OAK RIDGE Reservation

DOE/ORO/2205

Annual Site Environmental Report Summary

Tomorrow's Environment - Today's Focus

Message from the Students

Dear DOE Stakeholder:

This semester has been a unique one for us in Mrs. Bock's Senior English Class. We have had a once in a lifetime experience as students. Not only were we able to produce a document for our community, we were given an opportunity to learn about the rich, influential history of our area and discover up close the incredible Department of Energy laboratories on the Oak Ridge Reservation. We visited Oak Ridge National Laboratory, the Y-12 analytical lab, and the East Tennessee Technology Park. Most of us had no knowledge of how important these facilities are or that top scientists in the country are doing so many new things. Hopefully, our document will be a learning experience for you — it sure was for us.

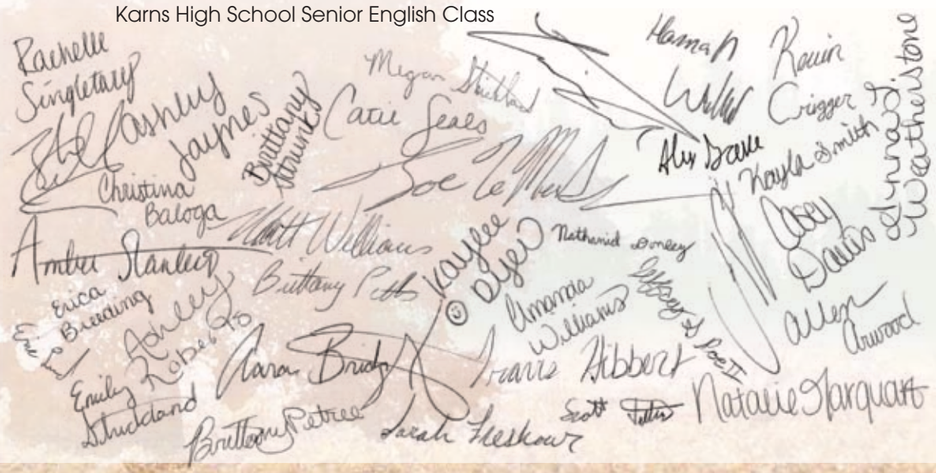
To write this we had to search government documents and summarize technical information so the public didn't have to wade through so much material and hopefully to make it flow smoothly between sections and thus be easier to read and understand. After writing we created our own graphics for the sections and then worked with professional graphic artists from ORNL to finalize our ideas. Although this took a lot of effort, we had fun doing it.

We learned that the Oak Ridge Reservation is an incredible place with so much research, and it is not as dangerous as some think. Although there are experiments using radiation and chemicals, they are very careful and exposure is minimal, and very little chemical or radiation contamination reaches outside the facilities. We believe the best weapon against contamination is knowledge about it. We hope with this report some of that knowledge will be yours. We feel this important and great reservation should not remain a secret because the plants were not about the bomb but about the American dream and perseverance.

As said on the cover, "Tomorrow's environment is today's focus." Hopefully, with this book our focus has made things clearer for you, as clarity goes hand and hand with understanding. We would like to thank our teacher, Heather Bock, for selecting our class for the project and Joan Hughes, from ORNL, and Dr. Tim Joseph, of DOE, for providing such a remarkable opportunity for our senior year (and the donuts), and for allowing our clowning around as well. And thanks to DOE for the computer and printer; we really needed them.

We hope you find this summary useful and informative, and we truly hope you enjoy reading it as much as we enjoyed writing it.

Karns High School Senior English Class



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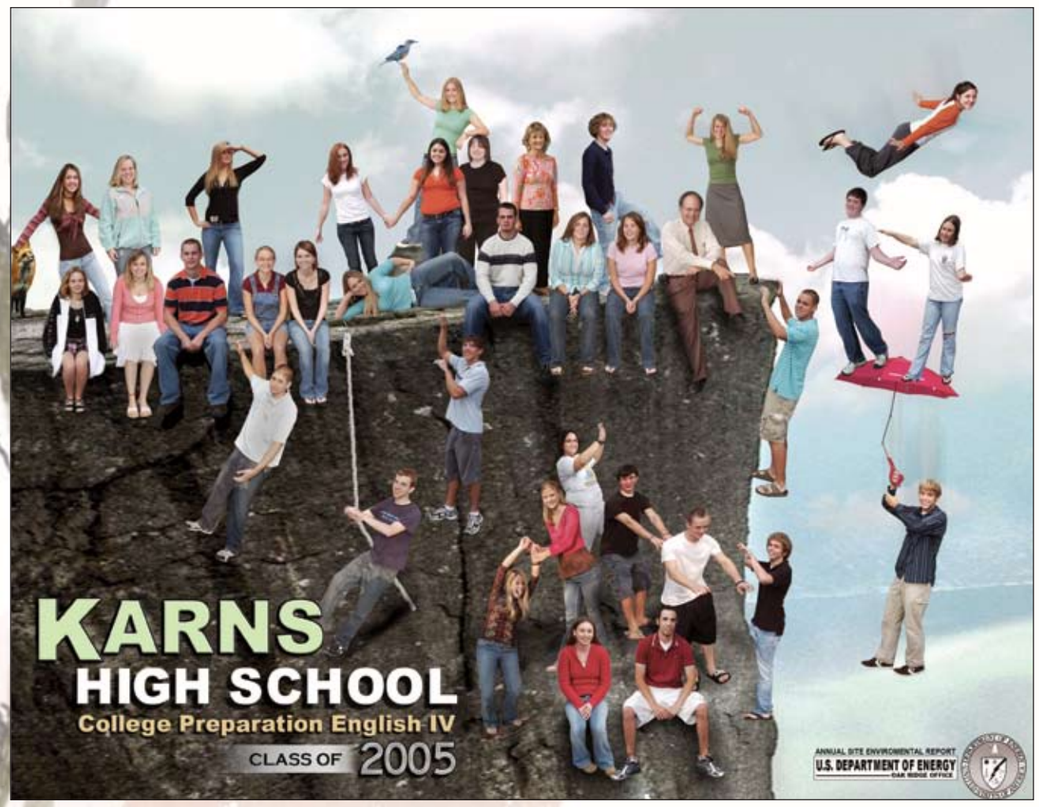
About the Cover

Tomorrow's Environment—Today's Focus:

Just as the beautiful red fox pup focuses on the dandelion for playful fun, the Department of Energy and our contractors focus on the fox and the environment in which it lives. The Oak Ridge Reservation has thousands of acres of natural habitat utilized by this and numerous other species, and our goal and responsibility is to continually improve this already beautiful environment for these amazing wonders of nature, so the tomorrows ahead will offer more for them and us. — Timothy Joseph, Ph.D.

Date published: December 2005

Credits



Top to bottom, left to right:

1st Row: Christina Baloga, Ashley Jaynes, Anna Weatherstone, Sarah Freshour, Brittany Petree, Kayla Smith, Brittany Pitts, Joan Hughes, Aaron Bridget, Heather Bock, Ashley Roberts

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The Oak Ridge Reservation
Annual Site Environmental Report Summary 2004
is on the world wide web: http://www.ornl.gov/aser

Preface

Annual Site Environmental Report Summary 2004

The Department of Energy (DOE) and our contractors strive to provide our stakeholders a comprehensive understanding of the consequences of DOE operations past and present. Toward this end a far-reaching multimillion-dollar annual monitoring and surveillance program collects and analyzes tens of thousands of air, surface and groundwater, soil, mud, plant, and animal samples and measurements. This effort represents the work of many dedicated environmental scientists who carry out these extensive programs and work hard to protect and enhance the environment. We publish the results in a detailed annual site environmental report (ASER), and a separate data volume for those who wish to see the supporting data.

These documents present all the facts and figures but are highly technical and not easily understood, and it's essential we provide a summary document simple to read and understand. So each year I team with Karns High School and ask students to write an annual site environmental report Summary that will be both informative and enjoyable to read. These environmental documents are perhaps the most important DOE reports because they explain the environmental monitoring programs and show the consequences of our operations in great detail to our legislatures, stakeholders, and the public. This ASER summary is written for you, the public, our most important stakeholder, with the hope that you find it comprehensible and of value in gaining an accurate understanding of the Oak Ridge Reservation. All three documents can be found on the web, along with previous publications, at http://www.ornl.gov/aser.

It's a great pleasure to meet my new class each year and capture fresh creative ideas. I'm always delighted to see their interest and desire to learn and to produce a document for the public that reflects their personality and skills, and one the public will utilize and find of value. I sincerely thank these talented Karns High School students and their exceptional teacher, Mrs. Heather Bock, for accepting my challenge to think out of the box and put together this DOE document. Thanks go out as well to each contributing art student, and of course to Principal Clifford Davis, Jr., for his enthusiastic support. When I gave this College Preparation English IV Class the challenge I was given back all smiles, eagerness, and an ardent zeal to succeed. I hope you, our public, find this product of their effort of value and quality.

As the ASER program manager I am always interested in your feedback on how we can improve the ASER and this summary document, for they are written for you. I invite your comments and can be reached by phone at (865) 576-1582, or by email at josepht@oro.doe.gov. Additional printed reports are available at the DOE Information Center, or by calling (865) 241-4780.

Genuine Regards,

Timothy Joseph, Ph.D.
Senior Scientist
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Oak Ridge Office

Message from Oak Ridge Operations Manager

It is with great pride DOE provides you, our public, with this *Annual Site Environmental Report Summary*. My special thanks go out to the hardworking students at Karns High School; Heather Bock, their teacher; and Clifford Davis, Jr., the principal. Without their skills, enthusiasm, and support, this document would not be possible. DOE appreciates the dedicated team from Karns High School, and we look forward to continuing our close partnership.

Gerald G. Boyd, Manager

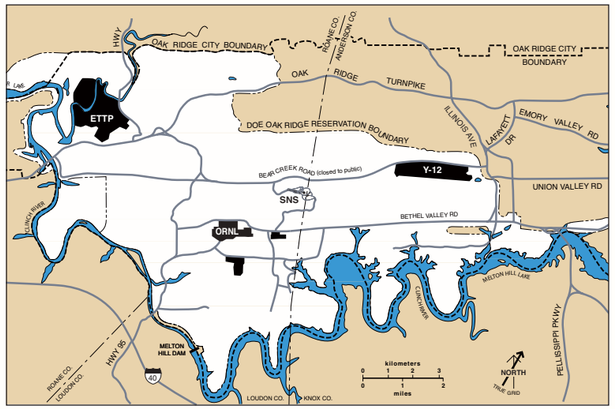
A Secret City

On August 2, 1939, just before the beginning of World War II, Albert Einstein wrote to then President Franklin D. Roosevelt. Einstein and several other scientists told Roosevelt of efforts in Germany to obtain uranium-235, which could be used to build an atomic bomb. American scientists knew that with this technology Germans had the potential to create a nuclear chain reaction explosive capable of mass destruction. This caused the United States government to begin forming the secret plan known then only as "The Manhattan Project," which was committed to carrying out research that would produce an atomic bomb. A secret location was needed in order to fulfill the goal of this operation and to keep it secret.

In the spring of 1942, the Army began to discuss with the Tennessee Valley Authority the need for unusually large amounts of electrical power for a secret plant to be located in the Tennessee Valley service area. During the summer, Army scouts working for the secret Manhattan Project chose an area of land near the small town of Clinton, Tennessee. On September 19, 1942, General (then Colonel) Leslie Groves ordered the seizure of land in the valleys of East Tennessee to be taken for the Manhattan Project. In late September, a War Department directive was issued for land condemnation. On October 6,1942, a petition was filed in U.S. District Court and through the War Powers Act, the U.S. Army Corps of Engineers purchased 866 tracts of land in Roane and Anderson Counties totaling 58,900 acres. The first of approximately one thousand families began leaving in November 1942.

The Manhattan Project was officially launched in June 1942, and construction began in November. There were about 75,000 people in Oak Ridge at the peak of the project, yet only about 5 knew the full story of exactly what they were doing. By the next summer, some 3,000 construction workers had built about 150 buildings. Within the city itself, a house was being completed every 30 minutes. Electricity consumption was 20% greater than New York City's electrical consumption. Over the course of six years, from 1939 to 1945, more than $2 billion was spent on the Manhattan Project. The formulas for creating the atomic bomb were created and put to use for the United States during the war.

Oak Ridge Today



Oak Ridge Y-12 National Security Complex

Since World War II, the number of buildings at Y-12 has nearly doubled. The "missions" of the buildings have also changed focus. The first site mission was the separation of uranium-235 from natural uranium using the electromagnetic separation process to construct an atomic bomb. Today the plant is a complex manufacturing facility that stretches over 811 acres and has approximately 500 buildings. The nuclear complex is operated by BWXT Y-12, LLC, for the National Nuclear Security Administration — a semi-autonomous agency within the Department of Energy.

Oak Ridge National Laboratory (ORNL)

Oak Ridge National Laboratory is the Department of Energy's largest science and energy laboratory. Managed since April 2000 by a partnership of the University of Tennessee and Battelle Memorial Institute, ORNL was established in 1943 as a part of the secret Manhattan Project to pioneer a method for producing and separating plutonium.

ORNL is an international leader in a range of scientific areas that support the Department of Energy's mission. The laboratory's six major scientific competencies include neutron science, energy, high-performance computing, complex biological systems, advanced materials, and national security.

ORNL is in the final stages of a $300 million project to provide a modern campus for the next generation of great science. A unique combination of federal, state, and private funds is building 13 new facilities. Included in these new facilities are the Functional Genomics Center, which houses ORNL's famous mutant mouse colony; the Center for Nanophase Materials Science, the Advanced Microscopy Laboratory, built specifically to house the world's highest resolution microscope; and the joint institutes for Computational Science, Biological Science; and Neutron Science. On budget and on schedule for completion in 2006, the $1.4 billion Spallation Neutron Source will make Oak Ridge the world's foremost center for neutron science research.

East Tennessee Technology Park (ETTP)

Formerly known as the K-25 site, this is the smallest of the three major sites on the Oak Ridge Reservation. During the war, this location used gaseous diffusion and thermal diffusion processes to produce enriched uranium for the creation of the atomic bomb. After the war, the site continued to produce uranium but also began making fuel for nuclear reactors. In the 1980s the demand for enriched uranium decreased, so the process at the K-25 site was shut down. In the 90s it was renamed "East Tennessee Technology Park" and its priority shifted to cleaning up the environment and becoming an industrial park.

Environmental Compliance Status

The three major facilities that occupy the Oak Ridge Reservation all manage activities to comply with federal, state, and local environmental protection laws.

Applicable Environmental Statutes

There are numerous environmental regulations that are pertinent to the Oak Ridge facilities, including:

Clean Air Act – This act provides the principal framework for national, state, and local efforts to protect air and improve air quality. The radiological off-site dose limit for protection of the public is 10 millirem per year for air emissions. Oak Ridge levels were way below this dose limit at 0.4 millirem in 2004. There was one Clean Air Act noncomformance in 2004 on the Oak Ridge Reservation, which is discussed below.

Resource Conservation and Recovery Act (RCRA) – This act was passed to address management of the country's huge volume of solid waste. It provides a system for controlling hazardous wastes from origin to disposal. There were two RCRA nonconformances on the Oak Ridge Reservation in 2004. Detail is provided below.

Safe Drinking Water Act – This act ensures the quality of American's drinking water by setting standards that make sure all drinking water is safe and nontoxic. There were no violations or concerns with any of the drinking water sample results from the three major Oak Ridge Reservation facilities in 2004.

Federal Facilities Compliance Act – This act mandates that federal facilities comply with the RCRA.

National Historic Preservation Act – This act establishes a program to protect and preserve agreed upon historic properties.

Comprehensive Environmental Response, Compensation, and Liability Act – This act was established to provide a systematic approach for locating, investigating, and cleaning up uncontrolled or abandoned hazardous waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. No releases of reportable quantities of hazardous chemicals or asbestos were reported by any of the sites in 2004.

Toxic Substances Control Act – This law regulates the manufacture, use, and disposal of certain toxic chemical substances, notably polychlorinated biphenyls (PCBs).

Clean Water Act – This act is the cornerstone of surface water quality protection in the United States. It established the National Pollutant Discharge Elimination System (NPDES) permit program which controls water pollution by regulating sources that discharge pollutants into waters of the United States. The three major facilities on the Oak Ridge Reservation all achieved an NPDES permit compliance rate greater than 99.9% in 2004. Permit nonconformances are discussed below.

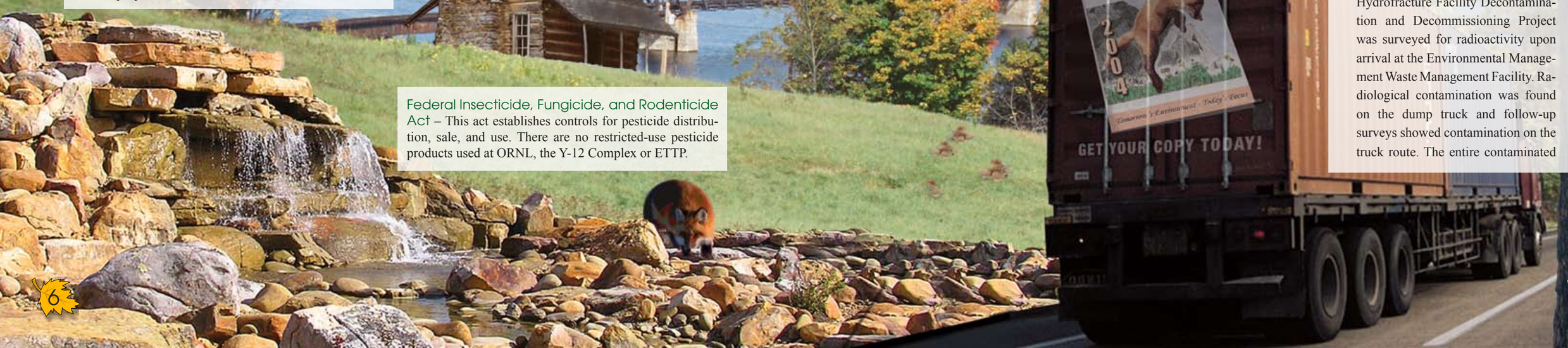
Federal Insecticide, Fungicide, and Rodenticide Act – This act establishes controls for pesticide distribution, sale, and use. There are no restricted-use pesticide products used at ORNL, the Y-12 Complex or ETTP.

Endangered Species Act – This act includes legislation to ensure the conservation of threatened and endangered plants, animals, and habitats. When operations or new projects are planned, the effects on animals and plants are taken into consideration. There are many plant and animal species of concern on the Oak Ridge Reservation protected under this act.

National Environmental Policy Act – This act requires evaluation of the environmental impacts of proposed federally funded projects and the examination of alternatives.

Reportable Environmental Occurrences, Noncompliances, Notices of Violations, and Corrective Actions

- Daily maximum and monthly average concentration limits for iron and copper at Outfall X02 at ORNL were exceeded in January 2004. The facility operator modified the treatment process to improve copper and iron removal.
- On February 9, 2004, there was an unpermitted discharge of fire retardant and chlorine into a storm drain system at ETTP. All residual materials were cleaned, and monitoring of Mitchell Branch was conducted to ensure against any long-term damage.
- On May 8, 2004, there was an exothermic reaction accident during heating of sodium shields at the ETTP. Personnel from Commodore Advanced Sciences Inc. were heating sodium metal when they heard a "pop" and a "whoosh" sound followed by liquid sodium leaking from its container. Attempts to stop the flow were unsuccessful. The sodium made contact with rainwater, an exothermic reaction occurred, and a reportable quantity of sodium was released.
- On May 14, 2004, a dump truck transporting a tank from the New Hydrofracture Facility Decontamination and Decommissioning Project was surveyed for radioactivity upon arrival at the Environmental Management Waste Management Facility. Radiological contamination was found on the dump truck and follow-up surveys showed contamination on the truck route. The entire contaminated



roadway was closed, and remediation at a cost of more than $1 million dollars was completed. There were no confirmed exposures or uptakes to individuals or to vehicles that had traversed the affected portions of the road were clean.

- On August 2, 2004, it was discovered that a restroom in the K-1007 building at ETTP was mistakenly connected to a storm drain network instead of the sanitary sewer system. The restroom was closed and drains were properly connected. Monitoring of receiving waters revealed that no significant impacts to the environment occurred.
- On August 5, 2004, one required carbonaceous biochemical oxygen demand value was not quantified for ORNL's Outfall X01. Oversight of subcontractors and communication of ORNL requirements were reevaluated to ensure incorporatation into work planning and implementation.
- On December 14, 2004, ORNL grounds keeping staff inadvertently released rinse water from a container of herbicide mixture into a short, unnamed tributary to White Oak Creek. Groundskeeping staff members, their management, and environmental protection staff held a meeting on December 16, 2004, resulting in review and update of written procedures and training.
- In 2004 it was discovered that a shower at the K-31 Building Decontamination and Decommissioning Project had been improperly connected to the sanitary sewer system and overflowed into the storm drain network. The facility was closed, and drains were properly connected to a portable tank to await proper disposal. Monitoring of the facility did not reveal any significant impacts to the environment.
- RCRA inspections by the state of Tennessee resulted in two notices of violations in 2004. At ORNL the violation was failure to make a waste determination on five waste drums, and ORNL completed all needed corrective actions. ETTP received a notice of violation that covered five items of noncompliance. An order with penalties was issued for one rusted drum and some waste containers on site for greater than one year. All corrective actions have been completed.
- One Clean Air Act notice of violation was issued at ORNL for a construction project air permitting administrative error. The situation was corrected.
- A notice of violation was issued against the Y-12 Complex potable water distribution system for failure to have a proper cross-connection program and failure to keep adequate records. Corrective actions are being implemented.
- ORNL had one reportable release of oil from an overturned forklift truck into Melton Branch. The release was contained, and appropriate notifications were made.

Basic Overview of Radiation

History

- Radiation (X rays) was discovered in 1895 by Wilhelm Roentgen in Germany. Roentgen won the Nobel Prize for physics in 1901.
- The fact that some elements (e.g., uranium) are radioactive was discovered in 1896, just a few months after the discovery of X rays, by Henri Becquerel in France. Becquerel shared the 1903 Nobel Prize in physics with Pierre and Marie Curie.
- Both discoveries came about due to the fogging of photographic material.

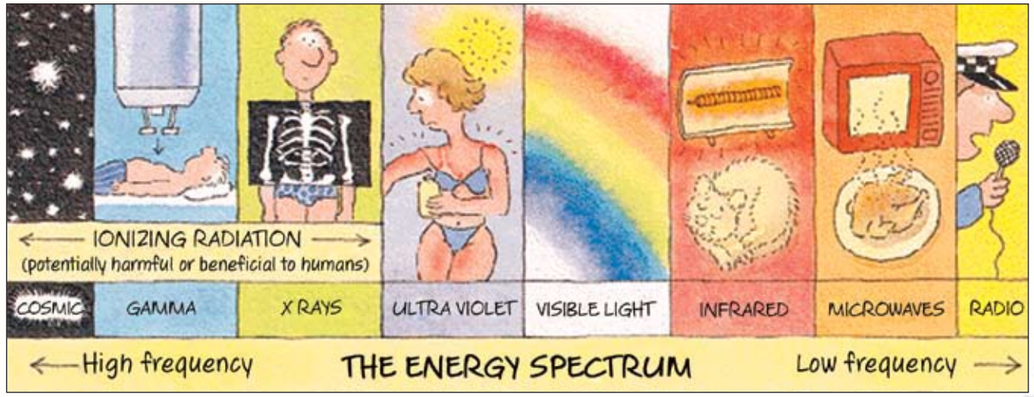


Illustration used by permission of the Uranium Information Centre, Melbourne, Australia

Understanding Radiation

- Radiation is energy that travels through matter or space in the form of waves or high-speed particles.
- Light, heat, and sound are types of radiation.
- Radioactivity is the property of some atoms to spontaneously give off energy as particles or rays.
- As a result of this emission of energy, a radioactive atom is converted, or decays, into a more stable atom.
- Radiation occurs naturally and is all around us. It comes from the sun, from the rocks in the earth, and from the food we eat. It is also key to many of the products that improve our quality of life, such as microwaves, radar, electric power lines, cellular phones, medical treatments, and X rays.
- The adverse affects of radiation are minimized by controlling exposure through minimizing time of exposure, maximizing the distance from the radiation source, and shielding with materials that are impenetrable by radiation.

What are the Dangers of Radiation?

- Cancer is considered to be the most significant health effect from radiation exposure.
- Short-term, high-level exposure is referred to as "acute" exposure. Medical patients receiving radiation treatments often experience acute effects because they are receiving high levels of radiation over short durations. Unlike cancer, effects from acute exposure appear quickly and include burns and radiation sickness. Radiation sickness can cause

premature aging or death. Symptoms include nausea, weakness, hair loss, skin burns, or diminished organ function.

- Exposure to different radionuclides leads to different health risks, but scientists believe overall that if each person in a group of 10,000 were exposed to 1 rem of ionizing radiation, about 8 more people would die of cancer than would otherwise. About 2000 people in a group of 10,000 are expected to die from cancer naturally, so there is a risk of eight deaths in 10,000 people if they all receive one rem instantaneously.

Positives of Radiation

- Radiation is used to successfully treat medical patients who have certain types of diseases.
- A scientific theory known as hormesis asserts that low levels of radiation are beneficial to health.
- Radiation has improved our lives by aiding in medical testing and procedures and by contributing to important consumer products and services such as smoke detectors, food sterilization processes, and leak detection.

What are the Types of Ionizing Radiation?

- There are three types of ionizing radiation: alpha, beta, and gamma.
  - → Alpha – A particle consisting of two protons and two neutrons. Alpha radiation is the most energetic but least penetrating form of radiation. It can be stopped by a sheet of paper and cannot penetrate human skin. However, if an alpha-emitting isotope is inhaled or ingested, it can cause highly concentrated local damage.
  - → Beta – High-energy electrons that can pass through 1 to 2 centimeters of water or human flesh and can be shielded by a thin sheet of aluminum. Beta particles are more deeply penetrating than alpha particles but, because of their smaller size, cause less localized damage.
  - → Gamma – High-energy, short-wavelength electromagnetic radiation emitted from the nucleus of an atom. Gamma rays are very penetrating and are shielded by dense materials such as lead or concrete. Gamma rays are similar to X rays, but gamma rays are emitted from the nucleus of an atom.X rays are not emitted from the nucleus, but are normally emitted by energy changes in electrons.

Dose Facts

What is Dose?

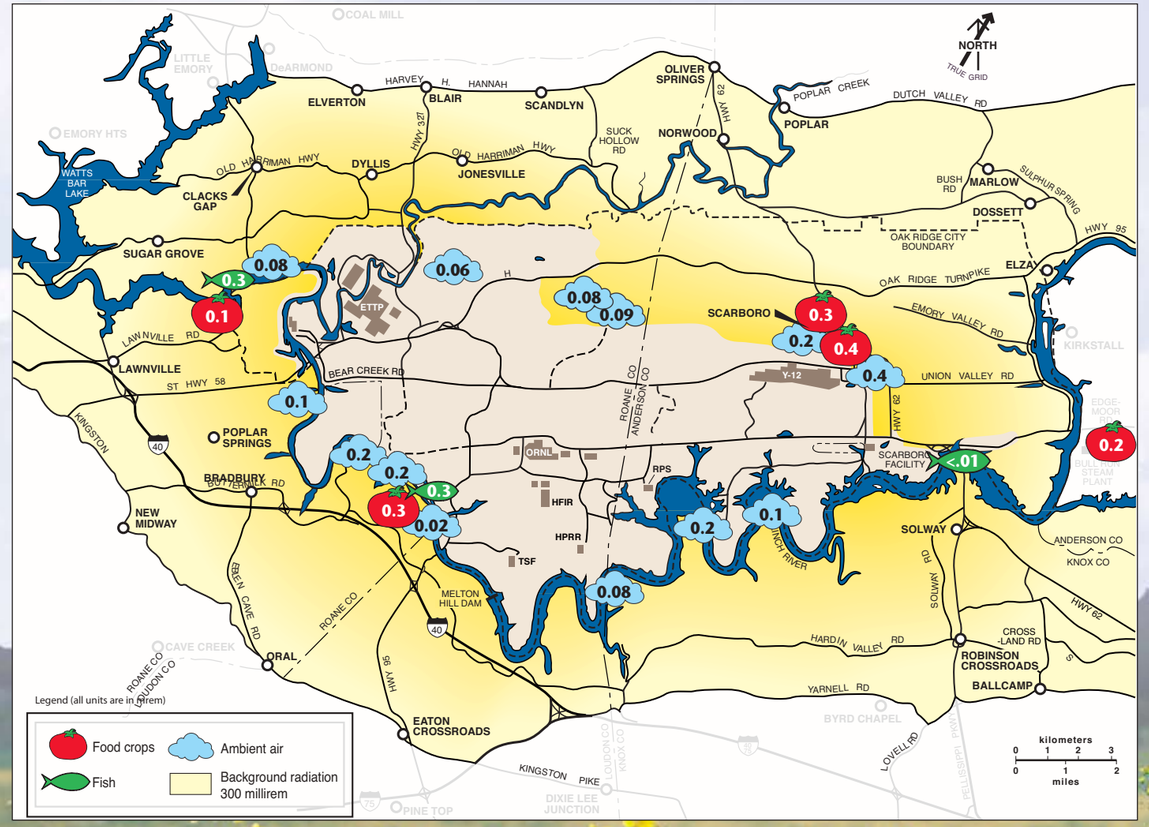
- A generic term to describe the amount of radiation a person receives.
- Dose is measured in units called "rems" – a thousandth of a rem is called a millirem.
  - An average person in the United States receives about 300 millimrem each year from natural sources (e.g., rocks in the earth, the sun, food, etc.) and an additional 60 millirem from consumer and medical products (e.g., dental X rays, natural gas for heating, road construction materials).

- The DOE has established a 100-millirem dose limit to members of the public from exposure pathways that are the result of their operations.
- The maximum dose any member of the public could have possibly received from activities on the Oak Ridge Reservation in 2004 was 12 millirem. This includes eating deer, turkey, fish, and geese harvested on or near the Reservation; drinking the most contaminated water; and breathing the most contaminated air. It is very unlikely any one person could have actually received this dose.

Dose From Being Exposed to Radioactive Materials Depends on

- Whether the material is inside or outside the body
- If inside the body, how long it remains in the body
- How much radioactive material there is
- The type of radiation the material emits
- How long the material will remain radioactive

Possible Radiation Doses on or near the Oak Ridge Reservation



Key Definitions

- **Ionization** – The process of removing the electrons from neutral atoms, which results in the breaking up of an electronically neutral atom or molecule into charged components.
- **Ionizing Radiation** – radiation capable of displacing electrons from atoms or molecules. Examples include alpha particles, beta particles, gamma rays or X rays, and cosmic rays. Human exposure to ionizing radiation can be dangerous because it damages the internal structure of living cells.
- **Non-Ionizing** – Radiation that doesn't have the amount of energy needed to ionize an atom with which it interacts. Non-ionizing radiation is generally not dangerous, with some exceptions, such as high-energy radio microwaves, which can damage biological tissue; intense visible light, which can cause blindness; and intense ultraviolet light, which can cause blindness and superficial skin burns in high doses over a short period of time and skin cancer and cataracts of the eye at lower doses over long periods of time.
- **Half-Life** – The time it takes for half of the radioactive atoms present in a substance to decay.
- **Radioactive Material** – Any material containing unstable radioactive atoms that emit radiation.
- **Radioactive Contamination** – Radioactive material in an unwanted place.

Levels of Radiation

100-1400 millirem

Gastrointestinal series (upper and lower):	1400 millirem
CT scan (head and body):	1100 millirem
Radon in average household:	200 millirem/year
Plutonium-powered pacemaker:	100 millirem/year

10-40 millirem

Living in Tennessee:	40 millirem/year
Natural radioactivity in our body:	40 millirem/year
Cosmic radiation:	31 millirem/year
Mammogram:	30 millirem
Smoking cigarettes (1 pack/day):	15-20 millirem/year
Consumer products:	11 millirem/year
Chest X ray:	10 millirem
Dental X ray:	10 millirem
Maximum possible from ORR:	12 millirem/year

0-9 millirem

Using natural gas in the home:	9 millirem/year
Road construction materials:	4 millirem/year
Concrete building:	3 millirem/year
Living near a nuclear power station:	1 millirem/year
Home smoke detector:	1 millirem/year
Air travel (every 2000 miles):	1 millirem

Environmental Monitoring

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. Data from environmental monitoring activities are used to assess exposures to members of the public and the environment, to help plan projects, and to respond to unexpected events that could result in contamination releases. Site-specific effluent and surveillance monitoring programs are conducted at the ETTP, the Y-12 Complex, and ORNL, and a reservation-wide surveillance program, which includes sampling locations on the reservation and in off-site areas is carried out to confirm the public and environment are not being exposed to levels of contaminants above established regulatory limits.

Oak Ridge National Laboratory

To demonstrate compliance with DOE orders and state and federal regulations, all airborne radionuclide sources on the Oak Ridge Reservation must be determined to estimate dose to the most exposed members of the public. At the Oak Ridge National Laboratory, five stacks are considered major radiological emissions sources and 24 sources are categorized as minor emission sources. The calculated radiation dose to the most exposed off-site individual from all airborne radiological release points at ORNL during 2004 was 0.12 millirem. This is well below the federal standard of 10 millirem per year and is less than 0.04% of the 300 millirem that the average United States citizen receives from natural sources of radiation in a year. Four ambient air stations are also located around the perimeter of ORNL to provide information on the impacts of airborne emissions from the operation of ORNL. In 2004 all of the results at the four ORNL ambient air stations were very low and were less than 1% of DOE established thresholds, called "Derived Concentration Guides."

Each year approximately 7000 water samples and measurements are taken at 169 locations around ORNL to demonstrate compliance with the NPDES permit. In 2004 ORNL NPDES compliance was greater than 99.9% with only three questionable results, which are described in the Environmental Compliance section. In addition to NPDES sampling, ORNL collects water samples at 18 surface water locations and from 43 wells to assess the impacts of past and current DOE operations on water quality. In 2004 the results were all consistent with historical data and show that ORNL is not having a significant adverse effects on publicly accessible waters.

East Tennessee Technology Park

At the ETTP some of the monitoring, primarily of discharges from the different processes, is governed by regulations and permits. Examples include monitoring of 39 storm water discharge points and stack monitoring at the TSCA Incinerator. Other monitoring activities, mainly of the groundwater, water bodies, and air, are governed by DOE orders and agreements with state and federal regulators. At ETTP, thousands of data points were collected on air, water, storm water, and effluent during 2004. Of these data points, more than 99.9% were well within the appropriate standards.

Y-12 National Security Complex

The Y-12 environmental protection program encompasses the protection of air, water, soil, and biota, both on and off the Y-12 site. The current environmental situation includes challenging physical features and a significant environmental legacy.

Challenging Physical Features:

- Located on headwaters of two small (zero flow) streams
- Located less than ½ mile from nearest resident
- Complex karst geology
- Aging infrastructure (e.g., storm and sanitary sewer lines)
- Regional ambient air particulate and ozone levels above new clean air standards

Significant Environmental Legacies:

- Significant mercury lost to environment in the '50s and '60s (~2 million pounds)
- Widespread uranium contamination
- Significant PCB legacy
- Widespread historical use of land-based disposal, resulting in groundwater contamination

artist: *Allison Horne*

artist: *Brandy Hicks*

There were seven environmental audits/inspections by outside regulatory agencies [Tennessee Department of Environment and Conservation (TDEC) and City of Oak Ridge], and no issues were identified. Y-12 received one notice of violation from the TDEC Division of Water Supply (Drinking Water Program) for an inadequate cross-connection control program for the potable water distribution system. During 2004 Y-12 had no reportable releases of hazardous substances, no reportable oil sheens, and no fish kills.

Surface streams and waste water discharges are regulated by TDEC via a single site-wide NPDES permit. Approximately 9500 laboratory analyses and thousands of field observations, from over 90 point-source discharges and storm water events, were collected. A 100% NPDES compliance rate was achieved. Biological monitoring of East Fork Poplar Creek indicates that while the ecological health of the stream continues to improve, the recovery has slowed in recent years. Mercury and PCBs at elevated levels continue to be detected in fish.

Air emissions are regulated under a Clean Air Act Title V permit issued by TDEC. The permit covers 35 emission sources and over 100 air emission points. Approximately 0.01 curies (~ 2 g) of uranium were released to the atmosphere. The resulting total effective dose equivalent of 0.4 mrem was well below the DOE limit of 10 mrem. The Y-12 Steam Plant, where coal and gas are burned, emitted 144 tons of NOx during the ozone season, well below the established limit of 232 tons. Although not required by regulations, a new fluoride monitor was installed in the local community to collect background information prior to start-up of a new system at Y-12. Initial monitoring data (maximum 0.114 $\mu g/m^3$) confirms the fluoride background to be well below the applicable standard (1.6 $\mu g.m^3$).

Approximately 300 groundwater wells and springs were sampled in 2004. Primary contaminants in the groundwater are nitrates, volatile organic compounds (VOCs), metals, and radionuclides. While some plumes show evidence of migration, the overall trends are stable or decreasing.

Oak Ridge Reservation Surveillance Monitoring

Meteorological Monitoring

There are nine meteorological towers that collect data on the atmosphere on the Oak Ridge Reservation. Data collected at these towers are used in routine dispersion modeling to predict impacts from facility operations and as input to emergency-response atmospheric models, which are used in the event of accidental releases. Data from the towers are also used to support various research and engineering projects.

Food Crops

Collection and analysis of vegetation samples serve three purposes: to evaluate potential radiation doses received by people consuming food crops; to predict possible concentrations in meat, eggs, and milk from animals consuming hay; and to monitor trends in environmental contamination and possible long-term accumulation of radionuclides.

- **Hay** – Hay from five areas on the Oak Rideg Reservation and one area immediately adjacent to the reservation is sampled. Areas 1, 2, and 3 are within the predicted air plume for an ORNL source and could be affected by ETTP sources. Areas 4, 5, and 6 are within the predicted air plumes for ETTP, ORNL, and Y-12 sources. Additionally, hay was collected from a reference location not affected by Oak Ridge Reservation activities. All samples were collected during July 2004 and were analyzed for gross alpha, gross beta, gamma emitters, and uranium isotopes. Gamma-emitting radionuclides were not detected at any of the locations with the exception of naturally occurring ^{7}Be and ^{40}K. Uranium concentrations at locations that could be impacted by ORR activities were slightly higher than concentrations at the background locations.
- **Vegetables** – Tomatoes, lettuce, and turnips were purchased from local farmers near the reservation. The locations were chosen based in availability and on their likelihood of being affected by routine releases from the Oak Ridge facilities. Samples were analyzed for gross alpha, gross beta, gamma emitters, and uranium isotopes. At the very most, a gardener could have received a dose of 0.4 millirem from radionuclides in these crops that could have originated from ORR. The DOE limit for the public is 100 millirem.

artist: *Nathan Bull*

artist: *Suzanne Adkins*

Milk

Ingestion is one pathway of exposure to radioactivity for humans. Radionuclides can be transferred from the environment to the people via food chains such as the grass-cow-milk pathway. The 2004 milk-sampling program consisted of grab samples collected every other month from three locations. One is a commercial dairy in Powell that processes milk from various locations in East Tennessee. The second dairy is in Claxton, and the third is a reference location in Maryville. Milk samples are analyzed for gamma emitters, tritium, and total radioactive strontium. A hypothetical person could have received a dose of about 0.07 mrem from drinking the milk from nearby locations and about 0.01 mrem from the remote location (excluding the contributions from ^{40}K, a naturally occurring radionuclide).

artist: *Angela Russell*

Fish

Members of the public could be exposed to contaminants originating from the DOE's Oak Ridge activities through consumption of fish caught in area waters. Fish are collected annually from three locations on the Clinch River, and edible flesh is analyzed to monitor this exposure pathway. Sunfish and catfish are collected from each of the three locations, filleted, and frozen. There is a "do not consume" fish advisory for catfish in all of Melton Hill Reservoir because of PCB contamination and a precautionary fish advisory for catfish in the Clinch River arm of Watts Bar Reservoir because of PCB contamination. These advisories extend to areas not impacted by DOE activities and are the result of activities by private industry, various utilities, the Tennessee Valley Authority and DOE activities. This advisory is applicable to an atypical consumer, those persons who, because of physiological factors or previous exposures, are more sensitive to specific pollutants; this may include

artist: *Jake Klotzbach*

pregnant or nursing women, children, and subsistence fishermen. In 2004, mercury and radionuclides were detected in both species of fish at all locations. PCB-1260, PCB-1254, gamma-chlordane, and pesticides were detected in the catfish composite sample at all three locations. These results are consistent with historical data and with the posted fish advisory. An avid fish consumer could have received a maximum dose of 0.3 mrem from consuming fish at any of the locations sampled.

artist: *Chris Clayton*

Fowl

No new species were observed on the reservation in 2004, and the 27 species that were observed are the fewest recorded in the last ten years. Species of interest observed on the ORR in 2004 include snow goose, greater yellowlegs, lesser yellowlegs, and bald eagle.

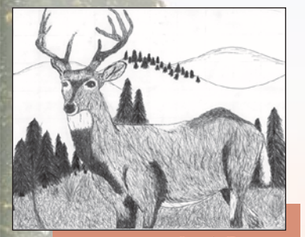
- Canada geese are rounded up each summer and are subjected to noninvasive gross radiological surveys. The 2004 Oak Ridge Reservation roundup was conducted on June 24 and 25. From the roundup, 70 geese were subjected to live whole-body gamma scans. None of the geese exceeded the administrative release limits. The maximum estimated dose to an individual who consumed a hypothetical released goose was about 0.4 millirem.
- Two turkey hunts were held on the reservation, on April 3–4 2004, and April 17–18, 2004. Hunting was open to both archery and shotguns. Thirty-seven turkeys were harvested. Two were juveniles and thirty-five were adults. None were retained for radiological activity. The maximum estimated dose to a person who consumed a released turkey in 2004 is estimated to be about 0.06 mrem. Since 1997, four hundred and fourteen turkeys have been harvested. Two of them were retained due potential radiological contamination.

artist: *Shane Knehans*

White-Tailed Deer

The 19th annual deer hunts managed by DOE and TWRA were held on the ORR during the final quarter of 2004. From the total harvest of 342, ten deer exceeded the release limit for beta-particle activity in bone. One-hundred forty five were bucks and 197 were does. Since 1985, 8865 deer have been harvested. Of these only 180 have been retained due to potential radiological contamination.

It is assumed that 55% of the field weight is edible meat; therefore, the average deer would yield 51.5 pounds of meat. The maximum estimated dose to a person consuming a deer harvested from the ORR during 2004 was calculated to be 4.6 millirem.



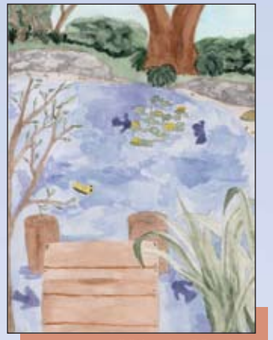
artist: *Jacob Duncan*

Air Monitoring

In addition to exhaust stack monitoring conducted at the DOE Oak Ridge installations, ambient air monitoring is performed to measure radiological parameters directly in the ambient air adjacent to the facilities. Sampling was conducted at each of ten reservation monitoring stations during 2004 to quantify levels of alpha-, beta-, and gamma-emitting radionuclides. This sampling is performed to make sure members of the public, nearby residences, and businesses located on or near the ORR do not receive doses of radiation in excess of any standards or regulations. All radionuclide concentrations measured at the Oak Ridge Reservation ambient air stations were less than 1% of Derived Concentration Guides, which are reference values determined by the Department of Energy to ensure that no member of the pubic receives a radiological dose from DOE activities above acceptable limits. The total estimated dose from atmospheric releases on the ORR was about 0.4 mrem (the standard is 10 mrem).

Surface Water

The ORR surface water monitoring program includes sample collection and analysis from three locations on the Clinch River. The water from all locations is screened for radioactivity and is analyzed for specific radionuclides when appropriate. Two of the sites are also checked for volatile organic compounds, and one is checked for PCBs. Samples from all three sites are analyzed for metals. None of the sites had radionuclides detected above 4% of the respective Derived Concentration Guides. No volatile organic compounds, other than acetone, which is a contaminant commonly introduced by analytical laboratories, were detected in 2004.

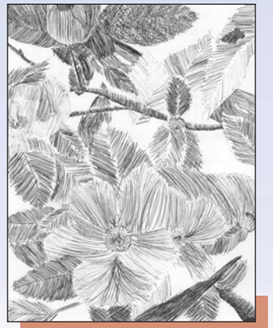


artist: *Mikaela Minihan*

Environmental Management and Restoration

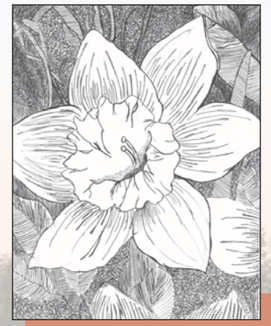
Waste Disposal Practices 1950s - 1970s

Between five and ten percent of the approximately 35,000 acres that make up the ORR has been contaminated by DOE operations since the 1940s. Contamination on the ORR resulted from DOE and its predecessor agencies' activities related to its programmatic missions of uranium enrichment, the production of weapons components, and energy research. Pollutants such as toxic chemicals and radioactive materials were stored or discarded in ponds, ditches, underground pipelines, and tanks or were buried in the ground or released into streams or creeks in the area. These storage methods are not used today, but in the 1940s and 1950s the dangers related to such practices were not well known or understood. When it became evident that the pollutants could be a risk to the public and the environment, the DOE's Environmental Management Program took responsibility for either cleaning up the contamination or for taking measures to make sure that the public and environment are protected from areas that contain contamination and cannot be cleaned up. Contaminated areas are not accessible by the public, and none of the contamination poses an imminent hazard to the health and safety of the public. The Comprehensive Environmental Response, Compensation, and Liability Act has established a process for cleaning up the most contaminated areas in the United States, and the cleanup activities on the ORR are conducted in accordance with that act.



artist: *Jennifer Nore*

The ETTP, which ceased uranium enrichment activities in 1987, is undergoing an accelerated cleanup, and uncontaminated buildings will be made available for private industrial uses. Contaminated facilities and uncontaminated buildings that cannot be used by private enterprises will be demolished. In 2004, 157,432 tons of material were dismantled and removed from the gaseous diffusion buildings K-33, K-31, and K-29. At the K25/K27 facilities, which are going to be demolished, equipment was removed, plans for waste handling and safety were developed, and more than 13,900 ft^3 of waste was removed. Waste removal and demolition associated with the main plant area continued in 2004.



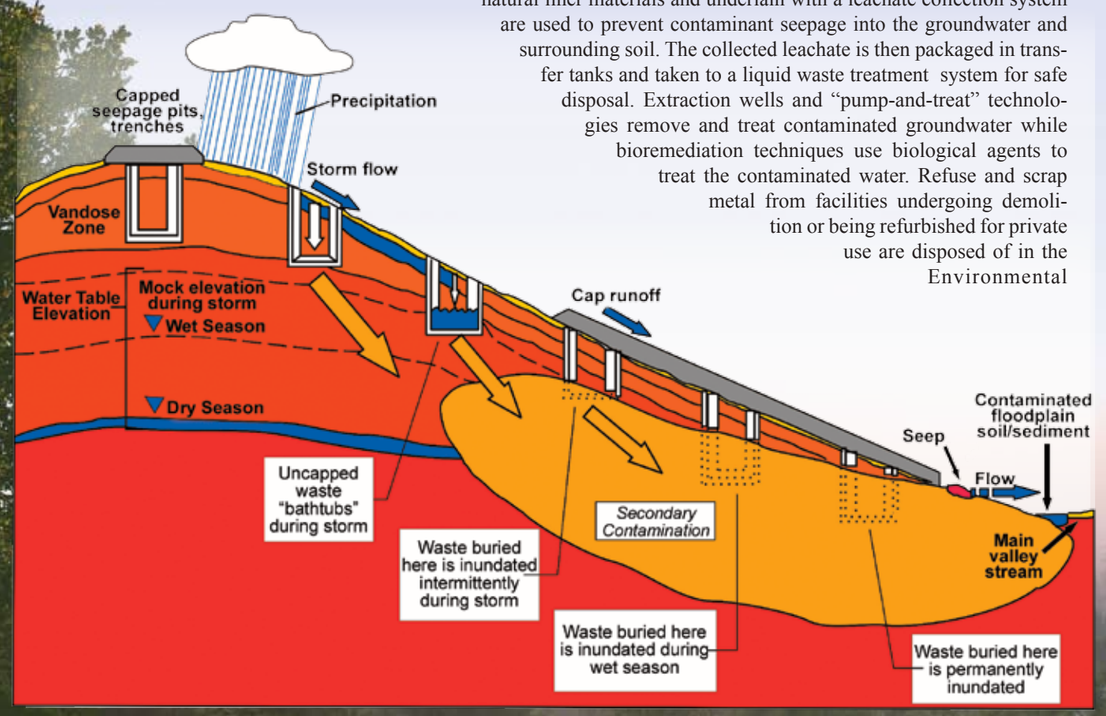
artist: *Heather Leatherwood*

At ORNL there are two major geographic groupings: Melton Valley and Bethel Valley in the White Oak Creek Watershed. Remediation activities in Melton Valley during 2004 included well plugging and abandonment; decontamination and decommissioning of the New Hydrofracture Facility; hydrologic isolation of the Pits and Trenches areas; capping SWSAs 4, 5, and 6; and remediation of several ponds. In Bethel Valley, which is the main plant area, characterization and planning were conducted for several activities, including the Bethel Valley Groundwater Engineering Study and remediation of the "Hot Storage Garden." Work was also done to stabilize several inactive facilities that contain hot cells and glove boxes by fixing contamination in place and sealing the units with foam.

At the Y-12 National Security Complex there are three main geographic areas: Bear Creek Valley, Upper East Fork Poplar Creek Watershed, and Chestnut Ridge. Groundwater pump-and-treat technology is used to contain volatile organic contaminants that have been migrating off the Y-12 Complex site in the Upper East Fork Poplar Creek Watershed. Construction began on a new facility to reduce mercury in surface water through treatment of contaminated spring water. Uranium-contaminated groundwater from the former S-3 Pond Site is treated by passing it through uranium-removing media before it is released to Bear Creek. Post-closure care of several facilities located in all three geographic areas was conducted in compliance with RCRA post-closure permits. Removal of contaminated soils and sediments from several Y-12 areas is planned for future action.

Remediation

The process of remediation includes a variety of techniques that help protect and restore the environment. Now, instead of using unlined ditches to hold contaminated wastes, trenches lined with many layers of synthetic and natural liner materials and underlain with a leachate collection system are used to prevent contaminant seepage into the groundwater and surrounding soil. The collected leachate is then packaged in transfer tanks and taken to a liquid waste treatment system for safe disposal. Extraction wells and "pump-and-treat" technologies remove and treat contaminated groundwater while bioremediation techniques use biological agents to treat the contaminated water. Refuse and scrap metal from facilities undergoing demolition or being refurbished for private use are disposed of in the Environmental Management Waste Management Facility. The DOE is adopting these measures to minimize any further spread of contamination and to protect the health of the public and the surrounding environment.



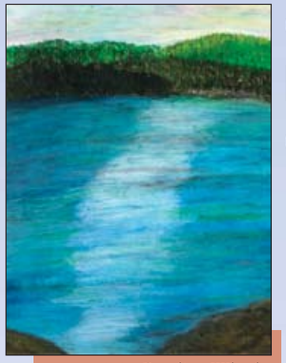
Public Involvement

The DOE actively seeks public involvement in many decisions affecting cleanup of the ORR. Public meetings are held, and there are many organizations through which interested or affected stakeholders can participate or obtain information.

- The Oak Ridge Site Specific Advisory Board is an independent, federally appointed citizens' panel that provides advice and recommendations to the DOE on its Environmental Management Program in Oak Ridge. Members are appointed by DOE and serve on a voluntary basis. All meetings are open to the public. Information is also available at http://www.oakridge.doe.gov/em/ssab/ or by calling (865) 241-4780.
- The Oak Ridge Reservation Local Oversight Committee (LOC) represents counties and communities affected most directly by DOE activities in Oak Ridge. The LOC is funded by a grant from the Tennessee Department of Environment and Conservation's DOE-Oversight Division. LOC board members are concerned with human health and the environment as well as with their communities' economic and social well-being. The board of directors meets six times a year, and the LOC Citizen's Advisory Panel meets once a month. Each year, the LOC publishes the Tennessee Department of Environment and Conservation DOE Oversight Division's Status Report to the public, which presents an independent view of the safety and quality of the Oak Ridge environment. The web site is www.local-oversight.org and the phone number is (865) 483-1333.
- The City of Oak Ridge Environmental Quality Advisory Board (EQAB) is an appointed advisory board of the Oak Ridge City Council. EQAB meets on the first Thursday of each month. Information is available at http://orserv01.ci.oak-ridge.tn.us/eqab/oakridge.htm.
- The Roane County Environmental Review Board was established to enable qualified individuals to review matters that are brought before the Roane County Commission concerning nuclear energy, hazardous waste, and/or the environment.
- The Tennessee Department of Environment and Conservation Department of Energy Oversight Office provides independent state oversight of DOE's Oak Ridge activities. Information is available at http://www.state.tn.us/environment.
- Advocates for the Oak Ridge Reservation is a nongovernmental organization that focuses on land use issues and has participated in initiatives regarding use of undeveloped lands on the ORR.
- The Oak Ridge Reservation Health Effects Subcommittee, funded by DOE, performs public health assessments to characterize health effects on the local community from past environmental releases to soil, water, and air.

artist: *Kristen Hurtubise*

artist: *Zach Undsey*



artist: *Caroline Wheeler*

Other Sources of Information About the Oak Ridge Reservation

The DOE Oak Ridge Office Public Affairs Office, which may be reached at (865) 576-0885, covers programs in science, environmental management and nuclear fuel supply at the Oak Ridge National Laboratory, East Tennessee Technology Park and Oak Ridge Institute of Science and Education. For national security programs, the National Nuclear Security Administration's Y-12 National Security Complex Public Affairs Office may be reached at (865) 576-9918.

- The Department of Energy Information Center is the central location for public information about all DOE programs in Oak Ridge. The Center is located at 475 Oak Ridge Turnpike in Oak Ridge. The Center may be reached at (865) 241-4780 or 1-800-382-6938, option 6. A website is also available at http://www.oakridge.doe/gov/info_ctr.
- Public activities are highlighted on the web at http://www.oakridge.doe.gov under the Public Acitivities section, including a monthly calendar of public meetings and announcements. You may have your name placed on the mailing list for the monthly newsletter Public Involvement News by calling (865) 576-4006.
- The Oak Ridge Site Specific Advisory Board has a video lending library at the DOE Information Center that provides the community with a valuable educational resource regarding environmental management program issues. Information on these library resources is available by calling (865) 241-4780 or by viewing the website, http://www.oakridge.doe.gov/em/ssab.
- The Public Involvement Plan for CERCLA Activities at the U.S. Department of Energy Oak Ridge Reservation (DOE/OR/01/2163&D2), available at the DOE Information Center, highlights opportunities for public participation in environmental cleanup activities at DOE sites in Oak Ridge.
- The American Museum of Science and Energy, located at 300 S. Tulane Avenue in Oak Ridge, contains many exhibits highlighting the history of DOE in Oak Ridge along with educational displays on science, nuclear energy, national security and environmental management. Public bus tours of the ORR are offered May - September. The museum may be reached at (865) 576-3200 or through the website, http://www.amse.org.

artist: *Gilissa Rosario*

artist: *Parker McCroskey*

Disclaimer

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ORR ASER 2004

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