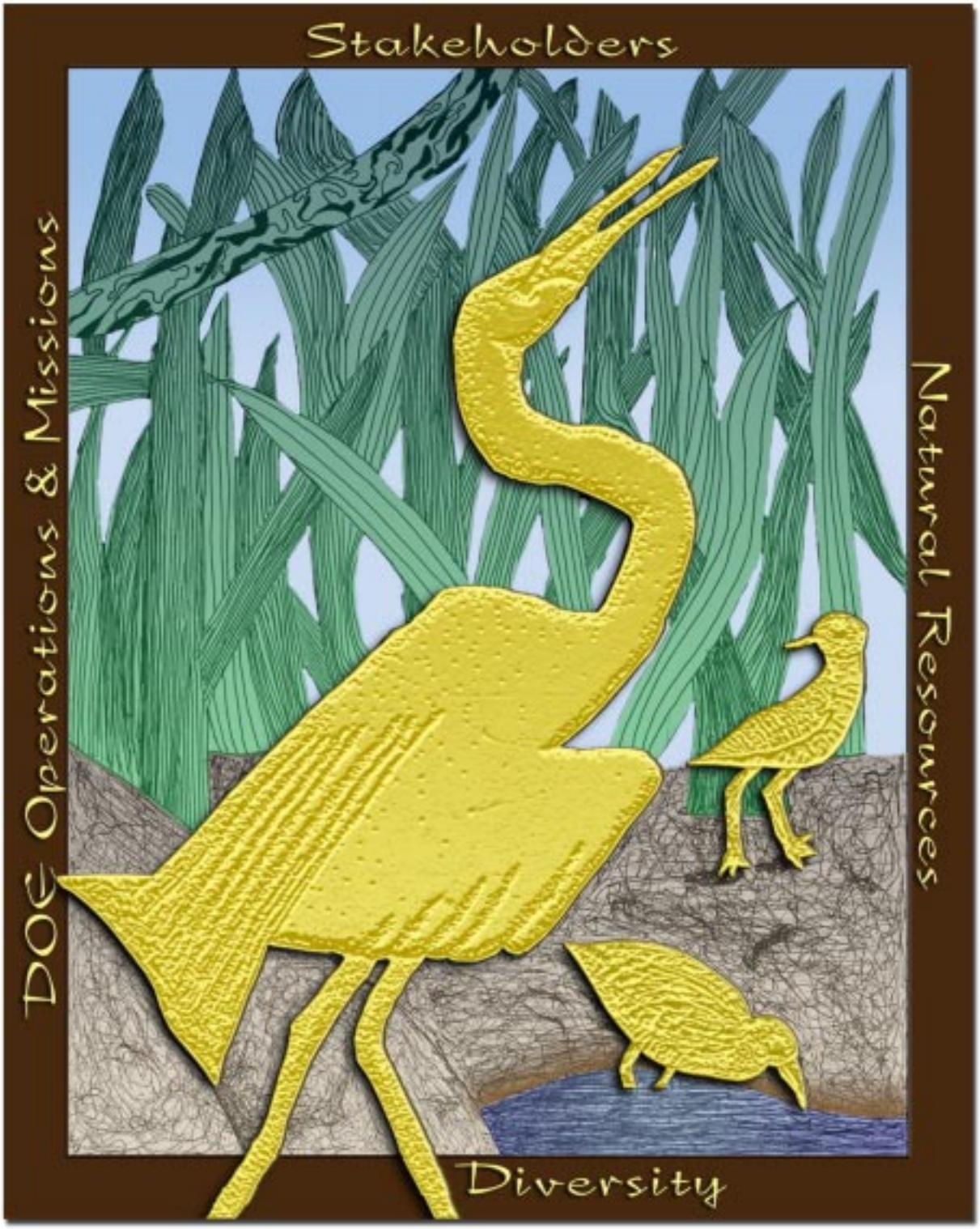
OAK RIDGE Reservation

Annual Site Environmental Report Summary



1999

Stewards of Tomorrow

Message from the Students

During the fall of 2000, we, the students in Mrs. Webster's 9th grade English class at Karns High School, were approached with the opportunity to help write and create an environmental report for the Oak Ridge Reservation (ORR). During the term, scientists and other employees from ORNL and Y-12 donated their valuable time to speak with us and to help us gain a general knowledge about the ORR and its activities. We would like to thank Leah Dever, manager of the U.S. Department of Energy's Oak Ridge Operations Office, who took time out of her demanding schedule to be interviewed and to give us an understanding of her position in Oak Ridge.

As we learned about the ORR's history and current endeavors, we began to understand the purpose for this annual report: to inform the public of the ORR's environmental cleanup projects, the laws that it must comply with, and the effects of radiation dose on residents in the East Tennessee area.

By adding the creative talents of artists and writers at our school, we worked to make this report colorful and appealing to the reader. If our efforts have been successful, this document will be informative and easy to understand and a means for the public to increase its knowledge and understanding of the ORR and its purpose in our lives.

About the cover:

Stewardship of the Oak Ridge Reservation by the Department of Energy is a formidable and challenging responsibility which we undertake with utmost attention and dedication. We shall endeavor always to keep our vision clearly fixed on our obligation and accountability as "Stewards of Tomorrow," so to manage our operations and achieve our many missions for the benefit of all stakeholders while preserving and enhancing the environment.

Cover artwork:
Jessica Heldman, Karns High School student artist.

Layout and design:
Gail S. Sweeden, Computing, Information, and Networking Division, UT-Battelle.

Credits

Seated left to right: Nick Kimber, Crystal Tippens, Ashley Hopper, Whitney Wright, Tara Vanosdale, Megan Haynes, Michelle Cooper, Kelsey Kennedy, Chesney Bowling, and Elisha Hill.

Standing, left to right: Laury Hamilton, Michael White, Ben Ashe, Brandon Fyffe, Jody Phillips, Jonathan Childress, Lynn Teague, Leah Dever, Timothy Joseph, Kerry Brown, Yarrick Kincaid, Chris Collier, Christina Costar, and Jennifer Webster.

Oak Ridge Reservation Annual Site Environmental Report Summary for 1999
on the World Wide Web: **http://www.ornl.gov/aser**

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under Contract No. DE-AC05-98OR22700

background artwork by student artists: Frog – Shaun Languedoc; Turtle – Tiffany Loveday; Dragonfly – Andrew Tessier; and Spear – Billy Owens.

Preface

Oak Ridge Reservation
Annual Site Environmental Report Summary for 1999

October 2000

This report summarizes the information found in the *Oak Ridge Reservation Annual Site Environmental Report for 1999.* The report presents the analysis, results, and interpretation of extensive, ongoing environmental monitoring and surveillance programs in which Department of Energy (DOE) contractors measure tens of thousands of data points in the water, air, soil, and animal life on and around the Oak Ridge Reservation. We monitor the environment for three important reasons.

1. A legacy of contamination exists on and off-site that must be closely watched.
2. Existing operations do produce pollutants that must be measured and controlled.
3. The Department of Energy must monitor and fully understand how all chemical and radiological contaminants move, so that we can be certain no harm is done to the public or the environment.

I consider the Annual Site Environmental Report our most pivotal and useful annual environmental document. The report and this *Summary Report* are public documents and are distributed to government regulators, scientists, engineers, business people, special interest groups, and members of the public. They are available in public reading rooms and libraries and can be easily accessed on the World Wide Web at: **http:/www.ornl.gov/aser/aser.htm.**

It concerns me that the Annual Site Environmental Report is so extensive, technical, and complex, for all stakeholders should have a document that they can understand. Therefore, I have again asked talented, young high school students from Karns High School to produce a Summary Report that is easily read, understood, and meaningful. This is their report. My genuine thanks go out to these students, the art students, and their teachers for their hard work, creativity, and dedication in meeting this challenge.

As the Department of Energy project director for the Annual Site Environmental Report, my foremost goal is to provide you, our stakeholders, with documents of quality, value, and usefulness. If you have any comments or suggestions on how to improve either the Annual Site Environmental Report or this summary report, I invite and welcome your input. If you would like additional copies of either document, please email or call me at: josepht@oro.doe.gov or 865-576-1582.

Timothy Joseph, Ph. D.
Senior Scientist
Annual Site Environmental Report Project Manager
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Contents

background artwork by student artist, Rebecca Ann Bernard

The History of the Department of Energy in Oak Ridge

The Department of Energy Presence in Oak Ridge

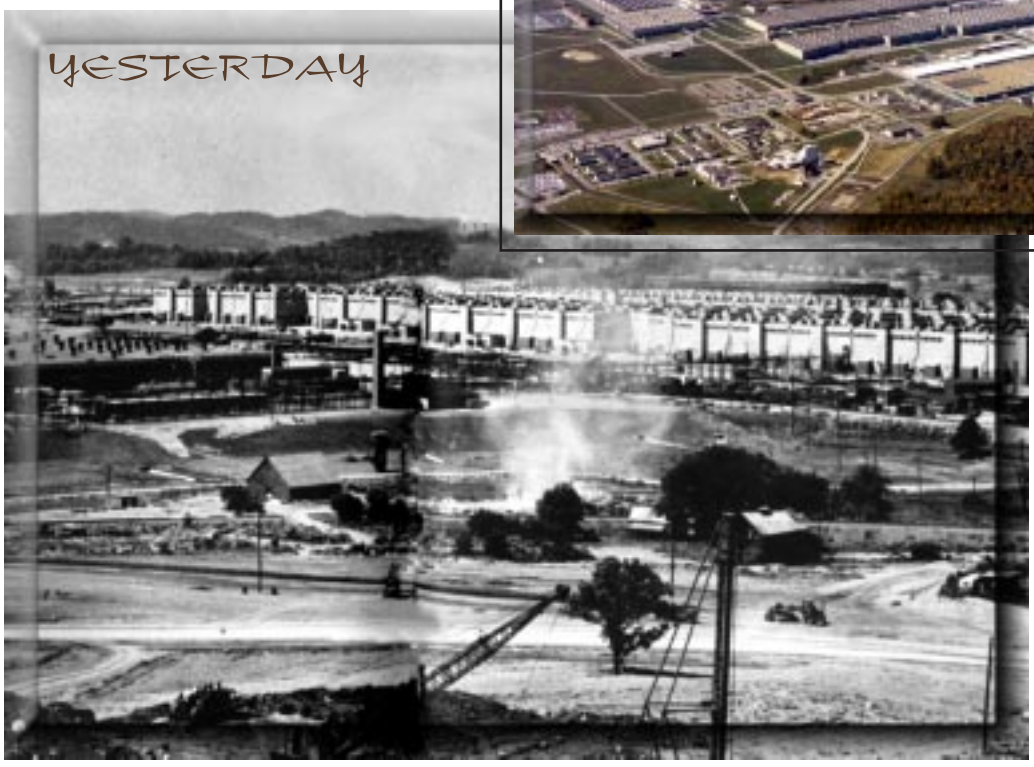
The facilities on the Oak Ridge Reservation began operating in 1943 as part of the Manhattan Project producing components for the first nuclear weapons. The Oak Ridge Reservation remains government-owned, although the nature of the work at the facilities has changed. The Reservation contains three major Department of Energy installations: the Oak Ridge Y-12 Plant, the Oak Ridge National Laboratory, and the East Tennessee Technology Park. The primary missions of the three sites have evolved during the past 57 years and continue to adapt to meet the changing defense, energy, and research needs of the United States.

The Oak Ridge Reservation encompasses about 34,424 acres of mostly contiguous land owned by the Department of Energy in the Oak Ridge area. The majority lies within the corporate limits of the city of Oak Ridge; 608 acres west of the East Tennessee Technology Park lie outside the city limits. The Tennessee Valley Authority's Melton Hill and Watts Bar Reservoirs on the Clinch and Tennessee Rivers form the southern and western boundaries of the reservation.

The population of the 10-county region surrounding the Oak Ridge Reservation is about 810,755 people, with 3.7% of its labor force employed on the Reservation. Other towns in close proximity to the Reservation include Oliver Springs, Clinton, Karns, Lenoir City, Farragut, Kingston, and Harriman. Knoxville, the major metropolitan area nearest Oak Ridge, is located about 25 miles to the east and has a population of about 167,854.

Except for the city of Oak Ridge, the land within 5 miles of the Oak Ridge Reservation is semirural and is used primarily for residences, small farms, and cattle pasture. Fishing, boating, water skiing, and swimming are popular recreational activities in the area.

Aerial view of the K-25 building, 1998.



The K-25 building, "the U," during wartime construction, 1940s.

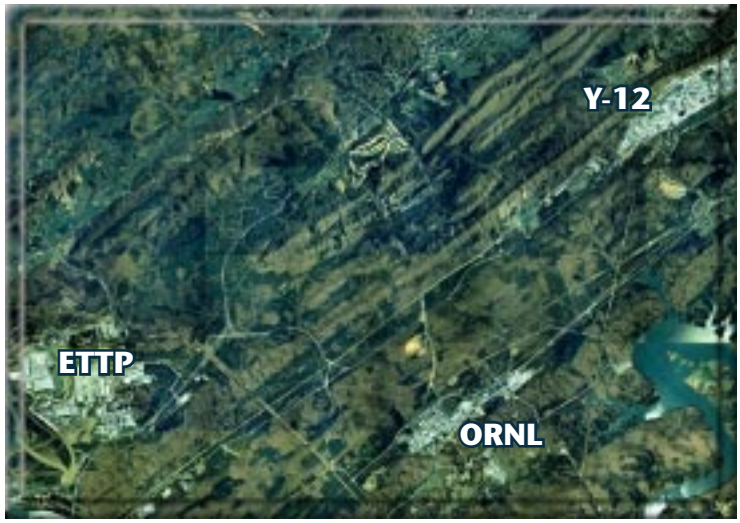
Over 50 years later...

The Oak Ridge Reservation contains three large plant sites:

The East Tennessee Technology Park. Formerly known as the K-25 Site, the East Tennessee Technology Park is the smallest of the three major sites on the Oak Ridge Reservation. In 1943, the plant was established to produce enriched uranium, using the gaseous diffusion process, for the first atomic bombs. Although the plant has many facilities, the main process was carried out in a giant U-shaped building, each side of which is a half mile long. The plant filtered the raw uranium hexafluoride gas through a series of barriers. The Uranium-235 was separated (this is the enriched uranium) and shipped to one of the other labs designated to assist in building the atomic bomb. The remaining isotopes, mostly Uranium-238, were stored in huge cylinders and kept in cylinder yards at the K-25 Site.

After the war, the K-25 Site continued to make enriched uranium for bombs, but it also began to make fuel for nuclear reactors. The plant also was the site of several experimental efforts to enrich uranium by other processes, such as laser enrichment or centrifuge enrichment.

In the 1980s, demand for enriched uranium decreased, so the process at the K-25 Site was shut down. During the 1990s, the K-25 Site was renamed the East Tennessee Technology Park, and the priority for the plant shifted to cleaning up the environment and old buildings for potential industrial reuse.



Aerial view of the East Tennessee Technology Park, Oak Ridge National Laboratory, and the Oak Ridge Y-12 Plant.

Oak Ridge National Laboratory. On first glance, there is little resemblance between the sprawling Oak Ridge National Laboratory of today and the single-mission radiochemical pilot plant of World War II. A closer inspection shows otherwise: An early scientific path led here, then branched this way and that; another converged from over yonder.

The Graphite Reactor showed many uses for nuclear energy, both as a scientific probe and as a pusher of submarines and spinner of turbines. And it led to other research reactors, beyond which awaits the Spallation Neutron Source. But the Graphite Reactor was the trailhead for other paths also, such as explorations of the problems — technological, environmental, and safety — that arose as a whole generation of nuclear reactors began showing their age and imperfection. And the wartime separation of plutonium led to the peacetime extraction of radiochemical exotica and the development of nuclear medicine. So it is with every path the Laboratory treads: It probably came from a patch of familiar scientific ground, and sooner or later it is likely to lead to some other place worth exploring. For the next 50 years, the journey begins with genetic research, protein engineering, advanced materials, environmental science, nuclear safety, fusion research. No one can say where it leads. Hard though it was to see at the time, the Oak Ridge National Laboratory's half-century of exploration has positioned it to head toward precisely these kinds of urgent challenges.

Oak Ridge Y-12 Plant. Since World War II, the number of buildings at Y-12 has doubled. Its mission and capabilities have changed as well. The first site mission was the separation of Uranium-235 from natural uranium by the electromagnetic separation process. The magnetic separators were taken out of commission at the end of 1946, when gaseous diffusion became the accepted process for enriching uranium. For more than 50 years, the plant has been a premier Department of Energy weapons manufacturing facility. Every weapon in the stockpile has some components manufactured at the Y-12 Plant. The plant's work in the Manhattan Project helped produce the first nuclear weapons. Weapon components later produced at the plant helped win the Cold War. Nuclear weapons remain an integral part of national security today. Today, the Department of Energy's Oak Ridge Y-12 Plant is a complex manufacturing facility that stretches over 811 acres. Its 250 buildings contain about 7 million square feet of floor space. (That s the square footage of 150 football fields!)

Compliance Laws and Regulations

The History of the Department of Energy and the Environment

The 40s — In 1943, when construction of the facilities on the Oak Ridge Reservation began, World War II raged across Europe and Asia. Winning the war, not protecting the environment, was the issue of concern. This was the attitude across America as all of industry geared up to produce what was necessary for victory. The military was in control of the facilities, but as the war came to an end in 1945 a new manager for this new nuclear industry was sought. In 1946, the Atomic Energy Act was passed giving the authority and oversight for atomic energy programs to a newly established Atomic Energy Commission.

The 50s — Post-World War II America was a happy time. America was doing very well for itself. No more depression of the 30s, no more war of the 40s. America's warriors had come home to families and jobs. Industry, factories, and production skyrocketed. Housing construction for middle class America during this period gave us the American dream. Resources were unlimited; the environment was indestructible. The nuclear industry was no different, looking for domesticated uses of the many new isotopes being discovered.

The 60s — This decade brought about the realization that we, as the Human Race, could hurt the world around us. Rachael Carson brought to our attention in her book *Silent Spring* that the birds weren't singing in the springtime anymore because the chemical boom of the 50s had killed large numbers of them. In 1965, Congress passed the Solid Waste Disposal Act to get some kind of handle on the large volume of waste produced by industry. America was waking up.

The 70s — America began to listen to the few who preached protecting the environment during the 1960s. Earth Day was established in 1970 to help us all focus on the limited resources and fragile nature of this planet we inhabit. This decade brought us several new environmental regulations and laws to protect the land we live on, the water we drink, and the air we breathe. The Environmental Protection Agency (EPA) was established to enforce these new laws. Environmental interest groups began to form as watch dogs for the newly formed EPA. America's public began to understand the importance of the environment.

The 80s — In 1977, a small community near Niagara Falls, New York, called Love Canal, began to notice chemicals leaking out of the ground into their backyards and playgrounds. This incident drew America's attention to the fact that many of the wastes generated during the 50s and 60s had been buried and left without regard to the harm they later may create for those living on or near the burial sites. Cleanup of these old sites became the focus of this decade. Many of the contaminated sites were found to be government installations, and Congress extended the EPA's authority to other government agencies.

The 90s — The 90s brought other government agencies into the environmental age. For instance, prior to 1989, separate offices within the Department of Energy had responsibility for the cleanup of contamination at these facilities; and cleanup was not always a high priority. In 1989, the Office of Environmental Restoration was created within the newly established Office of Environmental Management to consolidate, centralize, and promote the cleanup of contaminated waste sites and surplus facilities within the Department of Energy Complex. The Department of Energy contracted several private sector companies in the 1990s to clean up its facilities across the nation.

The New Millennium — As America faces a new millennium, it is beginning to realize the importance of keeping the environment in mind when developing new technologies and building new facilities. As Leah Dever, manager of the Oak Ridge Operations, puts it, "When we look to the future and are building new facilities, it is important to build them to state-of-the-art specifications that include pollution prevention and pollution control technology."

- *Clean Air Act*
- *Clean Water Act*
- *Safe Drinking Water Act*
- *National Pollutant Discharge Elimination System*
- *Comprehensive Environmental Response, Compensation, and Liability Act*
- *Federal Facility Compliance Act*
- *Federal Insecticide, Fungicide, and Rodenticide Act*
- *National Environmental Policy Act*
- *National Historical Preservation Act*
- *Resource Conservation and Recovery Act*
- *Toxic Substances Control Act*
- *National Emission Standards for Hazardous Air Pollutants*

background artwork by student artist, Jeanna Riley

1999 Environmental Highlights

Noncompliances or Notices of Violation

- There were no Notices of Violation in calendar year (CY) 1999 for Bechtel Jacobs, LLC, operations in Oak Ridge.
- There were no noncompliances for the Clean Air Act Program.
- During 1999, neither the Y-12 Plant, the Oak Ridge National Laboratory, or the East Tennessee Technology Park staff reported any Comprehensive Environmental Response, Compensation, and Liability Act Reportable Quantity releases to federal and state agencies. The National Response Center and Tennessee Emergency Management Agency were notified of one incident that involved an oil sheen observed on East Fork Poplar Creek from Y-12. Oak Ridge National Laboratory and the East Tennessee Technology Park did not report any oil sheens.
- The Oak Ridge Reservation had no releases subject to the Emergency Planning and Community Right-To-Know Act, Section 304, notification requirements during 1999.
- In 1999, all three Oak Ridge Reservation facilities operated in compliance with the regulatory dose limits and met the emission and test procedures of Tennessee Rule 1200-3-11-.08 (Emission Standards for Hazardous Air Pollutants for Radionuclides.)
- There were 10 Clean Water Act and/or National Pollutant Discharge Elimination System noncompliances at the East Tennessee Technology Park in 1999. Investigations of the noncompliances did not reveal any significant impacts to the environment.
- The Oak Ridge National Laboratory received a Notice of Violation in 1999 for two National Pollutant Discharge Elimination System permit limit excursions. The Oak Ridge National Laboratory provided a response to the Tennessee Department of Environment and Conservation describing corrective actions for the excursions cited in the Notice of Violation. No fines or penalties were assessed by the Tennessee Department of Environment and Conservation.
- The Y-12 Plant received two Notices of Violation in 1999 for National Pollutant Discharge Elimination System chlorine permit limit excursions in October and December of 1998 and an inability to meet minimum flow requirements in East Fork Poplar Creek in October 1998. Actions were taken at the time of the excursions to correct the problem. No fines or penalties were assessed by the Tennessee Department of Environment and Conservation.

Special Monitoring

- The Clean Air Act program conducted special ambient air monitoring for metals in support of the Governor's Blue Ribbon Panel Investigation. The monitoring did not find any conditions out of the ordinary.
- A study was initiated in CY 1999 to evaluate the performance of state-of-the-art particulate matter continuous emission monitors for the TSCA Incinerator to determine whether state-of-the-art monitors could meet applicable performance specifications on the TSCA Incinerator Stack. Of particular interest is the high volume of moisture contained in the incinerator's off-gases, which has presented significant challenges to continuous emission monitors implemented or tested at the incinerator in the past. The study will support decision making on the selection of appropriate particulate matter continuous emission monitors for permanent deployment at the TSCA Incinerator. The results of the study will be submitted to the Environmental Protection Agency for evaluation.

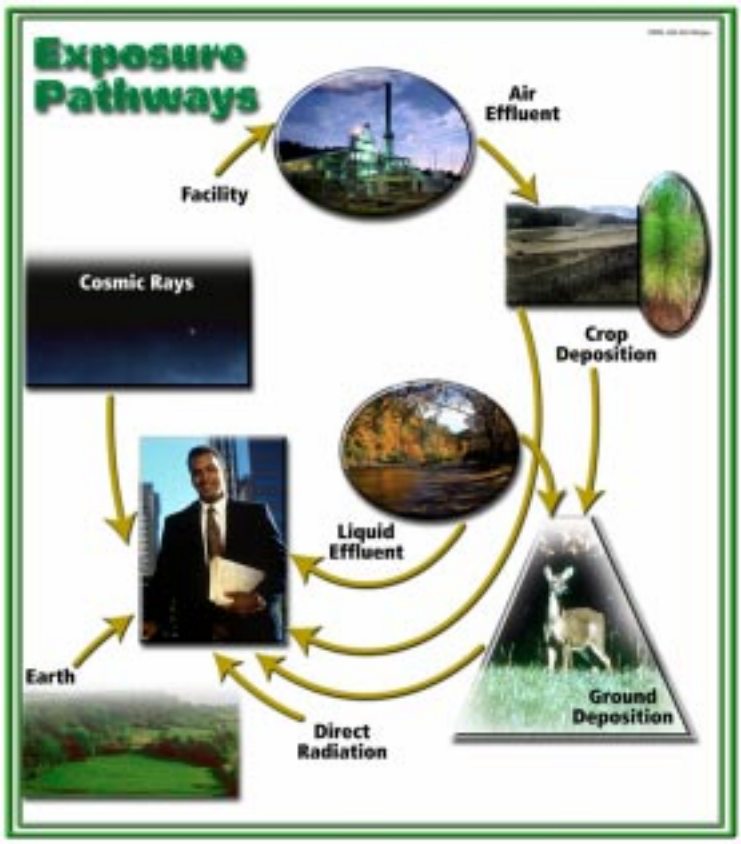
Radiation... What Is It?

It comes from outer space, the ground, and even from within our own bodies. Radiation is all around us and has been present since the birth of this planet. It is found in the food we eat, and even our own bodies give off some radiation. Naturally occurring radioactive materials were discovered in 1896. Less than 50 years later, the physicist Enrico Fermi split the atom, producing the first sustainable nuclear chain reaction. Today, both man-made and natural radiation are part of our lives. We use radioactive materials for beneficial purposes, such as generating electricity and diagnosing and treating medical problems. For example, Americans receive 200 million X-rays every year. Though radiation offers many benefits, exposure to it can also threaten our health and the quality of our environment. We cannot eliminate radiation from our environment. We can, however, reduce our risks by controlling our exposure to it.

Atoms are the microscopic building blocks that make up everything around us. Some atoms are unstable or somehow become unstable, and these atoms give off energy in the form of radiation. There are different types of radiation, some more energetic than others. One type of radiation, non-ionizing radiation, has enough energy to move atoms, but not enough to alter them chemically.

We measure radiation dose in units called rem (small doses are measured in millirem; one rem = 1,000 millirem). Scientists estimate that the average person in the United States receives a dose of about 360 millirem of radiation per year. Eighty percent of that exposure comes from natural sources: radon gas, the human body, outer space, and rocks and soil. The remaining 20 percent comes from man-made radiation sources, primarily medical X-rays.

Radiation is a carcinogen. In this respect, it is similar to many hazardous chemicals found in the environment that can cause cancer. It may also cause other adverse health effects, including genetic defects in the children of exposed parents or mental retardation in the children of mothers exposed during pregnancy. However, the risk of developing cancer due to radiation exposure is much higher than the risk of these other effects. Much of our knowledge about the risks from radiation is based on studies of over



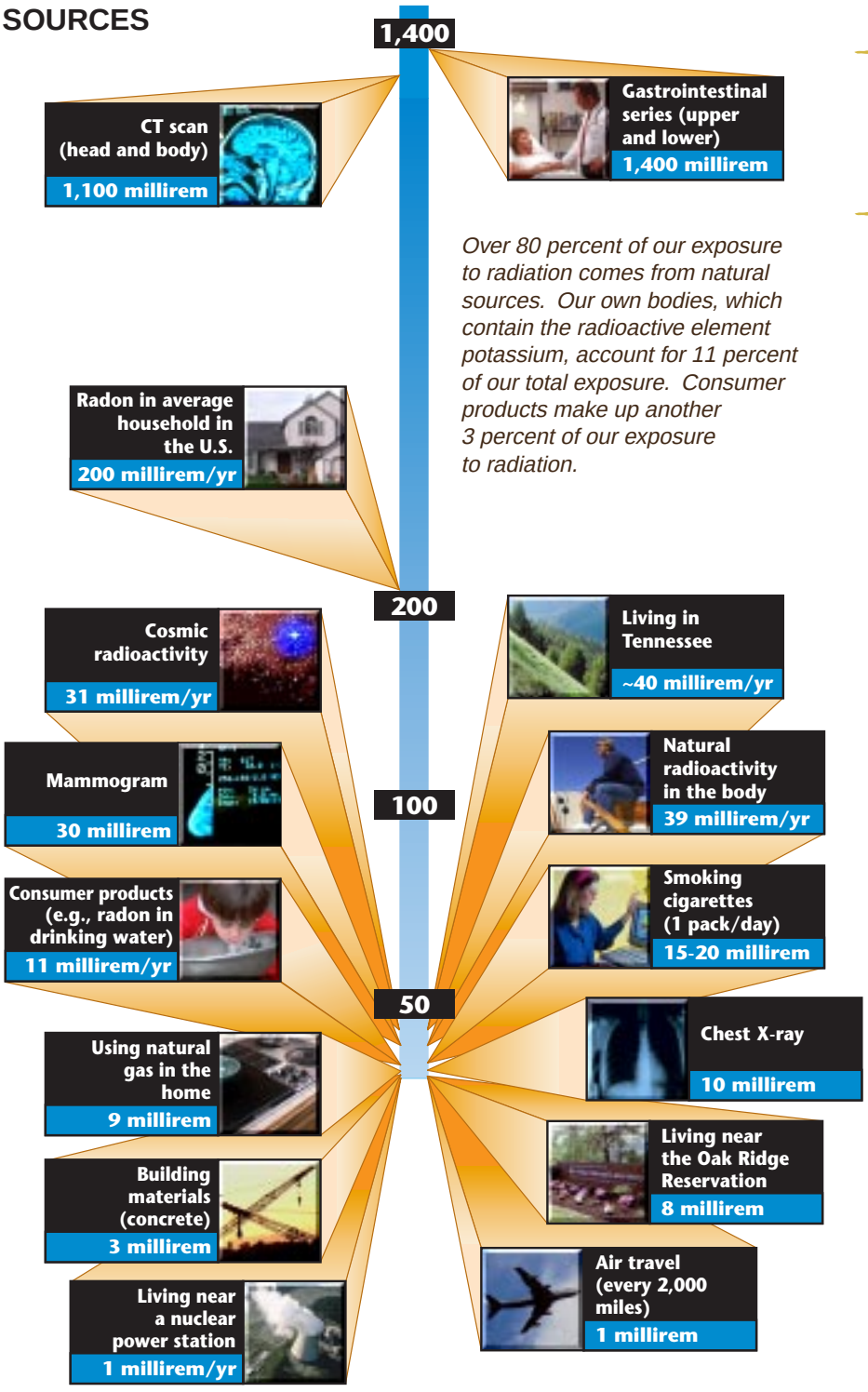
We can receive internal or external exposure to chemicals, radioactive materials, and radiation by way of a number of pathways. We receive radiation directly from cosmic radiation and from particles embedded in soil and suspended in air and water. We can breathe air or drink water that have both chemical and radiological contaminants suspended in them. In addition, airborne contaminants that settle on grass in pastures and hayfields can be eaten by cows, and the contaminants can show up in the milk we drink. Similarly, contaminants can be retained in fish and game animals.

100,000 survivors of the atomic bombs at Hiroshima and Nagasaki. In these studies, which have continued over the last 40 years, scientists have been able to observe the effects of a wide range of radiation doses, including doses comparable to an average person's lifetime dose from naturally occurring background radiation (about 20,000 millirem). We have learned many things from these studies. The most important are:

- The higher the radiation dose a person receives, the greater the chance of developing cancer.
- It is the chance of cancer occurring, not the kind or severity of cancer, that increases as the radiation dose increases.
- Most cancers do not appear until many years after the radiation dose is received (typically 10 to 40 years).

Current evidence suggests that any exposure to radiation poses some risk (i.e., there is no level below which we can say an exposure poses no risk). For the entire dose of radiation we accumulate over a lifetime from natural background radiation, the risk of developing cancer is estimated to be about one in one hundred. Based on this estimate, several percent of all fatal cancers in the U.S. are caused by background radiation. The additional contribution from all man-made sources of radiation is much smaller.

RELATIVE DOSES FROM RADIATION SOURCES



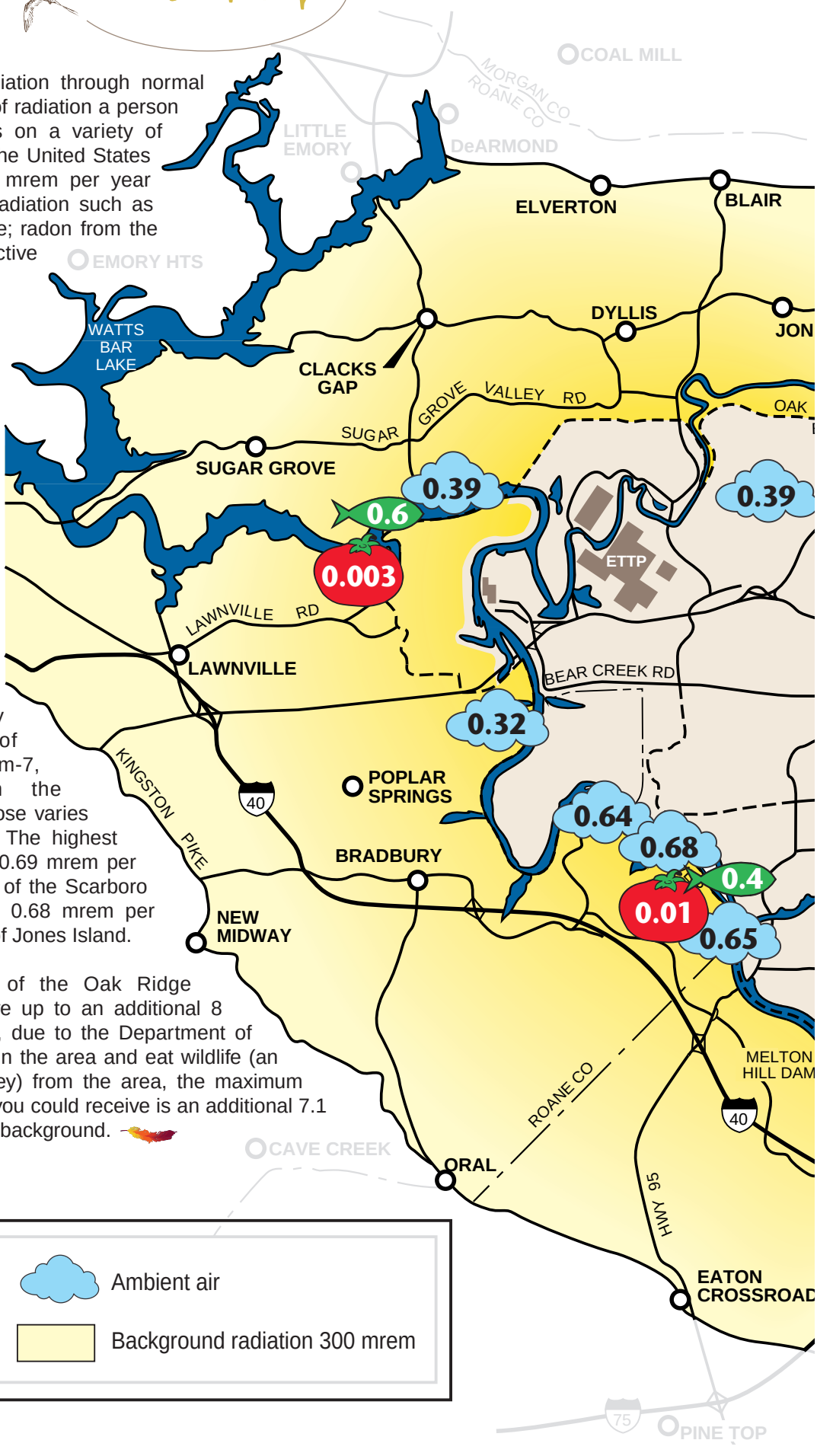
The average annual radiation exposure for a person living in the U.S.A. is 360 millirem.

Dose Map

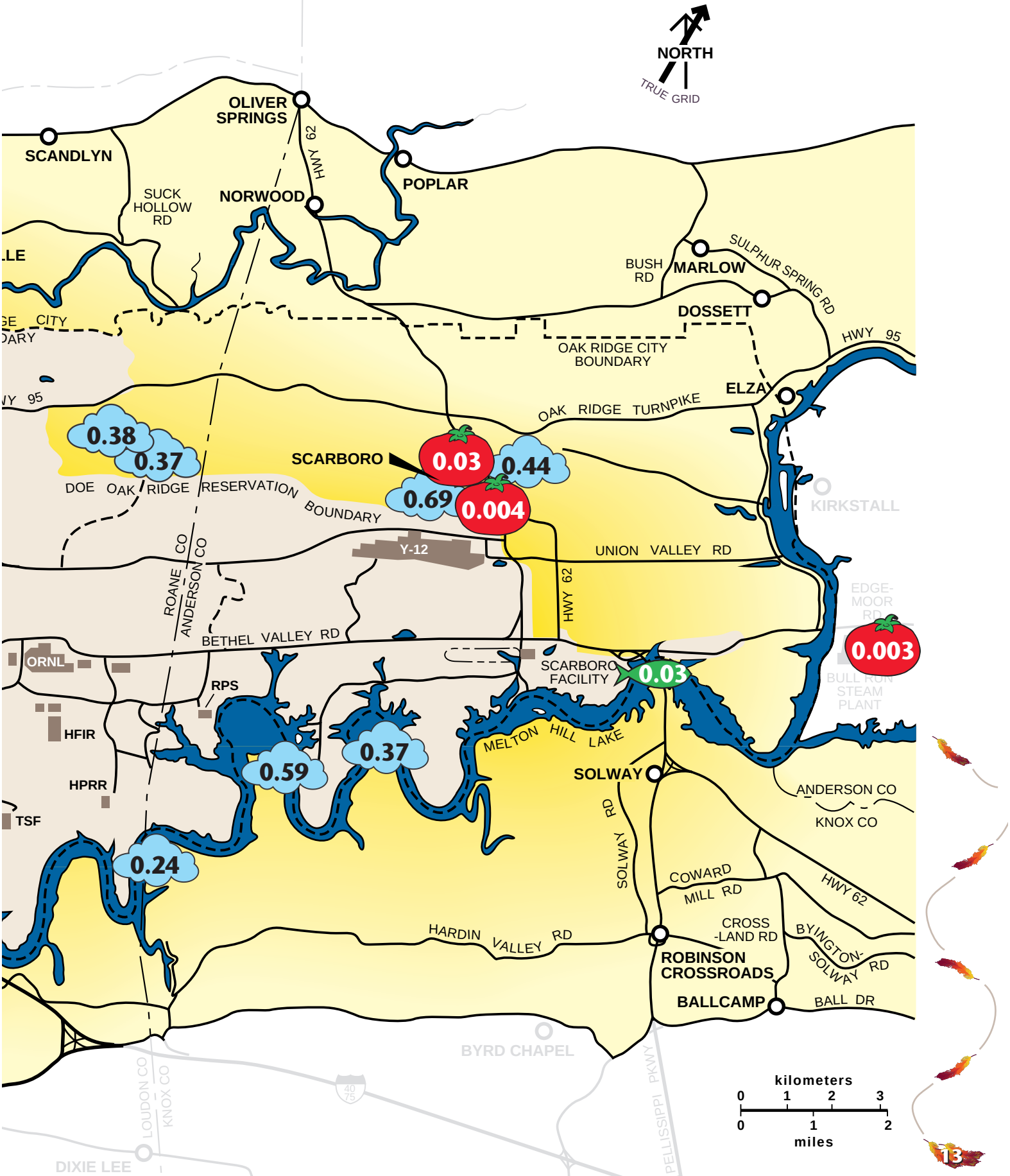
Everyone is exposed to radiation through normal daily activities. The amount of radiation a person receives in a year depends on a variety of factors. A typical person in the United States receives approximately 300 mrem per year from all natural sources of radiation such as cosmic rays from outer space; radon from the ground; and natural radioactive elements found in soil, water, and food. Approximately another 40 to 60 mrem per year come from man-made sources such as medical and dental exams (i.e., X-rays), air travel, and consumer products (i.e., wrist watches and smoke detectors).

The map on this page shows the Department of Energy's possible contribution to the radiation dose that a person could receive from breathing the air and eating large quantities of local crops and fish. It does not include contributions from naturally occuring isotopes of Potassium-40 and Beryllium-7, which are common in the environment. The radiation dose varies depending on the location. The highest dose from breathing the air, 0.69 mrem per year, would be in the vicinity of the Scarboro community. A similar dose, 0.68 mrem per year, would be in the vicinity of Jones Island.

If you live in the vicinity of the Oak Ridge Reservation, you may receive up to an additional 8 mrem, or 3% of background, due to the Department of Energy activities. If you live in the area and eat wildlife (an entire deer, goose, and turkey) from the area, the maximum possible amount of radiation you could receive is an additional 7.1 mrem, or about 2% of natural background.



Legend (all units are in mrem)


NORTH
TRUE GRID
OLIVER SPRINGS
SCANDLYN
HWY 62
SUCK HOLLOW RD
NORWOOD
POPLAR
BUSH RD
MARLOW
SULPHUR SPRING RD
DOSSETT
HWY 95
OAK RIDGE CITY BOUNDARY
ELZA
OAK RIDGE TURNPIKE
0.38
0.37
SCARBORO
0.03
0.44
0.69
0.004
DOE OAK RIDGE RESERVATION BOUNDARY
KIRKSTALL
Y-12
UNION VALLEY RD
ROANE CO
ANDERSON CO
HWY 62
EDGE-MOOR RD
0.003
BETHEL VALLEY RD
ORNL
SCARBORO FACILITY
0.03
BULL RUN STEAM PLANT
RPS
HFIR
MELTON HILL LAKE
0.59
0.37
SOLWAY
HPRR
ANDERSON CO
KNOX CO
TSF
SOLWAY RD
0.24
COWARD MILL RD
HWY 62
CROSS-LAND RD
BYINGTON-SOLWAY RD
HARDIN VALLEY RD
ROBINSON CROSSROADS
BALLCAMP
BALL DR
BYRD CHAPEL
LOUDON CO
KNOX CO
PELLISSIPPI PKWY
DIXIE LEE JUNCTION
kilometers
0 1 2 3
0 1 2
miles

Environmental Monitoring

Information from the Oak Ridge Reservation environmental monitoring programs is used to show compliance with applicable environmental laws, regulations, and Department of Energy requirements, and to identify trends, inform the public, and contribute to general environmental awareness. Discharges into the air and water are measured at the point of discharge; this is called effluent monitoring. Concentrations of contaminants also are measured in environmental media (i.e., fish, water, air, vegetables, and wildlife); this is called surveillance monitoring. The data gathered help to determine the effect of operations at the Department of Energy facilities on the public and environment. This information also can be used to help reduce or eliminate future releases of radioactive and hazardous materials. A lot of the information gathered during specific monitoring programs is published in routine reports to local, state, and federal agencies and to the public. The surveillance data are measurements of what is found in the environment regardless of origin (natural, residential, industrial, or Oak Ridge Reservation operation).

Air

Air, a primary exposure pathway, is sampled at the point of discharge from the stacks; this is known as effluent sampling. Airborne discharges from Department of Energy Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulations. Radioactive emissions are regulated by the Environmental Protection Agency (under the National Emission Standards for Hazardous Air Pollutants) and the rules of the Tennessee Department of Environment and Conservation's Division of Air Pollution Control. Nonradioactive emissions are regulated by the Tennessee Department of Environment and Conservation's Division of Air Pollution Control. There are more than 400 emission sources on the Oak Ridge Reservation, covered by approximately 70 active air permits, that have the potential to discharge pollution into the air.

TSCA Incinerator

Continuous sampling for radionuclide emissions is conducted at the East Tennessee Technology Park's TSCA Incinerator and the K-33 Decontamination Room, major sources at Oak Ridge National Laboratory, and exhaust stacks serving the uranium-processing areas at the Y-12 Plant. Other approved sampling methods and estimation techniques were used on the remaining minor emission points to calculate the radioactive emissions and approximate off-site dose.

The 1999 air emissions were below the permit limits on all permitted air sources. Airborne radioactive releases from the Reservation were well below the 10-millirem dose standard issued by the Environmental Protection Agency. The effective dose equivalent to the most exposed member of the public was 0.69 millirem per year in 1999. In other words, no single person should have received a radiation exposure from the Department of Energy activities greater than 0.69 millirem from the air pathway in the surrounding communities.

In addition to effluent air sampling, the natural air in the environment is sampled. This is called ambient air. The ambient air is sampled by using continuous high-volume samplers located around the perimeter of the Oak Ridge Reservation. There are eight locations around the Reservation and one background location at Fort Loudoun Dam. The purpose of the background location is to provide information on an area too far away to be affected by activities on the Oak Ridge Reservation. The results from the 1999 sampling activities indicate that there is not a statistically significant difference between the concentrations of radionuclides found in the background ambient air and Oak Ridge Reservation sampling locations. Potential doses range from 0.1 and 0.2 millirem on the Reservation perimeter, depending on the location, and 0.2 millirem at the background location.

Direct Radiation

External gamma radiation monitoring is conducted to determine whether Oak Ridge Reservation operations are increasing external radiation levels significantly above normal background levels. The data also provide a means for comparing results from year to year and establishing trends. The average external exposure rates from background sources in the state of Tennessee was approximately 6.4 μR/Hour with a corresponding effective dose equivalent rate of 42 millirem per year. The average exposure rate around

the Oak Ridge Reservation during 1999 was about 5.2 µR/Hour, or a corresponding effective dose equivalent rate of 36 millirem per year with the exception of two locations. The exceptions are a stretch of riverbank along the Clinch River (site of former cesium experiments) and a section of Poplar Creek that flows through the East Tennessee Technology Park near a storage area of uranium hexafluoride cylinders.

Surface Water

Water is another one of the primary pathways for contaminants to move from the Oak Ridge Reservation into public or private areas. Water from Department of Energy facilities that is directly discharged into lakes and streams is called effluent discharges. These effluent discharges are regulated by the Tennessee Department of Environment and Conservation under the National Pollutant Discharge Elimination System Program. Each of the three major sites has its own distinct permit for water discharges. Each permit identifies specific discharge limits for various contaminants, including oil and grease, chlorine, metals, volatile organic compounds, polychlorinated biphenyls, and others. During 1999, the permit requirements for all three sites, were met over 99% of the time.

Out in the environment, surface water samples were collected in streams, reservoirs, and public water intakes on and around the Reservation. All locations in the Reservation Surface Water Monitoring Program were checked for dissolved oxygen, pH, and temperature. A laboratory screening for radioactivity was performed on all samples. Radionuclides were detected at all locations where samples were collected except one, Walker Branch prior to entering the Clinch River. Three of the Reservation locations were tested for metals, one upstream and two downstream of any discharges from the Oak Ridge Reservation. Aluminum concentrations resulted in hazard quotients equal to or greater than one in all three of these locations. Iron concentrations in one of the downstream locations resulted in a hazard quotient greater than one. It is desired that hazard quotients stay below one. In addition to the Reservation Program, each site has a site-specific surface water monitoring program.

Surface water samples are collected in streams, reservoirs, and public water intakes

Average annual concentrations of radionuclides in water samples at the East Tennessee Technology Park (Gallaher) Water Plant were used to calculate potential individual doses from drinking water. A worker who drank 370 liters (98 gallons, or half of the worker's total annual intake) of East Tennessee Technology Park water during 1999 could have received a dose of about 0.6 mrem; a person who drank a greater amount of water from the Kingston Municipal Water Plant (730 liters, or 193 gallons) could have received a dose of about 0.2 mrem.

The maximum annual radiological dose associated with water exposure routes other than drinking water or eating fish was calculated to be 0.01 mrem, which is attributed to boating, swimming, and shoreline use.

Groundwater

Most residents in the Oak Ridge area do not rely on groundwater for domestic uses such as drinking water. Local groundwater provides for some domestic, municipal, farm irrigation, and industrial uses, however, and must be viewed as a potential pathway for exposure to hazardous wastes and as a means of contaminant transport. Groundwater monitoring programs on the Oak Ridge Reservation are guided by and comply with Environmental Protection Agency regulations that target protection of groundwater from contamination by hazardous wastes. Groundwater is monitored for volatile organic compounds, trace metals, major ions (electrically charged atoms and molecules), specific radionuclides, and general levels of radioactivity.

To assess the extent to which the groundwater from the Oak Ridge Reservation is transporting contaminants, data on water quality of springs, seeps, and surface water are used, along with sampling data from plant perimeter groundwater monitoring stations. This information is used to assess potential migration of contaminants beyond the boundary of the Oak Ridge Reservation.

The primary groundwater contaminants on the Oak Ridge Reservation are nitrates, volatile organic compounds, trace metals, and radionuclides. Most of this contamination is from former waste disposal sites, which are the subject of ongoing remediation, or from past projects no longer in operation. Results at the Y-12 Plant have not changed since 1995 and indicate that groundwater containing volatile organic compounds has migrated eastward across Scarboro Road and into Union Valley. There are no users of

groundwater in the affected area; nevertheless, administrative controls restricting future groundwater use have been established.

In September 1999, five new sampling locations were established north and northwest of the Y-12 Plant to evaluate possible contaminant transport from the Oak Ridge Reservation. These locations were monitored due to recent concerns regarding potential health impacts to nearby residences from Y-12 Plant operations. Three of the stations monitored tributaries draining the north slope of Pine Ridge on the Oak Ridge Reservation and discharging into the adjacent Scarboro Community. The remaining two locations monitored Gum Hollow Branch where it discharges from the Reservation and the area adjacent to the Country Club Estates Community. Samples were obtained and analyzed for metals, inorganics, volatile organics, and gross alpha and gross beta activities. There were no results that exceeded drinking water standards, nor were there any indications that contaminants were being discharged from the Reservation into these communities.

Hay

Hay is cut from six areas on the Oak Ridge Reservation and sold to area farmers for fodder. This makes hay another pathway for contamination to reach the public. An additional area outside the influence of Oak Ridge Operations is used as a background location.

The maximum dose (effective dose equivalent) to a person eating beef and drinking milk from the cattle that ate hay gathered from the Oak Ridge Reservation was about 0.02 millirem. This is less than 1% of the dose caused by naturally occurring radionuclides in all milk and beef.

Vegetables

The consumption of locally grown food crops is an example of another pathway that contamination from the Oak Ridge Reservation can be introduced to the public. Therefore, samples of tomatoes, lettuce, turnip greens, and turnips were collected from local farms near the Oak Ridge Reservation to determine the effect of Oak Ridge Operations on this pathway. These vegetables are representative of fruit-bearing, leafy, and root vegetable types.

The samples were found to contain small quantities of cesium, cobalt, and naturally occurring isotopes of potassium and beryllium. A person receiving the maximum potential dose from all three types of produce could have received an effective dose equivalent of about 0.04 millirem from radionuclides that could have been released from the Oak Ridge Reservation. This is less than 1% of the dose attributed to the naturally occurring radionuclides beryllium and potassium, which are found naturally in food crops.

Milk

A program has been established to collect milk from local dairy cows and have it analyzed for various radionuclides, including tritium, strontium, and iodine. The milk was collected at three locations near the Oak Ridge Reservation.

The samples were found to contain small quantities of radio-strontium, Iodine-131, tritium, and naturally occurring isotopes of potassium. The potential dose an individual could receive if he or she drank 310 liters of milk in a year was between 0.05 and 0.07 millirem from radionuclides that could have been emitted from the Oak Ridge Reservation. This is less than 1% of the dose attributed to naturally occurring radionuclides, beryllium and potassium, which are found naturally in milk.

Fish

Members of the public potentially could be exposed to contaminants originating from Department of Energy Oak Ridge Operation activities through consumption of fish caught in area waters. This

exposure pathway is monitored by collecting fish from three river locations and analyzing edible fish flesh for selected metals, pesticides, polychlorinated biphenyls, tritium, gross alpha, gross beta, gamma-emitting radionuclides, and total radioactive strontium.

Most nonradiological contaminants were undetected. Polychlorinated biphenyls and mercury had reporting values below the U. S. Food and Drug Administration's action level. An avid fish eater is assumed to consume 21 kilograms of fish a year. Given this assumption, an avid fish eater in 1999 could have received an effective dose equivalent of 0.03 mrem from eating fish caught from the Clinch River upstream from all Oak Ridge Reservation inputs. An avid fish eater in 1999 could have received an effective dose equivalent of 0.4 mrem from eating fish caught from the Clinch River downstream of the Oak Ridge National Laboratory, and an effective dose equivalent of 0.6 mrem from eating fish caught from the Clinch River downstream from all Department of Energy's Oak Ridge Reservation inputs.

White-Tailed Deer

In the fall 1999, the Tennessee Wildlife Resources Agency, held the 15th annual deer hunts on the Oak Ridge Reservation. A total of 349 deer were harvested. Out of the 349, four deer (approximately 1%) were confiscated because they exceeded the Department of Energy's Oak Ridge Operations established release limits. The deer were found to contain Cesium-137 and Strontium-90. The estimated maximum dose based on the consumption of the entire edible portions of the deer by a single individual was estimated to be 6.4 mrem.

Eastern Wild Turkeys

On the Oak Ridge Reservation in 1999, sixty-one wild turkeys were harvested. None were confiscated because of above-limit radioactivity levels. The average weight of the turkeys was 8.3 kg (18.2 lbs).

Canada Geese

Canada geese were rounded up and screened for radioactive contamination. The areas in which the geese were gathered were selected because they were located near known contamination sources. The total number of geese collected, weighed, and subjected to a whole-body gamma scan was 134; none exceeded the administrative limit.

Because of the unusually high number of geese retained from the west end of the Oak Ridge National Laboratory in 1998, four of the 28 geese collected from this area in 1999 were sacrificed and tissue samples were collected.

It is possible that one person could eat more than one goose that spent time on the Oak Ridge Reservation. Most hunters harvest an average one to two geese per hunting season. If one person consumed two hypothetical geese of maximum weight with the highest measured concentration of Cesium-137, that person could have received an effective dose equivalent of about 0.6 mrem.

Environmental Management Program Community and Reservation Activities

For over fifty years, one of the primary missions of the Department of Energy and its previous agencies was to produce nuclear weapons for the Nation's defense systems. Beginning in 1943, the production of materials for nuclear weapons produced harmful and hazardous radioactive waste, which contaminated facilities, structures, and environmental media. Congress passed two laws to address these problems: the Federal Facility Compliance Act, which requires that all federal facilities manage and dispose of waste in accordance with their respective site treatment plans, and the Comprehensive Environmental Response, Compensation and Liability Act, which addresses any environmental contamination resulting from past industrial operations, not strictly those performed at federal facilities. The Comprehensive Environmental Response, Compensation and Liability Act also requires that sites requiring cleanup actions be placed on the National Priorities List, and requires public involvement to ensure that citizens will be informed of cleanup decisions that may affect them or the areas in which they live.

Legacy Waste

In 1999, all site treatment plan milestones were met on schedule and within the budget. Significant contributions to this accomplishment included disposing of fire-slump sludge at the Envirocare facility in Utah; completing relocation of the Toxic Substance Control Act repackaging operation; and disposing of 172 cubic meters of low level waste, including 5.9 cubic meters of liquid fissile waste.

Transuranic Waste

The Transuranic Waste Program consists of designing and building a treatment facility for transuranic waste and preparing all documents and permits required by environmental regulations. In 1999, the permitting process was completed with the issuance of a Resource Conservation and Recovery Act permit and air and storm water permits.

WASTE OPERATIONS

The Waste Operations Program consists of operating and maintaining several facilities throughout the Oak Ridge Reservation that treat, store, dispose of, or recycle waste generated from any of the ongoing Department of Energy facility operations.

Y-12

Facilities operated and maintained at Y-12 by the Waste Operations Program include the West End Treatment Facility, the Groundwater Treatment Facility, the Uranium Chip Oxidation Facility, the Central Pollution Control Facility, two industrial landfills, and four construction and demolition landfills. The Central Pollution Control Facility met a site treatment plan requirement to treat 237,000 gallons of wastewater. The Y-12 Waste Operations Program has increased construction landfill capacity by 469,000 cubic yards.

Oak Ridge National Laboratory Waste Operations

An example of a waste operations facility at the Oak Ridge National Laboratory is the Process Wastewater Treatment Facility. This facility supports both environmental management projects and ongoing research and development activities at the Oak Ridge National Laboratory.

East Tennessee Technology Park Waste Operations

Waste operations at East Tennessee Technology Park include the Toxic Substances Control Act Incinerator, the Central Neutralization Facility, and the Filter Test Facility. These facilities are operated in accordance with all applicable permit requirements and environmental regulations.

REMEDIATION EFFORTS

Y-12

In 1999, removal action construction was started to capture and treat contaminated groundwater from the Bear Creek Valley S-3 Ponds. This included mobilization; trench excavation; 750 feet of interceptor drainage line installation; backfill, treatment system, and, drain field installation; and system hookup.

Agreement was reached among the Tennessee Department of Environment and Conservation, the Environmental Protection Agency, and the Department of Energy on the Upper East Fork Poplar Creek Watershed Record of Decision proposed interim goals for groundwater and surface water and the long-term goal for soil.

Also in 1999, the Removal Action Report for the Upper East Fork Poplar Creek Firing Range was published, the Basin 9822 Clean Out Project was completed, and the project team to reduce mercury in plant effluents hosted a Mercury Forum. The Reduction in Mercury in Plant Effluents Project achieved a record low mercury concentration in August of 1999 at Station 17. The average mercury concentration at Station 17 for August of 1999 was 320 parts per trillion.

Oak Ridge National Laboratory

In 1999, an action memorandum that included grouting of the five Old Hydrofracture Facility tanks and stabilization of the impoundment was issued, and a Removal Action Work Plan was submitted to the regulators.

Six of the eight gunite and associated tanks were successfully cleaned in 1999. Approximately 300,000 gallons of slurry was transferred to the active low level liquid waste system for future treatment. A proposal was made to regulators to use supernate returned from the active system, rather than clean water, to slurry the sludge in the remaining tanks. This change in operation is expected to reduce waste generation by approximately 100,000 gallons.

An action memorandum was approved for removal of waste from 11 inactive low level liquid waste tanks and was subsequently modified to include the remaining 16 inactive tanks. A Removal Action Work Plan for the 11 tanks was approved with an addendum to include the remaining 16 tanks submitted to the regulators. The addendum is awaiting regulator approval. Remediation of these 27 tanks will complete the inactive tanks remediation project.

Regulators approved a Removal Action Work Plan for the removal of Tank W-1A and surrounding soil in March of 1999. Field work for the removal of this tank began in August of 1999 and revealed that more blending than was originally assumed may be needed to meet the waste acceptance criteria for cesium required by Envirocare of Utah, the selected disposal facility. Removal of the tank will begin in 2000.

A Removal Action Work Plan for the removal of uranium deposits from the Molten Salt Reactor charcoal bed was approved in 1999. Examination of the charcoal revealed that it is nongranular rather than granular. This required a revised Removal Action Work Plan, which was being developed at the end of 1999. The regulators approved a Remedial Design Report/Remedial Action Work Plan for the removal of fuel and flush salts in 1999.

East Tennessee Technology Park

Other remediation efforts are ongoing. In 1999, most of the remediation efforts at the East Tennessee Technology Park were centered on cleaning contaminated buildings and preparing them for reuse or demolition. British Nuclear Fuels is engaged in decontaminating two of the largest buildings on the site; K-31 and K-33. In addition, Decon and Recovery Services is decontaminating K-1420. The K-1421 and K-1422 Buildings were decontaminated and demolished as part of this effort. Resource Conservation and Recovery Act closure of the K-1417-B Drum Storage Yard was completed. The K-1071 concrete pad, which had been used for compaction of waste drums before burial, was capped. The Mitchell Branch Plume Removal Action trench was optimized to increase the efficiency of the pumping operations.

Site Specific Advisory Board

In 1999 the Site Specific Advisory Board continued to advise the Department of Energy on issues dealing with environmental management, like long-term stewardship, environmental sampling, waste transportation and waste management. Throughout the year regular board meetings, as well as topic-specific meetings were held, all of which were open to the public. Further, Site Specific Advisory Board information including meeting schedules, membership, and recommendations to the Department of Energy is available on the World Wide Web at www.oakridge.doe.gov/em/ssab. Major highlights and accomplishments are also available to the public in the *Oak Ridge Site Specific Advisory Board 1999 Annual Report.*

Interview with the Oak Ridge Operations Manager

Leah Dever, Manager, Oak Ridge Operations

It was indeed a delight to visit Karns High School to meet with the talented students that worked so hard in putting together this summary document, and to answer questions from them and from other stakeholders they talked with during their survey. "Stewards of Tomorrow," the theme for this 1999 Annual Site Environmental Report, underscores my responsibility as Manager, and the Department of Energy Steward, to never lose sight of how the Department of Energy decisions can impact the health of the environment and public. I endorse this theme. And let me assure you that it will remain the vanguard of all my decisions. I look forward to working with all stakeholders to accomplish our many missions and challenges. If I may repeat what I said last year, I'm certain that by maintaining a positive spirit we can and will move forward together and accomplish these difficult tasks. I appreciate the alliance we share. Leah Dever

What part can the public play to help Oak Ridge maintain a healthy environment for the years to come?

The public plays a really important role. I feel that if the public can get involved in what we're doing, it really helps us do our jobs better. We are fairly active in our cleanup work with the public. We have held several public meetings where the public comes and gives us the benefit of their ideas and input. They provide a different perspective, which helps us understand how we might do a better job cleaning up things. Again I would stress that the public take advantage of the public meetings to convey their thoughts and ideas. Their input is very important to us.

During the course of the surveys that were conducted, I found that the public is not convinced that Oak Ridge is taking all the measures necessary to protect the environment from the work that is being conducted. How would you respond to that?

I believe that the public has the right to have that concern. Again, it goes back to getting involved and staying involved in the Department of Energy activities. The public needs to stay informed and this is accomplished by attending the Department of Energy public meetings.

Many people misunderstand the work that occurs at the Oak Ridge facilities. What would you say to help them better understand the activities that are conducted in Oak Ridge?

Get interested and learn. We try to get as much information as possible in the newspapers, so read your local newspapers. Watch the news and attend public meetings. I'm trying to encourage my staff to make more information available to the public so they can become more knowledgeable. We have meetings where we listen to the public and each other's points of view. Once the public has learned enough, they can give us input.

In your opinion, is the general public given enough information concerning Oak Ridge's impact on the environment?

Probably not enough information is being distributed. We still have many opportunities where we could share more information with the public. In our environmental restoration work, we get many of our studies out for the public to read. Still, we have a long way to go.

Currently, what steps are being taken to prevent further contamination of the environment?

We have many environmental cleanup projects in which we are trying to clean the source of the contamination. One example is the gunite tanks located at the Oak Ridge National Laboratory. The underground tanks held old legacy waste containing radioactive material. Through the remediation process the Department of Energy has succeeded in finishing the project; the tanks have been cleaned up, the waste solidified and the radioactive material shipped off-site for long term storage. Now that the contaminated material has been removed, it cannot cause further contamination.

In the near future, we will be demolishing some buildings on the East Tennessee Technology Park Site. These buildings are sources of radioactive contamination and polychlorinated biphenyls (PCBs) containing oils. These contaminants are leaking from the buildings, and if we can get rid of those buildings, that will halt much of that contamination. When we look to the future and are building new facilities, it is important to build them to state-of-the-art specifications that include pollution prevention and pollution control technology.

What is the single most important thing you do to help the environment?

If I had to pick one thing I would say that managing this huge site is the single most important thing I can do to protect the environment. I have thousands of people doing different jobs, and I have to trust them and communicate with them so that they know I want them to work in a safe way that protects the environment. More specifically, for me, it is going to the public meetings, reading the letters the public writes us, and trying to incorporate those issues into the decisions that we are making.

How is the wildlife affected by the burial of toxic wastes?

Wildlife can get contaminated by eating vegetation in contaminated areas on the reservation. That is why when we have public turkey and deer hunts on the reservation, we check the animals for radioactive contamination before they are released to the hunter. During the 1999 hunts, all turkeys passed inspections and three to four deer had contamination levels too high, and we felt they should not be released.

What water contaminants have been found in samples taken on the reservation?

We have found small amounts of various radionuclides including uranium, cesium, strontium, and cobalt. In addition to radionuclides, chemical contaminants have also been found such as mercury, polychlorinated biphenyls, and chlorine. We have found that the chlorine used to treat the water can be harmful to aquatic organisms. There are other things outside of contamination that we have to be concerned about. For instance, we have to check the pH of the water; if it gets too basic or acidic, fish cannot survive. Also, we have to be aware of thermal pollution to the water. This is where we discharge water too high in temperature for the fish, and if it is too high in temperature, we could kill them. This is why we have to build dams and fountains to cool the water before it can be discharged.

How safe is the public living in the areas surrounding Oak Ridge?

I think the public living near Oak Ridge is very safe. That doesn't mean that we don't have emergencies and that we don't plan for emergencies. But all in all, the public is very safe.

In the case of a major radiation release, what would the Department of Energy do, and would the public be informed?

If there was a major release, we would handle the situation under our emergency procedures. The public would be informed. We have public announcement systems, use local radio stations, and have procedures to contain such a release and prevent public harm. The chance of a major release is very, very small.

How does the Department of Energy ensure that the contractors are environmentally responsible?

We have clauses in the contracts that require contractors to comply with environmental laws and regulations. If they don't, they can be fined by the regulators and given other penalties. One of the biggest things that impact the contractors is their reputation. For the contractors, there is nothing worse than seeing a newspaper run a front-page story stating that they did something improperly or environmentally damaging. That is more damaging than any fine or penalty.

One a scale of one to ten, ten being the best, how productive a year has the Department of Energy had in cleaning up the environment in Oak Ridge?

I would give us a nine to a nine and a half. At the beginning of the year, we set milestones and requirements to be reached by the end of the year. We still have a long way to go, but we reached nearly all of the milestones we had committed to completing during the year.

How large of a role does the environment play in the decisions that you make?

The environment plays a very large role in nearly every decision that I make. If we're making plans to build something for the future, I want it to be environmentally sound. When we're cleaning up contamination and waste from past activities, that effect and consequences to the environment is a strong concern.

What is your most important obligation as the head of the facilities?

My most important obligation is to ensure the safety of all the workers. That is the thing I focus on the most. Safety is always the foremost on my mind. When doing the cleanup work, we always make sure that we are doing it in such a way that neither the workers nor the public will be harmed.

What message would you send concerning the Department of Energy's role in the general public's lives?

Keep working with us, and stay involved. It is very valuable to have an informed public that can help us make decisions and give us the wisdom of their experiences.

The latest information on environmental topics in Oak Ridge can be obtained on the World Wide Web:

- http://www.ornl.gov/aser provides access to the *Annual Site Environmental Report*
- http://www.doe.gov reaches the national Department of Energy Web site
- http://www.oakridge.doe.gov/ reaches the Department of Energy Oak Ridge Operations Web site
- http://www.bechteljacobs.com/emef/newsfacts/facsheet.htm gives you a list of fact sheets on each of the Oak Ridge environmental management projects
- http://www.em.doe.gov takes you to the national Department of Energy environmental management Web site
- http://www.ornl.gov/emef/facts/public.htm provides public involvement information for the environmental management program in Oak Ridge
- http://www.ornl.gov provides access to all Oak Ridge National Laboratory, Y-12 Plant, East Tennessee Technology Park, and other sites of local interest

Drawing by student artist, Rebecca Ann Bernard

Drawing by student artist, Joel Stalnaker

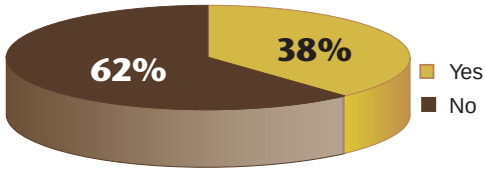
Drawing by student artist, Jessica Lovely

Drawing by student artist, Stefan Moore

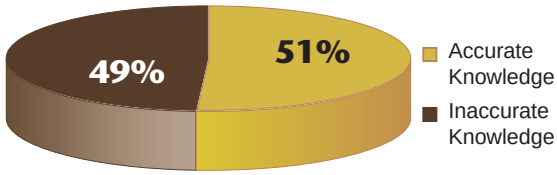
Student Survey

The students of Jennifer Webster's 9th grade English class surveyed 100 adults. These adults were comprised of family, neighbors, and others from the community. Several questions were asked to determine their knowledge in three areas. The results are found below. This is by no means a scientific survey, but the results are nonetheless interesting.

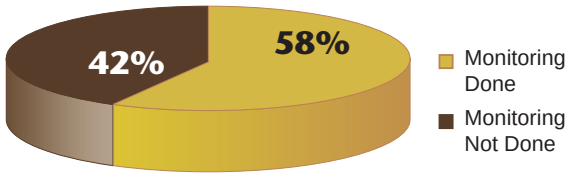
The first set of questions was used to determine the general knowledge those who were surveyed had of the Department of Energy. Thirty-eight percent of adults surveyed had some general knowledge of the Department of Energy. Sixty-two percent had no knowledge of the Department of Energy.



The second set of questions was used to determine the general knowledge those who were surveyed had of activities that went on the at the three Department of Energy facilities on the Oak Ridge Reservation. Fifty-one percent of those surveyed had fairly accurate information about the activities that go on at the three facilities. Forty-nine percent had little or inaccurate information of the activities at the three facilities.



The third set of questions was used to determine the general knowledge those who were surveyed had of whether the facilities and the Department of Energy monitors the environment in the Oak Ridge area. Fifty-eight percent believed that the environment was monitored by the facilities and the Department of Energy. Forty-two percent believed that the environment was not monitored by the facilities or the Department of Energy.



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