

Appendix M

Analysis of Environmental Justice

M.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, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority and low-income populations.

The Council on Environmental Quality (CEQ) has oversight responsibility for documentation prepared in compliance with the National Environmental Policy Act (NEPA). In December 1997, the CEQ released guidance on environmental justice (CEQ 1997). The CEQ's guidance was adopted as the basis for the analysis of environmental justice contained in the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS).

M.2 DEFINITIONS AND APPROACH

The following definitions were used in the analysis of environmental justice (CEQ 1997):

- **Low-income population:** Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the U.S. Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.
- **Minority:** Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
- **Minority population:** Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. In identifying minority communities, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a geographically dispersed/transient set of individuals (such as migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood, census tract, or other similar unit that is to be chosen so as to not artificially dilute or inflate the affected minority population. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.
- **Disproportionately high and adverse human health effects:** When determining whether human health effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practical:
 - a. Whether the health effects, which may be measured in risks and rate, are significant (as employed by NEPA), or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death;

- b. Whether the risk or rate of hazard exposure by a minority population or low-income population to an environmental hazard is significant (as employed by NEPA) and appreciably exceeds, or is likely to appreciably exceed, the risk or rate to the general population or other appropriate comparison group; and
 - c. Whether health effects occur in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.
- **Disproportionately high and adverse environmental effects:** When determining whether environmental effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practical:
 - a. Whether there is, or will be, an impact on the natural or physical environment that significantly (as employed by NEPA) and adversely affects a minority or low-income population. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities or low-income communities, when those impacts are interrelated to impacts on the natural or physical environment;
 - b. Whether environmental effects are significant (as employed by NEPA) and are or may be having an adverse impact on minority populations or low-income populations that appreciably exceeds, or is likely to appreciably exceed, those on the general population or other appropriate comparison group; and
 - c. Whether the environmental effects occur, or would occur, in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Data for the analysis of minorities were extracted from Table P12 of Summary Tape File 3A published on CD ROM by the Census Bureau (DOC 1992). Data for the analysis of low-income populations were extracted from Table P121 of Standard Tape File 3A.

Potentially affected areas examined in the SPD EIS include the areas surrounding proposed facilities for plutonium disposition located at four candidate DOE sites: the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), the Pantex Plant (Pantex), and the Savannah River Site (SRS). Other potentially affected areas examined include the areas surrounding proposed reactor sites for mixed oxide (MOX) fuel irradiation: Catawba Nuclear Station, McGuire Nuclear Station, and North Anna Power Station. Minority and low-income populations residing within a 1.6-km (1-mi) corridor centered on representative transportation routes were also included in the evaluation of environmental justice.

M.3 SPATIAL RESOLUTION

For the purposes of enumeration and analysis, the 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 or property lines. During the 1990 census, the 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

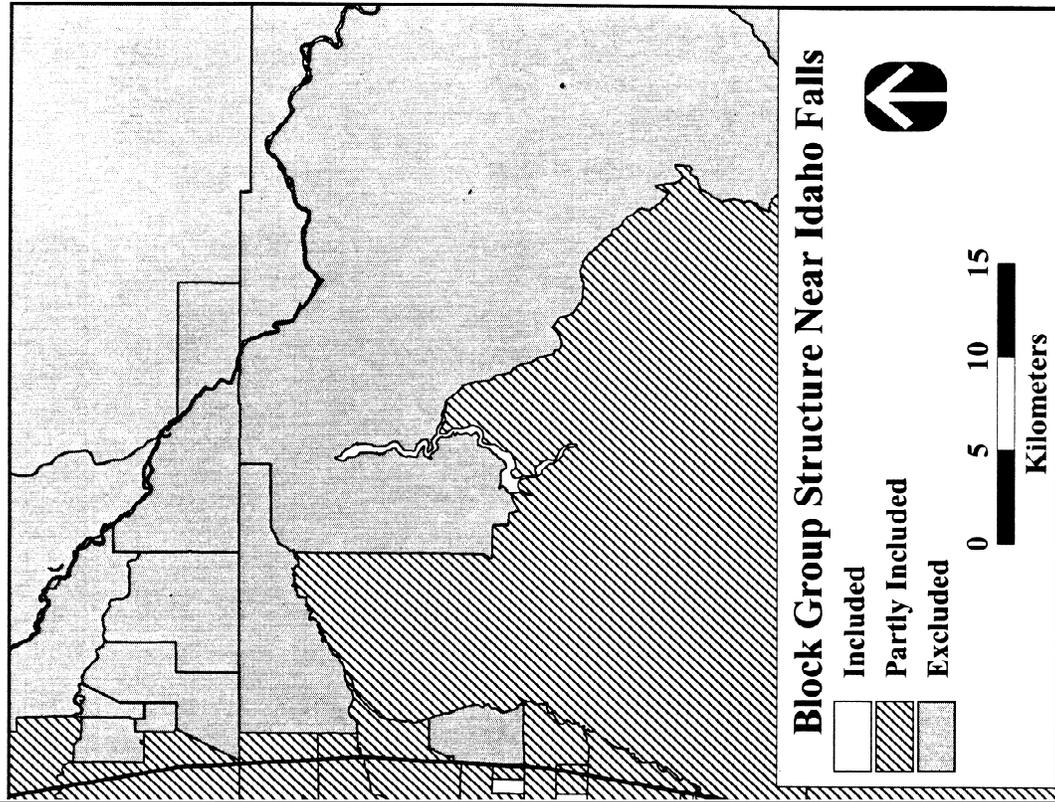
below, block groups are used throughout as the areal unit. Block groups generally contain between 250 and 500 housing units (DOC 1992:A-4).

During the decennial census, the Census Bureau collects data from individuals and then aggregates the data according to residence in geographical areas such as counties or block groups. Boundaries of the areal units are selected to coincide with geographical 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 the SPD EIS, radiological health effects due to an accident at one of the disposition facilities or reactor sites are evaluated for persons residing within a distance of 80 km (50 mi) of the accident site. In general, the boundary of the circle with an 80-km (50-mi) radius centered at the accident site will not coincide with boundaries used by the Census Bureau for enumeration of the population in the potentially affected area. Some block groups lie completely inside or outside the area included in the calculation of health effects. However, block groups intersecting the boundary of the potentially affected area are only partly included. Partial inclusion of block groups is illustrated in Figure M-1. This figure shows the block group structure near Idaho Falls, Idaho. The 80-km (50-mi) radius shown in this figure denotes the boundary used for calculation of health effects in the event of a radiological release at the Fuel and Materials Examination Facility (FMEF) at INEEL. Block groups that are unshaded in Figure M-1 lie within an 80-km (50-mi) radius centered at FMEF, and the total population of these block groups is included in the population count. Block groups shaded in gray lie outside of the circle, and the population of the shaded block groups is excluded from the population count. However, block groups such as those that are cross-hatched in Figure M-1 lie only partly within the circle. Because the geographical distribution of persons residing within a block group is not available from the census data, partial inclusions introduce uncertainties into the estimate of the population at risk.

In order to evaluate populations at risk in partially included block groups, it was assumed that residents are uniformly distributed throughout the area of each block group. For example, if 85 percent of the area of a block group lies within 80 km (50 mi) of the accident site, then it was assumed that 85 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 Census Bureau are small in comparison with the potentially affected area, then the uncertainties due to partial inclusions will be relatively small. Uncertainties in the estimates of populations surrounding disposition facilities and reactor sites are described in Appendixes M.5.1 and M.7.1, respectively.

M.4 POPULATION PROJECTIONS

In Chapter 4 and Appendixes J, K, and L of the SPD EIS, health effects were calculated for populations projected to reside in potentially affected areas during 2010 and 2015. Extrapolations of the total population for individual States are available from both the Census Bureau and various State agencies (Campbell 1996). The Census Bureau also projects populations by ethnic and racial classification in 1-year intervals for the years from 1995 to 2025. Data used to project minority populations in the SPD EIS were extracted from the Census Bureau's Web site (www.census.gov/population/www/projections/stproj.html). Minority populations determined from the 1990 census data were taken as a baseline. It was then assumed that percentage changes in the minority and majority populations of each block group for a given year (compared with the 1990 baseline data) would be the same as percentage changes in the State minority and majority populations projected for the same year. An advantage to this assumption is that the projected populations are obtained with consistent methodology regardless of the State and associated block group involved in the calculation. A disadvantage is that the methodology is insensitive to localized demographic changes that could alter the projection for a specific area.



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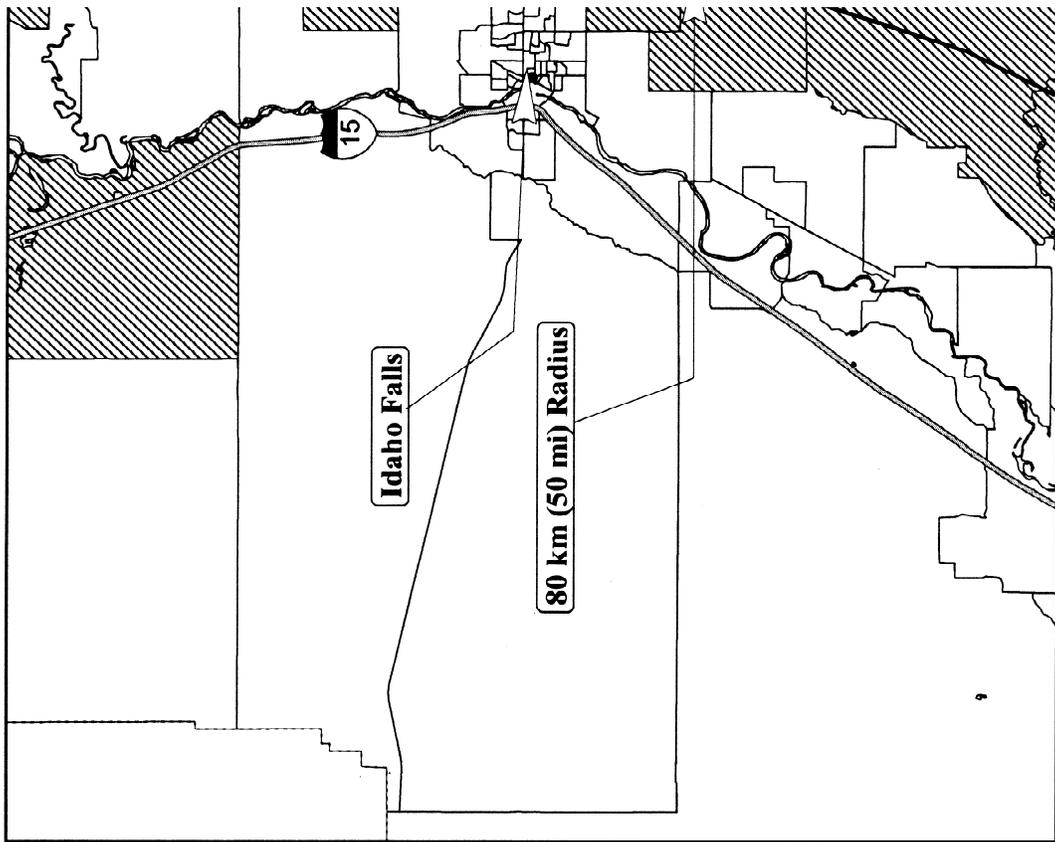


Figure M-1. Block Group Stru

The 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 (in 1-year intervals), (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 Black, 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:

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

where:

- $P(t_0)$ = cohort population at time $t_0 \leq t$, where 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 the equation are based on past data and various assumptions regarding changes in the rates for birth, mortality, and migration (Campbell 1996). The 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. In order 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 (non-Hispanic) populations.

M.5 RESULTS FOR THE CANDIDATE DOE SITES

M.5.1 Population Estimates

Table M-1 shows total populations, minority populations, and percentage minority populations that resided within 80 km (50 mi) of the various sites at the time of the 1990 census. The 80-km (50-mi) distance defines the radius of potential radiological effects for calculations of radiation dose to the general population (see Chapter 4 of the SPD EIS). Tables M-2 and M-3 show similar data for projected populations in 1997 and 2010. As discussed above, minority populations residing in potentially affected areas in 1990 were adopted as a baseline. Populations in 1997 and 2010 were then projected from the baseline data under the assumption that percentage changes in the majority and minority populations residing in the affected areas will be identical to those projected for State populations. The Census Bureau estimates that the national minority percentage will increase from approximately 24 percent in 1990 to 27 percent in 1997, and nearly 33 percent by 2010 (Campbell 1996). Percentage minority populations residing within 80 km (50 mi) of facilities at Hanford and SRS are projected to exceed the national percentage by year 2010. Percentage minority populations surrounding facilities at INEEL and Pantex were less than the national minority percentage in 1990 and are projected to remain so through the year 2010. In Tables M-1 through M-3, the sum of percentages shown in even-numbered columns beginning in column 6 may total slightly more or less than 100 percent due to roundoff.

Table M-4 illustrates the uncertainties in the population estimates for the year 2010 due to the partial inclusion of block groups within the boundaries of potentially affected areas. Column 2 of the table lists the number of

Table M-1. Racial and Ethnic Composition of Minority Populations Residing Within 80 km of Candidate DOE Sites in 1990

Candidate Site	Total Pop.	Minority Pop.	Percent Minority Pop.	Asian or Pacific Islander Pop.	Percent Asian or Pacific Islander Pop.	Black Pop.	Percent Black Pop.	Hispanic Pop.	Percent Hispanic Pop.	Native American Pop.	Percent Native American Pop.	Other Race	Percent Other Race Pop.	White Pop.	Percent White Pop.
Hanford 400 Area	277,515	70,493	25.4	3,989	1.4	2,788	1.0	59,736	21.5	3,981	1.4	372	0.1	206,651	74.5
Hanford 200 East	346,031	90,526	26.2	4,852	1.4	4,144	1.2	74,490	21.5	7,040	2.0	556	0.2	254,949	73.7
INEEL	119,138	11,757	9.9	1,166	1.0	385	0.3	7,154	6.0	3,052	2.6	135	0.1	107,246	90.0
Pantex	266,004	50,778	19.1	3,450	1.3	11,130	4.2	33,977	12.8	2,220	0.8	363	0.1	214,864	80.7
[Text deleted.]															
SRS APSF, if built	614,095	232,781	37.9	5,888	1.0	219,136	35.7	6,456	1.1	1,300	0.2	175	0.0	381,139	62.1
SRS DWPF	626,317	241,168	38.5	5,951	1.0	227,378	36.3	6,521	1.0	1,319	0.2	175	0.0	384,974	61.5

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Table M-2. Projected Racial and Ethnic Composition of Minority Populations Residing Within 80 km of Candidate DOE Sites in 1997

Candidate Site	Total Pop.	Minority Pop.	Percent Minority Pop.	Asian or Pacific Islander Pop.	Percent Asian or Pacific Islander Pop.	Black Pop.	Percent Black Pop.	Hispanic Pop.	Percent Hispanic Pop.	Native American Pop.	Percent Native American Pop.	Other Race	Percent Other Race Pop.	White Pop.	Percent White Pop.
Hanford 400 Area	324,640	98,586	30.4	5,640	1.7	3,153	1.0	85,642	26.4	4,151	1.3	418	0.1	225,636	69.5
Hanford 200 East	396,420	126,166	31.8	6,885	1.7	4,666	1.2	106,551	26.9	8,064	2.0	631	0.2	269,623	68.0
INEEL	145,117	16,785	11.6	1,627	1.1	590	0.4	10,793	7.4	3,775	2.6	166	0.1	128,166	88.3
Pantex	292,004	62,845	21.5	5,107	1.7	12,801	4.4	42,490	14.6	2,447	0.8	414	0.1	228,745	78.3
[Text deleted.]															
SRS APSF, if built	694,891	274,985	39.6	9,276	1.3	254,807	36.7	9,456	1.4	1,447	0.2	201	0.0	419,704	60.4
SRS DWPF	688,352	275,654	40.0	9,332	1.4	255,459	37.1	9,422	1.4	1,441	0.2	201	0.0	412,497	59.9

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Table M-3. Projected Racial and Ethnic Composition of Minority Populations Residing Within 80 km of Candidate DOE Sites in 2010

Candidate Site	Total Pop.	Minority Pop.	Percent Minority Pop.	Asian or Pacific Islander Pop.	Percent Asian or Pacific Islander Pop.	Black Pop.	Percent Black Pop.	Hispanic Pop.	Percent Hispanic Pop.	Native American Pop.	Percent Native American Pop.	Other Race	Percent Other Race Pop.	White Pop.	Percent White Pop.
Hanford 400 Area	426,473	163,767	38.4	9,287	2.2	3,907	0.9	144,750	33.9	5,824	1.4	508	0.1	262,198	61.5
Hanford 200 East	532,179	207,732	39.0	11,341	2.1	5,763	1.1	180,345	33.9	10,283	1.9	761	0.1	323,686	60.8
INEEL	185,748	27,887	15.0	2,426	1.3	960	0.5	18,887	10.2	5,615	3.0	210	0.1	157,651	84.9
Pantex	332,001	84,418	25.4	7,626	2.3	15,916	4.8	58,101	17.5	2,775	0.8	490	0.1	247,093	74.4
[Text deleted.]															
SRS APSF, if built	802,140	336,549	42.0	13,974	1.7	306,706	38.2	14,271	1.8	1,598	0.2	235	0.0	465,356	58.0
SRS DWPF	815,380	345,527	42.4	14,093	1.7	315,444	38.7	14,374	1.8	1,617	0.2	235	0.0	469,617	57.6

Key: APSF, Actinide Packaging and Storage Facility; DWPF, Defense Waste Processing Facility.

Table M-4. Uncertainties in Estimates of Total and Minority Populations for the Year 2010

Candidate Site	No. of Partially Included Block Groups		No. of Fully Included Block Groups		T/P	Upper Bound for Total Population	Estimate of Total Population	Lower Bound for Total Population	Upper Bound for Minority Population	Estimate of Minority Population	Lower Bound for Minority Population
Hanford 400 Area	8(OR)	39(WA)	31(OR)	233(WA)	5.6	422,872	415,828	397,570	161,697	159,713	153,854
200 East	13(OR)	42(WA)	6(OR)	365(WA)	6.7	519,364	509,136	482,861	205,420	202,832	196,212
INEEL	39		91		2.3	215,134	183,565	155,726	32,443	27,650	23,498
Pantex	22		483		22.0	338,218	330,300	321,477	85,566	83,963	82,332
SRS											
[Text deleted.]											
APSF, if built	27(GA)	55(SC)	245(GA)	277(SC)	6.4	865,698	807,583	753,569	365,148	339,708	318,908
DWPF	31(GA)	57(SC)	232(GA)	291(SC)	5.9	815,864	800,530	758,866	347,365	340,704	324,062

Key: APSF, Actinide Packaging and Reprocessing Facility; DWPF, Defense Waste Processing Facility; GA, Georgia; OR, Oregon; SC, South Carolina; WA, Washington.

block groups that are partly within the circle of 80-km (50-mi) radius centered at the various facilities. Column 3 shows the number of block groups that lie completely within the circle. Potentially affected areas surrounding Hanford and SRS include two States. Columns 2 and 3 show the number of partial or total inclusions for the affected States. Column 4 of the table, denoted as “T/P,” shows the number of totally included block groups divided by the number of partially included block groups. In order to minimize the uncertainties in the population estimate, it is desirable that this ratio be as large as possible. Column 5 shows upper bounds for the estimates of the total population listed in column 6. As discussed above, upper bounds were obtained by including the total population of all block groups that lie at least partially within the affected area. Lower bounds for the estimate of total population shown in column 7 were obtained by including only the populations of totally included block groups. Analogous statements apply to columns 8 through 10.

As would be expected from the value of T/P shown in column 4, uncertainties in the total population estimate for Pantex were the smallest among the four sites (+2.4 percent and -2.7 percent), as were the uncertainties in the estimate of the minority population at risk near Pantex (+1.9 percent and -1.9 percent). Uncertainties in the population estimates for INEEL were the largest among the four sites (+17.2 percent and -15.2 percent for total population; +17.3 percent and -15.0 percent for minority population). None of the uncertainties shown in Table M-4 are large enough to noticeably affect the conclusions regarding radiological health effects or environmental justice.

M.5.2 Geographical Dispersion of Minority and Low-Income Populations

Figures M-2 through M-9 show the geographical distributions of minority and low-income populations at risk in the vicinity of the candidate DOE sites. Distributions shown in these figures are based on baseline population data for 1990. Even-numbered figures show the geographical distribution of minority populations in potentially affected areas within a distance of 80 km (50 mi) of candidate facilities. Block groups are shaded to indicate the percentage of the total population comprised of minorities. According to the decennial census of 1990, minorities comprised 24.2 percent of the total population of the contiguous United States. Block groups unshaded in the even-numbered figures are those for which the percentage of minority residents is less than the national percentage minority population. Areas shaded in gray show block groups for which the percentage of minority residents exceeds the national minority percentage by less than a factor of two. Diagonally hatched block groups shown in the even-numbered figures are those for which the percentage of minority residents exceeds the national minority percentage by a factor of two or more.

Odd-numbered figures show the geographical distribution of low-income populations potentially at risk from implementation of the proposed action or alternatives. According to the decennial census of 1990, 13.4 percent of the population of the contiguous United States reported incomes less than the poverty threshold. Block groups unshaded in Figures M-1, M-5, M-7, and M-9 are those for which the percentage of low-income residents is less than the national percentage of persons reporting an income less than the poverty threshold. Areas shaded in gray show block groups for which the percentage of low-income residents exceeds the national low-income percentage by less than a factor of two. Diagonally hatched block groups shown in the odd-numbered figures are those for which the percentage of low-income residents exceeds the national low-income percentage by a factor of two or more.

M.5.3 Environmental Effects on Minority and Low-Income Populations Residing Near Candidate DOE Sites

The analysis of environmental effects on populations residing within 80 km (50 mi) of proposed facilities is presented in Chapter 4 of the SPD EIS. This analysis shows that no radiological fatalities are likely to result from implementation of the proposed action or alternatives. Radiological risks to the public are small regardless of the racial and ethnic composition of the population, and regardless of the economic status of

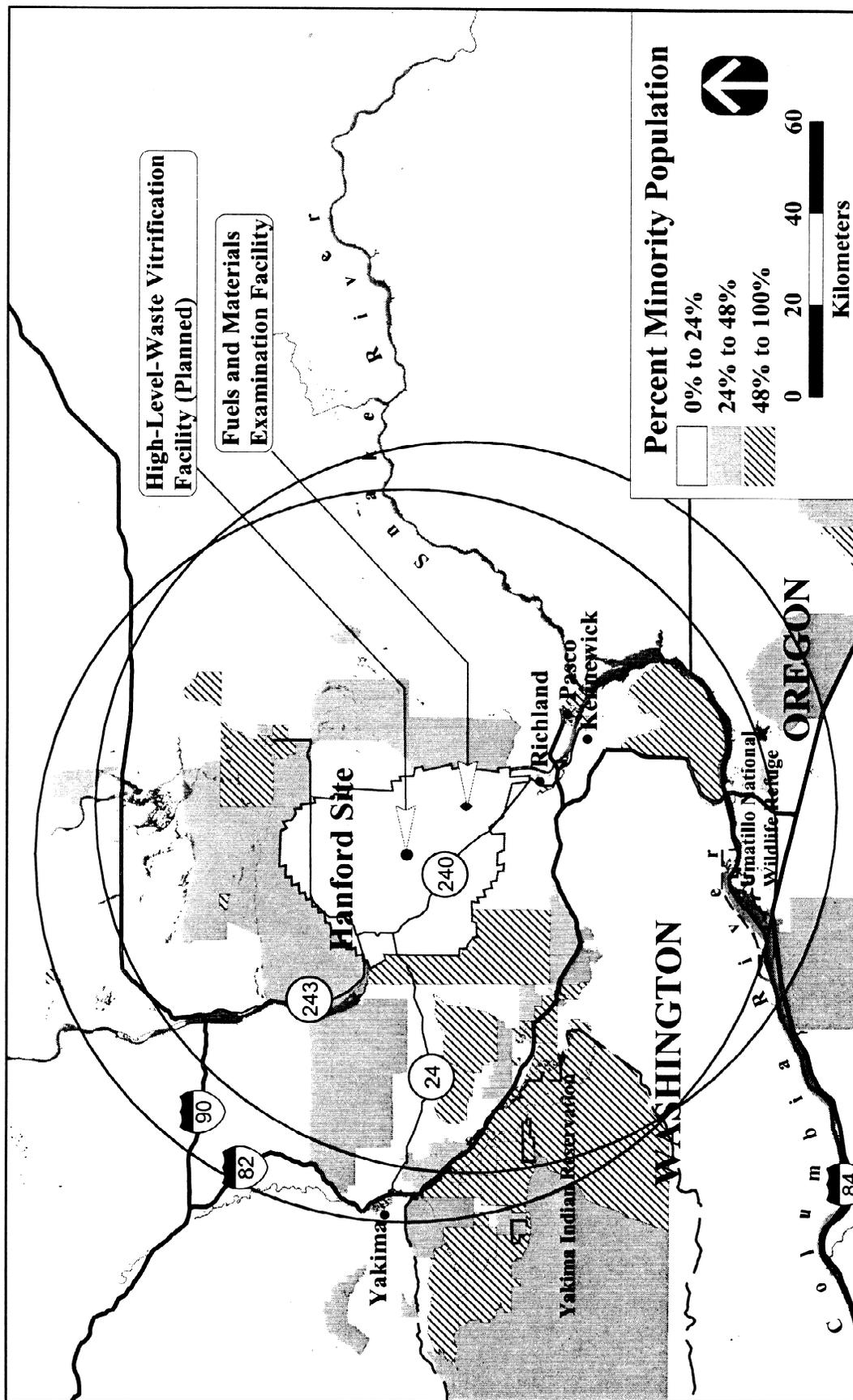


Figure M-2. Geographical Distribution of the Minority Population Residing Within 80 km (50 mi) of Proposed Facilities at Hanford