5. ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

5. ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

The nonradiological monitoring program involves the collection and analysis of surface water and groundwater samples from numerous locations throughout the site. The amount of nonradiological pollutants released to the air from ANL-E is extremely small, except for the boiler house, which is equipped with dedicated monitoring equipment for sulfur dioxide and opacity. One exceedance for opacity was noted during 1999 over a period of 1,600 hours of coal-burning operation of Boiler No. 5, the coal-burning boiler. Chapter 3 provides a detailed discussion of the environmental monitoring program.

Surface water samples for nonradiological chemical analyses are collected from NPDES-permitted outfalls and Sawmill Creek.[21] Analyses conducted on the samples from the NPDES outfalls vary, depending on the permit-mandated monitoring requirements for each outfall. The results of the analyses are compared with the permit limits for each outfall to determine whether they comply with the permit. In addition to being published in this report, the NPDES monitoring results are transmitted monthly to the IEPA in an official DMR.

In addition to the permit-required monitoring, other analyses are conducted on samples collected from the combined wastewater outfall (NPDES Outfall 001) to provide a more complete evaluation of the impact of the wastewater on the environment. Water samples from Sawmill Creek are also collected and analyzed for a number of inorganic constituents. The results of these additional analyses of the main outfall and receiving streams are then compared with IEPA General Effluent Standards and Stream Quality Standards listed in IAC, Title 35, Subtitle C, Chapter I.[22]

5.1. National Pollutant Discharge Elimination System Monitoring Results

5.1.1. Influent Monitoring

Since 1989, analyses of the laboratory wastewater influent have shown the presence of a variety of VOCs with variable concentrations. Although the practice is not authorized, it is suspected that limited quantities of VOCs are disposed of in the laboratory drain through laboratory sinks located throughout the site. In addition, VOCs are known to be discharged into the laboratory sewer from the 317/319 Lift Station, which pumps contaminated groundwater generated by ANL-E's RCRA corrective actions. The results of the analysis of laboratory wastewater influent are shown in Table 5.1.

The 1999 results for laboratory influent wastewater are quite similar to those for 1997 and 1998. Table 5.1 gives the 1999 results for the most common compounds detected. Bromoform, bromodichloromethane, chloroform, and dibromochloromethane are halomethanes that are produced

TABLE 5.1

Laboratory Influent Wastewater, 1999
(concentrations in µg/L)

Month	Acetone	Chloroform	Bromodi-chloroethane	Dibromo-chloromethane	Bromoform
January	168	3	2	1	<1
February	26	21	12	4	<1
March	3	5	3	1	<1
April	61	7	1	1	<1
May	<1	17	4	2	4
June	14	3	2	3	1
July	29	7	2	5	8
August	18	7	2	3	1
September	8	1	2	9	32
October	8	3	3	8	24
November	2	3	4	6	5
December	16	4	2	2	<1

as the result of contact of the chlorinated water supply with organic chemicals. Research activity probably accounts for the presence of other volatiles.

Historically, the more persistent VOCs were consistently noted but at lower ranges of concentration. Acetone was detected in 11 samples and levels ranged up to 168 µg/L, which is higher than the 1998 maximum value of 76 µg/L, but the yearly average was lower than the 1998 average (Figure 5.1). Infrequent trace levels of other chemicals, that is, acetonitrile, 2-butanone, carbon tetrachloride, methylene chloride, tetrahydrofuran, 1,1-dichloroethane, cis-1,2-dichloromethene, and 1,1,1-trichloroethane, were also noted.

Figures 5.1 and 5.2 present comparisons of the 1992 through 1999 laboratory influent wastewater results for the two more persistent VOCs. The persistent presence of acetone is likely due to laboratory activities such as rinsing glassware. Disposing of hazardous chemicals down laboratory drains is not authorized at ANL-E. ANL-E conducts a waste generator education program as part of its site safety awareness training program, in which proper handling and disposal of chemicals are explained.

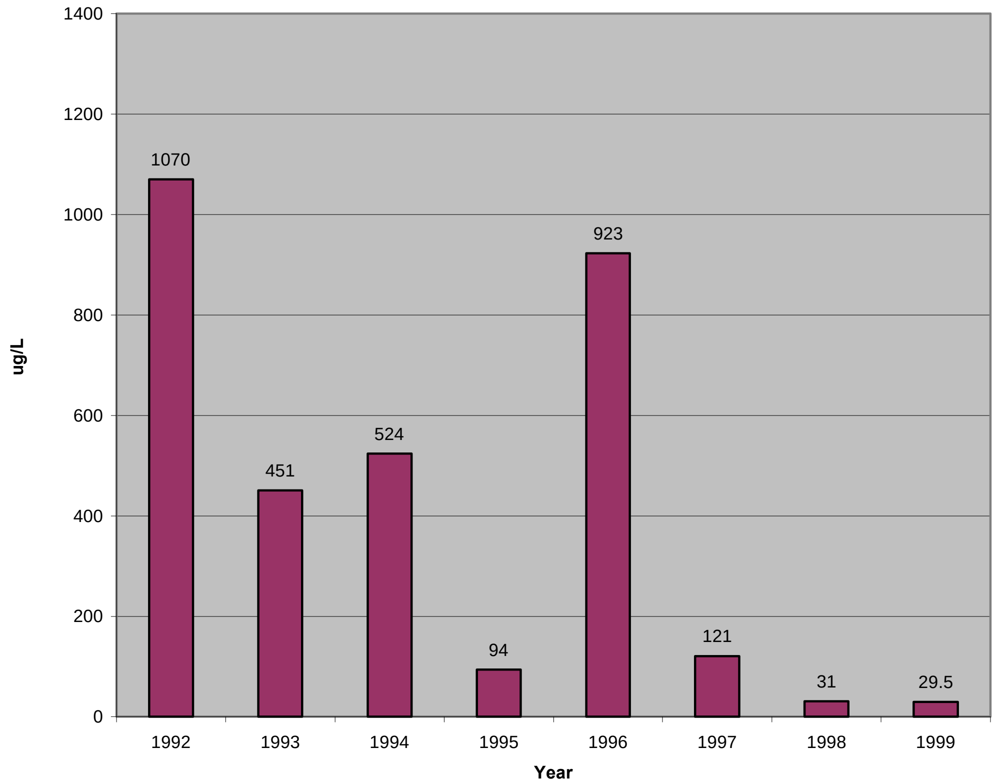

Figure 5.1 Average Acetone Levels in Laboratory Influent Wastewater, 1992 to 1999

5.1.2. Effluent Monitoring

Effluent samples are collected from ANL-E point-source discharges (outfalls) as specified by the NPDES permit. The permit specifies the frequency of sample collection and the specific parameters to be monitored for each individual outfall. Sample collection, preservation, holding times, and analytical methods are specified by the EPA as codified in 40 CFR Part 136, Tables 1B and 2.[23]

A small amount of process wastewater, primarily cooling tower blowdown and cooling water, is discharged directly to a number of small streams and ditches throughout the site. This wastewater does not contain significant amounts of contaminants and does not require treatment before discharge. These discharge points are included in the site NPDES permit as separate regulated outfalls.

The NPDES outfall locations are shown in Figure 5.3. Outfalls 001A and 001B, the two internal monitoring points representing the effluent from the sanitary system and laboratory system,

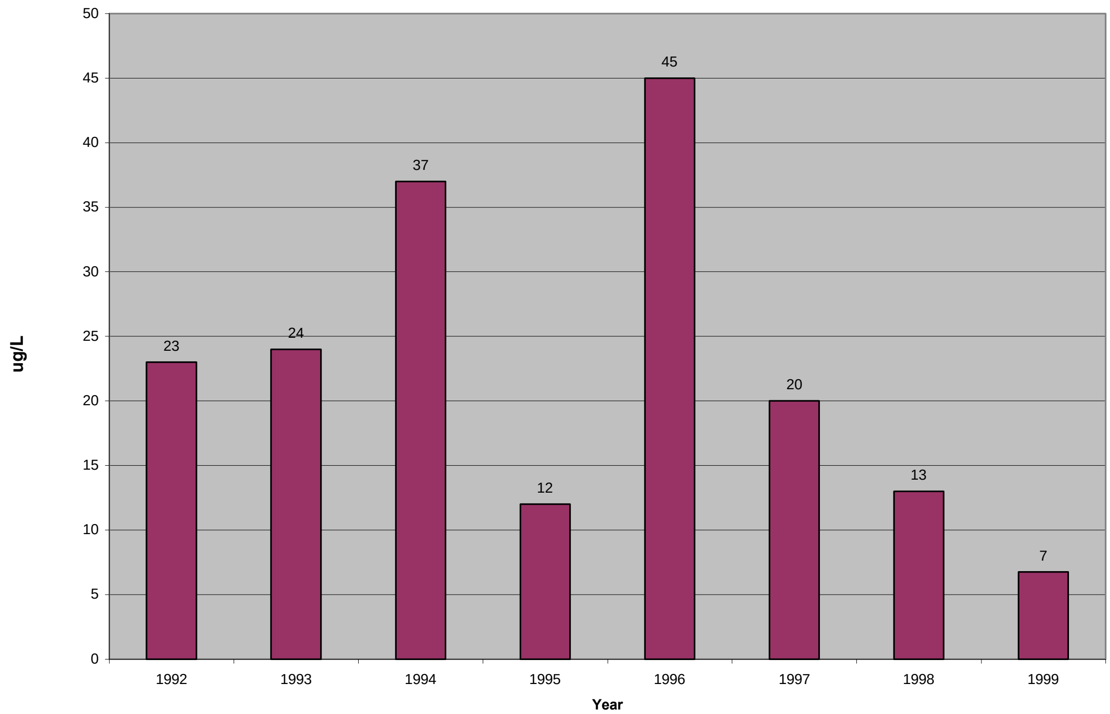

Figure 5.2 Average Chloroform Levels in Laboratory Influent Wastewater, 1992 to 1999

respectively, are both located at the WTP. Their flows combine to form Outfall 001, which also is located at the treatment facility. The combined stream flows through an outfall pipe that discharges into Sawmill Creek approximately 1,100 m (3,500 ft) south of the treatment plant.

5.1.2.1. Sample Collection

All samples are collected in specially cleaned and labeled bottles with appropriate preservatives added. Custody seals and chain of custody sheets also are used. All samples are analyzed within the required holding time. Samples are collected at locations 001A, 001B, and 001 on a weekly basis, consistent with permit requirements. Similarly, samples are collected at the other locations in accordance with the NPDES permit.

5.1.2.2. Sample Analyses - NPDES

NPDES sample analyses were performed in accordance with standard operating procedures (SOPs) that were issued as controlled documents. These SOPs cite protocols that can be found in 40 CFR Part 136, "Test Procedures for the Analysis of Pollutants Under the Clean Water Act."[23] Six metal analyses were performed by using flame atomic absorption spectroscopy. Mercury was

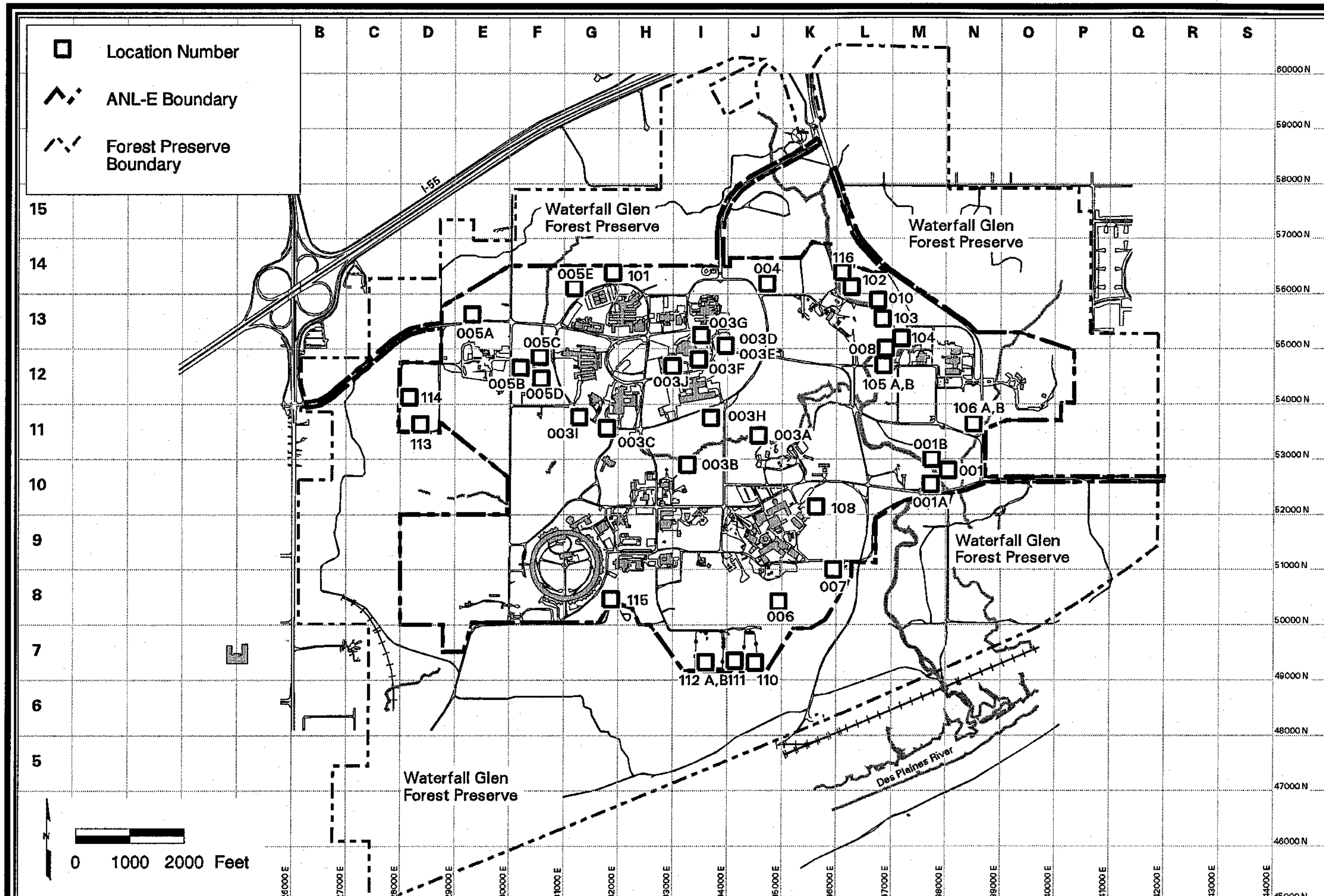

Figure 5.3 NPDES Outfall Locations

determined by cold vapor atomic absorption spectroscopy. Hexavalent chromium determination and chemical oxygen demand (COD) were performed by using a colorimetric technique. Five-day biochemical oxygen demand (BOD_5) was determined by using a dissolved oxygen probe. TSS, TDS, and oils and grease were determined gravimetrically. Sulfate determination was performed by using a turbidimetric technique; chloride was determined by titrimetry. Ammonia nitrogen was determined by distillation, followed by an ion-selective electrode finish. Five VOC concentrations were determined by using a purge and trap sample pretreatment, followed by gas chromatography-mass spectroscopy detection. The PCB Aroclor-1260 concentrations were determined by solvent extraction, followed by gas chromatography-electron capture detection. Beta radioactivity was performed by using a gas flow proportional counting technique. Hydrogen-3 concentrations were determined by distillation, followed by a beta liquid scintillation counting technique.

NPDES Outfall 001B is sampled and analyzed semiannually for priority pollutant compounds. VOCs were determined by using a purge and trap sample pretreatment, followed by gas chromatography-mass spectroscopy detection. Semivolatile organic compounds (SVOCs) were determined by solvent extraction, followed by gas chromatography-mass spectroscopy detection. PCBs and pesticides were determined by solvent extraction, followed by gas chromatography-electron capture detection. Thirteen metals were determined by graphite furnace atomic absorption and flame atomic absorption spectroscopy. Cyanide and phenol were determined by distillation, followed by a spectrophotometric finish.

NPDES Outfall 001 is sampled and analyzed annually for acute aquatic toxicity parameters. NPDES Outfalls 003H, 003I, 003J, 004, 006, and 115 are tested in July and August for aquatic toxicity. An off-site contractor laboratory performs both the sample collection and analyses. The testing is performed by diluting a series of ANL-E effluent samples with Sawmill Creek receiving water, into which species of fish and invertebrates are introduced. Survival is measured over two to four days, and statistically significant mortality is reported as a function of effluent concentration.

5.1.2.3. Results

During 1999, approximately 99% of all NPDES analyses were in compliance with their applicable permit limits, as compared with 1991 through 1998, when rates ranged from 96 to 99%. Specific limit exceedances are discussed later in this section, as well as in Chapter 2. A discussion of the analytical results for each outfall follows.

5.1.2.4. Outfalls

Outfall 001A. This outfall consists of treated sanitary wastewater and various wastewater streams from the boiler house area, including coal pile storm water runoff. The effectiveness of the sanitary wastewater treatment systems is evaluated by weekly monitoring for BOD_5, pH, and TSS. The limits for BOD_5 are a monthly average of 10 mg/L and a maximum value of 20 mg/L. The permit limits for TSS are a maximum concentration of 24 mg/L and a monthly average of 12 mg/L. The pH must range between values of 6 and 9. All samples collected and analyzed for these parameters during 1999 were within the permit limits.

The permit requires weekly monitoring for total chromium, copper, iron, lead, manganese, zinc, and oil and grease. Table 5.2 gives the effluent limits for these parameters and monitoring results. Two limits are listed; one is a maximum limit for any single sample, and the other is for the average of all samples collected during the month. The constituents in Table 5.2 are present in the coal pile runoff that may discharge to the sanitary sewage system. No limits were exceeded during 1999.

Outfall 001B. This outfall consists of processed wastewater from the laboratory wastewater system. The permit requires that weekly samples be collected and analyzed for BOD_5, TSS, mercury, pH, and COD.

The limits established for BOD_5 are a daily maximum of 20 mg/L and a 30-day average of 10 mg/L. The permit also contains BOD_5 mass loading limits of 52 kg/day (114 lb/day) as a daily maximum and 26 kg/day (57 lb/day) as a 30-day average. The mass loading represents the weight of material discharged per day and is a function of concentration and flow. The daily maximum limit for TSS is 24 mg/L; the 30-day average is 12 mg/L. The TSS mass loading limits are 62 and 31 kg/day (136 and 68 lb/day), respectively. No exceedances of the TSS or BOD_5 loading and concentration limits were noted in 1999.

TABLE 5.2

Outfall 001A Effluent Limits and Monitoring Results, 1999
(concentrations in mg/L)

Constituent	Minimum	Average	Average Limit	Maximum	Maximum Limit
Chromium	-[a]	<0.02	1.00	<0.02	2.00
Copper	0.011	0.025	0.50	0.052	1.00
Iron	<0.025	0.123	2.00	0.345	4.00
Lead	-	<0.10	0.20	<0.10	0.40
Manganese	<0.015	<0.020	1.00	0.059	2.00
Zinc	0.054	0.125	1.00	0.275	2.00
Oil and grease	-	<5.0	15.0	<5.0	30.0

[a] A hyphen indicates no minimum values.

The daily maximum concentration limit for mercury is 6 µg/L; the 30-day average is 3 µg/L. The corresponding loading values are 0.02 kg/day (0.034 lb/day) and 0.01 kg/day (0.017 lb/day). No exceedances of the mercury loading and concentration limits were noted during 1999.

No concentration limits have been established for COD. The once-per-week grab samples give a rough indication of the organic and inorganic contents of this stream. The values obtained in 1999 ranged from less than 10 to 19 mg/L.

A special condition at location 001B requires monitoring for the 124 priority pollutants listed in the permit during the months of June and December. The June sampling is to be conducted at the same time that aquatic toxicity testing of Outfall 001 is conducted. Samples were collected on June 22, 1999, and December 7, 1999, and analyzed within the required holding times.

Analysis of these samples indicated that very small amounts of a few chemicals were present. The results for SVOCs, PCBs, and pesticides were all less than the detection limits. The results for metals were similar to concentrations historically found in ANL-E treated drinking water. The samples contained some VOCs at very low levels. The majority of compounds detected were halomethanes. Table 5.3 lists the concentrations of volatile organics identified in these samples. Currently, no permit limits or effluent standards are available for these compounds for comparison with these results.

Outfall 001. After the treatment processes, the effluents from both the laboratory and sanitary WTP are combined to form one point-source discharge. The combined effluent flows through a 1,100-m (3,500-ft) outfall pipe where it is eventually discharged into Sawmill Creek.

Samples of the combined effluent are collected weekly or monthly as grab samples or 24-hour composite samples as specified in the NPDES permit. The samples are analyzed for a variety of metals, ammonia nitrogen, chlorides, sulfates, TDS, pH, and beta radioactivity. The permit requires analysis of the combined effluent once a week for TDS, chloride, and sulfate. Table 5.4 gives the results, limits, and number of exceedances.

TABLE 5.3

Outfall 001B Effluent Priority Pollutant Monitoring Results, 1999
(concentrations in µg/L)

Compound	Concentration in June Sample	Concentration in December Sample
Bromodichloromethane	1	1
Bromoform	5	<1
Chloroform	3	2
Dibromochloromethane	2	1
Methylene chloride	1	<1

TABLE 5.4

Outfall 001 Monitoring Results and Effluent Limits, 1999
(concentrations in mg/L)

Constituent	Minimum	Average	Maximum	Limit		Exceedances
Copper	0.011	0.021	0.039	0.051		0
TDS	469	713	1,346	1,000		4
Ammonia nitrogen	<0.1	0.9	2.0	10.0	(November–March)	0
				3.0	(April–October)	

Elevated TDS levels during the 1999 heating season are believed to be related to the combination of reduced flows, with increases in TDS concentrations from discharges from boiler blowdown, road salt, and cooling tower blowdown. For the past several years, chemical analysis for chloride has indicated a close relationship between TDS levels and chloride levels. Figure 5.4 shows the results of TDS and chloride analyses for 1996 through 1999. Elevated TDS levels prior to 1997 are attributed to high TDS levels (800 ppm) in ANL-E's domestic source water (i.e., groundwater, at that time).

In 1997, Lake Michigan water, which is characterized by low TDS levels (200 to 400 ppm), became ANL-E's domestic source water. Figure 5.5 shows the substantial decrease in average TDS levels at Outfall 001 since the introduction of Lake Michigan water. Figure 5.5 shows weekly TDS levels at Outfall 001 and the seasonal variation associated with heating and road salt usage. Four exceedances of the TDS limit were noted during 1999, and these were primarily due to road salt associated with snowmelt (see Figure 5.5).

Copper levels have decreased since 1997. The changeover in the domestic water supply from groundwater to Lake Michigan water during 1997 appears to have played a role in reducing the amount of copper in the wastewater. Lake Michigan water causes less corrosion of domestic water distribution copper piping than the previously used groundwater source. The addition of this water source, combined with the proper balance of chemical treatment additives, has reduced copper concentrations in the discharge to below permit limits. Figure 5.6 shows the 1996 through 1999 monthly average copper levels at Outfall 001. No copper exceedances occurred during 1999.

The upgrade of the sanitary WTP, completed in 1996, has enhanced the treatment of ammonia nitrogen. Figure 5.7 shows a decrease in the monthly average ammonia nitrogen levels prior to and after the sanitary WTP upgrade. Improved mechanical operation of the trickling filters results in a more even dispersion of the wastewater. Also, dome covers on the trickling filters allow the trickling filters to hold a constant temperature and aerobic conditions by providing a constant flow of air across the filter area. No ammonia nitrogen exceedances occurred during 1999.

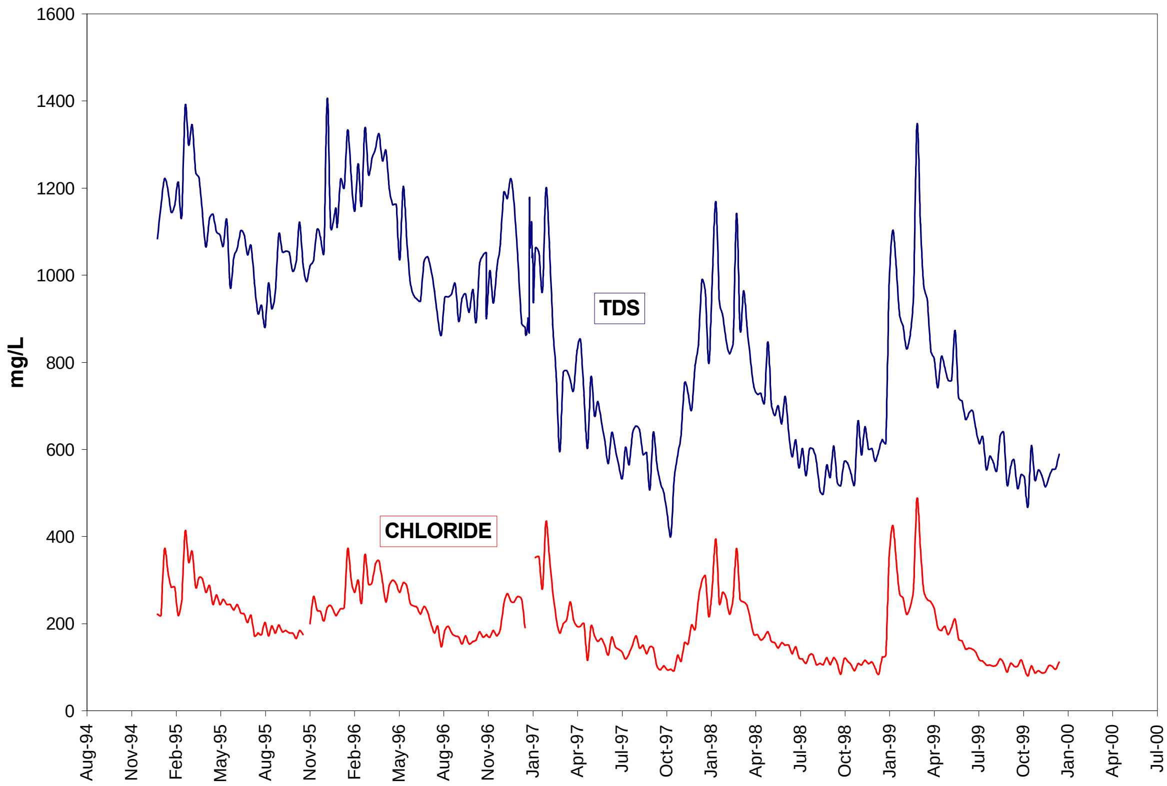

Figure 5.4 Total Dissolved Solids and Chloride in Outfall 001 Water, 1996 to 1999

The permit requires that a biological toxicity screening test be performed on wastewater from Outfall 001 in June of each year. The toxicity testing is run on two trophic levels of aquatic species for acute toxicity. The 1999 testing was conducted on samples collected June 23 – 27; the water flea (*Ceriodaphnia dubia*) and fathead minnow (*Pimephales promelas*) were used.

No toxicity was observed to the fathead minnows or to the water flea. The concentration of wastewater that produces 50% mortality in the test population (i.e., the LC_{50}) for both species is greater than 100%; that is, concentrations higher than those found in the effluent would be required for half to be killed. Table 5.5 summarizes the results from the toxicity tests for 1999. Table 5.6 summarizes the test results from 1991 to 1999.

The permit also requires that weekly pH, ammonia nitrogen, dissolved iron, manganese, and zinc measurements be made. No exceedances of these parameters were noted in 1999. Monthly monitoring for lead, hexavalent and trivalent chromium, and beta radioactivity is required.

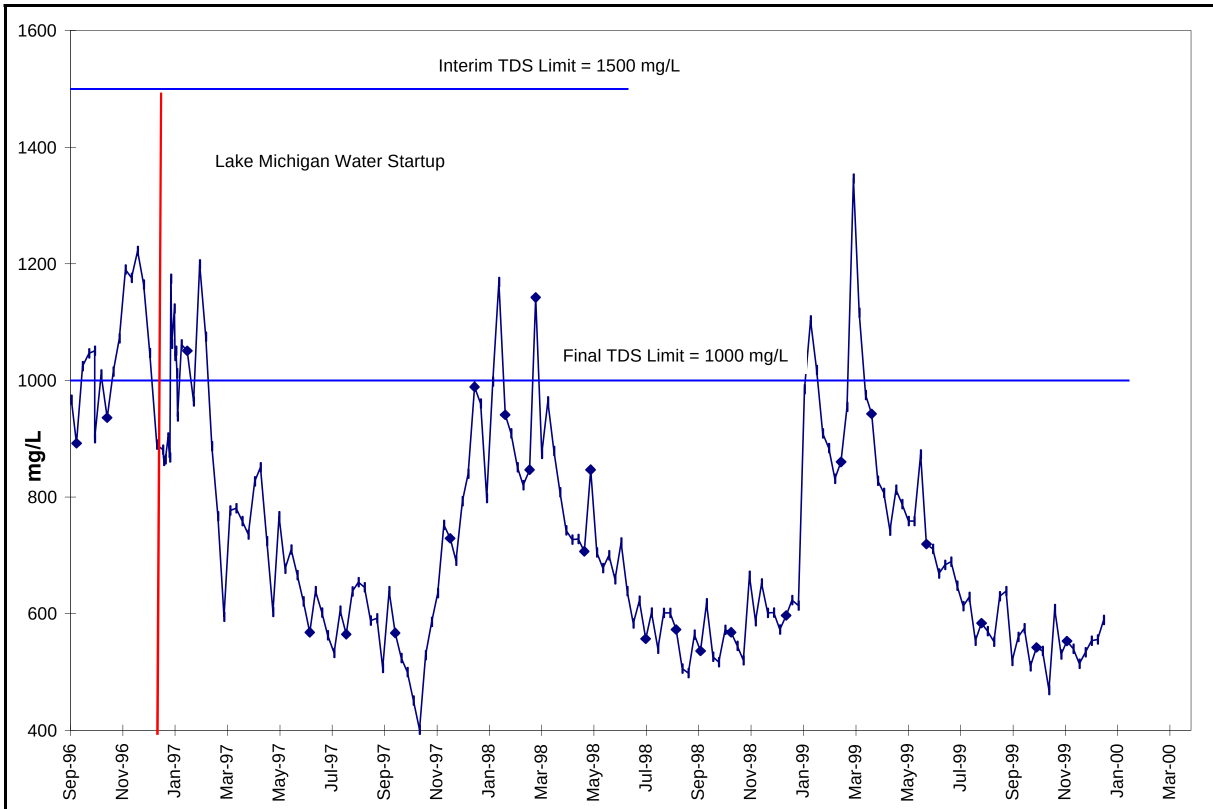

Figure 5.5 Total Dissolved Solids NPDES Outfall 001

TABLE 5.5

Outfall 001 Aquatic Toxicity Test Results, 1999

Test	End Point	96/48-Hour LC_{50} (%)
96-hour fathead minnow acute toxicity	Survival	>100.0
48-hour water flea acute toxicity	Survival	>100.0

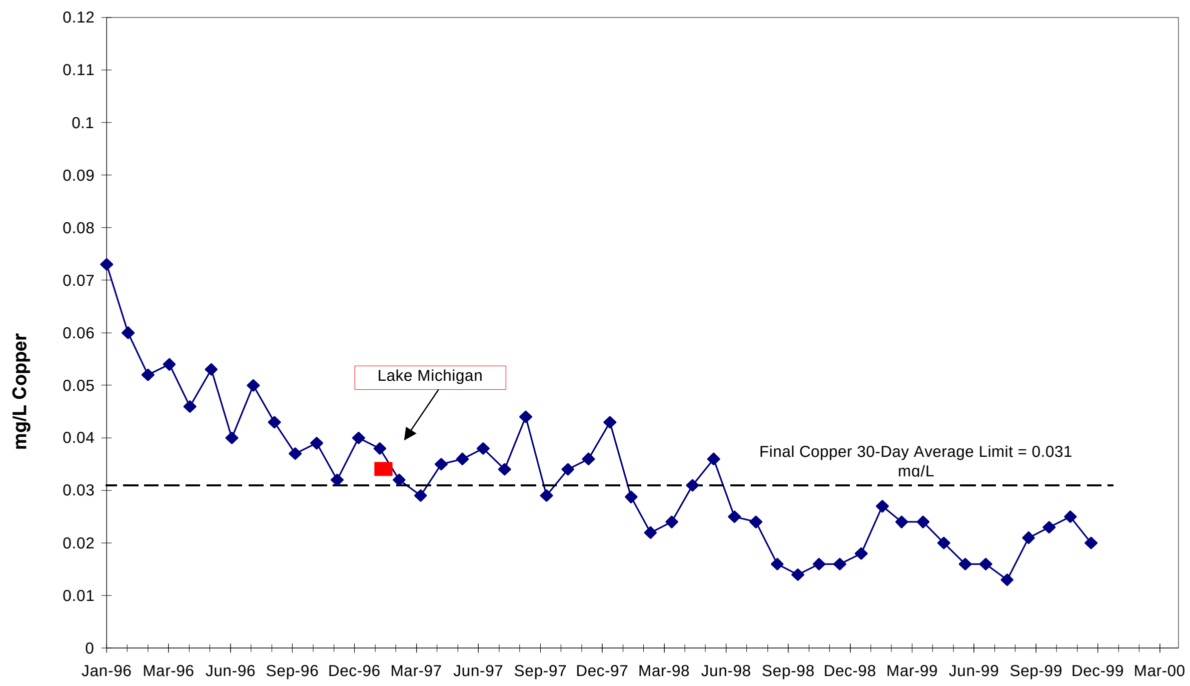

Figure 5.6 NPDES Outfall 001 30-Day Average Copper Results, 1996 to 1999

TABLE 5.6

Outfall 001 Aquatic Toxicity Test Results, 1991 to 1999

Test	1991 (%)	1992 (%)	1993 (%)	1994 (%)	1995 (%)	1996 (%)	1997 (%)	1998 (%)	1999 (%)
Minnow, acute, LC_{50}	61.6	<6.2	100.0	100.0	>100	>100	>100	>100	>100
Water flea, acute, LC_{50}	17.1	35.4	100.0	100.0	>100	>100	>100	>100	>100
Minnow, chronic, survival, NOEC[a]	50.0	100.0	50.0	100.0	-[b]	-	-	-	-
Minnow, chronic, survival, LOEC[c]	100.0	100.0	100.0	100.0	-	-	-	-	-
Minnow, chronic, growth, NOEC	50.0	100.0	50.0	100.0	-	-	-	-	-
Water flea, chronic, survival, NOEC	50.0	50.0	50.0	100.0	-	-	-	-	-
Water flea, chronic, survival, LOEC	100.0	100.0	100.0	100.0	-	-	-	-	-
Water flea, chronic, reproduction, NOEC	50.0	50.0	25.0	100.0	-	-	-	-	-
Algal growth, LOEC	6.2	6.2	100.0	100.0	-	-	-	-	-
Algal growth, NOEC	3.1	<6.25	100.0	100.0	-	-	-	-	-

[a] NOEC = no observable effect concentration; the highest concentration of the effluent at which no adverse effect is observed.

[b] A hyphen indicates that no analysis was performed because of a change in the permit.

[c] LOEC = lowest observable effect concentration; the lowest concentration of the effluent at which an adverse effect is observed.

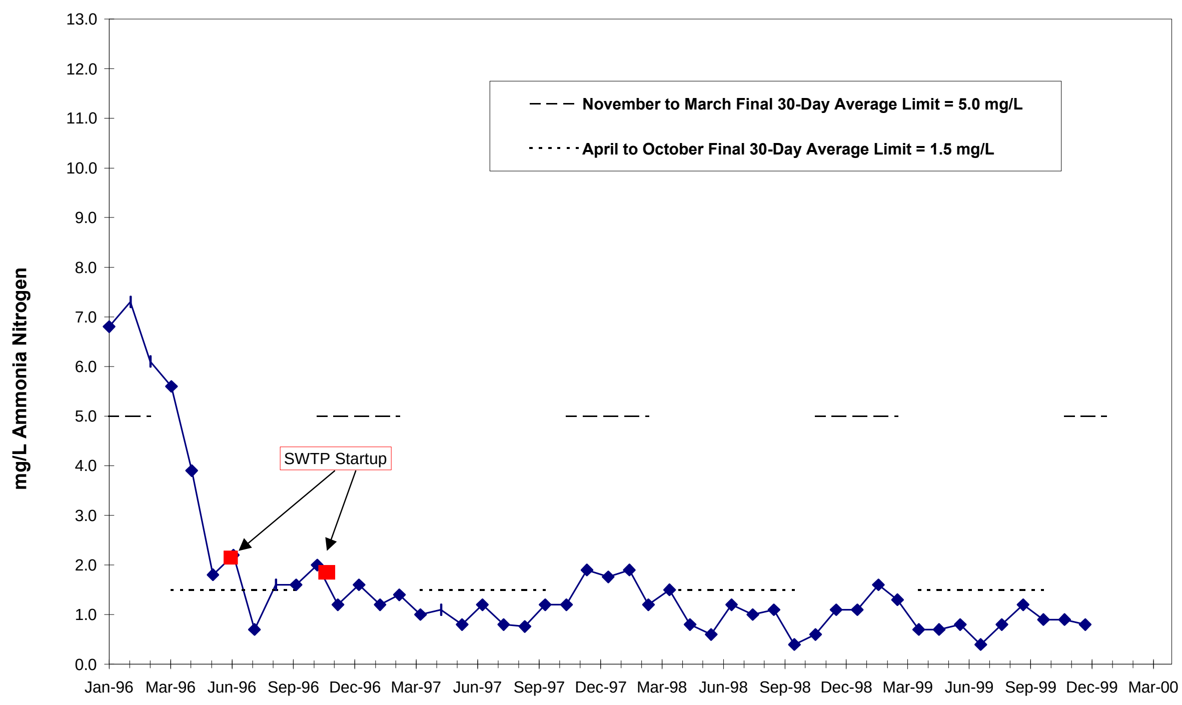

Figure 5.7 NPDES Outfall 001 30-Day Average Ammonia Nitrogen Results, 1996 to 1999

Outfall 003A. This potential discharge is located approximately 25 m (75 ft) north of the swimming pool and is a vitrified clay pipe that was originally used as the discharge point for all the swimming pool activities (filter backwash, draining, and overflow). Table 5.7 presents the sampling requirements and effluent limits.

By July 1995, discharge of chlorinated water from Outfall 003A had been completely eliminated by installation of a sump collection system that captures all the flow and discharges into the sanitary drain system.

Outfall 003B. This outfall is located approximately 150 m (500 ft) northeast of Building 308 and is composed of storm water runoff and condensate from the buildings in the watershed of the outfall. The discharge point is a 1-m (3-ft) concrete pipe to a tributary brook flowing north to the Freund Brook. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

Outfall 003C. The discharge from this outfall is made up of footing tile drainage and storm water runoff. The discharge point is a 0.65-m (2-ft) concrete pipe discharging into Freund Brook approximately 50 m (150 ft) upstream of the gas station, south of Building 205. The sampling requirements and effluent limits are given in Table 5.7. No exceedances occurred during 1999.

TABLE 5.7

NPDES Effluent Summary, 1999

Discharge Location	No. of Samples	Permit Constituent	Limit: 30-Day Average	Limit: Daily Maximum	No. Exceeding Limit
003A	0	Flow	None		0
		pH	6 – 9		0
		TSS	15	30	0
		TRC[a]	0.05		0
003B	12	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
003C	12	Flow	None		0
		pH	6 – 9		0
003D	12	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
003E	12	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
003F	11	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
		TDS	Monitor only		NA[b]
003G	12	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
003H	12	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
		TDS	Monitor only		NA

TABLE 5.7 (Cont.)

Discharge Location	No. of Samples	Permit Constituent	Limit		No. Exceeding Limit
			30-Day Average	Daily Maximum	
003I[c]	12	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
		TDS	Monitor only		NA
		Oil and grease	Monitor only		NA
003J	12	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
		TDS	Monitor only		NA
004	12	Flow	None		0
		pH	6 – 9		0
		TSS	15	30	0
005C	12	Flow	None		0
		pH	6–9		0
		Temperature	<2.8EC rise		0
		Oil and grease	Monitor only		NA
005E	12	Flow	None		0
		pH	6 – 9		0
006	12	Flow	None		0
		pH	6 – 9		0
		TSS	15	30	3
		TDS	Monitor only		NA
		Temperature	<2.8EC rise		0
007	12	Flow	None		0
	12	pH	6 – 9		0
	12	Temperature	<2.8EC rise		0
	36	TRC	0.05		0
	12	Oil and grease	Monitor only		NA
008	10	Flow	None		0
		pH	6 – 9		0
		VOC	Monitor only		NA

TABLE 5.7 (Cont.)

			Limit		
Discharge Location	No. of Samples	Permit Constituent	30-Day Average	Daily Maximum	No. Exceeding Limit
010	0	Flow	None		0
		pH	6 – 9		0
		TSS	15	30	0
		Total iron	2	4	0
		Dissolved iron		1.0	0
		Lead		0.1	0
		Zinc		1.0	0
		Manganese		1.0	0
		Hexavalent chromium	0.011	0.016	0
		Trivalent chromium	0.519	2.0	0
		Copper	0.031	0.051	0
		Oil and grease	15	30	0
108	12	Flow	None		0
		pH	6 – 9		0
		Temperature	<2.8EC rise		0
111	2	Flow	None		0
		Hydrogen-3	Monitor only		NA
112A	2	Flow	None		0
		Hydrogen-3	Monitor only		NA
112B	2	Flow	None		0
		Hydrogen-3	Monitor only		NA
113	5	Flow	None		0
		Hydrogen-3	Monitor only		NA
		PCB 1260	Monitor only		NA
		Lead, copper, nickel, zinc	Monitor only		NA
114	5	Flow	None		0
		Hydrogen-3	Monitor only		NA
		PCB 1260	Monitor only		NA
		Lead, copper, nickel, zinc	Monitor only		NA

TABLE 5.7 (Cont.)

Discharge Location	No. of Samples	Permit Constituent	Limit 30-Day Average	Limit Daily Maximum	No. Exceeding Limit
115	12	Flow	None		0
		pH	6 – 9		0
		Temperature	< 2.8EC rise		0
		TDS	Monitor only		NA
116	12	Flow	None		0
		pH	6 – 9		0
		TRC	0.05		0

[a] TRC = total residual chlorine.

[b] NA = not applicable.

[c] An unpermitted discharge occurred at Outfall 003I due to a break in a chiller water line.

Outfalls 003D and 003E. These two discharge points are from the steam trench around Inner Circle Drive and discharge into the north fork of Freund Brook approximately 150 m (500 ft) east of the intersection of Inner Circle Drive and Eastwood Extension. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

Outfall 003F. This outfall is intended to discharge excess water from the fire pond during storm events. The building discharges cooling tower water to the fire pond; the rate is generally insufficient to result in a discharge at this outfall. When the rate is sufficient, the discharge is through a cement raceway to the south fork of the north branch of Freund Brook. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

Outfall 003G. Footing tile drainage from the Inner Circle steam trench is pumped to the storm sewer passing around the northeastern portion of Building 201 and discharges into the northern fork of the southern branch of Freund Brook. Condensate leaks in the steam trench produce discharge on a regular basis to the storm sewer. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

Outfall 003H. This discharge originates from the footing tile drainage around Building 212 and storm water collected from around Buildings 212 and 214 and their associated parking lots. The cooling tower located on the south roof of Building 212 discharges into the tile drainage system and is the source of the industrial discharge. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

Special Condition No. 9 of the NPDES permit requires acute toxicity testing of the effluent from Outfalls 003H, 003I, 003J, 004, 006, and 115. The testing is performed on the fathead minnow and the water flea. The testing is performed on a biannual basis during the months of July and August. These outfalls were sampled during the periods of July 26 – 30 and August 24 – 28, 1999. Outfall 003H was acutely toxic to the fathead minnow and the water flea during the July test (see Section 2.2.1.2). Adjustments to the Building 212 cooling tower biocide addition were made after the July test. The August 1999 test results showed no toxicity. The results are summarized in Tables 5.8 and 5.9.

TABLE 5.8

Acute Toxicity Results: Fathead Minnow, 1999

NPDES Outfall	96-Hour LC_{50} July 26 – 30, 1999 (%)	96-Hour LC_{50} August 24 – 28, 1999 (%)	96-Hour LC_{50} September 27 – October 1, 1999 (%)	Comments
003H	<60	>100	NA	Acutely toxic/not acutely toxic
003I	>100	>100	NA	Not acutely toxic
003J	>100	>100	NA	Not acutely toxic
004	>100	>100	NA	Not acutely toxic
006	>100	>100	NA	Not acutely toxic
115	>100	84.2	>100	Acutely toxic

TABLE 5.9

Acute Toxicity Results: Water Flea, 1999

NPDES Outfall	48-Hour LC_{50} July 26 – 30, 1999 (%)	48-Hour LC_{50} August 24 – 28, 1999 (%)	48-Hour LC_{50} September 27 – October 1, 1999 (%)	Comments
003H	<60	>100	NA	Acutely toxic
003I	>100	>100	NA	Not acutely toxic
003J	>100	>100	NA	Not acutely toxic
004	>100	>100	NA	Not acutely toxic
006	>100	>100	NA	Not acutely toxic
115	<60	<60	42.7	Acutely toxic

Outfall 003I. This outfall collects storm water from Buildings 200 and 211 and the western portion of Building 205 areas and also accumulates cooling tower discharge from the cooling tower located behind Building 200. Table 5.7 gives the sampling requirements and effluent limits. One unpermitted discharge occurred in July due to a break in a chiller water line. Results of acute toxicity tests for Outfall 003I are presented in Tables 5.8 and 5.9. Outfall 003I was not acutely toxic to the fathead minnow or water flea.

Outfall 003J. This outfall collects storm water from the Building 213 area and parking lot. The storm water passes through a storm sewer around Building 201. Cooling tower blowdown is the industrial discharge to this system. The sampling requirements and effluent limits are given in Table 5.7. No exceedances were noted during 1999. Results of acute toxicity tests for Outfall 003J are presented in Tables 5.8 and 5.9. Outfall 003J was not acutely toxic to the fathead minnow or water flea.

Outfall 004. This outfall discharges storm water from the Buildings 202, 203, and 221 areas and cooling water from Building 221. The discharge is to a drainage ditch and sewer system that pass around the northeastern portion of Outer Circle Drive and to a ditch leading north to the fence line, east of the Visitor's Center. Table 5.7 gives the sampling requirements and effluent limits. No exceedances were noted during 1999. Results of acute toxicity tests for Outfall 004 are presented in Tables 5.8 and 5.9. Outfall 004 was not acutely toxic to the fathead minnow or water flea.

Outfall 005A. This outfall discharges runoff from the northwestern portion of the 800 Area. The flow passes under Westgate Road, east of the West Gate, and flows toward the northwestern fence line. This is a storm water only outfall.

Outfall 005B. The outfall for this watershed discharges runoff collected from the major portion of the 800 Area. The flow is collected from the parking lots and roadways and flows by storm sewers to the east, where it is discharged to the marsh located on the eastern side of Kearney Road. This is a storm water only outfall.

Outfall 005C. This outfall collects storm water from the northern side and the loading dock area of Building 200. The Building 200 once-through cooling water systems discharge to this outfall, which passes through sewers to the west of the loading dock and to the beaver pond west of Building 200. The sampling requirements and effluent limits are given in Table 5.7. No exceedances occurred during 1999.

Outfall 005D. The Building 200 M-Wing loading dock area storm water runoff is collected in a storm sewer and passes west to a beaver pond located west of Building 200. The discharge is through a 1-m (3-ft) corrugated pipe into the pond. This is a storm water only discharge.

Outfall 005E. This outfall discharges footing tile drainage from the west sides of Buildings 203 and 208. It also discharges storm water collected from the same area. The industrial discharge arises from cup drains and compressors discharging into the footing tile sumps. The sampling requirements and effluent limits are given in Table 5.7. No exceedances occurred during 1999.

Outfall 006. Cooling towers at Building 350 and the 377 Area discharge into the drainage ditch that flows south of the Canal Water Treatment Plant, bends south, and flows to the south fence line. The permit requires monthly sampling for pH, TSS, and temperature. The limits are given in Table 5.7. Three exceedances of the TSS limit occurred in 1999. The exceedances were due to summer algae growth (July), sediment runoff from an upstream construction project (August), and cooling tower drainage sediment (November). Results of acute toxicity tests for Outfall 006 are presented in Tables 5.8 and 5.9. Unlike 1995, 1996, and 1998, Outfall 006 was not acutely toxic to water fleas. As in 1996, 1997, and 1998, it was not acutely toxic to the fathead minnow.

Outfall 007. The watershed for Outfall 007 includes the southeastern section of the 300 Area and extends from Building 370 east to Building 366 and north to Building 367. Water is collected in catchment basins and conveyed toward the southeast to a point approximately 30 m (100 ft) southeast of Building 366, where it is discharged into a ditch on the south side of Old Bluff Road. This ditch runs along the roadside for 15 m (50 ft), at which point it turns south and runs to the fence line where it is discharged to the forest preserve. The once-through cooling water of compressors is the industrial component of this outfall. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

Outfall 008. The watershed for this outfall includes the area around the new Vehicle Maintenance and Grounds Building 46. Runoff is collected in storm water grates and catchments and conveyed through sewers to the discharge point in Sawmill Creek, which is located directly west of Building 24. Industrial activity in this small watershed involves operations associated with the maintenance of all facility vehicles; grounds, maintenance, and storage of the equipment associated with these activities; and fueling for the vehicles. Five VOCs are monitored once a month. Low levels (5 to 74 μg/L) of tetrachloroethylene are consistently noted at this outfall. A characterization study will be performed in this area to determine the source and extent of contamination. The only NPDES limit that applies at this point is pH. No exceedances were noted during 1999.

Outfall 010. This outfall is for the coal pile storage area runoff collection system overflow line. The collection system consists of a trench on the north and west sides of the coal pile; a sump is located at the extreme southern end of the western trench line. The overflow line comes into use only when the runoff reaches the level at which the trench system would overflow; the line was put into place to ensure against overflow conditions. During normal operations, the water is pumped to the equalization basin located in the western part of the 100 Area. The industrial activity associated with this outfall is solely the coal pile operation. The berm and trench system in place to collect runoff has been improved to eliminate discharge from the outfall.

This outfall is sampled once per day when flow occurs. Analyses are performed for pH, TSS, TDS, iron, lead, zinc, manganese, trivalent and hexavalent chromium, copper, and oil and grease. No flow occurred at this site during 1999.

Outfall 101. The drainage to this outfall is through ditches along the streets and sewer conduits from the parking lot to a marsh located between Outer Circle Drive and the fence line to the outfall; the conduits consist of a 0.65-m (2-ft) corrugated metal pipe with a Palmer-Bowlus flume. The drainage then discharges on the other side of the fence line into the forest preserve. The sources of storm water runoff to the outfall are the Building 203 parking lot and loading dock and the excess equipment storage area on the north side of Outer Circle Drive. This is a storm water only discharge.

Outfall 102. This watershed includes portions of the 100 Area. Large amounts of paved areas are associated with the industrial activities for the production of steam such as those areas associated with the water treatment plant, the lime sludge pond, and the tarmac around the boiler house. The contributing runoff flows are collected from storm water inlet grates and catch basins, through storm sewers to a discharge point consisting of a 0.30-m (1-ft) corrugated metal pipe extending out of the bank of Sawmill Creek. This is a storm water only discharge.

Outfall 103. The watershed for Outfall 103 includes the southern and southeastern extreme portions of the 100 Area and the area south of the coal pile. These areas drain into a storm sewer that runs due east of the coal pile toward Sawmill Creek. The outfall is located at the outlet of a 0.35-m (1.2-ft) corrugated metal pipe culvert located approximately 50 m (150 ft) from the creek. Activities that are industrial in nature take place in and around the utilities area and consist of boiler house steam generation, storage of plastic and metal, loading dock activities, a flue gas scrubber and cooling pond (no longer in use), steam condensate return storage (two tanks), and the southern access road to the coal pile storage area. This is a storm water only discharge.

Outfall 104. This outfall includes the buildings and parking areas remaining in the East Area, excluding Buildings 40 and 46. Buildings 4, 5, and 6 and their smaller attendant buildings are included. The area is served by a number of roadways leading to and from these buildings; contributing storm grate inlets are located on the roadways and parking areas. This is a storm water only discharge.

Outfalls 105A and 105B. Two discharge points are located within this watershed. The contributing sources of storm water for this watershed include runoff from the Building 40 area, elevated water tower tanks, and scrub vegetation areas on the west side of Tech Road. Industrial activity within this watershed includes receiving, loading, parking and storage areas, and oil-containing transformers. These are storm water only discharges.

Outfalls 106A and 106B. The watershed for these outfalls encompasses the largest portion of the East Area, most of which is now demolished and the buildings razed. A portion of the eastern end of the Shipping and Receiving Area is part of this watershed, that is, Building 33, which has electrical transformers located outside of it, and a portion of Argonne Park. Like Outfall 105 above, this watershed is served by two distinct outfalls. The industrial activities within this watershed involve the receiving and shipping areas with loading docks and the transformer area. These are storm water only discharges.

Outfall 108. This watershed encompasses a portion of the 300 Area. The drainage area includes the parking areas north of Building 360, the buildings in and around Building 360, excluding Buildings 370 and 390 and the southern and western ends of the 300 Area, and the paved parking and loading dock areas in and around the eastern portions of the 300 Area (surrounding Building 363). Ongoing industrial activities in this watershed are shipping and receiving, a metals reclaim dumpster (Building 363), loading dock activities, and numerous outdoor equipment storage areas. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

Outfall 110. The watershed for this outfall includes the 320 Area shooting range (inactive since March 1993) and the area just south of the range. No other industrial activities take place within this watershed at present. Past industrial activity involved use of the shooting range for practice by the security force. This is a storm water only discharge.

Outfall 111. This outfall is located on the south fence line of the site due south of the old, closed 319 Area Landfill, between the watershed for Outfall 110 and the watershed for Outfalls 112A and 112B. This watershed encompasses the 319 Area Landfill, the 318 Area (landfill area for compressed gases), and portions of the 317 Area, primarily the paved area. In addition, the roadways for access to these areas drain to this outfall through a small ditch running along the southern extreme of the 319 Area Landfill, turning south to the fence line, and then to the outfall location, which is a 0.65-m (2-ft) corrugated metal pipe culvert that passes under the fence and discharges into the forest preserve. Industrial activities within this watershed consist of 317 Area radioactive waste storage and remediation activities, the 319 Area Landfill, and associated roadways for access. This outfall is sampled semiannually for flow and hydrogen-3 and has no permit limits. Hydrogen-3 results were 115 pCi/L during January 1999 and 288 pCi/L during August 1999.

Outfalls 112A and 112B. The contributing sources of storm water within this watershed receive runoff from the southern and western sections of the 317 Area radioactive waste storage. Runoff flow is generally toward the south in sheet flow from the source areas; the eastern portions consolidate at the fence line at the southeastern corner of the 317 Area and pass under the fence through rough concrete fill. The western and central portions of the drainage area sheet flow consolidate in the same manner and pass under the fence through the same material, approximately 50 m (150 ft) to the west. Both flows discharge into large gullies in the forest preserve and form one flow approximately 100 m (328 ft) south of the ANL-E fence line. Industrial activity within this watershed consists of 317 Area radioactive waste storage and remediation activities, loading activities at Building 350, and the associated roadways for access. These outfalls are sampled semiannually for flow and hydrogen-3 and have no permit limits. Hydrogen-3 results were less than 100 pCi/L during January. There was no flow from these outfalls during the last two quarters of 1999.

Outfall 113. This outfall is the discharge point for runoff from the eastern, southern, and southwestern sections of the closed 800 Area Landfill. The outfall is located in a ditch on the extreme southern end of the landfill, approximately 50 m (150 ft) from the southwestern corner of the landfill fence line. This discharge flows under the fence in the ditch and empties into the creek that flows south from the wetland marsh west of the site. The marsh is the headwaters of one leg of the Freund Brook system that runs through the middle of the ANL-E site and discharges into Sawmill Creek. Industrial activity within this watershed is limited to the landfill. This outfall was sampled monthly when discharging and has no permit limits. Flow occurred during five months in 1999.

Outfall 114. This outfall is the discharge point for runoff coming from the northern and northwestern sections of the closed 800 Area Landfill. The outfall is located in a ditch on the extreme western side of the landfill, approximately halfway between the northern and southern boundaries of the landfill. The flow proceeds along the western edge of the landfill where water is added from the marsh. The flow eventually combines with the ditch from the Outfall 113 flow and then passes into the creek that flows south from the wetland marsh west of the ANL-E site. Industrial activity within this watershed is limited to the landfill. This outfall was sampled monthly when discharging and has no permit limits. Flow occurred during five months in 1999.

Outfall 115. This watershed encompasses the APS site and the southern areas around the Building 314, 315, and 316 complex. The APS flow drains into ditches that discharge through a cement culvert into a collection pond located on the southeastern portion of the APS site. The 0.65-m (2-ft) sewer conduit from the Building 314, 315, and 316 complex discharges into the same collection pond approximately 10 m (30 ft) east of the ditch culvert. The flow from this pond discharges south through a culvert into another pond, flows through this pond, and discharges through a 1-m (3-ft) corrugated metal pipe culvert under the south fence line into the forest preserve. Industrial activities within the watershed involve the APS; all roadways associated with APS; loading docks in the APS buildings; and the Building 314, 315, and 316 complex storage, loading areas, and cooling water discharges. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

Results of acute toxicity tests for Outfall 115 are presented in Tables 5.8 and Table 5.9. Outfall 115 was acutely toxic to the water flea and fathead minnow. The toxicity appears to come from the Building 315 cooling tower, which historically used a batch addition of biocide pellets. Installation of a bromine-based liquid biocide using an automated dispensing system appears to have improved the toxicity to the fathead minnow but not to the water flea. Therefore, this discharge was removed from the storm drain system (Outfall 115) and rerouted to the WTP.

Outfall 116. This outfall was originally intended as a storm water discharge point only; however, it also contains non-storm–water discharges as well. The source of the discharge was traced back and found to be potable water from the domestic water treatment plant located uphill from the rest of the main utilities area. This source was investigated for corrective action and the flow stopped. The watershed for this outfall contains sections of the domestic water treatment plant, including the garage and storage area, the area around Well 5, and the associated access roads for the domestic water treatment plant. Flow is conducted through storm water sewers and discharged at the outfall, which is a 0.25-m (0.82-ft) vitrified clay pipe with a cement raceway into Sawmill Creek. Industrial activities for this watershed include parking, loading, and materials storage around the domestic water treatment plant; domestic water treatment plant operation, including bulk chemical storage (brine tank) and transformers (Building 129); outdoor equipment storage area and four flammable materials storage cabinets (Building 130); outdoor materials storage (Buildings 107 and 163); well operation and maintenance (Building 160); and the associated roadways for these activities. Table 5.7 gives the sampling requirements and effluent limits. No exceedances occurred during 1999.

5.2. Additional Effluent Monitoring

To characterize the wastewater from the ANL-E site more fully, composite samples of the combined effluent from the WTP were collected each week and analyzed for the constituents shown in Table 5.10. The results were then compared with IEPA General Effluent Limits found in 35 IAC, Subtitle C, Part 304.[24]

5.2.1. Sample Collection

Samples for analysis of inorganic constituents were collected daily from Outfall 001 located at the WTP by using a refrigerated time-proportional sampler. A portion of the sample was transferred to a clean bottle, a security seal was affixed, and chain of custody was maintained. Five daily samples were composited on an equal volume basis to produce a weekly sample that was then analyzed.

TABLE 5.10

Chemical Constituents in Effluents from the ANL-E
Wastewater Treatment Plant, 1999

		Concentrations (mg/L)			
Constituent	No. of Samples	Average	Minimum	Maximum	Limit
Arsenic	52	0.0024	<0.0020	0.0026	0.25
Barium	52	0.0212	0.0180	0.0261	2.0
Beryllium	52			<0.0002[a]	-[b]
Cadmium	52			<0.0002	0.15
Chromium	52			<0.0440	1.0
Cobalt	52			<0.0260	-
Copper	52	0.0196	<0.0170	0.0300	0.5
Fluoride	52	0.8736	0.6000	1.1600	15.0
Iron	52	0.0598	0.0370	0.1490	2.0
Lead	52			<0.0020	0.2
Manganese	52	0.0171	0.0170	0.0259	1.0
Mercury	52	0.0001	<0.0001	0.0002	0.0005
Nickel	52			<0.0400	1.0
Silver	52	0.0008	<0.0005	0.0050	0.1
Thallium	52	0.0015	<0.0015	0.0018	-
Vanadium	52			<0.0240	-
Zinc	52	0.1237	0.0542	0.2528	1.0
pH (units)	49	NA[c]	7.00	7.84	6.0 – 9.0

[a] If all values are less than the detection limit for a constituent, only the maximum value is given.

[b] A hyphen indicates no effluent limit for this constituent.

[c] NA = not applicable.

5.2.2. Results

Fifteen metals were determined by inductively coupled plasma emission spectroscopy, flame atomic absorption spectroscopy, and graphite furnace atomic absorption spectroscopy. Mercury was analyzed using cold vapor atomic absorption spectroscopy, and fluoride was determined by a specific ion electrode. Table 5.10 gives the results for 1999. None of the annual average results exceeded General Effluent Limits.[24]

5.3. Sawmill Creek

Sawmill Creek is a small natural stream that is fed primarily by storm water runoff. During periods of low precipitation, the creek above ANL-E has a very low flow. At these times, a major portion of the water in Sawmill Creek south of the site consists of ANL-E wastewater and discharges to assorted storm drains. To determine the impact ANL-E wastewaters have on Sawmill Creek, samples of the creek downstream of all ANL-E discharge points were collected and analyzed. The results were then compared with IEPA General Use Water Quality Standards found in 35 IAC, Subtitle C, Part 302.[25]

5.3.1. Sample Collection

A time-proportional sampler was used to collect a daily sample at a point well downstream of the combined wastewater discharge point where thorough mixing of the ANL-E effluent and Sawmill Creek water is assured. Samples were collected in precleaned, labeled bottles and security seals were used. After pH measurement, the daily samples were acidified and then combined into equal volume weekly composites and analyzed for the same set of inorganic constituents as those in Table 5.10.

Fifteen metals were determined by inductively coupled plasma emission spectroscopy, flame atomic absorption spectroscopy, and graphite furnace atomic absorption spectroscopy. Mercury was analyzed with cold vapor atomic absorption spectroscopy. Fluoride was determined by a specific ion electrode.

5.3.2. Results

The results obtained are shown in Table 5.11. As in 1998, the annual average concentration for copper did not exceed the Water Quality Standard (WQS). Since the conversion to Lake Michigan water, copper levels have declined due to a gradual reduction in leaching of copper from the domestic water distribution system. The maximum concentrations for copper and iron exceeded

TABLE 5.11

Chemical Constituents in Sawmill Creek, Location 7M,[a] 1999

Constituent	No. of Samples	Concentrations (mg/L) Average	Minimum	Maximum	Limit
Arsenic	49	0.0027	0.0025	0.0041	0.36[b]
Barium	49	0.0427	0.0222	0.0681	5.0
Beryllium	49			< 0.0002[c]	-[d]
Cadmium	49	0.0004	0.0002	0.0014	0.03[b]
Chromium	49			< 0.0440	3.6[b]
Cobalt	49			< 0.0260	
Copper	49	0.0228	0.0170	0.0476	0.041[b]
Fluoride	49	0.5808	0.2620	1.02	1.4
Iron	49	1.0	0.07	3.1	1.0
Lead	49	0.0058	0.0011	0.0165	0.3[b]
Manganese	49	0.1714	0.0170	0.5040	1.0
Mercury	49			< 0.0001	0.0026[b]
Nickel	49			< 0.0400	1.0
Silver	49			< 0.0010	0.005
Thallium	49			< 0.0015	-
Vanadium	49			< 0.0240	-
Zinc	49	0.1453	0.0165	0.3842	1.0
pH (units)	49	NA[e]	6.89	8.20	6.5 – 9.0

[a] Location 7M is 15 m (50 ft) downstream from the ANL-E wastewater outfall.

[b] The acute standard for the chemical constituent is listed.

[c] If all values are less than the detection limit for a constituent, only the maximum value is given.

[d] A hyphen indicates no effluent limit for this constituent.

[e] NA = not applicable.

the WQS. Overall, the levels of copper are declining since the introduction of Lake Michigan water as ANL-E's domestic water source. Between 1996 and 1999, the average levels have ranged from 0.38, 0.31, 0.21, and 0.23 mg/L, respectively. The elevated iron levels are probably associated with inadequate retention time during periods of high wastewater flow that are known to contain increased coal pile runoff discharges.