VI. Community Health Concerns

ATSDR actively gathers comments and other information from those who live or work near the ORR. ATSDR is particularly interested in hearing from area residents, civic leaders, health professionals, and community groups. ATSDR will be addressing these community site-related health concerns in the ORR public health assessments that are related to those concerns.

To improve the documentation and organization of community health concerns at the ORR, ATSDR developed a *Community Health Concerns Database* specifically designed to compile and track community health concerns related to the site. The database allows ATSDR to record, track, and respond appropriately to all community concerns, and also to document ATSDR's responses to these concerns.

From 2001 to 2003, ATSDR compiled more than 2,500 community health concerns obtained from the ATSDR/ORRHES community health concerns comment sheets, written correspondence, phone calls, newspapers, comments made at public meetings (ORRHES and work group meetings), and surveys conducted by other agencies and organizations. These concerns were organized in a consistent and uniform format and imported into the database.

The community health concerns addressed in this public health assessment are those concerns in the ATSDR Community Health Concerns Database that are related to issues associated with radionuclide releases from White Oak Creek. The following table contains the actual comments and ATSDR's responses. These concerns and responses are sorted by category (Clinch River exposure pathway concerns, concerns about contaminants associated with X-10's releases to WOC, geographic area concerns, and other concerns that are generally related to the ORR).

1 **Community Health Concerns From the Oak Ridge Reservation Community Health Concerns Database**

	Actual Comment	*ATSDR's Response*
X-10 Processes and Exposure Pathways Evaluated		
1	My first thoughts are what are the routes of entry, what are we looking at from the waterway, from the airway, from the soil. Because if you are talking about the water and fisherman and residents you're talking downstream. But if you're talking wind, I don't know where that ends. I would like to hear what are you're thoughts are on what routes are we looking at. That would expand it even further if you look at sports men and the hunting migration.	This public health assessment evaluates the releases of radionuclides from the X-10 facility (now known as the Oak Ridge National Laboratory [ORNL]) into the water in White Oak Creek, and also assesses past and current off-site exposures to these radionuclides in the water for residents living within the White Oak Creek study area (the area along the Clinch River and the Lower Watts Bar Reservoir from the Melton Hill Dam to the Watts Bar Dam [see Figure 11]). This public health assessment evaluates the following key issues and concerns: contacting surface water and sediment during recreation; consuming game animals, fish, turtles, and homegrown vegetables; and exposure to external radiation. Please see Section. III.B. Exposure Evaluation of the Clinch River and Lower Watts Bar Reservoir and Figure 20. Possible Exposure Situations Along the Clinch River for more details.
2	How did they/are we looking at the X-10's major processes that may still be delivering an effect? There were cesium releases from the dam in 1985. And a flood in 1964 along with regular releases.	The Tennessee Department of Health's 1999 Reports of the Oak Ridge Dose Reconstruction, Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-Site Radiation Doses, and Health Risks (referred to as the "Task 4 report") focused on historical X-10 radionuclide releases to White Oak Creek dating back to 1944. ATSDR has evaluated the historical data, as well as data that were collected since the dose reconstruction (for example, data from the state of Tennessee, EPA, and DOE). As a result, this public health assessment evaluates both the past and current off-site exposures related to radionuclides from X-10. In this public health assessment, ATSDR considers the potential effects from the releases of cesium that occurred when severe rains caused a flood that eroded the bottom sediment of White Oak Lake (Blaylock et al. 1993; ChemRisk 1999a). In addition, the Task 4 report estimated the amount of radionuclides that were released to White Oak Dam, and ATSDR considers these releases in its public health assessment (ChemRisk 1999a). See Appendix D for a brief on the Task 4 report. Copies of the Task 4 report are available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 865-241-4780) or through DOE's public-use database at http://cedr.lbl.gov/DR/dror.html.

	Actual Comment	*ATSDR's Response*
3	The problems of the buried waste include little documentation on low-level waste, and that the X-10 records on high-level waste were destroyed in 1984. Some were reconstructed, but in general that is not an accurate inventory. That makes more important the good records of the outflows off the reservation.	In general, the records on X-10's earlier operations are not complete. However, a rather accurate account of X-10's major waste generating programs has been created from reviewing available records and by interviewing employees who worked at X-10 throughout most of its operational history. Six activities were determined to be responsible for basically all of X-10's waste production and on-site waste disposal. The six activities were the following (EPA et al. 1996): ▪ Fuel reprocessing ▪ Isotope production ▪ Waste management ▪ Radioisotope applications ▪ Reactor developments ▪ Multi-program laboratory operations The liquid and solid waste streams that were generated by these activities at X-10 can be described as non-hazardous, chemically hazardous, radioactive, or mixed (for example, consisting of both hazardous chemicals and radioactive substances). Even though X-10 generates various types of waste streams, the majority of its hazardous waste is mixed or radioactive. In addition to X-10's on-site waste production, a large amount of solid, low-level radioactive wastes that were produced at other sites are brought to the X-10 site for disposal. Several remedial activities have been conducted at the X-10 site (EPA et al. 1996). See Section II.C. Remedial and Regulatory History for more details. In addition, the Tennessee Department of Health evaluated radioactive waste disposal at X-10 dating back to 1944 in its Task 4 report entitled *Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-site Radiation Doses, and Health Risks*. See Appendix D for a brief on the 1999 Task 4 report. Copies of the Task 4 report are available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 865-241-4780) or through DOE's public-use database at http://cedr.lbl.gov/DR/dror.html.

	Actual Comment	ATSDR's Response
4	A subcommittee member asked whether, since vegetables and fish are the dominant pathways, people who live downstream are at higher risk.	In 1996, ATSDR conducted a health consultation to evaluate the health implications of current exposure to chemical and radiological contaminants in the Lower Watts Bar Reservoir surface water, sediment, and fish. ATSDR concluded that only PCBs in reservoir fish were of potential public health concern. The current levels of other contaminants in surface water, sediment, and fish were not a public health hazard. See Appendix D for a brief on the *1996 Health Consultation on the Lower Watts Bar Reservoir.* In this public health assessment, ATSDR evaluated radioactive contaminant data for the Clinch River and the Lower Watts Bar Reservoir surface water, sediment, vegetables, fish, and local game animals to determine whether the levels of radionuclides might pose a past, current, or future public health hazard. This evaluation included the following exposure scenarios: ▪ Incidental ingestion of water during recreational activities ▪ Contact with water (and sediment) during recreational activities ▪ Contact with dredged sediment used as topsoil in home gardens ▪ Consumption of locally produced milk and meats ▪ Consumption of fish or local game animals ATSDR concluded that people who used or lived near the Clinch River and the Lower Watts Bar Reservoir could have contacted these radionuclides in the past by eating fish and meat, drinking milk and water, and walking along shoreline sediment. In the past, people who frequently ate fish caught near Jones Island (close to the mouth of White Oak Creek) would have had slightly higher radiation doses and an increased theoretical risk above background of developing cancer. ATSDR believes that the actual risk of developing disease or cancer for people who ate fish from the Clinch River is small, if it exists at all. In addition, past exposure to radionuclides from drinking milk and water, walking along the shoreline, or eating meat and fish further downstream from Jones Island is not a health hazard and is not expected to result in adverse health effects or cancer. Therefore, ATSDR concluded that past exposures to radionuclides in sediment, surface water, and food in the Clinch River and the Lower Watts Bar Reservoir pose *no apparent public health hazard.* ATSDR concluded that current exposures to radionuclides from drinking surface water, contacting surface water and shoreline sediment via recreation, and consuming fish and game is not a health hazard because current exposure to radionuclides in the Clinch River and Lower Watts Bar Reservoir would result in radiation doses below levels expected to cause adverse health effects. Thus, current exposure to radionuclides released into White Oak Creek poses *no apparent public health hazard.* ATSDR is still evaluating past exposure to mercury and PCBs in the Clinch River and Lower Watts Bar Reservoir, and will address the health implications of past exposure to these contaminants in future public health assessments.

	Actual Comment	*ATSDR's Response*
5	My question is about safe gardening. How could you consider safe gardening in a contaminated soil?	The general answer is that it depends on what the soil is contaminated with and how much it is contaminated. This public health assessment evaluates exposures to radioactive contaminants released to the Clinch River and the Lower Watts Bar Reservoir via White Oak Creek. In the dose reconstruction of radionuclides released historically, the Task 4 report determined that the radionuclide levels in irrigation water (for homegrown vegetables) were below screening levels and therefore were not considered a hazard to people who ate locally grown vegetables. Given its assessment of both past and current data, ATSDR does not believe that radionuclides in soil within the White Oak Creek study area present a health hazard for people who consume vegetables from their gardens. ATSDR will address this question further when it considers other contaminants in future public health assessments. As a general rule, ATSDR recommends that everyone wash and peel all homegrown fruits, vegetables, and root crops before consumption. For more information on ATSDR's analysis of homegrown vegetables, see Section III.B. Exposure Evaluation of the Clinch River and Lower Watts Bar Reservoir for more details.
6	Was any analysis done of the game living on the reservation?	The annual DOE monitoring reports include analysis of some of the game that live on the reservation. Also, some of the ecological studies conducted under EPA's Superfund clean up work will include data on game. These DOE monitoring reports are available from the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee. You can obtain documents from the Information Center at http://www.oakridge.doe.gov/info_cntr/index.html or by calling 865-241-4780. This public health assessment evaluates the past consumption of fish and the current (1988–present) consumption of fish, geese, and turtles that might have lived on the reservation property. Please see Section III.B. Exposure Evaluation of the Clinch River and the Lower Watts Bar Reservoir for more information.

	Actual Comment	*ATSDR's Response*
7	People, actually, some of you might kind of take this lightly, but a lot of people in Oak Ridge feel this same way, a lot of people in Oak Ridge don't drink Oak Ridge water. They buy water. They don't drink Oak Ridge water.	Oak Ridge is supplied with public water from a water treatment plant that draws surface water from Melton Hill Lake. The intake at the lake is located approximately 1 mile upstream of the ORR. Until May 2000, DOE owned and operated the water treatment plant at its Y-12 facility and sold drinking water to the city of Oak Ridge for distribution to residents and businesses. The city of Oak Ridge now owns and operates the water distribution system (City of Oak Ridge 2002). Under the Safe Drinking Water Act, EPA sets health-based standards for hundreds of substances in drinking water and specifies treatments for providing safe drinking water (U.S. EPA 1999). The public water supply for Oak Ridge is continually monitored for these regulated substances. The Tennessee Department of Environment and Conservation (TDEC) receives a copy of the monitoring report to ensure that people are receiving clean drinking water. More information about the quality of the Oak Ridge public water supply system can be found at: http://www.cortn.org/PW-html/CCR2003.pdf (City of Oak Ridge 2002.) To ask specific questions related to your drinking water, please call TDEC's Environmental Assistance Center in Knoxville, Tennessee at 865-594-6035. To find additional information related to your water supply or other water supplies in the area, please call EPA's Safe Drinking Water Hotline at 800-426-4791 or visit EPA's Safe Drinking Water Web site at http://www.epa.gov/safewater. You can also look up monitoring results for the Oak Ridge or other public water supplies by visiting EPA's Safe Drinking Water Information System at http://www.epa.gov/enviro/html/sdwis/sdwis_query.html.

	Actual Comment	*ATSDR's Response*
8	Do agencies do some of their own sampling even when it has already been done before? The Ten Mile area gets water from a company in Spring City and this company has another company of choice test it. The State has never tested it independently and did not follow-up on water testing. Could ATSDR take a sample?	If ATSDR believed that the water at Spring City was a public health issue, then it would recommend that sampling be conducted. However, based on the findings in this PHA and ongoing monitoring programs, additional sampling is not necessary. Under the Safe Drinking Water Act, EPA sets health-based standards for hundreds of substances in drinking water and specifies treatments for providing safe drinking water (U.S. EPA 1999). The public water supplies for both Kingston and Spring City are continually monitored for these regulated substances. According to EPA's Safe Drinking Water Information System (SDWIS), the Kingston and Spring City public water supply systems have not had any significant violations (U.S. EPA 2004b). To look up information for these water supplies or other supplies in the area, go to EPA's SDWIS Web site at http://www.epa.gov/enviro/html/sdwis/sdwis_query.html. In 1996, the Tennessee Department of Environment and Conservation's (TDEC) DOE Oversight Division began participating in EPA's Environmental Radiation Ambient Monitoring System (ERAMS). Under this program, TDEC has conducted filter backwash sludge sampling at Spring City because contaminants from the ORR could potentially move downstream into community drinking water supplies. Also since 1996, EPA has analyzed samples from five public water suppliers located on and near the ORR through its ERAMS drinking water program. On a quarterly basis, TDEC takes finished drinking water samples from these locations and EPA analyzes the samples for radionuclides. The public water suppliers are as follows: Kingston Water Treatment Plant (TRM 568.4), DOE Water Treatment Plant at K-25 (CRM 14.5), West Knox Utility (CRM 36.6), DOE Water Treatment Plant at Y-12 (CRM 41.6), and Anderson County Utility District (CRM 52.5) (TDEC 2003b). In addition, the Tennessee Valley Authority (TVA) conducts sampling of radionuclides in fish tissues, and also analyzes the PCBs, pesticides, and metals in sediments from the river mile at Spring City.
9	When you're thinking of Bradbury (TN), that's basically going west of Exit 10. So the impact is basically southwest of the fact—to me it looks that people along the interstate, that area, would have been most susceptible to iodine than Bradbury. But Bradbury would be the most susceptible to some of the stuff dumped in White Oak Creek.	This public health assessment evaluates the X-10 releases of radionuclides into the water in White Oak Creek, which flows into the Clinch River and the Lower Watts Bar Reservoir. This assessment evaluates past and current exposure to radionuclide releases for people who use or live along the Clinch River and the Lower Watts Bar Reservoir (the area along the Clinch River from the Melton Hill Dam to the Watts Bar Dam [see the study area in Figure 11]). Bradbury and I-40 areas are in the study area. This document does not address the X-10 releases of iodine 131 into the air. ATSDR will evaluate the release of iodine 131 into the air in a future public health assessment.
10	Two community members noted that there was a barrier at White Oak Creek, but that people still fished there. The community members continued that the barrier was simply a cable that went across with a sign that said not to enter the area. They said that people would lift this up, go under the cable, and fish at the creek.	White Oak Creek is located on the Oak Ridge Reservation. Because White Oak Creek is on the ORR, access to the creek is restricted and controlled by DOE (ChemRisk 1999a). DOE has a cable barrier that runs across White Oak Creek to prevent trespassers from entering the creek for fishing and other prohibited activities. In addition, DOE has posted warning signs at the creek so that people will not enter the area (EEWG [former PHAWG] meeting minutes, May 5, 2003). Therefore, people who fish or enter White Oak Creek for other purposes are trespassing on DOE property.

	Actual Comment	ATSDR's Response
11	She wondered if there are any substances in the drinking water.	Kingston maintains public water supplies in the vicinity of the Oak Ridge Reservation (see Figure 13). The Kingston water supply has two water intakes, but only one of the intakes—located upstream on the Tennessee River in Watts Bar Lake at Tennessee River Mile (TRM) 568.4—would potentially be impacted by ORR contaminants (Hutson and Morris 1992; G. Mize, Tennessee Department of Environment and Conservation, Drinking Water Program, personal communication re: Kingston public water supply, 2004). Spring City obtains its water from an intake on the Piney River branch of Watts Bar Lake (Hutson and Morris 1992). Under the Safe Drinking Water Act, the EPA has set health-based standards for substances in drinking water and specified treatments for providing safe drinking water since 1974 (U.S. EPA 1999). In 1977, EPA gave the state of Tennessee authority to operate its own Public Water System Supervision Program under the Tennessee Safe Drinking Water Act. Through this program, TDEC's Division of Water Supply regulates drinking water at all public water systems. As a requirement of this program, all public water systems in Tennessee individually monitor their water supply for EPA-regulated contaminants and report their monitoring results to TDEC. The public water supplies for Kingston, Spring City, and other supplies in Tennessee are monitored for substances that include 15 inorganic contaminants, 51 synthetic and volatile organic contaminants, and 4 radionuclides (EPA 2004a). Please visit http://www.epa.gov/safewater/pws/pdfs/qrg_smonitoringframework.pdf for EPA's monitoring schedules for each contaminant (EPA 2004a). On a quarterly basis, TDEC submits the individual water supply data to EPA's Safe Drinking Water Information System (SDWIS) (TDEC 2003c). According to EPA's SDWIS, the Kingston and Spring City public water supply systems have not had any significant violations (U.S. EPA 2004b). To look up information related to these and other public water supplies, go to EPA's Local Drinking Water Information Web Site at http://www.epa.gov/safewater/dwinfo.htm. In addition, in 1996 TDEC's DOE Oversight Division started to participate in EPA's Environmental Radiation Ambient Monitoring System (ERAMS). As part of the Oak Ridge ERAMS program, TDEC collects samples from five facilities on the ORR and in its vicinity. Under the Oak Ridge ERAMS, TDEC collects finished drinking water samples from the Kingston Water Treatment Plant on a quarterly basis and then submits the samples to EPA for radiological analyses. The schedule and contaminants sampled at the Kingston Water Treatment Plant are presented in Section II.F.3. TDEC has also conducted filter backwash sludge sampling at Spring City because radioactive contaminants from the ORR could potentially move downstream into community drinking water supplies. TDEC analyzed Spring City samples for gross alpha, gross beta, and gross gamma emissions (TDEC 2002, 2003a, 2003b). To ask specific questions related to your drinking water, please call TDEC's Environmental Assistance Center in Knoxville, Tennessee at 865-594-6035 or call EPA's Safe Drinking Water Hotline at 800-426-4791. More details are also available at EPA's Safe Drinking Water Web site at http://www.epa.gov/safewater.

	Actual Comment	*ATSDR's Response*
Radionuclides Associated with X-10's Releases to White Oak Creek		
12	A subcommittee member asked about known health effects of niobium, sheet metal form.	Niobium has been used on the Oak Ridge Reservation at both the X-10 and Y-12 plants. In *Phase I of the Oak Ridge Health Studies (Dose Reconstruction Feasibility Study)*, the Tennessee Department of Health investigated niobium from the Oak Ridge Reservation and determined that it was not a high priority contaminant. In, however, the Reports of the Oak Ridge Dose Reconstruction, *Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-Site Radiation Doses, and Health Risks* (referred to as the "Task 4 report"), TDOH reevaluated niobium 95 releases into White Oak Creek and the radiation dose from niobium 95 was included in the evaluation of external exposure from shoreline sediments. In addition, the state reevaluated niobium from Y-12 in the *Task 7 Report—Screening-level Evaluation of Additional Potential Materials of Concern*. Through its assessment, the state determined that quantities of niobium from Y-12 were not large enough to present health risks to off-site populations (ATSDR et al. 2000; ChemRisk 1999c). Data on the toxicological effects of niobium are very limited, and EPA has not established regulatory limits for chronic exposure to niobium (ChemRisk 1999c). Most people rarely encounter niobium compounds. Unless known otherwise, all niobium compounds should be regarded as highly toxic in the laboratory. The metal dust causes eye and skin irritation, and is likely to represent a fire hazard. See Appendix D for briefs on the 1993 Phase I dose reconstruction feasibility study, the 1999 Task 4 report, and the 1999 Task 7 report. Copies of these three reports are available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 865-241-4780) or through DOE's public-use database at http://cedr.lbl.gov/DR/dror.html.
13	Does cesium stay in the muscle?	Cesium can enter the body through ingestion, inhalation, or injury to the skin. Once cesium enters the body, it is dispersed throughout the body's soft tissues. Slightly larger concentrations of cesium are found in muscle compared with amounts of cesium found in bone and fat. Compared with some of the other radionuclides, cesium remains in the body for a fairly short period of time (U.S. EPA 2003). Cesium does not stay in the muscle or other tissues. Cesium has a physical half-life of about 30 years and a biological half-life of 70 days. Therefore, the cesium is removed from the body through urine in about 70 days (EEWG [former PHAWG] meeting minutes from December 10, 2001; U.S. EPA 2003).

	Actual Comment	ATSDR's Response
14	A community member thought that over 2,000 curies (Ci) were released in one year (1956) over White Oak Dam, but this was a short half-life. He thought that it was two weeks for ruthenium 106. The community member thought that ruthenium went to rhodium, which had the largest beta of any radionuclide.	Ruthenium (Ru) 106 is a fission product with a radioactive half-life of approximately 368 days. Ru 106 decays, releasing a beta particle with energy of 0.039 million electron volts (MeV). This means that Ru 106 is a very weak emitter; however, its decay product rhodium (Rh) 106 is a very strong beta particle emitter. Rh 106 has a radioactive half-life of about 30 seconds and the maximum beta particle energy emission is 3.5 MeV. Rh 106 also emits several gamma rays of varying energy. When Ru 106 is taken into the body, the dose methodology and the dose coefficients used take into account the production of rhodium by the radioactive decay of the ruthenium. However, the dose delivered by the rhodium is not considered because its half-life of 30 seconds is too short to have an impact. In fact, neither the ICRP nor the EPA publish dose coefficients for Rh 106.
15	Back in the 1950s and 1960s when they were doing a lot of testing, strontium was a big worry. I'd never heard of I 131. Everyone was concerned then about health effects from strontium. Now all this talk about I 131. All of this was from same fallout (I 131 and strontium). Strontium pathway is basically the same as iodine.	The Task 4 report evaluated the estimated amount of radioactivity that was released from X-10 into White Oak Creek. During its evaluation, the state determined that specific radionuclides required further investigation; strontium 90 and iodine 131 were both included in this group. In this PHA, ATSDR evaluated past and current exposure to strontium contamination released from White Oak Creek, and determined that the levels of strontium in the water, sediment, vegetables, fish, and game were too low to be of public health concern (ChemRisk 1999a). See Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways in this PHA for ATSDR's analysis of past and present exposures to strontium. ATSDR will address historical exposures to iodine 131 released into the air from X-10 in a future PHA. Inhalation, drinking water, and food consumption are the pathways for both iodine and strontium. However, the primary health effects differ between these two radionuclides. Strontium 90 affects bone marrow and bone surfaces; its 29-year radioactive half-life and 30-year biological half-life make strontium one of the more hazardous contaminants associated with radioactive fallout. The primary health concerns for strontium include bone tumors and tumors in the blood cell forming organs. Whereas iodine 131 is deposited into the thyroid, and consequently, the primary health concern for iodine 131 is thyroid tumors. Traditionally, the primary exposure pathway to iodine 131 has been drinking milk from cows that consumed contaminated crops. Consumption of fruits and vegetables, and also inhalation, are other exposure pathways for iodine 131 (INEEL 2001a; 2001b). ATSDR will provide additional information on iodine from X-10 in a future PHA on iodine 131.

	Actual Comment	*ATSDR's Response*
Evaluation of Other Contaminants Released from the Oak Ridge Reservation		
16	The board (ORRHES) should familiarize itself with the off-site contamination that has gone on down river and downstream. There are 6 initial contaminants of concern (which include iodine 131, mercury, uranium, radionuclides in White Oak Creek, polychlorinated biphenyls, fluorine/fluoride), although there may be others. Why weren't the Oak Ridge signature contaminants of nickel, strontium, cesium, and chromium, which are in residents' bodies, included in the Phase I evaluation, and why was it not peer reviewed?	At the March 2001, June 2001, December 2001, and February 2002 Oak Ridge Reservation Health Effects Subcommittee (ORRHES) meetings, and at the Exposure Evaluation Work Group (formerly known as the Public Health Assessment Work Group [PHAWG]) meetings in 2001 and 2002, ATSDR presented and discussed in detail its screening process for evaluating past exposures (1944–1990) and determining contaminants of concern that warrant further evaluation. This comprehensive screening analysis included an evaluation of releases of hazardous substances (chemical and radiological) into the air, creeks, streams, and rivers from the Oak Ridge Reservation and the potential of off-site exposure to contaminants downstream. These detailed presentations also included discussions of ATSDR's review and analysis of the Tennessee Department of Health's ■ 1993 Phase I of the Oak Ridge Health Study—Dose Reconstruction Feasibility Study, and ■ 1999 Reports of the Oak Ridge Dose Reconstruction, The Report of Project 7—Screening-Level Evaluation of Additional Potential Material of Concern. These studies evaluated past chemical and radionuclide releases from the Oak Ridge Reservation and the potential of their releases to impact the health of people living near the reservation. Using ATSDR's screening process for evaluating past exposures, ATSDR scientists are conducting public health assessments on the release of and exposure to uranium, iodine 131, mercury, PCBs, radionuclides from White Oak Creek, fluorides, and other topics, such as the TSCA incinerator and off-site groundwater. ATSDR will evaluate past and current off-site exposures to these contaminants. In addition, the EEWG conducted an evaluation of ATSDR's screening process for past exposures. The EEWG's evaluation consisted of a detailed review and understanding of ATSDR's screening presentations to the subcommittee, ATSDR's independent technical reviewers' comments, the subcommittee's review and assessment of technical documents (as needed), and related public concerns or issues (as needed). After completing its evaluation, the EEWG recommended at the February 2002 ORRHES meeting that the ORRHES endorse ATSDR's screening process for determining contaminants of concern for past exposures (1944–1990 data). This endorsement begins with using those state of Tennessee's screening process and associated findings that identified ORR off-site releases warranting further evaluation. The ORRHES approved the EEWG's recommendation to endorse ATSDR's screening evaluation of past exposures. The February 2002 ORRHES meeting minutes are available on the ATSDR Web site at http://www.atsdr.cdc.gov/HAC/oakridge/meet/orr/m8_27.html.

	Actual Comment	ATSDR's Response
16	*Continued*	Cesium and strontium were first evaluated by the state of Tennessee in its 1993 *Phase I of the Oak Ridge Health Study Dose Reconstruction Feasibility Study* and then reevaluated in the 1999 Reports of the Oak Ridge Dose Reconstruction, *Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-Site Radiation Doses, and Health Risks* (referred to as the "Task 4 report"). ATSDR evaluated past and current exposure to cesium and strontium in this public health assessment. Nickel and chromium were evaluated in the 1993 Phase I of the Oak Ridge Health Study—Dose Reconstruction Feasibility Study and reevaluated in the 1999 Reports of the Oak Ridge Dose Reconstruction, The Report of Project 7—Screening-Level Evaluation of Additional Potential Material of Concern (ATSDR et al. 2000; ChemRisk 1999c). The Tennessee Department of Health had the 1993 Phase I of the Oak Ridge Health Study—Dose Reconstruction Feasibility Study reviewed by SENES Oak Ridge in 1995. This report entitled A Review of the Preliminary Screening Analysis Carried Out During the Oak Ridge Dose Reconstruction Feasibility Study was evaluated by ATSDR and the EEWG (former PHAWG). See Appendix D for briefs on the 1993 Phase I feasibility study, 1999 Task 4 report, and the 1999 Task 7 report. Copies of the Tennessee Department of Health reports are available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 865-241-4780) or through DOE's public-use database at http://cedr.lbl.gov/DR/dror.html.

	Actual Comment	*ATSDR's Response*
17	I had some questions about your study of the hundred and sixteen people in the southern Watts Bar area. I don't know if I am being premature in my questions to you, but did you all come to the conclusion that there was no danger from eating the fish for anything other than PCBs, when that was the only thing you tested for? If your testing was accurate and your conclusions were accurate, why hasn't something changed so far as all of those fish advisories? I don't think the community would mind if you had an advisory on don't eat the turtles.	ATSDR conducted a health consultation in 1996 to evaluate the public health implications of current exposure to chemical and radiological contaminants in the Lower Watts Bar Reservoir surface water, sediment, and fish and the effectiveness of the Department of Energy's (DOE) proposed remedial action plan for protecting public health. ATSDR found that only PCBs in the reservoir fish were of potential public health concern. The current levels of other contaminants in the surface water, sediment, and fish are not a public health hazard. After reviewing current levels of contaminants in the water, sediment, and wildlife, ATSDR concluded that: ■ The levels of PCBs in the Lower Watts Bar Reservoir fish posed a public health concern. Frequent and long-term ingestion of fish from the reservoir posed a moderately increased risk of cancer in adults and increased the possibility of developmental effects in infants whose mothers consumed fish regularly during gestation and while nursing. Turtles in the reservoir might also contain PCBs at levels of public health concern. ■ Current levels of contaminants in the reservoir surface water and sediment were not a public health hazard. The reservoir was safe for swimming, skiing, boating, and other recreational purposes. Drinking water from the municipal water systems, which draw surface water from tributary embayments in the Lower Watts Bar Reservoir and the Tennessee River upstream from the Clinch River and Lower Watts Bar Reservoir, was safe to drink. ■ DOE's selected remedial action was protective of public health. ATSDR recommended that the Lower Watts Bar Reservoir fish advisory remain in effect to minimize exposure to PCBs. ATSDR followed up the 1996 health consultation by conducting the *Watts Bar Reservoir Exposure Investigation* in March 1998. This study was done to measure *actual* PCB and mercury levels in people who have eaten large amounts of Watts Bar Reservoir fish or turtles. ATSDR tested for PCBs because previous investigations estimated that people who eat certain fish or turtles *might* have higher than average levels of PCBs in their bodies and suggested that the levels of PCBs in fish were a public health concern. ATSDR tested the blood samples for mercury because mercury was a historic contaminant of concern. Recent studies, however, have not detected mercury at levels of health concern in surface water, sediments, or fish from the Watts Bar Reservoir.

	Actual Comment	ATSDR's Response
17	*Continued*	The ATSDR exposure investigation revealed that the 116 study participants who consumed moderate to large amounts of fish and turtles had PCB levels similar to those of the general population. The PCB and mercury levels were less than ATSDR health officials expected for people who consume moderate to large amounts of certain fish or turtles from the Watts Bar Reservoir. Five people (4% of the 116 participants) had elevated serum levels of PCBs (above 20 micrograms per liter), one person had PCB levels above those in the general population, and one person had elevated blood mercury levels (above 10 micrograms per liter). ATSDR health officials believed that health effects were not likely based on the PCB and mercury levels seen in the exposure investigation participants. ATSDR recommended that health education activities be targeted to local health care providers, pregnant and nursing mothers, and any other potentially vulnerable populations to minimize exposure to PCBs. ATSDR developed an instructive brochure on the Tennessee Department of Environment and Conservation (TDEC) fish consumption advisories for the Watts Bar Reservoir. The brochure was the result of the collaborative effort of local citizens, organizations, and state officials. See Appendix D for a brief of the exposure investigation and Section II.F.1. for ATSDR's public health activities related to White Oak Creek radionuclide releases (ATSDR et al. 2000; ORHASP 1999).
18	Since the contamination from fish ingestion will not necessarily be measurable in the bloodstream at high levels at all times, a challenge test is needed to detect it. This was not used by ATSDR and is not normally used in a standard physician's office visit test. The ATSDR study results are countered by other studies, and communities in the southeast whose problems were addressed by ATSDR were not helped.	There are reliable and accurate medical tests that measure the level of mercury in the body by analyzing blood, breast milk, hair, or urine samples. These are not routine clinical tests, but they could be requested from a doctor. Most of these tests do not determine the form of mercury to which an individual is exposed. These clinical tests can show if mercury exposure has occurred, provide an idea as to the extent of exposure, and can be used to assess if harmful health effects are likely to occur, but they cannot tell exactly how much exposure has occurred (ATSDR 1999a). For more information on mercury, review ATSDR's toxicological profile on mercury at http://www.atsdr.cdc.gov/toxprofiles/phs46.html. PCBs are pervasive environmental contaminants that are found in body tissue and fluids of the general population. There are also medical tests that measure the level of PCBs in the body by analyzing blood, body fat, and breast milk. Serum or plasma lipid PCB concentrations are an indicator of PCB body burden. These are not routine clinical tests, but they could be requested from a doctor. These tests can indicate if a person was exposed to PCBs, but they cannot determine the exact amount of exposure, type of PCBs, or if adverse health effects will occur. Though, these tests can indicate whether you have been exposed to PCBs to a greater extent than the general public. Blood tests are the best method for detecting recent exposure to large amounts of PCBs. Thus, a physician with a background in environmental and occupational health should carefully interpret the test results (ATSDR 2000). For more information on PCBs, visit ATSDR's Web site for the PCB toxicological profile at http://www.atsdr.cdc.gov/toxprofiles/phs17.html.

	Actual Comment	*ATSDR's Response*
18	*Continued*	Previous investigations identified PCBs in reservoir fish as a possible contaminant of public health concern. TDEC and DOE had detected PCBs at levels up to about 8 ppm in certain species of reservoir fish during past studies. In an investigation on turtles in the Watts Bar Reservoir and the Clinch River, TDEC detected the highest PCB concentrations in the fat tissue (ranged from 0.274 to 516 ppm) of snapping turtles. The PCB concentrations detected in the muscle tissue of turtles ranged from 0.032 to 3.38 ppm. In 1994 and 1996 remedial investigations, based on estimated PCB exposure doses and estimated excess cancer risks for people consuming large amounts of fish over an extended time period, DOE determined that the fish ingestion pathway had the greatest potential to cause adverse health effects in the Lower Watts Bar Reservoir and the Clinch River/Poplar Creek, respectively. ATSDR also conducted a 1996 health consultation on the Lower Watts Bar Reservoir that reached similar conclusions as found in the remedial investigation. None of these studies, however, considered actual blood levels in fish and turtle consumers nor confirmed if people were actually exposed to PCBs or had elevated PCB levels. Because of these reasons and since so many uncertainties are involved in estimating exposure doses and excess cancer risk from ingesting reservoir fish and turtles, ATSDR conducted an exposure investigation to actually measure the serum PCB levels in fish and turtle consumers. In fact, ATSDR knows of no other studies in the Oak Ridge area that measured actual blood levels in community members to evaluate exposures from fish and turtle consumption. For this investigation, ATSDR targeted people who consumed moderate to large amounts of reservoir fish and turtles. Based on the actual measurements of serum PCB levels in participants, only 1 out of 116 had a serum PCB level higher than levels observed in the general population. Therefore, based on actual levels—not theoretical estimates as used in previous studies—of people who consumed moderate to high amounts of fish and turtles from the reservoir, PCB levels were comparable to the general population. See Appendix D for a brief on the *1998 Watts Bar Reservoir Exposure Investigation* and a brief on the *Turtle Sampling in Watts Bar Reservoir and Clinch River.*
19	Concerning studies of PCBs and blood samples in people who eat fish, I wonder how valid the information would be. Do PCBs stay in the blood, for example, and were they are a lot higher, one would presume, right after eating a meal than a week later? Were those factors taken into account in the study?	The *1998 Watts Bar Reservoir Exposure Investigation* was a cross-sectional study because it evaluated PCB and mercury exposures at a specific point in time. Blood tests are the best method for detecting exposure to PCBs. Serum or plasma lipid PCB concentrations are indicators of PCB body burden and can indicate whether you have been exposed to PCBs to a greater extent than the general public. In this type of study (a cross-sectional study), PCB and mercury blood levels indicate both chronic and acute (short-term) exposures, depending on recent fish consumption. PCB blood levels are likely to be higher right after eating a fish meal containing PCBs. This factor was taken into account in the exposure investigation. The investigation is discussed in more detail in Section II.F.1. of this document. In addition, ATSDR will address issues solely related to PCBs in a separate public health assessment that will be released in the near future. See Appendix D for a brief on the 1998 Watts Bar Reservoir Exposure Investigation.

	Actual Comment	ATSDR's Response
20	A community member said there are a couple of other dimensions that will complicate matters but she hopes they will be considered. One is the time frame. The workers and residents who lived nearby in the 50s and 60s had different exposures than now and will have different symptoms now. Also, geographically, the flow of water, the underground aquifer, that sort of thing. The two dimensions are geography and time will complicate this and shouldn't be overlooked. There may be people who lived in different locations and the well water was of different composition.	In this public health assessment, ATSDR evaluates radionuclides released into the surface water in White Oak Creek, and assesses past, current, and future impact from exposures to these radionuclide releases in the water for residents living off the Oak Ridge Reservation within the White Oak Creek study area (the area along the Clinch River and the Lower Watts Bar Reservoir from the Melton Hill Dam to the Watts Bar Dam [see Figure 11]). This PHA evaluates the following key issues and concerns: contacting surface water and sediment during recreation; consuming game animals, fish, turtles, and homegrown vegetables; and exposure to external radiation. In addition to this PHA, ATSDR scientists are conducting public health assessments on the releases of iodine 131, mercury, PCBs, uranium, fluorides, and other topics including off-site groundwater. The geography and characteristics of the aquifer will be considered in the groundwater public health assessment. In conducting PHAs, 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 exposures.
21	Will exposure investigations be done as they were for PCBs at Watts Bar?	ATSDR is not planning additional exposure investigations at this time. Instead, ATSDR is conducting public health assessments on the releases of iodine 131, mercury, PCBs, uranium, fluorides, and other topics. 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. ATSDR uses the public health assessment process to ▪ Identify populations (groups of people) off the site who could have been exposed to hazardous substances at levels of health concern, ▪ Determine the public health implications of exposure, ▪ Address the site-specific health concerns of people in the community, ▪ Recommend any needed follow-up public health actions to address exposure, and ▪ Communicate ATSDR's findings to the public.

	Actual Comment	*ATSDR's Response*
22	What is the probability of a clinic for residents closely associated and who live close by incinerators and the Clinch River and East Fork Poplar Creek?	ATSDR is using the public health assessment process to evaluate previous studies and environmental data to determine whether releases of hazardous substances from the Oak Ridge Reservation could have affected the health of people in communities near the reservation. The public health assessment is the primary public health process ATSDR uses to ▪ Identify populations off the site who could have been exposed to hazardous substances ▪ Determine the potential health effects of exposure ▪ Address the site-specific health concerns of people in the community ▪ Recommend any needed follow up public health actions to address exposure ▪ Communicate ATSDR's findings to the public ATSDR is working with the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) to ensure that the public health questions of people living in the Oak Ridge Reservation area are answered. In response to community concerns regarding a clinic, the ORRHES Needs Assessment Work Group conducted a comprehensive program review of the various federal agencies to determine whether it is possible to establish an occupational/environmental clinic or another form of clinical intervention near the Oak Ridge Reservation. On August 27, 2002, the ORRHES made the following recommendation to ATSDR. "The Oak Ridge Reservation Health Effects Subcommittee (ORRHES) has determined that discussion of public health activities related to the establishment of a clinic, clinical evaluations, medical monitoring, health surveillance, health studies, and/or biological monitoring is premature. Thus, the ORRHES recommends that formal consideration of these issues be postponed until the ATSDR public health assessment (PHA) process identifies and characterizes an exposure of an off-site population at levels of health concern. If this exposure warrants follow-up public health activities, the ORRHES will then consider these issues in making its recommendations to ATSDR." This ORRHES recommendation is based on the review, evaluation, and understanding of the comprehensive program review presented by the Needs Assessment Work Group at the August 27, 2002, ORRHES meeting. The August 27, 2002, ORRHES meeting minutes are available on ATSDR's Web site at http://www.atsdr.cdc.gov/HAC/oakridge/meet/orr/m8_27.html.

	Actual Comment	*ATSDR's Response*
23	Will you screen the effects of the environmental pollutants from the Kingston and Bull Run power plants whose interaction with the ORR concerns many people?	ATSDR is not evaluating all sources of contaminants in the area and is not adding exposures from these other sources. Congress created ATSDR to implement the health related sections of the 1980 Superfund law. ATSDR's congressional mandate is to conduct a public health assessment at U.S. EPA National Priorities List for Uncontrolled Hazardous Waste Sites (NPL). The DOE Oak Ridge Reservation (ORR) is on the NPL. ATSDR's focus is on ORR releases of contaminants to off-site locations. ATSDR is not going to conduct an evaluation of releases of contaminants from other industries in the area. However, environmental samples (air, water, sediment, soil) collected in and around the ORR may contain contaminants released from other industries in the area (for example, arsenic, mercury, and uranium released from the two large Tennessee Valley Authority [TVA] power plants). ATSDR will evaluate the levels of contaminants in these samples regardless of the source of the contaminants. If ATSDR identifies contaminants in off-site locations during its assessment that are of public health concern, then ATSDR will address exposures to these contaminants in the PHA.
24	This second paper in Radiation Research (after the Mangano paper) was a study of the mortality of 106,020 workers employed between 1943 and 1985 at the federal nuclear plants in Oak Ridge (who also live in communities around ORR). This second paper DID NOT find an increase in leukemia deaths relative to U.S. white males. A smaller group of 28,347 white males employed at X-10 or Y-12 who were at risk for exposure to external penetrating radiation was examined to determine if there was a relationship between rates of death from selected causes and level of radiation dose. There was no evidence for an association between leukemia deaths and external radiation. Leukemia death rates for X-10 workers were higher than U.S. rates and other similar Oak Ridge workers.	ATSDR is conducting public health assessments to evaluate whether the releases of contaminants from the Oak Ridge Reservation could be harmful to people who live in communities near the reservation. This assessment focuses on exposures to contaminants that occurred off the reservation. ATSDR does not evaluate health issues related to workplace exposures. ATSDR is, however, conducting a cancer incidence review to evaluate the cancers in the eight counties surrounding the reservation. For the review, ATSDR is using cancer incidence data from the state of Tennessee's cancer registry. Upon completion, the findings of the health statistics review will be released to the public. Information specific to workers can be found on the Internet at http://cedr.lbl.gov. This site provides information about epidemiologic studies of U.S. Department of Energy workers, including studies of workers at the Y-12, X-10, and K-25 sites.

VII. Child Health Considerations

ATSDR recognizes that infants and children can be more sensitive to environmental exposure than adults in communities faced with contamination of their water, soil, air, or food. This sensitivity is a result of the following factors: 1) children are more likely to be exposed to certain media (for example, soil or surface water) because they play and eat outdoors; 2) children are shorter than adults, which means that they can breathe dust, soil, and vapors close to the ground; and 3) children are smaller; therefore, childhood exposure results in higher doses of chemical exposure per body weight. Children can sustain permanent damage if these factors lead to toxic exposure during critical growth stages. ATSDR is committed to evaluating the special interests of children at sites such as the ORR.

Children playing in and living along the Clinch River and Watts Bar Reservoir could have been exposed to radiation when they used the river for food, water, or recreation. However, the levels of radionuclides in water, sediment, and fish are below those shown to cause adverse health effects. Dose and risk factors for most radionuclides in the Task 4 analysis do not differ greatly between children and adults (ChemRisk 1999a). Exposure to iodine 131 has been shown to increase the likelihood of thyroid disorders in children—that is, exposed children could have an increased likelihood of developing a disease (e.g., thyroid cancer) in their lifetimes (Vykhovanets et al. 1997; Astakhova et al. 1998; Heidenreich et al. 1999; Hahn et al. 2001). Nevertheless, based on the Task 4 analysis, the levels of iodine 131 in the surface water of the Clinch River and in the locally produced milk are too low to cause such health effects in children living near the Clinch River.

VIII. Conclusions

Having thoroughly evaluated past public health activities and available current environmental information, ATSDR has reached the following conclusions.

ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10. This classification means that people could be or were exposed, but that their level of exposure would not likely result in adverse health effects. (Definitions of ATSDR's public health categories are included in the glossary in Appendix A.)

ATSDR uses the ***no apparent public health hazard*** category in situations in which human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

Past Exposure

ATSDR concludes that past exposures to White Oak Creek radionuclides from walking on the shoreline, drinking milk and water, or eating meat and fish from the Clinch River are not a health hazard and are not expected to result in adverse health effects or cancer.

- Using the results of the Task 4 report, ATSDR re-evaluated *past* exposures (1944–1991) to radionuclides released from White Oak Creek into the Clinch River. People who used or lived near the Clinch River could have come in contact with X-10 radionuclides by eating fish and meat, drinking milk and water, and walking on shoreline sediment. Using organ doses from the Task 4 report, ATSDR's estimated whole-body doses (annual dose and committed effective dose over 70 years). An individual exposed to the primary radionuclides in Clinch River fish, shoreline sediment, meat, milk, and drinking water was expected to receive a committed effective dose to the whole body of less than 300 mrem over 70 years. This dose is about 18 times less than ATSDR's radiogenic comparison value of 5,000 mrem over 70 years. Doses below the radiogenic comparison value are not expected to result in observable health effects.

- ATSDR's estimated annual whole-body dose from combining the organ doses was 4 mrem/year and well below (25 times less than) ATSDR's MRL of 100 mrem/year and the

ICRP, NRC, and NCRP recommendation of 100 mrem/year for maximum dose for members of the public. ATSDR's external exposure MRL for ionizing radiation is based on noncancer health effects only; it is not based on a consideration of cancer effects. MRLs are estimates of daily human exposures to substances that are unlikely to result in noncancer effects over a specified duration. The ICRP, NRC, and the NCRP recommended maximum dose constraint for members of the public of 100 mrem/year considers both noncancer and cancer health effects.

- The estimated committed equivalent doses to all the organs from eating fish caught near Jones Island exceeded dose estimates for all other exposure pathways (walking along the shore and ingesting water, fish, milk, and meat) by at least a factor of 8. The estimated committed equivalent doses to the organs from past exposures to radionuclides in and along the Clinch River varied by critical organ (bone, lower large intestine, red bone marrow, breast, and skin).

- The highest committed equivalent dose to the organs was 810 millirem (mrem) to the bone for people who ate fish often (1 to 2.5 fish meals per week) and caught their fish near Jones Island. Doses to the bone were much lower for people who are fewer fish and fished further downstream. The estimated total committed equivalent dose to the bone over a lifetime (70 years) from all exposure pathways was less than 1,200 mrem over 70 years. This estimated total lifetime bone dose is well below (325 times less than) the doses of 390,000 to 620,000 shown to cause bone cancers in radium dial workers.

- ATSDR analyzed radiation doses from drinking water at K-25/Grassy Creek (CRM 17 to 5) and the city of Kingston (CRM 0), located downstream from the mouth of White Oak Creek. The doses to the bone, lower large intestine, red bone marrow, breast, and skin from drinking Clinch River water were at least 7 times lower than the doses to those same organs from eating Clinch River fish. The highest annual whole-body dose from drinking water of 0.3 mrem was estimated for K-25/Grassy Creek. This annual whole-body dose is more than 1,000 times less than the background dose of 360 mrem that the average U.S. citizen receives each year. Lower doses were associated with drinking water further downstream at the city of Kingston. Organ-specific doses from drinking city of Kingston water were at least 13 times less than the doses estimated for K-25/Grassy Creek drinking water.

- After reviewing information provided by a community member about the former Happy Valley settlement, ATSDR conducted a separate analysis of possible exposures to radionuclides for Happy Valley residents who relied on the K-25 water intake for their drinking water. ATSDR's estimated annual whole-body dose of 14 mrem from drinking water for a former Happy Valley resident is at least 7 times lower than ATSDR's MRL of 100 mrem/year and the ICRP, NRC, and NCRP recommendation of 100 mrem/year for maximum dose for members of the public.

- The estimated total committed equivalent dose to the lower large intestine from all pathways was less than 1,100 mrem over 70 years. This estimated dose is 4 times less than ATSDR's radiogenic comparison value of 5,000 mrem over 70 years, which is based on studies of atomic bomb survivors, radiation workers, and radiation workers' children.

- The estimated total committed equivalent dose to the red bone marrow over a lifetime (70 years) from all exposure pathways was less than 1,100 mrem over 70 years. This estimated total lifetime bone dose is well below (350 times less than) the doses of 390,000 to 620,000 mrem associated with bone cancers in radium dial workers.

- The estimated total committed equivalent dose to the breast in females over a lifetime (70 years) from all exposure pathways was less than 500 mrem over 70 years, which is well below (20 times less than) 10,000 mrem shown to cause effects in atomic blast survivors.

- The estimated total committed equivalent dose to the skin over a lifetime (70 years) from all exposure pathways was less than 400 mrem over 70 years, which is well below (22 times less than) 9,000 mrem shown to cause effects in patients irradiated for treatment of ringworms.

- All the estimated organ doses and whole-body doses from past exposure to radionuclides in the Clinch River are lower than ATSDR's comparison values and doses reported in radiological and epidemiological studies on the effects of radiation exposure. Therefore, considering the many conservative assumptions used in calculating the dose estimates, ATSDR believes that the actual likelihood of developing disease for people who were exposed to radionuclides in the Clinch River is small, if it exists at all.

Current Exposure

ATSDR concludes that current exposures to White Oak Creek radionuclide releases to the Clinch River and LWBR are not a health hazard and are not expected to result in adverse health effects or cancer. This is based on ATSDR's evaluation of walking on the shoreline, drinking milk and water, or eating meat and fish from the Clinch River and Lower Watts Bar Reservoir.

Lower Watts Bar Reservoir

- Using available environmental data collected from 1988 to 1994, ATSDR evaluated current exposures to radionuclides via ingestion of fish, incidental ingestion of surface water, and external exposure from dermal contact with surface water and shoreline and dredged channel sediment of the Lower Watts Bar Reservoir. Even assuming maximum concentrations of radionuclides and using conservative exposure scenarios, current exposure to radionuclides in the Lower Watts Bar Reservoir would result in radiation doses below levels expected to cause adverse health effects. ATSDR's estimated committed effective dose to the whole body for all pathways combined is less than 1,900 mrem—2.5 times below ATSDR's radiogenic CV of 5,000 mrem. The estimated annual whole-body dose is less than 30 mrem, and below ATSDR's screening comparison value of 100 mrem/year. Therefore, the estimated exposures for the LWBR are not expected to result in adverse health effects based on an evaluation of radiological, epidemiological, and medical literature.

Clinch River

- Using available environmental data collected from 1989 to the present, ATSDR evaluated current exposures to radionuclides via ingestion of fish and game, incidental ingestion of surface water, and external exposure from dermal contact with surface water and shoreline sediment of the Clinch River. ATSDR's estimated committed effective dose to the whole body for all pathways along the Clinch River combined is less than 240 mrem—more than 20 times below ATSDR's radiogenic CV of 5,000 mrem. The estimated annual whole-body dose is less than 3.4 mrem, and about 30 times below ATSDR's screening comparison value of 100 mrem/year. Therefore, the estimated exposures for the Clinch River are not expected to result in adverse health effects.

- Doses to organs varied by exposure pathway. ATSDR's estimates show that the *bone* would receive the highest total committed equivalent dose over a lifetime (70 years) of exposure to the radionuclides detected along the Clinch River. The highest doses to the bone resulted from ingestion of geese muscle or liver (230 mrem) and fish (114 mrem). Even so, the estimated dose to the bone is less than 5 mrem over 70 years—at least 78,000 times lower than the doses of 390,000 to 620,000 mrem associated with bone cancers in radium dial workers.

- ATSDR analyzed drinking water samples collected around the cities of Kingston and Spring City from 1990 to the present. ATSDR evaluated these samples for radiological content, and determined that all water samples were below EPA's maximum contaminant level (MCL). Therefore, ATSDR considers this water safe for consumption and other potable uses.

Future Exposure

Lower Watts Bar Reservoir and Clinch River

- ATSDR concludes that future exposures to White Oak Creek radionuclide releases to the Clinch River and LWBR are not a health hazard and are not expected to result in adverse health effects or cancer. This is based on ATSDR's evaluation of current doses and exposures related to releases from White Oak Creek, data on current contaminant levels in the LWBR and the Clinch River, consideration of the possibility that radionuclides could be released to White Oak Creek during remedial activities, and institutional controls that are in place to monitor contaminants in the LWBR and the Clinch River. These institutional controls consist of the following: 1) prevention of sediment-disturbing activities in the Clinch River and LWBR; 2) DOE's annual monitoring of Clinch River and LWBR surface water, sediment, and biota; 3) DOE's monitoring of White Oak Creek releases; 4) TDEC's monitoring of public drinking water supplies in Tennessee under the Safe Drinking Water Act for EPA-regulated contaminants; and 5) TDEC DOE Oversight Division's quarterly radiological monitoring of five public water supplies on the ORR and in its vicinity under the EPA's Environmental Radiation Ambient Monitoring System program.

IX. Recommendations

Having evaluated the past, current, and future public health activities and the available environmental information, ATSDR offers the following:

1. Tennessee Department of Environment and Conservation (TDEC) should continue to monitor public drinking water supplies in Tennessee under the Safe Drinking Water Act for U.S. Environmental Protection Agency (EPA)-regulated contaminants, and TDEC's Department of Energy (DOE) Oversight Division should continue its quarterly radiological monitoring of public water supplies on the Oak Ridge Reservation (ORR) and in its vicinity under the EPA's Environmental Radiation Ambient Monitoring System program.
2. Contaminants are not uniformly distributed in the sediment of Lower Watts Bar Reservoir (LWBR) and their concentrations vary by sediment composition, location, and depth. Therefore, the contaminated sediment of the LWBR should not be removed, dredged, or otherwise disturbed without careful review by the Watts Bar Interagency Working Group in accordance with the permitting process outlined in the Watts Bar Interagency Agreement. Given the current knowledge of contamination, ATSDR believes that the measures undertaken by the working group, if followed, are protective of public health.
3. DOE should continue to annually monitor the Clinch River and the LWBR for ORR-related radiological contaminants in surface water, biota, and sediment, and also continue its regular monitoring of White Oak Creek radionuclide releases.

X. Public Health Action Plan

The Public Health Action Plan (PHAP) for the White Oak Creek describes actions to be taken by ATSDR and other government agencies at and in the vicinity of the site after the completion of this public health assessment. The purpose of this PHAP is to ensure that this public health assessment not only identifies public health hazards, but that it also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. If additional information about White Oak Creek releases to the Clinch River becomes available, then that information could change a conclusion or the conclusions of this public health assessment; if that occurs, then human exposure pathways should be re-evaluated and these conclusions and recommendations should be amended, as necessary, to protect public health.

- ORR staff will notify ATSDR if environmental monitoring data indicate that statistically significant contaminant levels in the Clinch River are increasing. Upon such notification, ATSDR will determine appropriate public health actions.
- ATSDR will develop and implement additional environmental health education materials as necessary to help community members understand the findings and implications of this public health assessment.
- ATSDR supports DOE's remedial actions for the Lower Watts Bar Reservoir (LWBR) as being protective of public health. These actions include leaving the contaminated sediment in place with ongoing environmental monitoring and applying institutional controls to prevent disruption of contaminated sediment. Under the Watts Bar Interagency Agreement (established by DOE, EPA, TVA, TDEC, and USACE), the agencies will continue to work together to review permitting and any other activities that could possibly disturb LWBR contaminated sediment.

XI. Preparers of Report

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