Phase

9. Anaerobic Digestion
10. Sand Drying Beds
11. Land Spread

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





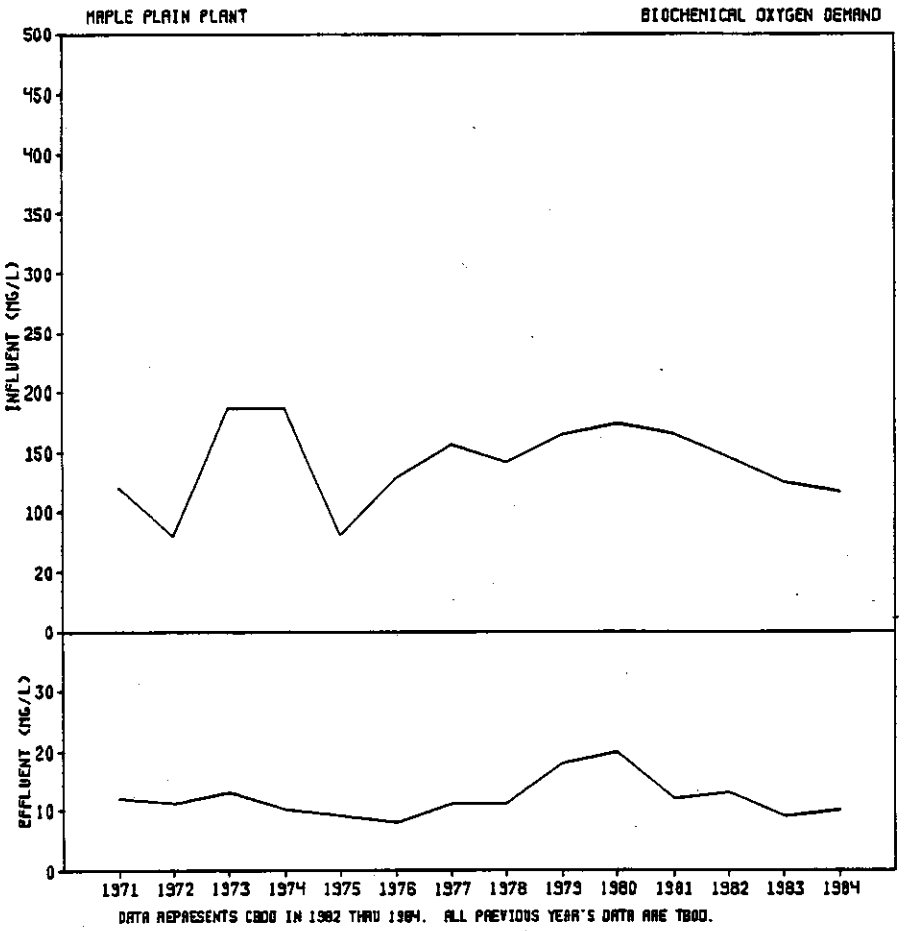
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Maple Plain

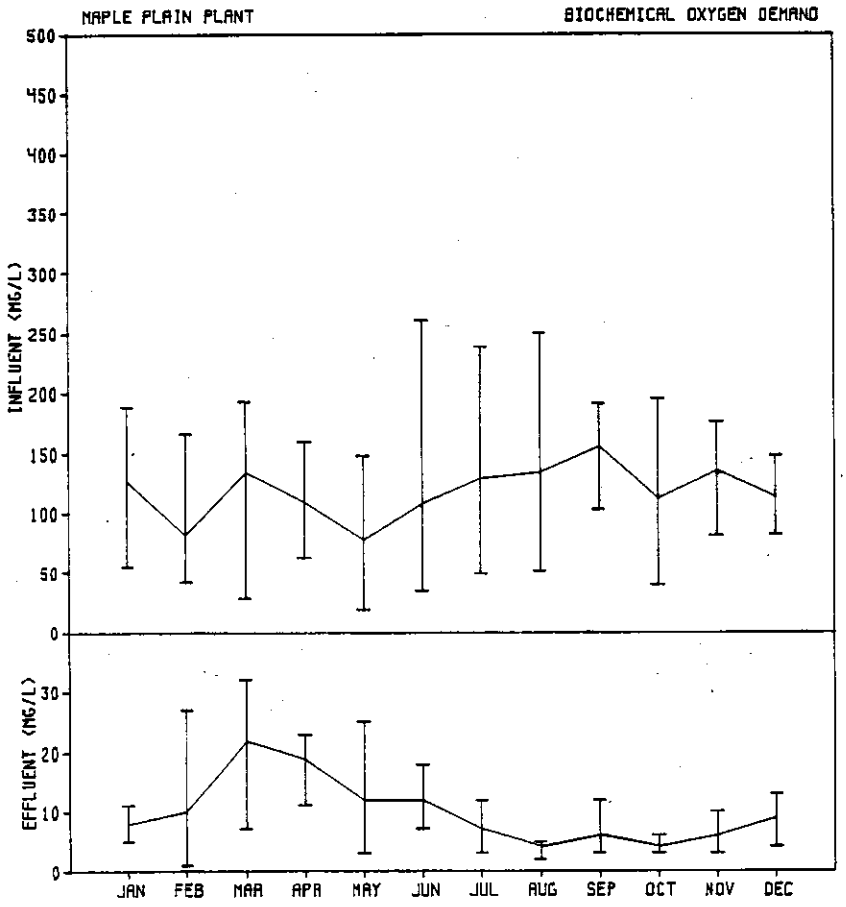
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	0.25	14	127	131	7.3-7.7	34.4	4.7	18.0	286
FEBRUARY	0.44	14	81	270	7.5-7.8	20.0	3.4	7.8	185
MARCH	0.51	12	134	136	7.4-7.7	26.8	5.6	10.3	271
APRIL	0.45	12	109	129	7.5-7.8	23.3	3.0	7.3	220
MAY	0.45	13	77	94	7.2-7.8	20.7	2.7	5.3	184
JUNE	0.60	13	108	171	7.2-7.5	21.9	4.0	6.9	292
JULY	0.35	14	129	158	7.3-7.6	28.2	5.2	10.4	310
AUGUST	0.33	17	134	264	7.3-7.6	24.4	3.8	10.3	479
SEPTEMBER	0.28	16	155	201	7.5-7.6	32.5	4.9	15.5	334
OCTOBER	0.48	--	112	172	7.4-7.7	28.9	4.1	13.4	260
NOVEMBER	0.33	14	135	435	7.4-7.6	23.4	4.5	10.5	282
DECEMBER	0.33	13	113	182	7.4-7.6	26.1	4.3	13.0	286
1984 AVERAGE	0.40	13	116	195	7.2-7.8	25.8	4.2	10.6	279
1983 AVERAGE	0.35	13	125	171	7.2-7.9	28.1	5.1	13.4	275

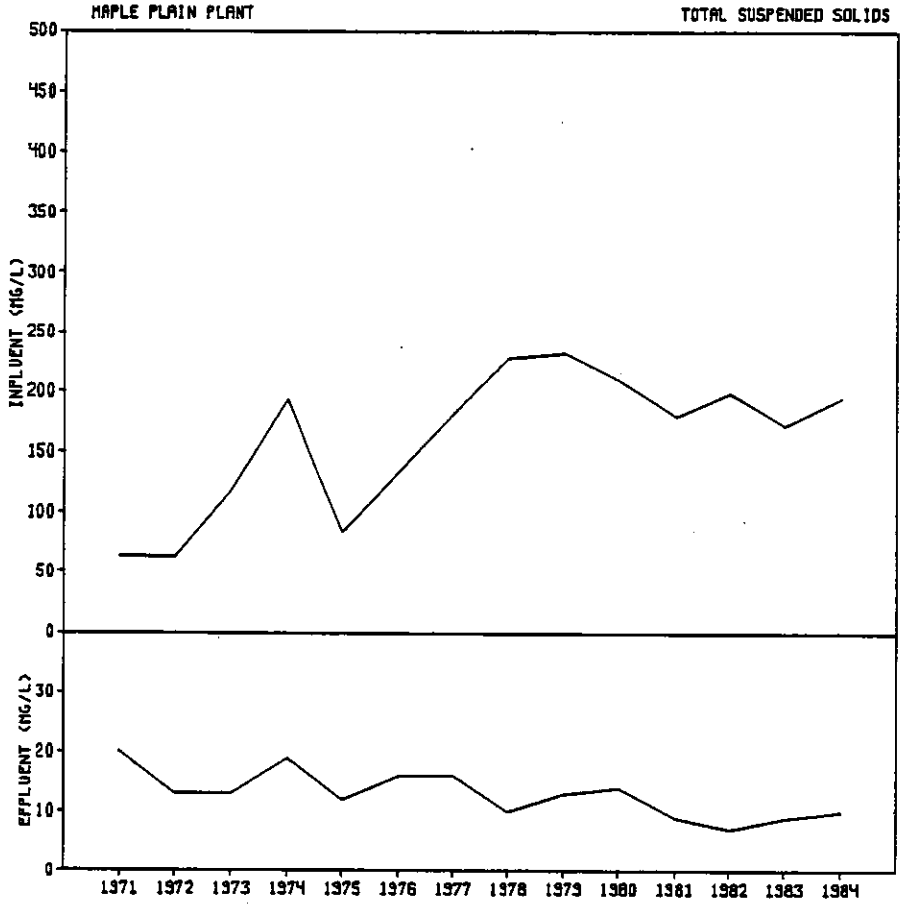
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Maple Plain

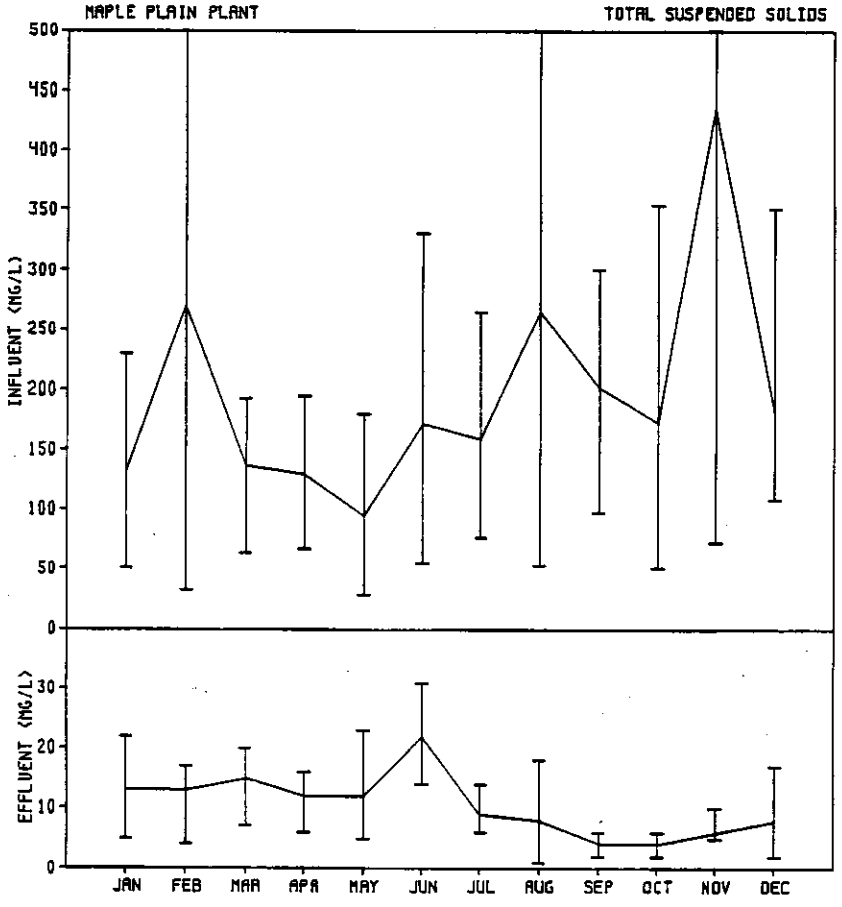
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	----	----	----	---	--	---	---	6.5-8.5	--	--
JANUARY	14	8	42	13	---	11	10.9	7.6	0.04	0.34	1.9	--	---	7.3	7.6-7.6	94	90
FEBRUARY	12	10	52	13	---	10	6.1	3.0	0.22	0.82	1.1	20	0.0	6.8	7.2-7.8	88	95
MARCH	26	22	77	15	4	17	12.0	7.8	0.09	0.94	2.2	22	0.0	5.1	7.5-7.7	83	89
APRIL	22	19	64	12	4	12	11.6	6.1	0.05	0.61	1.8	22	0.0	4.8	7.4-7.5	83	90
MAY	13	12	52	12	4	11	9.1	4.3	0.12	0.98	1.4	30	0.1	5.1	7.2-7.5	85	88
JUNE	17	12	49	22	19	11	6.0	2.8	0.08	0.76	1.1	29	0.0	3.1	7.3-7.6	89	87
JULY	8	7	41	9	5	7	16.2	9.6	0.02	0.32	2.0	23	0.0	4.6	7.5-7.6	95	94
AUGUST	4	4	43	8	12	5	11.1	8.0	0.09	0.35	1.7	20	0.0	7.3	7.1-7.8	97	97
SEPTEMBER	13	6	23	4	5	4	11.3	5.9	0.25	3.36	2.7	20	0.0	7.4	7.4-7.8	96	98
OCTOBER	5	4	37	4	4	8	5.3	3.2	0.19	5.76	1.9	26	0.0	7.8	7.5-7.9	96	98
NOVEMBER	7	6	48	6	---	--	8.4	4.8	0.15	4.59	2.5	--	---	7.8	7.4-7.7	96	99
DECEMBER	13	9	48	8	---	3	15.0	9.0	0.22	3.11	2.9	--	---	8.0	7.1-7.7	92	96
1984 AVG.	13	10	47	10	7	9	10.2	5.9	0.13	1.84	1.9	24	0.0	7.1	7.1-7.9	91	93
1983 AVG.	12	9	52	9	10	6	12.7	9.1	0.21	2.02	2.5	31	0.4	6.4	7.3-7.8	92	93

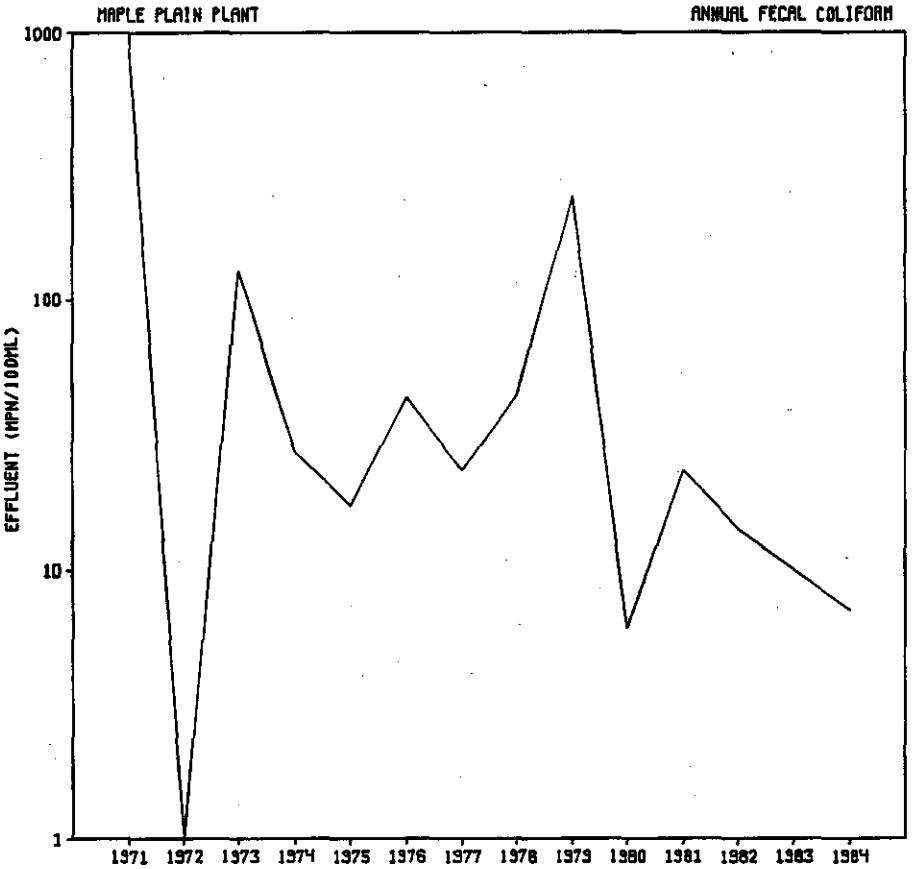
*For disinfection only.

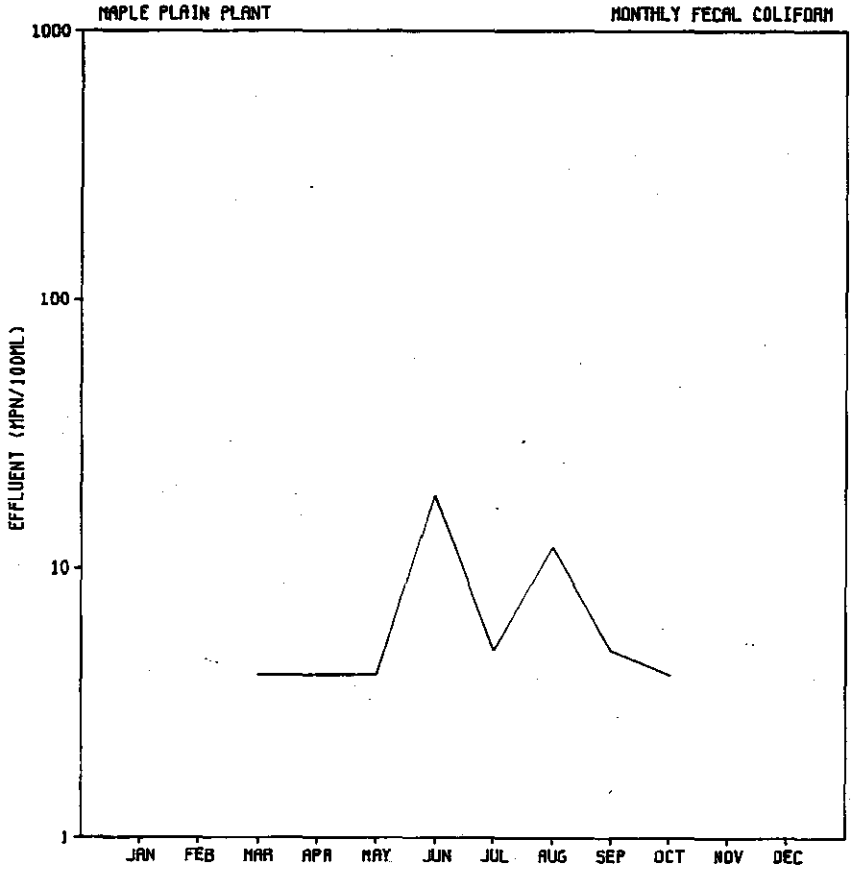

MAPLE PLAIN PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
20
0
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.


MAPLE PLAIN PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


MAPLE PLAIN PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
0
50
100
150
200
250
300
350
400
450
500
0
10
20
30
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


MAPLE PLAIN PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
0
50
100
150
200
250
300
350
400
450
500
0
10
20
30
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


MAPLE PLAIN PLANT
ANNUAL FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984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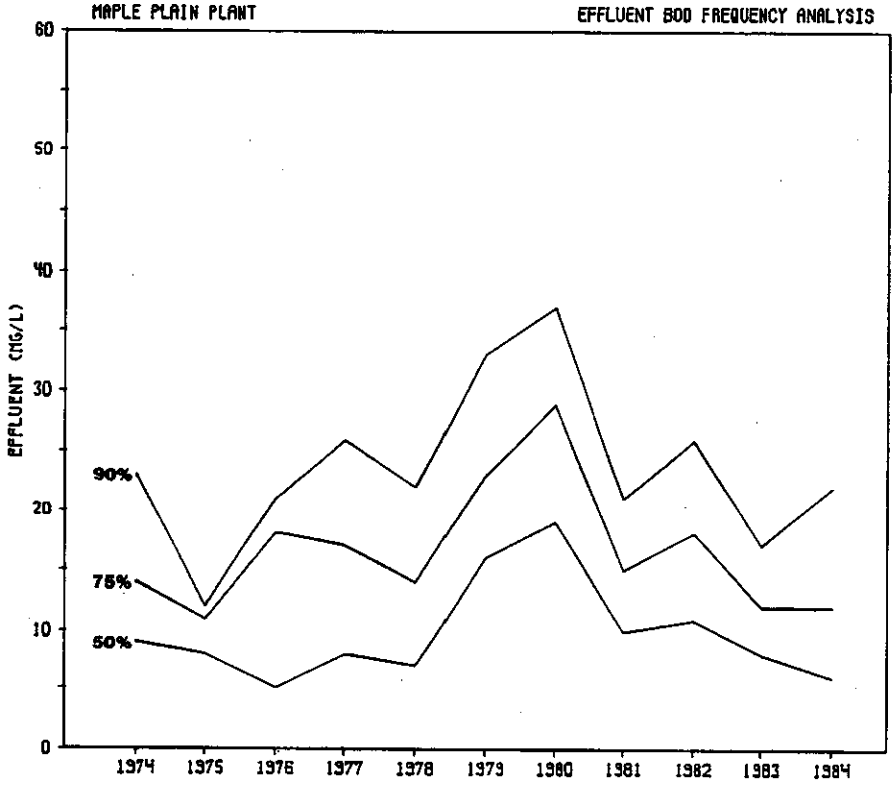
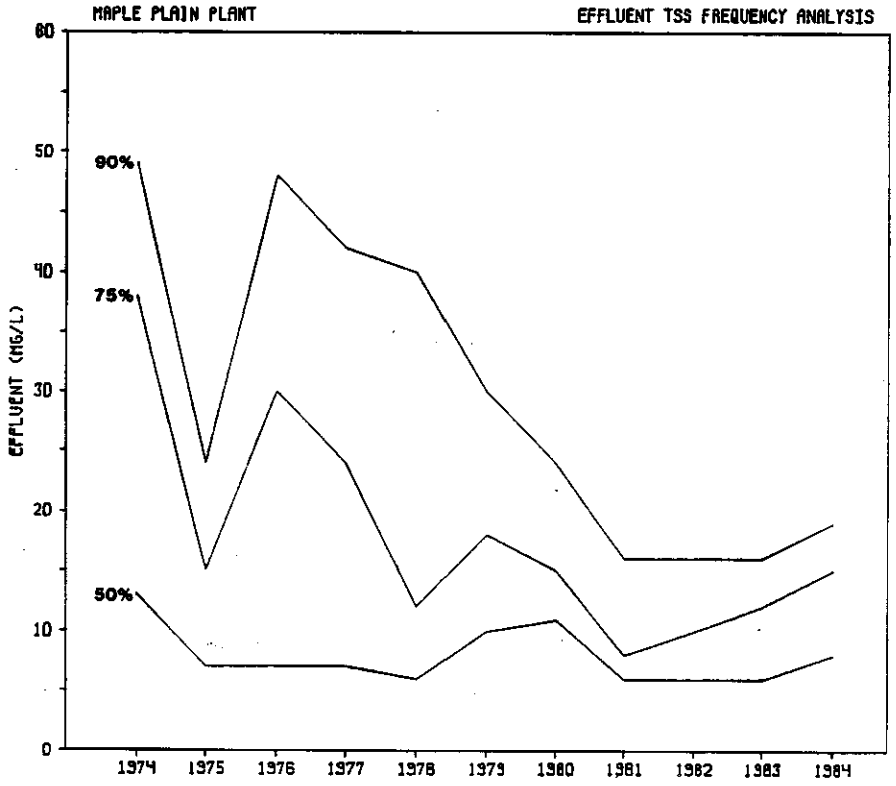
MONTHLY FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


MAPLE PLAIN PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


MAPLE PLAIN PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

MEDINA WASTEWATER TREATMENT PLANT

Plant History and Description

The Medina Plant was designed by W.T. Mills, and constructed in 1969. The plant serves the Hamel area and the City of Medina and has a design capacity of 0.10 mgd. The plant consists of a two-staged aerated lagoon system followed by two seepage ponds. The seepage pond contents are emptied by evaporation, percolation, and controlled discharge to nearby Elm Creek, when necessary.

Performance

Plant flow averaged 0.28 mgd in 1984, significantly higher than 0.18 mgd in 1983. Average aeration pond effluent quality was 11 mg/L BOD and 16 mg/L TSS, representing removal rates of 89 percent for BOD and 86 percent for TSS. The plant is presently operating at about 270 percent of its rated design capacity. The Commission applied for, and received on November 1, 1982, a revised NPDES Permit which allows for controlled discharge directly to Elm Creek. The Medina Plant had two weekly TSS, one monthly TSS, and one weekly fecal coliform violation. All four violations related to surface water discharge which was necessitated by the plant operating beyond its seepage capacity. The last surface discharge to Elm Creek was completed in December, 1984.

Future

The Medina Plant is scheduled to be phased out of operation in early 1985, by construction of an interceptor sewer through the City of Plymouth and into the Metropolitan Plant collection system.

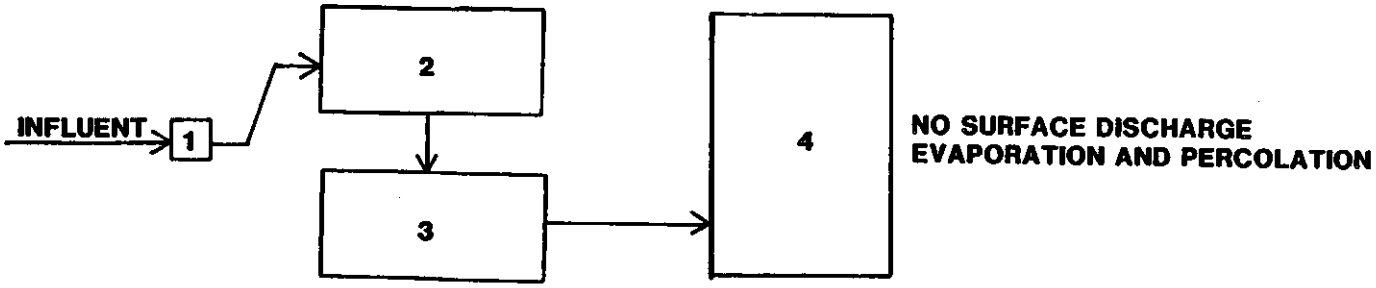
MEDINA PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, MGD	0.132	0.180	0.27	0.224	0.250	0.44
BOD Loading, lb/day	135	200	240	360	390	360
TSS Loading, lb/day	140	310	300	490	1,100	890
COD Loading, lb/day	255	420	550	300	760	1,210
Primary Aeration Pond						
Detention Time, days	12.5	9	6	7.4	7	4
BOD, lb/day/1000 cu. ft.	0.6	0.9	1.1	1.6	1.8	1.6
Final Aeration Pond						
Detention Time, days	12.5	9	6	7.4	7	4
Seepage Ponds						
Detention Time, days	72[1]	86[2]	50[3]	42[1]	53[2]	26[3]
BOD Loading, lb/acre/day	1.8	1.7	3	3.7	3.4	4

[1]Calculated assuming zero percolation and evaporation.
[2]Calculated assuming an annual average percolation rate of 70,000 gpd.
[3]Calculated assuming an annual average percolation rate of 80,000 gpd.

MEDINA WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



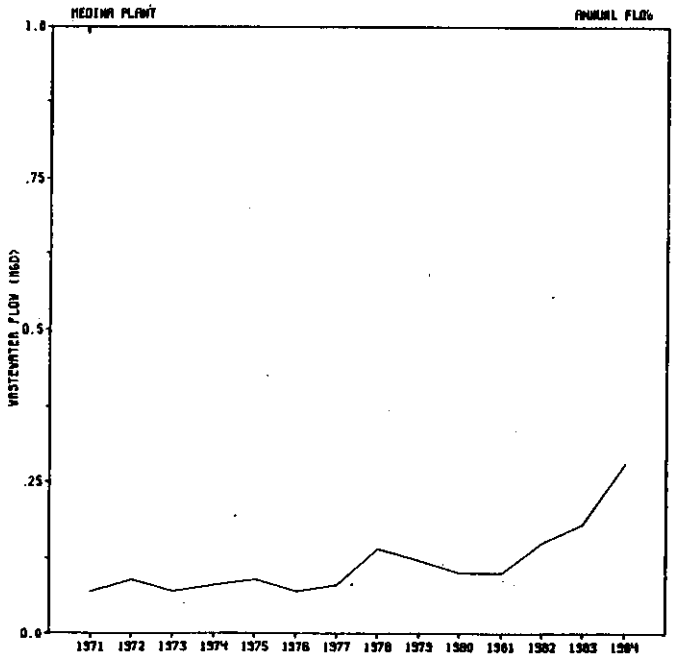
Unit Description

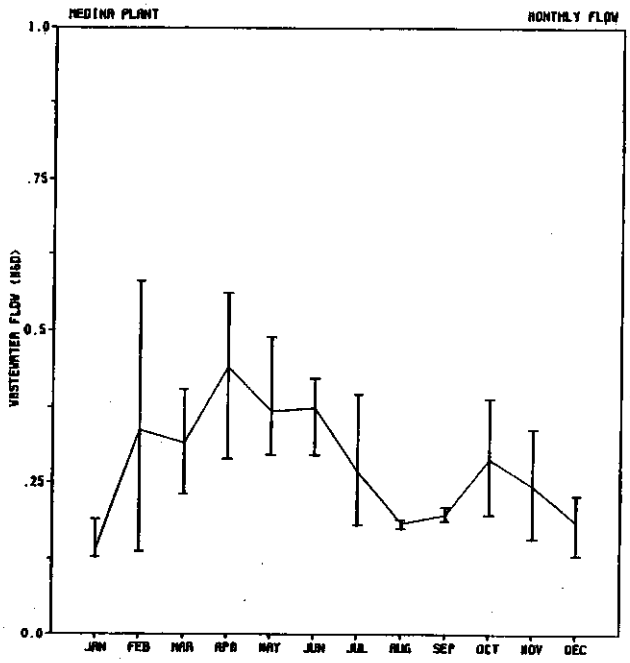
Liquid Phase

1. Screening
2. Primary Aerated Pond
3. Final Aerated Pond
4. Absorption Pond

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Medina

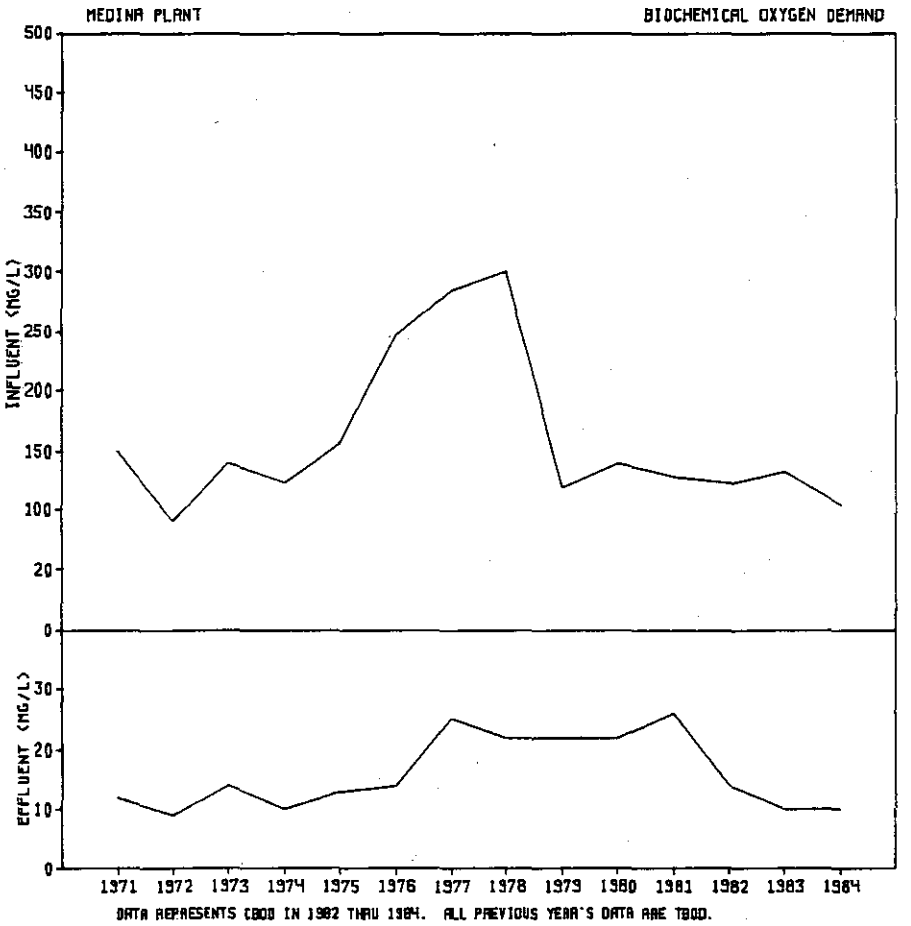
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	0.138	14	121	130	7.6-7.7	31.1	4.2	13.6	281
FEBRUARY	0.336	14	69	103	7.5-7.7	19.3	2.9	6.3	186
MARCH	0.316	12	135	114	7.6-7.7	23.8	4.7	10.0	223
APRIL	0.441	12	124	242	7.5-7.5	25.6	3.4	6.5	330
MAY	0.368	13	77	80	7.5-7.7	21.5	2.6	5.1	166
JUNE	0.374	14	65	97	7.5-7.6	18.7	2.6	5.3	165
JULY	0.269	14	101	105	7.4-7.5	29.1	4.1	9.9	247
AUGUST	0.183	16	103	118	7.5-7.6	31.9	4.1	16.0	291
SEPTEMBER	0.198	16	145	150	7.5-7.6	31.9	4.1	14.4	288
OCTOBER	0.290	15	107	167	7.5-7.6	28.5	4.5	11.3	228
NOVEMBER	0.244	14	122	153	7.3-7.5	26.5	4.2	11.1	250
DECEMBER	0.185	13	94	124	7.5-7.5	28.0	4.4	12.4	265
1984 AVERAGE	0.278	14	103	131	7.3-7.7	26.2	3.8	10.0	241
1983 AVERAGE	0.181	14	133	208	7.3-7.7	28.7	4.9	12.8	289

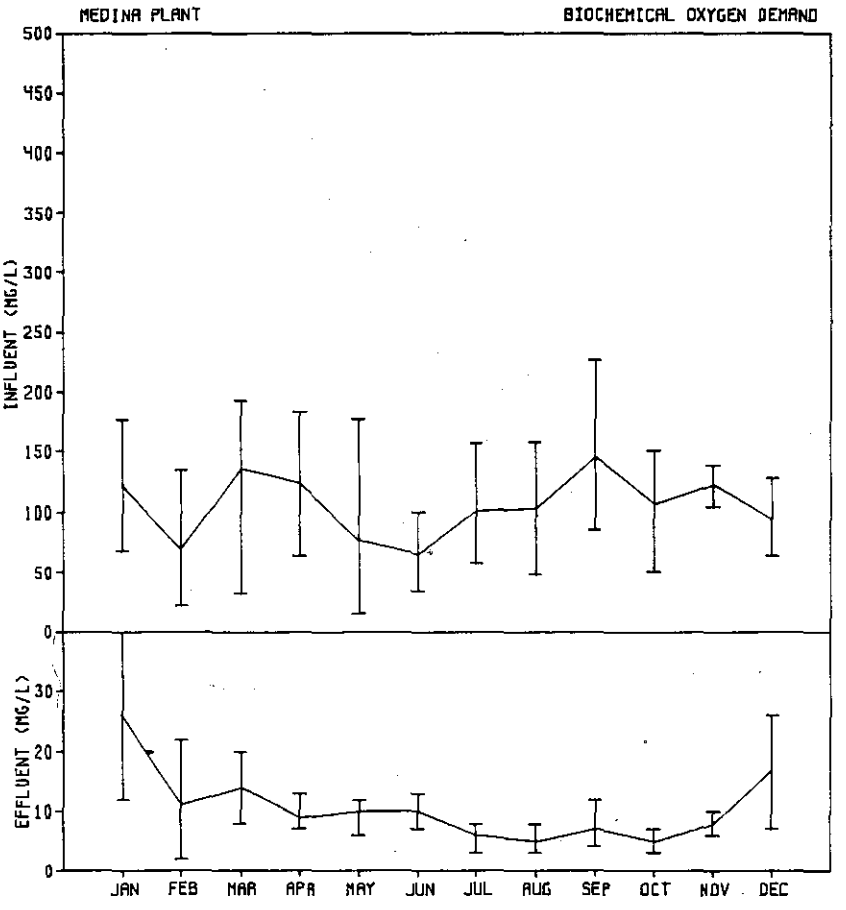
MONTHLY SUMMARY OF INTERMEDIATE EFFLUENT QUALITY
TREATMENT PLANT: Medina

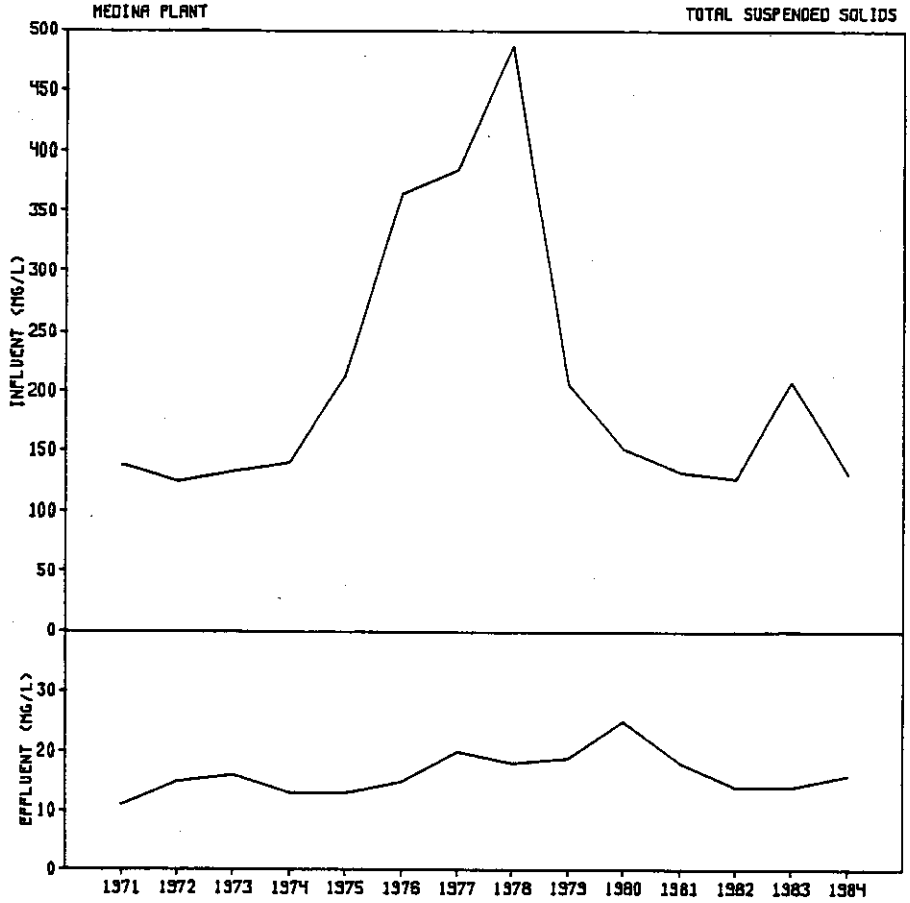
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2 Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
JANUARY	32	26	77	28	---	17	17.1	8.9	0.04	0.36	2.3	---	---	2.6	7.4-7.5	79	78
FEBRUARY	13	11	57	22	---	12	7.4	4.0	0.06	0.93	1.3	---	---	2.7	7.5-7.6	85	79
MARCH	14	14	76	12	---	16	9.1	5.6	0.12	0.12	1.3	---	---	2.4	7.4-7.6	90	89
APRIL	9	9	43	12	---	8	7.0	2.0	0.10	0.22	0.7	---	---	2.8	7.4-7.6	93	95
MAY	16	10	67	18	---	9	8.4	3.0	0.12	0.18	1.4	---	---	3.2	7.5-7.8	87	78
JUNE	14	10	50	18	---	10	5.9	3.3	0.05	0.62	0.9	---	---	2.5	7.5-7.5	85	81
JULY	8	6	48	8	---	8	15.5	10.7	0.02	0.28	1.9	---	---	2.2	7.4-7.5	94	93
AUGUST	6	5	43	7	---	7	14.6	11.0	0.11	0.35	2.2	---	---	---	--------	95	94
SEPTEMBER	20	7	34	7	---	5	13.8	9.4	0.31	4.72	3.1	---	---	2.4	7.5-7.6	96	96
OCTOBER	7	5	42	12	---	8	5.1	3.1	0.16	7.17	2.0	---	---	2.5	7.4-7.6	96	93
NOVEMBER	27	8	59	36	---	--	11.3	6.0	0.09	2.30	2.5	---	---	2.3	7.5-7.6	93	77
DECEMBER	33	17	42	29	---	4	7.8	4.8	0.68	2.80	2.2	---	---	2.5	7.4-7.5	82	77
1984 AVG.	15	10	53	16	---	10	10.2	6.0	0.13	1.70	1.8	---	---	2.6	7.4-7.8	89	86
1983 AVG.	14	10	59	14	---	7	14.0	9.6	0.13	1.30	2.7	---	---	3.0	7.3-7.7	91	89

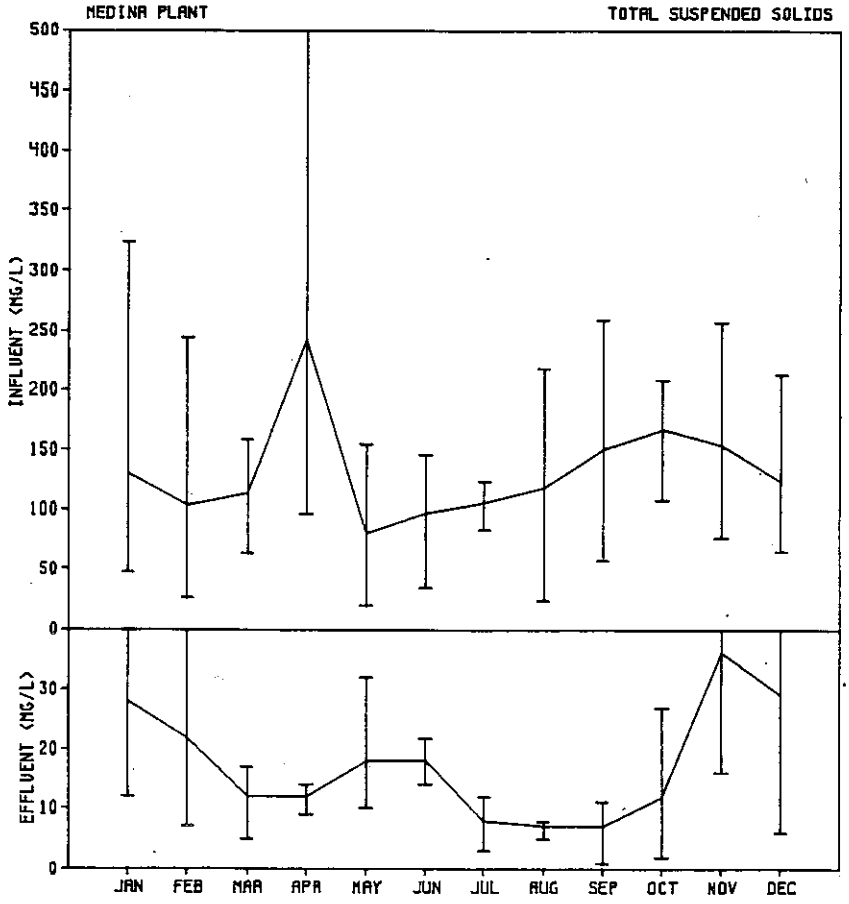
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Medina Surface Discharge

Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2 Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25			30	200	25		----			----			----	6.5-8.5		
JANUARY																	
FEBRUARY																	
MARCH	14			15	126	6.3		5.0			1.4			4.7	7.0-7.8		
APRIL																	
MAY	9			19	6	6.5		0.70			0.77			7.4	7.5-7.8		
JUNE																	
JULY	7			9	14	4.9		6.1			1.4			7.3	7.2-7.5		
AUGUST																	
SEPTEMBER																	
OCTOBER	5			10	4	3.4		0.24			1.4			10.2	7.8-8.0		
NOVEMBER	9			28	15	7.7		0.74			1.1			9.7	7.8-8.0		
DECEMBER	4			39	4	8.2		0.56			0.56			8.2	7.8		
1984 AVG.	8			20	28	6.2		2.22			1.10			7.9	7.0-8.0		
1983 AVG.	11			30	15	6.7		2.87			1.5			8.6	7.4-8.3		


MEDINA PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
20
0
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.


MEDINA PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


MEDINA PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
0
50
100
150
200
250
300
350
400
450
500
10
20
30
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


MEDINA PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
0
50
100
150
200
250
300
350
400
450
500
10
20
30
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

METROPOLITAN WASTEWATER TREATMENT PLANT

Plant History and Description

The existing Metropolitan Plant has been constructed in several stages. The original 1938 primary treatment was designed on the basis of an average annual wastewater flow of 134 mgd. It included pretreatment by screening and grit removal, primary treatment by sedimentation, intermediate treatment by chemical precipitation, effluent filtration and chlorination. The sludge disposal system included chemical conditioning (lime and ferric chloride), vacuum filtration, incineration, and land disposal of ash.

In the early 1960's, construction was initiated on the second stage of the plant. In 1966, the secondary treatment portion of the plant was placed into operation. This expansion was based on an annual average flow of 218 mgd and was designed to operate as a high rate activated sludge process. It consisted of four aeration tanks, three aeration compressors, twelve final sedimentation tanks, additional chlorination facilities, and a new chlorine contact effluent channel. The original sludge disposal system was expanded by construction of new gravity sludge thickeners, sludge holding tanks, and additional chemical conditioning, vacuum filtration and incineration facilities.

Stage Three was placed into operation in 1972. This phase added four more aeration tanks and two more air compressors to provide enough capacity to operate the step aeration activated sludge process. Incremental feed pipes were required as modification to the original aeration tanks. This completed the West Battery activated sludge system. One new incinerator was also constructed during this time to allow additional sludge disposal capacity.

By the mid 1970's, the fourth stage of construction was initiated to meet the following objectives: (1) to protect the plant from flood damage; (2) to maintain secondary treatment during flood periods; (3) to provide a minimum of primary treatment and disinfection for all dry and wet weather flows that reached the plant; (4) to provide secondary treatment capacity based on secondary treatment standards as defined by the 1972 Water Pollution Control Act Ammendments (PL92-500); (5) to provide solids processing capacity to handle the increased sludge generated by the liquid treatment expansion; and (6) to minimize energy consumption for solids processing at the plant.

By 1978, the bulk of the liquid treatment construction program had been completed. Completed projects included the flood protection facility, effluent pumping station, east battery pretreatment (screening and grit removal), east battery primary settling tanks and east battery aeration and final settling tanks.

By 1980, the first portion of the solids processing facilities was completed. These projects included floatation thickening for secondary sludge, sludge storage, thermal conditioning, return liquor treatment facilities and filter press dewatering. The sludge incineration and energy recovery facilities were behind schedule at that time. To meet air pollution control requirements, scrubbers were installed on the F & I No. 1 incinerators.

Further, to allow temporary shutdown of F & I No. 2 incinerators, an interim land disposal program was implemented. This required construction of sludge loadout facilities and asphalt sludge storage pads and composting area.

By late 1982, the startup phase had begun for the roll presses and the distributed digital acquisition and control system (computer system). Also during 1982, a new warehouse and maintenance facility was completed, providing the maintenance staff with the necessary facilities to properly and efficiently maintain this extensive and complex treatment facility. Computer-assisted inventory and maintenance systems now optimize storage and retrieval of materials and response time and reporting of maintenance work.

During 1983, the remaining solids processing facilities began operation. These include two new sludge incinerators, four modified F & I No. 2 sludge incinerators, energy recovery facilities, air pollution control equipment, dry ash handling and storage facilities, auxiliary boilers, and sludge dryers. As a result of successful incinerator startup and air compliance testing, a consent decree with the EPA, regarding plant air pollution control problems, was successfully concluded in December, 1983. In addition, the sludge energy recovery facilities began producing steam for plant process and heating uses, significantly reducing the plant's fuel costs.

Operation of the South St. Paul pretreatment facility was ceased in June, 1984. Wastewater is now screened and pumped directly to the Metro Plant.

Operation of the sludge incineration and energy recovery facilities saved $1.2 million in fuel costs, despite a shutdown for ash handling modifications in early 1984. Conversion to energy recovery as the primary sludge management method, with land application as the backup method, was completed during 1984. Modifications to the dry ash handling system were evaluated and implemented during 1984, eliminating an ash dust problem in the dry ash storage and loadout facility area. Experimentation with ash recycling by using ash as an admixture in commercial asphalt production was continued during 1984.

The new facilities at the Metropolitan Plant have enabled the transition from an inefficient, energy-intensive operation, unable to consistently meet the federal-mandated minimum requirements of secondary treatment standards, to a modern, efficient, flood-protected, energy-conserving operation, projected to meet the minimum standards for the metropolitan area to the year 2000. The massive program for land spreading of sludge, required to satisfactorily dispose of sludge when incineration capacity was inadequate, has now been transformed to a back-up role by the new system of incineration with heat recovery.

Following an extended public hearing, the Minnesota Pollution Control Agency issued a new NPDES permit for the Metropolitan Plant on December 14, 1982. The new permit requires progressively more stringent effluent quality to be achieved. In the summer months of 1985, the monthly discharge BOD standard drops to 18 mg/L and may decrease to as low as 10 mg/L in 1988. Ammonia standards, set to prevent toxic effects to fish, become applicable in the summer months of 1985 (8 mg/L) and may be further reduced to 5 mg/L in 1988. Final limitations for heavy metals (mercury, copper, and cadmium) and cyanide begin in 1986. In June, 1986, residual chlorine in the plant effluent must be removed to satisfactorily protect aquatic life in the Mississippi River.

Effluent BOD and ammonia limits scheduled for 1985 were met during the summer months of 1984 when biological ammonia removal was provided in the west secondary treatment facilities. Completion of the East Battery Expansion should provide greater treatment reliability and an industrial pretreatment program will assist in providing compliance with cyanide and metals limitations. Addition of effluent dechlorination facilities are under construction to achieve compliance with future chlorine residual limitations.

Performance

Plant flow averaged 222 mgd in 1984, similar to the 225 mgd in 1983. Effluent quality during 1984 was similar to that of 1983. Average effluent BOD and TSS concentrations during 1984 were 10 mg/L and 11 mg/L as compared to 1983 average effluent BOD and TSS values of 10 mg/L and 9 mg/L. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	14	10	8	8	24	15	13	12	36	22	19	17
TSS	10	7	7	8	24	12	11	12	47	21	17	19

*1982 through 1984 values represent CBOD.

Future

The Metropolitan Plant will continue to be the largest treatment facility in the Metropolitan Disposal System. Construction of additional aeration and final sedimentation tanks for the East Battery activated sludge system is underway and is expected to be completed in early 1985. Disinfection improvements and dechlorination to meet a chlorine residual standard are scheduled for completion by spring of 1986. Retrofit of existing facilities to be compatible with the distributed digital acquisition and control system, and rehabilitation of older plant systems, such as west pretreatment, west primary, and west secondary, are scheduled for construction during 1985-1988.

METROPOLITAN PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	208	225	222	239	285	285
Flow-East, mgd (1)	176	194	179	204	238	234
Flow-West, mgd (2)	32	31	43	35	47	65
BOD Loading, lb/day	350,000	330,000	330,000	440,000	390,000	370,000
TSS Loading, lb/day	420,000	360,000	370,000	600,000	460,000	490,000
Primary Sludge, dtpd	184	197	227	220	235	240
Secondary Sludge, dtpd	114	103	96	140	118	160
Total Sludge (with recycle), dtpd	298	300	323	360	353	400
Bar Screens						
East Battery						
No. of Units	4.2	5.9	5.2	4.8	6.7	6.3
Unit Flow, mgd	42	33	34	42	36	37
West Battery						
No. of Units	0.6	0.5	0.7	0.7	0.7	1.3
Unit Flow, mgd	50	69	61	50	72	40
Grit Tanks						
East Battery						
No. of Units	4.2	5.9	5.2	4.8	6.7	6.3
Hor. Velocity, fps	0.4	0.3	0.3	0.4	0.3	0.3
Unit Flow, mgd	42	33	34	42	36	38
West Battery						
No. of Units	1.2	0.9	1.4	1.4	1.3	2.5
Hor. Velocity, fps(3)	1.0	1.0	1.0	1.0	1.0	1.0
Unit Flow, mgd	25	35	31	25	36	20
Primary Sedimentation						
East Battery						
No. of Units	7.9	7.9	7.7	8.0	8.0	8.0
Detention Time, hr.	3.0	2.7	2.9	2.6	2.3	2.3
Overflow Rate, gpd/sq. ft.	930	1,020	980	1,060	1,240	1,220
West Battery						
No. of Units	5.6	4.9	5.8	4.9	5.9	5.6
Detention Time, hr.	8.0	7.1	6.5	6.4	5.7	5.0
Overflow Rate, gpd/sq. ft.	350	390	470	440	490	560
Activated Sludge-Aeration						
East Battery						
Flow, mgd	97	98	102	112	116	123
No. of Units	3.8	3.6	3.2	4.0	3.9	3.5
F:M Ratio, day^{-1}	0.22	0.20	0.24	0.27	0.21	0.20

METROPOLITAN PLANT PROCESS UNIT LOADINGS (cont.)

Parameter	Annual Average 1982	Annual Average 1983	Annual Average 1984	Maximum Month 1982	Maximum Month 1983	Maximum Month 1984
Activated Sludge-Aeration (Cont.)						
BOD Load, lb/day/1000 cu. ft.	47	40	52	62	41	39
Air Use, cu. ft./lb. BOD removed	1,700	2,590	1,830	2,600	1,820	2,320
Detention Time, hr.	4.7	4.6	3.5	4.3	3.7	3.3
West Battery						
Flow, mgd	111	127	120	127	169	162
No. of Units	4.0	4.2	4.4	4.3	5.0	6.0
F:M Ratio, day^{-1}	0.23	0.35	0.39	0.30	0.33	0.32
BOD Load, lb/day/1000 cu. ft.	49	46	49	59	38	34
Air Use, cu. ft./lb. BOD removed	1,800	2,120	1,870	2,100	1,580	2,420
Detention Time, hr.	4.3	3.0	2.9	4.0	3.2	3.5
Final Sedimentation						
East Battery						
No. of Units	8.8	8.3	9.0	9.0	7.0	8.7
Detention Time, hr.	3.5	3.5	3.1	3.1	2.8	2.6
Overflow Rate, gpd/sq. ft.	560	630	690	630	720	800
Solids Load, lb./sq. ft./day	10	10	11.5	14	11	12.3
West Battery						
No. of Units	11.6	11.4	11.5	12.0	11.3	11.6
Detention Time, hr.	4.0	3.4	3.2	3.6	2.9	2.7
Overflow Rate, gpd/sq. ft.	490	590	640	540	680	740
Solids Load, lb./sq. ft./day	9	10	10.6	11	10	12.2
Chlorination						
Chlorine Use, lb/day[4]	8,500	12,200	10,400	14,000	13,600	15,300
Chlorine Dose, mg/L	4.6	6.1	4.7	7.3	6.8	6.6
Contact Time, minutes	28	25	25	24	21	20
Gravity Thickening						
Solids Loading, lb./sq. ft./day	20	19	19	26	23	22
Overflow Rate, gpd/sq. ft.	430	450	505	470	530	600
Sludge Concentration, % TS[5]	6.5	7.4	7.0	6.4	8.8	7.8
Flotation Thickening						
No. of Units	10.9	9.5	11.5	12.7	13.1	11.6
Solids Loading, lb./sq. ft./day	9.4	15.2	9.2	11	20.8	13.0
Air:Solids Ratio	0.03	0.04	0.04	0.03	0.05	0.02
Sludge Concentration, % TS[6]	3.3	3.6	3.5	3.0	3.8	3.3

METROPOLITAN PLANT PROCESS UNIT LOADINGS (cont.)

Parameter	Annual Average 1982	Annual Average 1983	Annual Average 1984	Maximum Month 1982	Maximum Month 1983	Maximum Month 1984
Thermal Conditioning						
No. of Units	3.0	3.3	3.7	3.6	3.6	4.8
Feed Concentration, % TSS	3.9	4.5	4.1	4.1	6.8	3.7
TSS Solubilization, %	42	39	36	46	38	38
Decant Tank Underflow, % TSS	14	14	14	14	15	14
Chemical Conditioning						
Vacuum Filters (F & I No. 1)						
Lime Dose, % of dss	9	-------	-------	10	-------	-------
$FeCL_3$ Dose, % of dss	2.6	-------	-------	3.1	-------	-------
Vacuum Filters (F & I No. 2)						
Lime Dose, % of dss	27	29	-------	38	-------	-------
$FeCL_3$ Dose, % of dss	11	13	-------	15	-------	-------
Roll Press						
Dry Polymer, lb/day	-------	1,400	2,200	-------	2,200	2,600
Dry Polymer, lb/tds	-------	13	15	-------	18	17
Vacuum Filters[7]						
F & I No. 1						
No. of Units	4.4	-------	-------	5.0	-------	-------
Filter Rate, lb./sq. ft./day	3.3	-------	-------	3.6	-------	-------
Cake Solids, % TS	28	-------	-------	30	-------	-------
Dry Sludge, tpd	87	-------	-------	108	-------	-------
F & I No. 2						
No. of Uuits	5.6	1.1	-------	6.9	3.9	-------
Filter Rate, lb./sq. ft./day	2.0	1.1	-------	1.9	-------	-------
Cake Solids, % TS	25	24.4	-------	26	28.7	-------
Dry Sludge, tpd	90	11	-------	110	53	-------
Roll Presses						
No. of Units	-------	1.6	2.4	-------	2.5	2.8
Dry Sludge, tpd	-------	108	150	-------	145	190
Cake Solids, % TS	-------	32.1	34.2	-------	31.2	37.8
Filter Presses						
No. of Units	2.6	3.4	4.0	3.1	4.2	4.8
Dry Sludge, tpd[8]	41	75	69	87	110	82
Cake Solids, % TS[9]	48	42	38	45	48	41

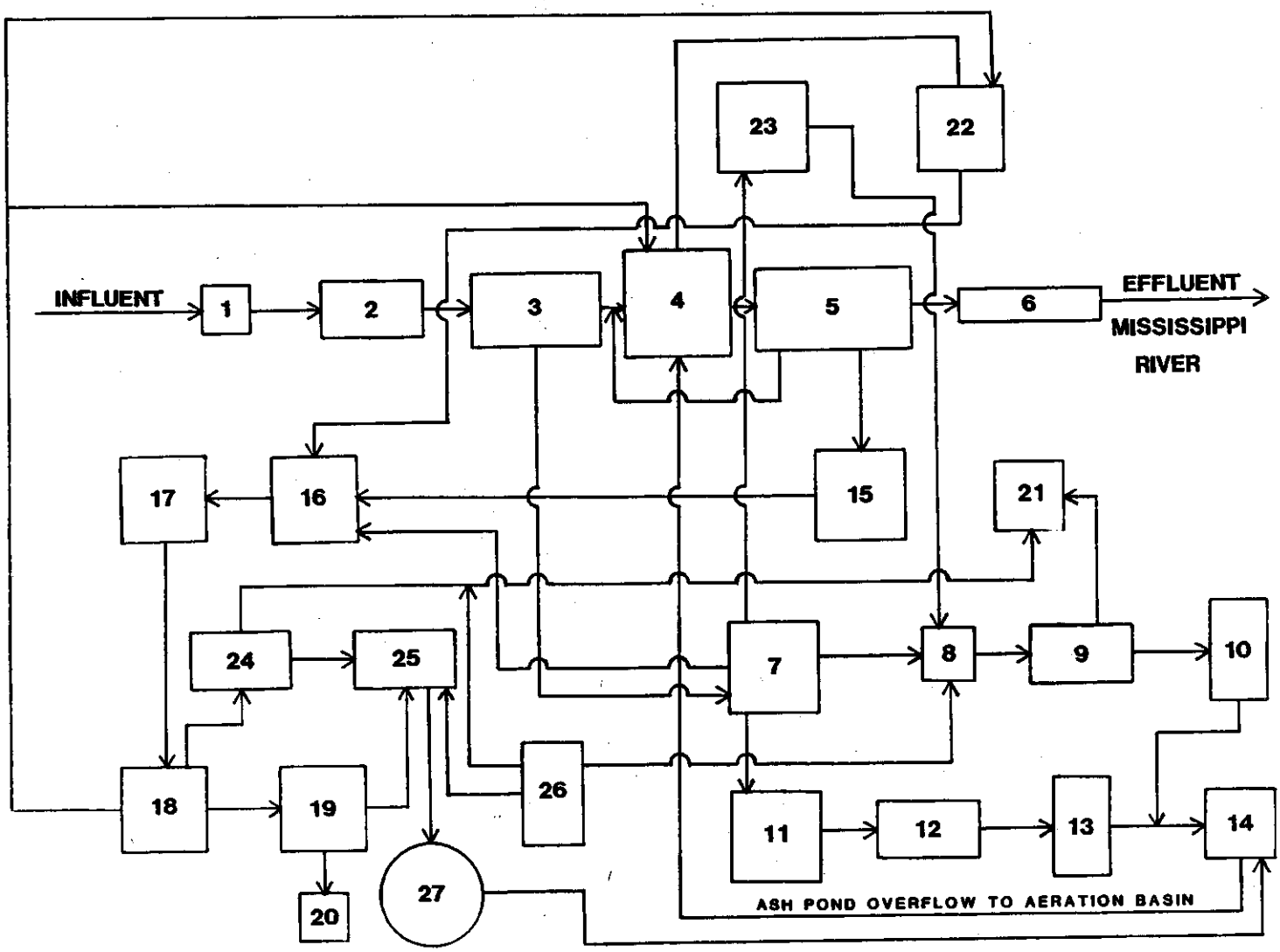
METROPOLITAN PLANT PROCESS UNIT LOADINGS (cont.)

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Incineration[10]						
No. of Units per day[11]	2.0	1.2	2.6	1.7	-------	3.3
Auxiliary Fuel Use, MMBtu/tds	6.5	1.6	0.7	5.8	-------	1.1
Dry Sludge, tpd	73	89	157	108	158	208
Wet Loading, lb./sq. ft./day	6.0	8.7	6.9	6.5	-------	7.0

NOTES:

1 Flow to East Pretreatment and East Primary.
2 Flow to West Pretreatment and West Primary.
3 Velocity in West Battery Grit Tank is gate controlled.
4 Average for months when disinfection is required (i.e., March - October).
5 Sludge concentration in Gravity Thickener underflow.
6 Sludge concentration in Flotation Thickener Sludge.
7 Vacuum filters ran only 8 months in 1983, and were not used in 1984.
8 Maximum month when most dry cake was produced.
9 Maximum month cake solids production as % TS.
10 F & I No. 1 not used since 1982.
11 Incinerators shut down March 2 - April 6, 1984.

METROPOLITAN WASTEWATER TREATMENT PLANT
FLOW DIAGRAM

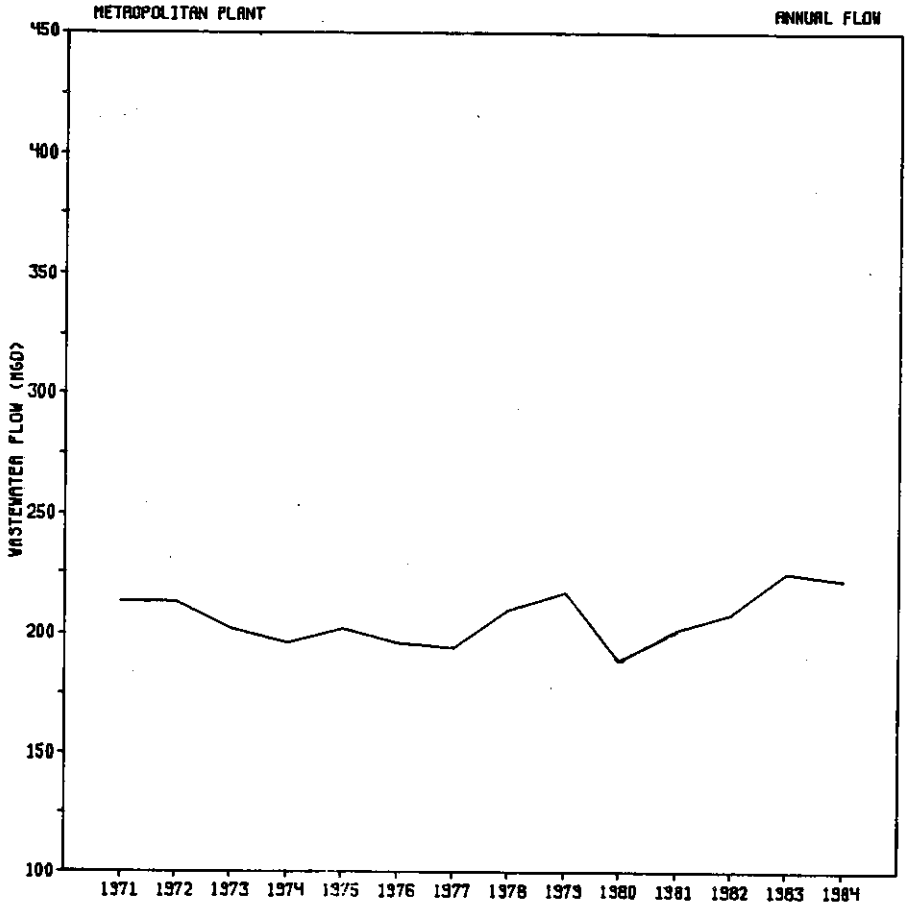


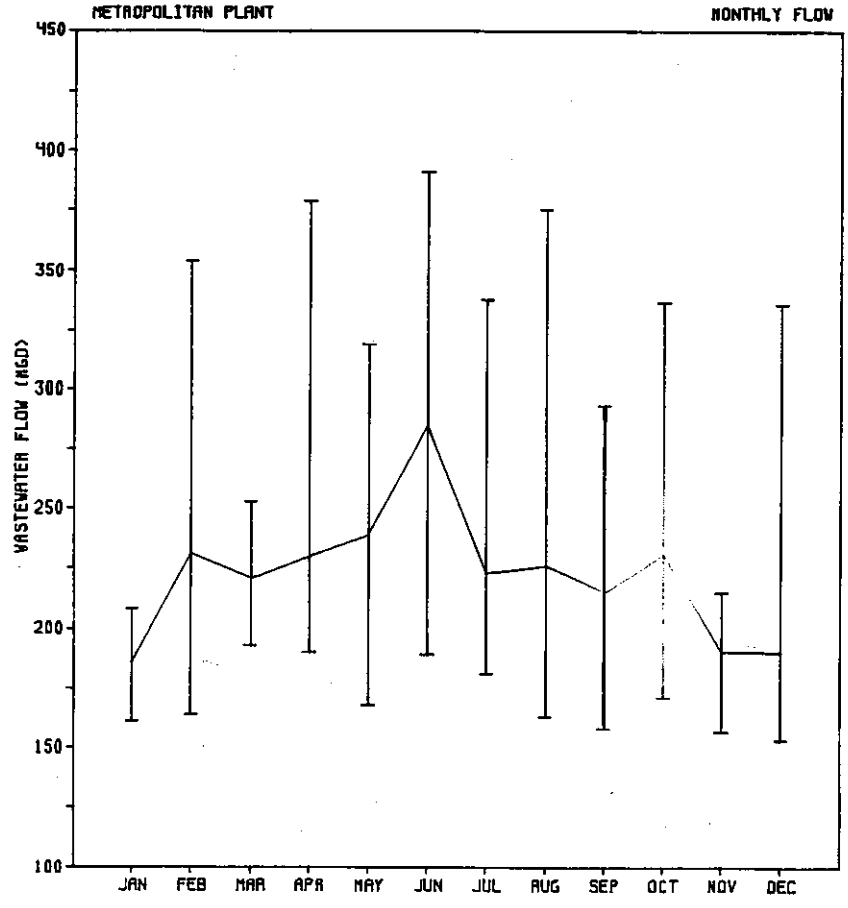
Liquid Phase

1. Screening
2. Grit Removal
3. Primary Sedimentation
4. Activated Sludge
5. Final Sedimentation
6. Chlorination

Solid Phase

7. Gravity Thickening
8. Holding Tank
9. Vacuum Filtration
10. Incineration
11. Concentration
12. Vacuum Filtration
13. Incineration
14. Ash Pond
15. Flotation Thickening
16. Sludge Storage
17. Thermal Conditioning
18. Decant Thickening
19. Plate & Frame Press
20. North Loadout
21. South Loadout
22. Return Liquors Bio.
23. Return Liquors P-Chem.
24. Vacuum Filter
25. Incinerator
26. Roll Press
27. Silos


METROPOLITAN PLANT
ANNUAL FLOW
WASTEWATER FLOW (MGD)
450
400
350
300
250
200
150
100
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


METROPOLITAN PLANT
MONTHLY FLOW
WASTEWATER FLOW (MGD)
450
400
350
300
250
200
150
100
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

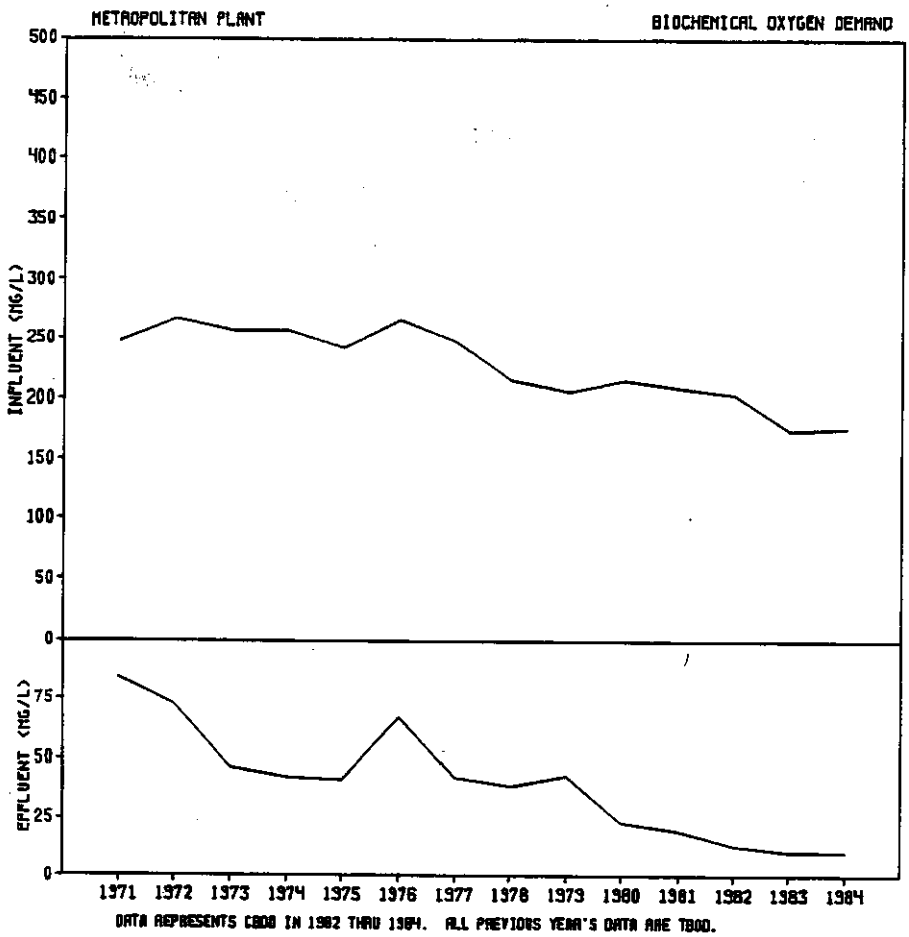
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Metropolitan

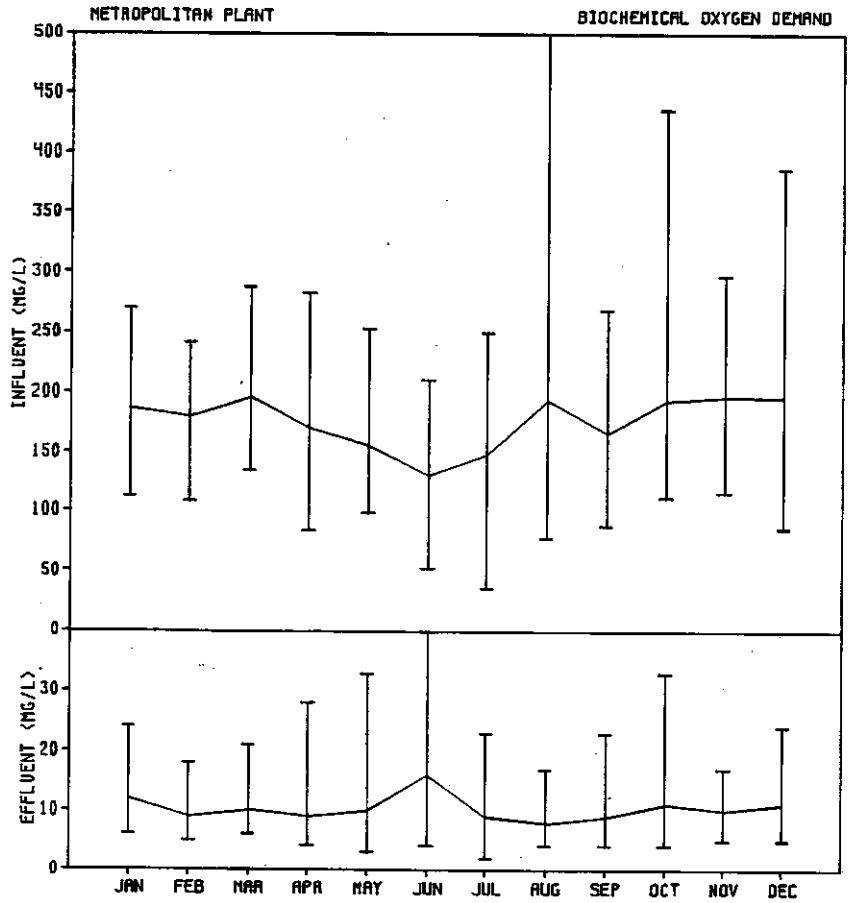
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	186	12	186	190	5.6-9.2	29.6	5.3	14.4	413
FEBRUARY	231	12	180	208	6.4-9.6	22.1	4.0	10.6	373
MARCH	221	12	196	219	6.7-9.4	26.5	4.4	12.9	422
APRIL	230	13	170	213	6.9-9.4	23.1	4.1	11.3	383
MAY	239	14	155	157	6.8-8.9	19.9	3.5	9.0	324
JUNE	285	17	130	158	6.2-8.9	16.8	2.8	6.6	297
JULY	223	19	148	196	6.0-9.3	18.8	3.6	6.0	349
AUGUST	226	21	193	258	6.2-8.5	18.3	3.4	8.4	401
SEPTEMBER	215	20	166	174	6.1-8.6	21.3	3.8	9.1	345
OCTOBER	231	18	193	221	5.6-9.1	23.4	4.1	9.8	405
NOVEMBER	191	16	197	198	6.5-9.7	27.8	4.8	11.6	432
DECEMBER	190	13	196	180	6.4-9.5	24.8	3.8	13.3	411
1984 AVERAGE	222	16	176	198	5.6-9.7	22.8	4.0	10.3	379
1983 AVERAGE	225	17	174	192	5.3-11.1	24.3	4.4	13.2	375

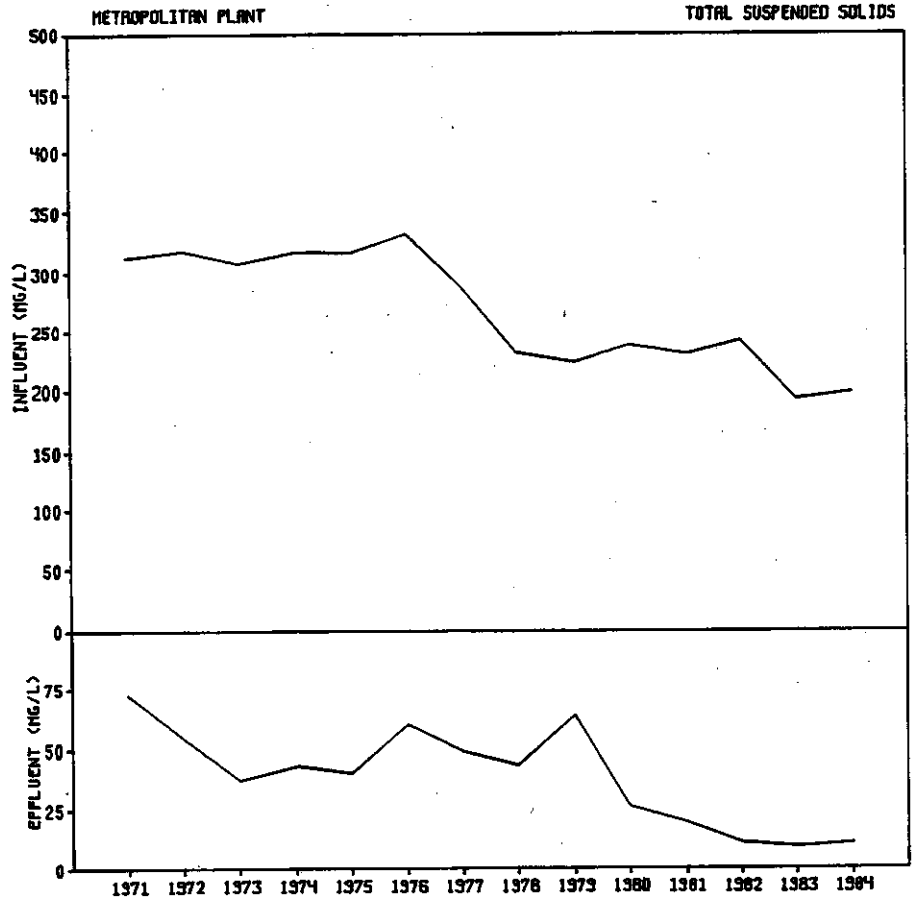
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Metropolitan

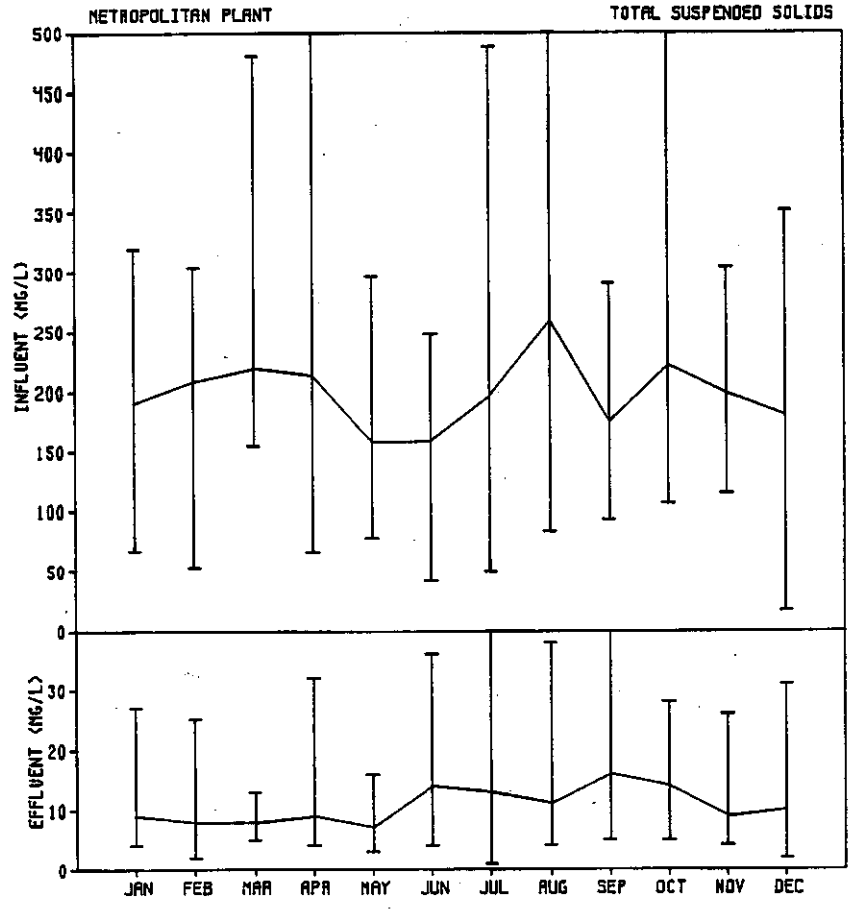
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	24	24	---	30	200	--	----	----	----	----	---	-----	---	#	6.5-8.5	--	--
JANUARY	22	12	81	9	---	4	23.9	16.2	0.36	3.63	2.5	-----	---	0.3	7.0-7.7	93	95
FEBRUARY	19	9	77	8	---	4	17.8	10.8	0.36	3.48	1.7	3387*	0.6*	0.5	6.9-8.1	95	96
MARCH	15	10	101	8	3	5	23.1	15.4	0.62	0.71	2.0	7252	2.0	3.3	7.1-8.0	95	96
APRIL	19	9	79	9	5	5	21.6	14.6	0.82	1.04	1.9	6833	1.8	8.0	7.2-7.8	95	96
MAY	25	10	80	7	11	5	17.8	10.2	1.44	1.18	1.5	7568	1.7	5.9	7.3-7.9	94	96
JUNE	27	16	83	14	59	8	11.5	6.1	1.73	1.94	1.7	11160	1.7	7.6	7.3-7.7	88	91
JULY	18	9	66	13	46	6	8.7	3.5	0.77	5.68	2.0	8923	1.3	6.3	7.3-7.8	94	93
AUGUST	15	8	62	11	127	6	9.4	4.9	0.70	6.11	2.1	15329	2.5	5.6	6.9-7.6	96	96
SEPTEMBER	16	9	66	16	60	8	11.2	5.5	0.51	7.30	2.5	13527	3.2	5.7	7.1-7.7	94	91
OCTOBER	20	11	74	14	34	8	15.4	9.2	0.80	2.10	1.9	11784	3.2	4.6	6.8-8.0	94	93
NOVEMBER	20	10	83	9	---	4	18.6	11.2	0.99	2.70	2.0	-----	---	2.2	7.2-7.8	95	96
DECEMBER	21	11	87	10	---	5	16.5	11.0	0.51	5.19	2.0	-----	---	2.9	7.1-7.6	94	95
1984 AVG.	20	10	78	11	43	6	16.3	9.9	0.79	3.42	2.0	10297	2.2	4.4	6.8-8.1	94	95
1983 AVG.	19	10	74	9	25	5	16.3	11.7	0.87	3.08	2.2	12120	2.9	3.4	7.0-8.2	94	95

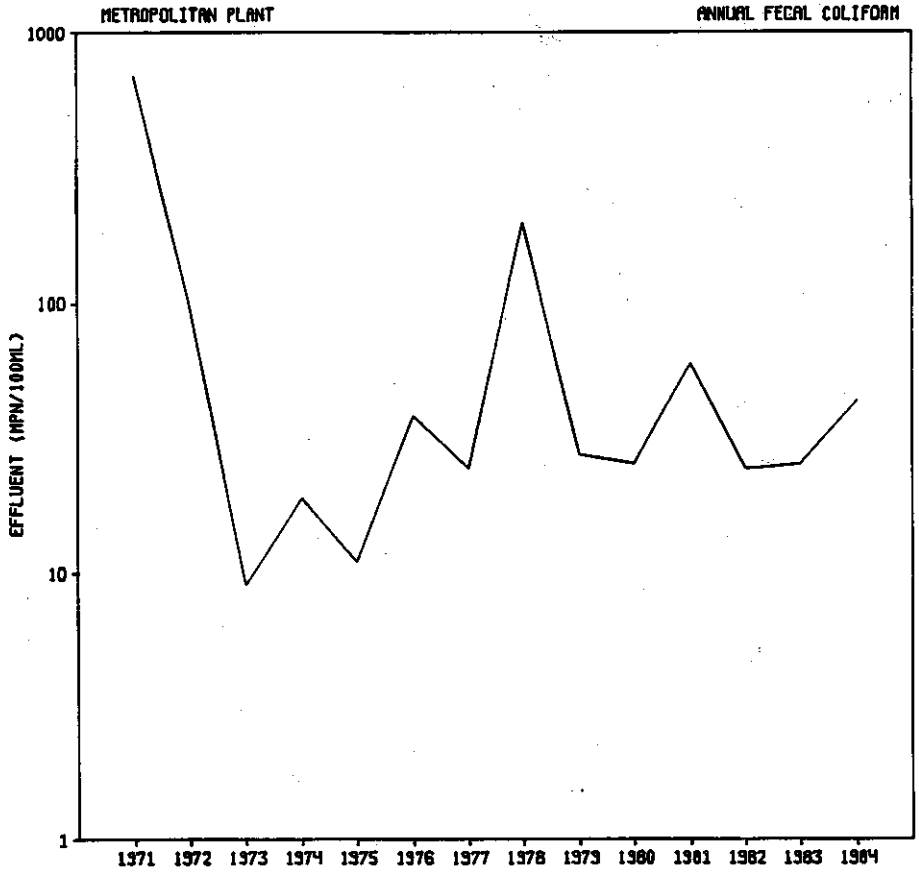
*Values represent a 3 day average for Feburary and are not included in the 1984 average.
**For disinfection only.
#Dissolved oxygen limitation of 7 mg/l for river flows less than 7,000 cfs and river D.O. values less than 6 mg/l upstream or less than 5.5 mg/l downstream for two consecutive sample days, during the period of June-September.

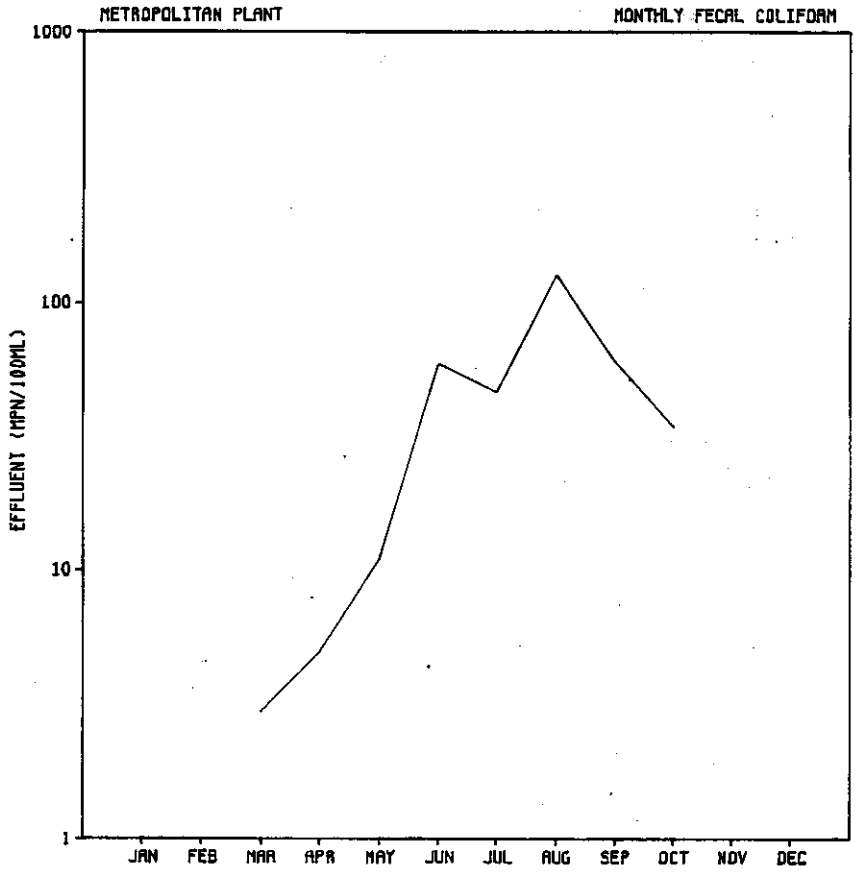

METROPOLITAN PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.

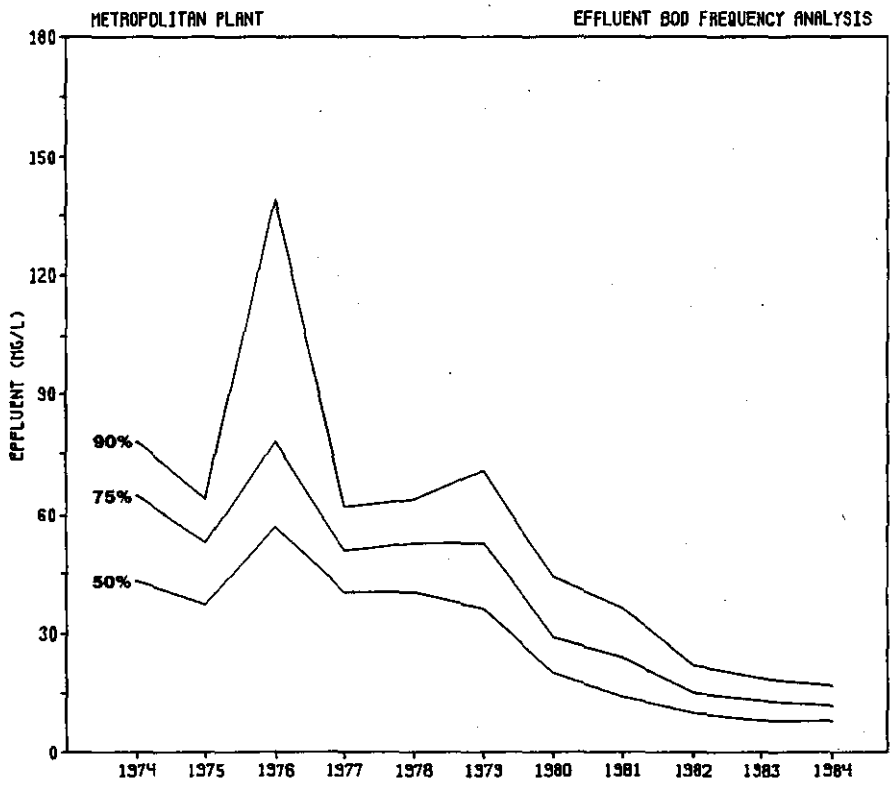

METROPOLITAN PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

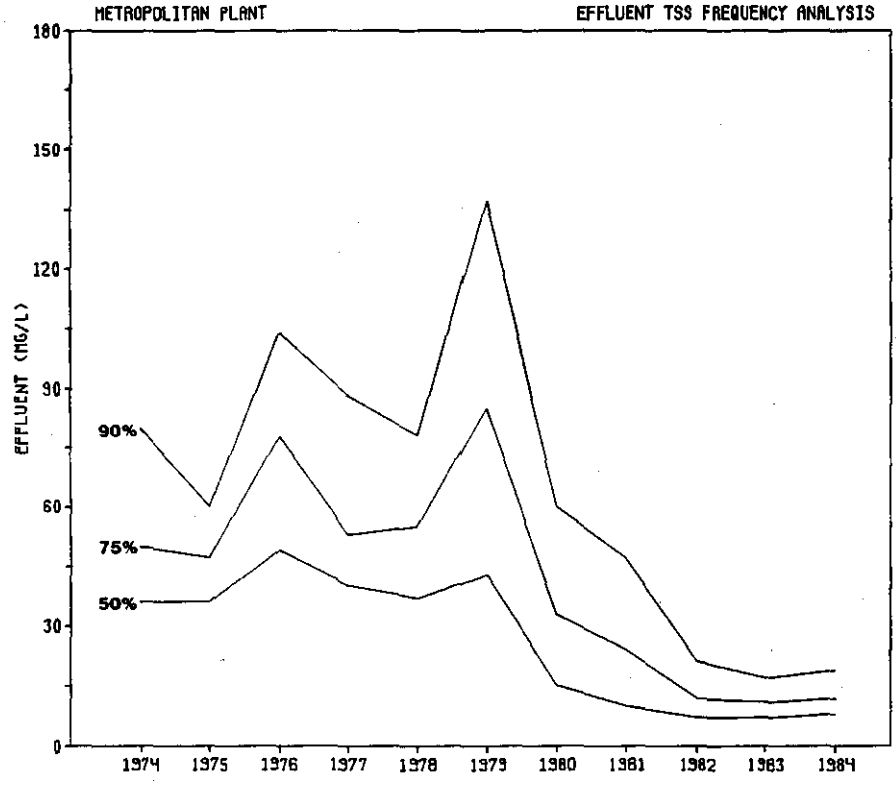

METROPOLITAN PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
75
50
25
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


METROPOLITAN PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


METROPOLITAN PLANT
ANNUAL FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


METROPOLITAN PLANT
MONTHLY FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


METROPOLITAN PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
180
150
120
90
60
30
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


METROPOLITAN PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
180
150
120
90
60
30
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

1984 INFLUENT DATA
TREATMENT PLANT Metropolitan

MONTH	Cu mg/l	Cr mg/l	Zn mg/l	Pb mg/l	Cd mg/l	Hg ug/l	CN mg/l	As ug/l	PCB ug/l	Ni mg/l	Phenol ug/l	Fe mg/l
January	0.22	<0.18	0.41	<0.06	0.013	<0.30	<0.044	<1.3	0.04	<0.13	46.8	1.23
February	0.22	<0.19	0.36	<0.08	0.014	<0.30	<0.063	1.9	0.04	<0.12	58.0	3.12
March	0.24	0.19	0.38	<0.07	0.014	<0.30	<0.079	1.4	0.03	0.14	57.6	1.91
April	0.24	<0.20	0.46	<0.07	0.011	<0.40	<0.047	1.9	0.05	0.13	17.5	1.60
May	0.19	<0.16	<0.34	<0.06	0.010	<0.30	<0.040	1.8	0.04	<0.10	24.0	1.80
June	0.17	<0.15	0.37	<0.07	0.009	<0.20	<0.060	1.9	0.04	<0.10	38.0	2.68
July	0.21	<0.15	0.40	<0.08	0.044	<4.30	<0.055	1.4	0.07	<0.11	35.0	1.73
August	0.28	<0.17	0.46	<0.08	0.014	<0.50	<0.054	2.3	0.07	<0.11	28.0	1.90
September	0.21	<0.15	0.42	<0.06	0.010	<0.30	<0.068	1.4	0.07	<0.10	42.8	1.62
October	0.22	0.18	0.48	<0.05	0.013	0.40	<0.058	1.7	0.06	<0.20	35.6	1.73
November	0.25	0.16	0.47	<0.06	0.009	<0.40	<0.059	1.4	0.06	<0.13	8.2	1.52
December	0.19	<0.14	0.30	<0.06	0.010	<0.60	<0.050	1.2	0.07	<0.10	72.0	1.43
1984 Avg.	0.22	<0.17	0.40	<0.06	0.014	<0.70	<0.056	<1.6	0.05	<0.12	38.6	1.86
1983 Avg.	0.20	<0.18	<0.36	<0.07	0.015	<0.55	<0.071	<1.5	0.40	<0.12	33.8	1.70

1984 EFFLUENT DATA
TREATMENT PLANT Metropolitan

MONTH	Cu* mg/l	Cr mg/l	Zn mg/l	Pb mg/l	Cd* mg/l	Hg* ug/l	CN* mg/l	As ug/l	PCB ug/l	Ni mg/l	Phenol ug/l	Fe mg/l
NPDES Limit**	0.14				0.030	4.00	0.193					
January	0.03	<0.05	0.11	<0.05	0.002	<0.20	<0.020	1.8	0.01	0.12	15.9	0.16
February	0.03	<0.06	0.13	<0.05	0.003	<0.20	<0.040	1.6	0.01	0.11	7.9	0.25
March	0.04	<0.05	0.11	<0.06	0.002	<0.20	<0.030	2.1	<0.01	0.11	5.9	0.15
April	0.03	<0.05	0.10	<0.05	0.001	<0.20	<0.030	<1.2	0.02	0.10	4.5	0.15
May	0.03	<0.05	0.11	<0.05	0.002	<0.20	<0.020	<1.0	0.01	<0.08	30.2	0.16
June	0.03	<0.05	0.11	<0.05	0.002	<0.20	<0.020	1.8	0.01	0.08	4.7	0.38
July	0.02	<0.05	0.11	<0.05	0.006	<0.20	<0.020	2.0	0.03	0.08	3.5	0.16
August	0.03	<0.05	0.11	<0.05	0.005	<0.20	<0.030	<2.2	0.03	0.08	5.0	0.13
September	0.03	<0.05	0.13	<0.05	0.004	<0.20	<0.030	1.8	0.03	0.08	----	0.66
October	0.02	<0.05	0.12	<0.05	0.003	<0.20	0.030	1.4	0.02	0.09	10.3	0.18
November	0.02	<0.05	0.10	<0.05	0.002	<0.20	<0.020	<1.1	0.02	0.09	56.6	0.23
December	0.02	<0.05	0.10	<0.05	0.002	<0.20	<0.020	1.3	<0.01	0.09	15.5	0.14
1984 Avg.	0.03	<0.05	0.11	<0.05	0.003	<0.20	<0.026	<1.6	<0.02	<0.09	14.5	0.23
1983 Avg.	0.03	<0.06	0.12	<0.05	0.002	<0.34	<0.068	<1.2	0.13	<0.09	7.3	0.21

*Monthly average reported values are monthly medians for Copper, Cadmium, Mercury, and Cyanide. The remaining parameters are monthly arithmetic averages.
** Limits are median values.

ROSEMOUNT WASTEWATER TREATMENT PLANT

Plant History and Description

The Rosemount Plant was designed by Banister, Short, Elliot, Hendrickson, and Associates and constructed in 1973. The plant has a design capacity of 0.6 mgd.

Liquid treatment consists of solids-contact clarification, dual media filtration, activated carbon column absorption and chlorination. Plant effluent is discharged to the Spring Lake area of the Mississippi River.

Solids processing facilities consist of sludge storage and sludge hauling to the Metropolitan Plant Interceptor System. The plant is presently operating at about 60 percent of capacity and subject to secondary treatment limits, and a phosphorus limit of 1 mg/L.

Performance

Plant flow averaged 0.37 mgd in 1984, slightly higher than 0.34 mgd in 1983. Average plant effluent quality was 18 mg/L BOD, 3 mg/L TSS and 0.2 mg/L P. Plant performance was good throughout the year with two NPDES Permit violations; one daily pH, and one monthly BOD. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	12	15	13	16	15	18	18	21	19	24	29	30
TSS	1	1	1	2	2	2	2	3	3	4	4	5

*1982 through 1984 values represent CBOD.

Future

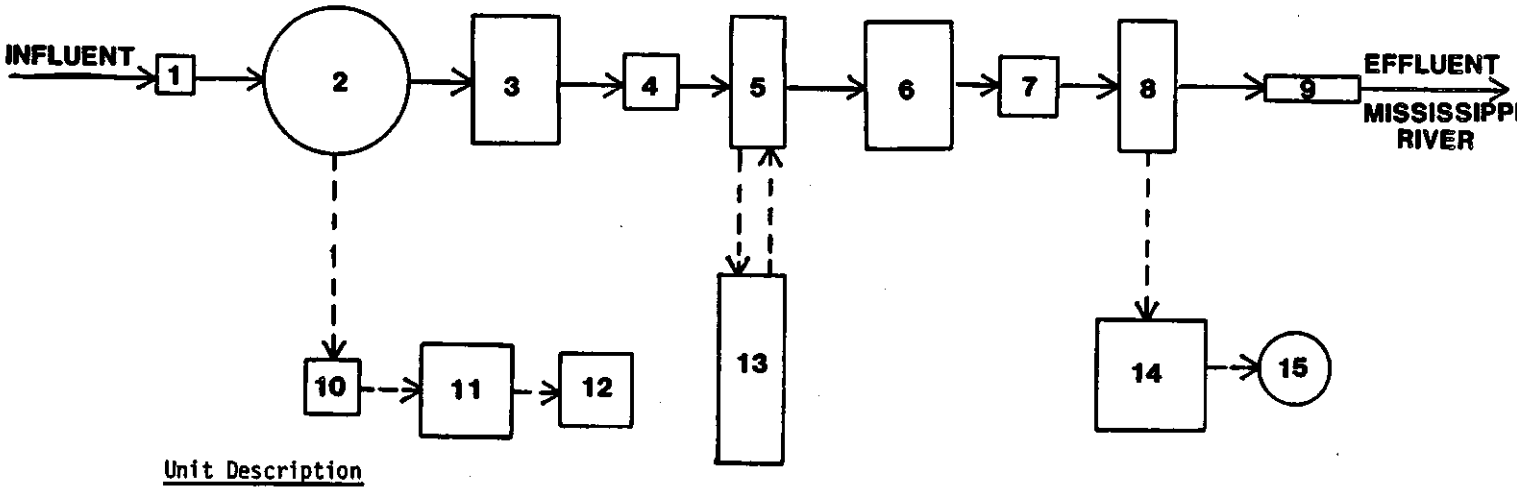
The plant was designed as a demonstration project and uses equipment intensive unit processes. As a result, the plant's useful life could be expected to be on the order of 10 to 15 years. For this reason, the plant is nearing the end of its useful life. The 201 Facility Plan recommended replacement of the physical-chemical facility with a biological treatment plant sometime during the 1980's. It is expected that a replacement plant will be constructed in the late 1980's.

ROSEMOUNT PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	0.31	0.34	0.37	0.40	0.38	0.40
BOD Loading, lb/day	440	460	390	490	520	510
TSS Loading, lb/day	620	680	400	700	1,300	470
Phosphorus Loading, lb/day	19	21	20	21	29	26
COD Loading, lb/day	1,100	1,200	990	1,200	1,400	1,160
Solids Contact Clarifier (One in Use)						
Surface Loading Rate, gpd/sq. ft.	700	700	750	900	770	810
TSS Removal, %	89	------	------	92	------	------
Phosphorus Removal, %	93	96	94	95	98	88
COD Removal, %	77	------	------	80	------	------
Dual Media Filters (Four in Use)						
Surface Loading Rate, gpm/sq. ft.	1.1	1.1	1.2	1.4	1.3	1.4
TSS Removal, %	59	------	------	80	------	------
Activated Carbon Columns (One Train)						
Surface Loading Rate, gpd/sq. ft.	4.3	4.7	5.1	5.6	5.2	5.5
COD Loading Rate, lb/day	190	220	190	290	280	380
COD Removal, %	28	------	------	60	------	------
TSS Removal, %	82	------	------	85	------	------
Sludge Production						
Volume, gpd	4,000	5,000	5,100	4,800	6,300	6,600
Mass, lb/day	3,400	4,000	4,100	4,000	4,600	5,800
Concentration, % TS	10	------	------	12	------	------

ROSEMOUNT WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

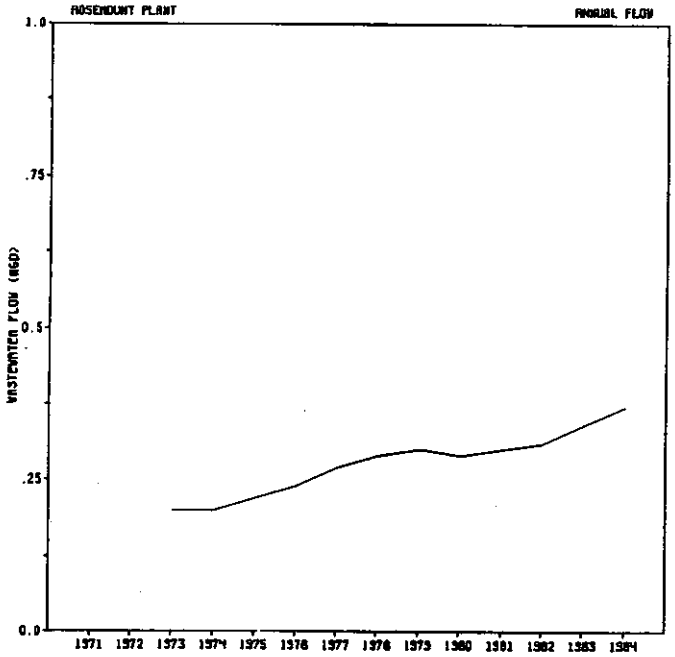
1. Screening
2. Solids Contact Clarifier
3. Dual Media Filters
4. Filtered Water Storage
5. Granular Carbon Columns
6. Dual Media Filters
7. Filtered Water Storage
8. Ion Exchange Columns
9. Chlorination

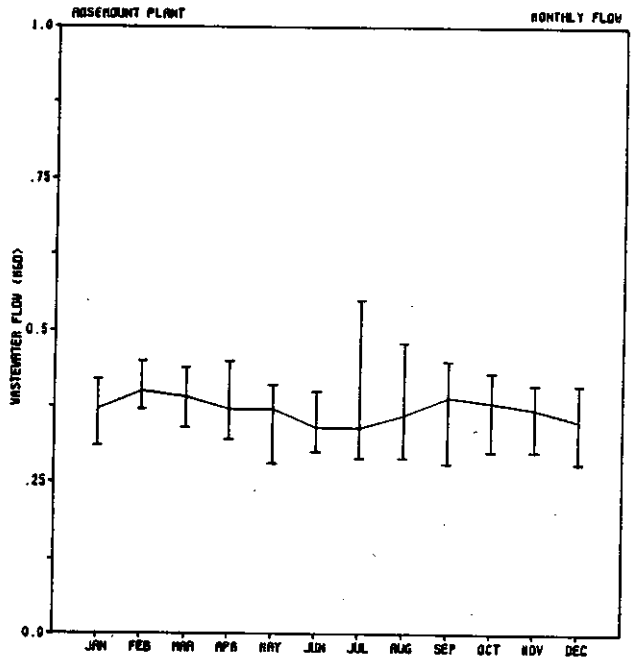
Solid Phase

10. Sludge Holding Tank
11. Sludge Dewatering
12. Land Spread
13. Carbon Regeneration System
14. Ion Exchange Regeneration System
15. Ammonia Recovery

Legend

——— Liquid Flow
- - - - Solids Transfer
▭ Existing Process Units
▭ Future Process Units





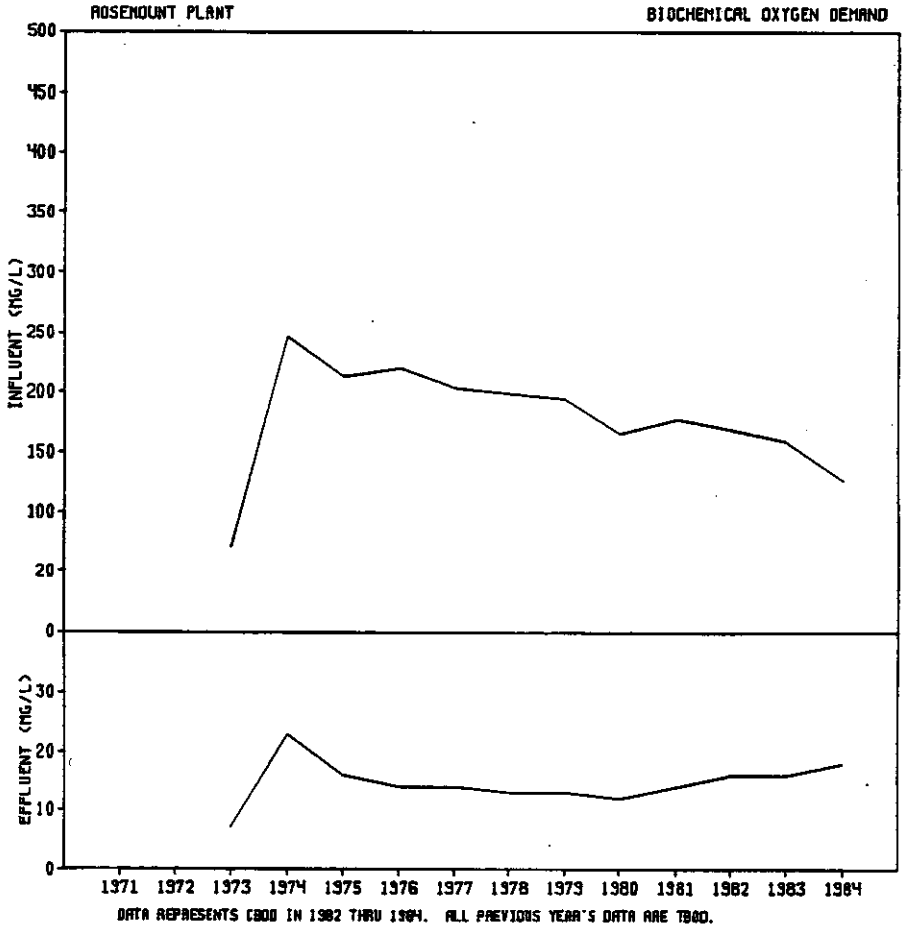
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Rosemount

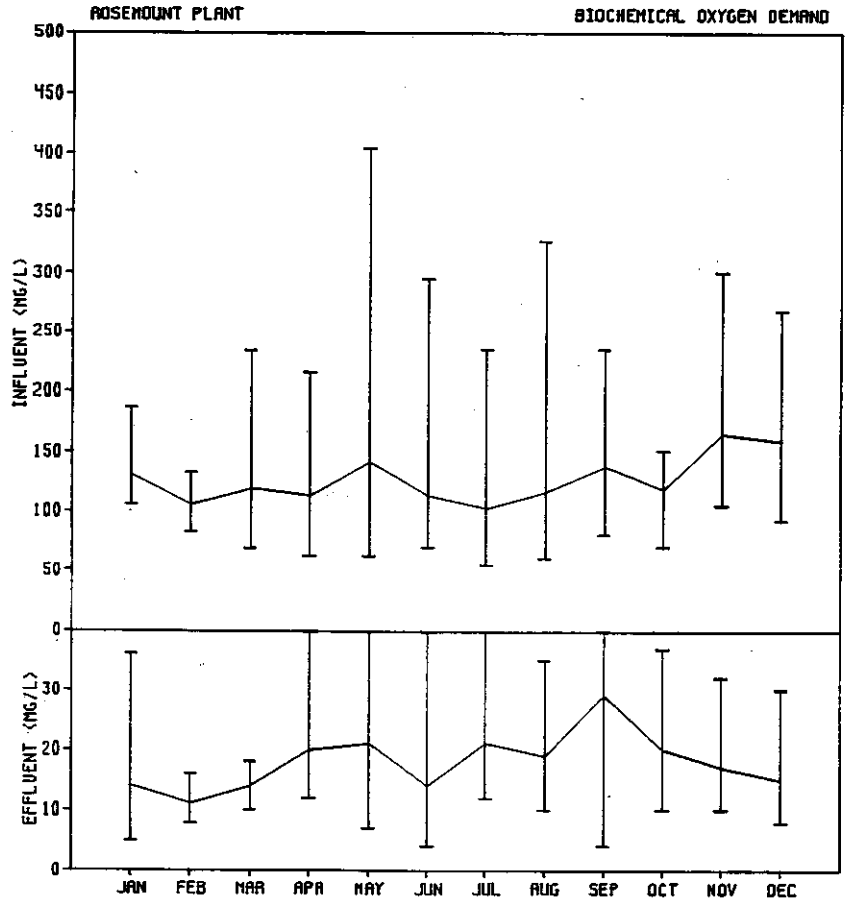
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	0.37	13	131	141	6.8-7.8	45.6	6.8	27.3	328
FEBRUARY	0.40	12	105	113	6.7-7.7	41.1	6.0	22.2	324
MARCH	0.39	11	119	109	7.0-8.2	38.5	5.7	22.3	305
APRIL	0.37	11	113	106	7.2-8.0	36.3	5.4	23.2	311
MAY	0.37	12	142	148	7.1-7.7	40.8	6.0	23.0	333
JUNE	0.34	14	113	132	7.1-7.8	34.8	5.4	20.0	291
JULY	0.34	16	102	161	7.0-7.8	38.9	5.4	21.0	322
AUGUST	0.36	17	116	140	7.1-7.9	40.5	5.9	20.8	317
SEPTEMBER	0.39	18	137	119	7.2-8.9	40.9	6.5	24.2	311
OCTOBER	0.38	17	118	92	7.0-8.3	44.1	6.8	21.2	285
NOVEMBER	0.37	16	165	144	7.3-9.0	44.8	8.4	25.8	376
DECEMBER	0.35	15	159	140	7.3-8.1	39.1	7.7	25.7	365
1984 AVERAGE	0.37	14	127	129	6.7-9.0	40.6	6.4	22.9	322
1983 AVERAGE	0.34	14	159	236	6.2-11.3	44.4	7.2	26.1	413

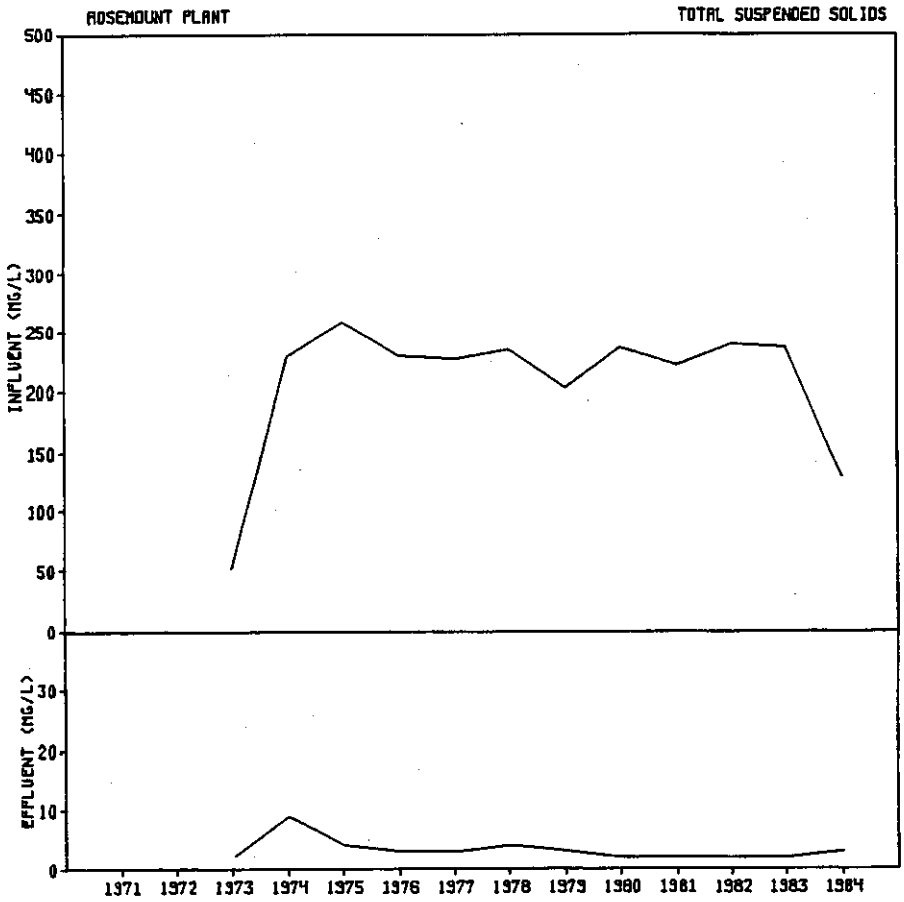
MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Rosemount

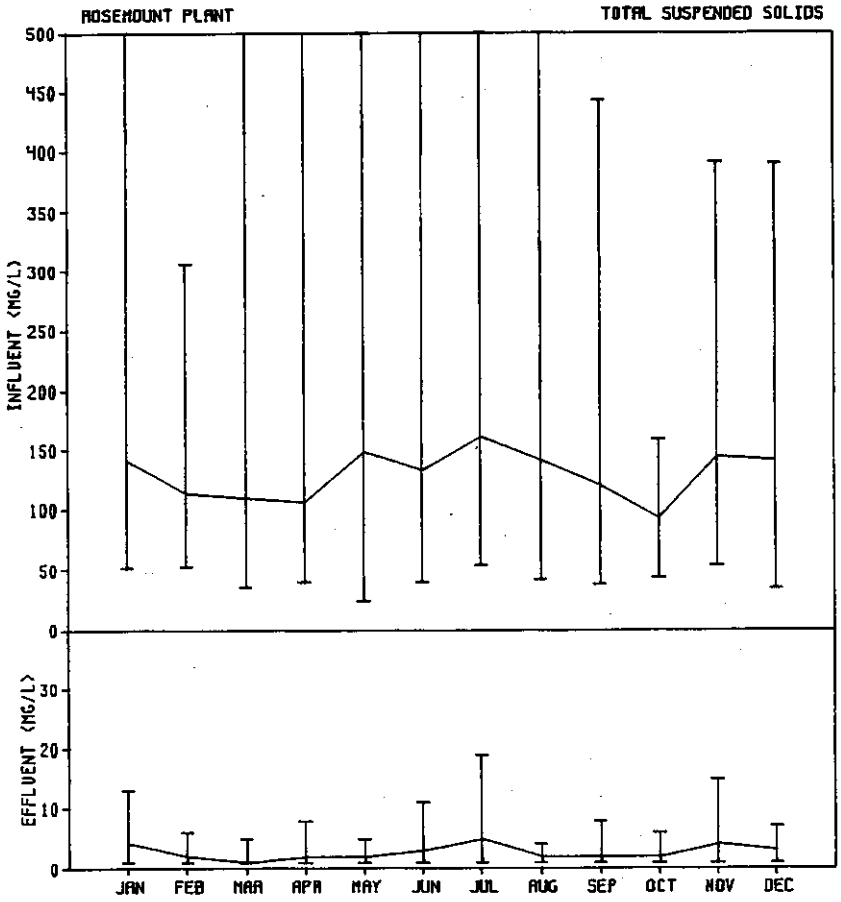
Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	----	----	----	1.0	--	---	---	6.5-8.5	--	--
JANUARY	16	14	54	4	---	3	35.6	28.6	0.29	0.37	0.1	--	---	8.0	6.8-8.4	89	97
FEBRUARY	12	11	44	2	---	2	33.0	26.0	0.24	0.43	0.1	23	0.4	8.6	6.7-8.3	90	98
MARCH	16	14	59	1	3	3	34.7	26.4	0.09	0.12	0.1	20	1.5	9.5	6.6-7.4	88	99
APRIL	22	20	72	2	2	4	32.4	25.8	0.30	0.87	0.1	19	1.5	9.1	6.8-8.4	82	98
MAY	21	21	70	2	2	3	33.4	25.3	0.24	1.36	0.1	20	1.4	7.2	6.8-8.2	85	99
JUNE	15	14	54	3	3	6	32.1	23.3	0.09	0.62	0.4	17	1.9	4.5	6.6-8.1	88	98
JULY	24	21	77	5	11	10	32.8	24.6	0.03	0.18	0.6	23	1.9	5.2	6.6-8.4	79	97
AUGUST	19	19	78	2	8	6	30.0	22.3	0.40	0.40	0.2	24	1.5	4.2	6.6-8.4	84	99
SEPTEMBER	31	29	69	2	6	8	32.8	25.0	0.11	0.19	0.3	37	1.5	4.5	6.6-8.0	79	98
OCTOBER	22	20	57	2	9	8	33.0	24.0	0.09	0.21	0.3	42	3.0	5.2	6.6-8.4	83	97
NOVEMBER	19	17	68	4	---	9	34.1	27.0	0.15	0.17	0.3	--	---	6.1	6.7-8.4	90	97
DECEMBER	17	15	68	3	---	9	33.0	29.3	0.94	0.48	0.2	--	---	7.2	6.6-9.0	90	98
1984 AVG.	20	18	64	3	5	6	33.0	25.7	0.26	0.47	0.2	25	1.8	6.6	6.6-9.0	86	98
1983 AVG.	17	16	51	2	4	3	33.5	28.0	0.60	1.85	0.2	30	1.7	7.2	6.2-8.4	90	99

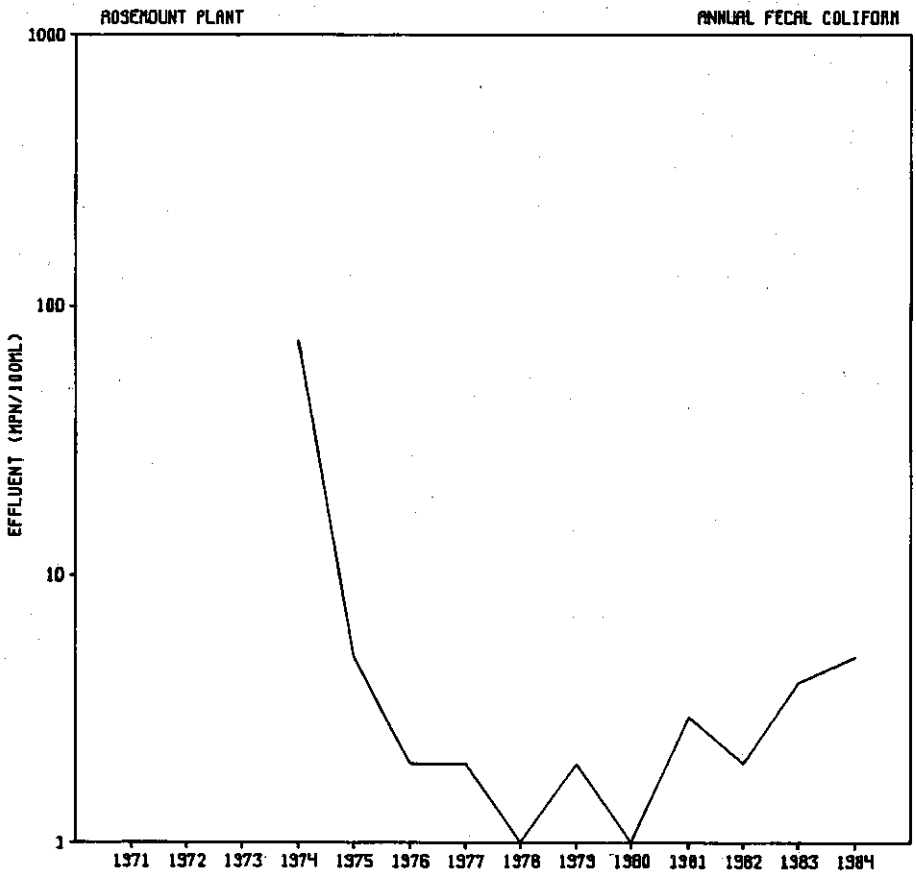
*For disinfection only.

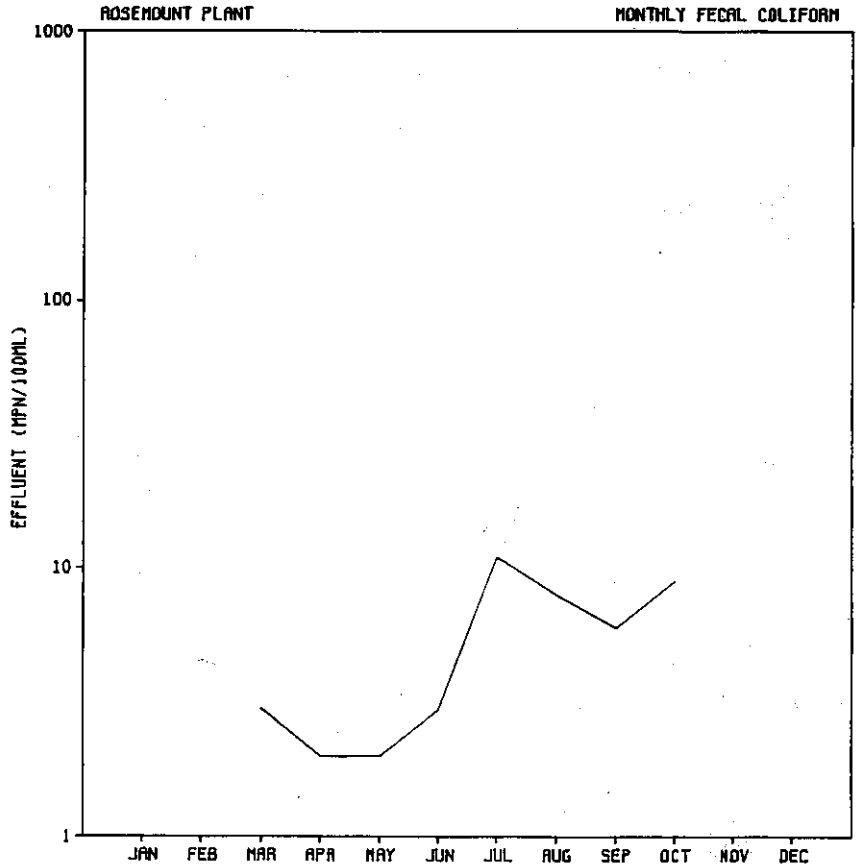

ROSEMOUNT PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
20
0
EFFLUENT (MG/L)
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.

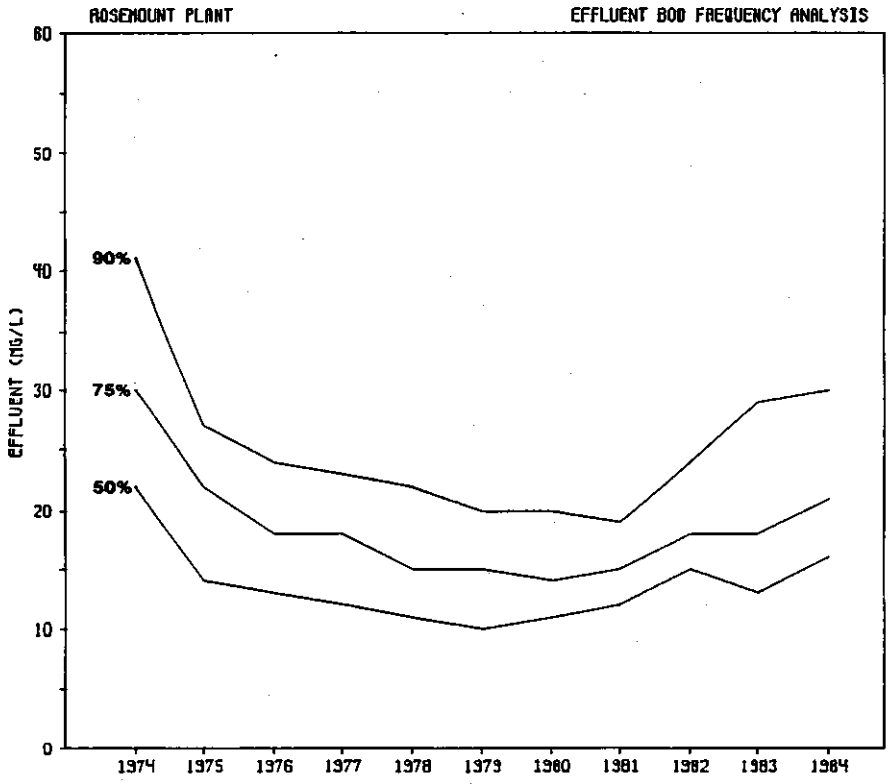

ROSEMOUNT PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

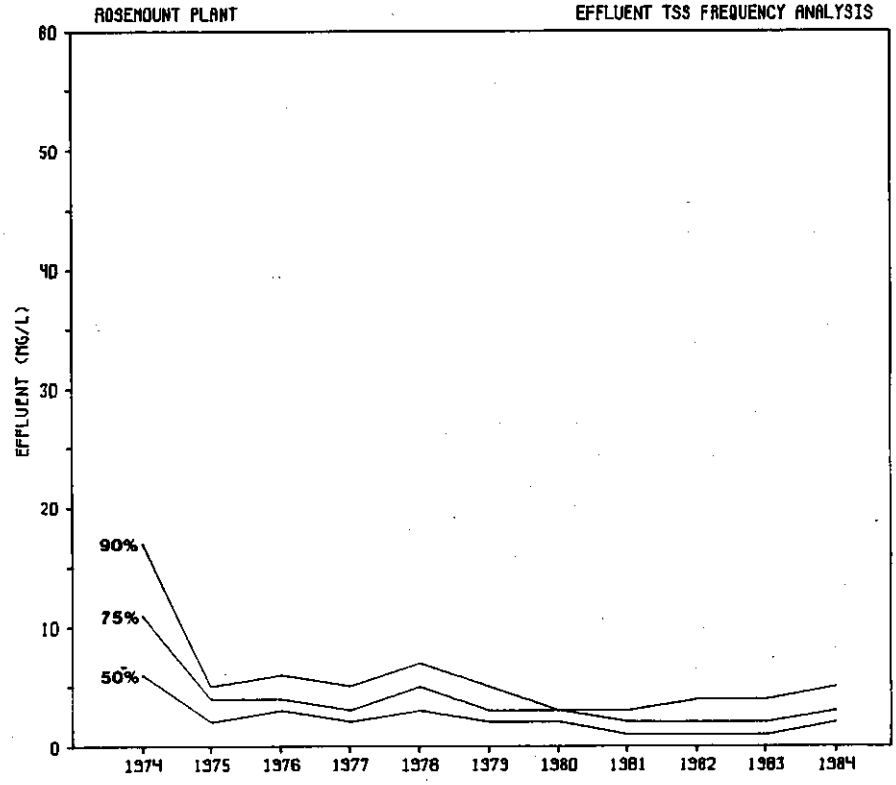

ROSEMOUNT PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


ROSEMOUNT PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


ROSEMOUNT PLANT
ANNUAL FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


ROSEMOUNT PLANT
MONTHLY FECAL COLIFORM
1000
100
10
1
EFFLUENT (MPN/100ML)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


ROSEMOUNT PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


ROSEMOUNT PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

SAVAGE WASTEWATER TREATMENT PLANT

Plant History and Description

The original Savage Treatment Plant was designed by Ellison-Philstrom, Inc. and constructed in 1963 with a capacity of 0.36 mgd. Interim improvements to the plant were designed by RCM and construction was completed in 1979. These plant modifications included the addition of a new synthetic media trickling filter, a new chlorine contact tank and a new sludge holding/decant tank. The current plant design capacity is 0.86 mgd. The plant serves the community of Savage in Service Area No. 4.

Liquid treatment consists of screening, influent pumping, primary clarification , a roughing filter, a synthetic media high-rate trickling filter, final clarification, chlorination and discharge to the Minnesota River.

Solids processing consists of a sludge holding and decant tank, anaerobic digestion, and sludge hauling to another plant for further treatment or sludge landspreading. The plant is presently operating at about 75 percent of its design capacity and is subject to secondary treatment limits.

Performance

Plant flow averaged 0.62 mgd during 1984, slightly higher than 0.59 mgd in 1983. Average plant effluent quality was 7 mg/L BOD and 3 mg/L TSS. Plant performance was excellent throughout the year with one NPDES Permit violation of the weekly fecal coliform limit. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	9	6	7	6	12	9	9	7	15	20	10	10
TSS	5	2	2	2	12	5	3	4	17	11	4	6

*1982 through 1984 values represent CBOD.

Future

The long-term plan for the Savage Plant is to phase it out of service and divert the flow to the Seneca Plant. This is projected to occur in the late 1980's as the plant reaches its capacity.

SAVAGE PLANT PROCESS UNIT LOADINGS

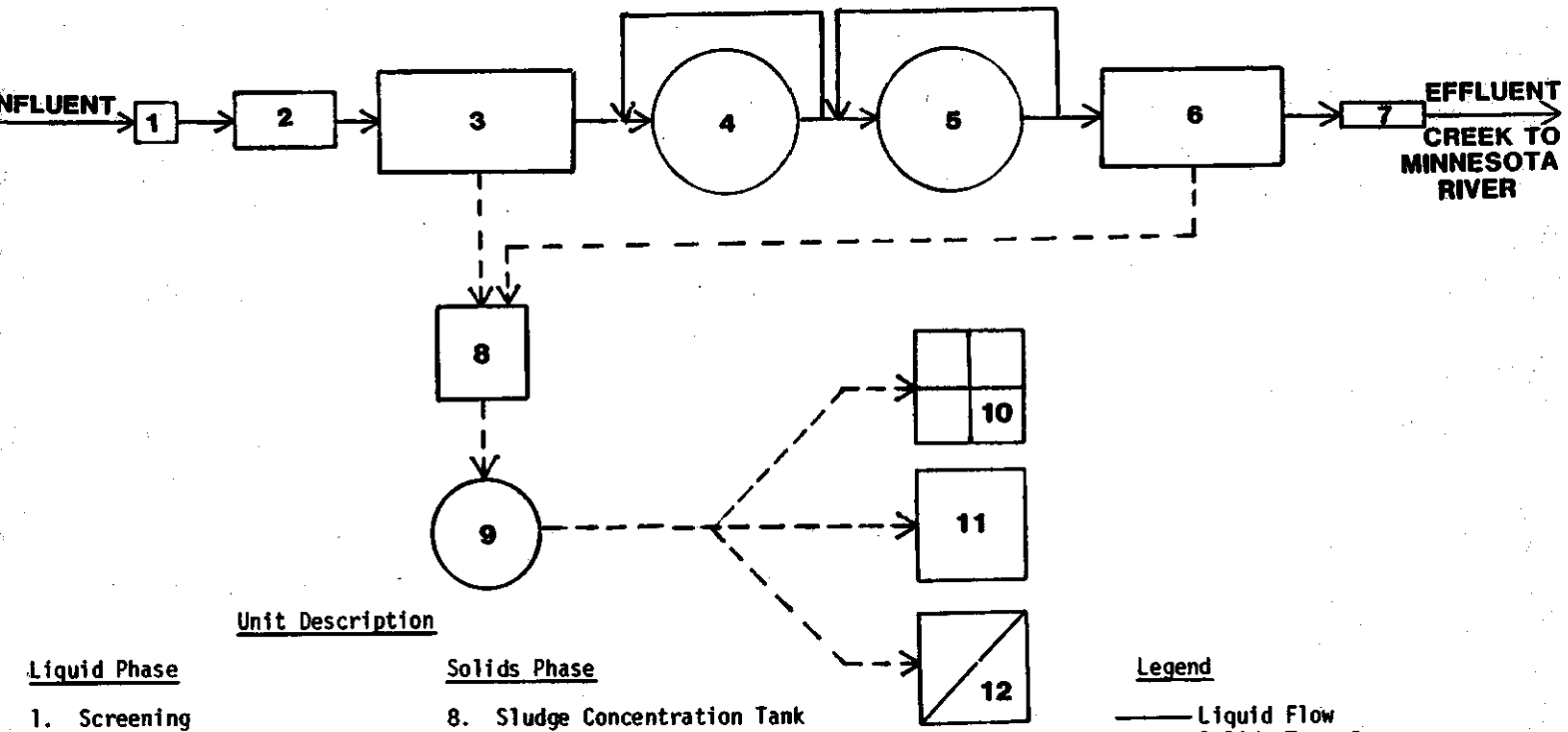
Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	0.48	0.59	0.62	0.62	0.87	0.89
BOD Loading, lb/day	610	590	540	910	690	710
TSS Loading, lb/day	700	960	860	1,010	2,100	1,790
COD Loading, lb/day	1,120	1,200	1,300	1,400	1,500	1,570
Sludge Production, lb/day	280	500	520	------	------	------
Grit Removal						
Overflow Rate, gpd/sq. ft.	26,700	33,000	34,000	34,400	48,000	49,000
Primary Sedimentation						
Detention Time, hr.	1.5	1.2	1.2	1.2	0.8	0.8
Weir Overflow Rate, gpd/lin. ft.	6,960	8,600	9,000	8,990	13,000	12,900
Surface Overflow, gpd/sq. ft.	1,260	1,600	1,600	1,630	2,300	2,300
Trickling Filter No. 1						
Hydraulic Loading, gpd/sq. ft. (inc. recir.)	±400	±400	600	------	------	------
Organic Loading, lb. BOD/day/1000 cu. ft. (Assume 20% Primary BOD Removal)	±45	±45	60	------	------	------
Trickling Filter No. 2						
Hydrualic Loading, gpd/sq. ft. (inc. recir)	±3,000	±3,000	2,500	------	------	------
Organic Loading, lb. BOD/day/1000 cu. ft. (Assume 50% Filter No. 1 BOD Removal)	±10	±10	18	------	------	------
Final Sedimentation						
Detention Time, hr.	2.4	1.9	1.8	1.8	1.3	1.3
Weir Overflow Rate, gpd/lin. ft.	5,000	6,200	6,500	6,460	9,100	9,300
Surface Overflow Rate, gpd/sq. ft.	530	650	690	680	970	990
Chlorination						
Contact Time, minutes	73	59	56	56	40	39
Chlorine Use, lb/day	19	25	39	30	34	51
Sludge Holding Tank						
Detention Time, days	±11	±13	11	------	------	------

SAVAGE PLANT PROCESS UNIT LOADINGS (cont.)

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Anaerobic Digester						
Detention Time, days	+50	+57	48	------	------	------
Solids Loading, lb/cu. ft./day	±0.05	±0.04	0.04	------	------	------
Sludge Transport						
Volume, gpd	690	1,500	1,800	-------	3,100	3,900

SAVAGE WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

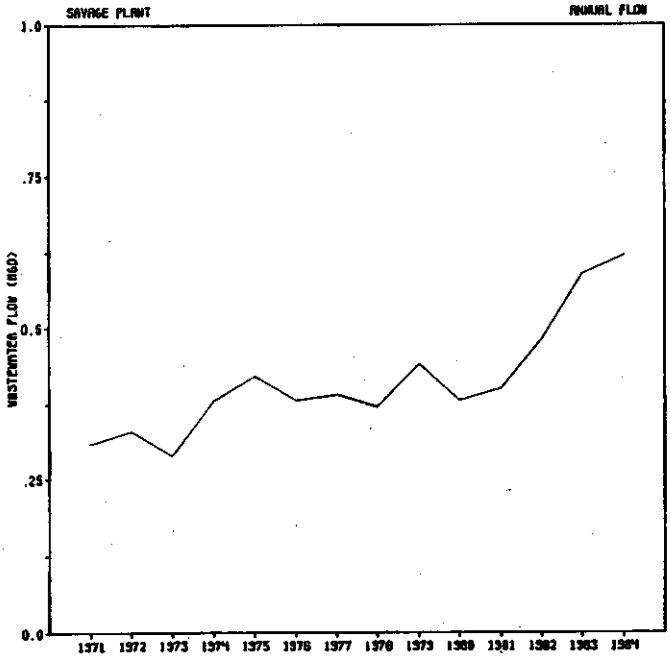
1. Screening
2. Grit Removal
3. Primary Sedimentation
4. Roughing Trickling Filter
5. Trickling Filter
6. Final Clarification
7. Chlorination

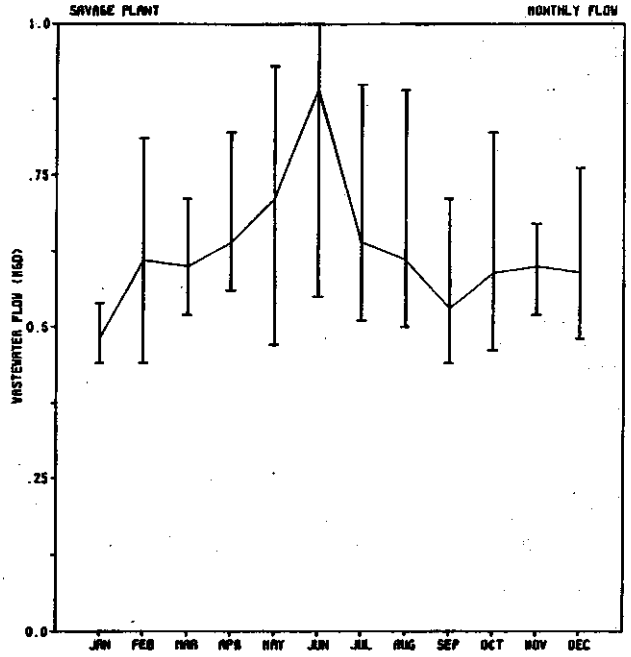
Solids Phase

8. Sludge Concentration Tank
9. Anaerobic Digestion
10. Drying Beds
11. Landspreading
12. Solids Disposal at Seneca Plant

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Savage

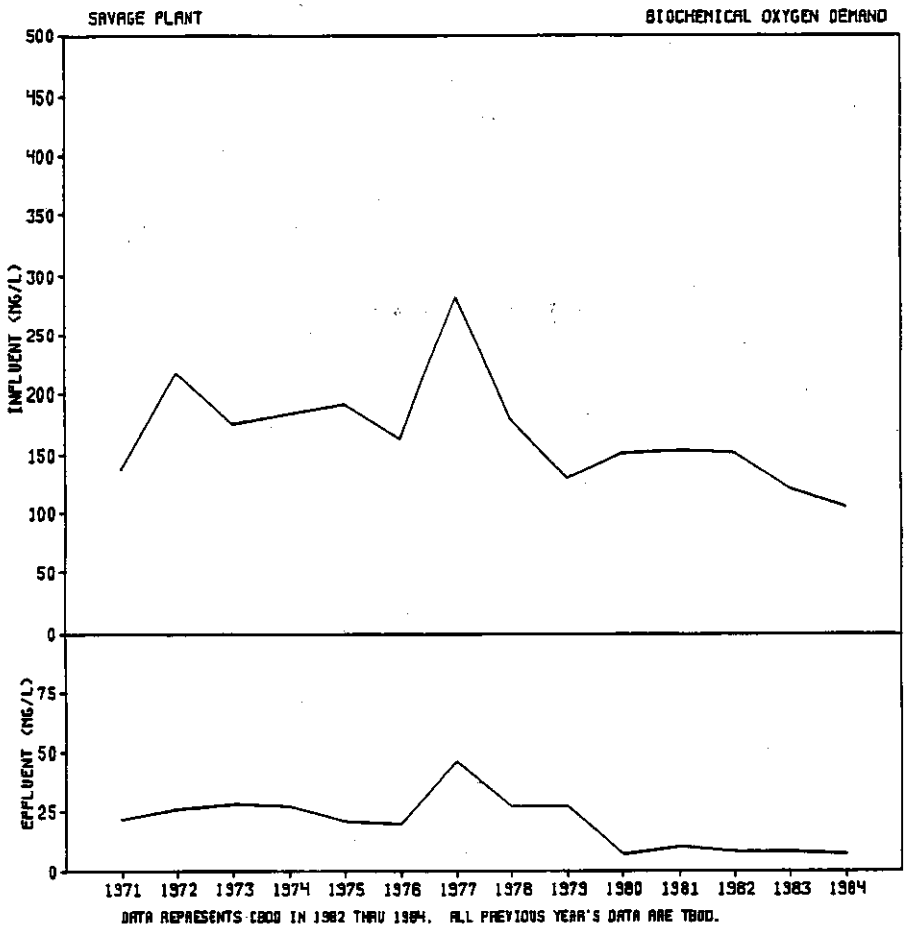
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	0.48	12	104	152	6.4-12.0	27.0	4.9	16.3	225
FEBRUARY	0.61	10	97	133	6.4-12.2	22.5	14.9	12.3	223
MARCH	0.60	10	92	171	1.6-13.4	20.6	10.6	12.0	256
APRIL	0.64	10	91	105	6.6-10.2	18.9	3.4	12.3	177
MAY	0.71	12	87	311	5.6-9.8	19.8	10.7	9.8	227
JUNE	0.89	15	64	103	0.0-12.8*	14.6	5.3	7.9	185
JULY	0.64	16	96	181	0.0-11.0*	24.2	12.3	11.3	279
AUGUST	0.61	18	121	211	6.6-10.2	23.5	8.6	12.3	295
SEPTEMBER	0.53	19	154	190	6.6-10.4	26.8	11.8	14.8	340
OCTOBER	0.59	18	109	173	6.8-10.8	23.6	7.8	12.5	269
NOVEMBER	0.60	15	111	101	6.6-10.2	23.3	10.5	14.4	230
DECEMBER	0.59	12	122	114	6.2-10.4	25.0	8.3	14.9	281
1984 AVERAGE	0.62	14	104	165	0.0-13.4	22.6	9.1	12.5	249
1983 AVERAGE	0.59	13	120	195	1.2-12.4	24.3	16.7	13.5	253

*Minimum pH 0.0 as reported on Operators Report.

MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Savage

Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	---	----	-----	---	--	---	----	6.5-8.5	--	--
JANUARY	8	6	37	2	---	3	2.4	1.4	0.23	12.13	3.6	--	---	9.1	7.4-7.7	94	99
FEBRUARY	9	7	57	1	---	2	3.6	1.2	0.26	8.65	9.7	44	2.0	9.4	7.4-7.8	92	99
MARCH	7	5	61	4	5	3	4.0	2.1	0.15	5.93	6.9	33	1.9	9.5	7.4-7.7	95	98
APRIL	6	5	37	1	7	3	3.6	1.5	0.12	5.00	4.0	27	1.3	9.5	7.4-7.8	94	99
MAY	9	8	54	3	14	5	4.9	1.7	0.17	4.59	6.3	23	1.1	9.3	7.4-7.8	90	99
JUNE	10	8	55	5	153	6	2.4	0.8	0.08	6.64	6.4	29	1.2	9.3	7.5-7.9	87	95
JULY	8	6	60	9	56	7	2.8	0.7	0.02	9.78	8.3	50	2.3	8.5	7.4-7.8	94	95
AUGUST	9	7	62	5	99	4	3.3	1.6	0.04	12.21	6.0	51	2.4	8.2	7.4-7.7	94	98
SEPTEMBER	10	8	42	2	41	4	2.8	0.4	0.03	7.74	14.7	42	2.6	8.3	7.4-7.8	95	99
OCTOBER	6	5	36	4	49	6	2.0	1.3	0.02	10.59	6.4	50	2.5	8.6	7.6-7.8	96	98
NOVEMBER	10	7	45	3	---	3	2.4	0.8	0.17	12.09	9.1	56	2.5	8.8	7.5-8.3	94	97
DECEMBER	11	10	60	2	---	3	3.3	1.2	0.26	11.36	7.4	--	--	8.7	7.5-7.8	92	98
1984 AVG.	8	7	50	3	53	4	3.1	1.2	0.13	8.92	7.3	38	1.9	8.9	7.4-8.3	93	98
1983 AVG.	8	8	44	3	22	3	3.7	1.4	0.17	7.77	4.6	25	2.0	8.9	7.3-7.9	93	98

*For disinfection only.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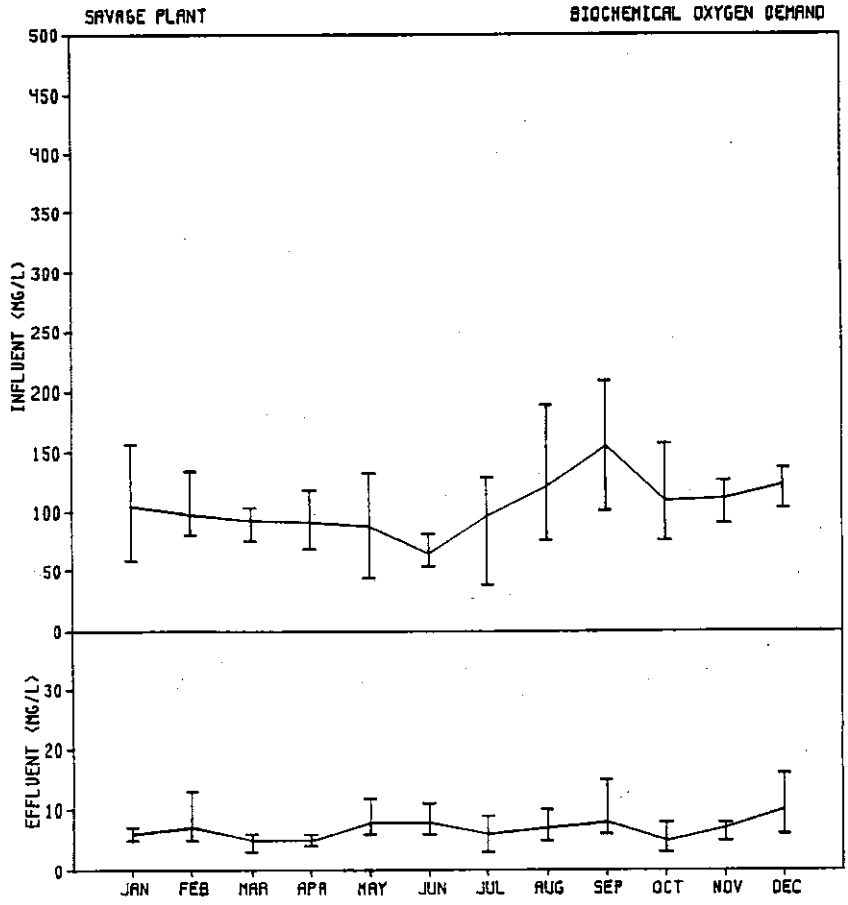
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.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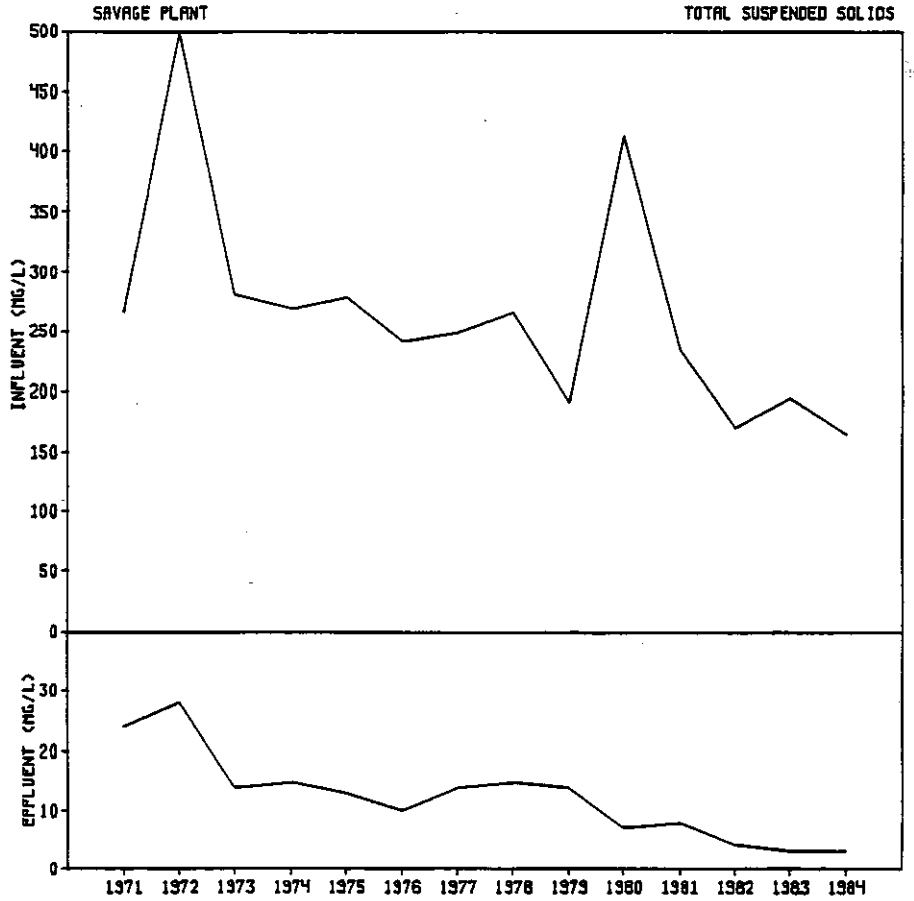
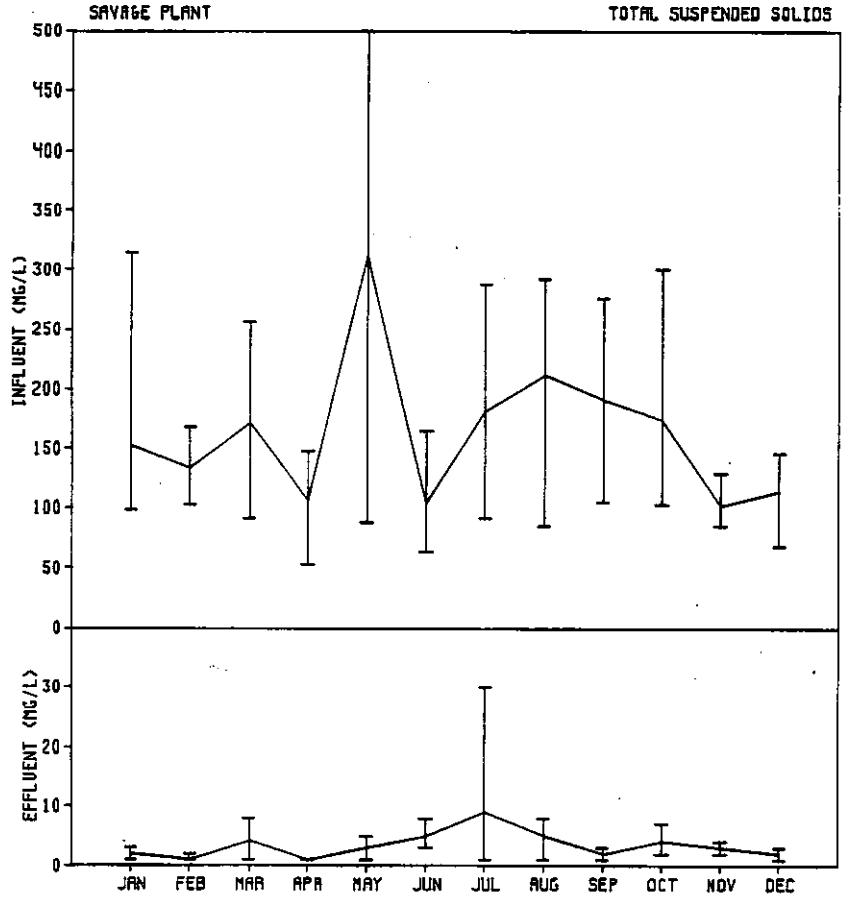
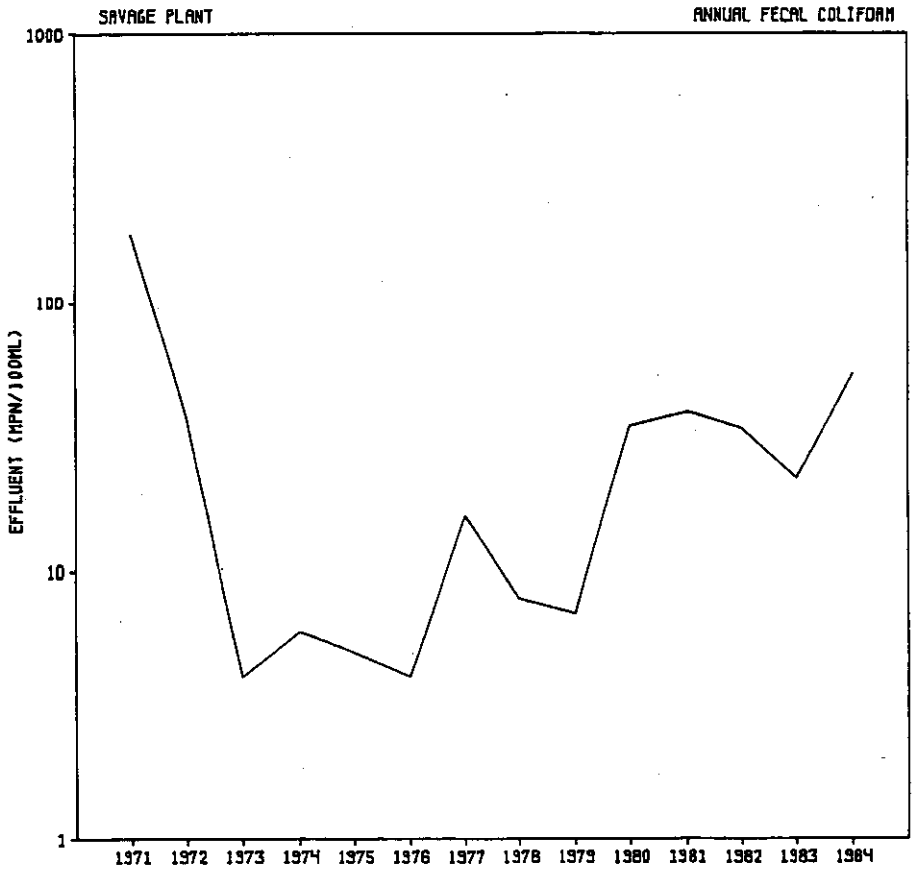
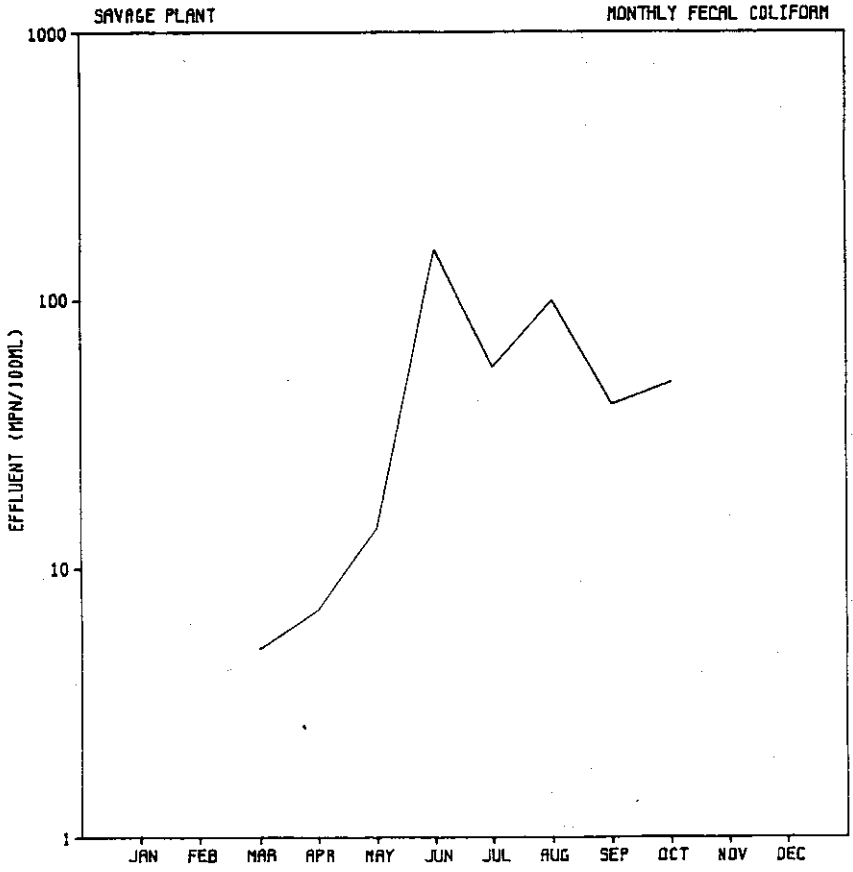
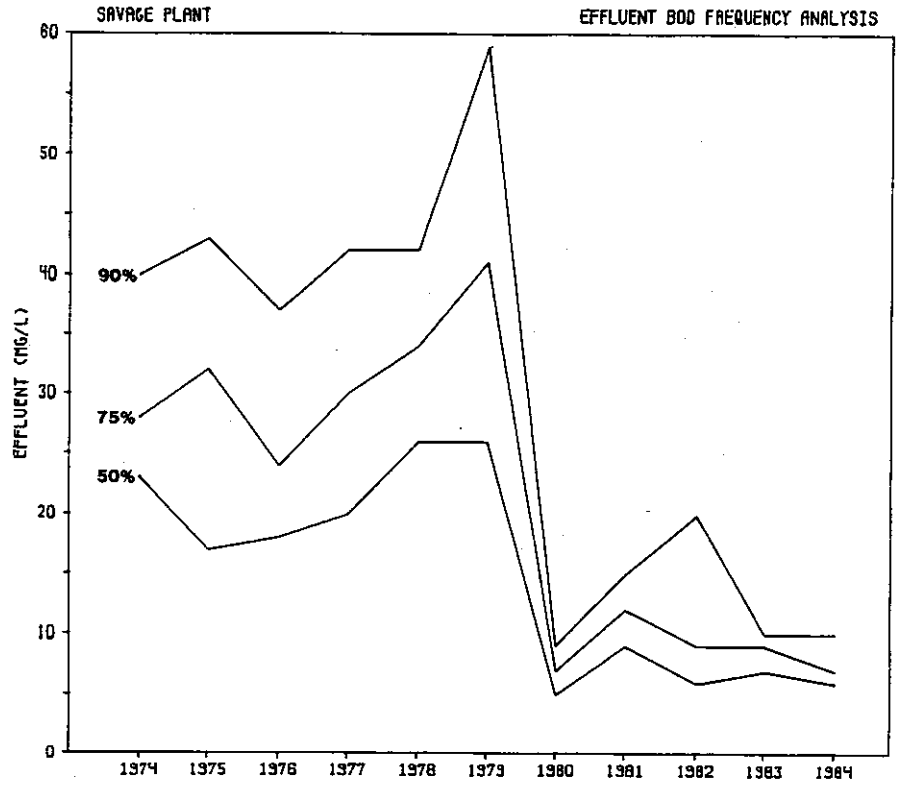
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

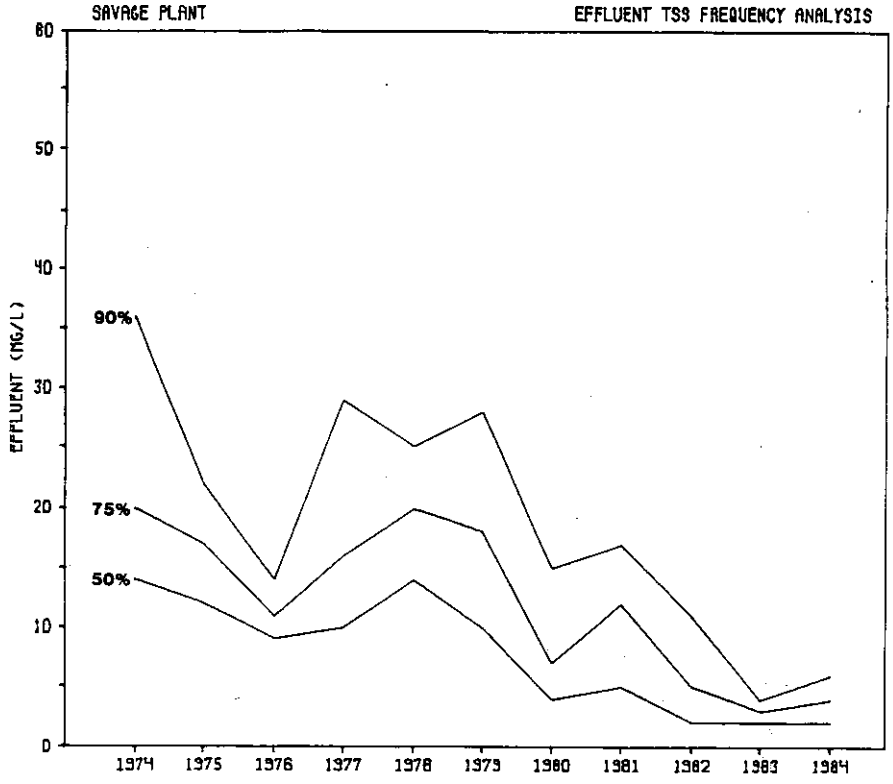

SAVAGE PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
0
50
100
150
200
250
300
350
400
450
500
0
10
20
30
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


SAVAGE PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
EFFLUENT (MG/L)
0
50
100
150
200
250
300
350
400
450
500
0
10
20
30
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


SAVAGE PLANT
ANNUAL FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


SAVAGE PLANT
MONTHLY FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


SAVAGE PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


SAVAGE PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

SENECA WASTEWATER TREATMENT PLANT

Plant History and Description

The Seneca Plant was designed by Black and Veatch Consulting Engineers, and was placed into operation in 1972, with a design capacity of 24 mgd.

Liquid treatment consists of screening, grit removal, primary sedimentation, complete mix activated sludge aeration, final clarification, chlorination, and discharge to the Minnesota River.

Solids processing consists of waste activated sludge air floatation thickening, combined sludge storage, chemical conditioning, vacuum filtration or belt filter press dewatering, and incineration. A polymer conditioning system and belt filter press dewatering system has been added and began operation in mid-1983. Operation of the belt filter press for sludge dewatering allowed the Seneca Plant to process 20% more sludge during 1984. An odor nuisance problem from the belt filter press operation was solved by installing a system to feed potasium permanganate to the liquid sludge as it is fed to the belt filter press. A plant odor assessment was completed during 1984. Several operational improvements and small capital improvements were recommended. The plant is presently operating at about 75 percent of its design capacity and is subject to secondary treatment limits.

Performance

Plant flow averaged 17.6 mgd during 1984, considerably higher than 15.8 mgd in 1983. Average plant effluent quality was 17 mg/L BOD and 21 mg/L TSS. Plant performance was good throughout the year with no NPDES Permit violations. Statistical analysis of data show the following trend in effluent BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	19	17	13	15	22	21	17	19	30	25	24	24
TSS	19	19	15	19	23	23	23	26	28	26	29	34

*1982 through 1984 values represent CBOD.

Future

The Seneca Plant is one of the Commission's permanent regional plants. Space is available for future plant expansion and advanced treatment as needed. Additional sludge processing improvements are planned for construction by the late 1980's.

SENECA PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	14.8	15.8	18.0	15.9	17.2	23.2
BOD Loading, lb/day	27,200	29,000	31,200	32,500	32,400	38,700
TSS Loading, lb/day	25,000	27,500	30,900	34,600	40,000	47,645
Grit Chambers						
Detention Time, minutes	25	23	20	23	22	16
Primary Clarifiers						
Surface Overflow Rate, gpd/sq. ft.	320	340	390	340	370	500
Weir Overflow Rate, gpd/lin. ft.	6,700	7,200	8,200	7,200	7,800	10,500
Detention Time, hr.	6.8	6.4	5.6	6.3	5.9	4.4
Removal Efficiency, % BOD	28	37	35	39	46	45
Removal Efficiency, % TSS	72	71	70	74	83	80
Aeration Tanks (Two)						
BOD Loading, lb/day/1000 cu. ft.	92	94	104	102	112	110
F:M Ratio, lb/day/lb. MLSS	0.58	0.59	0.66	0.69	0.76	0.70
Detention Time, hr.	2.4	2.2	1.9	2.2	2.1	1.7
Final Clarifiers (Two)						
Surface Overflow Rate, gpd/sq. ft.	600	640	730	650	700	940
Weir Overflow Rate, gpd/lin. ft.	9,900	10,600	12,100	10,600	11,500	15,500
Detention Time, hr.	4.5	4.2	3.9	4.2	3.8	2.8
Chlorination						
Chlorine Dose, mg/L	4.3	4.3	3.7	5.0	5.0	5.1
Chlorine Feed Rate, lb/day	520	550	580	610	650	742
Contact Time, minutes	36	40[1]	38[1]	34	39[1]	32[1]
Flotation Thickeners						
Solids Loading, lb./sq. ft./day	12	12	12	15	15	15
Vacuum Filters[2]						
Lime Dose, %	30	30	30	40	40	40
Ferric Chloride Dose, %	8	8	8	10	10	10
Filtration Rate, lb./sq. ft./day	3.2	3.2	3.2	3.5	3.5	3.5
Cake Solids, %	23.5	22	22	24.7	23	23

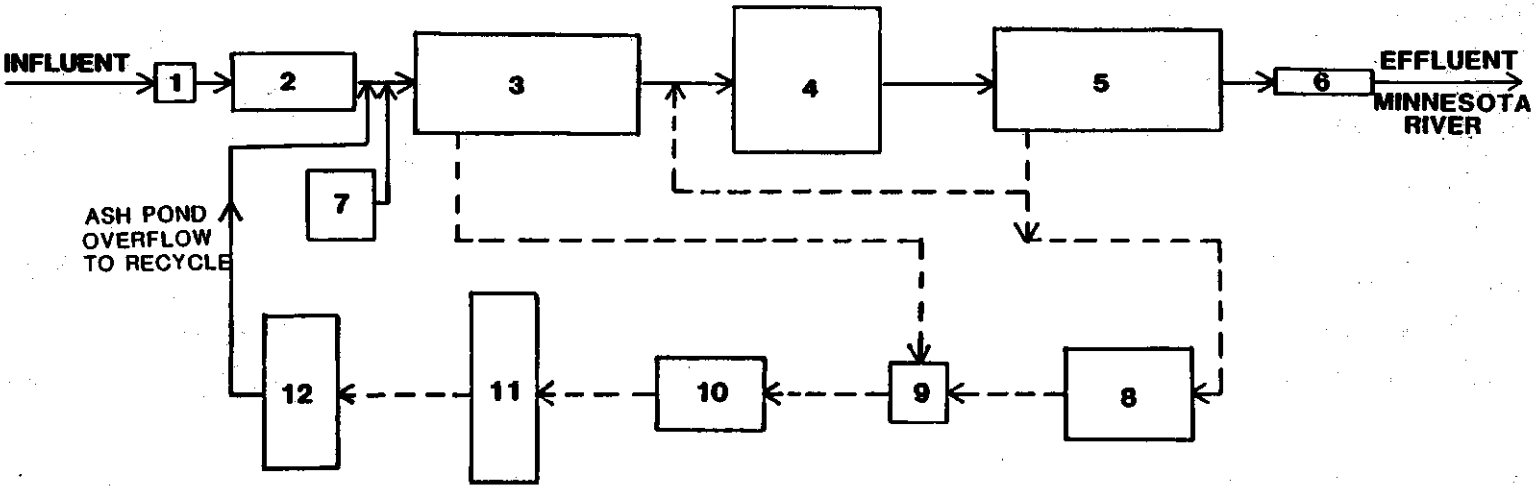
SENECA PLANT PROCESS UNIT LOADINGS (cont.)

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Belt Filter Press[2]						
Polymer Dosage, lbs/tds	------	8.5[3]	150[4]	------	10[3]	180[4]
Throughput of Dry Solids, lb/hr.	------	1,700	2,100	------	2,000	3,000
Cake Solids, %	------	24	25	------	26	27
Incinerators[2]						
Wet Sludge Loading Rate, lbs./sq. ft./hr.	4.0	4.0	4.0	4.3	4.3	4.3
Dry Solids Loading, lb/hr.	1,700	1,700	1,700	1,800	1,800	1,900
Auxiliary Fuel Use, MMBtu/tds	10	10	10	14	14	14

[1]Based on field measurements at the contact tanks and outfall flow characteristics.
[2]Solids processed includes sludge from Blue Lake Plant.
[3]Dry polymer.
[4]Liquid polymer.

SENECA WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

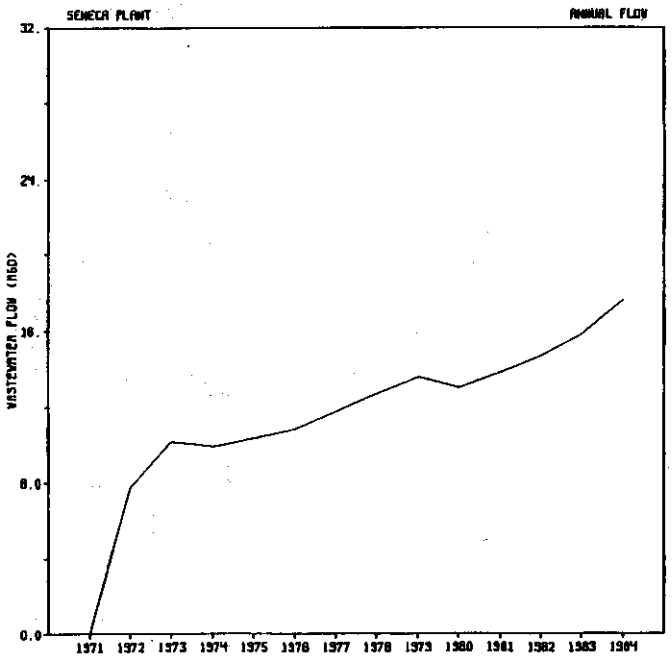
1. Screening
2. Grit Removal
3. Primary Sedimentation
4. Activated Sludge
5. Final Sedimentation
6. Chlorination
7. Chemical Addition and/or Pre-Chlorination

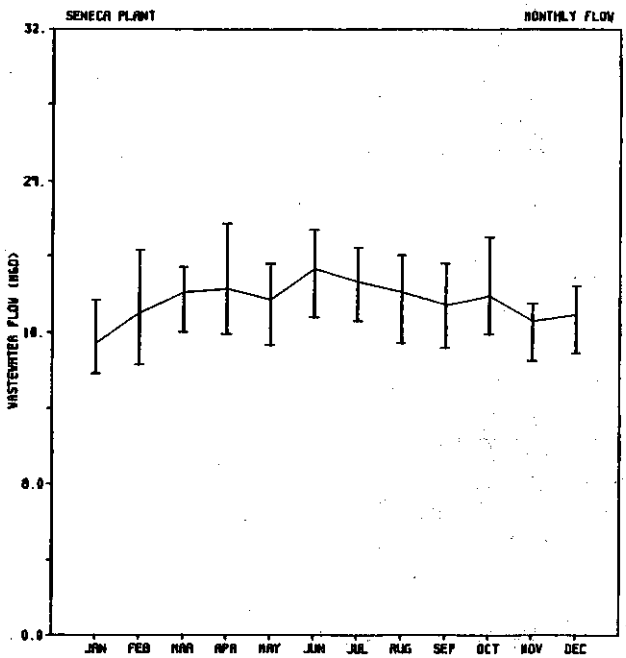
Solid Phase

8. Flotation Thickener
9. Holding Tank
10. Vacuum Filtration
11. Incineration
12. Ash Pond

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





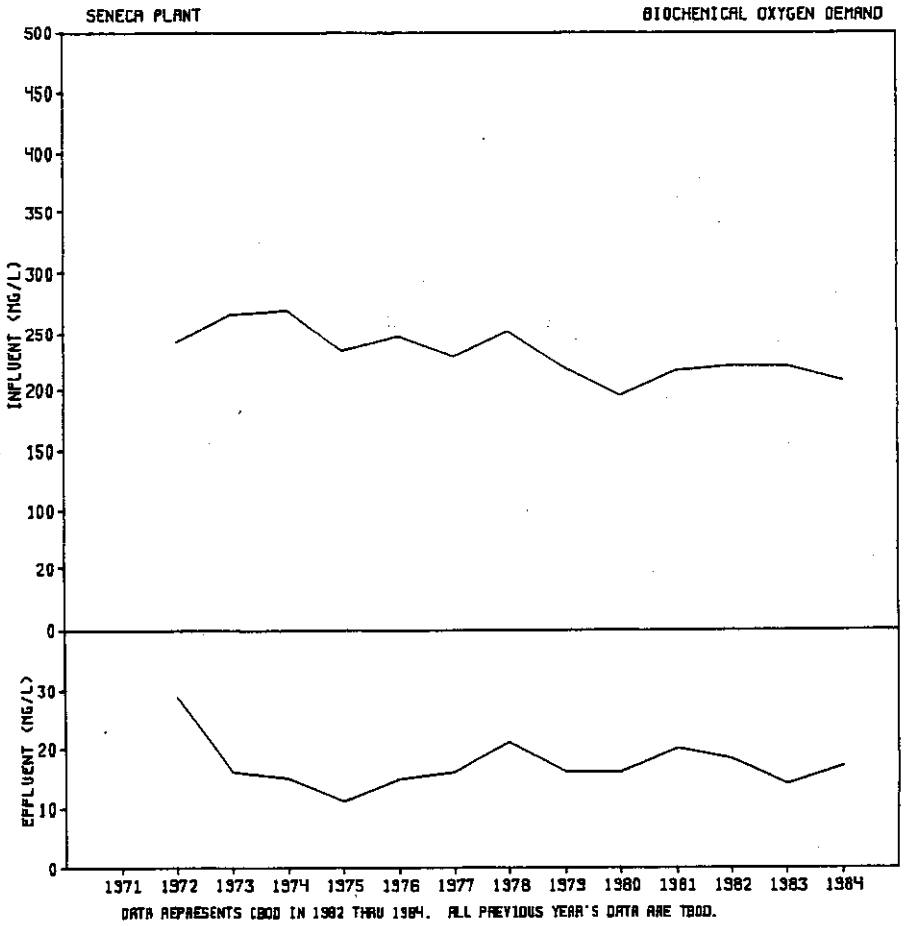
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Seneca

Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	15.4	14	207	207	6.6-7.4	36.6	7.0	18.3	448
FEBRUARY	17.0	14	185	225	4.9-8.3	36.4	7.7	16.0	433
MARCH	18.1	13	206	184	6.7-7.6	36.0	7.4	20.5	419
APRIL	18.3	14	195	167	6.8-7.8	34.9	7.5	18.6	414
MAY	17.7	15	206	195	6.7-8.6	31.5	7.1	14.4	421
JUNE	19.3	17	224	296	6.9-8.1	28.6	7.3	13.8	489
JULY	18.6	19	202	205	6.8-7.5	35.1	7.2	14.7	439
AUGUST	18.1	20	200	197	6.8-8.0	34.3	8.2	17.5	411
SEPTEMBER	17.4	20	214	196	6.8-7.5	34.3	7.1	16.8	463
OCTOBER	17.9	19	208	198	6.9-7.8	36.6	7.1	19.1	489
NOVEMBER	16.6	17	219	199	6.7-7.3	36.3	7.1	20.1	486
DECEMBER	16.9	18	222	194	6.5-7.1	36.7	6.6	23.4	478
1984 AVERAGE	17.6	17	207	205	4.9-8.6	34.8	7.2	17.8	449
1983 AVERAGE	15.8	16	221	211	6.2-8.7	34.9	7.7	19.1	469

MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Seneca

Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	C12* Used lbs	C12 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	----	----	----	---	---	---	---	6.5-8.5	--	--
JANUARY	28	24	94	28	---	9	28.5	20.8	0.13	0.37	5.1	---	---	8.6	6.7-8.4	88	87
FEBRUARY	19	16	80	24	---	7	24.5	18.0	0.12	0.39	4.6	---	---	8.4	6.8-7.4	91	89
MARCH	15	11	75	15	3	7	26.8	20.5	0.16	0.74	5.2	558	3.2	9.1	6.9-7.6	95	92
APRIL	22	13	76	14	3	9	24.8	18.5	0.26	1.09	4.2	536	2.4	8.6	7.1-7.8	93	92
MAY	18	14	74	14	3	8	23.1	15.8	0.18	0.97	3.6	518	2.9	9.1	7.0-7.5	93	93
JUNE	24	19	77	21	9	8	19.8	13.8	0.49	0.93	3.2	504	2.4	8.8	7.1-7.7	92	93
JULY	22	16	74	20	21	9	22.6	14.6	0.28	0.71	3.9	519	2.4	9.3	7.0-7.7	92	90
AUGUST	24	18	75	23	56	12	21.1	13.5	0.58	0.62	3.6	585	1.9	9.0	7.1-7.6	91	88
SEPTEMBER	24	13	76	23	17	9	17.8	10.4	1.37	1.25	4.4	742	3.2	9.2	6.6-7.6	94	88
OCTOBER	26	16	89	22	29	9	24.0	15.3	0.49	1.15	4.1	680	3.4	9.5	6.8-7.8	93	89
NOVEMBER	21	18	93	22	---	7	25.0	18.1	0.09	0.34	2.9	---	---	9.6	6.9-7.4	92	89
DECEMBER	29	24	106	30	---	11	27.4	19.8	0.11	0.32	5.0	---	---	8.6	6.8-7.3	89	84
1984 AVG.	23	17	82	21	18	9	23.8	16.6	0.35	0.74	4.2	580	2.7	9.0	6.6-8.4	92	90
1983 AVG.	22	14	72	18	26	7	20.6	15.9	0.57	0.73	3.7	528	0.7	9.1	6.7-7.8	94	91

*For disinfection only.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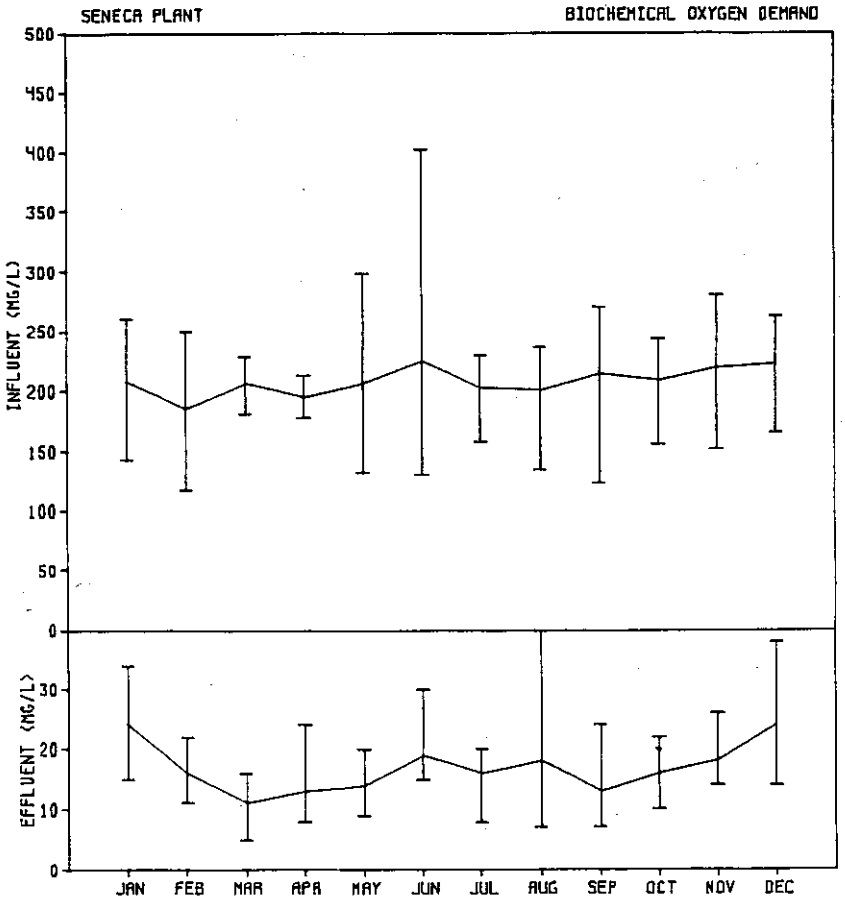
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.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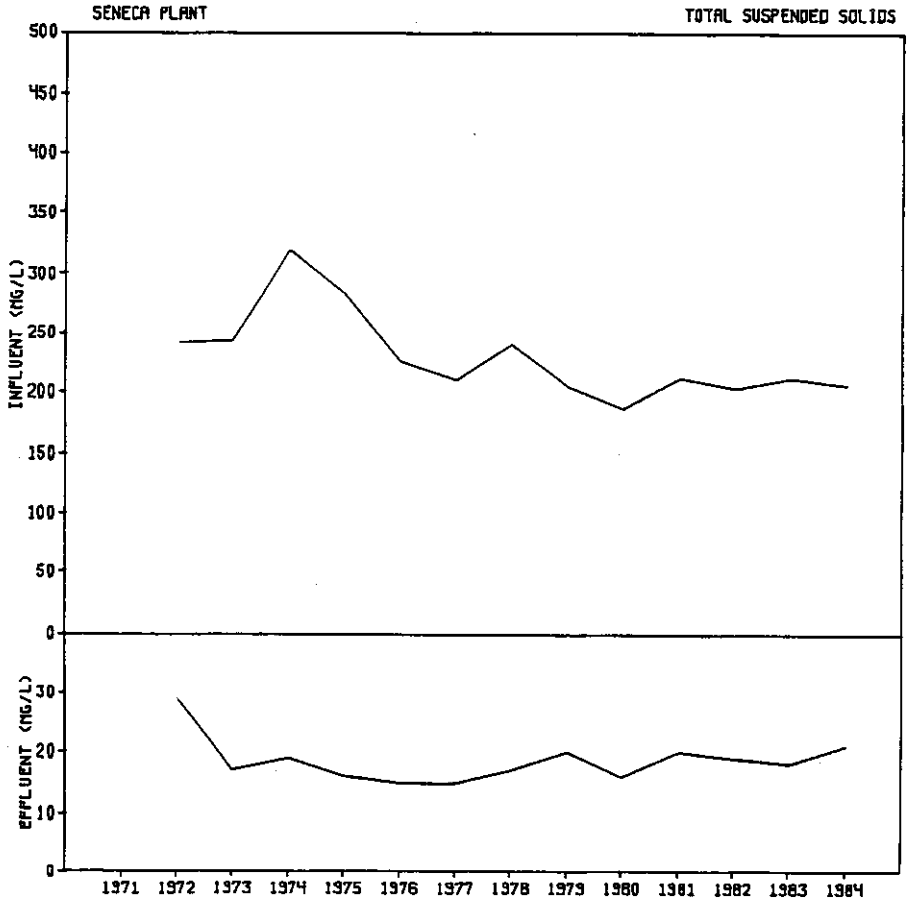
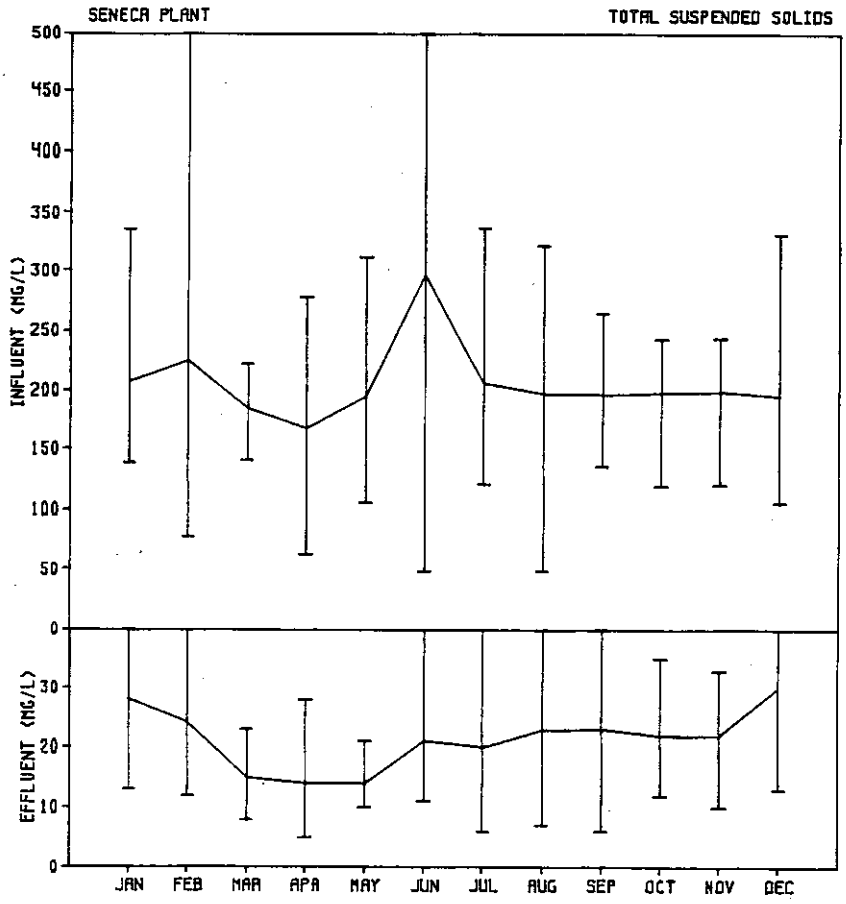
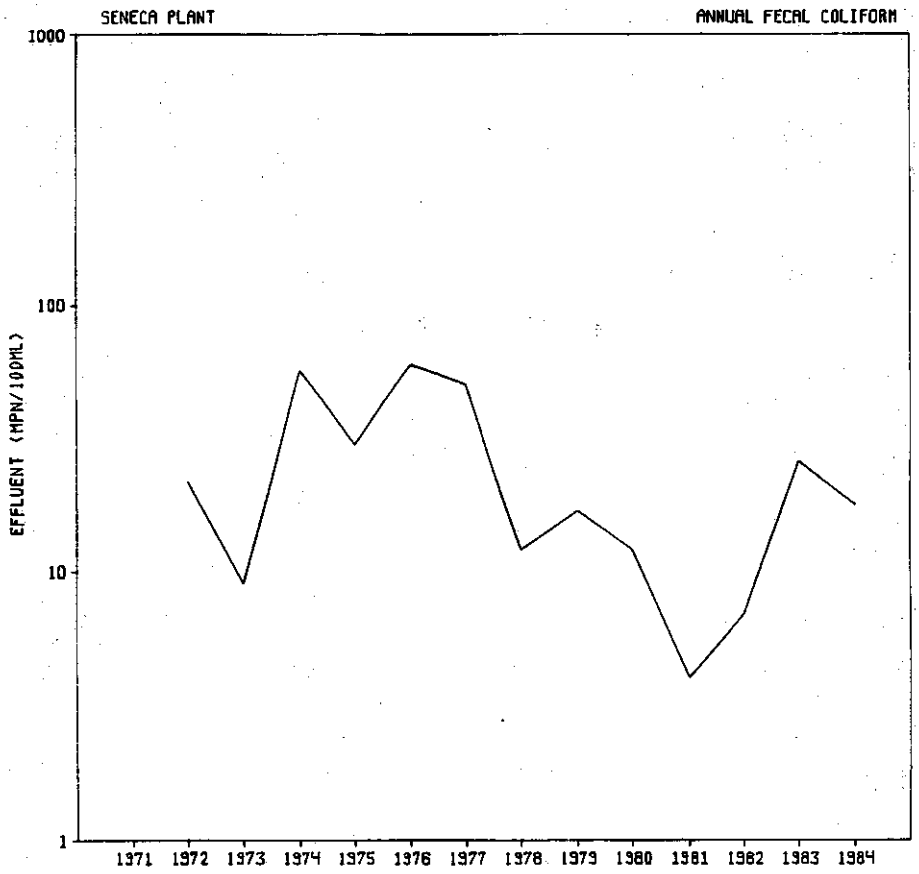
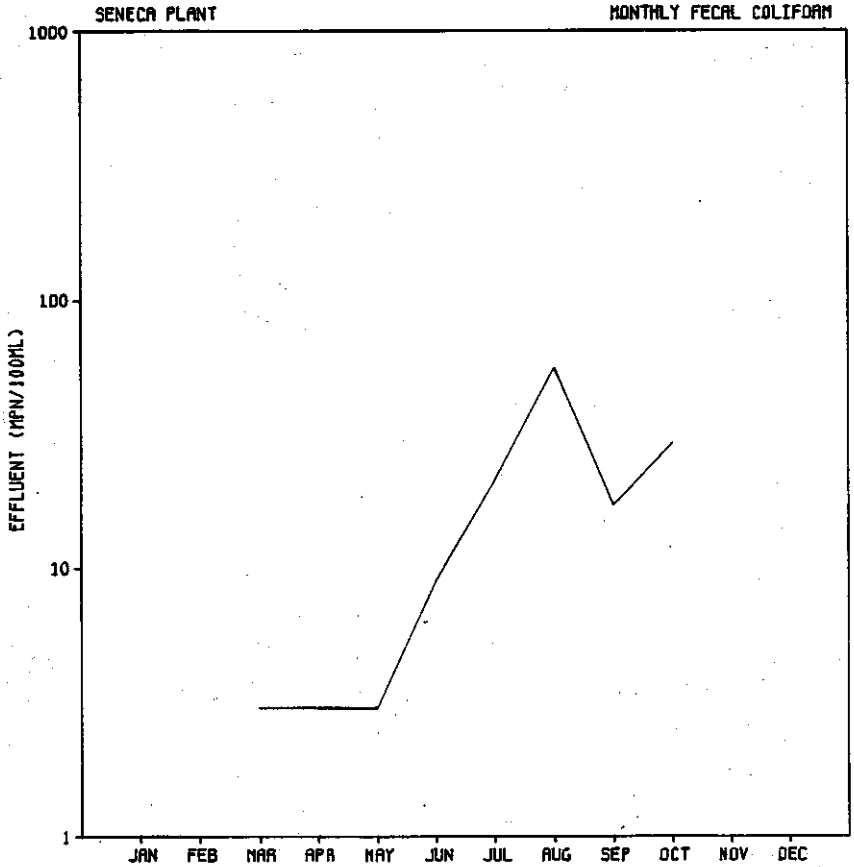
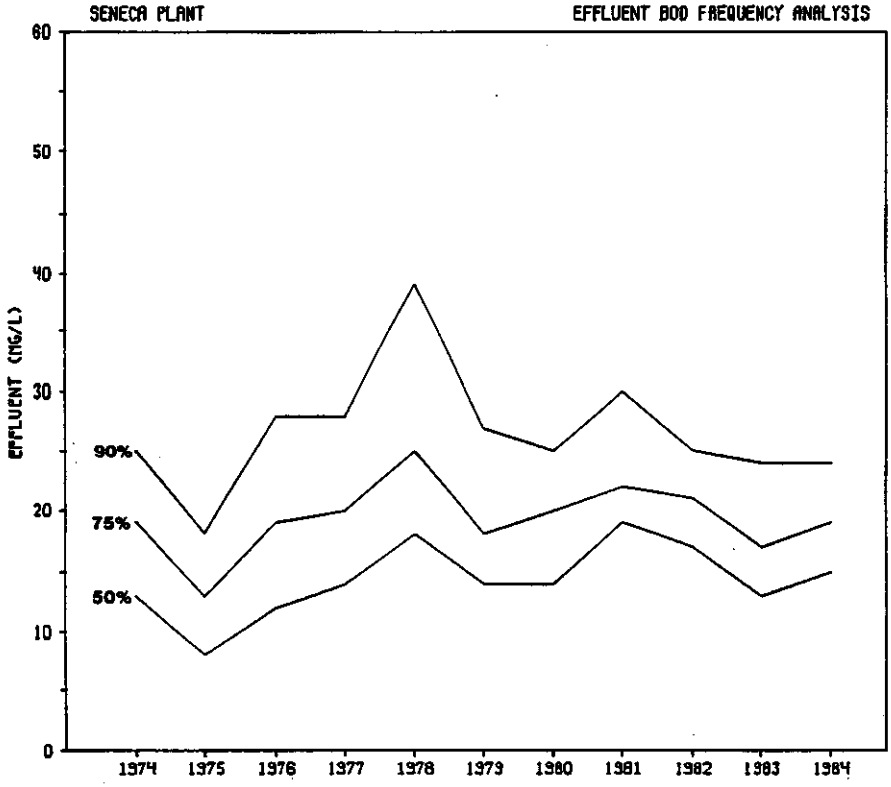
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

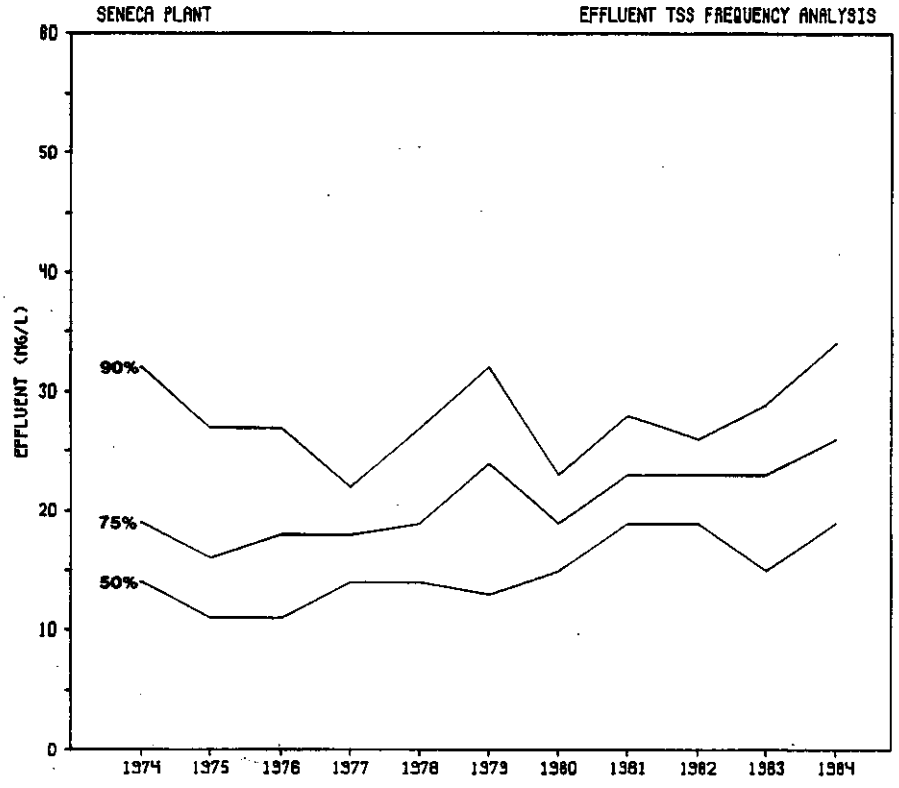

SENECA PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


SENECA PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


SENECA PLANT
ANNUAL FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


SENECA PLANT
MONTHLY FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


SENECA PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


SENECA PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

STILLWATER WASTEWATER TREATMENT PLANT

Plant History and Description

The Stillwater Plant was originally constructed in 1959 as a primary treatment plant. In 1970, the plant was upgraded to include secondary treatment and phosphorus removal facilities were added to the plant in 1973. The design capacity of the plant is 3.0 mgd. Actual operating capacity is somewhat less, due to the additional phosphorus removal facilities.

Liquid treatment consists of screening, grit removal, primary sedimentation, activated sludge aeration, alum addition for phosphorus removal, final clarification, chlorination, and discharge to Lake St. Croix (St. Croix River).

Solids processing consists of combined thickening in primary tanks, anaerobic digestion, and sludge hauling to either the Metropolitan Plant Interceptor System or sludge landspreading sites. The plant is presently operating at about 95 percent of its design capacity and is subject to secondary treatment limits and a phosphorus limit of 1 mg/L.

Performance

Plant flow averaged 2.95 mgd during 1984, slightly higher than 2.84 mgd in 1983. Average plant effluent quality was 8 mg/L BOD, 9 mg/L TSS and 0.4 mg/L P. Plant performance was excellent throughout the year, as no NPDES Permit violations were experienced. Statistical analysis of data show the following trend in BOD and TSS from 1981 through 1984.

Effluent Concentration, mg/l

	50% of Time				75% of Time				90% of Time			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
*BOD	14	10	9	7	24	12	12	10	33	14	18	13
TSS	8	8	10	8	12	10	14	10	15	12	20	13

*1982 through 1984 values represent CBOD.

Future

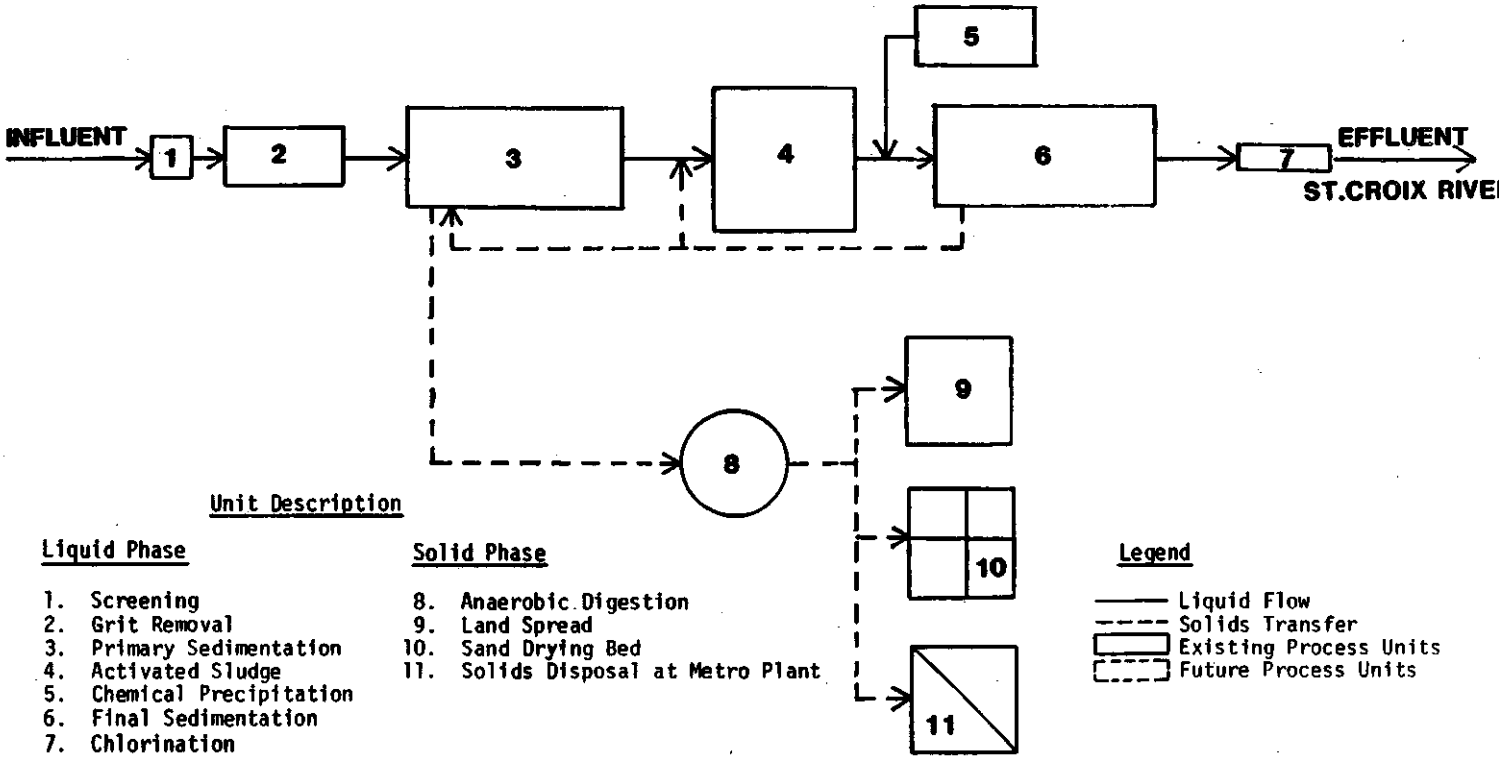
The Stillwater Plant is considered a permanent plant. The plant is expected to be expanded in the late 1980's to allow for the inclusion of flow from the City of Bayport and increased flow from the present service area.

STILLWATER PLANT PROCESS UNIT LOADINGS

Parameter	Annual Average			Maximum Month		
	1982	1983	1984	1982	1983	1984
Wastewater Flow, mgd	2.61	2.84	2.95	3.16	3.45	3.41
BOD Loading, lb/day	2,940	2,940	3,054	3,290	4,080	4,077
TSS Loading, lb/day	3,050	3,220	3,713	3,940	4,980	6,771
COD Loading, lb/day	5,350	5,720	6,454	5,920	7,280	9,272
Primary Sedimentation						
Detention Times, hr.	2.3	2.1	2.0	1.9	1.7	1.7
Weir Overflow Rate, gpd/lin. ft.	10,700	11,600	12,100	13,000	14,100	14,000
Surface Overflow Rate, gpd/sq. ft.	594	650	670	719	790	780
Aeration Basin						
BOD Loading, lb/day/1000 cu. ft.	54	43	45	61	61	60
Alum Feed Rate, gal/day	399	410	410	416	470	433
Final Sedimentation						
Detention Time, hr.	2.7	2.5	2.4	2.2	2.0	2.1
Weir Overflow Rate, gpd/lin. ft.	8,310	9,000	9,400	10,100	11,000	10,900
Surface Overflow Rate, gpd/sq. ft.	665	720	750	805	880	870
Chlorination						
Contact Time, minutes	36	33	32	30	27	28
Chlorine Use, lb/day	48	62	54	56	70	60
Anaerobic Digesters						
Solid Detention Time, days	27	36	28	24	27	21
Sludge Transport						
Volume, gpd	13,800	11,100	14,600	19,500	15,000	18,800
Mass, lb/day dry solids	3,090	2,600	3,400	4,220	4,000	4,300

STILLWATER WASTEWATER TREATMENT PLANT

FLOW DIAGRAM



Unit Description

Liquid Phase

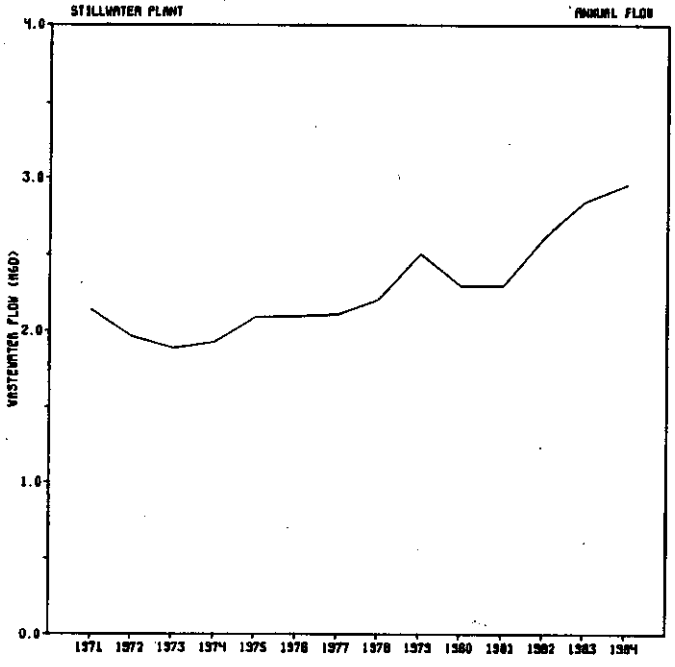
1. Screening
2. Grit Removal
3. Primary Sedimentation
4. Activated Sludge
5. Chemical Precipitation
6. Final Sedimentation
7. Chlorination

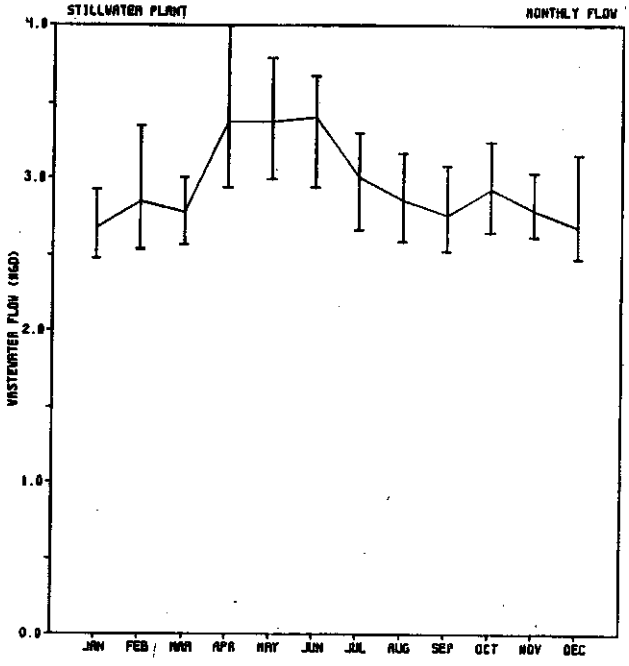
Solid Phase

8. Anaerobic Digestion
9. Land Spread
10. Sand Drying Bed
11. Solids Disposal at Metro Plant

Legend

- Liquid Flow
- Solids Transfer
- Existing Process Units
- Future Process Units





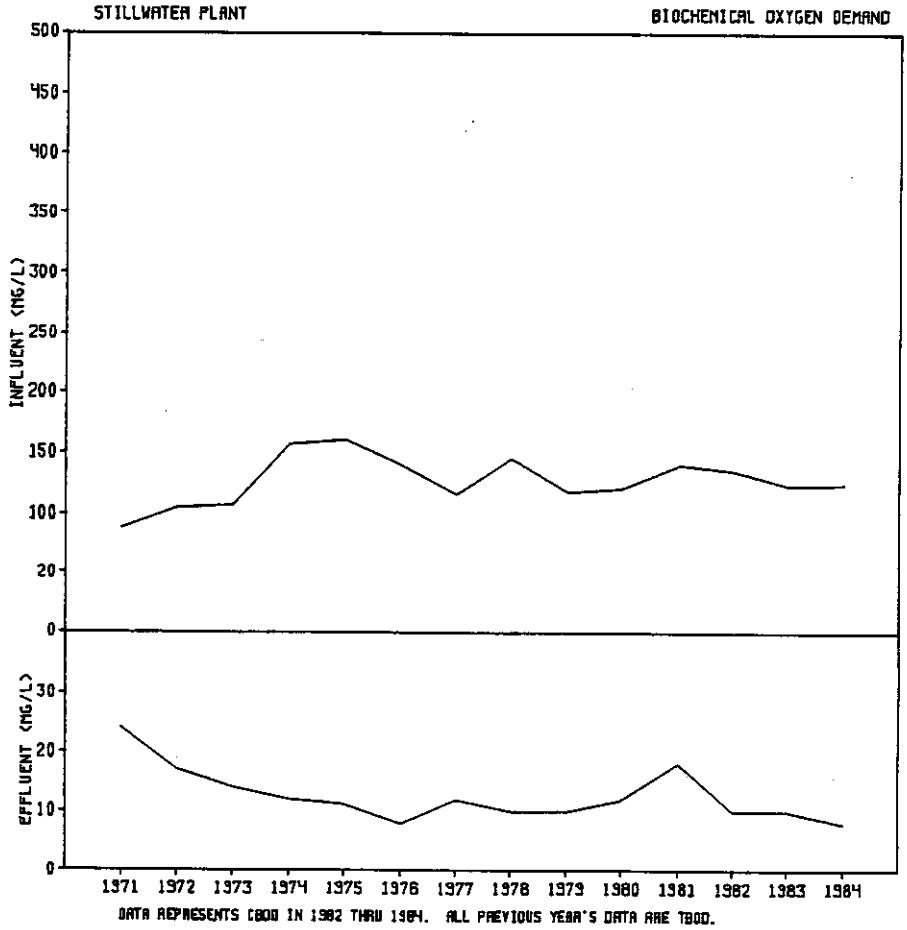
MONTHLY SUMMARY OF INFLUENT QUALITY
TREATMENT PLANT: Stillwater

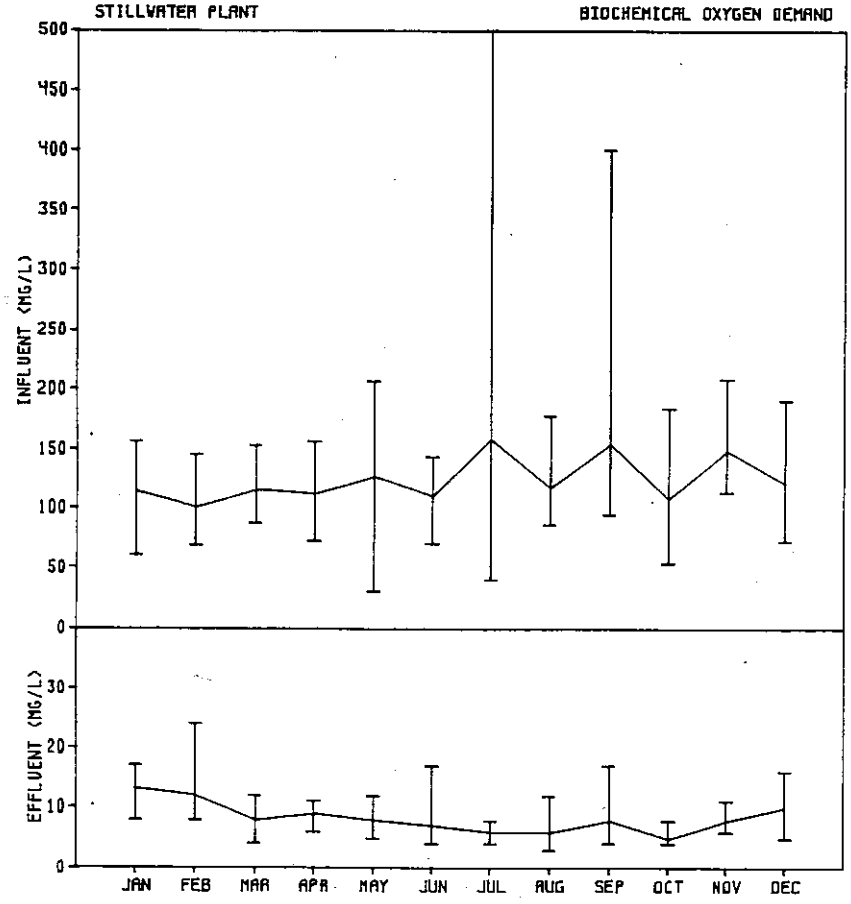
Month	Wastewater Flow, MGD	Temperature °C	TBOD mg/l	TSS mg/l	pH Range	KJN mg/l	Total-P mg/l	NH_3 mg/l	COD mg/l
JANUARY	2.67	11	114	114	6.6-8.2	24.6	4.8	14.1	213
FEBRUARY	2.84	10	100	120	6.4-8.4	20.1	4.8	9.8	203
MARCH	2.77	10	115	112	6.8-8.4	24.1	4.4	13.1	252
APRIL	3.38	11	112	142	6.8-8.7	20.3	4.2	11.4	259
MAY	3.38	11	127	140	6.8-8.4	21.0	4.3	9.5	257
JUNE	3.41	13	110	166	6.6-8.8	18.2	4.1	9.2	252
JULY	3.00	15	158	258	6.4-8.2	22.2	4.7	8.8	358
AUGUST	2.85	17	117	129	6.8-8.2	22.4	4.5	11.5	246
SEPTEMBER	2.75	15	154	193	6.9-7.6	23.3	5.5	9.6	313
OCTOBER	2.92	15	108	140	6.8-7.8	24.4	4.6	11.8	248
NOVEMBER	2.78	14	149	156	6.8-8.6	25.6	4.9	12.3	295
DECEMBER	2.68	12	121	115	4.0-9.6	22.9	4.4	14.1	233
1984 AVERAGE	2.95	13	125	150	4.0-9.6	22.6	4.6	11.2	262
1983 AVERAGE	2.84	13	124	137	6.2-8.4	22.8	4.7	11.9	243

MONTHLY SUMMARY OF EFFLUENT QUALITY
TREATMENT PLANT: Stillwater

Month	TBOD mg/l	CBOD mg/l	COD mg/l	TSS mg/l	FECAL COLI Geo Mean no/100 ml	TURB NTU	KJN mg/l	NH_3 mg/l	NO_2 mg/l	NO_3 mg/l	Total P mg/l	Cl2* Used lbs	Cl2 Res mg/l	DO mg/l	pH Range	% Removal BOD	% Removal TSS
NPDES LIMIT	25	25	--	30	200	25	----	----	----	----	1.0	--	---	---	6.5-8.5	--	--
JANUARY	16	13	43	12	---	5	16.4	12.6	0.37	2.06	0.4	--	---	5.1	6.9-7.1	88	89
FEBRUARY	14	12	50	12	---	4	13.5	9.1	0.61	2.10	0.5	22	0.4	5.3	6.9-7.0	88	90
MARCH	11	8	56	9	3	5	14.5	10.4	0.36	2.15	0.4	60	2.0	5.3	7.0-7.1	93	92
APRIL	15	9	36	9	3	4	13.1	10.3	0.17	1.08	0.3	58	1.9	5.1	6.9-7.2	92	94
MAY	12	8	42	8	6	4	13.4	8.3	0.34	1.56	0.3	50	1.7	4.7	7.0-7.1	94	94
JUNE	20	7	40	11	12	3	8.9	6.0	1.92	1.79	0.3	50	2.0	4.7	7.0-7.2	94	94
JULY	13	6	41	7	14	4	9.8	5.0	1.12	3.53	0.3	59	1.8	4.5	7.0-7.2	96	97
AUGUST	10	6	41	6	4	4	9.4	5.5	0.47	3.73	0.4	55	1.8	4.5	7.0-7.1	95	95
SEPTEMBER	12	8	33	8	8	5	9.5	5.1	0.51	4.02	0.5	50	1.5	4.4	6.9-7.1	95	96
OCTOBER	9	5	31	8	4	4	10.9	7.4	0.40	4.36	0.4	50	1.4	4.8	6.9-7.3	95	94
NOVEMBER	16	8	40	8	---	4	12.5	8.5	0.21	3.72	0.3	--	---	5.1	6.8-7.1	94	95
DECEMBER	18	10	48	13	---	6	12.1	8.7	0.21	4.18	0.4	--	---	4.7	6.9-7.1	92	89
1984 AVG.	14	8	41	9	7	4	12.0	8.0	0.56	2.86	0.4	54	1.8	4.8	6.8-7.3	93	93
1983 AVG.	16	10	44	12	25	5	14.1	10.9	0.93	1.67	0.6	61	2.0	4.8	6.8-7.2	92	91

*For disinfection only.


STILLWATER PLANT
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984
DATA REPRESENTS CBOD IN 1982 THRU 1984. ALL PREVIOUS YEAR'S DATA ARE TBOD.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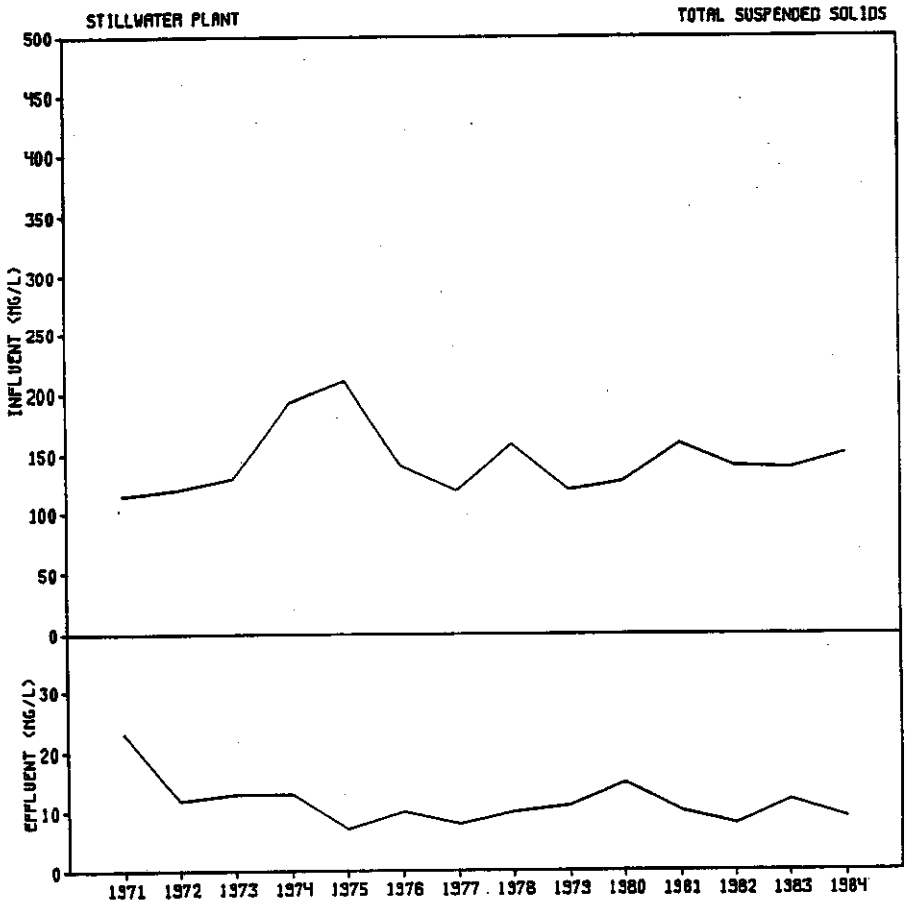
BIOCHEMICAL OXYGEN DEMAND
INFLUENT (MG/L)
EFFLUENT (MG/L)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC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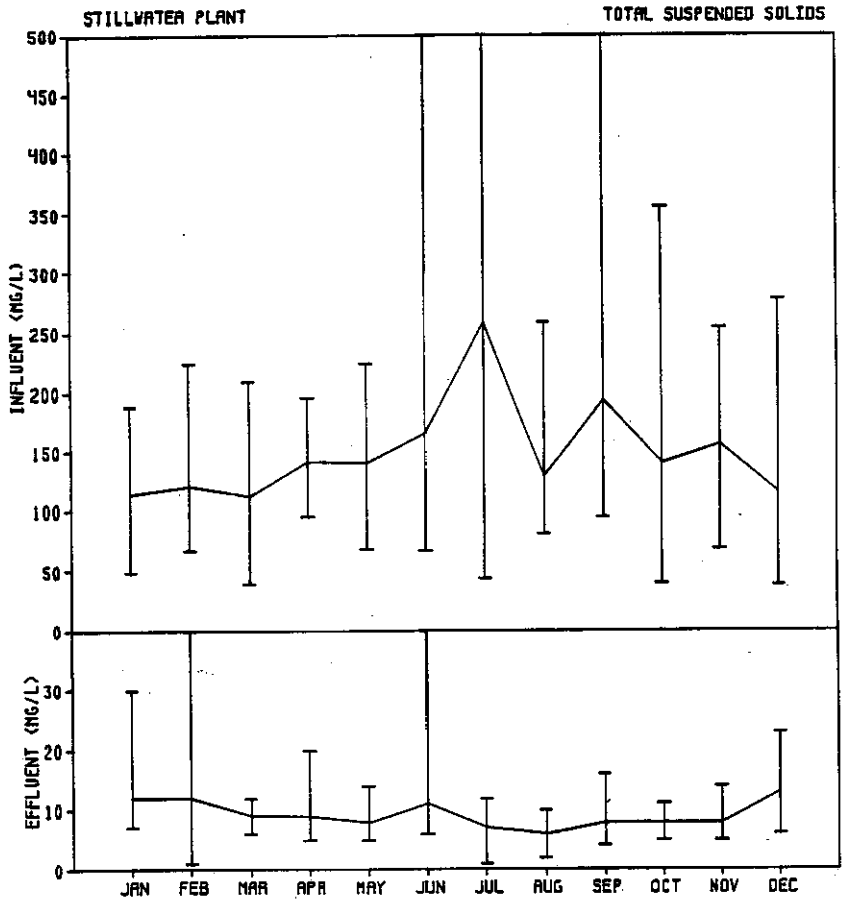
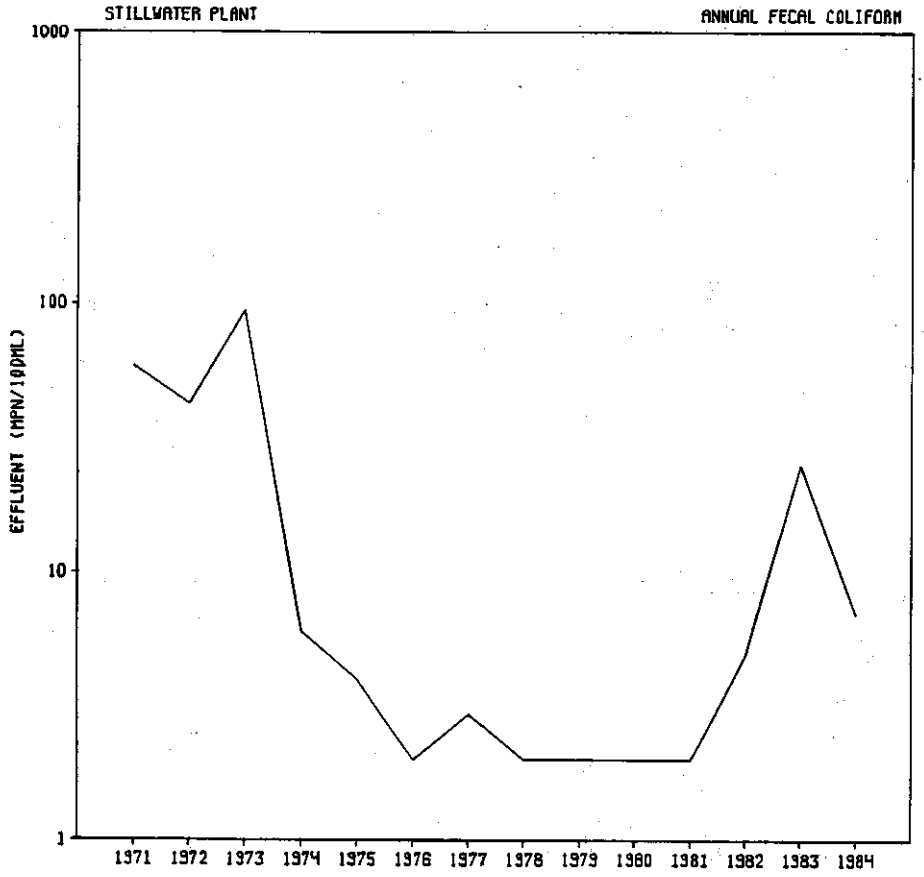
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


STILLWATER PLANT
TOTAL SUSPENDED SOLIDS
INFLUENT (MG/L)
500
450
400
350
300
250
200
150
100
50
0
EFFLUENT (MG/L)
30
20
10
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC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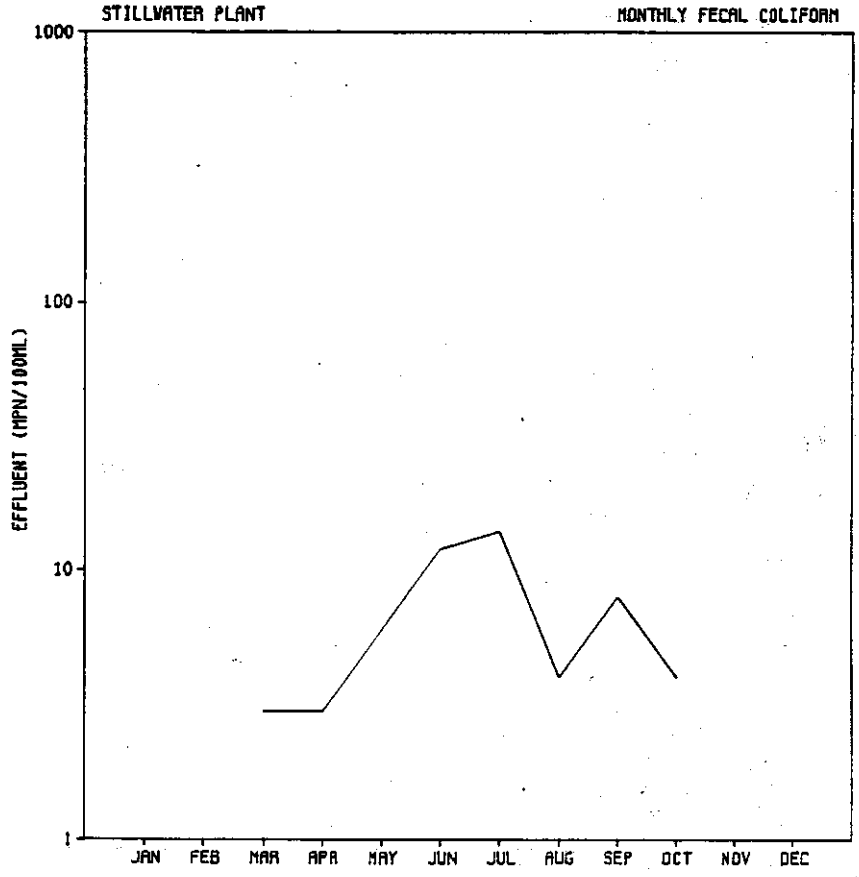
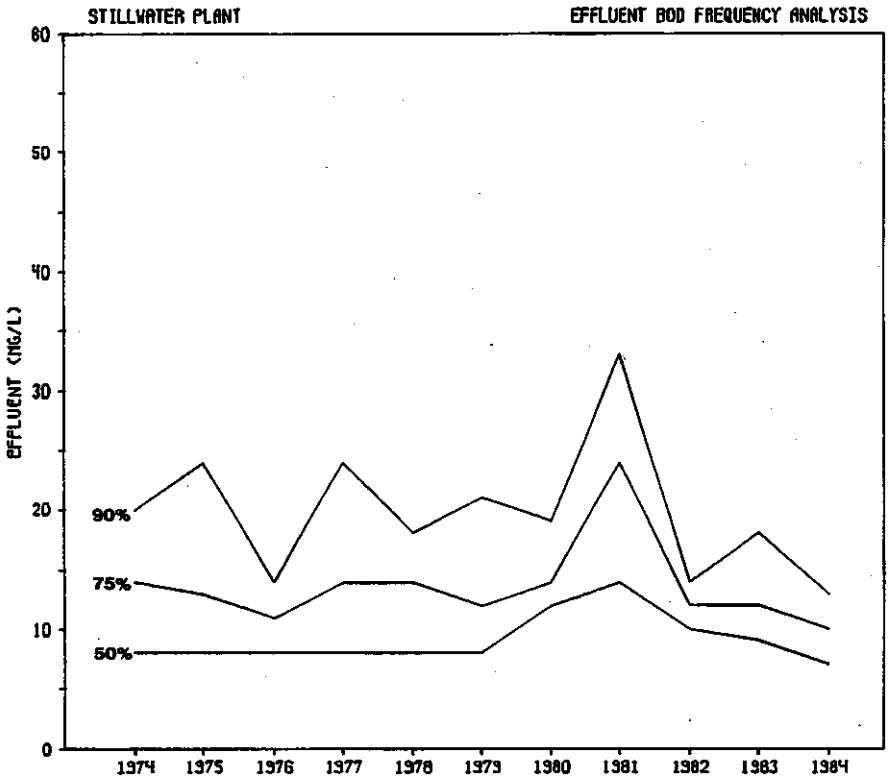
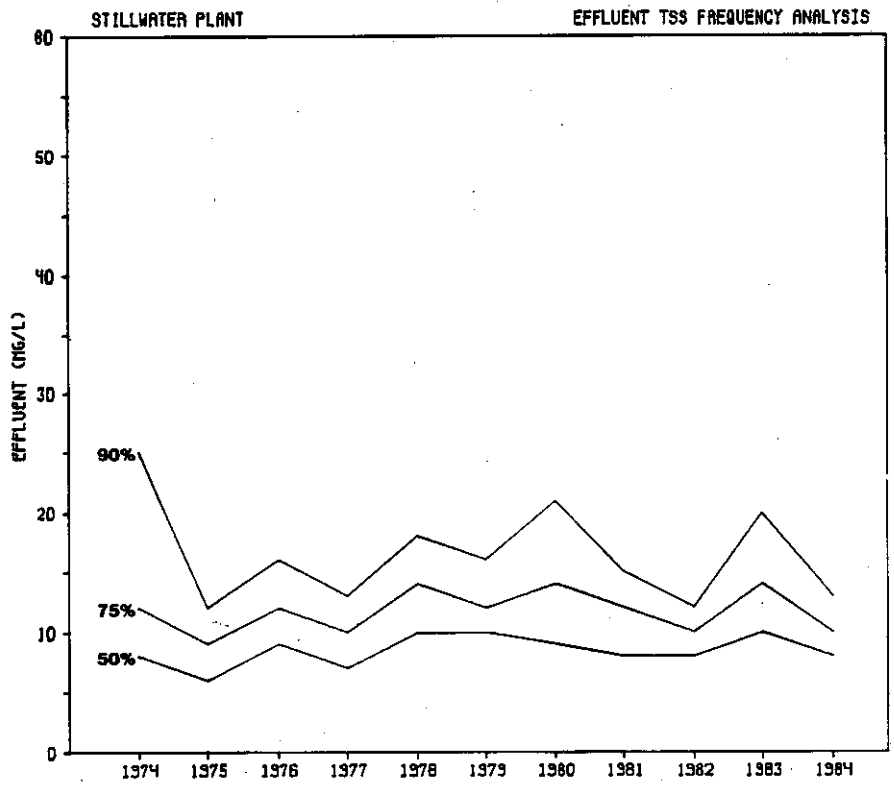
EFFLUENT (MPN/100ML)
1000
100
10
1
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984


STILLWATER PLANT
MONTHLY FECAL COLIFORM
EFFLUENT (MPN/100ML)
1000
100
10
1
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC


STILLWATER PLANT
EFFLUENT BOD FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


STILLWATER PLANT
EFFLUENT TSS FREQUENCY ANALYSIS
EFFLUENT (MG/L)
60
50
40
30
20
10
0
90%
75%
50%
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984

1984 EFFLUENT DATA
TREATMENT PLANT Stillwater

MONTH	Cu mg/l	Cr mg/l	Zn mg/l	Pb mg/l	Cd mg/l	Hg ug/l	CN mg/l	As ug/l	PCB ug/l	Ni mg/l	Phenol ug/l	Fe mg/l
January						<0.20						
February						<0.20						
March						<0.20						
April						<0.20						
May						<0.20						
June						<0.20						
July						<0.20						
August						-----						
September						<0.20						
October						<0.20						
November						<0.20						
December						<0.20						
1984 Avg.						<0.20						
1983 Avg.						<0.20						

APPENDIX

TABLE A-1

1984 ANNUAL AVERAGE
TREATMENT PLANT INFLUENT DATA

Treatment Plant	Flow mgd	Temp °C	TBOD mg/l	COD mg/l	TSS mg/l	pH Range	Nutrients Total P mg/l	Nutrients KJN mg/l	Nutrients NH3 mg/l
Anoka	2.49	19	184	381	150	6.5-8.8	7.2	34.1	15.7
Bayport	0.50	18	174	339	210	5.8-9.4	6.2	29.6	14.6
Blue Lake	19.5	14	177	434	204	4.3-9.4	6.1	27.8	10.7
Chaska	1.09	14	115	263	148	3.0-10.0	4.2	31.2	16.1
Cottage Grove	1.30	15	180	389	158	7.2-8.5	6.8	40.6	22.8
Empire	5.19	15	193	387	189	5.9-10.5	9.1	32.9	14.3
Hastings	1.64	17	196	472	196	4.4-11.2	10.6	45.7	23.1
Maple Plain	0.40	13	116	279	195	7.2-7.8	4.2	25.8	10.6
Medina	0.278	14	103	241	131	7.3-7.7	3.8	26.2	10.0
Metropolitan	222	16	176	379	198	5.6-9.7	4.0	22.8	10.3
Rosemount	0.37	14	127	322	129	6.7-9.0	6.4	40.6	22.9
Savage	0.62	14	104	249	165	0.0-13.4*	9.1	22.6	12.5
Seneca	17.6	17	207	449	205	4.9-8.6	7.2	34.8	17.8
Stillwater	2.95	13	125	262	150	4.0-9.6	4.6	22.6	11.2

*Minimum pH 0.0 as reported on Operator's Report.

TABLE A-2

ANNUAL AVERAGE FLOW DATA
FOR THE PERIOD 1971-1984

Treatment Plant	ANNUAL AVERAGE FLOW (MGD)													
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ANOKA	1.76	1.93	1.88	1.78	1.62	1.77	1.92	2.01	1.98	2.09	2.01	2.14	2.33	2.49
APPLE VALLEY	0.57	0.71	1.16	1.26	1.48	1.46	1.67	1.94	2.03	*---	----	----	----	----
BAYPORT	0.48	0.48	0.42	0.45	0.56	0.50	0.48	0.47	0.54	0.44	0.47	0.52	0.54	0.50
BLUE LAKE (POND)	1.43	2.96	3.74	----	-----	-----	-----	-----	----	----	----	----	----	----
BLUE LAKE	----	----	3.94	6.78	9.05	9.03	9.86	12.49	14.1	14.1	13.7	16.1	18.1	19.5
BURNSVILLE	1.76	2.10	*----	----	-----	-----	-----	-----	----	----	----	----	----	----
CHASKA	0.53	0.58	0.74	0.75	0.91	0.81	0.75	0.97	0.89	0.64	0.70	0.80	1.02	1.09
CHANHASSEN	0.07	*---	-----	----	-----	-----	-----	-----	----	----	----	----	----	----
COTTAGE GROVE	0.62	0.85	0.92	0.91	0.91	0.91	0.97	1.31	1.60	1.58	1.21	1.26	1.30	1.30
**EAGAN TOWNSHIP	-----	----	*----	----	-----	-----	-----	-----	----	----	----	----	----	----
EMPIRE	-----	----	-----	----	-----	-----	-----	-----	3.54	3.48	3.51	4.05	4.81	5.19
EXCELSIOR	0.56	0.50	*----	----	-----	-----	-----	-----	----	----	----	----	----	----
FARMINGTON	0.35	0.30	0.40	0.35	0.59	0.37	0.35	0.52	0.78	*---	----	----	----	----
FOREST LAKE TOWNSHIP	0.16	0.17	*----	----	-----	-----	-----	-----	----	----	----	----	----	----
FOREST LAKE VILLAGE	0.23	0.25	*----	----	-----	-----	-----	-----	----	----	----	----	----	----
HASTINGS	0.91	1.14	1.32	1.29	1.29	1.30	1.40	1.42	1.35	1.44	1.50	1.50	1.65	1.64
INVER GROVE HEIGHTS	0.59	0.64	*----	----	-----	-----	-----	-----	----	----	----	----	----	----
LAKEVILLE	0.45	0.36	0.33	0.37	0.50	0.38	0.36	0.48	0.60	*---	----	----	----	----
LONG LAKE	0.18	0.17	0.15	0.20	0.23	0.19	0.21	0.30	0.32	0.28	*---	----	----	----
MAPLE PLAIN	0.22	0.28	0.22	0.24	0.33	0.22	0.18	0.26	0.27	0.20	0.25	0.35	0.35	0.40
MEDINA	0.07	0.09	0.07	0.08	0.09	0.07	0.08	0.14	0.12	0.10	0.10	0.15	0.18	0.28
METROPOLITAN	213	213	202	196	202	196	194	210	217	206	202	208	225	222
MOUND	1.09	1.23	1.26	1.48	*----	-----	-----	-----	----	----	----	----	----	----
NEWPORT	0.18	0.17	0.18	0.17	0.21	*----	-----	-----	----	----	----	----	----	----
OAK PARK HEIGHTS	0.07	0.10	0.12	*---	-----	-----	-----	-----	----	----	----	----	----	----
ORONO	0.20	0.25	0.27	0.34	0.32	0.31	0.34	0.46	0.49	0.62	*---	----	----	----
PRIOR LAKE	0.10	0.12	0.13	0.17	0.31	0.44	0.10	0.01	*---	----	----	----	----	----
ROSEMOUNT (trickling filter)	0.10	0.11	0.12	*---	-----	-----	-----	-----	----	----	----	----	----	----
ROSEMOUNT AWTP	-----	----	0.20	0.20	0.22	0.24	0.27	0.29	0.30	0.29	0.30	0.31	0.34	0.37
ST. PAUL PARK	0.30	0.31	0.30	0.28	0.36	*----	----	-----	----	----	----	----	----	----
SAVAGE	0.31	0.33	0.29	0.38	0.42	0.38	0.39	0.37	0.44	0.38	0.40	0.48	0.59	0.62
SENECA	-----	7.76	10.12	9.89	10.34	10.81	11.72	12.71	13.6	13.0	13.8	14.7	15.8	17.6
SHAKOPEE	1.24	*---	-----	----	-----	-----	-----	-----	----	----	----	----	----	----
SOUTH ST. PAUL	10.10	9.38	9.66	9.72	*----	-----	-----	-----	----	----	----	----	----	----
STILLWATER	2.14	1.96	1.88	1.92	2.09	2.10	2.11	2.21	2.51	2.30	2.31	2.61	2.84	2.95
**VICTORIA	-----	----	-----	*---	-----	-----	-----	-----	----	----	----	----	----	----
WACONIA	-----	----	-----	----	0.23	0.26	0.25	*----	----	----	----	----	----	----
WAYZATA	0.53	*---	-----	----	-----	-----	-----	-----	----	----	----	----	----	----
ALL PLANTS EXCEPT METRO	26	31	36	39	32	32	33	39	45	41	40	45	50	54
ALL PLANTS	239	244	238	235	234	228	227	249	262	247	242	253	275	276

* Plant phased out during previous year.
**Flow data not available.

TABLE A-3

ANNUAL AVERAGE EFFLUENT CONCENTRATIONS
FOR THE PERIOD 1971-1984

Treatment Plant	ANNUAL AVERAGE BOD (MG/L)													
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982**	1983**	1984**
ANOKA	20	29	36	21	16	11	9	12	14	14	16	12	11	13
APPLE VALLEY	74	113	22	24	7	7	6	12	23	*--	---	---	---	---
BAYPORT	27	40	32	9	15	14	11	8	7	7	8	8	6	6
BLUE LAKE (POND)	31	31	39	---	---	---	---	---	---	---	---	---	---	---
BLUE LAKE	---	---	12	18	15	15	13	13	9	9	12	10	9	9
BURNSVILLE	40	55	*--	---	---	---	---	---	---	---	---	---	---	---
CHASKA	36	49	52	58	43	42	44	78	112	20	18	14	11	9
CHANHASSEN	84	*--	---	---	---	---	---	---	---	---	---	---	---	---
COTTAGE GROVE	53	52	60	36	25	55	39	34	19	11	12	10	9	9
EAGAN TOWNSHIP	50	52	*--	---	---	---	---	---	---	---	---	---	---	---
EMPIRE	---	---	---	---	---	---	---	---	10	3	3	2	3	2
EXCELSIOR	13	26	*--	---	---	---	---	---	---	---	---	---	---	---
FARMINGTON	39	52	46	85	64	29	76	31	52	*--	---	---	---	---
FOREST LAKE TOWNSHIP	8	35	*--	---	---	---	---	---	---	---	---	---	---	---
FOREST LAKE VILLAGE	77	114	*--	---	---	---	---	---	---	---	---	---	---	---
HASTINGS	12	7	15	34	15	12	16	18	18	18	20	20	16	22
INVER GROVE HEIGHTS	76	110	*--	---	---	---	---	---	---	---	---	---	---	---
LAKEVILLE	36	33	34	25	28	34	51	67	65	*--	---	---	---	---
LONG LAKE	53	24	18	35	40	41	43	42	43	58	*--	---	---	---
MAPLE PLAIN	12	11	13	10	9	8	11	11	18	20	12	13	9	10
MEDINA	12	9	14	10	13	14	25	22	22	22	26	14	10	10
METROPOLITAN	84	72	46	42	41	67	42	39	43	23	19	13	10	10
MOUND	24	35	53	98	*--	---	---	---	---	---	---	---	---	---
NEWPORT	48	88	58	47	49	*--	---	---	---	---	---	---	---	---
OAK PARK HEIGHTS	39	32	48	*--	---	---	---	---	---	---	---	---	---	---
ORONO	15	10	10	6	6	8	12	24	18	31	*--	---	---	---
PRIOR LAKE	34	26	28	22	24	35	22	24	*--	---	---	---	---	---
ROSEMOUNT (trickling filter)	36	68	76	*--	---	---	---	---	---	---	---	---	---	---
ROSEMOUNT AWTP	---	---	7	23	16	14	14	13	13	12	14	16	16	18
ST. PAUL PARK	66	93	52	51	63	*--	---	---	---	---	---	---	---	---
SAVAGE	22	26	28	27	21	20	46	27	27	7	10	8	8	7
SENECA	---	29	16	15	11	15	16	21	16	16	20	18	14	17
SHAKOPEE	355	*--	---	---	---	---	---	---	---	---	---	---	---	---
SOUTH ST. PAUL	60	42	31	46	*--	---	---	---	---	---	---	---	---	---
STILLWATER	24	17	14	12	11	8	12	10	10	12	18	10	10	8
VICTORIA	73	52	70	*--	---	---	---	---	---	---	---	---	---	---
WACONIA	---	---	---	---	17	62	52	31	*--	---	---	---	---	---
WAYZATA	41	*--	---	---	---	---	---	---	---	---	---	---	---	---
ALL PLANTS EXCEPT METRO (weighted avg.)	52	38	27	26	16	17	17	19	17	12	15	13	10	11
ALL PLANTS (weighted average)	81	67	43	40	38	60	38	36	39	21	18	12	10	10
ALL PLANTS EXCEPT METRO (actual average)	50	45	34	32	24	23	27	26	28	17	15	12	10	11
ALL PLANTS (actual average)	51	46	34	33	25	26	28	27	28	18	15	12	10	11

* Plant phased out during previous year.
**$CBOD_5$ values listed for 1982, 1983, and 1984.

TABLE A-4

ANNUAL AVERAGE EFFLUENT CONCENTRATIONS
FOR THE PERIOD 1971-1984

Treatment Plant	ANNUAL AVERAGE TSS (MG/L)													
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ANOKA	24	36	40	19	13	15	14	16	12	11	14	8	10	11
APPLE VALLEY	93	148	16	14	5	5	3	6	10	*--	---	---	---	---
BAYPORT	22	43	28	15	10	8	10	8	8	7	7	8	6	8
BLUE LAKE (POND)	34	58	45	---	---	---	---	---	---	---	---	---	---	---
BLUE LAKE	---	---	22	21	14	19	13	14	12	9	6	7	7	7
BURNSVILLE	60	86	*--	---	---	---	---	---	---	---	---	---	---	---
CHASKA	72	86	79	91	62	55	54	66	59	12	13	11	11	11
CHANHASSEN	71	*--	---	---	---	---	---	---	---	---	---	---	---	---
COTTAGE GROVE	63	70	93	84	36	25	23	28	14	8	7	7	11	9
EAGAN TOWNSHIP	60	69	*--	---	---	---	---	---	---	---	---	---	---	---
EMPIRE	---	---	---	---	---	---	---	---	5	2	2	1	1	2
EXCELSIOR	13	36	*--	---	---	---	---	---	---	---	---	---	---	---
FARMINGTON	70	77	54	75	29	23	34	34	37	*--	---	---	---	---
FOREST LAKE TOWNSHIP	11	24	*--	---	---	---	---	---	---	---	---	---	---	---
FOREST LAKE VILLAGE	105	163	*--	---	---	---	---	---	---	---	---	---	---	---
HASTINGS	10	10	18	26	20	21	18	20	19	23	22	31	23	32
INVER GROVE HEIGHTS	139	174	*--	---	---	---	---	---	---	---	---	---	---	---
LAKEVILLE	47	36	36	30	33	39	53	68	71	*--	---	---	---	---
LONG LAKE	35	47	23	50	39	48	37	30	26	43	*--	---	---	---
MAPLE PLAIN	20	13	13	19	12	16	16	10	13	14	9	7	9	10
MEDINA	11	15	16	13	13	15	20	18	19	25	18	14	14	16
METROPOLITAN	72	54	37	43	40	60	49	43	64	26	19	11	9	11
MOUND	37	36	47	38	*--	---	---	---	---	---	---	---	---	---
NEWPORT	85	120	96	110	89	*--	---	---	---	---	---	---	---	---
OAK PARK HEIGHTS	36	47	85	*--	---	---	---	---	---	---	---	---	---	---
ORONO	19	15	10	10	11	17	21	32	23	43	*--	---	---	---
PRIOR LAKE	28	33	27	25	25	28	17	17	*--	---	---	---	---	---
ROSEMOUNT (trickling filter)	51	63	58	*--	---	---	---	---	---	---	---	---	---	---
ROSEMOUNT AWTP	---	---	2	9	4	3	3	4	3	2	2	2	2	3
ST. PAUL PARK	69	77	47	48	47	*--	---	---	---	---	---	---	---	---
SAVAGE	24	28	14	15	13	10	14	15	14	7	8	4	3	3
SENECA	---	29	17	19	16	15	15	17	20	16	20	19	18	21
SHAKOPEE	146	*--	---	---	---	---	---	---	---	---	---	---	---	---
SOUTH ST. PAUL	38	22	22	31	*--	---	---	---	---	---	---	---	---	---
STILLWATER	23	12	13	13	7	10	8	10	11	15	10	8	12	9
VICTORIA	59	45	52	*--	---	---	---	---	---	---	---	---	---	---
WACONIA	---	---	---	---	33	53	42	40	*--	---	---	---	---	---
WAYZATA	34	*--	---	---	---	---	---	---	---	---	---	---	---	---
ALL PLANTS EXCEPT METRO (weighted avg.)	44	38	27	26	17	18	15	18	16	12	14	11	11	12
ALL PLANTS (weighted average)	69	52	36	40	37	54	44	38	56	24	18	11	9	11
ALL PLANTS EXCEPT METRO (actual average)	50	57	37	35	25	22	22	24	21	16	11	10	10	11
ALL PLANTS (actual average)	51	57	37	36	26	24	23	25	23	16	12	10	10	11

* Plant phased out during previous year.

TABLE A-5

ANNUAL AVERAGE EFFLUENT PERCENT REMOVAL
EFFICIENCY FOR THE PERIOD 1971-1984

Treatment Plant	ANNUAL AVERAGE BOD REMOVAL (%)													
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ANOKA	89	87	85	91	92	94	95	94	93	92	92	95	94	93
APPLE VALLEY	65	52	90	89	97	96	97	94	88	*--	--	--	--	--
BAYPORT	88	86	86	97	95	95	95	96	96	96	96	95	96	97
BLUE LAKE (POND)	87	92	88	--	--	--	--	--	--	--	--	--	--	--
BLUE LAKE	--	--	96	94	94	95	95	95	96	96	95	95	96	95
BURNSVILLE	74	69	*--	--	--	--	--	--	--	--	--	--	--	--
CHASKA	79	75	74	69	81	83	78	61	57	91	92	93	92	92
CHANHASSEN	70	*--	--	--	--	--	--	--	--	--	--	--	--	--
COTTAGE GROVE	81	80	76	85	89	72	81	83	89	94	94	95	95	95
EAGAN TOWNSHIP	75	69	*--	--	--	--	--	--	--	--	--	--	--	--
EMPIRE	--	--	--	--	--	--	--	--	95	98	99	99	99	99
EXCELSIOR	92	91	*--	--	--	--	--	--	--	--	--	--	--	--
FARMINGTON	86	87	86	91	86	94	83	91	82	*--	--	--	--	--
FOREST LAKE TOWNSHIP	--	--	*--	--	--	--	--	--	--	--	--	--	--	--
FOREST LAKE VILLAGE	51	40	*--	--	--	--	--	--	--	--	--	--	--	--
HASTINGS	96	97	92	81	91	94	92	93	92	91	91	92	93	89
INVER GROVE HEIGHTS	66	51	*--	--	--	--	--	--	--	--	--	--	--	--
LAKEVILLE	75	78	84	94	92	94	88	77	75	*--	--	--	--	--
LONG LAKE	75	86	93	86	73	78	79	74	74	61	*--	--	--	--
MAPLE PLAIN	90	86	93	95	89	94	93	92	89	88	93	90	92	91
MEDINA	92	90	90	92	92	94	86	93	82	84	80	87	91	89
METROPOLITAN	66	73	82	84	83	75	83	82	79	89	91	95	94	94
MOUND	82	79	75	52	*--	--	--	--	--	--	--	--	--	--
NEWPORT	79	64	72	78	71	*--	--	--	--	--	--	--	--	--
OAK PARK HEIGHTS	85	88	83	*--	--	--	--	--	--	--	--	--	--	--
ORONO	88	93	94	96	94	93	91	79	82	68	*--	--	--	--
PRIOR LAKE	82	78	80	80	77	68	71	78	*--	--	--	--	--	--
ROSEMOUNT (trickling filter)	74	72	65	*--	--	--	--	--	--	--	--	--	--	--
ROSEMOUNT AWTP	--	--	90	91	92	94	93	93	93	93	92	90	90	86
ST. PAUL PARK	88	66	79	78	72	*--	--	--	--	--	--	--	--	--
SAVAGE	84	88	84	85	88	88	84	85	79	95	93	94	93	93
SENECA	--	88	94	94	95	94	93	92	93	92	91	92	94	92
SHAKOPEE	11	*--	--	--	--	--	--	--	--	--	--	--	--	--
SOUTH ST. PAUL	88	92	90	87	*--	--	--	--	--	--	--	--	--	--
STILLWATER	73	84	87	92	93	94	90	93	92	90	87	93	92	93
VICTORIA	57	68	66	*--	--	--	--	--	--	--	--	--	--	--
WACONIA	--	--	--	--	90	90	85	90	*--	--	--	--	--	--
WAYZATA	78	*--	--	--	--	--	--	--	--	--	--	--	--	--
ALL PLANTS EXCEPT METRO (weighted avg.)	83	85	89	90	93	93	93	92	92	94	93	94	95	94
ALL PLANTS (weighted average)	68	75	83	85	84	77	84	84	81	90	91	94	94	94
ALL PLANTS EXCEPT METRO (actual average)	77	78	84	86	88	89	88	87	86	89	92	94	94	93
ALL PLANTS (actual average)	77	78	84	86	88	89	88	87	86	89	92	94	94	93

* Plant phased out during previous year.

TABLE A-6

ANNUAL AVERAGE EFFLUENT PERCENT REMOVAL
EFFICIENCY FOR THE PERIOD 1971-1984

Treatment Plant	ANNUAL AVERAGE TSS REMOVAL (%)													
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ANOKA	90	88	85	94	94	92	92	90	91	92	91	95	94	93
APPLE VALLEY	64	55	95	96	98	98	99	98	96	*--	--	--	---	--
BAYPORT	90	84	86	95	97	96	93	94	95	96	96	94	96	96
BLUE LAKE (POND)	78	66	75	--	--	--	--	--	--	--	--	--	--	--
BLUE LAKE	--	--	91	94	96	95	96	96	96	96	98	97	97	97
BURNSVILLE	75	72	*--	--	--	--	--	--	--	--	--	--	--	--
CHASKA	66	54	57	53	73	81	70	63	70	93	93	93	91	93
CHANHASSEN	75	*--	--	--	--	--	--	--	--	--	--	--	--	--
COTTAGE GROVE	82	78	66	71	85	86	90	86	91	95	96	96	93	94
EAGAN TOWNSHIP	72	61	*--	--	--	--	--	--	--	--	--	--	--	--
EMPIRE	--	--	--	--	--	--	--	--	98	99	99	99	99	99
EXCELSIOR	93	80	*--	--	--	--	--	--	--	--	--	--	--	--
FARMINGTON	73	74	76	79	88	90	86	82	75	*--	--	--	--	--
FOREST LAKE TOWNSHIP	--	--	*--	--	--	--	--	--	--	--	--	--	--	--
FOREST LAKE VILLAGE	41	37	*--	--	--	--	--	--	--	--	--	--	--	--
HASTINGS	97	97	92	87	90	90	90	92	91	90	91	87	87	83
INVER GROVE HEIGHTS	42	31	*--	--	--	--	--	--	--	--	--	--	--	--
LAKEVILLE	73	83	89	96	97	96	93	82	81	*--	--	--	--	--
LONG LAKE	83	84	92	89	79	82	86	85	88	79	*--	--	--	--
MAPLE PLAIN	68	79	89	90	86	88	91	96	94	93	95	94	93	93
MEDINA	92	88	88	91	91	96	88	96	91	83	86	88	89	86
METROPOLITAN	77	83	88	86	87	82	83	81	71	89	92	95	95	95
MOUND	80	82	74	80	*--	--	--	--	--	--	--	--	--	--
NEWPORT	66	50	56	56	51	*--	--	--	--	--	--	--	--	--
OAK PARK HEIGHTS	85	81	71	*--	--	--	--	--	--	--	--	--	--	--
ORONO	86	91	94	96	93	88	88	81	84	72	*--	--	--	--
PRIOR LAKE	89	82	86	80	86	80	80	88	*--	--	--	--	--	--
ROSEMOUNT (trickling filter)	72	87	83	*--	--	--	--	--	--	--	--	--	--	--
ROSEMOUNT AWTP	--	--	96	96	98	99	99	98	99	99	99	99	99	98
ST. PAUL PARK	78	75	83	82	80	*--	--	--	--	--	--	--	--	--
SAVAGE	91	96	95	94	95	95	94	94	93	99	97	97	98	98
SENECA	--	88	93	94	94	93	93	93	90	91	91	90	91	90
SHAKOPEE	38	*--	--	--	--	--	--	--	--	--	--	--	--	--
SOUTH ST. PAUL	93	94	93	92	*--	--	--	--	--	--	--	--	--	--
STILLWATER	80	90	90	93	97	93	93	94	91	88	94	94	91	93
VICTORIA	62	69	72	*--	--	--	--	--	--	--	--	--	--	--
WACONIA	--	--	--	--	82	86	84	89	*--	--	--	--	--	--
WAYZATA	72	*--	--	--	--	--	--	--	--	--	--	--	--	--
ALL PLANTS EXCEPT METRO (weighted avg.)	82	83	88	93	94	93	94	93	93	94	94	95	94	94
ALL PLANTS (weighted average)	78	83	88	87	88	83	84	84	75	90	92	95	95	95
ALL PLANTS EXCEPT METRO (actual average)	76	76	83	86	88	91	90	89	90	91	94	95	94	93
ALL PLANTS (actual average)	76	76	84	86	88	90	89	89	89	91	94	95	94	93

* Plant phased out during previous year.

TABLE A-7

INFLUENT BOD DATA 1971-1984

Treatment Plant	ANNUAL AVERAGE VALUES, BOD (MG/L)													
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ANOKA	182	223	240	237	189	170	175	199	206	176	211	223	193	184
APPLE VALLEY	211	235	220	228	204	189	228	216	194	*--	---	---	---	---
BAYPORT	225	286	229	282	330	270	228	200	198	197	184	161	158	174
BLUE LAKE	---	---	300	304	271	282	258	266	216	228	230	228	194	177
CHASKA	171	196	200	185	222	241	203	200	258	220	229	189	141	115
COTTAGE GROVE	279	260	250	234	222	197	209	198	172	171	204	208	181	180
EMPIRE	---	---	---	---	---	---	---	---	208	181	234	204	217	193
FARMINGTON	279	400	329	957	453	452	447	338	293	*--	---	---	---	---
HASTINGS	300	233	188	175	161	187	189	243	221	210	227	251	230	196
LAKEVILLE	144	150	213	426	373	570	432	290	257	*--	---	---	---	---
LONG LAKE	212	171	257	258	150	183	201	163	164	148	*--	---	---	---
MAPLE PLAIN	120	79	186	186	80	129	156	142	165	173	165	146	125	116
MEDINA	150	90	140	124	156	246	285	300	119	139	128	122	133	103
METROPOLITAN	247	267	256	256	241	266	246	215	205	215	208	203	174	176
NEWPORT	229	244	207	217	170	*--	---	---	---	---	---	---	---	---
ORONO	125	143	167	158	105	110	141	116	102	98	*--	---	---	---
PRIOR LAKE	189	118	140	111	104	110	76	103	*--	---	---	---	---	---
ROSEMOUNT	---	---	70	246	213	220	203	198	193	165	177	168	159	127
ST. PAUL PARK	550	274	248	227	224	*--	---	---	---	---	---	---	---	---
SAVAGE	138	217	175	184	191	163	283	179	130	151	153	151	120	104
SENECA	---	242	267	270	235	247	230	252	219	194	217	221	221	207
STILLWATER	89	106	108	157	161	140	116	146	118	121	141	135	124	125
WACONIA	---	---	---	---	169	676	341	*--	---	---	---	---	---	---
ALL PLANTS EXCEPT METRO (weighted avg.)					234	243	229	239	207	197	217	214	198	183
ALL PLANTS (weighted average)					240	263	243	219	205	212	209	205	178	177
ALL PLANTS EXCEPT METRO (actual average)					209	252	232	208	191	171	192	185	169	154
ALL PLANTS (actual average)					210	252	232	209	191	174	193	186	169	156

*Plant phased out during previous year.

TABLE A-8

INFLUENT TSS DATA 1971-1984

Treatment Plant	ANNUAL AVERAGE VALUES, TSS (MG/L)													
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
ANOKA	240	300	267	302	234	195	176	164	132	141	152	154	165	150
APPLE VALLEY	258	329	320	378	300	229	271	274	240	*--	---	---	---	---
BAYPORT	220	269	200	326	317	227	147	144	169	191	165	150	178	210
BLUE LAKE	---	---	244	364	347	361	324	317	270	244	241	230	224	204
CAHSKA	212	190	184	194	226	292	180	180	195	167	189	167	127	148
COTTAGE GROVE	350	318	274	294	241	185	220	200	163	152	187	173	160	158
EMPIRE	---	---	---	---	---	---	---	---	226	190	251	212	250	189
FARMINGTON	259	296	225	361	250	223	235	189	147	*--	---	---	---	---
HASTINGS	333	333	225	198	199	207	184	252	223	224	235	233	187	196
LAKEVILLE	174	212	327	849	997	876	759	388	365	*--	---	---	---	---
LONG LAKE	206	294	288	446	187	261	274	195	210	196	*--	---	---	---
MAPLE PLAIN	63	62	118	193	83	134	182	228	233	209	179	199	171	195
MEDINA	138	125	133	141	214	365	385	487	205	151	132	127	208	131
METROPOLITAN	313	318	308	317	316	332	288	231	222	237	230	241	192	198
NEWPORT	250	248	218	248	181	*--	---	---	---	---	---	---	---	---
ORONO	136	167	167	235	168	146	176	167	140	154	*--	---	---	---
PRIOR LAKE	255	183	193	123	180	139	83	149	*--	---	---	---	---	---
ROSEMOUNT	---	---	50	230	258	230	226	235	202	236	221	239	236	129
ST. PAUL PARK	318	308	276	270	241	*--	---	---	---	---	---	---	---	---
SAVAGE	267	700	280	269	278	241	249	265	190	565	234	170	195	165
SENECA	---	242	243	319	282	225	209	240	204	186	211	203	211	205
STILLWATER	115	120	130	193	210	140	118	158	119	127	159	139	137	150
WACONIA	---	---	---	---	187	381	270	*--	---	---	---	---	---	---
ALL PLANTS EXCEPT METRO (weighted avg.)					292	264	243	255	219	204	218	206	209	194
ALL PLANTS (weighted average)					313	323	281	235	221	232	228	235	195	197
ALL PLANTS EXCEPT METRO (actual average)					266	266	246	235	202	209	197	184	188	172
ALL PLANTS (actual average)					268	269	248	235	203	211	199	188	189	173

*Plant phased out during previous year.

TABLE A-9

STATISTICAL ANALYSES OF BIOCHEMICAL OXYGEN DEMAND DATA
FOR PLANTS IN OPERATION DURING 1984

TREATMENT PLANT EFFLUENT STATISTICAL DATA

BIOCHEMICAL OXYGEN DEMAND, mg/l*

Treatment Plant	50% of Time							75% of Time							90% of Time						
	1978	1979	1980	1981	1982**	1983**	1984**	1978	1979	1980	1981	1982**	1983**	1984**	1978	1979	1980	1981	1982**	1983**	1984**
ANOKA	11	12	12	15	10	10	12	16	16	17	20	14	14	16	22	22	22	26	19	17	21
BAYPORT	6	6	5	7	7	6	5	10	8	8	8	9	7	7	14	11	11	10	13	8	8
BLUE LAKE	11	7	8	9	10	8	9	14	10	10	13	13	11	11	22	15	14	19	16	13	14
CHASKA	61	93	14	14	12	9	6	100	160	22	24	16	13	10	140	210	38	34	22	17	14
COTTAGE GROVE	28	12	10	9	8	8	8	38	20	14	15	13	11	11	52	50	18	20	18	14	14
EMPIRE	--	4	2	3	2	2	1	--	10	2	4	3	3	2	--	28	5	4	4	4	3
HASTINGS	16	16	17	18	17	14	16	22	22	22	24	27	20	23	28	28	31	33	37	26	35
MAPLE PLAIN	7	16	19	10	11	8	6	14	23	29	15	18	12	12	22	33	37	21	26	17	22
METROPOLITAN	40	36	20	14	10	8	8	53	53	29	24	15	13	12	64	71	44	36	22	19	17
ROSEMOUNT	11	10	11	12	15	13	16	15	15	14	15	18	18	21	22	20	20	19	24	29	30
SAVAGE	26	26	5	9	6	7	6	34	41	7	12	9	9	7	42	59	9	15	20	10	10
SENECA	18	14	14	19	17	13	15	25	18	20	22	21	17	19	39	27	25	30	25	24	24
STILLWATER	8	8	12	14	10	9	7	14	12	14	24	12	12	10	18	21	19	33	14	18	13

* The data shows that for the percent of time shown, the effluent concentration was less than or equal to the tabulated values.

**1982 through 1984 data represents CBOD values.

TABLE A-10

STATISTICAL ANALYSES OF TOTAL SUSPENDED SOLIDS EFFLUENT DATA
FOR PLANTS IN OPERATION DURING 1984

TREATMENT PLANT EFFLUENT STATISTICAL DATA

TOTAL SUSPENDED SOLIDS, mg/l*

Treatment Plant	50% of Time							75% of Time							90% of Time						
	1978	1979	1980	1981	1982	1983	1984	1978	1979	1980	1981	1982	1983	1984	1978	1979	1980	1981	1982	1983	1984
ANOKA	13	10	10	12	7	9	10	20	15	15	18	10	12	13	28	21	20	24	15	16	16
BAYPORT	8	7	7	7	7	6	7	10	10	9	9	9	7	9	12	13	11	10	12	9	10
BLUE LAKE	13	11	8	6	6	7	5	28	14	11	7	8	9	7	22	17	15	9	10	11	10
CHASKA	58	43	11	13	10	8	5	88	83	15	16	14	14	9	120	130	18	22	19	22	18
COTTAGE GROVE	17	10	7	5	6	10	7	28	16	13	8	10	14	11	51	28	22	14	14	18	14
EMPIRE	--	3	1	1	1	1	1	--	5	3	1	1	1	2	--	11	4	2	2	2	3
HASTINGS	18	17	22	19	28	22	24	26	24	30	28	38	32	32	33	31	38	36	48	41	59
MAPLE PLAIN	6	10	11	6	6	6	8	12	18	15	8	10	12	15	40	30	24	16	16	16	19
METROPOLITAN	37	43	15	10	7	7	8	55	85	33	24	12	11	12	78	137	60	47	21	17	19
ROSEMOUNT	3	2	2	1	1	1	2	5	3	3	2	2	2	3	7	5	3	3	4	4	5
SAVAGE	14	10	4	5	2	2	2	20	18	7	12	5	3	4	25	28	15	17	11	4	6
SENECA	14	13	15	19	19	15	19	19	24	19	23	23	23	26	27	32	23	28	26	29	34
STILLWATER	10	10	9	8	8	10	8	14	12	14	12	10	14	10	18	16	21	15	12	20	13

*The data shows that for the percent of time shown, the effluent concentration was less than or equal to the tabulated values.

TABLE A-11

1984 METROPOLITAN PLANT SLUDGE QUANTITIES

PARAMETER	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	AVERAGE
SLUDGE: PRODUCTION WET TONS														
Roll Press Cake	12,636	12,633	14,888	9,318	14,255	16,535	15,044	14,693	14,100	17,229	16,027	16,325	173,683	14,474
Filter Press Cake	5,404	3,976	6,176	6,257	2,531	0	0	0	56	0	0	0	24,400	2,033
TOTAL	18,040	16,609	21,064	15,575	16,786	16,535	15,044	14,693	14,156	17,229	16,027	16,325	198,083	16,507
DRY TONS (Sludge Solids)														
Roll Press Cake	4,300	4,369	4,555	2,965	5,024	6,247	5,227	5,070	4,906	5,761	5,444	5,602	59,470	4,956
Filter Press Cake	1,920	1,332	2,552	2,497	468	0	0	0	2	0	0	0	8,771	731
TOTAL	6,220	5,701	7,107	5,462	5,492	6,247	5,227	5,070	4,908	5,761	5,444	5,602	68,241	5,687
SLUDGE: INCINERATED WET TONS														
Roll Press Cake	12,622	12,633	318	7,006	14,108	16,513	15,044	14,693	14,100	17,200	16,027	16,325	156,589	13,049
Filter Press Cake	5,404	3,229	180	0	0	0	0	0	56	0	0	0	8,869	739
TOTAL	18,026	15,862	498	7,006	14,108	16,513	15,044	14,693	14,156	17,200	16,027	16,325	165,458	13,788
DRY TONS (Sludge Solids)														
Roll Press Cake	4,295	4,369	97	2,229	4,972	6,239	5,227	5,070	4,906	5,751	5,444	5,602	54,201	4,517
Filter Press Cake	1,920	1,082	75	0	0	0	0	0	2	0	0	0	3,079	257
TOTAL	6,215	5,451	172	2,229	4,972	6,239	5,227	5,070	4,908	5,751	5,444	5,602	57,280	4,774
SLUDGE TO LAND WET TONS														
Roll Press Cake	15	0	14,570	2,312	146	21	0	0	0	29	0	0	17,093	1,424
Filter Press Cake	0	747	5,996	6,257	2,531	0	0	0	0	0	0	0	15,531	1,294
TOTAL	15	747	20,566	8,569	2,677	21	0	0	0	29	0	0	32,624	2,718
DRY TONS (Sludge Solids)														
Roll Press Cake	5	0	4,458	736	52	8	0	0	0	10	0	0	5,269	439
Filter Press Cake	0	250	2,477	2,497	488	0	0	0	0	0	0	0	5,712	476
TOTAL	5	250	6,935	3,233	540	8	0	0	0	10	0	0	10,981	915

TABLE A-12

1984 METRO PLANT SLUDGE QUALITY

	Solids %	Volatiles %	KJN %	NH3-N %	P %	mg/kg (dry weight basis) Cd	Cu	Ni	Pb	Zn	Cr	K	Hg	PCB
Roll Press Cake														
January	32.9	76.0	2.0	0.07	1.0	94	1,015	155	243	1,921	945	1,009	---	---
February	34.9	68.3	2.2	0.05	1.0	43	888	138	372	1,433	716	1,289	2.0	0.9
March	27.4	75.4	1.7	0.09	1.0	69	1,175	168	219	1,628	974	1,120	---	---
April	32.8	71.8	2.1	0.10	0.8	21	814	159	256	1,601	1,238	1,116	---	---
May	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
June	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
July	33.2	64.0	2.0	0.06	1.0	---	1,551	440	410	2,515	1,111	1,111	---	---
August	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
September	32.1	70.4	4.9	0.13	1.7	75	1,287	181	255	2,202	710	779	---	---
October	33.3	63.9	2.6	0.08	1.3	78	1,174	207	315	2,174	829	1,207	---	---
November	33.5	75.9	2.5	0.13	1.0	63	1,421	212	251	2,328	782	910	1.5	---
December	35.5	68.3	3.4	0.15	1.8	96	1,685	248	389	2,392	961	1,146	---	---
Average	32.8	70.4	2.6	0.09	1.2	67	1,223	212	301	2,022	919	1,077	1.7	0.9
Press Cake														
January	35.2	67.5	3.5	0.14	2.8	261	1,682	212	372	2,760	1,537	1,152	---	---
February	36.5	64.0	2.8	0.11	2.7	123	2,027	225	548	2,904	1,753	1,315	3.8	2.3
March	41.3	67.5	3.2	0.15	2.8	99	1,680	217	305	2,481	1,783	1,344	0.6	2.0
April	40.1	66.1	3.2	0.10	2.6	71	1,794	228	359	2,456	1,874	1,111	1.7	---
May	44.2	60.1	3.1	0.11	2.9	69	1,650	259	495	2,711	1,840	1,565	2.5	---
June	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
July	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
August	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
September	34.8	69.6	3.1	0.18	2.3	158	-----	---	---	-----	-----	-----	---	---
October	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
November	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
December	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
Average	39.7	66.1	3.2	0.12	2.8	107	1,720	221	388	2,684	1,664	1,185	2.0	2.2
Load Out Cake														
January	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
February	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
March	28.4	67.8	2.4	0.09	0.9	50	1,071	152	209	1,489	922	1,117	1.0	0.6
April	28.1	67.1	2.7	0.08	1.2	44	958	147	192	1,243	1,156	974	1.3	---
May	29.6	52.4	2.7	0.04	1.2	27	905	169	361	1,446	1,024	1,294	1.4	---
June	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
July	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
August	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
September	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
October	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
November	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
December	----	----	---	----	---	---	-----	---	---	-----	-----	-----	---	---
Average	28.4	67.3	2.4	0.09	1.0	48	973	154	239	1,355	1,064	1,090	1.2	0.6

TABLE A-13

1984 SLUDGE DISPOSAL

GALLONS HAULED (X 1000)

Plant - Disposal Location	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	SUB-TOTAL	TOTAL
Anoka														
Coon Rap. Int.	169.6	451.2	246.4	278.4	326.4	355.2	310.4	374.4	310.4	419.2	467.2	435.2	------	4,144
Bayport														
Oakdale Int.	114.6	88.8	107.4	119.8	127.4	101.4	120.8	107.0	0.0	0.0	0.0	0.0	888	
South St. Paul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.8	103.2	125.2	94.2	408	1,296
Blue Lake														
3rd & Comm.	739.0	1027.3	2235.1	1161.9	1133.1	763.6	975.0	2066.4	1802.6	2493.1	2305.0	176.1	16,878	
Seneca	2446.4	1512.6	879.9	2263.8	2829.1	2796.5	2177.2	1959.5	1786.6	976.7	648.2	3547.1	23,824	40,702
Chaska														
Blue Lake	162.6	295.8	274.4	288.0	261.2	235.4	318.4	274.4	177.0	271.0	68.6	10.4	2,637	
Landspreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5	230.4	236.8	514	3,151
Cottage Grove														
U of M	0.0	0.0	0.0	0.0	137.0	12.8	0.0	0.0	0.0	0.0	0.0	0.0	150	
Landspreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	
South St. Paul	233.6	262.4	275.2	56.0	63.6	188.8	150.4	373.4	393.6	444.8	453.2	227.2	3,122	
Drying Beds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	3,272
Hastings														
U of M	0.0	0.0	0.0	86.4	124.8	108.8	0.0	0.0	112.0	211.2	131.2	147.2	922	
Landspreading	0.0	0.0	0.0	198.3	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.0	208	
South St. Paul	201.6	366.8	73.6	3.2	0.0	70.4	48.0	192.0	0.0	0.0	3.2	0.0	959	2,088
Maple Plain														
Drying Beds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Landspreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Plymouth Int.	12.0	0.0	0.0	0.0	0.0	0.0	12.0	20.0	0.0	0.0	0.0	0.0	44	44
Rosemount														
3rd & Comm.	191.3	163.5	164.9	156.4	205.6	145.5	132.6	153.1	140.0	172.5	141.9	113.8	------	1,881
Savage														
Drying Beds	0.0	0.0	0.0	0.0	0.0	23.7	0.0	0.0	0.0	0.0	0.0	0.0	24	
Landspreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	64.0	0.0	0.0	0.0	70	
3rd & Comm.	0.0	0.0	18.0	54.0	0.0	45.0	122.0	0.0	0.0	60.0	0.0	0.0	299	
Seneca	42.0	36.0	0.0	0.0	60.0	57.5	0.0	0.0	0.0	0.0	32.0	53.0	281	674
Stillwater														
Oakdale Int.	414.6	420.0	502.2	464.6	475.0	487.6	452.6	473.0	0.0	0.0	0.0	0.0	3,689	
Landspreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	417.2	83.0	142.6	454.0	1,097	
South St. Paul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	145.8	185.6	223.6	9.6	565	5,351
Empire														
U of M	February - June 1,419,000 gallons													

TABLE A-14

1984 SENECA PLANT SLUDGE QUANTITIES*

MONTH	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	AVERAGE
BELT FILTER PRESS														
Wet Tons	2,097	2,658	2,624	1,949	2,788	3,000	2,354	2,111	2,031	2,534	1,833	4,039	30,018	2,502
Dry Tons	499	670	601	468	686	780	586	483	451	560	414	1,034	7,232	603
VACUUM FILTER														
Wet Tons	1,744	185	255	2,399	1,723	2,224	1,759	2,005	1,943	1,530	1,269	573	17,609	1,467
Dry Tons	394	43	54	528	395	556	426	461	446	308	285	138	4,034	336

*All values include conditioning chemicals.

TABLE A-15

1984 SENECA PLANT SLUDGE QUALITY

	Solids %	Volatiles %	KJN %	NH3-N %	P %	mg/kg (dry weight basis) Cd	Cu	Ni	Pb	Zn	Cr	K	Hg	PCB
Seneca Filter Cake														
January	23.0	46.7	2.58	0.07	1.00	12.1	1,435	321	328	512	450	788	2.4	----
February	----	----	----	----	----	----	-----	-----	---	---	---	---	---	----
March	----	----	----	----	----	----	-----	-----	---	---	---	---	---	----
April	23.1	43.4	3.22	0.07	1.08	10.3	1,231	831	203	454	747	837	1.7	----
May	22.7	44.6	3.78	0.10	1.20	11.0	881	556	189	441	407	860	1.4	1.90
June	24.2	42.8	3.42	0.06	1.14	10.2	1,334	671	435	443	441	997	1.4	1.60
July	26.2	40.9	2.79	0.05	0.94	12.4	932	278	214	466	328	872	1.4	----
August	23.7	44.7	3.09	0.09	1.13	14.4	931	183	189	483	250	921	0.9	----
September	24.3	37.0	2.85	0.06	0.94	12.4	1,063	507	182	436	482	738	1.5	----
October	20.9	28.9	2.37	0.18	3.42	9.6	622	206	153	335	325	670	0.8	----
November	21.9	55.2	3.66	0.05	1.28	11.0	1,677	1,472	235	494	1,143	932	1.3	----
December	23.2	41.4	3.06	0.06	0.99	11.2	1,597	202	252	420	256	798	1.7	----
Average	23.7	42.7	3.12	0.07	1.14	11.6	1,127	509	241	456	466	855	1.4	1.75

	Solids %	Volatiles %	KJN %	NH3-N %	P %	mg/kg (dry weight basis) Cd	Cu	Ni	Pb	Zn	Cr	K	Hg	PCB
Seneca Press Cake														
January	23.7	63.8	3.96	0.68	1.37	14.7	1,759	211	407	687	423	1,353	3.8	0.30
February	25.3	73.7	3.85	0.95	1.35	13.2	1,332	52	394	666	406	1,684	1.6	1.60
March	22.8	74.8	4.82	0.97	1.71	12.0	1,090	48	297	577	395	1,704	3.3	1.30
April	23.6	72.1	4.54	1.06	1.31	9.6	1,578	108	281	643	306	1,542	2.7	----
May	24.0	73.0	4.02	1.16	1.21	12.9	1,308	105	294	631	281	1,573	2.3	2.20
June	25.3	68.4	5.18	0.93	1.61	11.9	1,415	93	275	662	277	1,807	2.1	1.80
July	27.6	69.2	4.51	0.71	1.48	9.8	1,498	81	265	700	201	1,621	2.8	----
August	23.7	71.8	4.67	0.81	1.59	13.9	1,504	55	244	715	177	1,714	1.1	----
September	20.7	71.8	4.95	0.93	1.84	14.9	1,728	107	267	807	252	1,954	1.7	----
October	19.3	71.5	5.48	0.96	1.97	13.0	1,389	96	262	746	251	1,870	1.4	----
November	23.0	76.0	5.96	2.23	1.73	23.7	834	104	265	699	303	1,997	1.8	----
December	24.9	74.7	4.46	0.44	1.24	12.3	2,056	62	304	656	170	1,811	2.3	----
Average	24.0	71.6	4.60	0.95	1.49	13.0	1,483	92	297	679	286	1,697	2.2	1.44

DATE	ISSUED TO