4. ETTP Environmental Monitoring Programs

Setting

The East Tennessee Technology Park (ETTP), formerly known as the Oak Ridge Gaseous Diffusion Plant or K-25 Site, was originally built as part of the Manhattan Project. Uranium was enriched for weapons and nuclear reactor fuel elements and recycling of reactor return fuel elements. Other activities included research and support operations. After the enrichment operations ceased in 1985, the primary focus of the plant shifted to environmental restoration, reindustrialization, and reuse of the facilities.

Update

In 1999, the emissions of radionuclides from ETTP operations were well within the allowable derived concentration guides (DCGs) published in DOE Order 5400.5, and were similar in most respects to 1998 emissions. Nonradiological emissions were also within limits, and compliance with permit limits was better than 99%.

4.1 ETTP RADIONUCLIDE AIRBORNE EFFLUENT MONITORING

In order to demonstrate compliance with DOE Order 5400.5 and Tennessee Rule 1200-3-11-.08 Emission Standards for Emission of Radionuclides Other than Radon from Department of Energy Facilities (i.e., NESHAP), all airborne radionuclide emissions from DOE sources at ETTP must be determined for purposes of estimating dose to the most exposed member of the public.

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 NESHAP regulations. For 1999, other prime contractors working directly for DOE were also subject to NESHAP; data were obtained from the applicable sources and 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 Radionuclide Emissions Monitoring Approach

4.1.1.1 Minor sources

The number of minor sources in 1999 varied from the previous year's total because of fluctuations in site operations. For this reporting period, a total of 11 point and 2 grouped minor sources subject to NESHAP regulations operated. Minor sources are grouped if they have similar characteristics (e.g., general location, type of activity, or type of control) and provided that any one group does not have potential radionuclide emissions which would cause a dose in excess of 0.1 mrem/year effective dose equivalent (EDE) as defined under the rule. Laboratory hoods were grouped as 2 emission points, 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 by means of one of the following EPA approved methods:

1. radionuclide inventory (i.e., material balance)—seven point and one grouped source,
2. health physics air measurements where room ventilation emissions exceeded 10% of derived air concentration (DAC) worker protection guidelines—no sources,

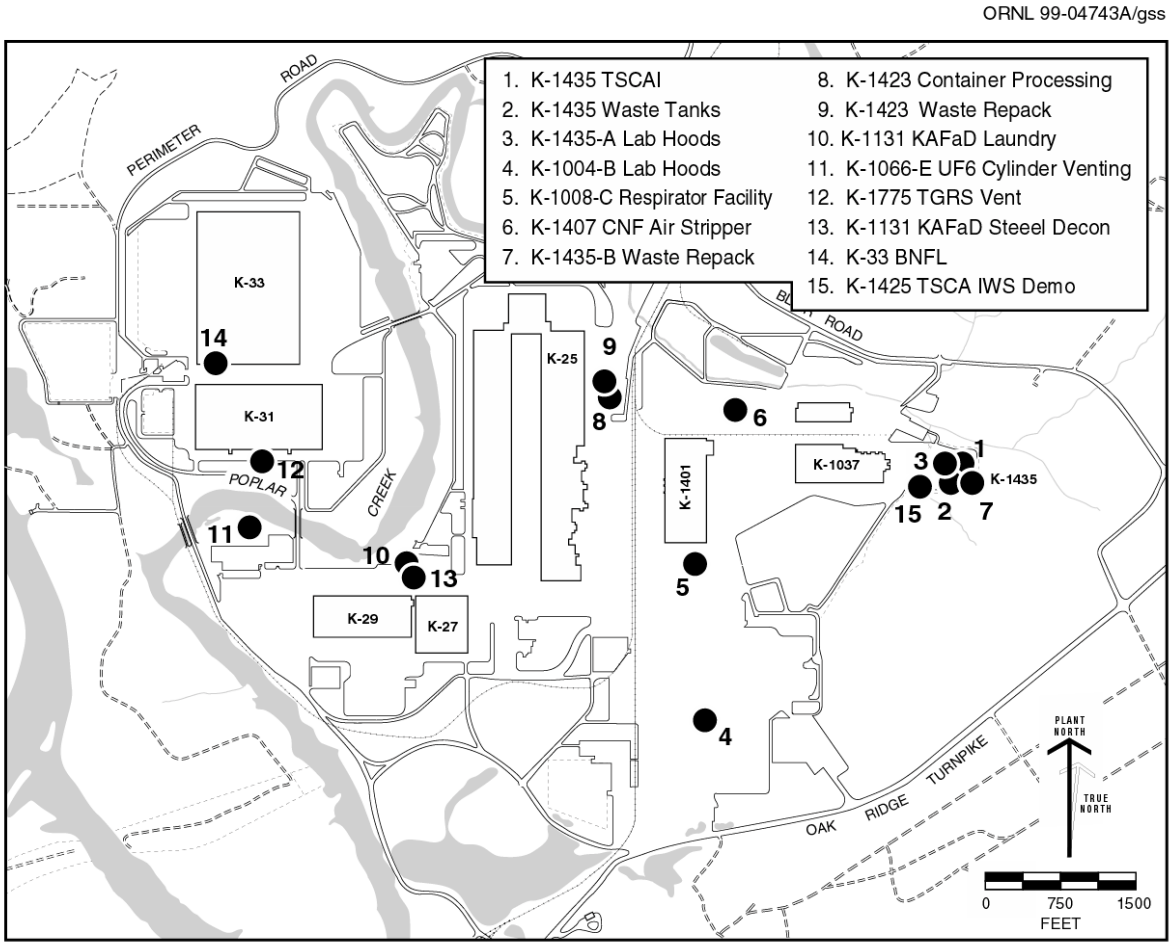

Fig. 4.1. Locations of airborne radionuclide point sources at the ETTP.

3. surrogate emission data from similar sources—four point sources, and
4. 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 major sources or 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 shutdown buildings;
- resuspension of contaminated soils, debris, or other materials;
- unventilated tanks;
- wastewater treatment systems;
- outdoor storage and processing areas;
- emissions from piping, valves, or other piping equipment and pump components; and
- decontamination and demolition activities.

Fugitive emission sources are monitored by way of the ORR and ETTP Ambient Air Surveillance Programs.

4.1.1.2 Major sources

The number of major sources operating increased from one in 1998 to two in 1999. Radionuclide emission measurements from the TSCAI were determined by means of 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 through impingers

with absorbing and adsorbing media to collect gaseous radionuclides. Measurements of TSCAI emissions were based on monthly composites of weekly stack samples.

British Nuclear Fuels Ltd. (BNFL) operated one source in the K-33 building requiring continuous monitoring of radiological emissions. This source had two identical atmospheric release points, each equipped with a particulate filtration system and a continuous sampling device.

4.1.2 Results

The ETTP 1999 radionuclide emissions from the major and minor 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 to the air were approximately three times greater than 1998 amounts. This increase in uranium emissions was attributable to increased uranium contained in feed to the TSCAI. The resulting airborne dose from all ETTP radionuclide emissions was still less than the Reservation maximum.

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 eight major air emission 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 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. Allowable emissions decreased significantly in 1998 because of privatization of the K-1095 Paint Shop and the K-1501 Steam Plant. The ETTP paid annual emission fees based on allowable emissions in 1999 amounting to $13,728.33. An inventory of actual emissions from all permitted sources in operation at the ETTP was also completed for 1999. Table 4.3 shows actual 1999 emissions from the ETTP.

The TSCAI 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 4.4).

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 and were composited into monthly samples. A single monthly 24-h composite sample was collected at K-1203. These samples were then analyzed for radionuclides. Results of these sampling efforts were compared with the derived concentration guides (DCGs).

Table 4.1. ETTP radionuclide air emission totals, 1999 (In curies)[a]

Radionuclide	Total Major	TSCAI (major)	Total Minor	Total ETTP
^{228}Ac	–	–	8.42E–06	8.42E–06
^{241}Am	–	–	1.01E–06	1.01E–06
^{125}Sb	–	–	6.65E–10	6.65E–10
^{133}Ba	–	–	1.04E–09	1.04E–09
^{212}Bi	–	–	2.78E–08	2.78E–08
^{214}Bi	–	–	2.24E–08	2.24E–08
^{109}Cd	–	–	1.30E–05	1.30E–05
^{249}Cf	–	–	5.55E–07	5.55E–07
^{14}C	6.47E–04	6.47E–04	7.67E–04	1.41E–03
^{143}Ce	–	–	9.27E–07	9.27E–07
^{144}Ce	–	–	5.21E–10	5.21E–10
^{134}Cs	–	–	3.38E–07	3.38E–07
^{137}Cs	3.49E–03	3.49E–03	2.39E–03	5.87E–03
^{51}Cr	–	–	2.11E–08	2.11E–08
^{57}Co	2.83E–09	2.83E–09	5.46E–07	5.49E–07
^{58}Co	–	–	4.99E–10	4.99E–10
^{60}Co	–	–	2.18E–06	2.18E–06
^{243}Cm	–	–	3.14E–07	3.14E–07
^{152}Eu	–	–	7.67E–07	7.67E–07
^{154}Eu	–	–	4.75E–07	4.75E–07
^{155}Eu	–	–	7.08E–07	7.08E–07
^{131}I	2.38E–09	2.38E–09	1.58E–06	1.58E–06
^{59}Fe	–	–	5.29E–10	5.29E–10
^{85}Kr	3.93E–04	3.93E–04	2.00E–01	2.00E–01
^{210}Pb	–	–	1.74E–06	1.74E–06
^{212}Pb	–	–	6.33E–08	6.33E–08
^{214}Pb	–	–	4.71E–08	4.71E–08
^{54}Mn	–	–	1.31E–10	1.31E–10
^{237}Np	2.86E–05	2.86E–05	2.23E–06	3.09E–05
^{95}Nb	–	–	2.83E–07	2.83E–07
^{238}Pu	2.89E–04	2.89E–04	7.78E–07	2.90E–04
^{239}Pu	2.96E–05	2.96E–05	1.67E–06	3.12E–05
^{240}Pu	–	–	1.68E–06	1.68E–06
^{210}Po	–	–	9.57E–07	9.57E–07
^{40}K	–	–	6.32E–06	6.32E–06
^{231}Pa	–	–	6.74E–07	6.74E–07
^{233}Pa	–	–	1.89E–06	1.89E–06
^{234}Pa	–	–	1.59E–08	1.59E–08
^{234m}Pa	2.91E–01	2.91E–01	5.04E–04	2.91E–01
^{226}Ra	–	–	1.10E–06	1.10E–06
^{228}Ra	–	–	1.02E–06	1.02E–06
^{106}Ru	–	–	4.65E–08	4.65E–08

Table 4.1 (continued)

Radionuclide	Total Major	TSCAI (major)	Total Minor	Total ETTP
^{22}Na	–	–	1.66E–06	1.66E–06
^{89}Sr	–	–	1.61E–09	1.61E–09
^{90}Sr	2.47E–05	2.47E–05	1.19E–05	3.66E–05
^{99}Tc	8.86E–03	8.86E–03	1.64E–04	9.02E–03
^{208}Tl	–	–	1.16E–08	1.16E–08
^{228}Th	2.51E–04	2.51E–04	9.52E–06	2.61E–04
^{230}Th	4.67E–04	4.67E–04	6.13E–06	4.73E–04
^{231}Th	–	–	4.11E–07	4.11E–07
^{232}Th	5.67E–04	5.67E–04	9.86E–06	5.77E–04
^{234}Th	4.61E–02	4.61E–02	1.09E–03	4.72E–02
^{3}H	5.28E+03	5.28E+03	3.87E–01	5.28E+03
^{233}U	–	–	3.53E–05	3.53E–05
^{234}U	3.24E–03	2.79E–03	6.15E–04	3.86E–03
^{235}U	1.74E–04	1.24E–04	3.24E–05	2.06E–04
^{236}U	–	–	2.21E–06	2.21E–06
^{238}U	4.60E–03	3.00E–03	8.00E–04	5.40E–03
^{65}Zn	–	–	5.96E–09	5.96E–09
^{95}Zr	–	–	3.43E–10	3.43E–10
Totals	5.28E+03	5.28E+03	5.94E–01	5.28E+03

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

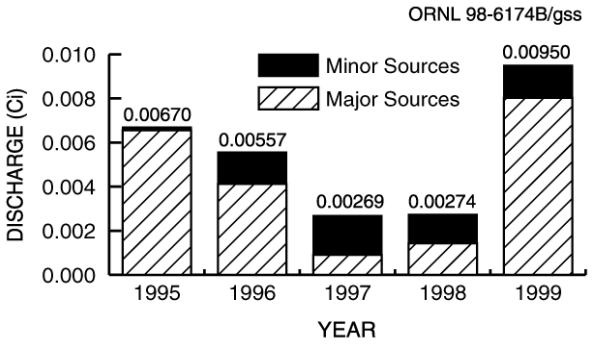

Fig. 4.2. Total curies of uranium discharged from the ETTP to the atmosphere, 1995–1999.

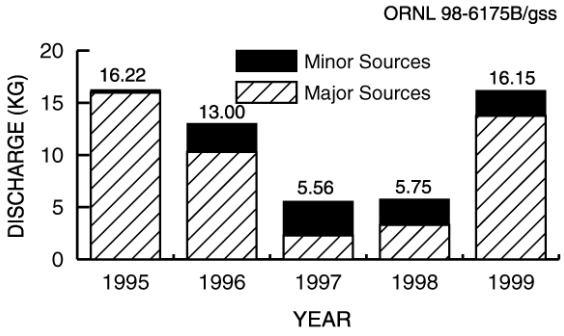

Fig. 4.3. Total kilograms of uranium discharged from the ETTP to the atmosphere, 1995–1999.

Table 4.2. Allowable emissions of criteria pollutants from the ETTP, 1995–99

Pollutant	Allowable emissions (tons/year)				
	1995	1996	1997	1998	1999
Particulate matter	296	247	194	192	13
Volatile organic compounds	167	150	120	122	14
Sulfur dioxide	428	428	428	427	39
Nitrogen oxides	224	224	224	185	20
Carbon monoxide	157	157	157	147	20
Hazardous Air Pollutants	24	24	24	24	21
Miscellaneous	125	0	0	0	0
Total	1421	1230	1147	1097	127

Table 4.3. Actual emissions of criteria pollutants from permitted ETTP sources, 1999

Pollutant	Actual emissions	
	lb/year	tons/year
Particulate matter	16.6	0.008
Volatile organic compounds	665.3	0.3
Sulfur dioxide	17.9	0.009
Nitrogen oxides	21,919.0	11.0
Carbon monoxide	5,480.0	2.7

Table 4.4. Actual vs allowable air emissions from the TSCA Incinerator at the ETTP, 1999

Pollutant	Emissions (tons/year)		Percentage of allowable
	Actual	Allowable	
Lead	0.008	0.575	1.4
Beryllium	0.000004	0.00037	1.1
Mercury	0.005	0.088	5.7
Hydrogen fluoride	0.003	2.98	0.1
Hydrogen chloride	0.007	16.12	0.04
Sulfur dioxide	0.009	38.5	0.02
Particulate	0.008	13.1	0.06

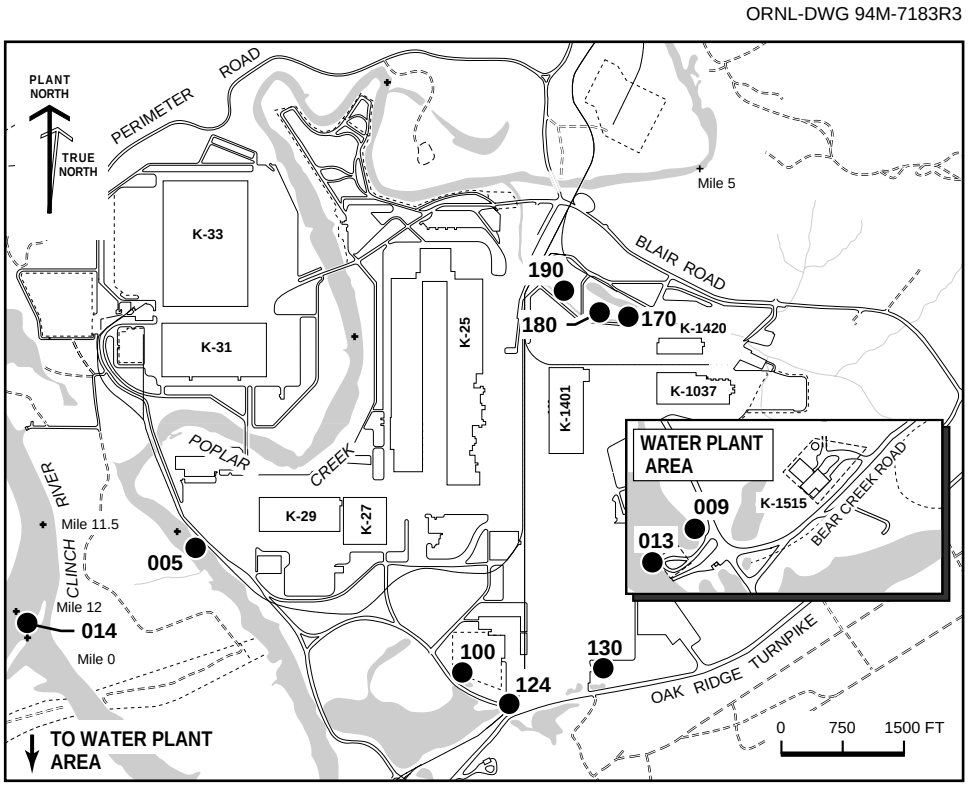

Fig. 4.4. ETTP NPDES major outfalls and Category IV storm drain outfalls.

4.3.2 Results

The sum of the fractions of the DCGs at K-1407-J was calculated at 19.9 % for CY 1999, down from 45.8 % for CY 1998. The decrease was determined to be caused by changes in TSCAI feed material. The sum of the fractions of the DCGs for effluent location K-1203 was less than 1% of the DCGs. Table 4.5 lists radionuclides discharged from the ETTP to off-site surface waters in 1999. Total uranium discharges from K-1407J and K1203 were 0.012 Ci in 1999. Total activity from transuranics from K-1407J (analyses for transuranics are not performed at K-1203) was 1.1×10^{-4} Ci, which is two orders of magnitude less than the contribution from 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 fraction 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). TSCAI wastewater, which is sent to the CNF for treatment before discharging at K-1407-J (Outfall 014), is the major contributor of uranium; other operations contribute a smaller amount.

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 conden-

Table 4.5. Radionuclides released to off-site surface waters from the ETTP, 1999
Effluent discharge locations K-1203 and K-1407-J

Isotope	Amount (Ci)[a]	Isotope	Amount (Ci)[a]
^{137}Cs	1.4E–3	^{14}C	1.5E–1
^{237}Np	7.6E–5	^{3}H	4.3E–0
^{238}Pu	2.2E–5	^{234}U	4.1E–3
^{239}Pu	1.1E–5	^{235}U	1.4E–3
^{99}Tc	1.1E–1	^{236}U	1.1E–4
		^{238}U	6.4E–3

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

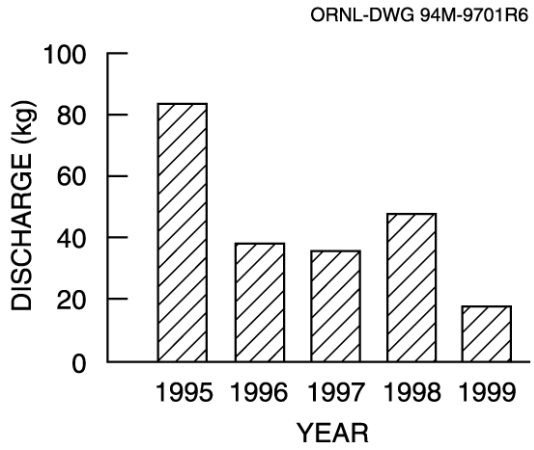

Fig. 4.5. Five-year trend of uranium releases to surface waters from the ETTP (Outfalls 005 and 014).

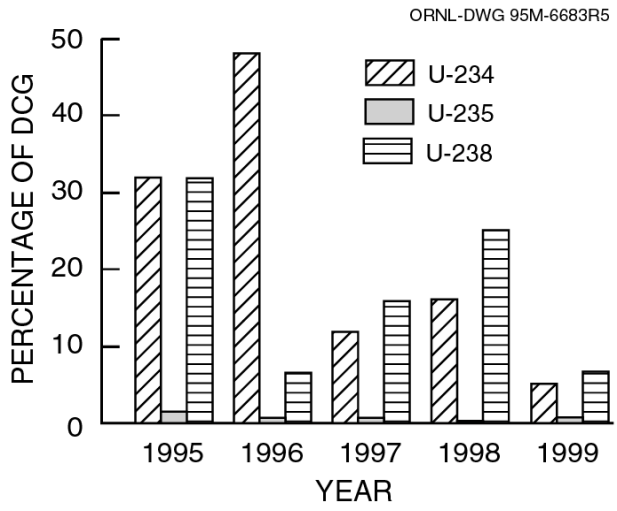

Fig. 4.6. Percentage of DCG for uranium isotopes from K-1407-J (Outfall 014).

sate, and groundwater to the Clinch River, Poplar Creek, and Mitchell Branch. The permit currently includes 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 4.6 details the permit requirements and compliance records for all of the outfalls that discharged during 1999. The table provides a list of the discharge points, effluent analytes, permit limits, number of noncompliances, and the percentage of compliance for 1999. Samples from these outfalls are collected and analyzed as specified in the NPDES permit.

The following are the four permitted process 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 (TDEC) 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

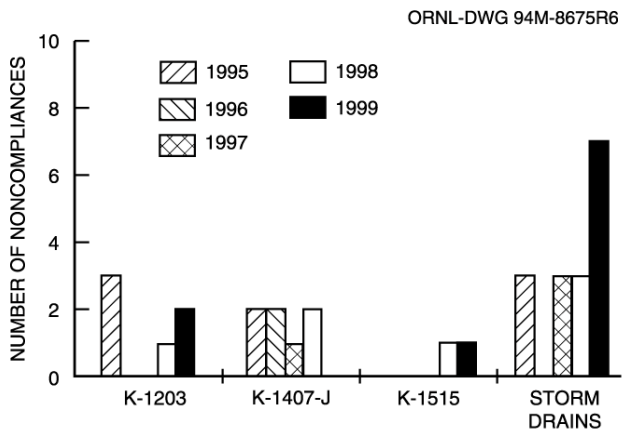

Fig. 4.7. ETTP NPDES compliance history by source of noncompliance.

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 was associated with two NPDES permit noncompliances during 1999, although one of these was the result of a laboratory error and not an operational problem. During the preparation of the ETTP February Discharge Monitoring Report (issued March 1999), it was discovered that the results for a required settleable-solids sample were missing. It was determined that the sample had been collected as required, but that a computer error in logging the sample into the laboratory had resulted in the sample being discarded instead of analyzed. Laboratory personnel received additional training to prevent recurrence of this problem. Settleable-solids samples both before and after this time were well within the permit limits. On August 24, 1999, a sample of effluent was collected and analyzed for fecal coliform. The results were 1,060 colonies per 100 mL, which exceeded the permit limit of 1,000 colonies per 100 mL. Reviews of operational logs and analytical records, checks of the equipment, and extensive investigation failed to identify the source of the problem. Although it is not certain, it is believed that the most likely cause was an error during the sampling. Results both before and after August 24 were well within the permit limits.

The K-1515 Sanitary Water Treatment Plant (Outfall 009) draws water from the Clinch River, treats it, and provides sanitary water to the ETTP and the Bear Creek Industrial Park. Backwash from the treatment facility contains both chlorine used to disinfect the water and an aluminum-based flocculent to remove suspended particles from the water. This backwash is discharged in to the K-1515-F settling pond to allow the chlorine to dissipate and the sediment to settle out before the water is discharged back to the Clinch River. The basin is cleaned of accumulated sediment annually. On November 15, 1999, a sample was collected and analyzed for aluminum. This resulted in a value of 3.19 mg/L, which exceeded the NPDES permit limit of 2.0 for the maximum daily concentration for aluminum. An investigation of the incident revealed that the basin had been recently been cleaned, which resuspended some of the sediment in the basin. The basin had then been allowed to discharge before the residual sediment had settled out. Cleaning procedures at the basin have been modified to prevent a recurrence.

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 TSCAI, 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 no NPDES noncompliances in 1999.

The ETTP NPDES permit includes 136 storm water outfalls that are grouped into four categories

Table 4.6. NPDES compliance at the ETTP, 1999

Discharge point	Effluent parameter	Effluent limits				No. of noncompliances	Percentage of compliance
		Monthly avg[a]	Daily max[a]	Monthly avg (lb/day)	Daily max (lb/day)		
005	Ammonia nitrogen	5	7	27	38		100
(K-1203	Biochemical oxygen demand	15	20	81	109		100
Sewage	Chlorine, total residual	0.14	0.24				100
Treatment	Dissolved oxygen		5[b]				100
Facility)	Fecal coliform, col/100 mL	200[c]	1,000			1	99.4
	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	27	244		100
	Unpermitted discharge	*f*	*f*	*f*	*f*		*f*
009	Aluminum	1.0	2.0			1	98.1
(K-1515-F	Chlorine, total residual		1.0				100
Sanitary	Flow, Mgd	*d*	*d*				100
Water	pH, standard units		6.0–9.0				100
Plant)	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	1,1,1-Trichloroethane	*d*	*d*				100
(K-1407-J	Acetone	*d*	*d*				100
Central	Acetonitrile	*d*	*d*				100
Neutralization	Benzene	*d*	0.005				100
Facility to	Bromoform	*d*	*d*				100
Clinch River)	Cadmium	0.18	0.69				100
	Carbon tetrachloride	0.5	0.5				100
	Chemical oxygen demand	*d*	*d*				100
	Chloride, total	35,000	70,000				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				100
	Petroleum hydrocarbons		0.1				100
	pH, standard units		6.0–9.0				100

Table 4.6 (continued)

Discharge point	Effluent parameter	Effluent limits				No. of noncompliances	Percentage of compliance
		Monthly avg[a]	Daily max[a]	Monthly avg (lb/day)	Daily max (lb/day)		
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				100
	Missed sample	*f*	*f*	*f*	*f*		100
Category II storm drains	Flow, Mgd	*d*	*d*				100
	pH, standard units		4.0–9.0				100
	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*	3	*f*
Category IV storm drains (to Poplar Creek)	Chlorine, total residual		0.14			1	99.4
	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	99.7
Category IV storm drains (to Mitchell Branch)	Chlorine, total residual		0.019				100
	Flow, Mgd	*d*	*d*				100
	Oil and grease	*d*	*d*				100
	pH, standard units		6.0–9.0			1	99.7
	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.

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, and weekly for Categories I through IV, respectively, with those outfalls that have the highest potential for pollution being sampled most frequently.

Seven NPDES noncompliances occurred at storm water outfalls during 1999. Storm water outfalls 100 and 190 each had two noncompliances, while storm water outfall 200 had three.

On January 15, 1999, a subcontractor generated a quantity of concrete dust while modifying building K-1423. The subcontractor used sanitary water to wash the dust into a nearby storm drain catchbasin. This activity was observed by an ETTP worker, who notified the plant shift superintendent. The work was stopped, and Environmental Compliance personnel advised the subcontractor of alternative disposal methods. Mitchell Branch, the receiving stream, was checked and no adverse impact could be seen.

On February 24, 1999, an oily sheen was observed on a concrete parking lot near the K-1415 Building that was being used to dismantle old transformers. The material had come from a diked area that was filled with rainwater and over flowed into a catchbasin leading to storm water outfall 200. Absorbent material was placed on the oily sheen and the catchbasins draining the area were blocked. Analysis of the spill indicated that the polychlorinated biphenyl (PCB) concentration in the oil was 41 ppb, well below the TSCA action level of 50 ppm. Mitchell Branch was inspected, and no sheen or other adverse impacts could be seen.

On August 12, 1999, workers drilling post holes near storm water outfall 190 accidentally punctured a transfer line leading from the trench project sumps to CNF. Approximately 1,750 gal of groundwater were released, an undetermined fraction of which flowed into Mitchell Branch. The line was repaired, and Mitchell Branch was inspected. No adverse impacts could be detected.

On August 30, 1999, the pH at storm water outfall 190 was measured at 5.9 SU. The minimum NPDES permit limit for pH at this outfall 6.0 SU. Measurements at other points in the system were within limits, and despite an extensive search no credible source of the low pH could be located. Follow-up measurements taken later at storm water outfall 190 were within permit limits. No adverse impacts to Mitchell Branch could be detected.

On October 13, 1999, leasees in building K-1200 were using a steam pressure washer to remove carpet adhesive. The adhesive was washed into a floor drain. The drain became clogged, and a plumber was contacted to remove the clog. The plumber poured bleach into the drain to remove the clog. When this failed, he used a drain snake to mechanically remove the clog. The floor drains in the building had been plugged as part of an earlier pollution prevention effort, but this drain was covered by carpeting and thus had been overlooked. It was determined that this drain discharged into the storm water outfall 100 system. Samples of the water in the drain were collected and analyzed for volatile organic compounds (VOCs), metals, and pH. Trace amounts of various metals were found, although all were below the screening criteria. A solvent (trichlorofluoromethane) was present in trace amounts (2.7 ppm). The pH was measured at 6.2 SU. The floor drain was permanently plugged, and leasees were cautioned to coordinate activities of this type with Bechtel Jacobs. The K-1007-P1 pond, which receives the discharge from storm water outfall 100, was inspected, and no evidence of adverse impact could be detected.

On October 18, 1999, approximately 100 gal of sanitary water that had been used for hydrostatic testing were released into the storm water outfall 200 system. The leasees who discharged the water were re-advised of ETTP policies and guidelines. Mitchell Branch was inspected, and no adverse impacts could be detected.

On December 27, 1999, the total residual chlorine (TRC) at storm water outfall 100 was measured at 0.19 ppm. This is slightly above the NPDES permit limit of 0.14 ppm. An investigation revealed that tablets in a dechlorination unit servicing a laboratory cooling system had become jammed, which allowed untreated sanitary water to enter the storm drain system. The tablets were replaced, and inspections were implemented to ensure that the tablets were feeding freely. Subsequent TRC measurements at Storm Water Outfall 100 were all within the permit limits.

4.5 STORM WATER POLLUTION PREVENTION PROGRAM

The development and implementation of the ETTP Storm Water Pollution Prevention (SWPP) Program is required by Part IV of the ETTP NPDES Permit No. TN0002950. The objective of the program is to minimize the discharge of pollutants in storm water runoff from ETTP.

The purpose of the ETTP SWPP Program is to assess the quality of storm water discharges from ETTP, determine potential sources of pollutants affecting storm water, and provide effective controls to reduce or eliminate these pollutant sources. The SWPP Program provides a means whereby sources of pollutants that are likely to affect the quality of storm water discharges are identified, best management practices (BMPs) which can be used to control the entry of pollutants into storm water discharges are developed, and methods for implementing pollution prevention practices are devised.

Based on knowledge of past processes and activities at the ETTP, only parameters of particular concern were monitored during the 1998–1999 SWPP Program. These parameters include gross alpha radioactivity, gross beta radioactivity, PCBs, mercury, metals, and VOCs. Gross alpha and gross beta radioactivity were monitored at storm drain outfalls where they were detected at levels above screening criteria during more than one previous SWPP sampling effort. PCBs were monitored at storm drain outfalls where they were detected above the analytical method detection limit. Mercury was monitored at locations where it was detected in amounts exceeding the screening criteria during more than one previous SWPP sampling effort. Metals were monitored at locations that may have received runoff from cooling tower areas where they were detected in amounts exceeding the screening criteria during more than one previous SWPP sampling effort. VOCs were monitored at storm drain locations that are potentially affected by contaminated groundwater plumes and at locations where they were detected in amounts exceeding the screening criteria during more than one previous SWPP sampling effort.

PCBs (Aroclor-1254) were detected at storm water outfall SD-280 at a concentration of 1.3 µg/L. The screening criterion for PCBs is that they must be below accepted laboratory detection limits. This screening criterion is found in Parts IA and III of the ETTP NPDES Permit.

Storm water outfall SD-280 is located at the north end of the K-1064 Peninsula and drains a grassy and graveled area. The K-1064 Peninsula area has been and continues to be used for a variety of purposes. Open burning of a variety of wastes, including organic wastes and waste oils, was conducted in this area during the 1950s. Wastes, including solvents, PCBs, organics, and radioactively contaminated oils were stored in drums at this area during the 1960s and 1970s. The area is currently being used for the storage of converter shells that were used in barrier operations, radioactively contaminated tankers and heavy equipment, maintenance supplies, and other equipment.

A remedial investigation of the K-1064 area will be conducted in the future. Additional monitoring for PCBs at storm water outfall SD-280 will be included in the 1999–2000 SWPP Program sampling effort.

Radiological contamination was detected above screening criteria levels at three locations. Alpha activity was detected at a level of 45 pCi/L at storm water outfall SD-158 and at a level of 64 pCi/L at storm water outfall SD-724. The screening criterion for alpha activity is 15 pCi/L, which is the maximum contaminant level (MCL) established by the Safe Drinking Water Act (SDWA). Beta activity was detected at a level of 100 pCi/L at storm water outfall SD-490. The screening criterion for beta activity is 50 pCi/L, which is the MCL established by the SDWA.

Additional monitoring for radionuclides, including uranium isotopes and transuranics, at storm water outfalls SD-158, SD-490, and SD-724 will be part of the 1999–2000 SWPP Program sampling effort.

Storm water outfall SD-158 drains an area located northeast of building K-1420 and south of the former K-1417 Drum Storage Area. Both of these facilities have outdoor radiological contamination areas. Decontamination and decommissioning (D&D) of building K-1420 is being performed in 2000 and this may improve the water quality in the future.

Storm water outfall SD-724 carries storm water from the K-770 scrap metal storage yard, which is known to contain materials having elevated levels of radioactive contamination. Remedial actions will be implemented at the K-770 scrap metal storage yard to remove the contaminated scrap metal. This should allow for a reduction in or the elimination of the discharge of radioactively contaminated storm water from this area.

Storm water outfall SD-490 drains a large area, including most of the southern end of the K-25 building, the K-1600 building, the K-601

building and the eastern portion of the K-29 building. Several areas near the K-25 and K-29 buildings are known to be radioactively contaminated. D&D of building K-25 is scheduled to begin in 2001.

Vinyl chloride was detected at storm water outfall SD-190 at a level of 17 µg/L. This level exceeds the screening criterion of 2 µg/L for this analyte. This screening criterion was taken from the Tennessee Water Quality Criteria for domestic water supply.

The presence of vinyl chloride at storm water outfall SD-190 is believed to be related to the discharge of contaminated groundwater from this outfall, not the discharge of contaminated storm water runoff. The sampling for this outfall was conducted in March 1999, which is before the Mitchell Branch collection trench pumps were optimized. Storm water samples collected in June 1999, which was after the pumps were optimized, show that no detectable vinyl chloride was present in the discharge from storm water outfall SD-190. Additional sampling for volatile organic compounds at outfall SD-190 will be performed in 2000.

Metals concentrations above applicable screening criteria were detected at several of the locations sampled as part of the 1998–1999 SWPP Program sampling effort. Metals that were commonly detected in storm water runoff included iron, magnesium, and manganese. However, the presence of these metals in storm water runoff in concentrations above screening criteria is not believed to be problematic. All of these metals are commonly found in soils and sediments within the geographic region of the ETTP. The source of the metals is most likely related to sediment and suspended solids being transported in storm water runoff. In addition, concentrations of these metals in storm water outfalls that flow constantly are believed to be attributable to the discharge of groundwater, which is known to occur at these storm water outfalls. Therefore, it is believed that the vast majority of detectable concentrations of metals found in storm water effluent from ETTP are due to the contact of storm water with the soil and/or the discharge of groundwater containing detectable metals concentrations.

In addition to the sampling effort, several storm water outfalls were smoke tested or dye tested as part of the 1998–1999 SWPP Program. This effort was conducted to reduce the number of storm water outfalls that are covered by the ETTP NPDES permit. As a result of this testing, ten storm water outfalls will be recommended to be removed from the new ETTP NPDES permit after it is issued by TDEC. The storm water outfalls cannot be removed from the current NPDES permit because it has expired, and regulations prohibit the modification of an expired permit.

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 1999 are given in Table 4.7. Table 4.7 provides the wastewater's no-observable-effect concentration (NOEC) and 96-hour lethal concentration for 50% of the test organisms (LC_{50}) for fathead minnows and *Ceriodaphnia* for each test. Average water quality measurements obtained during each toxicity test are shown in Table 4.8.

Effluent from K-1203 was tested twice during 1999 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 BIOLOGICAL MONITORING AND ABATEMENT PROGRAM

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. The BMAP consists of four tasks; (1) toxicity monitoring, (2) bioaccumulation monitoring, (3) monitoring of instream communities (both fish and benthic macroinvertebrates), and (4) waterfowl monitoring.

Table 4.7. 1999 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	2.8
		Ceriodaphnia	100	>100	2.8
	July	Fathead minnow	100	>100	3.1
		Ceriodaphnia	100	>100	3.1

[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 4.8. 1999 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	7.9	360	95	160
	July	8.0	330	110	140

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), and effluent from storm drains (SD170, SD180, and SD190), concurrently with surface water from six sites within Mitchell Branch. *Ceriodaphnia dubia* were used to evaluate effluent from SD170 and SD190 for toxicity six times during 1999. Full-strength effluent from SD170 reduced *Ceriodaphnia* survival or reproduction in three of six tests. Full-strength effluent from SD190 reduced *Ceriodaphnia* survival or reproduction in all six tests. Effluent from SD180 was evaluated for toxicity two times in 1999; the effluent reduced *Ceriodaphnia* reproduction in one of the two tests. Toxicity tests of surface water from Mitchell Branch downstream of each storm drain were conducted six times in 1999; no reduction in *Ceriodaphnia* survival or reproduction at any site was found. All of the *Ceriodaphnia* exposed to full-strength effluent from SD190 died during the December, 1998, test, so an investigation was launched to determine the cause of the toxicity. Although results were inconclusive, the evidence gathered indicates that the toxicity may be due to multiple sources and that both VOCs and metals contribute to the problem. In an effort to alleviate the toxicity, pumping rates at the Mitchell Branch Interceptor Trench Project were increased. This has proven to be only partially successful, and other alternatives are being considered.

4.7.2 Bioaccumulation Studies

In 1999, 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 µg/g, wet weight in 1993 to 3.2 µg/g, wet weight in 1999 (although this was down slightly from near 4 µg/g in 1998). Clam-monitoring results suggest that the observed increase was associated with SD190 because PCB levels in clams increased substantially over the last 6 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 decreased from last year (an average of 13.3 µg/g in 1999, down from

27.1 µg/g in 1998). Sampling of caged clams at various flow inputs to the pond clearly indicated continuing inputs of PCBs. Although PCBs were detected in clams from several storm water outfalls entering the P1 pond, SD100 continued to be the most contaminated outfall, having an average concentration of 16.4 µg/g. PCB accumulation in clams near SD100, SD 120, and the K-100-7-B weir in 1999 was greater than those observed in previous years.

Fish and caged clams from the K901-A pond were comparatively low (means of 0.5 µg/g, wet weight for largemouth bass (fillet samples), 5.9 µg/g for gizzard shad (whole-body samples), and 0.2 µg/g for clams) in PCBs, averaging near the historical concentrations in all species collected from this location. In late 1997, remediation efforts at the K-901-A pond had resulted in the elimination of almost all the fish in the pond. Subsequent heavy rains raised the level of the Clinch River so that the pond could be repopulated from the river. Fish collected in 1998, immediately after the repopulation, were relatively low in PCBs. Concentrations in the fish collected in 1999 were very similar to those in fish from the 1993 and 1996 studies. While these levels are above background levels, they are well below the levels found in fish from other ETTP locations.

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. In the 1999 studies, however, there is evidence of a rapid recovery to preconstruction conditions. In general, taxonomic richness (including the richness of the pollution sensitive taxa Ephemeroptera, Plecoptera, and Trichoptera) has increased at all sites. The magnitude of the increases has been greater in those sites within the industrial portion of the ETTP, although the richness at these sites continues to lag behind that of the reference site (MIK 1.43). Thus, the evidence indicates that past industrial operations have adversely impacted the stream but that pollution abatement and remediation measures in the last decade have improved the overall quality of the stream.

Fish community data gathered at both MIK 0.45 and MIK 0.71 show that Mitchell Branch has been adversely impacted but that some recovery is taking place. Species richness approaches values found in reference streams of similar size but still have not attained that level of community development. Measures of density, biomass, and species richness are greater at MIK 0.45 than at MIK 0.71, which is contrary to the overall trend since monitoring began. The most likely explanation is that the trench construction project removed much of the suitable habitat at MIK 0.71 and that many species will be slow to return to this section unless the habitat is re-established.

4.7.4 Waterfowl Surveys

Twenty-four waterfowl surveys were conducted on ETTP during 1999. The number of species recorded (forty) was similar to the number observed in the 1996 and 1997 surveys. The number of Canada geese continued to decline, a trend that has been apparent throughout the 1990's. The number of non-goose waterfowl species has increased. One possible explanation for these trends is that changes in land management and use have reduced the amount of preferred habitat for geese while the amount of habitat suitable for other waterfowl has increased.

No radioactively contaminated geese were found at ETTP during the waterfowl surveys.

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 the impact of plant operations 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. Additionally, results are compared with applicable risk-specific doses (RSDs) and reference air concentrations (RACs) as listed in 40 CFR 266 Subpart H.

The ambient air program sampling schedule and monitored parameters are listed in Table 4.9. 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. The principal parameters monitored are particulate matter (PM10), arsenic, beryllium, cadmium, chromium, lead, and total uranium. During the third quarter of 1999 radiochemical analyses were added that included isotopes of uranium (^{234}U, ^{235}U, and ^{238}U), ^{99}Tc, ^{237}Np, ^{238}Pu, and ^{239}Pu.

During this reporting period, the network was modified with respect to ETTP operations. At the beginning of 1999, the PM10 sampler at station

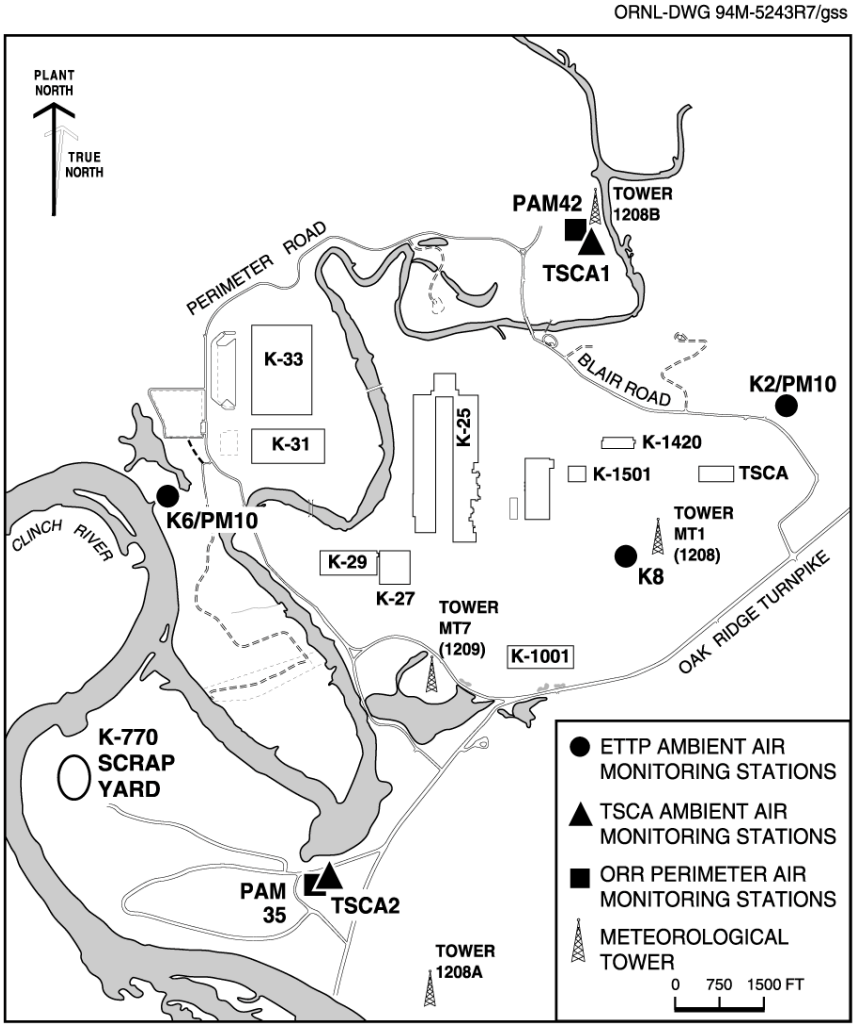

Fig. 4.8. Locations of ambient air monitoring stations at the ETTP, 1999.

Table 4.9. Summary of types and frequencies of samples collected at ETTP perimeter ambient air monitoring stations, 1999

Parameter	Sampling locations	Sampling period	Collection frequency	Analysis frequency[a]
		Criteria pollutants		
PM10	K2, K6	24 hour	Every sixth day[b]	Weekly
Lead	K2, K6	Continuous	Weekly	Monthly
	K8[c]	Continuous	Weekly	Weekly/Monthly
		Hazardous air pollutants carcinogen metals		
Arsenic	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly/Monthly
Beryllium	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly/Monthly
Cadmium	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly/Monthly
Chromium	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly/Monthly
		Organic compounds		
PCBs	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 (by inorganic analysis)		
Uranium (total)	K2, K6	Continuous	Weekly	Monthly
	K8	Continuous	Weekly	Weekly/Monthly
	PAM-35, -42	Continuous	Weekly	Quarterly
	TSCAI 1, 2	*d*	*d*	*d*
		Radionuclides (by radiochemical analysis)		
^{99}Tc, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{234}U, ^{235}U, ^{238}U	K2, K6, K8	Continuous	Weekly	Monthly

[a]Weekly frequency is analysis for each individual sample. Monthly and quarterly are composite sample analyses of all weekly samples collected 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.

K4 was relocated to station K2 (Fig. 4.8). During the first quarter of 1999, sampling station K8 sample preparation and analysis was changed from weekly individual samples to a monthly composite sample that is identical to other ETTP station operations. The location of station K8 is identified in Fig. 4.8.

High-volume sampling for uranium at stations K2 and K6 represent sampling in the prevailing site downwind and upwind directions, respectively. Station K8 is at an on-site location of the computer air-dispersion modeled maximum concentration of emissions from TSCAI as determined by the Governor's Blue Ribbon Panel. 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. Analyses of composite samples collected during September and December were supplemented with the addition of radiochemistry procedures. Samples were analyzed for selected transuranic nuclides and isotopes of uranium (refer to Table 4.9). Sampling for hazardous air

pollutant (HAP) carcinogen metals and lead continues at stations K2, K6, and K8.

4.8.1 Results

No standards were exceeded, and there were no significant elevations of pollutant concentrations associated with site operations. Sampling results assessing the impact of specific site activities on air quality show that the ETTP, including project-specific measurements, did not have any impact of concern on local air quality. These data support the state classification of this area, including the ETTP, as being in attainment with the Tennessee ambient air quality standard for particulate matter less than 10 microns in diameter (PM10). Also, radiochemical analyses of ambient air samples confirm low radiological emissions from the ETTP. Table 4.9 lists selected parameters measured during 1999.

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 4.10. For 1999, the 24-hour PM10 concentrations ranged from 2.7 to 40.3 µg/m^3. The highest measured value was 26.8% 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 4.10. The highest averaged PM10 annual result was 17.1 µg/m^3. This value was only 34.3% 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 determined by the inductively coupled plasma mass spectrometry (ICP-MS) analytical technique. Lead-measurement results are summarized in Table 4.11 and are compared with the Tennessee and national quarterly ambient air quality standard of 1.5 µg/m^3. There are no 24-hour, monthly, or annual ambient air quality standards for lead. The maximum individual lead result was 0.0048 µg/m^3. 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, K6, and K8 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,

Table 4.10. PM10 particulates in ambient air at the ETTP, 1999

Station	Number of samples	Annual summary of PM10 concentrations (µg/m3)			Max percentage of standard[a]	
		Annual avg	24-h max	24-h min	Annual	24-h
K2	60	17.1	38.0	3.4	34.3	25.4
K6	57	16.7	40.3	2.7	33.4	26.8
All stations	117	16.9	40.3	3.4	33.8	26.8

[a]PM10 Tennessee and national primary and secondary ambient air quality standards are 150 µg/m3 per 24 hours and 50 µg/m3 per year arithmetic mean.

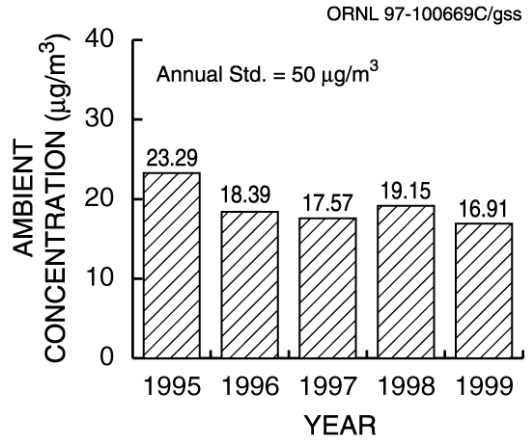

Fig. 4.9. Ambient air monitoring 5-year trend results for PM10 at the ETTP.

Table 4.11. Lead concentrations in ambient air at the ETTP, 1999

Station	Quarterly averages of monthly composites (µg/m3)				Max individual result	Min individual result	Max percent of quarterly standard[a,b]
	1	2	3	4			
K2	0.004116	0.002669	0.002933	0.004804	0.004804	0.002669	0.32
K6	0.003708	0.002914	0.003207	0.004165	0.004165	0.002914	0.28
K8	0.003621	0.003312	0.004262	*c*	0.004425	0.002482	0.30
Quarterly avg	0.003815	0.002965	0.003467	0.004485	0.004465	0.002965	0.29
Quarterly max	0.004116	0.003312	0.004262	0.004804	0.004804	0.003312	0.32
Annual average for all stations = 0.003598 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 discontinued sampling at the end of the third quarter of 1999.

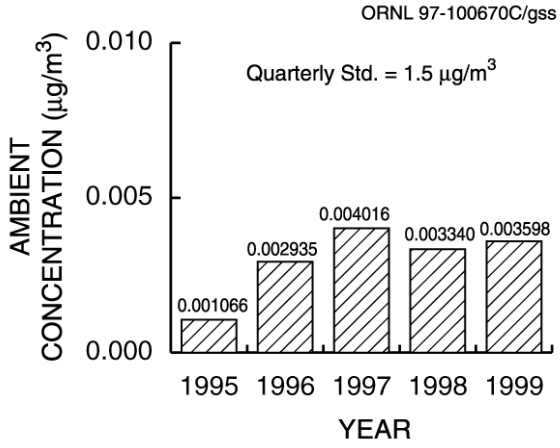

Fig. 4.10. Ambient air monitoring 5-year trend results for lead at the ETTP.

comparisons have been made against RSDs and RACs. Individual arsenic concentration results for all measurement sites ranged from approximately 0.0007 to 0.0011 µg/m^3. No beryllium measurement was above minimum detectable concentrations of the analytical method. Cadmium concentration results ranged from approximately 0.00015 to 0.00034 µg/m^3. Individual chromium measurements ranged from approximately 0.00036 to 0.00083 µg/m^3. A summary of the HAP carcinogenic metals measurements is presented in Table 4.12.

4.8.4 Radionuclide Levels

Total uranium metal was measured as a monthly composite of continuous weekly samples from stations K2, K6, and 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 annual averages and maximum individual concentration measurements for all sites are presented in Table 4.13. Results ranged from a minimum of approximately 0.00004 up to 0.001 µg/m^3. The highest monthly result was measured at Station K2. Station K2 is in the prevailing downwind direction of the ETTP. The highest annual average value for all stations due to uranium was only 0.32 mrem/year (the annual standard is 10 mrem per year). No uranium concentration levels of environmental concern were measured (see Fig. 4.11 for 5-year uranium trend).

Periodic radiochemical analyses were initiated during 1999 with the September composite samples collected at Stations K2, K6, and K8 and December samples from K2 and K6. The selected isotopes of interest were ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, and isotopic uranium (^{234}U, ^{235}U, ^{236}U, and ^{238}U). The calculated dose contributions for each and all nuclides measured are presented in Table 4.14. For comparison, the total uranium dose associated with ICP-MS analyses of the September and December composite samples are compared with the uranium results determined by radiochemical techniques. The data show that results from the different analytical techniques yield a similar dose with respect to each station. All ^{237}Np, ^{238}Pu, and ^{239}Pu results were below detectable levels. All ^{99}Tc results were insignificant compared with the dose contributions by the isotopes of uranium.

4.8.5 Organic Compound Levels

Currently, measurements of selected semi-volatile organics are performed only during an operational upset of the TSCAI. Two upsets occurred during waste-burning operations in 1999. On July 12, 1999, a thermal relief vent (TRV) event occurred at the TSCAI that automatically activated the TSCA ambient air stations. On August 1, 1999, a kiln surge vent event occurred at the TSCAI. By management decision, the TSCA ambient air station samples were not analyzed due to meteorological conditions at the time of the events. Conditions at the time of the

Table 4.12. HAP carcinogen metals in ambient air at the ETTP, 1999

Parameter	Ambient air concentration (µg/m^3)			% of Std.[a]	
	Annual avg	Monthly max	Monthly min		
Arsenic	0.000809	0.001278	0.000491	35.2	
Beryllium	<0.000008	<0.000009	<0.000007	<0.2	
Cadmium	0.000240	0.000336	0.000153	4.3	
				Cr-III	Cr-VI
Chromium	0.000529	0.000831	0.000364	<0.1	60.1

[a]There are no Tennessee or national ambient air quality standards; however, annual averages are compared to RSD's for As, Be, Cd, and Cr-VI and the RAC for Cr-III as listed in 40 CFR 266.

Table 4.13. Total uranium in ambient air by ICP/MS analysis at the ETTP, 1999

Station	No. of samples	Concentration[a] (µg/m³)		(µCi/mL)		% of DCG[b]		EDE[c] (mrem)	
		Avg	Max[d]	Avg	Max	Avg	Max	Avg	Max
K2	52	0.000482	0.001022	3.31E–16	7.02E–16	0.32	0.68	0.32	0.68
K6	52	0.000078	0.000168	5.38E–17	1.16E–16	0.05	0.11	0.05	0.11
K8	48	0.000342	0.000767	2.35E–16	5.26E–16	0.23	0.51	0.23	0.51
PAM35	52	0.000074	0.000112	5.10E–17	7.66E–17	0.05	0.07	0.05	0.07
PAM42	52	0.000070	0.000084	4.83E–17	5.75E–17	0.05	0.06	0.05	0.06
Site total	256	0.000209	0.001022	1.44E–16	7.02E–16	0.14	0.68	0.14	0.68

[a]Mass to curie concentration conversions assume a natural uranium assay of 0.717% ^{235}U.

[b]DOE Order 5400.5 Dose Conversion Guide (DCG) for natural occurring uranium is an annual concentration of 1E–13 µCi/mL which is equivalent to a 100 mrem annual dose.

[c]Effective Dose Equivalent as defined in 40 CFR 61, Subpart H and calculated based on the dose limit of 10 mrem which equates to an annual ambient air concentration of 0.015 µg/m³ per year assuming a naturally occurring ^{235}U assay.

[d]Maximum individual sample analysis result with dose calculations assuming the value to be an annual concentration.

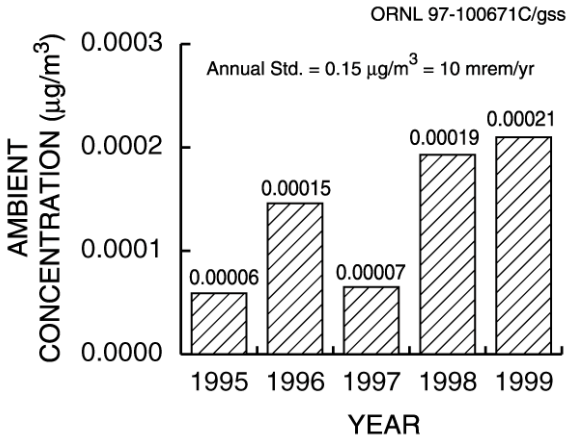

Fig. 4.11. Ambient air monitoring 5-year trend results for uranium at the ETTP.

Table 4.14. Radionuclides in ambient air by radiochemistry at the ETTP, 1999

Station[b]	Annualized dose[a] (mrem)							
	September composite				December composite			
	$^{Total}U$ by ICP	$^{Total}U$ by alpha spec	^{237}Np, $^{238/239}Pu$	^{99}Tc	$^{Total}U$ by ICP	$^{Total}U$ by alpha spec	^{237}Np, $^{238/239}Pu$	^{99}Tc
K2	0.550	0.758	ND[c]	0.002	0.264	0.414	ND	0.002
K6	0.061	0.074	ND	0.002	0.039	ND	ND	0.002
K8	0.511	0.341	ND	0.003	*	*	*	*
PAM35	0.074	*	*	*	0.034	*	*	*
PAM42	0.047	*	*	*	0.026	*	*	*

[a]The annualized dose is based on radiochemistry analyses of one monthly composite sample assuming the measured nuclide concentrations were representative for the year and the DOE Derived Concentration Guides for air inhalation.

[b]Station K8 was not operated during the December sampling period. Stations 35 and 42 results are based on ICP analyses of ORR quarterly composite split samples assuming a naturally occurring ^{235}U assay.

[c]"ND" indicates that the identified nuclide was not present at levels above the reported minimum detectable activity of the analytical method. No data available or sample taken indicated by "*".

event would not carry any potential release in the directions of the two 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, respectively. Other measured pollutant trends are discussed in this section. Variations of PM10 and lead measurements were insignificant and most likely reflect background concentration variations of air quality. 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. Over the last five years, arsenic, cadmium, and chromium have been typically indistinguishable from background levels except during specific projects that have included major demolition activities. All beryllium measurements, historical and current, have been at or near analytical minimum detectable concentrations. During the five-year period, no measurements have indicated any level of concern based on comparisons with any applicable standards.

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 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).

During the first three quarters of 1999, samples were collected and analyzed monthly for radionuclides and selected metals. Quarterly samples were collected and analyzed for general water-quality parameters and for organic compounds. Samples from K-1700 were analyzed quarterly for PCBs. In the last quarter of 1999, at most surveillance locations sampling was scaled back to semiannual sampling and analyses for radionuclides. Quarterly sampling for VOCs was retained at the K-1700 location. 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

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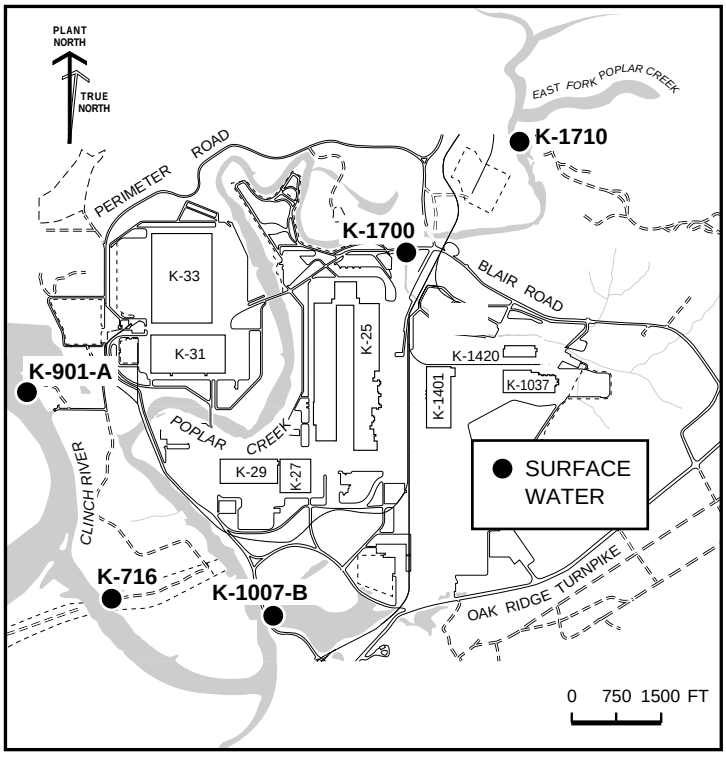

Fig. 4.12. Monitoring locations for surface water at the ETTP.

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. 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, 1.7 % 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 results at the other surface water surveillance locations are all at or below 1% of the allowable DCG. The 1999 radiological data do not indicate any significant radiological effects from ETTP operations on perimeter surface waters. The data are consistent with the results found throughout the 1990s. As a result, the frequency of monitoring at the surveillance locations was scaled back from monthly to semiannually at most locations. If ETTP operations were to change to include activities with the potential to increase radiological discharges, or if the semiannual monitoring detects significant increases, then the monitoring may be increased.

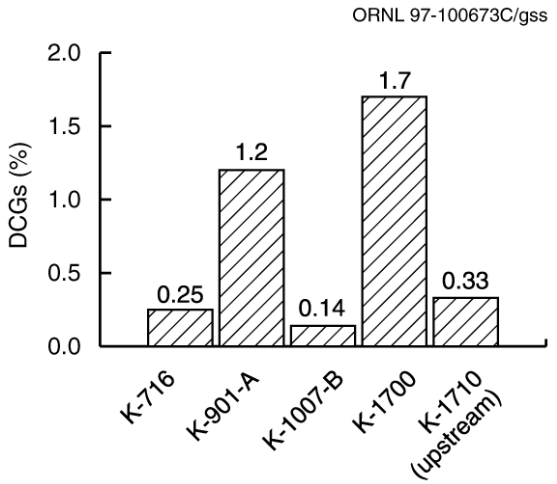

Fig. 4.13. Percentage of DCGs for ETTP surface monitoring locations.

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 K-1407-C Ponds, the principal driver at the ETTP is CERCLA.

The cleanup strategy described in *The Accelerating Cleanup: Paths to Closure, Oak Ridge Operations, Office* (DOE 1999b) 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. Although the groundwater monitoring program at ETTP had previously designated four wells as exit path monitoring wells, groundwater and subsurface geology data collected since that designation has determined that there are no discrete exit points for groundwater at ETTP. Groundwater discharges diffusely into Poplar Creek, the Clinch River, and the three main surface water bodies at

ETTP, the K-901 Pond, K-1007 Pond, and Mitchell Branch. Many of the contaminant sources at ETTP migrate toward one of these surface water bodies monitored for NPDES compliance. Because off-site releases need to be monitored more effectively, future editions of the FFA-required report, *Remediation Effectiveness Report for the U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee*, will include a summary of NPDES compliance. The current edition of this report includes summaries of groundwater monitoring actions required for individual cleanup actions at the ETTP, along with recommendations to modify any requirements that would further ensure protection of human health and the environment.