

ILLINOIS POLLUTION CONTROL BOARD
April 21, 1988

IN THE MATTER OF:)
)
THE PETITION OF THE) R86-3
NORTH SHORE SANITARY DISTRICT)
TO AMEND REGULATIONS)

PROPOSED RULE. FIRST NOTICE

OPINION AND ORDER OF THE BOARD (by B. Forcade):

This matter comes before the Board on a December 20, 1985, Petition of the North Shore Sanitary District ("NSSD") for a site-specific regulation to modify the Board's effluent phosphorus regulations. Specifically, the petition seeks an exception from 35 Ill. Adm. Code 304.123(a) for the discharges of phosphorus in excess of 1 mg/l in the effluent from the excess flow facilities located at the Waukegan Sewage Treatment Plant ("STP") and the North Chicago STP.* A public hearing was held October 19, 1987, in Waukegan, Illinois. No member of the public was in attendance. The Department of Energy and Natural Resources submitted its negative declaration re an Economic Impact Study (EcIS) on this proposed site-specific rule on December 15, 1987. Supplemental information, requested at hearing, was filed with the Board by the Illinois Environmental Protection Agency ("Agency") on January 22, 1988, and by NSSD on January 27, 1988.

*By another, independent petition, NSSD sought relief from the Board's Combined Sewer Overflow ("CSO") rules, 35 Ill. Adm. Code 306.302 through 306.306. The February 5, 1987 Opinion and Order in that proceeding, PCB 85-208, permits no CSO discharges to the lake until conveyance of the maximum flow to Gurnee and the North Chicago retention basins are full. It requires the construction of a 50 MG excess flow retention facility at Gurnee by January 1, 1991, then does not permit discharges to the lake until either the Gurnee and North Chicago retention facilities are full to capacity, or the plant inflow exceeds the pumping capacity to Gurnee and the North Chicago retention facility is full to capacity. The PCB 85-208 Opinion and Order permits CSO discharges from Waukegan only after "the maximum practical flow is receiving full treatment and the excess flow basins are full to capacity" (February 5, 1987 Opinion and Order in PCB 85-208 at pp. 8-9). The Opinion and Order in PCB 85-208 further requires NSSD to monitor the impact of its CSO discharges on the lake, but not specifically for phosphorus.

The Board has determined that the record does not indicate that NSSD Waukegan and North Chicago overflow discharges demonstrably cause or contribute to phosphorus water quality standard violations. Conversely, the Board is troubled with the prospect of their undiminished continuation, whether with or without chemical phosphorus removal. The Board has decided to adopt a site-specific rule that would eliminate the existing effluent phosphorus limitation for these discharges. Chemical phosphorus removal from the Waukegan STP and North Chicago STP is not clearly technically feasible and is clearly not economically reasonable. Similar or greater environmental benefits are achievable through alternative means.

Although NSSD has requested a scaled numerical phosphorus effluent limitation dependent on the number of discharge events occurring during a given month, this Board declines to adopt this approach. The record more adequately supports adopting measures intended to minimize overflow discharges. This includes adoption of certain plant practices and mandating an expansion in plant peak treatment and retention capacity. This was the approach favored by the Agency. The Board further adopts the Agency's recommended monitoring scheme with only slight modification.

I. Background

The NSSD was formed in 1914 under the Sanitary District Act of 1911 (Section 276.99, et seq., chapter 42, Ill.Rev.Stat.). The District encompasses the area in Lake County, Illinois, lying east of the tollway extending from the Lake-Cook County Line Road north to the Wisconsin border, except for the Village of Deerfield, part of the Village of Bannockburn, and the Wadsworth area. The eastern border is the Lake Michigan shoreline. The NSSD services approximately 210,000 people (R. 52; see PCB 85-208, February 25, 1987 Opinion and Order).

The NSSD operates four sewage treatment facilities, only two of which are of primary concern to this proceeding. The sewage treatment system has two CSO outfalls which discharge only intermittently to Lake Michigan. Effluent phosphorus limitations apply by regulation only to discharges to the lake. These two intermittent discharges are separately discussed below. Discussions of the potential impact of the phosphorus discharges on the lake and the NSSD-proposed alternative rule and the Agency proposal follows those.

Waukegan STP

The Waukegan STP service area primarily includes separate sanitary sewers. The plant is an activated sludge plant with a design capacity of 19.8 million gallons per day ("MGD") throughput, and its average dry weather flow receiving full treatment was 14.1 MGD in 1978-79. The plant can provide full treatment to a peak flow of about 30 MGD during wet weather and its average wet weather flow was 26.0 MGD during this period.

This period saw an average combined flow of 18.0 MGD receiving full treatment (Ex. 4, p. 3-1; R. 61, 64 & 68). The treated effluent is pumped about five miles overland by force main from the plant location on the shore of Lake Michigan to an outfall to the Des Plaines River (See Ex. 18; R. 54). No phosphorus limitation applies to this discharge.

The treatment plant is not capable of providing full treatment to all flows during wet weather periods. During extreme wet weather conditions, excess combined sewage-stormwater influent first enters a pair of presedimentation basins having a combined capacity of 1.38 million gallons ("MG"). Overflows from these basins successively enter three retention basins. Additional flows exceeding the 38 MG capacity of these three basins exit the third basin, are chlorinated in a contact chamber, and discharged via an overflow outfall to Lake Michigan. This outfall is used only intermittently during such extreme wet weather plant overflow events. This effluent receives no treatment other than any primary settling it undergoes in the presedimentation and retention basins, and the chlorination described (Ex. 4, pp. 3-1-3-2; R. 58-60). The record does not indicate whether it is feasible to pump the untreated overflow to the Des Plaines River with the treated effluent. No current facilities exist for phosphorus removal from this overflow effluent (Ex. 4, p. 3-1). No additional land is immediately available for expansion of the overflow storage capacity at this plant (R. 85).

The record testimony indicates that for part or all of the years 1979-83, the Waukegan STP experienced an average of 25 such discharge events per year with an annual average discharge of 267.5 MG to the lake (Ex. 4, p. 4-10). This is based on a study of the impact of the phosphorus in the overflow discharges by a consulting engineer contracted by NSSD, Donald F. Pirrung of Donohue & Associates, Inc. The record indicates that continuous overflow may occur from a few hours to two days. Such are called "events" by the witnesses (R. 17-19, 43-44 & 115), but certain more detailed data for the years 1980-87 are tabulated by discharge per day. For clarity, the discharge per day is discussed as "event-days" in the following discussions of these 1980-87 detailed data. These are likely equivalent terms.

Other, more detailed data spanning a longer time than that relied on by the NSSD engineer indicate an annual average discharge of 362.7 MG and an average of 30 events per year. These more extensive data permit a detailed analysis not possible based on the NSSD engineer's study. They are based on detailed tabulations of 224 overflow event-days during all or part of the years 1980-87. Overflow discharge volume data were available for 223 of these event-days, effluent phosphorus data were available for 197, and both types of data were available for 196 (Ex. 4, pp. 4-8; Ex. 5, App.; Ex. 7).

This detailed tabulation indicates that overflow discharges are sporadic, unpredictable, and potentially massive. For example, the lowest year saw only seven event-days with a total of 97.0 MG, and the highest year saw 49 event-days with a total discharge of 655 MG. The highest recorded single event during this period was the discharge of 67.7 MG. During a 25-day period during March and April, 1983, an event-day occurred every day for a total overflow discharge of 315.8 MG to the lake. A similar succession of 24 event-days occurred during February and March, 1985, which discharged a total volume of 398.1 MG to the lake. No precipitation data in the record correlate with the overflow data, but the general pattern is for the event-days to occur on each of from one to several days in a row (5 days average) -- presumably only during periods of extreme rainfall runoff. There appears no definite pattern to either the daily flow or the phosphorus content of the discharges during these several day periods. A summary tabulation of the annual totals and averages follows:

Summary Tabulation: Annual Waukegan STP Overflow Data

<u>Year</u>	<u>Annual Discharge</u>	<u>Annual Events</u>	<u>Phosphorus Average*</u>
1979	356 MG	37	1.8 mg/l as P
1980	213	19	1.38
1981	97	7	0.95
1982	354	34	1.17
1983	417	34	1.07
1984	191	21	1.09
1985	655	49	1.19
1986	638	43	1.09
1987 (6 mos)	155**	17	1.16
Total (8.5 yrs)	3,076 MG	261	--
Average	362 MG	31	1.22 mg/l as P

* Indicates average total phosphorus based on available data only. Some data were missing for each of nearly all years

** Indicates total discharged volume for available data. One datum was missing.

Examination of the detailed 1980-87 discharge data, categorized by size of the individual event-days, illustrates that elimination of smaller discharges diminishes the number of discharges more rapidly than it diminishes the total volume discharged. In the following table, the left column categorizes event-days by their individual discharge volume. The next two columns indicate the number and percent of event-days discharging the given volume. The fourth column indicates a cumulative percentage of the numbers of event-days discharging the given volume or less. The right three columns indicate the total volume discharged in each of the given categories, the percent of

the total volume that fell within that category, and the cumulative percentage of the total volume that falls in the given and smaller categories. The table follows:

Numbers and Volumes of Waukegan Overflow Discharges by Event Size

Size of Event	By Number of Events			By Category Volume		
	Number	Percent	Cum %	MG	Percent	Cum. %
Less than 1 MG	8	3.6	3.6	3.8	0.1	0.1
1 MG to 5 MG	58	26.0	29.6	164.9	6.1	6.2
5 MG to 10 MG	59	26.5	56.1	445.4	16.4	22.6
10 MG to 15 MG	34	15.2	71.3	422.2	15.5	38.1
15 MG to 20 MG	28	12.6	83.9	497.0	18.3	56.4
20 MG to 25 MG	14	6.3	90.1	311.5	11.5	67.8
25 MG to 30 MG	5	2.2	92.4	135.2	5.0	72.8
30 MG to 40 MG	5	2.2	94.6	168.7	6.2	79.0
40 MG to 50 MG	8	3.6	98.2	345.1	12.8	91.8
Greater 50 MG	4	1.8	100.0	223.3	8.2	100.0
Totals	223	100.0	—	2,720.1	100.0	—

The mean event size indicated by this data was 12.2 MG. The median was about 9.0 MG, but more than half the overall effluent volume consisted of events discharging more than 18.6 MG. Elimination of the first 10 MG of all event-days reduces the number of event-days from 223 to 98 (from 30 to 13 per year, average) and the overall discharge volume from 2,720.1 MG to 1,126.0 MG (from 363 MG to 150 MG per year, average; 58.6% reduction). Elimination of the first 14 MGD of all event-days reduces the number of event-days to 72 (10 per year, average) and the overall discharge volume to 792.4 MG (105.6 MG per year, average; 70.9% reduction). The NSSD engineer estimated, based on 1979-83 data, a reduction from an average of 37 events and 267.5 MG discharged per year to an average of 4 events and 19.8 MG discharged per year (93% reduction) if certain proposed plant improvements occurred at Waukegan. These respective estimates are disparate, and they are significant to later discussion.

The NSSD engineer indicated that the annual average phosphorus content of the Waukegan discharges during 1979-1983 ranged from 0.95 to 1.8 mg/l, with an overall average over the nearly five years of 1.3 mg/l (Ex. 4, p. 4-10; R. 17). Examination of the 197 detailed data for which phosphorus is available for 1980-87 reveals the same range, but an overall average of 1.14 mg/l as P. A summary tabulation of the 197 detailed data, categorized by effluent phosphorus content and the associated percentage of discharges within each category, follows:

Number of Event-Days Discharging Specified Phosphorus In Effluent

Year	Effluent Phosphorus Content (mg/l as P)										
	1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	Total					
1980	0	0%	11	61%	7	39%	0	0%	0	0%	18
1981	6	85%	0	0%	1	14%	0	0%	0	0%	7
1982	9	31%	16	55%	4	14%	0	0%	0	0%	29
1983	8	26%	19	61%	4	13%	0	0%	0	0%	31
1984	7	35%	12	60%	1	5%	0	0%	0	0%	20
1985	17	38%	23	51%	4	9%	0	0%	1	2%	45
1986	13	38%	13	38%	6	18%	1	3%	1	3%	34
1987	5	38%	5	38%	3	23%	0	0%	0	0%	13
TOTAL	65	33%	99	50%	30	15%	1	1%	2	1%	197
CUM.	65	33%	164	83%	194	98%	195	99%	197	100%	

During this entire period, only 80 (41%) of the samples complied with the effluent standard of 1.0 mg/l as P applicable to Lake Michigan discharges. The highest individual datum submitted was 2.7 mg/l (Ex. 4, p. 4-8; Ex. 5 App.; Ex. 7).

The record indicates that the amount of total phosphorus discharged by Waukegan in excess of the standard is a fraction of the total discharged in the effluent. The NSSD engineer indicated that the average annual total phosphorus loading to Lake Michigan during the period including part or all of 1979-83 was 2,900 pounds (Ex. 4, p. 4-10) -- only 668 pounds (30 percent) in excess of what would have entered the lake had the effluent consistently averaged 1.0 mg/l total phosphorus (as P). Analysis of the 196 tabulated individual 1980-87 event-days for which both total phosphorus and flow data were available indicates that Waukegan discharged a total of 25,950 pounds of total phosphorus to the lake during this seven and one-half years, for an annual average of 3,460 pounds as P. Factored up to account for the 12.5% of event-days for which the data is incomplete, the total becomes 29,660 pounds, or an annual average of 3,950 pounds as P. Further analysis of these detailed data indicates that the Waukegan STP overflow discharges in excess of 1.0 mg/l total phosphorus added an excess of 3,240 pounds of total phosphorus to the lake in violation of Section 304.123(a), or an average excess of about 433 pounds per year, when factored to account for the 12.5% of event-days for which complete phosphorus and flow data are missing. Again, an analysis based on the more recent data conflicts slightly with the NSSD engineer's estimates.

Existing plans to enlarge the Waukegan plant were central to the NSSD engineer's estimates on phosphorus removal. The current 201 Facilities Improvements plan for the Waukegan STP calls for an increase in the design capacity of the plant to 22.0 MGD. This would increase the peak treatment capacity to about 44 MGD. The intent of this plan is to accommodate anticipated demand for treatment capacity in the existing NSSD service area for the year 2000. It does not consider the possible addition of

more geographic area to the west of the existing boundaries. NSSD has not committed to making these improvements (R. 66-67 & 73-75). This additional treatment capacity would boost the current Waukegan plant peak treatment capacity of 30 MGD by about 14 MGD. It was upon these expansions that all phosphorus discharge reduction and removal cost estimates were based.

As indicated earlier, NSSD anticipates that these improvements, if implemented, would reduce the anticipated number of overflow events per year from 37 to only four, with a total estimated annual average volume from 267.5 MG to only 19.8 MG (93% reduction) (Ex 4, p. 3-1; R. 72-73). As mentioned earlier, examination of the detailed 1980-87 data indicates that elimination of the first 14 MG from all event-days reduces their number per year from 30 to 10 and the annual discharge volume to the lake from 362.7 MG to 105.7 MG (70.9% reduction) for this period. The estimates possible, based on 1980-87 data, clearly conflict with the NSSD estimates based on 1979-83 data. This warrants separate examination of the potential benefits.

Comparative estimation of the phosphorus reductions possible by the three options discussed in the record (implementation of the 201 Plan, chemical phosphorus removal, and implementation of the plan with chemical phosphorus removal) reveals that implementation of the 201 Plan confers greater benefits than chemical removal. Chemical removal in addition to plant improvements confers only a slightly increased benefit than flow diversion alone. This is true of either the NSSD engineer's estimates based on 1979-83 data or estimates based on the 1980-87 detailed data. The 1980-87 data indicate that flow diversion, above estimated at 70.9%, reduces the annual total phosphorus output from Waukegan from 3,950 pounds per year to 1,150 pounds per year as P. This eliminates 2,800 pounds of total phosphorus from discharge to the lake. Chemical phosphorus removal alone would only eliminate the 433 pounds of total phosphorus currently entering the lake in excess of 1.0 mg/l in the effluent (10.9% reduction). This permits the discharge of 3,520 pounds per year as P. Chemical phosphorus removal along with the 201 improvements would eliminate only 126 pounds of phosphorus in addition to the 2,800 pounds eliminated by diversion alone, allowing 1,030 pounds to enter the lake (74.1% reduction). For comparative purposes, these estimates are tabulated below parallel to those made by the NSSD engineer:

Comparison of NSSD and Estimated Phosphorus
Reductions by Method of Reduction for Waukegan

<u>Phosphorus Reduction Method</u>	<u>Phosphorus Discharges</u>	
	<u>NSSD 1979-83 Estimates</u>	<u>1980-87 Estimates</u>
Existing Facilities	2,900 pounds	3,950 pounds
Chemical Removal Alone	2,230 pounds	3,520 pounds
Phosphorus Reduction	23%	10.9%
201 Facilities Improvements	215 pounds	1,150 pounds
Phosphorus Reduction	93%	70.9%
Both Methods Together	165 pounds	1,030 pounds
Phosphorus Reduction	94%	74.1%

The report of the consulting engineer retained by NSSD to study phosphorus removal from the Waukegan overflow effluent to Lake Michigan indicates that the capital costs of installing equipment for chemical phosphorus removal are about \$682,900, whether or not the 201 Facilities Plan improvements are made. The annual operating costs are estimated at \$40,500 if the improvements are not made. This reduces to an estimated \$21,100 per year if the plan is implemented. This reduction probably results from the decreased overflow volume the improvements would allow. The annualized cost per pound of phosphorus removed was estimated at \$158 with existing plant facilities and \$1,738 if NSSD implements the 201 Plan (Ex. 4, p. 5-3). Testimony indicates that the normal cost per pound of phosphorus removed from a continuous effluent stream is in the range of \$1 to \$3 (R. 117-118). The stated reasons for the greatly increased cost of removing phosphorus from NSSD effluent were the intermittent nature of the flow, its variable phosphorus content, and various other factors which render process control difficult for this effluent. Adequate chemical mixing and treated effluent settling times, as well as precise chemical dosage rates were felt necessary to effect phosphorus removal (R. 25 & 114-115). The engineer's report and the laboratory bench tests upon which it was based both considered only ferric chloride precipitation as a method of control, but testimony indicates that the considerations and costs are similar for the use of aluminum sulfate (Ex. 4, pp. 5-1-5-2; R 114).

The NSSD cost estimates would change based on the above revised phosphorus removal estimates based on 1980-87 data, but no effort was made to do so. The major costs of phosphorus removal are the capital costs. These do not change with revised discharge flow and phosphorus removal estimates. Only the annual operating costs would change. Basing revised overall cost estimates on the subsequent data would not yield annualized per unit phosphorus removal costs very different from those presented by NSSD.

North Chicago STP

The NSSD North Chicago STP is a trickling filter plant with a 3.5 MGD treatment capacity. This plant collects wastes, inter alia, from Abbott Labs and Great Lakes Naval Training Center ("NTC"). It merely acts as a "roughing" plant because all its treated wastes are pumped about six miles to the NSSD Gurnee STP for full treatment and ultimate discharge to the Des Plaines River. No effluent phosphorus limitations apply to that discharge (Ex. 4, p. 3-2; R 47-48). Combined stormwater inflow to the North Chicago plant enter with the Abbott Labs and Great Lakes NTC streams, go through bar screens and an overflow diversion chamber, then are combined with treated effluent for pumping to the Gurnee plant for treatment (R.63; see Ex. 3). The pumping capacity to Gurnee is 25.5 mgd, but Gurnee could only accept 12.0 MGD for treatment in 1978-79 (Ex. 4, p. 3-2 & 4-7, R 80). The North Chicago plant, therefore, cannot currently use its full pumping capacity to Gurnee. Pumping too much effluent to the Gurnee plant results in an upset of that plant's biological system. Gurnee is currently only capable of operating at a peak capacity of 25 MGD to 30 MGD before this occurs (R. 80).

During extreme wet weather flows any additional flow beyond the accepting capacity of Gurnee enters a 1.8 MG retention basin at North Chicago (R. 63; Ex. 4, p. 3-2). Additional excess flows over this retention capacity are chlorinated and discharged to Lake Michigan without further treatment. There is no current capability for phosphorus removal at North Chicago and no land available at the plant for expansion of the overflow storage capacity (Ex. 4, p. 3-2; R. 85). Any expansion in overflow storage capacity would have to occur at the NSSD Gurnee STP (R. 47 & 67; see Ex. 4, p. 3-2). Nothing in the record considers the viability of discharging excess flows at the Gurnee STP to the Des Plaines River instead of to Lake Michigan.

The record testimony indicates that for all or part of the years 1979 and 1981-83, the North Chicago STP averaged 29 overflow events per year with an average annual overflow volume of 145.3 MG (Ex. 4, p. 4-10). This is based on the NSSD consulting engineer's study. Detailed data for overflow event-days are available for North Chicago similar to that discussed for Waukegan. The North Chicago data include 200 event-days, of which discharge flow data is available for 176, effluent phosphorus data for 171, and data for both criteria for 152 event-days. The detailed data on event-days in the record for 1980-87 (Ex. 4, pp. 4-9; Ex. 6 App.; Ex. 7) indicates an annual average number of 27 event-days, but based on the data for which excess flow discharge volumes were available (not including the 1980 data for which much discharge volume information was not recorded), the annual average discharge volume was 81.3 MG for the six and one-half years 1979 and 1981-87. The highest year indicated by the record (1979) saw a total effluent volume of 418

MG discharged to the lake in 50 event-days (Ex. 4, pp. 4-10). For those parts of the years 1980-87 for which the record includes 176 individual event-days with more detailed flow volume data, the largest single event-day occurred on December 3, 1982, when North Chicago discharged 12.67 MG to the lake, and February 23, 1985, when 12.32 MG entered the lake. During the week from December 2-8, 1982, seven event-days occurred for a total discharge of 49.39 MG. Between February 21, 1985 and March 10, 1985, 18 event-days discharged 78.46 MG to the lake. Although the occurrence of event-days is more sporadic at North Chicago than at Waukegan, they still tend to happen for periods from one to several days running (2.7 days average). There appears no definite pattern to either the daily flow or the phosphorus content of the discharges during these periods. A summary tabulation of the annual totals and averages follows:

Summary Tabulation: Annual North Chicago STP Overflow DATA

<u>Year</u>	<u>Annual Discharge</u>	<u>Annual Events</u>	<u>Phosphorus Average*</u>
1979	418 MG	50	3.0 mg/l as P
1980	9.3**	24	3.7
1981	28.6	21	3.9
1982	82.5	27	3.3
1983	84.9	26	2.1
1984	97.9	44	2.7
1985	116.3	27	2.1
1986	114.2	25	1.7
1987 (6 mos)	3.8**	6	2.46
Total (8.5 yrs)	942.4 MG**	251	--
Average	134.6 MG**	33	2.89 mg/l as P

* Indicates average total phosphorus based on available data only. Some data were missing for each of nearly all years

** Indicates total discharged volume for available data. 18 data for 1980 and 5 data for 1987 were missing. For this reason, the total flow and average annual flow data do not consider 1980 and 1987 data, leaving only a 7.0 year base for flow data.

Examination of the detailed 1980-87 discharge data for which discharge volumes were available indicates that elimination of smaller discharges diminishes the number of discharges more rapidly than it diminished their total volume. The tabulation below is similar to that given above for Waukegan. Reference is made to that narrative for explanation. The table follows:

Numbers and Volumes of North Chicago Overflow Discharges by Event Size

Size of Event	By Number of Events			By Category Volume		
	Number	Percent	Cum %	MG	Percent	Cum. %
Less than .25 MG	12	6.8	6.8	1.66	0.3	0.3
.25 MG to .50 MG	14	8.0	14.8	5.18	1.0	1.3
.50 MG to 1.0 MG	23	13.1	27.8	17.5	3.2	4.5
1 MG to 2 MG	32	18.2	46.0	45.82	8.5	13.0
2 MG to 4 MG	40	22.7	68.8	110.08	20.5	33.5
4 MG to 6 MG	26	14.8	83.5	125.90	23.4	56.9
6 MG to 8 MG	19	10.8	94.3	131.24	24.4	81.3
8 MG to 10 MG	5	2.8	97.2	43.96	8.2	89.5
Greater 10 MG	5	2.8	100.0	56.58	10.5	100.0
Totals		176	100.0	537.57	100.0	—

The mean event-day size indicated by this data was 3.05 MG. The median was about 2.16 MG, but half the total volume discharged was in event-days of greater than 5.29 MG. Elimination of the first 10 MG of all event-days reduces the number of event-days during this period (August, 1980 through March, 1987 = 80 months = 6.67 years) from 176 to 5 (from 26 to less than 1 per year, average) and the overall discharge volume from 537.57 MG to 6.58 MG (from 80.6 to 1.0 MG per year, average; 98.8% reduction). Elimination of the first 13 MG of each event-day eliminates them all. The NSSD engineer estimated, based on 1979-83 data, that certain improvements at the NSSD Gurnee plant would reduce the annual average number of events to seven and discharge volume to 20.6 MG (85.8% reduction). The respective estimates are disparate, and they are significant to later discussion.

The NSSD engineer indicated that the annual average phosphorus contents of the discharges during 1979-83 ranged from 1.97 to 3.88 mg/l, with an overall average over the five years of 3.0 mg/l. Examination of the 171 detailed data for 1980-87 for which phosphorus is available reveals a range of from 1.36 mg/l to 4.57 mg/l, with an average of 2.77 mg/l as P. A summary tabulation of these data, categorized by effluent phosphorus content, and the associated percentage of discharges within each category, follows:

Number of Event-Days Discharging Specified Phosphorus in Effluent

Year	Effluent Phosphorus Content (mg/l as P)											Total	
	1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0							
1980	0	0%	0	0%	7	37%	5	26%	6	32%	1	5%	19
1981	0	0%	0	0%	2	10%	14	67%	3	14%	2	10%	21
1982	0	0%	1	4%	7	29%	12	50%	4	17%	0	0%	24
1983	1	4%	10	40%	13	52%	1	4%	0	0%	0	0%	25
1984	1	3%	7	18%	16	41%	15	38%	0	0%	0	0%	3w
1985	2	2%	8	36%	8	36%	4	18%	0	0%	0	0%	22
1986	4	25%	8	50%	1	6%	3	19%	0	0%	0	0%	16
1987	2	40%	2	40%	1	20%	0	0%	0	0%	0	0%	5
TOTAL	10	6%	36	21%	55	32%	54	32%	13	8%	3	2%	171
CUM.	10	6%	46	27%	101	59%	155	91%	168	98%	171	100%	-

During this entire period, only ten (6%) of the samples complied with the effluent standard of 1.0 mg/l as P applicable to Lake Michigan discharges. One interesting trend indicated by this data is that the effluent phosphorus content of North Chicago discharges appears to decrease with each succeeding year. The highest individual datum submitted was 9.1 mg/l (Ex. 4, pp. 4-9; Ex. 6 App.; Ex. 7).

The record indicates that a significant portion of the total phosphorus discharged in the North Chicago effluent was in excess of the 1.0 mg/l Lake Michigan effluent standard. The NSSD engineer's estimate indicates that the average annual total phosphorus discharged from North Chicago to Lake Michigan during the period including part or all of 1979-83 was 3,635 pounds (Ex. 4, pp. 4-10 & 5-3) -- about 2,422 pounds (200 percent) in excess of what would have entered the lake had the effluent consistently averaged 1.0 mg/l as P. The highest single year indicated by the record was 1979, during which NSSD discharged 10,458 pounds of phosphorus to Lake Michigan -- 6,970 pounds (200 percent) in excess of a consistently 1.0 mg/l effluent (Ex. 4, pp. 4-10). Analysis of the 171 tabulated individual 1981-87 event-days indicates that the North Chicago STP overflow discharges in excess of 1.0 mg/l total phosphorus added an excess of 5,420 pounds of total phosphorus to the lake in violation of Section 304.123(a), or an average excess of 810 pounds per year, when factored to account for the 14.5% of event-days for which phosphorus data are missing. The overall total phosphorus discharged during the period was about 12,410 pounds when factored for the missing data, or an annual average of 1,860 pounds for these six and two-thirds years. The estimates based on 1981-87 data are lower than the NSSD engineer's estimates based on 1979-83. This may partly result from the trend towards lower effluent phosphorus levels since 1983.

The NSSD engineer who studied the phosphorus discharge problem projected an estimated capital cost of \$401,700 and an annual operating cost of \$32,000 for the installation of a ferric

chloride chemical removal system under the current operational scheme. This is about \$20 per pound of phosphorus that the system would remove (Ex. 4, p. 5-3). The engineer indicated that the costs for an aluminum sulfate removal system would be similar (R. 114).

The record reflects no planned improvements for the North Chicago plant that would impact its phosphorus discharges. The current 201 Facilities Improvements Plan for the Gurnee STP calls for an increase in the treatment and overflow retention capabilities of that plant. This would permit using the transfer pumps at North Chicago to operate at up to their 25.5 MGD capacity (Ex. 4, p. 3-2). These improvements include the addition of 50 MG excess flow retention capacity by the beginning of 1991 (R. 64 & 80). They also include staged increases in design treatment capacity, as follows: from the current 13.8 MGD to 17.25 MGD by December, 1987; to 19.6 MGD by December, 1988. (R. 67-68 & 83). The Gurnee STP currently receives an average of 12.4 MGD for treatment (R. 67). When fully expanded, the plant will accept a peak flow of 39.2 MGD (R. 83).

The addition of the 50 MG retention capacity is in response to the final Board Opinion and Order in PCB 85-208, for the purpose of controlling North Chicago excess flow discharges to the lake (R. 64; see supra Footnote on page 1 re PCB 85-208). The record is unclear whether NSSD is otherwise fully committed to the full plant expansion to 19.6 MGD by December, 1988. If NSSD can operate its North Chicago sewage transfer pump to Gurnee at its full capacity of 25.5 MGD, as opposed to the current maximum of about 12 MGD (R. 80-81), an additional 13.5 MGD can transfer to Gurnee before overflow occurs to Lake Michigan. It was on these expansions that the NSSD engineer based all his phosphorus reduction and cost estimates.

The NSSD engineer who studied the phosphorus discharge problem estimated that these improvements would reduce the average annual amount of phosphorus discharged from North Chicago from 3,635 pounds to 515 pounds (85% reduction) (Ex. 4, p. 5-3). Elimination of the first 13 MG from each discharge in the detailed 1981-87 data above eliminated all discharges. This would mean a 100% reduction in the 1981-87 estimated annual average of 1,860 pounds of phosphorus discharged to the lake. The NSSD engineer estimated that ideal ferric chloride phosphorus removal alone would reduce the North Chicago discharges to 1,211 pounds per year (67% reduction) (Ex. 4, p. 5-3). Based on the detailed 1981-87 data, ferric chloride would have reduced the phosphorus discharged by the above-estimated annual average excess of 810 pounds, to a permissible discharge of 1,050 pounds (43.7% reduction) (Ex. 4, p. 5-3). The detailed 1981-87 data indicate that this combination of flow diversion and phosphorus removal would likely be unnecessary because diversion alone would have eliminated the phosphorus during this period. For comparative purposes, these two estimates are tabulated below:

Comparison of NSSD and Estimated Phosphorus
Reductions by Method of Reduction for North Chicago

<u>Phosphorus Reduction Method</u>	<u>Phosphorus Discharges</u>	
	<u>NSSD 1979-83 Estimates</u>	<u>1980-87 Estimates</u>
Existing Facilities	3,635 pounds	1,860 pounds
Chemical Removal Alone	1,211 pounds	1,050 pounds
Phosphorus Reduction	67%	43.7%
201 Facilities Improvements	515 pounds	No Discharges
Phosphorus Reduction	85%	100%
Both Methods Together	171 pounds	---
Phosphorus Reduction	96%	---

The NSSD estimates based on 1979-83 data indicate a greater reduction by chemical reduction, but a lower reduction by flow diversion, than do the detailed 1981-87 data.

The NSSD engineer estimated the annual operating cost of the ferric chloride removal system on this reduced overflow volume would amount to \$7,500, which translates to \$134 per pound of phosphorus removed from the effluent. Such a system would remove only an average additional 344 pounds of phosphorus, permitting only 171 pounds to discharge to Lake Michigan. These treatment estimates assume consistent treatment (Ex. 4, p. 3-2). The same operational constraints that make the Waukegan effluent difficult to treat for phosphorus (i.e., intermittent, variable flow; variable effluent phosphorus content, etc.) apply to North Chicago (R. 114-115), but the North Chicago effluent does have a more consistent and higher phosphorus content than Waukegan. No effort was made to estimate removal costs based on 1981-87 data for the same reasons this was not done for the Waukegan cost estimates.

Impact of the Phosphorus Discharges on Lake Michigan

The engineering firm retained by NSSD to study the environmental impact of its phosphorus discharges made visual inspections of the lake, collected water samples and analyzed them for phosphorus, and performed a literature study of the pollution by and impact of phosphorus on the lake. Nothing in the record correlates phosphorus loading with algal bloom or chlorophyll content of the lake. No data exist in the record which indicate the algae or chlorophyll content of the lake in the areas of the NSSD Waukegan and North Chicago excess flow outfalls. The NSSD consulting engineer concluded that no evidence indicates an adverse environmental impact due to the phosphorus content of these effluents.

The near-shore area of Lake Michigan is mesotrophic along the north suburban shoreline as a result of local phosphorus contributions (Ex. 8, p. 18). The existing ambient water quality

standard for phosphorus in the lake is 0.007 mg/l (as P).^{*} 35 Ill. Adm. Code 302.504. An international treaty with Canada, the Great Lakes Water Quality Agreement of 1978, imposes a 1 mg/l total phosphorus effluent limitation on "all plants discharging more than one million gallons per day to achieve, where necessary to meet the loading allocations ..., or to meet local conditions, whichever are more stringent" Great Lakes Water Quality Agreement of 1978 , Ann. 3, par. 2(a), International Joint Com. (Nov. 22, 1978). The target "future phosphorus load" (i.e., the loading allocation) for Lake Michigan is indicated as 5600 metric tons (6170 short tons) per year. Id. at par. 3. The 1981 and 1982 estimated phosphorus loads to the lake were 4091 metric tons and 4084 metric tons, respectively (Ex. 4, p. 4-2). The applicability of this treaty to NSSD intermittent discharges is uncertain.

The Lake County contributions of phosphorus to Lake Michigan are significant, and the NSSD portion of that contribution is not insignificant. Lake County comprises 0.08 percent of the total shoreline of Lake Michigan with 31 miles of shore (Ex. 8, pp. 3 & 30), but it contributes 0.97% of the total phosphorus loading to the lake. An estimate of the total phosphorus loading from Lake County is as follows (Ex. 8, pp. 27-30):

<u>Phosphorus Source</u>	<u>Phosphorus Contribution</u>		
	<u>% County</u>	<u>% L Michigan</u>	
Stormwater	13,400 pounds	6.3%	0.061%
Beach Erosion	155,000 pounds	72.5%	0.705%
Baseflow	25,800 pounds	12.1%	0.117%
Atmosphere	6,100 pounds	2.9%	0.028%
Other Runoff	1,660 pounds	0.8%	0.008%
NSSD Overflow (1982)	11,800 pounds	5.5%	0.054%
Total Lake County	213,760 pounds	100.0%	0.972%
Total Lake Michigan (1978)	22,000,000 pounds	—	100%

The Lake County beach erosion contribution is the most significant source of phosphorus from that county, but it contains less than three percent available phosphorus. This decreases the environmental significance of its contribution. The next most significant sources of phosphorus are baseflow, from groundwater, and stormwater runoff. The NSSD overflow discharges contribute 5.5 percent of the overall Lake County phosphorus contribution, or 0.05% of the overall lake loading. Phosphorus levels in the lake, off Lake County, did drop during 1973-83, and the near-shore water quality was improved with respect to phosphorus since elimination of continuous discharges from NSSD treatment plants (Ex. 8, pp. 19 & 37).

* See infra footnote on page 16

The Lake Michigan Water Quality Reports indicate that high percentages of samples collected at ten Lake Michigan sampling stations from the Chicago River north to Waukegan Harbor violated the water quality standard for total phosphorus. The overall rates of violations at all ten stations were 33% in 1982, 37% in 1983, 43% in 1984, and 39% in 1985 (Ex. 4, p. 4-1; Ex. 9, p. 16; Ex. 10, p. 19; Ex. 11, p. 19). Only six of these sampling stations were near the Lake County shoreline, however, and only three were near the NSSD overflow outfalls (See Ex. 4, p. 4-4). The reports did not include station-by-station violations rates, and the detailed data were presented in a two-digit format that only permits approximation of the violations rates for the individual Lake County stations. Any total phosphate data of .02 mg/l or lower are considered herein within the standard, and any of .03 mg/l or higher are deemed to have "clearly violated" the standard.*

The detailed water quality survey data for 1981 through 1985 (Ex. 4, p. 4-3; Ex. 9, pp. 88-93); Ex. 10, pp. 99-104; Ex. 11, pp. 120-125) indicate that 56 of 198 samples (28%) collected at specified points nearest to the Lake County shoreline clearly violated the Lake Michigan water quality standard of 0.007 mg/l as P. 35 Ill. Adm. Code 302.504. The relevant sampling points and their approximate locations were the following:

5N	1 mile offshore from Great Lakes NTC
6N	1 mile offshore from midway between Great Lakes NTC and Waukegan Harbor
7N	1 mile offshore from Waukegan Harbor
8N	4 miles offshore from Lake Forest
9N	5 miles offshore from Highland Park
10N	3 miles offshore from Glencoe

The sampling points 5N, 6N, and 7N are nearest the NSSD Waukegan and North Chicago overflow discharge points, but are also nearest the shore. A total of 31 out of 99 of these near-shore, near NSSD samples (31%) clearly violated the standard. The other three off-shore sampling points away from NSSD outfalls clearly violated the standard in 25 of 99 samples (25%). There is no real statistical significance in the increase in the rate of clear violations nearer the NSSD overflow outfalls than at points 8N, 9N, and 10N.

It is difficult to attribute the increased rate of clear violations to the NSSD discharges, but the data do not permit

* The record indicates some confusion over the phosphorus water quality standard. The standard is 0.007 mg/l as phosphorus (P) or 0.021 as phosphate (PO₄). Convert phosphorus to phosphate by using a multiplication factor of 3.066. Convert phosphate to phosphorus by using a multiplication factor of 0.3261.

dismissing this possibility. Statistical analysis of these data, assuming a normal distribution, reveals the following with regard to the mean phosphorus content of the lake water at each station:

Station (N. to S.)	Phosphate Content (mg/l as PO ₄)*			Probability of Violation	Obs. "Clear Violations"
	Mean	Lower 95% C.L.	Upper 95% C.L.		
7N	.025	.017	.033	57%	30%
6N	.022	.016	.027	51%	33%
5N	.021	.016	.026	51%	30%
Avg. Near	.023	.019	.026	54%	31%
8N	.022	.015	.028	51%	24%
9N	.021	.016	.027	51%	24%
10N	.019	.015	.023	44%	27%
Avg. Away	.021	.017	.024	49%	25%
Avg. All	.022	.019	.024	52%	28%

*Denotes that the conversion from phosphate to phosphorus involves multiplication by 0.3261. To convert from phosphorus to phosphate multiply by 3.066.

The "probability of violation" is the probability that a random sample would violate the Lake Michigan 0.007 mg/l as P water quality standard. The imprecise nature and paucity of the two-digit data probably contribute significantly to the vast differences between the calculated probability of violation and the observed rates of "clear violation." Despite the lack of any statistical differences between the mean phosphorus contents at these six monitoring stations, the trend is for a regular decrease in the mean phosphorus content and the probability of violation as one moves southward from station to station, beginning at Waukegan Harbor.

The record includes no direct indication that NSSD phosphorus discharges cause or contribute to water quality Standard violations. Estimates of phosphorus contributions are possible for comparative purposes, however, using certain record estimations of the near-shore mixing zone. These estimates indicate a great potential for the larger NSSD discharges with higher phosphorus contents to at least contribute to such violations. The near-shore mixing zone used by the Northeastern Illinois Planning Commission was a 2,000 foot wide strip of water along the shore with an average depth of 10 feet. They used this to estimate the impact of pollutant loadings to the lake (Ex. 8, p. 23). This translates to a volume of approximately 470 MG within a 2,000 foot radius of an outfall on the shore. Assuming complete mixing within this zone, the following calculated contributions to the total phosphorus content of the lake water within this zone result:

Calculated Contribution to Lake Phosphorus
Content (mg/l as P) in 2,000 Foot Zone

Discharge Volume (MG)	Phosphorus Content of Effluent (mg/l as P)				
	1.0	1.3	2.0	3.0	5.0
1	.0021	.0028	.0043	.0064	* .0106
2	.0043	.0055	* .0085	* .0128	* .0213
5	* .0106	* .0138	* .0213	* .0319	* .0532
10	* .0213	* .0277	* .0426	* .0638	* .1064

*Denotes that the effluent contribution alone violates the water quality standard of 0.007 mg/l as P.

If this zone is extended to a one-mile radius with an average depth of 20 feet, the volume defined increases to 6,550 MG. The phosphorus contributions with ideal mixing within this zone then become:

Calculated Contribution to Lake Phosphorus
Content (mg/l as P) in One Mile Zone

Discharge Volume (MG)	Phosphorus Content of Effluent (mg/l as P)				
	1.0	1.3	2.0	3.0	5.0
1	.0002	.0002	.0003	.0005	.0008
2	.0003	.0004	.0006	.0009	.0015
5	.0008	.0010	.0015	.0023	.0038
10	.0015	.0020	.0031	.0046	*.0076
20	.0031	.0040	.0061	*.0092	*.0153

*Denotes that the effluent contribution alone violates the water quality standard of 0.007 mg/l as P.

These estimates do not account for the background phosphorus content of the local lake water, which appears to average near the water quality standard in the near-shore area off Lake County (See Ex. 9; Ex. 10; Ex. 11). It is worthwhile to remember in examining these tables what the record indicates with regard to Waukegan STP and North Chicago STP overflow discharges. The average discharge volume for a Waukegan event-day was 12.2 MG, with a maximum single event-day of 67.7 MG, during 1980-87. The average phosphorus content of this effluent was 1.14 mg/l as P during this period, with a maximum of 2.70 mg/l. The mean North Chicago event-day was 3.05 MG, with a maximum of 12.67 MG. The average North Chicago total phosphorus content was 2.77 mg/l as P, and the maximum was 9.08 mg/l.

The NSSD consulting engineer concluded that the impact of NSSD phosphorus discharges on the lake was unknown, but that it warranted further monitoring and study. The consulting engineer recommended that NSSD should develop and implement a program of

consistently sampling and testing its overflow effluent and the receiving lake water in the vicinity of its discharges for phosphorus. He further recommended that NSSD should reevaluate the need for phosphorus controls if a negative impact is determined (Ex. 4, pp. 1-2 & 1-3). The engineer concluded that implementing some form of phosphorus control in addition to implementing the prospective 201 Facilities Improvements would have no more than an insignificant effect on lake water quality (Ex. 4, p. 6-1). The engineer made no comment with regard to implementing phosphorus controls or the environmental impact if the 201 improvements do not occur. The engineer's projections of estimated annual phosphorus loadings to the lake and the calculated loadings based on 1980-87 detailed data were tabulated in the above discussions.

Phosphorus loadings to the lake are significant to the extent that they contribute to a water quality violation or have an adverse environmental impact by promoting algal bloom and lake eutrophication. The record hints that some reduction in phosphorus loading to the lake yields a calculable decrease in biomass, but the nature of the relationship is not given (See Ex. 11, pp. 56-58). This could mean that increased phosphorus loadings might result in a concomitantly increased algal bloom. This could contribute to the natural eutrophication of the lake. The record includes data for the algal and chlorophyll a contents of the lake, but not for an area near the NSSD outfalls, and not in a form that can relate to biomass and phosphorus. (See Ex. 9, pp. 49-58; Ex. 10, pp. 55-63; Ex. 11, pp. 51-61). The NSSD consulting engineer speculated that the NSSD phosphorus discharges would have only a negligible impact on the lake "if the 201 Facilities Plan improvements are implemented" over what would occur if NSSD instituted phosphorus removal (Ex. 4, p. 1-2). The record supports this conclusion, but in a slightly altered form: the facilities expansions that would allow excess flow diversion away from the lake would eliminate more phosphorus to the lake than would chemical removal alone.

NSSD Proposal and Agency Recommendation:

NSSD proposes in its comments to the December 24, 1987 Hearing Officer Order a numerical limit for its phosphorus discharges, as follows:

Waukegan:

Limit (mg/l as P) = $4.96 - (1.5 / 23 \times \text{event-days per month})$

North Chicago:

Limit (mg/l as P) = $5.96 - (1.5 / 23 \times \text{event-days per month})$

(Comments from the North Shore Sanitary District). This numerical standard would make the effluent limitation a function of the number of event-days, as follows:

Event-Day Month	Phosphorus Effluent Limitation (mg/l as P)	
	Waukegan	North Chicago
1	4.9	5.9
7	4.5	5.5
30	3.0	4.0

In its response, NSSD reaffirms facts adequately supported by the record: effluent phosphorus content, the number of event-days, and the overflow discharge volumes are dictated by factors beyond the control of NSSD. The Agency has not commented on this proposed numerical phosphorus limit. (See "Agency's Response to Hearing Officer Order" dated January 25, 1988 at p. 2). The Agency has proposed an alternative approach that appears more fully supported by the record.

The Agency proposes adoption of indirect discharge volume limits. It acknowledges that NSSD has no control over the amounts and patterns of precipitation, but focuses on the fact that NSSD does have control over the operation and expansion of its plants. The Agency suggests that this Board should require NSSD to provide peak wet weather treatment at its Waukegan STP of twice its design average flow once the proposed 201 Facilities Improvements expansion occurs. The Agency does not comment on the fact that NSSD has not yet committed to undertaking the 201 improvements at Waukegan. The Agency feels that certain plant improvements at Gurnee required by the February 5, 1987 Opinion and Order of this Board in PCB 85-208 will sufficiently reduce overflow discharges from the North Chicago plant.* The Agency concedes "that attempting phosphorus removal from these sources is impractical and probably not cost effective." ("Agency Response to Hearing Officer Order" at 3).

The Agency proposes that this Board require NSSD to monitor the lake for phosphorus on a continuing basis. It proposes monitoring weekly samples for phosphorus from certain local beaches near the NSSD CSO outfalls: Waukegan North, Waukegan Central, and Foss Park. It adds Illinois Beach State Park and Lake Bluff for data on background phosphorus levels in the lake. The Waukegan North site is about 1,700 feet south of the Waukegan CSO outfall, and the Waukegan Central site is about 2900 feet south of this outfall (Ex. 5, p. 3-3). Illinois Beach State Park is over a mile north of the Waukegan outfall (Ex. 1). The Foss Park sampling site is about 1,800 feet south of the North Chicago CSO outfall (Ex. 6, p. 3-3). Lake Bluff is about three miles south of North Chicago (Ex. 1). The Agency recommends testing the beach samples for phosphorus for two days following overflow events occurring during warm weather, and as soon as

* See supra footnote on page 1.

possible after events during the non-swimming months. The Agency further recommends offshore sampling and testing for three events per year, with one set of additional background samples during each spring, summer, and fall, at least two weeks after any discharges. It suggests that all event monitoring should occur within 24 hours of any event, where possible, and that any testing of water samples should include fecal coliform. The Agency finally recommends phosphorus, BOD, TSS, and volatile solids testing of sediment samples, but it does not recommend a sampling frequency.

II. Discussion

This is a troublesome proceeding. Although the record supports certain conclusions, information is lacking which could remove all hesitation in adopting a site-specific phosphorus rule for the Waukegan and North Chicago intermittent discharges. The following conclusions are made based on the record in this proceeding:

1. The costs of chemical phosphorus removal are very high for both Waukegan and North Chicago discharges. They increase to exorbitant if certain proposed 201 Facilities Improvements are implemented by NSSD;
2. The intermittent nature of the discharges would likely cause process control problems and less than optimal phosphorus removal, resulting in discharges in excess of the existing effluent limitation despite good engineering practice;
3. Merely focusing on a numerical effluent limitation can ease the burden of performance monitoring and enforcement, but it would likely not optimally reduce phosphorus discharges to Lake Michigan. It would also ignore the fact that the phosphorus concentrations in the overflow effluents are probably beyond consistent control;
4. Statistically, the average annual phosphorus content of the Waukegan effluents have not varied appreciably during 1981-87, but were slightly higher during 1979 and 1980, with an overall annual average concentration of 1.2 mg/l as P during the period 1979-87. During this period, 99% of samples measured 2.5 mg/l as P or less;

5. Statistically, the average annual phosphorus content of the North Chicago effluents significantly decreased since about 1983, and showed greater variability than those of Waukegan. The annual average phosphorus contents was 3.5 mg/l during 1979-82 and 2.2 mg/l during 1983-87, with an overall average of 2.9 during the entire period 1979-87. During 1980-82, 95% of samples contained total phosphorus of 5.0 mg/l as P or less, but 100% of samples contained less than 4.0 mg/l as P during 1983-87;
6. The individual volumes, annual numbers, and annual total volumes of overflow discharges from both Waukegan and North Chicago have shown great variability during 1980-87, but 1985 and 1986 (the last two years for which a full years' data were available) had the highest total annual volumes for both plants and the highest number of events at Waukegan. No definite increasing trends are yet apparent for these criteria;
7. The record indicates no significant correlations among any of the following variables: effluent phosphorus content, overflow discharge volume, or event frequency;
8. No basis exists in the record to support adoption of NSSD's proposed scaled phosphorus effluent limitations of from 3.0 to 4.9 mg/l as P for Waukegan or from 4.0 to 5.9 mg/l as P for North Chicago;
9. The greatest reductions in overall total phosphorus loading to the lake would result from diversion of overflow discharges to either alternate treatment or retention facilities. Elimination of the first 14 MG of each Waukegan discharge during 1980-87 for which detailed data exist in the record would have eliminated about 71% of the total volume discharged during this period. This would likely have reduced the total phosphorus discharged by at least a similar amount. Similar elimination of the first 13 MG of all North Chicago

discharges would have eliminated all discharges to the lake;

10. Operation of the North Chicago effluent transfer pump at its 25.5 MGD capacity, instead of its current maximum capacity of about 12 MGD results in an additional capacity of at least 13 MGD which could transfer overflow volume to the NSSD Gurnee plant. Construction of a 50 MG retention basin at Gurnee by January 1, 1991, and expansion of that plant's design capacity from 13.8 MGD to 19.6 MGD (from a peak capacity of about 28 MGD to about 39 MGD) by January 1, 1989, will permit operation of the North Chicago effluent transfer pump at its full capacity;
11. Expansion of the Waukegan plant's current design capacity of 19.8 MGD and peak capacity of about 30 MGD to a design capacity of 22 MGD and peak capacity of 44 MGD will result in an additional peak capacity of 14 MGD available to treat wastewater before it is diverted to that plant's 38 MG overflow retention system and to the lake. NSSD proposes such expansion as a part of its 201 Facilities Improvements Plan and projects the possible completion of this expansion in 1992 or 1993, but is not yet committed to implementing it;
12. The record amply supports providing some form of site-specific relief according to the Agency recommendation which seeks to limit phosphorus discharges by diversion or elimination of excess flows to the lake;
13. According such site-specific relief predicated on diversion or elimination of Waukegan excess flows would require the implementation of the plant improvements that would allow this to occur;
14. Additional land is unavailable at Waukegan and North Chicago to construct additional retention capacity at either facility;

15. The estimates of environmental and water quality impact of the overflows, discharge and the costs of phosphorus control submitted by NSSD, are predicated on the full implementation of the 201 Plan for Waukegan and expansions at Gurnee;
16. The frequency of water quality standards violations along the Lake Michigan shoreline in the vicinity of the Waukegan and North Chicago excess flow outfalls is significant, and the lake is mesotrophic in that area with an average phosphorus content very near the water quality standard, but the average phosphorus content and frequency of standard violations have decreased since NSSD eliminated its former continuous effluents discharges to the lake;
17. Nothing in the record permits the conclusion that either the Waukegan or North Chicago overflow discharges directly and significantly contribute to or cause water quality violations or cause an adverse impact on the lake;
18. Nothing in the record permits a conclusion that neither the Waukegan nor the North Chicago overflow discharges contribute to the frequent water quality violations near the Lake County shore and the mesotrophic condition of the lake in that area; and
19. Future monitoring of lake water quality for phosphorus in the vicinity of the Waukegan and North Chicago outfalls is feasible and reasonable. This could readily include samples collected at areas away from the outfalls to provide background quality information, so that detection of whether the NSSD discharges actually do cause or contribute to water quality violations or have an adverse impact on the lake is possible.

This record presents many problems by raising several questions that it fails to provide adequate information to answer. Many of these are listed below:

1. Do any lower cost alternatives exist for phosphorus removal to those mentioned in the record?;
2. What is the feasibility of transferring the untreated overflow effluent for discharge in the Des Plaines River along with the treated effluent?;
3. What has occurred and where in the NSSD system which has resulted in a significant reduction in the phosphorus content of North Chicago effluent?;
4. Why were the annual overflow effluent volumes significantly increased for both plants during 1985-86, and what caused the increased number of events at Waukegan?;
5. Is there any correlation between rainfall and the occurrences and volumes of overflow events?;
6. How did NSSD derive the formulae for its proposed structured limits?;
7. By what means did the NSSD consulting engineer derive his estimates of reductions in overflow discharge event frequency and volumes, and what impact will various changed circumstances have on the estimates of the frequency and volumes, such as revised expansions at the plants, increases in service areas, an increase in high flow inflow in the Gurnee STP service area, retention basin down time for service, etc.??;
8. What is the cost of the 201 Facilities Plan improvements at Waukegan?; and
9. What alternative actions can NSSD take to reduce phosphorus loadings to the lake if additional information later reveals that its discharges cause or contribute to water quality violations or cause an adverse impact on the lake?

The Board invites comments from any interested persons during the First Notice period on these issues and their prospective effects on this site-specific rule.

The record does not support a conclusion that NSSD's overflow discharges to Lake Michigan directly and significantly cause or contribute to violations of the applicable water quality standards. The record, however, does not support a conclusion that these discharges have no impact on water quality. What the record does indicate is this: Any adverse effect of these discharges would best be minimized by reducing the frequency and volumes of their occurrence, rather than by merely attempting to limit the phosphorus concentration in the existing discharge flows. The Board, therefore, concludes that NSSD attempts at compliance with the existing effluent limitation by chemical phosphorus removal would not be technically feasible and economically reasonable, and would likely result in little or no improvement in Lake Michigan water quality over what is possible if NSSD were to operate its system in compliance with a site-specific rule designed to minimize phosphorus discharges by alternative means.

This Board will not grant the NSSD proposed structured numerical limit. First, we observe that NSSD did not propose an alternative rule in its original petition, it merely requested the non-applicability of the existing rule. We next observe that NSSD first proposed its structured numerical limit in its response to comments by the hearing officer made at the public hearing. We also note that NSSD offered no support for its proposed rule, and it remains unsupported by the record. Finally, comparison with the record phosphorus data indicates the proposed structured limits would impose ceilings on effluent phosphorus contents far in excess of what one could reasonably anticipate. If this Board wants to impose a numerical effluent phosphorus limitation, the record must adequately support that limitation.

In this case, without the guidance of either NSSD or the Agency, this Board would have to independently derive a more reasonable numerical limitation. If this Board were so inclined, such a limitation would be based on the annual average and peak phosphorus contents indicated by the record. It would allow continued overflow discharges without violation, but would not permit degradation of effluent quality. In deriving such a standard, more recent trends would predominate where they conflict with prior indications of the effluent data. By this method, the Board would most likely adopt the following total phosphorus effluent limitations:

Waukegan STP	2.5 mg/l maximum
	1.3 mg/l annual average
North Chicago STP	4.0 mg/l maximum
	3.0 mg/l annual average

These limitations would adequately accommodate the current effluent qualities of both plants without permitting effluent

quality degradation. The Board invites any interested party to comment during the first notice period on the viability and desirability of such a numerical limit.

Whereas such a numerical effluent limitation would not allow degradation of the status quo, neither would it foster improvement in the phosphorus water quality of an already degraded part of the lake. This Board believes adoption of the Agency's approach is the best option available, with only minor modifications:

1. It would seek additional data collection for possible future regulatory action, should further study reveal that NSSD overflow discharges do, in fact, cause or contribute to water quality violations or cause an adverse impact on the lake; and
2. It would require implementation of the 201 Facilities Improvements at Waukegan to attain the benefits NSSD projected in its arguments in favor of site-specific relief.

The required sampling and testing would include criteria to monitor ambient and local lake water quality, rainfall, effluent quality, and local sediments near the outfalls. In addition to the submission of the testing data, NSSD would also submit records of the dates and volumes of each overflow discharge, the volumes of sewage transferred from North Chicago to Gurnee, and the volumes of sewage held in each retention basin each day. Data on fecal coliform counts to be collected along with the lake water phosphorus data should indicate the presence of raw sewage effluent. This Board believes this supplemental data will not only assist the Agency in monitoring NSSD compliance with this rule, but would also aid it and the Board in detecting possible future contributions to water quality violations. These data would further help determine a potentially more effective regulatory structure if one is later found necessary.

We leave to the Agency the details of the required data submissions, but based on its understanding of the Agency's Recommendation, this Board will require submission of the following data at the indicated intervals:

Local and Ambient Beach Water Quality - Total phosphorus and fecal coliform, on at least a weekly basis between March 1 and December 1, to be collected at a single selected site at the following locations:

Illinois Beach State Park,
Waukegan North Beach,

Waukegan Central Beach,
Foss Park, and
Lake Bluff.

Immediate Overflow Event Impact on Beach Water Quality - Total phosphorus and fecal coliform, one sample one day following and one sample two days following each overflow discharge from Waukegan in excess of 9 MG within a 24-hour period, to be collected at a single selected site at the following locations:

Waukegan North Beach, and
Waukegan Central Beach;

One sample one day following and one sample two days following each overflow discharge from North Chicago in excess of 2 MG within a 24-hour period, to be collected at a single selected site at the following location:

Foss Park;

Provided, however, that the selected sampling site for weekly ambient and local water quality is the same corresponding selected site for the immediate overflow event impact on water quality samples; and, further provided, that the immediate overflow event impact sample will obviate a weekly ambient and local water quality sample during that same week at that same site, and no more than a single sample shall be required at any single selected site in any single day.

Background Offshore Water Quality - Total phosphorus and fecal coliform, one sample during March, April, or May; one sample during June, July, or August; and one sample during September, October, or November, at least one week following the most recent overflow discharge from the corresponding facility, and collected at a point 2,000 feet directly offshore from the following outfalls:

Waukegan STP, and
North Chicago STP.

Immediate Event Impact on Offshore Water Quality - Phosphorus and fecal coliform, one sample collected one to two days following an overflow discharge from the corresponding facility, and collected at a point 2,000 feet directly offshore from the following outfalls:

Waukegan STP, and
North Chicago STP.

Effluent Quality - In addition to any monitoring currently required by the Agency, NSSD must consistently report the volume discharged and the effluent total phosphorus content for each day discharge occurs.

Rainfall - Daily rainfall amounts, to be recorded at each of Waukegan STP and North Chicago STP.

This Board will not adopt a sediment sampling and testing requirement in the absence of further clarification and justification. The NSSD engineer, the Agency, and this Board's review of the record have each stressed the importance of continued monitoring to determine more fully the impact of NSSD phosphorus discharges to the lake. The full monitoring requirements shall take effect with this rule. In addition to the Agency data submittal requirements, the Board's interest in this matter prompts it to require NSSD to submit the collected data, together with annual summaries of the data, in a comprehensive report to this Board for the years 1987 through 1991 on or before April 1, 1992.

The detailed collected data to be submitted in the comprehensive report to the Board shall include, at a minimum, all data collected for each of the following criteria: overflow events by date, overflow volume discharged by date and source, and overflow effluent total phosphorus content by date and source, and background offshore water quality, immediate overflow event offshore water quality impact, immediate overflow event beach water quality impact, and local and ambient beach water quality data for total phosphorus contents and fecal coliform counts by sample collection date and location, as each of these sampling criteria are described above. These collected data shall also include for the Waukegan, North Chicago, and Gurnee plants, the following by plant and date: the daily rainfall amounts, the total daily flows receiving full treatment, and the maximum daily volumes held in the respective retention basins. For North Chicago, the data shall include the maximum daily effluent transfer rate to Gurnee and the total daily volume so transferred.

The annual summaries shall include the total volumes discharged, the number of overflow events occurring and the average effluent phosphorus concentrations for the Waukegan and the North Chicago overflow discharge facilities for each of the years 1987 through 1991. They shall also include the average annual total phosphorus content of the lake water for each sampling location, and the total rainfall occurring at each

monitoring location, for each year that these criteria are monitored. The annual summaries shall include the annual total treated effluent volumes and the annual wet weather, dry weather, and overall daily average treatment flows for each of the Waukegan, the North Chicago, and the Gurnee treatment plants. This report shall also attempt to analyze and assess the probable effect of the NSSD excess flow discharges on lake phosphorus water quality. Finally, NSSD shall submit a copy of this report to the Agency, and NSSD or the Agency may use the opportunity of this April 1, 1992 report, or any earlier date, to bring to the Board's attention any trends that might indicate the need for further Board action. Submission of this report shall terminate NSSD's continued monitoring imposed by this Order, unless otherwise required by the Agency. The delayed date for submitting this comprehensive report shall not affect any other Agency-imposed requirement for more frequent periodic submission of monitoring data to the Agency.

The Board wants NSSD and other interested persons to take special note of the following:

Nothing in this Opinion and Order or in the site-specific rule obviates NSSD compliance with 35 Ill. Adm. Code 304.105.

ORDER

The Board hereby proposes the following rules for First Notice publication and directs the Clerk of the Board to file them with the Office of the Secretary of State.

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE C: WATER POLLUTION
CHAPTER I: POLLUTION CONTROL BOARD

PART 304
EFFLUENT STANDARDS

SUBPART A: GENERAL EFFLUENT STANDARDS

Section	
304.101	Preamble
304.102	Dilution
304.103	Background Concentrations
304.104	Averaging
304.105	Violation of Water Quality Standards
304.106	Offensive Discharges
304.120	Deoxygenating Wastes
304.121	Bacteria
304.122	Nitrogen (STORET number 00610)
304.123	Phosphorus (STORET number 00665)
304.124	Additional Contaminants

- 304.125 pH
- 304.126 Mercury
- 304.140 Delays in Upgrading
- 304.141 NPDES Effluent Standards
- 304.142 New Source Performance Standards (repealed)

SUBPART B: SITE SPECIFIC RULES AND EXCEPTIONS
NOT OF GENERAL APPLICABILITY

- Section
- 304.201 Calumet Treatment Plant Cyanide Discharges
 - 304.202 Chlor-alkali Mercury Discharges in St. Clair County
 - 304.203 Copper Discharges by Olin Corporation
 - 304.204 Schoenberger Creek: Groundwater Discharges
 - 304.205 John Deere Foundry Discharges
 - 304.206 Alton Water Company Treatment Plant Discharges
 - 304.207 Galesburg Sanitary District Deoxygenating Wastes Discharges
 - 304.208 City of Lockport Treatment Plant Discharges
 - 304.209 Wood River Station Total Suspended Solids Discharges
 - 304.212 Sanitary District of Decatur Discharges
 - 304.213 Union Oil Refinery Ammonia Discharge
 - 304.214 Mobil Oil Refinery Ammonia Discharge
 - 304.219 North Shore Sanitary District Phosphorus Discharges

SUBPART C: TEMPORARY EFFLUENT STANDARDS

- Section
- 304.301 Exception for Ammonia Nitrogen Water Quality Violations

Appendix A References to Previous Rules

AUTHORITY: Implementing Section 13 and authorized by Section 27 of the Environmental Protection Act (Ill. Rev. Stat. 1985, ch. 111-1/2, pars 1013 and 1027)

SOURCE: Filed with the Secretary of State January 1, 1978; amended at 2 Ill. Reg. 30, p. 343, effective July 27, 1978; amended at 2 Ill. Reg. 44, p. 151, effective November 2, 1978; amended at 3 Ill. Reg. 20 p. 95, effective May 17, 1979; amended at 3 Ill. Reg. 25 p. 190, effective June 21, 1979; amended at 4 Ill. Reg. 20, p. 53, effective May 7, 1980; amended at 6 Ill. Reg. 563, effective December 24, 1981; codified at 6 Ill. Reg. 7818, amended at 6 Ill. Reg. 11161, effective September 7, 1982; amended at 6 Ill. Reg. 13750 effective October 26, 1982; amended at 7 Ill. Reg. 3020, effective March 4, 1983; amended at 7 Ill. Reg. 8111, effective June 23, 1983; amended at 7 Ill. Reg. 14515, effective October 14, 1983; amended at 7 Ill. Reg. 14910, effective November 14, 1983; amended at 8 Ill. Reg. 1600, effective January 18, 1984; amended at 8 Ill. Reg. 3687,

effective March 14, 1984; amended at 8 Ill. Reg. 8237, effective June 8, 1984; amended at 9 Ill. Reg. 1379, effective January 21, 1985; amended at 9 Ill. Reg. 4510, effective March 22, 1985; peremptory amendment at 10 Ill. Reg. 456, effective December 23, 1985; amended at 11 Ill. Reg. 3117, effective January 28, 1987; amended in R84-13 at 11 Ill. Reg. 7291, effective April 3, 1987; amended in R86-17(A) at 11 Ill. Reg. 14748, effective August 24, 1987; amended in R84-16 at 12 Ill. Reg. 2445, effective January 15, 1988; amended in R86-3 at _____ Ill. Reg. _____, effective _____.

Section 304.219 North Shore Sanitary District Phosphorus Discharges

- a) This Section applies to discharges from the North Shore Sanitary District excess flow discharge facilities at Waukegan and North Chicago into Lake Michigan;
- b) The requirements of Section 304.123(a) shall not apply to the phosphorus content of the North Shore Sanitary District excess flow discharges from Waukegan and North Chicago into Lake Michigan. Instead, the following requirements shall to North Shore Sanitary District discharges into Lake Michigan:
 - 1) The North Shore Sanitary District shall discharge no effluent into Lake Michigan from its Waukegan treatment plant until after that plant has achieved its maximum peak treatment flow capacity and all the Waukegan treatment plant excess flow retention reservoirs are full to capacity;
 - 2) The North Shore Sanitary District shall discharge no effluent into Lake Michigan from its North Chicago treatment plant until after that plant has achieved its maximum peak treatment flow capacity, the North Chicago treatment plant excess flow retention reservoirs are full to capacity, the maximum practicable rate of transfer of untreated effluent to Gurnee has been achieved, the Gurnee treatment plant has achieved its maximum peak treatment flow capacity, and the Gurnee treatment plant excess flow retention reservoirs are full to capacity.
- c) The North Shore Sanitary District shall increase the maximum peak treatment flow capacity of its Waukegan treatment plant to at least 44 million gallons per day before January 1, 1992;
- d) The North Shore Sanitary District shall increase the maximum peak treatment flow capacity of its Gurnee

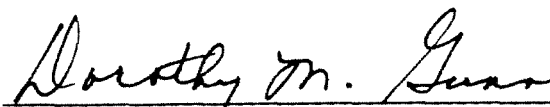
treatment plant to 39 million gallons per day before January 1, 1989;

- e) The North Shore Sanitary District shall increase the excess flow retention reservoir capacity at its Gurnee treatment plant to 50 million gallons before January 1, 1991;
- f) The North Shore Sanitary District shall operate its Waukegan or North Chicago treatment plant at its maximum peak treatment flow capacity during any period in which less than 90 percent of the retention reservoir capacity is available to receive excess flows at the relevant treatment plant, except when such unavailability results during times of normal retention basin maintenance; and
- g) The North Shore Sanitary District shall immediately embark on a program of excess flow and water quality impact monitoring, shall periodically submit the data from such monitoring to the Illinois Environmental Protection Agency ("Agency"), and shall submit a comprehensive study of this data and monitoring for the period 1987 through 1991 to the Board and the Agency before April 1, 1992.

IT IS SO ORDERED

Chairman J.D. Dumelle concurred.

I, Dorothy M. Gunn, Clerk of the Illinois Pollution Control Board, hereby certify that the above First Notice, Proposed Rule Opinion and Order was adopted on the 21st day of April, 1988, by a vote of 7-0.



Dorothy M. Gunn, Clerk
Illinois Pollution Control Board