PUBLIC COMMENT RELEASE

PUBLIC HEALTH ASSESSMENT

Y-12 Uranium Releases

OAK RIDGE RESERVATION (USDOE)

OAK RIDGE, ANDERSON COUNTY, TENNESSEE

EPA FACILITY ID: TN1890090003

Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Please address comments regarding this report to:

Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Attn: Chief, Program Evaluation, Records, and Information Services Branch, E-60
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You May Contact ATSDR TOLL FREE at
1-888-42ATSDR or
Visit our Home Page at: http://www.atsdr.cdc.gov

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the Superfund law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-60), Atlanta, GA 30333.

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ACRONYMS

ACAP	Atomic City Auto Parts
ALS	amyotrophic lateral sclerosis
AOEC	Association of Occupational and Environmental Clinics
ATSDR	Agency for Toxic Substances and Disease Registry
BW	body weight
CDC	Centers for Disease Control and Prevention
Cs 137	cesium 137
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Co 60	cobalt 60
COPD	chronic obstructive pulmonary disease
CR	concentration ratio
DHHS	U.S. Department of Health and Human Services
DOE	U.S. Department of Energy
EFPC	East Fork Poplar Creek
EMEG	environmental media evaluation guide
EPA	U.S. Environmental Protection Agency
FACA	Federal Advisory Committee Act
FAMU	Florida Agricultural and Mechanical University
fCi/m^3	femtocuries per cubic meter
GAO	General Accounting Office
g/kg/day	grams per kilogram per day
µg/kg	micrograms per kilogram
$\mu g/m^3$	micrograms per cubic meter
ICRP	International Commission on Radiological Protection
IR	ingestion rate
kg	kilogram
LET	Linear Energy Transfer
LNT	linear nonthreshold
LOAEL	lowest-observed-adverse-effect level
m^3/day	cubic meters per day
MCL	maximum contaminant level
mrem	millirem
mrem/year	millirem per year
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram per day
mg/m^3	milligrams per cubic meter
MRL	minimal risk level
MS	multiple sclerosis
NAACP	National Association for the Advancement of Colored People
NCEH	National Center for Environmental Health
NCRP	National Council on Radiation Protection and Measurements
NIOSH	National Institute for Occupational Safety and Health

NOAEL	no-observed-adverse-effect level
NPL	National Priorities List
ORHASP	Oak Ridge Health Agreement Steering Panel
ORR	Oak Ridge Reservation
ORRHES	Oak Ridge Reservation Health Effects Subcommittee
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
PHAWG	Public Health Assessment Work Group
ppb	parts per billion
ppm	parts per million
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SMR	standardized mortality ratio
Sr 90	strontium 90
Sv	sievert
TDEC	Tennessee Department of Environment and Conservation
TDOH	Tennessee Department of Health
TSCA	Toxic Substances Control Act
U	uranium
μg/L	micrograms per liter
USGS	U.S. Geological Survey
χ	chi

I. SUMMARY

In 1942, the federal government established the Oak Ridge Reservation (ORR) in Anderson and Roane counties in Tennessee as part of the Manhattan Project to research, develop, and produce special nuclear materials for nuclear weapons. Four facilities were built at that time. The Y-12 plant, the K-25 site, and the S-50 site were created to enrich uranium. The X-10 site was created to demonstrate processes for producing and separating plutonium. Since the end of World War II, the role of the ORR (Y-12 plant, K-25 site, and X-10 site) broadened widely to include a variety of nuclear research and production projects vital to national security.

In 1989, the ORR was added to the U.S. Environmental Protection Agency's National Priorities List because over the years the ORR operations have generated a variety of radioactive and nonradioactive wastes which are present in old waste sites and have been released into the environment. The U.S. Department of Energy is conducting clean-up activities at the ORR under a Federal Facility Agreement with the U.S. Environmental Protection Agency and the Tennessee Department of Environment and Conservation. These agencies are working together to investigate and take remedial action on hazardous waste from past and present activities at the site.

For the last 10 years, the Agency for Toxic Substances and Disease Registry (ATSDR) has responded to requests and addressed health concerns of community members, civic organizations, and other government agencies by working extensively to determine whether levels of environmental contamination at and near the ORR present a public health hazard to communities surrounding the ORR. During this time, ATSDR has identified and evaluated several public health issues and has worked closely with many parties. While the Tennessee Department of Health (TDOH) conducted the Oak Ridge Health Studies to evaluate whether off-site populations have experienced exposures in the past, ATSDR's activities focused on current public health issues related to Superfund clean-up activities at the site. Prior to this public health assessment, ATSDR addressed current public health issues related to two off-site areas affected by ORR operations—the East Fork Poplar Creek area and the Watts Bar Reservoir area.

During Phase I and Phase II of the Oak Ridge Health Studies, the TDOH conducted extensive reviews and screening analyses of the available information and identified four hazardous substances that may have been responsible for adverse health effects— radionuclides from White Oak Creek, iodine, mercury, and polychlorinated biphenyls (PCBs). In addition to the dose reconstruction studies on these four substances, the TDOH conducted additional screening analyses for releases of uranium, radionuclides, and several other toxic substances.

To expand upon the efforts of the TDOH, and not duplicate them, ATSDR scientists conducted a review and a screening analysis of the department's Phase I and Phase II screening-level evaluation of past exposure (1944–1990) to identify contaminants of concern for further evaluation. Based on this review, ATSDR scientists are conducting public health assessments on the release of iodine 131, mercury, PCBs, radionuclides from White Oak Creek, uranium, fluorides, and on other topics such as the Toxic Substances Control Act (TSCA) incinerator and off-site groundwater. In conducting these public health assessments, ATSDR scientists are evaluating and analyzing the information, data, and findings from previous studies and investigations to assess the public health implications of past and current exposure. The public health assessment is the primary public health process ATSDR uses to

1. Identify populations off the site who may have been exposed to hazardous substances at levels of health concern.
2. Determine the public health implications of the exposure.
3. Address the health concerns of people in the community.
4. Recommend follow-up public health actions or studies to address the exposure.

ATSDR scientists will also conduct a screening analysis of all available environmental sampling data from 1990 to the present to determine whether additional contaminants of concern need to be addressed.

This public health assessment evaluates the releases of uranium from the Y-12 plant; assesses past and current uranium exposure to residents living near the ORR, including the residents of the Scarboro community (the reference community); and addresses the community health

concerns and issues associated with the uranium releases from the Y-12 plant. The release and exposure to other contaminants of concern such as mercury, iodine 131, PCBs, uranium from the K-25 facility, and fluorides are not addressed in this document. These contaminants and other topics will be evaluated by ATSDR in separate public health assessments.

The 825-acre Y-12 plant, now called the Y-12 National Security Complex, is located in Bear Creek Valley and is bordered by Chestnut Ridge and Pine Ridge. The Y-12 plant was used in the 1940s to electromagnetically enrich uranium. In 1952, the facility was converted to enrich lithium-6 using a column-exchange process and to fabricate components for thermonuclear weapons using high-precision machining and other specialized processes. In 1992, after the Cold War, Y-12's mission was curtailed, and the plant is currently used for weapons disassembly and weapon renovation operations. The National Nuclear Security Administration currently uses the Y-12 National Security Complex as the primary storage site for highly enriched uranium. While operational levels have increased since 1992, the total operations have not approached the levels experienced prior to the 1990s.

The Y-12 plant is located about 2 miles south of downtown Oak Ridge. However, the Y-12 plant is separated from the main residential areas of Oak Ridge by Pine Ridge, a ridge that rises to about 300 feet above the valley floor. In 1942, the city of Oak Ridge was established for the 13,000 persons who were expected to work at the ORR. The population peaked at 75,000 in 1945 and decreased to 30,229 in 1950. Since 1959, when the city of Oak Ridge became self-governing, the Oak Ridge population has been approximately 27,000. The Scarboro community is a residential area within the city of Oak Ridge, about a half mile from the Y-12 plant, and is separated from the Y-12 plant by Pine Ridge. Scarboro was established in 1950 to provide single-family homes, duplexes, apartments, and an elementary school to African American Oak Ridge residents. Scarboro remains predominantly African American and has a population of approximately 300 persons.

In this public health assessment, the Scarboro community is used as a reference location because it represents an established community surrounding ORR where residents resided during the years of uranium releases. In Phase II of the Oak Ridge Health Studies, the TDOH identified

Scarboro as a reference location using air dispersion modeling to estimate average ground-level air concentrations at locations surrounding the reservation. Based on the air dispersion modeling results, Scarboro was the off-site population likely to receive the highest exposures to past releases from the Y-12 plant. The Task 6 report stated that "while other potentially exposed communities were considered in the selection process, the reference locations [Scarboro] represent residents who lived closest to the ORR facilities and would have received the highest exposures from past uranium releases…Scarboro is the most suitable for screening both a maximally and typically exposed individual."

ATSDR evaluated past and current exposure to uranium released from the Y-12 plant and found that the levels of uranium were too low for exposure to be of health concern for both radiation and chemical health effects.

Past Exposure

ATSDR evaluated both radiation and chemical aspects of past uranium exposure. Neither the total radiation dose, nor the chemical ingestion and inhalation doses from exposure to uranium released from the Y-12 plant in the past would cause harmful health effects for the reference population, the residents of Scarboro.

To evaluate past exposure to uranium releases from the Y-12 plant, ATSDR primarily relied on data generated during Task 6 of the TDOH's Reports of the Oak Ridge Dose Reconstruction, *Uranium Releases from the Oak Ridge Reservation—a Review of the Quality of Historical Effluent Monitoring Data and a Screening Evaluation of Potential Off-Site Exposures* (referred to as the "Task 6 report"). The Scarboro community was selected as the reference population after air dispersion modeling indicated that its residents were expected to have received the highest exposures. Therefore, in this evaluation, conclusions regarding exposures to Scarboro residents are also applicable to other residents living near the Y-12 plant.

To evaluate cancer health effects from past radiation exposure, ATSDR adjusted the total uranium radiation doses reported in the Task 6 report to be equivalent to a 70-year exposure.[1] The total radiation dose received by the reference population, the Scarboro community, from all air, surface water, and soil exposure pathways (155 millirem [mrem] over 70 years) is well below (32 times less than) the ATSDR radiogenic cancer comparison value of 5,000 mrem over 70 years. This radiogenic cancer comparison value assumes that the entire radiation dose (a 70-year dose, in this case) from the intake of uranium is received in the first year following the intake. ATSDR believes this radiogenic comparison value to be protective of human health and, therefore, does not expect carcinogenic health effects to have occurred from exposure to uranium in the past.

To evaluate noncancer health effects from the total past uranium radiation dose (committed effective dose equivalent (CEDE) of 155 mrem over 70 years) received by the Scarboro community, ATSDR divided the CEDE of 155 mrem, which is based on 70 years of exposure, by 70 years to approximate a value of 2.2 mrem as the radiation dose for the first year. This approximate dose of 2.2 mrem is well below (45 times less than) the ATSDR minimum risk level (MRL) of 100 mrem/year for chronic ionizing radiation exposure. ATSDR believes the chronic ionizing radiation MRL of 100 mrem/year is below levels that might cause adverse health effects in people most sensitive to such effects and, therefore, does not expect noncancer health effects to have occurred from radiation doses received from past Y-12 uranium releases.

To evaluate potential chemical health effects from past uranium exposure, ATSDR estimated exposure through the air pathway and compared the yearly air concentrations in the Scarboro community to ATSDR's inhalation MRL for uranium. Yearly estimated average air concentrations of uranium in Scarboro ranged from 2.1×10^{-8} to 6.0×10^{-5} milligrams per cubic meter (mg/m^3). These air concentrations are less than 1% of the inhalation MRL for chemical effects (8×10^{-3} mg/m^3). ATSDR also estimated exposure to uranium through the soil and surface water pathways and

The same value can be presented in different ways:
0.001
1.0E-03
1.0×10^{-3}
1/1,000
one in a thousand

[1] The values from the Task 6 report were multiplied by 1.35 (70 years/52 years) for comparison with ATSDR's comparison values.

compared the resulting doses to levels associated with known health effects. Yearly estimated doses from exposure to uranium via all soil ingestion and surface water exposure pathways ranged from 2.7×10^{-5} to 1.3×10^{-2} milligrams per kilogram per day (mg/kg/day). All doses are less than the dose (5×10^{-2} mg/kg/day) at which health effects (renal toxicity) have been observed in rabbits, the mammalian species most sensitive to uranium kidney toxicity. Therefore, ATSDR does not expect that residents were exposed in the past to levels of uranium that would cause harmful chemical effects.

Additionally, it should be noted that several levels of conservatism were built into this evaluation of past exposures. The values that ATSDR relied on to evaluate past exposures (those from the Task 6 report) came from a screening evaluation that routinely and appropriately used conservative and overly protective assumptions and approaches, which led to an overestimation of concentrations and doses. Even using these conservative overestimations of concentrations and doses, persons in the reference community (Scarboro) and other communities near the Y-12 plant were exposed to levels of uranium that are below health concern.

Current Exposure

ATSDR evaluated both radiation and chemical aspects of current uranium exposure. Based on our review of data collected in and around the Scarboro community, and as compared to background and distant areas, ATSDR has determined that the presence of uranium is not a public health concern.

To assess current exposure to uranium releases from the Y-12 plant, ATSDR evaluated air data from monitoring stations, surface water sampling from East Fork Poplar Creek and Scarboro, recent soil sampling from the Scarboro community, samples of garden crops from Scarboro, and garden crop samples from outlying areas. ATSDR evaluated the following pathways: (1) ingestion of soil, (2) ingestion of foods, (3) ingestion of water from nearby creeks, (4) inhalation of air, and (5) external exposure from uranium in soils.

To evaluate cancer effects of current radiation exposure to uranium, the radiation dose received by the reference population, the Scarboro community, from exposure to uranium through ingestion of soil and vegetables and inhalation of air (0.216 mrem) is well below (23,000 times less than) the radiogenic cancer comparison value of 5,000 mrem over 70 years. ATSDR derived this CEDE from the intake of uranium, with the assumption that the entire dose (a 70-year dose, in this case) is received in the first year following the intake. ATSDR believes this value to be protective of human health and, therefore, does not expect harmful radiation effects to occur from the exposure to uranium that is occurring currently.

ATSDR also evaluated noncancer health effect from the total current uranium radiation dose (CEDE of 0.216 mrem over 70 years) received by the Scarboro community, ATSDR divided the CEDE of 0.216 mrem, which is based on 70 years of exposure, by 70 years to approximate a value of 0.003 mrem as the radiation dose for the first year. This approximate dose of 0.003 mrem is well below (33,000 times lower than) the ATSDR minimum risk level (MRL) of 100 mrem/year for chronic ionizing radiation exposure. ATSDR believes the chronic ionizing radiation received by communities near the Y-12 plant from uranium exposure is below levels that might cause adverse health effects in people most sensitive to such effects and therefore does not expect noncancer health effects to occur from current radiation doses.

In addition, ATSDR compared the soil radioactivity concentrations in the reference location (Scarboro) with typical concentrations found in nature and from background samples collected from uncontaminated areas around the reservation. This evaluation showed that the soil radioactivity concentrations in Scarboro were indistinguishable from natural and background concentrations.

To evaluate potential chemical health effects, ATSDR estimated exposure through the air pathway and compared the yearly air concentrations in the Scarboro community to ATSDR's inhalation MRL. Average uranium air concentrations from monitoring stations near the ORR (ranging from 3.7×10^{-11} to 1.4×10^{-10} mg/m^3), including station 46 in Scarboro (5.4×10^{-11}), are several orders of magnitude below (over a million times less than) the intermediate-duration MRL of 87×10^{-3} mg/m^3 for insoluble forms of uranium. ATSDR also estimated exposure to

uranium through the soil and surface water pathways and compared the resulting doses to ATSDR's screening values: the environmental media evaluation guide (EMEG) and the oral MRL. The concentrations of uranium found in the surface water from off-site areas of East Fork Poplar Creek (0.197 and 12.8 micrograms per liter (µg/L) are below ATSDR's EMEG of 20 µg/L. Additionally, the estimated doses from ingestion of uranium in soil (ranging from 2.07×10^{-6} to 1.4×10^{-5} mg/kg/day) and food (3.0×10^{-5} and 3.9×10^{-5} mg/kg/day in the Scarboro community) were well below the oral MRL of 2×10^{-3} mg/kg/day. The maximum uranium dose from ingestion of Scarboro soil is approximately 140 times less that the oral MRL for uranium, and the uranium dose from ingestion of vegetables grown in the private garden in Scarboro is 50 times less than the oral MRL for uranium. Therefore, ATSDR does not expect that residents are currently being exposed to levels of uranium that would cause harmful chemical effects.

II. BACKGROUND

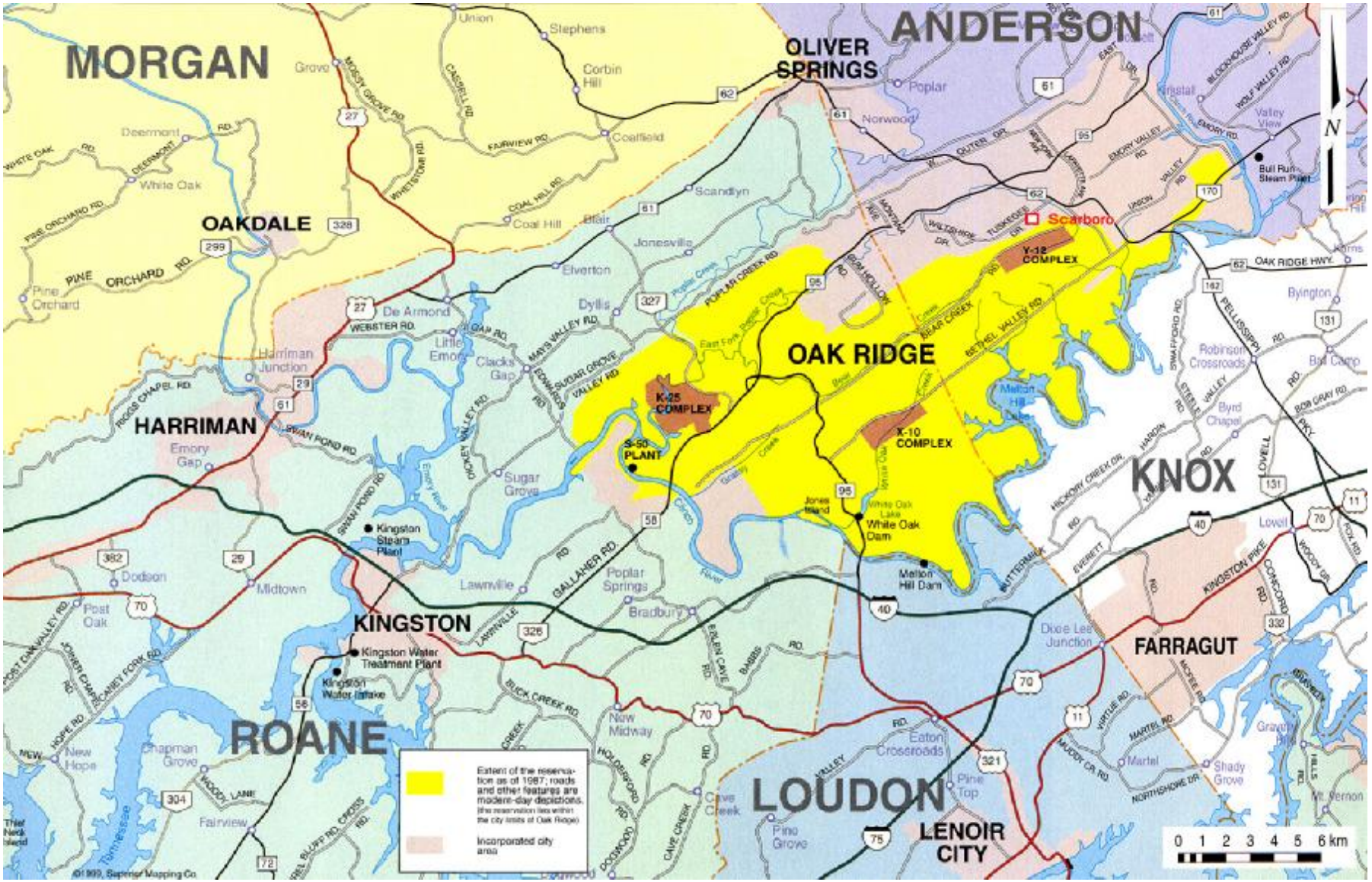
II.A. Site Description

In 1942, the federal government established the 58,000-acre Oak Ridge Reservation (ORR), located in Anderson and Roane counties in Tennessee, as part of the Manhattan Project to research, develop, and produce special nuclear materials for nuclear weapons (ChemRisk 1993a; TDOH 2000). Four facilities were built—the Y-12 plant, the K-25 site, and the S-50 site were created to enrich uranium (U), and the X-10 site was created to demonstrate processes for producing and separating plutonium (TDOH 2000).[2] The Clinch River forms the southern and western boundaries of the reservation and most of the property is within the Oak Ridge city limits (EUWG 1998). Please see Figure 1 for the location of the ORR.

The Y-12 plant is located in the eastern end of Bear Creek Valley; it is bordered on the south by Chestnut Ridge and on the north by Bear Creek Road and Pine Ridge (ChemRisk 1999). The main Y-12 production area is about 0.6 miles wide and 3.2 miles long; the area contains roughly 240 principal buildings, of which about 18 were directly involved with processing and/or storage of uranium compounds (Patton 1963, UCC-ND 1983 as cited in ChemRisk 1999). The 825-acre Y-12 plant is located within the corporate limits of the city of Oak Ridge, about 2 miles south of downtown (ChemRisk 1999). It is located less than a half-mile from the Scarboro community. However, Pine Ridge, which rises to about 300 feet above the valley floor, separates the Y-12 plant from the main residential areas of Oak Ridge (TDOH 2000).

[2] Because this health assessment focuses on exposure to uranium released from the Y-12 plant, the other main facilities on ORR are not discussed in detail

Figure 1. Location of Oak Ridge Reservation



II.B. Operational History

Since the early 1940s, large quantities of uranium were processed on the ORR to enrich it into uranium 235 for production of nuclear weapon components and for use in various research and development projects (ChemRisk 1993a as cited in ChemRisk 1996).

From 1944 to 1947, the Y-12 plant was used to electromagnetically enrich uranium, but in 1952 the facilities were converted to fabricate nuclear weapon components (ChemRisk 1999). During the Cold War, a column-exchange process (Colex) that used large quantities of mercury as an extraction solvent to enrich lithium in lithium 6 was built and operated (TDOH 2000). At the end of the Cold War, the Y-12 missions were curtailed. In 1992 the major focus of the Y-12 plant was the remanufacture of nuclear weapon components and the dismantlement and storage of strategic nuclear materials from retired nuclear weapons systems. In October 2000, oversight of the Y-12 plant was changed from the U.S. Department of Energy (DOE) Oak Ridge Operations to the DOE National Nuclear Security Administration. The National Nuclear Security Administration currently uses the Y-12 National Security Complex as the primary storage site for highly enriched uranium. While operational levels have increased since 1992, the total operations have not approached the levels experienced prior to the 1990s. See Figure 2 for a time line of the major processes at the Y-12 plant.

Task 6 of the reports of the Oak Ridge Dose Reconstruction (ChemRisk 1999) describes in greater detail the operational history of the Y-12 plant. The key processes and activities associated with uranium include: (1) feed preparation for enrichment operations (1943–1947), (2) electromagnetic enrichment (1943–1947), (3) uranium recovery and recycle operations (1944–1951), (4) uranium salvage operations (1947–1951), (5) uranium preparation and recycling for weapons component operations (1949–1995), (6) uranium forming and machining for weapon component operations (1949–1995 [continuing to the present]), and (7) weapons component assembly operations (1952–1995 [continuing to the present]) (ChemRisk 1999). Please see Section 1.4 and Appendix A of Task 6 of the Reports of the Oak Ridge Dose Reconstruction, *Uranium Releases from the Oak Ridge Reservation—a Review of the Quality of Historical Effluent Monitoring Data and a Screening Evaluation of Potential Off-Site Exposures* for additional details (ChemRisk 1999) (referred to as the "Task 6 report").

Figure 2. Y-12 Plant Time Line

MAJOR PROCESSES

- Electromagnetic Separation of U-235, 1943-48
- Uranium Chemical Processing and Parts Manufacturing, 1943-present
- Disposal in Boneyard/Burnyard, 1944-72
- Electromagnetic Separation of Stable Isotopes, 1947-90
- ELEX & COLEX Separarting Process for Lithium Isotopes (Using Mercury), 1950-63
- Production of Thorium Weapon Components, 1950-75
- Production of Lithium and Beryllium Weapon Components, 1950-present
- Waste Disposal in S-3 Ponds, 1951-82
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- 1950-present, Radioactivity, Mercury in EFPC, Bear Creek
- 1955-57, Mercury, Manganese in Clinch River, Poplar Creek, EFPC
- 1959-present, Radionuclides, Metals in Clinch River
- 1960-64, Radionuclides, Chemicals in Clinch River, Poplar Creek
- 1971-present, Uranium, Radionuclides, Metals in EFPC, Poplar Creek, Bear Creek
- 1971-90, PCBs in Bear Creek
- 1983, Organics, Priority Pollutants in Bear Creek
- 1983, VOCs, PCBs, Metals in Bear Creek
- 1984, Metals, VOCs, Radioactivity, Radionuclides in Clinch River, EFPC
- 1984-86, Mercury, Organics, in Bear Creek
- 1985, Herbicides, Pesticides, PCBs in Bear Creek
- 1986, Cs-137 in Watts Bar Reservoir
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- 1993, EFPC Remedial Investigation
- 1995-96, Clinch River/Watts Bar Remedial Investigations
- 1998, Radionuclides, metals, organics in Scarboro
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- 1967-present, Mercury, PCBs, Radionuclides, in Clinch River Fish
- 1970-82, Mercury in EFPC, Bear Creek Fish
- 1974-77, Mercury in Clinch River and Poplar Creek Fish
- 1977, Metals, PCBs in Clinch River and Poplar Creek Fish
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- 1982, Mercury in Cow and Horse Grazing on EFPC Floodplain
- 1983, Mercury in EFPC and Bear Creek Frogs and Crayfish
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- 1986-89, Metals, Pesticides, PCBs, in Melton Hill and Watts Bar Reservoir Fish
- 1987-present, Radioactivity in Geese
- 1989, Metals, PCBs, Pesticides, SVOCs, Radionuclides in Clinch and Tennessee River Fish
- 1993, EFPC Remedial Investigation
- 1995-96, Clinch River/Watts Bar Remedial Investigations

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- 1960-64, Organics and Radioactivity in Clinch and Tennessee River
- 1970, Mercury in Melton Hill Reservoir, EFPC, Bear Creek
- 1972, Mercury in EFPC, Bear Creek
- 1973-74, 79, PCBs in Clinch River, EFPC, Poplar Creek
- 1973-82, Metals and PCBs in Melton Hill Reservoir
- 1974-75, Mercury in EFPC
- 1975-present, Metals in Clinch River, EFPC
- 1981-82, Metals in Bear Creek and EFPC
- 1984-86, Metals, Organics, and Radionuclides in Bear Creek
- 1985, Herbicides, Pesticides, and PCBs in Bear Creek
- 1985, Metals, PCBs, Organics, and Radionuclides in Clinch River, Poplar Creek, EFPC, Bear Creek
- 1986, Cs-137 in Watts Bar Reservoir
- 1989-90, Metals, VOCs, SVOCs, PCBs, Pesticides, Tritium, Radionuclides in Clinch River, Poplar Creek
- 1990, Metals, Organics, Radionuclides in Melton Hill, Norris, and Watts Bar Reservoir
- 1993, EFPC Remedial Investigation
- 1995-96, Clinch River/Watts Bar Remedial Investigations
- 1998, Radionuclides, metals, organics in Scarboro
- 2001, Radionuclides, metals, VOCs, SVOCs, pesticides, & PCBs in Scarboro

Soil

- 1949-present, External Gamma Radiation Measurements
- 1959-1968, Routine Aerial Background Surveys
- 1971-present, Radionuclides in Soil at Perimeter and Remote Monitoring Stations
- 1973-74, 1980, 1986, 1989, and 1992, Airborne Gamma Radiation Surveys
- 1978-79, Technetium-99 in Soils near K-25
- 1983-87, Metals, PCBs, and Radionuclides in EFPC Floodplain Soils
- 1984, Radiation Survey of the Oak Ridge Sewer Beltway
- 1989-90, Surface Radiation Exposures to Hunters on ORR
- 1993, EFPC Remedial Investigation
- 1998, Radionuclides, metals, organics in Scarboro
- 2001, Radionuclides, metals, VOCs, SVOCs, pesticides, & PCBs in Scarboro

Air

- 1955-present, Particle Number, Fallout Particle Number, Beta Radioactivity, Beta Radioactivity in Rainwater, Uranium, Nickel, Lead, Chromium, Particulates (nickel, lead, chromium no longer sampled)
- 1963-present, I-131
- 1975-present, Particulate Gamma Emitters, SR-90, uranium, thorium
- 1986-present, Mercury
- 1990-present, Uranium Particulates, Flourides, Particulates
- 1993, EFPC Remedial Investigation

Drinking Water

- 1959-present, Radionuclides in Water from Clinch River Water Intakes
- 1981, 83, Radionuclides, Metals in Residential Well Water
- 1985, Radioactivity in Residential Well Water
- 1986, Radioactivity, Radionuclides, Inorganics in Residential Well Water
- 1986, 89-present, Metals, Organics, Radionuclides in Residential Drinking Water

PUBLIC HEALTH ACTIVITIES AT THE ORR

- 1942-93, Oak Ridge Health Studies Phase 1 Report—Dose Reconstruction Feasibility Study (10/93)
- 1942-90, PCBs, Phase II of Oak Ridge Health Studies Dose Reconstruction Reports (7/99)
- 1944-90, Uranium, Phase II of Oak Ridge Health Studies Dose Reconstruction Reports (7/99)
- 1944-56, White Oak Creek Releases, Phase II of Oak Ridge Health Studies Dose Reconstruction Reports (7/99)
- 1944-56, Iodine 131, Phase II of Oak Ridge Health Studies Dose Reconstruction Reports (7/99)
- 1950-63, Mercury, Phase II of Oak Ridge Health Studies Dose Reconstruction Reports (7/99)
- 1959, 1973, 1980, 1989, 1992, 1997, Aerial Radiological Surveys of the Scarboro Community (1998)
- 1980-92, Health Statistics Review of Mortality Rates (1994)
- 1984, Pilot Survey of Mercury Levels in Oak Ridge (10/85)
- 1985-95, Health Consultation on Lower Watts Bar Reservoir (2/96)
- 1988-90, Health Statistics Review to Address Oak Ridge Physician's Concerns (10/19/92)
- 1990-92, Health Consultation on Y-12 Weapons Plant Chemical Releases into East Fork Poplar Creek (3/93)
- 1992, Review of Clinical Information on Persons Living in or near Oak Ridge, Tennessee (9/92)
- 1995, Health Consultation on Proposed Mercury Clean-Up Levels (1/96)
- 1997, Watts Bar Reservoir Exposure Investigation (3/98)
- 1998, Scarboro Community Health Investigation (7/00)

1944 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005

II.C. Remedial and Regulatory History

Because ORR operations have generated a variety of radioactive and nonradioactive wastes, it was added to the National Priorities List (NPL) in 1989 (EPA 2002c). DOE is conducting clean-up activities at the ORR under a Federal Facility Agreement, which is an Interagency Agreement with the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC). This agreement allows for input from the public. These parties are working together to investigate and take remedial action on hazardous waste from past and present activities at the site. DOE is integrating required measures from the Resource Conservation and Recovery Act (RCRA) with response actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). See Figure 2 for a time line of surface water, biota, sediment, soil, air, and drinking water environmental monitoring data related to activities at the Y-12 plant.

The Federal Facility Agreement, which was implemented on January 1, 1992, is a legally binding agreement to establish timetables, procedures, and documentation for remediation actions at ORR. The Federal Facility Agreement is available online at http://www.bechteljacobs.com/facts/or/ffa.pdf.

Contaminants, such as uranium and mercury, are present in old waste sites, which occupy 5% to 10% of the ORR. The abundant rainfall (annual average of 55 inches) and high water tables (for example, 0 to 20 feet below the surface) on the reservation contribute to leaching of these contaminants, resulting in contaminated soil, surface water, sediments, and groundwater (EUWG 1998).

Since 1986 (when initial clean-up activities commenced), DOE has initiated approximately 50 response actions under the Federal Facility Agreement that address contamination and disposal issues on the reservation. In order to consolidate investigation and remediation of environmental contamination, the contaminated areas were divided into five large tracts of land, generally associated with the major hydrologic watersheds (EUWG 1998). The following remedial actions pertain to the Y-12 plant specifically:

- *Upper East Fork Poplar Creek (EFPC)* is located entirely on the site. It originates from a spring beneath the Y-12 plant and is initially confined to a manmade channel and flows

through the Y-12 plant along Bear Creek Valley. A Record of Decision (ROD) was negotiated between EPA, TDEC, and DOE that selected a number of different source control remedies to control the influx of mercury from the Y-12 plant into Upper EFPC. The major actions are the hydraulic isolation of contaminated soils in the West End Mercury Area, the treatment of the discharge of groundwater into Upper EFPC at Outfall 51, and the removal of contaminated sediments from Upper EFPC and Lake Reality. The goal is to restore surface water in Upper EFPC to human health recreational risk-based values at Station 17, which is where Upper EFPC flows into Lower EFPC (DOE 2002; EPA 2002a).

- *Lower East Fork Poplar Creek (EFPC)* flows north from the Y-12 plant off site into the city of Oak Ridge through a gap in Pine Ridge. Lower EFPC flows through residential and business sections of Oak Ridge to join Poplar Creek, which flows to the Clinch River. Lower EFPC was contaminated by releases of mercury and other contaminants, starting in the early 1950s. The remedial investigation/feasibility study (RI/FS) for Lower EFPC was completed in 1994. The ROD was approved in September 1995, and remediation field activities began in June 1996 (ATSDR et al. 2000). The Remedial Investigation and Proposed Plan ultimately led to the decision to excavate floodplain soils having mercury levels higher than 400 parts per million (ppm), sampling to ensure that all mercury above this level had been removed, and periodic monitoring (DOE 2001). The Agency for Toxic Substances and Disease Registry (ATSDR) evaluated the public health impacts of the 400 ppm clean-up level and concluded that it was protective of public health (ATSDR 1996).

- *Bear Creek Valley* is located on the reservation. A remedial decision for part of Bear Creek Valley was recently signed. Contaminated soil that is leaching uranium to groundwater and surface water is expected to be removed from the Boneyard/Burnyard and disposed of in an on-site CERCLA waste disposal facility and a capped aboveground disposal area. In addition, shallow groundwater near the S-3 ponds and the burial grounds will be treated through *in situ* reactive trenches (C.J. Enterprises 2001).

Further detailed information on remedial and regulatory information at the ORR can be found in *Oak Ridge Health Studies Phase 1 Report: Volume II – Part A – Dose Reconstruction Feasibility Study, Tasks 1 & 2, A Summary of Historical Activities on the Oak Ridge Reservation with Emphasis on Information Concerning Off-Site Emission of Hazardous Material* (ChemRisk 1993a); *Public Involvement Plan for CERCLA Activities at the U.S. Department of Energy, Oak Ridge Reservation* (C.J. Enterprises 2001); and *Oak Ridge Reservation Annual Site Reports*.

II.D. Land Use and Natural Resources

The ORR currently has about 35,000 acres with the three major DOE installations: the East Tennessee Technology Park (formerly the K-25 site), Oak Ridge National Laboratory (formerly the X-10 site), and the Y-12 National Security Complex (formerly the Y-12 plant) occupying about 30% of the reservation. The remaining 70% was established as a National Environmental Research Park in 1980, to provide protected land for environmental science research and education and to demonstrate that energy technology development can coexist with a quality environment. Large portions of the reservation, much of which had formerly been cleared for farmland, have grown into full forests over the past several decades. Some of this land includes areas known as "deep forest" that contain ecologically significant flora and fauna; portions of ORR are considered to be biologically rich (SAIC 2002).

The ORR also included an area set aside for residential, commercial, and support services. The city of Oak Ridge was created in 1942 to provide housing to the employees of ORR and was originally controlled by the military (Friday and Turner 2001). The self-governing portion of the city of Oak Ridge comprises about 14,000 acres and contains housing, schools, parks, shops, offices, and industrial areas. The urban population of Oak Ridge continued to grow over several decades, and some residential properties are located adjacent to the ORR boundary line. Outside the urban areas, much of the region (about 40%) is still a pattern of farms and small communities, as it was historically (ChemRisk 1993c).

Public access is restricted at the Y-12 plant, which is located entirely within the ORR "229 Boundary." Y-12 is "an active production and special nuclear materials management facility

[and so] additional security and access limitations apply" (DOE 2002). Out of 1,170 acres in the Upper EFPC area, 800 acres are currently used for industrial purposes. This area includes maintenance facilities, office space, training facilities, change houses, facilities that were formerly used by the Oak Ridge National Laboratory Biology Division, waste management facilities, construction contractor support areas, and a high-security portion that supports core National Nuclear Security Administration missions (DOE 2002).

A number of maps of this area indicate a wide range of land types, including "types of urban or built up land, agricultural land, rangeland, forestland, water, and wetlands," and uses that consist of "residential, commercial, public and semi-public, industrial, transportation, communication and utility, and extractive (e.g., mining)" (ChemRisk 1993c).

Agriculture (beef and dairy cattle) and forestry had been the two predominant land uses in the area around ORR; however, both of these uses are currently declining. For many years, milk was produced, bottled, and distributed locally. Corn, tobacco, wheat, and soybeans were the major crops grown in the area. Small game and waterfowl are hunted in the area continuously, and deer are hunted during certain periods (ChemRisk 1993c).

EFPC originates from within the Y-12 plant boundary, flows through the city of Oak Ridge for about 12 miles, and ultimately converges with Poplar Creek near the K-25 facility (DOE 1989). A number of small tributaries flow into the creek and support some small aquatic life. EFPC is classified by the state of Tennessee as appropriate for fishing, recreation, irrigation, livestock watering, and wildlife use (ATSDR 1993a). While people do not use the streams on the reservation, public access exists downstream from the reservation. The area that Lower EFPC flows through has many uses, which can be grouped into five categories: residential, commercial, agricultural, other, and DOE-owned (DOE 1995a). The creek appears to be too shallow for swimming, although some areas, particularly those near the confluence with Poplar Creek, are suitable for wading and fishing. TDEC issued a fishing advisory for EFPC that warns the public to avoid eating fish from the creek and to avoid contact with the water (ATSDR 1993a).

Groundwater is contaminated throughout much of the on-site Upper EFPC area. However, no one is currently using the groundwater in the area where a contaminated groundwater plume extends past the ORR boundary (i.e., in Union Valley to the east of ORR) (DOE 2002). The shallow groundwater along some off-site areas of the Lower EFPC floodplain contains metals at levels of public health concern; however, this off-site shallow groundwater is not used for drinking or other domestic purposes.

II.E. Demographics

Oak Ridge

The city of Oak Ridge, Tennessee, was established in Anderson County in 1942, for the 13,000 persons who were expected to work at the ORR (Friday and Turner 2001). By July 1944, the population of Oak Ridge had increased to 50,000. The population peaked at 75,000 in 1945 and decreased to 30,229 by 1950 (see Table 1) (Oak Ridge Comprehensive Plan 1988). In 1959, about 14,000 acres within the city of Oak Ridge became self-governing (ChemRisk 1993c). Almost since its establishment, the city of Oak Ridge has been the largest population center in the area (ChemRisk 1993c).

Table 1. Population of Oak Ridge from 1942 to 2000

	1942	1944	1945	1950	1960	1970	1980	1990	2000
Oak Ridge	13,000	50,000	75,000	30,229	27,169	28,319	27,662	27,310	27,387

Sources: ChemRisk 1993c; Oak Ridge Comprehensive Plan 1988; U.S. Census Bureau 2000

From 1940 to 1960, the city of Oak Ridge had a higher proportion of working age people and fewer seniors than the rest of Tennessee (ChemRisk 1993c). However, since 1960, the population of residents over age 35 and over age 55 has increased, while the population of children under age 16 has declined (Oak Ridge Comprehensive Plan 1988). The education level of Oak Ridge citizens is dramatically higher than in surrounding areas; Oak Ridge boasts one of the highest per capita ratios of Doctors of Philosophy (PhDs) of any city in the United States (Oak Ridge Comprehensive Plan 1988).

Scarboro

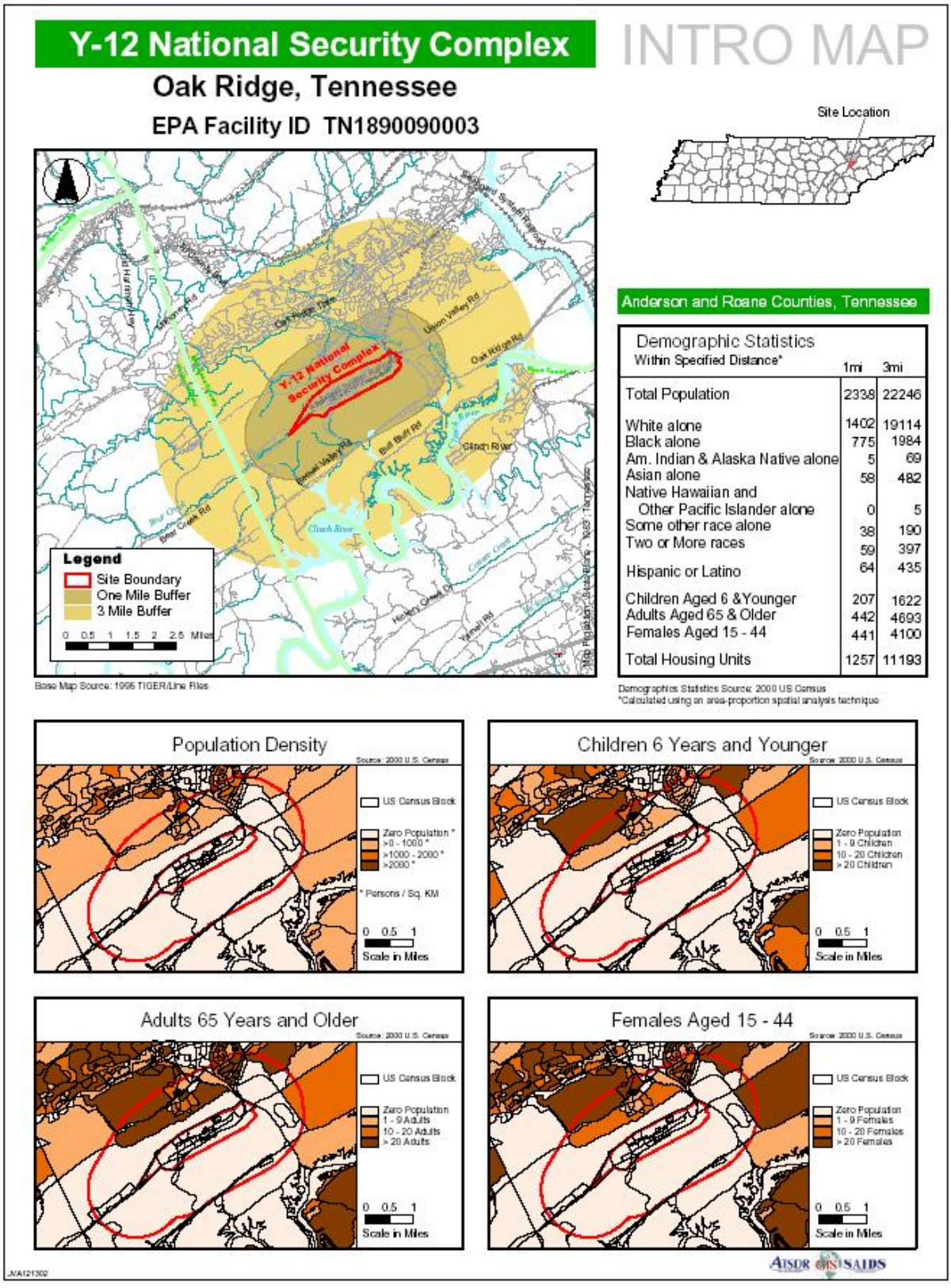
The Scarboro community is located within the city of Oak Ridge, about a half mile from the Y-12 plant and is separated from the Y-12 plant by Pine Ridge. Prior to 1950, the area was known as the Gamble Valley Trailer Camp, and the population was predominantly white. In 1950, Scarboro was established to provide single-family homes, duplexes, apartments, and an elementary school to African American Oak Ridge residents (Friday and Turner 2001). To this day, Scarboro remains predominantly African American (94%) (Joint Center Summary Number 4).

In the fall of 1999, the Joint Center for Political and Economic Studies conducted a survey of the broader Scarboro community (Friday and Turner 2001). The staff identified 380 residences, of which 326 were occupied, and about 266 persons responded to the survey (82%). The report generated from the survey is one of the few sources of detailed information available on the Scarboro community (Friday and Turner 2001). Some of the demographic information resulting from this survey is presented in the following paragraphs. For additional details, please see the *Scarboro Community Assessment Report* (Friday and Turner 2001).

The Scarboro community is aging—the average respondent is almost 53 years old and only 36% of participating households reported having at least one member between the ages of 18 and 34 years old. About half of the households reported having one senior citizen or more, while only 23% of the surveyed households reported having children. Additionally, 39% of respondents were retired. As of 1999, the average length of residence in Scarboro was 29 years. However, many (82%) of the young adult residents (18–30 years old) moved to Scarboro after 1994.

Figure 3 provides the current demographics for a 1-mile and 3-mile radius of the Y-12 plant.

Figure 3. Demographics within 1 and 3 miles of the Y-12 Plant



II.F. Summary of Public Health Activities Pertaining to Y-12 Uranium Releases

This section describes the public health activities that pertain to Y-12 uranium releases. Several additional public health activities that have been conducted at the ORR by ATSDR, the Tennessee Department of Health (TDOH), and other agencies are described in Appendix B. See Figure 2 for a time line of public health activities related to the Y-12 plant.

II.F.1. ATSDR

For the last 10 years, ATSDR has addressed health concerns of community members, civic organizations, and other government agencies by working extensively to determine whether levels of environmental contamination at and near the ORR present a public health hazard. During this time, ATSDR has identified and evaluated several public health issues and has worked closely with many parties, including community members, civic organizations, physicians, and several local, state, and federal environmental and health agencies. While the TDOH conducted the Oak Ridge Health Studies to evaluate whether off-site populations have experienced exposures in the *past*, ATSDR's activities focused on *current* public health issues to prevent duplication of the state's efforts. The following paragraphs highlight major public health activities conducted by ATSDR that pertain to Y-12 uranium releases.

Exposure Investigations, Health Consultations, and Other Scientific Evaluations. ATSDR health scientists have addressed current public health issues related to two areas affected by ORR operations—the EFPC area and the Watts Bar Reservoir area.

- *Health Consultation on Y-12 Weapons Plant Chemical Releases Into East Fork Poplar Creek, April 1993*. This health consultation provided DOE with advice on current public health issues related to past and present chemical releases into the creek from the Y-12 weapons plant. DOE implemented many of ATSDR's recommendations before finalizing its remedial investigation and feasibility study on EFPC. The EFPC Phase IA data evaluated for this health consultation indicate that the creek's soil, sediment,

groundwater, surface water, air, and fish are contaminated with various chemicals. ATSDR made the following public health conclusions.

1. Soil and sediments in certain locations along the EFPC floodplain are contaminated with levels of mercury that pose a public health concern.

2. Fish in the creek contain levels of mercury and polychlorinated biphenyls (PCBs) that pose a moderately increased risk of adverse health effects to people who eat fish frequently over long periods of time.

3. Shallow groundwater in a few areas along the EFPC floodplain contains metals at levels of public health concern; however, this shallow groundwater is not used for drinking or other domestic purposes.

Other contaminants, including radionuclides found in soil, sediment, surface water, and fish, were not detected at levels of public health concern.

- *Health Consultation on the Lower Watts Bar Reservoir, February 1996*. ATSDR concluded that PCBs detected in fish from lower Watts Bar Reservoir pose a public health concern. Frequent and long-term ingestion of fish from the reservoir poses a moderately increased risk of cancer and may increase the possibility of developmental effects in infants whose mothers consume fish regularly during gestation and while nursing. ATSDR also found that current levels of contaminants in the reservoir surface water and sediment were not a public health concern, and that the reservoir was safe for swimming, skiing, boating, and other recreational purposes. Additionally, water from the municipal water systems was safe to drink. ATSDR also reported that DOE's selected remedial actions would protect public health. These actions include maintaining the fish consumption advisories; continuing environmental monitoring; implementing institutional controls to prevent disturbance, resuspension, removal, or disposal of contaminated sediment; and providing community and health professional education about the PCB contamination.

Coordination with other parties. Since 1992 and continuing to the present, ATSDR has consulted regularly with representatives of other parties involved with the ORR. Specifically, ATSDR has coordinated efforts with TDOH, TDEC, the National Center for Environmental Health (NCEH), the National Institute for Occupational Safety and Health (NIOSH), and DOE. This effort led to the establishment of the Public Health Working Group in 1999, which led to the establishment of the Oak Ridge Reservation Health Effects Subcommittee (ORRHES). In addition, ATSDR provided some assistance to TDOH in its study of past public health issues. ATSDR has also obtained and interpreted studies prepared by academic institutions, consulting firms, community groups, and other parties.

- *Oak Ridge Reservation Health Effects Subcommittee*. ORRHES was created to provide a forum for communication and collaboration between citizens and the agencies that are evaluating public health issues and conducting public health activities at the ORR. The ORRHES was established in 1999 by ATSDR and Centers for Disease Control and Prevention (CDC) under the authority of the Federal Advisory Committee Act (FACA) as a subcommittee of the U.S. Department of Health and Human Services' Citizens Advisory Committee on Public Health Service Activities and Research at DOE Sites. The Subcommittee consists of individuals who represent diverse interests, expertise, backgrounds, and communities, as well as liaison members from state and federal agencies. To help ensure citizen participation, meetings of the Subcommittee's work groups are open to the public and anyone may attend and present ideas and opinions. The Subcommittee performs the following functions:

  - Serves as a citizen advisory group to CDC and ATSDR and provides recommendations on matters related to public health activities and research at the ORR.

  - Provides an opportunity for citizens to collaborate with agency staff members and to learn more about the public health assessment process and other public health activities.

- Helps to prioritize the public health issues and community concerns to be evaluated by ATSDR.

Figure 4 shows the organizational structure of the ORRHES, and Figure 5 provides a chart that graphically demonstrates the process of providing input into the public health assessment process. For more information on the ORRHES, visit the ORRHES Web site at http://www.atsdr.cdc.gov/HAC/oakridge/index.html.

➢ *ORRHES Work Groups*. The ORRHES may create various work groups to conduct in-depth exploration of specific issues and present findings to the Subcommittee for deliberation. Work group meetings are open to all who wish to attend and participate. The following ORRHES work groups were established:

- Agenda Work Group
- Communications and Outreach Work Group
- Health Education Needs Assessment Work Group
- Public Health Assessment Work Group
- Guidelines and Procedures Work Group

➢ *ATSDR Field Office*. In 2001, ATSDR opened a field office in Oak Ridge. The office was opened to promote collaboration between ATSDR and communities surrounding the ORR by providing community members with opportunities to become involved in ATSDR's public health activities at the ORR. The ATSDR field office is located at 1975 Tulane Avenue, Oak Ridge, Tennessee. ATSDR field office staff can be contacted by calling 865-220-0295.

1

Where can one obtain more information on ATSDR's activities at Oak Ridge?

ATSDR has conducted several additional analyses that are not documented here or in Appendix B, as have other agencies that have been involved with this site. Community members can find more information on ATSDR's past activities by the following three ways:

1. *Visit one of the records repositories.* Copies of ATSDR's publications for the ORR, along with publications from other agencies, can be viewed in records repositories at the Oak Ridge Public Library, the DOE Information Center in Oak Ridge, and the TDOH. For directions to these repositories, please contact the ATSDR Oak Ridge field office at 865-220-0295.

2. *Visit the ATSDR or ORRHES Web sites.* These Web sites include our past publications, schedules of future events, and other information materials. ATSDR's Web site is at www.atsdr.cdc.gov and the ORRHES site is at www.atsdr.cdc.gov/HAC/oakridge. The most comprehensive summary of past activities can be found at http://www.atsdr.cdc.gov/HAC/oakridge/phact/c_toc.html.

3. *Contact ATSDR directly.* Residents can contact representatives from ATSDR directly by dialing the agency's toll-free number, 1-888-42ATSDR (or 1-888-422-8737).

Figure 4. Organizational Structure for the Oak Ridge Reservation Health Effects Subcommittee

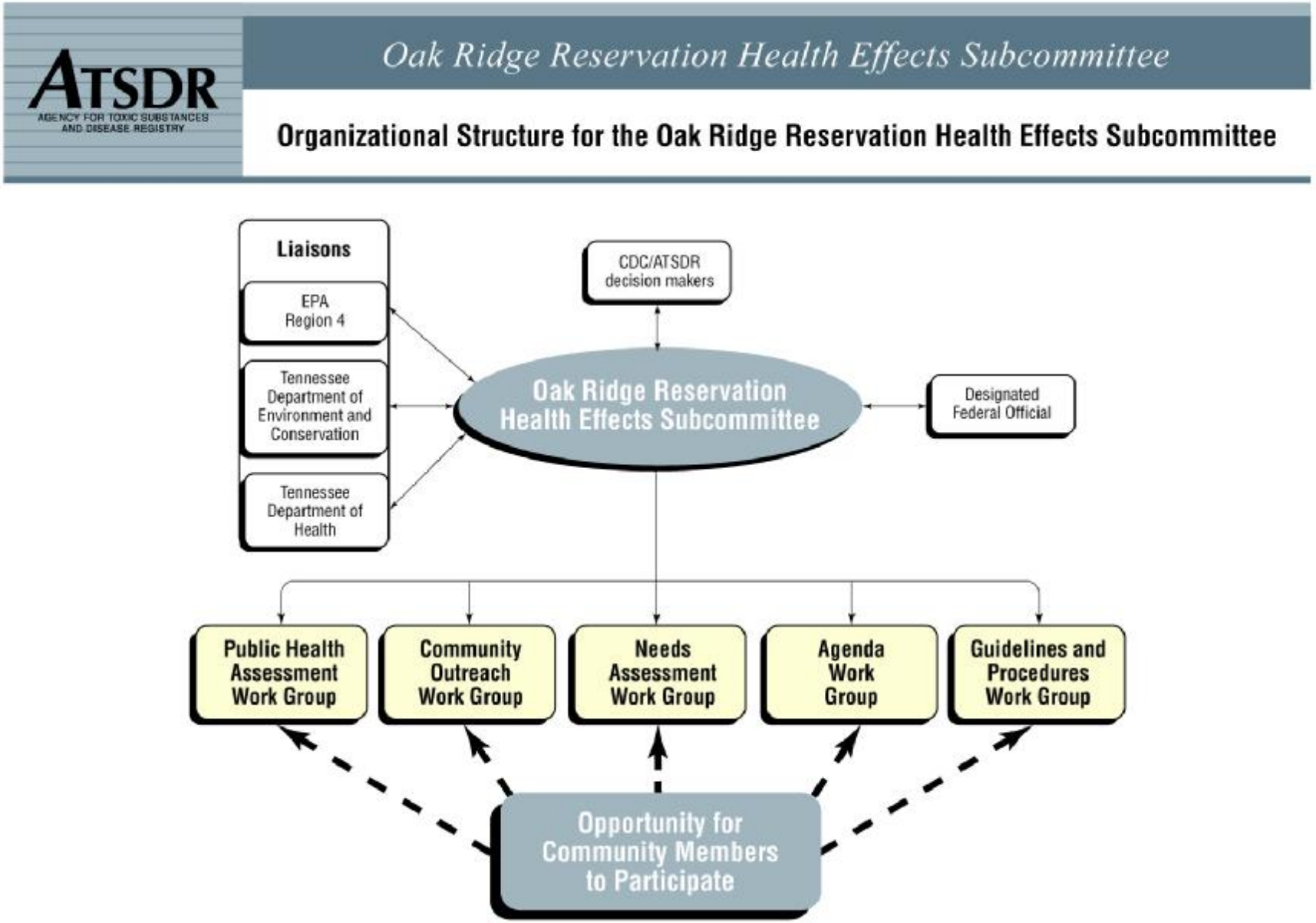
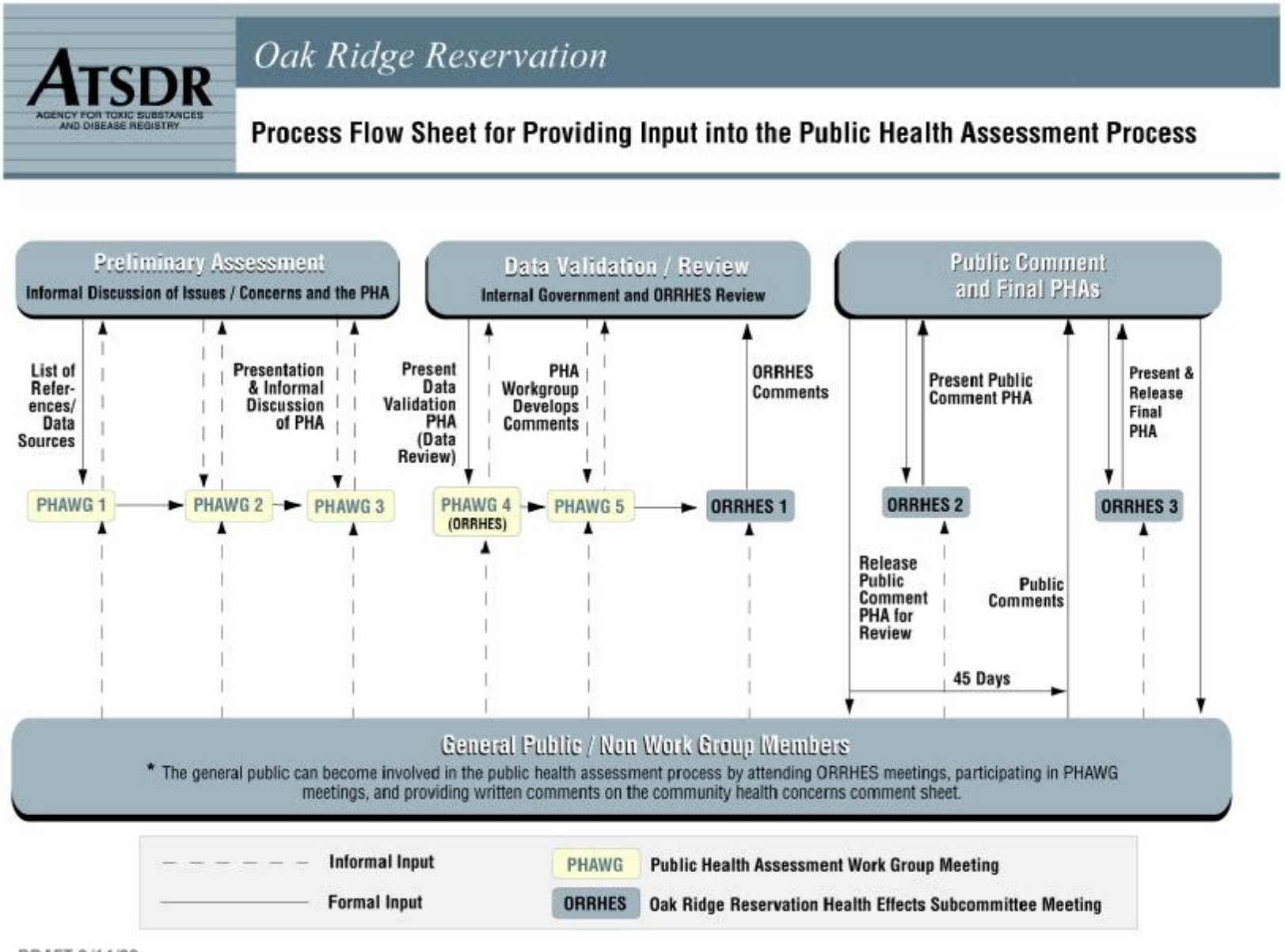


Figure 5. Process Flow Sheet for Providing Input into the Public Health Assessment



II.F.2. TDOH

Oak Ridge Health Studies. In 1991, DOE and the state of Tennessee entered into the Tennessee Oversight Agreement, which allowed the TDOH to undertake a two-phase independent state research project to determine whether past environmental releases from ORR operations harmed people who lived nearby (ORHASP 1999).

- *Phase I.* Phase I of the Oak Ridge Health Study is a Dose Reconstruction Feasibility Study. This feasibility study evaluated all past releases of hazardous substances and operations at the ORR. The objective of the study was to determine the quantity, quality, and potential usefulness of the available information and data on these past releases and subsequent exposure pathways. Phase I of the health studies began in May 1992 and was completed in September 1993.

  The findings of the Phase I Dose Reconstruction Feasibility Study indicated that a significant amount of information was available to reconstruct the past releases and potential off-site exposure doses for four hazardous substances that may have been responsible for adverse health effects. These four substances include (1) radioactive iodine releases associated with radioactive lanthanum processing at X-10 from 1944 through 1956; (2) mercury releases associated with lithium separation and enrichment operations at the Y-12 plant from 1955 through 1963; (3) PCBs in fish from EFPC, the Clinch River, and the Watts Bar Reservoir; and (4) radionuclides from White Oak Creek associated with various chemical separation activities at X-10 from 1943 through the 1960s.

- *Phase II (also referred to as the Oak Ridge Dose Reconstruction).* Phase II of the health studies conducted at Oak Ridge began in mid-1994 and was completed in early 1999. Phase II primarily consisted of a dose reconstruction study focusing on past releases of radioactive iodine, radionuclides from White Oak Creek, mercury, and PCBs. In addition to the full dose reconstruction analyses, the Phase II effort also included additional detailed screening analyses for releases of uranium and several other toxic substances that

had not been fully characterized in Phase I. The significant findings for each of the substances evaluated are presented in the following paragraphs.

- Radioactive iodine releases were associated with radioactive lanthanum processing at X-10 from 1944 through 1956. Results indicate that children who were born in the area in the early 1950s and who drank milk produced by cows or goats living in their yards, had an increased risk of developing thyroid cancer. The report stated that children living within a 25-mile radius of Oak Ridge were likely to have had an increased risk of more than 1 in 10,000 of developing thyroid cancer.

- The study evaluated mercury releases associated with lithium separation and enrichment operations at the Y-12 plant from 1955 through 1963. Results indicate that depending on their activities, individuals living in the area during the years that mercury releases were highest (mid-1950s to early 1960s) may have received annual average doses of mercury exceeding the EPA reference dose.

EPA's reference dose is an estimate of the largest amount of a substance that a person can take in on a daily basis over their lifetime without experiencing adverse health effects.

- Additional studies were conducted on PCBs in fish from EFPC, the Clinch River, and the Watts Bar Reservoir. Preliminary results indicated that individuals who consumed a large amount of fish from these waters might have received doses that exceeded the EPA reference dose for PCBs.

- Radionuclides associated with various chemical separation activities at the X-10 site from 1943 through the 1960s were released into White Oak Creek. Eight radionuclides (cesium 137, ruthenium 106, strontium 90, cobalt 60, cerium 144, zirconium 95, niobium 95, and iodine 131) deemed more likely to carry significant risks were studied. The results indicate that the releases caused small increases in the radiation dose of individuals who consumed fish from the Clinch River near the mouth of White Oak Creek. The dose reconstruction scientists estimated that a man who ate up to 130 meals of fish from the mouth of White Oak Creek every year for

50 years (worst-case scenario) would face an excess cancer risk ranging from 4 to 350 in 100,000. The risk from eating fish goes down proportionately for people who eat fewer fish and for people who eat fish caught farther downstream.

- Uranium was released from various large-scale uranium operations, primarily uranium processing and machining operations at the Y-12 plant and uranium enrichment operations at the K-25 and S-50 plants. Because uranium was not initially given high priority as a contaminant of concern, a Level II screening assessment for all uranium releases was performed. Preliminary screening indices were slightly below the decision guide of one chance in 10,000, which indicated that more work may be needed to better characterize uranium releases and possible heath risk.

➢ *The Oak Ridge Health Agreement Steering Panel (ORHASP)*—a panel of experts and local citizens—was appointed to direct and oversee the Oak Ridge Health Studies and provide liaison with the community. Based on the findings of the Oak Ridge Health Studies and what is generally known about the health risks posed by exposures to various toxic chemicals and radioactive substances, ORHASP concluded that past releases from ORR were likely to have affected the health of some people. Two groups most likely to have been harmed were (1) local children who drank milk produced by a "backyard" cow or goat in the early 1950s and (2) fetuses of women who routinely ate fish from contaminated creeks and rivers downstream of ORR in the 1950s and early 1960s. The Panel made eight recommendations in their project summary report:

1. Three specific initiatives directed to public health intervention should be undertaken:

    a) In partnership with a local college or university, a series of workshops should be periodically conducted for local physicians and other health professionals who need to be educated on ORR environmental and occupational health issues arising from the Oak Ridge Health Agreement Studies and other related health studies, as results become available.

b) In partnership with a local community college or community outreach program, a public information colloquium should be conducted to provide continuing dialogue and education on environmental and occupational health issues relevant to past, current, and future ORR operations.

c) A partnership working group of local, state, and federal public health officials, health care professionals and representatives of the greater Oak Ridge community should be established to evaluate the need for a formal clinical evaluation process. If such a process is determined to be feasible, the group should formulate recommendations for the development of (1) a goal for a formal community clinical evaluation process; (2) the types of and qualifications for health care professionals who would be involved in the clinical evaluations of concerned members of the community; and (3) protocol guidelines for individual clinical evaluations and referral for follow-up examinations. The group suggested that the results contained in this report and the other reports published as part of the Oak Ridge Health Agreement Studies serve as a basis for the development of such protocol guidelines.

2. Formal epidemiologic studies of populations exposed to iodine 131, mercury, PCBs, and radionuclides from White Oak Creek are unlikely to be successful and should not be performed at this time.

3. DOE, EPA, the state (and perhaps other agencies) should undertake a coordinated program to obtain needed information and satisfy stakeholder concerns. A soil sampling program is vital to gain information relevant to the historic contamination levels in residential areas closest to the ORR plants. Detailed sampling is recommended in all of the most closely situated neighborhoods and also in a few residential areas at greater distances. Any decision about additional dose reconstruction studies should be deferred until the results of the

recommended soil sampling program have been obtained and carefully interpreted.

4. DOE should undertake a program to measure the atmospheric dispersion of controlled tracer releases from representative stacks and vents at Y-12. The primary goal of these measurements would be to define the transport of a nondepositing tracer such as SF6 from the Y-12 plant to populated areas of Oak Ridge, including the Scarboro and Woodland communities, which are both relatively close to the plant.

5. More definitive information is needed to better understand the potential toxic effects of exposures to mixtures of contaminants—mercury and PCBs, for example—on the same organ systems. Studies relating to this topic should be undertaken by one or more appropriate government-sponsored public health research agencies.

6. DOE should take action to assure that copies of the important documents used in the health effects studies are properly indexed and retained at a secure location, irrespective of future shifts of contractor responsibility at the ORR facilities.

7. DOE should assure the long-term continuation of the ORR environmental monitoring program. The program should include routine measurements in critical media for those materials found to be most important in the health agreement studies, if the material in question could still be present in the local environment. Specifically, the ORR program should (a) continue to monitor the remaining environmental burden of mercury in EFPC within the Y-12 plant, in the lower EFPC floodplain, and in sediment in the downstream watercourses, tracking the resulting methyl mercury risk to consumers of fish taken from downstream fisheries; and (b) assure that the program continues to monitor uranium contamination originating from Y-12, with due consideration of isotopic form.

8. In the area of statewide health effects registries, (a) the state should continue efforts to improve the accuracy and completeness of the cancer incidence registry, and (b) the state should continue to seek funding for a statewide birth defects registry.

- *Feasibility of Epidemiologic Studies*. A study was conducted to explore the feasibility of initiating analytical (for example, case-control or cohort) epidemiological studies to address potential health concerns in the off-site populations surrounding the ORR. TDOH and the ORHASP contracted with a physician from Vanderbilt University's Department of Preventive Medicine to conduct the study. The study was released in July 1996. The study concluded that the feasibility and desirability of initiating future analytical epidemiologic studies would be significantly influenced by the findings of the dose reconstruction studies which will clarify the extent and magnitude of releases and possible human exposure from past releases of radioactive iodine, mercury, PCBs, uranium, and other radionuclides, including cesium 137.

- *Public Meetings*. Between January 1992 and December 1999, TDOH and ORHASP held open meetings in Oak Ridge (more than 40 meetings), Nashville (5 meetings), Harriman (2 meetings), and Knoxville (3 meetings). In addition, the ORHASP held two meetings in the Scarboro area to update the residents on Phase II of the Oak Ridge Health Studies. The first meeting was held at the Oak Valley Baptist Church in November 1995, and the second meeting was held at the Scarboro Community Center in September 1997.

II.F.3. Other Agencies

Scarboro Community Health Investigation. In November 1997, a Nashville newspaper published an article about illnesses among children living near the nuclear weapons facility at the ORR in eastern Tennessee. The article described a high rate of respiratory illness among residents of the nearby community of Scarboro; it told of 16 children who had repeated episodes of "severe ear, nose, throat, stomach, and respiratory illnesses." Among those respiratory illnesses were asthma, bronchitis, sinusitis, allergic rhinitis, and otitis media. The article implied that exposure to the

ORR caused these illnesses especially given the proximity of these children's residences to ORR facilities. In response to this article, the Commissioner of the TDOH asked the CDC to work with the department to investigate the situation in Scarboro. The Scarboro Community Health Investigation, which included a community health survey and a follow-up medical evaluation of children under 18 years of age, was coordinated by TDOH to investigate a reported excess of respiratory illness among children in the Scarboro community. This investigation, both the survey and the examination components, was mainly designed to measure the rates of common respiratory illnesses among children who reside in Scarboro, compare these rates with national rates, and to determine if there were any unusual characteristics of these illnesses. The investigation was not designed to find what caused the illnesses.

In 1998, a study protocol was developed and a community health survey was administered to the members of each household in the community. The purpose of the survey was to determine whether the rates of certain diseases were higher in Scarboro than elsewhere in the United States and to determine whether exposure to various factors increased residents' risk for health problems. In addition, information regarding occupations, occupational exposures, and general health concerns was collected for adults. The participation/response rate of the health investigation survey was 83% (220/264 households) and included 119 questionnaires about children living in these households and 358 questionnaires about adults. In September 1998, CDC released the preliminary results of the survey. The asthma rate was 13% among children in Scarboro, compared to national estimates of 7% among all children aged 0–18 years and 9% among African American children aged 0–18 years. The Scarboro rate was, however, within the range of rates from 6% to 16% reported in similar studies throughout the United States. The wheezing rate among children in Scarboro was 35%, compared to international estimates that range from 1.6% to 36.8%. With the exception of unvented gas stoves, no statistically significant association was found between exposure to common environmental triggers of asthma (that is, pests, environmental tobacco smoke, and the presence of dogs or cats in the home) or potential occupational exposures (such as living with an adult who works at the ORR or living with an adult who works with dust and fumes and brings exposed clothes home for laundering), and asthma or wheezing illness.

Based on the information obtained in the health investigation survey, 36 children, including those identified in the media report, were invited to receive a physical examination. These examinations were conducted in November and December 1998 to confirm the results of the community survey, to determine whether children with respiratory illnesses were getting the medical care they needed, and to determine whether the children reported in the newspaper to have respiratory medical problems really had these problems. Children who were invited to participate met one or more conditions: (1) severe asthma, defined as more than 3 episodes of wheezing or visiting an emergency room because of these symptoms; (2) severe undiagnosed respiratory illness, defined as more than 3 episodes of wheezing and visiting an emergency room because of these symptoms; (3) respiratory illness and no regular source of medical care; or (4) identified as having respiratory illness in newspaper reports. Of the 36 children invited, 23 participated in the physical examination. Some of the eligible 36 children had moved out of Scarboro; others either were not available or decided not to participate.

During the physical examination, nurses asked children who participated and their parents a series of questions about the health of the child; volunteer pediatricians reviewed the results of the nurse interview and examined the children. In addition to direct physical examinations, children also underwent a blood test and a special breathing test. If the examining doctor thought the child needed an x-ray to complete the assessment, this was done. All examinations, tests, and transportation to and from Knoxville were provided free of charge.

Immediately after the examinations, the results were reviewed and none of the children had findings that needed immediate intervention. A number of laboratory tests were found to be either above or below the normal range, such as blood calcium level, blood hemoglobin level, or breathing test abnormality. Following the initial review of results, laboratory results were communicated by letter or telephone to the parents of the children and their doctors. If the parents did not want the results sent to a doctor, the results were given to the parents by telephone. The parents of children with any health concern identified as a result of the examination were sent a personal letter from Paul Erwin, M.D., of the East Tennessee Regional Office of the TDOH, informing them of the need for follow-up with their medical provider. If they did not have a medical provider, they were to contact Brenda Vowell, RNC, Public Health

Nurse, East Tennessee Regional Office of the TDOH, for help in finding a provider and possible TennCare or Children's Special Service.

In January 1999, a team of physicians representing CDC, TDOH, the Oak Ridge medical community, and the Morehouse School of Medicine, thoroughly reviewed the findings of the physical examinations and the community survey. Of the 23 children who were examined, 22 had evidence of some form of respiratory illness (reported during the nurse interview or discovered during the doctor's examination). Overall, the children appeared healthy and no problems that needed urgent management were identified. Several children had mild respiratory illnesses at the time of the examination; only one child had findings of an abnormality of the lungs at the time of the examination. None of the children had wheezing. The examinations did not indicate any unusual pattern of illness among children in Scarboro. The illnesses that were detected were not more severe than would be expected and were typical of those that might be found in any community. The findings of examinations essentially confirmed the results of the community health survey. The results of the review were presented on January 7, 1999, at a community meeting in Scarboro. The final report was released in July 2000.

Three months after the letters went to the parents and physicians about the findings, attempts were made to telephone the parents of children who participated. Eight parents were successfully contacted. Because some of the parents had more than one child who was examined, questions addressed the health of 14 children. Parents of nine children could not be contacted despite attempts on several days to contact them by telephone.

Of the 14 children whose parents had been contacted, 7 had seen a doctor since the examinations. In most cases, the health of the child was the about the same, although one child had been hospitalized because of asthma, and another child's asthma medication had been increased to treat worsening asthma. Several children had nasal allergies, and several parents mentioned difficulties in obtaining medicines because of cost and lack of coverage by TennCare for the particular medicines. Health department nurses subsequently have assisted these parents in getting the needed medicines.

Scarboro Community Environmental Study. In 1998, soil, sediment, and surface water were sampled in the Scarboro community to address community concerns about environmental monitoring in the Scarboro neighborhood. The analytical component of the study was conducted by the Environmental Sciences Institute at Florida Agricultural and Mechanical University (FAMU) and its contractual partners at the Environmental Radioactivity Measurement Facility at Florida State University and the Bureau of Laboratories of the Florida Department of Environmental Protection, and by DOE subcontractors in the Neutron Activation Analysis Group at the Oak Ridge National Laboratory. Organic compounds were only detected in one of the samples tested. This same sample also contained lead and zinc at concentrations twice as high as that found in the Background Soil Characterization Project (DOE 1993). Mercury was found within the range given in the Background Soil Characterization Project, and about 10% of the soil samples showed evidence of enrichment in uranium 235. The final Scarboro Community Environmental Study was released in September 22, 1998, during a Scarboro community meeting (FAMU 1998).

Scarboro Community Environmental Sampling Validation Study. In 2001, EPA's Science and Ecosystem Division Enforcement Investigation Branch collected soil, sediment, and surface water samples from the Scarboro community to respond to community concerns, identify data gaps, and validate the sampling performed by FAMU in 1998 (FAMU 1998). A draft report was released in September 2002 (EPA 2002b). EPA concluded that the results support the sampling performed by FAMU in 1998, and that the residents of Scarboro are not currently being exposed to harmful levels of substances from the Y-12 plant.