4. ETTP Environmental Monitoring Programs

4.1 ETTP RADIOLOGICAL AIRBORNE EFFLUENT MONITORING

Locations of airborne radionuclide point sources at the ETTP are shown in Fig. 4.1. Radionuclide emission information for these release points is compiled under the direction of Bechtel Jacobs Company LLC from operators subject to 40 CFR 61 Subpart H regulations (NESHAP). For 1998, other prime contractors working directly for DOE may also be subject to 40 CFR 61 subpart H; however, no data were obtained from these sources and therefore they are not reported here. Point sources shown in Fig. 4.1 include both individual point sources and grouped point sources, such as laboratory hoods. Radionuclide emissions data were determined from either EPA-approved sampling results or EPA-approved calculation methods.

4.1.1 Sample Collection and Analytical Procedure

4.1.1.1 Minor sources

The number of minor sources in 1998 varied from the previous year ~~totals~~ because of fluctuations in site operations. For this reporting period, a total of 11 point and 3 grouped minor sources subject to 40 CFR 61 regulations operated. Minor sources are grouped if they have similar character-

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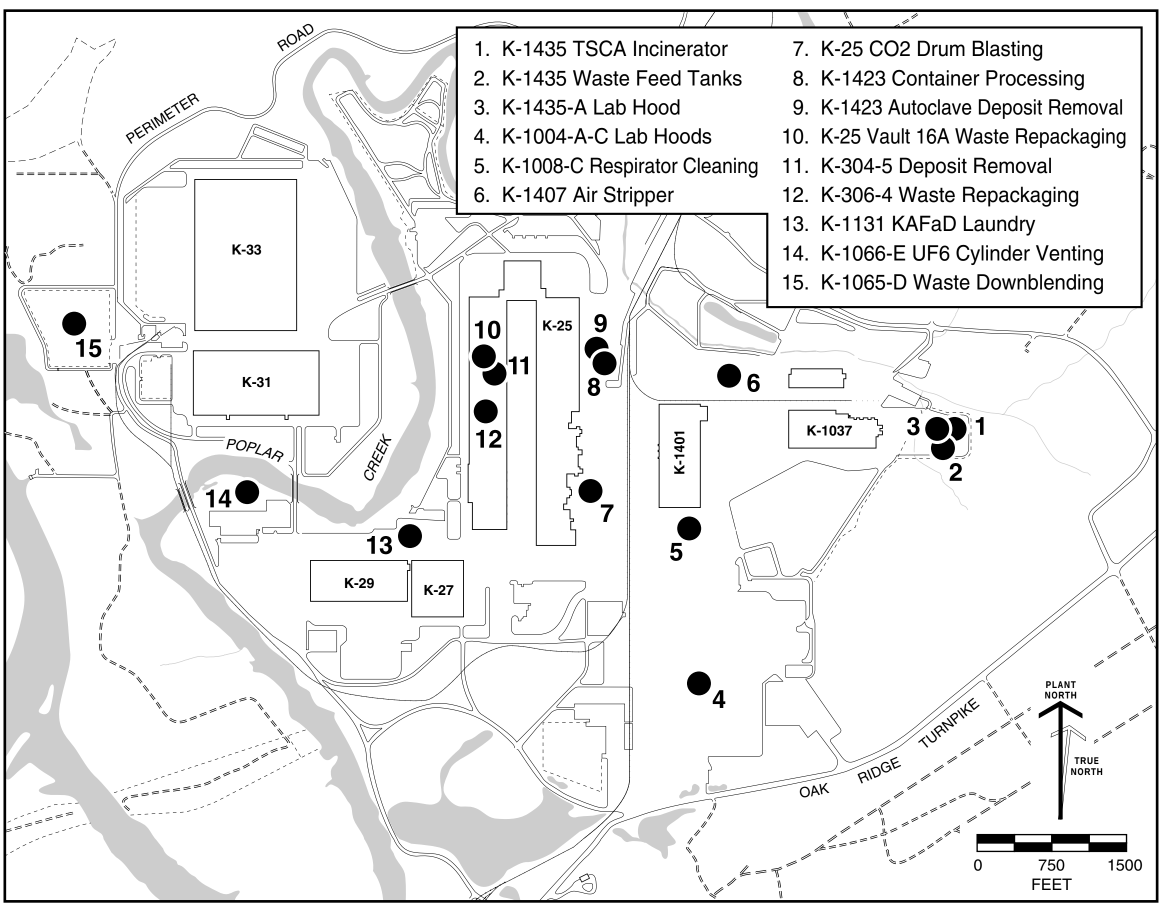

Fig. 4.1. Locations of airborne radionuclide point sources at the ETTP.

istics (e.g., general location, type of activity, or type of control) and provided that any one group does not exceed 0.1 mrem/year potential effective dose equivalent (EDE) as defined under the rule. Laboratory hoods were grouped as two sources of 40 and 2 emission points respectively and the Toxic Substances Control Act Incinerator (TSCAI) tank farm as a group of 15 emission points.

Emissions from the various minor sources located at the ETTP were estimated using one of the following 40 CFR 61, Appendix D, or other approved methods: (1) radionuclide inventory (e.g., material balance)—seven point and two grouped sources, (2) health physics air data where room ventilation emissions exceeded 10% of the derived air concentration (DAC) worker protection guidelines—no sources, (3) surrogate—four point sources, (4) and evaporative emissions—one grouped source. All techniques are conservative methods of estimating emissions based on the physical form of the radionuclides and the maximum operating temperature of the process or activity.

Any remaining emissions were classified as diffuse/fugitive sources that are spatially distributed in nature, or were not emitted with forced air from a stack, vent, or other confined conduit. Typical examples of diffuse/fugitive sources include emissions from building breathing; resuspension of contaminated soils, debris, or other materials; unventilated tanks; ponds, lakes, and streams; wastewater treatment systems; outdoor storage and processing areas; leaks from piping, valves, or other process equipment; and decontamination and demolition activities.

4.1.1.2 Toxic Substances Control Act Incinerator

Radionuclide emission measurements from the TSCAI were determined using a continuous stack sampling system. The system is designed to automatically adjust sample flow rate to maintain near-isokinetic sampling conditions at the stack. The effluent is passed through filter media to collect particulate matter and impingers with absorbing and adsorbing media to collect gaseous radionuclides. Measurements of TSCAI emissions were based on monthly composites of weekly stack samples

4.1.2 Results

The ETTP 1998 radionuclide emissions from the TSCAI and minor source emission sources are shown in Table 4.1. Additionally, Figs. 4.2 and 4.3 show a comparison of the total discharges of uranium with those of previous years. The total curies and mass of uranium discharged are comparable to last year. Variations are typically the result of changing levels of activities, waste burning, and uranium assay from year to year.

4.2 ETTP NONRADIOLOGICAL AIRBORNE EMISSIONS MONITORING

Under an application shield granted by the Tennessee Department of Environment and Conservation (TDEC) Division of Air Pollution Control, the ETTP operated nine major air emissions sources subject to Tennessee Title V Major Source Operating Permit program rules. No direct monitoring of airborne emissions is required for nonradionuclide air contaminants from permitted sources. Instead, monitoring of key process and air pollution control device parameters is done to ensure compliance with all permitted emission limits.

The ETTP is required to pay annual major source emission fees for all regulated pollutants excluding carbon monoxide and pollutants from exempt and fugitive emission sources. To verify the annual air emission fee assessment, based on the ETTP’s allowable limits for air pollutants, an inventory of allowable emissions from the permitted sources at the ETTP is updated annually. Table 4.2 shows the allowable emissions of criteria pollutants from ETTP operations for the past 5 years. The ETTP paid annual emission fees based on allowable emissions in 1998 amounting to $11,860.53. An inventory of actual emissions from all permitted sources in operation at the ETTP was also completed for 1998. Table 4.3 shows actual 1998 emissions from the ETTP.

Table 4.1. ETTP radionuclide air emission totals, 1998 (In curies)[a]

Radionuclide	Major	Minor	Total
^{228}Ac	–	4.10E–06	4.10E–06
^{241}Am	–	1.59E–06	1.59E–06
^{133}Ba	–	2.09E–08	2.09E–08
^{212}Bi	–	4.95E–08	4.95E–08
^{214}Bi	–	5.01E–09	5.01E–09
^{14}C	–	1.47E–04	1.47E–04
^{109}Cd	–	1.25E–05	1.25E–05
^{143}Ce	–	9.65E–07	9.65E–07
^{144}Ce	–	3.23E–09	3.23E–09
^{249}Cf	–	1.08E–08	1.08E–08
^{243}Cm	–	6.13E–09	6.13E–09
^{244}Cm	–	1.25E–07	1.25E–07
^{57}Co	1.90E–07	2.13E–07	4.03E–07
^{58}Co	–	5.91E–11	5.91E–11
^{60}Co	–	1.37E–06	1.37E–06
^{134}Cs	–	3.58E–07	3.58E–07
^{137}Cs	3.98E–04	9.53E–06	4.08E–04
^{152}Eu	–	2.62E–07	2.62E–07
^{154}Eu	–	2.39E–07	2.39E–07
^{155}Eu	–	3.30E–07	3.30E–07
^{59}Fe	–	1.45E–11	1.45E–11
^{3}H	1.65E+01	1.76E–02	1.65E+01
^{131}I	–	1.80E–07	1.80E–07
^{40}K	7.44E–06	6.50E–06	1.39E–05
^{85}Kr	–	6.93E–01	6.93E–01
^{54}Mn	–	5.15E–12	5.15E–12
^{22}Na	–	7.80E–07	7.80E–07
^{95}Nb	–	5.44E–08	5.44E–08
^{237}Np	5.09E–07	1.27E–06	1.78E–06
^{231}Pa	–	1.30E–09	1.30E–09
^{233}Pa	–	2.13E–08	2.13E–08
^{234}Pa	–	3.12E–08	3.12E–08
^{234m}Pa	1.46E–01	4.75E–04	1.46E–01
^{210}Pb	–	8.65E–07	8.65E–07
^{212}Pb	–	7.17E–08	7.17E–08
^{214}Pb	–	6.83E–09	6.83E–09
^{210}Po	–	1.05E–08	1.05E–08
^{238}Pu	8.52E–04	1.24E–06	8.53E–04
^{239}Pu	3.67E–05	2.75E–06	3.94E–05
^{240}Pu	–	7.10E–10	7.10E–10
^{226}Ra	–	1.10E–08	1.10E–08

Table 4.1 (continued)

Radionuclide	Major	Minor	Total
^{228}Ra	–	7.24E–08	7.24E–08
^{106}Ru	–	1.38E–08	1.38E–08
^{125}Sb	–	4.29E–11	4.29E–11
^{89}Sr	–	6.25E–06	6.25E–06
^{90}Sr	–	1.40E–04	1.40E–04
^{99}Tc	4.57E–03	2.60E–04	4.83E–03
^{228}Th	1.40E–07	5.39E–06	5.53E–06
^{229}Th	–	1.08E–10	1.08E–10
^{230}Th	1.27E–05	5.26E–06	1.80E–05
^{231}Th	–	2.61E–08	2.61E–08
^{232}Th	3.13E–07	5.32E–06	5.63E–06
^{234}Th	4.56E–03	4.62E–04	5.02E–03
^{208}Tl	–	2.69E–08	2.69E–08
^{233}U	–	6.81E–06	6.81E–06
^{234}U	3.09E–04	4.63E–04	7.72E–04
^{235}U	9.58E–06	1.88E–05	2.84E–05
^{236}U	–	6.59E–07	6.59E–07
^{238}U	1.11E–03	8.20E–04	1.93E–03
^{65}Zn	–	4.28E–09	4.28E–09
^{95}Zr	–	2.69E–11	2.69E–11
Totals	1.67E+01	7.14E–01	1.74E+01

[a] 1 Ci = 3.7E+10 Bq.

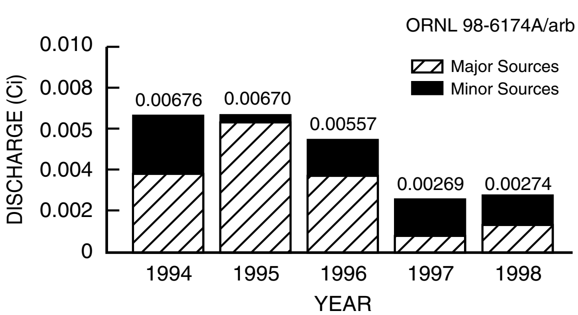

Fig. 4.2. Total curies of uranium discharged from the ETTP to the atmosphere, 1994–1998.

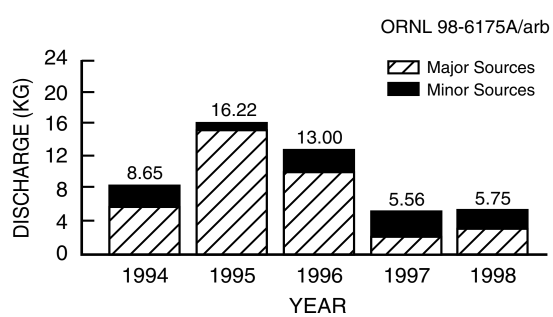

Fig. 4.3. Total kilograms of uranium discharged from the ETTP to the atmosphere, 1994–1998.

Table 4.2. Allowable emissions of criteria pollutants from the ETTP, 1994–98

Pollutant	Allowable emissions (tons/year)				
	1994	1995	1996	1997	1998
Particulate matter	141	296	247	194	192
Volatile organic compounds	153	167	150	120	122
Sulfur dioxide	429	428	428	428	427
Nitrogen oxides	226	224	224	224	185
Carbon monoxide	157	157	157	157	147
Hazardous Air Pollutants	24	24	24	24	24
Miscellaneous	125	125	0	0	0
Total	1251	1421	1230	1147	1097

Table 4.3. Actual emissions of criteria pollutants from the ETTP, 1998

Pollutant	Actual emissions (tons/year)
Particulate matter	1.07
Volatile organic compounds	0.48
Sulfur dioxide	0.76
Nitrogen oxides	15.45
Carbon monoxide	12.63

Table 4.4. Actual vs allowable air emissions from the K-1501 Steam Plant at the ETTP, 1998 (1st Qtr)

Pollutant	Emissions (tons/year)		Percentage of allowable
	Actual	Allowable	
Particulate matter	0.68	35	1.9
Sulfur dioxide	0.21	97	0.2
Nitrogen oxides	5.4	41	13.2
Volatile organic compounds	0.4	2	20.0
Carbon monoxide	10.12	32	31.6

Table 4.5. Actual vs allowable air emissions from the TSCA Incinerator at the ETTP, 1998

Pollutant	Emissions (tons/year)		Percentage of allowable
	Actual	Allowable	
Lead	0.005	0.575	0.9
Beryllium	0.000004	0.00037	1.1
Mercury	0.0062	0.088	7.0
Hydrogen Fluoride	0.0028	2.98	0.09
Hydrogen Chloride	0.009	16.12	0.06
Sulfur dioxide	0.056	38.5	0.15
Particulate	0.008	13.1	0.06

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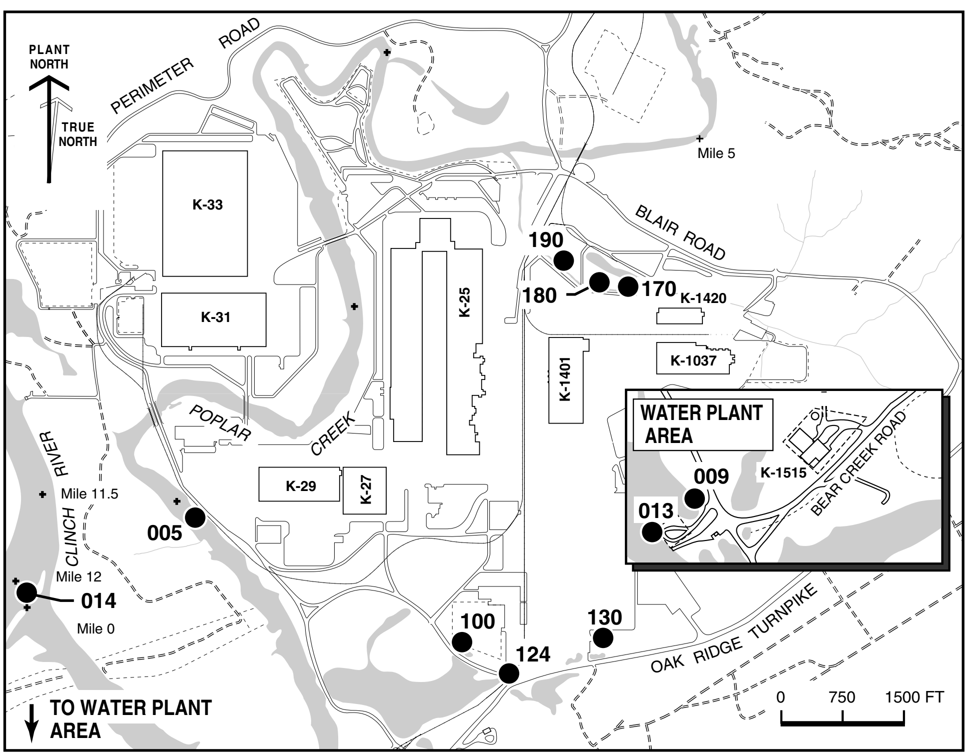

Fig. 4.4. ETTP NPDES major outfalls and Category I storm drain outfalls.

4.2.1 Results

The major sources of criteria air pollutants at the ETTP are the three remaining steam-generating units in operation at the K-1501 Steam Plant. These remaining units use natural gas as their primary fuel source, with No. 2 fuel oil used as backup during curtailment of natural gas supplies. Table 4.4 presents the actual and allowable emissions from the steam plant for first quarter 1998. The K-1501 Steam Plant was leased to Operations Management International, Inc. (OMI) in April 1998.

The TSCA Incinerator is permitted as a major source of air emissions from the ETTP. Emissions from the incinerator are controlled by extensive exhaust-gas treatment. Thus, actual emissions from the incinerator are significantly less than the permitted allowable emissions (Table 4.5).

4.3 LIQUID DISCHARGES—ETTP RADIOLOGICAL MONITORING SUMMARY

The ETTP conducts radiological monitoring of liquid effluent to determine compliance with applicable dose standards. It also applies the ALARA process to maintain potential exposures to members of the public as low as is reasonably achievable (ALARA).

4.3.1. Sample Collection and Analytical Procedure

The ETTP monitored two major effluent discharge points for radiological parameters: the K-1203 Sewage Treatment Plant (STP) discharge (Outfall 005) and the treated effluent from the K-1407-J Central Neutralization Facility (CNF) (Outfall 014) (Fig. 4.4). Weekly samples were collected from the CNF. The weekly samples were composited into monthly samples. A single monthly 24-h composite sample is collected at K-1203. These samples are then analyzed for radionuclides. Results of these sampling efforts were compared with the derived concentration guides (DCGs).

4.3.2 Results

The sum of the fractions of the DCGs at K-1407-J was calculated at 45.8% for CY 1998, up from 31.4% for CY 1997. The increase was determined to be caused by changes in TSCA Incinerator feed material. The sum of the fractions of the DCGs for effluent location K-1203 was less than 1%. Table 4.6 lists radionuclides discharged from the ETTP to off-site surface waters in 1998. Total uranium discharges from K-1407J and K1203 were 2.6E-2 Ci in 1998. Total transuranics from K-1407J (analyses for transuranics are not performed at K-1203) were 2.3E-5 Ci, which is 3 orders of magnitude less than uranium.

Uranium discharges to surface waters during a 5-year period were investigated to observe their trend (Fig. 4.5). The effluent point having the greatest DCG percentage was the K-1407-J outfall. Uranium isotopes were the major contributors to the function of the DCG, although tritium accounted for the largest portion of the total activity discharged. This is because the allowable DCG for tritium is much higher than the DCG for uranium (Fig. 4.6). The fluctuation in uranium discharges is attributed to TSCA Incinerator wastewater, which is sent to the CNF for treatment before discharging at K-1407-J (Outfall 014).

4.4 NONRADIOLOGICAL LIQUID DISCHARGES—ETTP SURFACE WATER EFFLUENTS

The current ETTP National Pollutant Discharge Elimination System (NPDES) permit went into effect on October 1, 1992, and a major modification was issued effective June 1, 1995. The modification included removal of inactive outfalls, addition of effluent limits for new treatment technologies at the CNF, addition of new storm drains, and clarification of various requirements. In accordance with the NPDES permit, the ETTP is authorized to discharge process wastewater, cooling water, storm water, steam condensate, and groundwater to the Clinch River, Poplar Creek, and Mitchell Branch. The permit currently in

Table 4.6. Radionuclides released to off-site surface waters from the ETTP, 1998
Effluent discharge locations K-1203 and K-1407-J

Isotope	Amount (Ci)[a]	Isotope	Amount (Ci)[a]
^{137}Cs	1.2E–3	^{14}C	8.9E-2
^{237}Np	1.6E–5	^{3}H	4.1E–0
^{238}Pu	5.1E–6	^{234}U	9.0E–3
^{239}Pu	2.2E–6	^{235}U	4.9E–4
^{99}Tc	3.5E–2	^{236}U	1.0E–4
		^{238}U	1.7E–2

[a]1 Ci = 3.7E+10 Bq.

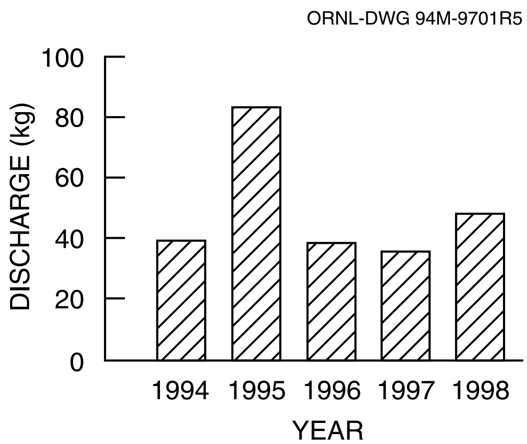

Fig. 4.5. Five-year trend of uranium releases to surface waters from the ETTP.

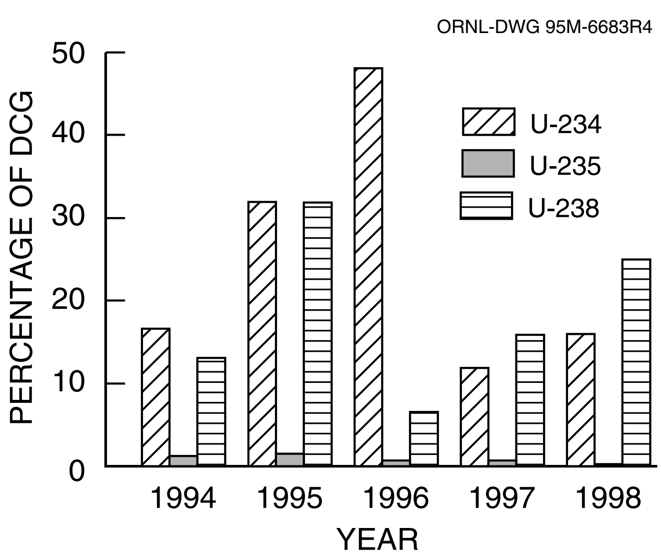

Fig. 4.6. Percentage of DCG for uranium isotopes from K-1407-J (Outfall 014).

cludes 4 facility outfalls and 136 storm water outfalls. Compliance with the permit for the last 5 years is summarized by the major effluent locations in Fig. 4.7. Table 4.7 details the permit requirements and compliance records for all of the outfalls that discharged during 1998. The table provides a list of the discharge points, effluent analytes, permit limits, number of noncompliances, and the percentage of compliance for 1998. Samples from these outfalls are collected and analyzed as specified in the NPDES permit.

The following are the four permitted major outfalls at the ETTP (Fig. 4.4):

- 005 (K-1203 Sewage Treatment Plant),
- 009 (K-1515 Sanitary Water Treatment Facility),
- 013 (K-1513 Sanitary Water Intake Backwash Filter), and
- 014 (K-1407-J CNF discharge to the Clinch River).

Outfall 005 is a permitted outfall for discharge of the treated effluent from the K-1203 Sewage Treatment Plant (STP) to Poplar Creek. Outfall 009 is a permitted outfall for the discharge of treated effluent from the K-1515 Sanitary Water Treatment Facility to the Clinch River. Outfall 013 is a permitted outfall for the discharge backwash from the K-1513 Sanitary Intake Filter to the Clinch River.

Although no monitoring is required at Outfall 013, routine inspections are conducted to ensure that no unsightly debris or scum is discharged through this point as the result of backwash operations at the K-1513 sanitary intake filter. Outfall 014 is a permitted outfall for the discharge of effluent from the CNF to the Clinch River.

The current ETTP NPDES Permit expired on September 30, 1997. An application for renewal of this permit was submitted to the Tennessee Department of Environment and Conservation in March 1997. To facilitate the transfer of ownership/operation of ETTP facilities to other parties, it was determined that separate NPDES permits would be required for each of the ETTP treatment facilities. In addition, it was determined that a separate NPDES permit for the storm water drainage system would be necessary. The ETTP will continue to operate under its present NPDES permit until new permits are issued. It is expected that the new NPDES permits will be issued some time in 2000.

4.4.1 Results

Outfall 005 is the discharge point for the ETTP STP, which is an extended aeration treatment plant having a rated capacity of 2.3 million L/d [0.6 million gallons per day (Mgd)] and a current use of about 1.4 million L/d (0.36 Mgd). Treated effluent from the main plant is discharged into Poplar Creek through this outfall. This facility had one NPDES permit noncompliance during 1998.

On April 22, 1998, Environmental Compliance personnel were notified by the Analytical Services Organization that the settleable solids analysis of a sample obtained on April 19, 1998, at the K-1203 Sewage Treatment Plant resulted in a measurement of 0.6 mL/L. The maximum NPDES permitted level for settleable solids at this outfall is 0.5 mL/L.

OMI Utilities personnel immediately reviewed operational records and flow data for the K-1203 facility as well as rainfall data on the date the sample was obtained. ETTP and surrounding areas had received unusually heavy amounts of rainfall for several days preceding and during the time period when the sample was obtained.

Because of excessive flow rates at the facility resulting from the heavy rainfall, wastewaters were diverted to the Imhoff Holding Tanks on two occasions during the period of heavy rainfall to avoid hydraulic upset conditions. Wastewater was diverted from 11 p.m. on April 16, 1998, to 2:00 a.m. on April 17. A diversion of the Imhoff Tanks was also initiated on April 18 at 11:30 a.m. and continued until 6:00 a.m. on April 19. The sample for settleable solids was obtained at 8:10 a.m. on April 19. All other measurements required by the NPDES permit that were obtained at the facility during the period of heavy rainfall [biological oxygen demand (BOD), fecal coliform, suspended solids, and pH] were within the limits specified by the NPDES permit. No adverse environmental impacts to the receiving waters of Poplar Creek occurred as a result of the settleable solids exceedence.

Table 4.7. NPDES compliance at the ETTP, 1998

Discharge point	Effluent parameter	Effluent limits: Monthly av[a]	Effluent limits: Daily max[a]	Effluent limits: Monthly av (lb/day)	Effluent limits: Daily max (lb/day)	No. of noncompliances	Percentage of compliance
005 (K-1203 Sewage Treatment Facility)	Ammonia nitrogen	5	7	12	17		100
	Biochemical oxygen demand	15	20	37	49		100
	Chlorine, total residual	0.14	0.24				100
	Dissolved oxygen		5[b]				100
	Fecal coliform, col/100 mL	200[c]	1,000				100
	Flow, Mgd	*d*	*d*				100
	LC_{50}, *Ceriodaphnia*, %		14.6[b]				100
	LC_{50}, *Pimephales*, %		14.6[b]				100
	NOEL,[e] *Ceriodaphnia*, %		4.2[b]				100
	NOEL,[e] *Pimephales*, %		4.2[b]				100
	pH, standard units		6.0–9.0				100
	Settleable solids, mL/L		0.5			1	99.6
	Suspended solids	30	45	74	111		100
	Unpermitted discharge	*f*	*f*	*f*	*f*		*f*
009 (K-1515-C Sanitary Water Plant)	Aluminum	1.0	2.0				100
	Chlorine, total residual		1.0			1	98
	Flow, Mgd	*d*	*d*				100
	pH, standard units		6.0–9.0				100
	Settleable solids, mL/L		0.5				100
	Suspended solids	30	40				100
	Unpermitted discharge	*f*	*f*	*f*	*f*		*f*
013 (K-1513 Sanitary water intake and backwash filter	Visual inspection of receiving stream						
014 (K-1407-J Central Neutralization Facility to Clinch River)	1,1,1-Trichloroethane	*d*	*d*				100
	Acetone	*d*	*d*				100
	Acetonitrile	*d*	*d*				100
	Benzene	*d*	0.005				100
	Bromoform	*d*	*d*				100
	Cadmium	0.18	0.69				100
	Carbon tetrachloride	0.5	0.5				100
	Chemical oxygen demand	*d*	*d*				100
	Chloride, total	35,000	70,0000				100
	Chlorine, total residual		1.0				100
	Chlorodibromomethane	*d*	*d*				100
	Chloroform	0.5	0.5				100
	Chromium	1.71	2.77				100
	Copper	1.34	2.15				100
	Dichlorobromemethane	*d*	*d*				100
	Flow, Mgd	*d*	*d*				100
	Ethylbenzene	*d*	0.01				100
	Gross alpha, pCi/L	*d*	*d*				100
	Gross beta, Pci/L	*d*	*d*				100
	Lead	0.38	0.69				100
	Methyl ethyl ketone	*d*	*d*				100
	Methylene chloride	*d*	*d*				100
	Naphthalene	*d*	*d*				100
	Nickel	2.38	3.98				100
	Oil and grease		30				100
	PCB	0.00022	0.00045			2	83.3
	Petroleum hydrocarbons	*d*	0.1				100
	pH, standard units		6.0–9.0				100

Table 4.7 (continued)

Discharge point	Effluent parameter	Effluent limits: Monthly av[a]	Daily max[a]	Monthly av (lb/day)	Daily max (lb/day)	No. of noncompliances	Percentage of compliance
014 (continued)	Silver	0.24	0.43				100
	Suspended solids		40				100
	Tetrachloroethylene		0.7				100
	Toluene	*d*	0.01				100
	Total toxic organics		2.13				100
	Trichloroethylene	0.5	0.5				100
	Unpermitted discharge	*f*	*f*	*f*	*f*		*100*
	Uranium, total	*d*	*d*				100
	Vinyl chloride	0.2	0.2				100
	Zinc	1.48	2.61				100
Category I storm drains	Flow, Mgd	*d*	*d*				100
	pH, standard units		4.0–9.0			1	99.2
	Missed sample	*f*	*f*	*f*	*f*		100
Category II storm drains	Flow, Mgd	*d*	*d*				100
	pH, standard units		4.0–9.0			1	99.1
	Suspended solids	*d*	*d*				100
	Unpermitted discharge	*f*	*f*	*f*	*f*		*f*
Category III storm drains	Flow, Mgd	*d*	*d*				100
	Oil and grease	*d*	*d*				100
	pH, standard units		4.0–9.0				100
	Suspended solids	*d*	*d*				100
	Unpermitted discharge	*f*	*f*	*f*	*f*		*f*
Category IV storm drains (to Poplar Creek)	Chlorine, total residual		0.14				100
	Flow, Mgd	*d*	*d*				100
	Oil and grease	*d*	*d*				100
	pH, standard units		6.0–9.0				100
	Suspended solids	*d*	*d*				100
	Unpermitted discharge	*f*	*f*	*f*	*f*		*f*
Category IV storm drains (to Mitchell Branch)	Chlorine, total residual		0.019			1	91.7
	Flow, Mgd	*d*	*d*				100
	Oil and grease	*d*	*d*				100
	pH, standard units		6.0–9.0				100
	Suspended solids	*d*	*d*				100
	Unpermitted discharge	*f*	*f*	*f*	*f*	1	*f*

[a]Units are mg/L unless otherwise stated.
[b]Daily minimum.
[c]Geometric mean.
[d]Nonlimited parameter.
[e]No-observed-effect limit.
[f]Not applicable.

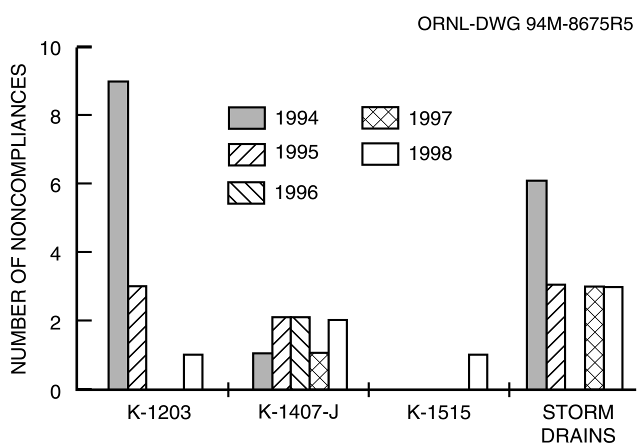

Fig. 4.7. ETTP NPDES compliance history by source of noncompliance.

Outfall 009 (leased to OMI) is the discharge point for the K-1515 sanitary water plant, which provides sanitary water to the ETTP to be used for drinking, fire protection, and other purposes. It also provides water to two industries in the Bear Creek Road Industrial Park through an arrangement with the city of Oak Ridge. Raw water is taken from the Clinch River and treated at K-1515. Effluent from the K-1515-F Holding Lagoon at the K-1515 Sanitary Water Treatment Facility is discharged through Outfall 009. The K-1515 sanitary water plant had one noncompliance with the ETTP NPDES permit during 1998.

On February 17, 1998, the concentration of total residual chlorine (TRC) in a weekly grab sample obtained at NPDES Outfall 009 was measured at 1.4 milligrams/liter (mg/L). This concentration exceeded the daily maximum NPDES permitted level of 1.0 mg/L for this outfall.

An investigation was immediately initiated to determine the cause of the elevated TRC concentration. Quality assurance methods associated with the laboratory analysis of the sample were evaluated, and the analytical results were determined to be accurate.

The K-1515 Sanitary Water Treatment Facility operations were reviewed. The K-1515-F Lagoon has three discharge valves at different elevations (high, middle, and low) to facilitate maintenance of water levels in the lagoon. Because of the mild winter, a recurring algae growth problem was beginning to develop in the K-1515-F Lagoon. Utilities Operations personnel have controlled the algae by leaving the middle and high discharge valves open, thus maintaining flow in the lagoon while keeping the water level as low as possible. This valve configuration combined with the normal chlorine levels in the lagoon has successfully controlled the algae growth.

On February 15, 1998, personnel discovered a broken shaft on the paddles in the Number 1 Flocculation Basin at the facility. The basin was isolated, drained to the K-1515-F Lagoon, and washed down with sanitary water in preparation for repairs to the paddle shaft on February 16, 1998. This process added approximately 65,000 gallons of chlorinated water to the K-1515-F Lagoon. Prior to draining of the flocculating basin to the K-1515-F Lagoon, the middle discharge valve at the K-1515 Lagoon was closed; the high discharge valve remained open. No discharge occurred from the lagoon on February 16, 1998. Approximately 0.5 inches of rainfall occurred during the latter part of February 16, causing the water level in the lagoon to rise and discharge through the high elevation valve to NPDES Outfall 009 on February 17. The chlorinated water from the draining and washing down of the flocculating basins combined with the normal chlorinated water in the K-1515-F Lagoon is believed to be the cause of the elevated TRC measurement.

Immediately upon notification of the TRC results on February 17, 1998, the high elevation discharge valve was closed and dechlorination tablets were placed in the lagoon discharge basin. Corrective actions have been developed to prevent recurrence of this incident.

The ETTP CNF, Outfall 014, has provisions for treatment of nonhazardous and hazardous wastes. Nonhazardous flow entering the CNF consists of steam plant effluents and various small-quantity or infrequent streams from waste disposal requests. Hazardous streams include effluents from the TSCA Incinerator, the steam plant hydrogen softener waste stream, and various small-quantity or infrequent streams from waste disposal requests.

To begin treatment of waste streams contaminated with various organics, the CNF was upgraded in 1996 to include pressure filters, carbon adsorption, and air stripping. These upgrades were approved by TDEC, and construction was completed in April 1996. Operational testing was completed in June 1996, and the new organics treatment system went on line in July 1996. The CNF had two NPDES noncompliances in 1998.

On February 4, 1998, the concentration of polycholorinated biphenyls (PCB) in a monthly composite sample obtained at NPDES Outfall 014 was measured at 3.1 micrograms/liter (µg/L), Aroclor-1254. This concentration exceeded the daily maximum permitted level of 0.45 µg/L total PCB, as well as the maximum monthly average permitted level of 0.22 µg/L total PCB.

An investigation was initiated to determine the cause of the elevated PCB concentrations. CNF and Toxic Substances Control Act Incinerator (TSCAI) operations were reviewed for the time period immediately prior to and during the time the composite sample was obtained and were determined to be in accordance with normal operating conditions. K-1501 Steam Plant operations during the same period were also determined to be normal. No wastewater transfers from the SW-31 Spring collection system to the CNF were initiated in the January 24, 1998 to February 13, 1998 time period.

Laboratory operations and calculations associated with the analytical measurement of PCB in the composite sample were reviewed. It was determined that the potential for contamination from previous samples analyzed for PCB in the laboratory was very remote. Calculations were reviewed and verified and determined to be accurate.

Despite a comprehensive investigative effort, no direct cause for the February 4, 1998, PCB exceedence has been identified. A direct cause determination for this event is not foreseeable.

The ETTP NPDES permit includes 136 storm water outfalls that are grouped into four categories based on their potential for pollutants to be present in their discharge. Category I storm water outfalls have intermittent flow and drain storm water runoff from areas remotely associated with plant activities and subsurface runoff; Category II storm water outfalls have intermittent flow and drain storm water runoff from building roof drains and paved areas associated with plant activities; Category III storm water outfalls have intermittent flow and drain storm water runoff from areas associated with concentrated storage areas, roof drains, coolant systems, and parking lots; and Category IV storm water outfalls have continuous flow and drain cooling water discharges and runoff from industrial areas. Monitoring at storm water outfalls is conducted semiannually, quarterly, monthly, or weekly for Categories I through IV, respectively, with those outfalls that have the highest potential for pollution being sampled most frequently.

Four NPDES noncompliances and one fish kill event that was not classified as a noncompliance occurred at storm water outfalls during 1998 Single noncompliances occurred at Outfall 650 and Outfall 670. Two of the noncompliances and the fish kill occurred at Outfall 190.

On April 20, 1998, a routine semiannual pH measurement was obtained at Storm Drain Outfall SD-650. The pH at SD-650 was measured at 10.7. In addition, a routine quarterly pH measurement was obtained at Storm Drain Outfall SD-670, which is located adjacent to SD-650, on April 20, 1998. The pH at SD-670 was measured at 11.2. The NPDES permit limit for pH at these storm drain outfalls is 9.0. Immediately upon notification of the two NPDES permit noncompliances, an investigation into potential sources of the elevated pH readings was conducted. It was determined that the most likely source of the elevated pH readings was the percolation of storm water through buried concrete rubble that was generated during the demolition of the K-892-G and K-892-H cooling towers in 1996. The concrete rubble generated by the demolition was crushed into small pieces, placed back into the cooling tower basins, compacted, covered with soil, and reseeded. It is believed that the concrete rubble may have become saturated with storm water from unusually heavy rainfall events that occurred during the week prior to the occurrence of these noncompliances, resulting in the elevated pH. SD-650 and SD-670 are rarely observed to be flowing during short-term, low- or high-intensity rainfall events. However, a total of more than 6 inches of rainfall had occurred during the week prior to the occurrence of the noncompliances.

Personnel placed a pneumatic plug into the end of SD-670 to stop the flow from the pipe. The flow from SD-650 was stopped by plugging the two 6-inch-diameter pipes in the open concrete basin located upstream of the storm drain outfall. No further incidents have been reported at either of these two storm drains.

On April 6, 1998, a routine quarterly sample for total residual chlorine (TRC) was obtained at Storm Drain Outfall SD-190, as required by the NPDES permit. The TRC concentration in the sample was measured at 0.58 mg/L. The maximum NPDES permitted level for TRC at this outfall is 0.019 mg/L.

Immediately upon notification of the elevated TRC measurement, dechlorination tablets were placed in the discharge from SD-190 to eliminate discharges of chlorine to Mitchell Branch, and an investigation to determine the source of the chlorine was initiated. By obtaining chlorine measurements at catch basins in the SD-190 drainage network and reviewing sanitary water distribution system block plans, the source was traced to an underground leak in a 4-inch sanitary water feeder line at the northwest side of Building K-1401. Additional dechlorination tablets were placed in a catch basin near the leaking line to ensure adequate dechlorination of the leaking water until repairs could be completed. No TRC was detected in catch basins downstream from this area, indicating effective dechlorination of the discharge.

Personnel isolated the leak and stopped the flow of chlorinated water to the SD-190 storm drain system and initiated efforts to excavate and repair the leaking line. All repairs were completed, and the line was returned to service on April 20, 1998.

On September 30, 1998, an employee reported observing liquid being poured into a storm drain catch basin. Upon further investigation, it was discovered that mop water containing a citrus-based cleaner had been poured into the storm drain. The mop water had been used to clean an office area in K-1401 that was being leased by a private company. The catch basin that the liquid was poured into was located on the west side of Building K-1401 between doors 3W and 4W. This catch basin discharged through the Storm Drain Outfall SD-190 drainage network. Management personnel of the private company were asked to remind their personnel not to dispose of any material in the storm drain system. The building operator for Building K-1401 was requested to show lessees occupying the building appropriate locations connected to the sanitary sewer system where discharges of this type can be conducted. Guidelines for protection of surface waters were developed and were distributed to all ETTP tenants.

On October 26, 1998, a small fish kill and elevated water temperatures were noted by sampling technicians at Storm Drain Outfall SD-190 during routine sampling activities. Approximately 14 dead fish were observed at SD-190. Water temperature at the storm drain was measured at approximately 40°C. The normal temperature of the SD-190 discharge is approximately 15–20°C. After an initial observation of the conditions in the area where the dead fish were found, it was determined that the elevated water temperature was most likely responsible for the fish kill.

The building manager for Building K-1401 discovered a malfunctioning pump serving a steam condensate tank in the basement of K-1401. The pump normally pumps hot steam condensate back to the K-1501 steam plant where it is recycled. Because the pump had failed, the associated steam condensate tank had filled up and was overflowing. By tracing the drainage network of the storm drain system in the K-1401 area, it was determined that the overflowing steam condensate was entering the storm drain system and was discharging at SD-190. This was determined to be the source of the elevated water temperatures at SD-190. The steam was cut off to Building K-1401 to allow the flow of condensate to stop and allow the water in the condensate tank to cool. Maintenance personnel then repaired the condensate pump.

On October 27, the water temperature at SD-190 was measured at 18.6°C, which is considered to be normal for this storm drain outfall. Additional dead fish were observed at the terminus of the SD-190 pipe, bringing the total number of dead fish observed during this event to 28. These fish are believed to have been part of the initial fish kill that was observed on October 26.

The building manager for Building K-1401 has rerouted the condensate overflow line from the storm drain system to the groundwater sumps in the basement of the building. If future condensate overflows occur, the condensate will be sent to CNF rather than to the storm drain system. This will prevent the possibility of fish kills occurring as a result of a condensate overflow at this location.

4.5 STORM WATER POLLUTION PREVENTION PROGRAM

The Storm Water Pollution Prevention (SWPP) Program is a requirement of the NPDES permit. Its purpose is to minimize the discharge of pollutants in storm water runoff. The Environmental Protection Agency forms that must be completed as part of the application for the ETTP NPDES permit for the storm water drainage system required a large quantity of data that had not been collected during previous storm drain sampling efforts. Therefore, the 1997–98 SWPP sampling effort was primarily devoted to the collection of analytical data that would allow for the completion of the NPDES permit renewal application for the ETTP storm water drainage system.

Many of the parameters that were sampled during this sampling program, including nitrate/nitrite nitrogen and phosphorous, are indicative of nutrients that would be common in runoff from agricultural operations. Since no operations of this type are conducted at the ETTP, the levels of these contaminants were below screening criteria.

Oil and grease samples were collected to determine the contribution to contamination of water resources resulting from the parking lot runoff, paving operations, etc. Despite the large number of automobiles, machinery, and equipment operated at the ETTP, there appears to be a little contribution of petroleum contaminants to area water resources by ETTP storm water runoff. Results of oil and grease analysis showed that levels were below the analytical method detection limit in the samples collected during the 1997–98 SWPP Program.

4.6 ETTP TOXICITY CONTROL AND MONITORING PROGRAM

The ETTP NPDES permit requires that biannual toxicity testing be performed at Outfall 005 (K-1203, the Sewage Treatment Plant).The results of the toxicity tests of wastewaters conducted during 1998 are given in Table 4.8. This table provides the wastewater's no-observable-effect concentration (NOEC) and 96-hour lethal concentration (LC_{50}) for 50% of the test organisms for fathead minnows and *Ceriodaphnia* for each test. Average water quality measurements obtained during each toxicity test are shown in Table 4.9.

Effluent from K-1203 was tested twice during 1998 with fathead minnows and *Ceriodaphnia*. In both tests, full-strength samples did not reduce survival, growth, or reproduction. Thus the NOECs were 100% and the LC_{50}s were >100%.

4.7 ETTP BMAP

The Biological Monitoring and Abatement Program (BMAP) is a requirement of the ETTP NPDES permit. Its purpose is to assess the ecological health of the ETTP receiving streams and ponds. A number of BMAP indicators changed dramatically in 1998 in comparison to past years. It is likely that a number of these indicators, most specifically the fish and benthic community measures, were affected by the construction and lining activities in Mitchell Branch during spring and summer of 1998 as part of the Mitchell Branch Plumes Project. Major habitat changes in the upstream section of Mitchell Branch are the likely cause of negative impacts to the fish and benthic communities living in this reach. Monitoring of biological communities downstream of the impacted area showed that the construction impacts were relatively localized. It is still unclear as to how changes in groundwater flow as a result of the Plumes Project may affect water quality in Mitchell Branch. Toxicity investigations continue in an effort to evaluate the potential causes of toxicity in samples from storm drain (SD) 190 in 1998. Other changes, such as changes in PCBs in Mitchell Branch biota, appear to be unrelated to the construction activities.

4.7.1 Toxicity Monitoring

The toxicity monitoring task for the ETTP BMAP includes tests of effluent from treatment facilities (see ETTP Toxicity Control and Monitoring Program, Sect. 4.6), effluent from storm drains (SD170, SD180, and SD190), and surface water from six sites within Mitchell Branch. Effluent from SD170 and SD190 was evaluated for toxicity six times during 1998 using *Ceriodaphnia dubia*. Full-strength effluent from SD170 reduced *Ceriodaphnia* survival or reproduction in four of six tests. Full-strength effluent from SD190 reduced *Ceriodaphnia* survival or reproduction in five of six tests. Effluent from SD180 was evaluated for toxicity two times in 1998; the effluent reduced *Ceriodaphnia* reproduction in one of the two tests. Most toxicity tests of surface water from Mitchell Branch downstream of each storm drain found no reduction in *Ceriodaphnia* survival or reproduction at any site. In January 1998, *Ceriodaphnia* reproduction was reduced in water from sites Mitchell Branch Kilometer (MIK) 0.78 and MIK 0.12, but there was no corresponding toxicity in the storm drains immediately upstream of those sites. In December

Table 4.8 . 1998 ETTP NPDES Permit Number TN 0002950 toxicity tests results

ETTP Outfall	Test date	Species	NOEC[a] (%)	LC_{50}[b] (%)	IWC[c] (%)
K-1203 (Outfall 005)	January	Fathead minnow	100	>100	2.45
		Ceriodaphnia	100	>100	2.45
	July	Fathead minnow	100	>100	2.5
		Ceriodaphnia	100	>100	2.5

[a]No-observable-effect concentration.
[b]96-hour lethal concentration for 50% of the test organisms.
[c]Instream waste concentration (based on critical low flow of Poplar Creek).

Table 4.9. 1998 ETTP average water quality parameters measured during toxicity tests of ETTP wastewaters
Values are averages of full-strength wastewater for each test (N = 6 or 7)

ETTP Outfall	Test date	pH (standard units)	Conductivity µS/cm)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)
K-1203 (005)	January	8.11	380	110	160
	July	7.9	320	69	130

1998, *Ceriodaphnia* reproduction at MIK 0.45 was significantly lower than reproduction at the reference site (MIK 1.43). Because all of the *Ceriodaphnia* exposed to full-strength effluent from SD190 also died during this time, the reduced reproduction at MIK 0.45 appears to be linked to a toxicant in effluent from SD190. This occurrence of high mortality of *Ceriodaphnia* in SD190 has prompted follow-up investigations in an attempt to determine the cause of the toxicity.

4.7.2 Bioaccumulation Studies

In 1998, resident fish and caged clams in Mitchell Branch, the K1007-P1 pond, and the K901-A pond were monitored for PCB contamination. In Mitchell Branch, the mean PCB concentrations in redbreast sunfish increased steadily from less than 1 ppm in 1993 to near 4 ppm in 1998. It is unlikely that the remediation activities in Mitchell Branch were the cause of the increase observed in 1998 because the fish were collected in January prior to major trenching activities. Clam monitoring results suggest that the observed increase was associated with SD190 because PCB levels in clams increased substantially over the last 5 years in clams placed below the SD190 discharge and near the weir in Mitchell Branch, but not upstream of these sites.

In the K1007-P1 pond, PCB concentrations in largemouth bass also increased over the last 5 years, although the average in 1998 (27.13 µg/g, wet weight) was only slightly higher than in 1997. Sampling of caged clams at various flow inputs to the pond clearly indicated continuing inputs of PCBs (means ranged from 1.22 to 7.75 µg/g). SD100 continued to be the most contaminated outfall entering the pond, although PCB accumulation in clams near SD100 was lower in 1998 than previous years.

Fish and caged clams from the K901-A pond were very low in PCBs, averaging near background concentrations in all species collected. The fish were collected from the pond only a few weeks after the pond was refilled (the pond was largely drained during remediation activities in 1997). Fish collected from the pond were presumably recent migrants from the Clinch River. Fish collected in the past from the Clinch River have been relatively high in PCBs, so the very low concentrations in K901-A fish is unexplained. It is possible the fish collected from the K901-A pond had lost much of their PCB body burdens (initially obtained from the Clinch) while exposed to a less PCB-contaminated pond environment.

4.7.3 Ecological Surveys

The benthic macroinvertebrate community downstream of the main storm drains in Mitchell Branch continued to show impacts compared with the upstream reference site. Results from 1998 show that construction of the interceptor trench adjacent to Mitchell Branch significantly impacted MIK 0.71 and MIK 0.78. There appeared to be few or no negative effects from this construction on the invertebrate community at MIK 0.45, which is downstream of the zone where the stream was reconstructed. Changes in total taxonomic richness and taxonomic richness of the pollution-intolerant *Ephemeroptera, Plecoptera,* and *Trichoptera* (i.e., EPT richness) at MIK 0.45 and MIK 1.43 from 1997 to 1998 were similar (i.e., average values declined at both sites) and of a comparable magnitude. Total taxonomic richness at MIK 0.78, on the other hand, dropped to its lowest level since April 1994, and at MIK 0.71, total taxonomic richness dropped to its lowest level since 1988. Densities were also lower at all sites in 1998 than in 1997. However, densities were similar at all sites in 1998, indicating that benthic invertebrate densities were within the normal range of reference conditions soon after the interceptor ditch was completed.

Fish community data collected in April and May 1998 indicated that species richness, density, and biomass all declined and reached very low levels similar to those found at the site prior to the recovery of the mid-1990s. The community at MIK 0.71 changed from a diverse assemblage to one containing two common, small-stream fishes that are adapted to colonize or re-invade disturbed habitats. Negative impacts to the fish community in this reach were likely the result of major changes in stream channel morphology, substrate size and complexity, and abundance and quality of associated riparian vegetation. At the downstream site (MIK 0.45), any potential impact associated with the upstream remediation was not evident. There were negligible changes from trends of the past few years in species richness/composition, total density, and biomass.

The benthic macroinvertebrate and fish community data are consistent in demonstrating impacts at upstream sites (MIK 0.78 and MIK 0.71) but not at downstream sites (MIK 0.45) in response to the remediation activity.

4.8 ETTP AMBIENT AIR MONITORING

DOE Order 5400.1 requires surveillance of ambient air to assess the impact of DOE operations on air quality. In addition, airborne radionuclide monitoring is required for compliance with radionuclide NESHAP regulatory agreements. DOE Order 5400.5 also specifies locations for airborne radionuclide surveillance. The ETTP ambient air monitoring program is designed to monitor selected air contaminants for the ongoing monitoring of plant operations' impact on the immediate environment. Specific locations were selected to determine air contaminant concentrations in the prevailing directions, upwind and downwind of the site, and to obtain airborne radiological measurements in the direction of both the nearest and most exposed member of the public. The locations of these monitoring stations are shown in Fig. 4.8. The ETTP ambient air monitoring program complies with all requirements of DOE orders. National ambient air quality standards are referenced by DOE orders as guidance with respect to ambient air concentrations of certain air contaminants. These regulations specify 24-hour, quarterly, and annual standards for specific or criteria pollutants.

The ambient air program sampling schedule and monitoring capabilities for airborne particulate matter, uranium, and selected hazardous air pollutant (HAP) metals are listed in Table 4.10. All parameters are chosen with consideration of existing and proposed regulations and the nature of operations in and around the ETTP. Changes in emissions, wind profile, site activities, or any other parameter that may alter the potential impact of ETTP activities on nearby communities or the environment may warrant periodic changes of air contaminants measured, number of stations, or relocation of existing stations.

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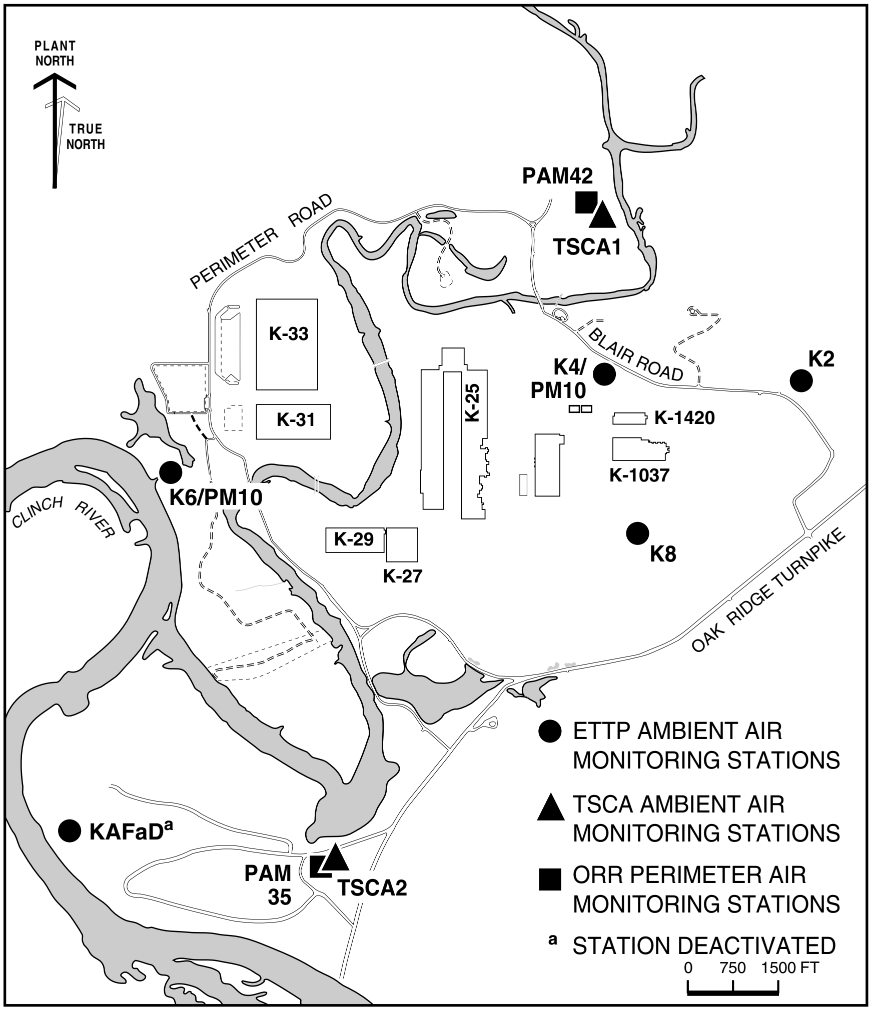

Fig. 4.8. Locations of ambient air monitoring stations at the ETTP.

During this reporting period, the network was modified with respect to ETTP operations. At the beginning of 1998, the KAFaD project station (see Fig. 4.8) high-volume (HV) sampler was deactivated because of the completion of the demolition project. During the fourth quarter of 1998, a temporary sampling station (K8) was activated to investigate the potential maximum impact of TSCAI emissions within the ETTP fenceline. Station K8 was equipped with an HV-type unit to sample continuously to measure levels of air pollutants as identified in Table 4.10. All sampling schedules and procedures were identical to the ETTP ambient air monitoring network operations with the exception that individual weekly samplers were analyzed. The location of station K8 is identified in Fig. 4.8.

HV sampling for uranium continues at stations K6 and K2, representing samples in the prevailing site upwind and downwind directions, respectively. Additional uranium monitoring coverage is supplied by ORR perimeter air monitoring (PAM) stations 35 and 42. The PAM locations represent coverage in the direction of the nearest and the most exposed individuals as defined by DOE Order 5400.5. Sampling for HAP carcinogen metals and lead continues at stations K2 and K6.

4.8.1 Results

No standards were exceeded, and there were no significant elevations of pollutant concentra-

Table 4.10. Summary of collection and analysis frequencies of samples collected at ETTP perimeter ambient air monitoring stations, 1998

Parameter	Sampling locations	Sampling period	Collection frequency	Analysis frequency[a]
		Criteria pollutants		
PM10	K4, K6	24 hour	Every sixth day[b]	Weekly
Lead	K2, K6	Continuous	Weekly	Monthly
	K8[c]	Continuous	Weekly	Weekly
		Hazardous air pollutants carcinogen metals		
Arsenic	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly
Beryllium	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly
Cadmium	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly
Chromium (total)	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly
		Organic compounds		
PCB's	TSCAI 1, 2	*d*	*d*	*d*
Furan	TSCAI 1, 2	*d*	*d*	*d*
Dioxin	TSCAI 1, 2	*d*	*d*	*d*
Hexachlorobenzene	TSCAI 1, 2	*d*	*d*	*d*
		Radionuclides		
Uranium (total)	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly
	PAM-35, -42	Continuous	Weekly	Quarterly
	TSCAI 1, 2	*d*	*d*	*d*

[a]Weekly frequency is analysis of each individual sample. Monthly and quarterly are composite sample analyses of all weekly samples over the identified period.
[b]24-hour sample every sixth day from midnight to midnight.
[c]Temporary sampling station.
[d]Stations are activated automatically only if a TSCA Incinerator operational upset occurs. Identified samples are then immediately submitted for analysis.

tions associated with site operations. Sampling results assessing specific site activities' impact on air quality show that the ETTP, including project-specific measurements, did not have any impact of concern on local air quality. These data also support the state classification of this area, including the ETTP, as in attainment with the Tennessee ambient air quality standard for particulate matter less than 10 microns in diameter (PM10). Table 4.10 lists selected parameters measured during 1998

4.8.2 Criteria Pollutant Levels

Daily PM10 analyses were performed on all 24-hour samples. A summary of all PM10 measurements is presented in Table 4.11. For 1998, the 24-hour PM10 concentrations ranged from 0.7 to 89.6 µg/m^3. The highest measured value was 59.7% of the Tennessee 24-hour primary and secondary ambient air quality standards (i.e., 150 µg/m^3). These levels are not an environmental concern.

Annual PM10 arithmetic averages of 24-hour measurements are presented in Table 4.11. The highest averaged PM10 annual result was 19.2 µg/m^3. This value was only 38.3% of the Tennessee and national annual primary and secondary ambient air quality standards for PM10 (i.e., 50 µg/m^3). Historical data show that this level is typical of annual measurements and is of no environmental concern (see Fig. 4.9 for 5-year PM10 trend).

Quarterly lead results were determined from analyses of both monthly composites of continuous weekly samples from stations K2 and K6 and weekly analyses of samples from K8. The total mass quantities of lead for each sample were

Table 4.11. PM10 particulates in ambient air at the ETTP, 1998

Station	Number of samples	Annual summary of PM10 concentrations (µg/m^3)			Max percentage of standard[a]	
		Annual av	24-h max	24-h min	Annual	24-h
K4	59	19.6	89.6	0.7	39.1	59.7
K6	54	18.7	59.5	2.0	37.4	39.7
All stations	113	19.2	89.6	0.7	38.3	59.7

[a]PM10 Tennessee and national primary and secondary ambient air quality standards are 150 µg/m^3 per 24 hours and 50 µg/m^3 per year arithmetic mean.

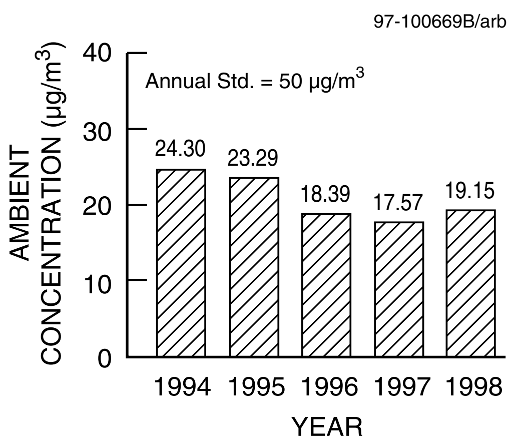

Fig. 4.9. Ambient air monitoring 5-year trend results for PM10 at the ETTP.

Table 4.12. Lead concentrations in ambient air at the ETTP, 1998

Station	Quarterly averages of monthly composites (μg/m³)				Max individual result	Min individual result	Max percentage of quarterly standard[a,b]
	1	2	3	4			
K2	0.003404	0.004105	0.002530	0.005004	0.005004	0.002530	0.33
K6	0.003400	0.002655	0.002062	0.004124	0.004124	0.002062	0.27
K8[c]	*	*	*	0.003712	0.003712	0.003712	0.25
Quarterly av	0.003402	0.003380	0.002296	0.004284	0.004284	0.002296	0.29
Quarterly max	0.003404	0.004105	0.002530	0.005004	0.005004	0.002530	0.33
Annual average for stations K2 and K6 = 0.003340 μg/m³							

[a]Tennessee and national air quality standard for lead is 1.5 μg/m³ quarterly arithmetic average.
[b]Conservative comparison of the maximum individual result (monthly or weekly) with the quarterly standard.
[c]ETTP on-site temporary station activated at the end of the third quarter of 1998.

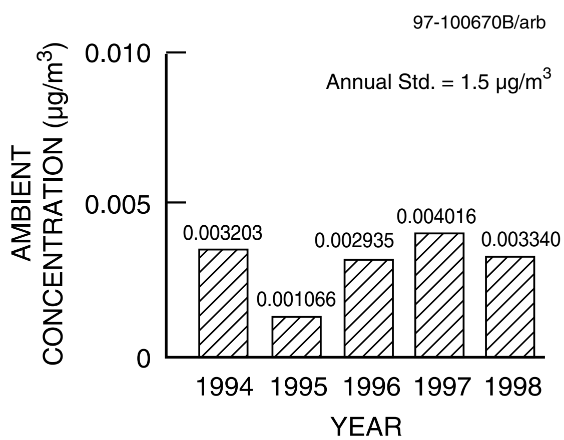

Fig. 4.10. Ambient air monitoring 5-year trend results for lead at the ETTP.

determined by the inductively coupled plasma mass spectrometry (ICP-MS) analytical technique. A summary of lead measurement results are presented in Table 4.12 and are compared with the Tennessee and national quarterly ambient air quality standard of 1.5 μg/m³. There are no 24-hour, monthly, or annual ambient air quality standards for lead. The maximum individual lead result was 0.005 μg/m³. This value was only 0.3% of the quarterly standard for lead. No lead concentration levels of environmental concern were measured (see Fig. 4.10 for 5-year lead trend).

4.8.3 Hazardous Air Pollutant Carcinogenic Metal Levels

Analyses of HAP carcinogenic metals (arsenic, beryllium, cadmium, and chromium) were performed on both monthly composites of continuous weekly samples from stations K2 and K6 and on each weekly sample from station K8. Total mass of each selected metal was determined by the ICP-MS analytical technique. There are no Tennessee or national ambient air quality standards for these HAP carcinogen metals. However, arsenic individual concentration results for all measurement sites ranged from 0.000295 to

Table 4.13. HAP carcinogen metals in ambient air[a] at the ETTP, 1998

Parameter	Summary of K2 and K6 monthly composites of 40 samples (µg/m³)			Summary of K8 weekly results of 13 samples (µg/m³)		
	Annual av[b]	Monthly max	Monthly min	Fourth quarter av[c]	Weekly max	Weekly min
Arsenic	0.000621	0.001130	0.000377	0.000792	0.001101	0.000295
Beryllium	<0.000010	0.000014	<0.000006	<0.000009	<0.000009	<0.000008
Cadmium	0.000303	0.000467	0.000214	0.000316	0.000524	0.000065
Chromium	0.000616	0.001082	0.000212	0.000411	0.000874	0.000057

[a]There are no Tennessee or national ambient air quality standards; however, EPA has identified arsenic, beryllium, cadmium, and chromium as HAP carcinogen metals.

[b]Average of all station K2 and K6 composites of weekly measurements.

[c]Average of station K8 weekly measurements.

0.00113 µg/m³. No beryllium measurement was above minimum detectable concentrations of the analytical method. Cadmium concentration results ranged from 0.000101 to 0.000531 µg/m³. Individual chromium measurements ranged from 0.000150 to 0.00108 µg/m³. A summary of the HAP carcinogen metals measurements is presented in Table 4.13.

4.8.4 Radionuclide Levels

Of the radionuclides, only uranium was measured as a monthly composite of continuous weekly samples from stations K2 and K6, weekly samples from station K8, and quarterly composites of weekly continuous samples from stations PAM35 and PAM42. The total uranium mass for each sample was determined by the ICP-MS analytical technique. The uranium concentrations for all measurement sites are presented in Table 4.14 and ranged from 0.000029 to 0.00253 µg/m³. The highest results were measured at Station K2. Station K2 is in the prevailing downwind direction of the ETTP. The annual average values for all stations were less than 1% of the annual standard of 0.15 µg/m³ (1.0×10^{-1} pCi/m³) for naturally occurring uranium. No uranium concentration levels of environmental concern were measured (see Fig. 4.11 for 5-year uranium trend).

4.8.5 Organic Compound Levels

Currently, measurements of selected semivolatile organics are performed only during an operational upset of the TSCA Incinerator. No upsets occurred during waste burning operations in 1998 that activated the TSCA ambient air stations.

4.8.6 Five-Year Trends

Five-year summaries of ETTP ambient air monitoring data are shown in Figs. 4.9, 4.10, and 4.11 for PM10, lead, and uranium. Other measured pollutant trends are discussed in this section. Variations of PM10 measurements were insignificant and most likely reflect background concentration variations of air quality. Lead measurement variations from 1993 to 1994 were primarily caused by changes in analytical techniques. The minor changes are most likely a result of typical background variations of lead concentrations. Uranium levels reflect typical levels that can be associated with normal ETTP operations.

Arsenic, beryllium, and cadmium measurements were initiated in 1993, and chromium was initiated in 1986. Both arsenic and chromium measurement variations over the last 5 years have been indistinguishable from background levels except during the cooling tower demolition project activities in 1995 and 1996. All beryllium measurements, historical and current, have been at

Table 4.14. Uranium in ambient air at the ETTP, 1998

Station	Number of samples	Summary of composite analyses (µg/m³)		
		Annual av[a]	Max[b]	Min
K2	52	0.000571	0.002529	0.000069
K6	52	0.000086	0.000322	0.000029
PAM35	52	0.000062	0.000092	0.000045
PAM42	52	0.000051	0.000070	0.000035
All stations	208	0.000193	0.002529	0.000029
		Summary of weekly analyses (µg/m³)		
		Fourth quarter av	Max	Min
K8	13	0.000111	0.000725	0.000016

[a]The annual standard for naturally occurring uranium is 1E–01 pCi/m³, which is equivalent to 0.15 µg/m³.

[b]Maximum individual composite result.

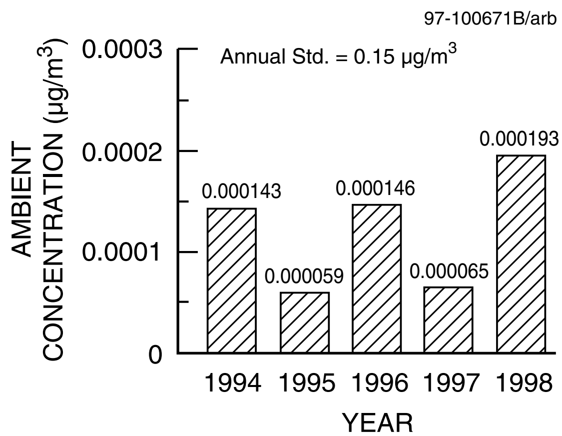

Fig. 4.11. Ambient air monitoring 5-year trend results for uranium at the ETTP.

or near analytical minimum detectable concentrations. During the 1994–95 period, cadmium concentration measurement variations have occurred coincidental to ground disturbance activities such as logging or bulldozing or in areas where large exposed earthen areas exist.

4.9 ETTP SURFACE WATER MONITORING

Surface water surveillance is currently conducted at five locations at the ETTP (Fig. 4.12). Station K-1710 provides information on conditions upstream of the ETTP. Station K-716 is located downstream from most ETTP operations and provides information on the cumulative effects of the ETTP activities as well as those upstream. The remaining sampling locations are at

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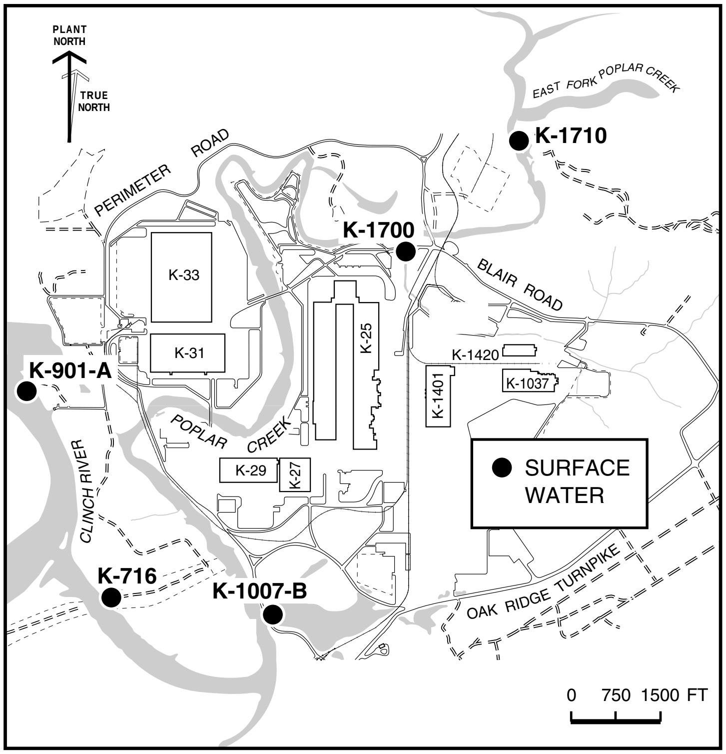

Fig. 4.12. Monitoring locations for surface water at the ETTP.

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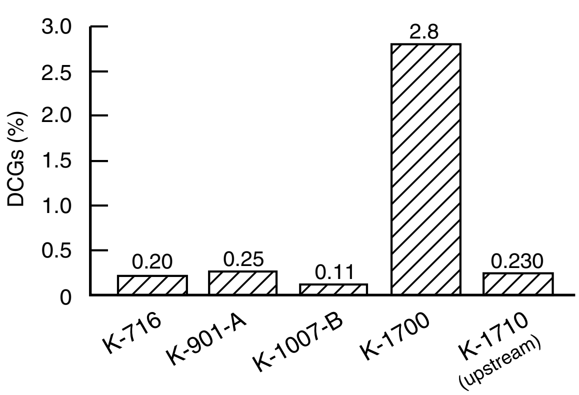

Fig. 4.13. Percentage of DCGs for ETTP surface monitoring locations.

points where drainage in the major surface water basins converges before discharging to Poplar Creek (K-1007-B and K-1700) or to the Clinch River (K-901-A).

Samples are analyzed monthly for radionuclides and selected metals. Quarterly samples are collected and analyzed for general water quality parameters and for organic compounds. In addition, samples from K-1700 are analyzed quarterly for PCBs. Radionuclide results are compared with the DCGs. Nonradiological results are compared with Tennessee water quality standards (WQSs) for fish and aquatic life. The WQSs use the numeric values given in the Tennessee general water quality criteria (TWQC), which are a subset of the WQSs.

In most instances, results of the analyses for nonradiological parameters are well below the applicable standards. Heavy metals were occasionally detected but always in very low concentrations. In addition, natural conditions cause periodic exceedences of WQSs for dissolved oxygen.

Dissolved oxygen measurements regularly fall below the minimum WQS during the summer months because of increased temperature (and therefore lower solubility of the gas) and increased biological activity. Similarly, increased photosynthesis during the summer months causes an increase in the pH of area waterways, sometimes exceeding the maximum WQS. Water bodies in the vicinity of the ETTP are regularly inspected for signs of stress on aquatic organisms during these periods. No evidence that these conditions have a negative impact on the aquatic communities was discovered during 1998. For most of the remaining analyses, results are below detection limits for the instrument and method. Moreover, analytical results for samples collected upstream of the ETTP are chemically similar in most respects to those collected below the ETTP.

The sum of the fractions of the DCGs for all locations remained below the annual limit, as required by DOE Order 5400.5 (Fig. 4.13). The highest sum of the fractions, 2.8% of the allowable sum of the fractions of the DCGs, was reported for sampling location K-1700. These results are still well below the conservative limits established by the order. The 1998 radiological data do not indicate any significant radiological effects from ETTP operations on perimeter surface waters.

4.10 GROUNDWATER MONITORING AT THE ETTP

4.10.1 Background and Hydrogeologic Setting

Groundwater monitoring at the ETTP is focused primarily on investigating and characterizing sites for remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). As a result of the Federal Facility Agreement (FFA) and certification of closure of the K-1407-B and -C Ponds, the principal driver at the ETTP is CERCLA.

The cleanup strategy described in the site management plan has been developed to accelerate the transition of areas of concern from characterization to remediation by making decisions at the watershed scale based on recommended land use. The watershed is a surface drainage basin that includes an area of concern or multiple areas of concern to be investigated and/or remediated. This approach allows for the systematic monitoring and evaluation of contaminant sources and migration through the use of integrated surface-water and groundwater monitoring.

ETTP Groundwater Protection Program requirements were incorporated into the Integrated Water Quality Program (IWQP) in FY 1997 so that there is no longer a site-level program (DOE 1998e). The IWQP, which was established to provide a consistent approach to watershed monitoring across the ORR, will be responsible for conducting groundwater surveillance monitoring at the ETTP. Six watersheds have been designated at the ETTP for monitoring and reporting groundwater quality data. The watershed designations and associated areas of concern are described in the following section.

Unlike the other ORR facilities, where many source areas are located in relatively undeveloped areas of the reservation, most source areas at the ETTP are located within the highly industrialized areas of the site. The surface topography has been considerably altered as a result of site construction. Large areas have been excavated or filled to yield the present, low-relief landscape. As much as 60 ft of materials have been excavated locally, with equal amounts of fill placed in adjacent low areas. These filled areas may represent primary pathways for contaminant migration when located below the water table. A number of sinkholes have been identified on historic aerial photos that are not visible on the surface today. Many of these have been filled during site construction, and buildings (such as K-33) have been erected directly above them.

The storm drain network discharges to either Mitchell Branch, the K-1007-P1 pond, the K-901-A pond, or directly to Poplar Creek and the Clinch River. Storm drain video surveys show both infiltrating and exfiltrating water along the lines, suggesting that the storm drains may serve as groundwater sinks (where located below the water table) or sources in other areas of the plant. In addition, at least ten buildings have been determined to have basements with sumps below the seasonal low water table. Water that accumulates in the sumps is discharged either to the sanitary sewer or CNF system, storm drains, or, on rare occasions, to the ground. All of these systems have been active since building construction in the 1940s.

Bedrock underlying the ETTP can be broadly categorized as carbonate (Knox and Chickamauga groups) or clastic (Rome Formation and possibly the Conasauga Group). The carbonates underlie most of the main plant area, including the K-27/29 peninsula, K-1070-A Burial Ground, the K-25 Building, and the K-1004 laboratory area. The eastern portion of the site, including the K-1070-C/D site and much of the Mitchell Branch area, is underlain by clastics of the Rome formation and possibly the Conasauga Group. The structural geology of the ETTP is perhaps the most complicated on the ORR and includes “map-scale” folds and faults and “outcrop-scale” fractures, folds, and faults. Complex faulting, fracturing, and folding in the clastic bedrock preclude definition of simple bedding geometry. Therefore, groundwater flow paths cannot be predicted in this area of the site.

Cavities have been encountered in 39% of all subsurface penetrations at the ETTP. Cavity heights are typically greater in the Knox Group carbonates. During recent drilling in the vicinity of the K-1070-A Burial Ground, cavernous bedrock with cavities up to 22 ft (6.7 m) in height has been encountered; however, based on camera and sonar surveys, the lateral extent of these cavities appears limited. Although large cavities have been reported in some locations in the Chickamauga bedrock, typical cavity heights are generally less than 5 ft (1.5 m).

Groundwater occurs in both the unconsolidated zone and bedrock, primarily as a single water table aquifer. Perched water may be of local significance. With few exceptions, the water table occurs in the overburden above bedrock across the site, with saturated overburden thickness ranging up to 70 ft. Because bedrock is exposed along the bottom of the Clinch River and Poplar Creek, the unconsolidated zone flowpaths are truncated at these boundaries. Water level data indicate that groundwater flows radially from higher elevations toward the bounding surface water features; however, the sumps and drains that lie below the seasonal low water table affect the configuration of the water table surface and thus affect the contaminant flow directions.

Groundwater flow in the unconsolidated zone is expected to be in the direction of the mapped hydraulic gradients. In the carbonate bedrock, groundwater flow is expected to be controlled by hydraulic gradients and geologic strike. In the Rome Formation, groundwater flow directions cannot be predicted with any certainty. Recent studies have shown that hydraulic gradients are steepest (and consequently, overall flux is greatest) during the wet season and low pool stage periods. Much of the site is paved or otherwise covered, reducing direct recharge by groundwater; however, leaking underground utilities and storm drains are likely to recharge the groundwater substantially.

Few perennial springs have been identified along Poplar Creek or the Clinch River. Wet-season springs located along the exposed low pool stage shores of Poplar Creek and the Clinch River do not appear consistently from year to year. In general, both springs and seeps at the ETTP are characterized by moderate to low flow rates.

4.10.2 Watersheds

Six watersheds, each defined as a geographic area that encompasses a surface water drainage basin, have been defined at the ETTP. These watersheds are described in the following sections and are indicated in Fig. 4.14.

4.10.3 K-1007-B Watershed

The K-1007-B Watershed encompasses the southern area of the ETTP. Areas of concern in this watershed include the K-1004-J Vaults, the K-1004-L underground storage tank (UST), the K-1004-L recirculating cooling water (RCW) lines, the K-1004 cooling tower basin, the K-1004 laboratory drain, the K-1007-P1 Pond, the K-1007 UST, and the K-1200 Centrifuge complex. Potential contaminants include heavy metals, acids, organic solvents, other organic chemicals, and radioactivity.

4.10.4 Mitchell Branch Watershed

The Mitchell Branch Watershed encompasses the northeastern portion of the ETTP and includes the K-1407-A Neutralization Pit, the former K-1407-B and C Ponds, the K-1407-C soil, the K-1700 stream (Mitchell Branch), the K-1070-B Old Classified Burial Ground, the K-1401 acid line, the K-1401 degreasers, the K-1401 basement, the K-1413 neutralization pit, the K-1420 building process lines, the K-1420 oil storage area, the K-1420 incinerator, the K-1413 treatment tanks, the K-1413 building and process lines, the K-1070-C/D Classified Burial Ground, the K-1070 concrete pad, the K-1070-D storage dikes, the K-1070 pits, and the K-1414 Garage. The potential contaminants include organic solvents, waste oils, heavy metals, PCBs, and radioactivity.

4.10.5 Ungaged Watershed

The Ungaged Watershed encompasses areas where groundwater and surface water discharge directly to Poplar Creek and includes the western half of the K-25 Building, the K-1064 peninsula, the K-27/29 peninsula, the K-31 Building, and the eastern half of the K-33 Building. Areas of contamination in this watershed include the K-1066-J cylinder storage yard; the K-1024 dilution pit; the K-1064 drum storage and burn area; the K-1064 drum deheading facility; the K-802-B, K-802-H, K-832-H, K-892-G, K-892-H, K-892-J, and K-862-E cooling tower basins; the K-31 and K-33 RCW lines; the K-732, K-762, and K-792 switchyards; the K-27 and K-29 RCW lines; the

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Fig. 4.14. ETTP watershed areas.

K-1410 neutralization pit; the K-1131 facility; the K-1232 chemical recovery facility lagoon; and the K-1231 facility. Potential contaminants include waste oils, heavy metals, organic solvents, PCBs, and radioactivity.

4.10.6 K-901/K-1070-A Watershed

The K-901/K-1070-A Watershed encompasses the northwestern portion of the ETTP. The areas of concern include the K-1070-A burial ground, the K-1070-A landfarm, the K-901-A holding pond, the K-901 north and south disposal areas, the K-895 cylinder destruct facility, and the K-1066-K cylinder storage yard. Potential contaminants are organics, heavy metals, PCBs, and radioactivity.

4.10.7 Duct Island Watershed

The Duct Island Area consists of the K-1070-F peninsula on Poplar Creek and contains the K-1070-F contractors' burial ground, the K-900 bottle smasher, and the Duct Island Road. Potential contaminants are heavy metals, organics, and uranium.

4.10.8 K-770/Powerhouse Watershed

The K-770/Powerhouse Watershed borders the Clinch River in the southwestern portion of the ETTP. Areas of concern included in this watershed are the K-770 Scrap Yard, the K-725 Beryllium Building, the K-720 ash pile, the F-05 laboratory, the K-709 switchyard, the K-710 sludge beds and Imhoff Tanks, and the K-1085 Firehouse Burn Area. The potential contaminants are waste oils, organics, heavy metals, PCBs, and radioactivity.

4.11 GROUNDWATER MONITORING RESULTS

The IWQP annual report (DOE 1998b) contains groundwater data results received for the ETTP for 1997. No annual report was issued for 1998. Results related to the effectiveness and protectiveness of implemented environmental restoration remedies are presented in the context of operational and regulatory history in the IWQP Annual Remediation Effectiveness Report, which is an FFA-required report (DOE 1999).