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## APPENDIX G ENVIRONMENTAL JUSTICE ANALYSIS

### G.1 INTRODUCTION

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs Federal agencies to identify and address, as appropriate, the disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority populations and low-income populations.

The Council on Environmental Quality has oversight responsibility for documentation prepared in compliance with the National Environmental Policy Act (NEPA). In December 1997, the Council released its guidance on environmental justice under the National Environmental Policy Act (CEQ 1997). The Council's guidance was adopted as the basis for the analysis of environmental justice contained in this environmental impact statement (EIS).

This section provides an assessment of the potential for disproportionately high and adverse human health or environmental effects due to production of tritium in a commercial light water reactor (CLWR) on minority and low-income populations that live within areas surrounding the candidate facilities. The potential for adverse impacts from onsite activities during tritium production and transportation is determined in this EIS.

### G.2 DEFINITIONS AND APPROACH

The following definitions of minority individuals and population were used in this analysis of environmental justice:

- **Minority Individuals**—Members of any of the following population groups: Hispanic, Native American, Asian or Pacific Islander, or Black.
- **Minority Population**—The total number of minority individuals residing within a potentially affected area.

In the discussions of environmental justice in this document, persons self-designated as Hispanic are included in the Hispanic population, regardless of race. For example, the Asian or Pacific Islander population is composed of persons self-designated as Asian or Pacific Islander and not of Hispanic origin. Asian or Pacific Islanders who designate themselves as having Hispanic origins are included in the Hispanic population. Data for the analysis of minorities and racial population were extracted for year 2025 from the U.S. Census Bureau's worldwide web site (<http://www.census.gov/population/www/projections/stproj.html>).

Executive Order 12898 specifically addresses “disproportionately high and adverse effects” on “low-income” populations. The Council on Environmental Quality recommends that poverty thresholds be used to identify “low-income” individuals.

The following definitions of low-income individuals and population were used in this analysis:

- **Low-Income Individuals**—All persons whose self-reported incomes are less than the poverty threshold.

- **Low-Income Population**—The total number of poverty-level individuals residing within potentially affected area.

Data for the analysis of low-income populations were extracted from Table P121 of Standard Tape File 3 (DOC 1992).

### **Disproportionately High and Adverse Human Health Effects**

Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts to human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority population or low-income population is significant and exceeds the risk of exposure rate for the general population or, where available, for another appropriate comparison group (CEQ 1997).

### **Disproportionately High and Adverse Environmental Impacts**

A disproportionately high environmental impact refers to an impact (or risk of an impact) in a low-income or minority community that is significant and exceeds the environmental impact on the larger community. An adverse environmental impact is a deleterious environmental impact that is determined to be significant. In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed low-income or minority populations were considered (CEQ 1997).

Potentially affected areas examined in this EIS include areas defined by an 80-kilometer (50-mile) radius centered on candidate facilities for CLWR production of tritium located at the Watts Bar, Sequoyah, and Bellefonte Nuclear Plants. Minority and low-income populations residing within a 1.6-kilometer (1-mile) corridor centered on representative transportation routes were also included in the evaluation of environmental justice.

## **G.3 METHODOLOGY**

### **G.3.1 Spatial Resolution**

For the purposes of enumeration and analysis, the U.S. Census Bureau has defined a variety of areal units (DOC 1992). Areal units of concern in this document include (in order of increasing spatial resolution) states, counties, census tracts, block groups, and blocks. The block is generally the smallest of these entities and offers the finest spatial resolution. This term refers to a relatively small geographical area bounded on all sides by visible features such as streets and streams or by invisible boundaries such as city limits and property lines. During the 1990 census, the U.S. Census Bureau subdivided the United States and its territories into 7,017,425 A blocks. For comparison, the number of counties, census tracts, and block groups used in the 1990 census were 3,248; 62,276; and 229,192; respectively. While blocks offer the finest spatial resolution, economic data required for identification of low-income populations are not available at the block-level of spatial resolution. In the analysis below, block groups are used throughout as the areal unit. Block groups generally contain between 250 and 500 housing units (DOC 1992).

During the decennial census, the U.S. Census Bureau collects data from individuals and aggregates the data according to residence in a geographical area, such as a county or block group. Boundaries of the areal units are selected to coincide with features such as streams and roads or political boundaries such as county and city borders. Boundaries used for aggregation of the census data usually do not coincide with boundaries used in the calculation of health effects. As discussed in Chapter 5 of this EIS, radiological health effects due to an accident at one of the sites for commercial production of tritium are evaluated for persons residing within a distance of 80 kilometers (50 miles) of the accident site. In general, the boundary of the circle with an

80-kilometer (50-mile) radius centered at the accident site will not coincide with boundaries used by the U.S. Census Bureau for enumeration of the population in the potentially affected area. Some block groups lie completely inside or outside of the radius for health effects calculation. However, other block groups are only partially included. As a result of these partial inclusions, uncertainties are introduced into the estimate of the population at risk from the accident.

To estimate the populations at risk in partially included block groups, it was assumed that populations are uniformly distributed throughout the area of each block group. For example, if 30 percent of the area of a block group lies within 80 kilometers (50 miles) of the accident site, it was assumed that 30 percent of the population residing in that block group would be at risk. An upper bound for the population at risk was obtained by including the total population of partially included block groups in the population at risk. Similarly, a lower bound for the population at risk was obtained by excluding the population of partially included blocks from the population at risk. As a general rule, if the areas of geographic units defined by the U.S. Census Bureau are small in comparison with the potentially affected area, then the uncertainties due to partial inclusions will be relatively small.

### G.3.2 Population Projections

Health effects were calculated for populations projected to reside in potentially affected areas during the year 2025. Extrapolations of the total population for individual states are available from both the U.S. Census Bureau and various state agencies (DOC 1996). The U.S. Census Bureau also projects populations by ethnic and racial classification in 1-year intervals for the years from 1995 to 2025 at the state level. State agencies project total populations for individual counties. No Federal or state agency projects block groups or low-income populations. Data used to project minority populations were extracted from the U.S. Census Bureau's Internet web site (<http://www.census.gov/population/www/projections/stproj.html>). To project minority populations in potentially affected areas, minority populations determined from the 1990 census data were taken as a baseline for each block group. Then it was assumed that percentage changes in the minority population of each block group for a given year (compared to the 1990 baseline data) will be the same as percentage changes in the state minority population projected for the same year. An advantage to this assumption is that the projected populations are obtained using a consistent method, regardless of the state and associated block group involved in the calculation. A disadvantage is that the method is insensitive to localized demographic changes that could alter the projection in a specific area.

The U.S. Census Bureau uses the cohort-component method to estimate future populations for each state (DOC 1996). The set of cohorts is comprised of: (1) age groups from 1 year or less to 85 years or more, (2) male and female populations in each age group, and (3) the following racial and ethnic groups in each age group: Hispanic, non-Hispanic Asian, non-Hispanic African American, non-Hispanic Native American, and non-Hispanic White. Components of the population change used in the demographic accounting system are births, deaths, net state-to-state migration, and net international migration. If  $P(t)$  denotes the number of individuals in a given cohort at time "t," then:

$$P(t) = P(t_0) + B - D + DIM - DOM + IIM - IOM \tag{1}$$

where:

- $P(t_0)$  = Cohort population at time  $t_0 \leq t$ . For this analysis,  $t_0$  denotes the year 1990.
- $B$  = Births expected during the period from  $t_0$  to  $t$ .
- $D$  = Deaths expected during the period from  $t_0$  to  $t$ .
- $DIM$  = Domestic migration expected into the state during the period from  $t_0$  to  $t$ .
- $DOM$  = Domestic migration expected out of the state during the period from  $t_0$  to  $t$ .
- $IIM$  = International migration expected into the state during the period from  $t_0$  to  $t$ .
- $IOM$  = International migration expected out of the state during the period from  $t_0$  to  $t$ .

Estimated values for the components shown on the right side of equation 1 are based on past data and various assumptions regarding changes in the rates for birth, mortality, and migration (DOC 1996). Persons of Hispanic origin are included in the Hispanic population regardless of race. It should be noted that the U.S. Census Bureau does not project populations of individuals who identified themselves as “other race” during the 1990 Census. This population group is less than 2 percent of the total population in each of the states. However, to project total populations in the environmental justice analysis, population projections for the “other race” group were made under the assumption that the growth rate for the “other race” population will be identical to the growth rate for the combined minority and White populations.

#### **G.4 ENVIRONMENTAL JUSTICE ASSESSMENT**

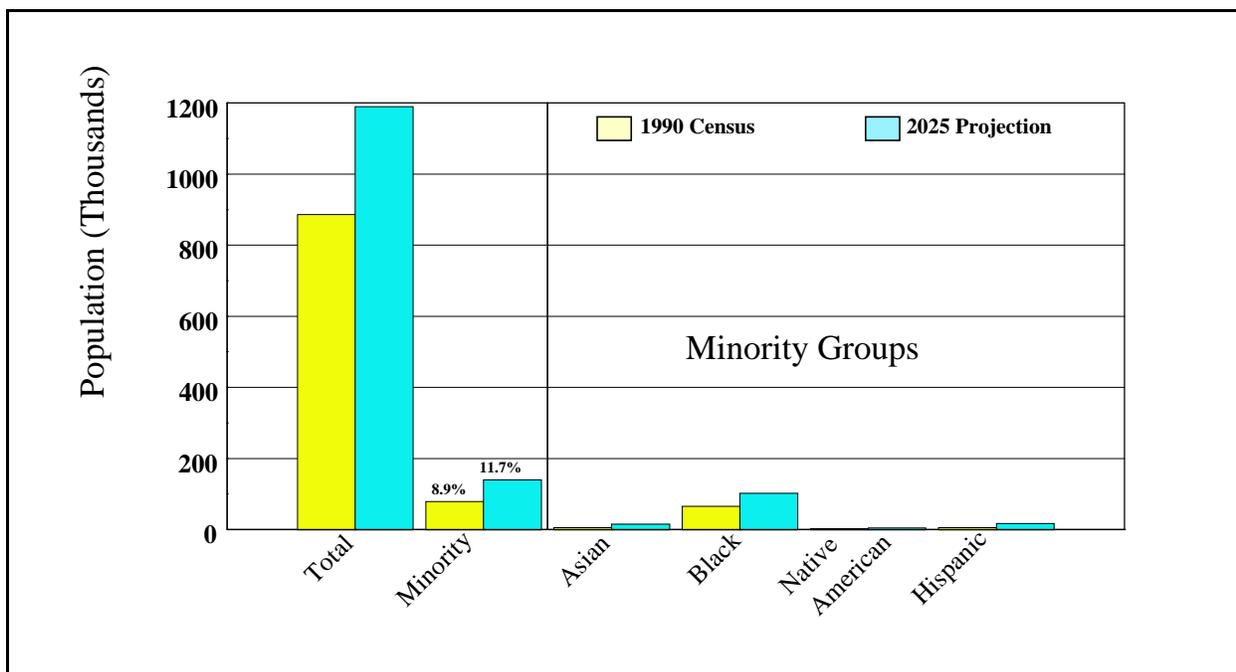
The analysis of environmental justice concerns was based on an assessment of the impacts reported in Chapter 5 of this EIS. This analysis was performed to identify any disproportionately high and adverse human health or environmental impacts on minority or low-income populations surrounding the three potential sites. Demographic information obtained from the U.S. Census Bureau was used to identify the minority populations and low-income communities in the zone of potential impact surrounding the sites. The outer zone is within the region of influence, a circle that has an 80-kilometer (50-mile) radius around the potential sites. This radius is consistent with that used to evaluate the collective dose for human health effects, air impact modeling, and socioeconomic impacts, and is judged to encompass all of the impacts that may occur.

#### **G.5 RESULTS FOR THE SITES**

As discussed in Chapter 3 of this EIS, three CLWR sites were selected as candidates for the production of tritium: Watts Bar, Sequoyah, and Bellefonte. This section will describe the analysis of potentially affected minority and low-income populations residing near the candidate sites. It should be noted that projections of the total population provided in this appendix differ from the projected total populations used in the health effects calculations described in Chapter 5. This is because the projections used in the analysis of environmental justice are based on projections for the states provided by the U.S. Bureau of the Census (DOC 1996). Projections used in the analysis of health effects are based on county-wide projections provided by state agencies. As discussed in Section G.3.2, the county projections are more sensitive to localized demographic changes. However, the states do not provide projections for minority populations. Therefore, the U.S. Bureau of the Census projections were used in the analysis of environmental justice. Population projections obtained with the two approaches differ by 8 percent or less and will have essentially no effect on the results of the analyses.

##### **G.5.1 Watts Bar Site**

**Figure G–1** shows the racial and ethnic composition of the minority population residing within 80 kilometers (50 miles) of the Watts Bar site in 1990 (DOC 1992) and those projected to reside in the potentially affected area in the year 2025. In the interval between 1990 and 2025, the percentage of the total population composed of minorities is projected to increase from 8.9 percent to 11.7 percent. For comparison, during the 1990 census, minorities were found to comprise approximately one-quarter of the total national population. By the year 2025, minorities are projected to comprise approximately one-third of the total national population. The percentage minority population residing in the potentially affected area surrounding the Watts Bar site was less than the corresponding national percentage in 1990, and is expected to remain so through the year 2025. Blacks are the largest minority group residing in the potentially affected area, while the Asian and Hispanic populations are projected to show the largest growth rates.



**Figure G–1 Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the Watts Bar Site**

**Figure G–2** shows the location of minority populations residing near the Watts Bar site in 1990. It also shows the annual dose to an individual located 40 kilometers (25 miles) from a 3,400 Curie release with its source at the Watts Bar site. All of the annual doses shown in Figure G–2 are several orders of magnitude less than the annual dose due to natural background radiation and would be expected to pose small, if any, risks to the health of an individual. As indicated in Figure G–2, block groups for which the percentage of minority residents exceeds the corresponding national percentage are concentrated in the Chattanooga, Tennessee, area.

**Figure G–3** shows data similar to that of Figure G–2, except that the annual doses displayed in Figure G–3 apply to an individual located 8 kilometers (5 miles) from the Watts Bar site. All of the annual doses shown in Figure G–3 are several orders of magnitude less than the annual dose from the natural background radiation and would be expected to result in small, if any, impacts on the health of an individual.

During the 1990 census, 13.6 percent of the residents within the potentially affected area surrounding the Watts Bar site reported incomes below the poverty threshold. Slightly over 13 percent of the national population reported incomes below the poverty threshold, and nearly 16 percent of the residents of Tennessee reported incomes below the poverty threshold during the same year. Thus, the percentage low-income population residing within the potentially affected area exceeded that for the nation, but is less than the corresponding percentage for Tennessee. **Figures G–4 and G–5** show the geographical distribution of low-income residents surrounding the Watts Bar site. Block groups for which the percentage of low-income residents exceeds the corresponding national percentage are located throughout the potentially affected area.

As discussed in Chapter 5, the production of tritium at the Watts Bar site would pose little risk to the public and the natural environment. Thus, selection of the Watts Bar site for the production of tritium would not be expected to pose disproportionately high and adverse risks to potentially affected minority and low-income populations residing near the Watts Bar site.

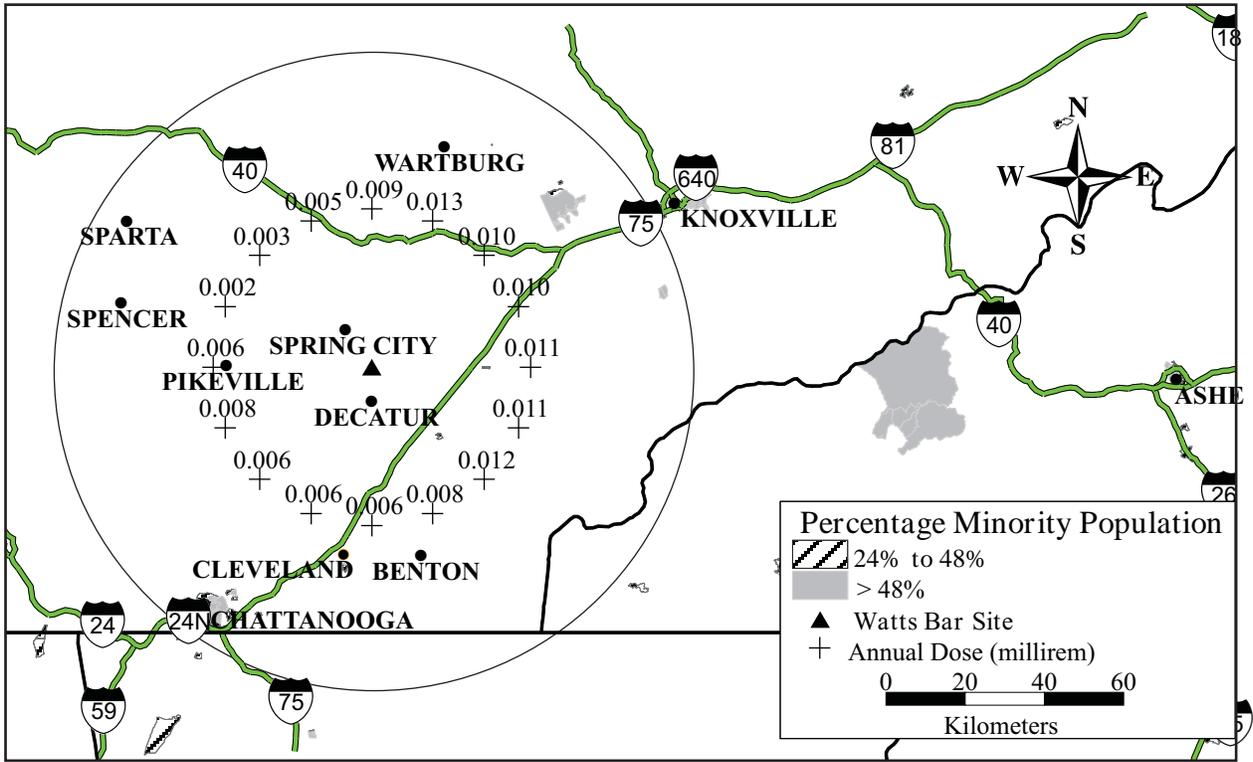


Figure G-2 Minority Population Residing Within 16 Kilometers (10 Miles) of the Watts Bar Site

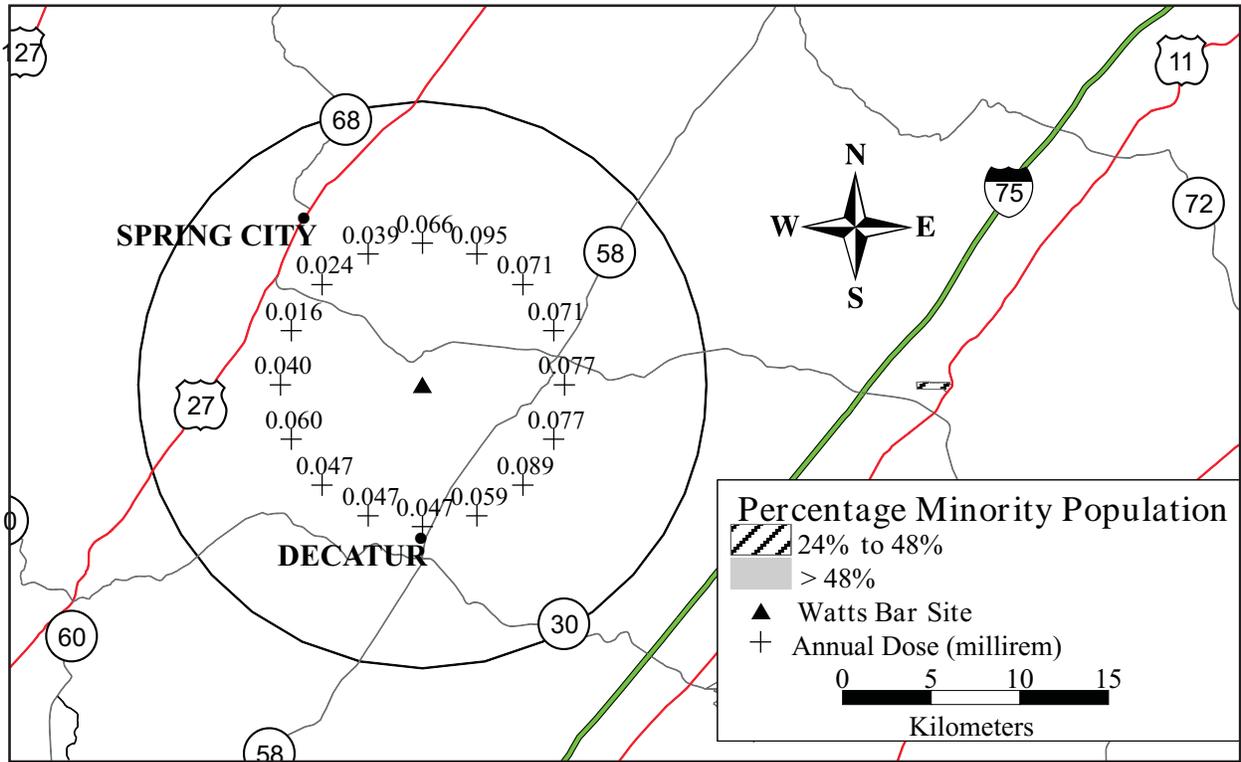
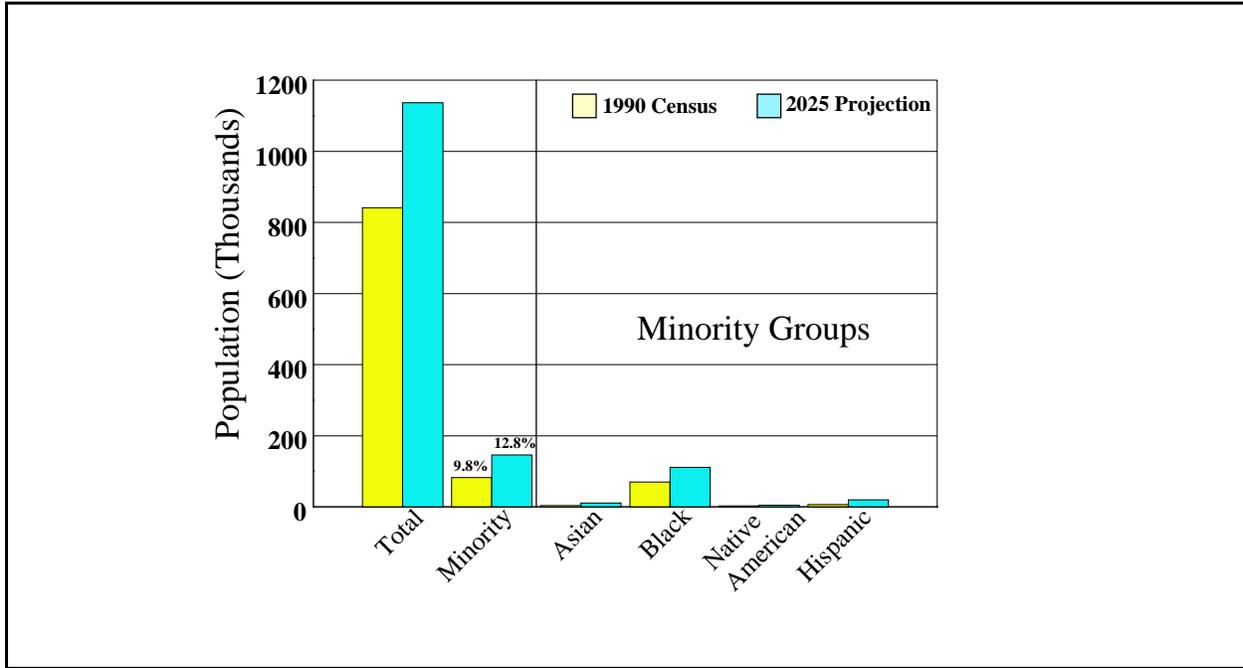


Figure G-3 Minority Population Residing Within 80 Kilometers (50 Miles) of the Watts Bar Site



### G.5.2 Sequoyah Site

**Figure G–6** shows the racial and ethnic composition of the minority population residing within 80 kilometers (50 miles) of the Sequoyah site in 1990 (DOC 1992) and those projected to reside in the potentially affected area in the year 2025. In the interval between 1990 and 2025, the percentage of the total population composed of minorities is projected to increase from 9.8 percent to 12.8 percent. For comparison, during the 1990 census, minorities were found to comprise approximately one-quarter of the total national population. By the year 2025, minorities are projected to comprise approximately one-third of the total national population. The percentage minority population residing in the potentially affected area surrounding the Sequoyah site was less than the corresponding national percentage in 1990, and is expected to remain so through the year 2025. Blacks are the largest minority group residing in the potentially affected area, while the Asian and Hispanic populations are projected to show the largest growth rates.



**Figure G–6 Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the Sequoyah Site**

**Figure G–7** shows the location of minority populations and low-income populations residing near the Sequoyah site. It also shows the annual dose to an individual located 40 kilometers (25 miles) from a 3,400 Curie release with its source at the Sequoyah site. All of the annual doses shown in Figure G–7 are several orders of magnitude less than the annual dose from the natural background radiation and would be expected to pose small, if any, risks to the health of an individual. As indicated in Figure G–7, block groups for which the percentage of minority residents exceeds the corresponding national percentage are concentrated in the Chattanooga area.

**Figure G–8** shows data similar to that in Figure G–7, except that the annual doses displayed in Figure G–8 apply to an individual located 8 kilometers (5 miles) from the Sequoyah site. All of the annual doses shown in Figure G–8 are several orders of magnitude less than the annual dose from the natural background radiation and would be expected to pose little, if any, risk to the health of an individual.

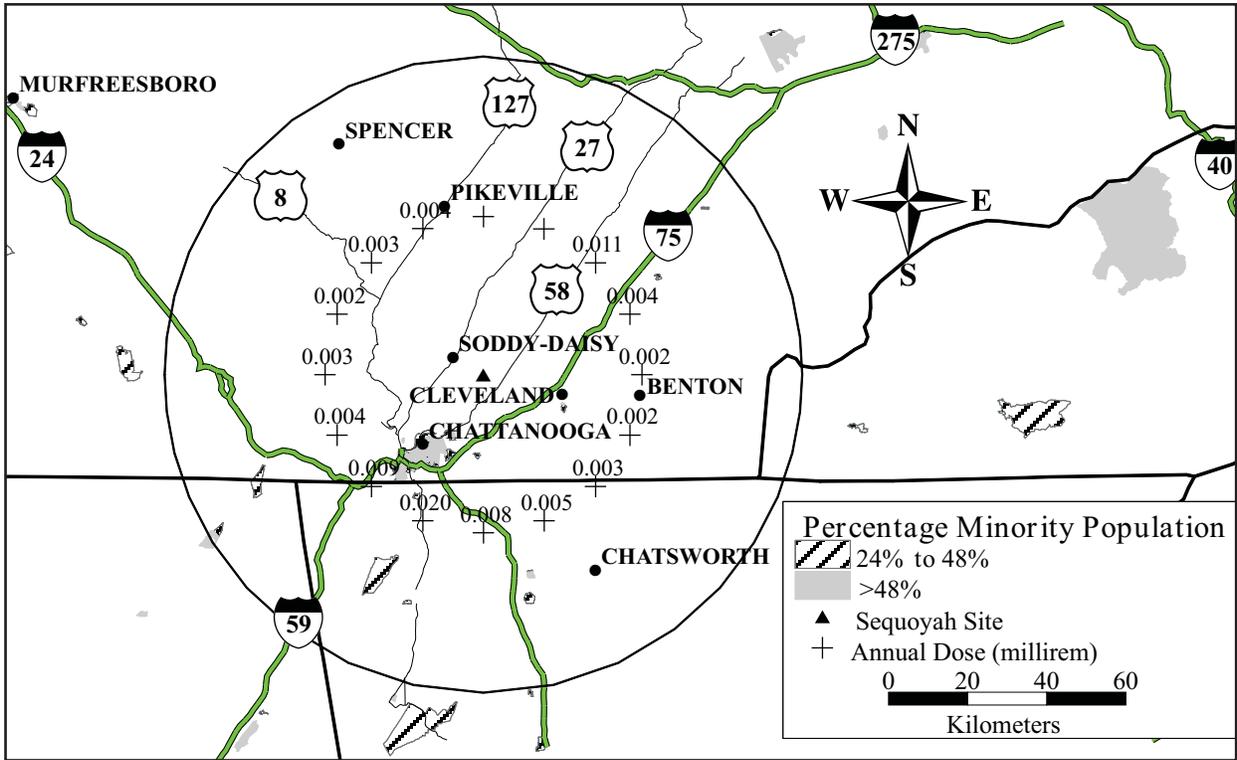


Figure G-7 Minority Population Residing Within 80 Kilometers (50 Miles) of the Sequoyah Site

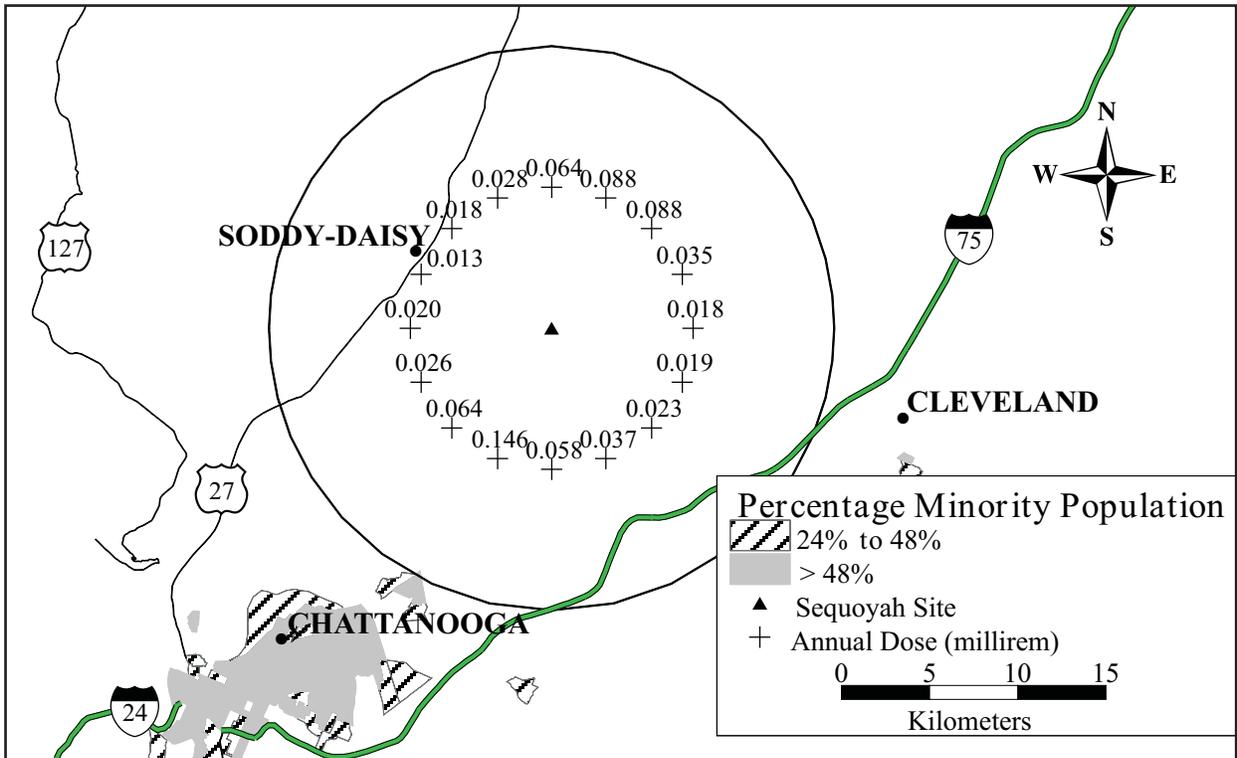
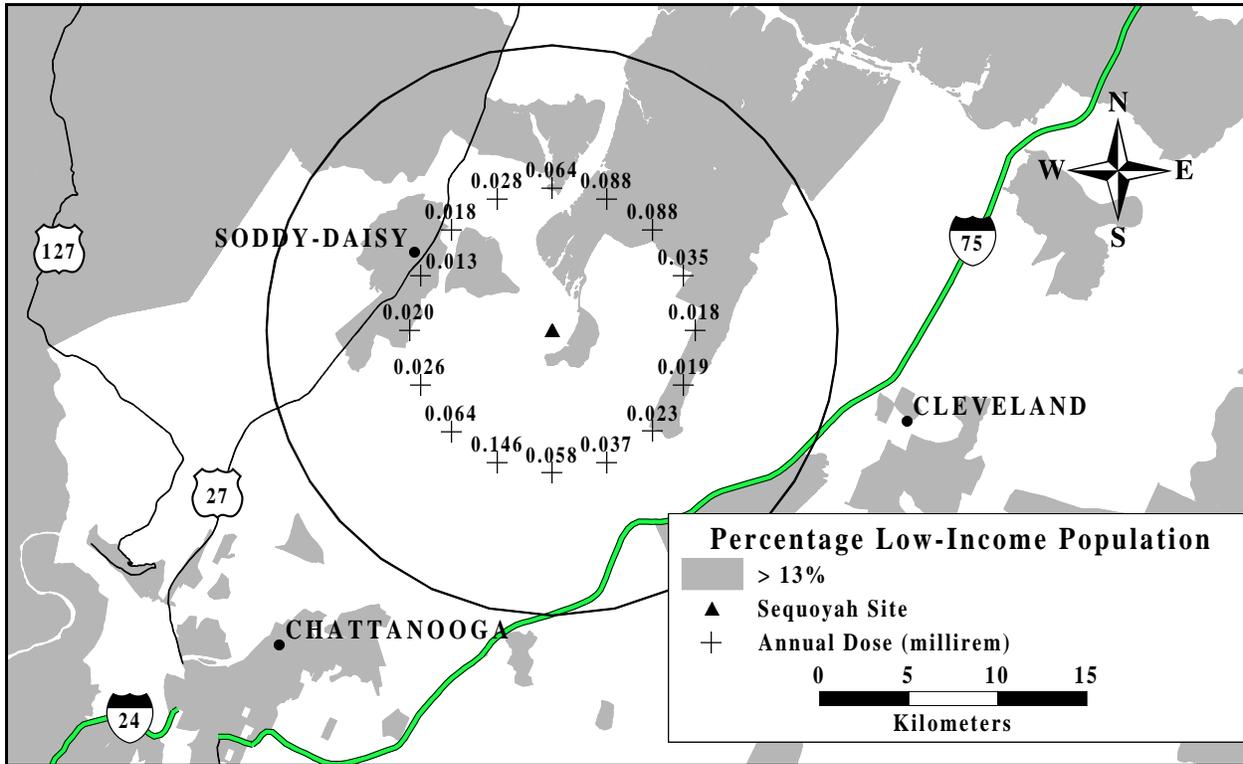
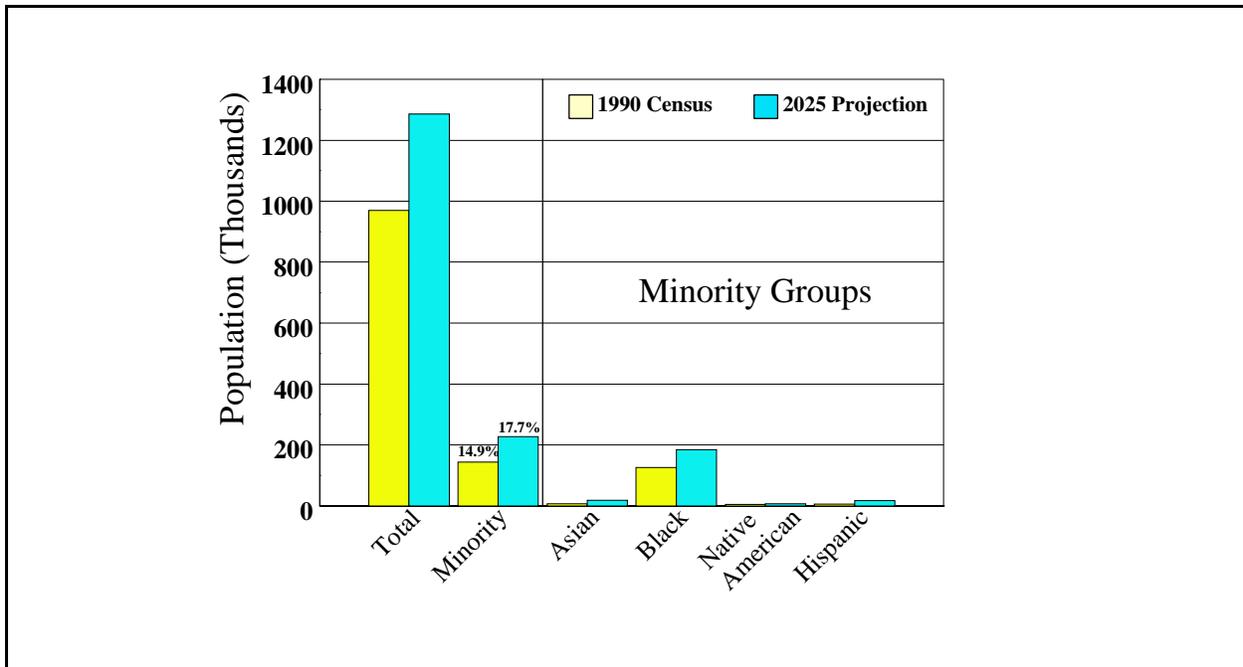


Figure G-8 Minority Population Residing Within 16 Kilometers (10 Miles) of the Sequoyah Site





**Figure G-10 Low-Income Population Residing Within 16 Kilometers (10 Miles) of the Sequoyah Site**



**Figure G-11 Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the Bellefonte Site**

Figure G-12 shows the location of minority populations residing near the Bellefonte site. Minority residents are concentrated in urban areas near Chattanooga and Huntsville-Decatur, Alabama. Throughout the potentially affected area, there are relatively few locations for which the percentage minority population exceeds the corresponding national percentage. Figure G-12 also shows the annual dose to an individual located 40 kilometers (25 miles) from a 3,400 Curie release with its source at the Bellefonte site. All of the annual doses shown in Figure G-12 are several orders of magnitude less than the annual dose from the natural background radiation and would be expected to pose little, if any, risk to the health of an individual.

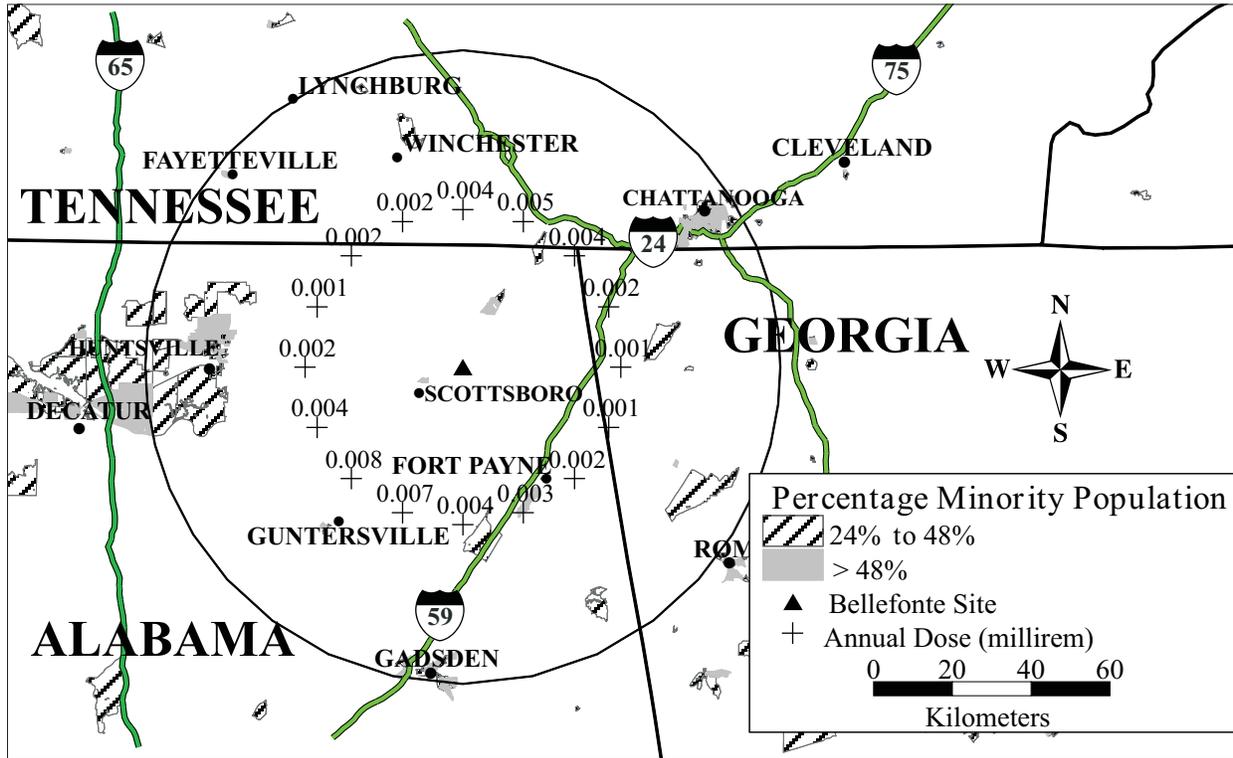


Figure G-12 Minority Population Residing Within 80 Kilometers (50 Miles) of the Bellefonte Site

Figure G-13 shows data similar to that of Figure G-12, except that the annual doses displayed in Figure G-13 apply to an individual located 8 kilometers (5 miles) from the Bellefonte site. All of the annual doses shown in Figure G-13 are several orders of magnitude less than the annual dose from the natural background radiation, and would be expected to pose little, if any, risk to the health of an individual.

During the 1990 census, 14.7 percent of the residents within the potentially affected area surrounding the Bellefonte site reported incomes below the poverty threshold. Slightly over 13 percent of the national population reported incomes below the poverty threshold, and approximately 18 percent of the residents of Alabama reported incomes below the poverty threshold during the same year. Thus, the percentage low-income population residing within the potentially affected area exceeded that for the nation, but is less than the corresponding percentage for Alabama. Figures G-14 and G-15 show the geographical distribution of low-income residents surrounding the Bellefonte site. On the other hand, block groups for which the percentage of low-income residents exceeds the corresponding national percentage are located throughout the potentially affected area.

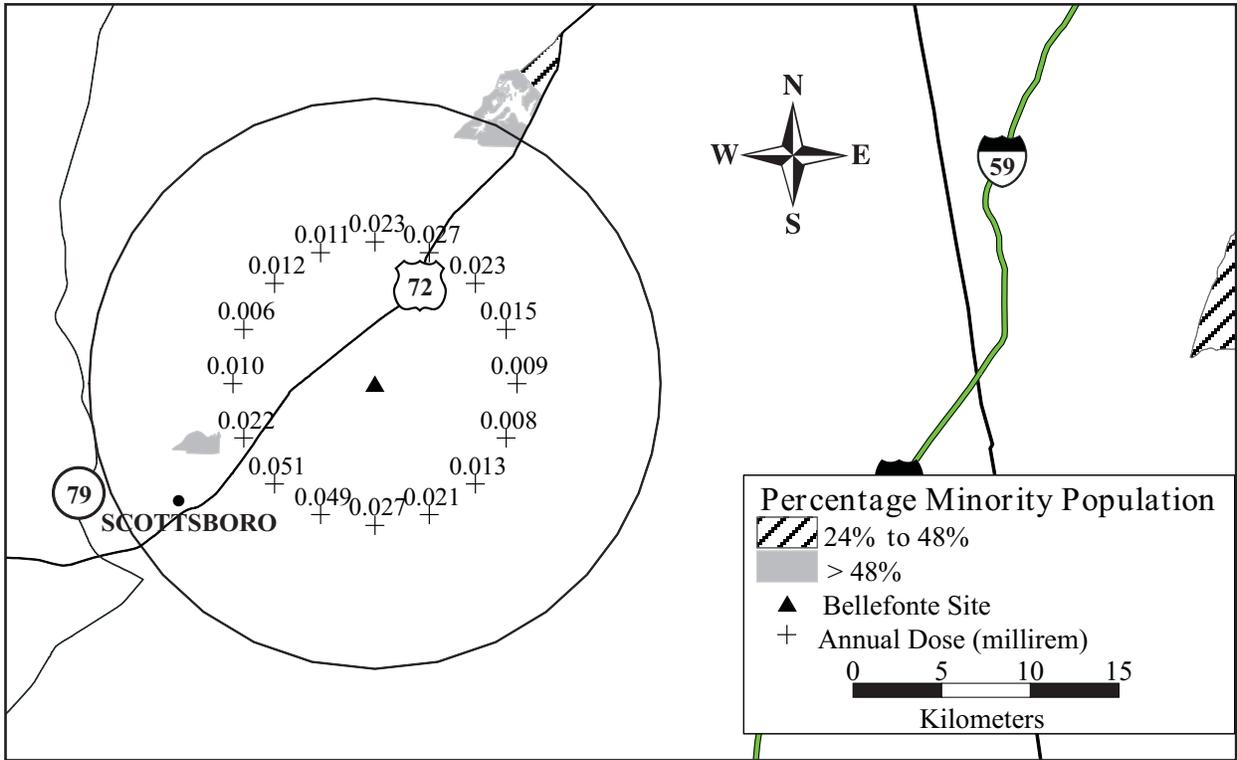


Figure G-13 Minority Population Residing Within 16 Kilometers (10 Miles) of the Bellefonte Site

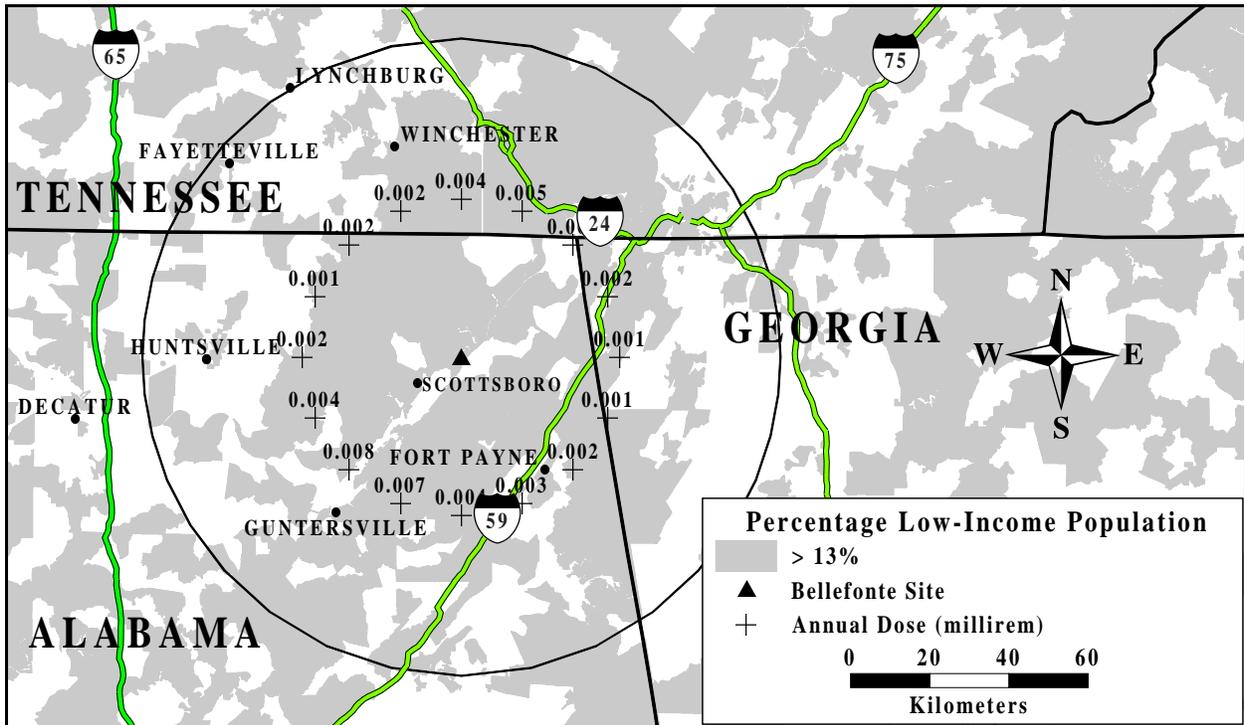
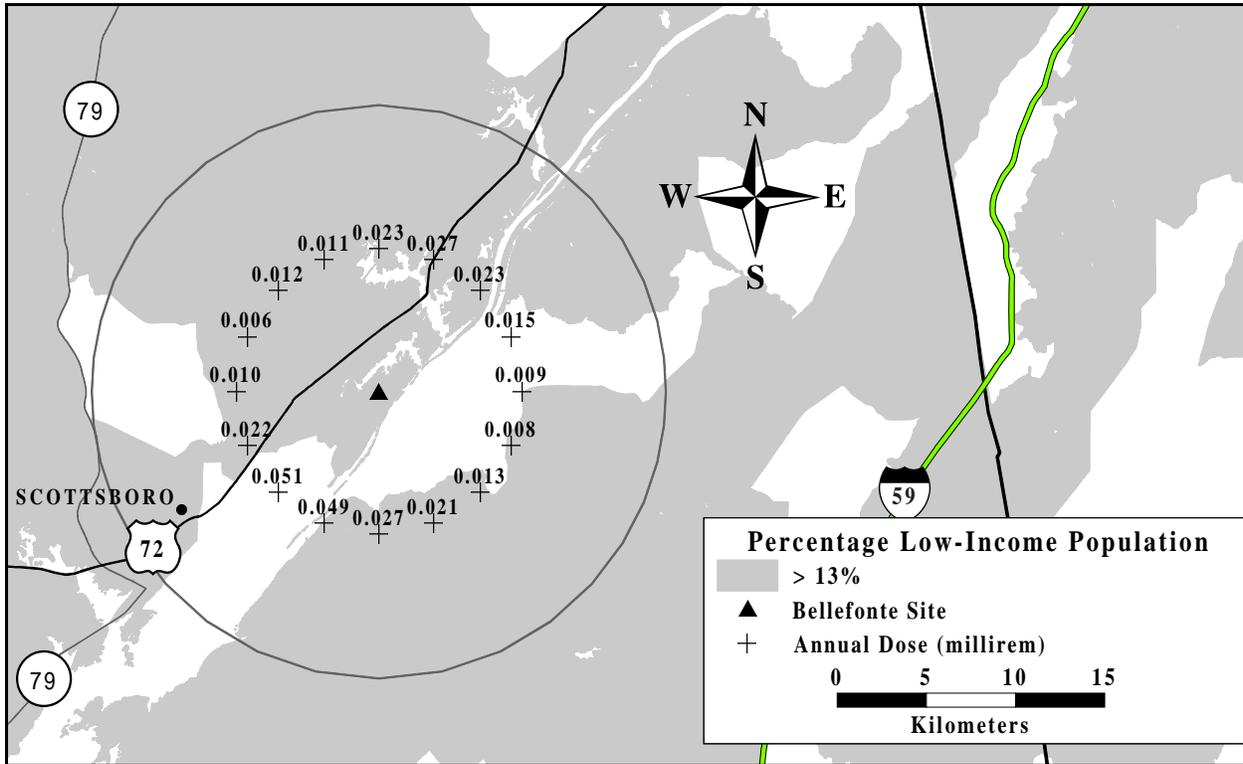


Figure G-14 Low-Income Population Residing Within 80 Kilometers (50 Miles) of the Bellefonte Site



**Figure G-15 Low-Income Population Residing Within 16 Kilometers (10 Miles) of the Bellefonte Site**

As discussed in Chapter 5, the production of tritium at the Bellefonte site would pose small risks to the public and the natural environment. Thus, selection of the Bellefonte site for the production of tritium would not be expected to pose disproportionately high and adverse risks to potentially affected minority and low-income populations residing near the Bellefonte site.

**G.6 RESULTS FOR TRANSPORTATION ROUTES**

Overland transportation of tritium involves radiological and nonradiological risks to the public. **Tables G-1 through G-3** show minority and low-income populations residing along highway routes from Watts Bar, Sequoyah, and Bellefonte Nuclear Plants to the Savannah River Site in South Carolina. These tables show populations residing within the 1.6-kilometer (1-mile) corridor centered along highway routes from all three potential sites to the Savannah River Site. Data presented in the tables were resolved at the block-group level. Data for minority populations are projected for the year 2025 and data for low-income populations are taken from the 1990 Census. The distances along highway routes connecting the Savannah River Site with other sites are as follows: 558 kilometers (349 miles), Bellefonte; 497 kilometers (311 miles), Sequoyah; and 576 kilometers (360 miles), Watts Bar.

As discussed in Appendix E, it is unlikely that radiological and nonradiological harm to the general population, including low-income populations and minority populations, would result from highway transportation of tritium.

**G.7 OTHER ENVIRONMENTAL IMPACTS**

No significant adverse impacts to biotic resources, air resources, socioeconomics, land use, or cultural resources were identified in Chapter 5. Therefore, no disproportionately high or adverse impacts were

identified for any segment of the population. None of the alternatives would have a significant adverse impact on the previously mentioned resources because, under all of the alternatives, a limited amount of previously undisturbed land would be used on and off the sites.

### **G.8 CUMULATIVE IMPACTS**

Based on the analysis of the environmental impacts evaluated in this EIS, along with the impacts of other past, present, and reasonably foreseeable future activities, no reasonably foreseeable cumulative adverse impacts are expected to affect the surrounding minority and low-income populations.

**Table G-1 Minority Populations Residing Near Highway Routes from Potential Sites to the Savannah River Site**

<i>Site</i>	<i>Population Along Route</i>	<i>Minority Population Along Route</i>	<i>Percent Minority Population Along Route</i>
Watts Bar	296,423	122,972	41.5
Sequoyah	298,364	123,694	41.5
Bellefonte	303,417	129,701	43.0

**Table G-2 Racial and Ethnic Composition of Minority Populations (2025) Residing Within 1.6 Kilometers (1 Mile) Along Highway from Potential Sites to the Savannah River Site**

<i>Site</i>	<i>Total Pop.</i>	<i>Total Minority Pop.</i>	<i>Percent Minority Pop.</i>	<i>American Indian, Eskimo, or Aleut Pop.</i>	<i>Percent American Indian, Eskimo, or Aleut Pop.</i>	<i>Asian or Pacific Islander Pop.</i>	<i>Percent Asian or Pacific Islander Pop.</i>	<i>Black Pop.</i>	<i>Percent Black Pop.</i>	<i>Hispanic Origin Pop.</i>	<i>Percent Hispanic Origin Pop.</i>
Watts Bar	296,423	122,972	41.5	739	0.24	12,108	4	97,594	33	12,531	4
Sequoyah	298,364	123,694	41.5	720	0.24	12,368	4	98,146	33	12,460	4
Bellefonte	303,417	129,701	43.0	821	0.30	12,303	4	104,289	34	12,288	4

**Table G-3 Low-Income Populations Residing Near Highway Routes from Potential Sites to the Savannah River Site**

<i>Site</i>	<i>Population Along Route</i>	<i>Low-Income Population Along Route</i>	<i>Percent Low-Income Population Along Route</i>
Watts Bar	296,423	21,415	7
Sequoyah	298,364	21,489	7
Bellefonte	303,417	24,731	8

## **G.9 REFERENCES**

CEQ (Council on Environmental Quality), 1997, *Environmental Guidance Under the National Environmental Policy Act*, Executive Office of the President, Washington, DC, December 10.

DOC (U.S. Department of Commerce), 1992, *1990 Census of Population and Housing, Summary Tape File 3 on CD-ROM*, Bureau of the Census, Washington, DC, May.

DOC (U.S. Department of Commerce), 1996, "Population Projections for States by Age, Sex, Race, and Hispanic Origin: 1995 to 2025" (available at <http://www.census.gov/population/www/projections/pp147.html>), Population Division, October.