
APPENDIX H ENVIRONMENTAL JUSTICE ANALYSIS

H.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 NEPA (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 appendix provides an assessment of the potential for disproportionately high and adverse human health or environmental effects on minority or low-income populations that could result from implementation of alternatives for management of the U.S. Department of Energy's (DOE) inventory of sodium-bonded spent nuclear fuel.

H.2 DEFINITIONS AND APPROACH

Minority Individuals and Population

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 discussions of environmental justice in this EIS, 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 the year 2010 from the U.S. Census Bureau's worldwide web site (DOC 1999).

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 (CEQ 1997).

Low-Income Individuals and Population

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

- **Low-Income Individuals**—Persons whose self-reported incomes are less than the poverty threshold
- **Low-Income Population**—The total number of poverty-level individuals residing within a potentially affected area

Data for the analysis of low-income populations were extracted from the U.S. Census Bureau's 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 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 the treatment and management of sodium-bonded spent nuclear fuel at Argonne National Laboratory-West (ANL-W) and the Savannah River Site (SRS).

H.3 METHODOLOGY

H.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 EIS include (in order of increasing spatial resolution) states, counties, census tracts, block groups, and blocks. The block is 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 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 4 of this EIS, radiological health effects due to an accident at each of the sites 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.

Tables H-1 through H-3 show lower and upper population bounds for the ANL-W site located within the boundary of the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho, and F- and L-Areas at SRS in South Carolina. Estimated populations listed in column 3 of these tables were obtained under the assumption that populations are distributed uniformly throughout each block group that lies at least partly within 80 kilometers (50 miles) of the candidate sites. Lower population bounds given in column 2 were obtained by summing only those populations residing in block groups that are wholly included within a circle of an 80-kilometer radius centered at each candidate site. Upper bounds shown in column 4 are the sum of populations residing within all block groups that are at least partly included within that circle. For these candidate sites, lower bounds differed from the corresponding estimate by no more than 12.9 percent, while upper bounds differed from the corresponding estimate by 10.4 percent or less. As discussed in Chapter 4 and summarized in Table 2-4 of Chapter 2, implementation of the alternatives would pose no significant radiological or nonradiological risks to the general public. Under normal operations, the radiological risk of a latent cancer fatality among the surrounding population is approximately one in 90,000 or less. In the event of an accident involving a radiological release affecting the general population, the maximum risk to the public would occur at SRS under Alternative 5, where 0.013 latent cancer fatalities would be expected. Under Alternative 5, unless the population at risk near SRS were increased by nearly a factor of 77 over the estimated value, no latent cancer fatalities would be expected. Thus, uncertainties in the estimates of total, minority, and low-income populations are not large enough to noticeably affect the conclusions regarding environmental effects on minority and low-income populations that would result from implementation of the proposed action or alternatives.

Table H-1 Total Population Estimates and Bounds in 1990 for Candidate Sites

<i>Candidate Site</i>	<i>Lower Bound</i>	<i>Estimated Total Population</i>	<i>Upper Bound</i>
ANL-W	168,365	181,088	197,519
F-Area	569,693	608,891	660,363
L-Area	559,870	606,819	663,376

Table H-2 Minority Population Estimates and Bounds in 1990 for Candidate Sites

<i>Candidate Site</i>	<i>Lower Bound</i>	<i>Estimated Minority Population</i>	<i>Upper Bound</i>
ANL-W	13,712	15,737	17,369
F-Area	215,781	230,116	251,696
L-Area	218,414	237,094	260,629

Table H-3 Low-Income Population Estimates and Bounds in 1990 for Candidate Sites

<i>Candidate Site</i>	<i>Lower Bound</i>	<i>Estimated Low-Income Population</i>	<i>Upper Bound</i>
ANL-W	22,966	25,105	27,455
F-Area	98,972	106,281	116,037
L-Area	98,519	107,469	117,988

H.3.2 Population Projections

Health effects were calculated for populations projected to reside in potentially affected areas during the year 2010. Extrapolations of the total population for individual states are available from both the U.S. Census Bureau and various state agencies (Campbell 1996). The U.S. Census Bureau also projects populations by ethnic and racial classification in one-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 (DOC 1999). 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 (Campbell 1996). The set of cohorts is composed 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:

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

where:

- $P(t_0)$ = Cohort population at time t_0 is less than or equal to 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 into the state expected during the period from t_0 to t .
- DOM = Domestic migration out of the state expected during the period from t_0 to t .
- IIM = International migration into the state expected during the period from t_0 to t .
- IOM = International migration out of the state expected during the period from t_0 to t .

Estimated values for the components shown on the right side of the equation are based on past data and various assumptions regarding changes in the rates for birth, mortality, and migration (Campbell 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.

H.4 ENVIRONMENTAL JUSTICE ASSESSMENT

The analysis of environmental justice effects was based on an assessment of the impacts reported in Chapter 4 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 ANL-W and SRS. 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 two sites. The zone, or region of influence, is a circle that has an 80-kilometer (50-mile) radius around the proposed 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.

H.5 RESULTS FOR THE SITES

As discussed in Chapter 2 of this EIS, candidate sites for the treatment and management of sodium-bonded spent nuclear fuel are located at ANL-W and SRS. This section describes the environmental justice 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 4. 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 (Campbell 1996). Projections used in the analysis of health effects are based on county-wide projections provided by state agencies. As discussed in Section H.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 have essentially no effect on these results of the analyses.

H.5.1 Argonne National Laboratory-West

Figure H-1 shows the racial and ethnic composition of the minority population of ANL-W projected to reside in the potentially affected area in the year 2010. In the interval between 1990 and 2010, the percentage of the total population composed of minorities is projected to increase from 8.7 percent to 13.3 percent. For comparison, during the 1990 census, minorities were found to compose approximately one-quarter of the total national population. By the year 2010, minorities are projected to compose closer to one-third of the total national population. The percentage of the minority population residing in the potentially affected area surrounding ANL-W was less than the corresponding national percentage in 1990, and is expected to remain so through the year 2010. Hispanics 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.

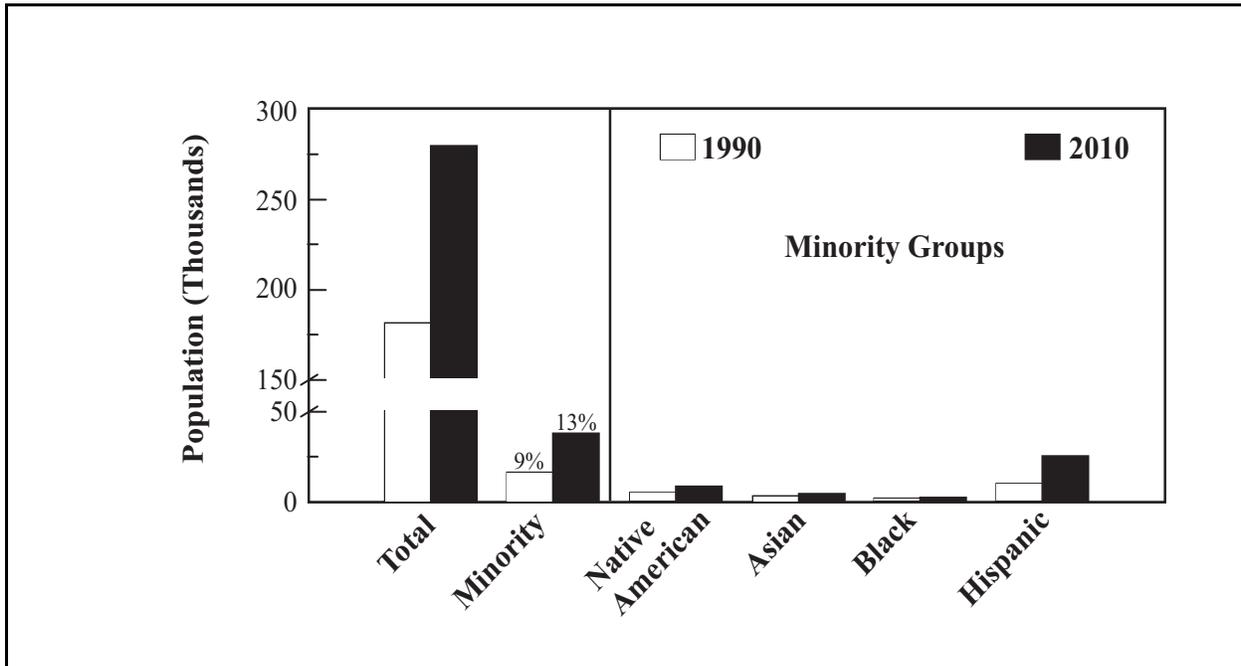


Figure H-1 Projected Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of ANL-W in 2010

Figure H-2 shows the location of minority populations residing near the ANL-W in 1990. As indicated in the figure, block groups for which the percentage of minority residents exceeds the corresponding national percentage are located throughout the potentially affected area.

During the 1990 census, 15 percent of the residents within the potentially affected area surrounding ANL-W reported incomes below the poverty threshold. Slightly over 13 percent of the national population reported incomes below the poverty threshold, and approximately 13 percent of the residents of Idaho reported incomes below the poverty threshold during the same year. Thus, the percentage of the low-income population residing within the potentially affected area exceeded that for the nation and the state of Idaho by approximately 2 percent. **Figure H-3** shows the geographical distribution of low-income residents surrounding the ANL-W site in 1990. Block groups for which the percentage of low-income residents exceeds the corresponding national percentage are located throughout the potentially affected area.

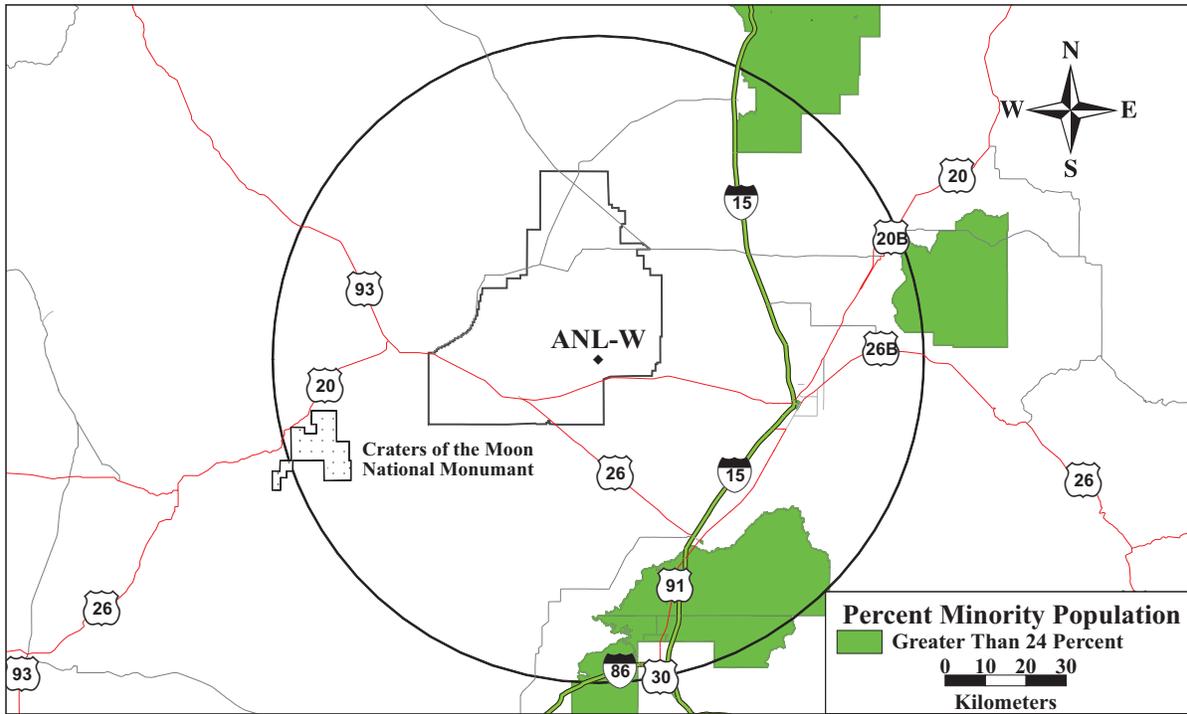


Figure H-2 Minority Population Residing Within 80 Kilometers (50 Miles) of the ANL-W Site in 1990

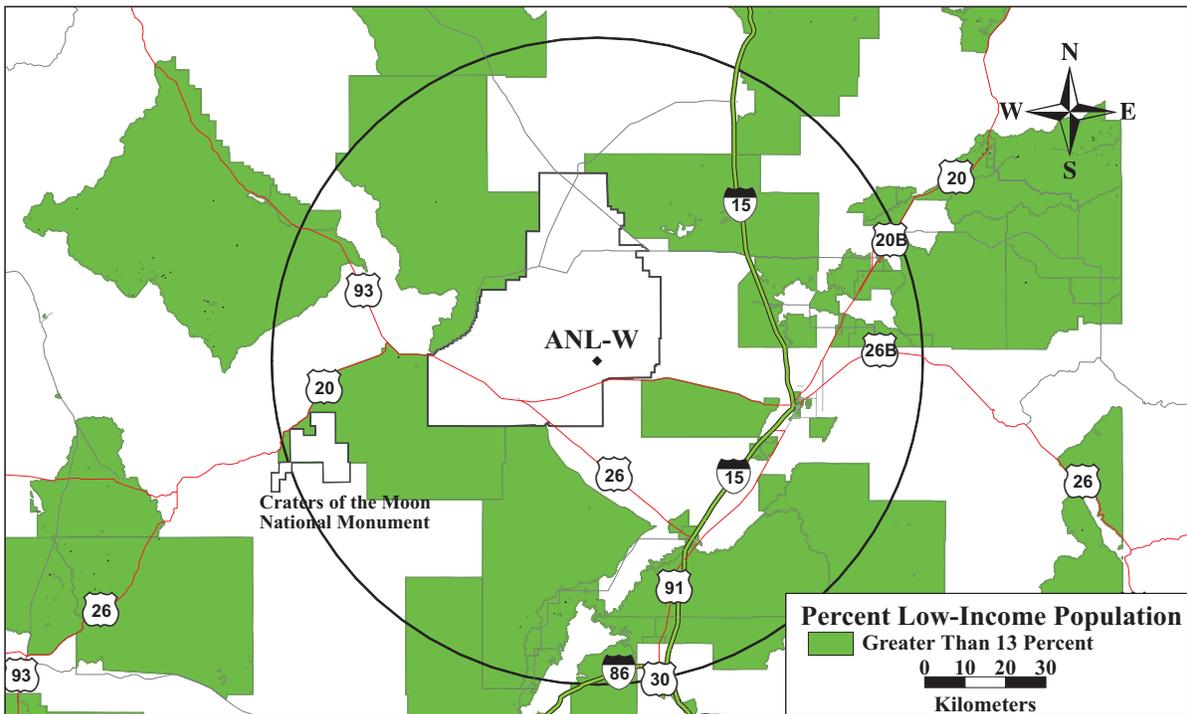


Figure H-3 Low-Income Population Residing Within 80 Kilometers (50 Miles) of ANL-W in 1990

H.5.2 The Savannah River Site F-Area

Figure H-4 shows the racial and ethnic composition of the minority population residing within 80 kilometers (50 miles) of F-Area at SRS in 1990, and the minority population projected to reside in the potentially affected area in the year 2010. In the interval between 1990 and 2010, the percentage of the total population composed of minorities is projected to increase from 37.9 percent to 42 percent. For comparison, during the 1990 census, minorities were found to compose approximately one-quarter of the total national population. By the year 2010, minorities are projected to compose nearly one-third of the total national population. The percentage of the minority population residing in the potentially affected area surrounding F-Area was larger than the corresponding national percentage in 1990, and is expected to remain so through the year 2010. 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.

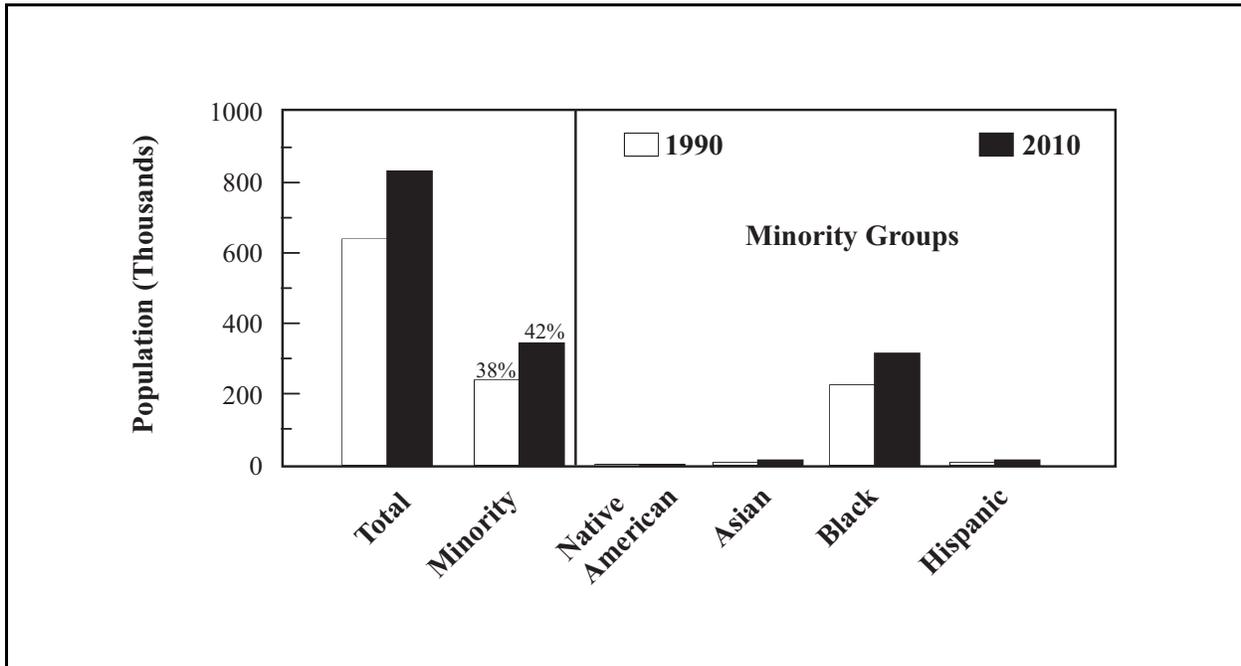


Figure H-4 Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the SRS F-Area in 2010

Figure H-5 shows the geographical distribution of minority populations residing near the SRS F-Area (and L-Area) in 1990. L-Area is discussed in Section H.5.3, below. Block groups for which the percentage of the minority population exceeds the national percentage are located throughout the potentially affected area surrounding F-Area.

During the 1990 census, 18 percent of the residents within the potentially affected area surrounding F-Area reported incomes below the poverty threshold. Slightly over 13 percent of the national population reported incomes below the poverty threshold, and nearly 15 percent of the residents of the combined States of Georgia and South Carolina reported incomes below the poverty threshold during the same year. Thus, the percentage of low-income population residing within the potentially affected area exceeded that for the Nation and the States of Georgia and South Carolina. **Figure H-6** shows the geographical distribution of low-income residents surrounding the F-Area site (and L-Area Site) in 1990. Block groups for which the percentage of low-income residents exceeds the corresponding national percentage are located throughout the potentially affected area.

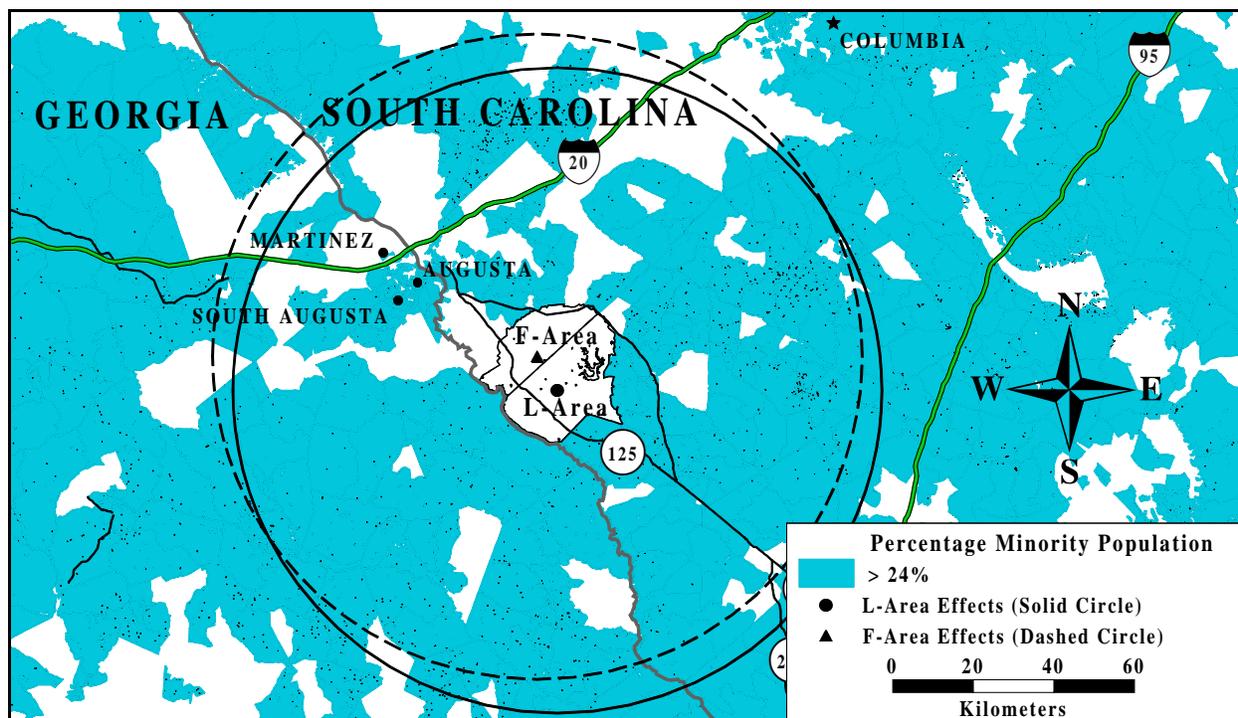


Figure H-5 Minority Population Residing Within 80 Kilometers (50 Miles) of SRS F-Area and L-Area in 1990

H.5.3 The Savannah River Site L-Area

Figure H-7 shows the racial and ethnic composition of the minority population projected to reside in the potentially affected area surrounding the SRS L-Area by the year 2010. In the interval between 1990 and 2010, the percentage of the total population composed of minorities is projected to increase from 39.1 percent to 43 percent. For comparison, during the 1990 census, minorities were found to compose approximately one-quarter of the total national population. By the year 2010, minorities are projected to compose close to one-third of the total national population. The percentage of the minority population residing in the potentially affected area surrounding L-Area was larger than the corresponding national percentage in 1990, and is expected to remain so through the year 2010. 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 H-5 shows the geographical distribution of minority populations residing near the SRS L-Area and F-Area in 1990. F-Area was discussed in Section H.5.2 above. As indicated in the figure, block groups for which the percentage of minority residents exceeds the national percentage are distributed throughout the potentially affected area surrounding L-Area.

During the 1990 census, 20.6 percent of the residents within the potentially affected area surrounding L-Area reported incomes below the poverty threshold. Slightly over 13 percent of the national population reported incomes below the poverty threshold, and nearly 15 percent of the residents of the combined States of Georgia and South Carolina 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 and the States of Georgia and South Carolina. As shown in Figure H-6, block groups for which the percentage of low-income residents exceeds the corresponding national percentage are located throughout the potentially affected area.

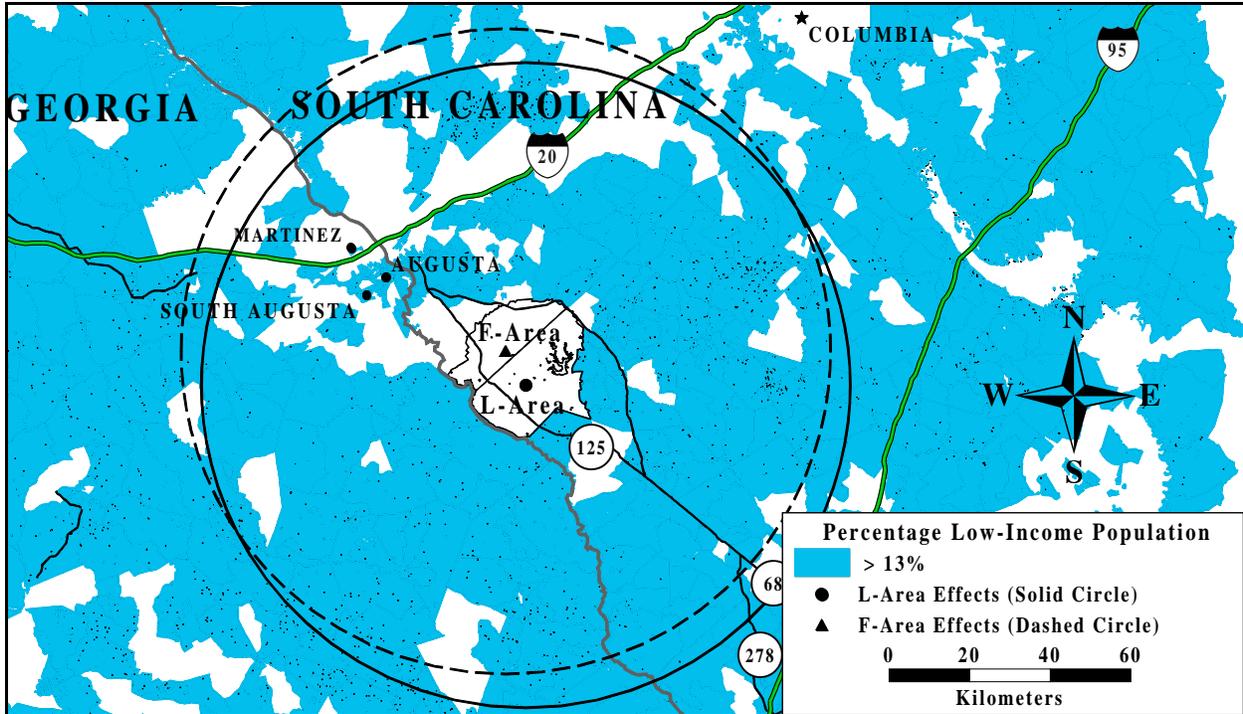


Figure H-6 Low-Income Populations Residing Within 80 Kilometers (50 Miles) of SRS F-Area and L-Area in 1990

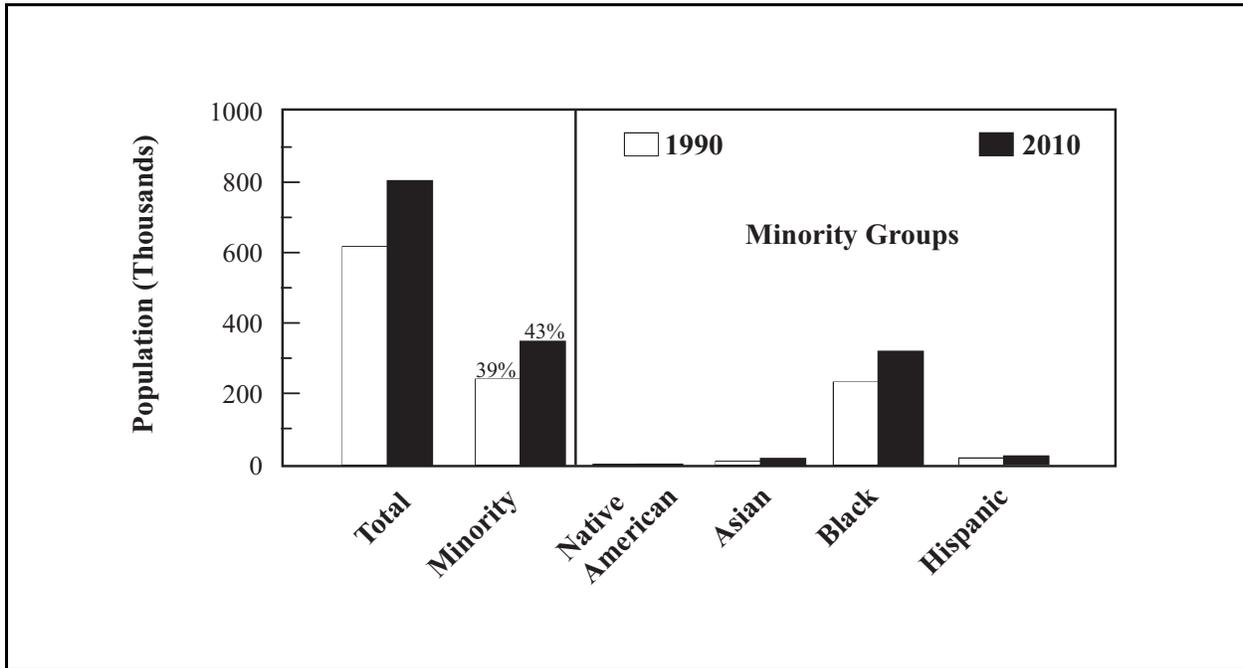


Figure H-7 Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the SRS L-Area in 2010

H.5.4 Environmental Impacts at the Sites

Environmental effects that would result from implementation of the various alternatives are discussed in Chapter 4 and summarized in Table 2-4 of Section 2. It was demonstrated in Chapter 4 that implementation of the alternatives would pose no significant radiological or nonradiological risks to the public. **Table H-4** summarizes the radiological impacts described in Chapter 4 that are relevant to the evaluation of environmental justice. Columns 3 and 4 of the table show the estimated likelihood of latent cancer fatalities for the maximally exposed offsite individual and the surrounding population, respectively, under normal operations over the lifetime of the project. For most of the alternatives, the risk of a latent cancer fatality calculated for the maximally exposed offsite individual was too small to be physically observable. Estimated latent cancer fatalities from accidents were less than those expected for normal operations. As indicated in columns 3 and 4 of the table, as well as the discussions of Chapter 4, implementation of the alternatives would pose no significant radiological risks to the general public, and these risks are independent of the racial, ethnic, and economic composition of potentially affected populations. Thus, implementation of the alternatives would pose no disproportionate risks to minority populations or low-income populations within the general population.

Table H-4 Summary of Radiological Effects of the Alternatives on the Public

<i>Alternative</i>	<i>Project Duration (years)</i>	<i>Estimated Likelihood of an Latent Cancer Fatality for the Offsite Maximally Exposed Individual</i>	<i>Estimated Likelihood of an Latent Cancer Fatality Among the Population at Risk</i>
No Action	35	Essentially Zero	1 in 154,000
1	13	Essentially Zero	1 in 125,000
2	09	Essentially Zero	1 in 118,000
3	09	Essentially Zero	1 in 100,000
4	12	Essentially Zero	1 in 118,000
5	09	Essentially Zero	1 in 91,000
6	10	Essentially Zero	1 in 83,000

H.6 RESULTS FOR TRANSPORTATION ROUTES

As discussed in Chapter 4 of this EIS, no significant radiological or nonradiological risks along representative transportation routes would result from implementation of the alternatives for the treatment and management of sodium-bonded spent nuclear fuel. Therefore, implementation of these alternatives would pose no disproportionately high and adverse risks to minority and low-income groups within the general public.

H.7 OTHER ENVIRONMENTAL IMPACTS

No significant adverse impacts to biotic resources, air resources, socioeconomics, land use, or cultural resources were identified in Chapter 4. Therefore, no disproportionately high and 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, all activities associated with the treatment and management of sodium-bonded spent nuclear fuel would take place within existing facilities at ANL-W and SRS.

H.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 disproportionate and adverse impacts are expected to affect the surrounding minority and low-income populations.

H.9 REFERENCES

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

Campbell, Paul R., 1996, *Population Projections for States by Age, Sex, Race, and Hispanic Origin: 1995 to 2025* (available at <http://www.census.gov/population/www/projections/ppl47.html>), U.S. Bureau of the Census, Population Division, October.

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