4. ETTP Environmental Monitoring Programs

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 included 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.

Environmental monitoring remains a major activity on the ETTP. Environmental monitoring encompasses two activities: effluent monitoring and environmental surveillance. Effluent monitoring consists of the collection and analysis of samples or measurements of liquid or gaseous effluents at their emission points to determine and quantify contaminants released. Environmental surveillance consists of the collection and analysis of samples of air, water, soil, vegetation, biota, and other media from the ETTP and its surroundings. External direct radiation is also measured. Data from environmental monitoring activities are used to assess exposures to members of the public and the environment, to assess the effects of ETTP operations on the public and the environment, to help plan remediation projects, and to evaluate the efficacy of these projects.

In 2004, the emissions of radionuclides from ETTP operations were well within the allowable DCGs published in DOE Order 5400.5 and were similar in most respects to 2003 emissions. Potential direct radiation to the public from uranium hexafluoride cylinder storage yards and the K-770 scrap metal yard at ETTP remained below the requirements in DOE orders. 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 2004, other prime contractors working directly for DOE at ETTP were also subject to NESHAP; data were obtained from the applicable sources and are 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 2004 varied from the previous year's total because of fluctuations in site operations. For this reporting period, a total of five point sources and two 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 that would cause a dose in excess of 0.1 mrem/year effective dose equivalent (EDE) as defined under the rule. An example of a minor source is the TSCA Incinerator tank farm with 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:

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

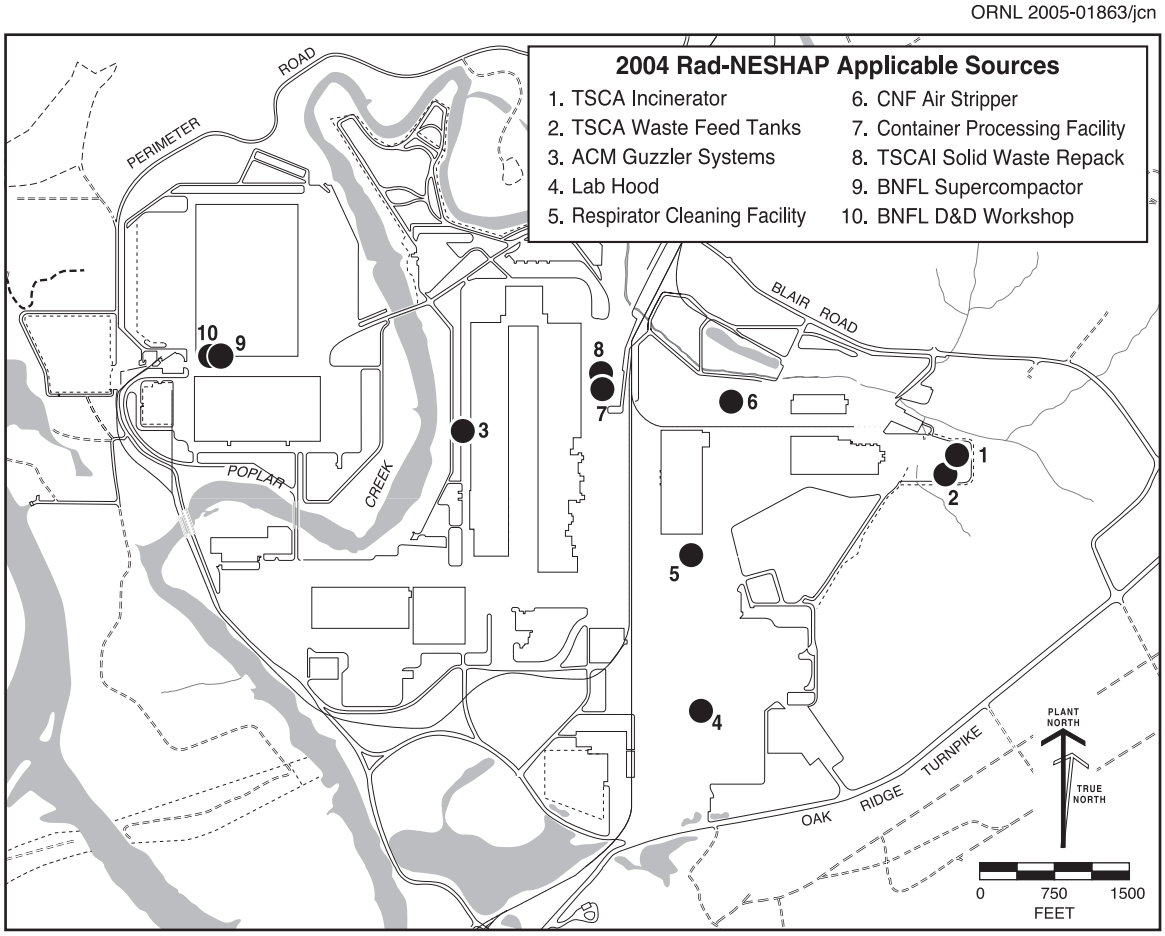


Fig. 4.1. Locations of airborne radionuclide point sources at the ETTP.

- surrogate emission data from similar sources—no sources, 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 major sources or diffuse/fugitive sources that are spatially distributed in nature or that 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

Three ETTP major sources operated during 2004. Radionuclide emission measurements from the TSCA Incinerator 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 TSCA Incinerator

emissions were based on monthly composites of weekly stack samples.

BNFL, Inc., operated two sources in the K-33 building requiring the continuous monitoring of radiological emissions. The decontamination and decommissioning workshop has two identical atmospheric release points, each equipped with a particulate filtration system and a continuous sampling device. The supercompactor vent continuous sampling system is the same design as the decontamination and decommissioning workshop units.

4.1.2 Results

The ETTP 2004 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 can vary from year to year. The variations are attributable to changes in project activities and source process rates. The resulting airborne dose from all ETTP radionuclide emissions was less than the reservation maximum limit of 10 mrem/year.

4.2 ETTP Nonradiological Airborne Emissions Monitoring

Under an application shield granted by the TDEC Division of Air Pollution Control, the ETTP has eight major air emission sources listed as subject to Tennessee Title V Major Source Operating Permit program rules. In addition, ETTP has a general fugitive air emissions permit for minor sources.

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 performed to ensure compliance with all permitted emission limits.

The ETTP is required to pay a major source emission fee each year for all regulated pollutants, excluding carbon monoxide and pollutants from exempt emission sources. To verify the air emission fee that is based on a combination of permitted allowable and actual emissions for air pollutants, an inventory of regulated emissions from the permitted sources at the ETTP is updated annually. Table 4.2 shows the results of the annual inventory of emissions of criteria pollutants from ETTP operations for the past 5 years. Beginning in 1999, the ETTP steam plant was transferred to CROET and is no longer included in the ASER. In June 2004 the steam plant was permanently shut down and the associated air permits were surrendered. The ETTP paid an annual fee in 2004 amounting to $3500 based on the fee rate of $17.50 per ton of emissions but not less than $3500 during that period for a facility subject to Title V Major Source Operating Permit requirements. Table 4.3 shows the inventoried regulated emissions during the 2004 reporting period from the ETTP.

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. For fee-reporting purposes, permitted allowable limits are used to determine the total potential emissions from the incinerator. A comparison of actual and allowable TSCA Incinerator emissions is presented in Table 4.4. All other permitted sources have emissions inventoried based on permit allowable limits.

4.3 Liquid Discharges—ETTP Radiological Monitoring Summary

The ETTP conducts radiological monitoring of liquid effluent and storm water discharges to determine compliance with applicable dose standards. It also applies the “as low as reasonably achievable” (ALARA) process to minimize potential exposures to members of the public.

4.3.1 Sample Collection and Analytical Procedure

The ETTP monitored the treated effluent from the K-1407-J CNF (outfall 001). Weekly samples were collected from the CNF and were composited into monthly samples. The samples were then analyzed for radionuclides. Results of these sampling efforts were compared with the DCGs listed in DOE Order 5400.5.

The Storm Water Pollution Prevention Program, which is described in more detail in Sect 4.5, included sampling for gross alpha and

Table 4.1. ETTP radionuclide air emission totals, 2004 (Ci)

Radionuclide	Total major	TSCAI (major)[a]	Total minor	Total ETTP
^{225}Ac	–	–	2.48E–13	2.48E–13
^{227}Ac	–	–	2.50E–10	2.50E–10
^{228}Ac	–	–	5.59E–08	5.59E–08
^{241}Am	–	–	1.35E–06	1.35E–06
^{243}Am	–	–	2.89E–09	2.89E–09
^{207}Bi	–	–	4.33E–12	4.33E–12
^{212}Bi	–	–	6.84E–08	6.84E–08
^{214}Bi	–	–	6.18E–08	6.18E–08
^{14}C	6.78E–05	6.78E–05	4.49E–06	7.23E–05
^{141}Ce	–	–	1.82E–11	1.82E–11
^{36}Cl	–	–	1.79E–08	1.79E–08
^{134}Cs	–	–	2.35E–08	2.35E–08
^{135m}Cs	–	–	3.90E–08	3.90E–08
^{136}Cs	–	–	2.94E–09	2.94E–09
^{137}Cs	9.77E–05	9.77E–05	1.83E–06	9.96E–05
^{51}Cr	–	–	3.68E–09	3.68E–09
^{57}Co	2.15E–10	2.15E–10	2.13E–08	2.16E–08
^{60}Co	–	–	1.61E–07	1.61E–07
^{244}Cm	–	–	2.35E–08	2.35E–08
^{245}Cm	–	–	1.17E–09	1.17E–09
^{247}Cm	–	–	1.70E–09	1.70E–09
^{248}Cm	–	–	8.52E–11	8.52E–11
^{152}Eu	–	–	5.44E–08	5.44E–08
^{154}Eu	–	–	6.11E–08	6.11E–08
^{155}Eu	–	–	2.15E–08	2.15E–08
^{129}I	–	–	3.09E–06	3.09E–06
^{131}I	–	–	2.41E–07	2.41E–07
^{85}Kr	1.39E–03	1.39E–03	8.95E+07	1.39E–03
^{210}Pb	–	–	2.86E–07	2.86E–07
^{212}Pb	–	–	9.42E–08	9.42E–08
^{214}Pb	–	–	7.06E–08	7.06E–08
^{237}Np	6.02E–07	6.02E–07	8.05E–07	1.41E–06
^{63}Ni	–	–	1.36E–10	1.36E–10
^{93m}Nb	–	–	9.06E–10	9.06E–10
^{95}Nb	–	–	2.07E–07	2.07E–07
^{238}Pu	3.17E–06	3.17E–06	5.72E–07	3.74E–06
^{239}Pu	6.43E–05	6.43E–05	9.08E–06	7.34E–05
^{242}Pu	–	–	4.32E–09	4.32E–09
^{244}Pu	–	–	1.60E–09	1.60E–09
^{40}K	–	–	1.41E–06	1.41E–06
^{231}Pa	–	–	8.11E–08	8.11E–08
^{233}Pa	–	–	2.21E–09	2.21E–09
^{234}Pa	–	–	2.93E–07	2.93E–07
^{234m}Pa	1.16E–02	1.16E–02	4.27E–04	1.20E–02
^{226}Ra	–	–	5.68E–06	5.68E–06
^{228}Ra	–	–	2.41E–08	2.41E–08
^{106}Ru	–	–	9.93E–08	9.93E–08
$^{89/90}$Sr	4.69E–06	4.69E–06	7.09E–07	5.40E–06
^{99}Tc	7.51E–03	7.51E–03	4.52E–04	7.96E–03

Table 4.1 (continued)

Radionuclide	Total major	TSCAI (major)[a]	Total minor	Total ETTP
^{208}Tl	–	–	1.02E–07	1.02E–07
^{228}Th	3.15E–05	3.15E–05	2.82E–07	3.18E–05
^{230}Th	3.01E–04	3.01E–04	1.36E–06	3.02E–04
^{231}Th	–	–	6.42E–07	6.42E–07
^{232}Th	1.40E–04	1.40E–04	2.80E–07	1.41E–04
^{234}Th	3.46E–03	3.46E–03	2.98E–04	3.76E–03
^{3}H	1.11E+02	1.11E+02	1.73E–02	1.11E+02
^{232}U	–	–	2.15E–08	2.15E–08
^{233}U	–	–	4.71E–06	4.71E–06
^{234}U	5.96E–04	5.96E–04	1.52E–04	7.49E–04
^{235}U	7.81E–04	7.81E–04	1.00E–05	7.91E–04
^{236}U	–	–	9.56E–07	9.56E–07
^{238}U	9.30E–04	9.30E–04	2.72E–04	1.20E–03
Totals	1.11E+02	1.11E+02	1.90E–02	1.11E+02

[a]Toxic Substances Control Act Incinerator.

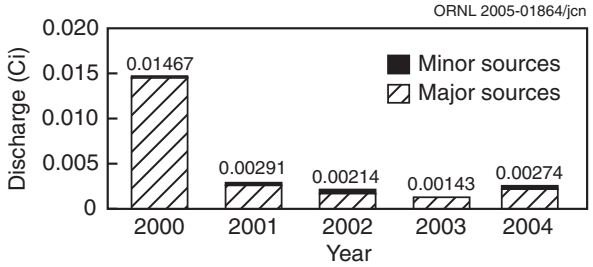


Fig. 4.2. Total curies of uranium discharged from the ETTP to the atmosphere, 2000–2004.

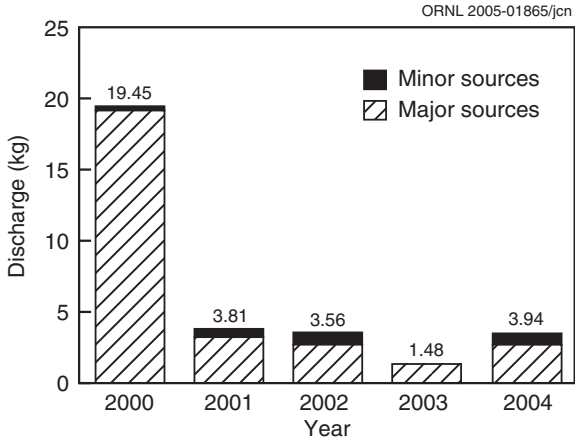


Fig. 4.3. Total kilograms of uranium discharged from the ETTP to the atmosphere, 2000–2004.

beta radioactivity as well as specific radionuclides at selected storm water outfalls. Results were used to estimate the total discharge of each radionuclide from ETTP via the storm water discharge system. Figure 4.4 shows the location of the major NPDES outfalls.

4.3.2 Results

The sum of the fractions of the DCGs at the CNF was calculated at 17.2% for 2004, up from 8.4% in 2003. Table 4.5 lists radionuclides discharged from the ETTP CNF to off-site surface waters in 2004. Total uranium discharges from the CNF were 0.01 Ci in 2004. Total discharge of transuranics was 0.0000107 Ci, which is three orders of magnitude less than the contribution from uranium.

In terms of total activity of the discharges, ^{3}H, ^{14}C, and ^{99}Tc were the greatest contributors. However, their allowable DCGs are greater than those for the uranium isotopes, so their contribution to the sum of the fractions of the DCGs is relatively small. Technetium-99 accounted for just over 2% of the sum of the fractions, while ^{3}H and ^{14}C each accounted for less than 1% of 1%. Uranium discharges from the CNF during a 5-year period were investigated to observe their trend (Fig. 4.5). Uranium isotopes were the major contributors to the fraction of the DCG, contributing two-thirds of the sum of the fraction of the DCG (Fig. 4.6). Thorium-230 was only detected in two of the samples, but due to its low DCG, the ^{230}Th results contributed approximately 2.7% of the DCGs for this outfall. All of the remaining isotopes cumulatively accounted for approximately 0.4% of the allowable DCG. TSCA Incinerator wastewater, which is sent to

Table 4.2. Allowable emissions of criteria pollutants from the ETTP, 2000–2004

Pollutant	Allowable emissions (tons/year)				
	2000	2001	2002	2003	2004
Particulate matter	13	13	13	13	13
Volatile organic compounds	14	14	14	14	14
Sulfur dioxide	39	39	39	39	39
Nitrogen oxides	20	20	20	20	20
Carbon monoxide	20	19	19	19	19
Hazardous air pollutants	21	20	21	21	21
Miscellaneous	0	0	0	0	0
Total	127	125	126	126	126

Table 4.3. Actual emissions of criteria pollutants from permitted ETTP sources, 2004

Pollutant	Actual emissions	
	lb/year	tons/year
Particulate matter	502.7	0.251
Volatile organic compounds	518.3	0.259
Sulfur dioxide	8.8	0.004
Nitrogen oxides	17,091	8.55
Carbon monoxide	4,273	2.14

Table 4.4. Actual vs allowable air emissions from the Toxic Substances Control Act Incinerator at the ETTP, 2004

Pollutant	Emissions (tons/year)		Percentage of allowable
	Actual[a]	Allowable	
Lead	0.0013	0.575	0.2
Beryllium	0.000023	0.00037	6.2
Mercury	0.0011	0.088	1.3
Hydrogen fluoride	0.00057	2.98	<0.1
Hydrogen chloride	0.070	16.12	0.4
Sulfur dioxide	0.0044	38.5	<0.1
Particulate matter	0.251	13.1	1.9

[a]Actual emissions based on removal efficiencies measured during the permit required air emission test conducted during 2000 with the exception of hydrogen fluoride, which is based on the CY 1995 test.

the CNF for treatment before being discharged to the Clinch River, is a major contributor of uranium; other operations contribute smaller amounts.

4.4 Nonradiological Liquid Discharges—ETTP Surface Water Effluents

The current ETTP NPDES permit (Permit Number TN0002950) for storm water discharges went into effect on April 1, 2004. This permit authorizes the ETTP to discharge storm water runoff, groundwater infiltration, groundwater from sumps, noncontact cooling water, and steam condensate to the Clinch River, Poplar Creek, and Mitchell Branch through 121 storm water outfalls. The current NPDES permit (Permit Number TN0074255) for the CNF went into effect on November 1, 2003. This permit authorizes treated industrial effluent from outfall 001 to be discharged to the Clinch River. Table 4.6 details the requirements and compliance records for the two NPDES permits for 2004. The table provides a list of the discharge points, effluent parameters, effluent limits, number of noncompliances, and the percentage of compliance for 2004. Samples from these outfalls are collected and analyzed as specified in the NPDES permits.

4.4.1 Results

The ETTP had three NPDES noncompliances in 2004 under NPDES Permit No. TN0002950; all were unpermitted discharges through storm water outfalls. On the morning of February 9, 2004, a lessee unintentionally started a fire by using a cutting torch inside a

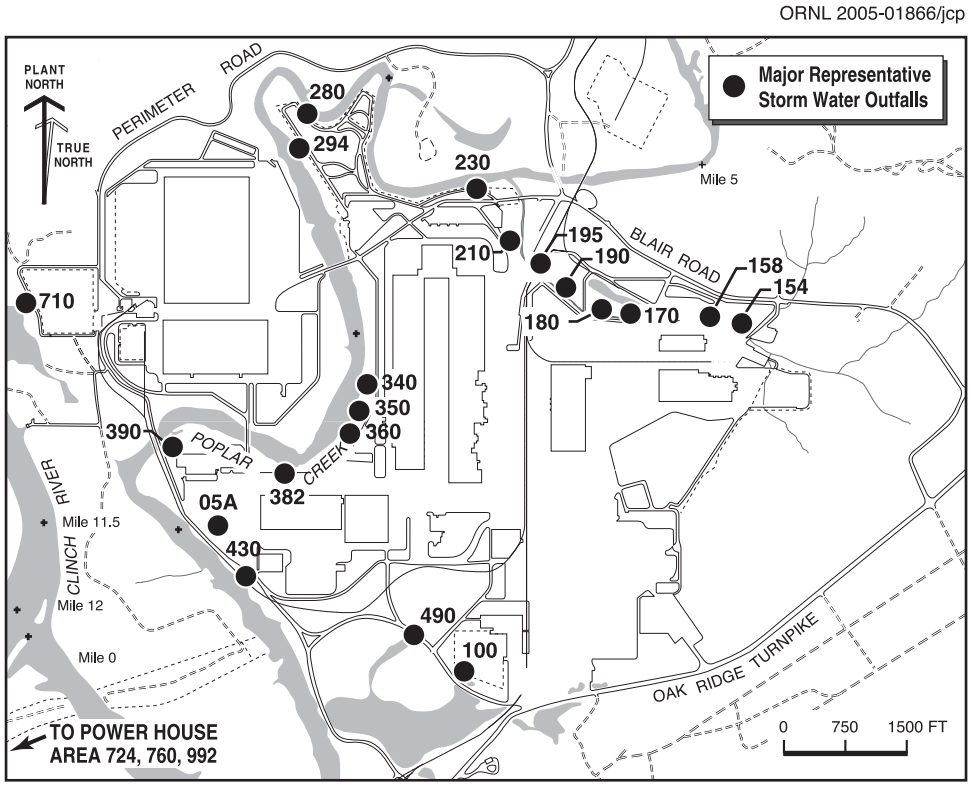


Fig. 4.4. ETTP National Pollutant Discharge Elimination System major representative storm water outfalls.

Table 4.5. Radionuclides released to off-site surface waters from the ETTP, 2004

Effluent discharge location: Central Neutralization Facility

Radionuclide	Amount (Ci)	Radionuclide	Amount (Ci)
^{14}C	3.4E–1	^{230}Th	6.2E–4
^{137}Cs	1.6E–4	^{234}Th	1.6E–3
^{3}H	4.0E–2	^{234}U	3.6E–3
^{237}Np	1.3E–6	^{235}U	2.7E–4
^{238}Pu	2.2E–6	^{236}U	1.7E–4
^{239}Pu	7.3E–7	^{238}U	6.4E–3
^{99}Tc	3.3E–1		

scrap metal dumpster to reduce the size of the pieces of metal in the dumpster. Efforts were made by the lessee to extinguish the fire with sanitary water and a fire extinguisher. When the lessee's efforts proved unsuccessful, the ETTP Fire Department was contacted and responded to the fire. The fire department successfully extinguished the fire with a combination of approximately 200 to 300 gal of fire water and F-500 suppression foam. The lessee vacuumed up as much of the water as possible in the area near the dumpster and in the area near the two adjacent storm drain catch basins. Although absorbent socks and plastic sheeting had been placed over the two nearby catch basins, some of the water-foam mixture leaked from the dumpster and the overflow vent of the fire truck onto the pavement. Straw bales, absorbent socks, and an absorbent boom were placed at the drainage channel located immediately south of outfall 180 in an attempt to prevent the water-foam mixture from entering Mitchell Branch. Subsequent

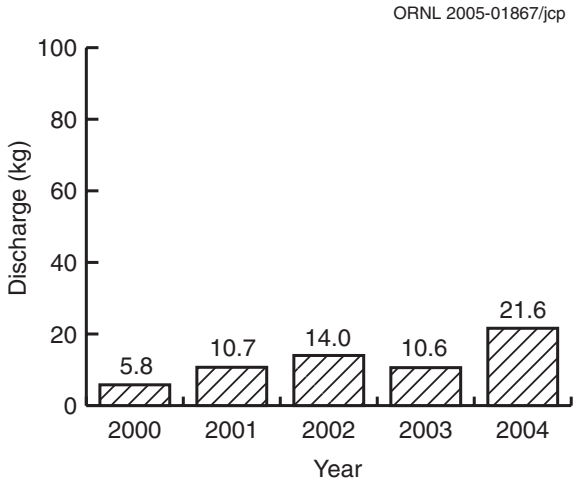


Fig. 4.5. Five-year trend of uranium releases to surface waters from the K-1407-J Central Neutralization Facility.

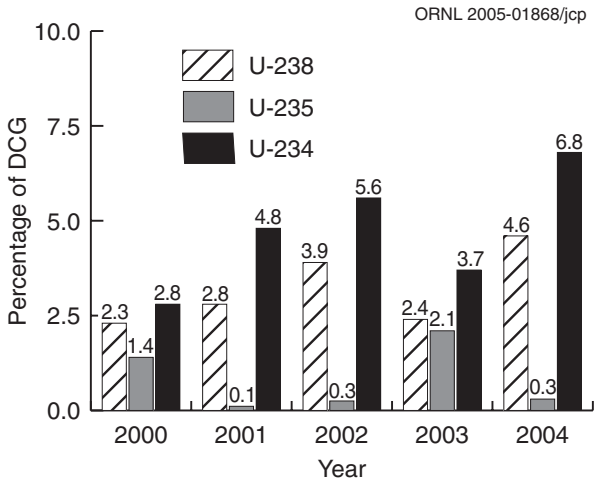


Fig. 4.6. Percentage of DOE derived concentration guides for uranium isotopes from the K-1407-J Central Neutralization Facility.

observations of the drainage channel indicated that small amounts of the materials generated in the firefighting effort reached the two storm drain catch basins near the dumpster and were discharged into the storm water outfall 180 piping network. The materials that were believed to have entered the storm drain catch basins included fire extinguisher powder residue, chlorinated sanitary water, F-500 suppression foam, fire water, and residual liquid that was initially present in the dumpster before the fire occurred. A stream survey was conducted on the afternoon of February 9, 2004, to determine whether the discharge had any impact on the biota near storm water outfall 180 and in Mitchell Branch. Several dead fish were noted in the storm water outfall 180 discharge pipe and in Mitchell Branch immediately downstream of the outfall. Sampling of the discharge of storm water outfall 180 and of the liquids that were vacuumed from the area adjacent to the dumpster was performed on the evening of February 9, 2004. The samples were analyzed in an effort to determine the factors that might have caused the fish kill. The analytical results from the samples did not reveal any definitive cause of the fish kill. On February 9, 10, and 11, 2004, ORNL Environmental Sciences Division personnel were requested to conduct stream surveys to determine the impact of the discharged material on the fish in Mitchell Branch. Forty-nine dead fish were collected over the course of the three stream surveys. The field readings did not show any abnormal conditions that might have caused the fish kill. The discharge that entered the storm drain system as a result of the firefighting effort, and the subsequent fish kill in Mitchell Branch, were determined to be a violation of the ETTP NPDES permit.

On August 2, 2004, personnel were conducting routine NPDES permit compliance sampling at storm water outfall 100. The water discharging from the outfall was observed to be gray in color with solid material floating on the surface. The discolored water was traced back to a storm drain catch basin located immediately east of the entrance to the cafeteria in Building K-1007. It was noted that a raw sewage smell was emanating from the catch basin. Dye testing confirmed that the sanitary sewer line in the cafeteria was discharging to the storm drain system. A large sink, open floor drains, and restroom facilities were dye tested, and all were found to be connected to the storm drain system. The sanitary wastewater from the cafeteria was authorized to be discharged to the ETTP Sewage Treatment Plant through a sewer use permit issued by the site's utilities operator. When the cafeteria was designed, sanitary wastewater discharges were thought to have been connected to a six-inch sanitary sewer line at two locations inside the building. Instead, the plumbing subcontractor mistakenly made the two sanitary sewer connections to a six-inch roof drain collection line that discharges to the storm drain system. These connections were made immediately before the

Table 4.6. National Pollutant Discharge Elimination System compliance at the ETTP, 2004

Effluent parameter	Effluent limits[a]		No. of noncompliances	Compliance (%)
	Monthly avg	Daily max		
Outfall 001 (K-1407-J Central Neutralization Facility to the Clinch River)				
Benzene		0.005		100
Cadmium	0.18	0.69		100
Carbon tetrachloride	0.5	0.5		100
Chloride, total	35,000	70,000		100
Chloroform	0.5	0.5		100
Chromium	1.71	2.77		100
Copper	1.34	2.15		100
Cyanide, total	0.650	1.200		100
Ethylbenzene		0.01		100
Lead	0.38	0.69		100
Nickel	2.38	3.98		100
Oil and grease	26	30		100
PCB	0.00022	0.00045		100
pH, standard units		6.0–9.0		100
Silver	0.24	0.43		100
Suspended solids	31	40		100
Tetrachloroethylene		0.7		100
Toluene		0.01		100
Total toxic organics		2.13		100
Trichloroethylene	0.5	0.5		100
Vinyl chloride	0.2	0.2		100
Zinc	1.48	2.61		100
Group I storm water outfalls				
pH, standard units		4.0–9.0		100
Group II storm water outfalls				
pH, standard units		4.0–9.0		100
Unpermitted discharge			1	*b*
Group III storm water outfalls				
pH, standard units		4.0–9.0		100
Unpermitted discharge			1	*b*
Group IV storm water outfalls				
Chlorine, total residual		0.140		100
pH, standard units		6.0–9.0		100
Unpermitted discharge			1	*b*

[a]Units are mg/L unless otherwise stated.
[b]Not applicable.

cafeteria opened in January 2004; therefore, sanitary wastewater had been discharging from the cafeteria to the storm drain system from January until it was discovered in early August. Corrective actions to repair the system were initiated in August 2004. A new section of 18-inch storm drain piping was installed outside the cafeteria to reroute the roof drainage. The portion of the storm drain system inside the building where the sanitary wastewater was being discharged was permanently isolated from the storm drain system and was converted to sanitary sewer piping. The converted pipe section was connected to a new section of sanitary sewer line that discharges to the existing sanitary sewer lift station. This incident resulted in a noncompliance with the ETTP NPDES permit.

A subcontractor associated with the three-building (K-29, K-31, K-33) Decontamination and Decomissioning work scope discharged gray water from a worker decontamination shower facility into the ETTP storm drain system. This

unpermitted discharge took place over a period of approximately 3 to 4 years. The gray water was discharged from a trailer outside the K-31 Building where workers who were involved in asbestos abatement showered. Sanitary water from the ETTP sanitary water system was utilized in the shower facility. The gray water was filtered to remove any asbestos that might be present in the discharge. The gray water was discharged from the facility by means of a hose routed into the storm drain system. Because safety concerns were raised due to the tripping hazard presented by the hose, the subcontractor rerouted the hose from the storm drain system to a sanitary sewer manhole approximately 6 to 9 months ago, without approval from the company that operates the K-1203 Sewage Treatment Plant. The K-1203 Sewage Treatment Plant Sewer Use Policy establishes a permitting process to ensure that new connections comply with the requirements of the policy; however, the subcontractor did not use the permitting process. The sanitary sewer manhole selected by the subcontractor was not connected to an active portion of the K-1203 Sewage Treatment Plant; therefore, the manhole eventually backed up and overflowed onto the ground. The gray water migrated over the surface of the ground and into nearby storm water system inlets. The inlets were traced, and it was found that they discharge through storm water outfall 510. During the investigation of the discharge, the previous unpermitted discharge of the gray water from the shower facility to the storm drain system was discovered. Upon discovery of the gray water from the shower facility entering the storm water drainage system, all discharges from the facility were immediately halted until an alternate means of disposal could be identified. The facility was returned to service with the installation of a portable tank to collect the discharges from the facility. All discharges from the facility that were routed into the tank were to be properly disposed of at the K-1203 Sewage Treatment Plant. An application for a permit that would allow the facility to discharge directly into the ETTP sanitary sewer system was submitted and approved. The discharge of gray water from storm water outfall 510 over a period of 3 to 4 years and the entry of gray water from the overflowing sanitary sewer manhole that occurred in October 2004 are therefore being reported as a noncompliance with the ETTP NPDES permit.

4.5 Storm Water Pollution Prevention Program

4.5.1 Storm Water Monitoring Strategy

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

The purpose of the ETTP Storm Water Pollution Prevention 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. It provides a means whereby sources of pollutants that are likely to affect the quality of storm water discharges are identified, best management practices to control the entry of pollutants into storm water discharges are developed, and methods for implementing pollution prevention practices are devised.

During 2004, the ETTP Storm Water Pollution Prevention Program sampling was conducted in support of three different goals:

- **Sampling for the ETTP Water Quality Program (EWQP)—**Surface water samples were collected at locations that are exit pathways for contaminants from ETTP. The locations have a direct discharge or potential for direct discharge to Poplar Creek or the Clinch River.
- **Radiological monitoring of specified storm water outfalls—**Radiological monitoring of storm water discharges is conducted at ETTP to determine compliance with applicable dose standards. It also applies the ALARA process to minimize potential exposures to the public.
- **Sampling in preparation for the application for ETTP NPDES permit renewal—**Selected outfalls that were designated as group representatives in the reissued ETTP NPDES Permit Number TN0002950 were sampled, and the results will be incorporated in the ETTP NPDES permit renewal appli-

cation. The current ETTP NPDES permit expires on March 31, 2008; the permit renewal application must be submitted to TDEC 180 days prior to permit expiration.

4.5.2 ETTP Water Quality Program Monitoring Program Results

In 2004, surface water samples were collected at locations that are exit pathways for contaminants from ETTP as part of the Storm Water Pollution Prevention Program and in association with the EWQP monitoring program. These locations have a direct discharge or potential for direct discharge to Poplar Creek or the Clinch River. Data from the analysis of these samples will be used to identify areas where contaminants may be discharging directly to surface waters located outside the ETTP boundaries. In addition, surface water samples were collected at interior locations within ETTP. The data from these samples will be used to evaluate changes in contaminant concentrations near potential contaminant sources and to identify contaminants that may be discharging to surface waters within the boundaries of ETTP.

Gross alpha radiation was detected at storm water outfall 190 at a level of 68.3 pCi/L, which exceeds the screening level of 15 pCi/L for this analyte. No gross alpha or gross beta contamination above the screening levels was found at any of the other storm water outfalls that were sampled in 2004 as part of the EWQP sampling effort. In addition, no levels of transuranics or isotopic uranium exceeding 4% of the DCG level were detected in samples from any of the other storm water outfalls sampled in 2004 as part of the sampling effort. Volatile organic compounds were found at levels above screening criteria at storm water outfalls 180 and 190. No PCBs were detected at levels above detection limits at any of the locations sampled. Analytical results for this sampling effort are presented in Tables 4.7 and 4.8.

4.5.3 Radiological Monitoring of Storm Water Discharges

In 2004, radiological monitoring of storm water discharges was performed as part of the Storm Water Pollution Prevention Program. Analytical results above screening criteria for gross alpha radiation, gross beta radiation, and isotopic uranium were found at storm water outfall 160.

Table 4.7. EWQP storm water monitoring radiological monitoring results that exceeded screening criteria[a]

Storm water outfall	Gross alpha radiation (pCi/L)
190[b]	68.3

[a]Screening level is 15 pCi/L alpha radiation.
[b]Sample was collected during the second quarter of FY 2004.

Table 4.8. EWQP storm water monitoring—nonradiological monitoring results that exceeded screening criteria[a]

Storm water outfall	*cis*-1,2 Dichloroethene (µg/L)	Vinyl chloride (µg/L)
180[b]	120	–
190[c]	420	220
190[b]	850	280

[a]Screening levels are 100 µg/L for *cis*-1,2 dichloroethene and vinyl chloride.
[b]Sample collected during fourth quarter of FY 2004.
[c]Sample collected during second quarter of FY 2004.

Analytical results above screening criteria for the radiological monitoring are presented in Table 4.9. A synopsis of the results from radiological monitoring at all the storm water outfalls is given in Table 4.10.

4.5.4 NPDES Permit Renewal Sampling

A portion of the Storm Water Pollution Prevention Program sampling effort conducted in 2004 focused on selected outfalls that were

Table 4.9. Maximum exceedances of radiological screening criteria for each storm water outfall, 2004 (pCi/L)[a]

Storm water outfall	Alpha	Beta	$^{233/234}$U	^{238}U
158	64.9		31.9	
160	203	78.2	151.7	89.7

[a]Screening levels are 15 pCi/L alpha radiation, 50 pCi/L beta radiation, 20 pCi/L ^{234}U, 24 pCi/L ^{235}U, and 24 pCi/L ^{238}U.

Table 4.10. Radionuclides released to off-site surface waters from the ETTP storm water system, 2004

Radionuclide	Amount (Ci)	Radionuclide	Amount (Ci)
$^{237}Np^{a}$	–1.9E–5	^{234}U	9.0E–3
$^{238}Pu^{a}$	5.8E–5	^{235}U	4.9E–4
^{239}Pu	8.2E–6	^{236}U	1.2E–4
^{99}Tc	5.2E–2	^{238}U	4.5E–3

[a]All results less than or equal to laboratory error values.

designated as group representatives in the reissued ETTP NPDES Permit Number TN0002950. The storm water monitoring results will be incorporated in the ETTP NPDES permit renewal application. The current ETTP NPDES permit expires on March 31, 2008; the permit renewal application must be submitted to TDEC 180 days prior to permit expiration.

Gross alpha radiation and isotopic uranium levels above screening criteria were found in storm water outfall 158 as part of the NPDES permit renewal sampling effort. No analytical results for any of the other radiological analytes were above screening criteria at any of the locations sampled for which radiological results have been received for the NPDES permit renewal sampling effort.

Storm water from several outfalls that were sampled in 2004 as part of the sampling effort contained metals at concentrations above screening levels. The exact sources of the metals are not known. It is likely that they are natural components of soils and sediments in the area, but they are found in more limited quantities than other more common metals.

Analytical results above screening criteria for the nonradiological monitoring for the NPDES permit renewal sampling effort are presented in Table 4.11.

Table 4.11. Maximum exceedances of nonradiological screening criteria for each storm water outfall, 2004 (µg/L)

Outfall	Parameter	Monitoring result	Criteria
142	Zinc	779	100
154	Zinc	479	100
158	Aluminum	1070	100
158	Zinc	129	100
180	*cis*-1,2-Dichloroethene	120	100
190	*cis*-1,2-Dichloroethene	850	100
190	Vinyl chloride	280	2
198	Aluminum	1820	100
198	Iron	1530	100
210	Zinc	209	100
770	Iron	1740	100

4.6 ETTP Biological Monitoring and Abatement Program

BMAP is a requirement of the NPDES permit. Its purpose is to assess the ecological health of the ETTP's receiving streams and ponds. BMAP consists of four tasks:

- toxicity monitoring,
- bioaccumulation monitoring,
- ecological surveys of instream communities (both fish and benthic macroinvertebrates), and
- waterfowl monitoring.

BMAP is conducted by the ORNL Environmental Sciences Division under the direction of the ETTP Environmental Compliance and Protection Organization.

4.6.1 BMAP Toxicity Monitoring

The toxicity monitoring task for BMAP includes tests of effluent from storm water outfalls 170, 180, and 190 concurrently with surface water from three ambient sites in Mitchell Branch [Mitchell Branch kilometer (MIK) 0.45, 0.71, and 0.78. The number following "MIK" indicates the distance in kilometers from the mouth of Mitchell Branch on Poplar Creek]. In October 2004 the frequency of testing was reduced to twice per year. *Ceriodaphnia dubia* were used to evaluate effluent from storm water outfalls 170 and 190, and the ambient monitoring location for toxicity four times during 2004. Survival and growth tests using fathead minnows (*Pimephales promelas*) were conducted on effluent from storm water outfall 190 at the same time as the *Ceriodaphnia dubia* tests. These tests were conducted in February and March, June, August, and December. Effluent from storm water outfall 180 was evaluated for toxicity two times in 2004 (in February and March, and again in August).

Results of the toxicity tests are presented in Table 4.12. None of the tests on water taken from the ambient locations exhibited toxicity in

Table 4.12. Mitchell Branch and associated storm water outfall toxicity test results, 2004[a]

Test	MIK 1.43	MIK 0.78	SD 170	MIK 0.71	SD 180	MIK 0.54	SD 190	MIK 0.45	MIK 0.12
First quarter, February–March									
Ceriodaphnia survival	NR	NR	NR	NR	NR	NR	R	NR	NR
Ceriodaphnia reproduction	NR	NR	R	NR	NR	NR	R	NR	NR
Pimephales survival							NR		
Pimephales growth							NR		
Second quarter, June									
Ceriodaphnia survival	NR	NR	NR	NR	*b*	NR	R	NR	NR
Ceriodaphnia reproduction	NR	NR	NR	NR	*b*	NR	R	NR	NR
Pimephales survival							NR		
Pimephales growth							NR		
Third quarter, August									
Ceriodaphnia survival	NR	NR	NR	NR	NR	NR	R	NR	NR
Ceriodaphnia reproduction	NR	NR	NR	NR	NR	NR	R	NR	NR
Pimephales survival							NR		
Pimephales growth							NR		
Fourth quarter, December									
Ceriodaphnia survival	NR	NR	NR	NR	*b*	NR	R	NR	NR
Ceriodaphnia reproduction	NR	NR	NR	NR	*b*	NR	R	NR	NR

[a]NR: No significant reduction compared with the control population. R: Significant reduction compared with the control population.

[b]SD 180 is only sampled twice per year.

the 2004 tests. In *Ceriodaphnia* tests on effluent from storm water outfall 170, reproduction or survival was reduced in one of the four tests. However, none of the tests on effluent from storm water outfall 180 exhibited toxicity. In all four *Ceriodaphnia* tests, effluent from storm water outfall 190 reduced reproduction and/or survival. Fathead minnows were not significantly affected in any of the 2004 tests. Thus, the overall trend is one of consistent toxicity to *Ceriodaphnia* from storm water outfall 190, slightly less toxicity from storm water outfall 170, and no toxicity from storm water outfall 180. Although it was not possible to positively identify the source of the problem, the data gathered indicated that groundwater was percolating through waste in the K-1070-B Classified Burial Ground and leaching out small quantities of metals. Some of this groundwater was then flowing into the storm drain system and causing the toxicity. Nickel and zinc are present in water collected from the storm drain system near K-1070-B at levels that have been shown to be toxic to *Ceriodaphnia*.

4.6.2 BMAP Bioaccumulation Studies

In June and July, 2004, caged clams (*Corbicula fluminea*) were placed at several locations in the vicinity of ETTP storm water outfalls. The clams were allowed to remain in place for four weeks, and then were removed and analyzed for uptake of PCBs. Clams from all of the ETTP monitoring locations accumulated some level of PCBs. Results of monitoring in 2004 were generally similar to the 2003 results in terms of which areas were the most contaminated, although the levels fluctuated some. As before, the primary source of PCBs to K-1007P1 pond remains storm water outfall 100 (levels in clams from storm water outfall 100 averaged 8.0 ppm). Both Mitchell Branch and the K-1007-P1 Pond receive effluent from other storm water outfalls that contain smaller amounts of PCBs (levels in clams range from less than 0.04 ppm to 6.4 ppm). Concentrations in clams from Mitchell Branch progressively increase with the distance downstream. The PCBs in Mitchell Branch clams were primarily Aroclor 1254, while in the K-1007-P1 Pond clams Aroclor 1248 and 1254 were both present. As before, the concentration

of PCBs in clams from K-901-A was significantly lower than the concentration found in clams from K-1007-P1 Pond and Mitchell Branch.

Fish were collected from Mitchell Branch, K-1007-P1 Pond, and K-901-A Pond in April 2004. Largemouth bass and carp were collected from the pond sites, and redbreast sunfish were collected from Mitchell Branch. Game fish of a size large enough to be taken by sports fishermen were selected to provide accurate data of potential human health concerns and to reduce the amount of variation in contamination levels in the individual fish due to age and size differences. Fillets taken from each game fish were analyzed for PCBs. Table 4.13 gives a synopsis of the results. As in previous years, the fish from the K-1007-P1 pond contained the highest concentrations of PCBs, while those from Mitchell Branch contained smaller concentrations, and the fish from K-901-A contained the lowest concentrations. Average levels at most sites were within historic ranges for the respective locations, although concentration in the fish in the K-1007P1 pond showed a very sharp decline from an average of 17.02 ppm in 2003 to 4.55 ppm in 2004.

4.6.3 BMAP Ecological Surveys of Instream Communities

In April 2004, the benthic macroinvertebrate community was sampled at four Mitchell Branch locations (MIK 0.45, 0.71, 0.78, and 1.43). MIK 1.43 serves as the reference location. Except for a short-term impact at MIK 0.45 and 0.71 following construction of the interceptor trench, the benthic macroinvertebrate community at all locations in lower Mitchell Branch has generally increased in species richness and numbers of pollution-intolerant species over approximately the last ten years. (Figs. 4.7 and 4.8). The results from the 2003 sampling showed declines in species richness and richness of the pollution-intolerant species in Mitchell Branch. However, the results of the 2004 sampling at MIK 0.71 and MIK 0.45 show a strong increase in these parameters to levels more typical of the previous sampling events, and the levels at MIK 0.78 even exceeded those of the reference locality. These findings suggest that the declines in 2003 were the result of some transient disturbance, or perhaps part of a natural cycle.

Table 4.13. PCB concentrations in biota at ETTP, 2004

Location	Species	Mean concentration (ppm)	Range	No. >1ppm/N
MIK 0.2	Redbreast sunfish (*Lepomis auritus*)	2.28	0.4–3.1	3/6
K-1007-P1	Largemouth bass (*Micropterus salmoides*)	4.55	2.02–10.8	6/6
K-901-A	Largemouth bass (*Micropterus salmoides*)	0.64	0.33–1.08	1/4
Hinds Creek (reference)	Redbreast sunfish (*Lepomis auritus*)	<0.02	<0.02	0/6
MIK 0.78	Asiatic clams (*Corbicula fluminea*)	0.1	N/A	N/A
MIK 0.71(SD170)	Asiatic clams (*Corbicula fluminea*)	0.14	N/A	N/A
MIK 0.54(SD180)	Asiatic clams (*Corbicula fluminea*)	0.5	N/A	N/A
MIK 0.45 (SD190)	Asiatic clams (*Corbicula fluminea*)	1.5	N/A	N/A
SD190	Asiatic clams (*Corbicula fluminea*)	6.4	N/A	N/A
MIK 0.2	Asiatic clams (*Corbicula fluminea*)	4.3	N/A	N/A
SD100 (inside drain)	Asiatic clams (*Corbicula fluminea*)	2.6	N/A	N/A
SD100 (discharge to P1 Pond)	Asiatic clams (*Corbicula fluminea*)	8.0	N/A	N/A
SD120	Asiatic clams (*Corbicula fluminea*)	3.0	N/A	N/A
K-1007P3	Asiatic clams (*Corbicula fluminea*)	<0.04	N/A	N/A
SD480	Asiatic clams (*Corbicula fluminea*)	0.6	N/A	N/A
K-1007P1	Asiatic clams (*Corbicula fluminea*)	2.2	N/A	N/A
K-901-A	Asiatic clams (*Corbicula fluminea*)	0.37	N/A	N/A
Little Sewee Creek (reference)	Asiatic clams (*Corbicula fluminea*)	<0.04	N/A	N/A

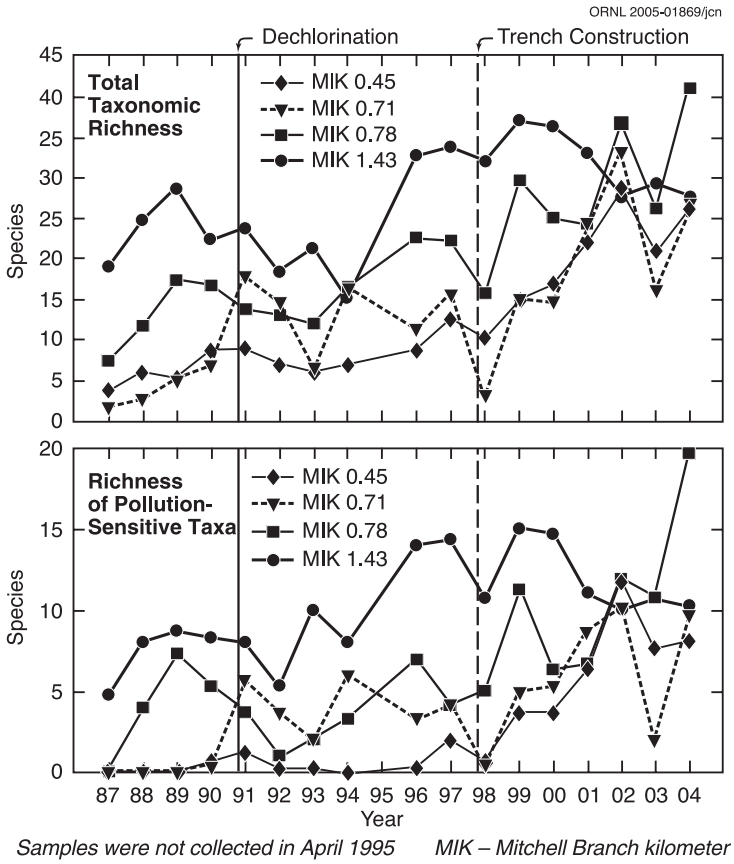


Fig. 4.7. Total taxonomic richness of pollution-sensitive taxa.

Although past ETTP operations had adversely affected the communities of Mitchell Branch, and although there continue to be some impacts, the results to date overall indicate that the institution of best management practices and remediation efforts has resulted in gradual, but more or less continuous, improvement of conditions in the stream.

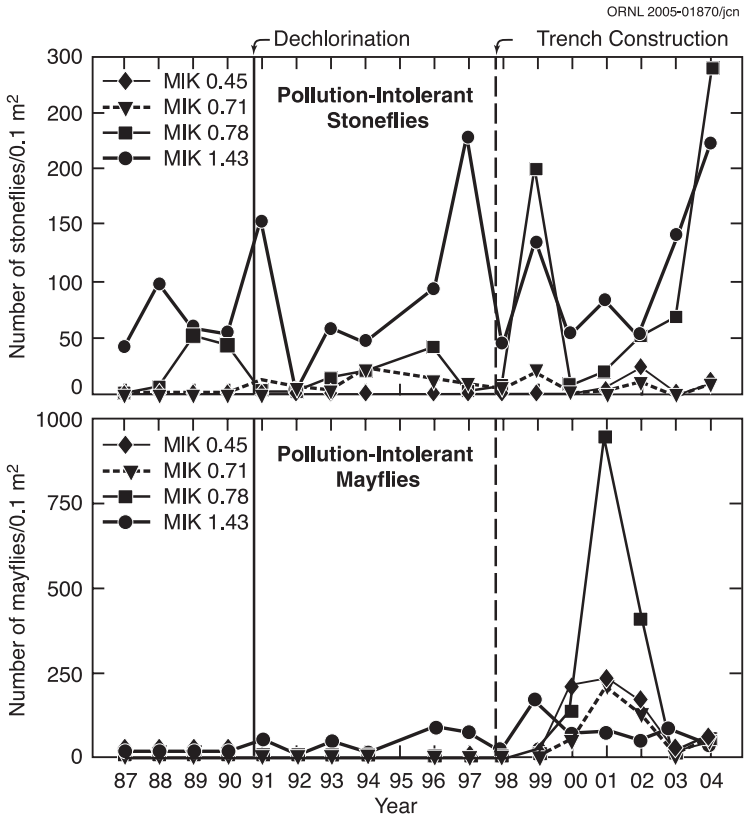
Fish communities in both Mitchell Branch (MIK 0.45 and 0.71) and the reference streams (Mill Branch kilometer 1.6 and Ish Creek kilometer 1.0) were sampled in April 2004. Species richness, density, and biomass were examined. Although the results from 2003 showed a decline in these parameters, possibly as a result of flooding in the spring of 2003, the 2004 results showed a marked increase in both species density and biomass, as well as a smaller increase in the species richness. The fish communities continue to be dominated by hardier, more tolerant species, a structure that is typical of streams that have been adversely impacted by pollution or disturbance. However, the trends show that Mitchell Branch is recovering from the past impacts.

4.6.4 BMAP Waterfowl Surveys

Waterfowl surveys were conducted each month until October, when the frequency was reduced to twice per year. Two state-listed species, the great egret (*Ardea alba*) and the sharp-shinned hawk (*Accipiter striatus*) were observed. One "in need of management" species, the vesper sparrow (*Pooecetes gramineus*) was also observed. Other interesting species found at ETTP include the osprey (*Pandion haliateus*), double-crested cormorant (*Phalacrocorax auritus*), greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), and the Canada goose (*Anser canadensis*). During the last several years, the number of species of waterfowl, as well as the number of individuals, has fluctuated. It is not clear at this time whether the fluctuations represent a temporary plateau on the route to recovery or whether the avian community has more or less reached a steady state for the current conditions.

4.7 ETTP Ambient Air Monitoring

DOE Order 450.1 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 requirements 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



There was no monitoring conducted during 1995.

Fig. 4.8. Density of pollution-intolerant and pollution-tolerant species in Mitchell Branch.

and most exposed member of the public. The current locations of these monitoring stations are shown in Fig. 4.9. 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-h, quarterly, and annual standards for specific or criteria pollutants. Additionally, results are compared with any applicable risk-specific dose and reference air concentration listed in 40 CFR 266, Subpart H.

The ambient air sampling schedule and monitored parameters are listed in Table 4.14. All parameters were 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 during 2004 were arsenic, beryllium, cadmium, chromium, lead, and uranium. Uranium was analyzed by both inorganic and radiochemical methods. Radiochemical analyses included isotopes of uranium (^{234}U, ^{235}U, ^{236}U, and ^{238}U), ^{99}Tc, ^{237}Np, ^{238}Pu, and ^{239}Pu.

During this reporting period, the ambient air monitoring network consisted of three ETTP sampling stations and utilized information obtained from two ORR perimeter air monitoring (PAM) stations. Samples were collected weekly from the following stations: K2, K6, K9, and PAM 35 and 42. Starting in 2004, sample compositing procedures were modified changing from monthly compositing to quarterly compositing (every 3 months) prior to analysis for all pollutant analyses.

4.7.1 Results

No standards were exceeded, and, with the exception of uranium levels, there were no significant variations of annual pollutant concentrations associated with site operations when compared with data from the previous year. 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. Also, radiochemical analyses of ambient air samples confirm low radiological emissions from the ETTP.

4.7.2 Criteria Pollutant Levels

Lead results were determined from analyses of quarterly composites of continuous weekly samples from stations K2, K6, and K9. The total mass quantities of lead for each sample were determined by the inductively coupled plasma mass spectrometry (ICP-MS) analytical technique. Lead analytical results are summarized in Table 4.15 and are compared with the Tennessee and national quarterly ambient air quality

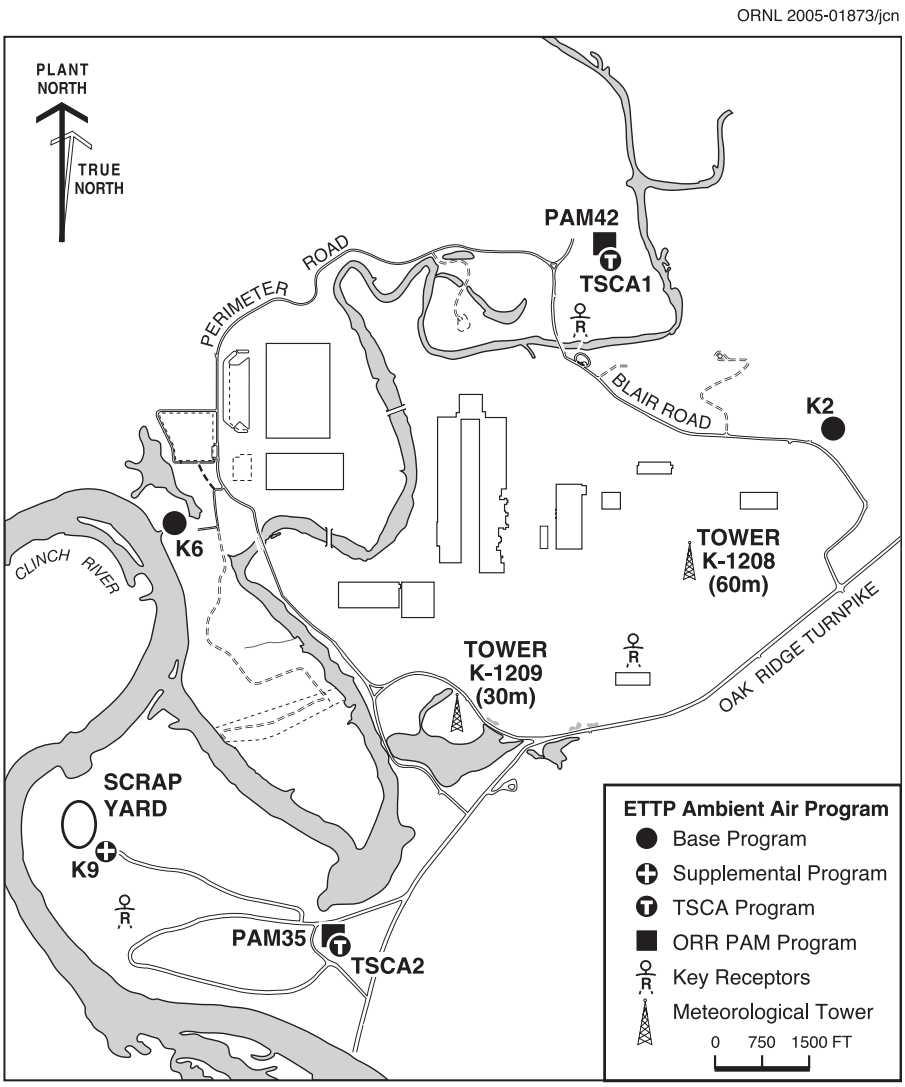


Fig. 4.9. Locations of ambient air monitoring stations at the ETTP.

standard of 1.5 μg/m^3. There are no 24-h, monthly, or annual ambient air quality standards for lead. The maximum individual lead result was 0.0014 μg/m^3. This value was only 0.09% of the quarterly standard for lead. No lead concentrations of environmental concern were measured (see Fig. 4.10 for a 5-year lead trend).

4.7.3 Hazardous Air Pollutant Carcinogenic Metal Levels

Analyses of hazardous air pollutant carcinogenic metals (arsenic, beryllium, cadmium, and chromium) were performed on quarterly composite samples of continuous weekly samples from stations K2, K6, and K9. 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 hazardous air pollutant carcinogenic metals. However, comparisons have been made against risk-specific doses and reference air concentrations.

The annual average arsenic concentration for all measurement sites was 0.00021 μg/m^3, well below the risk-specific dose of 0.0023 μg/m^3. The individual maximum measured result was 0.00044 μg/m^3. Annual beryllium measurements were at or near the minimum detectable concentrations of the analytical method, orders of magnitude below the risk-specific dose of 0.0042 μg/m^3. The combined beryllium average for all sites was < 0.000002 μg/m^3 with the individual maximum result of 0.000004 μg/m^3. The maximum

Table 4.14. Summary of types and frequencies of samples collected at ETTP perimeter ambient air monitoring stations, 2004

Parameter	Sampling locations	Sampling period	Collection frequency	Analysis frequency[a]
Criteria pollutants				
Lead	K2, K6, K9	Continuous	Weekly	Quarterly
Hazardous air pollutants carcinogen metals				
Arsenic	K2, K6, K9	Continuous	Weekly	Quarterly
Beryllium	K2, K6, K9	Continuous	Weekly	Quarterly
Cadmium	K2, K6, K9	Continuous	Weekly	Quarterly
Chromium	K2, K6, K9	Continuous	Weekly	Quarterly
Organic compounds				
Polychlorinated biphenyls	TSCAI[b] 1, 2	*c*	*c*	*c*
Furan	TSCAI 1, 2	*c*	*c*	*c*
Dioxin	TSCAI 1, 2	*c*	*c*	*c*
Hexachlorobenzene	TSCAI 1, 2	*c*	*c*	*c*
Radionuclides (by inorganic analysis)				
Uranium (total)	K2, K6, K9	Continuous	Weekly	Quarterly
	PAM 35, 42	Continuous	Weekly	Quarterly
	TSCAI 1, 2	*c*	*c*	*c*
Radionuclides (by radiochemical analysis)				
^{99}Tc, ^{237}Np, ^{238,239}Pu, ^{234,235,236,238}U	K2, K6, K9	Continuous	Weekly	Quarterly

[a]Monthly and quarterly frequencies are composite sample analyses of all weekly samples collected over the identified period.

[b]Toxic Substances Control Act (TSCA) Incinerator.

[c]Stations are activated automatically only if a TSCA Incinerator operational upset occurs. Identified samples are then immediately submitted for analysis.

Table 4.15. Lead concentrations in ambient air at the ETTP, 2004

Annual average for all stations = 0.00065 μg/m^3

Station	Quarterly averages of monthly composite samples (μg/m^3)				Max quarterly result (μg/m^3)	Max % of quarterly standard[a]
	1	2	3	4		
K2	0.00060	0.00052	0.00037	0.00113	0.00113	0.08
K6	0.00035	0.00055	0.00024	0.00098	0.00098	0.07
K9	0.00051	0.00063	0.00062	0.00136	0.00136	0.09
Quarterly avg	0.00049	0.00057	0.00041	0.00116	0.00116	0.08
Quarterly max	0.00060	0.00063	0.00062	0.00136	0.00136	0.09

[a]Tennessee and national air quality standard for lead is 1.5 μg/m^3 quarterly arithmetic average.

cadmium concentration result was 0.00008 μg/m^3. The < cadmium annual average was 0.00004 μg/m^3. Both results are well below the risk-specific dose of 0.0056 μg/m^3. Individual chromium measurements ranged from approximately < 0.00001 to 0.00015 μg/m^3. The annual average result for chromium was 0.00007 μg/m^3, well below the risk-specific dose of 0.00088 μg/m^3 for chromium VI. The form of chromium was not determined, and therefore the most conservative risk-specific dose (chromium VI) was used. A summary of the hazardous air pollutant carcinogenic metals measurements is presented in Table 4.16.

4.7.4 Radionuclide Levels

Total uranium metal was measured as quarterly composites from stations K2, K6, and K9. Quarterly composites of weekly continuous samples were analyzed from PAM stations 35 and 42.

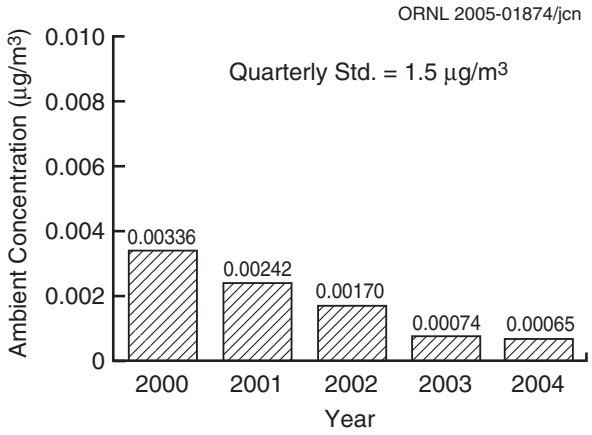


Fig. 4.10. Ambient air monitoring 5-year trend results for lead at the ETTP.

The total uranium mass for each sample was determined by the ICP-MS analytical technique. The annual uranium averages and maximum individual concentration measurements for all sites are presented in Table 4.17. Results ranged from a minimum of approximately 0.00003 to 0.00005 μg/m^3. The highest single quarterly result, 0.00011 μg/m^3, was measured at Station K9, which is in one of the prevailing wind directions from the K-770 Contaminated Scrap Metal Yard Remediation activity. The annual average value for all stations due to uranium was 0.00004 μg/m^3. The ICP-MS results are compared with a dose based on the DCG for natural uranium. (The DCG is based on an annual air concentration exposure that would give a dose of 100 mrem.) The sampling location with the highest annual average concentration of uranium was at PAM station 42. The annual result was only 0.00005 μg/m^3, which corresponds to 0.03% of the DCG (see Fig. 4.11 for 5-year uranium trend).

Figure 4.12 shows a comparison of trends of total uranium data from K2 and TSCA Incinerator stack emission data. The intent of this figure is to show the relative trend of each measurement result. A significant factor that can affect a comparison between the two data sets is the meteorology during each analysis period. Shorter reporting periods increase the potential that the plume from the incinerator may not be in the direction of K2 when operating. Another factor is the sensitivity of the analytical methods at these low levels of pollutants, which can introduce increased uncertainty in the data. The data show that K2 can detect airborne uranium during periods of waste incineration. All emission sources were operating within permitted limits and within all emission standards.

Periodic radiochemical analyses were initiated during 2000 on selected monthly composite samples collected at Stations K2, K6, and K9. For 2004, analyses were based on quarterly composite samples from these stations. 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 resulting annual concentrations for all nuclides measured are presented in Table 4.18. Results from stations K2, K6, and K9 are averages of four quarterly composite sample analyses and represent an annual average for this report. For comparison, the total uranium results associated with ICP-MS analyses of composite samples are comparable with the uranium results determined by radiochemical techniques.

Table 4.16. Hazardous air pollutant concentrations in ambient air at the ETTP, 2004

Parameter	Ambient air concentration (μg/m^3)			Percentage of standard[a]
	Annual avg (all stations)	Quarterly max	Max station	
Arsenic	0.00021	0.00044	K9	9.0
Beryllium	<0.000002	<0.000004	K9	<0.1
Cadmium	0.00004	0.00008	K2	0.8
Chromium	0.00007	0.00015	K2	
Cr-III				<0.1
Cr-VI				8.1

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

Table 4.17. Total uranium in ambient air by inductively coupled plasma mass spectrometry analysis at the ETTP, 2004

Station	Samples	Concentration[a]				Percent of DCG[b] (%)	
		μg/m^3		μCi/mL			
		Avg	Max[c]	Avg	Max[c]	Avg	Max[c]
K2	4	0.000030	0.000069	1.97E–17	4.59E–17	0.02	0.05
K6	4	0.000030	0.000047	2.01E–17	3.10E–17	0.02	0.03
K9	4	0.000044	0.000114	2.94E–17	7.57E–17	0.03	0.08
PAM35	2	0.000049	0.000056	3.25E–17	3.76E–17	0.03	0.04
PAM42	2	0.000052	0.000055	3.45E–17	3.68E–17	0.03	0.04
ETTP total	16	0.000041	0.000114	2.72E–17	7.57E–17	0.03	0.08

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

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

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

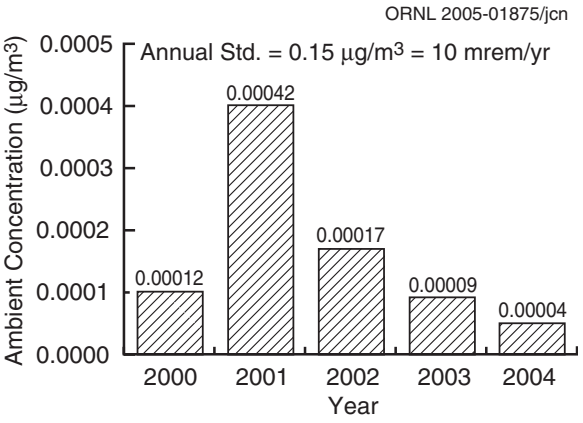


Fig. 4.11. Ambient air monitoring 5-year trend results for uranium at the ETTP.

4.7.5 Organic Compound Levels

Currently, measurements of selected semivolatile organics are performed only during an operational upset of the TSCA Incinerator. The incinerator experienced one automatic thermal relief vent opening during 2004 due to a power loss caused by a power surge in the ETTP distribution grid. This event occurred during the incineration of both liquid and solid wastes. In the event that an unplanned release occurred, organic compound ambient air sampling stations TSCA1 and TSCA2 (see Fig. 4.9) would be activated automatically or manually. However, the potential release of organic compounds from this event was established to be below levels that would be detectable by ambient air monitoring. This decision was based on the characterizations of the wastes being processed at that time of the event and on the current inventory in the incinerator. The calculated waste inventory could not produce a detectable off-site impact. Additionally, meteorological conditions would not carry any potential release from the vent in the direction of either sampling station. Therefore, the samplers were not activated for this event.

4.7.6 Five-Year Trends

Five-year summaries of ETTP ambient air monitoring data are shown in Figs. 4.10 and 4.11 for lead and uranium, respectively. Variations of 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 measurements were initiated in 1986. Over the last 5 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 5-year period, no ambient air measurements have indicated any level of concern based on comparisons with any applicable standards.

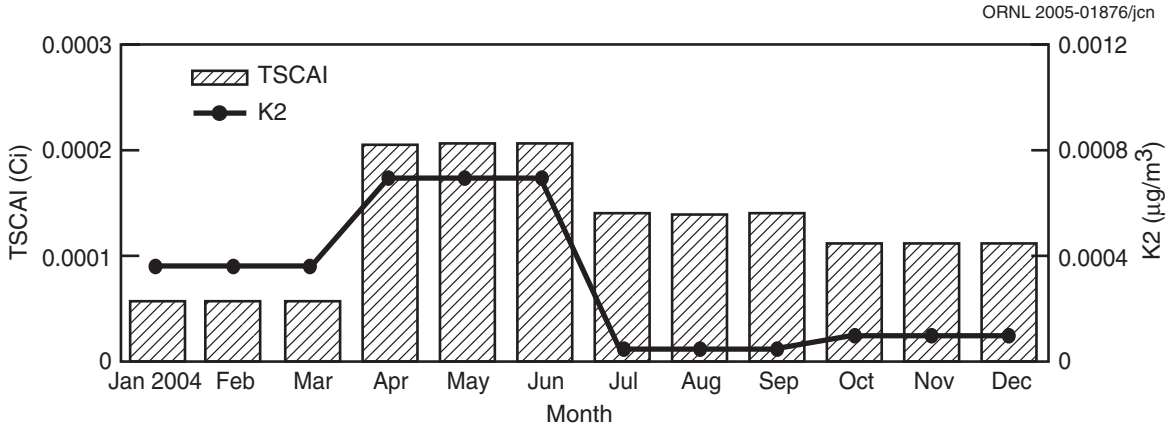


Fig. 4.12. Ambient air monitoring at ETTP Station K2 by ICP/MS vs TSCA Incinerator stack sampling results by radiochemistry.

Table 4.18. Radionuclides in ambient air by radiochemistry at the ETTP, 2004

Station	Concentration (µCi/mL)[a]								
	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{236}U	^{238}U	Total U
K2	ND	ND	1.30E–18	1.26E–16	1.05E–17	6.89E–19	1.10E–18	2.15E–17	3.38E–17
K6	7.34E–19	ND	2.40E–19	9.07E–17	1.52E–17	4.65E–19	2.86E–19	9.97E–18	2.59E–17
K9	ND	ND	2.79E–18	1.21E–16	1.63E–17	3.73E–19	2.03E–19	1.35E–17	3.03E–17

[a]K2, K6, K9 annual results are the average of four quarterly composite analyses.

4.8 ETTP Surface Water Monitoring

Surface water surveillance is currently conducted at eight locations at the ETTP (Fig. 4.13). Stations K-1710 and MIK 1.4 provide information on conditions upstream of the ETTP. Stations K-716 and Clinch River kilometer (CRK) 16 are located downstream from most ETTP operations and provide 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 (Stations K-1007-B, the K-700 Slough, and K-1700) or to the Clinch River (Station K-901-A).

At most surveillance stations, semiannual sampling and analyses for radionuclides and field readings (dissolved oxygen, temperature, and pH) are conducted. At CRK 16, samples for radionuclides, volatile organic compounds, and selected metals are collected and analyzed on a monthly basis. Quarterly sampling for volatile organics, in addition to radionuclides and field readings, is conducted at the K-1700 and MIK 1.4 locations. Radionuclide results are compared with the DCGs. Nonradiological results are compared with Tennessee water quality standards for fish and aquatic life. The water quality standards use the numeric values given in the Tennessee general water quality criteria, which are a subset of the water quality standards.

In most instances, results of the monitoring for nonradiological parameters are well within the applicable standards. Heavy metals were often detected at CRK16, K-901-A, and K-1700 (barium was the most common heavy metal detected), and certain volatile organics (primarily trichloroethane, vinyl chloride, and 1,2-dichloroethane) were regularly detected at K-1700, but in all instances the results were below the applicable water quality standard. Dissolved oxygen measurements at K-901-A fell below the minimum water quality standard of 5.0 mg/L during one summer sampling event due to a combination of elevated temperatures and the stagnation due to very low flows at that location. Water bodies in the vicinity of the ETTP are regularly inspected for signs of stress on aquatic organisms during low-flow periods. For the remaining analyses, results were within

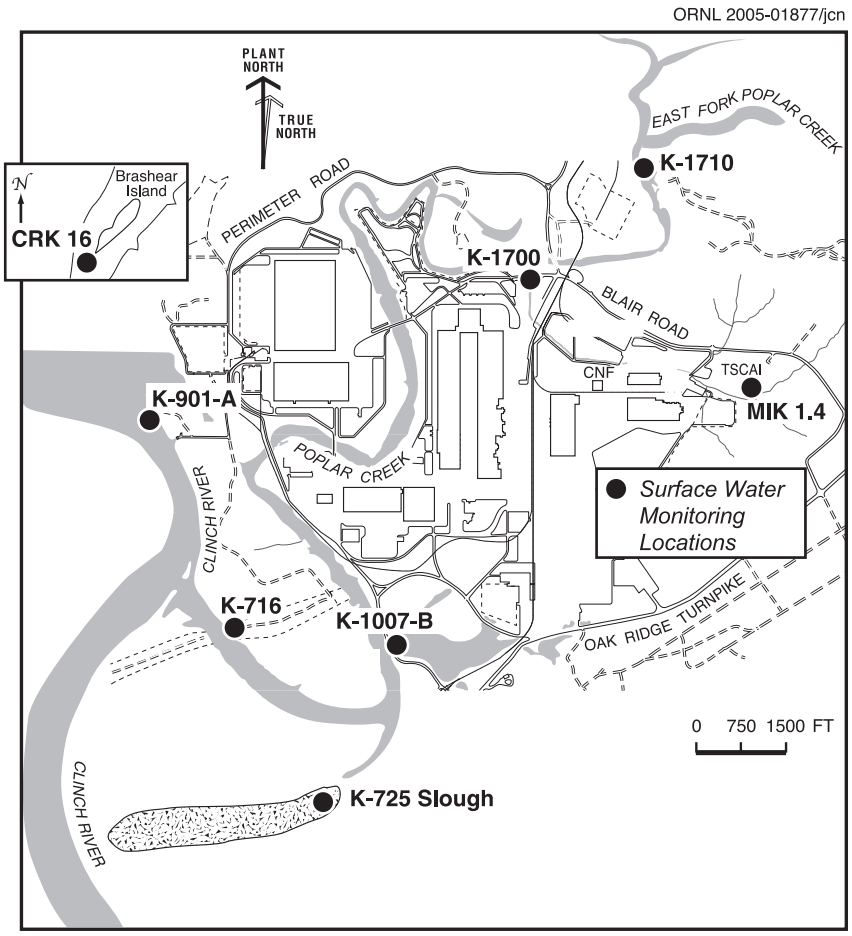


Fig. 4.13. Monitoring locations for surface water at the ETTP.

the reference standards or below detection limits for the instrument and method. Moreover, analytical results for samples collected upstream of the ETTP were chemically similar in most respects to those collected below the ETTP.

The sum of the fractions of the DCGs for most stations remained below 1% of the DCG values for ingestion (Fig. 4.14). The highest sum of the fractions, 1.9% of the DCGs, was reported for sampling location K-1700. The results at the other surface water surveillance locations are all below 1% of the DCGs. These data are consistent with the historical results. Due to this stasis, monitoring at the surveillance locations will continue to be maintained at the reduced frequency until significant changes are detected or until ETTP operations change to include activities with the potential to affect discharges.

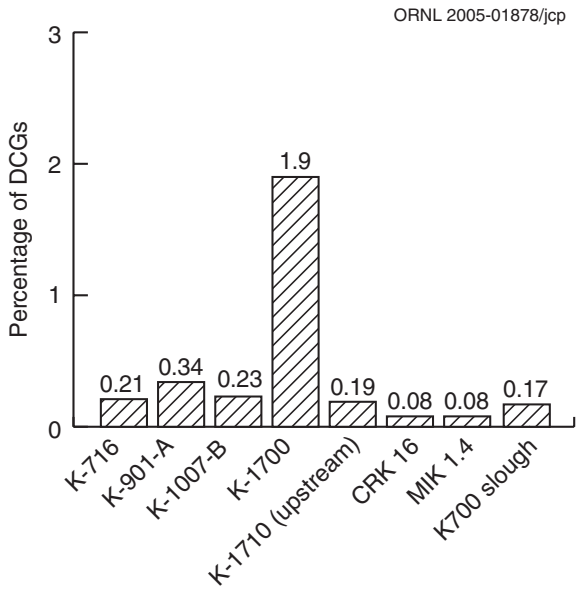


Fig. 4.14. Percentage of DOE derived concentration guides for ETTP surface water monitoring locations.

4.9 ETTP Groundwater Monitoring

Groundwater monitoring at the ETTP is focused primarily on investigating and characterizing sites for remediation under CERCLA. As a result of the Federal Facility Agreement 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 *Accelerating Cleanup: Paths to Closure* (DOE 1999a) 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 are incorporated into the Water Resources Restoration Program. The Water Resources Restoration Program, which was established to provide a consistent approach to watershed monitoring across the ORR, is responsible for conducting groundwater surveillance monitoring at the ETTP, including exit pathway monitoring wells. Groundwater discharges 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 contaminants at ETTP migrate toward one of these surface water bodies, which are monitored by the ETTP Environmental Monitoring Plan surface water surveillance program. The 2005 *Remediation Effectiveness Report* (DOE 2005a) 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.

4.10 ETTP Direct Radiation

The UF_6 cylinder storage yards and K-770 Scrap Yard at ETTP are potential sources of direct gamma and neutron radiation exposure to the public. Measured exposure rates and a hypothetical model of a maximally exposed individual were used to calculate theoretical doses. The calculated EDEs were based on gamma and neutron dose rates measured at the K-1066-J and K-1066-E Cylinder Yards along the near bank of Poplar Creek, the parking lot adjacent to the K-1066-K Cylinder Yard, and the near bank of the Clinch River in the vicinity of the K-770 Scrap Yard. The dose levels to the public calculated from the measured exposure rates are less than the 100-mrem/year limit established by DOE Order 5400.5.

Gamma and neutron dose rates from each area were measured in February or March 2004 with tissue-equivalent dose rate meters. The neutron dose rate meter used in 2004, upgraded in 2003 to provide digital counts, allowed lower neutron dose rates to be reported. Background readings were established at the ambient air monitoring stations north and northeast of ETTP off Blair Road, south and southwest of ETTP in the Powerhouse Area, and west of ETTP at the K-901 pumping station. The average gamma background was 0.005 mrem/h. The average neutron background was 0.006 mrem/h.

The potential maximally exposed individual model used for exposure from the K-1066-J or K-1066-E Cylinder Yard is a hypothetical fisherman who was assumed to have spent 250 h/year near the point of average exposure. This hypothetical individual could have received an EDE above background of about 4.00 mrem from gamma radiation and 2.00 mrem from neutron radiation along the bank of Poplar Creek near the K-1066-J Cylinder Yard, or 1.50 mrem from gamma radiation and 1.25 mrem from neutron radiation along the bank of Poplar Creek near the K-1066-E Cylinder Yard during 2004. This section of the creek runs through the ETTP plant and is used at times by fishermen; however, it is very unlikely that anyone would fish this stretch of Poplar Creek for 250 h/year.

General area dose rates were recorded in the vicinity of the K-770 Scrap Yard, along the near bank of the Clinch River. The average gamma dose rate was equivalent to the background level of 0.005 mrem/h, and the average neutron dose rate was less than the background level of 0.006 mrem/h. A hypothetical Clinch River fisherman would not be expected to have received any EDE attributable to the K-770 Scrap Yard during 2004.

The parking lot adjacent to the K-1066-K Cylinder Yard is used by workers and the public; therefore, it was included in the survey. This parking lot is intended for employees and has no public facilities. A potential maximally exposed individual is someone assumed to have spent 30 min per work day (125 h/year) waiting in the parking lot at the point of average exposure along the edge closest to the K-1066-K Cylinder Yard. This hypothetical individual could have received an EDE above background of about 1.63 mrem from gamma radiation and 0 mrem from neutron radiation during 2004.

4.11 Modernization and Reindustrialization

DOE-ORO established the Reindustrialization Program in 1996 as an innovative way to address some of the environmental and financial challenges left at the end of the Cold War. Under the program, transfers of excess or underutilized land and facilities are made available. The goal is to accelerate cleanup by reducing costs, while allowing for the productive use of the assets by the private sector. The process helps to offset negative impacts on the community caused by DOE downsizing, facility closeouts, and workforce restructuring. DOE-ORO worked with local officials and business leaders to establish CROET. Through CROET, the Reindustrialization Program has successfully leased land and facilities at the ETTP. DOE-ORO has transitioned to an accelerated cleanup of ETTP in preparation for its closure as a DOE site. ETTP will then be available for use as a private-sector industrial park. As part of this accelerated process, the emphasis is on facility transfer of ownership (title transfer).

In 2003, DOE-ORO completed a "finding of no significant impact" to allow the transfer of property to Horizon Center LLC. The property, in the past known as Parcel ED-1, only consists of the portions suitable for development. The remainder of the property, known as the Natural Area, will continue to be leased by Horizon Center LLC and owned by DOE.

DOE has been working with the state of Tennessee to grant the state an indefinite-term conservation easement of approximately 3000 acres to be located on the west end of the ORR. This action, the result of an agreement-in-principle related to the Natural Resources Damage Act affecting the ORR, was granted in early 2005.