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Technical Guidance for Siting Criteria Development

Prepared by D. C. Aldrich, J. L. Sprung, D. J. Alpert, K. Diegert, R. M. Ostmeyer, L. T. Ritchie, D. R. Strip/ SNL
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Sandia National Laboratories

**Prepared for
U.S. Nuclear Regulatory
Commission**

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FOREWORD

On July 29, 1980 an advance notice of rulemaking was published for the siting of nuclear power reactors. One of the principle elements contained in the advance notice was the development of a comprehensive analysis of all technical issues relevant to siting. Sandia National Laboratories was contracted by the Nuclear Regulatory Commission to perform the analysis and document the technical guidance to support the formulation of new regulations. This report completes the effort to provide the technical guidance.

The work has been primarily focused toward the development of generic siting criteria, uncoupled from specific plant design. To achieve this end, the NRC staff developed a representative set of severe accident release source terms which covers the full spectrum of postulated severe accident releases for typical light water reactors. NUREG-0773, "The Development of Severe Reactor Accident Source Terms: 1975-1981," provides the detailed description of the considerations that went into the development of the spectrum of source terms (SSTs) in general terms; a more specific discussion of the concept of a representative or generic spectrum of source terms is given in pages 6 through 21 of NUREG-0771, "Regulatory Impact of Nuclear Reactor Accident Source Term Assumptions." From the results of Probabilistic Risk Assessments available at the time of the preparation of this report, the NRC staff would assign typical probability values to the source terms for a range of light water reactor designs as follows:

Probability of SST1 release 1×10^{-5}/reactor year

Probability of SST2 release 2×10^{-5}/reactor year

Probability of SST3 release 1×10^{-4}/reactor year

Table 2.3.1-3 presents the comparative impact of these releases in terms of public health effects. These ratios indicate the relative importance of the source terms given equal probability of occurrence. Their absolute and relative probabilities of occurrence affect their significance for the selection of siting criteria.

There are very large uncertainties associated with these numbers. The absolute values and the ratios of these probabilities for a given facility are design specific. To accurately portray the risk, very specific accident sequence probabilities and source terms are needed. Thus, the results presented in this report do not represent nuclear power risk.

The siting source terms were used to calculate accident consequences at 91 U. S. reactor sites using site specific meteorology and population data and assuming an 1120 MWe reactor. These calculations treat siting factors such as weather conditions and emergency response probabilistically but postulate the siting source term release. The results are thus conditional consequence values.

Currently there is significant controversy about the realism of accident source terms, that is, the accuracy with which they describe potential releases of radioactivity for a gien sequence of events in a core melt accident. The work done to date on siting uses the source terms developed for the Reactor Safety Study, held unchanged by newer projections as explained in NUREG-0772, "Technical Bases for Estimating Fission Product Behavior During LWR Accidents." The staff expects newer information to be available by mid 1983 to modify these source terms. In the meanwhile, sensitivity analyses are given to explore how the calculated consequence values would change with various source term reductions.

Contained in this report are sensitivity studies for the major parameters important to siting decision making. Only through consideration of material such as this can reasoned decisions be made concerning recommendations for improved siting regulations.

This report represents some of the work being done to support the expanding use of probabilistic risk assessment in the regulatory process. The NRC must be careful with the results of such analyses, considering the very large uncertainties in the results. The studies shown in this report must be used in a manner that is consistent with the stated objectives. The results are to provide technical perspective on siting-related issues. Results presented in this report are not significantly different than results of consequence studies that have been available in the open literature for decades. Given the source term assumptions, large consequences are calculated. However, the risks (probabilities times consequences) posed by such accidents are very small. Therefore, the absolute numbers should only be quoted with the associated probabilities and with the stated assumptions recognizing the uncertainties in the analyses.

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Abstract

Technical guidance to support the formulation and comparison of possible siting criteria for nuclear power plants has been developed for the Nuclear Regulatory Commission by Sandia National Laboratories. Information has been developed in four areas: (1) consequences of hypothetical severe nuclear power plant accidents, (2) characteristics of population distributions about current reactor sites, (3) site availability within the continental United States, and (4) socioeconomic impacts of reactor siting.

The impact on consequences of source term magnitude, meteorology, population distribution and emergency response have been analyzed. Population distributions about current sites were analyzed to identify statistical characteristics, time trends, and regional differences. A site availability data bank was constructed for the continental United States. The data bank contains information about population densities, seismicity, topography, water availability, and land use restrictions. Finally, the socioeconomic impacts of rural industrialization projects, energy boomtowns, and nuclear power plants were examined to determine their nature, magnitude, and dependence on site demography and remoteness.

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Funding for this study was provided principally by the Siting Analysis Branch in NRC's Office of Nuclear Reactor Regulation (NRR). Jan Norris, NRC Project Monitor, Len Soffer, Bill Regan and Dan Muller from that office provided helpful discussions and suggestions during the course of the project. Supplemental funding for the accident consequence analyses was provided by the Division of Risk Analysis, Office of Nuclear Regulatory Research. Roger M. Blond, from that division, provided significant technical assistance and useful criticism for those evaluations. The accident source terms utilized in Chapter 2 were defined by R. M. Blond and M. A. Taylor, NRC. C. Cluett, S. Malhotra and D. Manninen, Battelle Human Affairs Research Centers, performed the assessment of socioeconomic impacts under contract to Sandia. David E. Bennett, Sandia National Laboratories, calculated the core radionuclide inventories used in the assessment of potential accident consequences. Nancy C. Finley, Sandia National Laboratories, performed the examination of offsite hazards (documented in a separate report) and provided assistance in the evaluation of socioeconomic impacts.

1. Introduction and Summary

1.1 Introduction

At the request of the Nuclear Regulatory Commission, Sandia National Laboratories has performed a study to develop technical guidance to support the formulation of new regulations for siting nuclear power reactors [1]. Guidance was requested regarding (1) criteria for population density and distribution surrounding future sites, and (2) standoff distances of plants from offsite hazards. Studies were performed in each of these two areas of concern.

The study of offsite hazards had two areas of concern: (1) determination of which classes of offsite hazards are amenable to regulation by fixed standoff distances, and (2) review of available methods for the determination of appropriate standoff distances. The hazards considered included aircraft, hazardous chemicals, dams, faults, adjacent nuclear power plants, tsunamis, meteorite impact, etc. The study concluded that none of the hazards are suitable to treatment by fixed standoff distances and that sufficient methods exist for evaluating the risk for most types of hazards. Because they have been published elsewhere [2], the results of the study of offsite hazards are not included in this report.

The studies of site characteristics, which are presented in this report, involved analyses in four areas, each of which could play a role in evaluating the impact of a siting policy. The four areas were: (1) consequences of possible plant accidents, (2) population distribution characteristics for existing sites, (3) availability of sites, and (4) socioeconomic impacts.

Accident consequence analyses were performed to help define the risks associated with existing sites and with alternative siting criteria. Consequence analyses also help to evaluate the dependence of risk on factors such as meteorology, population distribution, and emergency response which can be mandated or constrained by regulations. Population distributions at existing sites were examined to provide perspective on demographic characteristics as well as to determine whether there have been trends with time or regional differences in site selection. The site availability analysis examined the impact of various population distribution criteria on the amount of land restricted from siting. Impacts of environmental and legal constraints were also examined. In addition, studies were performed to evaluate the extent of socioeconomic impacts and the degree to which they are dependent on site demographic characteristics. These four areas of analysis provide information that could be used to assess and compare alternative siting criteria.

The information developed by this study is presented in four chapters and six appendices. Chapter 2 presents the results of the consequence analyses that were performed to identify factors that have a significant impact upon risk. The factors examined include source term magnitude (Section 2.3), meteorology (Section 2.4.1), population (Section 2.4.2), emergency response (Section 2.5), consequence distances (Section 2.6), reactor size (Section 2.7.1), plume heat content (Section 2.7.2), dry deposition velocity (Section 2.7.3), characteristics of population distributions (Section 2.7.4), and criteria for the interdiction of contaminated land (Section 2.7.5). CRAC2 [3,4], the computer model used to perform these consequence analyses, is described briefly in Section 2.2.1 and more fully in Appendix E. Model input data are described in Section 2.2.2. Site specific input data are presented in Appendix A and core radionuclide inventory data in Appendix B. Data and model uncertainties are discussed in Section 2.2.4. Finally, a series of site specific calculations were made using a standard set of source terms uncorrected for the characteristics of the reactor at the site. The results of these calculations are presented in Appendix C.

Chapter 3 and Appendix D present an examination of the population distributions surrounding existing sites to provide perspective on demographic characteristics and to determine (1) whether there is evidence of a trend over time to less-dense siting and (2) whether site characteristics differ significantly in different regions of the country. The site availability analyses developed a capability for measuring the impact of population criteria on the availability of reactor sites. Also considered in these analyses were the seismicity, topogaphic character, availability of surface and ground water at potential sites, and the restriction of power plant siting because of the presence of national parks or wilderness areas. This study, which was performed by Dames and Moore [5] under contract to Sandia, is presented in full in Chapter 4 and Appendix F. Finally, a study was performed to examine the socioeconomic impacts of reactor siting and the dependence of the magnitude of these impacts on site demography. The study examined impacts caused by large construction projects, energy boomtowns, and the construction of nuclear power plants. Also examined was the impact of site remoteness on transmission costs. The study, performed by Battelle-HARC under contract to Sandia, is summarized in Chapter 5 and presented in full in a separate report [6].

1.2 Summary

This report contains the results of numerous calculations and analyses performed at Sandia National Laboratories, Dames and Moore, and Batelle-HARC. The principal results or conclusions reached are:

- Estimates of the number of early fatalities are very sensitive to source term magnitude. Mean early fatalities (average result for many weather sequences) are decreased dramatically (about two orders-of-magnitude) by a one order-of-magnitude decrease in source term SST1 (large core melt, loss of most safety systems). Because the core melt accident source terms SST1-3 used in this study neglect or underestimate several depletion mechanisms, which may operate efficiently within the primary loop or the containment, consequence magnitudes calculated using these source terms may be significantly overestimated.

- The weather conditions at the time of a large release will have a substantial impact on the health effects caused by that release. In marked contrast to this, mean health effects (average result for many weather sequences) are relatively insensitive to meteorology. Over the range of meteorological conditions found within the continental United States (1 year meteorological records from 29 National Weather Service stations), mean early fatality values for a densely populated site show a range (highest value/lowest value) of only a factor of 2, and mean latent cancer fatalities a factor of 1.2.

- Peak early fatalities (maximum value calculated for any weather sequence) are generally caused by <u>rainout</u> of the radioactive plume onto a population center. For an SST1 release, the peak result is about 10-times less probable in a dry locale than in a wet one.

- The distances to which consequences might occur depend principally upon source term magnitude and meteorology. Frequency distributions of these distances, calculated using large numbers of weather sequences, yielded expected (mean), 99 percentile, and maximum calculated distances (expressed in miles) for early fatalities, early injuries, and land interdiction as follows:

Source Term	Consequence	Mean	99%	Maximum Calculated
SST1	Early Fatalities	<5	≲15	<25
	Early Injuries	~10	~30	≲50
	Land Interdiction	~20	>50	>50
SST2	Early Fatalities	~0.5	<2	<2
	Early Injuries	<2	<5	~5
	Land Interdiction	<2	~7	~10

  The maximum calculated distances are associated with improbable events, (e.g., rain-out of the plume onto a population center). For the SST1 release reduced by a factor of 10, early fatalities are confined to ~5 miles, early injuries to ~20 miles, and interdiction of land to ~25 miles.

- Calculated consequences are very sensitive to <u>site population distribution</u>. For each of the 91 population distributions examined, early fatality, early injury, and latent cancer fatality CCDFs were calculated assuming an SST1 release from an 1120 MWe reactor. The resulting sets of CCDFs had the following ranges:

  <u>Early Fatalities</u>. ~3 orders-of-magnitude in the peak and mean numbers of early fatalities and in the probability of having at least one early fatality.

Early Injuries. ~ 3 orders-of-magnitude in the means, ~ 2 in the peaks, and ~ 1 in the probability of having at least one early injury.

Latent Cancer Fatalities. ~ 1 order-of magnitude in the peaks and the means and in the probability of having at least one latent cancer fatality.

Generally, mean results are determined by the average density of the entire exposed population, while peak results (especially for early fatalities) are determined by the distance to and size of exposed population centers.

- Early fatalities and early injuries can be significantly reduced by emergency response actions. Both sheltering (followed by relocation) and evacuation can be effective provided the response is expeditious. Access to basements or masonry buildings significantly enhances the effectiveness of sheltering. Expeditious response requires timely notification of the public. If the evacuation is expeditious (timely initiation), evacuation speeds of 10 mph are effective. Evacuation before containment breach within 2 miles, after release within 10 miles, and sheltering from 10 to 25 miles appears to be a particularly effective response strategy.

- Population densities (people/sq mi) about the 91 sites have the following maximum, 90th percentile and median values within the indicated distance intervals:

Distance (mi)	0-5	0-10	0-20
Full Circle			
Maximum	790	660	710
90th percentile	190	230	380
Median	40	70	90
Most Populated 22.5° Sector			
Maximum	4200	3800	4500
90th percentile	950	1000	1800
Median	330	270	480

- At the 91 sites examined, the distance to the nearest exclusion zone boundary ranges from 0.1 to 1.3 miles and averages about 0.5 miles.

- There appears to be a slight trend with time towards selection of reactor sites in less densely populated locations.

- A site availability data base has been constructed on a 5 x 5 km grid cell for the continental United States. For each grid cell the data base contains information on population density, seismicity, topographic character, surface and ground water availability, and land use restrictions (wetlands, national parks, etc.)

- Analysis of boomtown literature, studies of large non-nuclear energy projects, and economic data from existing nuclear power plant sites suggests that only siting in very remote regions has the potential for significant socioeconomic impacts, that these impacts may be both beneficial or detrimental and that the detrimental impacts can be mitigated by advance planning.

- Outside of the Rocky Mountains, few potential reactor sites are located at a large distance from the national power grid. Consequently, site remoteness and transmission line costs are not strongly correlated.

This study examined a number of factors which could impact the development of siting criteria. The analyses, which are reported in the following chapters, can be used to determine many of the impacts of alternative criteria, and provide guidance in evaluating tradeoffs among criteria. In addition, the data and analyses contained in the study should be useful to the wider community of users interested in evaluating the consequences of reactor accidents.

References for Chapter 1

1. Advance notice of this rulemaking appeared in the Federal Register, July 29, 1980, FR DOC 80-22643.

2. N. C. Finley, Nuclear Power Plant Siting: Consideration of Offsite Hazards, NUREG/CR-2380, Sandia National Laboratories (to be published).

3. L. T. Ritchie, J. D. Johnson, and R. M. Blond, Calculations of Reactor Accident Consequences, Version 2: User's Guide, NUREG/CR-2326, SAND81-1994, Sandia National Laboratories, Albuquerque, NM, (to be published).

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5. J. H. Robinson and K. L. Hansen, Impact of Demographic Siting Criteria and Environmental Suitability on Land Availability, Dames and Moore, Los Angeles, California, 1981.

6. C. Cluett, S. Malhotra, and D. Manninen, Socioeconomic Impacts of Remote Nuclear Power Plant Siting, NUREG/CR-2537, SAND81-7230, Battelle Human Affairs Research Centers, Seattle, Washington, (to be published).

2. Consequences of Potential Reactor Accidents

2.1 Introduction

During this study, a large number of calculations were performed to provide a basis for understanding the dependence of reactor accident consequences on site characteristics. Some characteristics were examined because of the possibility of their inclusion in reactor siting criteria (e.g., population distribution, reactor power level). A number of additional parameters were investigated to determine the sensitivity of predicted consequences to variation or uncertainty in data used as input.

All consequence calculations for this study were performed using CRAC2, an improved version of CRAC,[a] the Reactor Safety Study [1] consequence model. Section 2.2.1 provides a brief overview of the CRAC2 model, while Section 2.2.2 describes the data used as input to the consequence calculations. Section 2.2.3 is a qualitative discussion of the sources and impacts of uncertainties associated with the consequence model. Section 2.2.4 defines the "base case" calculation which was used as a reference case for examination of the impact of variations in parameters and assumptions.

Section 2.3 briefly describes the five accident source terms used in the calculations. These source terms, denoted SST1-5, were developed by NRC and range from a full core-melt with uncontrolled release to a gap release with minimal leakage. Section 2.3.1 presents results of consequence calculations for each of the five source terms, and Section 2.3.2 examines the potential impact on consequences of reductions in the magnitude of the most severe accident (SST1).

Section 2.4 examines the impact of meteorology and population on consequence estimates. Meteorological data from 29 National Weather Service stations and wind rose and population data from each of the 91 currently approved reactor sites in the United States are examined. Section 2.5 presents the impact on consequences of various emergency response assumptions; both evacuation and sheltering scenarios are evaluated. Section 2.6 discusses the distances to which various consequences occur and the sensitivity of these distances to input

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a. CRAC stands for Calculation of Reactor Accident Consequences.

data and assumptions. Section 2.7 examines the sensitivity of consequences to variations in reactor size, energy-release rate, dry deposition velocity, population distribution, and land-interdiction criteria. Finally, Section 2.8 presents a summary of the insights gained from these calculations.

2.2 Background

2.2.1 Overview of Consequence Model

The accident consequence calculations described in this chapter were performed using CRAC2 [2,3], an improved version of the Reactor Safety Study (WASH-1400) consequence model, CRAC [1,4]. Modifications made in the upgrade from CRAC to CRAC2 are briefly described in Appendix E.[a] The model describes the progression of the cloud of radioactive material released from the containment structure during and following a reactor accident, and predicts its interaction with and influence on the environment and man. A schematic outline of the computational steps taken in the model is presented in Figure 2.2.1-1.

Analyses of potential plant system failures and accident phenomenology provide an estimate of accident probabilities and release characteristics (magnitudes, timing, etc.) that are used as input to the consequence model.[b] Given these estimates, a standard Gaussian dispersion model is used to calculate ground-level concentrations of airborne radioactive material downwind of the reactor site. Weather data for a 1-year period are input to the dispersion model in the form of hourly recordings of wind speed, thermal stability, and accumulated precipitation. The wind direction is assumed to be invariant during and following the release. Radionuclide concentrations within the cloud are depleted by deposition (both wet and dry) and radioactive decay, and integrated air and ground contamination are calculated for downwind distances.

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a. Results calculated using the two models are similar, as shown in the recent International Comparison Study of Reactor Accident Consequence Models [5,6].

b. Specific release characteristics assumed in this study are described in Section 2.3.

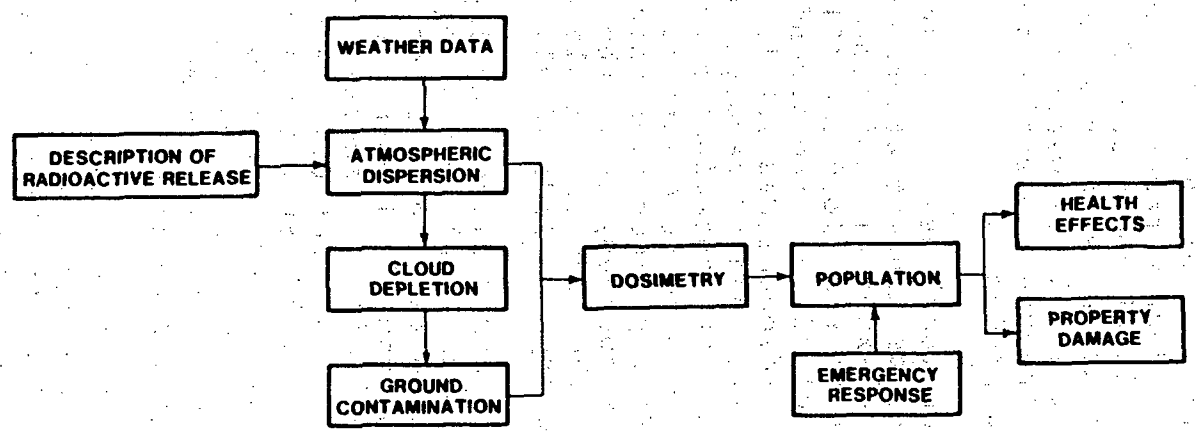

Figure 2.2.1-1. Schematic Outline of Consequence Model, CRAC2.

Hourly weather recordings are used to account for weather variations during the progression of the accident. Beginning at a selected hour within the year's data, the dispersion model uses the subsequent meteorological conditions to predict the dispersion, downwind transport, and deposition of the released cloud of radioactive material. Hourly recordings are sequentially incorporated until all of the released radioactive material (excluding the noble gases) has been deposited. By using an appropriate sample of weather sequences from the year's data, a frequency distribution of estimated consequences can be produced.

The consequence model uses the calculated airborne and ground radionuclide concentrations to estimate the public's exposure to external radiation from (1) airborne radionuclides in the cloud and (2) radionuclides deposited from the cloud onto the ground, and internal radiation from (1) radionuclides inhaled directly from the passing cloud, (2) inhaled resuspended radionuclides, and (3) the ingestion of contaminated food and milk. Radiation exposure from sources external to the body is calculated for time periods over which individuals are exposed to those sources, while the exposure from sources internal to the body is calculated over the remaining life of the exposed individual.

The consequence model allows the input of either site-specific or hypothetical population data as a function of distance and direction from the reactor site. A simple evacuation model is incorporated, which is based on a statistical analysis of evacuation data assembled by the U.S. Environmental Protection Agency [7-9] (see Appendix E). The model incorporates a delay time before public movement, followed by evacuation radially away from the reactor. A range of evacuation delay times, speeds, and distances have been assumed in this study, as is described in later sections.

Based on the calculated radiation exposure to downwind individuals, the consequence model estimates the number of public health effects that would result from the accidental release. Early injuries and fatalities, latent cancer fatalities, and thyroid and genetic effects may be computed. Early fatalities are defined to be those fatalities that occur within 1 year of the exposure period. They are estimated on the basis of exposure to the bone marrow, lung and gastrointestinal tract. Bone marrow damage is the dominant contributor to early fatalities. In both the Reactor Safety Study and this study, early fatalities are calculated assuming an $LD_{50/60}$[a] of 510 rads to the bone marrow. Supportive medical treatment of the exposed individual is also assumed. Early injuries are defined as non-fatal, non-carcinogenic illnesses, that appear within 1 year of the exposure and require medical attention or hospital treatment. The late somatic effects considered include latent cancer fatalities plus benign and malignant thyroid nodules.

The consequence model also includes an economic model to estimate the potential extent of property damage associated with the release of radioactive material. The total offsite dollar cost of the accident is estimated as the sum of (1) the evacuation cost, (2) the value of condemned crops and milk, (3) the cost of decontaminating land and structures, (4) the cost of interdicting land and structures, and (5) relocation costs (moving costs and temporary loss of income).

2.2.2 Input Data for Consequence Model

CRAC2 requires a large set of input data, including accident release characteristics and source terms, various site-related data (e.g., meteorology, population), reactor core radionuclide inventories, and emergency response scenarios. The accident release characteristics and source terms assumed in this study are described in Section 2.3.

The site-related data, gathered for use in this study, are presented in Appendix A. The data gathered includes:

1. General site and reactor data (e.g., reactor size, vendor, start-up date, site location) for each of the 91 U.S. sites at which a reactor is operating or a construction permit has been obtained.

2. Regional shielding factors for sheltered populations.

3. Site population data derived from the 1970 census.

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a. The dose that would be lethal to 50 percent of the population within 60 days.

4. Meteorological data consisting of hourly recordings of weather conditions from 29 National Weather Service stations plus mixing heights from Holzworth [10].

5. Annual site wind roses obtained from either Environmental Impact Reports or Safety Analysis Reports.

6. Site economic data, updated from those used in WASH-1400 to reflect inflation and changing economic conditions.

A core radionuclide inventory for a 3412 MWt (1120 MWe) reactor was calculated for this study using the SANDIA-ORIGEN [11] computer code. This calculation assumed an end-of-cycle fuel burnup of 33,000 MWd/MTU (about 25 percent greater than was assumed in WASH-1400) which is representative of the current generation of larger reactors. Differences in reactor size were accommodated by linearly scaling the inventory with rated thermal power level. A description of the inventory calculations and a discussion of the impact of inventories on predicted consequences are presented in Appendix B. The sensitivity of consequences to reactor size is examined in Section 2.7.1.

The emergency response submodel incorporated in CRAC2 is described in Section 2.5 and Appendix E. The model allows specification of up to six emergency response scenarios plus a weighted sum of these scenarios termed "Summary Evacuation." Unless otherwise specified, calculations were performed using the scenarios presented in Table 2.2.2-1. The scenarios range from a prompt evacuation to sheltering to no emergency response. The response distance of 10 miles was selected to coincide with the Emergency Planning Zone (EPZ) recommended by the NRC [12]. The delay times and speeds assumed were based on a statistical analysis of evacuation data gathered by the EPA (see Appendix E). The "Summary Evacuation" was defined as a 30 percent, 40 percent, 30 percent weighting[a] of scenarios 1, 2, and 3, and

a. Thirty percent of the <u>time</u>, <u>all</u> people within 10 miles evacuate with a 1 hour delay and 10 mph speed; 40 percent of the time, all people within 10 miles evacuate with a 3-hour delay and 10 mph speed; and 30 percent of the time all people within 10 miles evacuate with a 5-hour delay and 10 mph speed.

represents a "best estimate" for consequence predictions. Most of the results presented in the following sections assumed this "Summary Evacuation." The sensitivity of predicted consequences to emergency response assumptions is examined in Section 2.5. Differences in emergency response due to site-specific characteristics were not addressed.

Table 2.2.2-1. Emergency Response Scenarios

Scenario Number	Type of Response	Response Distance	Delay Time Before Response	Response Speed
1	Evacuation	10 miles	1-hour	10 mph
2	Evacuation	10 miles	3-hours	10 mph
3	Evacuation	10 miles	5-hours	10 mph
4	Evacuation	10 miles	5-hours	1 mph
5	Sheltering, Relocation	10 miles	none, 6-hours	---
6	No Emergency Response	--	--	---

2.2.3 Uncertainties

Uncertainties in offsite consequence predictions stem principally from uncertainties in two areas: modeling and input data. Modeling uncertainty arises from (1) an incomplete understanding of the phenomena involved in the transport of released radionuclides to man and the consequent health impacts, and (2) simplifications of phenomena made in the modeling process to reduce costs or model complexity. Input data uncertainty arises from problems associated with the quality and availability of data, selection or determination of appropriate values for model input (including radioactive source terms), and statistical variations in data. To date, a comprehensive assessment of these uncertainties in consequence predictions has not been performed. However, a number of partial uncertainty estimates have been derived using sensitivity analysis techniques [1,13,14].

Improvements in a number of model areas could substantially reduce current uncertainties. The most important of these include source terms (see Section 2.3), plume depletion processes (see Section 2.7.3), the effect of wind trajectories on population exposures, and the effectiveness of emergency response (see Section 2.5). Each of these areas is briefly described below.

Radioactive source terms for atmospheric releases are subject to a number of important uncertainties, including uncertainties about release magnitude and timing, and about aerosol size distributions. It has been suggested [15,16] that removal processes within the primary coolant system and containment could reduce the amount of material released to the atmosphere to levels significantly below those currently estimated. Possible removal processes include plate-out of hot vapors on cooler surfaces, agglomeration and deposition of aerosols, and dissolution in water. Better specification of the timing of a release is important for two reasons: (1) a longer warning period increases the chance of an effective emergency response and (2) a long, slow release spreads the radioactive material over a larger area, thereby decreasing individual doses and (usually) health effects. The particle-size distribution of the released material, and thus the efficiency of dry deposition processes during downwind transport, is determined principally by aerosol agglomeration rates. Resolution of these source-term uncertainties by ongoing or future research activities may require a reevaluation of some of the conclusions reached by this study. For example, some of the conclusions about emergency planning and response presented in Section 2.5 could be significantly altered.

A plume of radioactive material may be depleted during transport by dry deposition and/or washout processes. The dry-deposition removal rate is strongly dependent on the size distribution of particulate matter in the plume. Therefore, the current lack of information about this size distribution prevents reliable modeling of dry deposition. Since washout of material by rainfall is a very efficient removal mechanism, it is important to account for the frequency, intensity, and spatial variability of rainfall. Moreover, because high-consequence events are usually associated with rainfall over population centers, failure to adequately model rainfall can lead to large inaccuracies in predicted peak consequences.

Wind trajectories determine the specific population exposed by downwind transport of the plume of radioactive material. With the exception of the computer code CRACIT [17,18], current consequence models neglect wind trajectories. Although results obtained with CRACIT indicate that treatment of wind trajectories may affect risk less than intuition suggests [6], a thorough examination of this subject (perhaps using a Gaussian puff model), particularly for sites with complex terrain, seems essential [19].

The sensitivity of predicted consequences to different emergency response scenarios is examined in Section 2.5. If consequence models are to be applied to evaluate the risk at specific sites, consideration should be given to those characteristics of the site and of local organizations that could influence the effectiveness of offsite emergency response. For example, local and utility emergency response plans, available mechanisms for warning the public, and characteristics of the surrounding road network should be examined. Road networks could be particularly important if population densities are sufficient to result in "traffic jams" or "bottleneck" conditions, or if terrain features are likely to cause evacuation routes and the plume trajectory to overlap.

Another area of uncertainty is the estimation of the late somatic effects, of which the incidence of cancer is the most important. The recent BEIR III report [20] discusses these uncertainties, which are largest for low doses (and dose rates) of low-LET radiation. In addition, Loewe and Mendelsohn [21] have recently conducted a reassessment of the dosimetry data for the populations exposed by the detonations at Hiroshima and Nagasaki. These new findings have led to major changes in the estimates of the neutron and gamma-ray doses received by survivors. Efforts are currently underway at the Los Alamos National Laboratory to redefine the source terms from the two detonations and at Oak Ridge National Laboratory to recalculate dose estimates. When completed, these reassessments may result in some changes in estimates for late somatic effects.

2.2.4 Base Case Calculation

The results of a large number of calculations are presented in Sections 2.3 through 2.7 of this report. These calculations examine the impact on predicted consequences of a wide variety of parameters and assumptions. To simplify the examination of the impact of variations in input parameters and assumptions, a "base case" calculation was defined. Assumed in the base case were:

- a standard 1120 MWe PWR
- an SST1 release (defined in Section 2.3)
- New York City meteorology
- the Indian Point wind rose and population
- Summary Evacuation

The values of all other input parameters were those typically used in CRAC2. The sensitivity of predicted consequences to the base case assumptions and to other input parameter values is discussed in later sections.

2.3 Reactor Accident Source Terms

This section describes the reactor accident source terms used to perform the consequence calculations. Consequences that might result from these source terms are compared and the most important source terms are identified. In addition, source term uncertainties are addressed. Results that show the impacts of these uncertainties on reactor accident consequences are presented and discussed.

2.3.1 Accident Release Characteristics and Source Terms

The Nuclear Regulatory Commission recently sponsored an evaluation of the technical bases for reactor accident source term assumptions and the potential impact of possible source term changes on the regulatory process [16,22]. These studies found that the Design Basis Accidents (DBAs), which have been the basis for regulatory policies governing nuclear power plant siting and design, do not constitute a realistic representation of the full spectrum of possible accident source terms for any reactor design. Therefore, they do not provide an adequate estimate of reactor risk at specific sites. Consequently, after review of current source term information, the NRC defined a spectrum of accidents [22], which more adequately spans the range of possible accident source terms and better reflects current understanding of fission product behavior during reactor accidents.

The spectrum of accidents that was defined ranges from accidents within the design basis envelope to core melt accidents which may release large quantities of radioactive material to the environment. Five accident groups were designated as being representative of the spectrum of potential accident conditions. Each group represents a different degree of core degradation and of failure of containment safety features. Brief descriptions of the characteristics of the accident types included in each group are presented in Table 2.3.1-1.

For the purpose of decision-making in such areas as siting and emergency response, NRC defined a set of five Siting Source Terms (denoted SST1-5) to represent the five accident groups. By adjusting the probabilities associated with each of the five source terms, the set can be made to approximately represent any current LWR design.[a] Table 2.3.1-2 summarizes the five NRC-defined source terms used in this study.

The consequences that could potentially result from each of the five source terms were determined by performing a series of CRAC2 calculations. Table 2.3.1-3 compares the relative magnitudes (normalized to 100 for source term SST1) of the mean values[b] of selected consequences, given the occurrence of each of the five source terms and assuming an 1120 MWe PWR, Indian Point population distribution and wind rose, New York City meteorology, and Summary Evacuation (see Sections 2.2.2 and 2.5 and Appendix E). These results indicate that source terms SST2 through SST5 would not be expected to produce substantial numbers of offsite consequences

a. Detailed Probabilistic Risk Assessments (PRAs) have not been performed for all reactors. Based on currently available PRAs, NRC has suggested that representative probabilities for the SSTs are: P_1 for SST1 = 1×10^{-5}, P_2 for SST2 = 2×10^{-5}, and P_3 for SST3 = 1×10^{-4}. There are very large variations (factors of 10 to 100) in the accident probabilities associated with a specific design.

b. Using approximately 100 sampled weather sequences, the CRAC2 code calculates frequency distributions for consequences that might result from a radioactive release. The means of these distributions are the mean values referred to in the text.

compared to the SST1 source term. The mean consequences calculated for the SST1 release exceed those from the SST2 release by 1 to 4 orders of magnitude and exceed those from releases SST3, SST4, and SST5 by 4 to 7 orders of magnitude. Early fatalities, early injuries, and land interdiction do not result from releases SST3, SST4, and SST5 because these accidents do not release enough radioactivity to produce doses that exceed the dose thresholds for these consequences.

Table 2.3.1-1. Brief Descriptions Characterizing the Accident Groups Within the NRC "Accident Spectrum" [22]

Group 1	Severe core damage. Essentially involves loss of all installed safety features. Severe direct breach of containment.
Group 2	Severe core damage. Containment fails to isolate. Fission product release mitigating systems (e.g., sprays, suppression pool, fan coolers) operate to reduce release.
Group 3	Severe core damage. Containment fails by basemat melt-through. All other release mitigation systems function as designed.
Group 4	Modest core damage. Containment systems operate in a degraded mode.
Group 5	Limited core damage. No failures of engineered safety features/beyond those postulated by the various design basis accidents. The most severe accident in this group assumes that the containment functions as designed following a substantial core melt.

Table 2.3.1-2. NRC Source Terms for Siting Analysis

Release Characteristics[a]	Source Term				
	SST1	SST2	SST3	SST4	SST5
Accident Type	Core Melt	Core Melt	Core Melt	Gap Release	Gap Release
Containment Failure Mode	Overpressure	H_2 Explosion or Loss of Isolation	-	-	-
Containment Leakage	Large	Large	1%/day	1%/day	0.1%/day
Time of Release (hr)	1.5	3	1	0.5	0.5
Release Duration (hr)	2	2	4	1	1
Warning Time (hr)	0.5	1	0.5	-	-
Release Height (meters)	10	10	10	10	10
Release Energy	0	0	0	0	0
Inventory Release Fractions					
Xe-Kr Group	1.0	0.9	6×10^{-3}	3×10^{-6}	3×10^{-7}
I Group	0.45	3×10^{-3}	2×10^{-4}	1×10^{-7}	1×10^{-8}
Cs-Rb Group	0.67	9×10^{-3}	1×10^{-5}	6×10^{-7}	6×10^{-8}
Te-Sb Group	0.64	3×10^{-2}	2×10^{-5}	1×10^{-9}	1×10^{-10}
Ba-Sr Group	0.07	1×10^{-3}	1×10^{-6}	1×10^{11}	1×10^{-12}
Ru Group	0.05	2×10^{-3}	2×10^{-6}	0	0
La Group	9×10^{-3}	3×10^{-4}	1×10^{-6}	0	0

a. As defined in the Reactor Safety Study [1].

Table 2.3.1-3. Comparison of Conditional Mean Consequences Predicted for Five Source Terms[a,b]

Source Term	Mean Early Fatalities	Mean Early Injuries	Mean Latent Cancer Fatalities	Mean Thyroid Nodules	Mean Interdicted Land Area
SST1	100[b]	100	100	100	100
SST2	1×10^{-2}	0.5	7	3	1
SST3	0	0	2×10^{-2}	5×10^{-2}	0
SST4	0	0	4×10^{-4}	8×10^{-5}	0
SST5	0	0	4×10^{-5}	8×10^{-6}	0

a. Assumptions: 1120 MWe PWR, population distribution and wind rose for Indian Point, New York City meteorology, "Summary Evacuation" of persons within 10 miles.

b. All consequences are normalized to 100 for source term SST1.

Figures 2.3.1-1 and 2.3.1-2 present mean bone marrow dose and mean thyroid dose to exposed individuals as a function of distance for each of the five source terms.[a] The doses were calculated assuming no emergency response, an 1120 MWe PWR, and New York City meteorology. The mean doses at any distance vary by nearly 8 orders of magnitude over the spectrum of five releases. For any pair of releases, relative doses are roughly proportional to the ratios of curies of released radioactivity excluding noble gases (Xe-Kr group). These figures also show that individual bone marrow and thyroid doses would generally not be expected to exceed a few tens of millirem for the SST4 release and a few millirem for the SST5 release.

Figure 2.3.1-3 displays the variation with distance of the mean individual risks (averaged over 360 degrees[b]) of early fatality and early injury for source terms SST1 and SST2, and of latent cancer fatality (from early exposure only[c]) for all five source terms. These curves were calculated assuming an 1120 MWe PWR, New York City meteorology, a uniform wind rose, and no emergency response. Because early fatalities and injuries have dose thresholds, their risks of occurance decrease rapidly with distance for large source terms (e.g., SST1 and SST2) and are zero offsite ($\gtrsim$0.25 mi) for small source terms (e.g., SST3, SST4, and SST5). Since no offsite risk of early fatality or injury was predicted for source terms SST3, SST4, or SST5, in Figures 2.3.1-3a and 2.3.1-3b no curves were plotted for these source terms. In contrast to this, because no dose threshold is assumed for latent cancer fatalities, the risk of latent cancer fatality decreases more slowly with distance and is non-zero for all five source terms. Therefore, in Figure 2.3.1-3c a

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a. The doses are the means of the frequency distributions of estimated individual dose calculated using an appropriate sample of weather sequences from a single year of meteorological data.

b. Individual risks shown are the product of two probabilities: (1) the probability of exposure to the plume given that the release occurs, and (2) the probability that the individual dies following the exposure.

c. Early exposure includes exposure to the radioactive plume, all exposures resulting from inhalation of radioactive materials from the plume, and short-term exposure to radioactivity deposited on the ground from the plume.

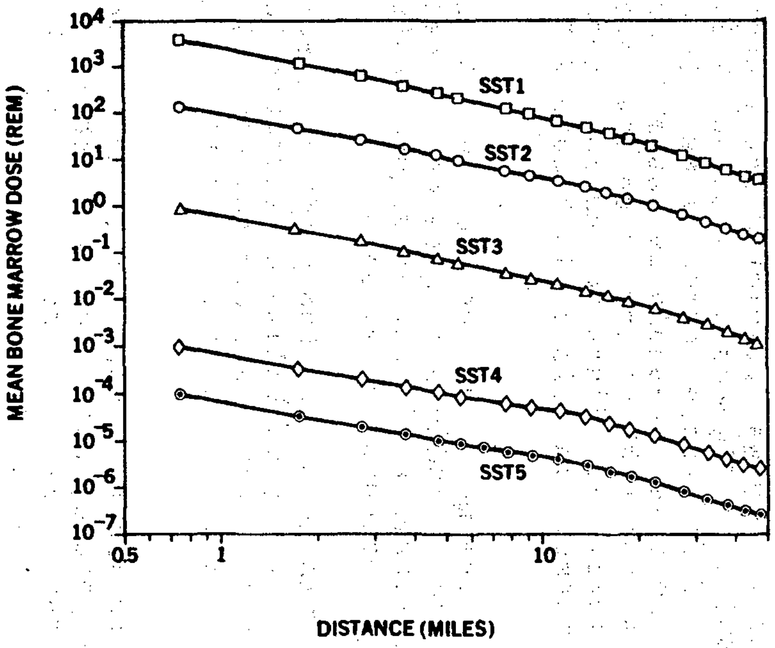

Figure 2.3.1-1. Comparison of Predicted Mean Bone Marrow Dose to Exposed Individuals vs Distance for the Five Source Terms.

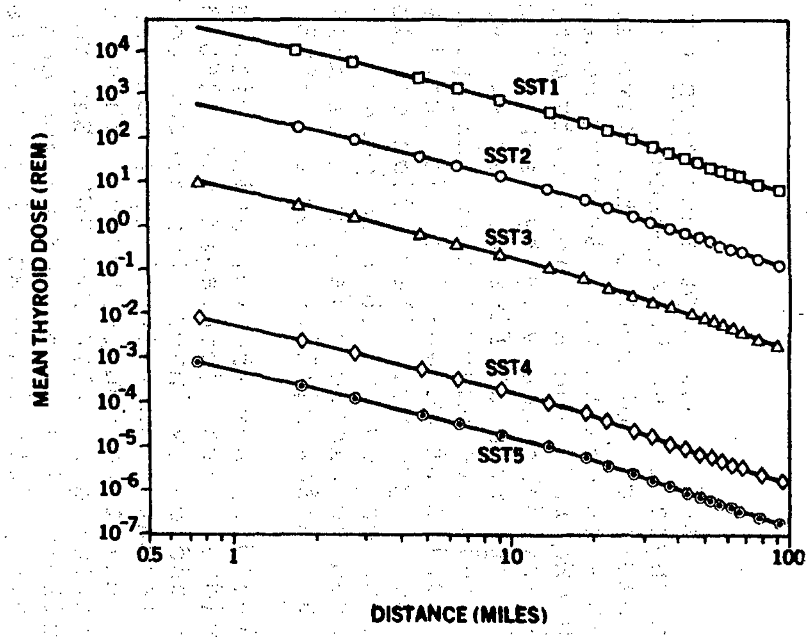

Figure 2.3.1-2. Comparison of Predicted Mean Thyroid Dose to Exposed Individuals vs Distance for the Five Source Terms.

Assumptions: 1120 MWe reactor, New York City meteorology, no emergency response, one day exposure to radionuclides deposited on the ground.

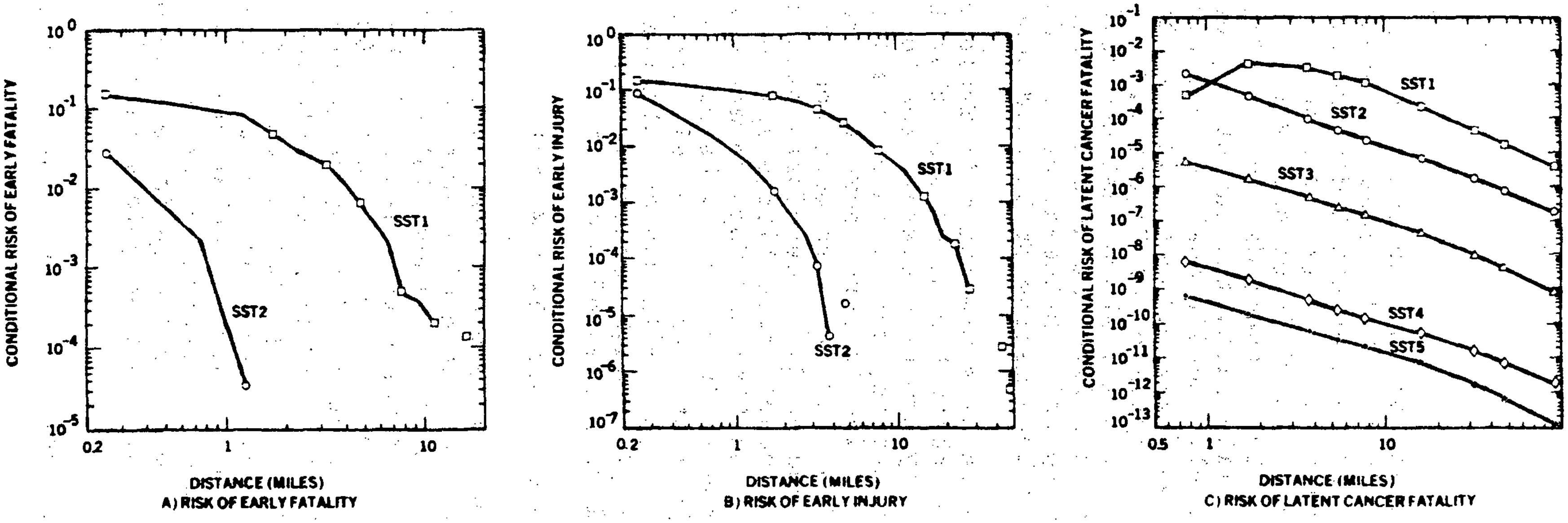

Figure 2.3.1-3. Risk to an Individual of a) Early Fatality, b) Early Injury, and c) Latent Cancer Fatality (from early exposure only) vs Distance Conditional on Each of the Five Siting Source Terms. <u>Assumptions</u>: 1120 MWe PWR, New York City meteorology, no emergency response, and a uniform wind rose.

risk curve is plotted for each source term. The latent cancer risk curve for the SST1 release crosses the risk curve for the SST2 release at short distances. The falloff in the latent cancer fatality risk at short distances ($\lesssim$2 mi) for SST1 is caused by the very high risk of early fatality at these distances. Because of the high early fatality risk, the latent cancer fatality risk is essentially conditional on surviving the high early radiation doses produced close to the reactor by SST1. Finally, comparison of Figure 2.3.1-3c with Figures 2.3.1-1 and 2.3.1-2 shows that the relative differences between the five latent cancer fatality risk curves are similar to those between the five dose vs distance curves for bone marrow or thyroid doses.

Together, the results presented in Table 2.3.1-3 and Figures 2.3.1-1 through 2.3.1-3 show that the SST1 accident would likely dominate overall reactor risk to the public.[a] Furthermore, consequences resulting from the SST4 and SST5 accidents were shown to be much smaller than those resulting from the core melt accidents (source terms SST1, SST2, and SST3). Therefore, because these non-melt releases probably have little influence on offsite reactor risk, the SST4 and SST5 releases will not be considered further. In addition, because offsite risk is dominated by the most severe core-melt accidents, the remainder of this chapter will concentrate principally on the SST1 release, although results for the SST2 and SST3 releases will be presented when appropriate.

2.3.2 Uncertainty in Source Term Magnitudes

At present there is a great deal of controversy over the magnitude and nature of source terms for severe reactor accidents. A recent study [15] suggested that source terms for atmospheric releases could be substantially smaller than those assumed in WASH-1400 (or also in this report). The study cited evidence that removal processes, which have generally been neglected but which should operate within the primary coolant system and containment, would decrease the amount of material released following an accident to amounts substantially below those usually assumed. Such removal processes include plate-out of hot vapors, agglomeration and deposition of aerosols, and dissolution of soluble materials in water.

a. This conclusion depends on the relative probabilities of releases.

The effectiveness of these removal processes would be strongly dependent on the conditions inside the coolant system and containment and on the chemical and physical form of the fission products. For example, Campbell et al. [23] suggest that under accident conditions in LWRs, fission product iodine would be in the form of a soluble metallic iodide (probably CsI) rather than volatile, molecular iodine, as is currently assumed. Also, Morewitz [24], after review of past reactor accidents and destructive tests, concluded that in all cases where water was present, no fission product tellurium had been released. Morewitz proposed two explanations for this observation: Either tellurium remains in solution in the form of soluble $CsTe_2$, or tellurium particles are efficiently scavenged by rapid droplet growth caused by condensation of water vapor. Morewitz further noted that even in the absence of water droplet formation, the generation of large quantities of aerosol from structural materials (steel, concrete, etc.) would produce rates of aerosol agglomeration rapid enough to ensure that a large fraction of the radioactive particles would quickly settleout inside the containment.

These suggestions have received substantial support in a recent NRC report [16]. The significance of these proposals is that the solubility of volatile fission products and potential aerosol removal mechanisms could limit the quantity of released radionuclides to levels one to two orders of magnitude below those currently assumed.

To evaluate the impact on predicted consequences of significant reductions in the amount of released material, a series of calculations was performed with arbitrary reductions in the quantities of released fission products. The impact of potential reductions due to the solubility of fission products in water was evaluated by arbitrarily reducing the release fractions of iodine, cesium, and tellurium[a] to 50, 10 and 0 percent of the standard SST1 level, singly,

a. The tellurium release fraction includes both tellurium and antimony and the cesium release fraction includes both cesium and rubidium (see Table 2.3.1-2). Cesium and tellurium, however dominate the predicted consequences for each release group.

in pairs (Cs and I only), and all simultaneously (50 percent reduction only). To evaluate the impact on predicted consequences of potential reductions in source terms due to efficient aerosol removal processes, calculations were performed with the release fraction of all isotopes except noble gases arbitrarily reduced to 50, 10, 5, and 1 percent of the SST1 release.

The results of the calculations are summarized in Tables 2.3.2-1 and 2.3.2-2. Assumed in these calculations were the Indian Point site, New York City meteorology, an 1120 MWe reactor, and Summary Evacuation. The results in Table 2.3.2-1 indicate that a factor of 10 reduction in the release fraction of either iodine or tellurium results only in about a factor of 2 reduction in early effects. Because of the dose-threshold for early effects, this does not imply that iodine or tellurium "account" for half of the early effects.

Table 2.3.2-1 does, however, present a measure of the relative doses resulting from exposure to individual elements. Iodine isotopes account for about 35 percent of the expected acute bone marrow dose and for about 80 percent of the thyroid dose. Bone-marrow dose has been shown to be the dominant cause of early fatalities. Tellurium isotopes account for about 35 percent of the acute bone marrow dose and about 20 percent of the thyroid dose. Because of the long half-lives of Cs^{134} (2 years) and Cs^{137} (30 years), cesium is the dominant element for long-term exposure. However, a factor of 10 reduction in the release fraction of cesium reduces the mean number of latent cancer fatalities by only 25 percent.

The small reduction in the number of latent cancer fatalities is a result of the assumption in CRAC2 that land will be interdicted to reduce long-term exposure. Thus, reducing the release fraction of cesium reduces the amount of interdicted land but does not significantly alter the total population exposure. The amount of interdicted land is very sensitive to the release fraction of cesium. A factor of ten reduction in the cesium release fraction results in an 85% reduction in the interdicted land area. The sensitivity of latent cancer fatalities to the criterion used for the interdiction of land is discussed in Section 2.7.5.

Table 2.3.2-2 presents the impact on consequences of reductions in the SST1 release fractions of all

Table 2.3.2-1. Sensitivity of Mean Consequences to Reductions in SST1 Release Fractions of Iodine, Cesium, and Tellurium[a,b]

Accident Release	Early Fatalities	Early Injuries	Latent Cancer Fatalities	Acute Dose[c] Bone Marrow	Acute Dose[c] Thyroid	Area of Land Interdiction
SST1 (Standard)	100[b]	100	100	100	100	100
50% I	75	75	98	85	60	100
10% I	60	55	95	70	30	100
0% I	50	55	95	65	20	100
50% Cs	95	95	90	95	100	55
10% Cs	90	95	75	90	100	15
0% Cs	85	90	60	90	100	1
50% Te	75	65	95	85	90	100
10% Te	50	45	90	70	80	100
0% Te	45	40	90	65	80	100
50% I,Cs	70	70	90	80	60	55
10% I,Cs	45	55	70	60	30	15
0% I,Cs	40	50	55	55	20	1
50% I,Cs,Te	40	45	85	60	50	55

a. Assumptions: 1120 MWe reactor, Indian Point site, New York City meteorology, Summary Evacuation.

b. All consequences normalized to 100 for source term SST1.

c. Relative doses are approximately independent of distance.

Table 2.3.2-2. Sensitivity of Mean Consequences to Reductions in SST1 Release Fractions of All Elements Except Noble Gases[a,b]

Accident Release	Early Fatalities	Early Injuries	Latent Cancer Fatalities	Acute Doses[c] Bone Marrow	Acute Doses[c] Thyroid	Interdicted Land Area
SST1 (Standard)	100[b]	100	100	100	100	100
50% SST1[d]	30	35	74	53	50	55
10% SST1[d]	1	4	32	16	10	10
5% SST1[d]	0.2	2	19	11	5	5
1% SST1[d]	0.03	1	5	8	1	1

a. Assumptions: 1120 MWe reactor, Indian Point Site, New York City meteorology, Summary Evacuation.

b. All consequences normalized to 100 for source term SST1.

c. Relative doses are approximately independent of distance.

d. Release fractions reduced for all isotopes except noble gases.

elements except the noble gases. The results indicate that an order-of-magnitude decrease in the release fractions causes the mean number of early fatalities to decrease by about 2 orders-of-magnitude and other consequences to decrease by about 1 order-of-magnitude. The 99th percentile[a] of the calculated distribution of early fatalities for the standard SST1 release was 8,300. When the SST1 release fractions for elements other than noble gases were reduced to 10 and 1 percent of the standard values, the 99th percentile values for early fatalities fell to 100 and 0, respectively.

Only the impact on consequences of potential reductions in the magnitude of source terms has been examined in this section. Two other areas of large uncertainty, the energy release rate accompanying a radioactive release and the physical characteristics of the released material (as reflected in the dry deposition velocity) are discussed in Sections 2.7.2 and 2.7.3, respectively. Other areas of uncertainty, such as release timing (including variable and long duration releases) and release height, have not been addressed in this study.

In summary, if resolution of present uncertainties concerning Source term magnitudes determines that the amount of material released to the atmosphere is significantly less than that currently assumed, there could be large decreases in the predicted consequences of large core melt accidents (e.g., SST1 and SST2). Therefore, the reader should bear in mind that the consequences presented in this report may be significantly overestimated and, thus, some conclusions drawn may not remain valid.

2.4 Site Meteorology and Population

In very general terms, the predicted consequences of an accidental release of radioactive material are dependent on four factors: 1) the assumed source term, 2) the meteorological conditions during and following the release, 3) the number of people exposed to the released material, and 4) the effectiveness of population protective measures. In the previous section, the sensitivity of consequences to the source term was discussed. In this section, the impact on consequences of the mete-

a. Those consequences that would be equalled or exceeded by 1 out of every 100 releases.

investigated. The impact of emergency protective measures on consequences is discussed in Section 2.5.

2.4.1 Sensitivity to Meteorological Record

Predictions of the potential consequences of reactor accidents normally assume that an accident may occur at any time, day or night, under any possible weather conditions. So that all possible weather conditions are adequately represented in the calculations, CRAC2 samples weather sequences from an actual record of meteorological conditions. The meteorological record required by CRAC2 consists of the site wind rose and 8760 hourly observations (1 year) of wind speed, atmospheric stability, and accumulated precipitation. As described in Section 2.2.1 and Appendix E, approximately 100 weather sequences are sampled from the meteorological record and used in the calculations to generate frequency distributions for various consequences. Current regulatory policy requires a licensee to monitor meteorological conditions for at least 1 year as part of the site approval process [25]. Data from reactor sites, however, are often of poor quality. Some site meteorological files do not include observations of precipitation and there are often "gaps" in the recordings. For this study, meteorological records from 29 National Weather Service (NWS) stations were used with the site wind rose. The 29 records represent the broad range of climatic conditions found in the United States, ranging from arid climates, such as Phoenix, AZ, to wet climates, such as Apalachicola, FL. NWS data have several potential advantages over reactor site data in that they are generally of higher quality, are readily available, contain more detailed observations, and are of durations of up to 30 years. A description of the 29 meteorological records may be found in Section A.3 of Appendix A.

A sensitivity analysis was performed to examine the impact that the meteorological record used in the calculations has on predicted consequences. Each of the 29 records was used as input for calculations at the Indian Point and Diablo Canyon sites (i.e., the population distributions and wind rose for each site were used with each of the 29 NWS records). Indian Point was selected because it has one of the highest population densities surrounding the site, while Diablo Canyon has one of the lowest.

The calculations assumed Summary Evacuation (see Section 2.5), an 1120 MWe plant, and an SST1 release.

Any observed variation in the predicted consequences at either of the two sites must be due either to differences in the 29 meteorological records or to inadequacies in the procedure used to sample weather sequences.

The weather sequence sampling procedure currently used with CRAC2 has several deficiencies. Because only one year of data is sampled, very low probability sequences (e.g., intense rain at a specific distance) may not be adequately represented. Sequences that contain rain events are currently properly weighted as to frequency of occurrence only when the rain event occurs within 30 miles of the site. This is probably adequate for early fatalities, which typically do not occur beyond 25 miles. However, consequences such as early injuries and interdiction of land, that have dose thresholds and which occur to distances substantially greater than 30 miles, are probably not properly represented by a sampling procedure that does not characterize weather sequences beyond 30 miles. Finally, because rainfall sequences are not weighted for rainfall intensity, ground contamination also may not be adequately characterized by the current sampling procedure.

Figure 2.4.1-1 presents the 29 early fatality CCDFs[a] for the Indian Point site obtained using the 29 meteorological records. Probabilities are conditional on the occurrence of an SST1 accident. The means of the 29 conditional distributions vary by less than a factor of 2. At the 90th percentile of the distributions, the consequences range from about 2000 to 4000 early fatalities. At the 99th percentile, the range is about 7000 to 14,000. The higher-consequence events with conditional probabilities less than 10^{-2} typically result from sequences with an onset of precipitation over a populated area. The frequency of precipitation (fraction of hours with recorded precipitation) in the 29 records varies by about a factor of 10, ranging from 1 percent for the Phoenix record to 10 percent at Caribou, ME (see Table A.3-3). Therefore, the probabilities of the high-consequence events also vary by about a factor of 10. The peaks (maximum calculated number of early fatalities) of the 29 early fatality CCDFs also vary by about a factor of ten (10^4 to 10^5 fatalities). This

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a. Complementary Cumulative Distribution Functions are log-log plots of the probability that a consequence of a given magnitude will be equalled or exceeded.

Figure 2.4.1-1

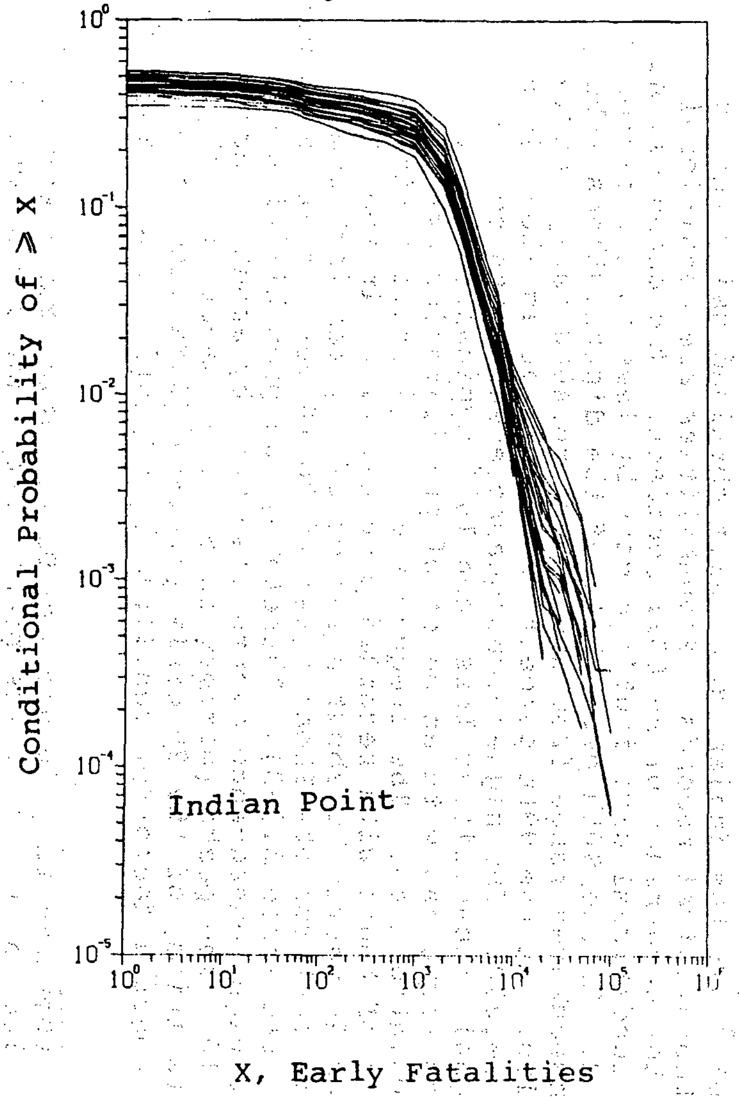
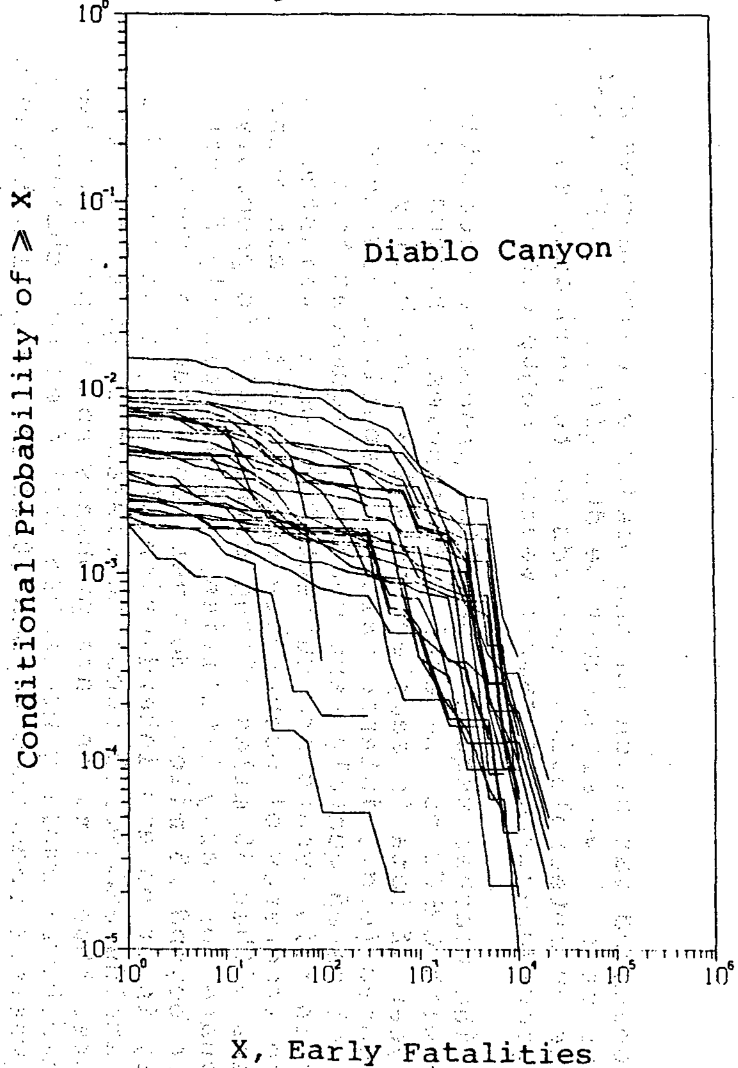


Figure 2.4.1-2



Early Fatality Complementary Cumulative Distribution Functions (CCDFs) Generated With Meteorological Data From 29 National Weather Service Stations. Probabilities are conditional on an SST1 accident occurring. The means of the distributions have the following ranges: Indian Point 710-1300, Diablo Canyon 0.1-18. <u>Assumptions</u>: Summary Evacuation, 1120 MWe reactor.

range probably is caused by inadequacies in the weather sequence sampling procedure used in the calculations.

In marked contrast to the Indian Point result, the 29 early fatality CCDFs for the Diablo Canyon site (Figure 2.4.1-2) are not closely clustered. Because of the very low population density surrounding the Diablo Canyon site, early fatalities occur above the 99th percentile of the distributions[a] for only one of the 29 meteorological records. Examination of the sequences which produced any early fatalities showed that almost all were sequences containing precipitation. The spread of the distributions (as much as 2 orders of magnitude in both probabilities and consequences) is caused by variations in the frequency of precipitation among the 29 records and inadequacies in the weather sequence sampling procedure.

Results similar to those presented in Figure 2.4.1-2 were found by Sprung [26] for calculations with buoyant plumes where, again, the occurrence of precipitation is required to produce significant numbers of early fatalities (Note that all releases in the present study are assumed to be non-buoyant. The effect of plume buoyancy on predicted consequences is discussed in Section 2.7.2.)

Figures 2.4.1-1 and 2.4.1-2 indicate that out to the 99th percentile of the conditional distributions, the meteorological record used in the calculations does not have a significant impact on the predicted distributions of early fatalities (CCDF mean values differ by less than a factor of 2). Figures 2.4.1-3 and 2.4.1-4 show the 29 early-injury CCDFs for the two sites. Except for three of the meteorological records, there is again very little variation among consequences with conditional probabilities greater than 10^{-2}. The outlying curves are for the Apalachicola, Seattle, and El Paso meteorological records at the Indian Point site and the Apalachicola and Seattle records at Diablo Canyon. Apalachicola and Seattle are two of the "wetter" meteorological records; inexplicably, El Paso is one of the driest. The source of these anomalies is not certain, but is probably due to inadequacies of the weather sequence sampling procedure (i.e., rain events beyond 30 miles are not appropriately weighted).

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a. Those consequences that would be equalled or exceeded by 1 out of every 100 releases.

Figure 2.4.1-3

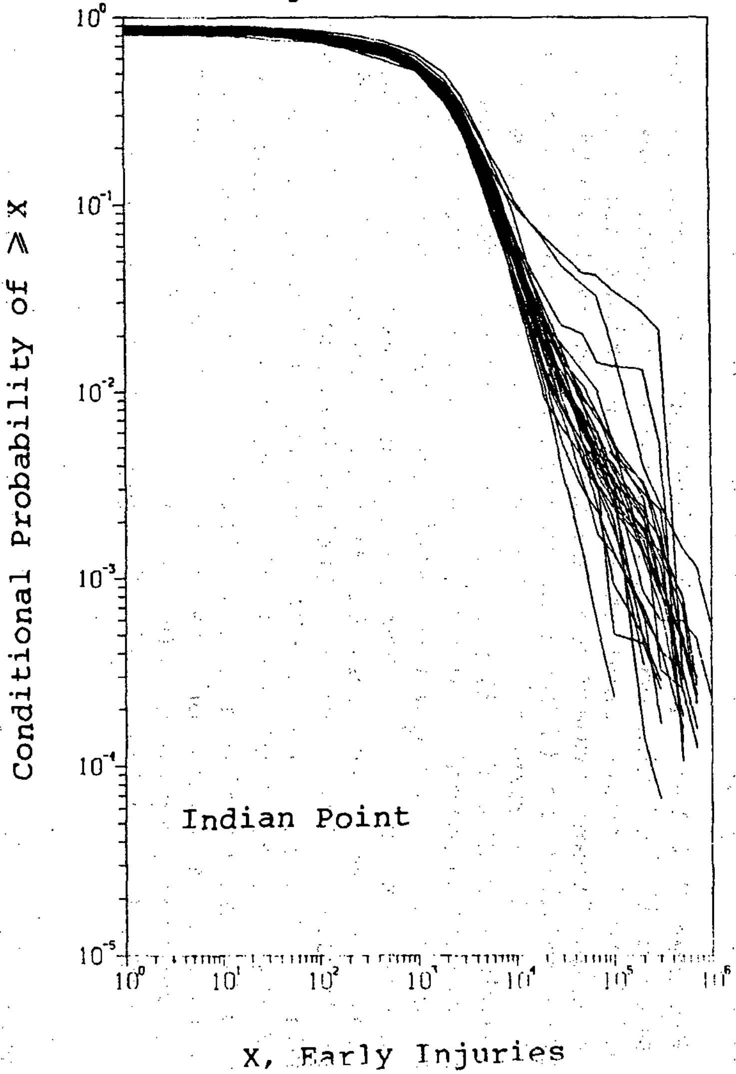
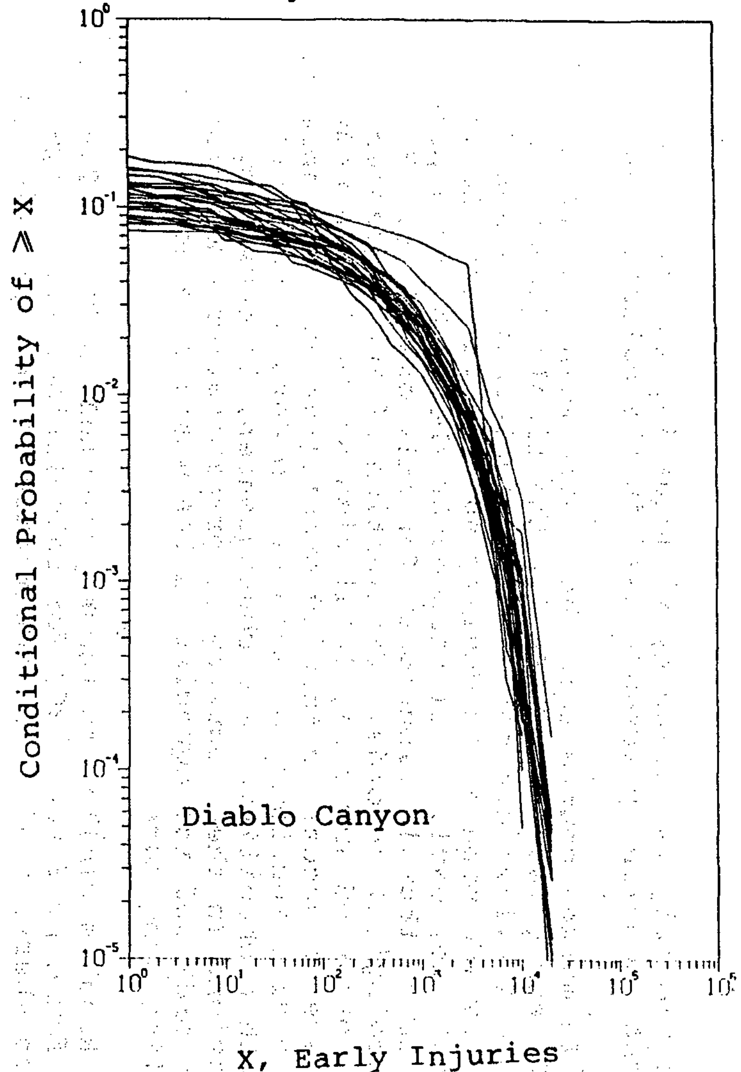


Figure 2.4.1-4



Early Injury Complementary Cumulative Distribution Functions (CCDFs) Generated With Meteorological Data From 29 National Weather Service Stations. Probabilities are conditional on an SST1 accident occurring. The means of the distributions have the following ranges: Indian Point 2400-14,000 (2,400 - 5,000 without the 3 high outlying CCDFs), Diablo Canyon 64-240. Assumptions: Summary Evacuation, 1120 MWe reactor.

Figures 2.4.1-5 and 2.4.1-6 present the 29 latent cancer fatality CCDFs for the two sites. Both figures show variations only in the probabilities of the high-consequence events, most likely a reflection of the different probability of precipitation in each meteorological record. These two figures clearly indicate that the meteorological record does not have a significant impact on predicted distributions of latent cancer fatalities.

Figure 2.4.1-7 shows the interdicted-land area CCDFs for the 29 records. Interdicted land is a measure of the potential offsite economic consequences of an accident and is calculated independent of population distribution and wind rose. At the 90th percentile, the predicted areas vary by about a factor of 3. There is a 2-order of magnitude spread in the probabilities of the CCDF maxima (high-consequence sequences). The different probabilities of precipitation among the 29 meteorological records can account for about 1 order of magnitude. The remaining factor of 10 most likely is caused by inadequacies in the weather-sequence categorization procedure (see Appendix E).

This section has examined the sensitivity of consequence magnitudes to meteorological record. The sensitivity to meteorological record of the distances to which consequences occur is discussed in Section 2.6.

The following conclusions can be drawn from this sensitivity analysis:

- o Given a specific release, the one-year meteorological record used in the calculations does not have a significant impact on predicted consequences out to the 99th percentile of the distributions. Therefore, when suitable meteorological data is not available from the site, the use of substitute meteorological data, such as that available from a nearby National Weather Service station, is probably adequate for performing consequence calculations with CRAC2.

- o Major differences in predicted consequences among the 29 meteorological records occur at probabilities less than 10^{-2} and probably arise from variations in the frequency of precipitation and inadequacies in the procedure used to sample weather sequences.

Figure 2.4.1-5

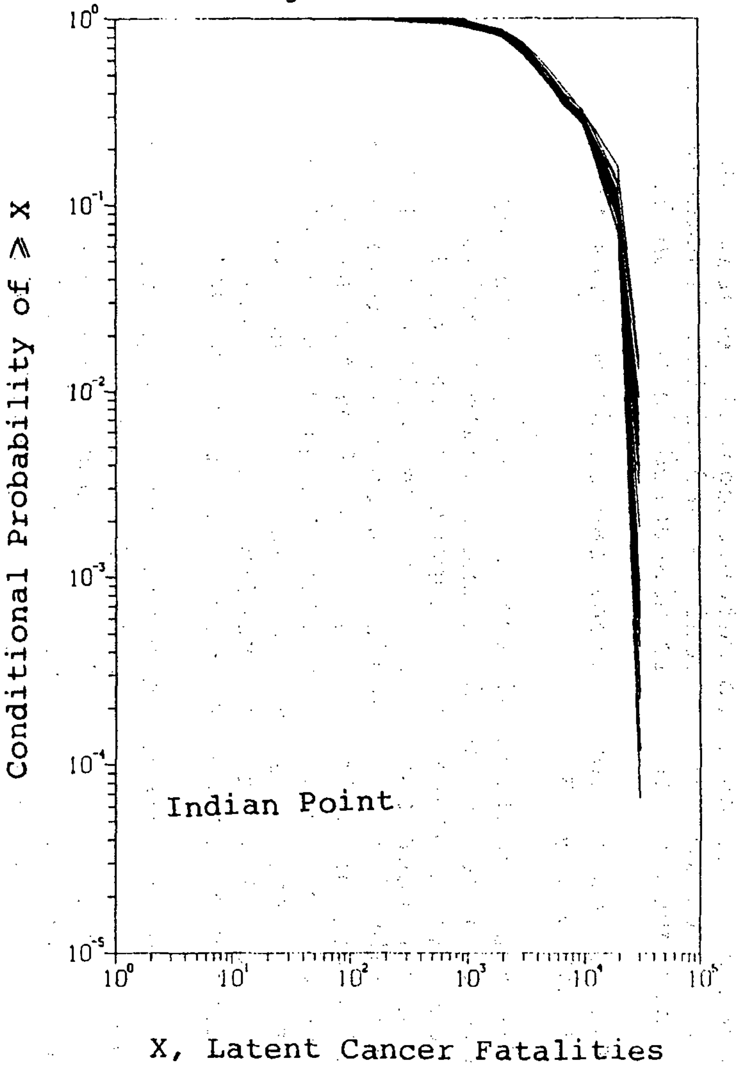
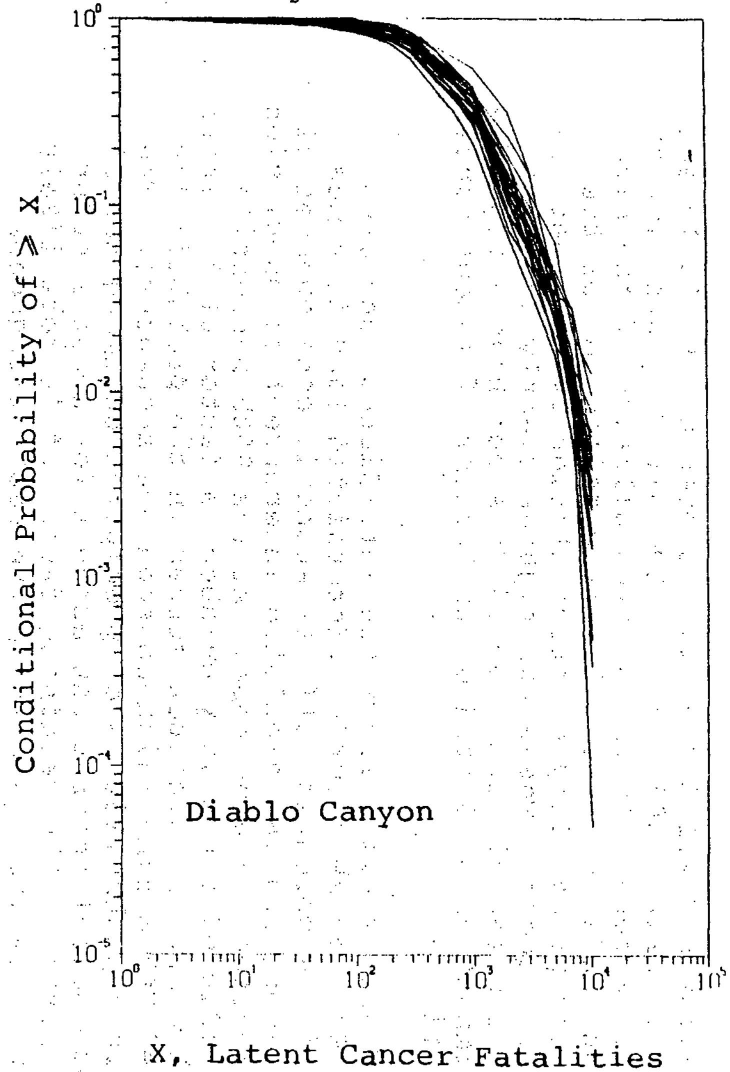


Figure 2.4.1-6



Latent Cancer Fatality Complementary Cumulative Distribution Functions (CCDFs) Generated With Meteorological Data From 29 National Weather Service Stations. Probabilities are conditional on an SST1 accident occurring. The means of the distributions have the following ranges: Indian Point 7600-9300, Diablo Canyon 750-1600. Assumptions: Summary Evacuation, 1120 MWe reactor.

o Further refinement is needed in the CRAC2 treatment of meteorological data. Possible improvements include the use in the weather sequence sampling procedure of more than 1 year of weather data and the consideration of precipitation intensity. In addition, sequences with an onset of precipitation may need to be categorized to distances beyond the present 30 miles, perhaps to 100 miles.

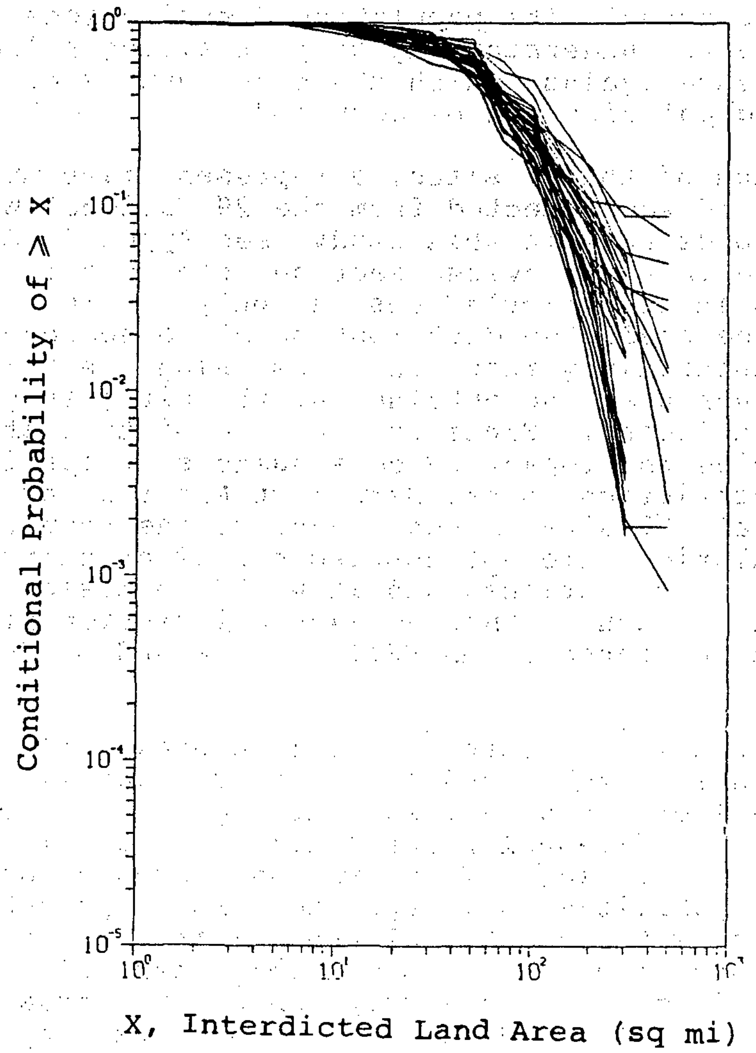


Figure 2.4.1-7. Interdicted Land Area Complementary Cumulative Distribution Functions (CCDFs) Generated with Meteorological Data from 29 National Weather Service Stations. Probabilities are conditional on an SST1 accident occurring. The means of the distributions range from 72 to 140 square miles. Assumption: 1120 MWe reactor.

2.4.2 Sensitivity to Site Population Distribution

To examine the role of population distribution in determining reactor accident consequences, a sensitivity study was performed using the actual population distribution and 1-year average wind rose from each of the 91 U.S. reactor sites having either an operating license or a construction permit. Calculations performed using actual site population distributions also provide a better understanding of past siting policy and a reference against which the consequences of proposed siting policies can be compared.

For each of the 91 sites, a representative meteorological record was selected from the 29 National Weather Service records used in this study (see Appendix A). As discussed in the previous section, the meteorological record used in the calculations has only a marginal impact on the predicted distribution of consequences. Thus, the uncertainty resulting from using a substitute record (rather than one obtained at the site) is probably not significant. Since the purpose of this study was to examine the impact on consequences of specific site characteristics, a standard 1120 MWe reactor was assumed at all 91 sites. Consequently, the results of these calculations are not assessments of existing reactor-site combinations, and it would be misleading to use them as such. Finally, each calculation also assumed the occurence of an SST1 release and of Summary Evacuation.

Figures 2.4.2-1a through 2.4.1-1c show early fatality, early injury, and latent cancer fatality CCDFs for all of the 91 sites. The figures have been truncated at conditional probabilities of 10^{-3} (one in a thousand releases). This was done because consequence probabilities and magnitudes for improbable events (those with conditional probabilities less than 10^{-3}) are very uncertain. A large part of this uncertainty is due to the assumption of an evacuation only within 10 miles. Because of this assumption, all persons beyond 10 miles were assumed to be exposed to deposited radionuclides for 1 day, regardless of dose rate[a]. Any emergency actions taken beyond 10 miles

a. Under some meteorological conditions, the 1-day bone marrow dose at 10 miles can exceed 1000 rem.

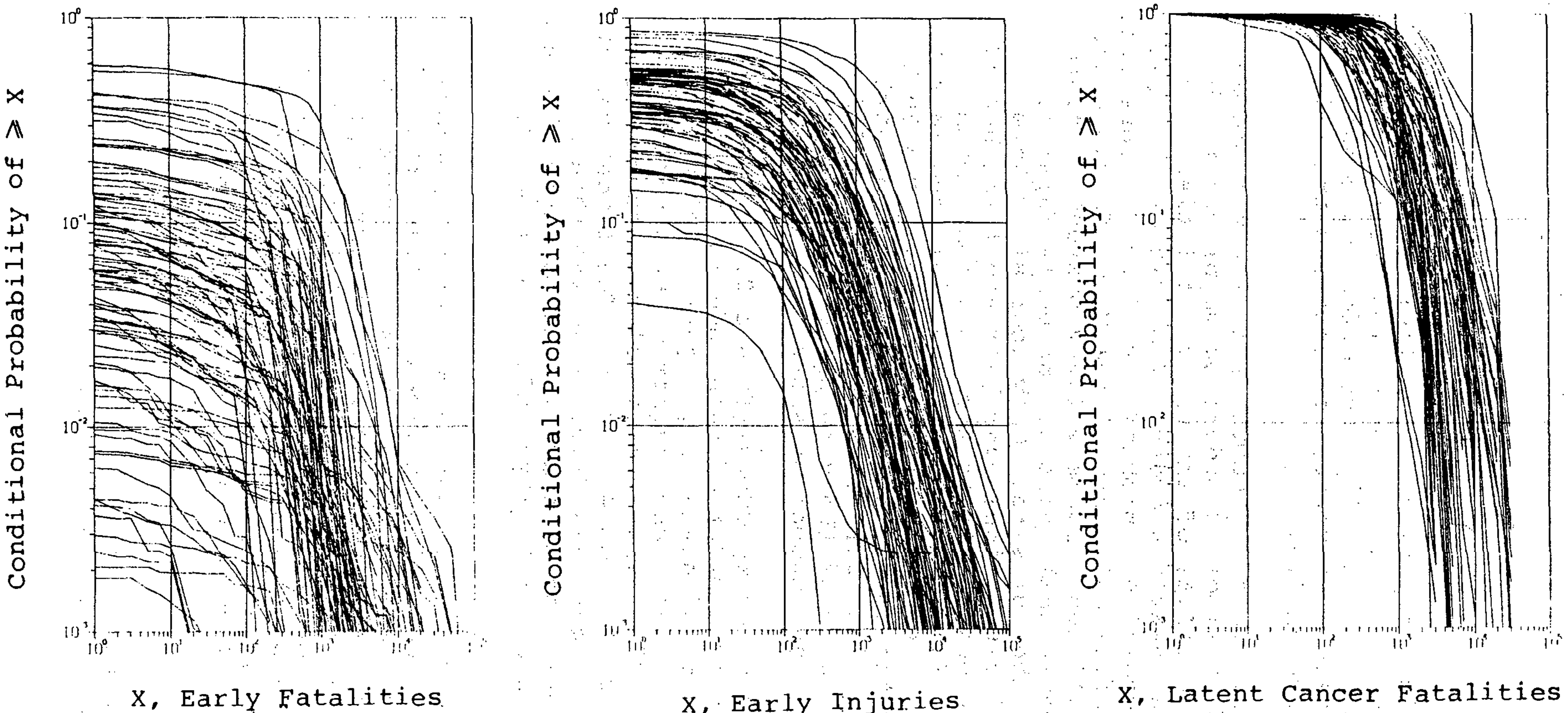


Figure 2.4.2-1. (a) Early Fatality, (b) Early Injury, and (c) Latent Cancer Fatality CCDFs Conditional on an SST1 Release at all 91 Current U.S. Reactor Sites. Assumptions: 1120 MWe reactor, Summary Evacuation, representative meteorology. Range of means: early fatalities 0.4 to 970, early injuries 4 to 3600, and latent cancer fatalities 230 to 8100.

(e.g., sheltering or prompt relocation) would significantly mitigate the consequences of low-probability, high consequence events [27]. The effect on consequences of different emergency response scenarios is discussed in Section 2.5.

The 91 early fatality CCDFs range (on the probability axis) over almost 3 orders of magnitude in the conditional probability of any early fatalities [i.e., P($\geq$1)] and over nearly 4 orders of magnitude in consequences at a conditional probability of 10^{-3} (consequence axis). The conditional means of the 91 CCDFs range from 0.4 to 970 fatalities. Figure 2.4.2-2 presents a histogram of the conditional means of the early fatality CCDFs versus number of sites. Only four sites have means above 250 fatalities; over half are less than 50. Table C-1 in Appendix C lists the conditional mean number of early fatalities, early injuries, and latent cancer fatalities for each of the 91 sites. The 99th percentile[a] of the conditional distributions of early fatalities range from zero to 8000. Figure 2.4.2-3 presents a histogram of the 99th percentile of the distributions versus number of sites.

The 91 early injury CCDFs (Figure 2.4.2-1b) range over approximately 1 order of magnitude in the conditional probability of having any injuries [P($\geq$1)] and over 2 orders in consequence magnitude at a conditional probability of 10^{-3}. The conditional mean numbers of early injuries range from 4 to 3600. The latent cancer fatality CCDFs (Figure 2.4.2-1c) show less than 1 order of magnitude spread on both axes. The conditional means of the latent cancer fatality CCDFs range from 230 to 8100.

In Section 2.4.1, it was shown that the meteorological record does not significantly affect the calculated distributions of consequences. Therefore, the wide variability in calculated distributions displayed in Figures 2.4.2-1a through c (early fatalities, early injuries, latent cancer fatalities) can be due <u>only</u> to differences in the 91 population distributions since all other factors were either held constant or have no significant effect on predicted consequences.

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a. Those consequences that would be equalled or exceeded by 1 out of every 100 releases.

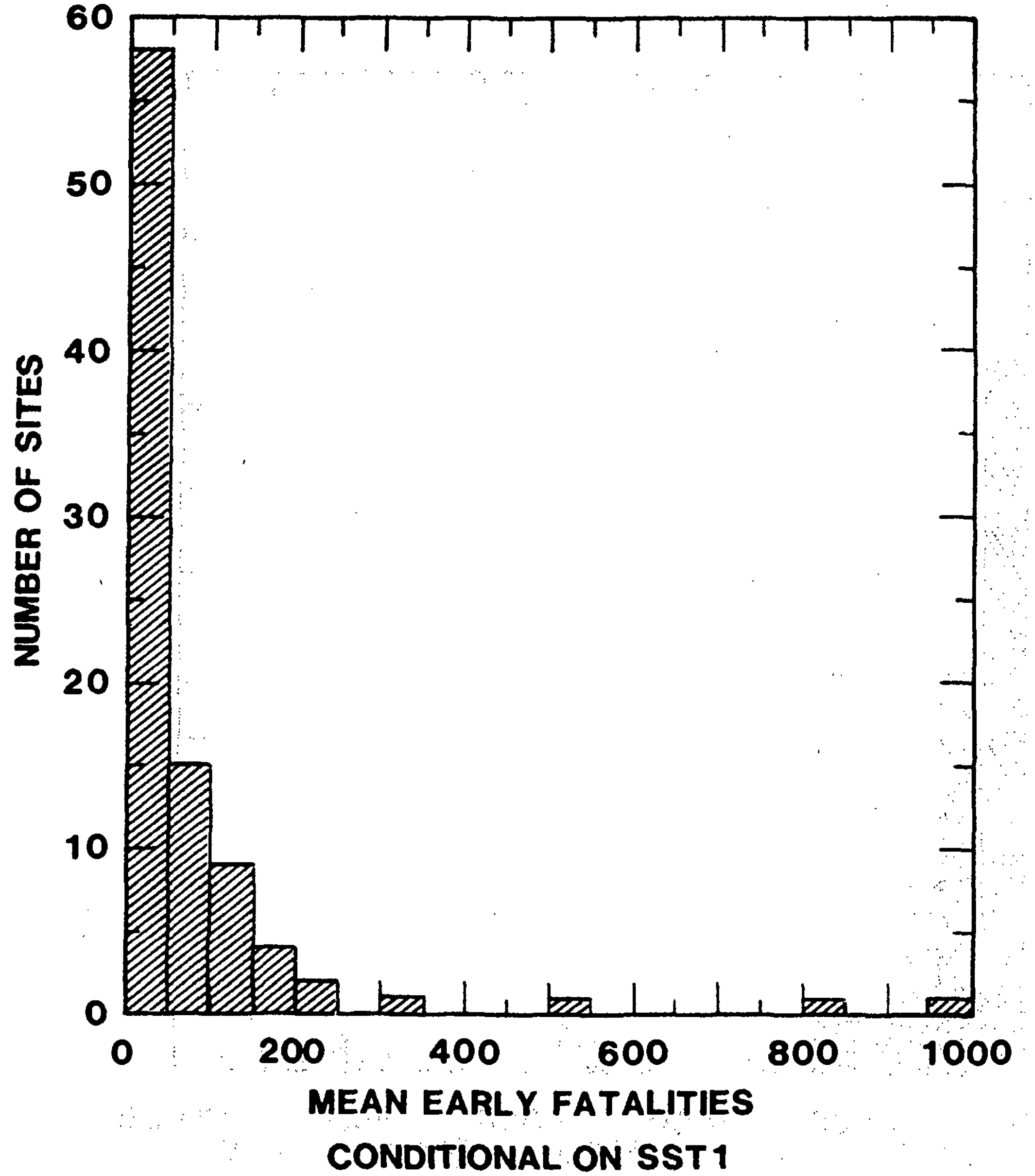

Figure 2.4.2-2. Histogram of Mean Early Fatalities for 91 Sites, Conditional on an SST1 release. <u>Assumptions</u>: 1120 MWe reactor, a representative meteorological record, and Summary Evacuation.

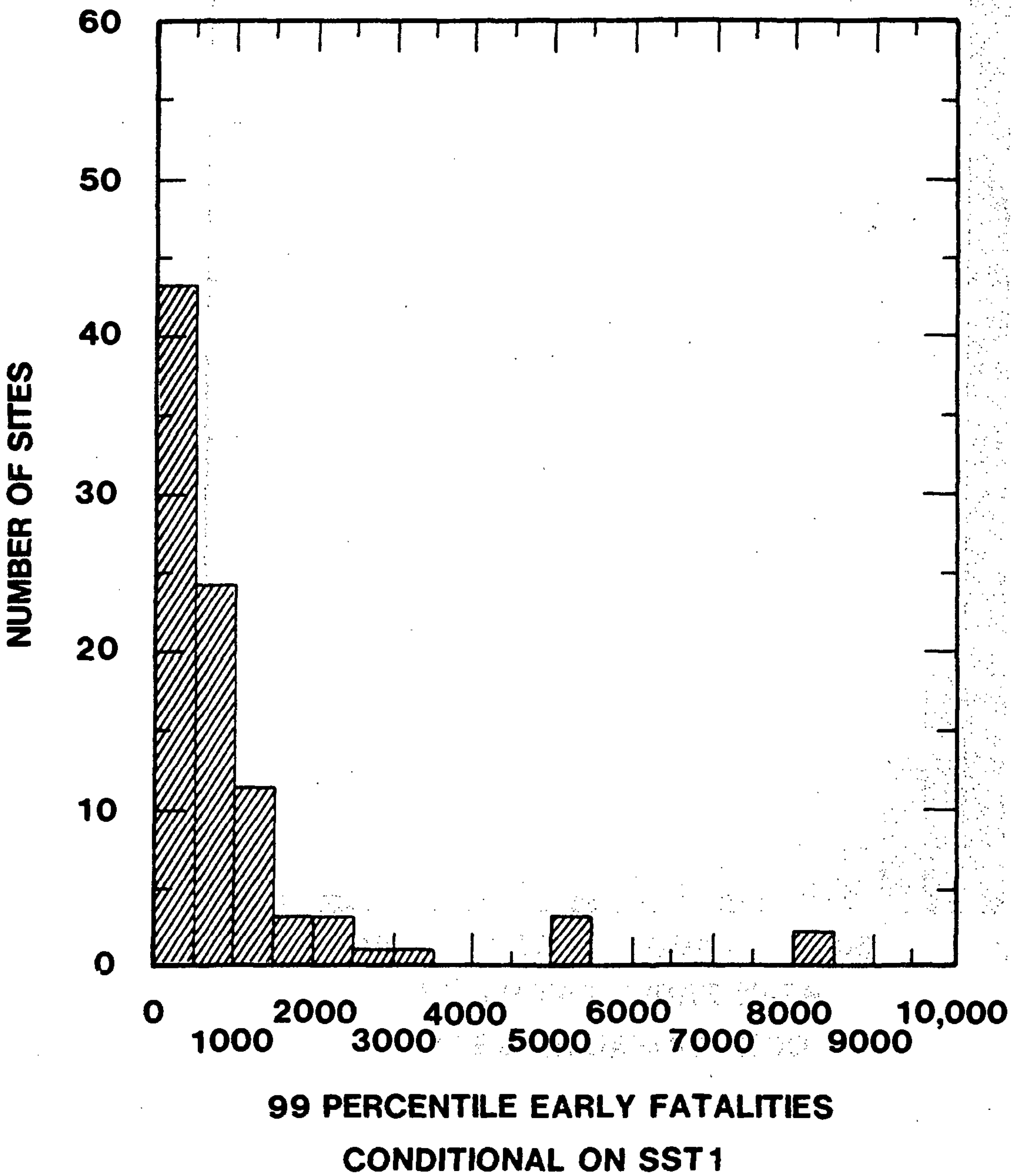

Figure 2.4.2-3. Histogram of the 99th Percentile of the Distribution of Early Fatalities for 91 Sites, Conditional on an SST1 Release. Assumptions: 1120 MWe reactor, a representative meteorological record, and Summary Evacuation.

The different degrees of variability of the three consequences are primarily due to the different distances to which each consequence occurs. Within 20 miles of the reactor there is tremendous variability in the 91 population distributions. Within this distance, the population densities range from 1 to 710 people per square mile (see Section 3). Therefore, the distributions of early fatalities, which are confined to areas within a few tens of miles of the site (most occur within a few miles, see Section 2.6), show the greatest variability. Early injuries can occur to many tens of miles, but most occur within about 30 miles. Within 50 miles of the 91 sites, average population densities range from 10 to 2100 people per square mile. Since this range (factor of 210) is less than that observed to 20 miles (factor of 710), the variability in the 91 early injury CCDFs is less than that obtained for early fatalities. Finally, when averaged over very large areas, the variability in the 91 population distributions is greatly reduced. The population densities within 200 miles of the 91 sites vary between 14 and 335 people per square mile (factor of 24). Thus, the distributions of latent cancer fatalities, which can occur over very large areas, show the least variability.

Some specific characteristics of population distributions which might impact the variability of consequences are discussed in Section 2.7.4. Finally, for each of the 91 sites examined in this report, early fatality, early injury, and latent cancer fatality CCDFs conditional on an SST1 release are presented in Appendix C. When examining these CCDFs, it is important to remember that they are not truly site specific. Although each CCDF was calculated using the site's wind rose, the population distribution about the site, and an appropriate substitute meteorological record, the SST1 release assumed in each calculation was not modified to reflect the specific design of the site's reactor. Instead, a standard 1120 MWe PWR was assumed in each calculation.

2.5 Sensitivity to Emergency Response

Should an accident at a nuclear power plant lead to a significant release of radioactivity, public radiation exposures could be mitigated by evacuation, sheltering, relocation, or medical prophylaxis[a]. Summary Evacuation within 10 miles was assumed in most of the calculations presented in other sections of this report. In this section the sensitivity of early fatalities and early injuries to emergency response is examined by a series of parametric calculations. All of these calculations assume an SST1 release from an 1120 MWe reactor, Indian Point population and wind rose, and New York City meteorology.

The emergency response submodel in CRAC2 was briefly described in Section 2.2.2 and is more fully described in this section and in Appendix E. The model allows for the mitigation of radiation exposures by evacuation or by sheltering followed by relocation. Evacuation is characterized by the delay time between accident warning and the initiation of evacuation, by the distance within which people evacuate, and by the evacuation speed [8]. Sheltering is characterized by the distance within which all people take shelter, the shielding factors afforded by the structures in which they take shelter [29-31], and the delay time between cloud passage and the relocation of sheltered population. The parameters that describe these emergency response scenarios are first defined and then the results of the parametric calculations are presented.

a. Evacuation is the expeditious movement of people to avoid exposure to the passing cloud of radioactive material. Sheltering is the expeditious movement of people indoors, if possible, into basements or masonry buildings which afford enhanced shielding from radiation. Relocation is the movement of exposed persons out of contaminated areas after the passage of the radioactive cloud. Medical Prophylaxis is the administration of agents which decrease or block internal exposures (e.g., KI prophylaxis decreases thyroid exposures [28]).

The following eight parameters essentially determine the impact of the CRAC2 emergency response model on consequence predictions:

Warning Time: Time from accident notification by plant personnel to release of radioactivity due to containment failure (e.g., 0.5 hr for SST1).

Delay Time: Time from accident notification to the initiation of emergency response (0 hr for sheltering; 1-5 hr for evacuation).

Evacuation Radius: The radius within which all occupants of a 90° sector (centered on the plume centerline) evacuate (10 mi in the base case calculation).

Evacuation Speed: The effective speed at which evacuees move radially away from the reactor (10 mph in the base case calculation).

Evacuation Distance: The radial distance to which the evacuees move (5 mi beyond the evacuation radius; therefore, 15 mi for the base case calculation) before they are removed from the calculation because they are assumed to have enough information to avoid additional exposure.

Sheltering Radius: The radius within which all non-evacuating occupants of a 90° sector (centered on the plume) take shelter. If the sheltering radius is less than or equal to the evacuation radius, only evacuation takes place. If the sheltering radius is larger than the evacuation radius, then all persons between the evacuation radius and the sheltering radius take shelter. Beyond the sheltering radius, normal activity is assumed to continue (i.e., some people are outdoors).

Shielding Factor [29]: The fraction of the dose to an unsheltered individual received by an individual sheltered in a building or in a vehicle (i.e., during evacuation). Shielding factors for buildings depend on the housing stock (percent brick, availability of basements) and, therefore, vary by geographic region. Different shielding factors are used to decrease unshielded exposures to the radioactive plume and to contaminated ground (see Appendix A).

Relocation Time: The period which elapses after passage of the radioactive plume before non-evacuating individuals are moved from contaminated areas (24 hr in the base case calculation)

Relationships between several of these eight emergency response model parameters are schematically depicted in Figure 2.5-1.

The CRAC2 emergency response submodel allows for the specification of up to six different emergency response scenarios and will calculate a weighted average of the results for any designated set of scenarios. CRAC2 calculations presented in other sections of this report generally assume "Summary Evacuation," which is the weighted summation of three different evacuation scenarios as follows:

Scenario Number	Scenario Weight[a]	Type of Response	Response Distance	Response Speed	Delay Before Response
1	30%	evacuation	10 miles	10 mph	1 hour
2	40%	evacuation	10 miles	10 mph	3 hours
3	30%	evacuation	10 miles	10 mph	5 hours

a. The 30%/40%/30% weighting provides a best fit to EPA evacuation data [7] (See Appendix E).

The sensitivity of the CRAC2 evacuation model to evacuation speed has been previously investigated by Aldrich, et al. [9], who found that, for evacuation within 10 miles after a 3 hour delay, early fatalities were minimally affected by effective evacuation speed provided that the evacuation speed was at least 10 mph. The impact of delay time on early health effects is illustrated in Figure 2.5-2, which presents early fatality CCDFs for 10 mph evacuations within 10 miles after delays of 1, 3, and 5 hours, respectively (scenarios 1, 2, and 3). Also plotted is the CCDF for Summary Evacuation, which is the 30:40:30 weighted summation of the CCDFs for scenarios 1, 2, and 3. Figure 2.5-2 shows (1) that early fatalities are substantially decreased by short delay times ($\lesssim 1$ hr); and (2) that Summary Evacuation yields results nearly identical to those obtained for scenario 2 (3 hr delay).

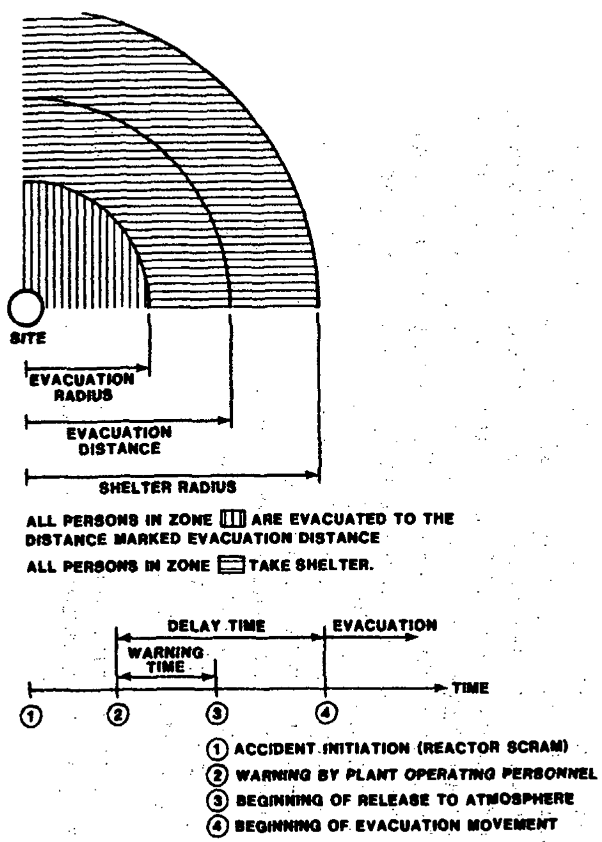

Figure 2.5-1.

Relationships Between Evacuation Model Parameters.

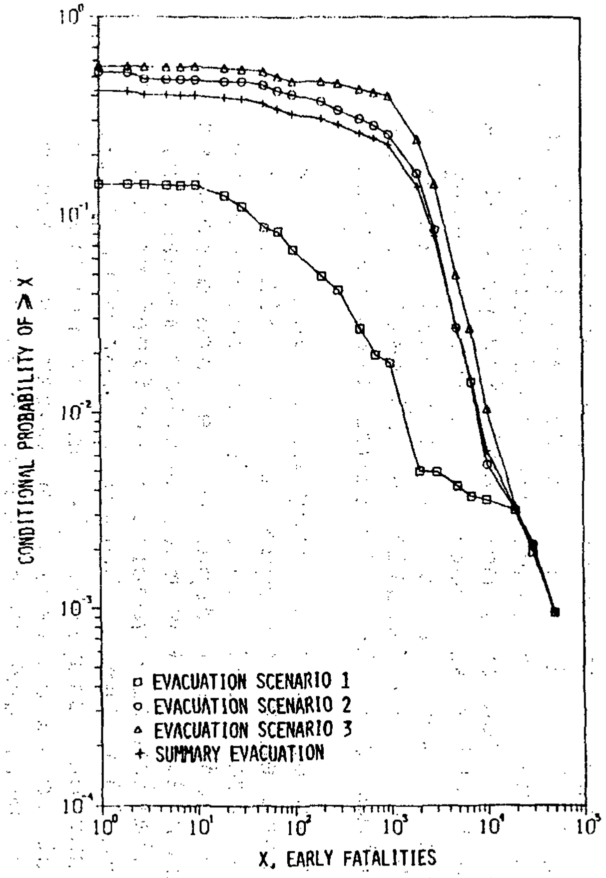

Figure 2.5-2.

Early Fatality Complementary Cummulative Distribution Functions for 10 mph Evacuations within 10 Miles after Delays of 1, 3, and 5 Hours (Scenarios 1, 2, and 3, respectively) and for Summary Evacuation. Assumptions: 1120 MWe reactor, Indian Point population and wind rose, New York City meteorology.

Table 2.5-1 presents mean and 99th percentile[a] values of early fatalities and early injuries for emergency response scenarios 1, 2, and 3 and for Summary Evacuation. The table shows (1) that, for evacuations of population within 10 miles of the reactor, mean and 99th percentile values of early fatalities are more sensitive to delay time than are the corresponding values for early injuries; and (2) that for both early fatalities and early injuries, 99th percentile values are about 10 times mean values.

The different sensitivities displayed result largely from the fact that each consequence has a different characteristic distance within which the consequence is calculated to occur (distance dependencies are discussed in detail in Section 2.6). For most weather sequences, fatal doses of radiation are generally confined to distances of less than 10 miles. Therefore, for almost all of the weather sequences sampled, the entire population potentially subject to fatal radiation doses is evacuating. Consequently, mean and 99 percentile values for early fatalities are highly sensitive (factors of $8 \approx 1400/180$ and $7 \approx 10,000/1400$) to delay time. In contrast to this, doses of radiation sufficient to cause early injuries frequently occur to distances significantly greater than 10 miles. Therefore, because a significant fraction of the population potentially subject to doses sufficient to cause injuries (i.e., the population beyond 10 miles) is not evacuating, mean and 99th percentile values of early injuries are less sensitive (factors of 1.7 and 1.1) to delay time than are the corresponding values for early fatalities. Finally, for evacuations of population within 10 miles, peak values (worst case calculated for any weather sequence, conditional probabilities of $\lesssim 10^{-3}$) of early fatalities and early injuries are essentially insensitive to evacuation delay time e.g., in Figure 2.5-2 the four early fatality CCDFs have identical tails). This is because early fatality and injury worst case results (CCDF tails) are caused by rainout of radioactivity from the plume onto population centers (cities) located more than 10 miles from the reactor. Since these cities were not evacuated in this set of calculations, these calculations yield peak values of early fatalities and early injuries that are not affected by evacuation delay time.

Table 2.5-2 presents the effect of the distance within which population is evacuated upon early fatalities

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a. Consequence magnitude that would be equalled or exceeded following 1 out of every 100 releases.

Table 2.5-1. Effect of Delay Time on Early Fatalities and Early Injuries for Evacuation to 10 Miles. Results are Conditional on an SST1 Release.

Delay Time (hr)	Early Fatalities		Early Injuries	
	Mean	99th Percentile	Mean	99th Percentile
1	180	1,400	2500	30,000
3	920	8,000	4000	32,000
5	1400	10,000	4300	34,000
Summary	830	8,300	3600	33,000

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City meteorology.

Table 2.5-2. Effect of Evacuation Distance on Early Fatalities and Early Injuries for Summary Evacuation. Results are Conditional on an SST1 Release.

Evacuation Distance (mi)	Early Fatalities		Early Injuries	
	Mean	99th Percentile	Mean	99th Percentile
0[a]	3600	18,000	6300	41,000
5	1100	11,000	5500	40,000
10	830	8,300	3600	33,000
25	700	7,200	1800	9,400

a. No evacuation

Assumptions: 1120 MWe reactor, SST1 release, New York City meteorology, Indian Point population and wind rose.

and early injuries for Summary Evacuation. The table shows that mean and 99th percentile values of early fatalities and injuries are all quite sensitive to the distance within which population is evacuated. Because worst case results (conditional probabilities of $\lesssim 10^{-3}$) for early fatalities are generally caused by rainout of the radioactive plume onto a city located further than 10 but less than 25 miles from the reactor, evacuation within 25 miles lowers the worst case number of early fatalities from 57,000 (for evacuation within 10 mi) to 15,000 (for evacuation within 25 mi).

The next three tables examine the sensitivity of early health effects to sheltering parameters. Table 2.5-3 displays the effect of the distance within which population takes shelter in preferred locations (building interiors, basements if available) on early fatalities and early injuries. Examination of the table shows that the effect of response distance for sheltering is similar to that for evacuation. Mean and 99th percentile values of early fatalities and injuries are all quite sensitive to sheltering distance. As before, 99th percentile values are about 10 times the mean result and a 25 mile response distance significantly decreases (by about a factor of 5) the worst case result (conditional probability of $\lesssim 10^{-3}$) below the result obtained with a 10 mile response distance.

Table 2.5-4 illustrates the impact of the availability of basements upon the degree of shielding (and thereby the reductions in consequences) afforded by sheltering. The table shows that mean and 99th percentile values of early fatalities are substantially decreased, if Northeast regional shielding factors (building characteristics: 87% basements, 47% brick) are used rather than Pacific Coast regional shielding factors (building characteristics: 23% basements, 27% brick) [29]. Because sheltering was assumed to take place only to 10 miles, mean and 99th percentile values of early injuries show a lessened sensitivity. These results are consistent with results previously obtained by Aldrich et al. [27].

Table 2.5-3. Effect of Sheltering Distance on Early Fatalities and Early Injuries for Preferential Sheltering Followed by Relocation. Results are Conditional on an SST1 Release.

Sheltering Distance (mi)	Early Fatalities Mean	Early Fatalities 99th Percentile	Early Injuries Mean	Early Injuries 99th Percentile
5	830	9,300	5600	40,000
10	560	5,500	3700	32,000
15	490	4,900	2700	25,000
25	420	4,500	1800	11,000

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City meteorology, no evacuation, Northeast regional shielding factors, relocation after 6 hr.

Table 2.5-4. Effect of Early Fatalities and Early Injuries for Sheltering to 10 Miles Followed by Relocation. Results are Conditional on an SST1 Release.

Number of Basements	Early Fatalities Mean	Early Fatalities 99th Percentile	Early Injuries Mean	Early Injuries 99th Percentile
Few[a]	1200	9,300	4100	34,000
Many[b]	560	5,500	3700	32,000

a. 23% basements (Pacific Coast regional shielding factors used, see Appendix A).

b. 87% basements (Northeast regional shielding factors used, see Appendix A).

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City meteorology, no evacuation, relocation after 6 hr.

After plume passage, relocation of sheltered populations decreases exposure to contaminated ground. The effect upon early fatalities and early injuries of decreasing relocation time from 24 to 6 hours is presented in Table 2.5-5. As before, because sheltering was assumed to take place only to 10 miles, mean and 99th percentile early injury values show little sensitivity, while mean and 99th percentile values for early fatalities decrease by a factor of two.

Table 2.5-5. Effect of Relocation Time on Early Fatalities and Early Injuries for Sheltering to 10 Miles. Results are Conditional on an SST1 Release.

Relocation	Early Fatalities		Early Injuries	
Time (hr)	Mean	99th Percentile	Mean	99th Percentile
6	560	5,500	3700	32,000
12	750	7,500	3800	33,000
24	1200	9,300	4100	34,000

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City meteorology, no evacuation, Northeast regional shielding factors.

Table 2.5-6 gathers together in a single table the results of all the calculations which examined evacuation or sheltering separately. The table presents the variation with response distance of early health consequences for five evacuation scenarios and three sheltering scenarios. Examination of Table 2.5-6 shows that for any response distance, expeditious evacuation (1 hr delay, 10 mph) and sheltering with expeditious relocation (after 6 hr) yield the smallest predictions of early health consequences. The table also confirms the strong dependence of mean early health consequences on response time and the less strong dependence on response distance.

Table 2.5-6. Dependence of Early Fatalities and Early Injuries on Response Distance for Eight Emergency Response Scenarios. Results are Conditional on an SST1 Release

Emergency Response		Response Distance (mi)									
Type	Characteristics	0[a]	5	10	15	25	0[a]	5	10	15	25
		Mean Early Fatalities					Mean Early Injuries				
Evacuation	5 hr delay, 1 mph	3,600	2,100	1,900	1,800	1,800	6,300	6,200	5,300	5,100	4,700
	5 hr delay, 10 mph	3,600	1,600	1,400	1,300	1,250	6,300	6,000	4,300	3,300	2,500
	3 hr delay, 10 mph	3,600	1,200	920	860	790	6,300	5,800	4,000	3,000	2,200
	Summary Evacuation	3,600	1,100	830	780	700	6,300	5,500	3,600	2,700	1,800
	1 hr delay, 10 mph	3,600	440	180	110	40	6,300	4,600	2,500	1,500	700
Sheltering[b]	24 hr relocation	3,600	c	1,200	c	c	6,300	c	4,100	c	c
	12 hr relocation	3,600	c	750	c	c	6,300	c	3,800	c	c
	6 hr relocation	3,600	830	560	490	420	6,300	5,600	3,700	2,700	1,800
		99th Percentile Early Fatalities[d]					99th Percentile Early Injuries[d]				
Evacuation	5 hr delay, 1 mph	18,000	16,000	14,000	12,000	11,000	41,000	41,000	40,000	41,000	28,000
	5 hr delay, 10 mph	18,000	14,000	10,000	9,400	8,800	41,000	40,000	34,000	26,000	10,000
	3 hr delay, 10 mph	18,000	11,000	8,000	7,300	7,000	41,000	40,000	32,000	26,000	10,000
	Summary Evacuation	18,000	11,000	8,300	7,600	7,200	41,000	40,000	33,000	26,000	9,400
	1 hr delay, 10 mph	18,000	7,000	1,400	1,200	1,000	41,000	39,000	30,000	24,000	5,200
Sheltering[b]	24 hr relocation	18,000	c	9,300	c	c	41,000	c	34,000	c	c
	12 hr relocation	18,000	c	7,500	c	c	41,000	c	33,000	c	c
	6 hr relocation	18,000	9,300	5,500	4,900	4,500	41,000	40,000	32,000	25,000	11,000

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City Meteorology.

a. No emergency response.

b. Northeast Regional Shielding Factors.

c. Not calculated.

d. Consequence magnitude equalled or exceeded following 1 out of every 100 releases.

Figures 2.5-3 and 2.5-4 present the variation with distance of the risk to an individual of early health effects (death or injury) for seven emergency response scenarios. The figures show that, as distance decreases, the different scenarios predict increasingly similar individual risks (the seven risk curves converge). The curves converge at short distances because many weather sequences result in radiation doses large enough to have fatalities or injuries for each of the seven emergency response scenarios. For example, expeditious evacuation (1 hr delay) is not always adequate because for many weather sequences the radioactive plume reaches people before they begin to evacuate. And sheltering with expeditious relocation is inadequate because for many weather sequences fatal or injury causing doses are still received by sheltered persons even with expeditious relocation. Accordingly, because at short distances each of the seven scenarios fails to provide sufficient protection for a substantial number of weather sequences, at these distances little sensitivity to differences in emergency response is observed. In agreement with Table 2.5-6, both figures show that individual risk of early health consequences decreases most rapidly with distance for expeditious evacuation (1 hr delay, 10 mph) or sheltering with expeditious relocation (after 6 hr).

The emergency response submodel in CRAC2 is able to apply one emergency response scenario to an inner region and a second scenario to an outer region. Using this option, the impact of emergency response scenarios, which call for both evacuation and sheltering, and the effect of response beyond 10 miles were briefly examined. Table 2.5-7 presents some evacuation data from Table 2.5-2 and contrasts that data with results obtained for emergency response scenarios which call for evacuation of population within 10 miles and sheltering of population from 10 to 25 miles. The table shows that for Summary Evacuation, increasing the response distance from 10 to 25 miles decreases mean and 99th percentile early injury values by factors of 2 and 3.5, respectively, while mean and 99th percentile early fatality values are somewhat lowered (mean, 19%; 99th, 15%). The table also shows (1) that Summary Evacuation to 10 miles in combination with sheltering (relocation after 24 hr) from 10 to 25 miles is as effective as Summary Evacuation to 25 miles; and (2) that in comparison to Summary Evacuation, expeditious evacuation (1 hr delay, 10 mph)

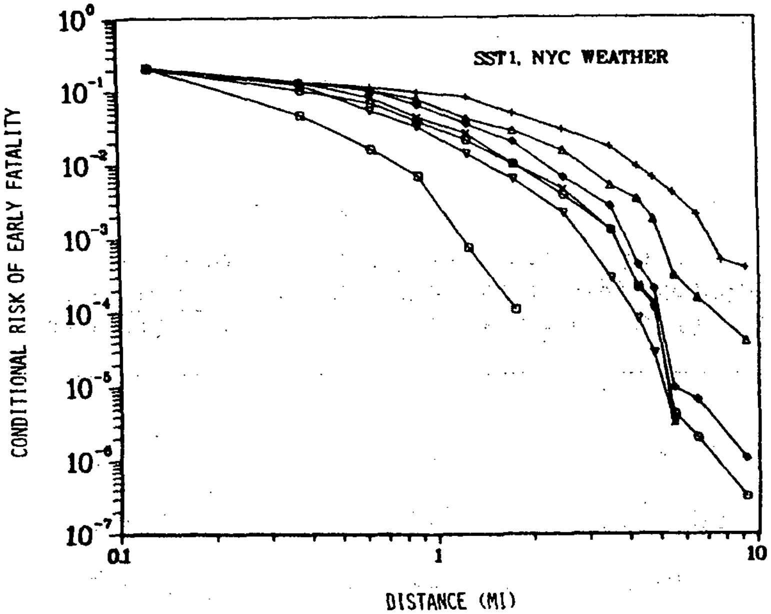

Figure 2.5-3. Conditional Risk of Early Fatality

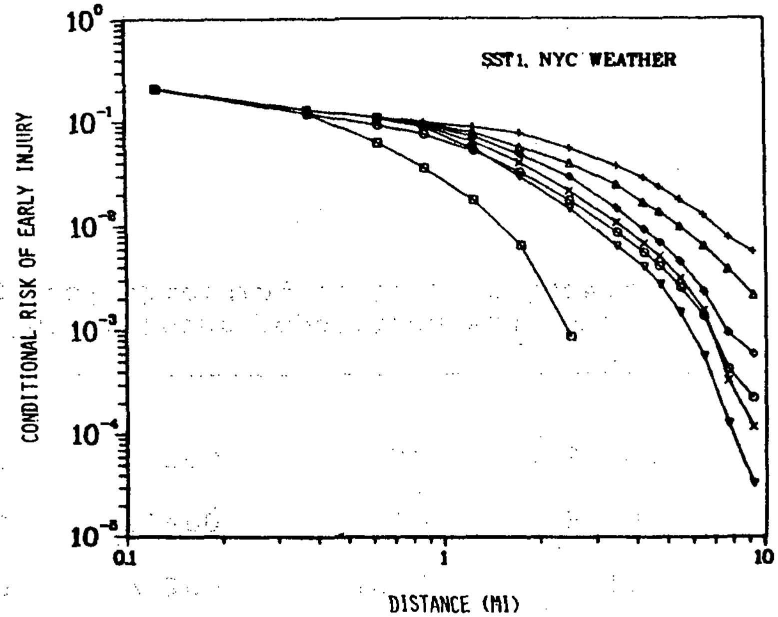

Figure 2.5-4. Conditional Risk of Early Injury

Legend

+ - No evacuation
△ - 5 hr delay, 1 mph, within 10 mi
◊ - 5 hr delay, 10 mph, within 10 mi
× - 3 hr delay, 10 mph, within 10 mi
○ - Summary Evacuation, within 10 mi
▽ - Sheltering within 10 mi, 6 hr relocation
□ - 1 hr delay, 10 mph, within 10 mi

Assumptions: 1120 MWe reactor, uniform wind rose, New York City meteorology, results conditional on an SST1 release.

Table 2.5-7. Impact of Emergency Response Beyond 10 Miles on Early Fatalities and Early Injuries. Results are Conditional on an SST1 Release.

Evacuation Distance (mi)	Evacuation Delay	Sheltering Distance (mi)	Early Fatalities		Early Injuries	
			Mean	99th Percentile	Mean	99th Percentile
0 - 10	Summary	None	830	8,300	3600	33,000
0 - 25	Summary	None	700	7,200	1800	9,400
0 - 10	Summary	10 - 25	690	5,400	1900	8,400
0 - 10	1 hr	10 - 25	40	750	750	5,800

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City Meteorology, Northeast regional shielding factors, relocation of sheltered individuals after 24 hr.

to 10 miles combined with the sheltering (relocation after 24 hr) from 10 to 25 miles substantially reduces mean and 99th percentile values for early fatalities (factors of 17 and 7, respectively) and significantly reduces mean and 99th percentile values for early injuries (factors of 2.5 and 1.5, respectively). Further, peak early fatalities (conditional probabilities $\lesssim 10^{-3}$) are reduced by a factor of almost 10 (peak 15,000 to 1,600). Because of the substantial impact of emergency response beyond 10 miles upon peak early fatalities, it should be noted that most results presented in other sections of this report assume no immediate emergency response beyond 10 miles and consequently may significantly overestimate early fatality peaks.

Finally, Figure 2.5-5 indicates the sensitivity of early fatalities to the range of emergency response scenarios examined. In Figure 2.5-5 the CCDF for Summary Evacuation is the "base case" (see Section 2.2.4) result. The two bounding early fatality CCDFs for no emergency response and for expeditious evacuation to 25 miles show that the emergency response scenario selected has a substantial impact on consequence magnitude.

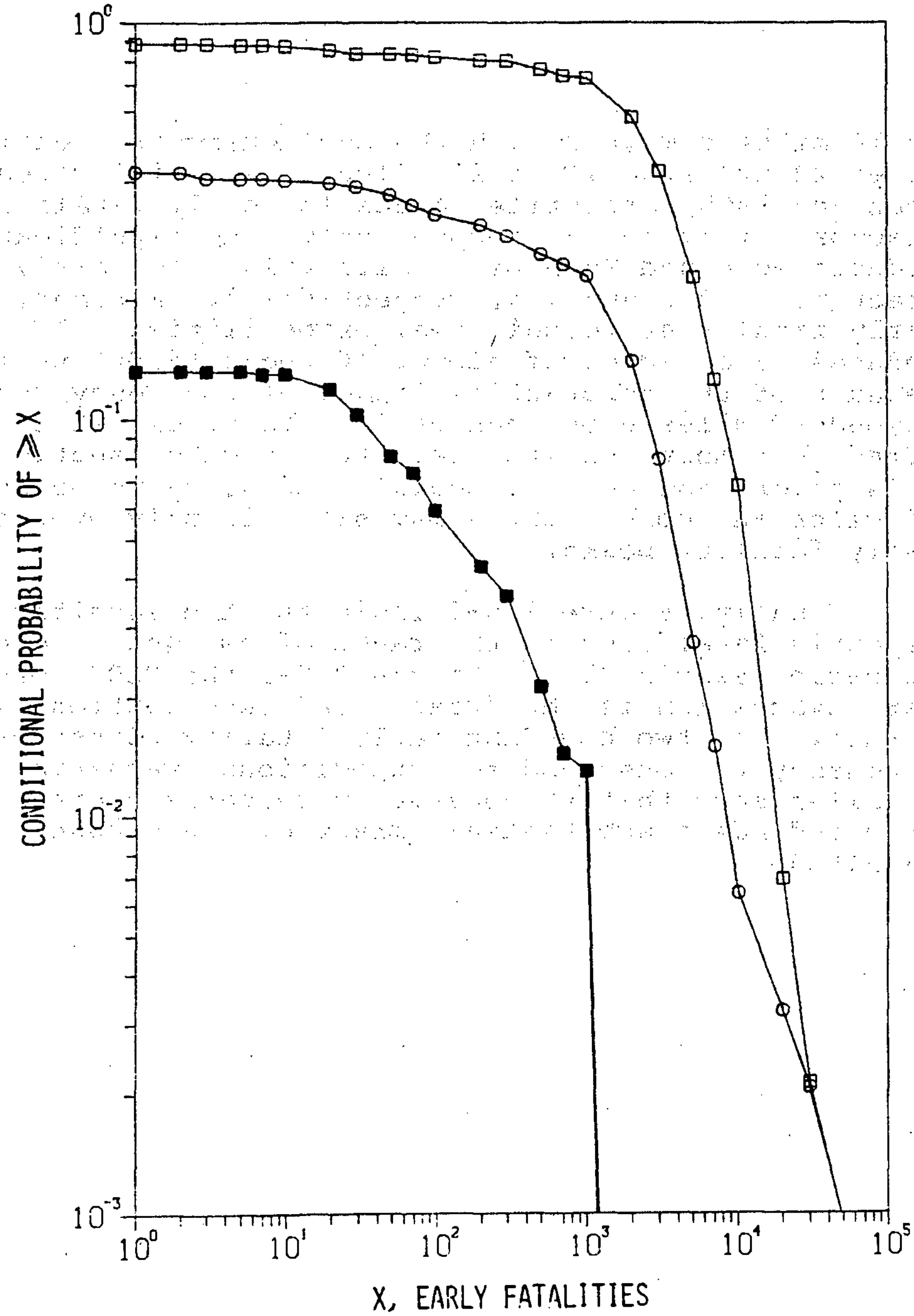

Figure 2.5-5. Impact of Range of Emergency Response Scenarios upon Early Fatalities. Results Conditional upon an SST1 Release

□ - No emegency response
○ - Summary Evacuation, within 10 mi
■ - 1 hr delay, 10 mph, within 25 mi

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City meteorology.

2.6 Distance Dependencies of Reactor Accident Consequences

This section considers distances within which selected consequences might occur, as well as distances within which Protective Action Guides (PAGs) for radiation exposure [32] might be exceeded following a severe reactor accident. The sensitivities of these distances to meteorological conditions at the time of the accident, to differences between meteorological records, to accident severity, and to emergemcy response are examined. Because of the current controversy concerning the magnitudes of source terms for severe accidents (see Section 2.3.2), the impact of source term reductions on distance estimates is also considered.

The consequences that could result from a severe reactor accident include short-term effects such as early fatalities and injuries and long-term effects such as delayed cancer deaths and interdiction of land. Because early consequences would occur only after large, acute doses of radiation, these effects would be limited to areas close to the reactor (a few tens of miles). Population restrictions within these areas could therefore significantly impact the number of early consequences. As a result, estimates of distances to which fatal or injury-causing doses of radiation could be received are of interest for the development of reactor siting criteria. Following a severe reactor accident, contamination could be sufficiently high to require interdiction of property (buildings and land) to substantial distances (several tens of miles). Because interdiction of large areas could be a significant, and possibly dominant, contributor to the offsite costs of a reactor accident, distances to which land might be interdicted could also be an important consideration for the development of siting criteria. Since latent cancers can be induced by small doses of radiation, they can occur at large distances from the reactor. As a result, latent cancers would generally be less affected by population restrictions close to a reactor than would early fatalities or early injuries.

For each sampled meteorological sequence, the CRAC2 code calculates the maximum distances at which selected consequences might occur. These distances will depend on the magnitude and characteristics of the source term as well as plume dispersion and depletion processes. By using the weather sequence sampling technique discussed in Section 2.2.1, the CRAC2 code can generate CCDFs of "maximum" consequence distances for any given source term. These curves illustrate the impact that radionuclide dispersion, which is determined by the weather conditions at the time of the accident, has on distances to which consequences occur.

Figures 2.6-1, 2.6-2, and 2.6-3 show SST1 and SST2 early fatality distance, early injury distance, and interdiction distance[a] CCDFs for the 29 meteorological records discussed in Section 2.4. The figures show that for an SST1 release early fatality distances range from 1 to 20 miles, early injury distances from 1 to 80 miles, and interdiction distances from 1 to 100 miles. Thus, for a single event, consequence distances are strongly influenced by the weather at the time of the release. However, the figures also show that for a specific release (e.g., SST1), CCDFs calculated using different meteorological records are quite similar. For example, the 90th percentile values of the 29 early fatality CCDFs calculated assuming an SST1 release range only from 6 to 9 miles.

These results also show that for the SST1 release, early fatalities would be limited to about 20 miles, injuries to about 50 miles, and land interdiction to about 100 miles. For the SST2 release, early fatalities would generally be limited to about 2 miles, injuries to about 8 miles, and land interdiction to about 10 miles. For each set of CCDFs, the variation in the peaks, and probabilities of the peaks, is principally due to a combination of (1) the order of magnitude variation in rain frequencies for the 29 meteorological records and (2) errors inherent in the weather sequence sampling procedure (see Section 2.4).

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a. Fatality and injury distances are defined to be distances within which individuals are at risk of being an early fatality or injury given the assumed release (SST1 or SST2). The interdiction distance is defined to be the distance within which land would be interdicted following the assumed release. The SST3 release is not large enough to cause early fatalities, early injuries, or interdiction of land offsite.

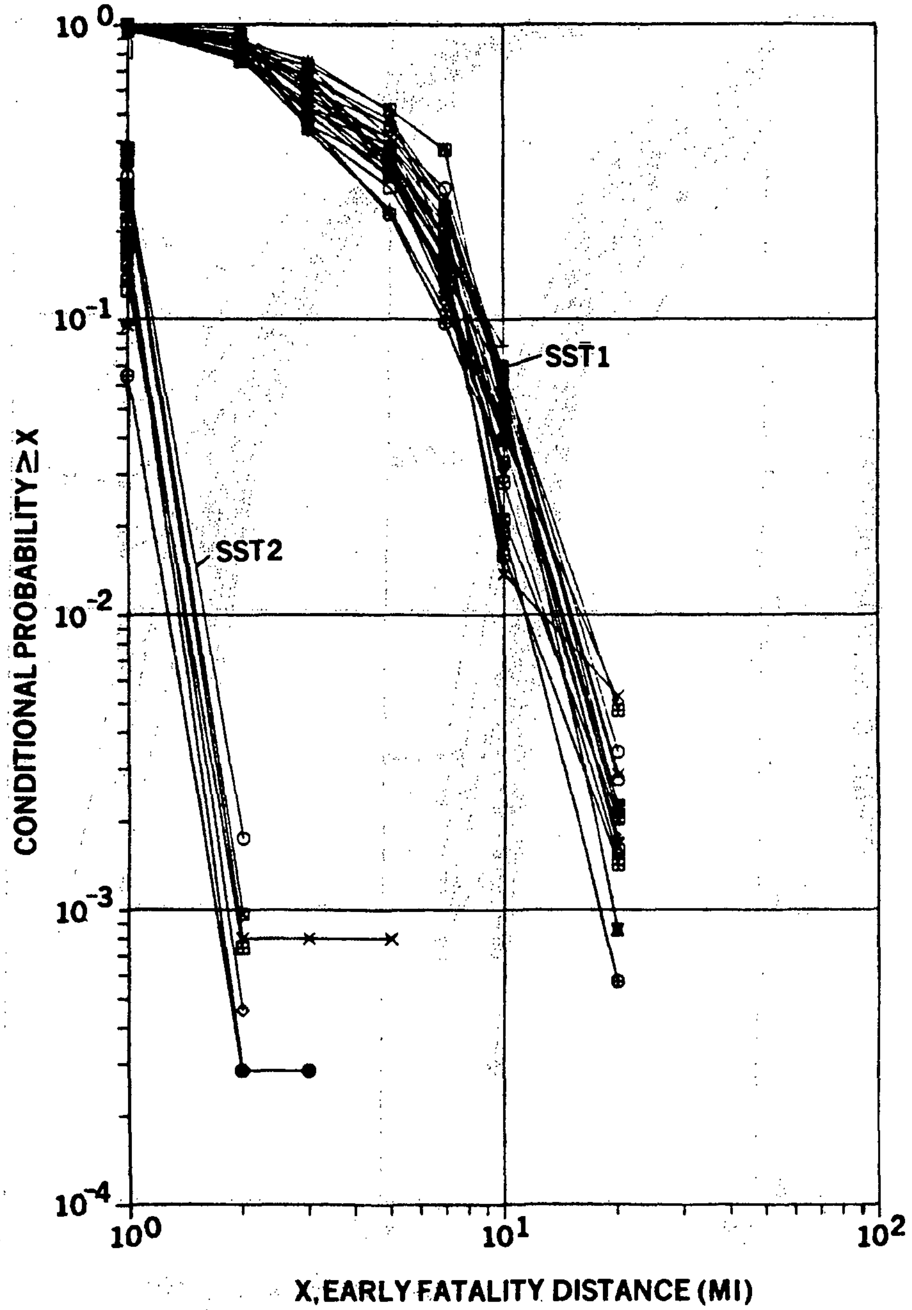

Figure 2.6-1. Conditional CCDFs of Early Fatality Distance for 29 Meteorological Records Calculated Assuming SST1 and SST2 Releases from an 1120 MWe PWR and No Emergency Response.

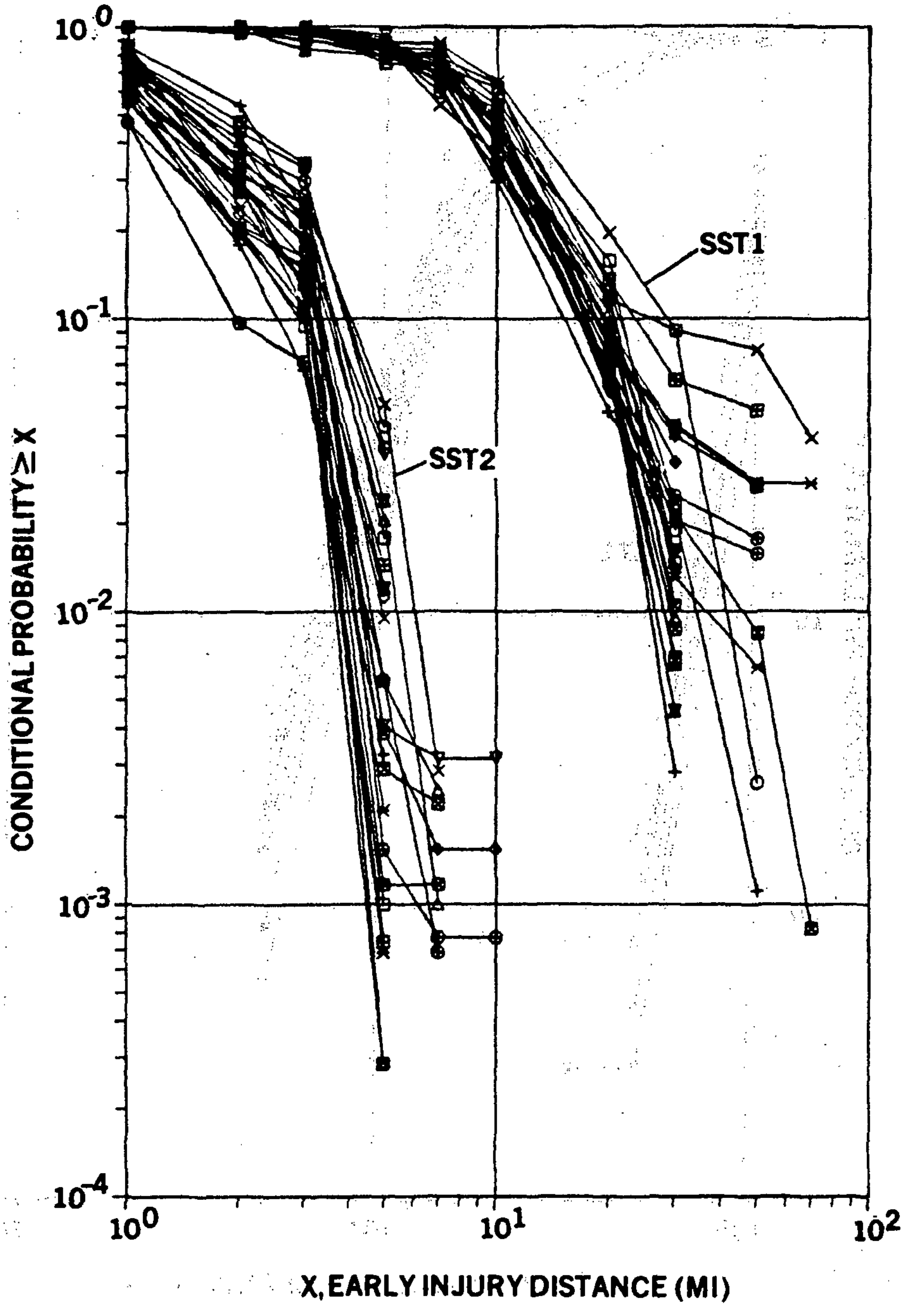

Figure 2.6-2. Conditional CCDFs of Early Injury Distance for 29 Meteorological Records Calculated Assuming SST1 and SST2 Releases from an 1120 MWe PWR and No Emergency Response.

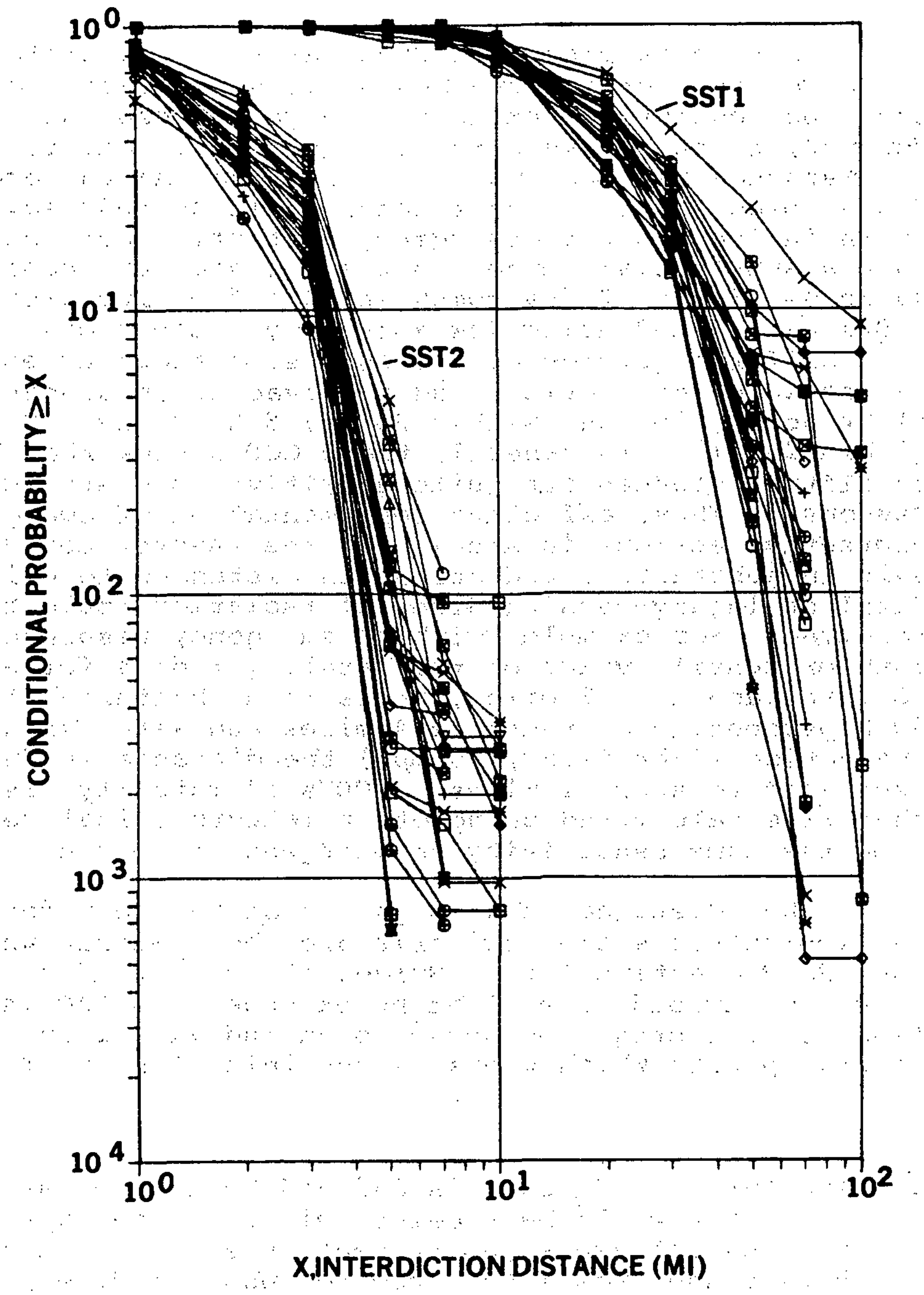

Figure 2.6-3. Conditional CCDFs of Interdiction Distance for 29 Meteorological Records Calculated Assuming SST1 and SST2 Releases from an 1120 MWe PWR.

The results presented thus far show the distances to which fatal or injury-causing doses of radiation could be received assuming no emergency response. However, given a severe reactor accident, some type of emergency response would be expected and therefore, acute doses close to the reactor could be reduced. As shown in Section 2.5, emergency protective actions can have a substantial impact on reactor accident consequences. Figure 2.6-4 compares SST1 fatality distance CCDFs calculated using New York City meteorology and four different emergency response scenarios: no emergency response, sheltering, and two evacuation scenarios (1 hr delay, 10 mph, within 25 mi; 5 hr delay, 10 mph, within 25 mi). In general, these CCDFs show that early fatality distances are quite sensitive to emergency response. Thus, effective implementation of emergency protective actions in areas near the reactor could result in substantial reductions in distances to which fatal or injury-causing doses of radiation could be received. For example, with no emergency response the 90th precentile value of the fatality radius for an SST1 release is $\gtrsim 8$ miles, while with sheltering the 90th percentile distance is 4 miles and with expeditious evacuation (1 hr delay, 10 mph) the distance is further decreased to about 2 miles. CCDFs of fatality distance that were calculated using other meteorological records show the same sensitivity to emergency response.

Other distances that might be of interest for the development of siting criteria are those within which the EPA Protective Action Guides (PAGs) [32] for whole body and thyroid dose might be exceeded. A PAG is defined as the projected dose[a] to an individual in the general public which warrants the initation of emergency

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a. The "projected dose" is defined by the EPA as the dose that would be received within a few days following the release if no protective actions are taken. PAGs range from 1 to 5 rem for whole body exposure and from 5 to 25 rem for projected dose to the thyroid. The lower value of these ranges should be used if there are no major local constraints limiting the ability to provide protection at that level. However, when determining the need for protective action, in no case should the higher value be exceeded.

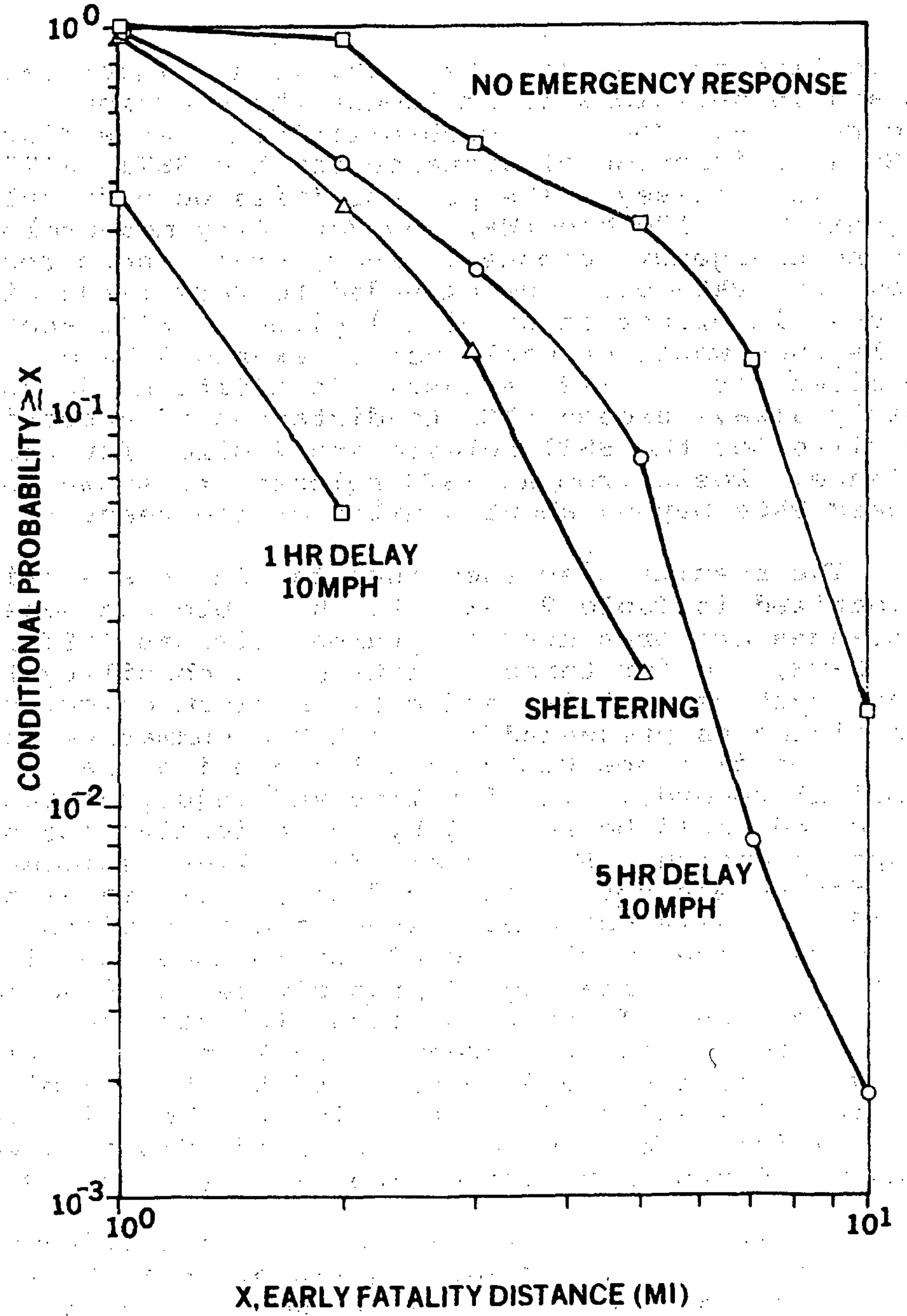
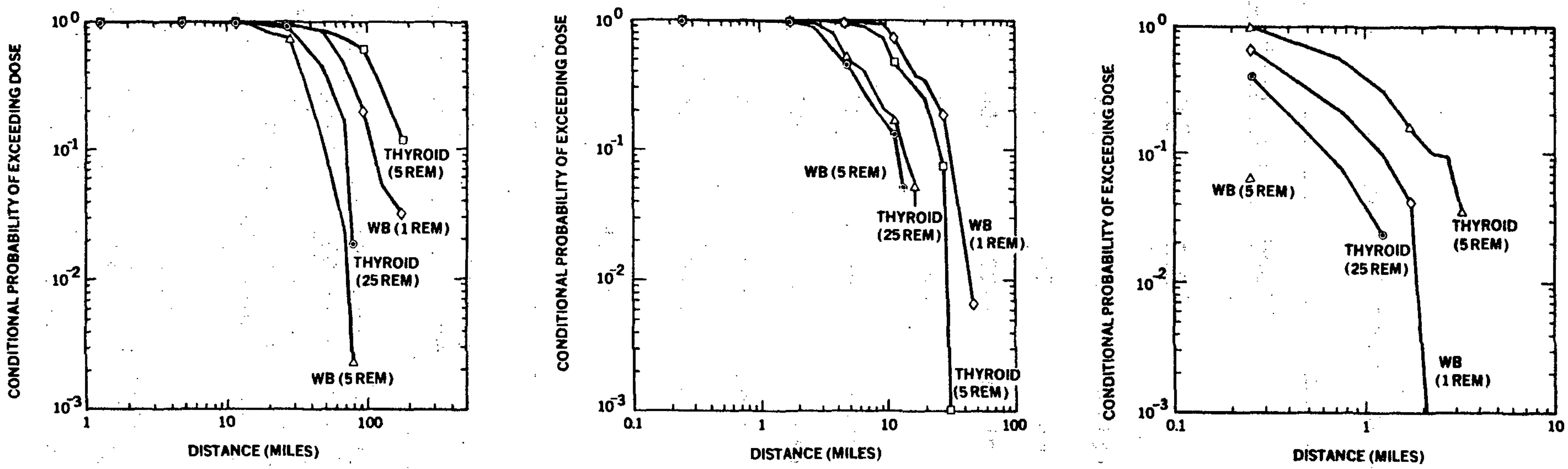


Figure 2.6-4. Sensitivity of SST1 Early Fatality Distances to Emergency Response. Assumptions: New York City meteorology, 1120 MWe PWR, and 25 Mile Response Radius.

protective actions and, as such, is a trigger value to aid in decisions to implement these actions. Figure 2.6-5 shows the probabilities of exceeding the PAGs as a function of distance for the SST1, SST2, and SST3 releases. The probabilities were calculated assuming an 1120 MWe PWR, New York City meteorology, and no emergency response. In general, these results show that PAGs could be exceeded to very large distances (in excess of 50 miles) given an SST1 accident while they would probably not be exceeded beyond about 30 miles for an SST2 release. In addition, doses would nearly always exceed PAGs to distances of approximately 30 miles for the SST1 release and 2 miles for the SST2 release. Doses from an SST3 release are shown not to exceed PAGs beyond about 3 miles of the reactor.

The results discussed thus far in this section are summarized in Table 2.6-1. In the table consequence distances are presented for three releases (SST1, SST2, and SST3) and for three conditional probability levels: mean, 99th percentile, and peak (maximum calculated). The distances presented in the table summarize the large number of distance CCDFs calculated using the 29 meteorological records. The fatality and injury distances presented could be reduced by any effective emergency response action. In general, Table 2.6-1 suggests that: (1) for severe core melt accidents, early fatalities would generally not occur beyond about 15 miles, and in the worst case, would be confined to about 25 miles, while early injuries would probably be confined to downwind distances of about 50 miles; (2) for smaller core melt accidents (on the order of SST2 in severity), early fatalities would be confined to about 2 miles, and injuries and land interdiction to about 7 miles; and (3) for accidents on the order of SST3 in severity, PAGs would probably not be exceeded beyond a few miles.

As discussed earlier, latent somatic effects could result from relatively small doses of radiation. Therefore, given a reactor accident, these consequences could occur at large downwind distances from the reactor. Figure 2.6-6 shows the cumulative fraction of latent cancer fatalities versus distance for the SST1, SST2, and SST3 releases. These curves were calculated assuming an 1120 MWe PWR, New York City meteorology, and a one mile per hour evacuation to ten miles after a five hour delay. In general, the results show that significant fractions of latent health effects could occur at large distances from the reactor. For the uniform



a) SST1 b) SST2 c) SST3

Figure 2.6-5. Conditional Probability of Exceeding PAGs Versus Distance for SST1, SST2, and SST3 Source Terms. Assumptions: 1120 MWe PWR, New York City meteorology, and no emergency response.

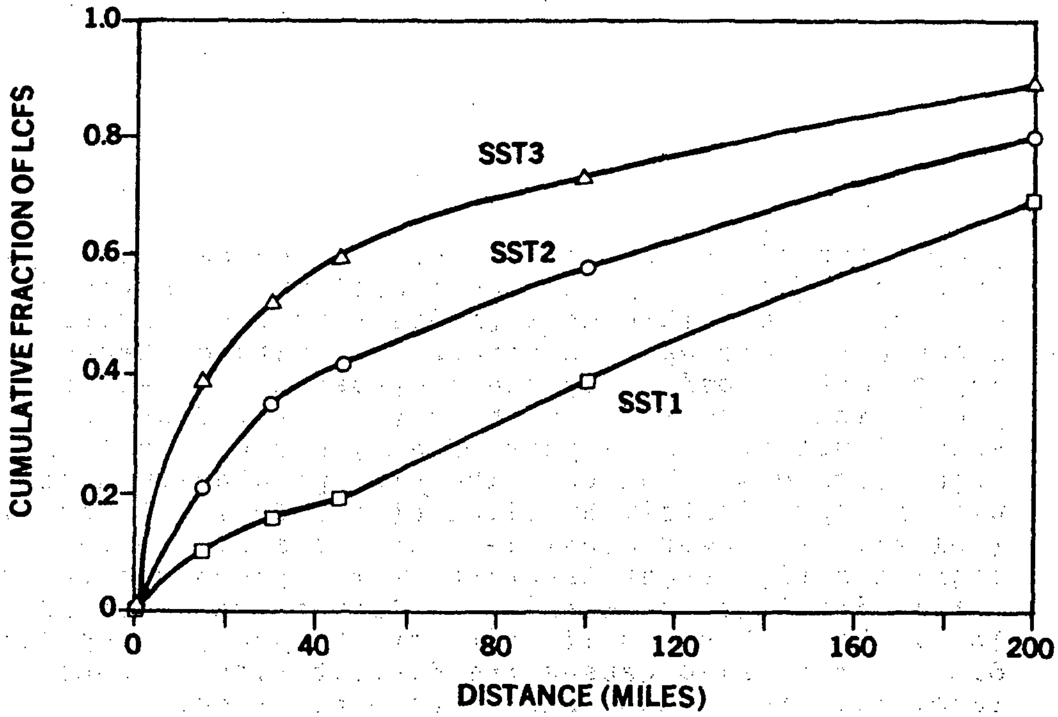
Table 2.6-1. Summary of Consequence Distances[a] (miles)

Source Term	Consequence	Conditional Probability Level[b]		
		Mean	99%	Calc Max
SST1	Early Fatalities	<5	≤15	<25
	Early Injuries	~10	~30	≳50
	Land Interdiction	~20	>50	>50
	PAGs[c]	≳50	>50	>50
SST2	Early Fatalities	~0.5	<2	≲2
	Early Injuries	<2	<5	~5
	Land Interdiction	<2	~7	~10
	PAGs[c]	≲20	~20	<50
SST3	PAGs[c]	≲0.5	<2	<3

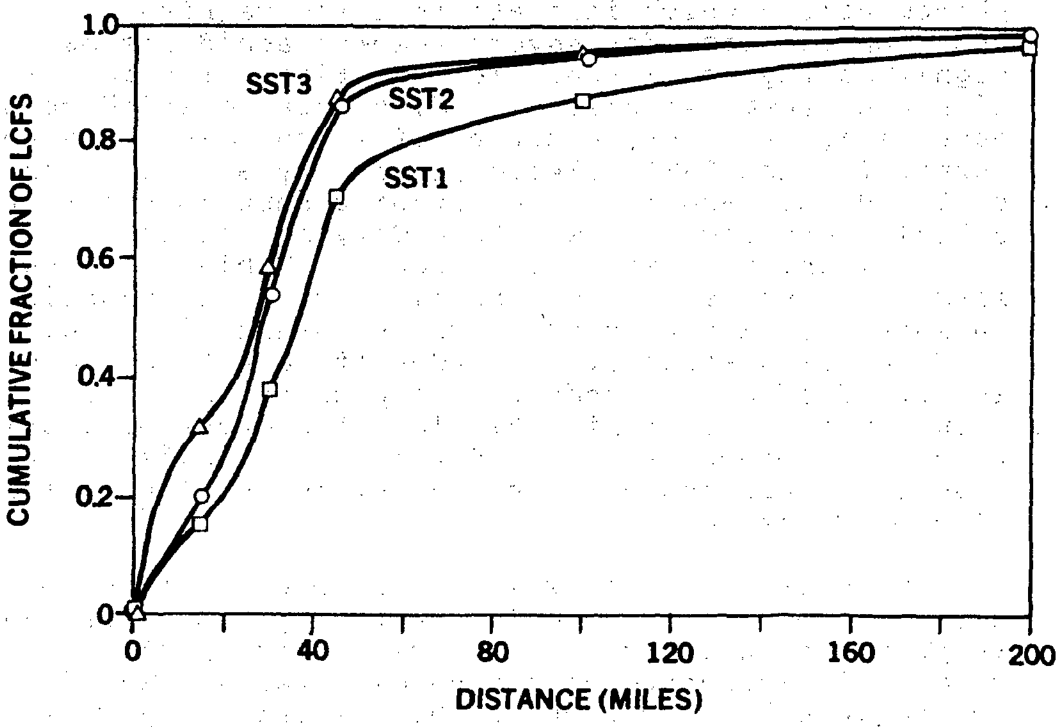
a. These distances are for a 1120 MWe PWR which is comparable in size to many of the most recently sited nuclear reactors.

b. Mean distances are the average of the probability distributions of distance; 99% distances refer to those beyond which a consequence or dose is calculated to occur in 1 in 100 accidents; and the calculated maxima represent the largest distances calculated.

c. A PAG is defined as the "projected" dose to an individual in the general public which warrants the initiation of emergency protective actions. PAGs range from 1 to 5 rem for whole body exposure and from 5 to 25 rem for projected dose to the thyroid.



a) Uniform Population Distribution



b) Indian Point Population Distribution

Figure 2.6-6. Cumulative Fraction of Latent Cancer Fatalities as a Function of Distance from the Reactor a) for a Uniform Population Distribution and b) for the Indian Point Population Distribution.

Assumptions: 1120 MWe PWR, New York City meteorology, and a slow evacuation (5 hr delay, 1 mph, 10 mi response distance).

population distribution, the calculated cancer fatalities are shown to be somewhat uniformly distributed with distance. This uniform distribution results because the decrease in cancer risk with distance is approximately offset by the increase in the exposed population. The results shown for the Indian Point site illustrate the impact of a highly non-uniform population distribution. The high population densities within approximately 50 miles of the Indian Point site (relative to lower densities further away) cause a significantly larger fraction of the predicted cancer fatalities to occur within 50 miles of the reactor. Thus, the high non-uniformity of the exposed population distribution also causes the distribution of cancer fatalities to be non-uniform with distance.

Section 2.3.2 discussed recent reviews of accident phenomenology which indicate that the magnitudes of current source terms for severe reactor accidents may be significantly too large. To investigate the impact of source term reductions on distances to which consequences might occur, a series of calculations was performed for the SST1 release reduced by arbitrary factors of 2, 10, 20, and 100. Important assumptions for the calculations included New York City meteorology, an 1120 MWe PWR, and no emergency response. Table 2.6-2 summarizes the results and in general shows that reductions in severe accident source terms substantially reduce consequence distances. An order of magnitude reduction in the SST1 release reduced the peak fatal distance from about 20 miles to 5 miles while a two-order of magnitude reduction reduced the peak distance to 1 mile. Similar reductions are shown for early injury and land interdiction distances.

This section has examined the impact of meteorological conditions, accident severity, and emergency response on consequence distances. Four factors, that also could influence consequence distances, are discussed in other sections of this report. They are reactor size (i.e., size of radionuclide inventory, see Section 2.7.1), plume heat content (determines plume rise, see Section 2.7.2), dry deposition velocity (see Section 2.7.3) and interdiction criteria (see Section 2.7.5).

Table 2.6-2. Sensitivity of Fatal, Injury, and Interdiction Distances to Release Magnitude[a]

Source Term	Fatal Distance (mi)			Injury Distance (mi)			Interdiction Distance (mi)		
	Mean	99%[b]	Peak[b]	Mean	99%[b]	Peak[b]	Mean	99%[b]	Peak[b]
SST1	3.9	12	18	11	35	50	19	55	85
1/2 SST1[c]	2.5	10	18	7.0	20	25	14	45	50
1/10 SST1[c]	0.9	2.2	5.0	2.8	10	18	5.5	18	25
1/20 SST1[c]	0.5	2.0	2.0	1.9	7.0	10	3.6	12	18
1/100 SST1[c]	0	1.0	1.0	0.9	4.0	5.0	1.1	10	10

a. Assumptions: New York City meteorology, 1120 MWe PWR, and no emergency response.

b. The 99 percent distances refer are the distances beyond which a consequence is calculated to occur in only 1 in 100 accidents. The peak result is that obtained for the most unfavorable weather sequence sampled.

c. Release fractions reduced for all isotopes except noble gases.

2.7 Other Sensitivity Calculations

2.7.1 Reactor Size

All of the calculations presented in previous sections of this report assume an 1120 MWe reactor. This reactor size was selected because many reactors currently operating and most under construction are about this size. Because consequences depend strongly on the amount of radioactivity released (see Section 2.3, Accident Source Terms), which in turn is dependent on reactor size, the sensitivity of consequences to reactor size was examined. Calculations were performed for nine reactor sizes ranging from 11.2 to 1500 MWe. All calculations assumed a 1120 MWe core radionuclide inventory scaled according to reactor size, an SST1 release, New York City meteorology, and the Indian Point population distribution and wind rose. The linear scaling procedure used is described in Appendix B, Core Radionuclide Inventories, which also discusses inventory changes due to annual operating cycle and differences between PWR and BWR inventories.

Figures 2.7.1-1 and 2.7.1-2 present conditional CCDFs of early fatalities, early injuries, latent cancer fatalities, interdiction distance, and interdicted land area for five of the nine reactor sizes examined, assuming Summary Evacuation. Table 2.7.1-1 presents the mean and 99th percentile values of these distributions. The effects of emergency response and reactor size on mean early fatalities are presented in Table 2.7.1-2. Finally, Figure 2.7.1-3 presents plots of the mean values presented in each table versus reactor size.

Several conclusions can be drawn from these results. First, Figure 2.7.1-3 shows that mean values of all five consequences increase <u>roughly</u> linearly with reactor size. The rates of increase are largest for early fatalities and smallest for interdiction distance. Table 2.7.1-1 shows that mean values increase more rapidly than 99th percentile values. The mean early fatality results presented in Table 2.7.1-2 clearly display the significant impact of emergency response, seen previously (see Section 2.5). For an 1120 MWe reactor, No Evacuation yields a mean result of almost 3600 early fatalities, while Best Evacuation (1 hr delay, 10 mph, 10 mi response region) decreases this number to less than 300. Figure 2.7.1-3a shows that for an emergency response of a given effectiveness, there is a reactor size (x-axis

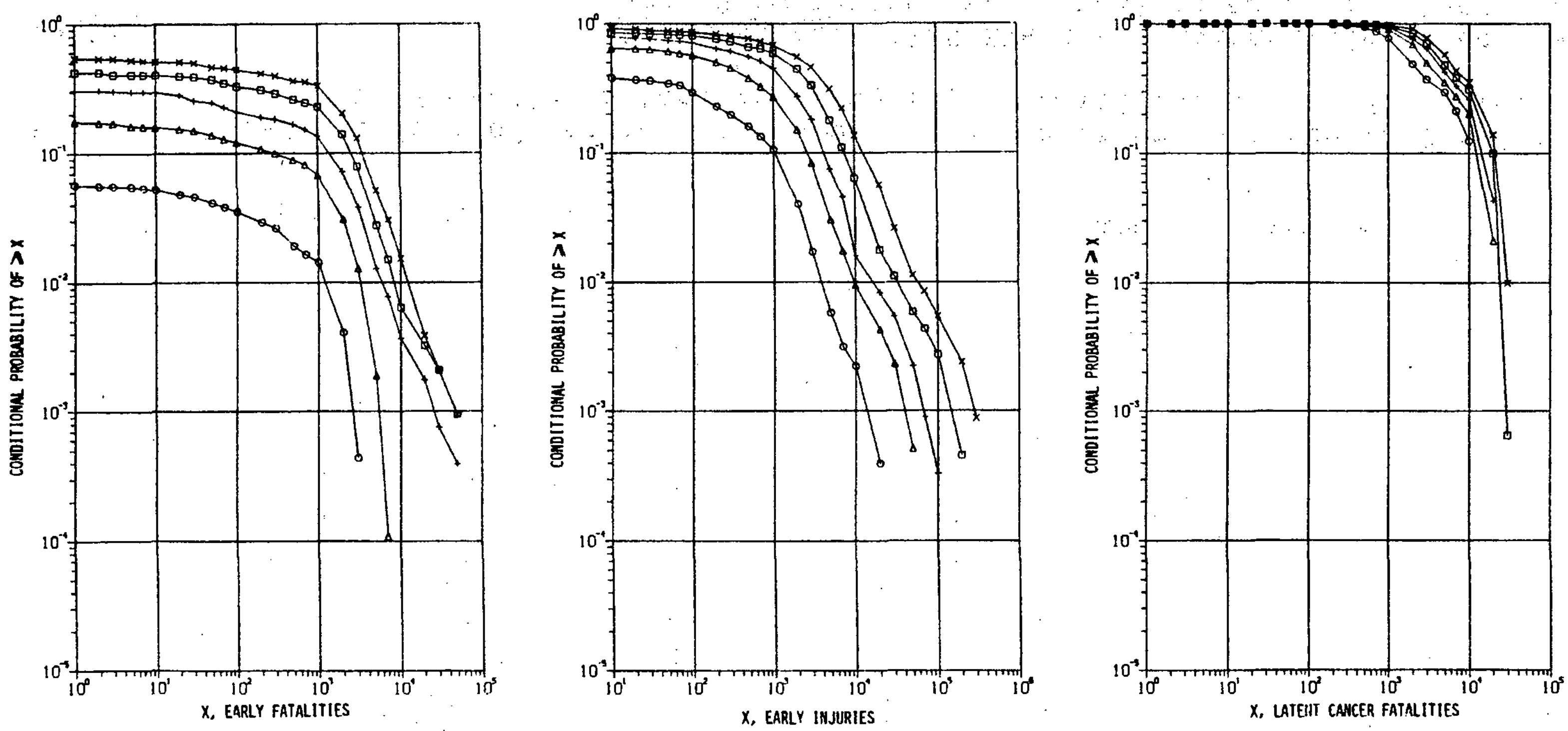


Figure 2.7.1-1. Effect of Reactor Size upon a) Early Fatalities, b) Early Injuries, and c) Latent Cancer Fatalities, Conditional on an SST1 Release.

Legend

- × - 1500 MWe reactor
- □ - 1120 MWe reactor
- \+ - 750 MWe reactor
- △ - 500 MWe reactor
- ○ - 250 Mwe reactor

Assumptions: 1120 MWe core radionuclide inventory scaled to reactor size, SST1 release, New York City Meteorology, Indian Point wind rose and population, Summary Evacuation.

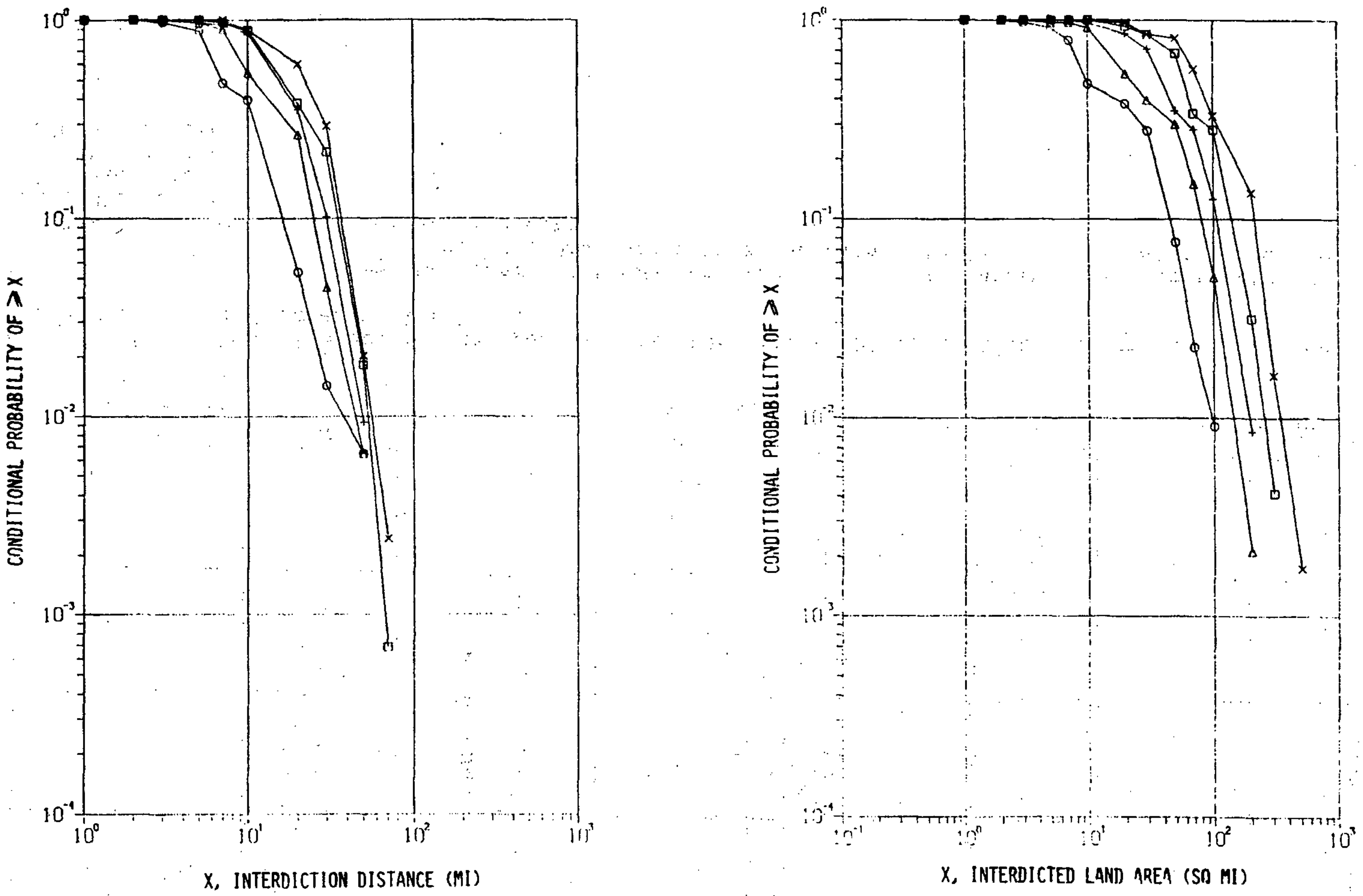


Figure 2.7.1-2. Effect of Reactor size upon a) Interdiction Distance (mi) and b) Interdicted Land Area (sq mi), Conditional on an SST1 Release.

<u>Legend</u>

× - 1500 MWe reactor
□ - 1120 Mwe reactor
+ - 750 MWe reactor
△ - 500 MWe reactor
○ - 250 Mwe reactor

<u>Assumptions</u>: 1120 MWe core radionuclide inventory scaled to reactor size, SST1 release, New York City meteorology, Indian Point wind rose and population, Summary Evacuation.

Table 2.7.1-1. Dependence of Consequences Upon Reactor Size, Conditional on an SST1 Release[a]

Reactor Size (MWe)	Early Fatalities		Early Injuries		Latent Cancer Fatalities		Interdiction Distance (mi)		Interdicted Land Area (sq mi)	
	Mean	99th	Mean	99th	Mean	99th	Mean	99th	Mean	99th
250	34	1,200	323	3,800	3970	10,000	9.7	38	20.8	97
500	172	3,200	1020	9,700	5560	20,000	13.1	45	37.2	120
750	455	5,900	1880	16,000	6710	20,000	16.0	49	53.7	190
1120	831	8,200	3640	33,000	8110	24,000	19.3	54	75.8	250
1500	1250	12,000	6340	57,000	9600	30,000	22.8	56	106	340

a. Assumptions: 1120 MWe core radionuclide inventory scaled according to reactor size, SST1 release, New York City meteorology, Indian Point population and wind rose, Summary Evacuation.

Table 2.7.1-2 Dependence of Mean Early Fatalities Upon Reactor Size and Evacuation Scenario, Conditional on an SST1 Release[a]

Reactor Size (MWe)	Evacuation Scenario		
	Best Evacuation[b]	Summary Evacuation	No Evacuation
11.2[c]	0	0.3	1
56[c]	0	2	34
112[c]	0	9	147
250	0.01	34	551
500	6	172	1490
560[c]	17	224	1700
750	102	455	2380
1120	176	831	3580
1500	287	1250	4880

a. 1120 MWe core raduinuclide inventory scaled according to reactor size, SST1 release, New York City meteorology, Indian Point population and wind rose.

b. 1 hour delay, 10 mph, 10 mi response region (see Section 2.5).

c. Noble gas release fractions not scaled; this has no significant impact on early fatalities (see Section 2.3, Accident Source Terms).

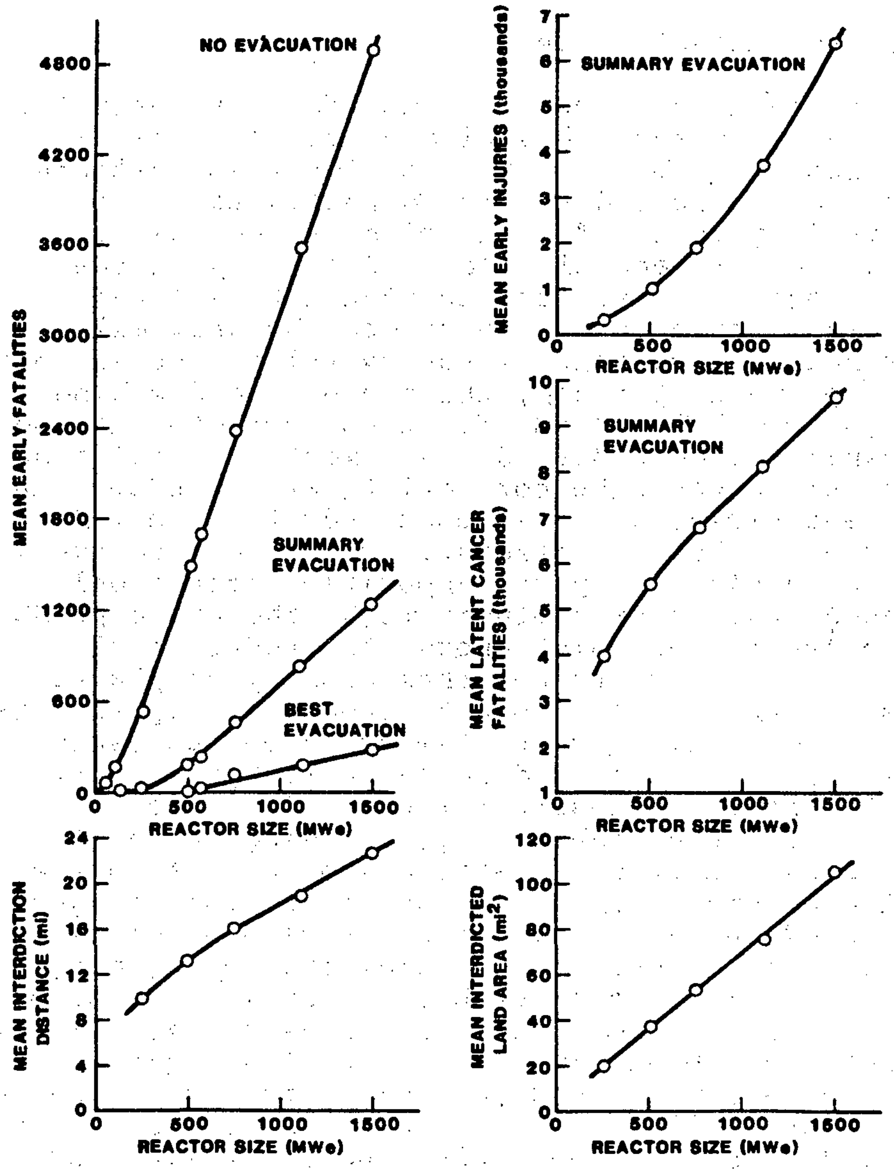


Figure 2.7.1-3. Plots of Mean Values of a) Early Fatalities, b) Early injuries, c) Latent Cancer Fatalities, d) Interdiction Distance (mi), and e) Interdicted Land Area (sq mi) vs Reactor Size, Conditional on an SST1 Release.

Assumptions: 1120 Mwe core radionuclide inventory scaled to reactor size, SST1 release, New York City meteorology, Indian Point population and wind rose.

intercept) for which on the average (mean result) few early fatalities would be expected. For Best Evacuation that size is ~500 MWe; for Summary Evacuation, ~100 MWe; and for no evacuation, ~10 MWe.

2.7.2 Energy Release Rate

The calculations considered so far have been for ground-level releases containing no sensible heat, i.e., nonbuoyant plumes. In an accident where there is a large uncontrolled release directly to the atmosphere, it is possible for the plume to contain a sizable amount of sensible heat. For example, the release categories described in WASH-1400 [1] had energy release rates of up to several hundred million BTUs per hour.[a] The rate of energy release determines the final plume height and, therefore, the downwind distance at which the plume first contacts the ground (touchdown). Since under the same weather conditions a buoyant plume would be more dilute at touchdown than a nonbuoyant plume, a significant reduction in the number of early health effects is possible. However, since plume depletion by dry deposition occurs only after touchdown, buoyant plumes might therefore produce ground concentrations high enough to produce early effects at greater distances than nonbuoyant plumes. Furthermore, for highly buoyant plumes, precipitation-washout is the primary mechanism by which radioactive material reaches the ground in sufficient concentrations to cause early health effects. Thus, for a buoyant release the probability of having any early fatalities and injuries is strongly dependent on the occurrence of precipitation. The final plume height is calculated in CRAC2 using the formulae developed by Briggs [33] for emissions from smokestacks. Considerable differences could exist between smokestack plumes and plumes released in a reactor accident [34]. These differences have been investigated by Russo, Wayland, and Ritchie [35] who found that predicted consequences were only marginally sensitive to the moisture content of the plume and atmosphere but, under certain conditions, consequences could be quite sensitive to radioactive heating and initial plume momentum.

For the present study, the sensitivity of predicted consequences to energy release rate was investigated

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a. In WASH-1400, an energy release rate of 170×10^6 BTU/hr was assumed for a PWR-2 accident.

by performing calculations for an SST1 release with three arbitrary energy release rates: 17, 170, and 430 million BTU/hour. New York City meteorology and a uniform population density of 50 people per square mile beyond 1 mile were assumed. Table 2.7.2-1 compares selected results for these energy release rates with a cold (no sensible heat) SST1 release (the base case, see Section 2.2.4).

Table 2.7.2-1. Sensitivity of Estimated Consequences to Energy Release Rate[a]

Release	SST1	SST1	SST1	SST1
Energy Release Rate (BTU/hr)	0	17×10^6	170×10^6	430×10^6
Mean Early Fatalities				
Summary Evacuation	22	12	9	10
No Evacuation	140	140	47	47
Mean Early Injuries				
Summary Evacuation	140	180	110	85
No Evacuation	350	390	270	150
Mean Latent Cancer Fatalities	730	790	830	860
Maximum Calculated Fatal Distance (mi)	17.5	17.5	25	25
Maximum Calculated Injury Distance (mi)	50	50	50	60
Maximum Calculated Land Interdiction Distance (mi)	85	85	85	85

a. Assumptions: New York City meteorology, uniform population of 50 people per square mile beyond 1 mile.

The results for the low-energy release (17×10^6 BTU/hr) differ only slightly from those for the cold release, because this release rate is not large enough to cause substantial differences in the plume touchdown point. The two high-energy release rates result in consequences markedly different from the cold release. Because the occurrence of precipitation is necessary to cause significant numbers of early health effects for hot releases, the mean number of early effects is lower for the high-energy releases.

At very large distances, the amount of initial plume-rise does not significantly affect the transport and deposition of radioactive material. Consequently, latent cancer fatalities, which occur to great distances (see Section 2.6), are not significantly affected by plume buoyancy. The maximum observed fatal distance is 8 miles farther for the high-energy releases, although the maximum calculated injury distance is only slightly increased and interdicted land distance is unaffected. Neither land interdiction nor injury distances are very sensitive to energy release rate because these consequences also occur to distances where initial plume rise is generally not important.

Figure 2.7.2-1 plots the conditional individual risk of early fatality versus distance for the four energy release rates, assuming a uniform wind rose. Within 10 miles, the hot releases have lower risks than the cold releases. However, for low probability events (i.e., precipitation), the hot releases could result in fatalities out to 25 miles. The non-monotonicity in the risk at about 8 miles for the two hot releases (170×10^6 and 430×10^6 BTU/hr) is believed to be an artifact of the weather-sequence sampling procedure used (see Section 2.4.1).

In summary, for an SST1 release the estimated numbers of early fatalities and injuries and the distance to which early fatalities occur are both quite sensitive to the energy release rate. However, consequences which can occur to great distances, such as latent cancer fatalities, are not sensitive to energy release rate. The maximum distances, to which early injuries may occur or land may be interdicted, are also not sensitive to energy release rate. A cautionary note: these conclusions may not hold for source terms significantly smaller than SST1.

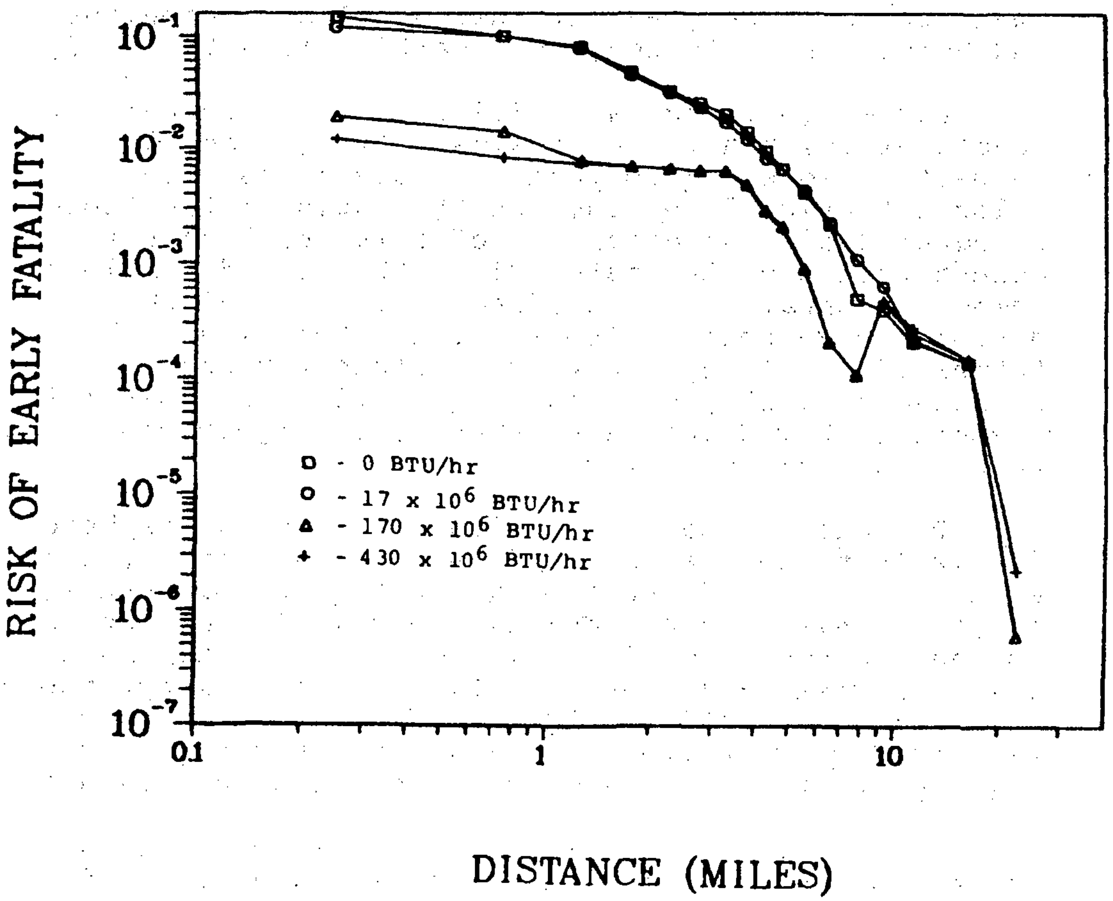

Figure 2.7.2-1. Individual Risk of Early Fatality Versus Distance for 4 Energy Release Rates, Conditional on an SST1 Release. Assumptions: SST1 release, New York City meteorology, uniform wind rose, no emergency response.

2.7.3 Dry Deposition Velocity

The deposition of radioactive material on the ground is the first step in many of the pathways by which radioactive material can reach people. Dry deposition of airborne material onto a surface is a complex process which includes a number of different phenomena such as gravitational settling, turbulent and molecular diffusion, and inertial impaction [36].

Hosker [37] and Kaul [38] have reviewed current models of dry removal processes. All current dry-deposition models incorporate a "dry-deposition velocity" which is defined as the ratio of the time-integrated air concentration of a material to the concentration of the material on the ground. A large number of parameters can affect the value of the deposition velocity. About 80 have been listed by Sehmel [39]. Among these are surface roughness, relative humidity, chemical composition, and particle diameter. Dry deposition velocity is highly sensitive to particle diameter [39].

Radioactive material released to the atmosphere is likely to have a range of particle diameters, each with a different deposition velocity. Despite this, in CRAC2 only a single deposition velocity may be input for each element considered, and generally the same value (1 cm/sec) is used for all elements except noble gases (the deposition velocity of noble gases is zero). All CRAC2 calculations presented in other sections of this report treat deposition velocity in this manner.

As discussed in Section 2.2.3, there are large uncertainties about the characteristics of the radioactive aerosol released from containment. Because predicted ground concentrations can be very sensitive to deposition velocity, a sensitivity analysis was performed to assess the impact of dry deposition velocity on predicted consequences. The analysis was somewhat simplistic in that only a single deposition velocity was used. Thus, no attempt was made to account for a range of particle sizes by use of a distribution of deposition velocities. Also neglected were effects of chemical composition and the possibility that different elements may be associated with particles of different sizes. Gravitational settling of particles, which can be treated by "tilted plume" models [40] was also ignored (gravitational settling would be the dominant contributor to dry removal for particle diameters greater than about 5 microns).

Calculations were performed for an SST1 release with five deposition velocities: 0.1, 0.3, 1.0, 3.0, and 10.0 cm/sec.[a] These values are believed to span the range of possible deposition velocities. Only non-buoyant releases were considered. For buoyant releases, early consequences are dominated by the occurrence of precipitation; therefore, the variation of consequences with dry deposition velocity could be substantially smaller for buoyant releases (see Section 2.7.2). Other assumptions included Summary Evacuation, an 1120 MWe reactor, the Indian Point population distribution and wind rose, and New York City meteorology. Different population distributions and emergency response assumptions could impact the observed variation of early consequences with deposition velocity (see Sections 2.4 and 2.5).

Figure 2.7.3-1 presents the early fatality CCDFs for the set of deposition velocities examined. Except for the low-probabililty, high-consequence events, there are only very minor differences. Mean numbers of early fatalities vary by less than a factor of 1.5. Deposition velocities of 0.1, 0.3, and 1.0 cm/sec yield the highest consequence events (over 50,000 fatalities) from weather sequences with precipitation beginning between 10 and 20 miles from the reactor. With either a 3 or 10 cm/sec deposition velocity, the particulate matter in the plume is sufficiently depleted before this distance range is reached and, thus, rain does not produce a ground concentration in this interval high enough to cause significant numbers of early fatalities.

Figure 2.7.3-2 shows the conditional individual risk of early fatality versus distance within 10 miles of the reactor. Larger values of deposition velocity result in slightly greater individual risk within 2 miles of the reactor but a much reduced risk farther out. Table 2.7.3-1 lists the means, 90th and 99th percentiles, and maxima of the CCDFs of early fatality distance, early injury distance, and interdicted land

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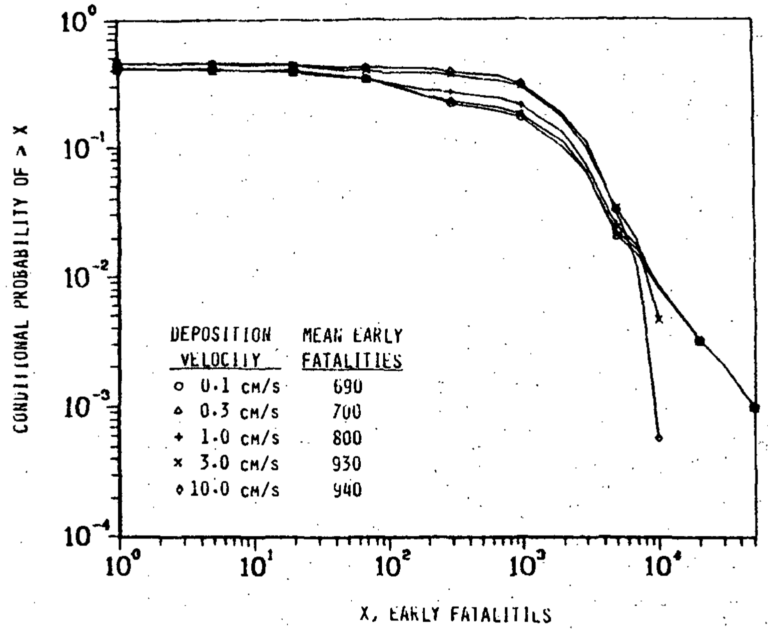
a. In all calculations a single deposition velocity was used for all elements except noble gases. The deposition velocity of the noble gases was assumed to be zero.



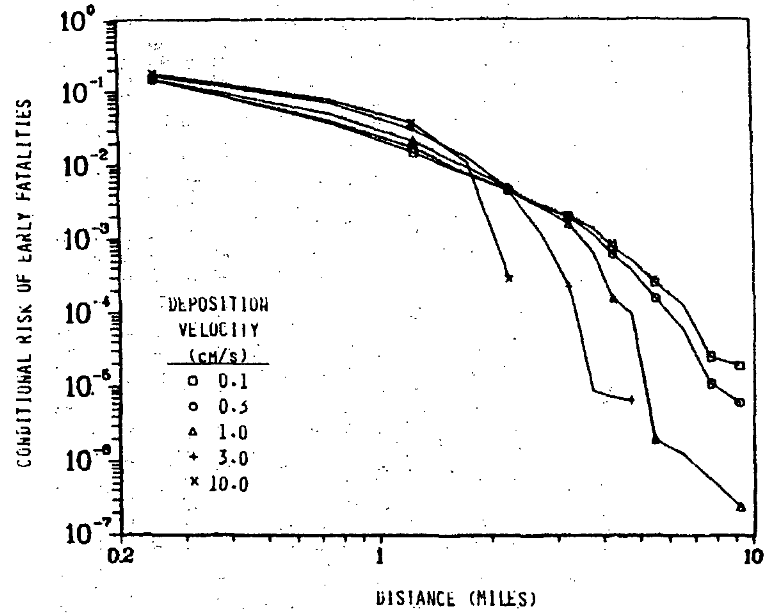


Figure 2.7.3-1. Early Fatality CCDFs for Five Different Deposition Velocities (for particulate matter only), Conditional on an SST1 Release.

Figure 2.7.3-2. Individual Risk of Early Fatality vs Distance for 5 Deposition Velocities, Conditional on an SST1 Release

Assumptions: 1120 MWe reactor, SST1 release, Indian Point wind rose and population, New York City meteorology, Summary Evacuation.

Table 2.7.3-1 Sensitivity of the Distances (miles) to which Consequences Occur for Various Deposition Velocities.

Dry-Deposition Velocity (cm/sec)	Early Fatality Distance				Early Injury Distance				Land Interdiction Distance			
	Mean	90%	99%	Maximum Calculated	Mean	90%	99%	Maximum Calculated	Mean	90%	99%	Maximum Calculated
0.1	2.1	4	15	25	7.2	15	55	65	11	30	60	100
0.3	1.9	4	15	25	7.1	20	40	50	16	40	65	85
1.0	1.7	4	12	18	8.3	25	35	50	19	40	60	85
3.0	1.6	3	4	18	6.6	12	23	25	20	25	40	45
10	1.4	3	3	3	3.5	6	15	18	13	22	23	25

Assumptions: 1120 MWe reactor, SST1 release, New York City meteorology, Summary Evacuation within 10 miles.

distance (see Section 2.6). The mean distances for each consequence are only marginally sensitive to deposition velocity. However, the tail of the distributions (99th percentile and maximum calculated) are very sensitive to deposition velocity. As the deposition velocity increases, there is a large reduction in the 99th percentile and maximum calculated distances. Again, the tails of each distribution result from sequences with precipitation beginning some distance from the reactor. Deposition velocities above about 3 cm/sec deplete the plume closer to the reactor, and thus the distance to which precipitation can produce significant ground concentrations is much reduced.

Despite the narrow scope of this sensitivity analysis (only the deposition velocity has been studied rather than trying to account for the more realistic condition of a distribution of deposition velocities), the following conclusions can be drawn:

- For a single deposition velocity applicable to all particulate matter, the maximum distance to which land is interdicted and early fatalities and injuries occur is very sensitive to deposition velocity. These maximum distances occur for low-probability, worst-case weather conditions.

- For the population distribution and emergency response scenario assumed (Summary Evacuation), the mean number of early fatalities is only moderately sensitive to deposition velocity and thus <u>may</u> be largely insensitive to the particle-size distribution of the released material.

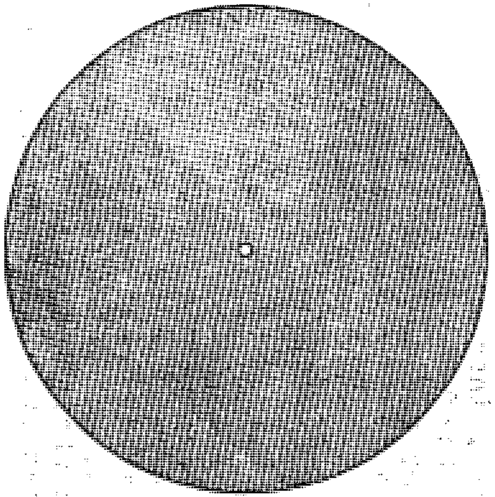
2.7.4 Population Distribution

Results presented in Section 2.4, Site Meteorology and Population, showed that early fatalities and early injuries are strongly sensitive to the characteristics of the surrounding population distribution. Three sets of calculations were performed to better define the sensitivity of early fatalities and injuries to the following features of population distributions: (1) radial and angular variations in population density, (2) the size and distance of population centers, and (3) exclusion zone size.

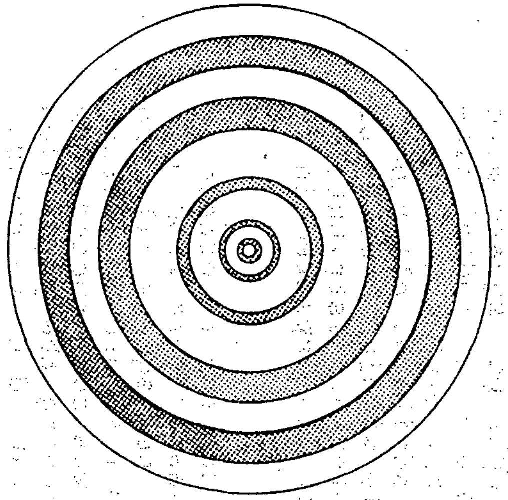
Radial and Angular Variations. Radial and angular variations in population density were examined by constructing a hypothetical reference population distribution and then calculating consequences for that distribution and eight transformations of that distribution. Beyond 20 miles all of the distributions were identical. Each had uniform populations of 750 people per square mile from 20 to 30 miles, 2500 from 30 to 50 miles, 500 from 50 to 100 miles, and 300 from 100 to 500 miles. None of the distributions had any people within 0.5 miles of the reactor (0.5 mile Exclusion Zone). All nine distributions met the following criterion: within 5, 10, 15, 20, and 30 miles of the reactor, the average population density was either zero (the distribution is empty to that radial distance) or 750 people per square mile (if there are any people within a given radial distance, then on average within that distance there are 750 people per sq mi). In addition, all nine distributions had 939,000 people within 20 miles of the reactor, but each had a different distribution of those people, as is schematically depicted in Figure 2.7.4-1.

Figure 2.7.4-1 indicates that the reference distribution (Distribution 1) was uniform from 0.5 to 20 miles. It had 530 people per square mile from 0.5 to 2 miles and 750 people per square mile from 2 to 20 miles. Distribution 2 was constructed from the reference distribution by moving the population within 20 miles forward into 5 high density rings. Distribution 3 moved the population within 20 miles entirely into a single 22.5° sector. Distributions 4 through 8 moved all of the population within 2, 5, 10, 15, or 20 miles, respectively, into a single 22.5° sector toward the back of the vacated region. Distribution 9 was constructed by scaling the actual population distribution around a New England reactor site, so that the resulting distribution had 530 people per square mile from 0.5 to 2 miles and 750 people per square mile in each of four distance intervals: 2-5, 5-10, 10-15, and 15-20 miles.

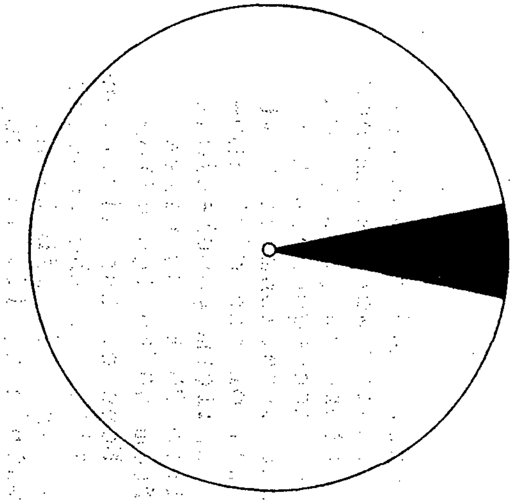
The transformations used to generate Distributions 4 through 8 in effect created population centers by vacating 15 of the 16 sectors of the reference distribution out to 2, 5, 10, 15, or 20 miles, respectively. The population centers thereby created had the following sizes and distances from the reactor:



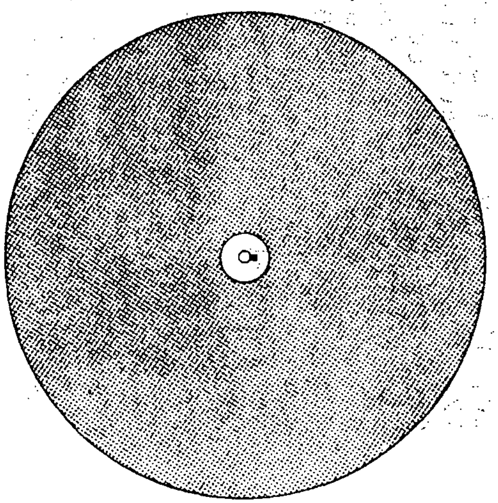
Distribution 1



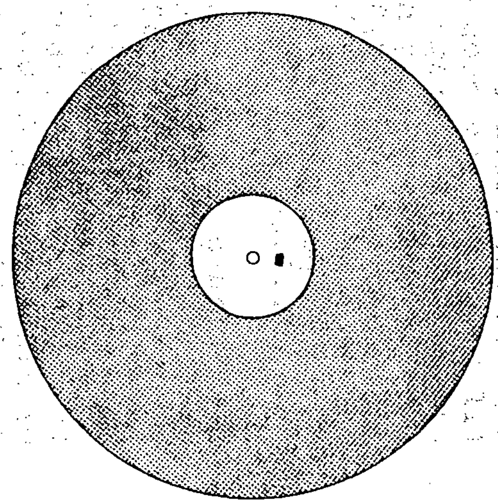
Distribution 2



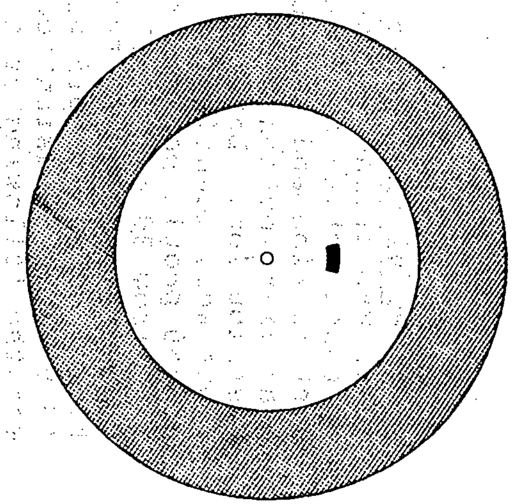
Distribution 3



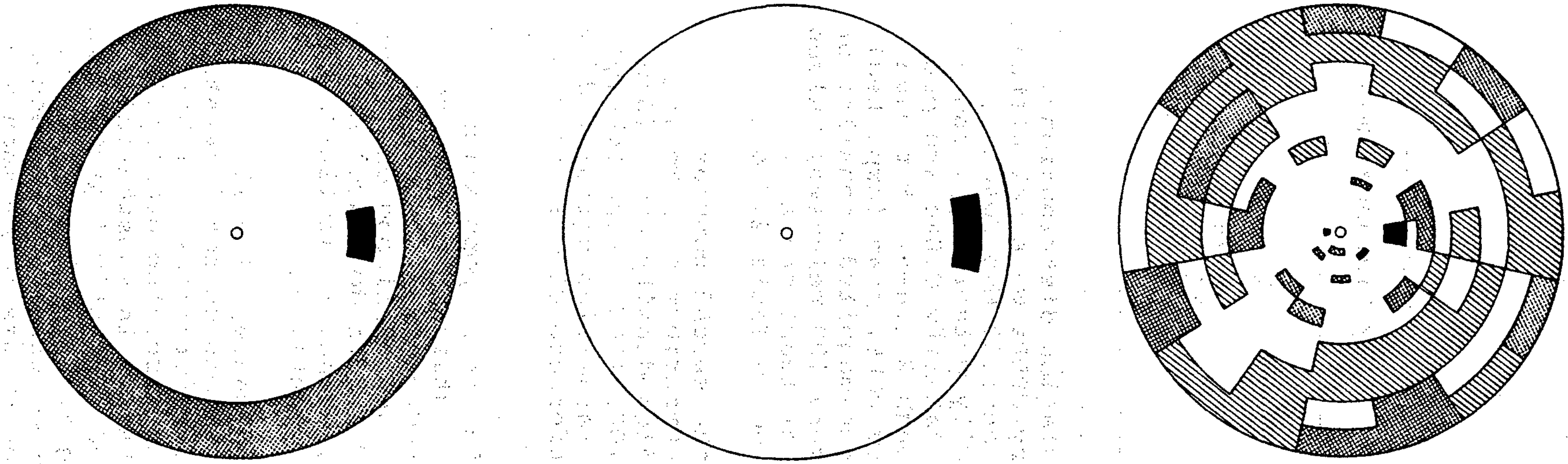
Distribution 4



Distribution 5



Distribution 6



Distribution 7 Distribution 8 Distribution 9

<u>Figure 2.7.4-1</u>. Schematic Representations of the Nine Hypothetical Population Distributions Used to Examine the Impact on Consequences of Radial and Angular Variations in Population Density.

1) Distribution 1 (Reference Distribution): uniform to 20 mi.
2) Distribution 2: 4 high density population rings.
3) Distribution 3: all population in 1 sector.
4) Distribution 4: city at 1.0 mi, uniform beyond 2 mi.
5) Distribution 5: city at 3.0 mi, uniform beyond 5 mi.
6) Distribution 6: city at 6.8 mi, uniform beyond 10 mi.
7) Distribution 7: city at 12.5 mi, uniform beyond 15 mi.
8) Distribution 8: city at 16.3 mi, uniform beyond 20 mi.
9) Distribution 9: real distribution scaled to match the densities of Distribution 1.

Distribution	City Size	City Distance (mi)
4	6,300	1
5	55,800	3
6	232,000	6.75
7	527,000	12.5
8	940,000	16.25

For each of the nine population distributions, early fatality and early injury CCDFs were calculated assuming an SST1 release from an 1120 MWe reactor, Summary Evacuation, New York City meteorology, and a uniform wind rose. The early fatality CCDFs are presented in Figures 2.7.4-2 through 2.7.4-5. For each early fatality and early injury CCDF, mean (expected) and 99th percentile (consequence magnitude equalled or exceeded following 1 out of every 100 releases) values and the probability of having at least one early fatality or injury are presented in Table 2.7.4-1.

Figure 2.7.4-2 compares the second population distribution to the Reference Distribution. Moving population forward into five high-density rings (densities of 2700, 7000, 5100, 1700, 1600, respectively) increases the number of early fatalities calculated at each probability level (the reference CCDF is shifted toward higher consequences).

Figure 2.7.4-3 compares the third population distribution to the Reference Distribution. Moving all of the population into 1 sector (vacating 15 sectors out to 20 miles) reduces the likelihood of having any early fatalities (the CCDF shifts downward) but increases the number observed, whenever fatalities do occur (the CCDF shifts to the right).

The CCDF shifts downward because, with 15 sectors vacant to 20 miles, many plumes do not intersect any population before plume concentrations fall below fatality dose thresholds. Therefore, the probability of having at least 1 early fatality is substantially decreased. If plumes were always exactly 1 sector wide, then the probability of having at least 1 early fatality would decrease by a factor of exactly 16. Because plume meander frequently causes plumes to be much wider

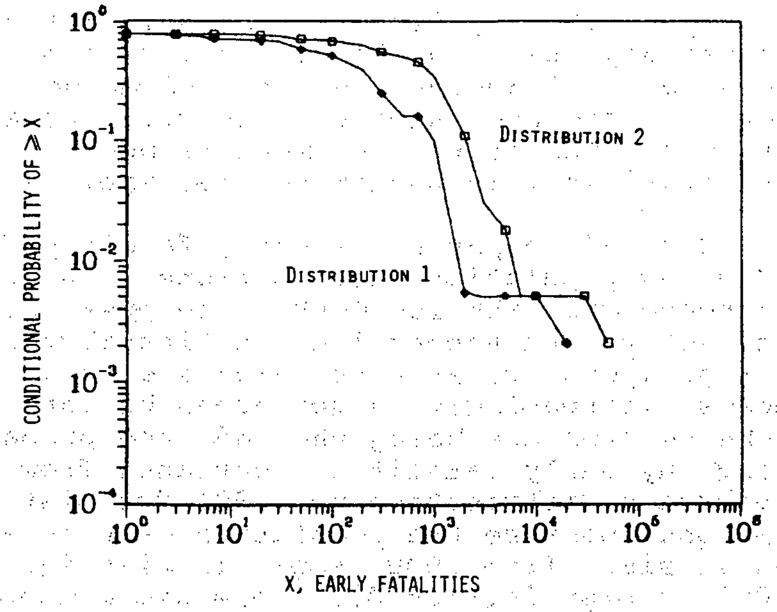


Figure 2.7.4-2. Comparison of the Early Fatality CCDF for Population Distribution 2 (4 high density rings) to that of the Reference Distribution.[a]

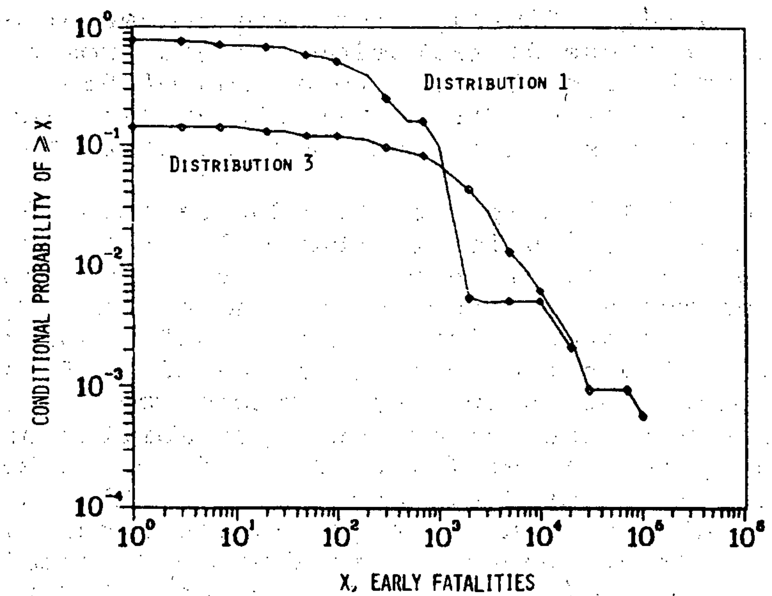


Figure 2.7.4-3. Comparison of the Early Fatality CCDF for Population Distribution 3 (all population in 1 sector) to that of the Reference Distribution.[a]

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a. Assumptions: 1120 MWe reactor, SST1 release, New York City meteorology, uniform wind rose, Summary Evacuation.

than 1 sector, the probability of observing at least 1 early fatality actually decreases by only a factor of ~6. Conversely, because all of the people out to 20 miles are now in 1 sector, when the plume goes out that sector, consequence magnitudes increase by about the same factor. Therefore, the mean (expected) result (400 early fatalities) is unchanged (see Table 2.7.4-1).

Figure 2.7.4-4 compares the early fatality CCDFs calculated using population distributions 4 through 8 to the Reference Distribution CCDF. The presence of population centers and vacant land in Distributions 4 through 8 produces two effects which are related. First, because increasingly larger areas of land surrounding the reactor are being vacated, the probability of observing any early fatalities decreases from 0.8 for the Reference Distribution to 0.001 for Distribution 8. Second, because the population centers are increasing in size (from 6000 people in Distribution 4 to 1,000,000 in Distribution 8), the maximum number of early fatalities (conditional probabilities of $\lesssim 10^{-3}$, caused by adverse weather) also increases from 2.5 x 10^4 early fatalities for the Reference Distribution (which contains no population center) to 4.0 x 10^5 for Distribution 8 (which contains a population center of almost 1 million people). Finally, the mean number of early fatalities for these distributions ranges from a low of 110 for Distributions 6 and 8 to a high of 560 for Distribution 4, while 99th percentile values range from 0 for Distributions 7 and 8 to 8500 for Distribution 5.

Figure 2.7.4-5 compares the CCDF calculated using the Reference Distribution to that calculated using Distribution 9. Figure 2.7.4-5 shows that incorporation into the Reference Distribution of radial and angular irregularities characteristic of a "real" population distribution alters the early fatality CCDF of the Reference Distribution in a predictable way. Because Distribution 9 is not uniform, the probability of having any early fatalities falls to 0.2 from the Reference Distribution value of 0.8, mean early fatalities decrease to 260 from 400, but the 99th percentile result increases from 1200 to 2800. Because Distribution 9 contains population centers (17,700 at 2.75 miles; 62,800 at 5.5 miles; 150,000 at 19 miles), the largest calculated number of early fatalities increased to 6.5 x 10^4 from the Reference Distribution value of 2.5 x 10^4.

Examination of Table 2.7.4-1 and Figures 2.7.4-2 through 2.7.4-4 shows that the chance of having any early fatalities or early injuries, and the numbers that

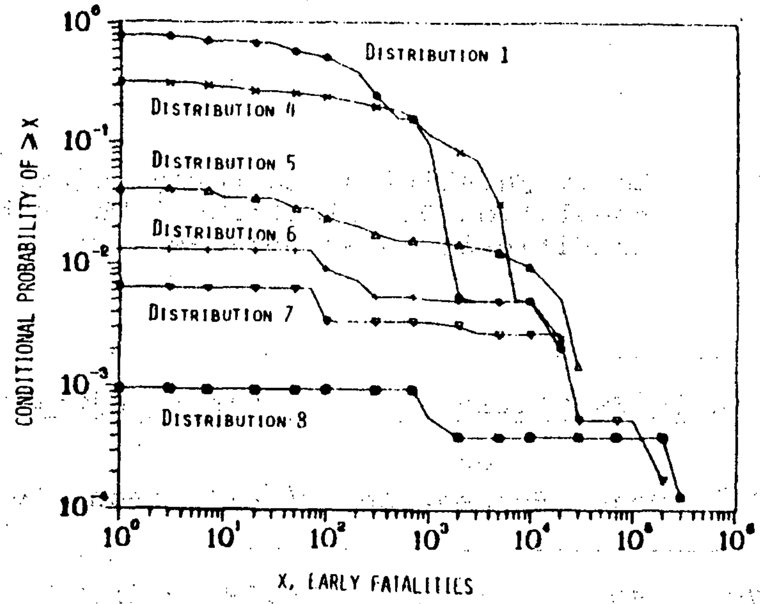

Figure 2.7.4-4. Comparison of the Early Fatality CCDFs for Distributions 4 thru 8 (distributions that contain cities) to that of the Reference Distribution.[a]

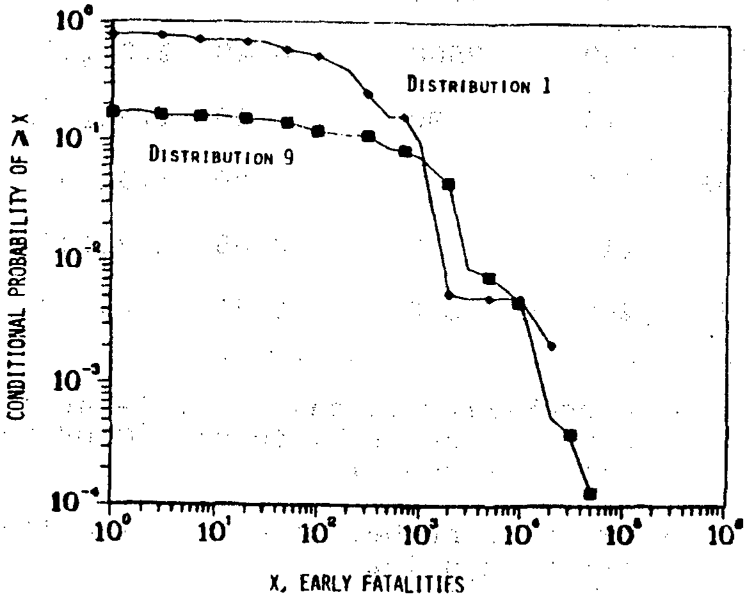

Figure 2.7.4-5. Comparison of the Early Fatality CCDF of Distribution 9 (scaled real population distribution) to that of the Reference Distribution.[a]

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a. Assumptions: 1120 MWe reactor, SST1 release, New York City meteorology, uniform wind rose, Summary Evacuation.

Table 2.7.4-1. Early Fatalities and Early Injuries for Population Distributions 1 Through 9, Conditional on an SST1 Release

	Early Fatalities			Early Injuries		
Distribution	P(≥1)	Mean	99th Percentile	P(≥1)	Mean	99th Percentile
1	0.79	400	1200	0.99	2.2×10^3	19,000
2	0.79	1000	2700	0.99	3.9×10^3	30,000
3	0.14	400	5600	0.17	2.2×10^3	67,000
4	0.32	560	5800	0.82	2.3×10^3	17,000
5	0.04	250	8500	0.48	2.2×10^3	26,000
6	0.01	110	90	0.38	1.5×10^3	27,000
7	0.006	160	0	0.20	1.9×10^3	59,000
8	0.001	110	0	0.05	1.2×10^3	34,000
9	0.17	260	2800	0.62	1.8×10^3	24,000

P(≥1) = probability of having at least 1 early fatality or early injury (CCDF probability-axis intercept).

Mean = expected number of early fatalities or early injuries.

99th Percentile = consequence magnitude equalled or exceeded following 1 out of every 100 releases.

<u>Assumptions</u>: 1120 MWe reactor, SST1 release, New York City meteorology, uniform wind rose, Summary Evacuation.

might occur, are both highly variable. Therefore, because each of the nine distributions met the same radial population density criterion (populated radial intervals have population densities of 750 people per sq mi), it appears that any siting population criterion that restricts only the number of people within various radial distances may allow population distributions with significantly different risk characteristics. For this reason, consideration should perhaps be given to additional criteria which limit the number of people in any single sector or annular region.

Size and Distance of Population Centers. The effect of the size and distance of population centers upon consequences was further examined by imposing population centers of three sizes (10^4, 10^5, and 10^6 people) upon a 50 people per square mile background population density at the distances given in Table 2.7.4-2, thereby generating 13 population distributions, the background distribution and 12 distributions with population centers. Early fatality CCDFs were calculated for each ot the 13 distributions assuming an SST1 release from a 1120 MWe reactor, New York City meteorology, a uniform wind rose, a 1-mile population exclusion zone, and evacuation to 10 miles at 10 mph with a distribution of delay times (Summary Evacuation, see Section 2.5). Mean, 90th, 99th, and maximum early fatality values for each CCDF are presented in Table 2.7.4-2.

Four conclusions may be drawn from the results presented in Table 2.7.4-2. First, irrespective of size, population centers beyond 25 miles do not contribute to early fatalities, i.e., these population centers have early fatality CCDFs identical to the background CCDF. Early fatalities are confined to 25 miles because, even for unfavorable meteorological conditions, plume concentrations fall below all early fatality thresholds before that distance.[a]

Second, population centers between 10 and 20 miles cause peak early fatality values[b] to increase substantially and mean values to increase by up to factors

a. The maximum distance to which early fatalities occur for an SST1 release was shown in Section 2.6 to range from 13 to 25 miles, depending on meteorology, and is 18 miles for New York City meteorology.

b. Improbable events with conditional probabilities of $\leq 10^{3}$ caused by adverse weather, e.g., rainout of the radioactive plume onto a population center.

Table 2.7.4-2. Effects of Size and Distance of Population Centers on Early Fatalities, Conditional on an SST1 Release

Center Population	Center Distance (mi)	Early Fatalities			
		Mean	90 Percentile	99 Percentile	Maximum Calculated[a]
Background[b]	--	23	67	150	1,700
10^6	175.0	23	67	150	1,700
	92.5	23	67	150	1,700
	52.5	23	67	150	1,700
	32.5	23	67	150	1,700
10^5	52.5	23	67	150	1,700
	27.5	23	67	150	1,700
	16.25	37	67	150	51,000
	11.25	44	67	160	49,000
10^4	16.25	26	67	150	11,000
	11.5	27	67	150	10,000
	5.5	24	68	160	1,700
	2.25	120	190	2,300	5,100

a. Maximum value calculated for any weather sequence. An improbable event (conditional probability $\lesssim 10^{-3}$) typically caused by adverse weather (rainout of the radioactive plume onto a city).

b. Background population density = 50 people per sq mi.

Assumptions: 1120 Mwe reactor, SST1 release, New York City meteorology, uniform wind rose, Summary Evacuation.

of 2, but do not affect 90th or 99th percentile values (only mean and peak values differ from those of the background CCDF). Examination of individual calculations shows that population centers between 10 and 20 miles experience early fatalities principally when rain falls on the radioactive plume after it arrives over the population center. Because this is an improbable event, it affects only the CCDF peak and not its 90th, or 99th percentile values.[a]

Third, if effectively evacuated, population centers between 5 and 10 miles probably can avoid early fatalities (the CCDF for the population center at 5.5 miles is almost identical to the background CCDF). The population center at 5.5 miles experiences few early fatalities because the characteristics of Summary Evacuation (delay times, evacuation speed, see Section 2.5) assure that most persons in the population center avoid large exposures to radioactivity by evacuation for most weather sequences sampled.

Fourth, population centers very close to a reactor (≤5 miles) are more likely to experience early fatalities even with evacuation (the CCDF of the population center at 2.25 miles differs from the background CCDF at all levels of probability). Early fatalities are likely to occur because only a timely warning followed by a very prompt evacuation could assure that all people in population centers within 5 miles of a reactor will escape plume exposures (see Section 2.5).

<u>Exclusion Zone Size</u>. All existing reactors are surrounded by an exclusion zone, which has no permanent inhabitants and is controlled exclusively by the utility operating the reactor. At current reactor sites exclusion zones are irregularly shaped with minimum exclusion distances which range from 0.1 to 1.3 miles (average 0.6 miles, see Appendix D). Larger exclusion zones would be expected to reduce the incidence of early health effects (those health effects induced by relatively large doses to individuals). The influence of exclusion zone size on early fatalities and injuries was examined for each

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a. The effects of rain are discussed more fully in Sections 2.4 and 2.6; the effects of assuming emergency response beyond 10 miles are considered in Section 2.5.

of four emergency response scenarios (Scenarios 1, 5, 6, and 7 as defined in Section 2.2.2). Scenario 1 is an expeditious evacuation (1 hr delay, 10 mph), Scenario 5 is No Emergency Response, Scenario 6 is Poor Evacuation (5 hr delay, 1 mph), and Scenario 7 is Summary Evacuation. All calculations assumed no immediate emergency response beyond 10 miles, a uniform population distribution (100 persons per square mile), an SST1 release from an 1120 MWe reactor, and New York City meteorology.

Table 2.7.4-3 presents for each emergency response scenario the mean number of early fatalities calculated to occur within each of 20 distance intervals to 17.5 miles (for New York City meteorology, early fatalities are confined to 17.5 miles). Without any emergency response, the expected total number of early fatalities is 338, given an SST1 release at a reactor having a surrounding population density of 100 persons per square mile and no exclusion zone. However, if the reactor had a 1-mile exclusion zone, 58 fatalities would be avoided. Alternatively, an effective emergency response within 10 miles (e.g., Best Evacuation) would reduce the mean number of fatalities observed from 338 to 23 without any exclusion zone, and to 14 fatalities (those occurring beyond 10 miles) with a 1-mile exclusion zone.

The combined effects of exclusion zone size and emergency response effectiveness are further illustrated by the data in Table 2.7.4-4, which is drawn from Table 2.7.4-3. Table 2.7.4-4 presents for various combinations of emergency response effectiveness and exclusion zone size the number of early fatalities occurring within and beyond 10 miles and their sum. Table 2.7.4-4 shows that for large core-melt accidents mean early fatalities are reduced 16-fold (from 320 to <20) by an 0.5-mile exclusion zone and a very effective evacuation (Best Evacuation), by a 3-mile exclusion zone and a reasonably effective evacuation (Summary Evacuation), or by a 5-mile exclusion zone and an ineffective evacuation (Poor Evacuation). Alternatively, an 0.5-mile exclusion zone and a very effective evacuation within 2 miles (achieved possibly by early warning [41]) and a reasonably effective evacuation from 2 to 10 miles reduced mean early fatalities 12-fold (320 to 26).

Table 2.7.4-5 shows how the probability of having at least 1 early fatality or early injury varies with

Table 2.7.4-3. Mean Early Fatalities by Distance Intervals for Four Emergency Response Scenarios, All Evacuations[a]

Distance Interval	Emergency Response[b]			
	None	Poor	Summary	Best
0.0				
0.25	6.3	6.3	5.6	3.9
0.5	11.5	11.4	8.6	2.4
0.75	17.6	16.6	9.9	1.6
1.0	22.2	16.3	8.2	0.6
1.5	51.4	26.1	12.6	0.2
2.0	42.3	25.7	7.7	0.1
2.5	38.9	21.0	4.5	0.0
3.0	29.5	10.0	2.3	0
3.5	26.6	6.5	1.5	0
4.0	19.6	5.1	0.7	0
4.5	14.7	3.9	0.2	0
5.0	11.3	2.1	0.1	0
6.0	15.2	0.6	0.0	0
7.0	7.8	0.2	0.0	0
8.5	3.1	0	0	0
10.0	6.4	0.6	0.0	0
12.5	6.9	6.9	6.9	6.9
15.0	0	0	0	0
17.5	7.1	7.1	7.1	7.1
Total	338	166	76	23

a. Assumptions: SST1 release, 1120 MWe reactor, New York City meteorology, uniform wind rose, 100 people per square mile.

b. No emergency response beyond 10 miles; relocation after 1 day (i.e., 1-day exposure to radioactivity deposited on the ground).

Table 2.7.4-4. Dependence of Mean Early Fatalities on Emergency Response Effectiveness and Exclusion Zone Size[a]

Emergency Response	Exclusion Zone (mi)	Mean Early Fatalities		
		>10 mi	≤10 mi	Total
Best Evacuation[b]	0.5	14	2.5	16.5
Summary Evacuation[b]	3.0	14	2.5	16.5
	2.0	14	9.3	23.3
	1.0	14	29.6	43.6
	0.5	14	47.7	61.7
Poor Evacuation[b]	5.0	14	1.4	15.4
	3.0	14	19.0	33.0
	2.0	14	50.0	64.0
	1.0	14	101.8	115.8
	0.5	14	134.7	148.7
No Evacuation	5.0	14	32.5	46.5
	3.0	14	104.7	118.7
	2.0	14	173.1	187.1
	1.0	14	266.8	280.8
	0.5	14	306.6	320.6
Best ≤2 mi, Summary >2 mi	0.5	14	11.8	25.8

a. Assumptions: SST1 release, 1120 MWe reactor, New York City meteorology, 100 people per square mile.

b. No emergency response beyond 10 miles; relocation after 1 day (i.e., 1-day exposure to radioactivity deposited on the ground).

Table 2.7.4-5. Probability of Having at Least 1 Early Fatality or Injury[a] by Exclusion Zone Distance[b]

Emergency Response	None	Poor	Summary	Best	None	Poor	Summary	Best
Distance (mi)	Early Fatalities				Early Injuries			
0	1.00	1.00	0.96	0.88	1.00	1.00	1.00	1.00
0.25	1.00	1.00	0.81	0.38	1.00	1.00	1.00	1.00
0.5	1.00	0.97	0.76	0.26	1.00	1.00	0.92	0.72
0.75	0.97	0.85	0.55	0.21	1.00	1.00	0.85	0.50
1.0	0.97	0.60	0.37	0.10	1.00	1.00	0.82	0.41
2.0	0.59	0.40	0.19	0.01	0.98	0.97	0.76	0.36
5.0	0.20	0.10	0.02	0.01	0.78	0.57	0.39	0.36

a. CCDF intercept on probability axiz (y-axis).

b. Assumptions: SST1 release, 1120 MWe reactor, New York City meteorology, 100 people per square mile.

exclusion zone size. The table shows that the probability of having at least 1 early fatality following a large core-melt accident (SST1 release) can be reduced to 0.2 by the following combinations of an Emergency Response and an Exclusion Zone distance:

Emergency Response	None	Poor	Summary	Best
Exclusion Zone (mi)	5	4	2	0.75

Taken together Tables 2.7.4-3 through 2.7.4-5 suggest that a large Exclusion Zone without an emergency response is not nearly as effective as a substantially smaller Exclusion Zone and a timely emergency response.

Finally, because atmospheric releases of radioactivity of the size of SST1 are improbable (possibly extremely improbable, see Section 2.3.2, Source Term Uncertainties), it is important to note that for smaller releases (e.g., SST1 reduced an order of magnitude or SST2) the mean and peak distances to which early fatalities and injuries are likely to occur is much reduced, even with no emergency response (see Section 2.6, Distance Dependencies). Thus, for SST1 reduced 10-fold, on the average (mean result) fatalities would be confined to 1 mile and injuries to 3 miles, while for SST2 these distances are 0.5 miles and 2 miles, respectively. Thus, for releases substantially smaller than SST1, because early health effects are usually confined to only a few miles, typical Exclusion Zones (~1 mi) can have a substantial impact even without an emergency response.

2.7.5 Interdiction Dose Criterion

Following a nuclear power plant accident, continued usage of land contaminated by radioactive material deposited from the plume would result in increased population exposures, and thus would increase latent health effects. Chronic exposure to contaminated land can be avoided by interdicting the usage of the land until removal processes (decontamination, radioactive decay, weathering, runoff) have decreased exposures to acceptable levels. The dose criterion (allowed groundshine dose to an individual accumulated in 30 years) for interdiction of land is called the "interdiction dose." As interdiction dose increases, latent health effects increase (because more people are continuing to use contaminated land) and interdicted land area and interdiction costs decrease (because less land is interdicted).

All of the calculations presented in other sections of this report used an interdiction dose of 25 rem due to a 30-year exposure to contaminated land. This section examines the sensitivity of latent cancer fatalities and of interdiction distance (distance to which land is interdicted), area, and costs to interdiction dose. Calculations were performed for four different 30-year interdiction doses (5, 10, 25, and 50 rem) and also for no interdiction. All of these calculations used an 1120 MWe reactor, the SST1 source term, the Indian Point population distribution and wind rose, and New York City meteorology.

Figures 2.7.5-1a through 2.7.5-1c present CCDFs for latent cancer fatalities and the interdiction distance and area. Table 2.7.5-1 presents mean and 90 percentile (conditional probability of 10^{-1}) values of latent cancer fatalities and of interdiction distance, area, and costs as a function of interdiction dose. In Figures 2.7.5-2a through 2.7.5-2c the mean values in Table 2.7.5-1 (except the cost data) are plotted versus interdiction dose. Examination of the CRAC2 code showed that the near linear dependence of mean latent cancer fatalities upon interdiction dose displayed in Figure 2.7.5-2a was to be expected.[a] Figure 2.7.5-2a shows that, if all contaminated ground were interdicted (interdiction dose of zero), then 3200 latent cancer fatalities would still result due to the pre-interdiction dose (cloudshine dose; inhalation dose, which includes the chronic dose from

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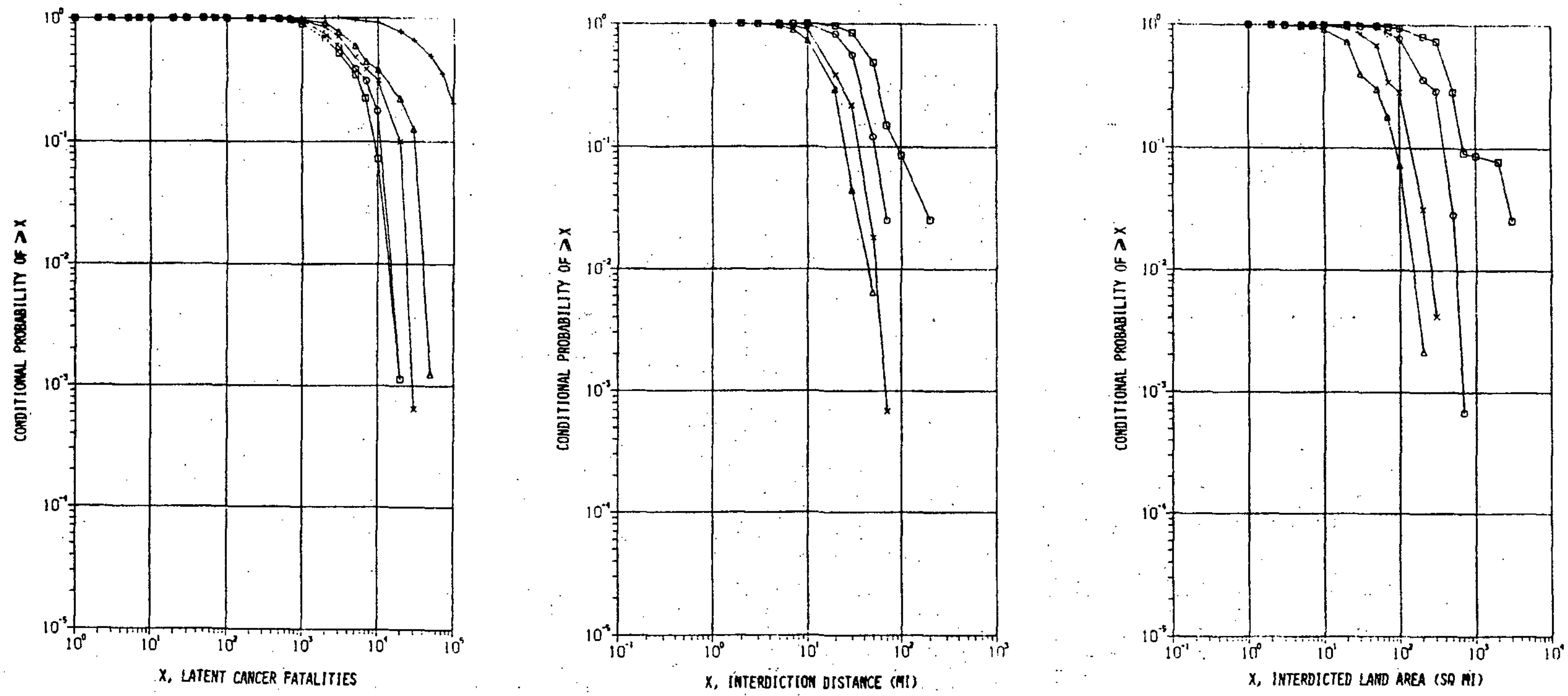
a. Latent cancer fatalities $\sim$ population dose $\sim \rho \int_{x_o}^{500} D(x)x\,dx$,

where ρ = population density (approximately constant over large areas), $D(x)$ = dose at distance x, x_o = interdiction distance, and 500 mi = maximum distance for latent cancers (variable but large). From the transport and deposition algorithms used in CRAC2, $D(x) \sim x^{-2}$. So latent cancer fatalities

$\sim \rho \, \ell n\, x \Big|_{x_o}^{500}$ which is approximately linear in x_o for $x_o \leq 50$ mi.



a) b) c)

Figure 2.7.5-1: Impact of 30-Year Interdiction Dose upon a) Latent Cancer Fatalities, b) Interdiction Distance (mi), and c) Interdicted Land Area (sq mi)

Legend

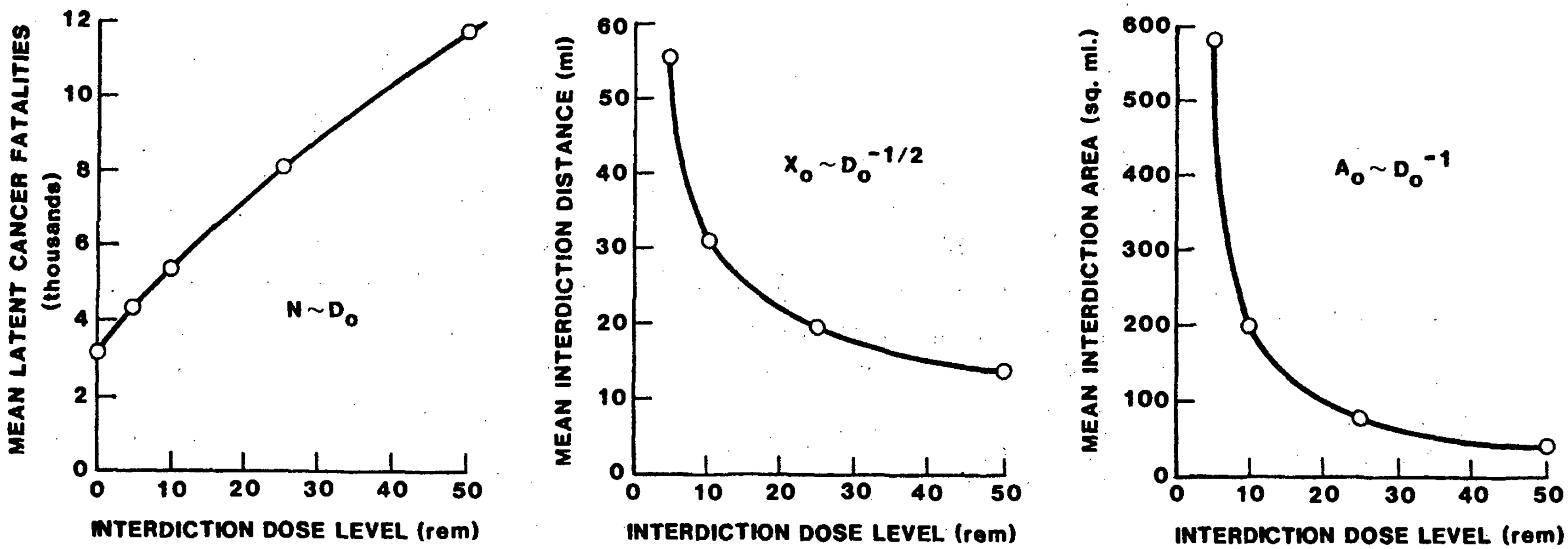
- +- no interdiction
- Δ- 50 rem interdiction dose
- X- 25 rem interdiction dose
- O- 10 rem interdiction dose
- □- 5 rem interdiction dose

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City meteorology.

Table 2.7.5-1. Mean and 90th Percentile Values of Several Consequences by Interdiction Dose Level[a]

Interdiction Dose (rem)	Latent Cancer Fatalities		Interdiction Distance (mi)		Interdicted Land Area (sq. mi)		Interdiction Costs (billions)
	Mean	90 Percentile	Mean	90 Percentile	Mean	90 Percentile	Mean
5	4,300	9,100	56	90	580	640	36
10	5,400	11,000	32	52	200	380	17
25	8,100	20,000	19	35	76	140	5
50	12,000	31,000	14	25	41	86	2
None	68,000	130,000	0	0	0	0	0

a. SST1 release, 1120 MWe reactor, Indian Point population and wind rose, New York City meteorology.



a) b) c)

Figure 2.7.5-2: Plots of a) Mean Latent Cancer Fatalities, b) Mean Interdiction Distance (mi), and c) Mean Interdicted Land Area vs Interdiction Dose Level (rem).

Assumptions: 1120 MWe reactor, SST1 release, Indian Point population and wind rose, New York City meteorology.

radioactivity deposited in the respiratory system; and pre-interdiction groundshine dose, which is assumed to be 1 day in duration). Figure 2.7.5-2b shows that interdiction distance is inversely proportional to the square root of the interdiction dose ($x_o \sim D_o^{-1/2}$) and Figure 2.7.5-2c shows that interdiction area is inversely proportional to interdiction dose ($A_o \sim D_o^{-1}$), which is not surprising since interdiction area should be roughly proportional to the square of interdiction distance ($A_o \sim x_o^{-2}$).

Table 2.7.5-1 and Figures 2.7.5-1a through 2.7.5-1c show that latent cancer fatalities, and interdiction distance, area, and costs are all quite sensitive to interdiction dose. If all contaminated land were interdicted, the mean number of latent cancer fatalities would be reduced by about a factor of 20 from the number that would occur, if no land were interdicted (at the 90 percentile level the reduction factor is 15). Similarly, a 10-fold increase (5 to 50 rem) in interdiction dose produces about a 10-fold decrease in mean interdiction area and nearly a 20-fold decrease in mean interdiction costs.

Data in Table 2.7.5-1 can be used to illustrate the inverse relationship between latent fatalities and interdiction costs. For example, changing the interdiction dose criterion from no interdiction (all doses are tolerated) to an interdiction dose of 50 rem decreases mean latent fatalities by 57,000 and produces interdiction costs of $\$1.9 \times 10^9$ or $\sim\$3 \times 10^4$ per life saved. Further decrease from 50 rem to 25 rem saves an additional 4000 lives at a cost of $\sim\$7 \times 10^5$ per life, while the decrease from 25 rem to 10 rem saves 3000 lives at a cost of $\sim\$5 \times 10^6$ per life. Therefore, because of the inverse relationship between latent cancer fatalities and interdiction area, the high cost of interdicting land may make the interdiction of large areas (selection of a low interdiction dose) unacceptable.

2.8 Summary

This chapter has presented results from a large number of CRAC2 calculations, which characterize the sensitivity of accident consequences to input data and model parameters. Sensitivities were determined by comparison to a Base Case Calculation which assumed an SST1 release from a standard 1120 MWe reactor, meteorology typical of New York City, the Indian Point wind rose and population distribution, and Summary Evacuation. The principal conclusions derived from the results of these calculations are as follows:

- Estimates of the number of early fatalities are very sensitive to source term magnitude. Mean early fatalities (average result for many weather sequences) are decreased dramatically (about two orders-of-magnitude) by a one order-of-magnitude decrease in source term SST1 (large core melt, loss of most safety systems). Because the core melt accident source terms SST1-3 used in this study neglect or underestimate several depletion mechanisms, which may operate efficiently within the primary loop or the containment, consequence magnitudes calculated using these source terms may be significantly overestimated.

- The weather conditions at the time of a large release will have a substantial impact on the health effects caused by that release. In marked contrast to this, mean health effects (average result for many weather sequences) are relatively insensitive to meteorology. Over the range of meteorological conditions found within the continental United States (1 year meteorological records from 29 National Weather Service stations), mean early fatality values for a densely populated site show a range (highest value/lowest value) of only a factor of 2, and mean latent cancer fatality values a factor of 1.2.

- Peak early fatalities (maximum value calculated for any weather sequence) are generally caused by rainout of the radioactive plume onto a population center. For an SST1 release, the peak result is about 10-times less probable in a dry locale than in a wet one.

- The distances to which consequences might occur depend principally upon source term magnitude and meteorology. Frequency distributions of these distances, calculated using large numbers of weather sequences, yielded expected (mean), 99 percentile, and maximum calculated distances (expressed in miles) for early fatalities and early injuries as follows:

Source Term	Consequence	Mean	99%	Maximum Calculated
SST1	Early Fatalities	<5	≲15	<25
	Early Injuries	~10	~30	≲50
	Land Interdiction	~20	>50	>50
SST2	Early Fatalities	~0.5	<2	<2
	Early Injuries	<2	<5	~5
	Land Interdiction	<2	~7	~10

The maximum calculated distances are associated with very improbable events, (e.g., rain-out of the plume onto a population center). For the SST1 release reduced by a factor of 10, early fatalities are confined to ~5 miles, early injuries to ~20 miles, and interdiction of land to ~25 miles.

- Calculated consequences are very sensitive to site population distribution. For each of the 91 population distributions examined, early fatality, early injury, and latent cancer fatality CCDFs were calculated assuming an SST1 release from an 1120 MWe reactor. The resulting sets of CCDFs had the following ranges:

  Early Fatalities. ~3 orders-of-magnitude in the peak and mean numbers of early fatalities and in the probability of having at least one early fatality.

  Early Injuries. ~3 orders-of-magnitude in the means, ~2 in the peaks, and ~1 in the probability of having at least one early injury.

  Latent Cancer Fatalities. ~1 order-of-magnitude in the peaks and the means and in the probability of having at least one latent cancer fatality.

Generally, mean results are determined by the average density of the entire exposed population, while peak results (especially for early fatalities) are determined by the distance to and size of exposed population centers.

- Early fatalities and early injuries can be significantly reduced by emergency response actions. Both sheltering (followed by relocation) and evacuation can be effective, provided the response is expeditious. Access to basements or masonry buildings significantly enhances the effectiveness of sheltering. Expeditious response requires timely notification of the public. If the evacuation is expeditious (timely initiation), evacuation speeds of 10 mph are effective. Evacuation before containment breach within 2 miles, after release within 10 miles, and sheltering from 10 to 25 miles appears to be a particularly effective response strategy.

- Because accident source terms increase with reactor size, smaller reactors pose lesser risks to the public than are posed by larger reactors.

- Buoyant plumes (high heat content) can be lofted over close-in populations, thereby decreasing the risk of early health effects at short distances ($\lesssim$10 mi) but increasing that risk at longer distances ($\sim$20 mi). Because only rainout of lofted plumes is able to produce fatal exposures, mean early fatality values for buoyant plumes are substantially decreased by comparison to non-buoyant plumes (early fatalities result from fewer weather sequences).

- Dry deposition velocity has a substantial impact on the distance to which land is interdicted and early health effects occur. However, the number of early health effects calculated are only moderately sensitive to dry deposition velocity.

- Exclusion zones (unless very large) are unlikely to significantly reduce early health effects for very large core melt accidents such as SST1. However, for smaller accidents (e.g. 1/10 SST1, SST2) early health effects could be significantly mitigated by exclusion zones of 1 to 2 miles.

- Decreasing the level of contamination at which land is interdicted decreases latent cancer fatalities and increases the amount of land interdicted. As interdiction dose is increased, interdiction costs (value of interdicted land and buildings) increase more rapidly than does the number of latent cancer fatalities avoided.

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3. Population Statistics for Current Reactor Sites

3.1 Introduction

This chapter examines a variety of characteristics of the population distributions about the 91 reactor sites first discussed in Section 2.4 and described in detail in Appendices A and C. Each of these sites has either an operating license or a construction permit. The site characteristics examined include distance to the boundary of the reactor site exclusion zone, site population factors, the distribution of population densities within different radial annuli and distances, maximum population densities within 22.5° and 45° sectors, and time-dependent trends in site population densities. As a group these analyses delineate the demographic characteristics of current reactor sites and provide a perspective of past siting decisions.

The population distributions examined in this chapter were derived from 1970 census data. A computer program was used (see Appendix A) to construct from U. S. Census Enumeration District (CED) data, the population distribution (16 sectors, 34 radial intervals) surrounding each of the 91 reactor sites. The procedure used may produce a distribution with significant errors close to the site. Errors may result because the computer program assumes that the entire population of each CED is located entirely at the "centroid" of the CED, when it may actually be dispersed over areas which are substantially larger than the area of the spatial interval in which the centroid is located. Because a CED typically contains about 1000 persons, the magnitude of this error decreases as population density increases. Given the spacing of the circular polar grid, the error is most likely negligible beyond 20 miles even for sparsely populated regions ($\lesssim$ 40 people per sq mi). Beyond 7 miles, errors are unlikely to be substantial for population densities greater than 500 people per square mile.

Throughout this chapter results are frequently presented for each of the five NRC administrative regions. Figure 3-1 displays the boundaries of these regions and the locations of the 91 reactor sites examined. In Section 3.2 scatter plots of site exclusion zone distances and site population factors are presented by region. Section 3.3 presents population density CCDFs and displays percentile values drawn from the CCDFs for each region. Scatter plots of these data are also

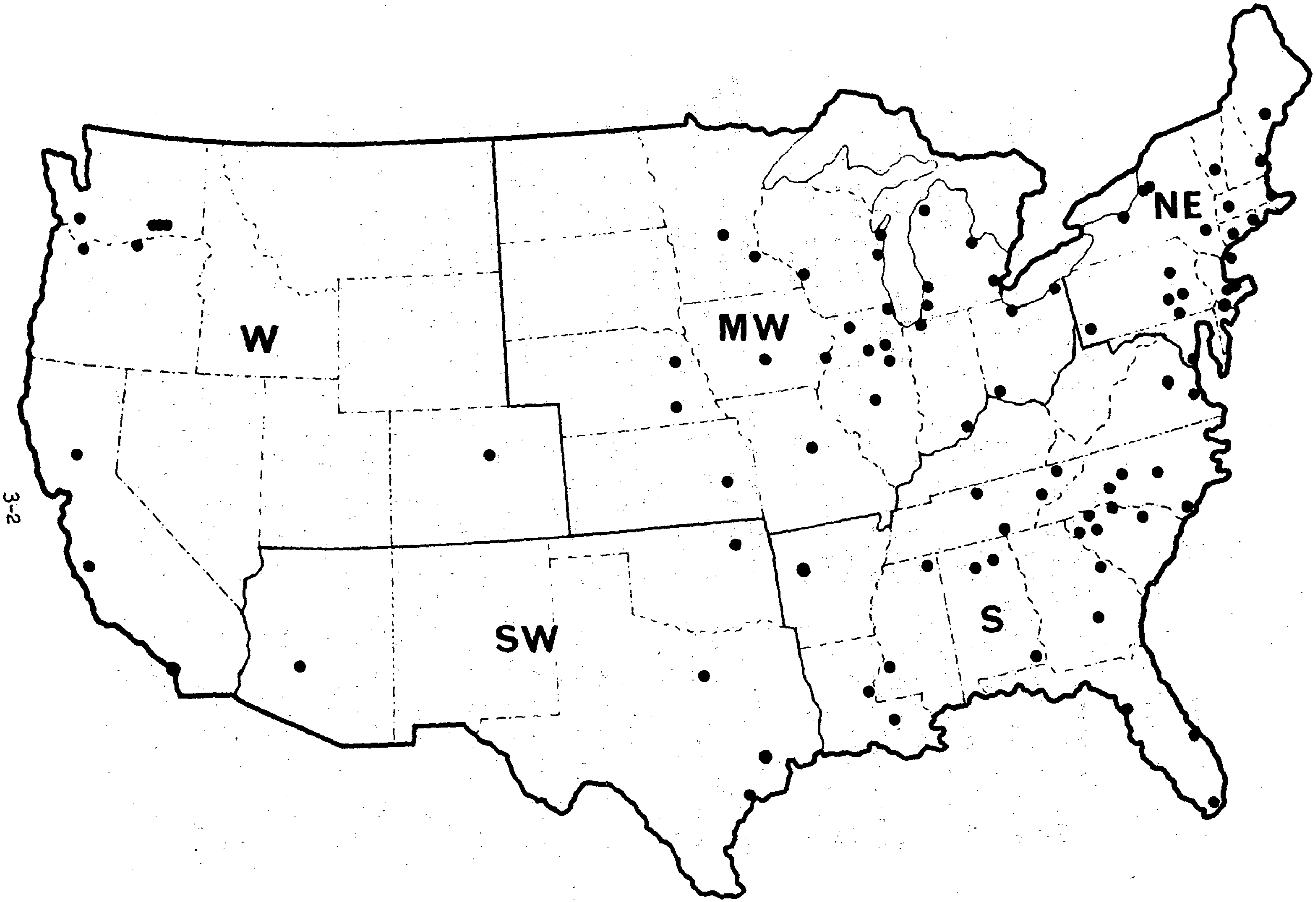

Figure 3-1. The Five NRC Administrative Regions and the Location of the 91 Reactor Sites.

presented. Time trends of site population characteristics are analyzed by region in Section 3.4. Finally, population characteristics for individual sites and additional regional results are presented in Appendix D, and additional population data are available in NUREG-0348 [1].

3.2 Exclusion Zones and Site Population Factors

Distance to the exclusion zone boundary, distance to nearby cities, and site population factors have all been used by the NRC to describe population distributions about reactor sites. Consequence sensitivity to exclusion zone size and to distance to nearby cities was examined in Section 2.7.4. This section examines regional variation (1) of the minimum distance to the exclusion zone boundary and (2) of site population factors, with and without wind rose weighting.

All reactors are surrounded by an exclusion zone, which has no permanent inhabitants and is controlled exclusively by the utility operating the reactor. Exclusion zones are usually irregularly shaped. For the 91 sites examined in this study, minimum distances to the exclusion zone boundary range from 0.1 to 1.3 miles with 0.5 miles being about average. The value for each of the 91 sites is presented in Appendix D. Figure 3-2 displays these values as scatter plots, one for each NRC administrative region. Median values for each scatter plot are indicated on the figure. The median values increase in the order NE, MW, W, S, SW.

Site population factors were developed by the NRC [2] to provide a way to compare populations around different sites. The factors are intended to be dimensionless measures of the total risk to the population within a specified radial distance. Since correlations between population distribution and wind direction may significantly influence risk at some sites, a wind rose weighted formulation of the site population factor was also developed.

The Site Population Factor (SPF) and Wind Rose weighted Site Population Factor (WRSPF) are defined as follows:

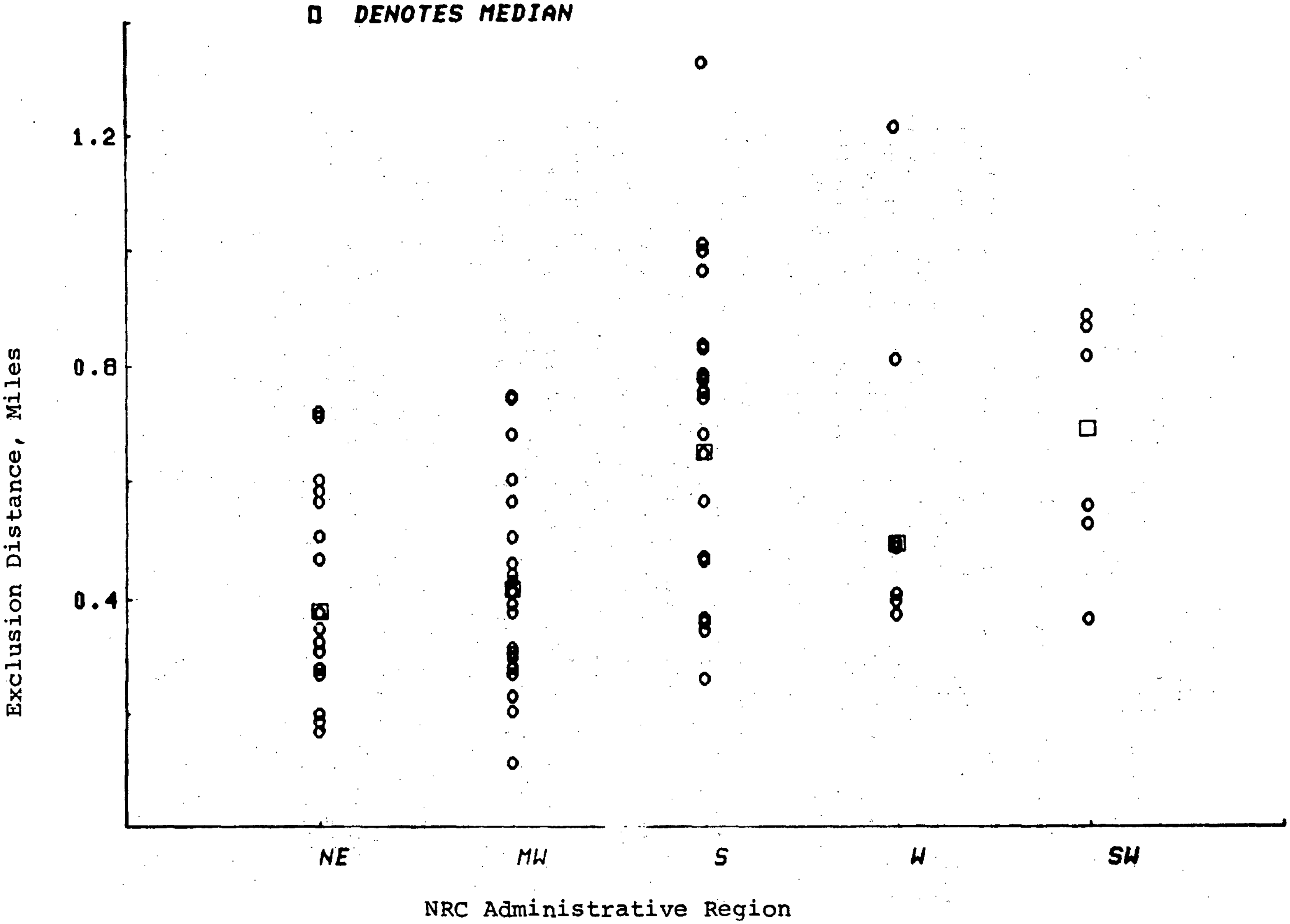

Figure 3-2. Exclusion Distances for 91 Reactor Sites by Geographic Area.

$$SPF_n = \frac{\sum_{i=1}^{m} p_i \Big/ r_i^{1.5}}{\sum_{i=1}^{m} \bar{p}_i \Big/ r_i^{1.5}} \qquad WRSPF_n = \frac{16 \sum_{i=1}^{m} \left[\sum_{j=1}^{16} w_j p_{i,j} \right] \Big/ r_i^{1.5}}{\sum_{i=1}^{m} \bar{p}_i \Big/ r_i^{1.5}}$$

where r_i is the outer radius of annulus i of m concentric annuli ($r_o = 0$, $r_m = n$).

n is the outer radius of the outermost annulus, annulus m.

$\bar{p}_i$ is the population of annulus i assuming a uniform population density of 1000 people per sq mi, i.e, $\bar{p}_i = 10^3 \pi (r_i^2 - r_{i-1}^2)$

p_i is the actual population of annulus i.

$p_{i,j}$ is the actual population of the ith radial interval of wind rose sector j.

w_j is the fraction of time that the wind blows into sector j.

Finally, the power 1.5 to which the radius r_i is raised was selected because it approximates the functional relationship between risk and distance; and $WRSPF_n = SPF_n$ whenever $w_j = 1/16$ for all j, i.e., whenever the wind rose is uniform.

Site population factors (both SPF_n and $WRSPF_n$ for n = 5, 10, 20, and 30 miles) are presented in Appendix D for each of the 91 sites. Table 3-1 presents average values for these factors for each of the five NRC administrative regions. Examination of Table 3-1 shows that, for each distance and for both factors, the regional average values are highest for the Northeast region and lowest for the Southwest region, and decrease in the order NE, MW, S, W, SW.

Table 3-1

SPF and WRSPF Values for the Five NRC Administrative Regions[a]

	NE	MW	S	W	SW
SPF_5	0.16±0.22	0.09±0.15	0.03±0.04	0.01±0.02	0.01±0.01
SPF_{10}	0.17±0.19	0.10±0.14	0.05±0.03	0.03±0.03	0.01±0.01
SPF_{20}	0.20±0.18	0.12±0.12	0.08±0.06	0.04±0.03	0.03±0.02
SPF_{30}	0.25±0.24	0.14±0.13	0.09±0.06	0.05±0.04	0.04±0.04
$WRSPF_5$	0.17±0.29	0.10±0.18	0.04±0.04	0.02±0.02	0.01±0.01
$WRSPF_{10}$	0.18±0.22	0.11±0.16	0.05±0.03	0.04±0.06	0.02±0.01
$WRSPF_{20}$	0.22±0.20	0.13±0.14	0.08±0.07	0.05±0.04	0.03±0.02
$WRSPF_{30}$	0.26±0.26	0.15±0.14	0.09±0.07	0.06±0.06	0.04±0.03

[a]Standard Deviations are indicated as bounds

3.3 Site Population Statistics

The 91 population distributions examined in this chapter are all constructed on a 16 sector, circular polar grid. For any specified portion (a circle, an annulus, a sector) of that grid, 91 values of population density are available, one for each of the 91 population distributions. By cumulation of the 91 values for a given portion of the grid, a population density CCDF may be constructed.* Six different sets of population density CCDFs have been constructed for the following areas of the population distribution grid:

Set 1: eight annuli (0-2, 2-5, 5-10, 10-20, 20-30, 30-50, 50-100, and 100-200 mi).

Set 2: eight radial distances (0-2, 0-5, 0-10, 0-20, 0-30, 0-50, 0-100, and 0-200 mi).

*Population density CCDFs are Log-Log plots of the fraction of sites vs population density. Any point on the distribution gives the fraction of sites (y-axis value), which have a population density within the specified portion of the grid (annulus, circle, sector), that is greater than or equal to the specified population density (x-axis value).

Set 3: the most populated 22.5° sector in each of six annuli (0-2, 2-5, 5-10, 10-20, 20-30, and 30-50 mi) on the 16 sector grid.

Set 4: the most populated 22.5° sector in each of six radial distances (0-2, 0-5, 0-10, 0-20, 0-30 mi, and 0-50 mi) on the 16 sector grid.

Set 5: the most populated 45° sector (two adjacent 22.5° sectors) in each of six annuli (0-2, 2-5, 5-10, 10-20, 20-30, and 30-50 mi) on the 16 sector grid.

Set 6: the most populated 45° sector (two adjacent 22.5° sectors) in each of six radial distances (0-2, 0-5, 0-10, 0-20, 0-30, and 0-50 mi) on the 16 sector grid.

Each set of CCDFs contains CCDFs for each of the five NRC administrative regions (NE, MW, S, W, SW) and for all regions combined (All). CCDFs were also calculated for 45° sectors because atmospheric dispersion can produce plumes with an angular dispersion greater than 22.5°.

Because of the large number of CCDFs calculated (total of 240) most of the CCDFs are presented in Appendix D. Also presented in Appendix D are the site specific data from which the CCDFs were constructed. In this section, Figure 3-3 presents CCDFs of population density at the 91 sites for six radial annuli (0-2, 2-5, 5-10, 10-20, 20-30, and 30-50 mi) and Figure 3-4 presents CCDFs for six radial distances (0-2, 0-5, 0-10, 0-20, 0-30, and 0-50 mi). CCDFs of population density, in the most populated 22.5° and 45° sectors at each of the 91 sites, are presented for the same two sets of six annuli and six radial distances in Figures 3-5 through 3-8. Tables 3-2 and 3-3 list maximum, 90th percentile, median, and minimum population densities for each of the five NRC administrative regions and for all regions combined for eight annuli and eight radial distances. Table 3-4 presents population densities for 4 radial distances of the most populated 22.5° sector for each of the five administrative regions and for all regions combined. Finally, Figures 3-9 through 3-11 present scatter plots

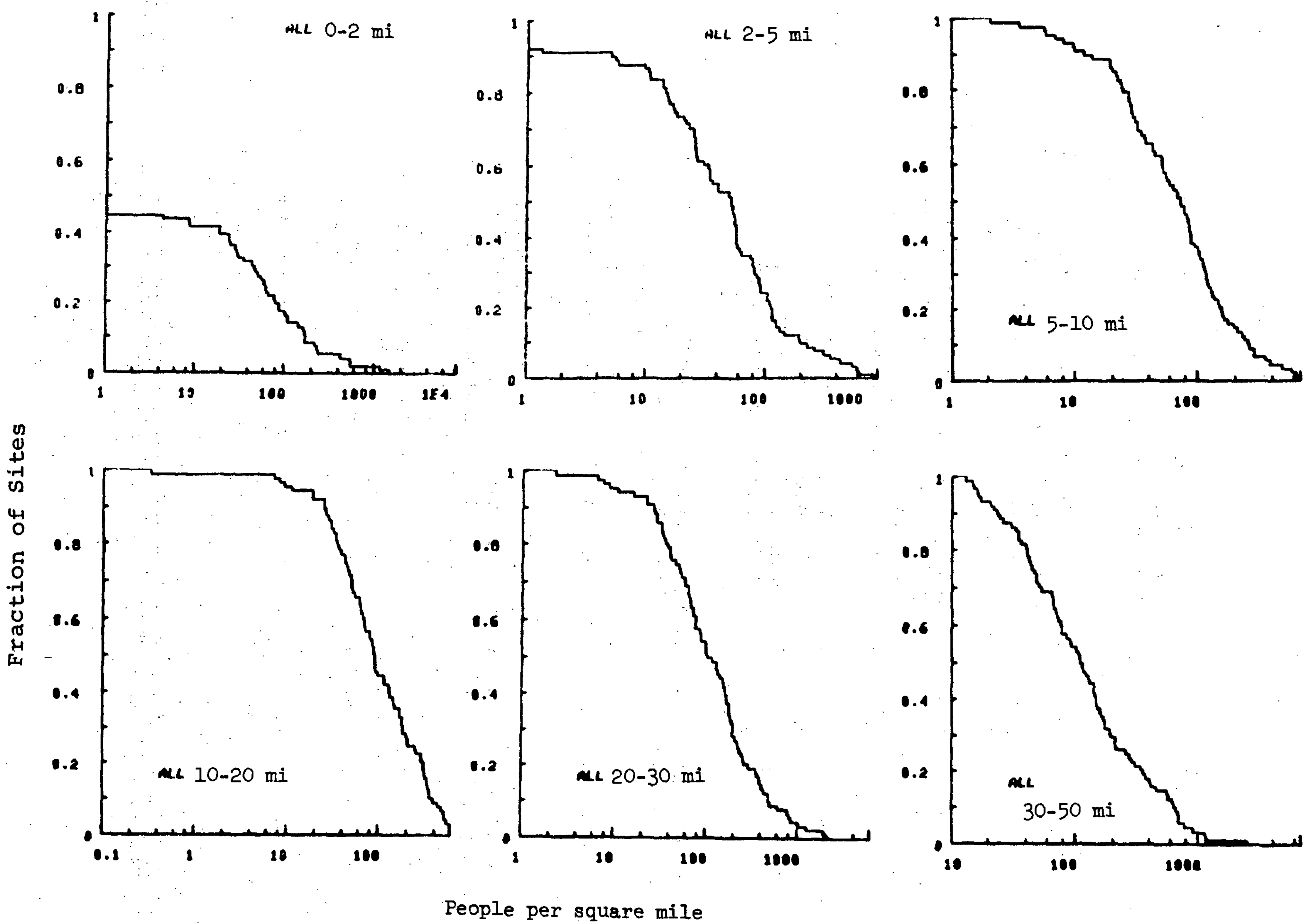

Figure 3-3. CCDFs of Population Density (People/Mile^2) at 91 Sites for Six Radial Annuli.

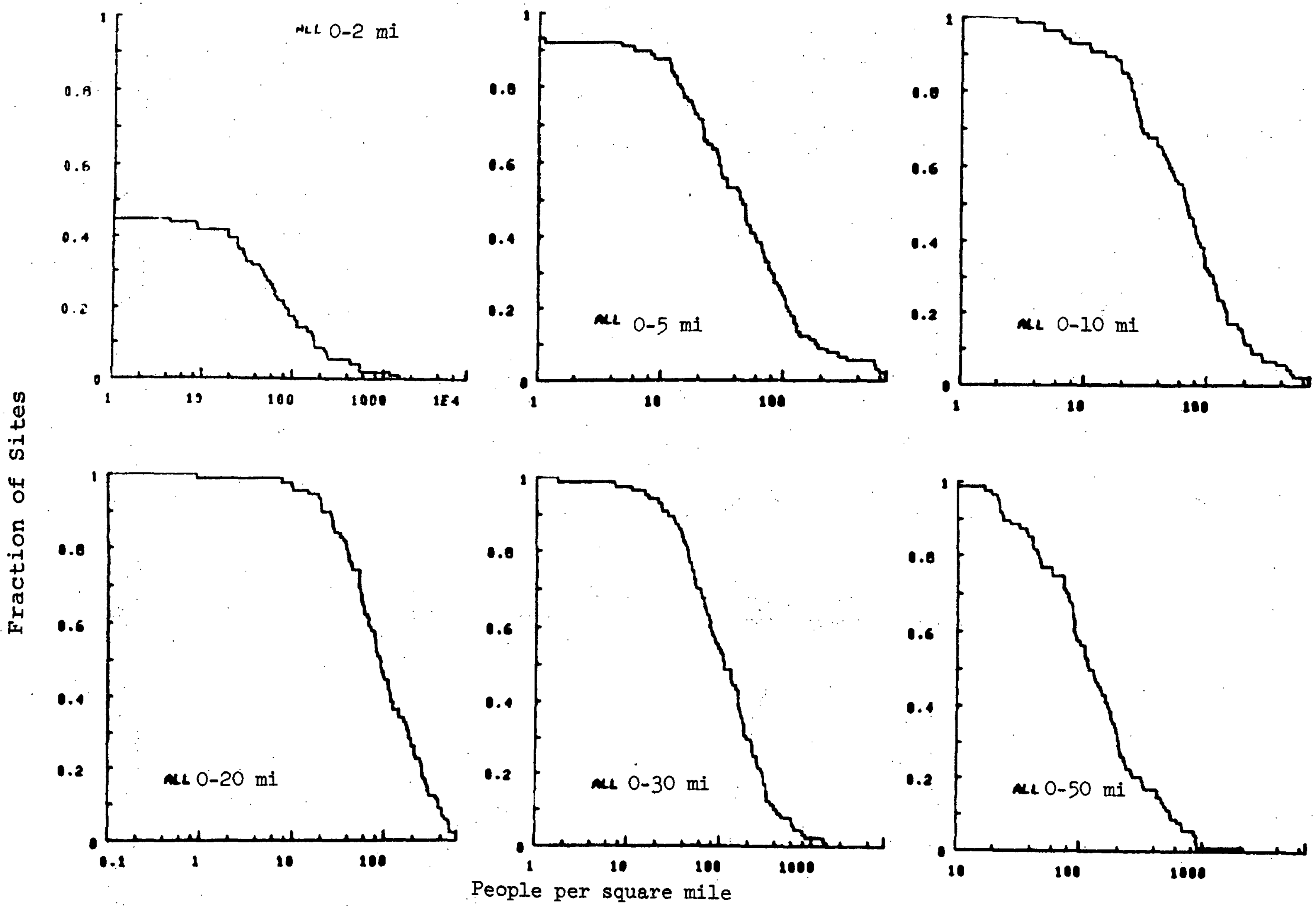

Figure 3-4. CCDFs of Population Density (People/Mile^2) at 91 Sites for Six Radial Distances

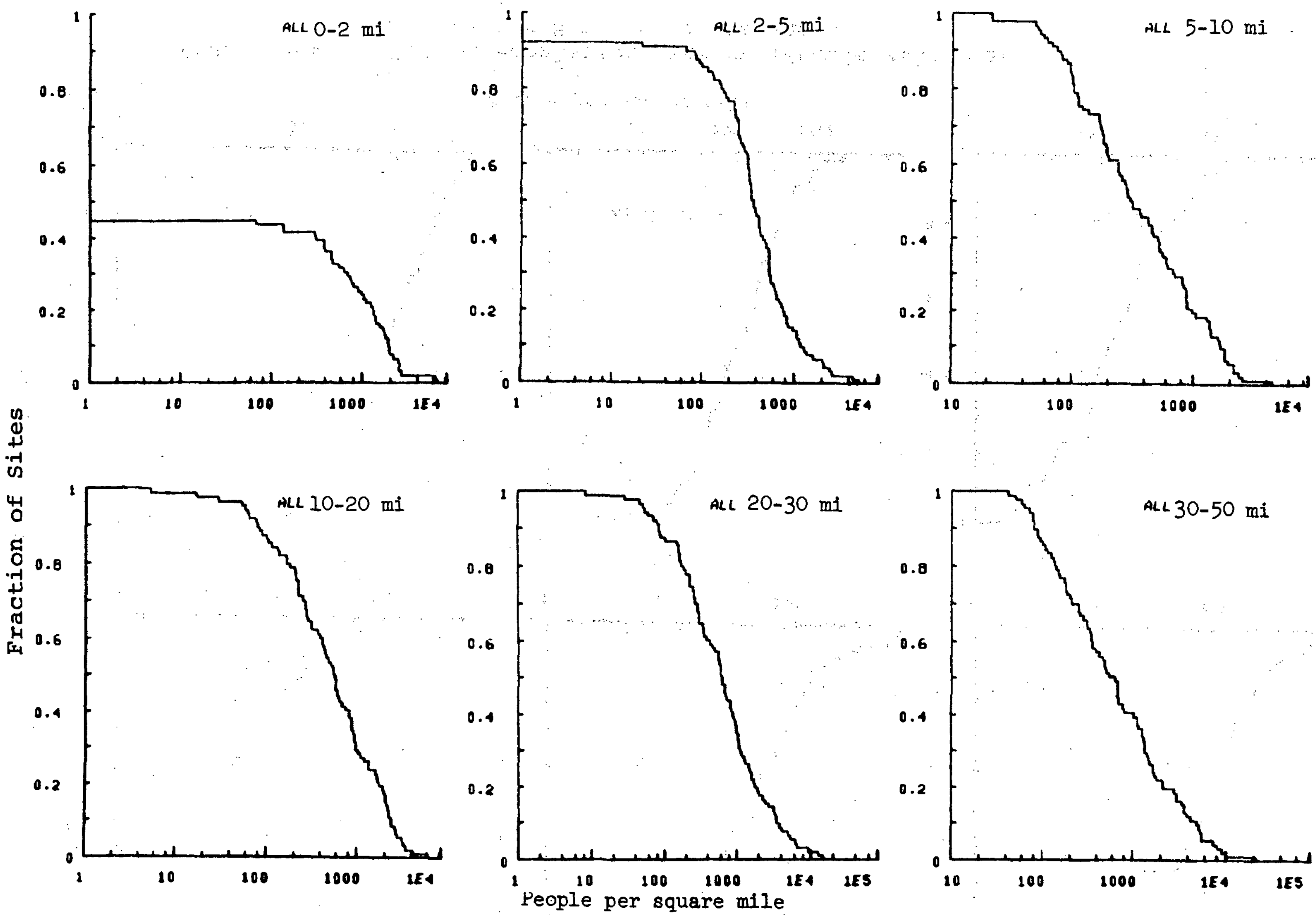

Figure 3-5. CCDFs of Population Density (People/Mile^2) in the Most Populated 22.5 Degree Sector at 91 Sites for Six Radial Annuli.

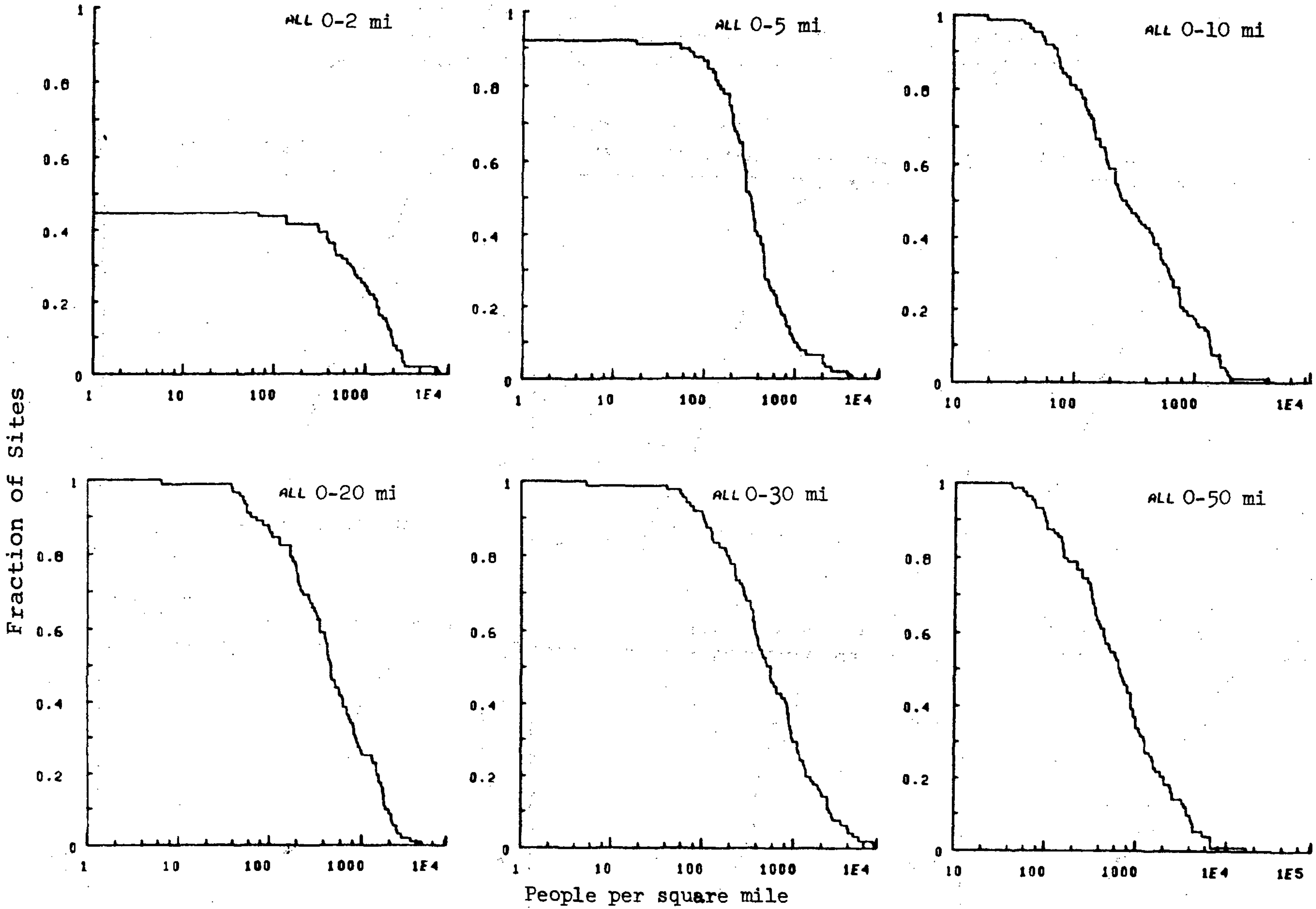

Figure 3-6. CCDFs of Population Density (People/Mile^2) in the Most Populated 22.5 Degree Sector at 91 Sites for Six Radial Distances.

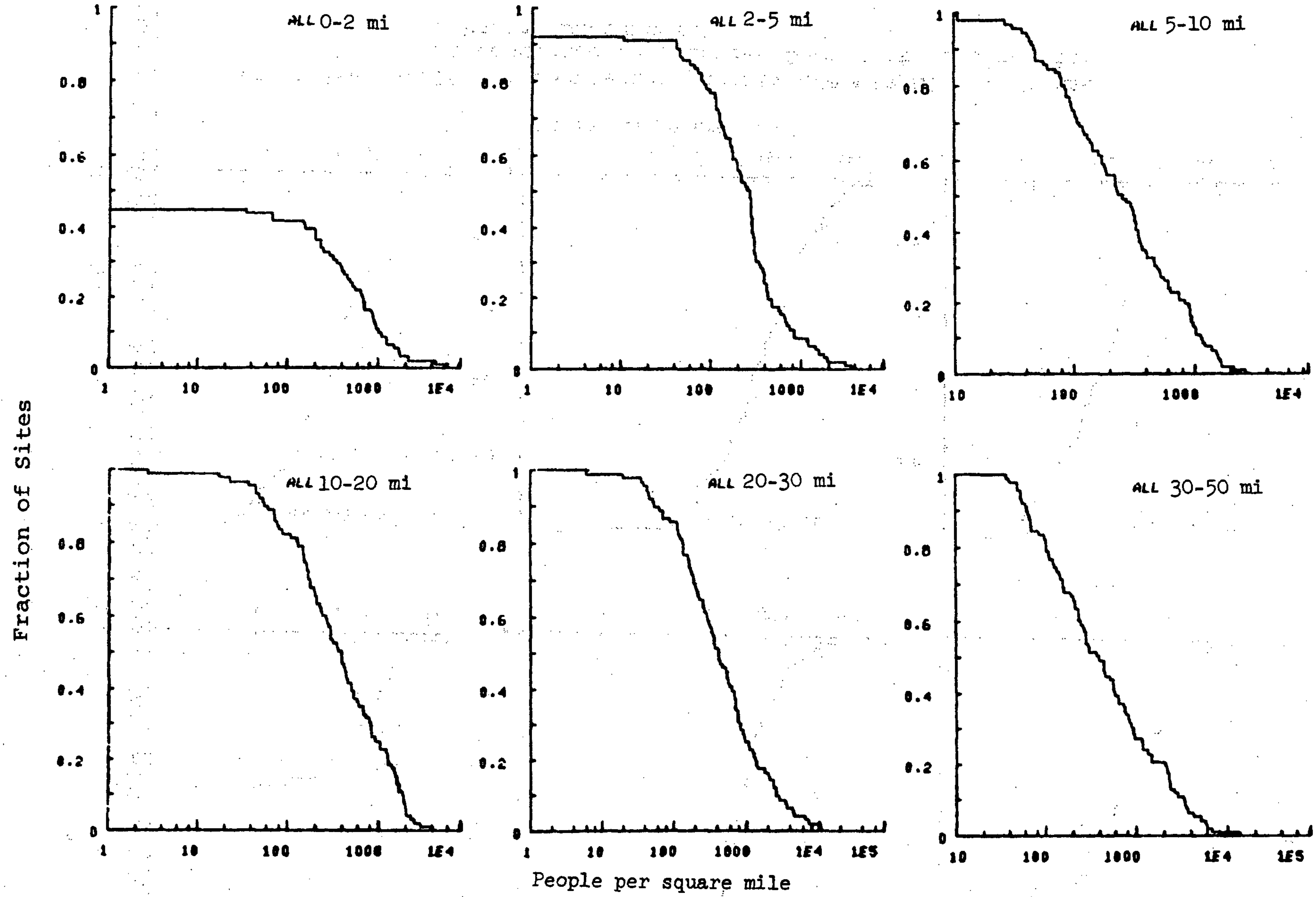

Figure 3-7. CCDFs of Population Density (People/Mile^2) in the Most Populated 45 Degree Sector at 91 Sites for Six Radial Annuli.

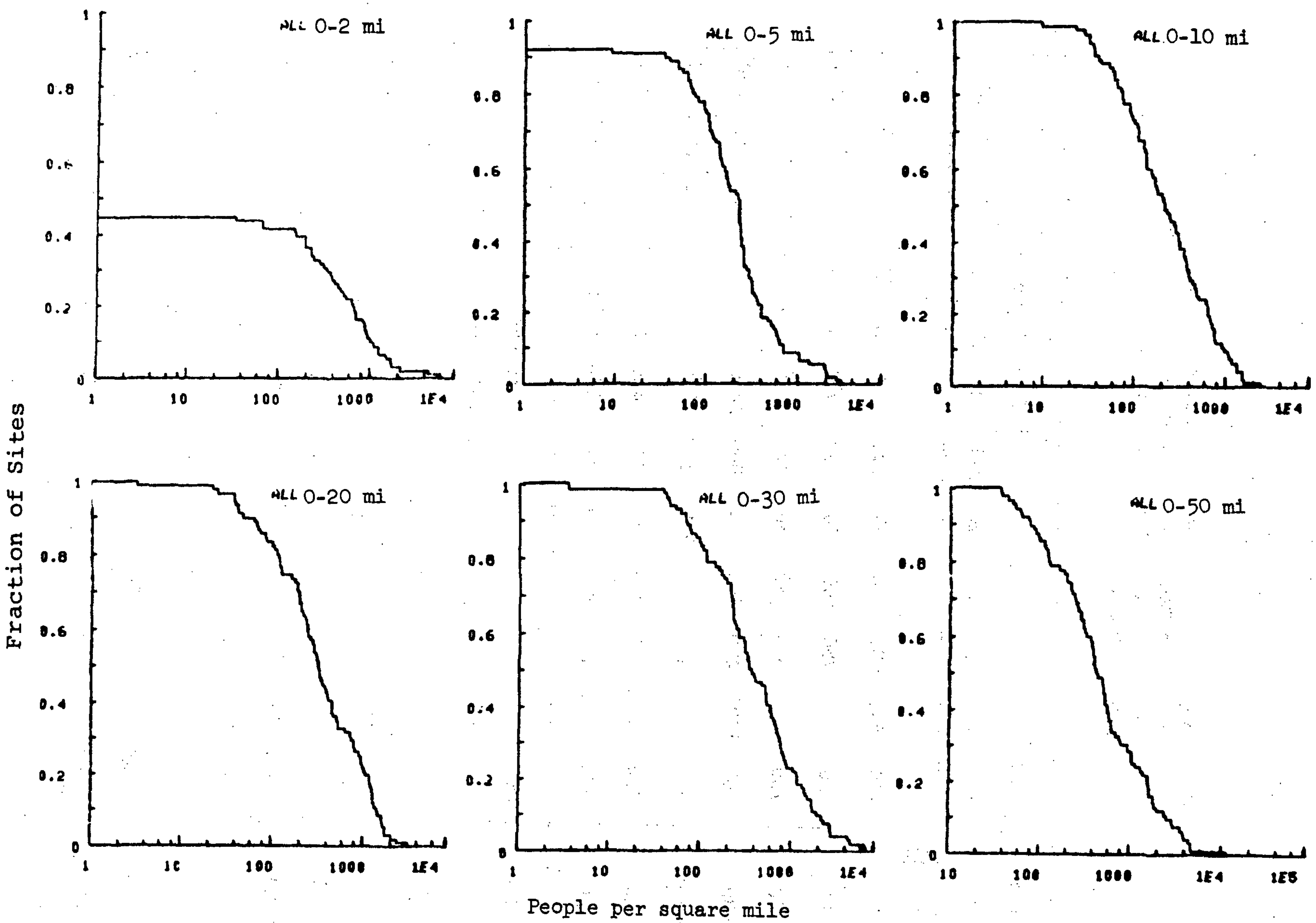

Figure 3-8. CCDFs of Population Density (People/Mile^2) in the Most Populated 45 Degree Sector at 91 Sites for Six Radial Distances.

Table 3-2. Maximum, 90th Percentile, Median, and Minimum Population Densities (people/sq mi) for Seven Radial Annuli by Geographic Region and for All Regions Combined.

CCDF Value	Maximum						90th Percentile					
Region	NE	MW	S	W	SW	All	NE	MW	S	W	SW	All
Interval (mi)												
0-5	790	540	180	100	30	790	740	270	100	100	30	190
5-10	620	700	250	100	40	700	550	280	180	200	40	260
10-20	730	530	510	180	150	730	670	340	300	180	150	380
20-30	2000	1300	490	490	230	2000	1800	620	200	490	240	490
30-50	2500	1200	210	630	290	2500	770	940	160	620	280	660
50-100	880	440	180	310	90	880	820	430	110	310	90	420
100-200	350	190	160	150	40	350	280	170	110	150	40	190

CCDF Value	Median						Minimum					
Region	NE	MW	S	W	SW	All	NE	MW	S	W	SW	All
Interval (mi)												
0-5	100	60	30	20	10	40	0	8	0	0	0	0
5-10	130	60	80	30	20	80	6	4	8	2	7	2
10-20	170	90	70	60	30	90	40	9	10	0	7	0
20-30	180	120	100	50	40	110	50	9	8	2	7	2
30-50	400	100	80	40	130	110	50	20	10	20	30	10
50-100	360	130	80	50	40	90	20	10	30	10	20	10
100-200	170	110	70	30	30	80	20	30	8	9	6	6

Table 3-3. Maximum, 90th Percentile, Median, and Minimum Population Densities (people/sq mi) for Seven Radial Distances by Geographic Region and for All Regions Combined.

CCDF Value	Maximum						90th Percentile					
Region	NE	MW	S	W	SW	All	NE	MW	S	W	SW	All
Interval (mi)												
0-5	790	540	180	100	30	790	740	270	100	100	30	190
0-10	650	660	200	170	30	660	470	270	150	170	280	230
0-20	710	470	410	160	110	710	630	340	250	160	110	380
0-30	1500	850	380	320	180	1500	1300	460	290	330	180	420
0-50	2100	890	210	460	200	2100	880	830	200	460	200	530
0-100	760	370	170	350	100	760	750	350	130	360	100	440
0-200	350	210	160	120	50	350	340	200	100	120	50	290
CCDF Value	Median						Minimum					
Region	NE	MW	S	W	SW	All	NE	MW	S	W	SW	All
Interval (mi)												
0-5	100	60	30	20	10	40	0	8	0	0	0	0
0-10	120	60	70	30	20	70	4	10	6	3	7	3
0-20	210	90	60	50	30	90	30	10	20	1	8	1
0-30	230	120	100	50	30	110	50	20	10	2	7	2
0-50	320	120	90	50	90	120	50	20	20	10	20	10
0-100	330	120	80	70	70	90	80	10	40	10	30	10
0-200	290	130	80	40	40	90	50	30	20	20	10	10

Table 3-4. Maximum, 90th Percentile, Median, and Minimum Population Densities (people/sq mi) for the Most Populated 22.5° Sector within Four Radial Distances by Geographic Region and for All Regions Combined.

CCDF Value	Maximum						90th Percentile					
Region	NE	MW	S	W	SW	All	NE	MW	S	W	SW	All
Interval (mi)												
0-5	4200	2000	950	450	320	4200	3500	2000	510	460	310	950
0-10	2000	3800	1300	1600	140	3800	1300	1400	1000	1500	140	1000
0-20	4500	3400	2600	800	860	4500	2000	2100	2100	780	860	1800
0-30	8700	5200	4000	1800	1600	8700	3700	3200	1300	1800	1600	2500

CCDF Value	Median						Minimum					
Region	NE	MW	S	W	SW	All	NE	MW	S	W	SW	All
Interval (mi)												
0-5	630	350	240	280	170	330	0	50	0	0	0	0
0-10	750	220	280	150	70	270	40	40	60	20	50	20
0-20	880	620	360	430	150	480	170	40	50	6	40	6
0-30	940	800	430	290	120	550	110	60	40	5	70	5

by administrative region of the site specific population data for population density seven annuli and seven radial distances, and for four radial distances of the most populated 22.5° sector.

In Section 2.7.4 the sensitivity of consequences to population distribution was examined using a number of hypothetical population distributions, all of which had average densities within 30 miles of the reactor of 750 people per square mile. Figure 3-4 shows that, within 30 miles of the reactor, only 4 of the 91 sites (4%) have population densities within that distance which exceed 750 people per square mile. Figure 3-8 shows that for the most populated 45° sector 30 of the 91 sites (33%) have population densities that exceed 750 people per square mile. Finally, Figure 3-6 and Table D1.4 show that for the most populated 22.5° sector 38 of the 91 sites (42%) have densities greater than 750 people per square mile.

Examination of the reactor site population density scatter plots for the five NRC administrative regions presented in Figures 3-9 through 3-11 shows that the densities within any region range across approximately two orders of magnitude and that between regions there is substantial overlap of ranges. Densities are largest in the Northeast and lowest in the Southwest; qualitatively the densities are ordered from largest to smallest: NE, MW, S, W, SW. Tables 3-2 through 3-4 confirm this qualitative ordering, although there are a number of exceptions (S and W are often inverted).

3.4 Time Dependent Trends

Figure 3-12 presents scatter plots by region of the year of site selection (the year in which a construction permit was granted was used as a surrogate for the actual year of site selection) for the 91 reactor sites examined in this study. Only four sites were selected prior to 1960, two each in the Northeast and the Midwest. Not until 1973 was a reactor site selected in the Southwest.

Because the years during which sites were selected are distributed over time quite differently by region, trends by selection year in the density of the population distributions surrounding reactor sites were also examined both by region and for all regions combined. Figure 3-13 presents plots of population density within

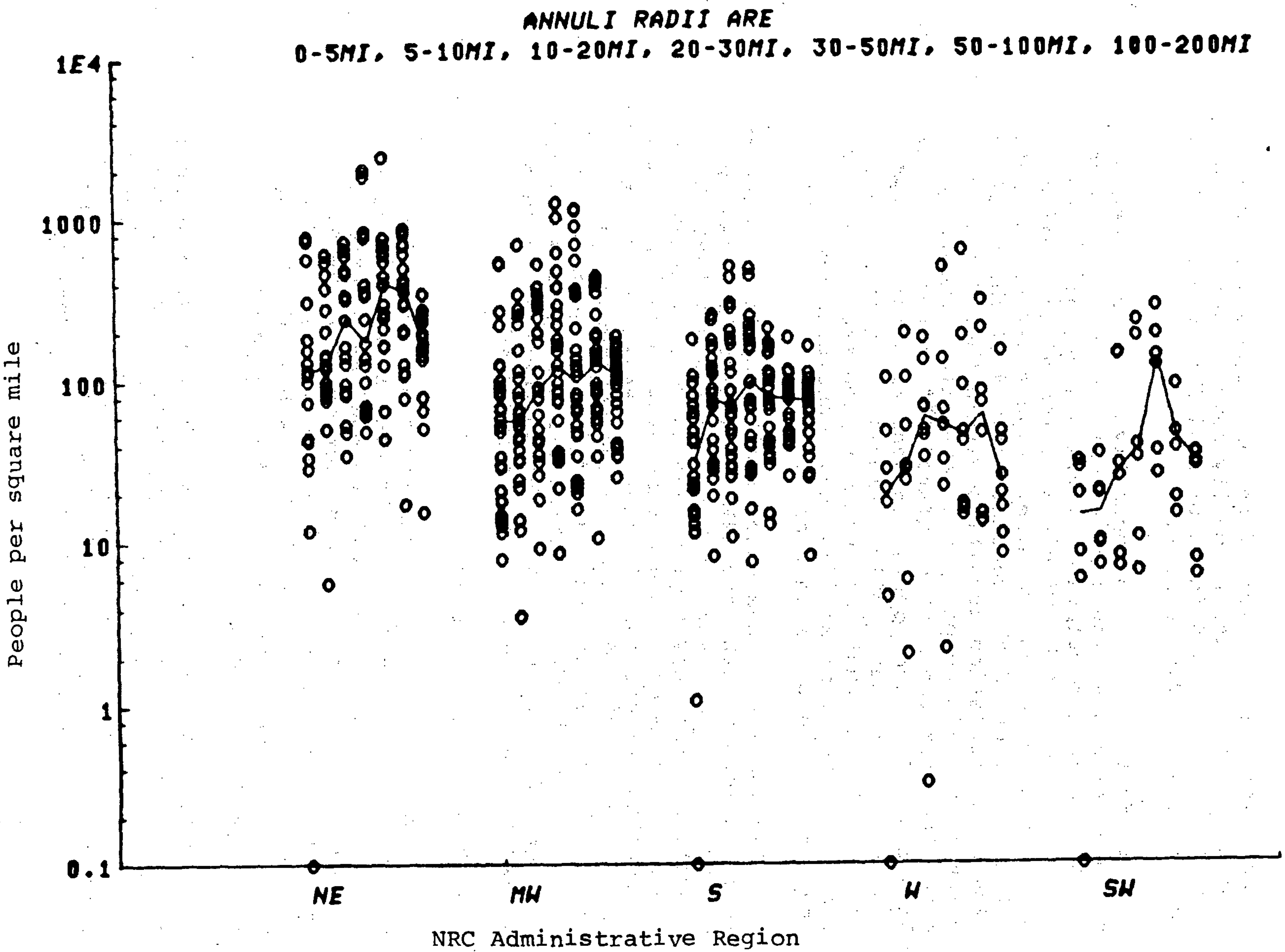

Figure 3-9. Population Density (People/Mile^2) at 91 Reactor Sites by Geographic Region for 7 Radial Annuli: 0-5, 5-10, 10-20, 20-30, 30-50, 50-100, and 100-200 Miles (the Lines Connect Median Values).

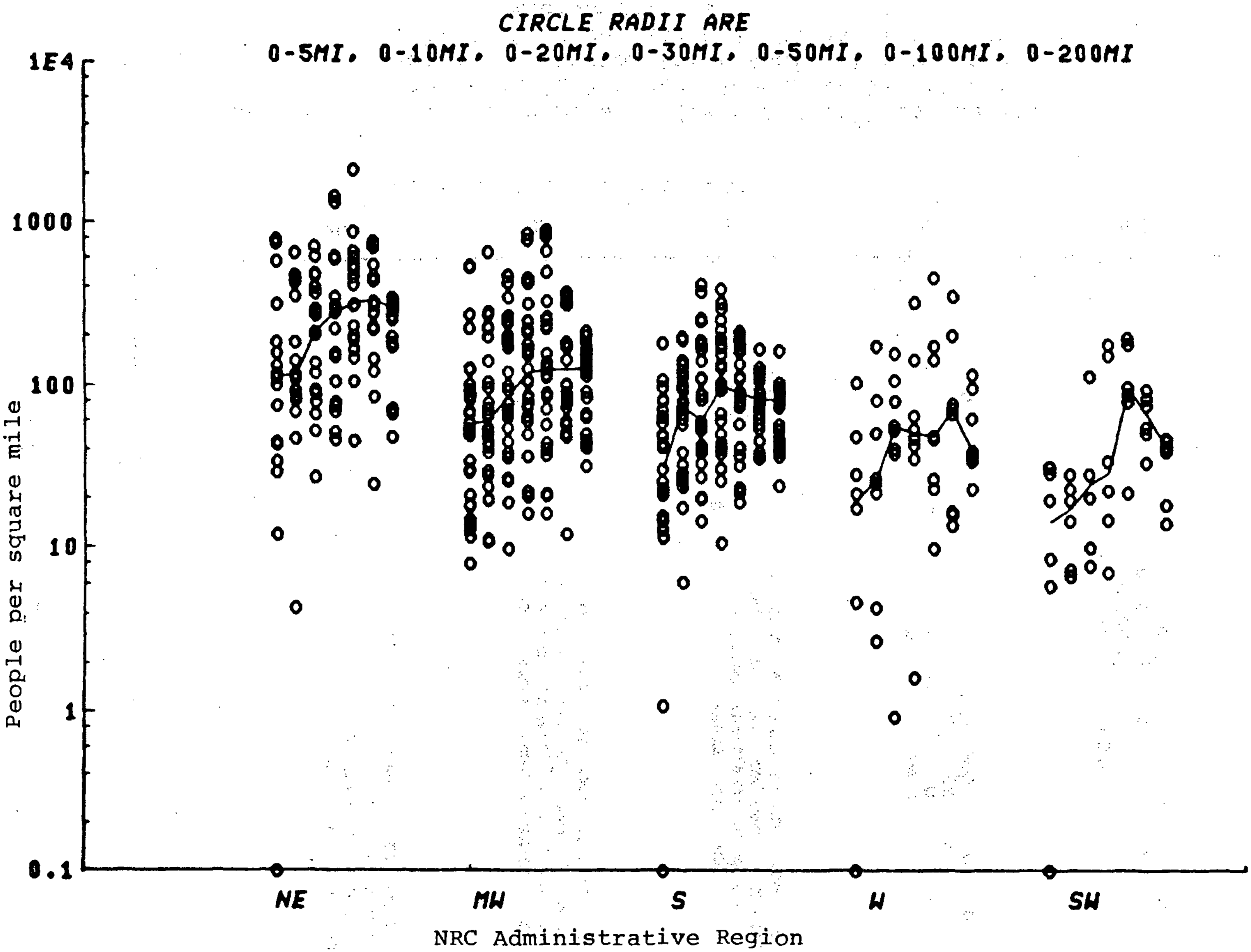

Figure 3-10. Population Density (People/Mile^2) at 91 Reactor Sites by Geographic Region for 7 Radial Distances. 0-5, 0-10, 0-20, 0-30, 0-50, 0-100, and 0-200 Miles.

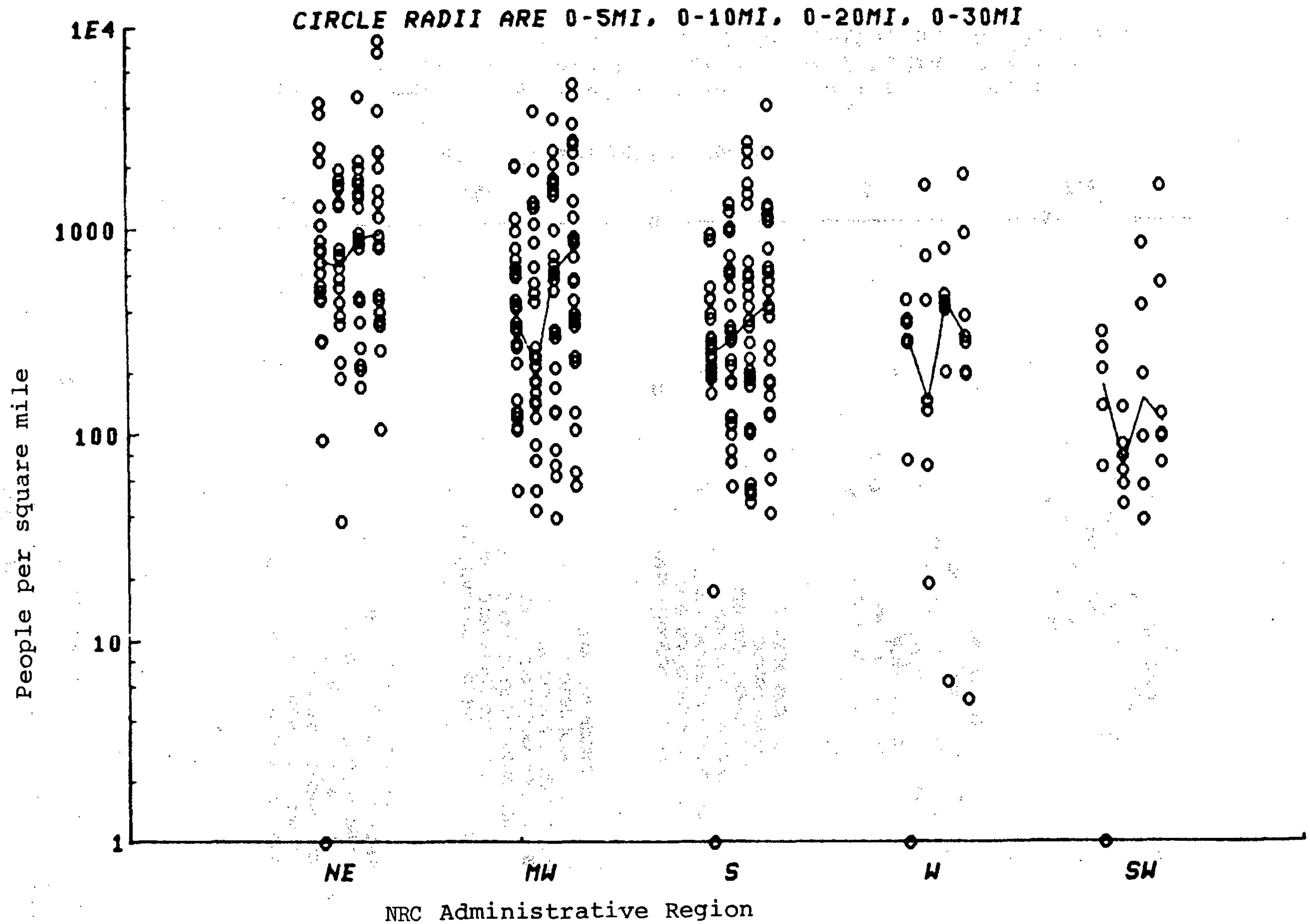

Figure 3-11. Population Density (People/Mile^2) in the Most Populated 22.5 Degree Sector at 91 Sites by Geographic Region for 4 Radial Intervals: 0-5, 0-10, 0-20, and 0-30 Miles. (The lines connect median values).

30 miles of the site versus year of site selection, for each region and for all regions combined. The line on each plot is the least squares linear fit of the data. The slope of the line is the change in the logarithm of 30-mile population density with time. The lines for the Northeast, Midwest, and South have slopes which, given the scatter in the data points, are little different from zero (NE = -0.04, MW = -0.01, S = 0.03). Given the narrow time span and considerable scatter of the five Southwest site selection years, the slope of that plot (SW = 0.7), though substantial, is of no importance. Only for the West (W = -0.23) and to a lesser degree for all regions combined (All = -0.08) do the slopes of the plots seem important.

To better define the significance of the time trends displayed in Figure 3-13, an analysis of variance [3] of the logarithm-transformed population density data was performed. The analysis partitioned the variability in the data among four terms: one for the common time trend of all regions combined, one for unique time trends within each region, one for regional differences corrected for regional time trends, and a residual term for variability not attributable to either regional differences or time trends. The results of this analysis are presented in Table 3-5. In the table, the mean square value is obtained by dividing the sum of squares value by its number of degrees of freedom (number of independent terms in the sum of squares). Comparison of the magnitude of the mean square values indicates the relative importance of the three terms (mean square values large by comparison to the residual mean square value are useful in explaining the observed variability).

Table 3-5 Analysis of Variance

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square
Common time trend	11.2	1	11.2
Regional time trend	18.4	4	4.6
Regional differences corrected for regional time trends	7.1	4	1.8
Residual	82.0	81	1.0
TOTAL	118.7	90	

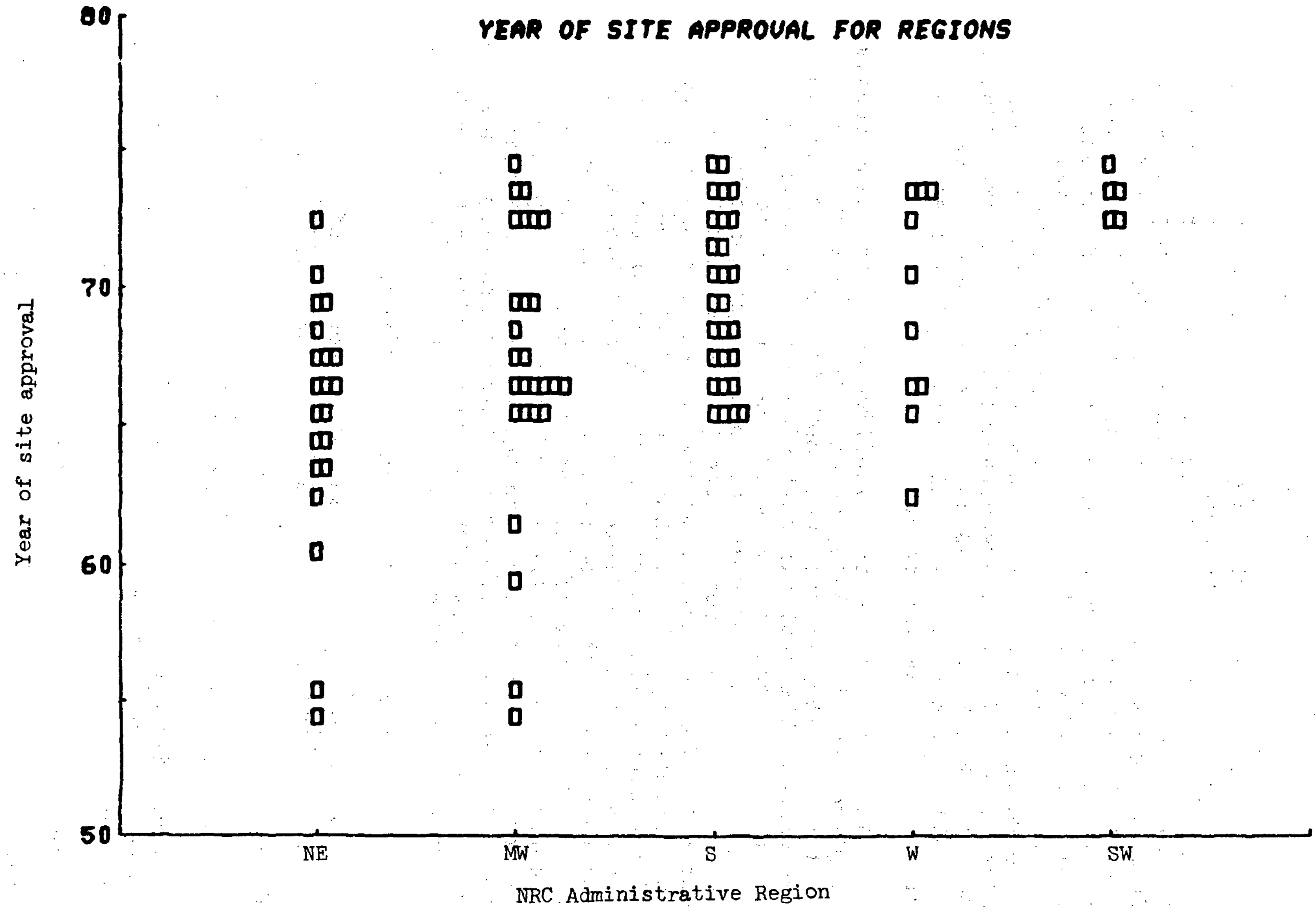

Figure 3-12. Scatter Plot by Region of Year of Site Approval.

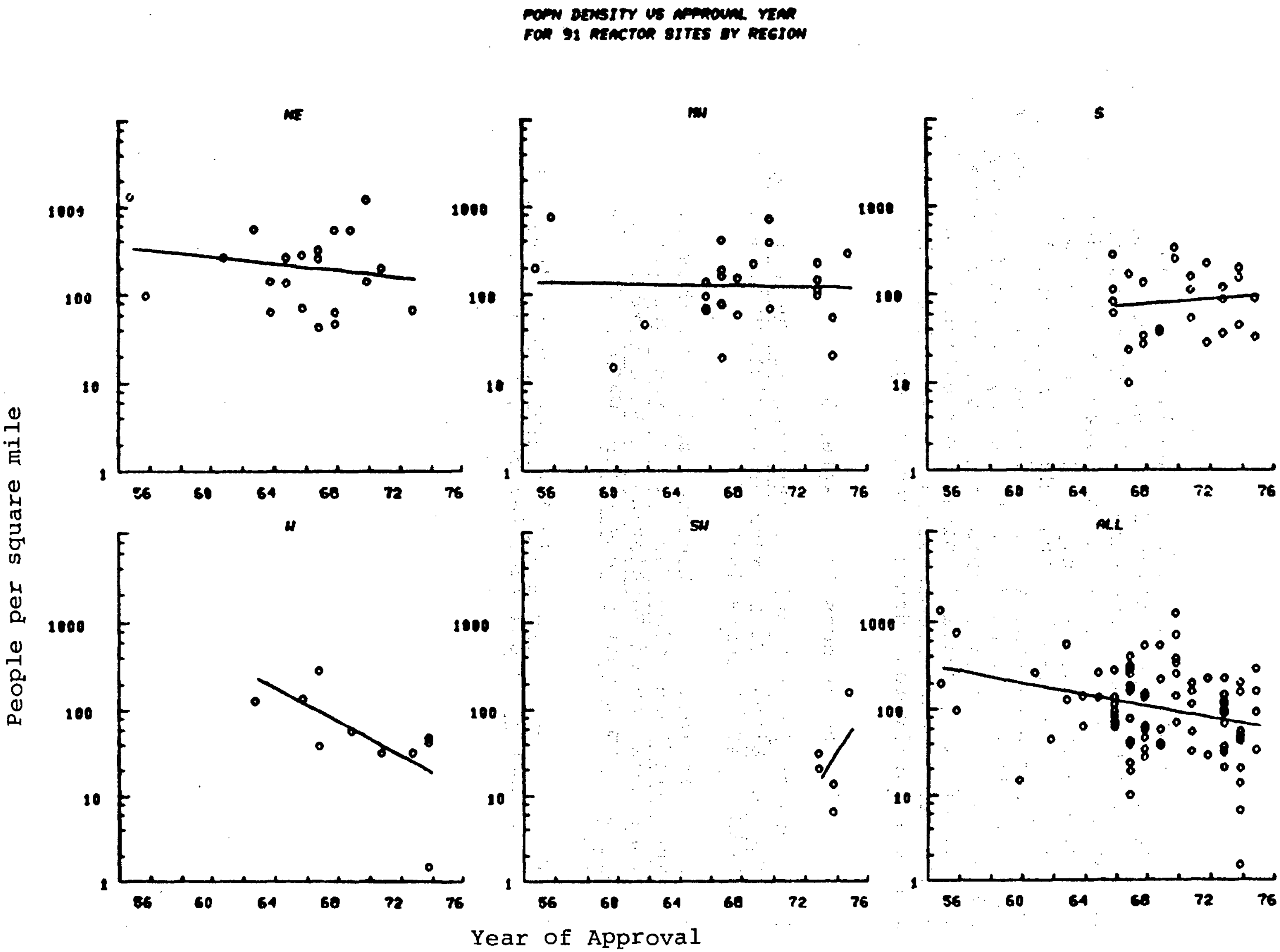

Figure 3-13. Plots of 30-Mile Population Density vs. Year of Site Approval. The lines are the least squares linear fit to the data. The slope of the lines are: NE = -0.04, MW = -0.01, S = 0.03, W = -0.23, SW = 0.7 and All = -0.08.

Table 3-5 suggests that the variability in logarithm-transformed site population data results principally from a common trend with time. Since this common trend is not strong (the slope of the linear correlation for all regions combined is only -0.08), its importance is unclear. It is possible that the trend toward less dense siting with time is (1) real, or (2) an artifact of the data. If the trend is real, it may result from some factor not addressed by this analysis (e.g., with the passage of time, suitable sites near cities become unavailable, so more remote sites are selected, which are necessarily less densely populated).

References for Chapter 3

1. Demographic Statistics Pertaining to Nuclear Power Reactor Sites, U. S. Nuclear Regulatory Commission, NUREG-0348, October 1979.

2. J. E. Kohler, A. P. Kenneke, and B. K. Grimes, The Site Population Factor: A Technique For Consideration of Population In Site Comparison, U. S. Atomic Energy Commission, WASH-1235, October 1974.

3. P. W. M. John, Statistical Design and Analysis of Experiments, Macmillan, New York, NY, 1971.

4. Site Availability Impacts

4.1 Introduction

The previous chapters of this report have examined the potential consequences of accidents at nuclear power reactors and the relationship of site population distribution to consequences. In addition, the population characteristics of current sites were examined. In order to reduce societal risk from siting, it is desirable to locate reactors in areas of low population density. This, of course, forces a trade-off between reduced risk and site availability. To evaluate more precisely the implications of this trade-off, this chapter reports on work performed by Dames and Moore, under contract to Sandia, to study the impacts of siting criteria alternatives on land availability. The study included consideration of the impacts on site availability of environmental factors (seismicity, topographic character, surface and groundwater availability, and restrictions due to regulations (wetlands, National parks, etc.)) as well as population.

4.2 Methodology

The study was performed in three steps: identification of issues affecting site availability, data collection, and analysis and display of data. The final step was performed iteratively, using Dames and Moore's Geographic Information Management System (GIMS), which manipulates geographical data in a grid cell format.

4.2.1 Issues of Concern

A set of general siting issues was defined and used to identify and discriminate more suitable siting areas from less suitable ones. These issues cover a variety of demographic considerations and a diverse set of environmental siting criteria relating normally to costs.

Three issues were defined for population criteria. These are:

1. Stand-off Zones -- restrictions imposed by distance from urban centers of a particular size;

2. Population Density -- a measure of population density within a specified (circular) area; and

3. Angular Population Distribution -- a measure of the uniformity of population distribution within a specified (circular) area.

Four issues were defined for environmental criteria. These are:

1. Restricted Lands -- those areas in which the development of a nuclear power plant is difficult due to legal constraints or the predominance of wetlands;

2. Seismic Hardening -- the additional cost or difficulty of compliance with seismic design criteria; assumed to be measured by the maximum expected (50 year) horizontal ground acceleration expressed in fractions of gravity (g);

3. Site Preparation -- A relative measure of the ruggedness or topographic character expressed as an index which indicates the percentage of land with access and construction difficulty; and

4. Water Availability -- an index reflecting the relative cost of obtaining water for cooling.

The latter three issues were further combined to define an overall environmental suitability measure.

It is necessary to keep in mind that the goal of this study was to provide information regarding land availability and not to select sites on which to construct nuclear power plants. The defined issues were analyzed on a nationwide basis to yield trends and indicate areas on a regional basis that could be considered for selection of power plant sites. Site selection analyses are generally conducted at a more specific scale and level of resolution. This is especially true for environmental criteria. Many site selection issues are related to physical features that are not geographically extensive, or consider factors that are important in the site planning process (which includes the precise location of the reactor and other plant facilities within the site). While these factors are important for specific site identification, they are not considered here.

4.2.2 Data Structure Diagram

A data structure diagram describing the flow of data and information through the Dames and Moore study is presented in Figure 4-1. The diagram shows the sources and flow of information on the demographic and environmental issues as well as how these issues are combined to provide assessments of land availability for various siting criteria.

The data structure diagram is principally an aid to help conceptualize the entire impact analysis. For the most part, each box on the diagram represents a map that was created or a data file that could be displayed as a map.

4.2.3 Display of Results

Results are presented as maps which display the impact of a criterion, which when printed on a transparent medium, can be overlaid on other maps to see the effect of composite criteria. Many of the results are displayed for the whole U.S. as well as for the northeastern section of the U.S. (the most populous region of the country).

In addition to maps, results are presented as tabulations of statistics for each state for various categories of information. Most of this statistical work was performed for comparisons of impacts of environmental suitability and population criteria and is described in Section 4.6.

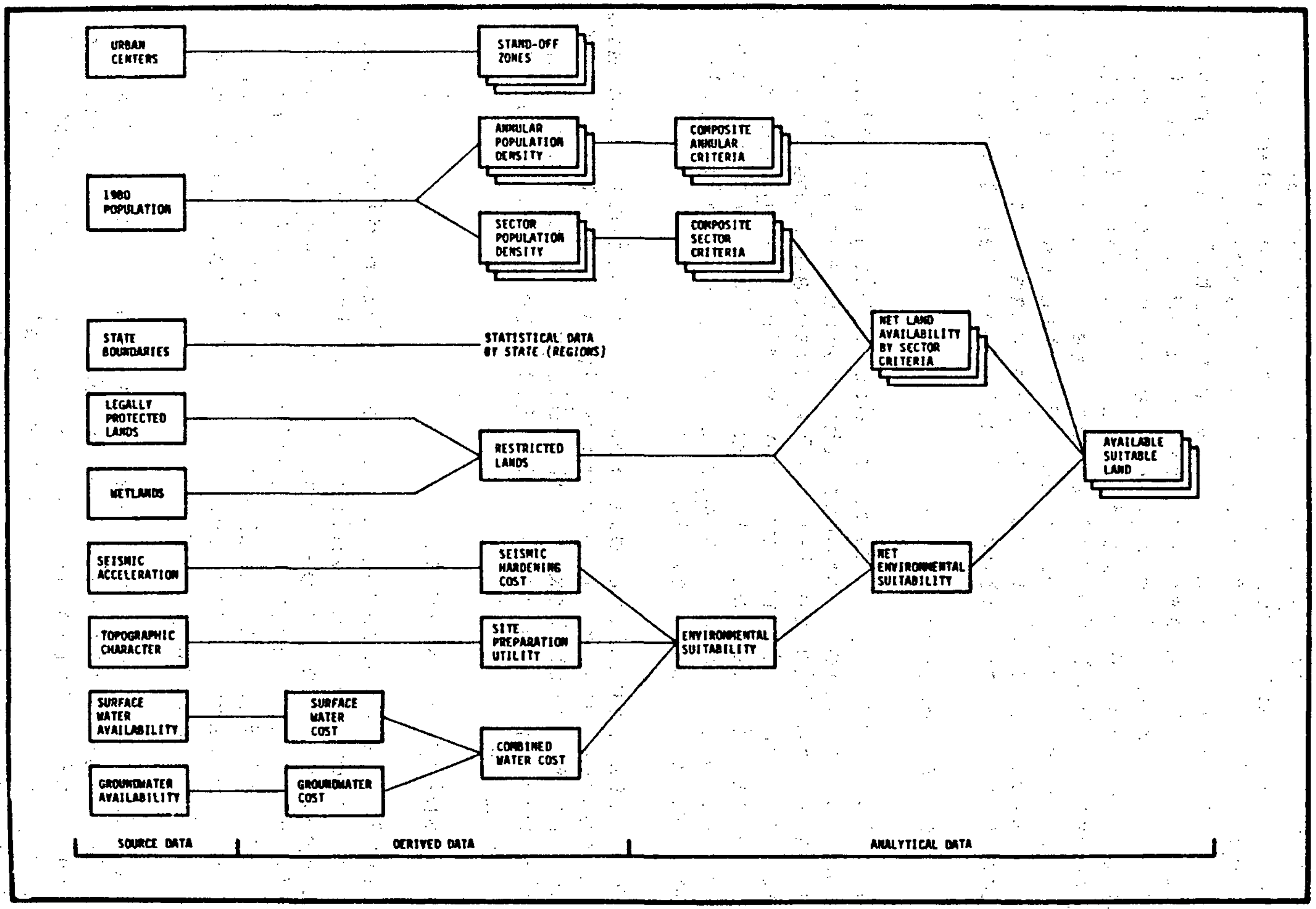

Figure 4-1 Data Structure Diagram for the Dames and Moore Study

4.2.4 Geographic Information Management System

The Dames and Moore Geographic Information Management System (GIMS) was employed for this study. GIMS is a computerized system that provides planners with a comprehensive approach to recording, storing, manipulating and displaying the mappable information used in studies of this nature. The system provides a data base which can be readily updated, and allows evaluation of many alternative criteria that would otherwise be explored by time-consuming manual procedures.

4.2.5 Mapping Approach

The mapping approach is a function of four related factors: (1) characteristics of the study area; (2) nature of the input data; (3) analysis methodology; and (4) desired output or display products. All of these factors are important in determining the base map and grid cell size and shape. Based on these considerations, the Albers Equal Area projection was chosen at a scale of 1:3,168,000 (1 inch = 50 miles) for digitizing input data and displaying output results. In addition, it was decided that data would be analyzed using a grid system consisting of square cells 5 km on a side (each cell represents 25 km^2 or 9.65 square miles). An artificial equal-area grid was placed on the base map by converting longitude and latitude coordinates into X and Y coordinates given in meters on the ground from an origin in the southwest corner of the map. Using grid cells of this size and shape and the Albers projection ensures that any maps produced from the analysis have several important characteristics:

1. Format is consistent with map projection and level of detail of input data;
2. A reliable sampling of population data (especially for the smaller area annuli) is maintained;
3. Computer time and cost are at an efficient level;
4. Maps are of manageable size while retaining important visible regional patterns;

5. Directional bias of analysis is minimal; and

6. Line printer graphics show area relationships truly, and thus, do not distort the implied impacts of criteria.

4.3 Data Base

The data base consists of those data necessary for analyzing both demographic criteria and net environmental suitability. It includes:

1. Demographic Data
   - o Location and population of urban centers
   - o 1980 population estimated for enumeration districts
2. State and national boundaries
3. Restricted lands
   - o Legally protected
   - o Major wetlands
4. Seismic hardening
   - o Seismic acceleration
5. Site preparation
   - o Topographic character
6. Water availability
   - o Surface water availability
   - o Groundwater availability

4.3.1 Demographic Data

Site availability impacts based on demographic characteristics considered both standoff distances from urban centers and surrounding population density and angular distribution. These analyses required two types of data.

4.3.1.1 Urban Centers

Data concerning urban centers were extracted from NUREG-0348 [1]. This publication categorizes urban centers into three groups: those centers with population in excess of 25,000 people, greater than 100,000 people, and greater than 200,000 people. The data were updated with information provided by the NRC to include population figures for urban centers greater than 250,000 people, greater than 500,000 people and greater than 1,000,000 people.

Populations for these urban centers were identified geographically by latitude and longitude coordinates. The degrees of longitude and latitude were converted into X and Y coordinates which corresponded to the same geographic grid that was applied to the Albers base map as discussed in Section 4.2.5. This conversion prepared the data for eventual use in the production of maps showing how much land would be available after imposing population center standoff zone criteria. The analysis of standoff zones is discussed in Section 4.5.1.

4.3.1.2 Population Density

To calculate population density, analyze various criteria, and ensure that the results are reliable in the face of changing national population trends, it was necessary to obtain the most up-to-date and detailed population figures. Figures from the 1980 decennial census were not available in time for use in this study. In their place, estimates for 1980 population were used. Data were supplied by the National Planning Data Corporation (Ithaca, New York). While it is difficult to give an estimate for the percent error, it is believed that the data are quite reliable, especially when individual data points (which correspond to centroids of enumeration districts or block groups) are taken in groups of 4 or 5. This is typically the case in this study. It is especially true for all areas except the most remote and rural. Thus, the data are considered reliable for its intended function, the analysis of population data around the more urbanized areas of the country.

The 1980 population estimates were obtained formatted on magnetic tapes with population figures geographically referenced by latitude and longitude. As with urban center data, the degrees of longitude and latitude were converted into X and Y coordinates on the Albers grid system. This process prepared the demographic data base for analysis of population density. The analysis is discussed in Section 4.5.2.

4.3.2 State Boundaries

Using the Albers base map at 1:3,168,000 scale, all coastlines, international boundaries, and state boundaries were digitized. The area within each state was assigned a unique code to identify it for further use. The state boundaries map file allows analysis or display of results on an individual state basis or by any group of states.

4.3.3 Restricted Lands

The nature of certain areas of the country causes them to be protected or restricted from development. Two types of lands were considered as restricted: legally protected lands and existing wetlands.

4.3.3.1 Protected Lands

The Energy Reorganization Act of 1974 (Section 207) states that national forests, national parks, national historic monuments and national wilderness areas should be excluded from consideration as potential nuclear energy center sites. While this study did not deal with nuclear energy centers, it is reasonable to consider such lands as protected from the siting of a single nuclear power plant, regardless of a national policy on this matter. Utility industries tend to avoid such areas because of the possibility of time consuming and costly legal battles. The following areas were considered to be protected:

- National Parks
- National Forests
- National Monuments
- National Wilderness Areas

- National Grasslands
- National Wildlife (Game) Refuges
- National Recreation Areas
- National Seashores
- State Parks
- State Forests
- State Reserves/Refuges
- State Recreation Areas
- Military Reservations
- Indian Reservations

Three different map sources were used to obtain the locations of these protected lands. The United States base map utilized in this study (compiled by the U.S. Geological Survey, 1965) was used to extract the location of national parks, forests, monuments, wildlife refuges, and Indian reservations. Sectional sheets at a scale of 1:2,000,000 from the National Atlas [2] were used to update the boundary information for the above protected lands as well as to obtain the location of national recreational areas. Because of the relatively small size of protected state areas and some protected national areas, a screening process was used for certain types of land, rather than identifying and digitizing every one. Because this study dealt not with site selection but with the general patterns of land availability, a minimum size screen of 100 square miles was used for the following types of areas: military reservations, national grasslands, state parks, state forests, state monuments, state reserves and refuges, and state recreational areas. Information for these types of lands was obtained from the 1980 Rand McNally Atlas, as this was the most detailed, up-to-date and uniform source of information.

4.3.3.2 Wetlands

Besides the above legally protected lands which would be restricted from development either on the basis of national policy or avoidance on the part of the utility industry, certain types of environmental restrictions might be imposed as well. For this study, one such environmental constraint was applied -- namely, the location of major wetlands. It is the policy of the Water Resources Council to ensure the protection of wetlands from adverse impacts and degradation [3].

No uniform nationwide data base exists regarding the location of major wetlands. After consideration of several approaches to defining the extent of wetlands in an efficient manner, a source was found to satisfy the needs of this study. The 1:2,000,000 scale sectional sheets of the National Atlas [2] were used to outline the extent of major wetlands. At this scale, only major wetlands can be shown. A comparison of these source data with more detailed map data shows that some of the wetland boundaries have been generalized and most wetlands less than 60 square miles were probably not shown on the sectional sheets.

The locations of both protected lands and wetlands were digitized into separate map files. Each of the 15 different types of protected lands was given a unique identifying code to allow individual consideration of each type of protected land. The two map files were added together to produce a map file called restricted lands (Figure F1 in Appendix F). The restricted lands file was later added to the individual environmental issue map files as well as the environmental suitability map file to produce maps showing the location of restricted lands, and conversely, the net availability of land.

4.3.4 Seismic Hardening

There are generally three major factors to be considered in the seismic evaluation of a nuclear power plant site:

1. Fault Rupture Hazard -- primarily a siting problem;

2. Dynamic Soil Stability (liquefaction) -- both a siting and a design problem; and

3. Strong Ground Motion (vibratory) -- both a siting and design issue.

Siting requirements are specified by the NRC [4] and the evaluation of a site (for design purposes) is based on the additional cost imposed by the site-related conditions. Although a detailed site qualifications study would require the careful consideration of all three factors, their evaluation generally requires effort far beyond the scope of this study. However, after careful consideration of their overall impact, a methodology was developed for a coarse screening process which reflects the overall impact of these factors. The data necessary to evaluate the potential problem from the standpoints of rupture hazard and dynamic soil stability were not uniformly available throughout the United States. For this reason, seismic hardening was evaluated solely on the basis of vibratory ground motion.

Strong ground motion criteria are determined by the postulated Safe Shutdown Earthquake (SSE) which is the largest possible event on the controlling seismogenic feature, which could be a capable fault (not necessarily the closest one) or a tectonic province. The SSE is determined on the basis of historical earthquake data (seismicity) and detailed investigation of the length and capability of nearby faults, according to procedures specified by the NRC [5]. The plant must be able to survive such an earthquake in a manner which will not result in the release of radioactivity in excess of stated limits. An additional design requirement is imposed by the Operating Basis Earthquake (OBE) which is commonly defined as having a peak acceleration equal to 1/2 that of the SSE. The plant must be designed so that it can continue to operate during and after an OBE: alternatively, none of the structural or mechanical components may be stressed beyond their elastic limit by the OBE.

While the detailed investigations required for the determination of the SSE for each 5 km by 5 km grid cell were clearly beyond the scope of this study, it was possible using available data to probabilistically evaluate the relative severity of the strong ground motion hazard in the study area and consider costs of seismic hardening. This was accomplished using probabilistic studies of seismic risk prepared by Algermissen and Perkins [6] and the Applied

Technology Council (ATC) [7] and supplemented with information from a U.S. Geological Survey professional paper [8]. The ATC map represents an adaptation of a comprehensive analysis by Algermissen and Perkins. The map shows accelerations in bedrock expressed as a fraction of gravity. The combination of these three sources resulted in the seismic acceleration source data map illustrated in Figure F2, Appendix F.

The map shows the horizontal acceleration (expressed as a fraction of gravity) in rock with a 90 percent probability of not being exceeded in 50 years. According to Algermissen and Perkins:

> "Certain facilities such as nuclear power plants may require design adequate for accelerations with exceedance probability no larger than 0.5 percent in 50 years. For structures for which very low exceedance probabilities are appropriate, it is clear that this source map indicates only a relative idea of the hazards -- the design motions will be high for much smaller exceedance probabilities. In those regions where seismicity is lower than in California, the accelerations shown on this map vary with return period according to the very approximate rule: the level of motion doubles as the return period increases by 5 (exceedance probability decreases by 5)."

This rule was used to modify the values on the source data map. The exceedance probability was decreased by a factor of 5 -- from 10 percent to 2 percent -- and the acceleration values were doubled. Another iteration of this process decreased the exceedance probability from 2 to 0.4 percent and again doubled the acceleration values. The new values were then considered to be four times the values expressed in Figure F2. Thus, the data in the modified map file became consistent with the notion of using a 0.5 percent exceedance probability for nuclear power plants (as suggested by Algermissen and Perkins).

The seismic risk source data file was further adapted by interpolating between the contour levels to develop a more continuous distribution of seismic risk (horizontal acceleration). The continuous distribution was desirable from a siting standpoint, so that sites falling on either side of a dividing contour would not appear to have greatly differing seismic requirements. (The contours of the source map do not generally have any geological significance which would warrant such sharp distinctions.) It is still recognized that the absolute resolution of the source data map is probably no more precise than the contour intervals given. However, the relative ranking of areas for reactor sites is probably representable to the finer resolution implied by the interpolation.

The general impact of seismic design requirements is assumed to be proportional to the specific cost of the additional design and construction features required to satisfy the seismic design requirements. In NUREG/CR-1508 [9], seismic hardening costs were calculated and shown on a graph relating the Safe Shutdown Earthquake expressed as a fraction of gravity to the estimated cost differential in millions of dollars. The cost curve used in this study is shown in Figure 4-2.

The map shown in Figure F2, Appendix F, indicates that the lowest acceleration contour is equal to 0.05g. Remembering that the exceedance probability was twice decreased by a factor of 5 (thereby twice doubling the ground motion), the lowest acceleration contour may now be considered equivalent to 0.2g. By applying Stevenson's cost information to the modified probabilistic seismic acceleration information, a cost surface that shows the additional cost of seismic hardening was generated.

Using the curve shown in Figure 4-2, acceleration values between 0.2g and 0.6g (0.05 and 0.15 on the source map) were assigned costs ranging from $23.7 million to $55.5 million. Acceleration values of less than 0.2g were assigned a cost of $23.7 million (the same as for 0.2g). This was because nuclear power plants in the U.S. are designed for an SSE of 0.2g, although it may be possible to build them more cheaply. For acceleration values greater than 0.6g, it was felt that there is no reasonable way to accurately estimate the increased costs of seismic hardening. Rather than assign a cost, they were labeled "inestimably high".

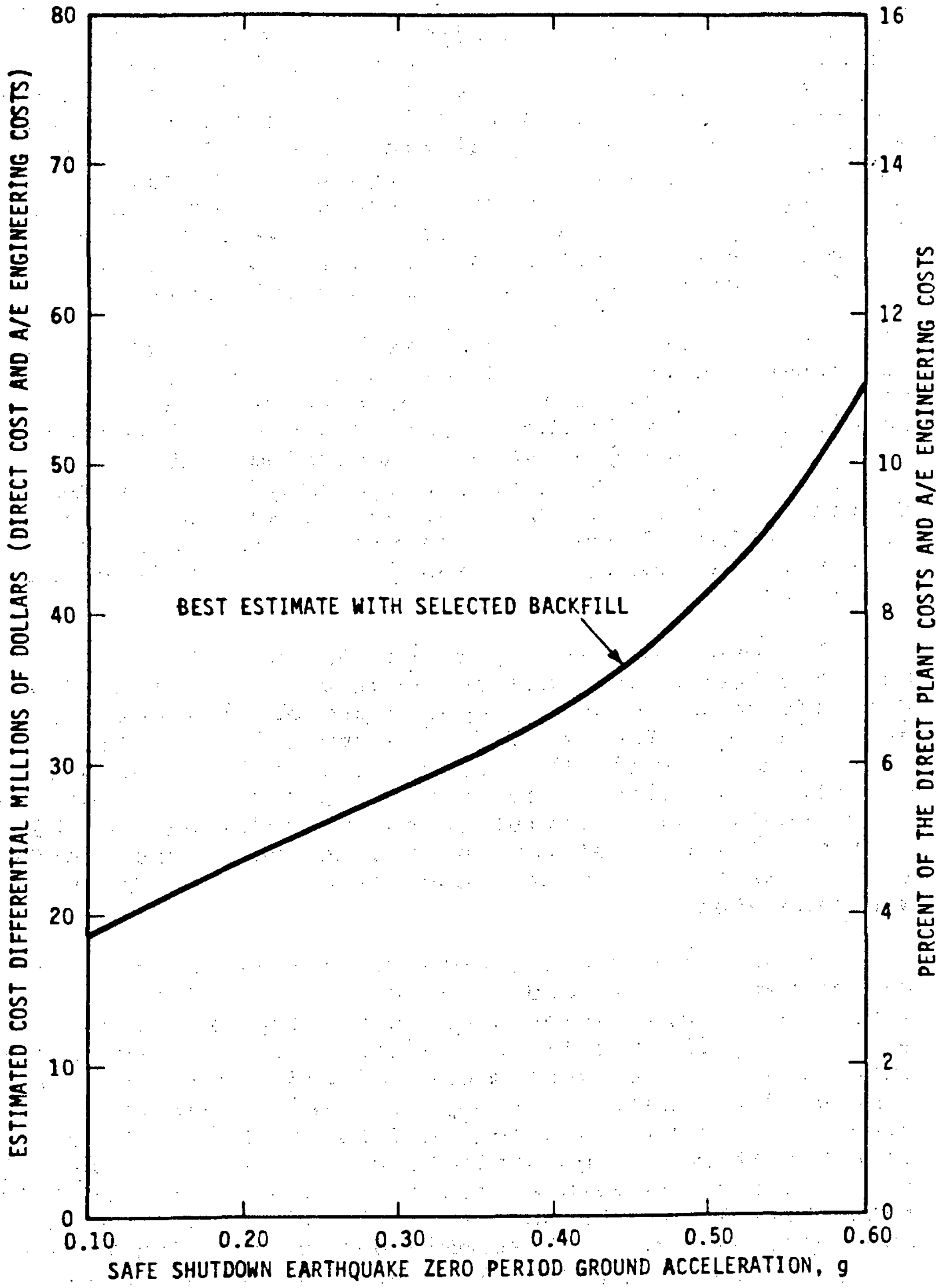

Figure 4-2. Cost Increase As A Function Of Seismic Load for Nominal 1100-MWe Nuclear Power Plant (1977 Dollars)

The costs derived from Figure 4-2 (1977 dollars) were next converted to 1980 dollars yielding a low of $31.5 million and a high of $73.9 million. To calculate the cost of seismic hardening that was considered as "additional", the design-basis value of $31.5 million was subtracted from all the costs. This resulted in a range of costs of 0.0 to $42.4 million. The graphic display of seismic hardening cost is shown in Figure F3, Appendix F.

4.3.5 Site Preparation

An increase in slope or ruggedness of terrain translates directly into increased cost for construction. This includes the difficulty that may be encountered in excavation for foundations, construction of access roads where low grades are required (due to the transport of large components such as the turbine or pressure vessel), and finally, measures that must be taken to mitigate environmental disturbances such as control of run-off and erosion from cut slopes.

To evaluate the impact of topographic character on site preparation cost over a large regional area, a general index that indicates both the steepness of slopes and the areal extent of such slopes was sought. Such data was found in a paper by E. H. Hammond [10] and his map which was adapted and found in the National Atlas [2]. Regions on the map are characterized by the percentage of their area which is classified with a topographical gradient of less than 8 percent slope (gently sloping). The 8 percent slope is not a critical threshold value for land utilization. It does, however, indicate a value beyond which movement of vehicles becomes impeded, and in general, construction and operation becomes more difficult.

The smallest region delimited and given a classification has an area of about 800 square miles. Smaller areas are omitted or absorbed into the adjacent region that they most resemble. With this level of resolution, it is possible that sites suitable for building a nuclear power plant exist within the area characterized by even the highest proportion of rugged terrain. However, at this regional level of analysis, these special conditions are not practically observed. Because not only site ruggedness but the ruggedness of the access route for implacement of heavy components affects the construction costs, the analysis of site preparation costs is based solely on the general indication of topographic character, as defined by the data. Figure F4, Appendix F, is a map showing the source data with grey tones implying preparation costs. Four terrain classifications are shown: regions with less than 20%, 20 to 50%, 50 to 80%, and greater than 80% gently sloping (less than 8% slope).

4.3.6 Water Availability

Cooling system cost has become a major component of total power plant cost. Several factors are involved in determining cooling system cost: the type of cooling system -- mechanical draft wet towers, natural draft wet towers, cooling ponds, or once through cooling; climatic temperature distributions; existing priorities for use of available water; and restrictions such as wild and scenic rivers. While a detailed analysis of these factors is beyond the scope of this study, a methodology was developed to present a general picture of water availability and the cost involved in its use. Sources of both surface water and groundwater were mapped and costs were determined for each. The two map files were then overlaid, and a map was produced showing the least cost of available water.

4.3.6.1 Surface Water

Hydrological implications of water consumption by nuclear power plants have been discussed by Giusti and Meyer [11]. Many existing power plants are located on sites next to streams and draw their water directly from those streams without provisions for significant storage. In siting plants along rivers one must consider the periods of low flow when the impact on the water resources of total water consumed in the cooling process is at a maximum. This consideration is especially significant for plants that do not use cooling ponds with a large amount of storage capacity. In light of this, it is important to have reliable estimates of the low flow of streams from which plants can draw cooling water. According to Giusti and Meyer there are several reasons for estimating these flows:

1. Safety -- the regulatory staff of the U.S. Atomic Energy Commission (1972) in reference to a safety analysis report for nuclear power plants states:
"Estimate the probable minimum flow rate resulting from the most severe drought considered reasonably possible in the region as such conditions may affect the ability of the ultimate heat sink to perform adequately.";

2. Standards -- most states have issued standards regarding the maximum permissible mineral concentration in surface water to be used for cooling. As is well known, this concentration is at a maximum at a low flow period because the flow consists of groundwater discharge which is normally more concentrated mineralogically than surface water. Additional concentration of the stream flow mineral content is brought about by transpiration which is also at a maximum during low flow periods;

3. Ecology -- maximum ecological impact on fresh water biota can occur on some streams during low flow periods if the mineral concentration exceeds certain limits or if the flow is abruptly reduced by withdrawal at power plants. Furthermore, the withdrawal entails loss of biota by physical entrainment on the intake screens or by physical injury on passage through the water pumps; and

4. Plant Operation -- the conditions described above may be such as to force the shutdown of the plant, with contingent costs and loss of revenue to plant operators and loss of service to consumers. While this may be considered an acceptable operational rule under exceptional circumstances, say once in 10 years, it becomes a serious problem of misdesign when recurring more often, say once every year.

Stankowski, Limerinos, and Euell [12] have examined the low water flow in the United States to provide information regarding potential sources of cooling water. They have prepared a map which identifies those streams for which the average 7-day low flow with a recurrence interval of 10 years is at least 300 cubic feet per second (cfs). (The 7-day, 10-year low flow or 7Q10, is the average low flow that occurs over 7 consecutive days with a probable recurrence of 10 years.) Their map shows those stream reaches that: (1) have a 7Q10 of at least 300 cfs, or (2) could furnish a sustained flow of at least 300 cfs if storage were provided. For their study, 300 cfs was selected as the needed flow in the stream on the assumption that many states will not permit more than 10 percent of the dependable flow to be withdrawn for a consumption use. Ten percent of 300 cfs equals 30 cfs which is the amount of water that might be considered necessary to cool a 1,000 MWe nuclear power plant if cooling towers, sprays, or ponds are used. The requirement of 30 cfs for cooling is in agreement with the information produced by Giusti and Meyer [11]. The Stankowski, et al., map was digitized and used as a source map to show surface water availability.

To extend the utility of surface water information, the map file showing surface water availability was converted into a map showing surface water cost. First, an estimate was made of the dollar per mile pumping cost to move surface water. These costs were estimated for each of the four terrain types characterized for site preparation (Section 4.3.5). Both an initial capital cost and a 30-year operating and maintenance cost were estimated. In addition to the pumping cost, a penalty cost was added for those streams that required the use of reservoirs in order to sustain a 7Q10 of 300 cfs. Based on this information, a computer model was used to calculate, for each cell, the cost of obtaining surface water as a function of pumping costs over a variety of terrain and the potential use of a reservoir. The model determined the least of the cost alternatives for supplying surface water to a cell. The cost information was mapped and is shown in Figure F5, Appendix F. There are eight equal interval levels between zero and $300 million. Costs above $300 million were grouped together -- amounting to about 10 percent of the study area. This grouping at the high cost end allows regional differences in the more reasonable range of costs to be displayed.

4.3.6.2 Groundwater Availability

Groundwater is an important source of cooling water in many parts of the country. Characteristics of groundwater can vary quite dramatically within a small region. Despite this, an attempt was made to locate a source of information that would satisfy the broad scale requirements of this study. Using the USGS Water Supply Paper 1800 [13], and supplementing this with such maps as the Hydrologic Investigations Atlas [14], Tectonic Map of North America [15], and Shaded Relief of U.S. [16], major regions and subregions of the country were mapped as source data. Although variability exists within any one of the regions or sub-regions, regions do show differences regarding their characteristics of quality, quantity, depth to water, and required well field size.

Based on these characteristics, cost information was applied to the map data. Both capital costs and 30-year operating and maintenance costs were calculated for each of the delimited areas on the basis of dollars per well. To obtain the equivalent of 30 cfs from any of the generalized aquifers, it would be necessary to sink several wells. The required number of wells was calculated by dividing 30 cfs by the expected yield per well of the given aquifer. Multiplying this number of wells by the cost per well resulted in the cost associated with bringing 30 cfs to the surface from any of the generalized aquifers. It was observed that several of the generalized aquifer areas require well fields which are too large for practical use. For these areas, groundwater was considered to be unavailable in a practical sense. For reasonably sized well field areas, the cost of collecting the water from numerous wells and bringing it to a single point was estimated. For each of the groundwater regions, the two costs -- that of bringing the water to the surface, and that of collecting the water from a well field, were added together. The cost data were then mapped as is shown in Figure F6, Appendix F.

4.3.6.3 Combined Water Costs

Using the cost information for both surface water and groundwater, a map file was created which indicated the cost of obtaining cooling water using the least expensive alternative. To do this, the two map files -- surface water costs and groundwater costs, were compared on a cell-by-cell basis. For every cell, the lowest cost value was saved and placed into another map file. This was called "combined water cost" and the map is shown in Figure F7, Appendix F.

4.4 Environmental Suitability Analysis

In order to evaluate the impact of demographic criteria on land availability it was necessary to first establish a base of available land. This base was constructed from the protected area and environmental consideration data bases. The environmental factors were combined by dividing utility functions for each factor, and then summing the utility values within each cell. The protected areas were then overlaid on this data.

4.4.1 Individual Site Availability Issue Assessments (Utility Functions)

To evaluate the suitability of each potential site area, each of the siting issues was first evaluated independently. This evaluation was accomplished by defining a utility function for each issue such that the characteristics of a specific site area could be translated into a value on a defined suitability scale. This was a numeric scale ranging from 1 to 9, where 1 was the lowest level of suitability and 9 was the highest.

4.4.1.1 Seismic Hardening Cost Utility Function

The issue of seismic hardening was assigned a utility function on the basis of additional hardening costs as discussed in Section 4.3.4. Table 4-1 shows the data categories of seismic hardening costs and their corresponding utility value.

A map of the seismic hardening utility function was produced and is shown in Figure F3, Appendix F. (This is the same map used to show the cost of seismic hardening.)

TABLE 4-1

SEISMIC HARDENING UTILITY FUNCTION

Cost in Millions of 1980 Dollars	Utility Value
0.0 to 6.1	8 (high suitability)
6.1 to 12.1	7
12.1 to 18.2	6
18.2 to 24.1	5
24.1 to 30.3	4
30.3 to 36.4	3
36.4 to 42.4	2
No reasonable estimate	1 (low suitability)

4.4.1.2 Site Preparation Utility Function

Actual dollar costs associated with site preparation could not be located as source data. However, discussions with authorities in the construction of nuclear power plants as to how the topographic character of the landscape might affect the site preparation costs have allowed for the assignment of the utility values to terrain classifications which were discussed in Section 4.3.5. These are shown in Table 4-2.

A map of the site preparation utility function was created and is shown in Figure F4, Appendix F. (This is the same map used to show the site preparation source data.)

TABLE 4-2

SITE PREPARATION UTILITY FUNCTION

Topographic Character (percent of area that is gently sloping*)	Utility Value
>80 percent	8 (high suitability)
50 to 80 percent	5
20 to 50 percent	2
<20 percent	1 (low suitability)

*Gently sloping means 8 percent slope.

4.4.1.3 Water Availability Utility Function

Utility values have also been assigned to data representing the cost of obtaining cooling water. Based on this cost information (described in Section 4.3.6), costs in excess of $300 million were grouped together and assigned the lowest utility value. For costs less than $300 million utility values were assigned on the basis of 8 equal intervals as shown in Table 4-3.

TABLE 4-3

WATER AVAILABILITY UTILITY FUNCTION

Combined Water Cost (in millions of 1980 dollars)	Utility Value
0 to 37.5	9 (high suitability)
37.5 to 75.0	8
75.0 to 112.5	7
112.5 to 150.0	6
150.0 to 187.5	5
187.5 to 225.0	4
225.0 to 262.5	3
262.5 to 300.0	2
>300.0	1 (low suitability)

A map was prepared showing the water availability utility function and is shown in Figure F7, Appendix F. (This is the same map used to show the combined water cost.)

4.4.2 Site Availability Issue Overlay

Using the utility functions, each issue map was translated into a partial suitability map where each potential site area was represented by a utility value. These individual suitability maps are represented in Figures F3, F4 and F7. They are considered partial suitability maps because each includes only one siting issue. They were combined into a composite suitability map by adding the individual map files together. It was felt that the reconnaissance nature of this study, as well as the broad scale representation of environmental data, did not justify a more sophisticated manipulation of the files. For this reason, the three maps were overlaid -- each with an equal importance weighting.

The addition of the three utility value map files resulted in a map file with values ranging from 4 through 25 -- each value having a different frequency of occurrence. Maintaining the relationship that high values represented the most suitable land, the distribution of the composited utility values was divided into five intervals. The intervals were selected to include equal land areas. This resulted in five categories or levels of environmental suitability -- each level representing 20 percent of the data base. The restricted lands file was then added to the composite utility value file. A color-coded version of a map produced from this combined file was supplied to NRC.

4.4.3 Environmental Statistics

Analysis of the impact of various siting criteria on land availability was accomplished in two ways: creation of maps to visually show these impacts and production of statistics to quantify the impacts. The maps concerning environmental factors have been presented elsewhere in this section. To quantify the impacts of various siting criteria, tables were prepared which used the data files created during the visual or map analysis. Statistics regarding the amount of area in each data category were computed for each of the 48 states.

For each of the three environmental issues -- seismic hardening costs, site preparation costs, and water availability costs -- a table was prepared that shows the amount of land in each of the categories that was represented by a utility value. Two additional tables were produced: one for surface water cost and one showing the five different levels of composite environmental suitability. These statistics are shown in Tables F1.1 through F1.5, Appendix F. The numbers in each column indicate the amount of land in the specified category. The area is shown in square miles as well as percent of the total state area.

4.5 Demographic Analysis

As discussed in Section 4.2, three issues were defined as relevant to population criteria - stand-off zones, population density, and angular distribution. Stand-off zones are restrictions on distances from urban centers to nuclear plant sites. Population density is a measure of the persons per square mile within a specified (circular) area surrounding a site. The population density calculations were mapped as single data files or in combination with other annular densities to produce composite population criteria maps. Angular distribution restrictions are limitations on the permissable population within one or more 22 1/2° sectors surrounding a site.

4.5.1 Stand-off Zones

To study the impact of restrictions imposed by distance from urban centers, stand-off zone maps were prepared. As discussed in Section 4.3.1, populations and locations were provided for urban centers of a variety of sizes. The location of these urban centers was indicated by a single latitude/longitude coordinate which was converted to a Y and X coordinate corresponding to grid cells on the Albers base map. Urban centers were grouped according to their size: greater than 25,000, 100,000, 200,000, 250,000, 500,000 and 1,000,000 people. For each grid cell in the study area, its distance from the nearest urban center of a particular size was computed. This resulted in six separate data files. These files were converted into maps by specifying a threshold distance at which a cell would be considered either suitable or unsuitable for siting a nuclear plant. Based on the above data, thirteen such stand-off maps were produced. The maps produced are indicated in Table 4-4 and presented in Figures F8.1 through F8.13, Appendix F. The maps illustrating stand-off zones from the three largest cities were created only for the northeastern U.S.

Maps of stand-off zones are quite self-explanatory. There is a direct relationship between the stand-off distance and the amount of area that is constrained by the specified criteria.

TABLE 4-4

STAND-OFF ZONES

Size of Urban Center	Mapped Stand-Off Distance (in miles)
25,000	5, 10
100,000	10, 15, 25
200,000	25, 30, 40, 50, 100
250,000	12.5
500,000	18
1,000,000	25

An example of these maps is shown in Figure 4-3.

4.5.2 Population Density

A wide variety of population distribution criteria based on density surrounding a prospective site were studied for their impact on land availability. Densities were calculated for both circular areas and annular areas. As described in Section 6.3.1, population source data was identified by a latitude and longitude coordinate system. These coordinates were converted into the Y and X coordinates compatible with the Albers grid base map. This raw data were then converted into a set of map files giving the population density of an area a given radius centered on each cell. Maps of varying thresholds were produced from these files. The matrix shown in Figure 4-4 indicates all of the map files that were produced regarding population density. An "X" in a box means that the map files were produced for both the total US and the northeastern window. An "NE" in a box means that the map file was produced only for the northeast. An example of these maps is shown in Figure 4-5. Maps representative of the variety of population densities are shown in Figures F9.1 through F9.26, Appendix F.

An understanding of the spatial relationships produced by various criteria can be gained by comparing some of the maps. Figure F9.5 shows the areas constrained by a density threshold of 100 people per square mile in the 0-5 mile circle. Figure F9.8, concerning the same circle employs a density threshold of 500 persons per square mile. It is obvious that

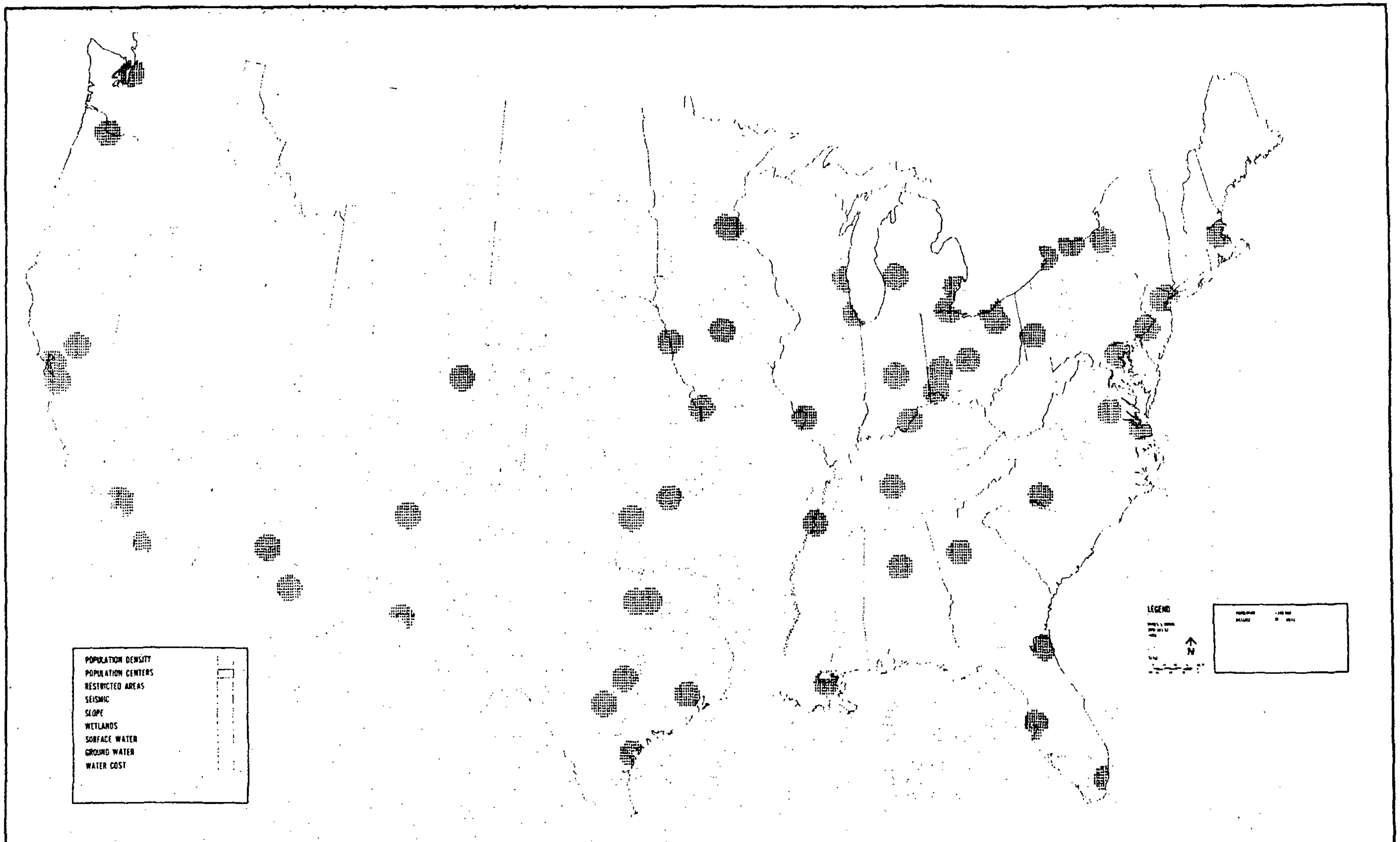

Figure 4-3. Example of Standoff Zone Maps.

ANNULUS RADII IN MILES	DENSITY PEOPLE/SQUARE MILE ≥100	≥150	≥200	≥250	≥350	≥400	≥500	≥750	≥800	≥1000
0-2	X			X			NE	NE		
0-5	X		X		X		X			
0-10	X		X		X		X			
0-20			X							
0-30							X			X
5-10		X			X		X			
5-20									X	
10-20						X	X			X
20-30							X			X
30-50							X			X

Figure 4-4. Annular Population Density Data Files

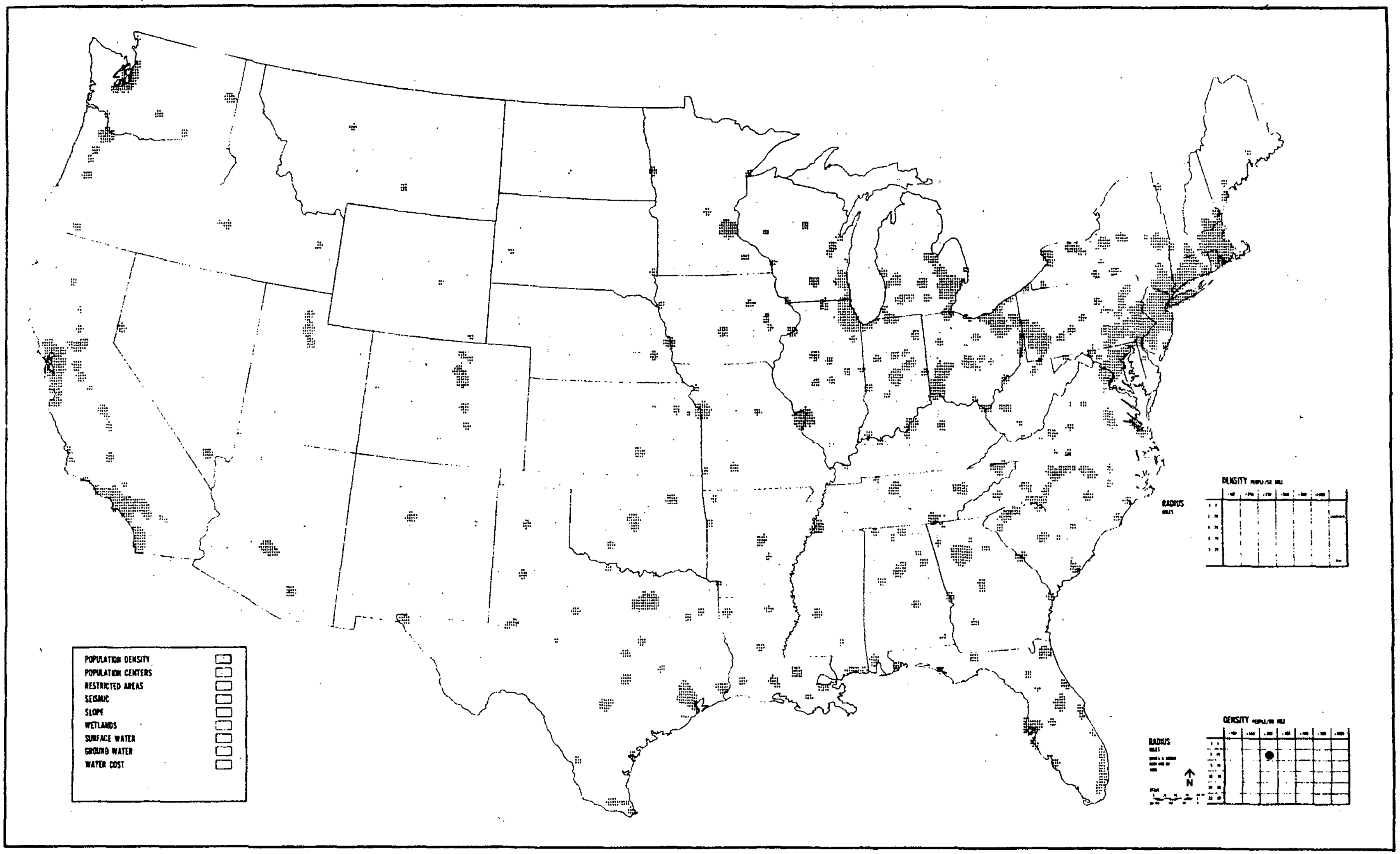

Figure 4-5. Example of Annular Population Density Data Maps.

every area constrained in Figure F9.8 is also constrained in Figure F9.5. If the size of the annulus remains constant, the area constrained using a higher density threshold is always completely contained within the area constrained by a lower threshold. In addition, the use of a lower density threshold as in Figure F9.5, constrains a much greater portion of the suburban and rural land areas.

Spatial differences are also noted through a comparison of circle size while maintaining a constant density threshold. For example, compare Figure F9.8, which shows the areas constrained by a 500 people per square mile density threshold within the 0-5 mile circle, with Figure F9.14 which applies the same threshold to the 0-30 mile circle. Use of the larger radius tends to constrain only the urban and some suburban areas of major cities. None of the rural or smaller urban areas are constrained and the impacts look similar to those which result from stand-off zone criteria.

Another interesting spatial effect of the demographic criteria can be seen on any of the maps in which the annulus is defined using an inner radius greater than zero. In these cases, the annulus surrounding a prospective site is shaped like a ring rather than a circle and the effect is that the shape of some of the constrained areas is also that of a ring. The occurrence of this type of pattern depends upon the specified density threshold in conjunction with the limits of the annulus and the population data itself. For example, Figure F9.23 indicates the amount of land constrained if a criterion of 500 people per square mile in the 20-30 mile annulus were applied. Note that in the St. Louis area the land surrounding the city would be constrained -- but not the land comprising the city. St. Louis' land area is small enough so that a relatively small population is located between 20 and 30 miles of the city center, and yet the city population is large enough to cause the density threshold to be exceeded in the surrounding areas. Chicago, on the other hand, occupies an area large enough so that grid cells at the city center are within 20 to 30 miles of significant population and the pattern of constrained land is solid.

A comparison of the St. Louis area between Figure F9.23 and Figure F9.21, which employs the same density threshold within the 10 to 20 mile annulus indicates not only the absence of a ring structure but also a shrinking of the extent to which land is constrained using the smaller annulus. The pattern of the area constrained near Chicago remains solid in both figures; however, both the extent and amount of land increase with increasing annular radii. Thus, if the density threshold remains constant, the extent from the central city of the criterion's effect increases with increasing annular radius. However, the total amount of land constrained may not increase accordingly due to the possible elimination from constraint of the central city.

4.5.3 Composite Population Densities

When using a criterion of the form of less than 500 people per square mile from 2 to 30 miles, it is possible for a cell to satisfy that criterion, while it doesn't satisfy a 500 people per square mile criterion out to only 15 miles. This occurs when there is a dense population pocket surrounded by low density areas. In order to pinpoint areas for which this occurs, a new set of criteria were developed which restricted population to a given density for all radii from an inner radius to an outer radius. Thus, for the example of 500 people per square mile from 2 to 30 miles, the new criterion is satisfied only if the population density is less than 500 people per square mile from 2 to R miles, where R takes every value from 2 to 30.

Evaluating population density for every radius from the inner radius to the outer radius is impractical in practice, so an approximation is used.

Using the example of mapping any cells that exceed the 500 persons per square mile threshold for the 2-30 mile annulus, density calculations were made for 6 portions of the 2-30 mile annulus and were then composited. First, any cell that exceeded the 500 persons per square mile threshold within the 2-3 mile annulus was recorded. Next, unsuitable cells in the 2-4 mile annulus were recorded and unsuitable cells in the 2-5 mile annulus were recorded. This process was repeated for the 2-10 mile annulus, 2-20 mile annulus, and the large 2-30 mile annulus. These 6 individual files were then added together, creating a file in which a cell that was shown to be unsuitable in any of the 6 was also considered unsuitable for the 2-30 mile composite annulus. In this manner, data files were created for the 2-30 mile composite annulus for the following densities.

250 persons/square mile
500 persons/square mile
750 persons/square mile
1,000 persons/square mile
1,500 persons/square mile

Example maps for the northeast are shown in Figures F10.1 thru F10.4, Appendix F.

Besides creating a composite map file for a particular annulus (such as 2-30 miles) and a particular density (such as 500 persons per square mile), another type of composite was created. This consisted of two separate annuli -- each with its own given population density threshold. For example, as discussed above, 6 individual data files were added together to create the 2-30 mile composite annulus. Now, a different annulus with a different population density threshold was added to the 2-30 mile composite annulus. Two maps were created in this manner and are shown in Figures F11 and F12, Appendix F. Each map shows cells that are considered unsuitable for the 2-30 mile composite annulus (with density of 500 persons per square mile) as well as for the 0-2 mile annulus for population densities of either 100 persons per square mile or 250 persons per square mile. In addition to these two mapped data files, other complex composite files were created. Some of these were used for statistical analyses in combination with the environmental criteria. (These statistics are discussed in Section 4.6). The six complex composite data files which were created are indicated in Table 4-5. The numbers in the columns underneath the two annuli represent population density figures (persons/mile^2).

TABLE 4-5

COMPLEX COMPOSITE POPULATION DENSITIES

0-2 Miles		2-30 Miles (Composite)
(1)	100	250
(2)	100	500
(3)	250	500
(4)	250	750
(5)	500	750
(6)	500	1500

4.5.4 Sector Population Density

To this point in the chapter, any potential demographic criteria addressing population density were analyzed using what might be termed a uniform density distribution. Criteria were stated in terms of the number of persons that would be allowed in an area of a given size -- that is, population density -- and the shape of the area was always circular. Using a circular area allowed relatively dense concentrations of population to exist provided that the total number of people within the circle did not exceed a stated limit.

Results of reactor accident consequence calculations indicate that certain risk characteristics depend strongly on the maximum number of persons within any given direction sector (see Section 2.7.4). Therefore, criteria regarding the maximum allowable population within sectors in addition to total population surrounding a site were considered. The impact on land availability was examined for alternative sector criteria and compared to the impact of uniform density criteria.

Sector criteria were stated in terms of allowing up to a fraction of the allowed number of people to be located in any sector of a particular width. For example, a sector criteria might be stated: no more than 1/6 of the people allowed by a uniform density of 500 persons per square mile can be located in any 45 degree sector at distances within 3 miles of a site.

The impact of sector criteria was investigated with regard to several variables. The parameters were:

- Distance: Radii of 2, 5, 10, 20, and 30 miles
- Sector width: 22.5, 45.0, 90.0 degrees, and 360 degrees (for uniform density)
- Fraction: 1/16, 1/8, 1/4, 1/3, and 1/2 the population allowed by uniform density
- Density: 250, 500, 750, and 1500 persons per square mile

Population counts were determined within 2, 5, 10, 20, and 30 miles of potential sites (grid cells) and within sector widths of 22.5, 45.0, and 90.0 degrees. The maximum number of persons found in a sector of a stated width and for a particular radius was recorded. For example, investigating a circle of radius 10 miles and using a sector width of 22.5 degrees, the circle was divided into 16 sectors. The number of people was determined within each sector and the maximum of the 16 counts was recorded. This procedure of determining the maximum count was undertaken 15 times -- once for every combination of sector width (3) and radius (5).

Alternative criteria were then applied to the count data on the basis of allowing a certain fraction of the total number of people allowed within the circle to be located in any sector. The total number of people allowed in a circle is dependent upon the radius (for area) and the density that is allowed. For this sector analysis, the previously established densities were analyzed -- 250, 500, 750, and 1500 persons per square mile and five radii were used -- 2, 5, 10, 20, and 30 miles. For 0-2 miles, only one density was used as a part of every criteria -- namely, 250 persons per square mile. To calculate the allowable population theshold out to 5, 10, 20, and 30 miles for each of the densities, the area from 2 miles to r miles (radius) was multiplied by the density and the product added to the threshold for 0-2 miles with its 250 persons per square mile density. For example, at 20 miles using density 750 persons per square mile, the threshold equals:

(Area of 0-2) x 250 + (Area of 2-20) x 750

= (12.57 x 250) + (Area of 2-20) x 750

= (3142 + 933075)

= 936,217 people

Using only one density (250 persons per square mile) for 0-2 miles and four densities for the other four distances resulted in 17 separate thresholds. These thresholds were used not only for uniform density criteria analyses but also for calculating the fractional thresholds applied to sector population distributions. Thus, if a criterion was stated that no more than 1/4 of the people allowed by a uniform density of 750 persons per square mile within 20 miles would be allowed in a sector, the threshold would be 936,217 x 1/4 = 234,054 people.

Being consistent with previously computed impacts, the impacts for sector criteria for any particular density or fraction were composited to 30 miles. That is, sites exceeding a threshold at 2 miles were recorded and saved into a map file. Sites exceeding a threshold at 5 miles were also recorded and stored into a map file, as were all sites for 10, 20, and 30 miles. Finally, all five map files were merged resulting in a file that showed sites constrained by any one or more of the thresholds. Spatially, it was found that any criteria at smaller radii tended to eliminate sites in rural areas as well as in cities but only out to their edge. Criteria applied at larger radii tended to eliminate cities and large areas around their edges (similar to a "standoff" criteria) but allow local population concentrations in rural areas. By compositing criteria for all five radii, both urban and rural population concentrations were evaluated for their impact on availability of potential nuclear sites. Additionally, it was found that the effects of sector criteria occurred in the same areas as affected by annular density criteria.

Sector criteria were of interest in regard to their impact on land availability above and beyond that already affected by uniform density criteria. To depict and quantify this information, tables were created to show the amount of land available for siting in each state if a particular sector criterion was established. The information is shown in Tables F2.1 through F2.24, Appendix F. Each table shows the impact of alternative fractional criteria along with the uniform density criteria on land availability. All of the fractional and uniform density criteria have been composited to 30 miles by adding the individual impacts of a criterion at 2, 5, 10, 20, and 30 miles.

Each table considers a unique combination of allowable annulus population density and sector width. The four population densities and three sector widths resulted in 12 combinations. Twenty-four tables were created as each of the 12 combinations was tabulated using two different formats. Tables F2.1 through F2.12 are formatted such that the numbers in the columns represent the amount of land that is uniquely constrained by the specified criteria.

The columns are arranged so that total magnitude of constrained land decreases from left to right. As an example, Table F2.1 indicates the impacts of alternative fractional criteria applied to 22.5 degree sectors using a density threshold of 250 people per square mile for both the 0-2 mile and 2-30 mile annulus. The leftmost column "Available Land," shows the amount of land available for siting if the criterion stated in the adjacent column is applied; that is, no more than 1/16 of the population allowed in the annulus at a density of 250 people per square mile can be located in any 22.5 degree sector of the annulus. The criterion stated in the second column of these 12 tables always represents the most constraining fractional criterion.

The rightmost column, "Restricted Lands," shows the amount of land that is constrained because it is either legally protected or a major wetland. No demographic criteria affect these numbers.

The numbers in each of the middle columns show the amount of land that is uniquely constrained by the specified criterion which is above the total amount previously constrained by the criteria in all of the columns to the right. In Table F2.1, for example, the column labeled "Uniform Density" shows for Alabama values of 5,703 square miles or 11.0 percent of the state area. This is the area that would be constrained by applying a uniform (annular) density criterion and it is additional to the area already constrained by restricted lands (2,075 square miles or 4.0 percent). Thus, the application of this particular uniform density criterion in Alabama would constrain a total of 7,778 square miles or 15.0 percent of the state area if no sector criteria were applied. The next column to the left, "1/2 Allowable Pop.," would add another 2,355 square miles or 4.5 percent of constraint if a sector criterion were stated that no more than 1/2 of the total population allowed by a density threshold of 250 people per square mile in both the 0-2 mile and 2-30 mile annuli could be located in any 22.5 degree sector. Similarly, using a criterion of allowing up to 1/3 of the allowable uniform density population to be located in a single sector, would constrain an additional 6,388 square miles or 12.3 percent of the land area. The total constrained land in this case would be 16,521 square miles or 31.8 percent of the state area. Conversely, 68.2 percent (100 minus 31.8) of the land would be available for siting.

To more clearly summarize the information that shows the availability of land when specific sector criteria are applied, Tables F2.13 through F2.24 were created in a different format than the previous 12 tables. On these tables, the numbers in the columns show the amount of land available for siting if the specified criterion is applied. For example, Table F2.13 indicates that 68.2 percent of the land in Alabama would be available for siting if a criterion of allowing up to 1/3 of the population (allowed by a uniform density criteria using a density threshold of 250 people per square mile in both the 0-2 mile and 2-30 mile annuli) to be located in any 22.5 degree sector. This number agrees with the one produced in the above example regarding Table F2.1. The column labeled "Uniform Density" indicates land availability when no sector criteria are applied. The column "No Pop. Criteria" shows the amount of land available when only restricted lands are considered a constraint.

4.6 Impact Analysis

Analysis of the impact of various siting criteria on land availability was accomplished in two ways: creation of maps to visually show these impacts, and production of statistics to quantity the impacts. Many of the maps produced have already been reviewed in other sections of this chapter. All maps were produced on a transparent base enabling them to be overlaid. This capability allows creation of complex composite population criteria maps. In addition, these population criteria maps can be overlaid on the color-coded environmental suitability map.

To quantify the impacts of various siting criteria, tables were prepared which used the data files created during the visual or map analysis. For a particular subject, whether environmental or demographic, statistics regarding the amount of area impacted were computed for each of the 48 states. Fifteen tables were produced which were grouped into three different types: environmental criteria, environmental suitability levels versus selected population cases, and population criteria versus individual environmental suitability levels.

4.6.1 Environmental Statistics

For each of the three environmental issues -- seismic hardening costs, site preparation costs, and water availability costs -- a table was prepared that showed the amount of land in each of the categories that was represented by a utility value (see Section 4.4). Two additional tables were produced: one for the surface water cost, and one showing the five different levels of composite environmental suitability. As discussed earlier, these statistics are shown in Tables F1.1 through F1.5, Appendix F.

4.6.2 Impact Comparisons

The overlay of transparent maps provided a quick look at potential land availability. A map containing five levels of environmental suitability along with a sixth level showing restricted lands, when overlaid with a variety of population criteria, produces numerous groupings of data. To present these data in statistical form, a method was devised to keep each table simple enough to be understood, while retaining a large amount of information.

First, five population cases were defined on the basis of complex composite criteria. These population cases are shown in Table 4-6. The numbers in the columns underneath the 0-2 and 2-30 mile annuli represent population density figures.

TABLE 4-6

Population Case	0-2 Miles	2-30 Miles (Composite)
1	100	250
2	250	500
3	250	750
4	500	750
5	500	1500

Five tables were produced -- one for each population case -- which compared the environmental suitability levels to an individual population case. These statistics indicate the amount of land in each of the environmental suitability levels that is available for siting nuclear power plants if a given set of population criteria (a population case) is applied. These statistics are shown in Tables F3.1 to F3.5.

To illustrate the effect of applying different population criteria (the five population cases) on land availability in a particular environmental suitability class, five more tables were produced. In these tables, the statistics represent the amount of land available for siting nuclear power plants in a given environmental suitability class as well as the amount of land uniquely constrained by each of the five population cases. These statistics are shown in Tables F3.6 through F3.10. The columns representing population cases have been arranged such that in moving from left to right, the stringency decreases. The leftmost column of the table -- available land -- shows land that is available for the given environmental suitability class even if the most stringent population criterion (population case 1) is applied. The second column -- population case 1 -- represents an additional amount of land considered available if population case 1 were relaxed. The next column -- population case 2 -- represents the additional increment of available land if the criteria for population case 2 were also relaxed. It follows that if no population criteria were established, the amount of land available in a particular environmental suitability class would be equal to the total of the first six columns in the table; the only land considered constrained would be that by a restricted land designation.

4.7 Summary

The analytical methods used in this study were designed to explore the impact of various demographic siting criteria on the availability of land considered suitable for the siting of nuclear power plants. Maps were created so that impacts could be easily visualized and tabular statistics were prepared to allow a more rigorous analysis.

The determination of land considered suitable for siting was accomplished through a multi-objective environmental suitability analysis. The analysis was performed using factors generally related to engineering costs as well as conservation of specific resources. Because this investigation concerned the entire 48 contiguous United States and was not a site selection project, environmental factors were analyzed at a relatively general level of detail and were each considered to be of equal importance. The most suitable areas were characterized by an adequate water supply, low seismicity and gentle topography as well as an absence of protected resources. Although the map of environmental suitability (Figure F8) shows the eastern one-half of the country to be more suitable than the western, it is felt that there are numerous suitable sites available in the western portion.

Three types of population criteria were investigated: stand-off zones, annular density and sector density. The effects of stand-off zone criteria are straightforward. There is a direct relationship between the stand-off distance and the amount of land area constrained.

The analysis of annular density thresholds showed that the use of smaller radii to define the annulus resulted in constraints on sites near both large and small urban populations as well as sites near some locally dense rural areas. Larger radii tended to constrain a greater amount of area near suburban population but only around major cities; small urban and rural areas were not constrained.

Because results of reactor accident consequence calculations indicated (Section 2.7.4, Chapter 2) that certain risk characteristics depended strongly on the maximum number of persons within any given direction sector, sector population criteria were designed. Their impacts were investigated to determine the amount of land area that would be constrained additional to that affected by annular density criteria. It was found that sector criteria affected the same areas and those adjacent to the areas affected by annular densities. Also, the area of impact responded to changes in annular radius in the same manner as for annular density criteria.

Transparent overlay maps and tabular statistics were provided to NRC for use in establishing siting criteria which would be numerically based upon population density, distribution and exclusion distance. Tabular statistics were used to quantify the impacts on a state-by-state basis. The use of transparent overlays provides a means not only to see the impacts of the generated criteria but also to create and view the effects of complex criteria by overlaying any combination of maps. Maps showing demographic criteria were also overlain onto the map of environmental suitability to visualize the potentially available suitable land. Through both the overlay procedure and a comparison of statistics, it was found that the greatest impacts of demographic criteria occur in the areas of high environmental suitability (i.e., Northeast).

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5. Socioeconomic Impacts

5.1 Introduction

Because the construction and operation of a nuclear power plant can have social and economic impacts on nearby communities, the dependence of socioeconomic impacts on site location was examined by the Battelle Human Affairs Research Centers (Battelle-HARC) under contract to Sandia National Laboratories. The Battelle-HARC study (1) developed a classification scheme for the remoteness of light water reactor (LWR) site locations; (2) calculated average growth rates for several demographic and economic variables during the period of plant construction for two groups of LWR sites of differing remoteness, (3) examined the dependence of transmission line costs on site remoteness; and (4) discussed the significance of these results in the light of previous studies of the socioeconomic impacts of rural industrialization projects, boom towns, and nuclear power plants. This chapter presents a summary of the Battelle-HARC study. Full details are reported in the final report of that study [1].

5.2 Site Remoteness

Conceptually, the degree of remoteness of a nuclear power plant site depends upon both population density (the more sparse the population the more remote the site) and proximity to major population centers (nearby cities of significant size decrease remoteness). To capture this dual dependence, two measures were developed to define the degree of site remoteness, one of population sparseness and the other of proximity to urban centers.

Sparseness was defined in terms of total population and number of communities of population 25,000 or more within 20 miles of the site. Four sparseness categories were defined as follows:

Sparseness Measure

Category	Definition
Most Sparse ↑	1. Less than 50,000 persons and no community with more than 25,000 persons within 20 miles.
	2. From 50,000 to 74,999 persons and no community with more than 25,000 persons within 20 miles.
	3. From 75,000 to 149,999 persons <u>or</u> less than 75,000 persons but with at least one community with more than 25,000 persons within 20 miles.
Least Sparse	4. 150,000 or more persons within 20 miles.

Proximity was defined in terms of total population and the presence of cities with population ≥100,000 within 50 miles of the site. Four proximity categories were defined as follows:

Proximity Measure

Category	Definition
Not in Close Proximity	1. No city with more than 100,000 persons and less than 400,000 persons within 50 miles.
	2. No city with more than 100,000 persons and between 400,000 and 1,499,999 persons within 50 miles.
↓	3. One or more large cities with more than 100,000 persons and less than 1,500,000 persons within 50 miles.
In Close Proximity	4. 1,500,000 or more persons within 50 miles.

The distance of 20 miles and a community size of 25,000 (sparseness measure) were chosen because the NRC Siting Policy Task Force [2] recommended that population densities around sites be limited out to a distance of 20 miles and because current siting practice requires that the nearest town of 25,000 persons be at least more distant than one and one-third times the distance to the outer boundary of the low population zone surrounding the plant site. The distance of 50 miles (proximity measure) was chosen because workforce commuting distances, which strongly affect the degree of population increase during construction periods and thus the magnitude of socioeconomic impacts, are usually limited to about a one-hour commute [3], or about 50 miles at current speed limits.

Table 5-1 presents the cross-classification by sparseness and proximity of 84 LWR sites in the U.S., where reactors are currently operating or under construction.

Table 5-1. Site Remoteness Matrix

		Proximity				
	Category	1	2	3	4	Total
Sparseness	1	11	1	3	0	15
	2	3	1	4	2	10
	3	4	7	10	4	25
	4	0	0	11	23	34
	Total	18	9	28	29	84

Within this matrix remoteness decreases as one moves from cell (1,1) to cell (4,4) and sites in cells with indices that sum to the same total [e.g., cells (3,1), (2,2), and (1,3)] should be similar in degree of remoteness. By summing the numbers of sites having similar degrees of remoteness, the distribution of remoteness over the 84 sites is obtained. Table 5-2 displays this distribution.

Table 5-2. Distribution of Remoteness

Group	Cell	Number of Sites
1. Most Remote Sites	(1,1)	11
2. ↑	(2,1), (1,2)	4
3.	(3,1), (2,2), (1,3)	8
4.	(4,1), (3,2), (2,3), (1,4)	11
5.	(4,2), (3,3), (2,4)	12
6.	(4,3), (3,4)	15
7. Least Remote Sites	(4,4)	23
		84

Tables 5-1 and 5-2 show that, of the 84 sites, only 15 are not located within 20 miles of a town of 25,000 or within 50 miles of a city of 100,000. By contrast, 23 of the 84 sites have populations of 150,000 within 20 miles of the site and 1,500,000 within 50 miles. Thus, Tables 1 and 2 show that most current U.S. LWRs are not remotely sited.

5.3 Growth Rates

The socioeconomic impacts of large industrial projects usually depend on the size of the project work-force. Since the peak construction workforce ($\gtrsim 2000$) for a nuclear power plant is substantially larger than the plant's operational staff (~ 200), the socioeconomic impacts of nuclear power plants should be largest during the plant's construction phase. A measure of the magnitude of these impacts can be obtained by calculating average growth rates for population and economic activity in the areas surrounding nuclear power plants during their preconstruction (baseline) and construction periods. Variation of impacts with remoteness can be examined by performing these calculations for two groups of sites, a non-remote group and a remote group, and comparing the results.

Time series data for population, employment (total, retail trade, and construction), payroll (total, retail trade, and construction), and government revenues (property tax per capita) and expenditures (total, education, highway, health, and welfare) were obtained for the preconstruction and construction periods at 21 nuclear power plant sites. Cross-classification of the 21 sites, according to the sparseness and proximity measures previously defined, yields Table 5-3. Table 5-3 shows that 7 of the sites are relatively remote and the other 14 are nonremote.

Table 5-3. Cross-classification Remoteness Matrix for 7 Remote and 14 Non-Remote Sites.

		Proximity				
	Category	1	2	3	4	Total
Sparseness	1	4	-	-	-	4
	2	1	-	-	-	1
	3	2	-	2	1	5
	4	-	-	5	6	11
	Total	7	0	7	7	21

Population data were available in census publications [4] for the years 1960, 1966, and 1970 through 1978. Employment and payroll data were obtained for the years 1959, 1962, and 1964 through 1978 from County Business Patterns [5]. Government revenue and expenditure data were collected from the County and City Data Book [6] for 1962, 1967, and 1972, and from the Census of Governments [7] for 1977.

Average yearly values of government revenues and expenditures for the preconstruction (baseline) and construction periods for the non-remote group of 14 sites and the remote group of 7 sites are presented in Table 5-4. Table 5-4 also presents the percentage

Table 5-4. Average Yearly Government Revenue and Expenditures for Remote and Non-Remote Groups*

Variable	Remote			Non-Remote		
	Baseline Period	Construction Period	Percentage Increase†	Baseline Period	Construction Period	Percentage Increase†
Property Tax Per Capita	71	88	24	112	139	24
Total Government Expenditures	7,658	12,567	64	78,582	115,478	47
Education Expenditures	3,852	6,566	70	30,274	57,159	89
Highway Expenditures	684	909	33	5,677	6,383	12
Health Expenditures	792	1,687	113	3,626	5,657	56
Public Welfare Expenditures	174	200	15	5,275	9,787	85

*Property tax per capita in dollars, expenditures in thousands of dollars.
†[(Construction Period Value/Baseline Period Value)-1]100.

increase of each variable for the construction period relative to the baseline period. Table 5-4 shows that the percentage increases in total government, highway, and health expenditures were greater at remote than non-remote sites, that the converse is true for education and welfare expenditures, and that the increase in per capita property tax was the same for both site groups. Therefore, because these data showed no consistent variation and because the amount of data was scant (data were available for only 4 years), average yearly growth rates were not calculated for these government variables.

The exponential growth of the variable X at a rate k per year over the time period t is given by

$$X_t = X_{t_o} e^{kt} \qquad (1)$$

Average growth rates for a group of sites can be obtained by linear regression analysis after recasting equation 1 as follows, where k is the yearly average growth rate of the variable X for the site group, i is a site index, and weww$_i$ is a site specific difference term.

$$\ell n\, X_{i,t} = \ell n X_{i,t_o} + \bar{k}t + \varepsilon_i \qquad (2)$$

Average growth rates were calculated for both site groups for the preconstruction (baseline) and construction periods for 7 variables (population, and total, retail, and construction employment and payroll). Table 5-5 presents the results of these linear regression analyses.

Examination of Table 5-5 reveals a consistent pattern. For each of the 7 variables and for both periods (baseline and construction), growth rates are higher for the remote site group than for the non-remote group. On the average, during the baseline period growth rates at remote sites exceed those at non-remote sites by about 50 percent. During the construction period growth rates at remote sites are 2 to 3 times larger than are growth rates at non-remote sites. As would be expected, growth rates are largest for construction payroll and employment. In addition, because of the increased demand for labor, the average number of hours worked also increases and therefore payroll growth exceeds employment growth.

Table 5-5. Average Growth Rates for Population, Employment, and Payroll at Remote and Non-Remote Sites.

	Average Yearly Growth Rates (%)[a]				Construction Impacts (%)[b]		Impact Differences (%)[c]
	Preconstruction		Construction				
	Remote	Non-Remote	Remote	Non-Remote	Remote	Non-Remote	
Population	1.7±0.2	1.4±0.2	6.1±0.8	1.6±0.6	4.3±1.0[d]	0.2±1.4	4.1±2.4[d]
Total Employment	5.7±0.4	3.9±0.2	12.8±1.5	4.4±0.9	7.1±1.9[d]	0.5±1.1	6.5±3.0[d]
Total Payroll	8.4±0.3	5.7±0.3	18.9±2.4	7.3±1.5	10.5±2.7[d]	1.6±1.8	8.9±4.5[d]
Retail Employment	5.5±0.3	3.8±0.3	8.8±1.0	4.3±0.6	3.4±1.3[d]	0.5±0.9	2.8±2.2[d]
Retail Payroll	8.1±0.2	5.0±0.3	9.9±1.0	4.5±0.6	1.7±1.2	-0.5±0.9	2.2±2.1[e]
Construction Employment	8.3±0.8	3.9±0.5	33.3±3.5	11.8±2.2	24.9±4.3[d]	7.9±2.7[d]	17.1±7.0[d]
Construction Payroll	10.8±1.0	7.2±0.6	45.9±5.0	17.2±3.1	35.1±6.0[d]	10.0±3.7[d]	25.1±9.7[d]

a. All values are significant at the 0.01 level by f-test
b. (Construction Growth Rate) - (Preconstruction Growth Rate)
c. (Remote Impact) - (Non-Remote Impact)
d. Significant at the 0.01 level by t-test
e. Significant at the 0.05 level by t-test

By subtracting baseline period growth rates from construction period growth rates, estimates of the growth rates due only to nuclear power plant construction (construction impact) are obtained. Table 5-5 shows that for the non-remote group of sites, construction impacts were significant only for construction payroll and employment. However, for the remote group of sites, impacts were signifificant for all variables, being largest for construction payroll (35%) and employment (25%) and substantial for total payroll (10%). Finally, the last column of Table 5-5 shows that, for all variables except retail payroll, impact differences (remote site construction impact minus non-remote site construction impact) are all statistically significant at the 0.01 level.

5.4 Transmission Line Costs

Transmission line costs are comprised of installation and operating costs. Installation costs depend on (1) the length of the right-of-way along which the lines will be strung in order to connect the power plant to the existing national power grid; (2) right-of-way acquisition costs; (3) the number and size (conductor rating) of the lines installed; and (4) installation labor costs (right-of-way preparation, construction of line towers and substations, stringing of lines). Operating costs consist principally of the cost of line losses during transmission and maintenance costs.

Transmission losses are less for shorter line lengths and larger conductors. Larger conductors cost more than smaller conductors, require a wider right-of-way (125 ft wide for 230 kV cable; 200 ft for 500 kV [8]), and are more costly to install. Despite these higher costs, EPRI projections [9] predict an increasing use of higher rated (larger) conductors through the year 2000. This agrees with the findings by Power Transmission, Inc. [10] that utilities currently prefer to minimize future transmission losses by installation of larger conductors.

Unit costs for labor (hourly wages) in suburban areas were found by an EPRI study [11] to exceed those in rural areas by about 25%. Unit costs for the acquisition of land for right-of-way are also likely to be lower in rural areas than in suburban areas. In contrast to this, total costs due to acquisition of right-of-way, purchase of materials and equipment, payment of labor, and transmission line losses all increase with increasing line length. Therefore, since remote siting would seem to require longer transmission lines, remote siting would appear to entail higher transmission line installation and operating costs. This is not always the case, however.

Maps of the existing national transmission grid show that, except for the more remote regions of the Rocky Mountains, grid transmission lines pass through all regions (both remote and non-remote) of the U.S. [12]. Although consideration of environmental, social, and asthetic issues as required by NEPA has tended to somewhat lengthen line right-of-ways, the factor that dominates the length of new transmission lines is the gross distance of the power plant site from the nearest leg of the national transmission grid. Because this grid runs through both remote and non-remote areas, remote siting does not necessarily mean a lengthy transmission line. Table 5-6 presents data in support of this conclusion.

Table 5-6 presents data on the conductor rating, length, and acreage of the transmission lines which connect 29 power plant sites (those with all facilities operating as of 1978) of varying remoteness to the national power grid. Examination of the right-of-way lengths, which were drawn from DOE maps [12], shows that for existing sites right-of-way lengths do not correlate with remoteness. Some remote sites are closer to the national grid than are some less remote sites. Thus, it is distance from the national transmission grid and not distance from major population centers (remoteness) that principally determines the costs of transmission line installation and operation.

5.5 Discussion

Major construction projects have large workforce requirements. In rural settings, when workforce requirements can not be met locally or by commuting from nearby cities, in-migration of workers occurs. If this in-migration is substantial, "boomtown" conditions may result and the host area may experience significant socioeconomic impacts. This scenario has been the subject of considerable study. Rural industrial development studies [13,14] have examined the impacts of industrial projects upon small, rural communities. Boomtown studies [15-18] have examined the local impacts of rapid, large-scale energy development projects, located primarily in remote farming and ranching areas of the Rocky Mountains. The impacts of nuclear power plant construction have also been examined by several previous studies [19-21].

Table 5-6. Power Transmission Line Data for 29 Operating Nuclear Sites

Remoteness Index	Total Miles of Right-of-Way	Estimated Acres of Right-of-Way	Average Kilovolts Per Mile of Line
1-1	230	4,182	345
2-1	266	4,030	230
2-1	38	800	399
3-2	52	661	156
3-2	230	4,061	301
3-2	102	1,855	345
3-2	179	2,670	206
2-4	30	545	345
2-4	151	2,655	309
3-3	118	2,675	418
3-3	85	1,370	267
3-3	5	91	345
3-3	95	1,803	316
3-3	84	1,273	230
3-3	123	2,236	337
3-4	17	309	345
3-4	124	2,255	345
3-4	24	291	115
4-3	170	3,576	423
4-3	85	1,455	304
4-3	25	358	198
4-3	67	1,218	345
4-4	409	8,291	147
4-4	60	758	134
4-4	4	61	230
4-4	104	2,545	485
4-4	90	1,636	345
4-4	217	4,561	378
4-4	29	527	345

Significant in-migration to a construction project's host area occurs only if workforce requirements can not be met locally or by commuting from nearby population centers (generally, those located within about a one-hour commute of the site [3]). Even when substantial in-migration does occur, a boomtown can be avoided, if the resulting population growth is spread over several nearby communities [22]. In general, adverse socioeconomic impacts are not observed until the rate of population growth of a single community exceeds 10 to 15 percent per year [23,24]. Under these conditions institutional breakdowns may occur in the labor and housing markets and in the provision of government services (education, health care, recreational facilities, police and fire protection) [23].

The small sizes, undiversified economies, small tax bases, homogeneous populations, and traditional life styles of rural communities tend to increase their susceptibility to socioeconomic impacts resulting from rapid population growth. Mortgage investors tend to find small, economically undiversified, rural communities unattractive investment locales. Lack of mortgage money combined with shortages of building materials and housing construction workers can produce a serious housing shortage. Because of their limited tax bases and because the project under construction generally yields little tax revenue until nearly completed, rural communities are often unable to finance the increased load of government services needed to accommodate rapid population growth. Finally, rural communities having a homogeneous population and life style may be less willing or able to welcome newcomers having different ideas, ways of doing business, and life styles and to accept the changes in personal, social, business, and institutional interactions that incorporation of the newcomers into their communities would entail [16-18,25].

The willingness of rural communities to accept change depends upon community perception of the benefits (and risks) that will accompany the changes, and upon the degree of community involvement in the decisions which determine the nature and rate of the changes. Because the construction of a large industrial or energy facility promises increased tax revenues, new jobs, more retail trade, and therefore improved government services, an end to out-migration of children and friends [14,15], and a higher standard of living [21], many rural communities welcome these projects (at least initially).

However, community resistance may develop, if the economic benefits are unevenly distributed (e.g., business men and land owners profit while the poor, the elderly, and minorities suffer), if the project is perceived to benefit principally distant cites (e.g., electric generating stations [19,25]), if project decisions affecting the community are made without community involvement, and if there are concerns about the safety of the facility (e.g., nuclear power plants [21]).

The degree to which the socioeconomic impacts, characteristic of rural industrialization and boomtowns, have occurred as the result of nuclear power plant siting was examined by gathering data about peak construction employment, number of in-migrants, and socioeconomic impacts at 12 remote nuclear power plant sites. The data, which were extracted from Environmental Impact Statements and post-licensing case studies (where available), are presented in Table 5-7. For the 12 sites listed in Table 5-7, peak construction employment was approximately 2200 (±700), or 5 percent of the surrounding population to 20 miles. For the 9 sites where in-migration data were available, peak construction in-migration (workers plus families) on an average represented only 3 percent of the surrounding population to 20 miles. Examination of the last column in Table 5-7 shows that with scattered exceptions (crowded classrooms, Yellow Creek; stressed government services, Hatch; wage inflation, St. Lucie; safety controversy, Diablo Canyon) the socioeconomic impacts at the 12 sites were largely beneficial (significantly increased tax revenues, increased retail trade). Given the modest increases in total population in the regions surrounding the sites, it is not surprising that detrimental impacts were minimal, while economic impacts were favorable.

Since socioeconomic impacts depend principally on the rate of population growth, which scales with construction workforce growth, additional data on construction workforce growth were developed for 19 non-remote construction projects including 15 nuclear power plants and for 28 remote construction projects including one nuclear power plant. The data are presented in Table 5-8, which shows that an average remote site experiences twice as much in-migration as a non-remote site.

Table 5-7. Socioeconomic Impacts at Selected Remote Sites

Site (Projected Year of Completion for Each Reactor at a Site)[1]	Utility (Total Megawatts at Site)[1]	Remoteness Index[2]	Estimated Peak Construction Employment (Workers)	Total Population Within 20 Miles (1980 Projected, provided by Dames & Moore)	Estimated Number of Inmigrants at Peak of Construction	Overall Assessment Social and Economic Impacts
YELLOW CREEK[3] 1985, 1988 (Luka, MS)	TVA 2570 MWe	(1,1) Most Sparse Least Proximate	2,600	55,430	780 Workers (470 with families, 310 without families)	Increase in students will require seventeen classrooms and teachers; classroom space is currently scarce.
GRAND GULF[4] 1982, 1986 (Port Gibson, MS)	Mississippi Power & Light 2,500 MWe	(1,1)	Up to 2,600	27,592	Not provided	1. More electrical power available. 2. Dramatically increases the tax base. 3. Significant direct and indirect increases in employment and income.[4](p. 8-16)
SOUTH TEXAS[5] PROJECT 1984, 1986 (Palacios, TX)	Houston Lighting and Power Company 2,500 MWe	(1,1)	2,100	32,307	2,000 persons	Similar to Grand Gulf.
HATCH[6,7] 1975, 1979 (Baxley, GA)	Georgia Power Company 1,572 MWe	(1,1)	2,300	49,808	920 to 1,150 workers	Some growth impacts on schools, housing, and public services but not serious. No unmanageable strains on community intrastructure. Plant's economic benefits (reduced tax rate, growth and employment) were viewed very positively by host area.
VOGTLE[8] 1985, 1988 (Waynesboro, GA)	Georgia Power Company 2,200 MWe	(1,2)	3,800	26,170	815 workers	Construction of the proposed nuclear plant will slow, but not halt, the current trend in population migration from this rural area. For the effects of construction to be most beneficial, efforts to attract new and related commercial activity should continue.(p. 27)
CLINTON[9] 1982 (Clinton, IL)	Illinois Power Company 1,900 MWe	(2,2)	1,200	47,792	418 persons (191 workers, 121 adults, 106 children)	Minimal impacts anticipated due to close proximity (approximately 60 miles) of large urban areas.
ARKANSAS[10] 1973,1976 (Russelville, AK)	Arkansas Power and Light Company 1,748 MWe	(1,1)	973	59,322	200 persons	1. Stabilize area's construction workers. 2. Increases in direct and indirect employment and income. 3. Expansion of electric power provisions to the service area. 4. Increase in property tax payments which aided in reversal of school overcrowding and financial difficulties.
ST. LUCIE[11] 1976, 1983 (Hutchison Island, FL)	Florida Power and Light Company 1,554 MWe	(3,1)	1,847	121,542	Not provided	1. Increased tax base by approximately 35%. 2. Public construction projects in the county had to be delayed or cancelled due to inflated wage rates resulting from construction of the plant.
CRYSTAL[12] RIVER 1977 (Crystal River, FL)	Florida Power Corporation 825 MWe	(1,1)	1,790	38,705	Not provided	1. Increased tax base. 2. 50% (85) of operating workforce relocated to Crystal River. 3. Retail sales in area increased due to relocation of non-local construction workforce.
DIABLO[13] CANYON 1981, 1981 (Avila Beach, CA)	Pacific Gas and Electric 2,190 MWe	(2,1)	2,470	101,151	3,308 persons[17]	1. Divisiveness of entire Diablo Canyon issue among community residents (not necessarily due to workforce in-migration). Operation of facilities held up due to environmentalists' concerns regarding geologic fault at site.
FARLEY[14] 1977, 1980 (Dothan, AL)	Alabama Power Company 1,720 MWe	(3,1)	2,250[18]	93,185	1,057 workers[19]	1. Increase in direct and indirect employment and income.
SURREY[15] 1972, 1973 (Gravel Neck, VA)	Virginia Electric and Power Company 1,550 MWe	(4,4)[20]	1,934	284,669	102 persons[16]	1. Increase in tax base. 2. Increased employment, business income, tourism, traffic and land cost during construction in Surrey and Isle of Wight Counties.

Table 5-7. Footnotes

[1]"Commercial Nuclear Power Stations in the United States--Operable, Under Construction or Ordered--August 1, 1980, Wallchart, published by Nuclear News, La Grange Park, Illinois.

[2]The remoteness index as defined by sparseness and proximity measures (see text).

[3]Tennessee Valley Authority, Final Environmental Statement, Yellow Creek Nuclear Plant Units 1 and 2, Vol. 1, Vol. 2., January 1978.

[4]Mississippi Power & Light Company, Final Environmental Statement Related to Construction of Grand Gulf Nuclear Stations Units 1 and 2, Sec. 8.2, August 1973.

[5]Houston Lighting & Power Company, "Benefits and Costs" Chapter 8 and "Summary Benefit-Cost Analysis" Chapter 11 of South Texas Project-Environmental Report, Vol. 1, amended June 1975.

[6]Altameda Area Planning and Development Commission, Impact of the Georgia Power Company Nuclear Plant on Community Facilities in the Toomb--Appling BiCounty Area, Georgia Institute of Technology, Winter 1969.

[7]Shields, M. A., et al., Socioeconomic Impacts of Nuclear Power Plants: A Paired Comparison of Operating Facilities, NUREG/CR-0916, Oak Ridge, TN: Oak Ridge National Laboratory, July 1979.

[8]Central Savannah Area Planning and Development Commission, Impact of the Georgia Power Company Vogtle Nuclear Power Plant on the Central Savannah River Area, Appendix A, Georgia Institute of Technology, Spring 1972.

[9]Illinois Power Company, "Economic and Social Effects of Plant Construction and Operation," Chapter 8 of Environment Report--Construction Permit Stage for the Clinton Power Station, September 1974.

[10]Pijawka, D., Arkansas Nuclear One, Preliminary Site Report, Washington: U.S. Nuclear Regulatory Commission, February 1979.

[11]Pijawka, D., St. Lucie, Units 1 and 2, Preliminary Site Visit Report, Washington: U.S. Nuclear Regulatory Commission, February 1979.

[12]Pijawka, D., Crystal River, Unit 3, Preliminary Site Visit Report, Washington: U.S. Nuclear Regulatory Commission, February 1979.

[13]York, M. N., Diablo Canyon, Units 1 and 2, Preliminary Site Visit Report, Washington: U.S. Nuclear Regulatory Commission, February 1979.

[14]Alabama Power Company, Final Environmental Statement Related to Operation of Joseph M. Farley Nuclear Plant, Units 1 and 2, December 1974.

[15]Flynn, J., Surrey Nuclear Plant, Units 1 and 2, Preliminary Site Visit Report, Washington: U.S. Nuclear Regulatory Commission, February 1979.

[16]Flynn J., Socioeconomic Impacts of Nuclear Generating Stations, Surry Case Study, Washington: U.S. Nuclear Regulatory Commission, November 1980.

[17]Pijawka, D., and Yoquinto, G., Socioeconomic Impacts of Nuclear Generating Stations, Diablo Canyon Case Study, Washington: U.S. Nuclear Regulatory Commission, December 1980.

[18]Alabama Power Company, Estimate, February 1979.

[19]Based on percentages from a survey at Joseph M. Farley #2. Malhotra, S., Manninen, D., Migration and Residential Location of Workers at Nuclear Power Plant Construction Sites, Vol. 11, Profile Analysis of Worker Survey, Final Report. BHARC-100/80/030, Seattle, WA: Battelle Human Affairs Research Centers, September 1980.

[20]Based on population size within 20 and 50 miles of the site, Surrey is classified as non-remote. However when natural barriers are taken into consideration the population of the area within 20 miles of the site which has easy access to the site is considerably less. The figure for 50 miles is still appropriate as a representation of the population within commuting distance of the site.

Table 5-8. Variation in Migrant Proportion by Location

Location*	Number of Sites	Migrant Proportion (%) Construction Workers: Average	Range
Remote			
Bureau of Reclamation Water Development Projects[1,2]	10	59	40-89
Old West Regional Commission Study, Coal-fired Power Plants[3]	14	60	21-97
North Dakota State University			**
Leland Olds and Square Butte[4]	2	50	
Coal Creek[5]	1	39	
NRC Labor Migration Study[6,7]	1	47	
	N = 28	Weighted Average = 58	
Non-remote			
NRC Labor Migration Study[6,7] (excluding TVA)	8	29	15-49
TVA Sites[8]			
Nuclear[9]	7	26	11-40
Non-nuclear[9]	2	34	29-47
Bureau of Reclamation Water Development Projects[2]	2	17	12-22
	N = 19	Weighted Average = 27	

*Remoteness assignments were made using the sparseness and proximity measures described in the text.

**Migrant proportions were not provided separately for these sites in the reference document.

Table 5-8. Footnotes

[1]J. A. Chalmers, Bureau of Reclamation Construction Worker Survey, Bureau of Reclamation, Engineering and Research Center, October 1977.

[2]In general the Bureau of Reclamation Water Development Projects were constructed in sparsely settled regions of the western United States. Two sites, however, were located in the Phoenix area and are included in the nonremote group.

[3]Mountain West Research, Inc., Construction Worker Profile, Final Report, prepared for the Old West Regional Commission, 1975.

[4]A. G. Leholm, F. L. Leistritz and J. S. Wieland, Profile of Electric Power Plant Construction Work Force, Agricultural Economics Statistical Series, Issue No. 22, Department of Agricultural Economics, North Dakota State University, July 1976.

[5]J. S. Wieland and F. L. Leistritz, Profile of the Coal Creek Project Construction Work Force. Agricultural Economics Miscellaneous Report No. 33, Department of Agricultural Economics, North Dakota State University, February 1978.

[6]S. Malhotra and D. Manninen, Migration and Residential Location of Workers at Nuclear Power Plant Construction Sites, Vol. II Profile Analysis of Worker Surveys, Battelle Human Affairs Research Centers, September 1980.

[7]The NRC labor migration study included only one remote site.

[8]TVA has published numerous reports containing the results of construction worker surveys conducted at TVA sites. For example see Tennessee Valley Authority, Hartsville Nuclear Plants Socioeconomic Monitoring and Mitigation Report, March 31, 1978, Knoxville, Tennessee, Tennessee Valley Authority, 1978.

[9]Multiple surveys were conducted at the TVA sites. The average and range of migrant proportions shown are for 35 surveys conducted at the nine TVA sites.

5.6 Conclusions

Classification of current nuclear power plant sites according to remoteness shows that most sites are nonremote, while few are truly remotely sited. In fact, although half of the current sites are located in nonmetropolitan counties, a majority are within 60 miles of [19] and few are more than 100 miles from a major metropolitan area.

The data on growth rates (Table 5-5) and construction workforce in-migration proportions (Table 5-8) show that population and economic growth rates are higher at more remote as opposed to less remote sites. Impacts do increase with site remoteness. However, although the differences in growth rates between more and less remote sites presented in Table 5-5 are all statistically significant, the 6 percent growth rate in total population observed for the more remote sites is significantly below the rate of 10 to 15 percent needed to produce boomtown conditions and thus adverse socioeconomic impacts. This conclusion is supported by the data presented in Table 5-7, which showed that 12 somewhat remotely sited nuclear power plants produced principally favorable socioeconomic impacts (much increased tax revenues, increased retail trade, some strains on government services, stabilization of population) on nearby communities.

Finally, it seems clear (1) that should future nuclear power plants be sited no more remotely than are current plants, then they will have few if any adverse socioeconomic impacts and (2) should they be sited in truly remote locations, then the potential for adverse impacts on nearby small rural communities can be substantially reduced by advance planning.

References for Chapter 5

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3. W. R. Freudenburg, "The Social Impact of Energy Boom Development on Rural Communities: A Review of Literatures and Some Predictions," Department of Sociology, Yale University, August 1976.

4. U.S. Bureau of the Census, Current Population Reports, Series P-25 and P-26, Washington: Government Printing Office, 1966 and 1971-1978.

5. U.S. Bureau of the Census, County Business Patterns (for individual states), Washington: Government Printing Office, 1959 and 1962 and 1964-1978.

6. U.S. Bureau of the Census, County and City Data Book, Washington: Government Printing Office, 1967 and 1972 and 1977.

7. U.S. Bureau of the Census, Census of Governments, Washington: Government Printing Office, 1977.

8. EPRI Planning and Evaluation Staff, "Technical Assessment Guide," EPRI Rept. No. PS 1201-SR, July 1979, Exhibit 9-1, p. 9-2.

9. Ibid, p. 2-3.

10. I. S. Grant and V. J. Longo, "Economic Incentives for Larger Transmission Conductors," Power Transmission, Inc., Schenectady, NY, p. 1.

11. Commonwealth Associates, Inc., "Cost Components of High Capacity Transmission Options," EPRI Rept. No. EL-1065, Vol. 1, May 1979, p. 2-35.

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19. U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Socioeconomic Impacts: Nuclear Power Station Siting, NUREG-0150, June 1977.

20. E. Peelle, "Social Effects of Nuclear Power Plants," in C. P. Wolf, ed., 2: Social Impact Assessment, Milwaukee, WI: Environmental Design Research Association, Inc., 1974, p. 114.

21. M. A. Shields et al., Socioeconomic Impacts of Nuclear Power Plants: A Paired Comparison of Operating Facilities, NUREG/CR-0916, Oak Ridge, TN: Oak Ridge National Laboratory, July 1979.

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25. U.S. Congress, Senate, Statement of S. H. Murdock in Hearing Before the Subcommittee on Rural Development, Committee on Agriculture, Nutrition, and Forestry, The Socioeconomic Effects of a Nuclear Waste Storage Site on Rural Areas and Small Communities, 96th Cong., 2d Sess., 1980, p. 67.

Appendix A: Site Data

A large body of site-related data was collected for use in performing the consequence calculations discussed in Chapter 2 of this report. These data are summarized in the following sections of this appendix as listed below.

Section	Data Description
A.1	General Site and Reactor Data
A.2	Site Population Data
A.3	Weather Data
A.4	Site Wind Pose Data
A.5	Economic Data

A.1 General Site and Reactor Data

Calculations were performed for 91 sites where reactors are currently operating, are under construction, or have been assigned a construction permit. Table A.1-1 lists the site locations (county/state) and the power level (MWe), type, supplier, and date of startup (actual or expected) for the reactors located at these sites. Table A.1-2 gives the latitude and longitude of each site,* as well as the meteorological station and sheltering region assigned for performing site consequence calculations. The meteorological data used in this study are further described in Section A.3. The sheltering region is based on housing types and is used to determine external exposure shielding factors when population sheltering is assumed to be an emergency protective measure. The important housing characteristics and assumed shielding factors for the seven regions used in this study are described in Table A.1-3. For further information on sheltering regions and shielding factors, see reference [2].

*Latitudes and longitudes were taken from reference [1].

Table A.1-1 General Site and Reactor Data

Plant	Location (County/State)	Power Level (MWe)	Type	Reactor Supplier	Actual or Expected Date of Startup
Allens Creek	Austin, TX	1200	BWR	GE	/87
Arkansas 1,2	Pope, AR	836	PWR	B&W	12/74
		912	PWR	C-E	3/80
Bailly	Porter, IN	645	BWR	GE	6/87
Beaver Valley 1,2	Beaver, PA	833	PWR	W	4/77
		833	PWR	W	5/86
Bellefonte 1,2	Jackson, AL	1213	PWR	B&W	9/83
		1213	PWR	B&W	6/84
Big Rock Pt.	Charlevoix, MI	63	BWR	GE	12/62
Black Fox 1,2	Rogers, OK	1150	BWR	GE	7/85
		1150	BWR	GE	7/88
Braidwood 1,2	Will, IL	1120	PWR	W	10/85
		1120	PWR	W	10/86
Browns Ferry 1,2,3	Limestone, AL	1067	BWR	GE	8/74
		1067	BWR	GE	8/75
		1067	BWR	GE	3/77
Brunswick 1,2	Brunswick, NC	790	BWR	GE	3/77
		790	BWR	GE	11/75
Byron 1,2	Ogle, IL	1120	PWR	W	10/83
		1120	PWR	W	10/84
Callaway 1,2	Callaway, MO	1150	PWR	W	10/82
		1150	PWR	W	4/87
Calvert Cliffs 1,2	Calvert, MD	850	PWR	C-E	5/75
		850	PWR	C-E	5/77
Catawba 1,2	York, SC	1145	PWR	W	7/83
		1145	PWR	W	1/85
Cherokee 1,2,3	Cherokee, SC	1280	PWR	C-E	1/90
		1280	PWR	C-E	1/92
		1280	PWR	C-E	Indef.
Clinton 1,2	Dewitt, IL	950	BWR	GE	12/82
		950	BWR	GE	Indef.
Comanche Peak 1,2	Somervell, TX	1150	PWR	W	/81
		1150	PWR	W	/83
Cooper	Nemaha, NB	778	BWR	GE	7/74
Crystal River 3	Citris, FL	825	PWR	B&W	3/77
Davis-Besse	Ottawa, OH	906	PWR	B&W	11/77
Diablo Canyon 1,2	San Luis Obispo, CA	1084	PWR	W	/81
		1106	PWR	W	/81
Donald C. Cook 1,2	Berrien, MI	1054	PWR	W	8/75
		1094	PWR	W	6/78
Dresden 1,2,3	Grundy, IL	200	BWR	GE	8/60
		800	BWR	GE	8/70
		800	BWR	GE	10/71
Duane Arnold	Linn, IA	545	BWR	GE	5/74
Fermi 2	Monroe, MI	1100	BWR	GE	3/82
Fitzpatrick*	Oswego, NY	821	BWR	GE	7/75
Forked River **	Ocean, NJ	1120	PWR	C-E	5/86
Ft. Calhoun	Washington, NB	457	PWR	C-E	9/73
Ft. St. Vrain	Weld, CO	330	HTGR	GA	1/79
Ginna (Brookwood)	Wayne, NY	490	PWR	W	3/70
Grand Gulf 1,2	Clairborne, MS	1250	BWR	GE	4/82
		1250	BWR	GE	9/86
Haddem Neck	Middlesey, CT	575	PWR	W	1/68
Hartsville A1,A2, B1,B2	Troysdale & Smith, TN	1233	BWR	GE	7/86
		1233	BWR	GE	7/87
		1233	BWR	GE	Indef.
		1233	BWR	GE	Indef.

*Same site as Nine Mile Point
**Same site as Oyster Creek

Table A.1-1 General Site and Reactor Data (cont)

Plant	Location (County/State)	Power Level (MWe)	Type	Reactor Supplier	Actual or Expected Date of Startup
Hatch 1,2	Appling, GA	786	BWR	GE	12/75
		786	BWR	GE	8/79
Hope Creek 1,2*	Salem, NJ	1070	BWR	GE	12/86
		1070	BWR	GE	12/89
Indian Point 2,3	Westchester, NY	873	PWR	W	7/74
		965	PWR	W	8/76
Joseph M. Farley 1,2	Houston, AL	860	PWR	W	12/77
		860	PWR	W	11/80
Kewaunee	Kewaunee, WI	535	PWR	W	6/74
LaCross	Monroe, WI	50	BWR	Allis	11/69
LaSalle 1,2	LaSalle, IL	1078	BWR	GE	6/81
		1078	BWR	GE	6/82
Limerick 1,2	Montgomery, PA	1055	BWR	GE	4/85
		1055	BWR	GE	4/87
Maine Yankee	Lincoln, ME	790	PWR	C-E	12/72
Marble Hill 1,2	Jefferson, IN	1130	PWR	W	/86
		1130	PWR	W	/87
McGuire 1,2	Mecklenberg, NC	1180	PWR	W	8/80
		1180	PWR	W	4/82
Midland 1,2	Midland, MI	530	PWR	B&W	7/84
		805	PWR	B&W	12/83
Millstone 1,2,3	New London, CT	660	BWR	GE	12/70
		870	PWR	C-E	12/75
		1150	PWR	W	5/86
Monticello	Wright, MN	536	BWR	GE	7/71
Nine Mile Pt. 1,2**	Oswego, NY	610	BWR	GE	12/69
		1080	BWR	GE	10/86
North Anna 1,2,3,4	Louisa, VA	850	PWR	W	6/78
		850	PWR	W	8/80
		934	PWR	B&W	4/87
		934	PWR	B&W	4/88
Oconee 1,2,3	Oconee, SC	860	PWR	B&W	7/73
		860	PWR	B&W	9/74
		860	PWR	B&W	12/74
Oyster Creek ***	Ocean, NJ	620	BWR	GE	12/69
Palisades	VanBuren, MI	740	PWR	C-E	12/71
Palo Verde 1,2,3	Manicopa, AZ	1270	PWR	C-E	5/83
		1270	PWR	C-E	5/84
		1270	PWR	C-E	5/86
Peach Bottom 2,3	York, PA	1065	BWR	GE	7/74
		1065	BWR	GE	12/74
Pebble Springs 1,2	Gilliam, OR	1260	PWR	B&W	9/88
		1260	PWR	B&W	9/90
Perkins 1,2,3	Davie, NC	1280	PWR	C-E	Indef.
		1280	PWR	C-E	Indef.
		1280	PWR	C-E	Indef.
Perry 1,2	Lake, OH	1205	BWR	GE	5/84
		1205	BWR	GE	5/88
Phipps Bend 1,2	Hawkins, TN	1233	BWR	GE	Indef.
		1233	BWR	GE	Indef.
Pilgrim 1,2	Plymouth, MA	670	BWR	GE	12/72
		1150	PWR	C-E	Indef.
Pt. Beach 1,2	Manitowoc, WI	497	PWR	W	12/70

*Same site as Salem
**Same site as Fitzpatrick
***Same site as Forked River

Table A.1-1 General Site and Reactor Data (cont)

Plant	Location (County/State)	Power Level (MWe)	Type	Reactor Supplier	Actual or Expected Date of Startup
Prairie Island 1,2	Goodhue, MN	520	PWR	W	12/73
		520	PWR	W	12/74
Quad Cities 1,2	Rock Island, IL	800	BWR	GE	8/72
		800	BWR	GE	10/72
Rancho Seco	Sacramento, CA	913	PWR	B&W	4/75
River Bend 1,2	West Feliciani, LA	940	BWR	GE	4/84
		940	BWR	GE	Indef.
Robinson 2	Darlington, SC	665	PWR	W	3/71
St. Lucie 1,2	St. Lucie, FL	777	PWR	C-E	12/76
		777	PWR	C-E	5/83
Salem 1,2*	Salem, NJ	1090	PWR	W	6/77
		1115	PWR	W	1/81
San Onofre 1,2,3	San Diego, CA	436	PWR	W	1/68
		1100	PWR	C-E	12/81
		1100	PWR	C-E	2/83
Seabrook 1,2	Rockingham, NH	1150	PWR	W	12/83
		1150	PWR	W	/85
Sequoyah 1,2	Hamilton, TN	1148	PWR	W	/80
		1148	PWR	W	6/81
Shearon Harris 1,2, 3,4	Wake & Chatham, NC	900	PWR	W	3/85
		900	PWR	W	3/88
		900	PWR	W	3/94
		900	PWR	W	3/92
Shoreham	Suffolk, NY	820	BWR	GE	3/83
Skagit 1,2	Skagit, WA	1288	BWR	GE	Indef
		1288	BWR	GE	Indef
South Texas 1,2	Matagorda, TX	1250	PWR	W	4/84
		1250	PWR	W	4/86
Surry 1,2	Surry, VA	775	PWR	W	12/72
		775	PWR	W	5/73
Susquehanna 1,2	Luzerne, PA	1050	BWR	GE	1/82
		1050	BWR	GE	1/83
Three Mile Island 1,2	Dauphin, PA	792	PWR	GE	9/74
		880	PWR	W	12/78
Trojan	Columbia, OR	1130	PWR	W	5/76
Turkey Pt. 3,4	Dade, FL	666	PWR	W	12/72
		666	PWR	W	9/73
Vermont Yankee	Windham, VT	514	BWR	GE	11/72
Virgil Summer	Fairfield, SC	900	PWR	W	6/81
Vogtle 1,2	Burke, GA	1100	PWR	W	/85
		1100	PWR	W	/88
WPPSS 1,2,4	Benton, WA	1250	PWR	B&W	6/85
		1100	BWR	GE	1/83
		1250	PWR	B&W	6/86
WPPSS 3,5	Grays Harbor, WA	1240	PWR	C-E	6/86
		1240	PWR	C-E	6/87
Waterford 3	St. Charles, LA	1165	PWR	C-E	/82
Watts Bar 1,2	Rhea, TN	1177	PWR	W	9/81
		1177	PWR	W	6/82
Wolf Creek	Coffey, KS	1150	PWR	W	4/83
Yankee Rowe	Franklin, MA	175	PWR	W	6/61
Yellow Creek 1,2	Tishomingo, MS	1285	PWR	C-E	11/85
		1285	PWR	C-E	4/88
Zimmer	Clermont, OH	810	BWR	GE	/81
Zion 1,2	Lake, IL	1100	PWR	W	6/73
		1100	PWR	W	12/73

*Same site as Hope Creek

Table A.1-2 General Site Data

Plant	Number Site	Latitude	Longitude	Meteorological Station	Sheltering Region	State
Allens Creek	1	29-40-43	96-06-15	Fort Worth (14)	3	TX
Arkansas	2	35-18-42	93-13-15	Columbia (10)	7	AR
Bailly	3	41-38-30	87-07-30	Chicago (9)	2	IN
Beaver Valley	4	40-37-18	80-26-06	Washington, DC (29)	1	PA
Bellefonte	5	34-42-32	85-55-36	Nashville (23)	7	AL
Big Rock Point	6	45-21-32	85-11-45	Milwaukee (21)	2	MI
Black Fox	7	36-07-01	95-32-54	Columbia (10)	3	OK
Braidwood	8	41-14-37	88-13-44	Moline (22)	4	IL
Browns Ferry	9	34-42-13	87-07-16	Nashville (23)	7	AL
Brunswick	10	33-57-32	78-01-15	Cape Hatteras (6)	6	NC
Byron	11	42-04-30	89-16-55	Moline (22)	4	IL
Callaway	12	38-45-42	91-46-52	Columbia (10)	4	MO
Calvert Cliffs	13	38-25-39	76-25-35	Washington, DC (29)	6	MD
Catawba	14	35-03-05	81-04-10	Nashville (23)	6	SC
Cherokee	15	35-02-12	81-30-43	Nashville (23)	6	SC
Clinton	16	40-10-19	88-50-03	Moline (22)	4	IL
Comanche Peak	17	32-17-49	97-47-07	Ft. Worth (14)	3	TX
Cooper	19	40-21-41	95-38-17	Omaha (25)	4	NB
Crystal River	20	28-57-26	82-41-56	Apalochicola (2)	7	FL
Davis-Besse	21	41-35-42	83-05-11	Chicago (9)	2	OH
Diablo Canyon	22	35-12-41	120-51-08	Santa Maria (27)	5	CA
Donald C. Cook	18	41-58-44	86-33-43	Chicago (9)	2	MI
Dresden	23	41-23-23	88-16-17	Moline (22)	4	IL
Duane Arnold	24	42-05-54	91-46-21	Omaha (25)	4	IA
Fermi	26	41-58-41	83-15-34	Chicago (9)	2	MI
Fitzpatrick*	27	43-31-19	76-23-54	Milwaukee (21)	1	NY
Forked River**	28	39-48-36	74-12-36	New York (24)	1	NJ
Ft. Calhoun	29	41-31-12	96-04-50	Omaha (25)	4	NB
Ft. St. Vrain	30	40-14-40	104-52-27	Dodge City (11)	4	CO
Ginna	31	43-16-39	77-18-30	Milwaukee (21)	1	NY
Grand Gulf	32	32-00-27	91-02-53	Lake Charles (17)	7	MS
Haddem Neck	33	41-28-56	72-29-57	New York (24)	1	CT
Hartsville	34	36-21-15	86-05-10	Nashville (23)	7	TN
Hatch	35	31-56-05	82-20-40	Charleston (8)	6	CA
Hope Creek***	92	39-27-46	75-32-08	Washington, DC (29)	1	NJ
Indian Point	36	41-15-57	73-56-06	New York (24)	1	NY
Joseph M. Farley	25	31-13-21	85-06-42	Lake Charles (17)	7	AL
Kewaunee	37	44-19-34	87-31-27	Milwaukee (21)	2	WI
LaCrosse	39	43-33-36	91-13-42	Madison (18)	2	WI
LaSalle	38	41-14-24	88-40-12	Moline (22)	4	IL
Limerick	40	40-13-12	75-35-24	Washington, DC (29)	1	PA
Maine Yankee	42	43-57-02	69-41-48	Caribou (7)	1	ME
Marble Hill	41	38-26-00	85-26-53	Moline (22)	2	IN
McGuire	43	35-25-59	80-56-55	Nashville (23)	6	NC
Midland	44	43-35-10	84-13-08	Milwaukee (21)	2	MI

*Same site as Nine Mile Point
**Same site as Oyster Creek
***Same site as Salem

Table A.1-2 General Site Data (cont)

Plant	Number Site	Latitude	Longitude	Meteorological Station	Sheltering Region	State
Millstone	45	41-18-32	72-10-04	Boston (4)	1	CT
Monticello	46	45-20-03	93-50-55	Madison (18)	2	MN
Nine Mile Point*	47	43-31-19	76-23-54	Milwaukee (21)	1	NY
North Anna	48	38-03-48	77-47-13	Washington, DC (29)	6	VA
Oconee	49	34-47-40	82-53-55	Nashville (23)	6	SC
Oyster Creek**	50	39-48-50	74-12-41	New York (24)	1	NJ
Palisades	51	42-19-24	86-18-52	Chicago (9)	2	MI
Palo Verde	52	33-23-25	112-51-45	Phoenix (26)	3	AZ
Peach Bottom	53	39-45-33	76-16-08	Washington, DC (29)	1	PA
Pebble Springs	54	45-42-05	120-08-17	Medford (19)	5	OR
Perkins	55	35-50-53	80-27-10	Nashville (23)	6	NC
Perry	56	41-48-03	81-08-36	Chicago (9)	2	OH
Phipps Bend	57	36-27-47	82-48-32	Nashville (23)	7	TN
Pilgrim	58	41-56-40	70-34-41	Boston (4)	1	MA
Point Beach	59	44-16-35	87-31-08	Milwaukee (21)	2	WI
Prairie Island	60	44-37-25	92-38-04	Madison (18)	2	MN
Quad Cities	61	41-43-38	90-20-30	Moline (22)	4	IL
Rancho Seco	62	38-21-00	121-07-12	Fresno (15)	5	CA
River Bend	63	30-45-26	91-19-54	Lake Charles (17)	7	LA
Robinson	64	34-24-12	80-09-30	Nashville (23)	6	SC
St. Lucie	65	27-20-55	80-14-47	Miami (20)	7	FL
Salem †	66	39-27-46	75-32-08	Washington, DC (29)	1	NJ
San Onofre	67	33-2-53	117-31-17	Santa Maria (27)	5	CA
Seabrook	68	42-53-53	70-51-05	Boston (4)	1	NH
Sequoyah	69	35-13-31	85-05-13	Nashville (23)	7	TN
Shearon Harris	70	35-38-00	78-57-22	Nashville (23)	6	NC
Shoreham	72	40-57-30	72-52-00	New York (24)	1	NY
Skagit	71	48-32-00	122-07-26	Seattle (28)	5	WA
South Texas	73	28-47-42	96-02-53	Brownsville (5)	3	TX
Surry	75	37-10-00	76-41-50	Washington, DC (29)	6	VA
Susquehanna	76	41-06-00	76-09-00	Washington, DC (29)	1	PA
Three Mile Island	77	40-09-12	76-43-37	Washington, DC (29)	1	PA
Trojan	78	46-02-24	122-52-06	Medford (19)	5	OR
Turkey Point	79	25-26-02	80-19-54	Miami (20)	7	FL
Vermont Yankee	80	42-46-49	72-30-57	Caribou (7)	1	VT
Virgil Summer	74	34-17-54	81-18-55	Nashville (23)	6	SC
Vogtle	81	33-08-31	81-45-53	Charleston (8)	6	CA
WPPSS 1,2,4††	84	46-28-03	119-18-51	Medford (19)	5	WA
WPPSS 3,5	85	46-57-11	123-28-11	Medford (19)	5	WA
Waterford	82	30-00-00	90-28-12	Lake Charles (17)	7	LA
Watts Bar	83	35-36-10	84-47-25	Nashville (23)	7	TN
Wolf Creek	87	38-14-20	95-41-20	Omaha (25)	4	KN
Yankee Rowe	88	42-43-41	72-55-29	New York (24)	1	MA
Yellow Creek	89	34-57-24	88-12-57	Nashville (23)	7	MS
Zimmer	90	38-51-55	84-13-45	Nashville (23)	2	OH
Zion	91	42-27-34	87-48-23	Chicago (9)	4	IL

*Same site as Fitzpatrick
**Same site as Forked river
†Same site as Hope Creek
††Same site as Skagit

Table A.1-3 Sheltering Regions

Region Number	Location	% Brick Housing Units	% Homes With Basements	Shielding Factor* Cloud	Shielding Factor* Ground
1	Northeast	47	87	0.5	0.08
2	Great Lakes	36	77	0.6	0.1
3	Southwest	40	13	0.7	0.3
4	Midwest	35	71	0.5	0.09
5	Pacific Coast	27	23	0.7	0.3
6	Atlantic Coast	45	51	0.6	0.2
7	Southeast	59	16	0.7	0.2

*The ratio of dose received when sheltered to the dose that would be received if outdoors. Cloud refers to gamma exposure from radionuclides dispersed in the atmosphere. Ground refers to gamma exposure from ground-deposited radionuclides.

A.2 Population Data

CRAC2 requires a description of the population distribution surrounding the reactor site being evaluated. Distributions are input as population counts for individual spatial elements. These elements are the cells in a polar grid consisting of up to 34 annuli and 16 sectors (each 22 1/2° in width). This study used 34 annuli, with radii of 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 6, 7, 8.5, 10, 12.5, 15, 17.5, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 85, 100, 150, 200, 350, and 500 miles. The population distribution for each site was derived from 1970 census data using a program called SECPOP which was developed by the Office of Radiation Programs, Environmental Protection Agency.* SECPOP constructs a polar grid from user-specified annular radii and number of sectors. This grid is centered on a location specified by latitude and longitude. A data file containing census data is then scanned to determine which enumeration district centroids fall into each spatial element. The population of each enumeration district is considered to be wholly within the spatial element in which its centroid falls. While this is an approximation, especially in sparsely populated areas for which the centroids are widely dispersed, it has an accuracy comparable to much of the other data used as input to CRAC2. In addition, the nature of the inaccuracy is such that it should have a very limited impact on conclusions drawn from exercising the model. The latitudes and longitudes for the 91 sites are provided in Table A.1-2. Summary population statistics for each site are provided in Chapter 3 and Appendix E.

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*Technical Memorandum 73-146, U.S. Department of Commerce, Office of Telecommunications.

A.3 Weather Data

CRAC2 requires an input file containing 8760 hourly weather observations (one year). The hourly observations consist of wind speed, wind direction, stability class, and precipitation. These data are used in the dispersion/ deposition submodel to determine the rate at which the radioactive plume travels, disperses, and is depleted.

Past studies have typically employed data gathered by a licensee over a one-year period at a proposed site, usually as part of the license application. For this study we have selected 29 National Weather Service (NWS) stations as the sources of meteorological data. NWS data are available for a large number of sites, cover long periods of time, are generally of higher quality, and are more detailed than actual reactor site data. Each of the NWS stations selected has approximately 25 years of available data. Therefore, rather than select a single year at random, a Typical Meteorological Year (TMY) [3] was used to represent the long-term average behavior of the weather at a station. The technique used to determine a TMY involves comparing the distribution of certain weather characteristics for a given month over the entire period of record. Using statistical techniques described in reference [3], the one month "most typical" of the period is selected as part of the TMY. This procedure was performed for each of the twelve calendar months to obtain the TMY. In addition, a small amount of smoothing is performed at the boundaries between months to avoid abrupt changes in weather conditions.

The criteria used to generate the TMYs were selected based on their relevance to solar heating simulations and include temperature, wind speed, and insolation. Since these parameters are correlated to the data required for the CRAC2 input, the TMYs are considered to be reasonably representative years to use as input to the consequence model. These data are probably better than the single year weather data used in the past which are of uncertain quality and are subject to the anomalies of a single year's weather.

The TMYs are available from the National Climatic Center (NCC), Asheville, NC. The data tapes supplied by the NCC are not compatible with CRAC2 requirements. In addition, these tapes do not contain a classification of stability class. A conversion program, METDAT, was developed by Science Applications, Inc. (SAI) under contract to Sandia. This program uses CRSTER [4], developed by the National Oceanic and Atmospheric Administration (NOAA), to generate the stability class using the insolation and wind speed data available in the TMY tapes.

CRAC2 requires rainfall intensity data for each hourly observation. Like atmospheric stability, rainfall data are not available on the TMY tapes. Therefore, rainfall statistics were gathered from other NWS data and were merged with the TMY information using the METDAT program.

The diffusion model used in CRAC2 also takes into account mixing height during dispersion calculations. The mixing height can affect the vertical diffusion of the radionuclide plume because mixing is essentially terminated at these levels. The mixing heights used for the 29 NWS stations were determined from the Holzworth isopleths of mean annual afternoon mixing height [5] (see Figure A.3-1). Table A.3-1 lists the 29 NWS stations with the assigned mixing heights. Figure A.3-2 shows the location of these stations in addition to the locations of the 91 reactor sites.

The meteorological data used for each of these 29 stations are summarized in Table A.3-2 in terms of the weather bin categories described in Appendix F. Additional rainfall data for the 29 stations are included in Table A.3-3.

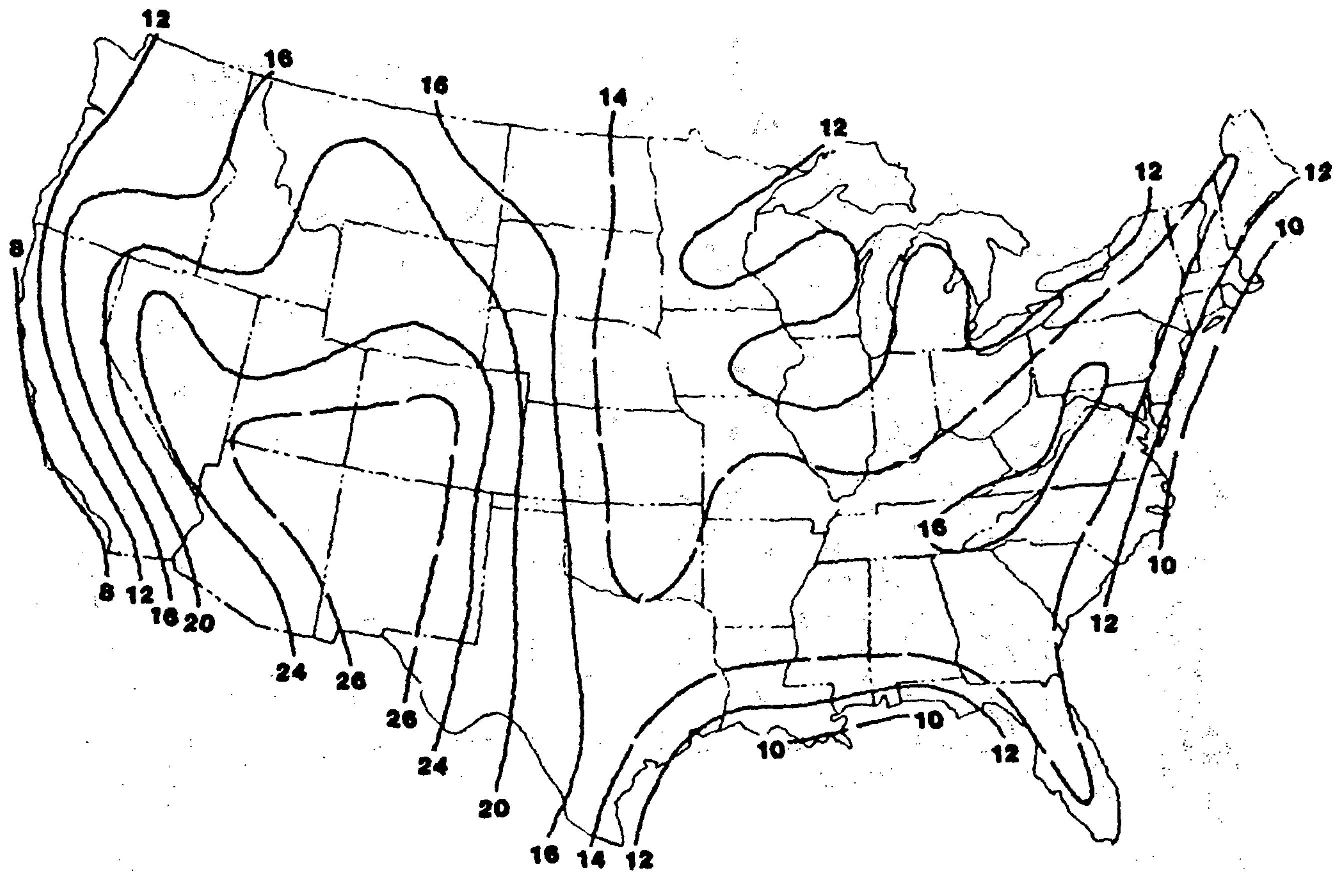

Figure A.3-1 Isopleths (m x 10^{-2}) of Mean Annual Afternoon Mixing Heights. From reference [5].

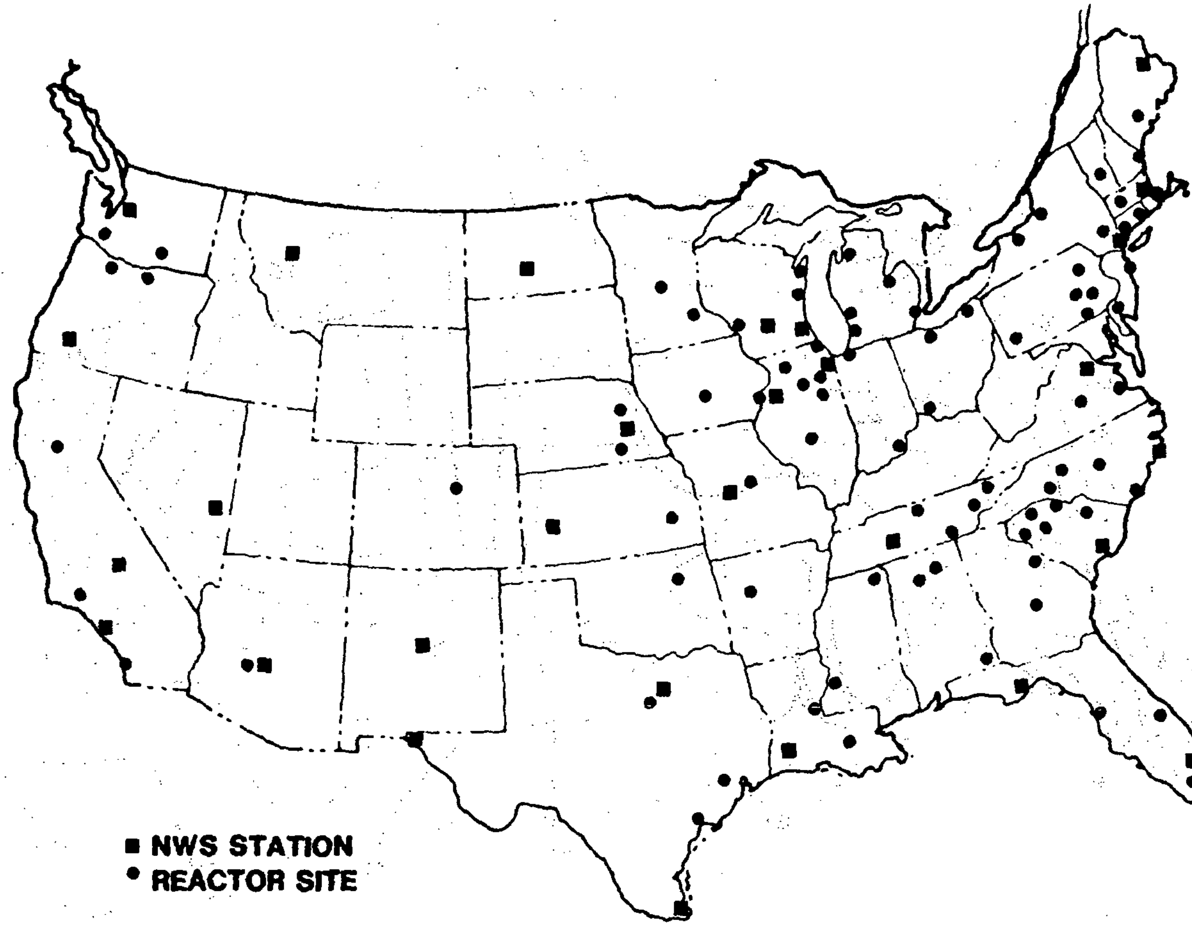

Figure A.3.2 Geographic location of the 29 NWS Stations and the 91 Reactor sites.

Table A.3-1 NWS Station Locations and Mixing Heights

No.	Station	Mixing Height (m)	No.	Station	Mixing Height (m)
1	Albuquerque, NM	2600	16	Great Falls, MT	2000
2	Apalachicola, FL	1200	17	Lake Charles, LA	1100
3	Bismarck, ND	1500	18	Madison, WI	1200
4	Boston, MA	1100	19	Medford, OR	1600
5	Brownsville, TX	1300	20	Miami, FL	1200
6	Cape Hatteras, NC	1000	21	Milwaukee, WI	1200
7	Caribou, ME	1300	22	Moline, IL	1200
8	Charleston, SC	1300	23	Nashville, TN	1600
9	Chicago, IL	1200	24	New York, NY	1200
10	Columbia, MO	1200	25	Omaha, NB	1300
11	Dodge City, KS	1600	26	Phoenix, AZ	2400
12	El Paso, TX	2600	27	Santa Maria, CA	800
13	Ely, NV	2400	28	Seattle, WA	1200
14	Fort Worth, TX	1500	29	Washington, DC	1500
15	Fresno, CA	1600			

Table A.3-2 Meteorological Data for 29 NWS Stations Summarized Using Weather Bin Categories

<u>Weather Bin Definitions</u>

R - Rain starting within indicated interval (miles).
S - Slowdown occurring within indicated interval (miles).
A-C D E F - Stability categories
1(0-1), 2(1-2), 3(2-3), 4(3-5), 5(GT 5) - Wind speed intervals (m/s).

Percent of Weather Sequences

Weather Bin	Albuquerque (1)	Apalachicola (2)	Bismarck (3)	Boston (4)	Brownsville (5)	Cape Hatteras (6)	Caribou (7)	Charleston (8)	Chicago (9)	Columbia (10)	Dodge City (11)	El Paso (12)
1 R (0)	1.46	4.50	3.94	8.89	2.25	6.69	10.14	5.87	6.19	6.26	3.69	1.30
2 R (0-5)	0.09	0.70	0.15	0.17	0.06	0.11	0.38	0.29	0.15	0.11	0.11	0.06
3 R (5-10)	0.31	1.14	0.40	0.79	0.39	0.75	1.26	0.88	0.68	0.75	0.27	0.26
4 R (10-15)	0.55	1.34	0.67	1.24	0.49	1.12	1.60	1.32	1.21	0.91	0.58	0.51
5 R (15-20)	0.33	1.11	0.76	0.82	0.54	1.02	1.28	0.81	0.87	0.91	0.37	0.34
6 R (20-25)	0.33	0.99	0.55	0.90	0.53	0.83	1.12	0.87	0.68	0.76	0.55	0.32
7 R (25-30)	0.40	0.96	0.66	0.94	0.42	0.83	1.29	0.99	0.86	0.76	0.50	0.34
8 S (0-10)	2.00	1.36	1.02	0.55	0.34	0.14	0.53	0.51	0.51	0.53	0.24	0.98
9 S (10-15)	2.01	1.02	0.90	0.43	0.27	0.08	0.42	0.43	0.41	0.42	0.25	0.96
10 S (15-20)	1.78	1.04	0.63	0.50	0.27	0.09	0.40	0.33	0.35	0.39	0.14	0.91
11 S (20-25)	1.55	1.02	0.73	0.37	0.21	0.07	0.29	0.39	0.38	0.32	0.15	0.71
12 S (25-30)	1.62	1.19	0.88	0.45	0.31	0.14	0.33	0.39	0.28	0.45	0.18	0.89
13 A-C 1,2,3	12.97	6.44	4.22	1.51	1.18	1.66	4.29	3.05	2.66	3.32	2.48	11.08
14 A-C 4,5	11.08	15.70	7.11	7.52	11.46	12.48	5.48	13.11	10.98	13.53	13.03	14.74
15 D 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 D 2	1.51	2.19	1.71	0.74	0.59	0.21	1.82	1.06	1.02	0.92	0.43	1.31
17 D 3	3.07	2.81	3.18	1.77	1.95	1.67	4.49	3.41	3.62	3.05	1.61	2.91
18 D 4	4.81	7.72	8.56	9.63	7.33	8.50	10.92	12.45	11.90	11.18	7.39	5.89
19 D 5	19.29	12.31	35.99	45.75	43.07	38.66	31.10	19.92	32.15	27.92	49.13	20.50
20 E 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21 E 2	1.26	1.85	1.11	0.23	0.54	0.26	0.53	0.83	0.48	0.50	0.09	1.53
22 E 3	3.15	2.48	1.91	0.79	2.44	1.23	2.43	4.01	2.20	2.00	0.67	3.15
23 E 4	7.87	5.34	6.21	6.36	7.28	9.68	6.71	7.57	7.25	9.06	7.68	6.45
24 E 5	2.35	1.85	1.67	3.13	2.69	3.01	2.09	1.80	2.84	2.23	3.74	2.51
25 F 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26 F 2	6.94	14.51	7.71	1.13	3.69	1.56	3.11	8.17	2.75	2.32	0.72	9.59
27 F 3	7.50	6.46	5.48	1.80	6.40	4.20	4.75	6.92	4.93	4.73	2.24	8.32
28 F 4	5.78	4.01	3.85	3.58	5.30	5.00	3.28	4.61	4.60	6.74	3.74	4.42
29 F 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.3-2 Meteorological Data for 29 NWS Stations Summarized Using Weather Bin Categories (cont)

Weather Bin Definitions

R - Rain starting within indicated interval (miles).
S - Slowdown occurring within indicated interval (miles).
A-C D E F - Stability categories
1(0-1), 2(1-2), 3(2-3), 4(3-5), 5(GT 5) - Wind speed intervals (m/s).

Percent of Weather Sequences

Weather Bin	Ely (13)	Fort Worth (14)	Fresno (15)	Great Falls (16)	Lake Charles (17)	Madison (18)	Medford (19)	Miami (20)	Milwaukee (21)	Moline (22)	Nashville (23)	New York (24)
1 R (0)	3.06	3.97	2.09	5.56	3.73	6.08	4.61	4.37	6.12	5.84	6.60	7.96
2 R (0-5)	0.36	0.10	0.11	0.40	0.32	0.24	1.37	0.32	0.18	0.11	0.18	0.14
3 R (5-10)	0.65	0.47	0.56	0.94	1.00	0.98	1.56	1.14	0.66	0.79	0.79	0.71
4 R (10-15)	0.65	0.66	0.49	1.11	0.98	1.28	1.59	1.34	1.20	1.03	1.04	1.16
5 R (15-20)	0.66	0.45	0.32	0.82	0.68	1.03	1.13	1.15	0.84	0.83	0.90	0.86
6 R (20-25)	0.57	0.45	0.40	0.59	0.76	0.84	1.13	1.02	0.71	0.66	0.01	0.76
7 R (25-30)	0.51	0.48	0.39	0.76	0.66	0.98	1.19	1.31	0.88	0.80	0.73	0.70
8 S (0-10)	0.86	0.49	0.90	0.59	0.51	0.94	1.47	0.62	0.59	0.47	0.73	0.27
9 S (10-15)	0.32	0.33	0.81	0.39	0.43	0.73	1.37	0.50	0.40	0.32	0.66	0.18
10 S (15-20)	0.73	0.25	0.70	0.40	0.35	0.75	1.30	0.49	0.34	0.35	0.65	0.21
11 S (20-25)	0.28	0.33	0.62	0.34	0.38	0.58	1.27	0.41	0.32	0.41	0.68	0.16
12 S (25-30)	0.64	0.33	0.78	0.33	0.42	0.68	1.29	0.53	0.43	0.35	0.70	0.21
13 A-C 1,2,3	9.60	4.12	16.69	4.49	3.97	3.38	15.49	3.46	2.25	3.50	4.40	1.92
14 A-C 4,5	13.70	14.92	7.45	8.12	11.58	8.64	6.06	15.70	9.68	10.73	11.18	10.18
15 D 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 D 2	1.54	0.67	4.65	1.36	1.35	2.40	10.54	0.95	1.26	1.71	2.23	0.70
17 D 3	3.12	2.35	5.91	2.92	4.87	3.90	7.31	2.39	2.53	4.68	3.86	2.58
18 D 4	8.57	9.57	4.94	8.64	13.79	11.86	4.50	8.89	10.61	10.82	9.66	10.82
19 D 5	25.41	31.63	7.21	42.24	19.93	29.43	5.27	17.64	36.80	29.33	19.65	37.96
20 E 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21 E 2	0.59	0.43	2.40	0.55	0.75	1.26	2.93	1.16	0.78	1.63	1.36	0.31
22 E 3	1.78	2.10	3.85	2.34	3.89	1.97	3.26	3.73	0.70	2.56	3.36	1.91
23 E 4	10.75	8.80	6.37	6.28	6.29	5.40	2.11	8.20	6.90	5.74	6.06	7.79
24 E 5	3.78	2.88	2.39	2.79	0.99	1.24	0.45	1.97	2.11	1.47	1.07	3.08
25 F 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26 F 2	2.82	2.90	13.63	2.32	6.95	8.12	13.89	8.06	5.22	8.24	7.25	1.32
27 F 3	4.29	5.14	11.28	3.09	9.62	4.32	7.65	8.54	3.78	5.32	8.26	3.54
28 F 4	4.81	6.18	5.07	2.64	5.75	2.96	1.26	6.12	3.71	3.49	4.41	4.59
29 F 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.3-2 Meteorological Data for 29 NWS Stations Summarized Using Weather Bin Categories (cont)

Weather Bin Definitions

R - Rain starting within indicated interval (miles).
S - Slowdown occurring within indicated interval (miles).
A-C D E F - Stability categories
1(0-1), 2(1-2), 3(2-3), 4(3-5), 5(GT 5) - Wind speed intervals (m/s).

Percent of Weather Sequences

Weather Bin	Omaha (25)	Phoenix (26)	Santa Maria (27)	Seattle (28)	Washington (29)
1 R (0)	5.43	1.00	2.24	8.72	5.79
2 R (0-5)	0.13	0.08	0.19	0.42	0.39
3 R (5-10)	0.62	0.31	0.40	1.87	1.28
4 R (10-15)	0.89	0.25	0.62	2.12	1.14
5 R (15-20)	0.70	0.23	0.41	1.90	0.88
6 R (20-25)	0.51	0.24	0.32	1.53	0.87
7 R (25-30)	0.59	0.22	0.43	1.77	0.86
8 S (0-10)	1.16	1.27	2.41	1.36	0.71
9 S (10-15)	0.90	1.21	1.84	1.44	0.67
10 S (15-20)	0.75	1.20	1.63	1.02	0.48
11 S (20-25)	0.67	0.91	1.45	0.98	0.63
12 S (25-30)	0.86	1.13	1.77	1.21	0.63
13 A-C 1,2,3	3.79	16.02	7.96	5.15	7.33
14 A-C 4,5	12.36	15.92	12.53	6.87	11.30
15 D 1	0.00	0.00	0.00	0.00	0.00
16 D 2	1.26	1.52	11.16	2.95	2.98
17 D 3	3.23	3.18	8.66	6.55	6.08
18 D 4	8.87	6.69	6.97	16.12	10.64
19 D 5	30.39	6.30	13.40	19.46	16.20
20 E 1	0.00	0.00	0.00	0.00	0.00
21 E 2	0.99	1.96	2.44	0.72	1.85
22 E 3	2.24	3.57	2.41	2.07	3.52
23 E 4	6.53	6.35	2.42	4.82	5.27
24 E 5	1.77	0.92	0.81	1.02	1.23
25 F 1	0.00	0.00	0.00	0.00	0.00
26 F 2	7.63	11.20	11.16	3.46	9.81
27 F 3	4.17	12.09	4.81	3.80	6.38
28 F 4	3.56	6.22	1.54	2.68	3.09
29 F 5	0.00	0.00	0.00	0.00	0.00

Table A.3-3 Summary of Rainfall Data for 29 NWS Station TMYs

Station	Hours of Observed Rainfall	Annual Rain (inches)
Albuquerque (1)	128	7
Apalachicola (2)	394	65
Bismarck (3)	345	16
Boston (4)	779	41
Brownsville (5)	197	16
Cape Hatteras (6)	586	49
Caribou (7)	888	31
Charleston (8)	514	52
Chicago (9)	542	37
Columbia (10)	548	37
Dodge City (11)	323	26
El Paso (12)	114	6
Ely (13)	268	10
Fort Worth (14)	348	33
Fresno (15)	183	7
Great Falls (16)	487	16
Lake Charles (17)	327	41
Madison (18)	533	29
Medford (19)	404	17
Miami (20)	383	53
Milwaukee (21)	536	27
Moline (22)	512	37
Nashville (23)	578	49
New York (24)	697	49
Omaha (25)	476	30
Phoenix (26)	88	4
Santa Maria (27)	196	10
Seattle (28)	764	40
Washington (29)	507	32

A.4 Site Wind Rose Data

CRAC2 uses a straight-line trajectory model for plume movement, employing the wind speeds in the weather sequence to determine the rate of travel. To calculate the effects of the accident in different directions, CRAC2 uses the wind rose as an empirical distribution for the probability that the plume trajectory will be in a given direction. All consequences are calculated assuming that the plume follows each of the 16 directions, and the results are weighted by the frequency of wind travel in that direction.

The wind rose data for the 91 sites were taken from either the Environmental Reports or the Preliminary or Final Safety Analysis Reports submitted to the Nuclear Regulatory Commission. The site wind roses used in this study are presented in Table A.4-1. A summary histogram of peak to mean wind rose probability ratios for the 91 sites is presented in Figure A.4-1. This histogram illustrates the importance of wind rose probabilities to reactor accident consequence calculations. (The mean wind rose probability is 1/16.)

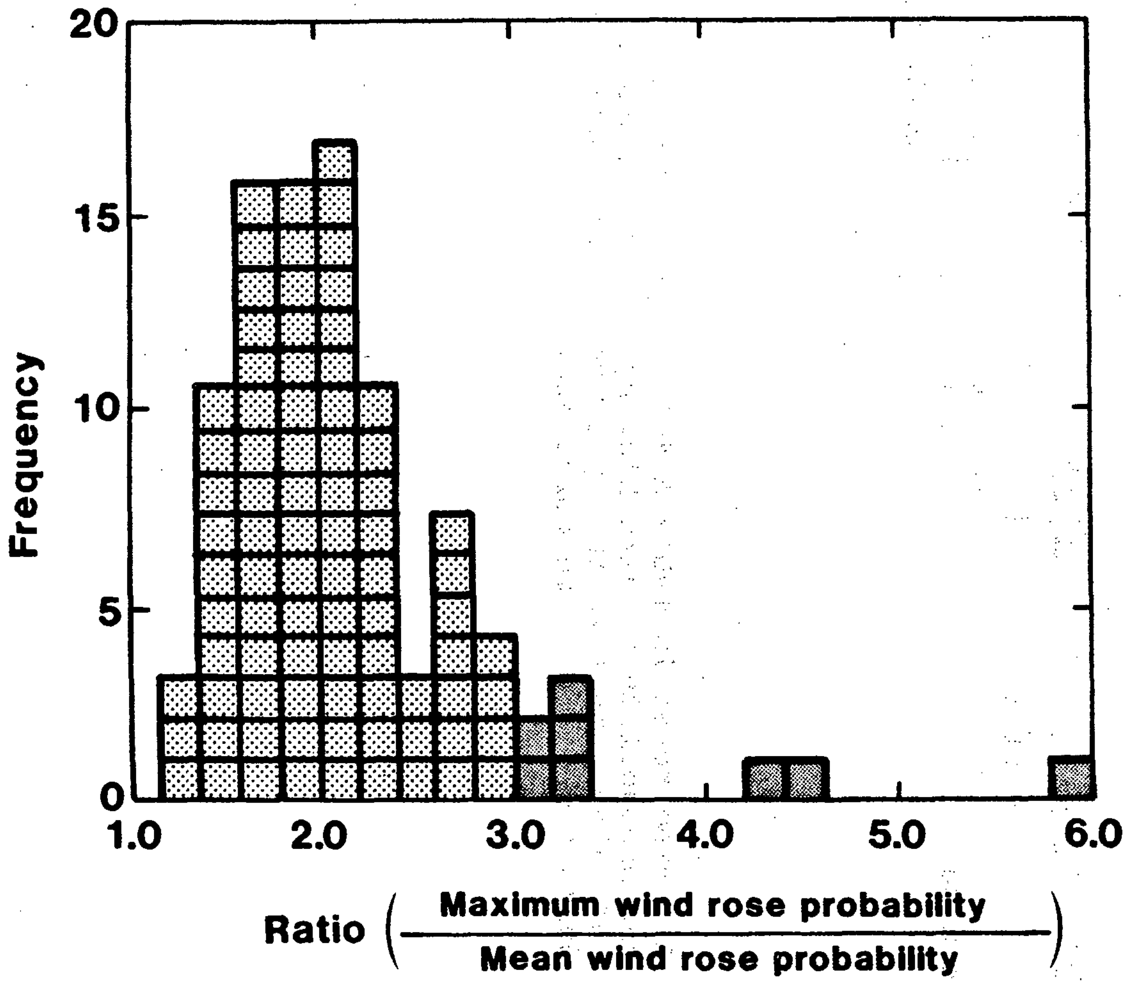

Figure A.4-1 Summary Histogram of Peak to Mean Wind Rose Probability Ratios for the 91 Sites

Table A.4-1

Site Wind Rose Data

Explanation of Titles:

Arkansas	1 + 2	190 ft	6/69-5/70
site name	reactors	anemometer height	period of data collection

Note: All wind roses in Table A.4-1 are presented as the probability of wind blowing toward the sector indicated. This is the opposite of the conventional definition used by meteorologists.

Table A.4-1 Site Wind Rose Data

Probability of Wind Blowing Towards Sector

Station	N S	NNE SSW	NE SW	ENE WSW	E W	ESE WNW	SE NW	SSE NNW
Allens Creek		10 m				8/1/1972 - 7/31/1973		
	.121	.073	.043	.024	.022	.021	.027	.069
	.107	.075	.062	.050	.046	.055	.101	.104
Arkansas 1, 2		190 ft				6/69 - 5/70		
	.103	.074	.052	.074	.126	.087	.053	.021
	.025	.015	.037	.056	.098	.077	.057	.042
Bailly		230 ft				12/4/51 - 12/3/57		
	.064	.105	.095	.086	.069	.056	.040	.038
	.064	.068	.069	.063	.038	.028	.053	.066
Beaver Valley 1, 2		150 ft				9/15/69 - 9/5/70		
	.087	.078	.051	.041	.083	.137	.123	.050
	.055	.023	.021	.023	.040	.059	.067	.064
Bellefonte 1		54 ft				1971		
	.064	.075	.092	.082	.071	.067	.060	.076
	.069	.066	.031	.040	.037	.053	.064	.053
Big Rock Point		250 ft				2/61 - 2/63		
	.112	.075	.071	.081	.099	.058	.057	.065
	.056	.039	.034	.046	.088	.037	.037	.045
Black Fox		33 ft				12/73 - 11/74		
	.180	.055	.026	.026	.022	.030	.051	.059
	.067	.064	.056	.045	.034	.046	.079	.160
Braidwood 1		30 ft				11/1/73 - 10/31/74		
	.105	.113	.077	.065	.061	.070	.065	.045
	.052	.048	.048	.045	.043	.044	.056	.063
Browns Ferry 1, 2, 3		300 ft				2/11/67 - 12/31/68		
	.072	.066	.058	.058	.052	.067	.055	.054
	.052	.067	.056	.038	.032	.072	.101	.099
Brunswick 1, 2		350 ft				9/25/70 - 1/5/73		
	.055	.077	.145	.088	.053	.037	.036	.041
	.059	.065	.084	.078	.053	.044	.047	.038
Byron 1		30 ft				6/11/73 - 5/31/74		
	.097	.089	.081	.065	.075	.063	.076	.057
	.053	.037	.048	.058	.049	.044	.039	.069
Callaway		10 m				5/4/73 - 5/4/74		
	.126	.096	.074	.043	.058	.070	.058	.050
	.051	.040	.026	.028	.036	.046	.083	.116
Calvert Cliff 1, 2		33 ft						
	.116	.089	.070	.045	.064	.061	.103	.078
	.084	.058	.038	.024	.035	.028	.028	.082
Catawba 1		30 ft				6/30/71 - 6/30/72		
	.023	.056	.207	.087	.043	.024	.026	.026
	.075	.079	.179	.060	.033	.025	.040	.017
Cherokee		30 ft				9/11/73 - 9/11/74		
	.036	.048	.124	.104	.094	.081	.114	.059
	.064	.059	.075	.055	.029	.022	.036	.019
Clinton		10 m				5/72 - 6/73		
	.104	.093	.086	.054	.042	.041	.042	.052
	.070	.068	.071	.056	.054	.038	.049	.067
Commanche Peak		10 m				5/12/72 - 5/14/76		
	.151	.084	.041	.025	.024	.029	.067	.076
	.060	.040	.029	.025	.032	.060	.105	.149

Table A.4-1 Site Wind Rose Data (cont)

Probability of Wind Blowing Towards Sector

Station	N S	NNE SSW	NE SW	ENE WSW	E W	ESE WNW	SE NW	SSE NNW
Cook DC 1, 2		200 ft				1967		
	.091	.105	.055	.045	.056	.069	.057	.062
	.078	.042	.042	.050	.040	.063	.072	.073
Cooper		318 ft				3/70 - 2/71		
	.116	.117	.079	.037	.030	.041	.060	.100
	.094	.061	.025	.031	.027	.034	.058	.090
Crystal River		33 ft				1/1/75 - 12/31/75		
	.043	.048	.051	.048	.082	.057	.043	.030
	.062	.047	.098	.121	.111	.064	.061	.034
Davis-BE 1		35 ft				8/4/74 - 8/3/75		
	.064	.116	.130	.102	.081	.039	.053	.037
	.030	.039	.058	.057	.077	.041	.038	.039
Diablo Canyon 1, 2		250 ft				10/69 - 9/70		
	.031	.012	.014	.015	.026	.045	.363	.128
	.059	.029	.055	.017	.014	.015	.103	.075
Dresden 2, 3		300 ft						
	.088	.090	.096	.067	.101	.085	.080	.056
	.049	.031	.039	.033	.036	.033	.060	.055
Duane Arnold		165 ft				1971		
	.129	.073	.053	.036	.051	.062	.083	.095
	.075	.040	.032	.034	.039	.060	.061	.076
Farley 1, 2		33 ft						
	.073	.070	.064	.044	.044	.045	.067	.090
	.097	.083	.086	.062	.044	.035	.040	.056
Fermi 2						9/1/73 - 8/31/74		
	.041	.088	.089	.102	.083	.086	.063	.047
	.026	.025	.059	.063	.069	.050	.058	.058
Fitzpatrick		200 ft				1963 - 1964		
	.087	.059	.102	.132	.115	.056	.053	.035
	.040	.047	.033	.014	.018	.037	.101	.068
Forked River		400 ft				2/66 - 2/67		
	.075	.096	.087	.068	.087	.093	.075	.063
	.044	.037	.052	.055	.039	.040	.047	.040
Fort Calhoun		40 ft				10/68 - 9/70		
	.093	.059	.034	.021	.042	.079	.113	.098
	.071	.018	.017	.022	.028	.064	.115	.126
Fort St. Vrain		205 ft				1967 - 1968		
	.063	.069	.076	.057	.040	.029	.035	.039
	.164	.085	.076	.064	.058	.043	.051	.049
Ginna R.E.		50 ft				1966 - 1967		
	.090	.081	.102	.097	.112	.101	.079	.044
	.030	.032	.031	.038	.045	.036	.030	.052
Grand Gulf 1						1951 - 1960		
	.101	.074	.062	.043	.036	.043	.070	.064
	.065	.060	.061	.040	.040	.044	.080	.117
Haddem Neck		129 ft				1963		
	.048	.046	.043	.038	.070	.160	.265	.052
	.013	.006	.009	.013	.035	.092	.055	.055
Hartsville		33 ft				2/1/73 - 1/31/74		
	.045	.058	.048	.056	.051	.034	.044	.025
	.045	.113	.175	.063	.050	.074	.069	.051

Table A.4-1 Site Wind Rose Data (cont)

Probability of Wind Blowing Towards Sector

Station	N S	NNE SSW	NE SW	ENE WSW	E W	ESE WNW	SE NW	SSE NNW
Hatch, E.I. 1, 2		150 ft				6/1/70 - 8/31/74		
	.055	.069	.082	.073	.075	.077	.072	.049
	.040	.038	.051	.067	.081	.068	.057	.044
Indian Point 2, 3		100 ft				1/1/71 - 12/31/71		
	.076	.055	.038	.039	.053	.079	.077	.070
	.124	.135	.066	.027	.019	.019	.041	.063
Kewaunee		180 ft				8/31/68 - 3/25/70		
	.082	.090	.064	.075	.094	.117	.082	.080
	.066	.055	.042	.030	.022	.023	.028	.050
LaSalle 1, 2		300 ft						
	.088	.090	.096	.067	.101	.085	.080	.056
	.049	.031	.039	.033	.036	.033	.060	.055
La Crosse		350 ft				1968 - 1970		
	.194	.139	.084	.018	.051	.026	.076	.062
	.125	.101	.048	.011	.022	.010	.026	.033
Limerick 1		270 ft				1/72 - 12/74		
	.071	.068	.052	.051	.090	.150	.109	.059
	.054	.039	.035	.046	.0670	.040	.037	.040
Marble Hill		33 ft				1/74 - 12/74		
	.058	.141	.124	.074	.062	.060	.044	.037
	.045	.044	.063	.060	.047	.030	.030	.041
Me Yankee		149 ft				7/67 - 6/68		
	.118	.124	.082	.041	.041	.055	.088	.089
	.075	.068	.064	.030	.024	.027	.031	.044
McGuire 1, 2		130 ft				10/17/70 - 10/16/71		
	.070	.090	.122	.062	.054	.042	.042	.040
	.057	.068	.113	.078	.056	.037	.038	.030
Midland 2						1962 - 1966		
	.060	.082	.123	.106	.124	.066	.064	.051
	.045	.046	.061	.043	.045	.024	.028	.032
Millstone 1, 2		152 ft				8/65 - 9/67		
	.038	.060	.076	.170	.078	.070	.078	.073
	.066	.060	.036	.035	.058	.035	.025	.041
Monticello		140 ft				2/9/67 - 2/10/68		
	.089	.091	.063	.055	.030	.089	.104	.119
	.036	.041	.029	.051	.031	.055	.052	.065
Nine M. Pt. 1, 2		204 ft				1963 - 1964		
	.082	.060	.104	.131	.118	.059	.054	.037
	.041	.048	.034	.013	.018	.037	.097	.069
North Anna 1, 2, 3		150 ft				9/16/71 - 9/15/72		
	.141	.095	.058	.047	.055	.047	.074	.084
	.100	.048	.044	.035	.041	.035	.042	.054
Oconee 1, 2, 3						6/19/68 - 6/19/69		
	.021	.036	.075	.051	.062	.043	.061	.081
	.174	.084	.100	.058	.060	.038	.036	.019
Oyster Creek		400 ft				2/66 - 2/67		
	.075	.096	.087	.068	.087	.093	.075	.063
	.044	.037	.052	.055	.039	.040	.047	.040
Palisade		55 ft				9/67 - 8/68		
	.204	.113	.027	.030	.058	.046	.072	.081
	.080	.033	.013	.012	.052	.038	.049	.093

Table A.4-1 Site Wind Rose Data (cont)

Probability of Wind Blowing Towards Sector

Station	Height	Period	N S	NNE SSW	NE SW	ENE WSW	E W	ESE WNW	SE NW	SSE NNW
Palo Verde 1	200 ft	8/13/73 - 8/13/74	.055	.073	.144	.082	.068	.047	.052	.035
			.048	.059	.068	.048	.073	.059	.056	.041
Peach Bottom 2, 3	320 ft	8/67 - 7/69	.085	.064	.046	.052	.069	.095	.115	.109
			.060	.043	.031	.032	.034	.046	.054	.064
Pebble Springs	30 ft	1/74 - 12/74	.017	.039	.075	.201	.313	.094	.021	.009
			.012	.019	.050	.055	.035	.028	.020	.014
Perkins	30 ft	10/12/73 - 10/11/74	.036	.067	.125	.066	.058	.047	.064	.053
			.068	.066	.104	.067	.063	.037	.044	.034
Perry 1	200 ft	5/1/72 - 4/30/73	.105	.095	.092	.084	.081	.054	.057	.042
			.045	.030	.057	.045	.048	.037	.054	.073
Phipps Bend	33 ft	2/1/74 - 1/31/75	.037	.054	.107	.106	.053	.071	.053	.120
			.054	.110	.112	.045	.020	.018	.021	.019
Pilgrim 1	72 ft		.051	.185	.118	.085	.094	.060	.053	.046
			.051	.038	.042	.035	.048	.031	.033	.030
Point Beach 1, 2	150 ft	4/67 - 4/68	.088	.122	.087	.048	.081	.097	.075	.056
			.096	.070	.055	.022	.020	.018	.031	.036
Prairie 1, 2	140 ft	6/1/71 - 5/31/72	.065	.031	.025	.031	.073	.102	.125	.065
			.046	.023	.019	.019	.055	.108	.134	.080
Quad Cities 1, 2	400 ft	4/68 - 9/69	.072	.128	.090	.049	.045	.069	.083	.067
			.068	.051	.042	.028	.037	.033	.075	.063
Rancho Seco	50 ft	1967 - 1969	.066	.073	.069	.107	.114	.078	.100	.074
			.049	.034	.029	.021	.029	.039	.057	.062
Riverbend 1	135 ft	10/1/72 - 9/30/73	.057	.058	.048	.048	.054	.048	.061	.066
			.069	.066	.066	.060	.076	.082	.072	.067
H. B. Robinson 2	120 ft	4/14/67 - 4/19/68	.045	.074	.072	.081	.071	.037	.036	.043
			.141	.114	.095	.050	.040	.035	.038	.029
Saint Lucie 1	50 ft	11/1/72 - 12/31/72	.062	.056	.063	.046	.030	.041	.053	.029
			.045	.038	.070	.088	.121	.093	.098	.067
Salem 1, 2	300 ft	6/69 - 5/71	.067	.062	.060	.056	.073	.095	.132	.094
			.062	.046	.049	.037	.028	.023	.042	.074
San Onofre	10 m	1/25/73 - 1/24/76	.066	.061	.054	.065	.088	.109	.060	.031
			.034	.111	.134	.028	.016	.022	.049	.070
Seabrook 1	30 ft	11/71 - 10/72	.030	.040	.069	.089	.110	.167	.145	.049
			.039	.024	.033	.046	.038	.041	.043	.037

Table A.4-1 Site Wind Rose Data (cont)

Probability of Wind Blowing Towards Sector

Station	N S	NNE SSW	NE SW	ENE WSW	E W	ESE WNW	SE NW	SSE NNW
Sequoyah 1, 2		33 ft				4/21/71 - 3/31/72		
	.066	.151	.161	.48	.024	.024	.035	.070
	.058	.169	.116	.026	.011	.008	.013	.019
Shearon Harris		10 m				1/76 - 12/76		
	.079	.107	.098	.079	.053	.054	.057	.062
	.083	.067	.063	.047	.033	.031	.035	.053
Skagit		10 m						
	.014	.011	.021	.037	.128	.109	.085	.062
	.037	.021	.041	.028	.109	.058	.039	.020
Shoreham		150 ft				10/1/73 - 9/30/74		
	.060	.129	.095	.050	.079	.103	.094	.066
	.050	.045	.049	.043	.032	.028	.036	.041
South Texas		33 ft				7/20/73 - 7/20/74		
	.148	.046	.029	.010	.015	.014	.020	.037
	.075	.078	.080	.047	.053	.059	.137	.153
Virgin C. Summer		202 ft				1975		
	.068	.090	.118	.087	.064	.046	.055	.043
	.029	.042	.080	.070	.059	.041	.052	.056
Surry St 1, 2		150 ft				11/67 - 12/69		
	.064	.082	.082	.062	.059	.061	.087	.081
	.072	.051	.046	.045	.057	.052	.055	.043
Susquehanna 1						1956 - 1960		
	.037	.070	.125	.126	.044	.059	.100	.090
	.046	.039	.049	.054	.040	.062	.031	.029
Three Mile Island		100 ft				4/71 - 3/72		
	.054	.045	.054	.059	.091	.092	.091	.070
	.040	.027	.036	.057	.085	.082	.062	.057
Trojan		30 ft				9/1/71 - 8/31/72		
	.203	.070	.026	.013	.022	.037	.070	.132
	.172	.054	.016	.006	.007	.009	.046	.120
Turkey Point 1, 2		30 ft				1969		
	.038	.041	.047	.027	.027	.047	.051	.077
	.035	.028	.048	.100	.136	.135	.100	.062
Vermont Yankee 1		140 ft				8/67 - 7/68		
	.072	.027	.018	.023	.069	.086	.117	.196
	.070	.025	.017	.019	.024	.066	.085	.086
Vogtle		30 ft				12/73 - 12/74		
	.064	.062	.074	.079	.084	.075	.056	.031
	.043	.043	.072	.065	.069	.060	.063	.060
Waterford 3		30 ft				5/72 - 4/73		
	.042	.053	.045	.047	.049	.056	.064	.072
	.046	.092	.088	.059	.029	.100	.083	.077
Watts Bar 1, 2		300 ft				7/1/73 - 6/30/75		
	.033	.109	.183	.089	.040	.031	.035	.037
	.053	.106	.132	.059	.041	.019	.014	.019
WPPS 1, 4		33 ft				4/74 - 3/75		
	.100	.082	.063	.052	.061	.099	.107	.085
	.164	.045	.036	.031	.022	.026	.040	.075
WPPS 2		33 ft				4/74 - 3/75		
	.100	.082	.063	.052	.061	.099	.107	.085
	.164	.045	.036	.031	.022	.026	.040	.075

Table A.4-1 Site Wind Rose Data (cont)

Probability of Wind Blowing Towards Sector

Station	N S	NNE SSW	NE SW	ENE WSW	E W	ESE WNW	SE NW	SSE NNW
WPPS 3, 5		60 m				5/73 - 4/74		
	.071	.098	.124	.170	.125	.031	.015	.010
	.014	.019	.062	.074	.047	.052	.050	.027
Wolf Creek		10 m				6/1/73 - 5/31/75		
	.080	.100	.040	.024	.030	.041	.064	.069
	.164	.058	.039	.035	.039	.046	.061	.111
Yankee Rowe		30 ft				10/71 - 9/72		
	.101	.080	.052	.037	.039	.041	.072	.086
	.086	.064	.065	.063	.047	.036	.052	.081
Yellow Creek		33 ft				7/1/74 - 6/30/75		
	.142	.097	.049	.039	.040	.050	.057	.087
	.037	.070	.049	.019	.021	.046	.060	.130
Zimmer 1		30 ft				3/1/72 - 2/28/74		
	.108	.066	.068	.056	.051	.059	.047	.062
	.062	.031	.027	.023	.030	.054	.127	.129
Zion		35 ft				1970		
	.071	.078	.079	.113	.069	.076	.046	.071
	.046	.059	.037	.039	.035	.035	.060	.096

A.5 Economic Data

The input data to the economic model in CRAC2 can be divided into two groups: those which are national in character and those which are applicable to individual states. Appendix VI of WASH-1400 [6] contains a detailed discussion of these parameters.

The national data can be further divided into data which measure costs on a per capita basis, and data which measure costs on a per acre basis. Decontamination costs for business, residential, and public areas, relocation costs, consumed dairy products, and consumed nondairy products, are all measured in dollars per person. The decontamination cost for farm land is measured in dollars per acre. Table A.5-1 lists current figures for these cost parameters and in addition compares these costs with those contained in Appendix VI of WASH-1400.

WASH-1400 Appendix VI describes some of the decontamination techniques considered when the original costs estimates were made. It does not, however, give a detailed breakdown of costs. As an approximation, the decontamination costs were broken down into labor, energy, and durable goods (equipment) components. The breakdown of costs was assumed to be 40% labor, 50% energy, and 10% durable goods for farmland decontamination and 60%, 30%, and 10% for decontamination of public areas. Using data contained in the Statistical Abstract of the US [7], the change in the Consumer Price Index (CPI) from 1972 to 1979 was calculated for each of these areas. These factors are 1.69 for labor, 2.66 for energy, and 1.55 for durable goods. The updated decontamination costs were obtained by multiplying the original WASH-1400 cost figures by the appropriately weighted combinations of these CPI factors.

Relocation costs were calculated in Appendix VI as a combination of lost income, both individual and corporate, and moving costs. These costs, which were calculated on a per capita basis, are $1,100 for lost individual income, $940 for lost corporate income, and $1,300 for transportation expenses. Based on data from the Statistical Abstract, the employee compensation rate has increased by a factor of 1.44 between 1973 and 1978. The nonfarm business gross national product (GNP) has increased by a factor of 1.54 and transportation services by a factor of 1.53 in the same period. The updated relocation cost was obtained by summing the products of each of the three costs and the appropriate factor.

The revised per capita value of residential, business, and public areas, and annual per capita dairy and nondairy consumption costs were derived from data contained in the Statistical Abstract of the U.S. The net value of residential, business, and public assets, less farm assets, was divided by the US population to obtain the updated per capita value of nonfarm assets. The updated agricultural consumption figures were obtained by dividing the total annual market value of these commodities by the US population. Per capita agricultural consumption figures are used by CRAC2 to determine radiation exposure through dairy and nondairy product ingestion.

The data, which are supplied on a state-by-state basis, all relate to farm costs and values. The input parameters are fraction of state area devoted to farming, average annual sale of farm products in dollars per acre, the fraction of farm sales resulting from dairy products, the average value of farmland in dollars per acre, and the major farming season. Table A.5-2 lists the values for all of these fields. The Statistical Abstract of the United States is the source for farmland value and farmland fraction. Farm sales and dairy share are found in reference [8]. The farming seasons are the same as the WASH-1400 figures.

Table A.5-1 National Economics Data

Description	WASH-1400 Data	Current Data
Decontamination cost for farmland ($/acre)	230	500*
Decontamination cost for residential, business, and public property ($/person)	1,700	4,400*
Value of residential, business, and public property ($/person)	17,000	32,000*
Depreciation rate for improvements (yr^{-1})	0.2	0.2
Relocation cost ($/person)	2,900	4,300**
Annual cost of dairy product consumption ($/person)	--	135**
Annual cost of non-dairy product consumption ($/person)	--	690**

*Represents 1979 statistics
**Represents 1978 statistics

Table A.5-2 Agricultural Land Use Characteristics

State	Fraction of State Used as Farm Land*,**	Average Annual Sale of Farm Products† ($/acre-year)	Average Share of Dairy Products† ($ dairy/$ products)	Average Value of Farmland† ($/acre)	Major Farming Season
Maine	0.077	250	0.182	485	May-Sept
New Hampshire	0.097	150	0.444	802	May-Sept
Vermont	0.283	177	0.791	657	May-Sept
Massachusetts	0.123	372	0.283	1366	May-Sept
Rhode Island	0.081	476	0.220	2133	May-Sept
Connecticut	0.140	500	0.313	2158	May-Sept
New York	0.315	188	0.579	642	May-Sept
New Jersey	0.197	376	0.162	2222	May-Sept
Pennsylvania	0.307	239	0.413	669	May-Sept
Ohio	0.618	183	0.153	1516	May-Sept
Indiana	0.728	206	0.067	1498	May-Sept
Illinois	0.795	213	0.041	1786	May-Sept
Michigan	0.285	197	0.238	955	May-Sept
Wisconsin	0.520	194	0.598	807	May-Sept
Minnesota	0.563	160	0.185	854	May-Sept
Iowa	0.944	242	0.050	1458	May-Sept
Missouri	0.724	111	0.079	674	May-Sept
North Dakota	0.922	45	0.047	306	May-Sept
South Dakota	0.922	46	0.074	257	May-Sept
Nebraska	0.967	99	0.027	470	May-Sept
Kansas	0.915	92	0.034	437	May-Sept
Delaware	0.471	508	0.046	1725	April-Oct
Maryland	0.414	273	0.227	1799	April-Oct
Virginia	0.371	126	0.171	864	April-Oct
West Virginia	0.270	44	0.203	472	April-Oct
North Carolina	0.368	261	0.056	819	April-Oct
South Carolina	0.327	148	0.063	635	April-Oct
Georgia	0.417	164	0.058	609	April-Oct
Florida	0.368	233	0.077	930	April-Oct
Kentucky	0.557	141	0.117	792	April-Oct
Tennessee	0.507	118	0.140	669	April-Oct
Alabama	0.400	144	0.041	515	April-Oct
Mississippi	0.475	135	0.047	520	April-Oct
Arkansas	0.494	158	0.030	691	April-Oct
Louisiana	0.332	137	0.087	763	April-Oct
Oklahoma	0.782	68	0.051	442	April-Oct
Texas	0.811	54	0.053	354	April-Oct
Montana	0.658	20	0.026	186	May-Sept
Idaho	0.894	93	0.114	485	May-Sept
Wyoming	0.560	15	0.024	119	May-Sept
Colorado	0.570	69	0.039	332	April-Oct
New Mexico	0.600	21	0.056	100	April-Oct
Arizona	0.556	36	0.069	134	April-Oct
Utah	0.236	36	0.215	265	April-Oct
Nevada	0.127	19	0.117	104	April-Oct
Washington	0.369	132	0.138	586	May-Sept
Oregon	0.300	68	0.093	330	May-Sept
California	0.318	316	0.119	936	April-Oct

*Fraction of total state area (including water areas) devoted to agricultural use
**Reflect 1979 statistics
†Reflect 1978 statistics

References for Appendix A

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2. D. C. Aldrich, D. M. Ericson, and J. D. Johnson, Public Protection Strategies for Potential Nuclear Accidents: Sheltering Concepts with Existing Public and Private Structures, SAND77-1725, Sandia Laboratories, Albuquerque, NM, February 1978.

3. I. Hall, R. Prairie, and E. Boes, Generation of Typical Meteorological Years for 26 SOLMET Stations, SAND78-1601, Sandia Laboratories, August 1978.

4. User's Manual for Single Source (CRSTER) Model, US Environmental Protection Agency, Office of Air and Waste Management, Research Triangle Park, NC, July 1977.

5. G. C. Holzworth, Mixing Heights, Wind Speeds, and Potential for Urbain Air Pollution Throughout the Contiguous United States, Publ. No. AP-101, US Environmental Protection Agency, Office of Air Programs, Research Triangle Park, NC, 1972.

6. Reactor Safety Study, Appendix VI: Calculation of Reactor Accident Consequences, WASH-1400 (NUREG 75/014), US Nuclear Regulatory Commission, October 1975.

7. US Department of Commerce, 1979, Statistical Abstract of the United States.

8. US Department of Agriculture, Agricultural Statistics, 1979.

Appendix B: Reactor Core Radionuclide Inventories

B.1 Core Radionuclide Inventory

Reactor accident consequence calculations are often performed using the Reactor Safety Study [1] radionuclide inventory for a 3200 MWt Westinghouse pressurized water reactor (PWR). This inventory, calculated for an end-of-cycle equilibrium core, has been used to represent both boiling water reactor (BWR) and PWR cores. Recently, however, an end-of-cycle equilibrium inventory for a 3412 MWt Westinghouse PWR was calculated using the SANDIA-ORIGEN computer code [2]. This inventory, which was calculated using a 25% greater fuel burnup than used for the WASH-1400 inventory, was used to perform the reactor consequence calculations discussed in Chapter 2. (A spent fuel burnup of 26,400 MWd/MTU was assumed to calculate the WASH-1400 inventories.)

The 3412 MWt PWR inventory was calculated by assuming that the three regions of the reactor core (each initially loaded with uranium enriched to 3.3% U-235) were operated at a constant specific power density of 38.3 MW/MTU charged. A three year refueling cycle and an 80% capacity factor were also assumed. This inventory is representative of an equilibrium core at a time when the three regions have average burnups of 11,000, 22,000, and 33,000 MWd/MTU charged (end-of-cycle).

The SANDIA-ORIGEN code calculates the time dependent activities of approximately 500 radionuclides, including activation products, fission products, and actinides. Of this number, only 54 radionuclides are expected to significantly impact reactor accident consequence calculations and as a result, are input to the CRAC2 code. The elimination of radionuclides from consideration was based on a number of parameters, such as quantity (curies), release fraction, radioactive half-life, dosimetry, and chemical characteristics [1]. Table B.1-1 lists the 54 radionuclides used to perform the consequence calculations. Also given is the activity of each radionuclide at the time the accident is assumed to occur. The reactor core inventories used to perform the power level sensitivity calculations discussed in Chapter 2 were obtained by linearly scaling (by thermal power level) the inventories presented in Table B.1-1.

Table B.1-1 Inventory of Radionuclides in the 3412 MWt PWR Core

No.	Radionulcide	Radioactive Inventory Source (curies x 10^{-8})	Half-Life (days)
1	Cobalt-58	0.0075	71.0
2	Cobalt-60	0.000045	1,920
3	Krypton-85	0.0066	3,950
4	Krypton-85m	0.31	0.183
5	Krypton-87	0.57	0.0528
6	Krypton-88	0.77	0.117
7	Rubidium-86	0.00048	18.7
8	Strontium-89	0.96	52.1
9	Strontium-90	0.052	10,300
10	Strontium-91	1.2	0.403
11	Yttrium-90	0.055	2.67
12	Yttrium-91	1.2	59.0
13	Zirconium-95	1.5	65.2
14	Zirconium-97	1.6	0.71
15	Niobium-95	1.4	35.0
16	Molybdenum-99	1.7	2.8
17	Technetium-99m	1.4	0.25
18	Ruthenium-103	1.2	39.5
19	Ruthenium-105	0.82	0.185
20	Ruthenium-106	0.29	366
21	Rhodium-105	0.56	1.50
22	Tellurium-127	0.075	0.391
23	Tellurium-127m	0.0098	109
24	Tellurium-129	0.25	0.048
25	Tellurium-129m	0.067	34.0
26	Tellurium-131m	0.13	1.25
27	Tellurium-132	1.3	3.25
28	Antimony-127	0.077	3.88
29	Antimony-129	0.27	0.179
30	Iodine-131	0.87	8.05
31	Iodine-132	1.3	0.0958
32	Iodine-133	1.8	0.875
33	Iodine-134	2.0	0.0366
34	Iodine-135	1.7	0.280
35	Xenon-133	1.8	5.28
36	Xenon-135	0.38	0.384
37	Cesium-134	0.13	750
38	Cesium-136	0.039	13.0
39	Cesium-137	0.065	11,000
40	Barium-140	1.7	12.8
41	Lanthanum-140	1.7	1.67
42	Cerium-141	1.5	32.3
43	Cerium-143	1.5	1.38
44	Cerium-144	0.92	284
45	Praseodymium-143	1.5	13.7
46	Neodynium-147	0.65	11.1
47	Neptunium-239	19.0	2.35
48	Plutonium-238	0.0012	32,500
49	Plutonium-239	0.00026	8.9×10^6
50	Plutonium-240	0.00029	2.5×10^6
51	Plutonium-241	0.054	5,350
52	Americium-241	0.000036	1.6×10^5
53	Curium-242	0.014	163
54	Curium-244	0.00084	6,630

B.2 Radionuclide Inventory Impacts on Reactor Accident Consequences

The potential impacts of different radionuclide inventories on predicted accident consequences, and the appropriateness of inventory scaling, were examined using the CRAC2 code [3]. Consequence calculations were performed using end-of-cycle equilibrium inventories for the WASH-1400 3200 MWt Westinghouse PWR, the 3412 MWt Westinghouse PWR, a 3578 MWt General Electric (GE) BWR, and a 1518 MWt Westinghouse PWR. Calculations were also performed for the 3412 MWt PWR at 1/3 and 2/3 of the way way through the annual operating cycle. (The 3578 MWt BWR and 1518 MWt PWR inventories, like those for the 3412 MWt PWR, were generated with the SANDIA-ORIGEN computer code.) The operating characteristics for the four reactors are summarized in Table B.2-1. The 3412 MWt and 1518 MWt PWRs and the 3578 MWt BWR are considered to be representative of current reactor designs and compositions.

Table B.2-2 summarizes the four reactor inventories for selected radionuclides. In general, inventories of short-lived radionuclides are proportional to reactor thermal power level, while inventories of long-lived radionuclides are proportional to burnup; both are influenced by in-core fuel management plans.

Consequences were calculated assuming (1) an SST1 release (large-scale core melt with uncontrolled release directly to the atmosphere), (2) Indian Point population and wind-rose data, (3) New York City weather data, and (4) a distribution of evacuations within 10 miles of the reactor.* Table B.2-3 summarizes the consequence calculation results from which the following observations can be made.

1) The 3412 MWt PWR land interdiction and decontamination results are approximately 30% larger than those for the WASH-1400 PWR. Differences for other consequences are somewhat less (10-17%).

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*Consists of a 30%, 40%, 30% weighting of a 10 mile per hour evacuation after 1, 3, and 5 hour delays, respectively.

Table B.2-1 Reactor Operating Characteristics

Characteristic	WASH-1400	3412 MWt PWR	3578 MWt[a] BWR	1518 MWt PWR
Total Uranium in Fresh Core (MT)	---	89.1	136.7	47.5
Initial U-235 Enrichment (percent)	3.3	3.3	2.66, 2.83	3.2
Refueling Cycle	annually	annually	annually	annually
Number of Years an Element Spends in Core (years)	3	3	3,4	3
Capacity Factor (Percent of time at Full Power)	---	80	80	80
Average Fuel Burnup at discharge (MWd/MTU)	26,400	33,600	---	28,000
Average Power Density (MW/MTU)	40	38.3	26.1	32.0

[a]The SANDIA-ORIGEN BWR calculations were performed on a per fuel assembly basis. The code generated radionuclide inventories by blending individual assembly results.

Table B.2-2 Inventory of Selected Radionuclides for the Reactors Studied.

Radionuclide	Half-Life (days)	End-of-Cycle 3412 MWt PWR (Ci)	(Designated Inventory) ÷ (3412 MWt PWR Inventory)				
			WASH-1400 End-of-Cycle 3200 MWt PWR	End-of-Cycle 3578 MWt BWR	End-of-Cycle 1518 MWt PWR	1/3 Cycle 3412 MWt PWR	2/3 Cycle 3412 MWt PWR
Kr-85	0.117	6.64×10^5	1.03	1.36	0.44	0.68	0.84
Mo-99	2.8	1.66×10^8	0.94	1.05	0.45	1.02	1.01
Tc-99m	0.25	1.43×10^8	1.00	1.05	0.45	1.03	1.01
Ru-103	39.5	1.25×10^8	0.85	1.06	0.44	0.87	0.96
Ru-105	0.185	8.22×10^7	0.88	1.07	0.43	0.86	0.94
Ru-106	366	2.90×10^7	0.86	1.24	0.42	0.66	0.83
Te-129m	0.34	6.70×10^6	0.79	1.06	0.44	0.88	0.96
Te-131m	1.25	1.28×10^7	1.00	1.07	0.44	0.97	0.98
Te-132	3.25	1.27×10^8	0.92	1.06	0.45	1.00	1.00
Sb-129	0.179	2.72×10^7	1.22	1.06	0.44	0.93	0.97
I-131	8.05	8.74×10^7	0.98	1.06	0.45	0.99	1.00
I-132	0.096	1.29×10^8	0.92	1.05	0.44	0.99	1.00
I-133	0.875	1.84×10^8	0.94	1.05	0.45	1.02	1.01
I-134	0.037	2.02×10^8	0.95	1.05	0.45	1.02	1.01
I-135	0.28	1.73×10^8	0.88	1.06	0.45	1.02	1.01
Cs-134	750	1.26×10^7	0.60	1.20	0.38	0.55	0.76
Cs-136	13.0	3.91×10^6	0.77	1.04	0.41	0.67	0.84
Cs-137	11,000	6.54×10^6	0.72	1.39	0.44	0.67	0.83
Ba-140	12.8	1.68×10^8	0.94	1.05	0.45	1.02	1.01
Ce-144	284	9.15×10^7	0.92	1.14	0.45	0.77	0.90

Table B.2-3 Summary of CRAC2 Consequence Predictions.

Consequence	End-of-Cycle 3412 MWt PWR	WASH-1400 End-of-Cycle 3200 MWt PWR	End-of-Cycle 3578 MWt BWR	1/3 Cycle 3412 MWt PWR	2/3 Cycle 3412 MWt PWR	End-of-Cycle 1518 MWt PWR	Scaled[1] End-of-Cycle 1518 MWt PW
Mean Early Fatalities	800	690	890	750	780	150	150
Mean Early Injuries	3600	3000	4100	3400	3500	960	970
Mean Latent Cancer Fatalities	7800	7000	8400	6800	7300	5300	5400
Mean Land Interdiction Area (km^2)	200	140	280	130	160	92	97
Mean Land Decontamination Area (km^2)	3800	2800	5900	2800	3100	2000	2100

[1]Inventory = (1518 MWt/3412 MWt) x (3412 MWt PWR inventory).

2) The 3578 MWt BWR land decontamination and interdiction consequences are approximately 50% larger than those for the 3412 MWt PWR. Again, differences for other consequences are on the order of 10%.

3) Comparison of the 3412 and 1518 MWt PWR results indicate reductions in reactor size result in proportionately larger reductions in early consequences.

4) Comparison of the 1/3, 2/3, and end-of-cycle 3412 MWt PWR results indicate that differences in radionuclide inventory during the annual operating cycle have little influence on early consequences. However, time of the accident during the cycle does significantly influence predicted latent cancer fatalities and areas of land interdiction and decontamination.

5) There is essentially no difference in consequences for the 1518 MWt PWR predicted by using either the calculated or scaled inventories.

Differences in latent cancer fatality, land interdiction, and land decontamination consequences largely result from long-lived radionuclide inventory differences (e.g., Cs-137). Differences in early consequences are primarily due to differences in short-lived radionuclide inventories.

In summary, the results presented above indicate that reactor accident consequences are sensitive to differences in radionuclide inventories due to reactor size and design. Because of in-core fuel management plans, boiling water reactors will likely have larger inventories of long-lived radionuclides than a pressurized water reactor of the same size. Therefore, using PWR inventories for BWR consequence calculations could underestimate latent consequences. The time of a reactor accident during the annual operating cycle has little influence on early consequences; however, it can significantly influence latent effects. Reductions in reactor size will lead to substantial reductions in early consequences, more so than would be expected based on differences in reactor power levels. In addition, linear scaling of radionuclide inventories by thermal power level is adequate for consequence calculations, provided that the reactor of interest has operating and design characteristics similar to those of the reactor from which the inventories are scaled.

References for Appendix B

1. "Reactor Safety Study Appendix VI: Calculation of Reactor Accident Consequences," WASH-1400 (NUREG 75/014), U.S. Nuclear Regulatory Commission, October 1975.

2. D. E. Bennett, Radionuclide Core Inventories for Standard PWR and BWR Fuel Management Plans, SAND82-1111, NUREG/CR-2724, Sandia National Laboratories, Albuquerque, NM, to be published.

3. R. M. Ostmeyer, "Radionuclide Inventory Impacts on Reactor Accident Consequences," Transactions of the American Nuclear Society (November 1981).

Appendix C: Site Specific Consequence Estimates

This appendix presents the consequence estimates for each of the 91 sites analyzed in Chapter 2. It is important to note that in each case the calculations assumed (1) that the site contained an 1120 MWe PWR, (2) meteorology based on the most appropriate regional National Weather Service Station (from among the 29 detailed in Appendix A), (3) actual site wind rose and population, (4) a summary evacuation (all persons within 10 miles evacuate at 10 mph after delays of 1, 3, or 5 hours, with probability .3, .4, .3, respectively) and (5) hypothetical releases of radioactive materials (see Section 2.3, Chapter 2). Thus the estimates presented in this appendix are only a guide to the impact of site characteristics (principally population distribution) on predicted consequences. In no way are these to be taken as estimates of existing/reactor combinations.

Table C.1 provides a summary of the mean early fatalities, early injuries, and latent cancer fatalities for SST1, SST2, and SST3. Figures C-1 through C-18 contain early fatality, early injury, and latent cancer fatality CCDFs for each of the 91 sites, conditional on an SST1 release and assuming the 1120 MWe PWR, summary evacuation, regional meteorology, and actual site population and wind rose. Since some of these characteristics do not exactly duplicate the characteristics of the actual reactor/site combinations, the CCDFs are not to be used in place of actual risk estimates for existing reactor/site combinations.

Table C-1. Mean Number (Per Reactor-Year) of Early Fatalities, Early Injuries and Latent Cancer Fatalities for each of 91 Sites, for SST1, SST2, or SST3 Accident Source Terms.

Assumptions:

(1) Standard 1120 MWe PWR

(2) Summary Evacuation

(3) Actual Site Population and Wind rose

(4) Best Estimate Meteorology

	Mean Early Fatalities*			Mean Early Injuries*			Mean Latent Cancer Fatalities*		
	SST1	SST2	SST3	SST1	SST2	SST3	SST1	SST2	SST3
Allens Creek	$31xP_1$	$0xP_2$	$0xP_3$	$93xP_1$	$0.9xP_2$	$0xP_3$	$620xP_1$	$49xP_2$	$0.2xP_3$
Arkansas	$17xP_1$	$0xP_2$	$0xP_3$	$150xP_1$	$0.2xP_2$	$0xP_3$	$950xP_1$	$82xP_2$	$0.3xP_3$
Bailly	$58xP_1$	$0xP_2$	$0xP_3$	$1200xP_1$	$0.5xP_2$	$0xP_3$	$3300xP_1$	$260xP_2$	$0.9xP_3$
Beaver Valley	$150xP_1$	$0xP_2$	$0xP_3$	$1200xP_1$	$0.4xP_2$	$0xP_3$	$3400xP_1$	$200xP_2$	$0.6xP_3$
Bellefonte	$63xP_1$	$0.08xP_2$	$0xP_3$	$110xP_1$	$5.6xP_2$	$0xP_3$	$1000xP_1$	$70xP_2$	$0.3xP_3$
Big Rock Pt.	$15xP_1$	$0xP_2$	$0xP_3$	$90xP_1$	$0.5xP_2$	$0xP_3$	$680xP_1$	$53xP_2$	$0.2xP_3$
Black Fox	$13xP_1$	$0xP_2$	$0xP_3$	$220xP_1$	$0.01xP_2$	$0xP_3$	$780xP_1$	$69xP_2$	$0.3xP_3$
Braidwood	$160xP_1$	$0.05xP_2$	$0xP_3$	$420xP_1$	$10xP_2$	$0xP_3$	$3200xP_1$	$240xP_2$	$0.9xP_3$
Browns Ferry	$25xP_1$	$0xP_2$	$0xP_3$	$220xP_1$	$0.03xP_2$	$0xP_3$	$970xP_1$	$69xP_2$	$0.3xP_3$
Brunswick	$12xP_1$	$0xP_2$	$0xP_3$	$120xP_1$	$0.01xP_2$	$0xP_3$	$890xP_1$	$98xP_2$	$0.4xP_3$

*Detailed Probabilistic Risk Assessments (PRAs) have not been performed for all reactors. Therefore, consequence calculations were performed in this study using Siting Source Terms (SSTs) defined by NRC (see Section 2.3.1, Chapter 2). By adjusting the probabilities associated with each of the source terms, the set can be made to approximately represent any current LWR design. Based on currently available PRAs, NRC has suggested that representative probabilities for the SSTs are: P_1 for SST1 = 1×10^{-5}, P_2 for SST2 = 2×10^{-5}, and P_3 for SST3 = 1×10^{-4}. There are very large variations (factors of 10 to 100) in the accident probabilities associated with a specific design.

Caution should be used when applying these numbers. Probability times consequence is not an adequate representation of risk; it provides only a common measure for comparative purposes (i.e., rank ordering). The Complementary Cumulative Distribution Functions (shown in Figure C-1 through C-18) are a better representation of risk.

Table C-1. (continued)

	Mean Early Fatalities*			Mean Early Injuries*			Mean Latent Cancer Fatalities*		
	SST1	SST2	SST3	SST1	SST2	SST3	SST1	SST2	SST3
Byron	$54xP_1$	$0.09xP_2$	$0xP_3$	$330xP_1$	$4.3xP_2$	$0xP_3$	$2500xP_1$	$190xP_2$	$0.7xP_3$
Callaway	$10xP_1$	$0xP_2$	$0xP_3$	$100xP_1$	$0.04xP_2$	$0xP_3$	$1200xP_1$	$97xP_2$	$0.3xP_3$
Calvert Cliffs	$18xP_1$	$0xP_2$	$0xP_3$	$170xP_1$	$0.08xP_2$	$0xP_3$	$2400xP_1$	$120xP_2$	$0.4xP_3$
Catawba	$100xP_1$	$0xP_2$	$0xP_3$	$710xP_1$	$0.2xP_2$	$0xP_3$	$1500xP_1$	$110xP_2$	$0.4xP_3$
Cherokee	$27xP_1$	$0xP_2$	$0xP_3$	$250xP_1$	$0.1xP_2$	$0xP_3$	$1200xP_1$	$76xP_2$	$0.3xP_3$
Clinton	$16xP_1$	$0xP_2$	$0xP_3$	$130xP_1$	$0.7xP_2$	$0xP_3$	$2300xP_1$	$170xP_2$	$0.7xP_3$
Comanche Peak	$1.3xP_1$	$0xP_2$	$0xP_3$	$37xP_1$	$0xP_2$	$0xP_3$	$640xP_1$	$49xP_2$	$0.2xP_3$
Cooper	$4.7xP_1$	$0xP_2$	$0xP_3$	$47xP_1$	$0.09xP_2$	$0xP_3$	$900xP_1$	$81xP_2$	$0.3xP_3$
Crystal River	$21xP_1$	$0xP_2$	$0xP_3$	$88xP_1$	$0.9xP_2$	$0xP_3$	$590xP_1$	$66xP_2$	$0.3xP_3$
Davis-Besse	$21xP_1$	$0xP_2$	$0xP_3$	$420xP_1$	$0.6xP_2$	$0xP_3$	$2600xP_1$	$160xP_2$	$0.5xP_3$
Diablo Canyon	$4.7xP_1$	$0xP_2$	$0xP_3$	$50xP_1$	$0xP_2$	$0xP_3$	$1200xP_1$	$98xP_2$	$0.4xP_3$
Donald C. Cook	$55xP_1$	$0.04xP_2$	$0xP_3$	$590xP_1$	$2.2xP_2$	$0xP_3$	$2500xP_1$	$120xP_2$	$0.4xP_3$
Dresden	$42xP_1$	$0xP_2$	$0xP_3$	$540xP_1$	$0.3xP_2$	$0xP_3$	$3300xP_1$	$260xP_2$	$0.9xP_3$
Duane Arnold	$21xP_1$	$0xP_2$	$0xP_3$	$380xP_1$	$0.4xP_2$	$0xP_3$	$1700xP_1$	$190xP_2$	$0.8xP_3$
Fermi	$160xP_1$	$0.08xP_2$	$0xP_3$	$970xP_1$	$7.1xP_2$	$0xP_3$	$3000xP_1$	$200xP_2$	$0.6xP_3$
Fitzpatrick	$5.0xP_1$	$0xP_2$	$0xP_3$	$110xP_1$	$0.06xP_2$	$0xP_3$	$1200xP_1$	$57xP_2$	$0.2xP_3$
Forked River	$84xP_1$	$0xP_2$	$0xP_3$	$530xP_1$	$0.8xP_2$	$0xP_3$	$4400xP_1$	$200xP_2$	$0.6xP_3$
Fort Calhoun	$50xP_1$	$0.1xP_2$	$0xP_3$	$440xP_1$	$3.0xP_2$	$0xP_3$	$1100xP_1$	$110xP_2$	$0.4xP_3$
Ft. St. Vrain	$15xP_1$	$0xP_2$	$0xP_3$	$220xP_1$	$0xP_2$	$0xP_3$	$810xP_1$	$82xP_2$	$0.3xP_3$
Ginna	$11xP_1$	$0xP_2$	$0xP_3$	$370xP_1$	$0.1xP_2$	$0xP_3$	$1900xP_1$	$89xP_2$	$0.3xP_3$
Grand Gulf	$14xP_1$	$0xP_2$	$0xP_3$	$73xP_1$	$0.7xP_2$	$0xP_3$	$700xP_1$	$60xP_2$	$0.3xP_3$
Haddam Neck	$110xP_1$	$0xP_2$	$0xP_3$	$890xP_1$	$1.2xP_2$	$0xP_3$	$2100xP_1$	$160xP_2$	$0.5xP_3$

*See footnote, page C-2.

Table C-1. (continued)

	Mean Early Fatalities*			Mean Early Injuries*			Mean Latent Cancer Fatalities*		
	SST1	SST2	SST3	SST1	SST2	SST3	SST1	SST2	SST3
Hartsville	19xP_1	0xP_2	0xP_3	140xP_1	0.04xP_2	0xP_3	970xP_1	64xP_2	0.2xP_3
Hatch	4xP_1	0xP_2	0xP_3	62xP_1	0.04xP_2	0xP_3	770xP_1	64xP_2	0.2xP_3
Hope Creek	120xP_1	0xP_2	0xP_3	440xP_1	0xP_2	0xP_3	3000xP_1	160xP_2	0.5xP_3
Indian Pt.	830xP_1	0.08xP_2	0xP_3	3600xP_1	18xP_2	0xP_3	8100xP_1	590xP_2	1.8xP_3
Joseph M. Farley	12xP_1	0xP_2	0xP_3	85xP_1	0.03xP_2	0xP_3	670xP_1	56xP_2	0.2xP_3
Kewaunee	1.2xP_1	0xP_2	0xP_3	78xP_1	0xP_2	0xP_3	1200xP_1	70xP_2	0.3xP_3
LaCrosse	32xP_1	0xP_2	0xP_3	200xP_1	1.8xP_2	0xP_3	850xP_1	58xP_2	0.2xP_3
La Salle	26xP_1	0xP_2	0xP_3	180xP_1	0.6xP_2	0xP_3	2800xP_1	200xP_2	0.7xP_3
Limerick	970xP_1	2.2xP_2	0xP_3	2800xP_1	6.6xP_2	0xP_3	5400xP_1	370xP_2	1.3xP_3
Maine Yankee	4.1xP_1	0xP_2	0xP_3	34xP_1	0xP_2	0xP_3	770xP_1	29xP_2	0.1xP_3
Marble Hill	28xP_1	0xP_2	0xP_3	420xP_1	0xP_2	0xP_3	2400xP_1	180xP_2	0.7xP_3
McGuire	130xP_1	0xP_2	0xP_3	680xP_1	0xP_2	0xP_3	1600xP_1	130xP_2	0.5xP_3
Midland	320xP_1	0.2xP_2	0xP_3	1100xP_1	1.3xP_2	0xP_3	2200xP_1	130xP_2	0.5xP_3
Millstone	240xP_1	0.02xP_2	0xP_3	990xP_1	4.5xP_2	0xP_3	3200xP_1	160xP_2	0.6xP_3
Monticello	12xP_1	0xP_2	0xP_3	200xP_1	0.08xP_2	0xP_3	1100xP_1	98xP_2	0.4xP_3
Nine Mile Pt.	5.2xP_1	0xP_2	0xP_3	110xP_1	0.06xP_2	0xP_3	1200xP_1	58xP_2	0.2xP_3
North Anna	14xP_1	0xP_2	0xP_3	92xP_1	0.08xP_2	0xP_3	1800xP_1	75xP_2	0.3xP_3
Oconee	2.0xP_1	0xP_2	0xP_3	240xP_1	0.03xP_2	0xP_3	1100xP_1	70xP_2	0.3xP_3
Oyster Creek	84xP_1	0xP_2	0xP_3	530xP_1	0.8xP_2	0xP_3	4400xP_1	200xP_2	0.6xP_3
Palisades	37xP_1	0.02xP_2	0xP_3	250xP_1	1.3xP_2	0xP_3	1700xP_1	90xP_2	0.3xP_3
Palo Verde	5.8xP_1	0xP_2	0xP_3	59xP_1	0.2xP_2	0xP_3	450xP_1	26xP_2	0.09xP_3
Peach Bottom	97xP_1	0xP_2	0xP_3	400xP_1	0.02xP_2	0xP_3	2800xP_1	140xP_2	0.4xP_3

*See footnote, page C-2.

Table C-1. (continued)

	Mean Early Fatalities*			Mean Early Injuries*			Mean Latent Cancer Fatalities*		
	SST1	SST2	SST3	SST1	SST2	SST3	SST1	SST2	SST3
Pebble Springs	$0.41xP_1$	$0xP_2$	$0xP_3$	$3.7xP_1$	$0xP_2$	$0xP_3$	$230xP_1$	$18xP_2$	$0.07xP_3$
Perkins	$98xP_1$	$0xP_2$	$0xP_3$	$520xP_1$	$2.1xP_2$	$0xP_3$	$1500xP_1$	$120xP_2$	$0.5xP_3$
Perry	$95xP_1$	$0.07xP_2$	$0xP_3$	$520xP_1$	$4.2xP_2$	$0xP_3$	$2500xP_1$	$160xP_2$	$0.6xP_3$
Phipps Bed	$170xP_1$	$0.3xP_2$	$0xP_3$	$300xP_1$	$16xP_2$	$0xP_3$	$1300xP_1$	$82xP_2$	$0.3xP_3$
Pilgrim	$71xP_1$	$0.02xP_2$	$0xP_3$	$300xP_1$	$2.4xP_2$	$0xP_3$	$1500xP_1$	$85xP_2$	$0.3xP_3$
Pt. Beach	$7.7xP_1$	$0xP_2$	$0xP_3$	$110xP_1$	$0.3xP_2$	$0xP_3$	$1400xP_1$	$77xP_2$	$0.3xP_3$
Prairie Is.	$56xP_1$	$0xP_2$	$0xP_3$	$260xP_1$	$2.4xP_2$	$0xP_3$	$1400xP_1$	$110xP_2$	$0.4xP_3$
Quad Cities	$17xP_1$	$0xP_2$	$0xP_3$	$290xP_1$	$0.04xP_2$	$0xP_3$	$1900xP_1$	$170xP_2$	$0.7xP_3$
Rancho Seco	$15xP_1$	$0xP_2$	$0xP_3$	$110xP_1$	$0.02xP_2$	$0xP_3$	$870xP_1$	$87xP_2$	$0.3xP_3$
River Bend	$31xP_1$	$0xP_2$	$0xP_3$	$200xP_1$	$0.2xP_2$	$0xP_3$	$750xP_1$	$60xP_2$	$0.2xP_3$
Robinson	$16xP_1$	$0xP_2$	$0xP_3$	$170xP_1$	$0.01xP_2$	$0xP_3$	$880xP_1$	$59xP_2$	$0.2xP_3$
St. Lucie	$77xP_1$	$0xP_2$	$0xP_3$	$310xP_1$	$0.6xP_2$	$0xP_3$	$700xP_1$	$69xP_2$	$0.4xP_3$
Salem	$120xP_1$	$0xP_2$	$0xP_3$	$440xP_1$	$0xP_2$	$0xP_3$	$3000xP_1$	$160xP_2$	$0.5xP_3$
San Onofre	$11xP_1$	$0xP_2$	$0xP_3$	$150xP_1$	$0xP_2$	$0xP_3$	$1800xP_1$	$150xP_2$	$0.5xP_3$
Seabrook	$13xP_1$	$0xP_2$	$0xP_3$	$210xP_1$	$0.04xP_2$	$0xP_3$	$1000xP_1$	$54xP_2$	$0.2xP_3$
Sequoyah	$110xP_1$	$0xP_2$	$0xP_3$	$690xP_1$	$0.6xP_2$	$0xP_3$	$1300xP_1$	$95xP_2$	$0.3xP_3$
Shearon Harris	$40xP_1$	$0xP_2$	$0xP_3$	$260xP_1$	$0.4xP_2$	$0xP_3$	$1300xP_1$	$110xP_2$	$0.4xP_3$
Shoreham	$140xP_1$	$0xP_2$	$0xP_3$	$870xP_1$	$1.9xP_2$	$0xP_3$	$3400xP_1$	$170xP_2$	$0.5xP_3$
Skagit	$50xP_1$	$0xP_2$	$0xP_3$	$370xP_1$	$0.4xP_2$	$0xP_3$	$500xP_1$	$49xP_2$	$0.2xP_3$
South Texas	$5.2xP_1$	$0xP_2$	$0xP_3$	$32xP_1$	$0xP_2$	$0xP_3$	$610xP_1$	$43xP_2$	$0.2xP_3$
Surry	$65xP_1$	$0xP_2$	$0xP_3$	$330xP_1$	$0xP_2$	$0xP_3$	$1700xP_1$	$95xP_2$	$0.3xP_3$
Susquehanna	$180xP_1$	$0xP_2$	$0xP_3$	$700xP_1$	$0.2xP_2$	$0xP_3$	$3300xP_1$	$150xP_2$	$0.5xP_3$

*See footnote, page C-2.

Table C-1. (continued)

	Mean Early Fatalities*			Mean Early Injuries*			Mean Latent Cancer Fatalities*		
	SST1	SST2	SST3	SST1	SST2	SST3	SST1	SST2	SST3
Three Mile Island	$240xP_1$	$0xP_2$	$0xP_3$	$1200xP_1$	$4.5xP_2$	$0xP_3$	$3500xP_1$	$170xP_2$	$0.6xP_3$
Trojan	$46xP_1$	$0.1xP_2$	$0xP_3$	$350xP_1$	$3.8xP_2$	$0xP_3$	$1100xP_1$	$73xP_2$	$0.3xP_3$
Turkey Pt.	$31xP_1$	$0xP_2$	$0xP_3$	$460xP_1$	$0xP_2$	$0xP_3$	$690xP_1$	$83xP_2$	$0.4xP_3$
Vermont Yankee	$130xP_1$	$0xP_2$	$0xP_3$	$320xP_1$	$4.4xP_2$	$0xP_3$	$1800xP_1$	$72xP_2$	$0.3xP_3$
Virgil Summer	$12xP_1$	$0xP_2$	$0xP_3$	$120xP_1$	$0xP_2$	$0xP_3$	$1000xP_1$	$63xP_2$	$0.2xP_3$
Vogtle	$0.07xP_1$	$0xP_2$	$0xP_3$	$85xP_1$	$0xP_2$	$0xP_3$	$900xP_1$	$70xP_2$	$0.3xP_3$
WPPSS 1,4	$0.1xP_1$	$0xP_2$	$0xP_3$	$110xP_1$	$0xP_2$	$0xP_3$	$310xP_1$	$37xP_2$	$0.2xP_3$
WPPSS 2	$1.0xP_1$	$0xP_2$	$0xP_3$	$120xP_1$	$0xP_2$	$0xP_3$	$720xP_1$	$53xP_2$	$0.2xP_3$
WPPSS 3,5	$0.1xP_1$	$0xP_2$	$0xP_3$	$110xP_1$	$0xP_2$	$0xP_3$	$310xP_1$	$37xP_2$	$0.2xP_3$
Waterford	$170xP_1$	$0.2xP_2$	$0xP_3$	$580xP_1$	$8.3xP_2$	$0xP_3$	$990xP_1$	$93xP_2$	$0.4xP_3$
Watts Bar	$13xP_1$	$0xP_2$	$0xP_3$	$110xP_1$	$0.02xP_2$	$0xP_3$	$1000xP_1$	$66xP_2$	$0.3xP_3$
Wolf Creek	$2.4xP_1$	$0xP_2$	$0xP_3$	$34xP_1$	$0.04xP_2$	$0xP_3$	$760xP_1$	$70xP_2$	$0.3xP_3$
Yankee Rowe	$18xP_1$	$0xP_2$	$0xP_3$	$180xP_1$	$0.05xP_2$	$0xP_3$	$2300xP_1$	$100xP_2$	$0.2xP_3$
Yellow Creek	$5.6xP_1$	$0xP_2$	$0xP_3$	$68xP_1$	$0xP_2$	$0xP_3$	$850xP_1$	$63xP_2$	$0.3xP_3$
Zimmer	$46xP_1$	$0xP_2$	$0xP_3$	$670xP_1$	$0.4xP_2$	$0xP_3$	$2400xP_1$	$170xP_2$	$0.6xP_3$
Zion	$520xP_1$	$4.1xP_2$	$0xP_3$	$1600xP_1$	$32xP_2$	$0xP_3$	$4000xP_1$	$330xP_2$	$1.2xP_3$

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

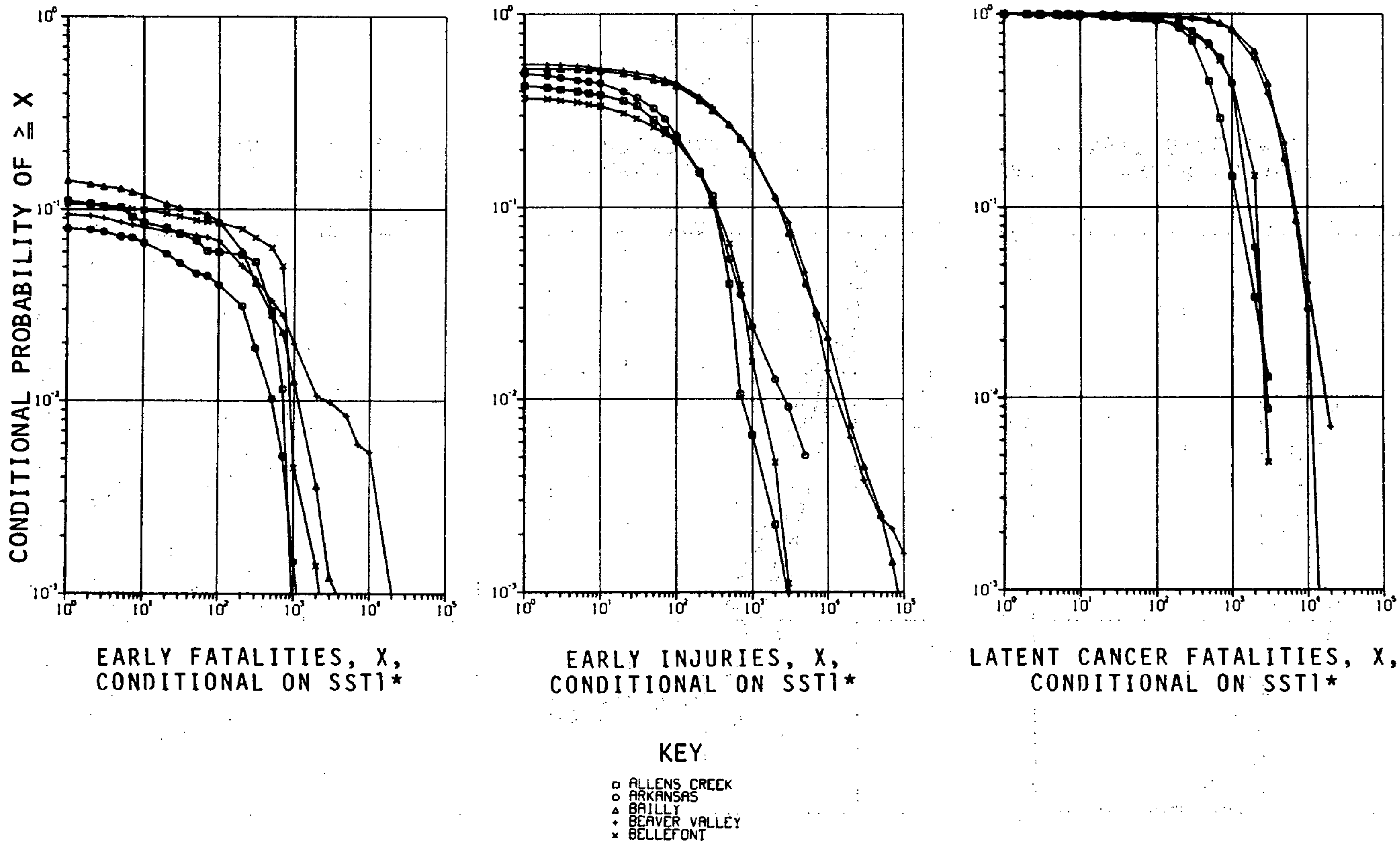

Figure C-1: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

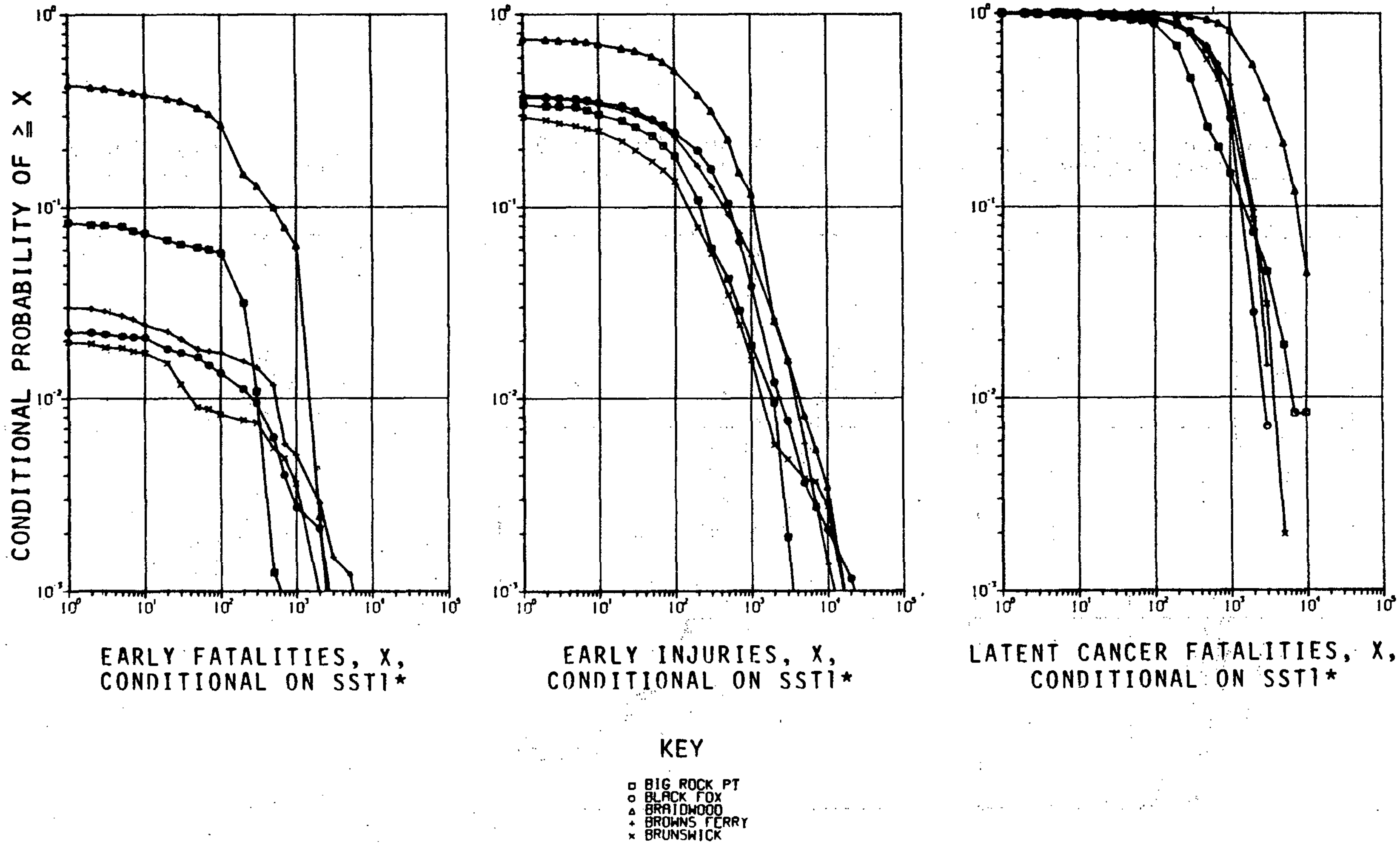

Figure C-2: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

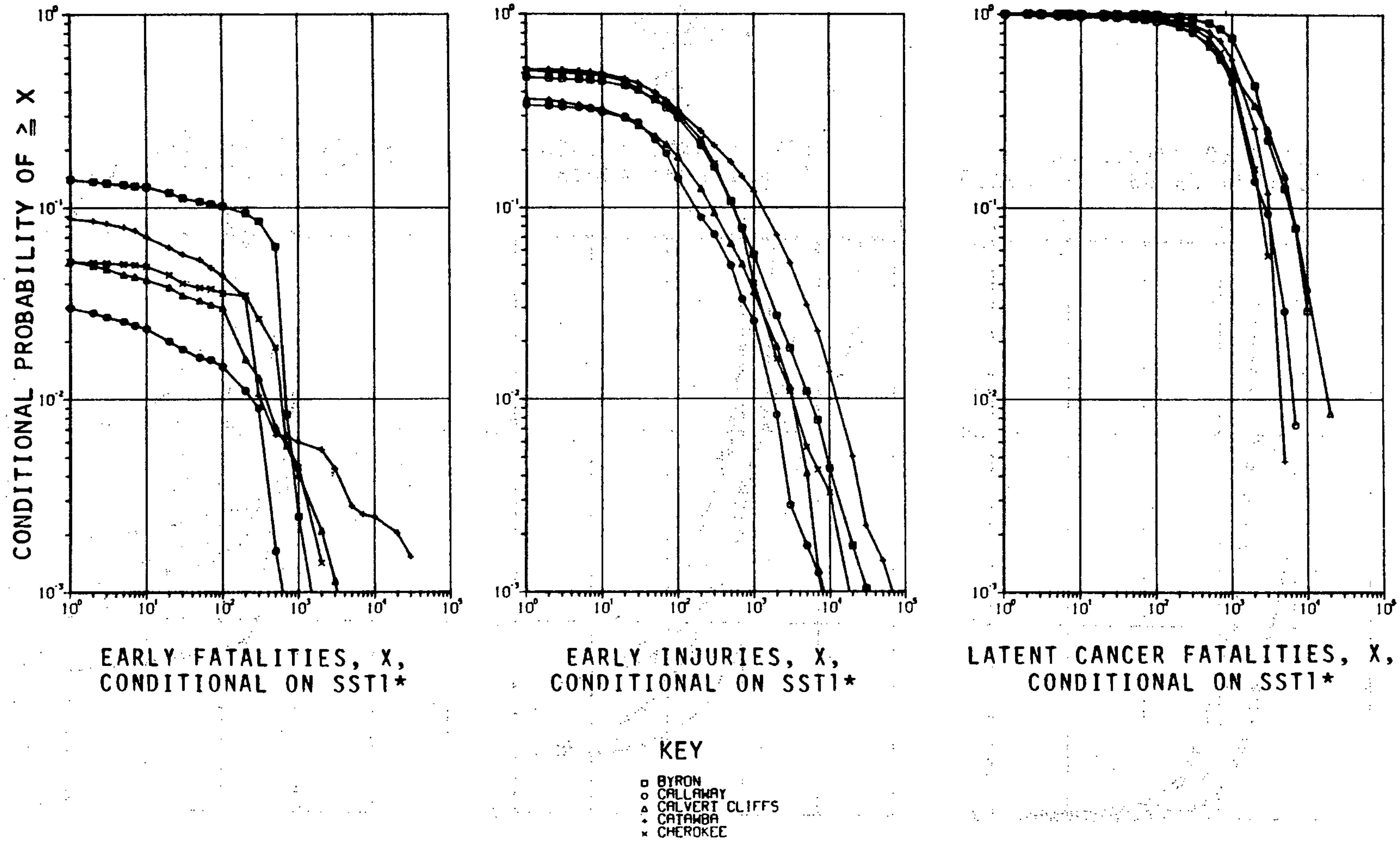

Figure C-3: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

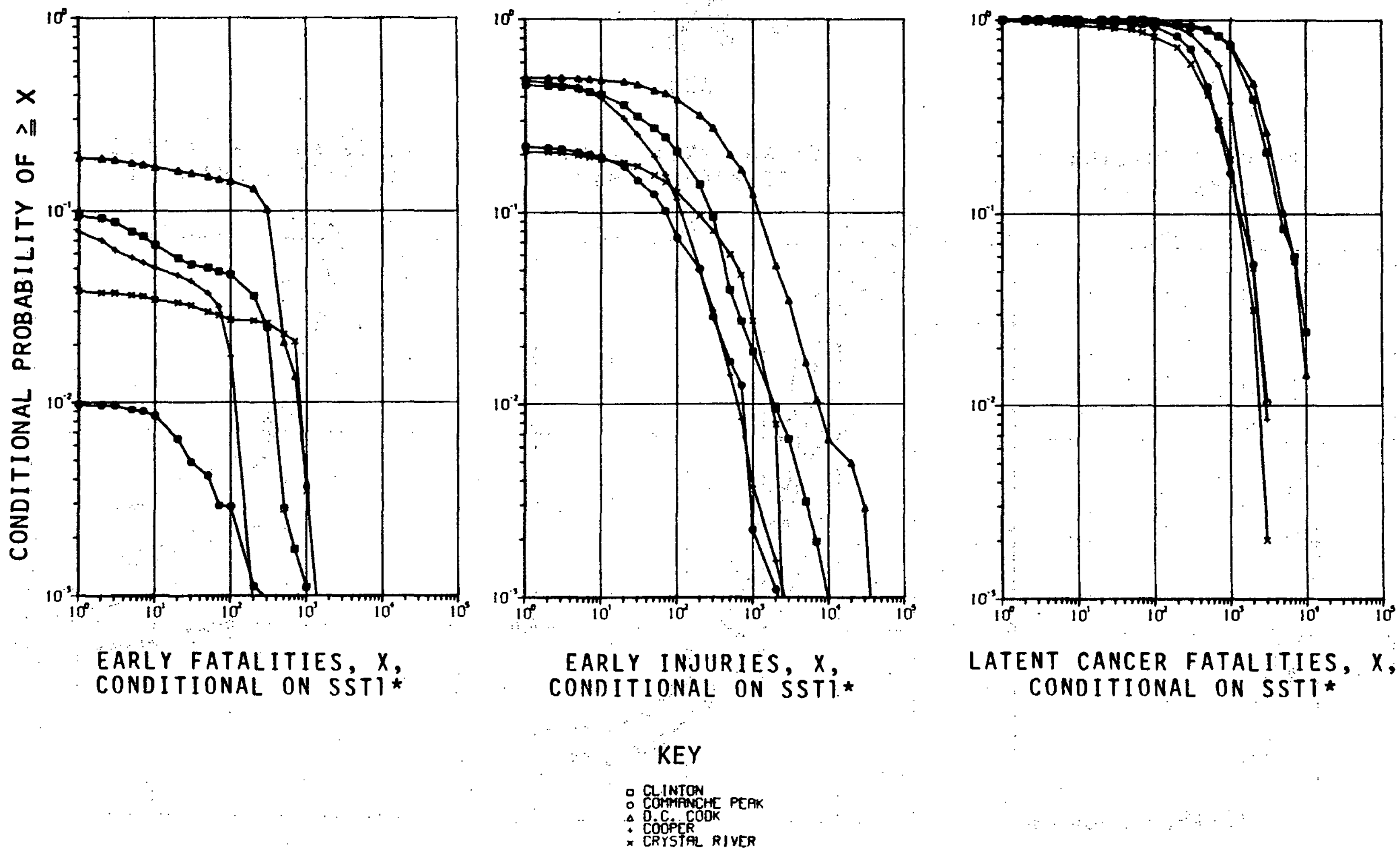

Figure C-4: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs <u>do not</u> represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

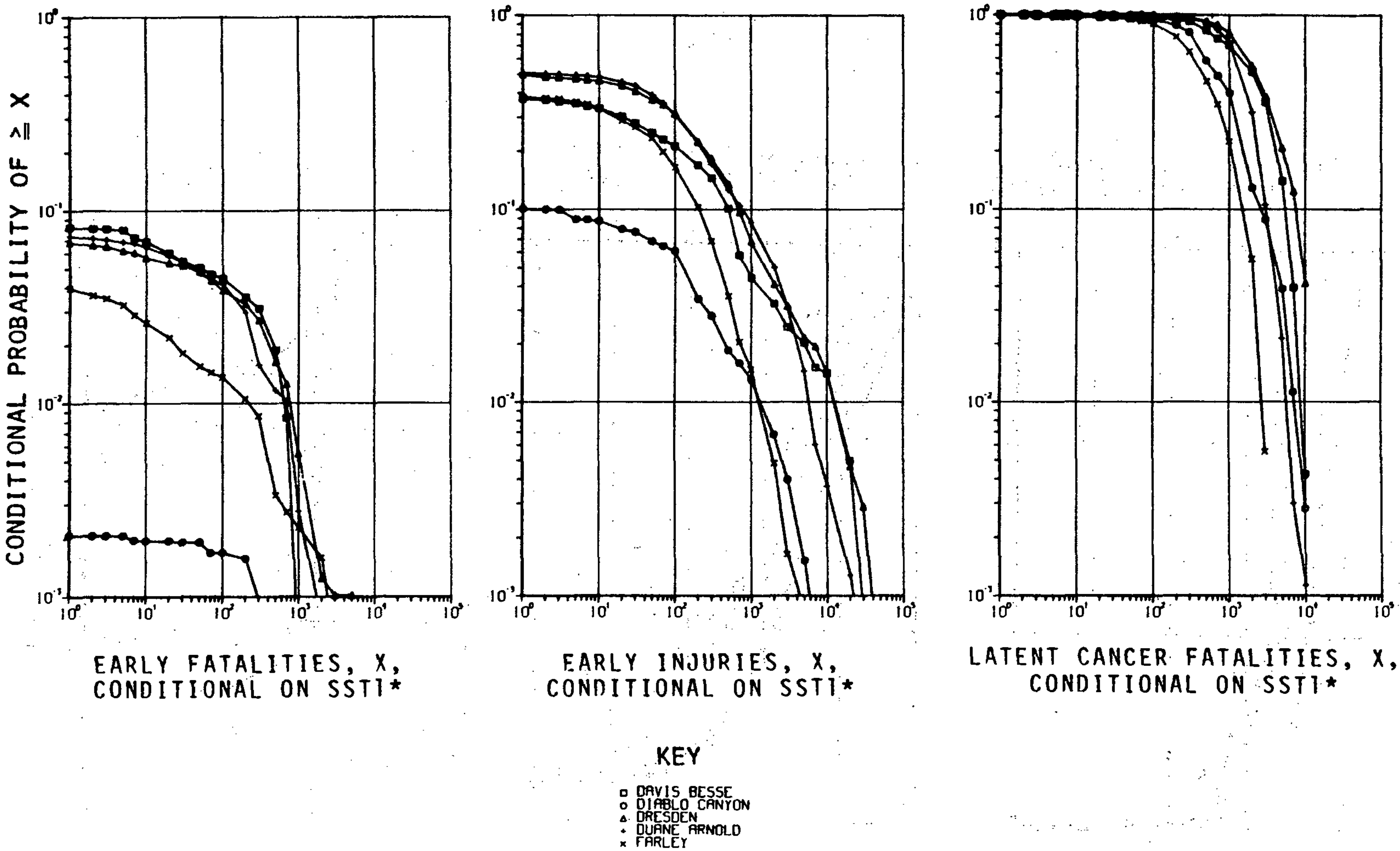

Figure C-5: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

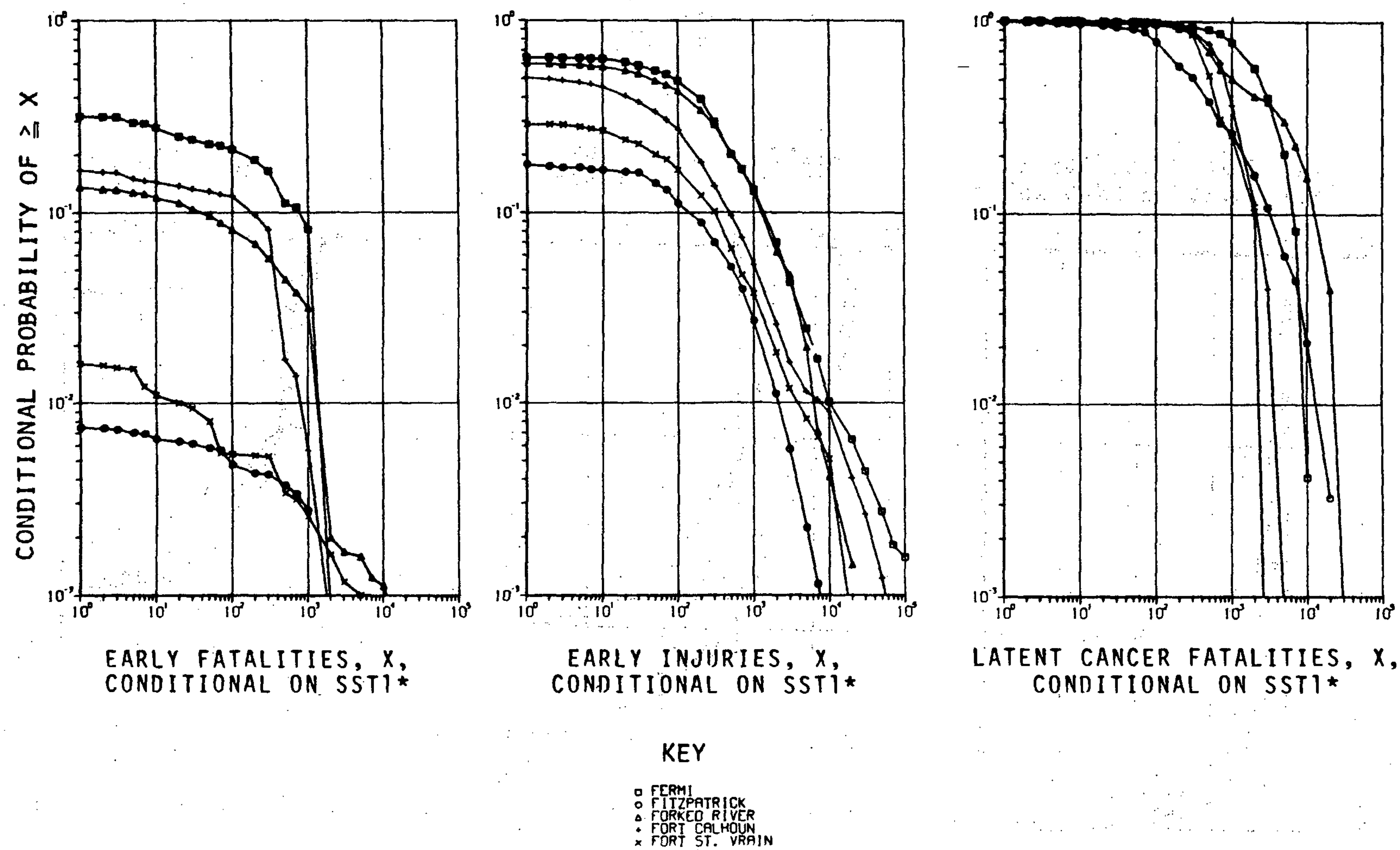

Figure C-6: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

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*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

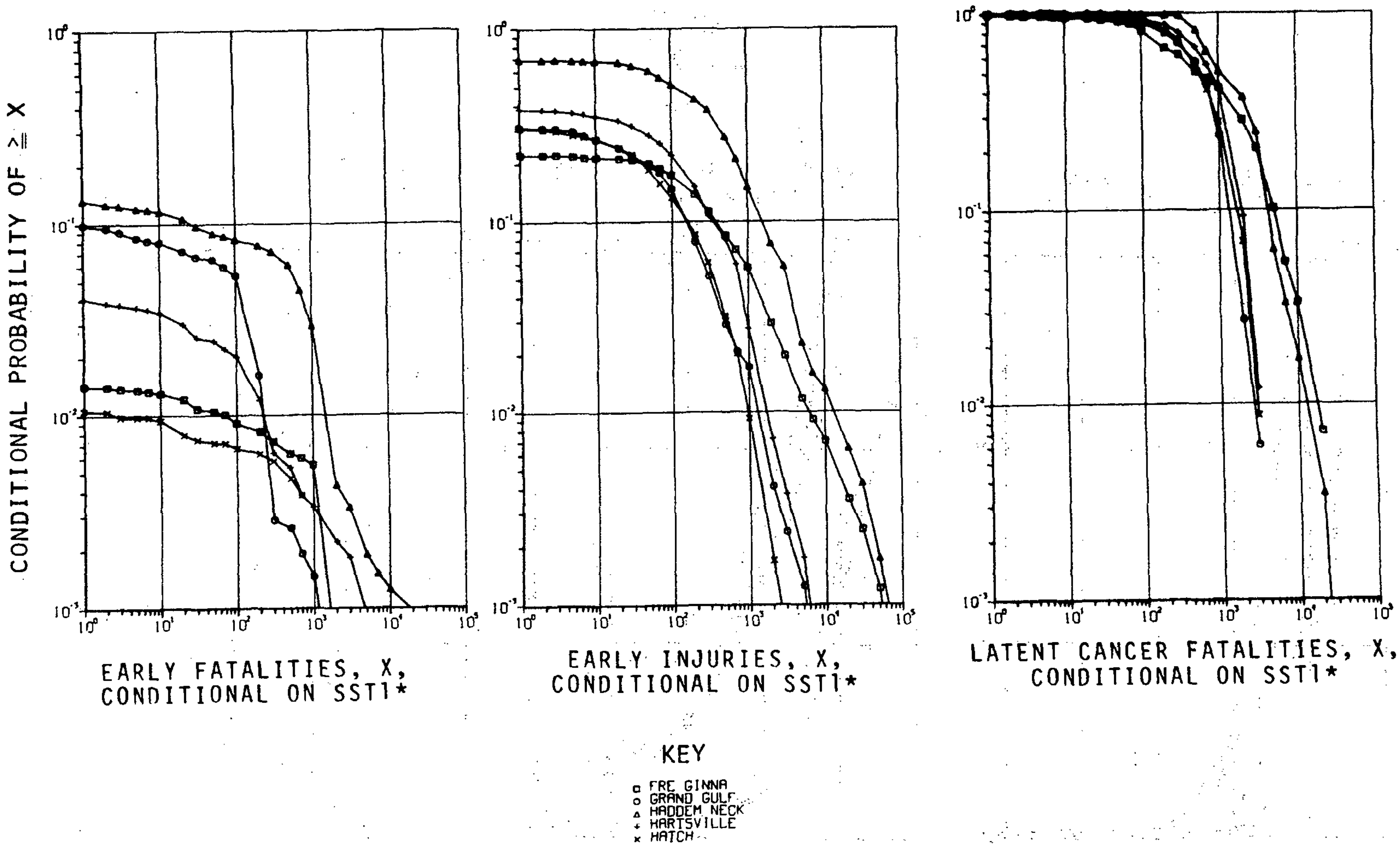

Figure C-7: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

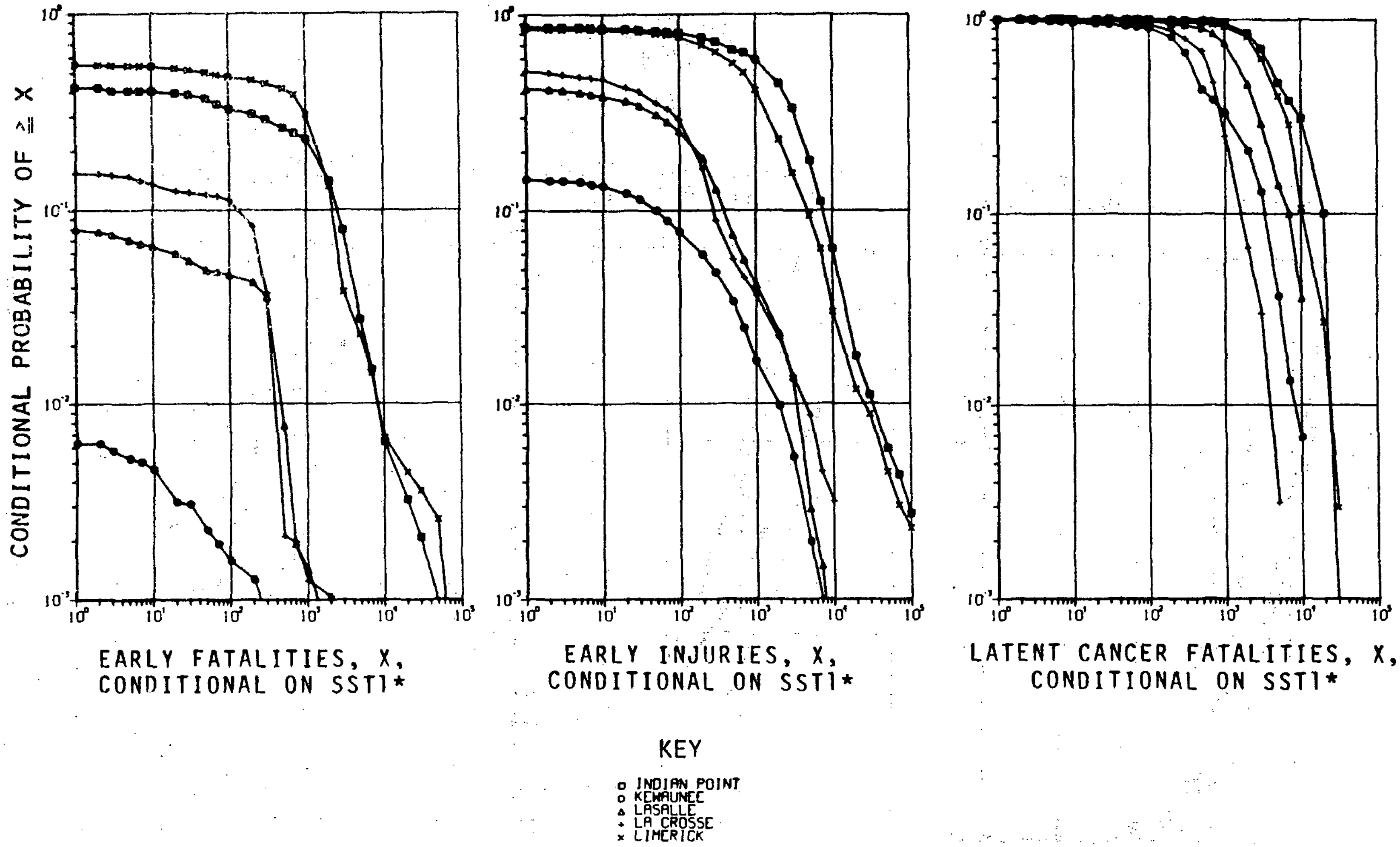

Figure C-8: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

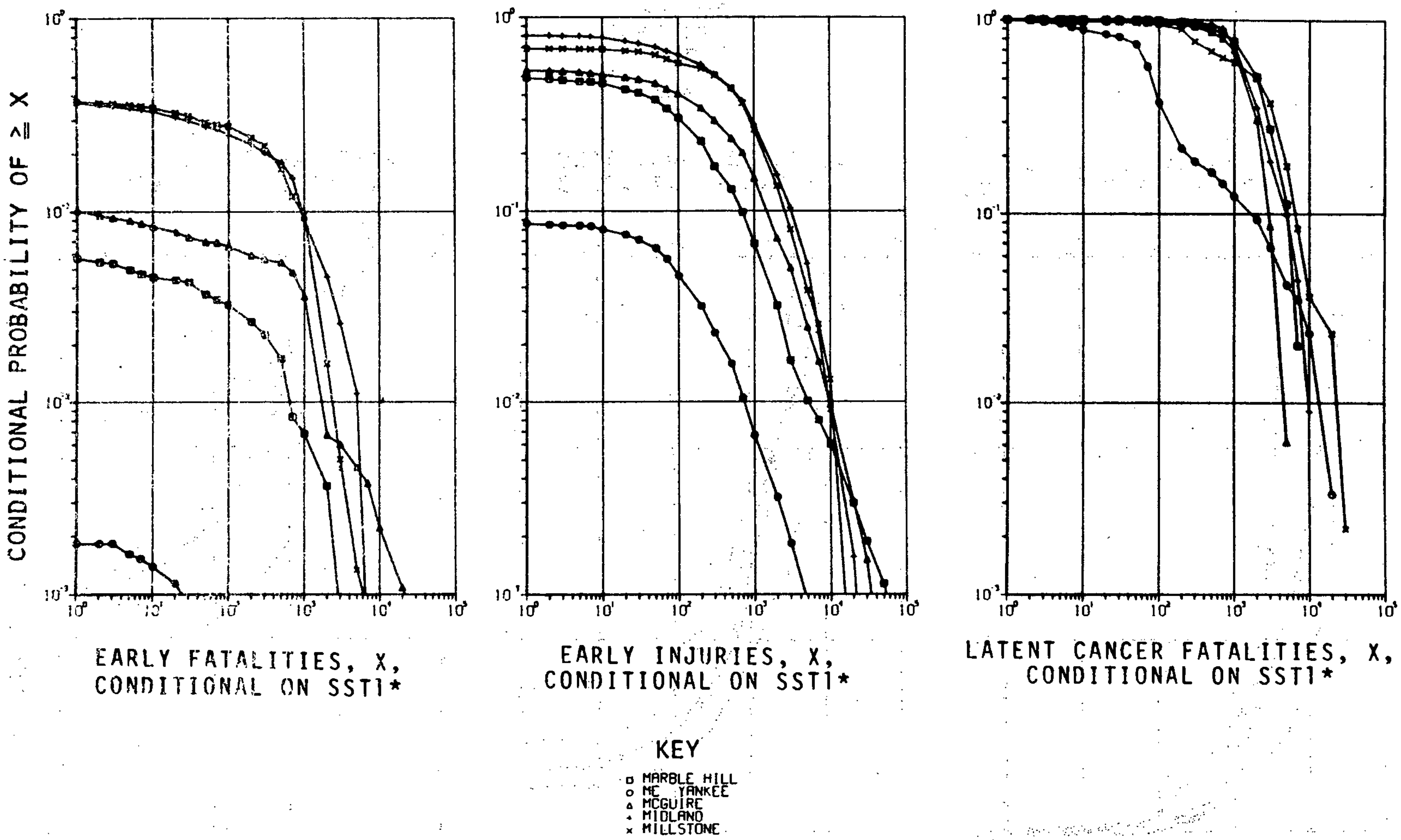

Figure C-9: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

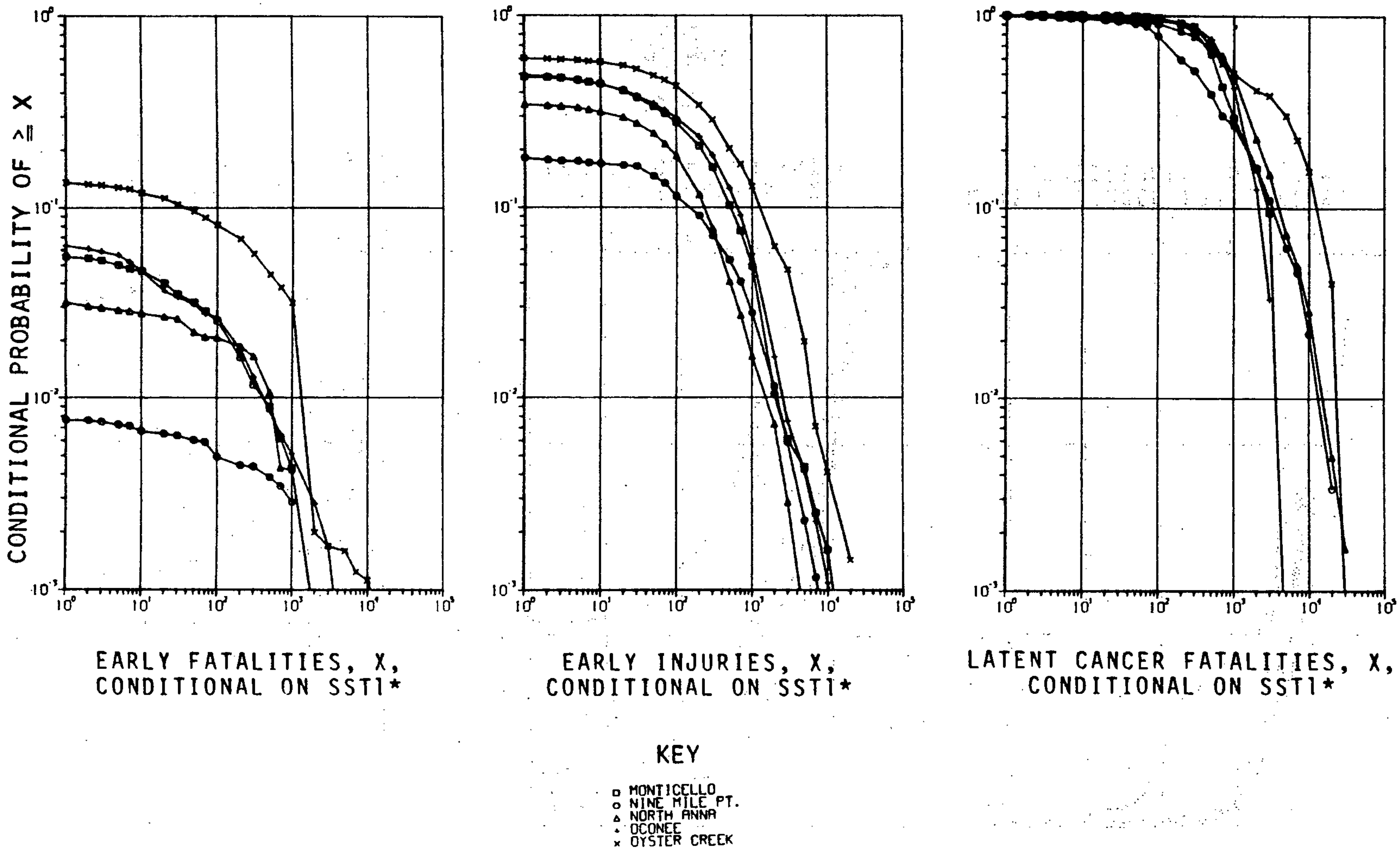

Figure C-10: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

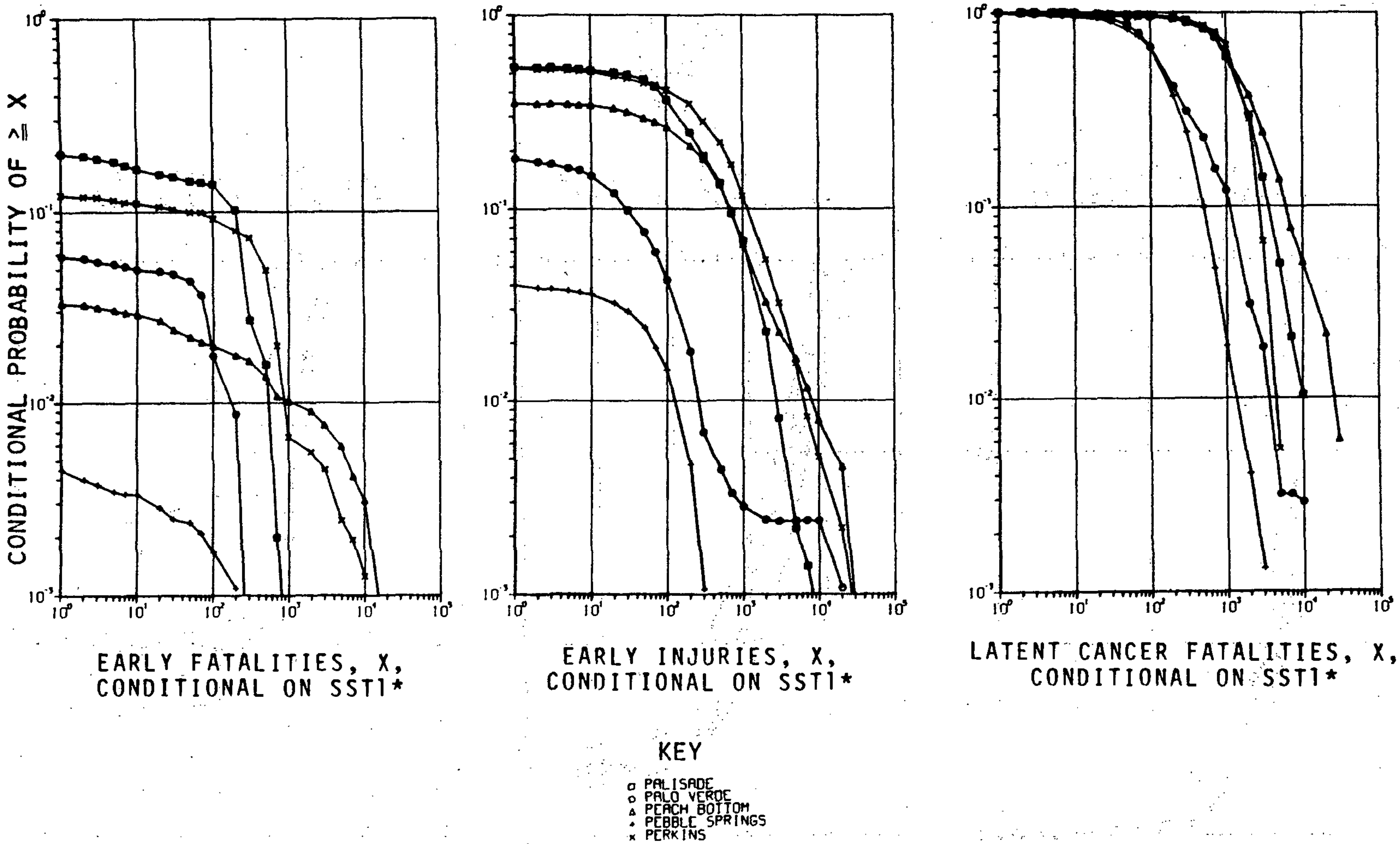

Figure C-11: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

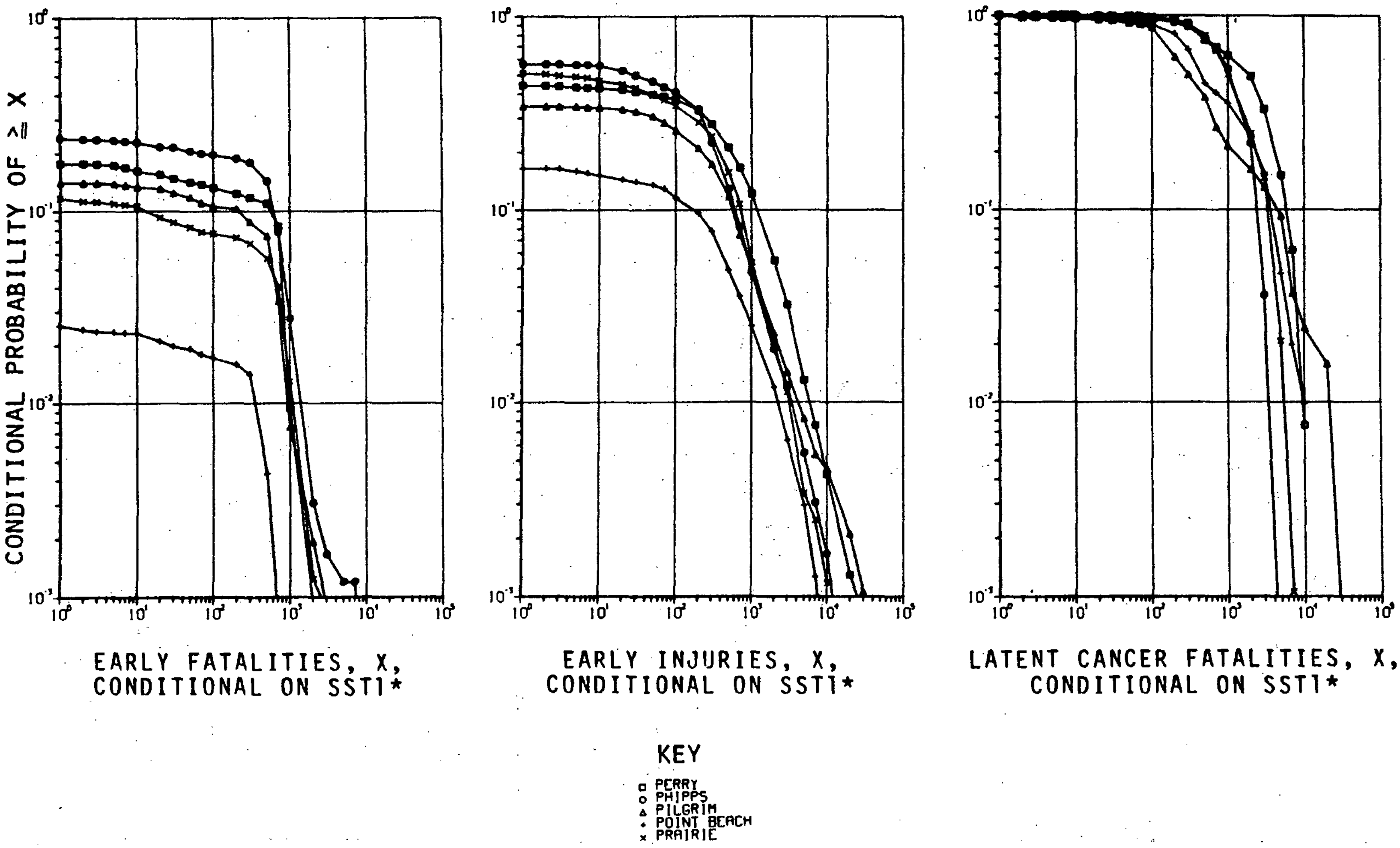

Figure C-12: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

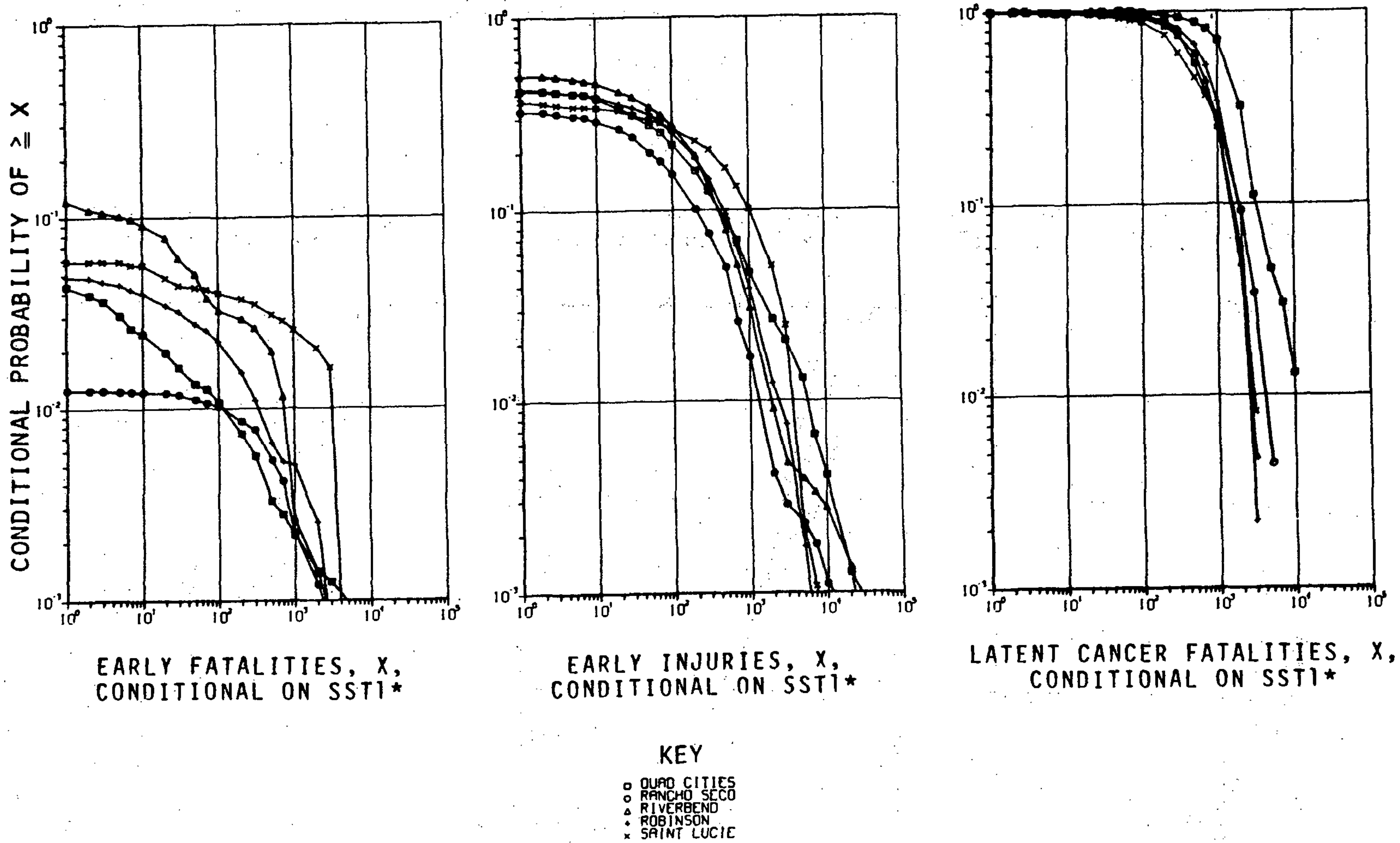

Figure C-13: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

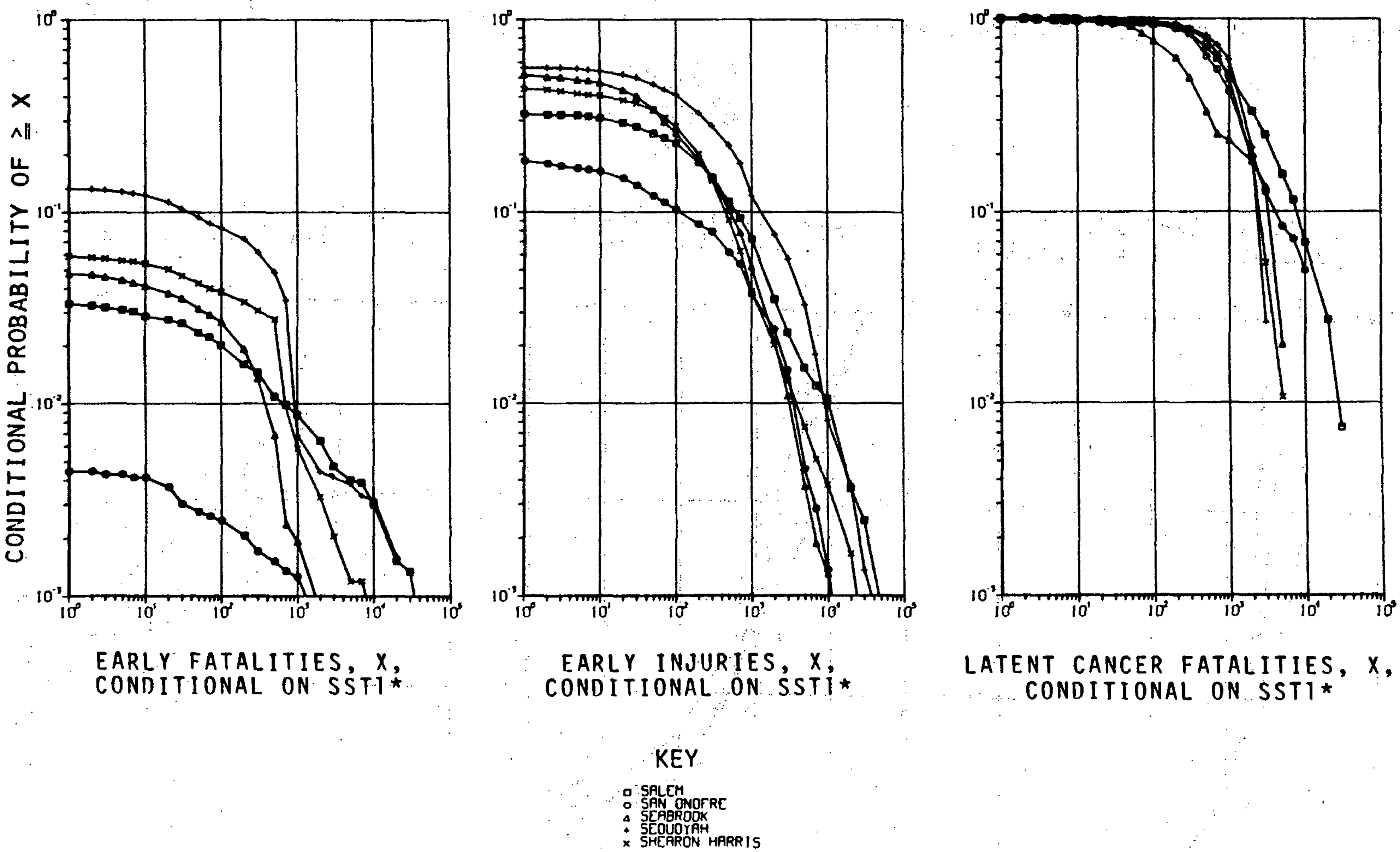

Figure C-14: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

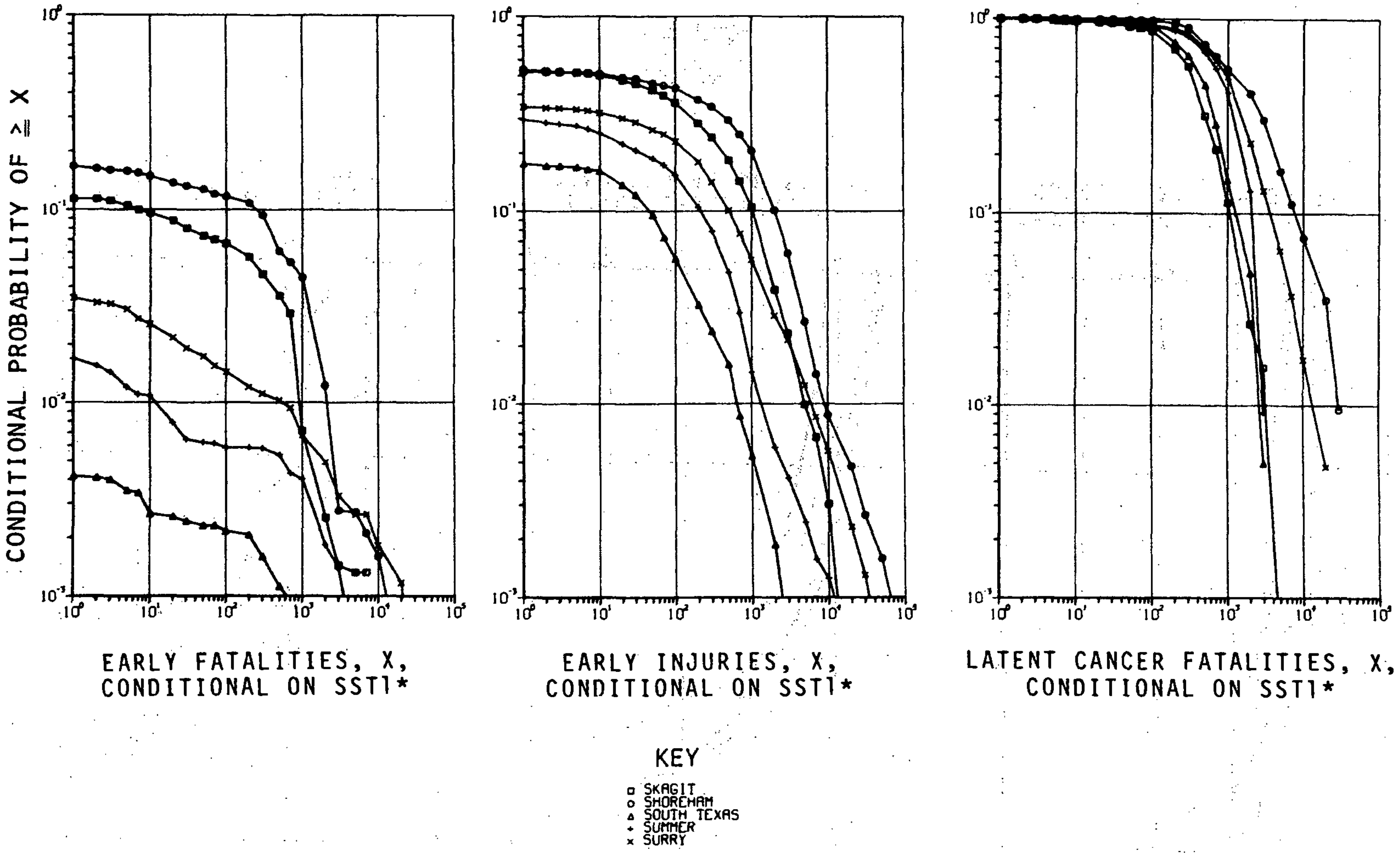

Figure C-15: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

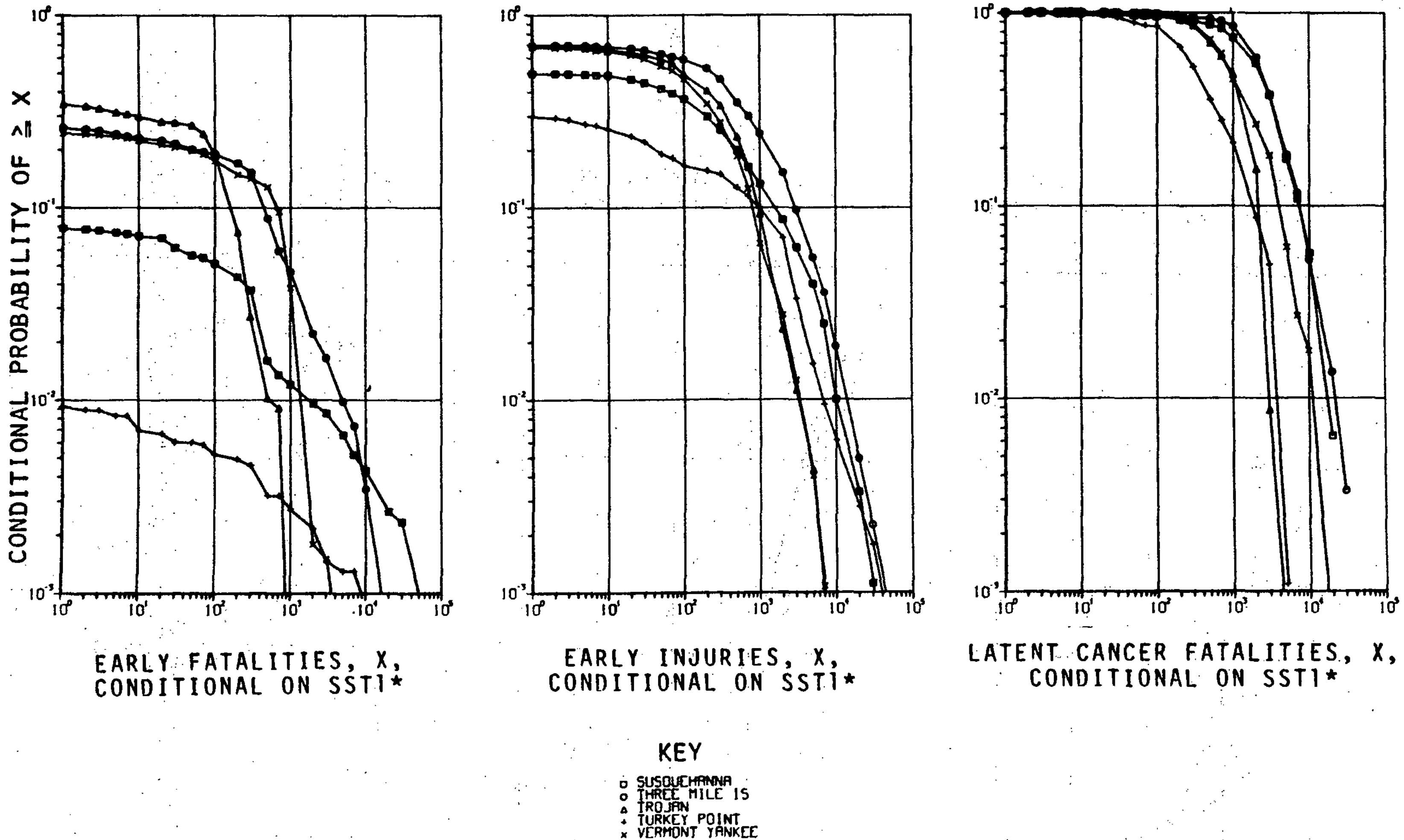

Figure C-16: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2.

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

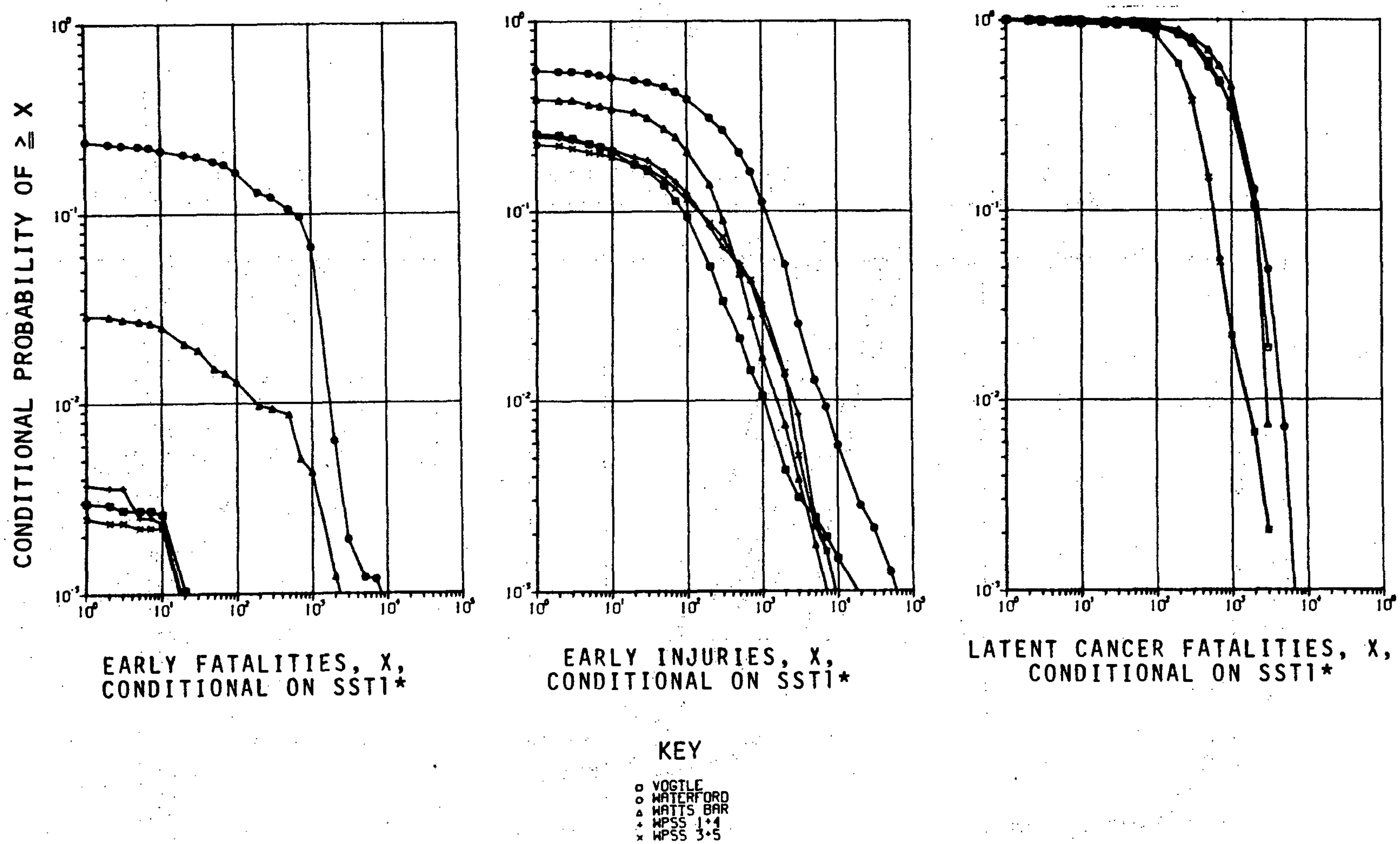

Figure C-17: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2

Note: These CCDFs do not represent effects from existing reactor/site combinations, all assume an 1120 MWe reactor. In addition, these results are conditional on the occurrence of a hypothetical SST1 release. Recent evidence suggests that the source term magnitude assumed for SST1 may be overestimated by a factor of 10 or more (see section 2.3.2).

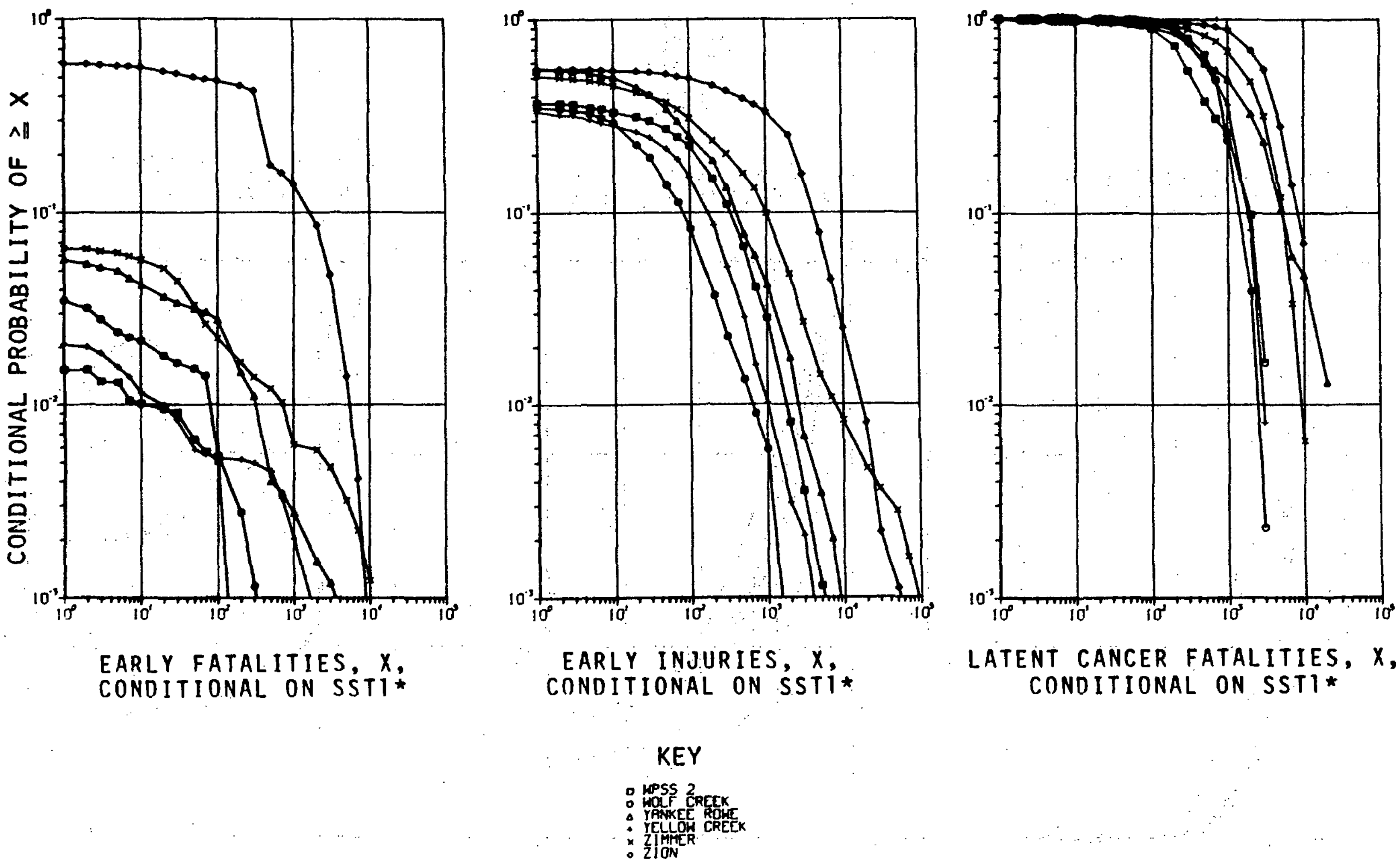

Figure C-18: Early fatality, early injury, and latent cancer fatality CCDFs at named sites, conditional on an SST1 release.
Assumptions: 1120 MWe reactor, summary evacuation, representative meteorology (see Appendix A), and actual site population and windrose.

*See footnote, page C-2

Appendix D: Additional Population Statistics for Current Reactor Sites

The demographic characteristics of the 91 reactor sites described in Chapter 2 and Appendix A were analyzed for this study. These data, which were summarized in Chapter 3, provide a perspective of previous siting decisions and delineate the population characteristics of current reactor sites. This appendix contains additional demographic data which complement the data presented in Chapter 3. These data are presented in the following sections.

Section	Data Description
D.1	Site Population Statistics
D.2	Exclusion Distances
D.3	Site Population Factors

D.1 Site Population Statistics

The 91 population distributions examined in this report were all constructed on a 16 sector, circular polar grid. For any specified portion (a circle, an annulus, a sector) of that grid, 91 values of population density are available, one for each of the 91 population distributions. By cumulation of the 91 values for a given portion of the grid, a population density CCDF may be constructed.* Six different sets of population density CCDFs have been constructed for the following areas of the population distribution grid:

<u>Set 1</u> (Figures D.1-1 thru D.1-8): Eight annuli (0-2, 2-5, 5-10, 10-20, 20-30, 30-50, 50-100, and 100-200 mi).

<u>Set 2</u> (Figures D.1-9 thru D.1-16): eight radial distances (0-2, 0-5, 0-10, 0-20, 0-30, 0-50, 0-100, and 0-200 mi).

*Population density CCDFs are Log-Log plots of the fraction of sites vs population density. Any point on the distribution gives the fraction of sites (y-axis value), which have a population density within the specified portion of the grid (annulus, circle, sector), that is greater than or equal to the specified population density (x-axis value).

Set 3 (Figures D.1-17 thru D.1-22): the most populated 22.5° sector in each of six annuli (0-2, 2-5, 5-10, 10-20, 20-30, and 30-50 mi) on the 16 sector grid.

Set 4 (Figures D.1-23 thru D.1-28): the most populated 22.5° sector in each of six radial distances (0-2, 0-5, 0-10, 0-20, 0-30 and 0-50 mi) on the 16 sector grid.

Set 5 (Figures D.1-29 thru D.1-34): the most populated 45° sector (two adjacent 22.5° sectors) in each of six annuli (0-2, 2-5, 5-10, 10-20, 20-30, and 30-50 mi) on the 16 sector grid.

Set 6 (Figures D.1-35 thru D.1-40): the most populated 45° sector (two adjacent 22.5° sectors) in each of six radial distances (0-2, 0-5, 0-10, 0-20, 0-30, and 0-50 mi) on the 16 sector grid.

Each figure contains six CCDFs, one for each of the five NRC administrative regions (NE, MW, S, W, SW, see Figure 3-1) and one for all regions combined (All).

Tables D.1-1 thru D.1-4 present the data used to construct the CCDFs in Figures D.1-1 thru D.1-28. Table D.1 presents, for each of the 91 sites, population densities within eight annuli; Table D.2 presents similar data for eight radial distances; Table D.3 for the most populated 22.5° sector of six annuli; and Table D.4 for the most populated 22.5° sector of six radial distances.

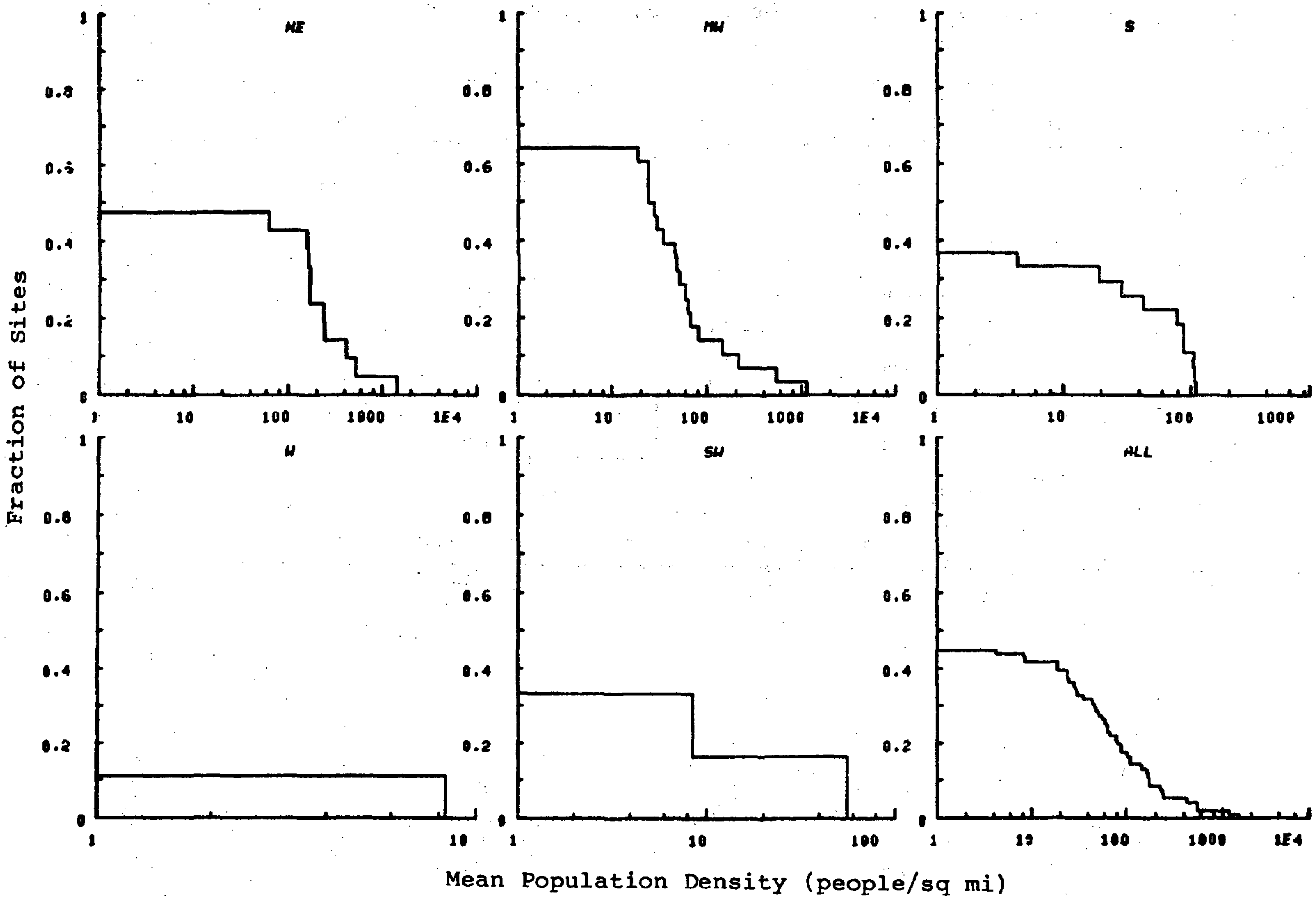

Figure D.1-1. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Annulus Interval 0-2 Miles.

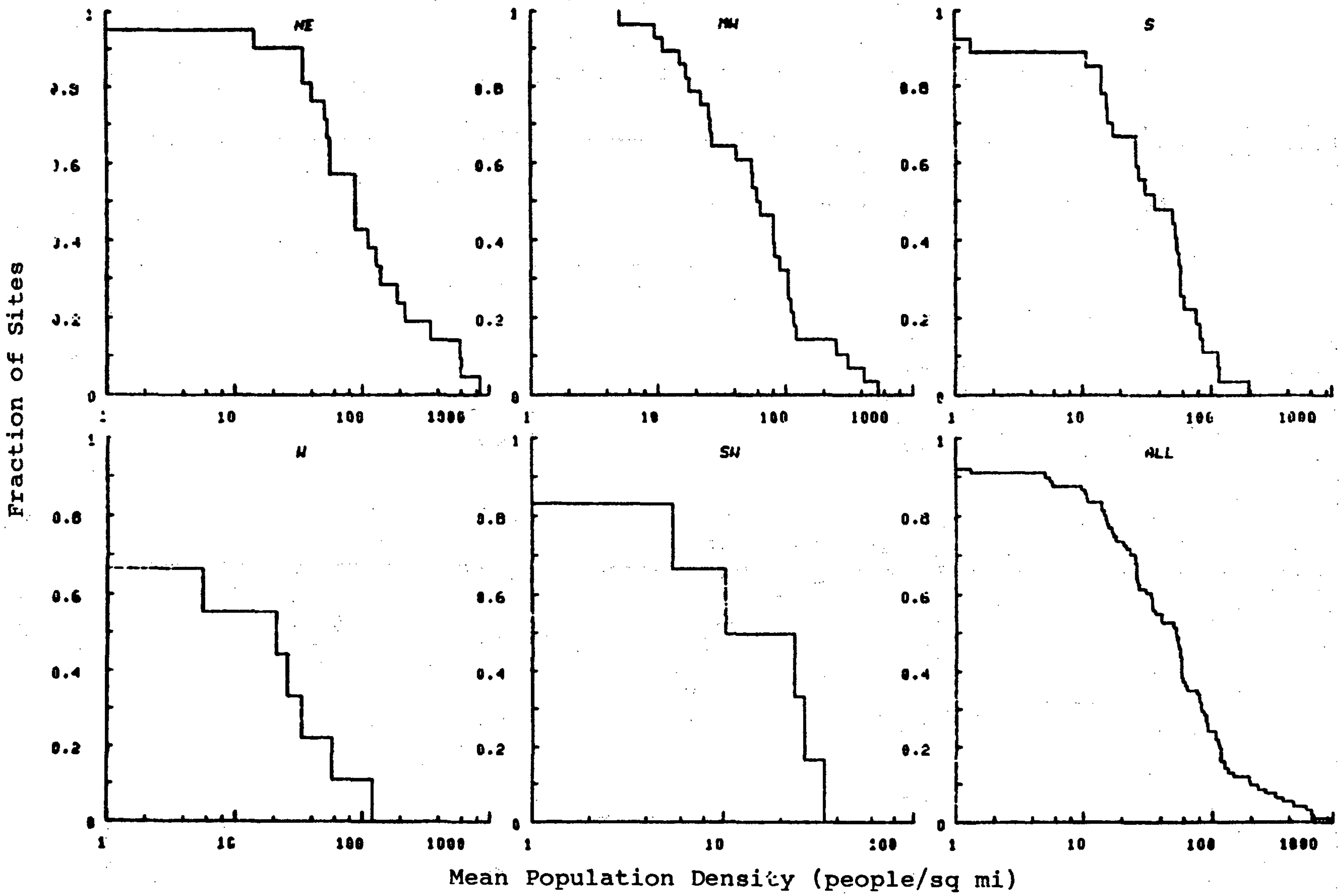

Figure D.1-2. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Annulus Interval 2-5 Miles.

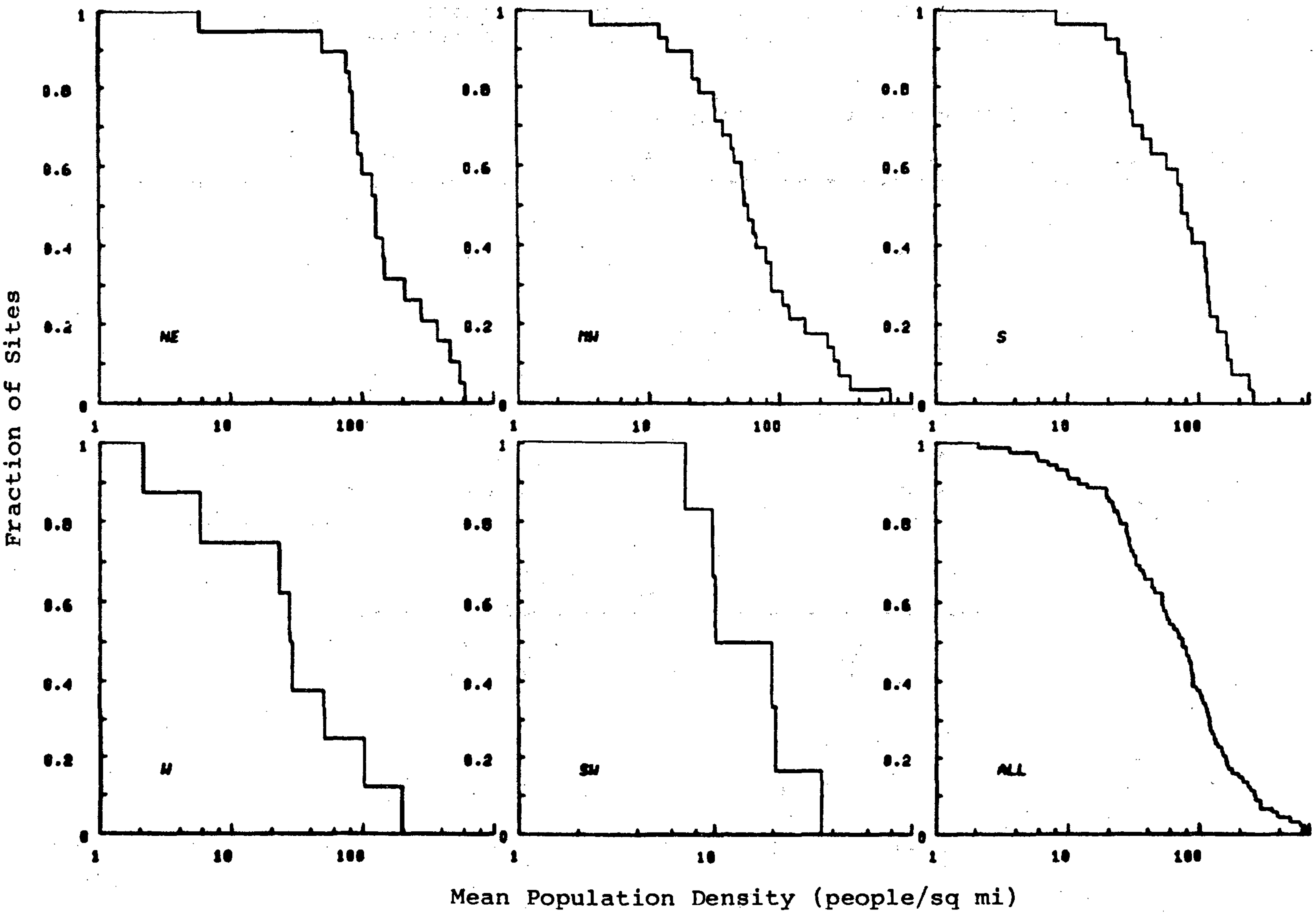

Figure D.1-3. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Annulus Interval 5-10 Miles.

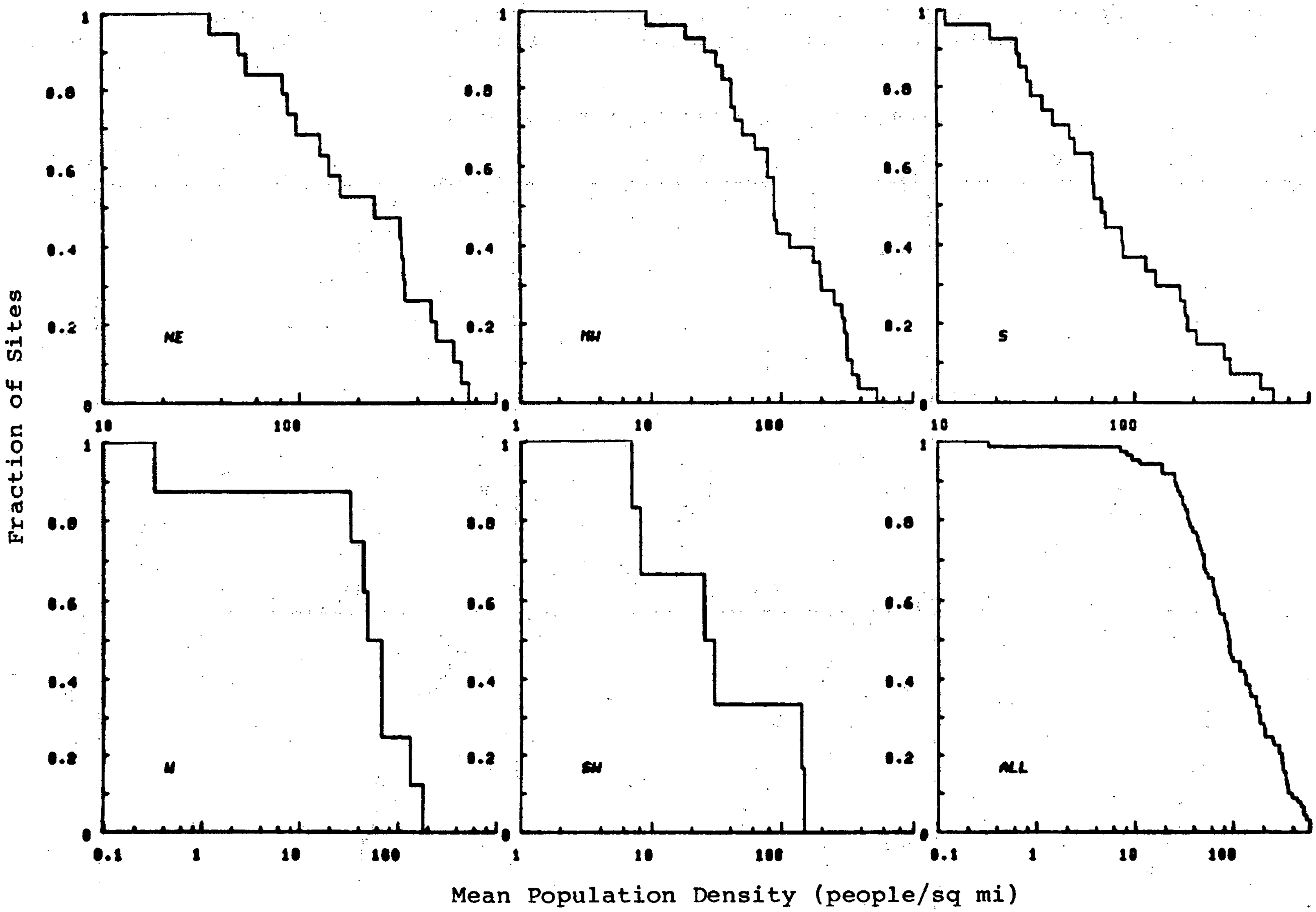

Figure D.1-4. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Annulus Interval 10-20 Miles.

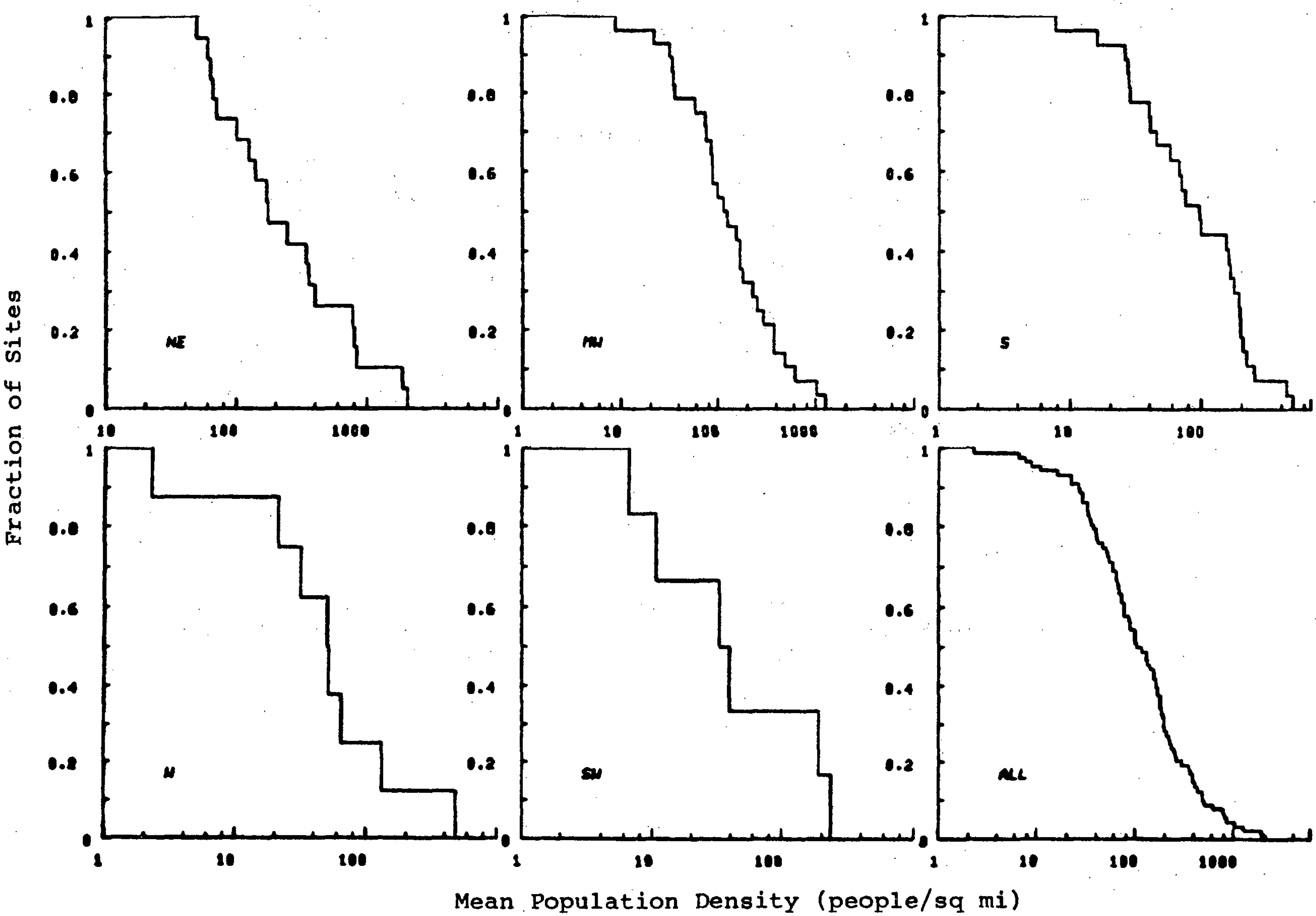

Figure D.1-5. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Annulus Interval 20-30 Miles.

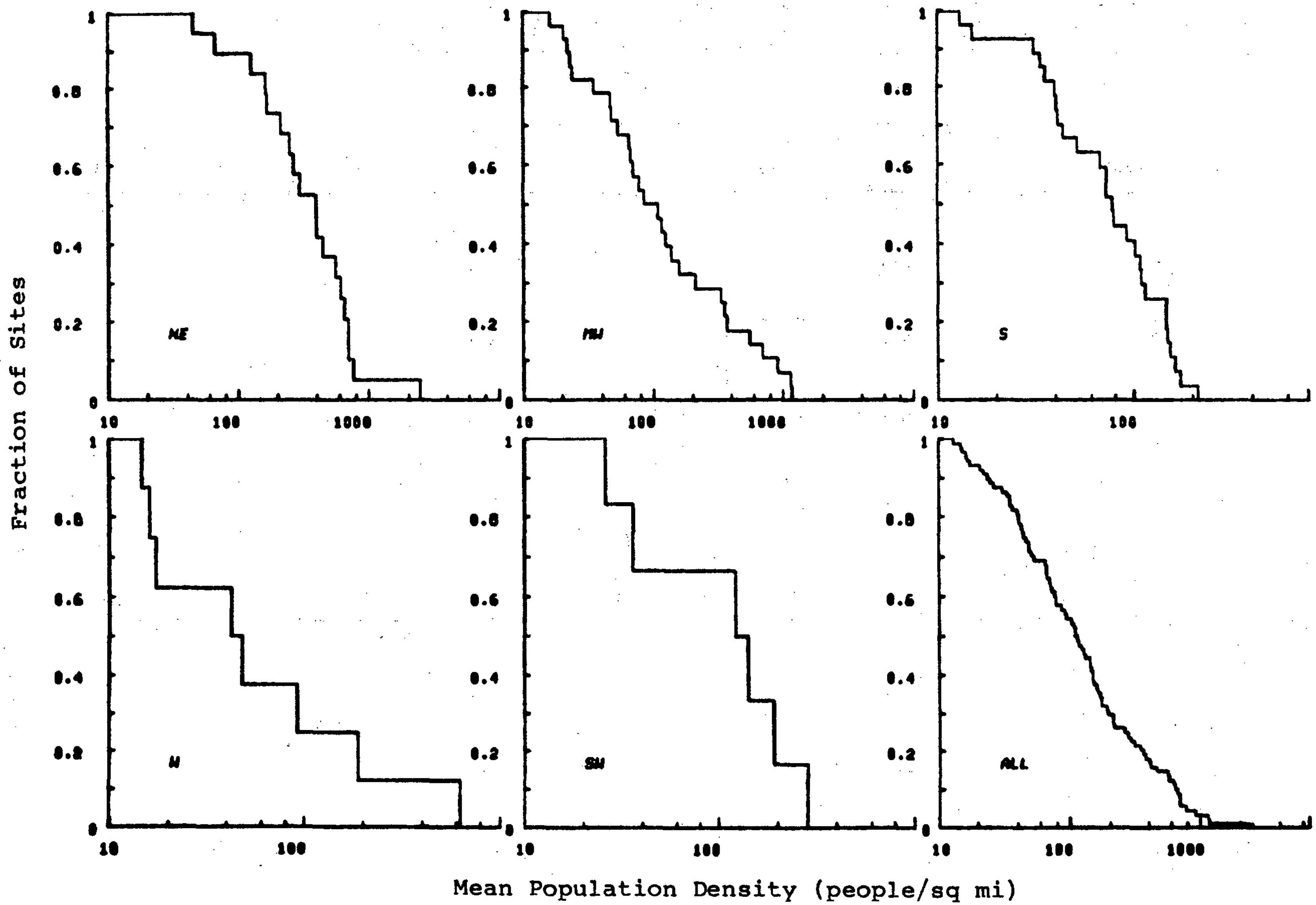

Figure D.1-6. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Annulus Interval 30-50 Miles.

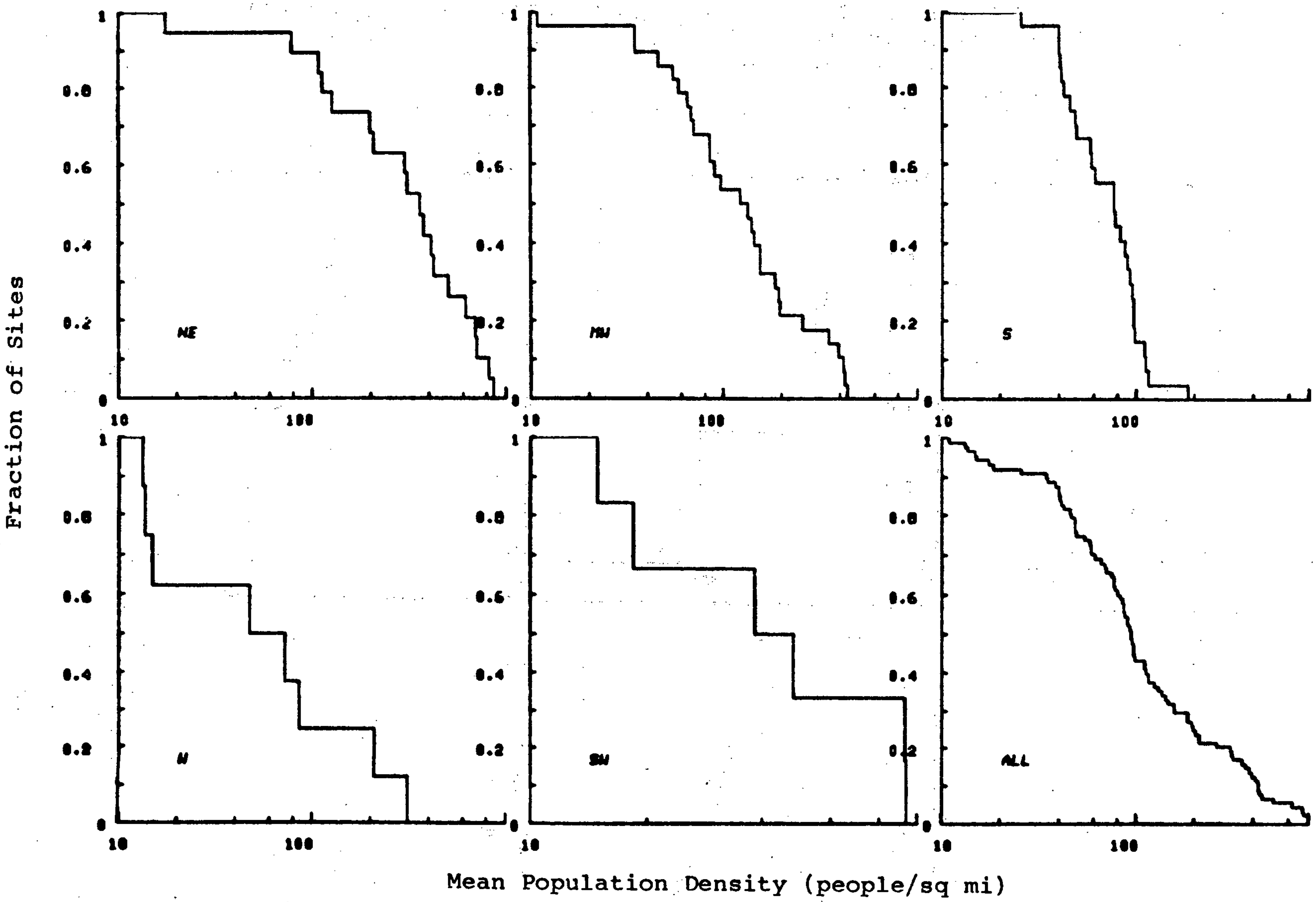

Figure D.1-7. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Annulus Interval 50-100 Miles.

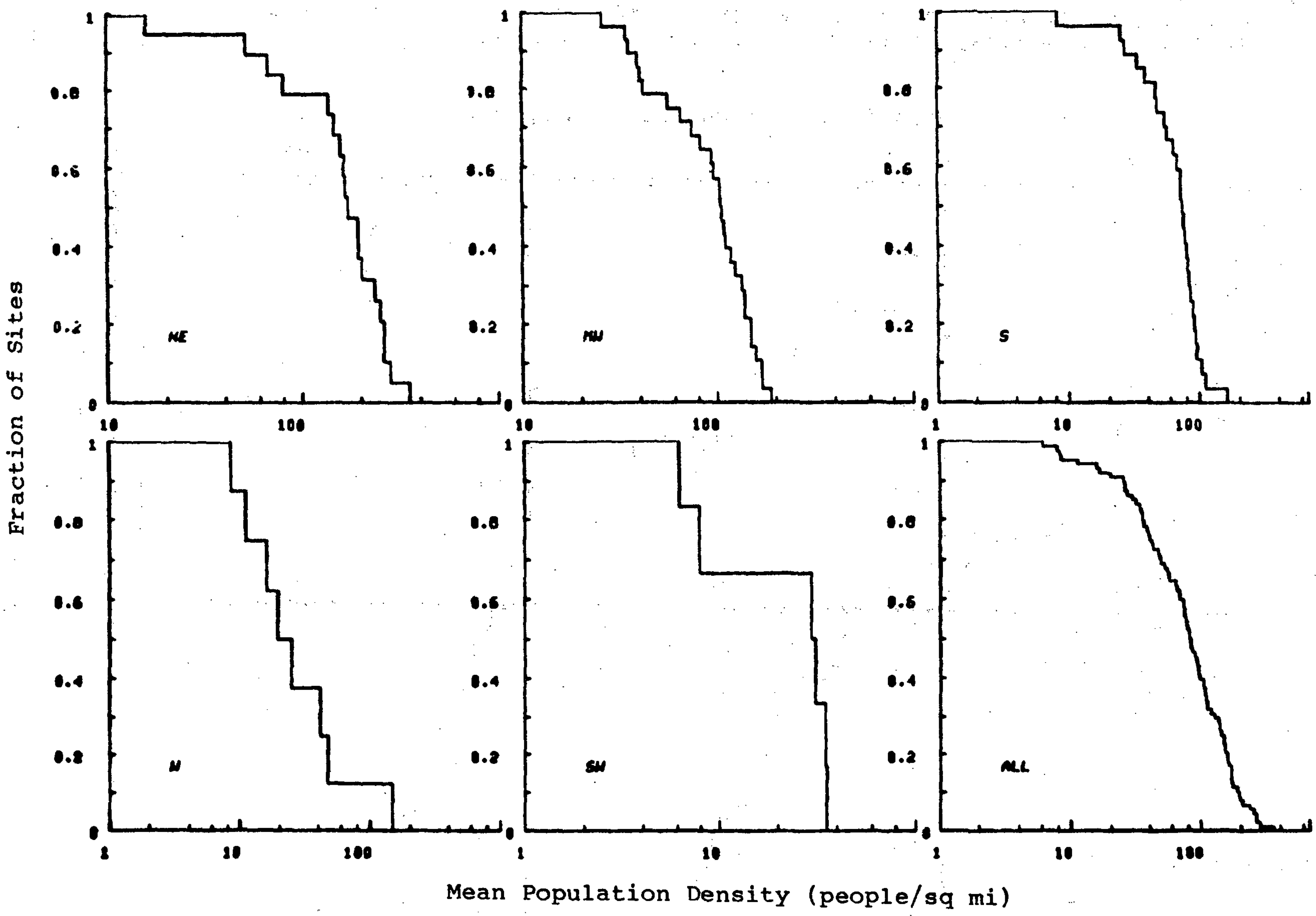

Figure D.1-8. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Annulus Interval 100-200 Miles.

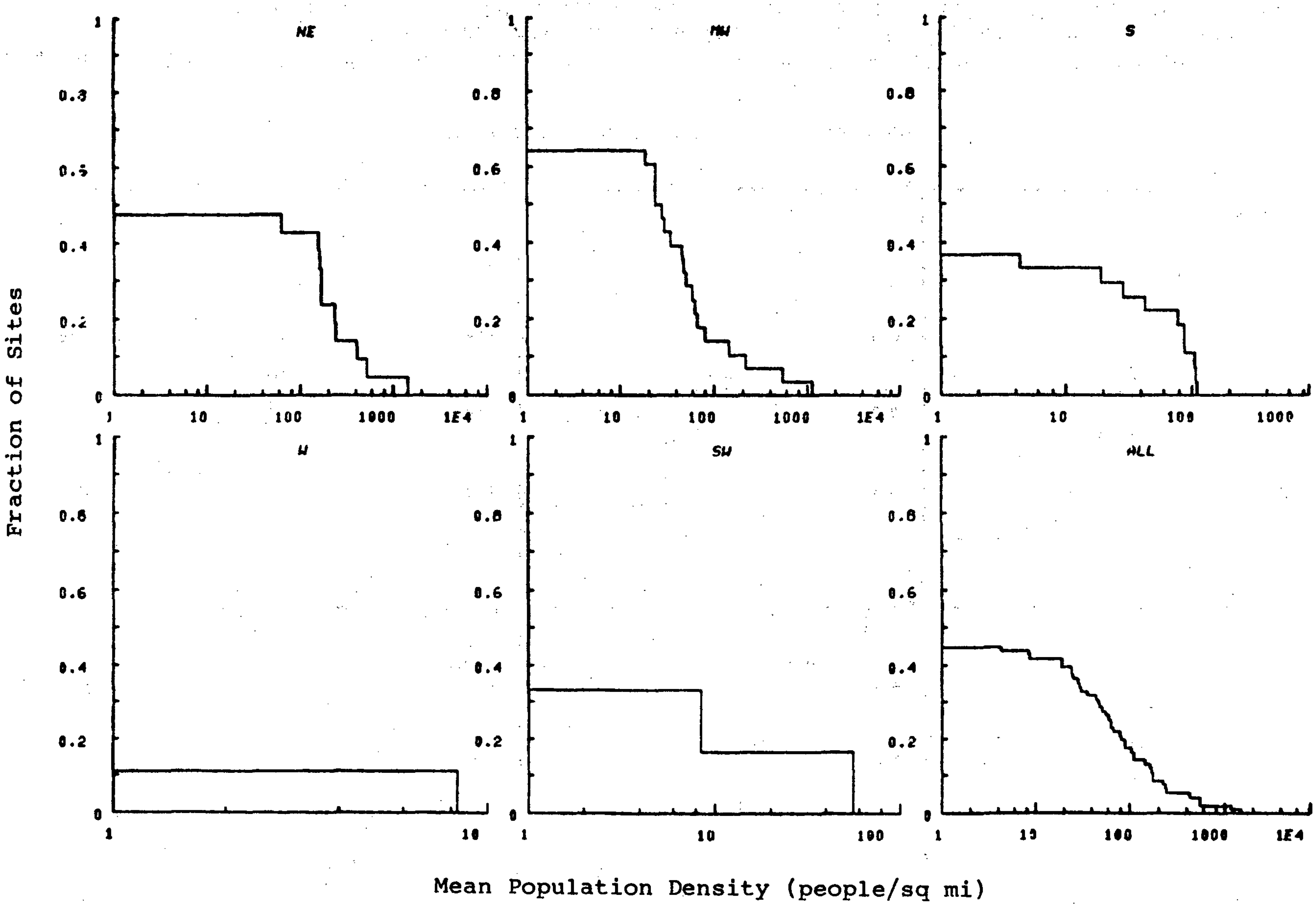

Figure D.1-9. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Radial Distance 0-2 Miles.

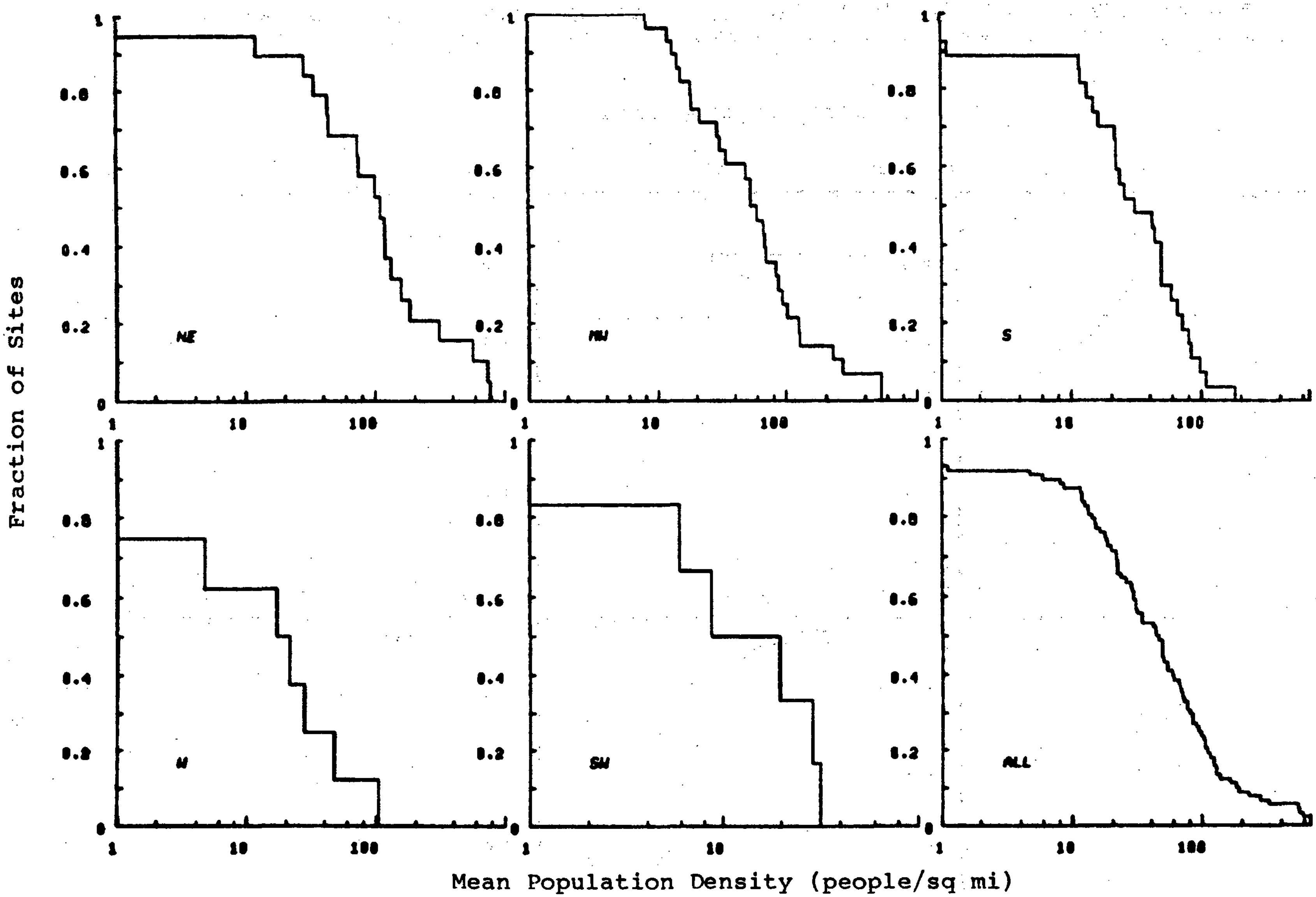

Figure D.1-10. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Radial Distance 0-5 Miles.

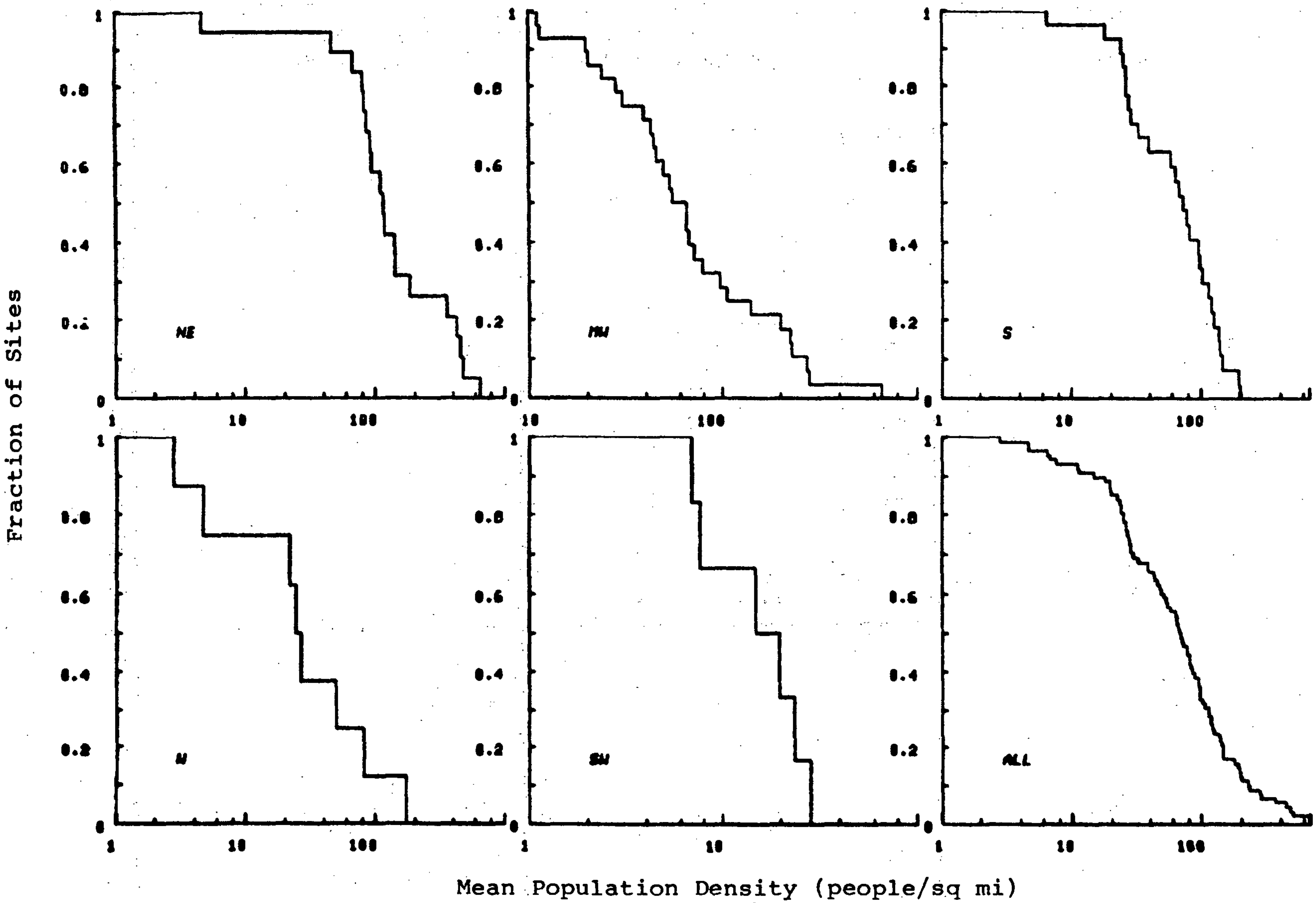

Figure D.1-11. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Radial Distance 0-10 Miles.

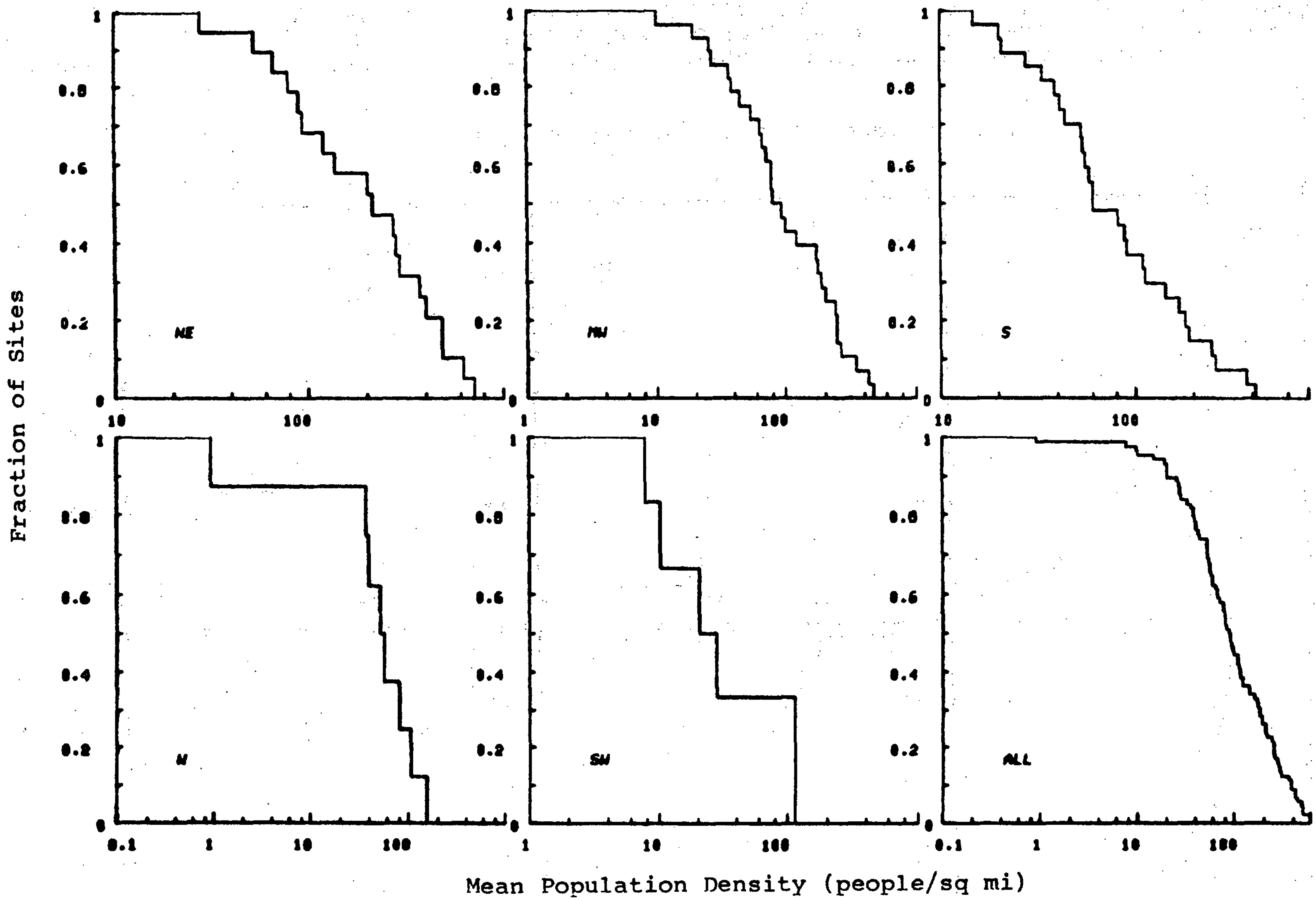

Figure D.1-12. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Radial Distance 0-20 Miles.

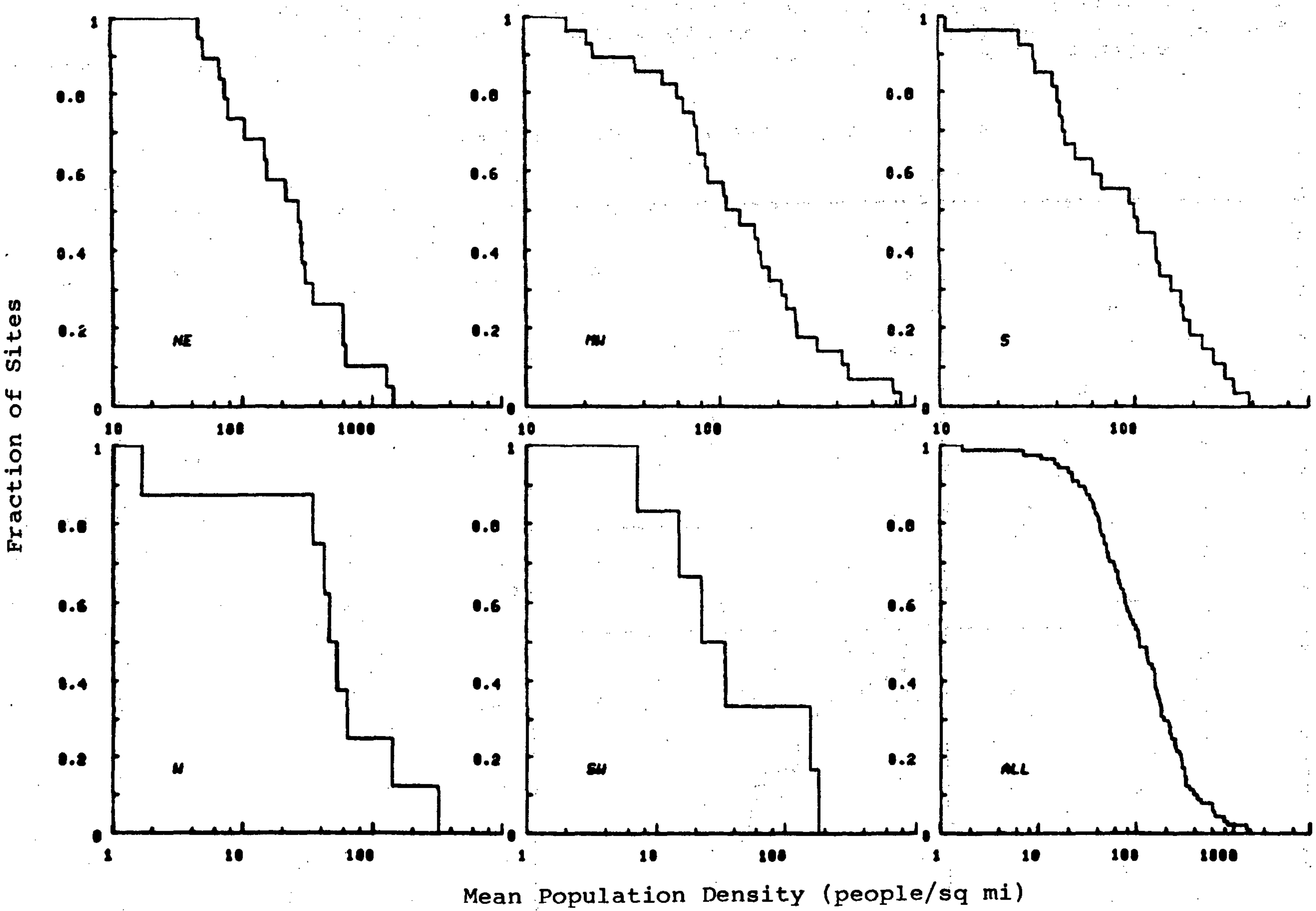

Figure D.1-13. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Radial Distance 0-30 Miles.

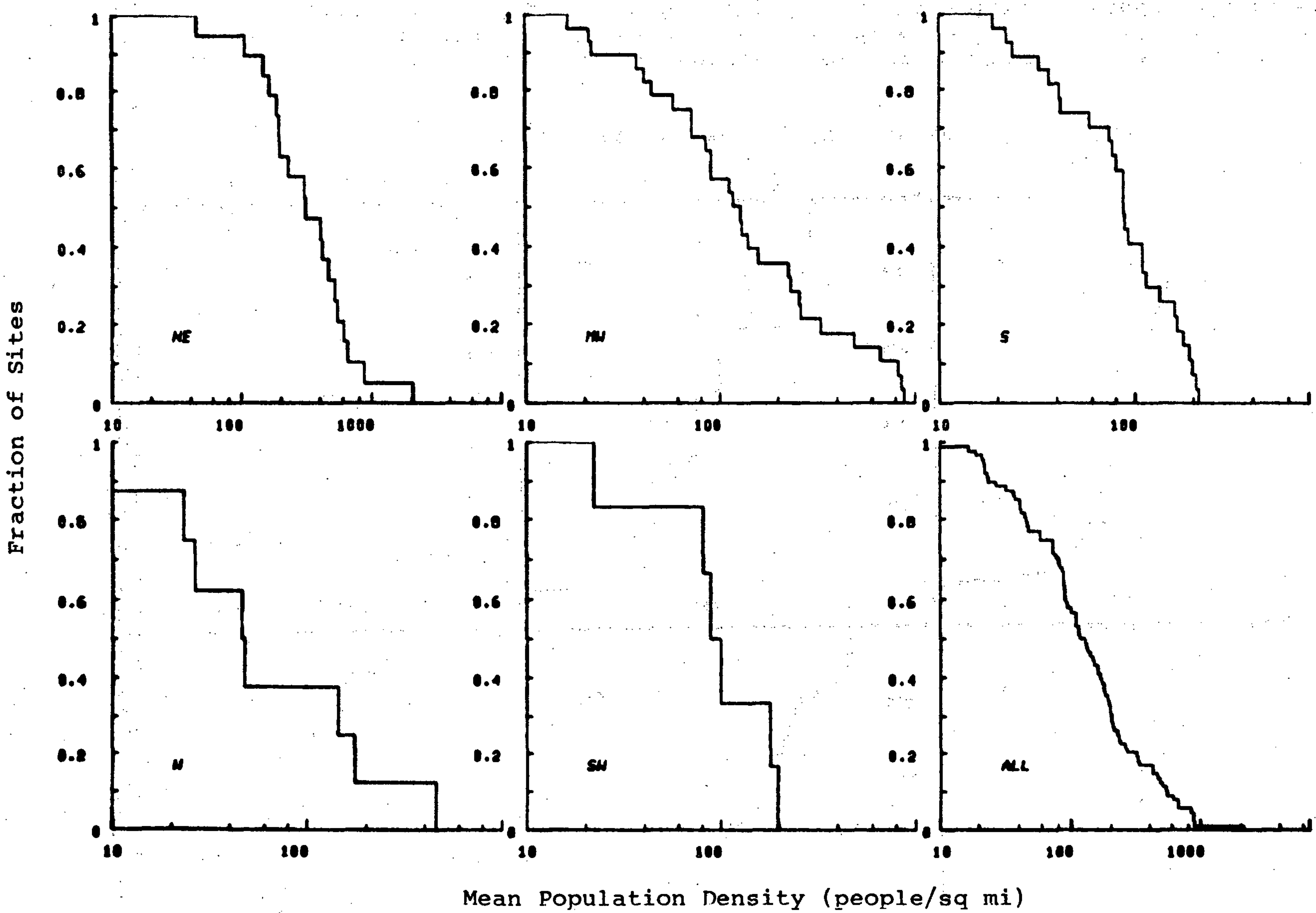

Figure D.1-14. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Radial Distance 0-50 Miles.

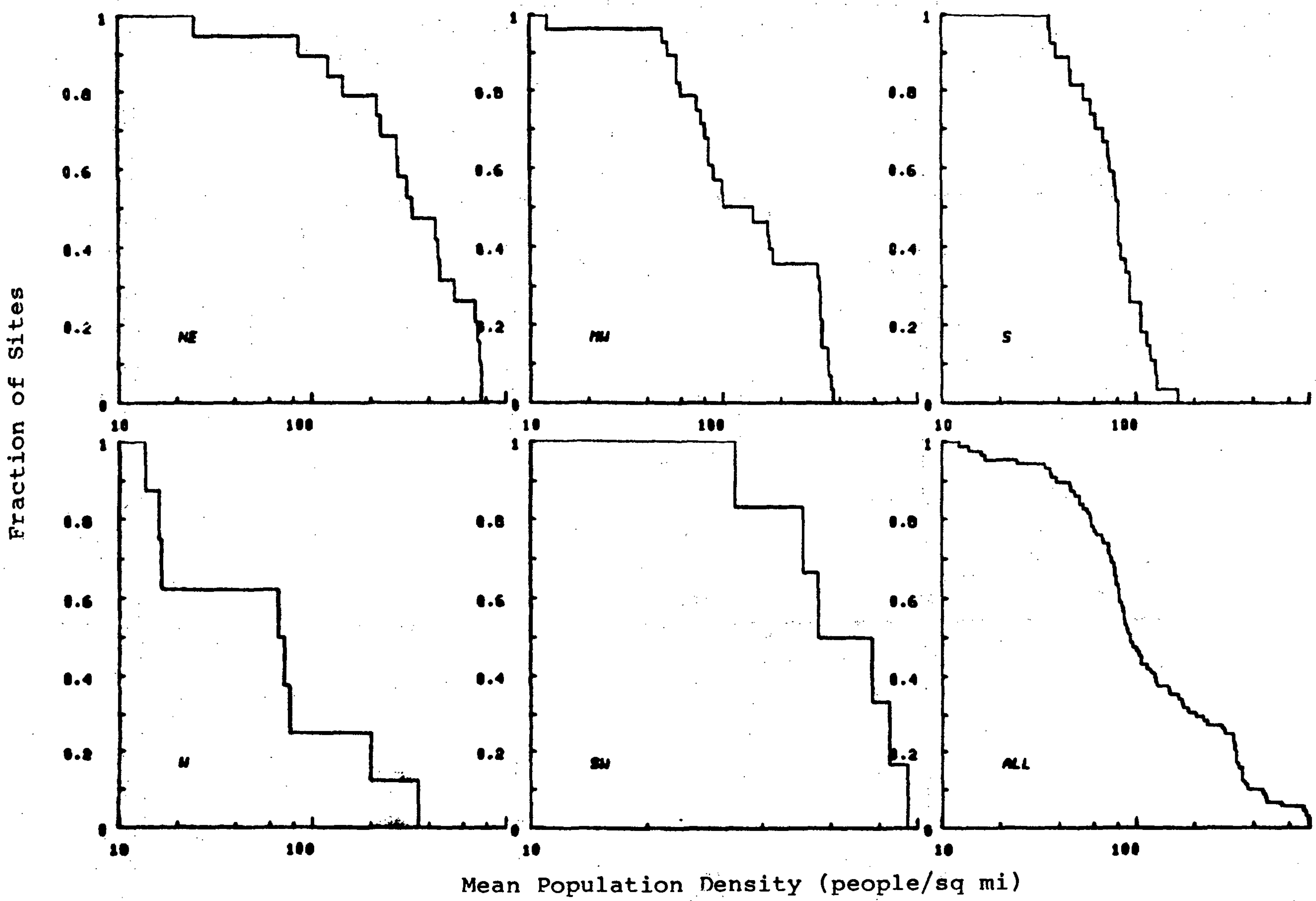

Figure D.1-15. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Radial Distance 0-100 Miles.

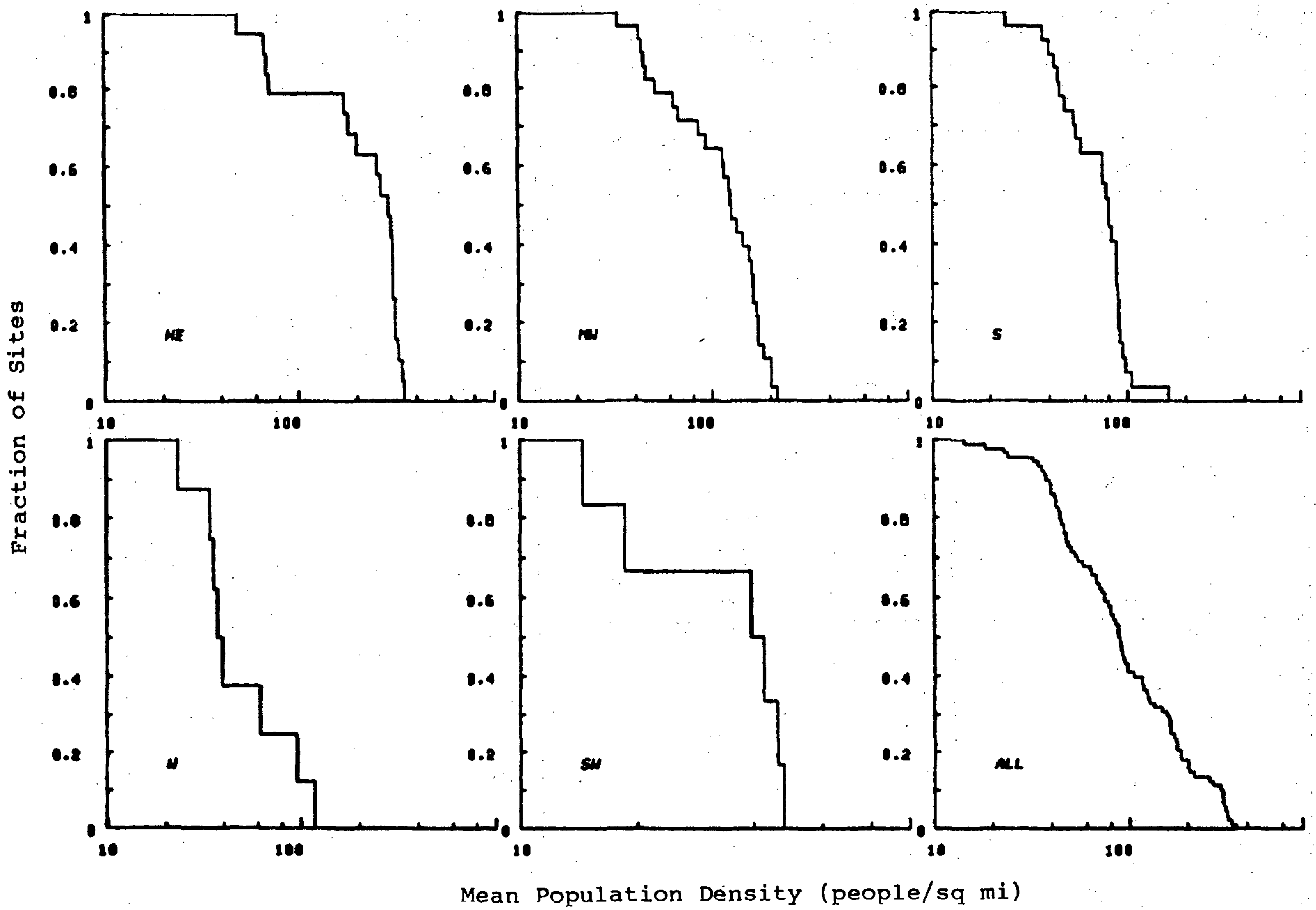

Figure D.1-16. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Radial Distance 0-200 Miles.

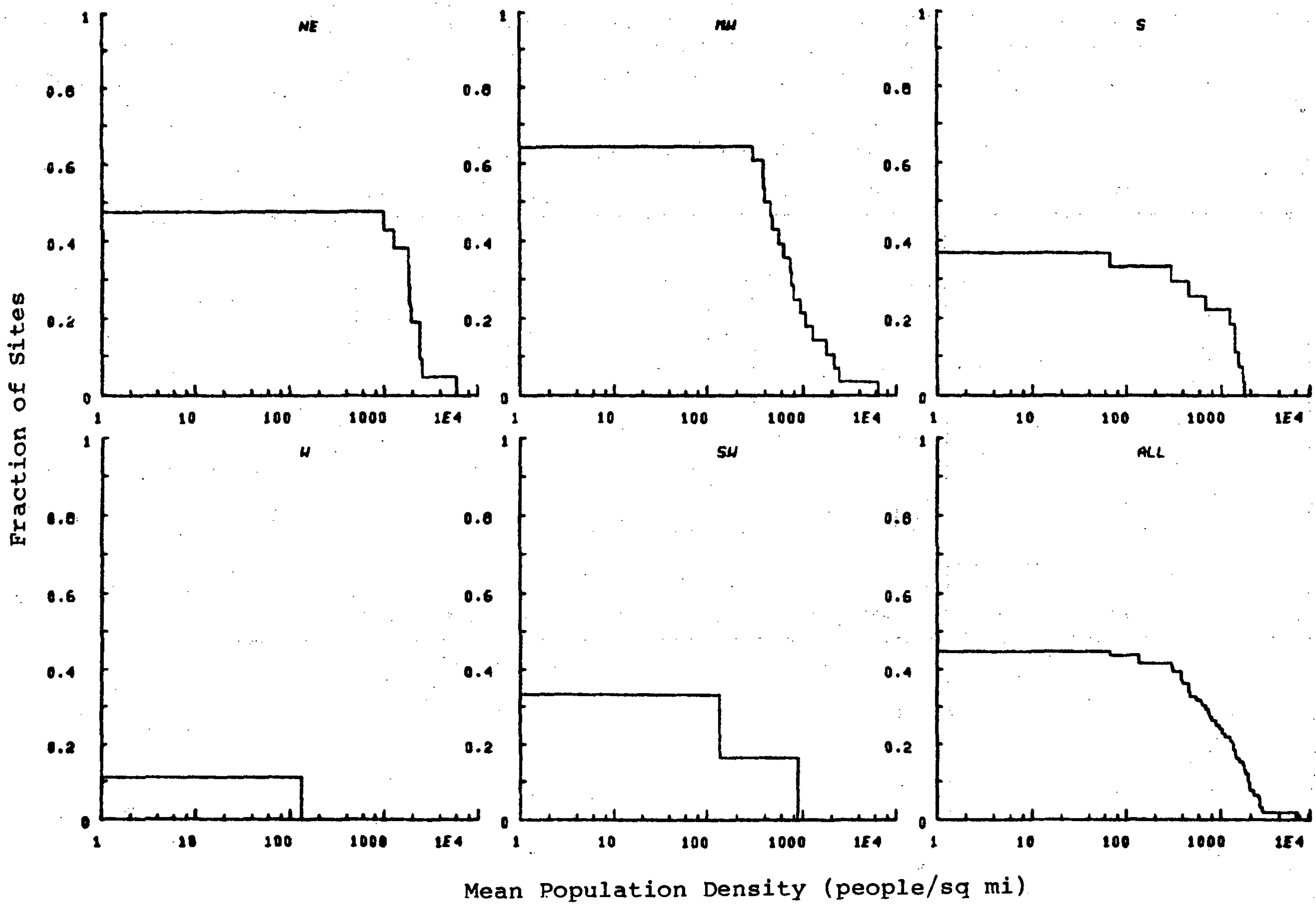

Figure D.1-17. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Annular Interval 0-2 Miles.

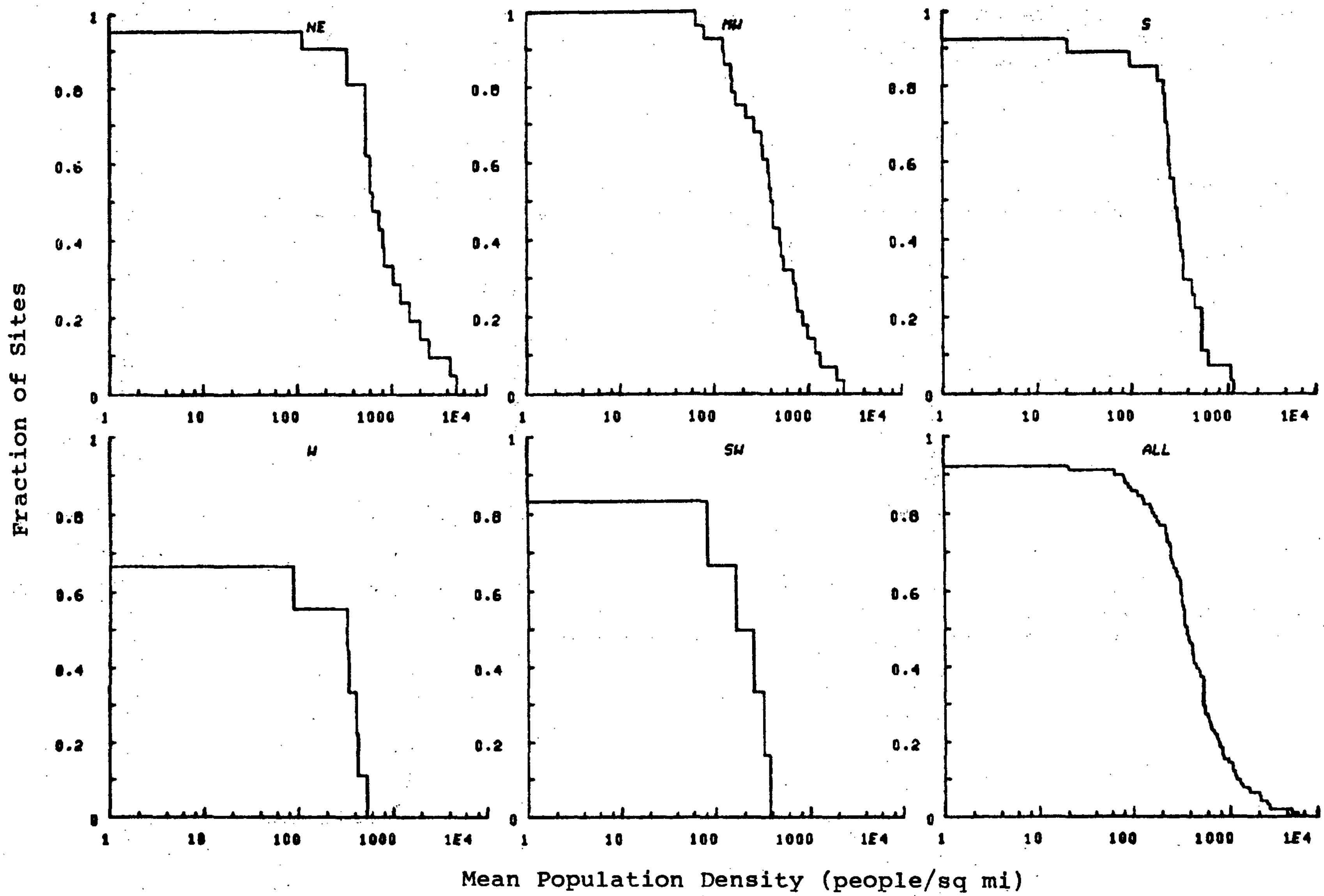

Figure D.1-18. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Annular Interval 2-5 Miles.

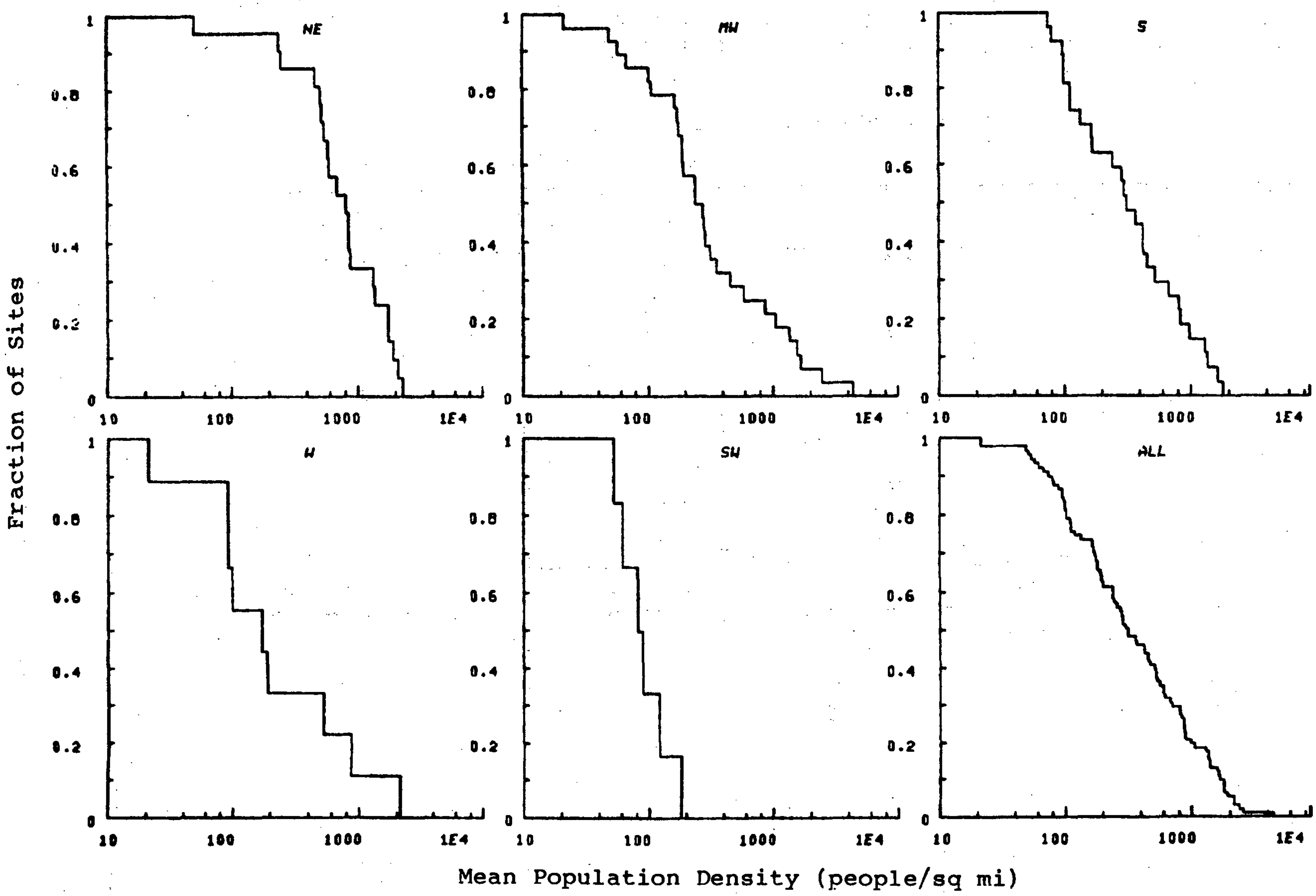

Figure D.1-19. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Annular Interval 5-10 Miles.

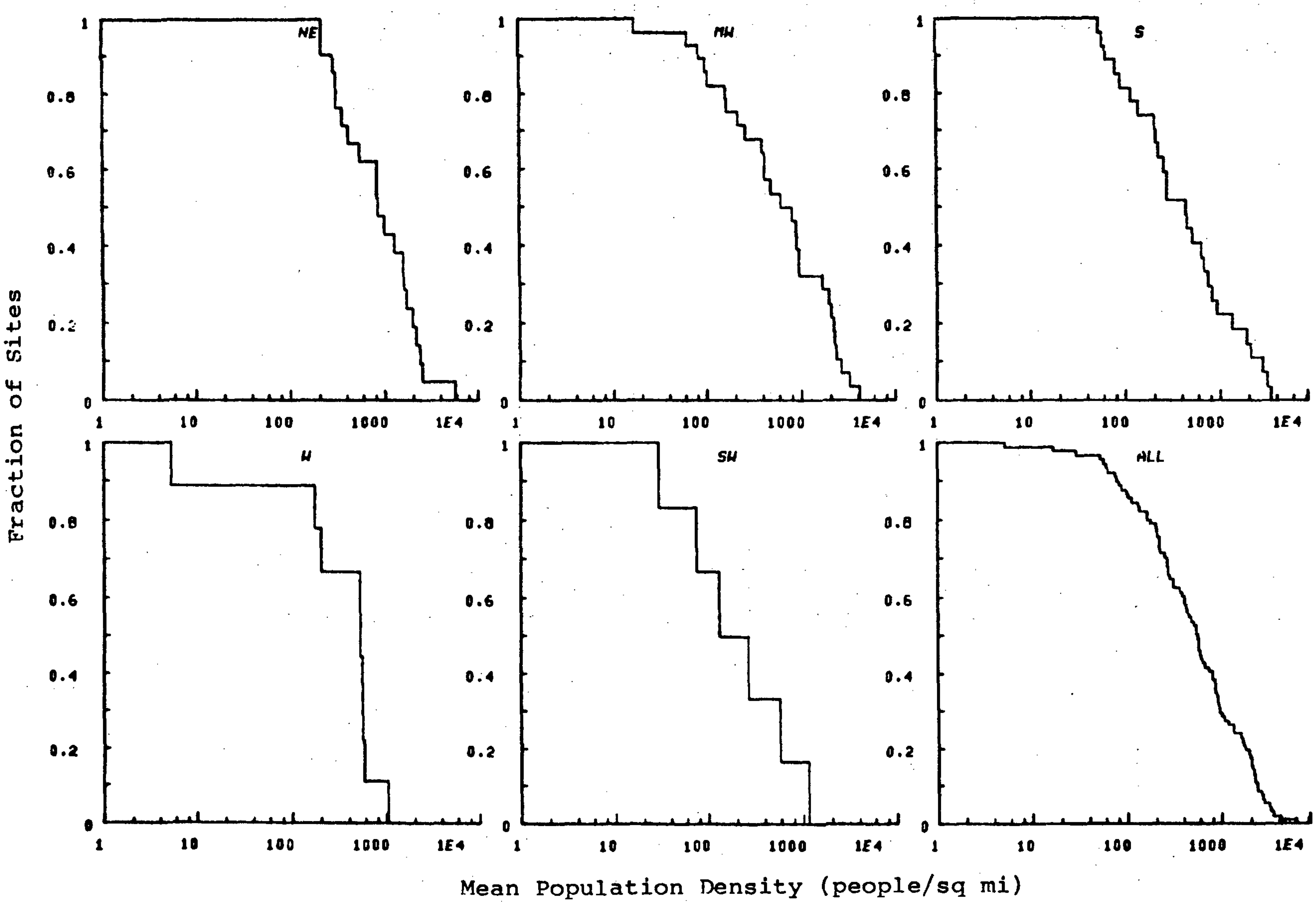

Figure D.1-20. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Annular Interval 10-20 Miles.

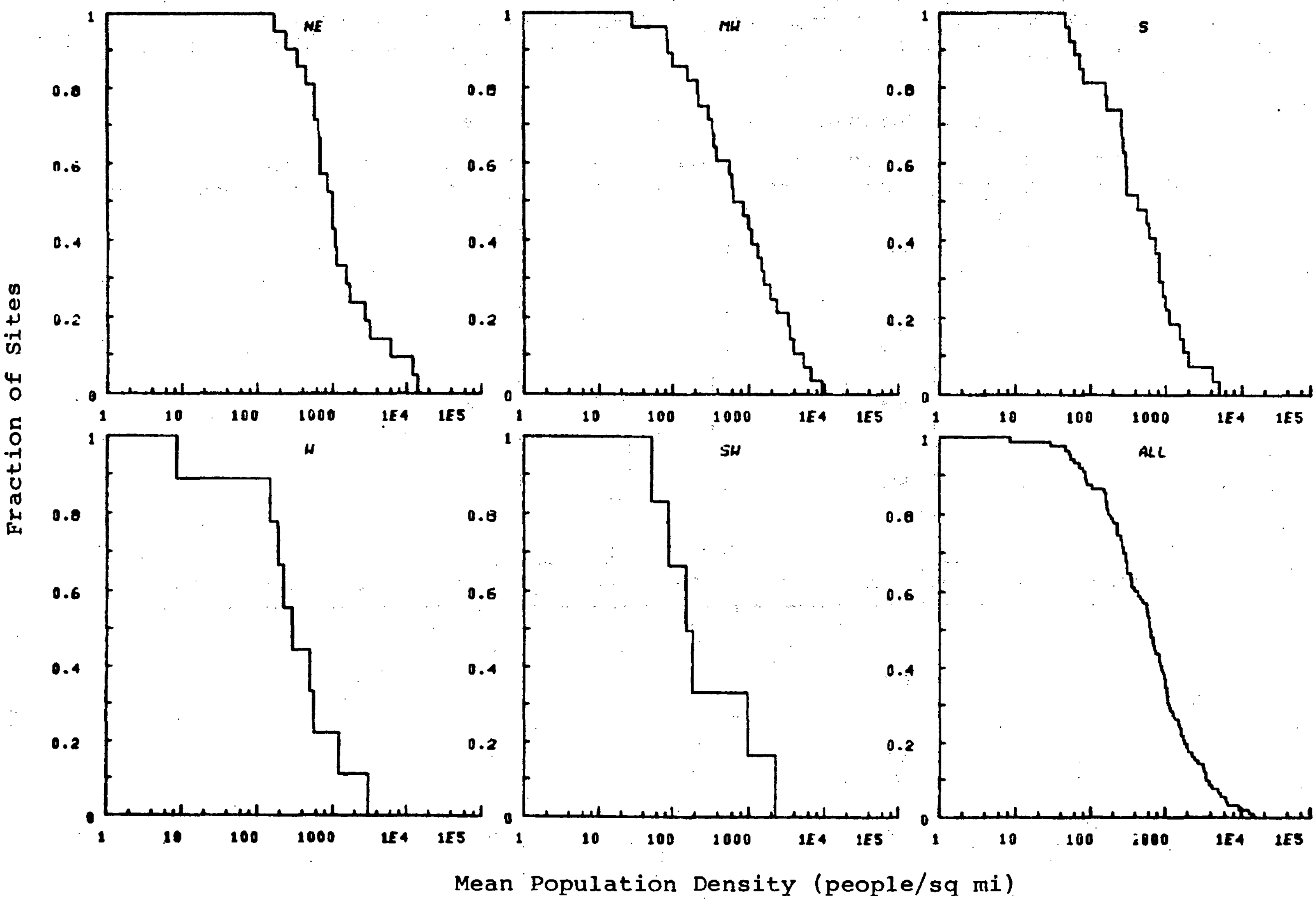

Figure D.1-21. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Annular Interval 20-30 Miles.

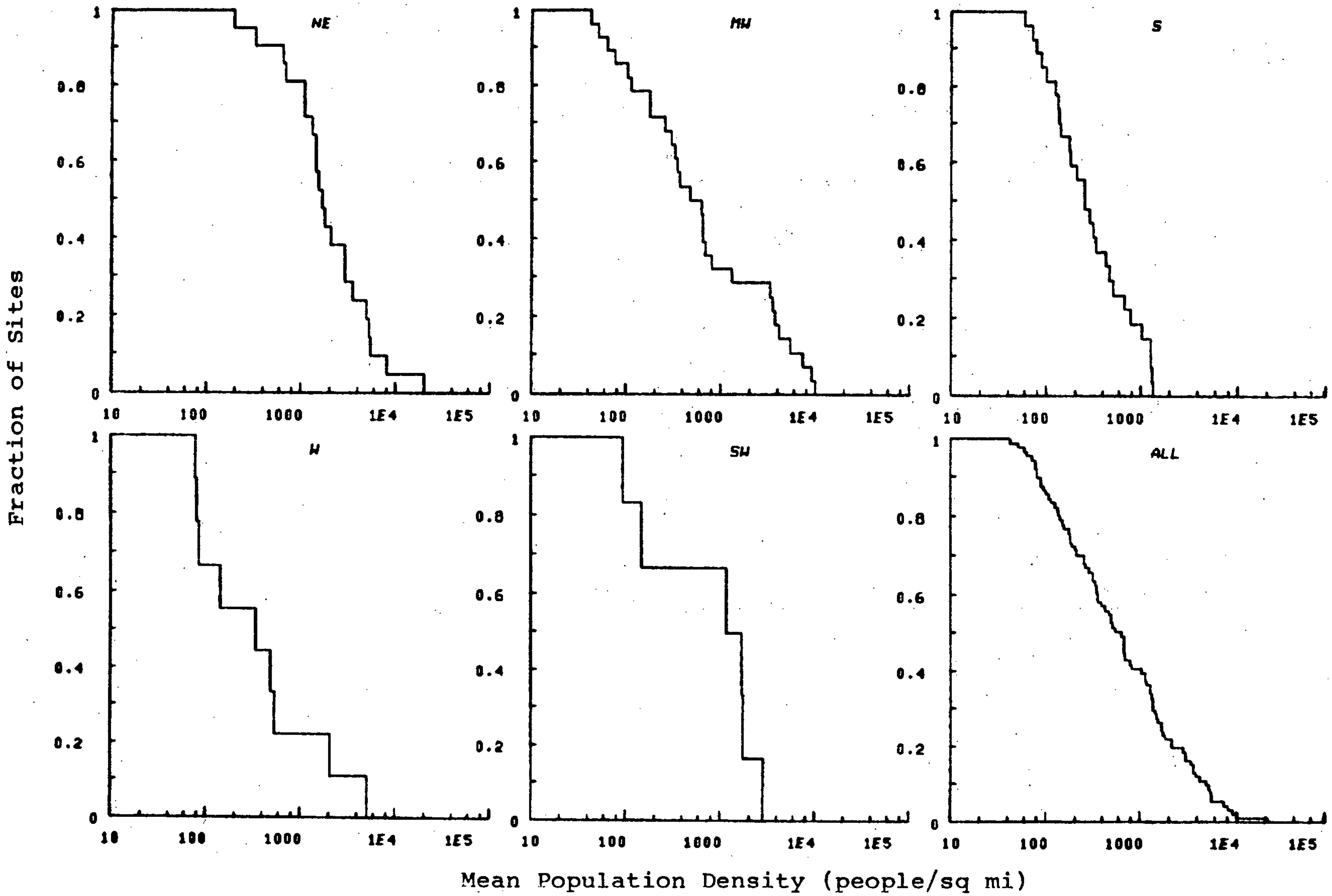

Figure D.1-22. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Annular Interval 30-50 Miles.

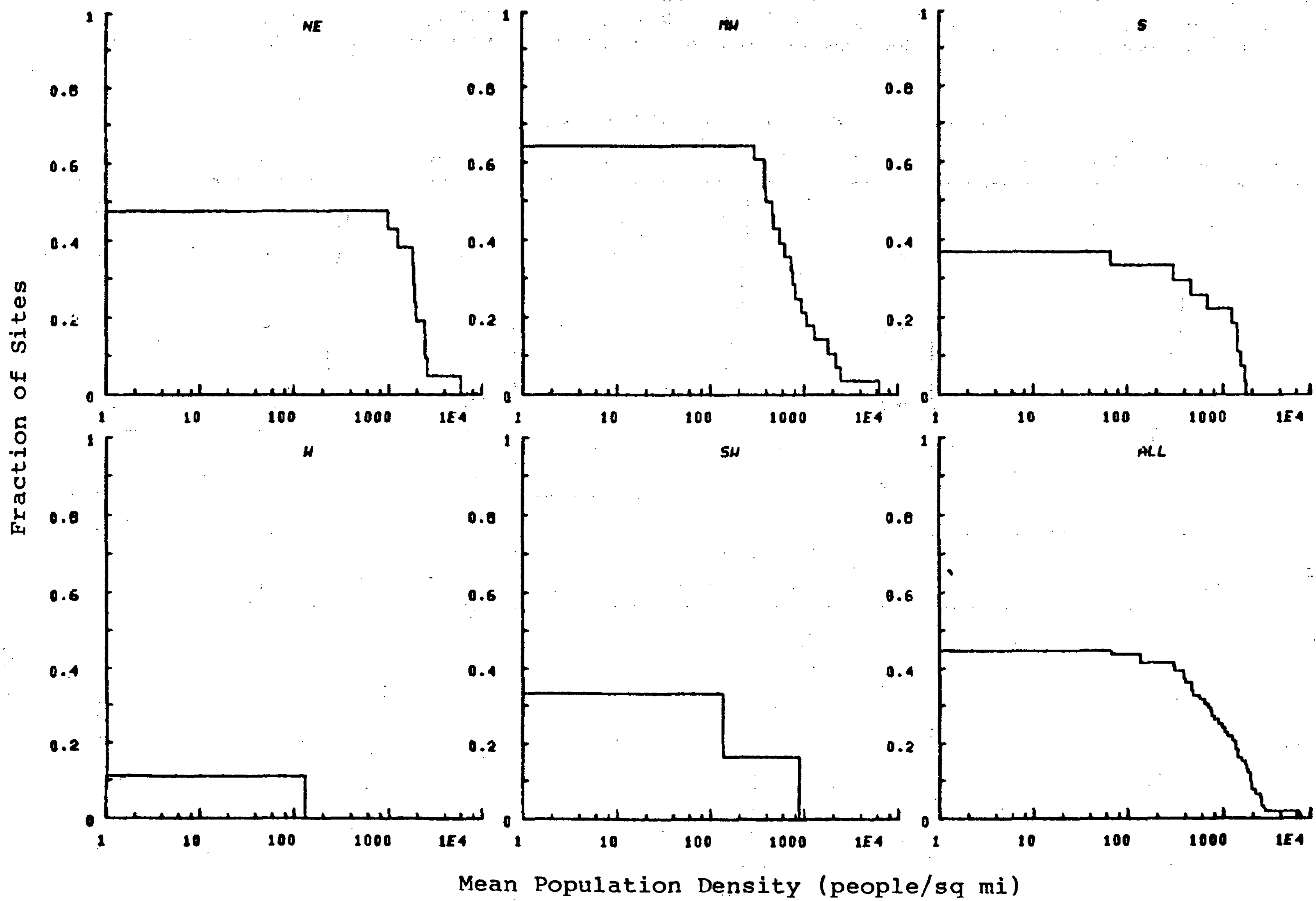

Figure D.1-23. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Radial Distance 0-2 Miles.

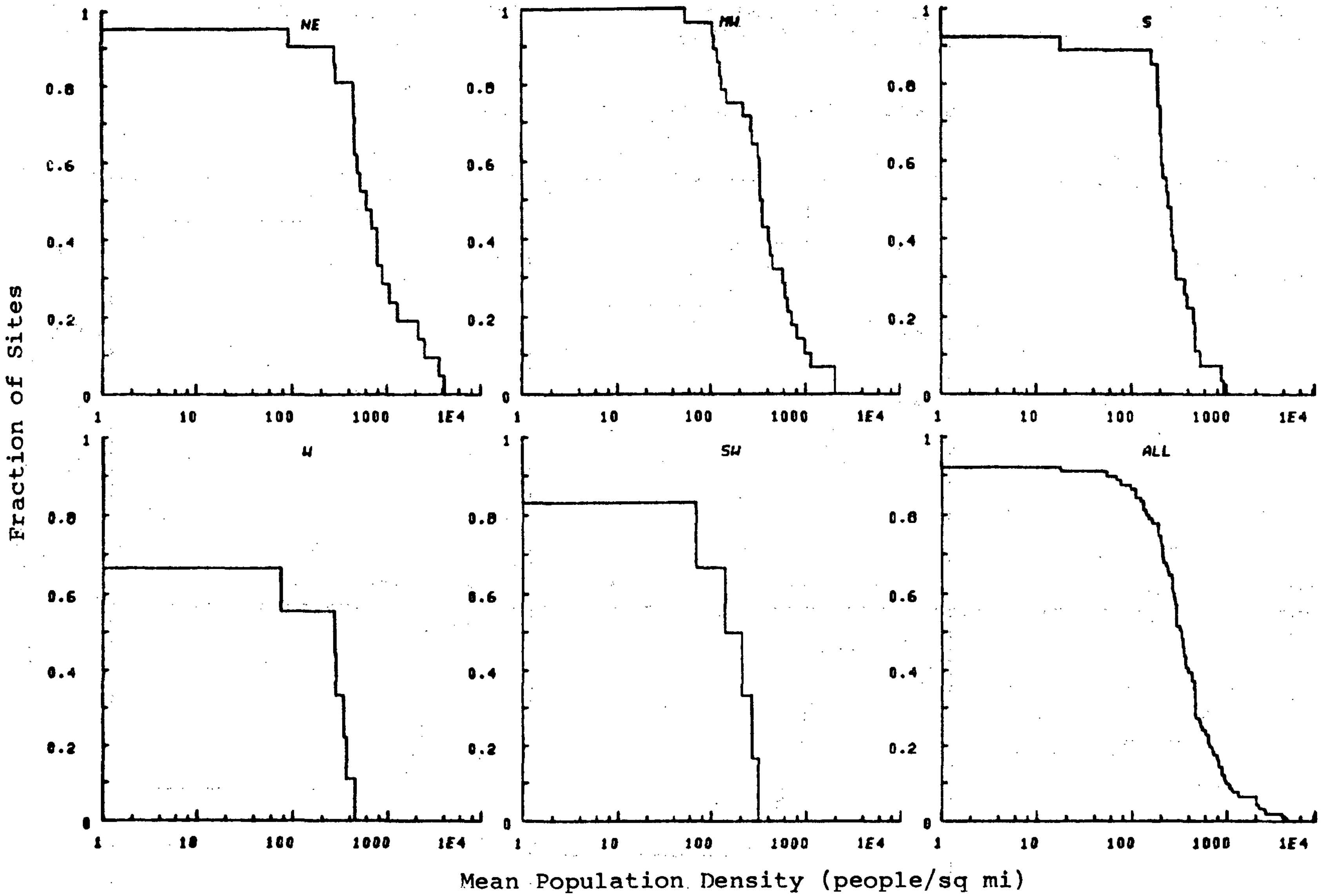

Figure D.1-24. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Radial Distance 0-5 Miles.

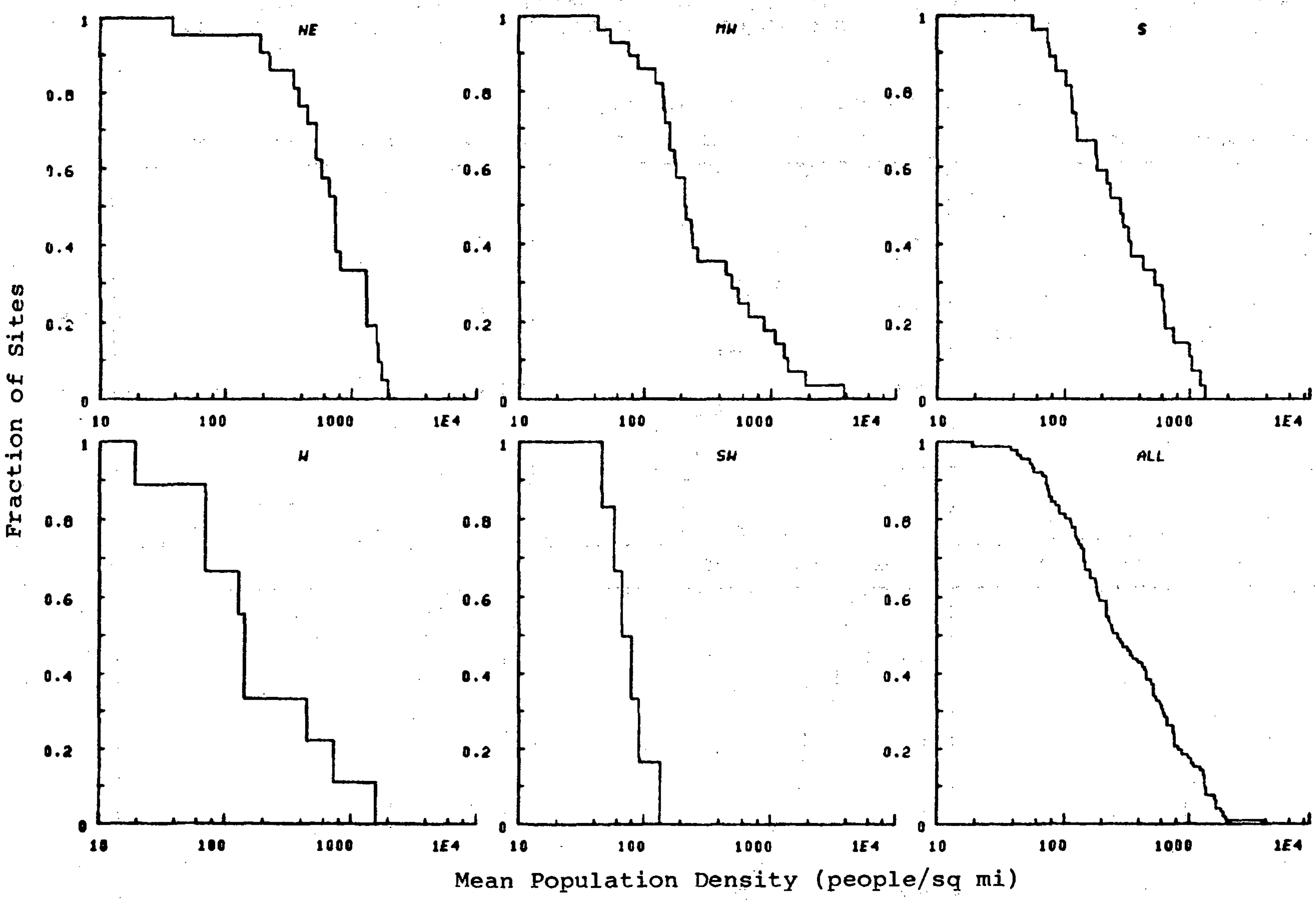

Figure D.1-25. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Radial Distance 0-10 Miles.

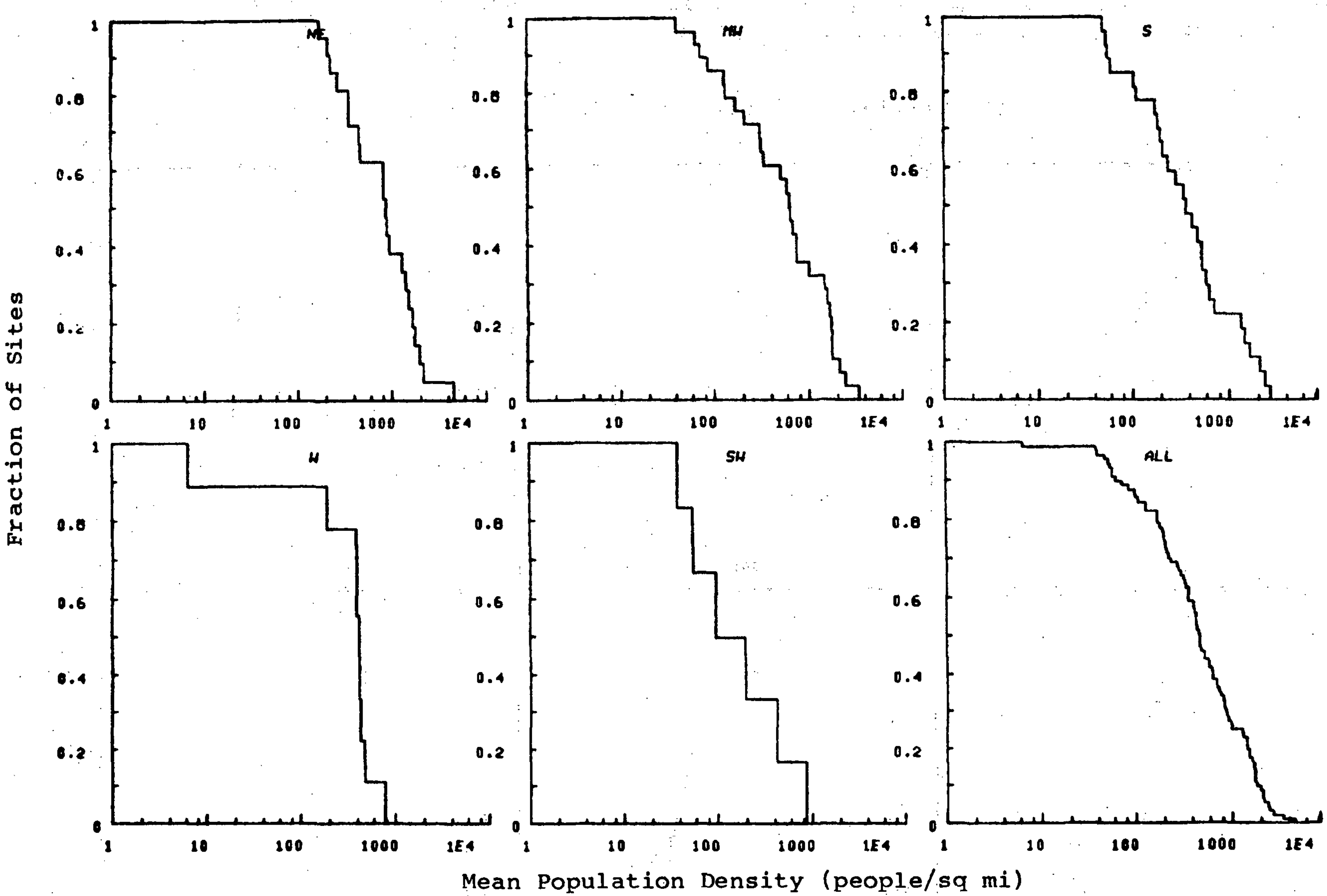

Figure D.1-26. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Radial Distance 0-20 Miles.

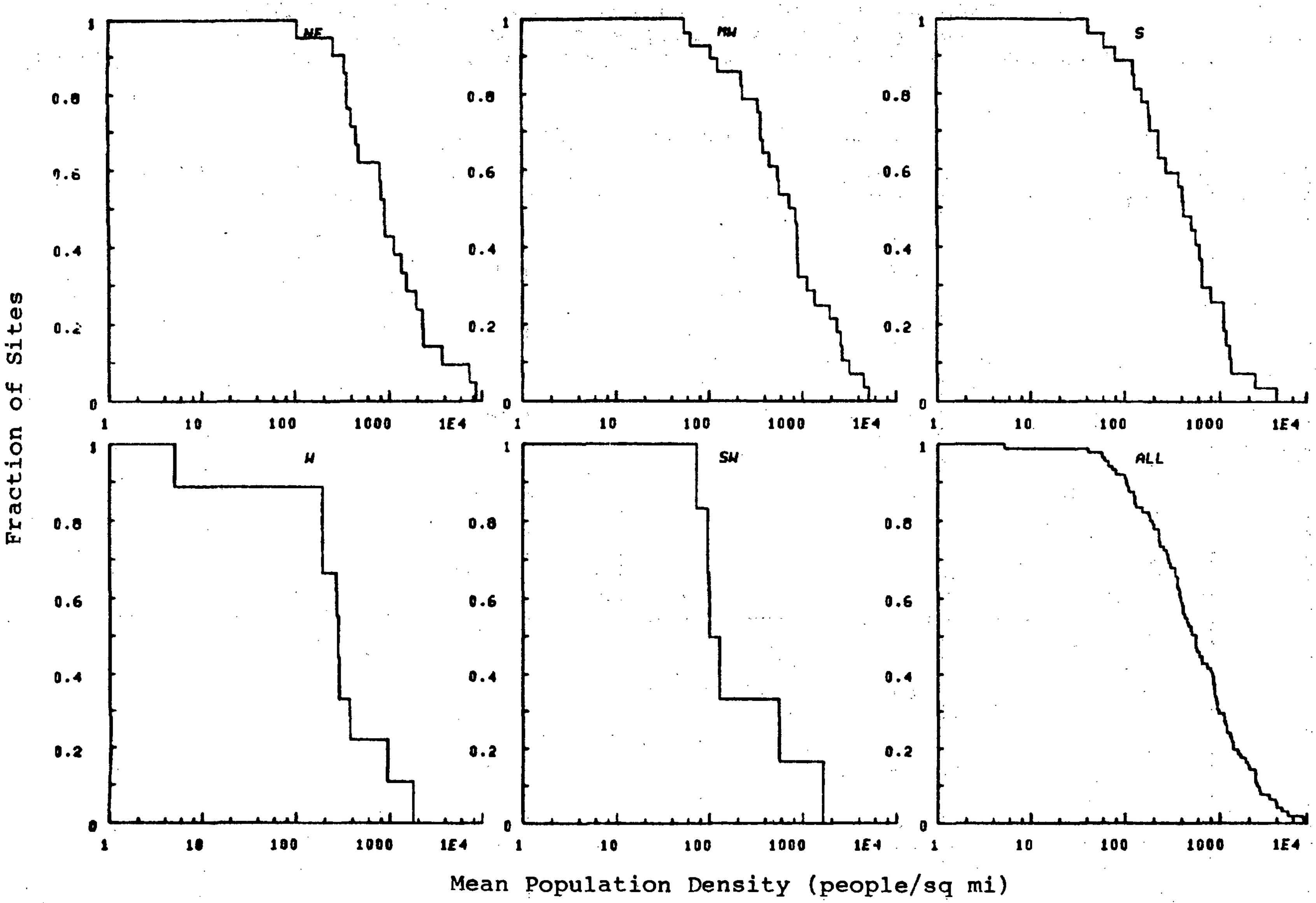

Figure D.1-27. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Radial Distance 0-30 Miles.

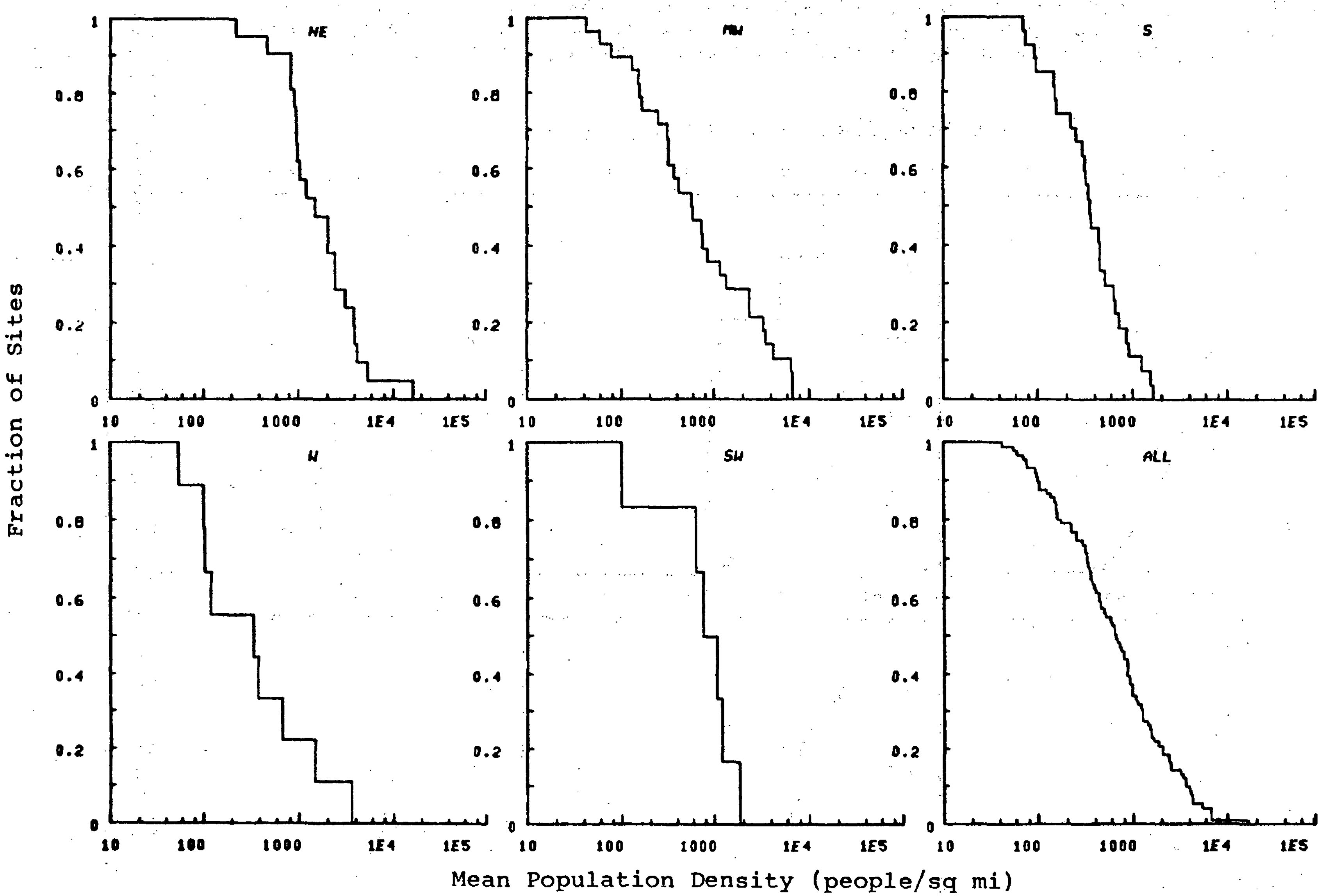

Figure D.1-28. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 22.5° Sector of the Radial Distance 0-50 Miles.

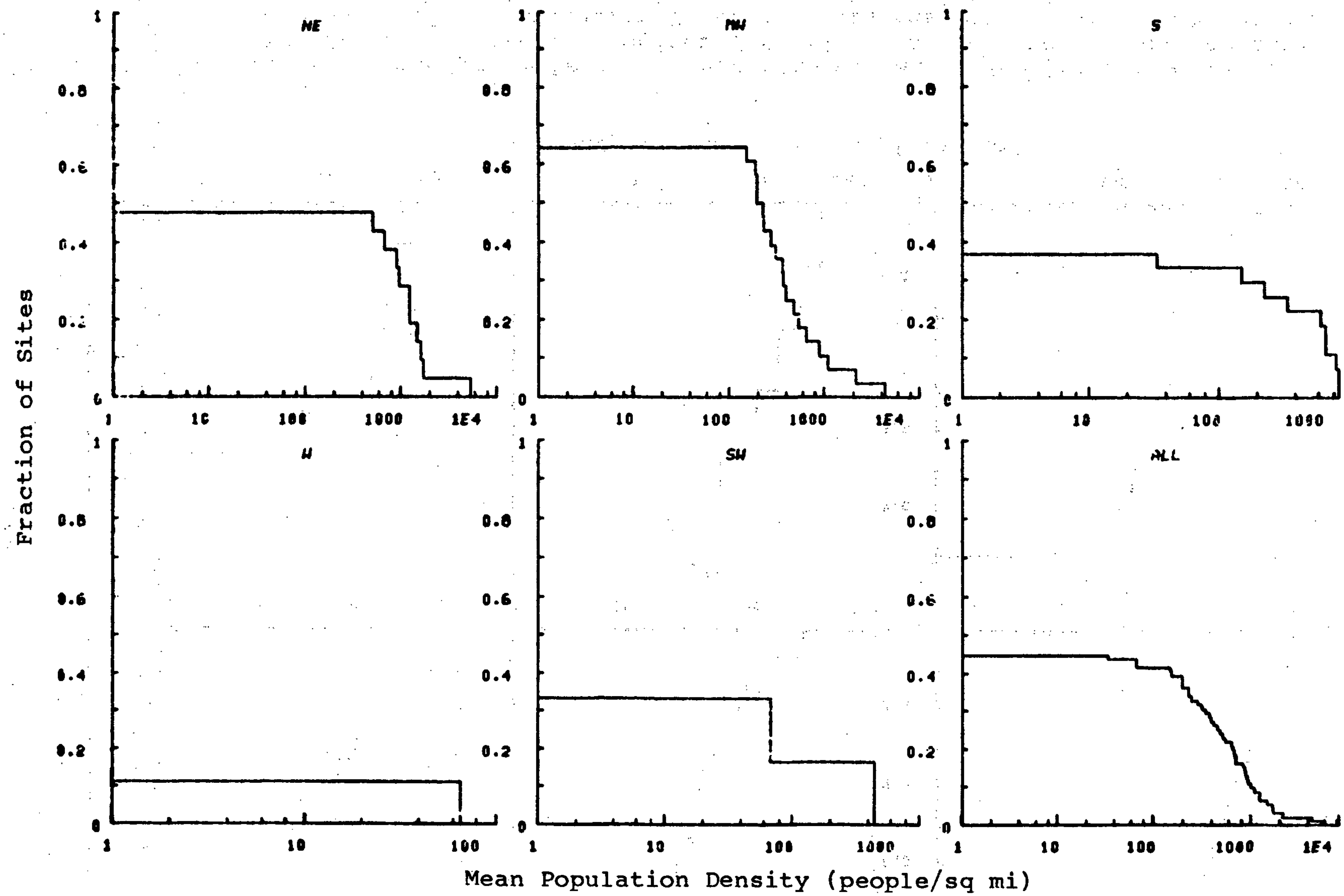

Figure D.1-29. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Annular Interval 0-2 Miles.

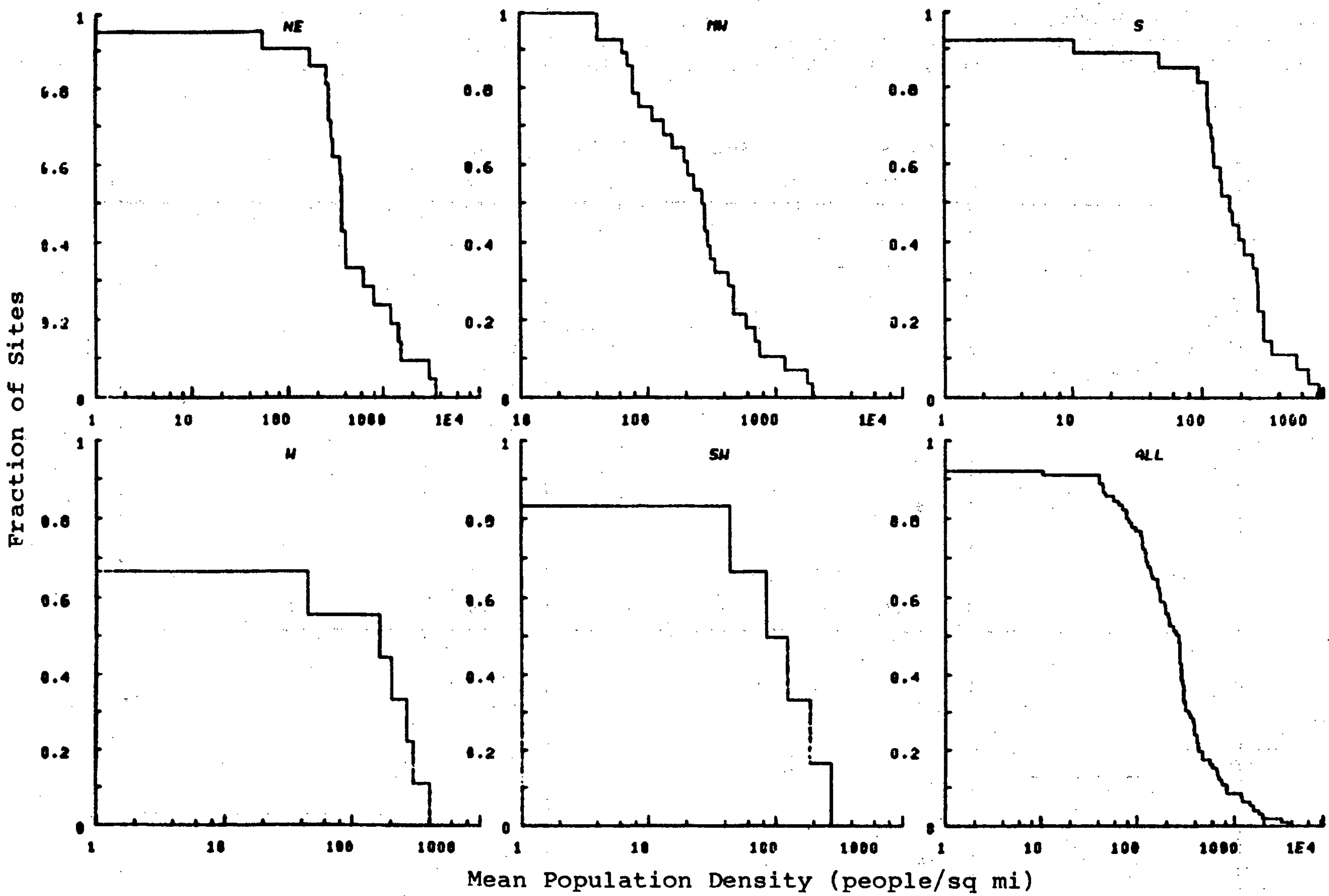

Figure D.1-30. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Annular Interval 2-5 Miles.

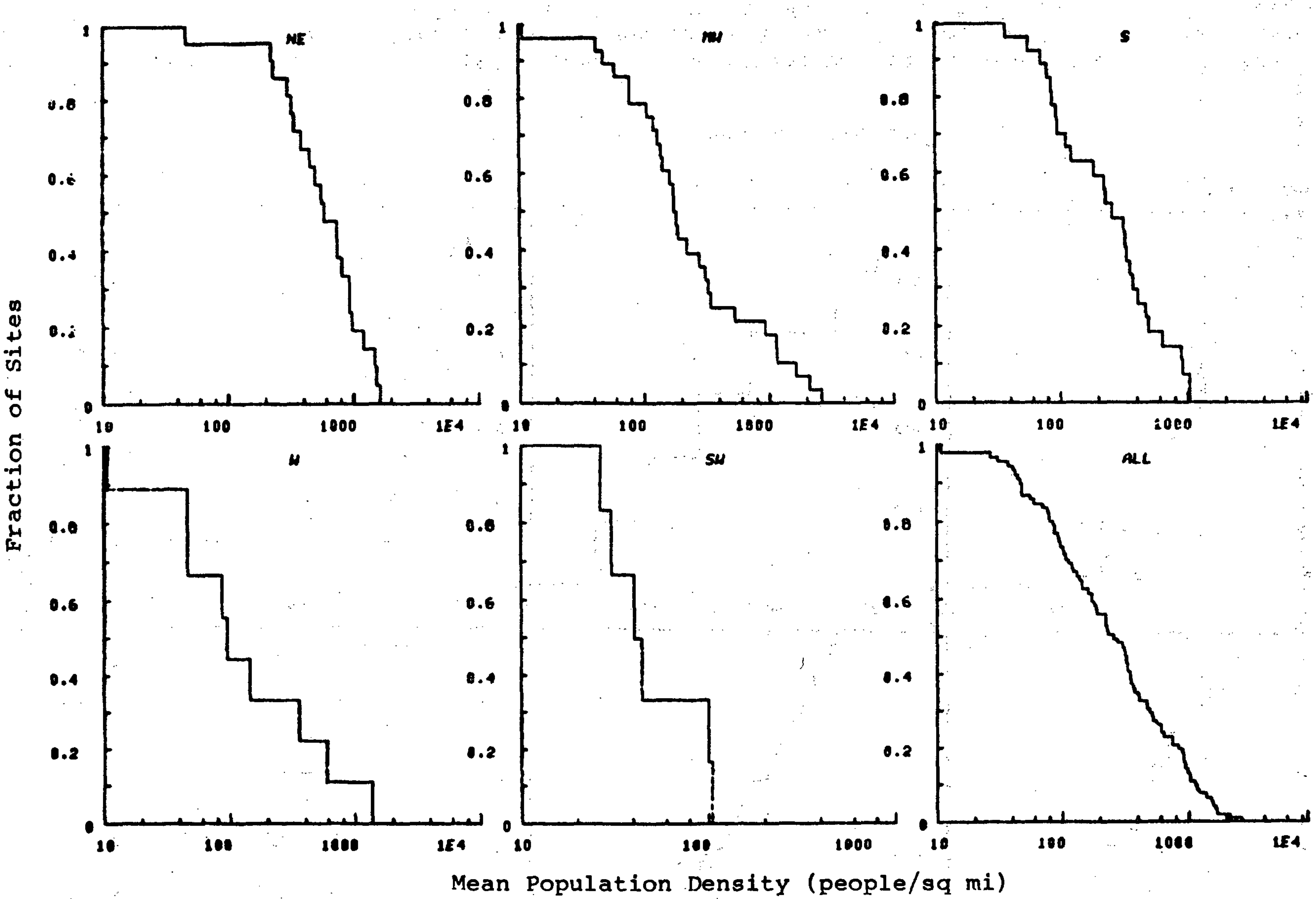

Figure D.1-31. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Annular Interval 5-10 Miles.

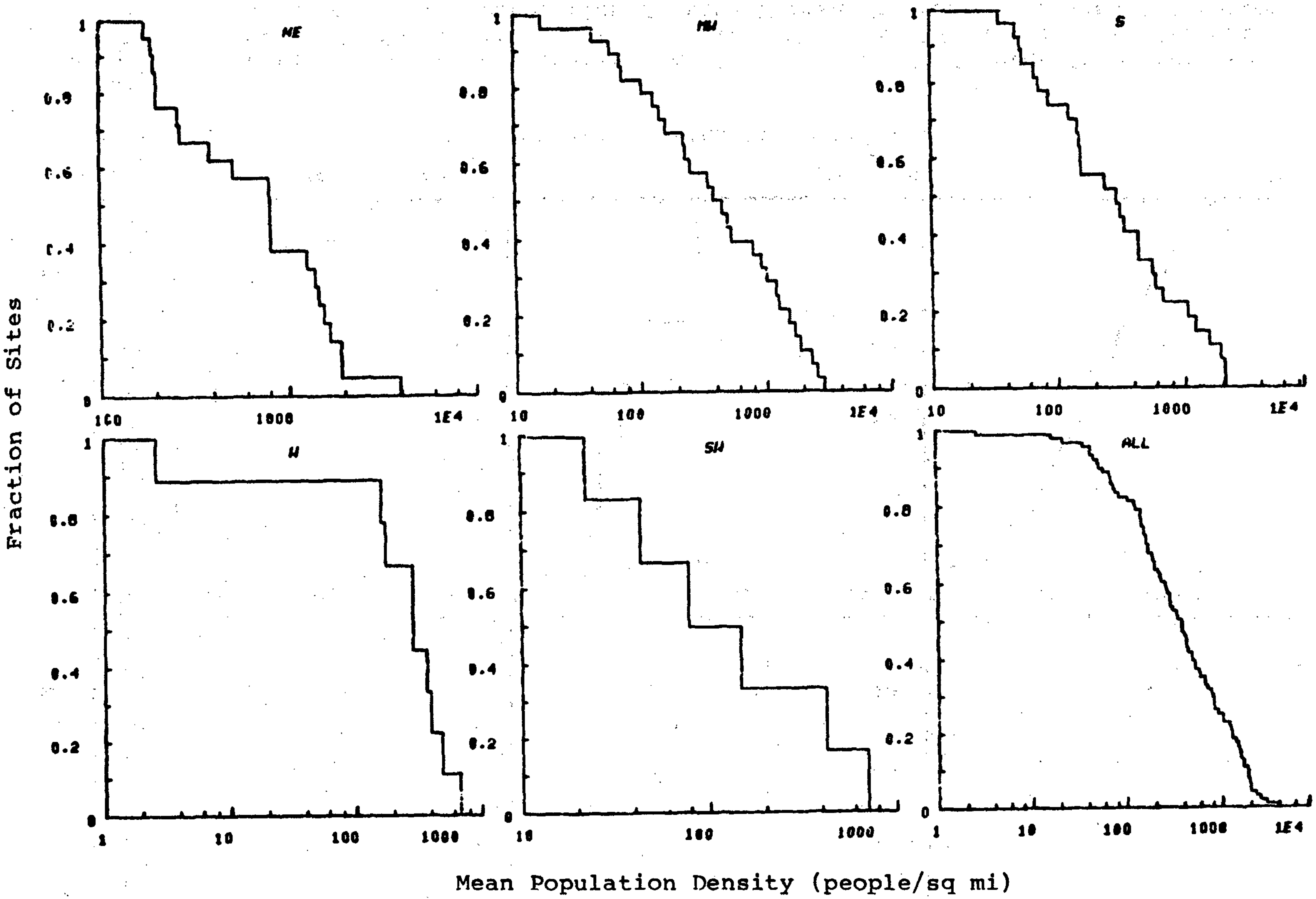

Figure D.1-32. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Annular Interval 10-20 Miles.

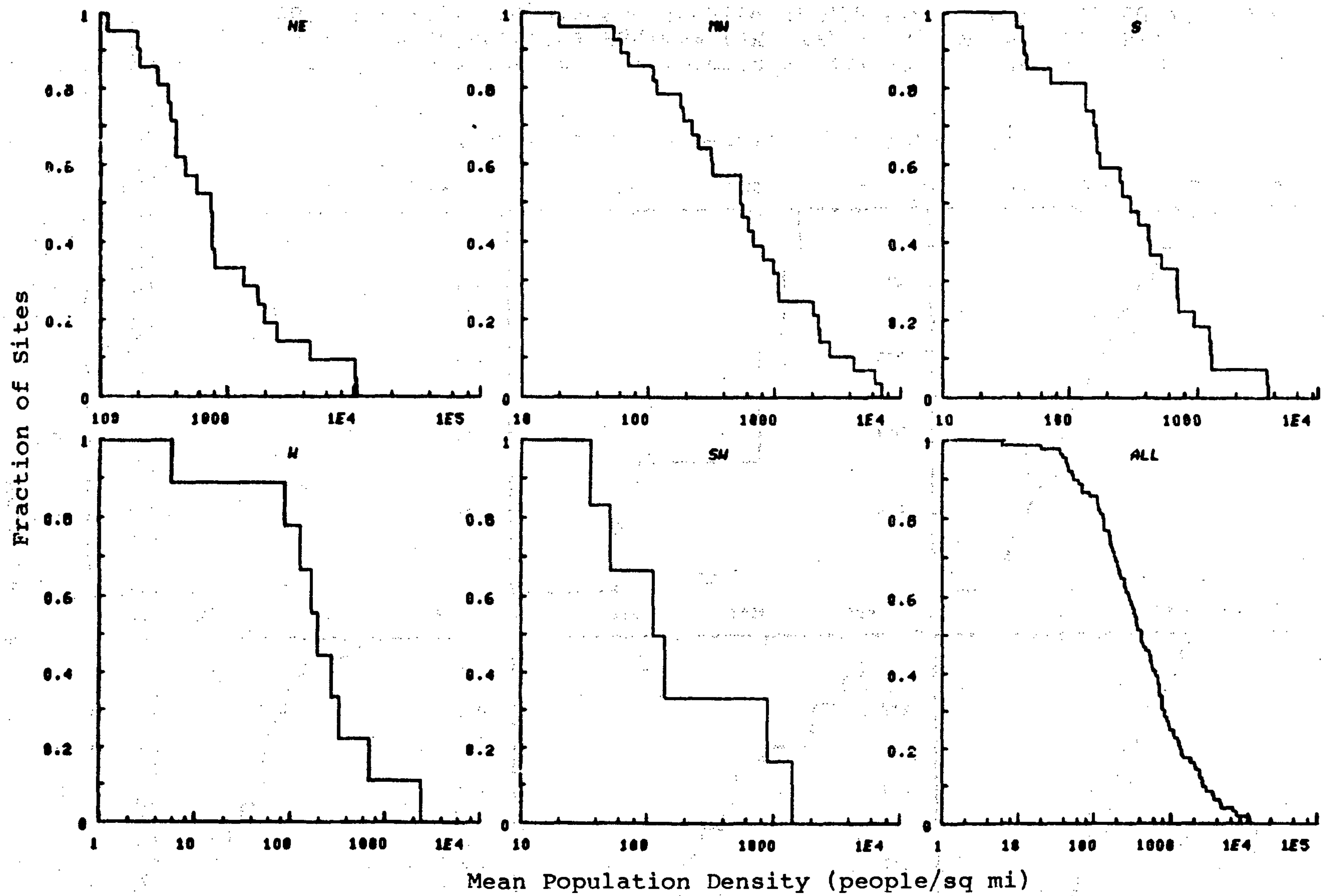

Figure D.1-33. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Annular Interval 20-30 Miles.

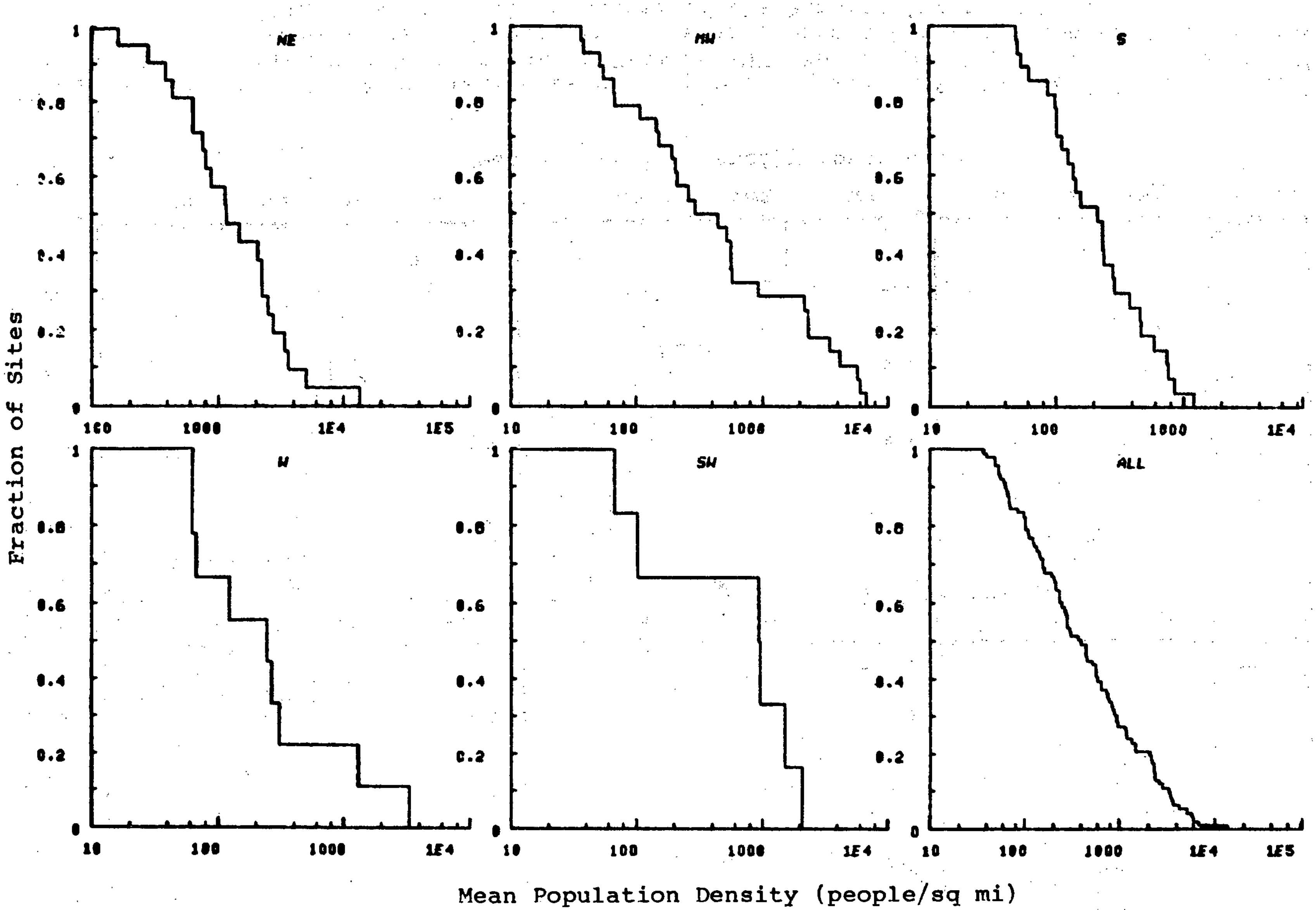

Figure D.1-34. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Annular Interval 30-50 Miles.

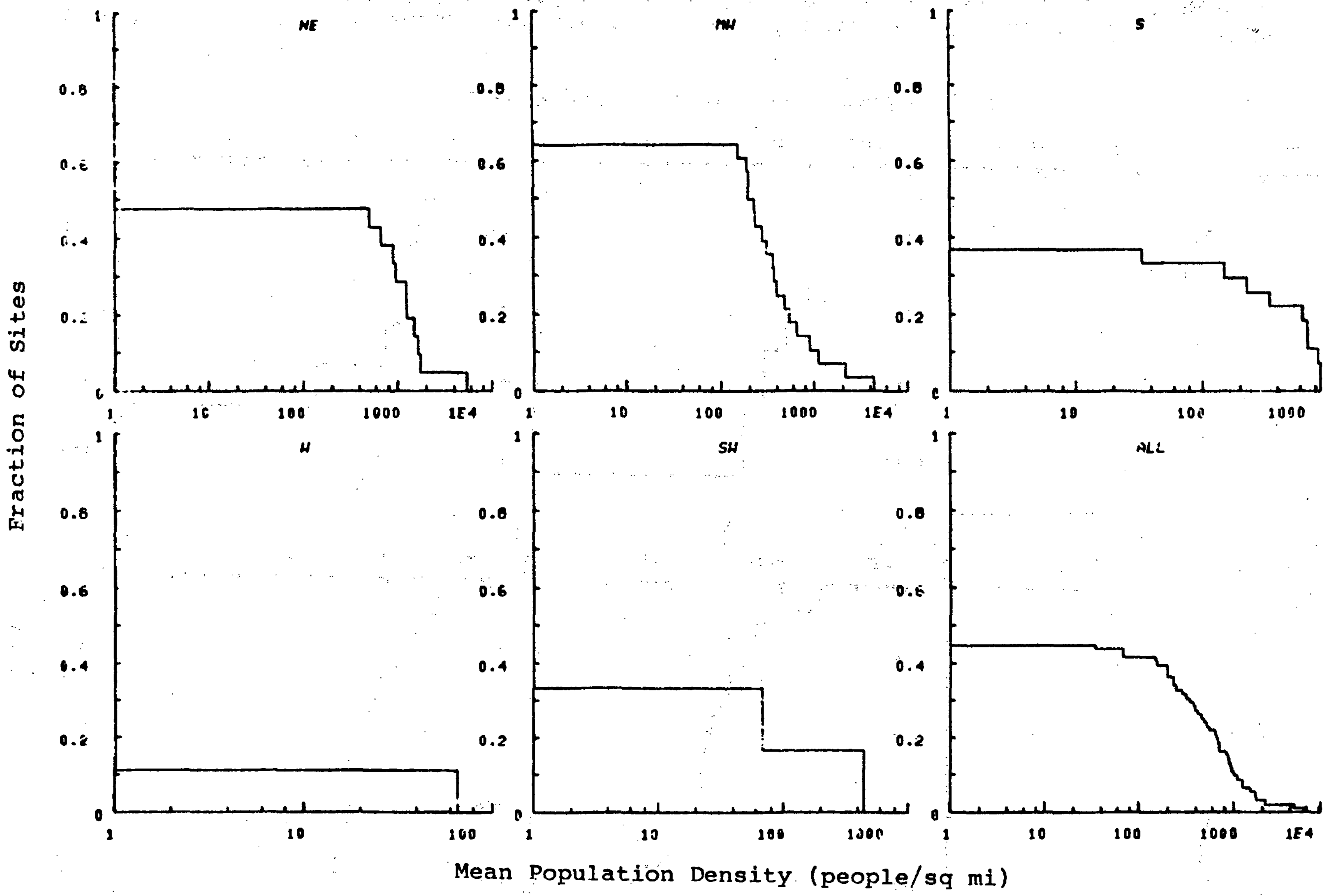

Figure D.1-35. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Radial Distance 0-2 Miles.

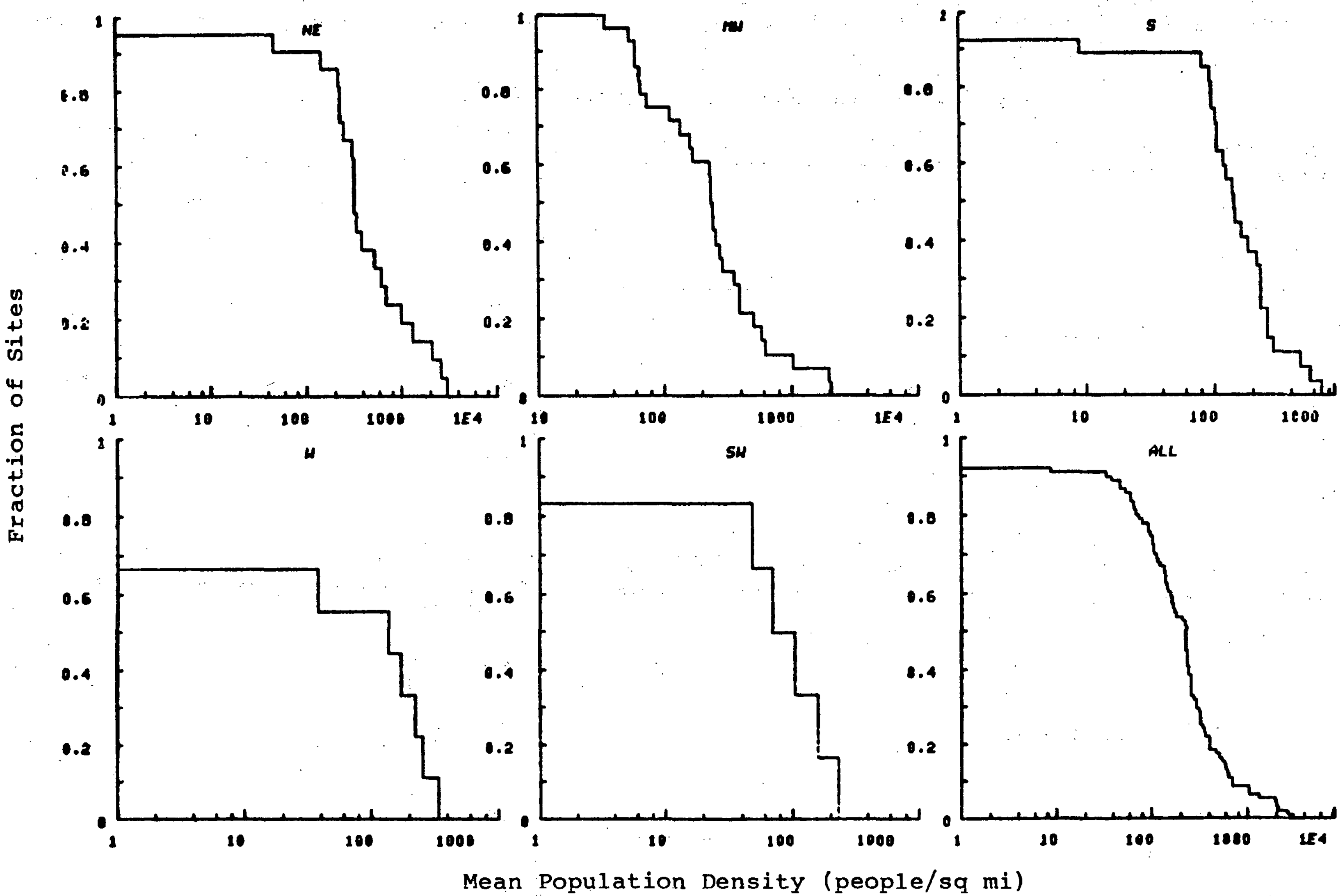

Figure D.1-36. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Radial Distance 0-5 Miles.

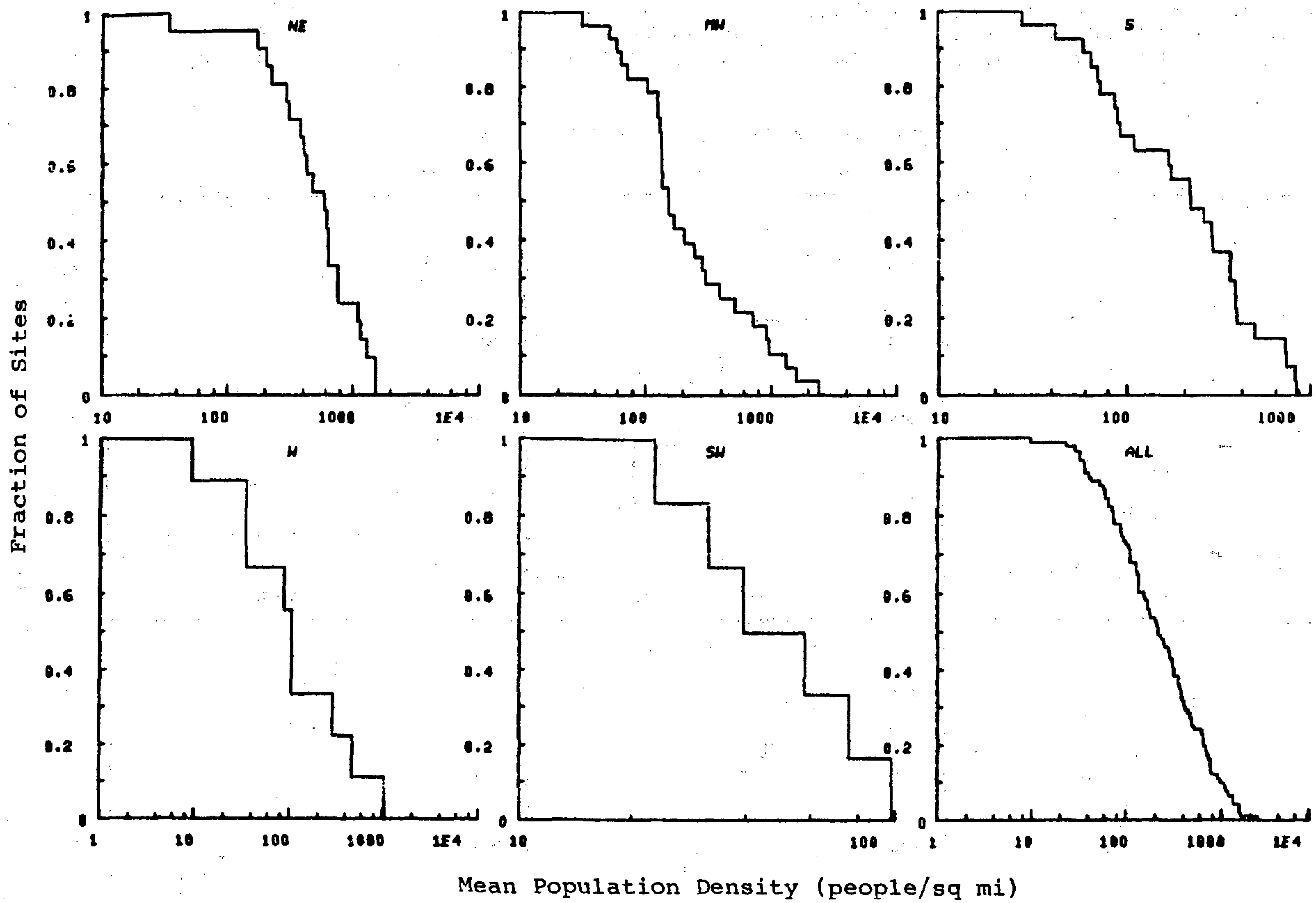

Figure D.1-37. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Radial Distance 0-10 Miles.

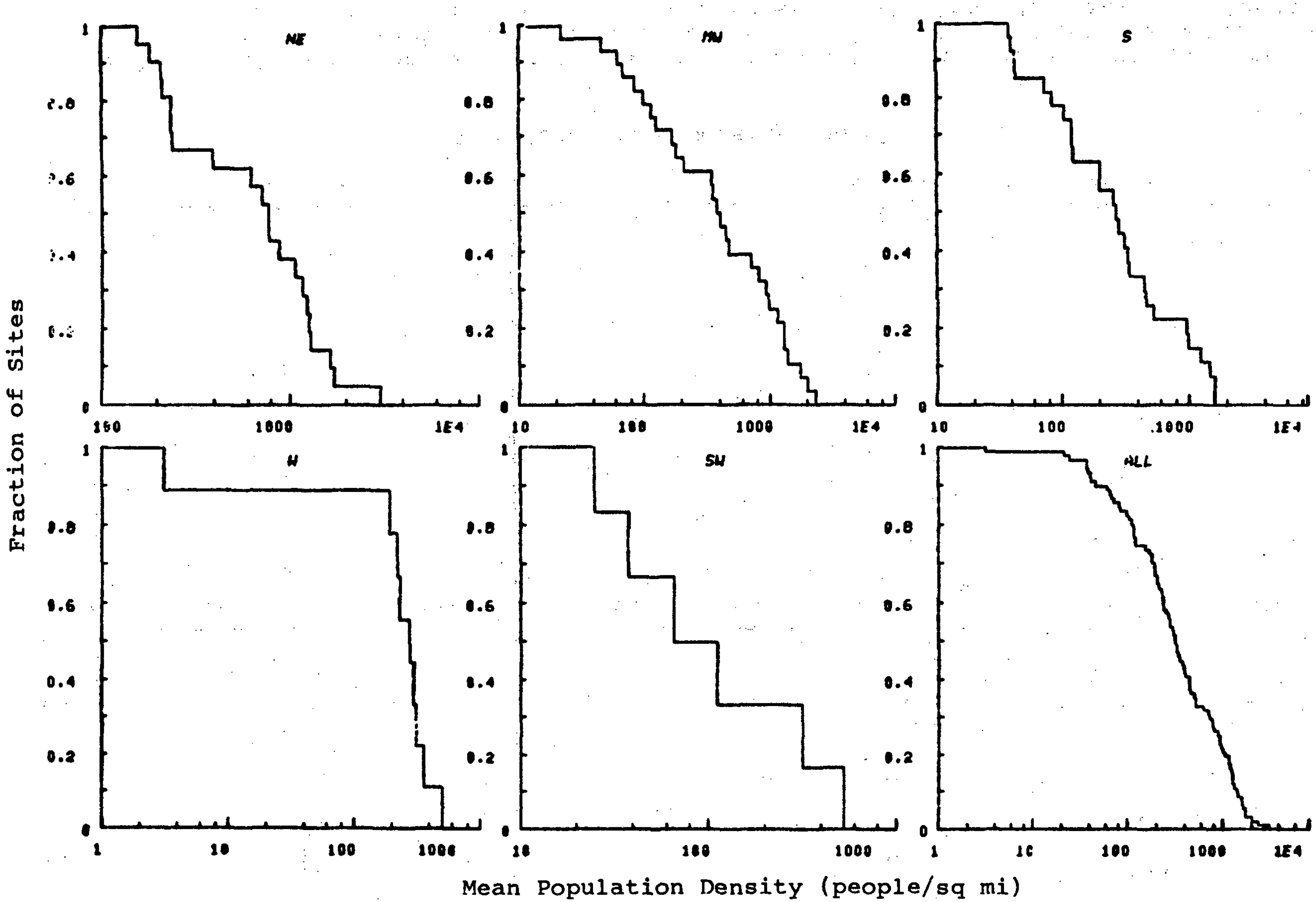

Figure D.1-38. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Radial Distance 0-20 Miles.

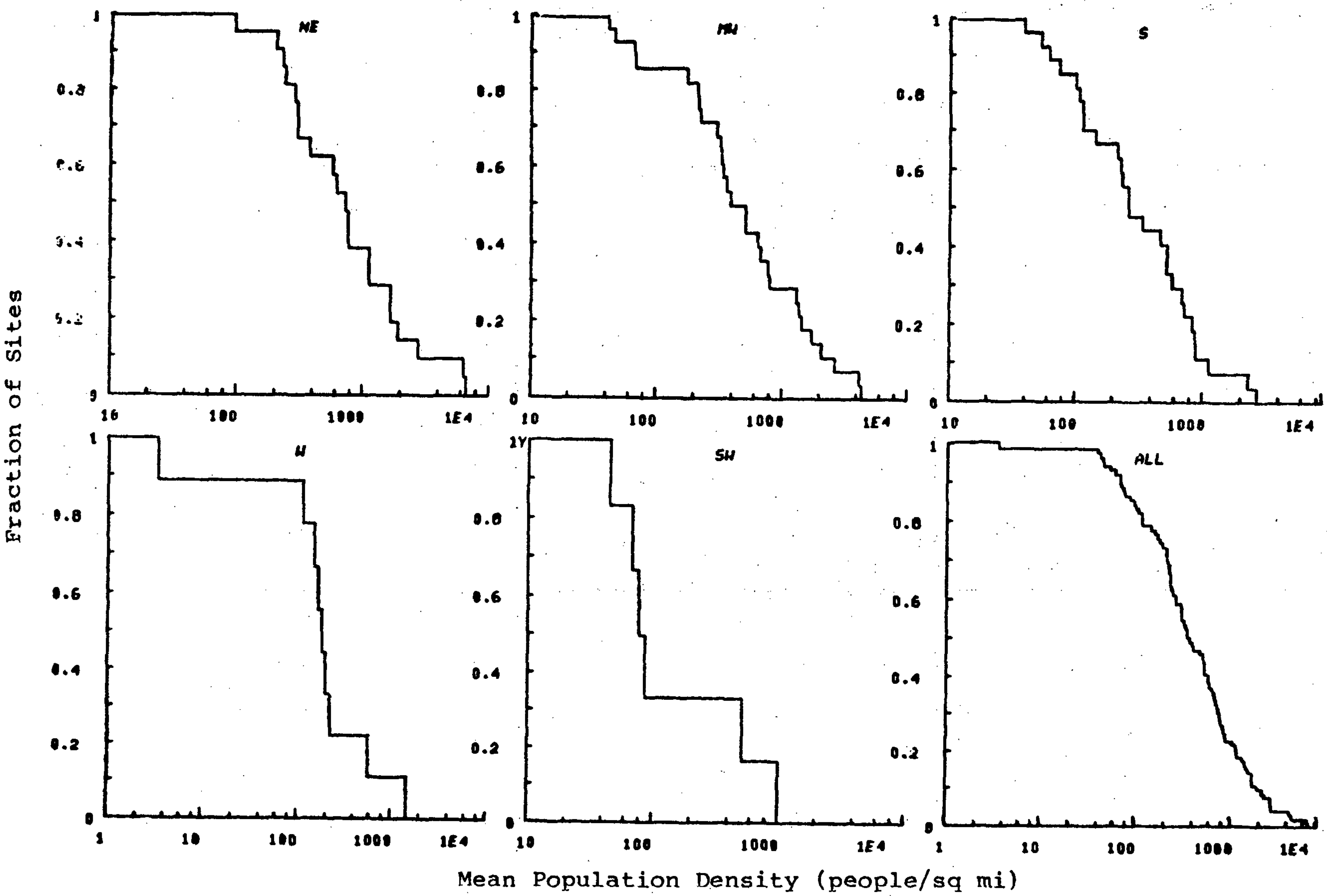

Figure D.1-39. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Radial Distance 0-30 Miles.

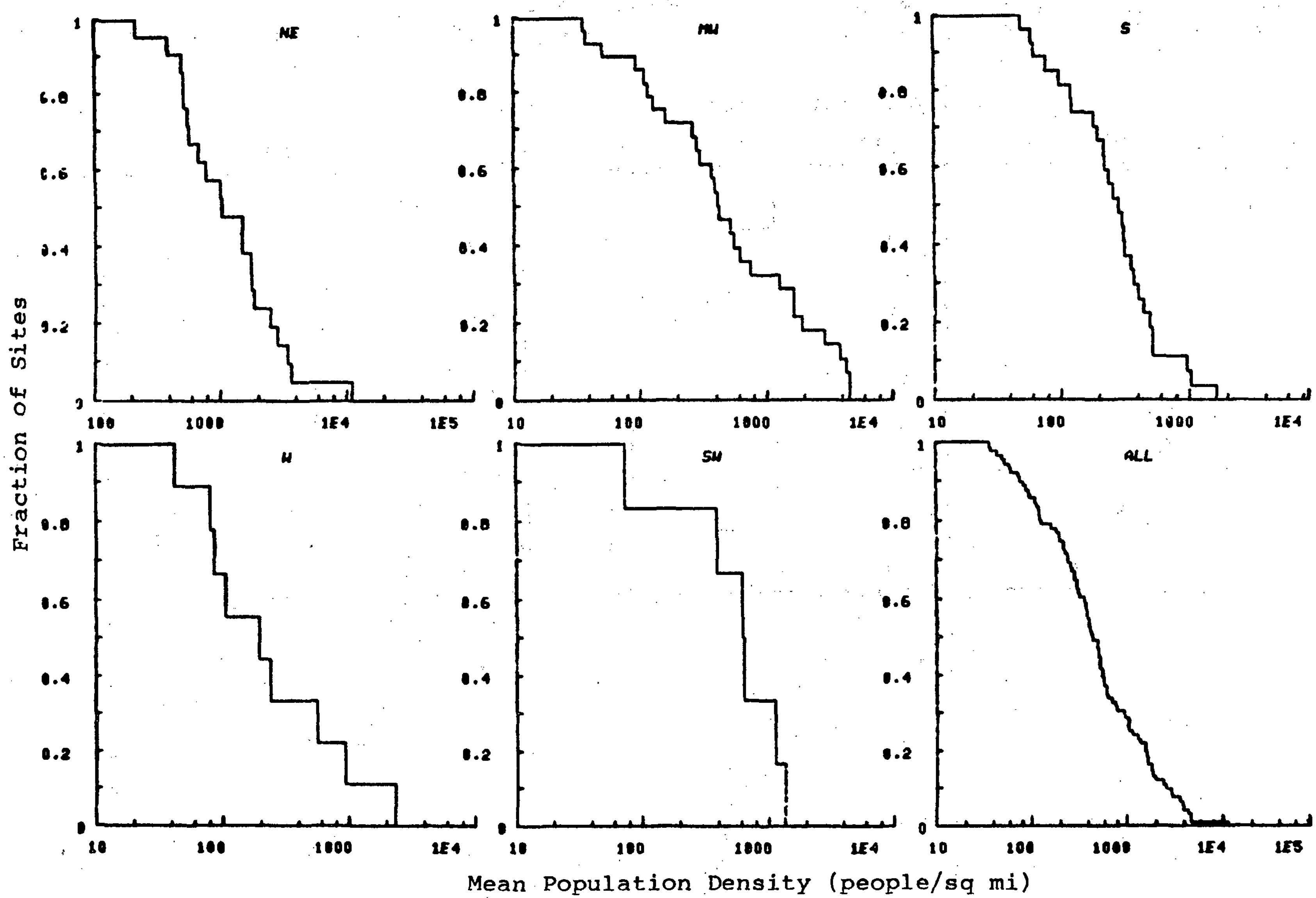

Figure D.1-40. CCDFs of Population Density (people/sq mi) at 91 Reactor Sites for the Five NRC Administrative Regions (NE, MW, S, W, SW) and for All Regions Combined (All): Population Density Within the Most Populated 45° Sector (two adjacent 22.5° sectors) of the Radial Distance 0-50 Miles.

TABLE D.1-1

POPULATION DENSITIES (PEOPLE PER SQ. MI.) FOR 91 REACTOR SITES
INNER AND OUTER ANNULAR RADII ARE GIVEN IN MILES

	SITE	0-5	5-10	10-20	20-30	30-50	50-100	100-200
1	ALLENS CREEK	31	21	30	39	286	48	35
2	ARKANSAS 1 + 2	58	83	26	16	15	42	47
3	BAILLY S	271	283	534	1024	906	145	134
4	BEAVER VALLEY 1 + 2	160	565	342	787	403	210	139
5	BELLEFONTE 1	21	89	30	41	147	87	76
6	BIG ROCK POINT	54	14	27	9	16	11	39
7	BLACK FOX	29	10	147	234	36	38	35
8	BRAIDWOOD 1	127	53	79	168	700	258	111
9	BROWNS FERRY 1, 2, +	12	121	88	98	71	76	80
10	BRUNSWICK 1 + 2	31	25	62	26	13	40	48
11	BYRON 1	83	59	250	127	85	439	74
12	CALLAWAY	8	12	32	87	24	123	56
13	CALVERT CLIFF 1 + 2	34	52	55	51	456	201	167
14	CATAWBA 1	49	237	431	154	107	116	73
15	CHEROKEE	48	113	113	220	162	95	91
16	CLINTON	18	46	36	168	79	68	188
17	COMMANCHE PEAK	20	20	7	33	142	94	30
18	COOK DC 1 + 2	93	157	115	226	117	418	169
19	COOPER S	14	22	19	22	22	70	40
20	CRYSTAL RIVER	15	30	11	8	31	89	25
21	DAVIS-BE 1	31	55	89	380	212	350	158
22	DIABLO CANYON 1 + 2	0	30	69	32	17	13	151
23	DRESDEN 2 + 3	68	118	199	259	1157	156	108
24	DUANE ARNOLD	50	346	42	37	54	58	94
25	FARLEY 1 + 2	22	29	71	27	41	48	55
26	FERMI 2	126	259	386	1254	562	194	125
27	FITZPATRICK	29	150	50	72	129	79	67
28	FORKED RIVER 1	76	131	146	176	565	875	148
29	FORT CALHOUN	101	25	312	182	23	34	42
30	FORT ST VRAIN	9	35	143	188	192	15	6
31	R. E. GINNA	77	124	611	143	67	114	52
32	GRAND GULF 1	16	28	19	40	40	49	57
33	HADDEM NECK	113	211	473	803	305	822	158
34	HARTSVILLE	44	37	61	46	148	46	83
35	HATCH, E.I. 1 + 2	13	20	38	28	33	41	64
36	INDIAN PT 2 + 3	752	617	732	2046	2462	304	196
37	KEWAUNEE	21	33	80	99	66	84	139
38	LASALLE 1 + 2	12	53	90	75	140	391	118
39	LA CROSSE	13	22	89	34	35	55	106
40	LIMERICK 1	792	381	668	1877	619	705	169
41	MARBLE HILL	88	44	301	379	67	141	104
42	ME YANKEE	0	6	36	63	45	18	82
43	MCGUIRE 1 + 2	64	137	505	193	113	111	73
44	MIDLAND 2	535	87	289	85	109	185	97
45	MILLSTONE 1 + 2	582	284	167	102	410	624	204
46	MONTICELLO	67	38	45	155	340	35	26

TABLE D.1-1 (cont'd)

SITE	0-5	5-10	10-20	20-30	30-50	50-100	100-200
47 NINE M. PT. 1 + 2	29	150	50	72	129	79	67
48 NORTH ANNA 1, 2, + 3	12	28	29	58	146	183	161
49 OCONEE 1, 2 + 3	42	176	68	163	72	77	94
50 OYSTER CREEK	76	131	146	176	565	875	148
51 PALISADE	70	106	92	58	158	423	148
52 PALO VERDE 1	6	7	8	7	122	18	8
53 PEACH BOTTOM 2 + 3	44	96	246	362	659	428	263
54 PEBBLE SPRINGS	5	2	0	2	15	15	48
55 PERKINS	79	109	203	251	172	96	78
56 PERRY 1	224	230	178	296	374	135	170
57 PHIPPS BEND	82	57	128	98	78	78	92
58 PILGRIM 1	119	85	132	407	699	110	194
59 POINT BEACH 1 + 2	30	80	63	88	70	90	139
60 PRAIRIE 1 + 2	60	67	51	114	358	46	34
61 QUAD CITIES 1 + 2	18	64	313	77	47	85	150
62 RANCHO SECO	22	29	133	492	93	210	16
63 RIVERBEND 1	49	74	86	176	43	92	34
64 H. B. ROBINSON 2	97	75	50	75	77	98	68
65 SAINT LUCIE 1	71	160	34	29	41	58	38
66 SALEM 1 + 2	45	102	334	348	778	410	249
67 SAN ONOFRE	18	103	183	134	632	314	11
68 SEABROOK 1	120	88	89	64	272	129	16
69 SEQUOYAH 1 + 2	108	115	303	71	51	82	89
70 SHEARON HARRIS	23	69	168	205	109	97	74
71 SHOREHAM	135	146	347	847	699	714	173
72 SKAGIT	49	52	34	66	43	74	9
73 SOUTH TEXAS	0	10	25	11	26	94	31
74 VIRGIL C. SUMMER	1	43	47	194	67	110	84
75 SURRY ST 1 + 2	26	253	185	194	212	40	111
76 SUSQUEHANNA 1	188	130	330	178	172	378	354
77 THREE MILE ISLAND	320	470	499	248	168	506	281
78 TROJAN	104	197	50	52	190	48	26
79 TURKEY POINT 1 + 2	0	164	179	437	152	26	8
80 VERMONT YANKEE 1	102	79	99	68	217	363	236
81 VOGTLE	0	8	26	162	35	58	79
82 WATERFORD 3	181	119	282	490	91	40	27
83 WATTS BAR 1 + 2	22	31	61	68	101	61	103
84 WPPSS1+4	0	6	69	22	16	14	43
85 WPPSS 3 + 5	28	24	46	53	49	86	20
86 WPPSS 2	0	6	61	27	16	14	43
87 WOLF CREEK	34	4	9	32	21	97	35
88 YANKEE ROWE	12	88	84	129	255	311	261
89 YELLOW CREEK	15	32	42	35	49	66	65
90 ZIMMER 1	53	87	203	622	126	156	105
91 ZION	538	697	347	484	1130	196	83

TABLE D.1-2

CUMMULATIVE POPULATION DENSITIES (PEOPLE PER SQ. MI.) FOR 91 REACTOR SITES, CIRCLE RADII ARE GIVEN IN MILES

	SITE	0-5	0-10	0-20	0-30	0-50	0-100	0-200
1	ALLENS CREEK	31	23	28	35	196	85	48
2	ARKANSAS 1 + 2	58	77	39	26	19	37	44
3	BAILLY S	271	280	471	778	860	324	182
4	BEAVER VALLEY 1 + 2	160	464	373	603	475	277	174
5	BELLEFONTE 1	21	72	41	41	109	92	80
6	BIG ROCK POINT	54	24	26	16	16	12	32
7	BLACK FOX	29	15	114	181	88	51	39
8	BRAIDWOOD 1	127	72	77	128	494	317	163
9	BROWNS FERRY 1, 2, +	12	94	89	94	80	77	80
10	BRUNSWICK 1 + 2	31	26	53	38	22	36	45
11	BYRON 1	83	65	204	161	112	357	145
12	CALLAWAY	8	11	27	61	37	102	67
13	CALVERT CLIFF 1 + 2	34	48	53	52	310	229	182
14	CATAWBA 1	49	190	371	250	159	126	87
15	CHEROKEE	48	97	109	171	165	113	96
16	CLINTON	18	39	37	109	90	74	159
17	COMMANCHE PEAK	20	20	10	23	99	95	46
18	COOK DC 1 + 2	93	141	122	180	139	349	214
19	COOPER S	14	20	19	21	22	58	44
20	CRYSTAL RIVER	15	26	15	11	24	73	37
21	DAVIS-BE 1	31	49	79	246	225	318	198
22	DIABLO CANYON 1 + 2	0	22	57	43	27	17	117
23	DRESDEN 2 + 3	68	105	176	222	821	322	162
24	DUANE ARNOLD	50	272	100	65	58	58	85
25	FARLEY 1 + 2	22	27	60	42	41	46	53
26	FERMI 2	126	226	346	851	666	312	172
27	FITZPATRICK	29	119	67	70	107	86	72
28	FORKED RIVER 1	76	117	139	160	419	761	301
29	FORT CALHOUN	101	44	245	210	91	48	43
30	FORT ST VRAIN	9	29	114	155	179	56	19
31	R. E. GINNA	77	112	486	295	149	123	70
32	GRAND GULF 1	16	25	20	31	37	46	54
33	HADDEM NECK	113	187	401	624	420	722	299
34	HARTSVILLE	44	39	55	50	113	62	78
35	HATCH, E.I. 1 + 2	13	18	33	31	32	39	58
36	INDIAN PT 2 + 3	752	651	711	1453	2099	752	335
37	KEWAUNEE	21	30	68	85	73	81	124
38	LASALLE 1 + 2	12	42	78	76	117	322	169
39	LA CROSSE	13	20	71	51	41	51	92
40	LIMERICK 1	792	483	622	1319	871	746	313
41	MARBLE HILL	88	55	240	317	157	145	115
42	ME YANKEE	0	4	28	47	46	25	68
43	MCGUIRE 1 + 2	64	119	408	289	176	128	87
44	MIDLAND 2	535	199	266	166	129	171	116
45	MILLSTONE 1 + 2	582	359	215	152	317	547	290
46	MONTICELLO	67	45	45	106	256	90	42

TABLE D.1-2 (cont'd)

	SITE	0-5	0-10	0-20	0-30	0-50	0-100	0-200
47	NINE M. PT. 1 + 2	29	119	67	70	107	86	72
48	NORTH ANNA 1, 2, + 3	12	24	28	44	109	165	162
49	OCONEE 1, 2 + 3	42	142	87	129	93	81	91
50	OYSTER CREEK	76	117	139	160	419	761	301
51	PALISADE	70	97	93	74	128	349	198
52	PALO VERDE 1	6	7	8	7	81	34	14
53	PEACH BOTTOM 2 + 3	44	83	205	292	527	452	311
54	PEBBLE SPRINGS	5	3	1	2	10	14	40
55	PERKINS	79	102	178	219	189	119	88
56	PERRY 1	224	228	190	249	329	183	173
57	PHIPPS BEND	82	63	112	104	87	80	89
58	PILGRIM 1	119	94	122	280	548	220	201
59	POINT BEACH 1 + 2	30	67	64	77	73	85	126
60	PRAIRIE 1 + 2	60	65	55	88	261	100	51
61	QUAD CITIES 1 + 2	18	53	248	153	85	85	134
62	RANCHO SECO	22	27	107	321	175	201	63
63	RIVERBEND 1	49	68	81	134	76	88	47
64	H. B. ROBINSON 2	97	80	58	67	73	92	74
65	SAINT LUCIE 1	71	138	60	43	42	54	42
66	SALEM 1 + 2	45	88	272	314	611	460	302
67	SAN ONOFRE	18	82	158	144	456	350	96
68	SEABROOK 1	120	96	91	76	202	147	49
69	SEQUOYAH 1 + 2	108	113	255	153	88	83	87
70	SHEARON HARRIS	23	58	141	176	133	106	82
71	SHOREHAM	135	144	296	602	664	702	305
72	SKAGIT	49	51	38	54	47	67	23
73	SOUTH TEXAS	0	7	21	15	22	76	42
74	VIRGIL C. SUMMER	1	33	43	127	89	105	89
75	SURRY ST 1 + 2	26	196	188	191	204	81	104
76	SUSQUEHANNA 1	188	144	284	225	191	331	348
77	THREE MILE ISLAND	320	433	483	352	234	438	321
78	TROJAN	104	174	81	65	145	72	37
79	TURKEY POINT 1 + 2	0	123	165	316	211	72	24
80	VERMONT YANKEE 1	102	84	95	80	168	314	255
81	VOGTLE	0	6	21	99	58	58	73
82	WATERFORD 3	181	135	245	381	195	79	40
83	WATTS BAR 1 + 2	22	29	53	61	87	68	94
84	WPPSS1+4	0	4	53	36	23	16	36
85	WPPSS 3 + 5	28	25	41	48	48	77	34
86	WPPSS 2	0	4	47	36	23	16	36
87	WOLF CREEK	34	11	10	22	21	78	46
88	YANKEE ROWE	12	69	81	107	202	283	267
89	YELLOW CREEK	15	28	39	37	44	60	64
90	ZIMMER 1	53	78	172	422	232	175	122
91	ZION	538	657	424	457	888	369	154

TABLE D.1-3

POPULATION DENSITIES (PEOPLE PER SQ. MI.) IN
MOST POPULATED 22.5° SECTOR OF EACH ANNULUS

SITE	0-5MI	5-10MI	10-20MI	20-30MI
1 ALLENS CREEK	209.4	182.3	130.8	153.1
2 ARKANSAS 1 + 2	364.2	676.5	112.0	69.4
3 BAILLY S	1123.1	1650.5	4113.3	9294.1
4 BEAVER VALLEY 1 + 2	1073.8	2108.9	1003.9	6199.0
5 BELLEFONTE 1	199.6	420.6	89.1	79.7
6 BIG ROCK POINT	716.9	48.9	160.5	28.7
7 BLACK FOX	267.3	81.0	1148.5	2232.1
8 BRAIDWOOD 1	619.3	283.1	409.3	1462.9
9 BROWNS FERRY 1, 2, + 3	189.1	814.7	502.6	730.4
10 BRUNSWICK 1 + 2	452.3	112.9	809.6	254.8
11 BYRON 1	356.3	173.8	2191.8	355.3
12 CALLAWAY	129.8	57.3	161.8	557.6
13 CALVERT CLIFF 1 + 2	293.4	240.3	220.0	171.7
14 CATAWBA 1	263.0	1613.2	2719.9	607.2
15 CHEROKEE	276.9	981.9	448.0	807.3
16 CLINTON	107.8	287.3	83.1	1001.1
17 COMMANCHE PEAK	316.6	88.5	29.2	183.6
18 COOK DC 1 + 2	335.3	1053.0	474.3	1930.4
19 COOPER S	54.2	108.6	63.1	83.7
20 CRYSTAL RIVER	235.3	164.5	51.7	52.6
21 DAVIS-BE 1	337.6	318.3	417.2	2358.0
22 DIABLO CANYON 1 + 2	0.0	175.2	566.8	295.7
23 DRESDEN 2 + 3	332.7	359.6	2023.6	1093.6
24 DUANE ARNOLD	269.1	2488.4	102.4	86.2
25 FARLEY 1 + 2	160.7	134.5	619.9	46.1
26 FERMI 2	586.9	1364.6	2637.4	6556.7
27 FITZPATRICK	468.3	1758.1	310.2	599.6
28 FORKED RIVER 1	458.6	858.5	847.5	1029.9
29 FORT CALHOUN	976.8	239.0	3212.8	1593.9
30 FORT ST VRAIN	139.1	120.7	574.2	965.4
31 R. E. GINNA	692.2	515.3	5883.2	700.6
32 GRAND GULF 1	207.8	168.7	60.7	301.1
33 HADDEM NECK	789.6	881.2	1725.3	2730.1
34 HARTSVILLE	456.9	79.6	274.1	160.2
35 HATCH, E.I. 1 + 2	210.4	112.9	136.1	61.5
36 INDIAN PT 2 + 3	2513.7	1916.9	2363.0	14617.9
37 KEWAUNEE	225.1	197.0	814.8	1292.6
38 LASALLE 1 + 2	122.2	192.5	383.3	337.7
39 LA CROSSE	148.3	68.0	891.6	160.7
40 LIMERICK 1	4232.5	1340.1	2167.5	12296.5
41 MARBLE HILL	649.0	166.2	2318.0	3443.4
42 ME YANKEE	0.0	50.9	218.8	683.2
43 MCGUIRE 1 + 2	388.5	425.8	3096.1	433.5
44 MIDLAND 2	2006.6	276.6	2221.0	304.1
45 MILLSTONE 1 + 2	3739.0	1369.8	865.4	251.1
46 MONTICELLO	456.3	190.9	98.2	621.0

TABLE D.1-3 (cont'd)

	SITE	0-5MI	5-10MI	10-20MI	20-30MI
47	NINE M. PT. 1 + 2	468.3	1758.1	310.2	599.6
48	NORTH ANNA 1, 2, + 3	187.2	98.5	57.2	294.6
49	OCONEE 1, 2 + 3	215.1	821.7	277.7	920.6
50	OYSTER CREEK	458.6	858.5	847.5	1029.9
51	PALISADE	415.8	460.0	944.2	220.5
52	PALO VERDE 1	69.7	53.2	75.4	88.1
53	PEACH BOTTOM 2 + 3	290.1	255.2	1292.9	1092.9
54	PEBBLE SPRINGS	76.4	21.2	5.3	8.6
55	PERKINS	458.8	314.9	675.8	810.2
56	PERRY 1	811.4	1561.6	899.0	3837.3
57	PHIPPS BEND	265.9	287.9	915.8	557.4
58	PILGRIM 1	886.6	611.8	413.4	1773.1
59	POINT BEACH 1 + 2	355.1	876.7	617.3	625.4
60	PRAIRIE 1 + 2	280.3	596.8	219.0	866.5
61	QUAD CITIES 1 + 2	109.8	240.1	1937.6	383.8
62	RANCHO SECO	348.6	101.5	573.9	3087.3
63	RIVERBEND 1	295.8	298.9	440.0	1673.5
64	H. B. ROBINSON 2	525.0	523.0	198.9	262.9
65	SAINT LUCIE 1	947.7	1350.3	221.0	303.3
66	SALEM 1 + 2	626.6	601.1	2014.0	1568.1
67	SAN ONOFRE	280.9	887.1	1061.9	1252.7
68	SEABROOK 1	540.7	469.8	548.7	453.3
69	SEQUOYAH 1 + 2	294.2	372.0	1900.2	274.7
70	SHEARON HARRIS	190.5	242.8	721.1	1106.3
71	SHOREHAM	805.7	816.3	1589.7	3219.4
72	SKAGIT	288.3	525.8	207.1	502.3
73	SOUTH TEXAS	0.0	61.4	265.7	53.3
74	VIRGIL C. SUMMER	17.7	99.8	206.9	1956.7
75	SURRY ST 1 + 2	244.5	1751.9	1320.4	1521.0
76	SUSQUEHANNA 1	1309.7	561.9	2560.7	869.8
77	THREE MILE ISLAND	2157.0	2319.5	1622.8	1158.4
78	TROJAN	365.9	2151.1	176.8	582.6
79	TURKEY POINT 1 + 2	0.0	1289.1	2107.5	4119.7
80	VERMONT YANKEE 1	507.7	532.1	361.2	350.6
81	VOGTLE	0.0	74.4	76.9	991.7
82	WATERFORD 3	880.3	452.7	3399.3	5068.1
83	WATTS BAR 1 + 2	203.1	98.3	248.0	163.3
84	WPPSS1+4	0.0	95.1	581.8	158.1
85	WPPSS 3 + 5	453.7	193.3	540.7	225.5
86	WPPSS 2	0.0	95.1	538.3	197.7
87	WOLF CREEK	427.6	21.5	16.8	225.3
88	YANKEE ROWE	95.5	705.1	286.1	670.6
89	YELLOW CREEK	132.2	101.6	262.6	102.3
90	ZIMMER 1	325.9	180.0	949.5	5331.2
91	ZION	2040.9	4367.4	1665.5	3344.7

TABLE D.1-4

POPULATION DENSITIES (PEOPLE PER SQ. MI.) IN
MOST POPULATED 22.5° SECTOR OF EACH CIRCLE

SITE	0-5MI	0-10MI	0-20MI	0-30MI
1 ALLENS CREEK	209.4	136.7	98.1	128.6
2 ARKANSAS 1 + 2	364.2	598.4	194.6	125.1
3 BAILLY S	1123.1	1355.6	3423.9	5163.4
4 BEAVER VALLEY 1 + 2	1073.8	1594.2	903.2	3845.3
5 BELLEFONTE 1	199.6	335.6	107.7	80.5
6 BIG ROCK POINT	716.9	215.9	132.2	66.2
7 BLACK FOX	267.3	66.8	861.4	1622.9
8 BRAIDWOOD 1	619.3	218.8	316.7	878.7
9 BROWNS FERRY 1, 2, + 3	189.1	611.1	529.7	427.3
10 BRUNSWICK 1 + 2	452.3	113.1	607.2	411.4
11 BYRON 1	356.3	162.6	1656.5	889.0
12 CALLAWAY	129.8	43.0	129.7	341.3
13 CALVERT CLIFF 1 + 2	293.4	229.0	210.1	109.3
14 CATAWBA 1	263.0	1209.9	2075.7	1259.9
15 CHEROKEE	276.9	736.4	361.2	501.1
16 CLINTON	107.8	215.5	72.2	572.2
17 COMMANCHE PEAK	316.6	79.1	38.5	102.0
18 COOK DC 1 + 2	335.3	867.9	572.7	1141.4
19 COOPER S	54.2	90.3	63.3	56.5
20 CRYSTAL RIVER	235.3	123.4	53.5	41.4
21 DAVIS-BE 1	337.6	238.7	327.8	1367.2
22 DIABLO CANYON 1 + 2	0.0	131.4	441.6	201.4
23 DRESDEN 2 + 3	332.7	269.7	1538.2	876.8
24 DUANE ARNOLD	269.1	1922.2	505.8	241.8
25 FARLEY 1 + 2	160.7	100.8	475.8	231.4
26 FERMI 2	586.9	1073.2	2069.3	4507.6
27 FITZPATRICK	468.3	1318.6	362.0	365.6
28 FORKED RIVER 1	458.6	758.5	825.3	939.0
29 FORT CALHOUN	976.8	244.2	2417.8	1960.0
30 FORT ST VRAIN	139.1	90.6	430.7	553.9
31 R. E. GINNA	692.2	386.5	4507.8	2392.7
32 GRAND GULF 1	207.8	178.5	51.8	183.1
33 HADDEM NECK	789.6	660.9	1439.7	2009.7
34 HARTSVILLE	456.9	114.2	205.6	155.2
35 HATCH, E.I. 1 + 2	210.4	84.7	102.1	61.2
36 INDIAN PT 2 + 3	2513.7	1627.5	2161.0	8684.2
37 KEWAUNEE	225.1	147.7	618.5	735.8
38 LASALLE 1 + 2	122.2	144.4	301.9	228.0
39 LA CROSSE	148.3	53.7	682.1	392.5
40 LIMERICK 1	4232.5	1343.5	1758.1	7511.8
41 MARBLE HILL	649.0	184.6	1753.1	2692.1
42 ME YANKEE	0.0	38.1	173.6	404.3
43 MCGUIRE 1 + 2	388.5	319.4	2386.1	1301.3
44 MIDLAND 2	2006.6	549.1	1718.5	911.8
45 MILLSTONE 1 + 2	3739.0	1962.1	877.7	485.5
46 MONTICELLO	456.3	143.2	86.2	368.5

TABLE D.1-4 (cont'd)

	SITE	0-5MI	0-10MI	0-20MI	0-30MI
47	NINE M. PT. 1 + 2	468.3	1318.6	362.0	365.6
48	NORTH ANNA 1, 2, + 3	187.2	73.9	47.0	178.5
49	OCONEE 1, 2 + 3	215.1	629.3	235.0	611.8
50	OYSTER CREEK	458.6	758.5	825.3	939.0
51	PALISADE	415.8	448.9	741.4	452.0
52	PALO VERDE 1	69.7	57.3	56.5	74.1
53	PEACH BOTTOM 2 + 3	290.1	191.4	969.7	841.6
54	PEBBLE SPRINGS	76.4	19.1	6.4	5.2
55	PERKINS	458.8	291.7	529.3	651.1
56	PERRY 1	811.4	1276.5	993.4	2573.3
57	PHIPPS BEND	265.9	215.9	688.3	374.3
58	PILGRIM 1	886.6	584.3	456.1	1155.4
59	POINT BEACH 1 + 2	355.1	657.6	627.4	362.0
60	PRAIRIE 1 + 2	280.3	496.1	171.2	557.5
61	QUAD CITIES 1 + 2	109.8	180.1	1456.3	860.5
62	RANCHO SECO	348.6	146.1	430.4	1814.3
63	RIVERBEND 1	295.8	231.9	335.1	1078.7
64	H. B. ROBINSON 2	525.0	523.5	280.0	270.5
65	SAINT LUCIE 1	947.7	1012.7	419.0	230.7
66	SALEM 1 + 2	626.6	450.8	1511.5	1543.0
67	SAN ONOFRE	280.9	735.6	796.4	951.5
68	SEABROOK 1	540.7	352.3	475.5	344.2
69	SEQUOYAH 1 + 2	294.2	283.0	1456.0	799.7
70	SHEARON HARRIS	190.5	182.1	580.4	647.5
71	SHOREHAM	805.7	813.7	1289.1	2361.5
72	SKAGIT	288.3	451.5	201.2	301.2
73	SOUTH TEXAS	0.0	46.0	199.3	98.3
74	VIRGIL C. SUMMER	17.7	74.9	173.9	1091.1
75	SURRY ST 1 + 2	244.5	1313.9	1318.8	1164.1
76	SUSQUEHANNA 1	1309.7	748.9	1979.1	1362.8
77	THREE MILE ISLAND	2157.0	1758.2	1656.6	824.4
78	TROJAN	365.9	1618.7	480.5	382.6
79	TURKEY POINT 1 + 2	0.0	966.8	1628.8	2316.4
80	VERMONT YANKEE 1	507.7	526.0	270.9	261.4
81	VOGTLE	0.0	55.8	57.7	559.2
82	WATERFORD 3	880.3	426.9	2618.1	3979.2
83	WATTS BAR 1 + 2	203.1	124.5	186.0	127.9
84	WPPSS1+4	0.0	71.4	436.3	281.7
85	WPPSS 3 + 5	453.7	145.0	405.5	196.8
86	WPPSS 2	0.0	71.4	403.7	289.3
87	WOLF CREEK	427.6	123.0	39.7	129.5
88	YANKEE ROWE	95.5	528.8	223.7	464.0
89	YELLOW CREEK	132.2	76.2	213.0	107.0
90	ZIMMER 1	325.9	162.0	747.0	3264.5
91	ZION	2040.9	3779.5	1724.0	2349.3

D.2 Exclusion Distances

Table D.2-1 presents the distance to the closest boundary of the exclusion zone surrounding each of the 91 reactor sites, discussed in Chapter 2 and Appendix A. The variability of these distances is displayed in Figure 3-2 in Chapter 3.

TABLE D.2-1

EXCLUSION DISTANCES (MILES) FOR 91 REACTOR SITES

	SITE	EX. DIST.
1	ALLENS CREEK	0.82
2	ARKANSAS 1 + 2	0.65
3	BAILLY S	0.12
4	BEAVER VALLEY 1 + 2	0.38
5	BELLEFONTE 1	0.57
6	BIG ROCK POINT	0.51
7	BLACK FOX	0.53
8	BRAIDWOOD 1	0.28
9	BROWNS FERRY 1, 2, + 3	0.76
10	BRUNSWICK 1 + 2	0.57
11	BYRON 1	0.29
12	CALLAWAY	0.68
13	CALVERT CLIFF 1 + 2	0.71
14	CATAWBA 1	0.47
15	CHEROKEE	0.37
16	CLINTON	0.61
17	COMMANCHE PEAK	0.87
18	COOK DC 1 + 2	0.38
19	COOPER S	0.46
20	CRYSTAL RIVER	0.83
21	DAVIS-BE 1	0.39
22	DIABLO CANYON 1 + 2	0.50
23	DRESDEN 2 + 3	0.42
24	DUANE ARNOLD	0.27
25	FARLEY 1 + 2	0.78
26	FERMI 2	0.57
27	FITZPATRICK	0.61
28	FORKED RIVER 1	0.38
29	FORT CALHOUN	0.23
30	FORT ST VRAIN	0.37
31	R. E. GINNA	0.28
32	GRAND GULF 1	0.47
33	HADDEM NECK	0.33
34	HARTSVILLE	0.76
35	HATCH, E.I. 1 + 2	0.78
36	INDIAN PT 2 + 3	0.21
37	KEWAUNEE	0.75
38	LASALLE 1 + 2	0.32
39	LA CROSSE	0.21
40	LIMERICK 1	0.47
41	MARBLE HILL	0.42
42	ME YANKEE	0.38
43	MCGUIRE 1 + 2	0.47
44	MIDLAND 2	0.31
45	MILLSTONE 1 + 2	0.31

TABLE D.2-1 (cont'd)

SITE	EX. DIST.
46 MONTICELLO	0.30
47 NINE M. PT. 1 + 2	0.97
48 NORTH ANNA 1, 2, + 3	0.84
49 OCONEE 1, 2 + 3	1.00
50 OYSTER CREEK	0.25
51 PALISADE	0.42
52 PALO VERDE 1	0.56
53 PEACH BOTTOM 2 + 3	0.51
54 PEBBLE SPRINGS	0.49
55 PERKINS	0.37
56 PERRY 1	0.57
57 PHIPPS BEND	0.47
58 PILGRIM 1	0.27
59 POINT BEACH 1 + 2	0.75
60 PRAIRIE 1 + 2	0.44
61 QUAD CITIES 1 + 2	0.24
62 RANCHO SECO	0.40
63 RIVERBEND 1	0.57
64 H. B. ROBINSON 2	0.26
65 SAINT LUCIE 1	0.97
66 SALEM 1 + 2	0.72
67 SAN ONOFRE	0.50
68 SEABROOK 1	0.57
69 SEQUOYAH 1 + 2	0.36
70 SHEARON HARRIS	1.33
71 SHOREHAM	0.19
72 SKAGIT	0.38
73 SOUTH TEXAS	0.89
74 VIRGIL C. SUMMER	1.01
75 SURRY ST 1 + 2	0.35
76 SUSQUEHANNA 1	0.35
77 THREE MILE ISLAND	0.38
78 TROJAN	0.41
79 TURKEY POINT 1 + 2	0.79
80 VERMONT YANKEE 1	0.17
81 VOGTLE	0.68
82 WATERFORD 3	0.57
83 WATTS BAR 1 + 2	0.75
84 WPPSS1+4	1.21
85 WPPSS 3 + 5	0.81
86 WPPSS 2	1.21
87 WOLF CREEK	0.75
88 YANKEE ROWE	0.59
89 YELLOW CREEK	0.43
90 ZIMMER 1	0.24
91 ZION	0.57

D.3 Site Population Factors

Table D.3-1 presents the Site Population Factor (SPF_n) and the Wind Rose Weighted Site Population Factor ($WRSPF_n$) for each of the 91 reactor sites discussed in Chapter 2 and Appendix A. For every site, the factors have been calculated for each of the following four distances: 5, 10, 20, and 30 miles. The equations used in these calculations are presented in Section 3.2 of Chapter 3.

Table D.3-1. SITE POPULATION FACTORS (SPF) AND WIND ROSE WEIGHTED SITE POPULATION FACTORS (WRWSPF) FOR 91 REACTOR SITES

SITE NAME	REGION	SPF5	SPF10	SPF20	SPF30	WRSPF5	WRSPF10	WRSPF20	WRSPF30
ALLENS CREEK	SW	.31084E-01	.26170E-01	.27085E-01	.29669E-01	.29167E-01	.28190E-01	.29807E-01	.33529E-01
ARKANSAS 1 + 2	S	.34737E-01	.60184E-01	.48306E-01	.41624E-01	.26405E-01	.60023E-01	.48555E-01	.42815E-01
BAILLY S	MW	.17129E+00	.21447E+00	.33316E+00	.46225E+00	.15890E+00	.24294E+00	.40154E+00	.51750E+00
BEAVER VALLEY 1 + 2	NE	.90963E-01	.25042E+00	.28870E+00	.38618E+00	.76206E-01	.22261E+00	.24205E+00	.34474E+00
BELLEFONTE 1	S	.60386E-01	.72908E-01	.58133E-01	.54642E-01	.68453E-01	.84200E-01	.65040E-01	.59719E-01
BIG ROCK POINT	MW	.32287E-01	.25840E-01	.27861E-01	.23975E-01	.33586E-01	.27221E-01	.27626E-01	.23875E-01
BLACK FOX	SW	.17274E-01	.14603E-01	.55139E-01	.93730E-01	.14052E-01	.13323E-01	.41818E-01	.73356E-01
BRAIDWOOD 1	MW	.13580E+00	.10993E+00	.96933E-01	.11376E+00	.12694E+00	.10149E+00	.88696E-01	.99681E-01
BROWNS FERRY 1, 2, +	S	.79286E-02	.44405E-01	.64588E-01	.70623E-01	.83789E-02	.52503E-01	.78023E-01	.77970E-01
BRUNSWICK 1 + 2	S	.20188E-01	.22260E-01	.32303E-01	.31477E-01	.17567E-01	.22345E-01	.32863E-01	.31882E-01
BYRON 1	MW	.71963E-01	.67722E-01	.11826E+00	.12009E+00	.78011E-01	.73461E-01	.10725E+00	.11010E+00
CALLAWAY	MW	.90153E-02	.10237E-01	.19330E-01	.32205E-01	.51928E-02	.83736E-02	.17588E-01	.28591E-01
CALVERT CLIFF 1 + 2	NE	.19608E-01	.30431E-01	.40544E-01	.42677E-01	.25289E-01	.41027E-01	.55162E-01	.53537E-01
CATAWBA 1	S	.28386E-01	.97801E-01	.20199E+00	.19320E+00	.15367E-01	.58678E-01	.24996E+00	.24078E+00
CHEROKEE	S	.32364E-01	.60843E-01	.74998E-01	.10486E+00	.38806E-01	.82775E-01	.90473E-01	.11931E+00
CLINTON	MW	.19499E-01	.31270E-01	.33278E-01	.62732E-01	.15294E-01	.23542E-01	.29828E-01	.65338E-01
COMMANCHE PEAK	SW	.84912E-02	.12700E-01	.10855E-01	.15435E-01	.20515E-01	.20185E-01	.15354E-01	.17798E-01
COOK DC 1 + 2	MW	.84697E-01	.11303E+00	.11942E+00	.14056E+00	.88946E-01	.10599E+00	.10839E+00	.13656E+00
COOPER S	MW	.10078E-01	.14811E-01	.16822E-01	.17901E-01	.10219E-01	.14122E-01	.15045E-01	.17808E-01
CRYSTAL RIVER	S	.16346E-01	.22168E-01	.18219E-01	.16187E-01	.29057E-01	.30043E-01	.24442E-01	.21577E-01
DAVIS-BE 1	MW	.32672E-01	.40451E-01	.55738E-01	.12140E+00	.56239E-01	.59827E-01	.70913E-01	.12767E+00
DIABLO CANYON 1 + 2	W	.0	.98598E-02	.35215E-01	.34517E-01	.0	.57107E-02	.14153E-01	.18607E-01
DRESDEN 2 + 3	MW	.44720E-01	.67169E-01	.11713E+00	.14378E+00	.42523E-01	.70489E-01	.94596E-01	.11579E+00
DUANE ARNOLD	MW	.39515E-01	.12939E+00	.12819E+00	.10952E+00	.31349E-01	.13590E+00	.13519E+00	.11556E+00
FARLEY 1 + 2	S	.11499E-01	.17446E-01	.33556E-01	.32332E-01	.88854E-02	.15052E-01	.28956E-01	.28465E-01
FERMI 2	MW	.15821E+00	.19137E+00	.24531E+00	.44021E+00	.12502E+00	.17859E+00	.18463E+00	.31792E+00
FITZPATRICK	NE	.19642E-01	.68462E-01	.62453E-01	.63600E-01	.18665E-01	.98174E-01	.83389E-01	.82734E-01
FORKED RIVER 1	NE	.80588E-01	.94443E-01	.11249E+00	.12548E+00	.59297E-01	.72795E-01	.88249E-01	.10273E+00
FORT CALHOUN	MW	.73958E-01	.55546E-01	.12552E+00	.14071E+00	.10434E+00	.73081E-01	.20558E+00	.23105E+00
FORT ST VRAIN	W	.73534E-02	.20285E-01	.63296E-01	.86448E-01	.57651E-02	.21997E-01	.60302E-01	.97050E-01
GINNA R.E.	NE	.47184E-01	.72451E-01	.23521E+00	.21771E+00	.46365E-01	.81548E-01	.33809E+00	.31177E+00
GRAND GULF 1	S	.12290E-01	.19601E-01	.19342E-01	.23405E-01	.13523E-01	.22849E-01	.21192E-01	.24940E-01
HADDEM NECK	NE	.12231E+00	.14928E+00	.24484E+00	.36523E+00	.95413E-01	.19216E+00	.39105E+00	.52525E+00
HARTSVILLE	S	.21557E-01	.26881E-01	.37927E-01	.39203E-01	.20832E-01	.26524E-01	.36980E-01	.37850E-01
HATCH, E.I. 1 + 2	S	.11122E-01	.14720E-01	.22731E-01	.23889E-01	.12330E-01	.13566E-01	.21401E-01	.22887E-01
INDIAN PT 2 + 3	NE	.81326E+00	.74045E+00	.73557E+00	.98620E+00	.11763E+01	.95346E+00	.87477E+00	.11167E+01
KEWAUNEE	MW	.93780E-02	.17390E-01	.36598E-01	.47946E-01	.16358E-01	.23622E-01	.49717E-01	.72662E-01
LASALLE 1 + 2	MW	.13544E-01	.29233E-01	.55404E-01	.59426E-01	.90269E-02	.24474E-01	.60214E-01	.64080E-01
LA CROSSE	MW	.17126E-01	.19149E-01	.39487E-01	.38689E-01	.18270E-01	.20467E-01	.50259E-01	.48158E-01
LIMERICK 1	NE	.69580E+00	.58125E+00	.59208E+00	.83770E+00	.82582E+00	.65562E+00	.64060E+00	.77740E+00
MARBLE HILL	MW	.52590E-01	.48820E-01	.12305E+00	.18073E+00	.42417E-01	.45750E-01	.14729E+00	.21629E+00
ME YANKEE	NE	.0	.17540E-02	.14157E-01	.23032E-01	.0	.11468E-02	.11221E-01	.19443E-01
MCGUIRE 1 + 2	S	.68527E-01	.89197E-01	.22294E+00	.21853E+00	.55320E-01	.86377E-01	.20839E+00	.20379E+00
MIDLAND 2	MW	.51650E+00	.36272E+00	.32814E+00	.27855E+00	.47273E+00	.33162E+00	.27610E+00	.23981E+00
MILLSTONE 1 + 2	NE	.44527E+00	.39795E+00	.31930E+00	.27479E+00	.38361E+00	.33459E+00	.27492E+00	.24015E+00
MONTICELLO	MW	.36455E-01	.36888E-01	.40108E-01	.63248E-01	.35726E-01	.34907E-01	.38818E-01	.66259E-01
NINE M. PT. 1 + 2	NE	.19642E-01	.68462E-01	.62453E-01	.63600E-01	.18938E-01	.98586E-01	.83033E-01	.82225E-01
NORTH ANNA 1, 2, + 3	S	.78517E-02	.16242E-01	.20497E-01	.28285E-01	.17726E-01	.22356E-01	.24040E-01	.29313E-01
OCONEE 1, 2 + 3	S	.20946E-01	.71083E-01	.71072E-01	.87747E-01	.20376E-01	.54069E-01	.56339E-01	.70861E-01

Table D.3-1. (continued)

SITE NAME	REGION	SPF5	SPF10	SPF20	SPF30	WRSPF5	WRSPF10	WRSPF20	WRSPF30
OYSTER CREEK	NE	.80588E-01	.94443E-01	.11249E+00	.12548E+00	.59297E-01	.72795E-01	.88249E-01	.10273E+00
PALISADE	MW	.54980E-01	.74781E-01	.78747E-01	.74770E-01	.64503E-01	.90103E-01	.10466E+00	.10047E+00
PALO VERDE 1	SW	.59341E-02	.57060E-02	.64846E-02	.63884E-02	.72781E-02	.65626E-02	.68228E-02	.67668E-02
PEACH BOTTOM 2 + 3	NE	.21262E-01	.46280E-01	.10392E+00	.15471E+00	.16166E-01	.43229E-01	.10408E+00	.16286E+00
PEBBLE SPRINGS	W	.32039E-02	.26601E-02	.18549E-02	.19379E-02	.10765E-02	.18643E-02	.12494E-02	.16777E-02
PERKINS	S	.56885E-01	.73595E-01	.11950E+00	.14722E+00	.69392E-01	.77501E-01	.12927E+00	.16576E+00
PERRY 1	MW	.18134E+00	.19633E+00	.18713E+00	.20736E+00	.19364E+00	.22503E+00	.21854E+00	.25700E+00
PHIPPS BEND	S	.10524E+00	.84886E-01	.97704E-01	.97858E-01	.14545E+00	.11126E+00	.97714E-01	.90997E-01
PILGRIM 1	NE	.11534E+00	.10936E+00	.11597E+00	.17272E+00	.10559E+00	.10456E+00	.12056E+00	.18816E+00
POINT BEACH 1 + 2	MW	.27877E-01	.42796E-01	.50634E-01	.56737E-01	.30607E-01	.61374E-01	.78181E-01	.84759E-01
PRAIRIE 1 + 2	MW	.52533E-01	.60849E-01	.58239E-01	.68463E-01	.68078E-01	.89779E-01	.81843E-01	.98066E-01
QUAD CITIES 1 + 2	MW	.92684E-02	.28898E-01	.11576E+00	.10374E+00	.74518E-02	.26202E-01	.15572E+00	.14606E+00
RANCHO SECO	W	.11965E-01	.16493E-01	.49437E-01	.14276E+00	.21786E-01	.24511E-01	.62468E-01	.18807E+00
RIVERBEND 1	S	.30502E-01	.43767E-01	.55368E-01	.81505E-01	.26084E-01	.38615E-01	.53917E-01	.83519E-01
H. B. ROBINSON 2	S	.44152E-01	.60749E-01	.56364E-01	.59736E-01	.31658E-01	.40944E-01	.40993E-01	.46573E-01
SAINT LUCIE 1	S	.54634E-01	.83901E-01	.69669E-01	.61506E-01	.26940E-01	.57388E-01	.50326E-01	.43984E-01
SALEM 1 + 2	NE	.20414E-01	.44992E-01	.12554E+00	.17034E+00	.10118E-01	.37371E-01	.13494E+00	.17374E+00
SAN ONOFRE	W	.69002E-02	.48712E-01	.83838E-01	.96513E-01	.66242E-02	.33136E-01	.69350E-01	.73646E-01
SEABROOK 1	NE	.67564E-01	.70954E-01	.75767E-01	.74098E-01	.51712E-01	.53509E-01	.61434E-01	.60380E-01
SEQUOYAH 1 + 2	S	.74540E-01	.92644E-01	.16438E+00	.14585E+00	.10185E+00	.99429E-01	.24659E+00	.22043E+00
SHEARON HARRIS	S	.19205E-01	.32954E-01	.71277E-01	.10028E+00	.18313E-01	.27659E-01	.62008E-01	.89401E-01
SKAGIT	W	.34859E-01	.43992E-01	.42008E-01	.47567E-01	.55447E-01	.72359E-01	.61431E-01	.61842E-01
SHOREHAM	NE	.16493E+00	.15862E+00	.22164E+00	.35388E+00	.14089E+00	.14828E+00	.23875E+00	.39069E+00
SOUTH TEXAS	SW	.0	.32669E-02	.11964E-01	.11540E-01	.0	.31599E-02	.11627E-01	.10927E-01
VIRGIL C. SUMMER	S	.50986E-03	.16901E-01	.26477E-01	.59106E-01	.55440E-03	.16344E-01	.27235E-01	.54535E-01
SURRY ST 1 + 2	S	.11499E-01	.10123E+00	.12692E+00	.14067E+00	.14834E-01	.98112E-01	.11710E+00	.12781E+00
SUSQUEHANNA 1	NE	.88449E-01	.10759E+00	.17999E+00	.17990E+00	.13817E+00	.14840E+00	.18670E+00	.18442E+00
THREE MILE ISLAND	NE	.22949E+00	.31201E+00	.39996E+00	.37154E+00	.19179E+00	.30919E+00	.42313E+00	.39465E+00
TROJAN	W	.60039E-01	.10794E+00	.88903E-01	.80567E-01	.68927E-01	.18613E+00	.15456E+00	.14013E+00
TURKEY POINT 1 + 2	S	.0	.53684E-01	.98598E-01	.16790E+00	.0	.44722E-01	.72604E-01	.10295E+00
VERMONT YANKEE 1	NE	.95964E-01	.94227E-01	.95085E-01	.88880E-01	.10817E+00	.14159E+00	.11733E+00	.10598E+00
VOGTLE	S	.0	.36768E-02	.10877E-01	.39824E-01	.0	.34954E-02	.10971E-01	.29954E-01
WATERFORD 3	S	.16326E+00	.14943E+00	.18643E+00	.25577E+00	.14376E+00	.14389E+00	.15424E+00	.20717E+00
WATTS BAR 1 + 2	S	.15094E-01	.22252E-01	.34829E-01	.41281E-01	.10158E-01	.17328E-01	.28514E-01	.37329E-01
WPPSS1+4	W	.0	.33914E-02	.25418E-01	.24944E-01	.0	.14139E-02	.33159E-01	.31851E-01
WPPSS 2	W	.0	.26920E-02	.22569E-01	.23771E-01	.0	.11239E-02	.29885E-01	.30828E-01
WPPSS 3 + 5	W	.11904E-01	.18371E-01	.27064E-01	.31975E-01	.14094E-01	.15227E-01	.19507E-01	.25535E-01
WOLF CREEK	MW	.16991E-01	.12359E-01	.11440E-01	.15201E-01	.85718E-02	.66541E-02	.80877E-02	.13311E-01
YANKEE ROWE	NE	.12403E-01	.35226E-01	.51955E-01	.67440E-01	.15425E-01	.30277E-01	.44781E-01	.56389E-01
YELLOW CREEK	S	.65005E-02	.14117E-01	.22908E-01	.25371E-01	.66200E-02	.16426E-01	.25084E-01	.26547E-01
ZIMMER 1	MW	.27940E-01	.46397E-01	.93655E-01	.20516E+00	.20134E-01	.37355E-01	.79700E-01	.17520E+00
ZION	MW	.71363E+00	.70661E+00	.58157E+00	.55686E+00	.87872E+00	.84040E+00	.68575E+00	.65741E+00

Appendix E: CRAC 2: A Brief Description

The accident consequence calculations presented in Chapter 2 were performed using CRAC2 [1,2], an improved version of the WASH-1400 consequence model CRAC. A number of modifications were made in the upgrade from CRAC to CRAC2. These include changes in the treatments of atmospheric dispersion parameters, plume rise, precipitation scavenging (wet deposition), mixing heights, weather sequence sampling, emergency response (evacuation and sheltering), and latent cancer risk factors. These changes are briefly described below. In addition, several errors found in CRAC were corrected in the CRAC2 version.

E.1 Atmospheric Dispersion Parameters

The values of the horizontal dispersion coefficients, σ_y, obtained from the Pasquill-Gifford curves (and parameterized by Tadmore and Gur [3]) correspond to a release duration of three minutes. To correct the standard dispersion coefficients for releases of longer duration, the summary report of the National Commission on Air Quality's Atmospheric dispersion Modeling Panel [4] endorses the method suggested by Gifford [5]. An adjustment for releases of duration t_2 (minutes) is made by means of the formula

$$\frac{\sigma_{y_2}}{\sigma_{y_{PG}}} = \left(\frac{t_2}{3\ \text{min}}\right)^Q$$

where Q is within the range 0.25-0.3 for 1 hr $< t_2 <$ 100 hr and equals $\sim$0.2 for 3 min $< t_2 <$ 1 hr. In CRAC2, Q is equal to 0.2 for release durations between 3 minutes and one hour and 0.25 for release durations greater than one hour. The lower value of 0.25, rather than 0.3, was selected for long-duration releases because it results in higher concentrations.

The vertical dispersion coefficients, σ_z, obtained from the Pasquil-Gifford curves (parameterized by Martin and Tikvart [6]) are based on data from releases over terrain with very low surface roughness (grasslands with roughness length of approximately 3 cm). In CRAC2 a more typical roughness length of 10 cm (crops, bushes) is assumed. The vertical dispersion coefficients are adjusted using the following recommended equation [7,8]:

$$\sigma_{z2}/\sigma_{z1} = (r_2/r_1)^{0.2} ,$$

where σ_{z1} is the unadjusted parameter, σ_{z2} is the adjusted parameter, $r_1 = 3$ cm, and $r_2 = 10$ cm. Impacts of these changes in the treatment of dispersion parameters were examined in [9].

E.2 Plume Rise

The WASH-1400 consequence model used plume rise equations recommended in Briggs (1969) [10]. The plume rise model used in CRAC2 is based on a more recent paper by Briggs (1975) [11].

E.3 Precipitation Scavenging (Wet Deposition)

The WASH-1400 consequence model (CRAC) used weather data which reported rainfall in terms of the incidence or nonincidence of rain within any clock hour. To calculate precipitation scavenging, the model assumed that rain reported for a clock hour fell at a rate of 1 mm/hr for half the hour. The CRAC2 code contains a more sophisticated wet deposition model which requires as input the amount of rain falling in an hour. Rain is assumed to occur during the entire hour with a constant rate. The hourly rainfall rate is multiplied by a rainout coefficient to determine precipitation scavenging. A coefficient of 1.0×10^{-4} $(\text{sec})^{-1}(\text{mm/hr})^{-1}$ is used for stable conditions and 1.0×10^{-3} $(\text{sec})^{-1}$ $(\text{mm/hr})^{-1}$ for neutral and unstable conditions.

E.4 Mixing Heights

The WASH-1400 consequence model used Holzworth [12] morning and afternoon mixing heights for all stability conditions. In CRAC2, the treatment is somewhat simplified. For stable conditions (E and F stability), the inversion layer is ground based and no mixing depth is assumed. For neutral and unstable conditions, the Holzworth afternoon mixing height is assumed. This change has minimal impact on resulting predicted consequences.

E.5 Improved Weather Sequence Sampling Technique

WASH-1400's consequence model (CRAC) used a stratified sampling technique by which sequences are selected every four days ± thirteen hours to provide coverage of diurnal, seasonal and four-day weather cycles [13]. In this manner, a total of 91 weather sequences were chosen to represent one year of data (8760 hours). Sensitivity studies have shown that considerable variation in predicted consequences result from sampling by this method. Consequences can vary significantly for calculations performed using different sets of weather sequences (see Figure E5-1A). Differences in peak predicted consequences of an order of magnitude or more are not uncommon.

There are several reasons for the large variation in consequences due to the WASH-1400 sampling technique. Given an accident, large consequences are normally associated with relatively low probability weather conditions such as rainfall within a few 10's of kilometers of the site [14], wind-speed slowdowns, or stable weather conditions with moderate wind speeds. Not only is the occurrence of rainfall or a slowdown important, but where it occurs as well. Rain beginning over a densely populated area could result in extremely high consequences. Because of their low probability, such weather conditions will be selected infrequently, if at all, by the WASH-1400 sampling technique. Furthermore, estimated probabilities for adverse weather conditions can be significantly in error. For example, a particularly adverse weather sequence with actual probability of 1/8760 would, if sampled, be assigned a probability of 1/91.

CRAC2 uses a new weather sequence sampling method [15] which produces improved estimates of accident-consequence frequency distributions. Prior to sequence selection, the entire year of weather data is sorted into 29 weather categories (termed "bins"), as defined in Table E.5-1. Each of the 8760 potential sequences is first examined to determine if rain occurs anywhere within 50 kilometers (30 miles) of the accident site.

If not, a similar examination is made for wind-speed slowdowns. If neither of these conditions occurs, the sequence is categorized by the stability and wind speed at the start of the accident. A probability for each weather bin is estimated from the number of sequences placed in the bin. Sequences are then sampled from each of the bins (with appropriate probabilities) for use in risk calculations. In the current analysis, four sequences were selected from each bin. Sampling with this method assures that low probability adverse weather conditions are adequately included.

A comparison of the variation in consequences due to sampling by the two methods is provided in Figure E.5-1. For both methods, early-fatality frequency distributions (CCDF's) for a PWR2 release [15] were calculated with CRAC, using 32 different sets of weather sequences sampled from the New York City weather data summarized in Table E.5-1. Also assumed were a uniform population density of 100 people/mile^2 and a relatively ineffective evacuation. The results clearly indicate that the weather bin method results in substantially less variation due to sampling than the previous WASH-1400 technique.

E.6 Emergency Response (Evacuation) Model

The CRAC2 evacuation model [16,17] is significantly different from the RSS evacuation model. In lieu of the small "effective" evacuation speeds assumed in the RSS model, the revised treatment incorporates a delay time before public movement, followed by evacuation radially away from the reactor. Both an assumed delay time and evacuation speed are required as input to the model. Different shielding factors and breathing rates are used while stationary or in transit. In addition, all persons within the designated evacuation area move as a group with the same delay time and evacuation speed. Therefore, the possibility that some people may not leave the evacuated area is ignored. This latter assumption results in upper bound estimates of evacuation effectiveness, given a specific delay time and speed.* Unlike the RSS model in which persons continue

*The evacuation effectiveness would decrease linearly with an increasing nonparticipating fraction of the population. In actual evacuations, Civil Defense personnel have observed a nonparticipating minority of approximately 5%.

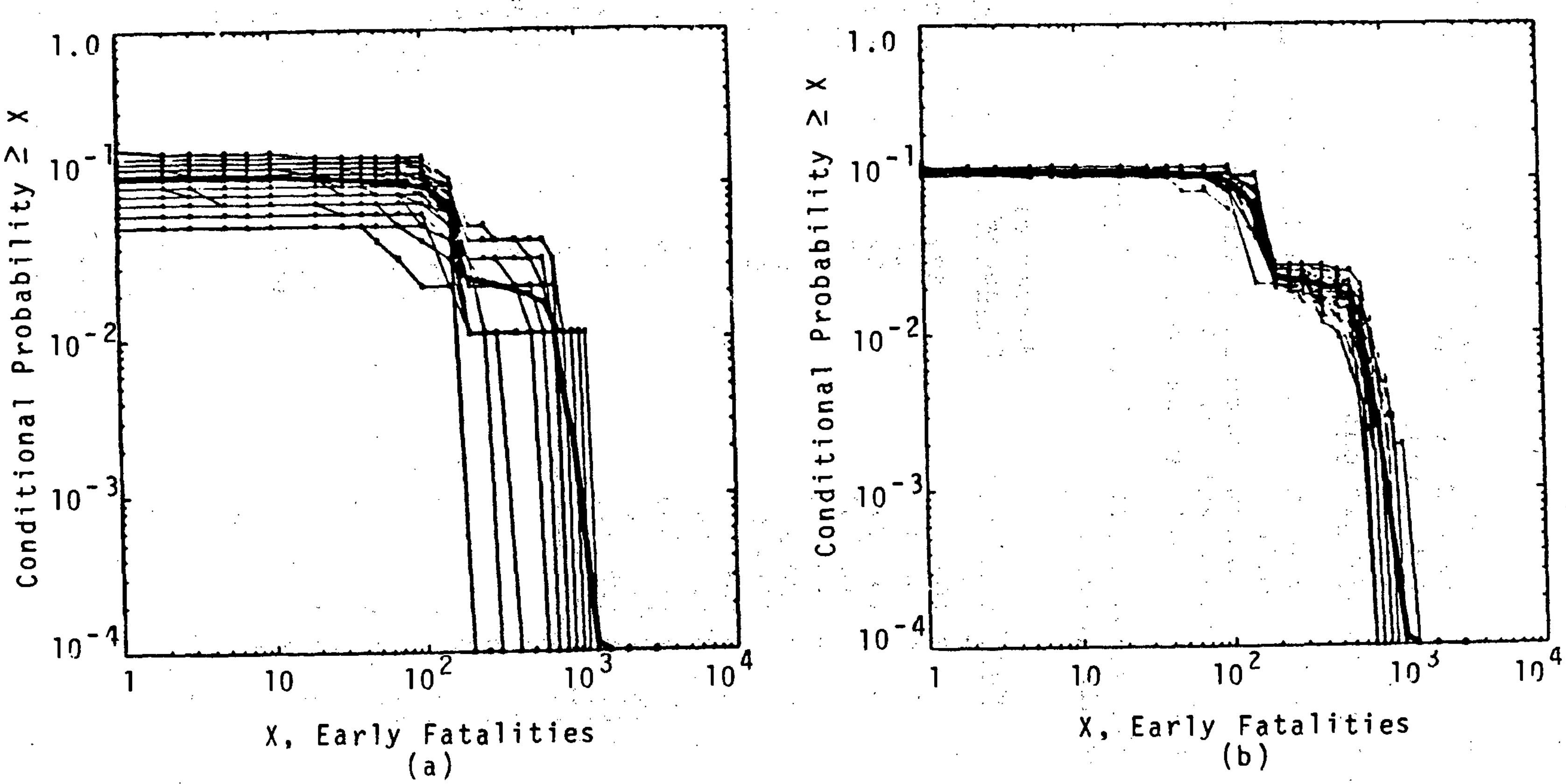

Figure E.5-1. Comparison of Uncertainty Due to Sampling by (A) WASH-1400 and (B) Weather Bin Techniques. For each technique, 32 different sets of weather sequences are used to generate early-fatality frequency distributions for a PWR2 release. A "best estimate" using all 8760 available sequences, is shown by the darkened line.

Table E.5-1 One Year of New York City Meteorological Data Summarized Using Weather Bin Categories

Weather Bin Definitions

R - Rain starting within indicated interval (miles).
S - Slowdown occurring within indicated interval (miles).
A-C D E F - Stability categories.

1(0-1), 2(1-2), 3(2-3), 4(3-5), 5(GT 5) - Wind Speed intervals (m/s).

Weather Bin		Number of Sequences	Percent
1	R (0)	697	7.96
2	R (0-5)	12	.14
3	R (5-10)	62	.71
4	R (10-15)	102	1.16
5	R (15-20)	75	.86
6	R (20-25)	67	.76
7	R (25-30	61	.70
8	S (0-10)	24	.27
9	S (10-15)	16	.18
10	S (15-20)	18	.21
11	S (20-25)	14	.16
12	S (25-30)	18	.21
13	A-C 1,2,3	168	1.92
14	A-C 4,5	892	10.18
15	D 1	0	0.00
16	D 2	61	.70
17	D 3	226	2.58
18	D 4	948	10.82
19	D 5	3325	37.96
20	E 1	0	0.00
21	E 2	27	.31
22	E 3	167	1.91
23	E 4	682	7.79
24	E 5	270	3.08
25	F 1	0	0.00
26	F 2	116	1.32
27	F 3	310	3.54
28	F 4	402	4.59
29	F 5	0	0.00
		8760	100.00

evacuating until they are either overtaken by the cloud or leave the model grid, all evacuating persons in the new model travel a designated distance from the evacuated area and are then removed from the problem. This treatment allows for the likelihood that after traveling outward for some distance, people may learn their position relative to the cloud and be able to avoid it.

The new model also calculates more realistic exposure durations to airborne and ground-deposited radionuclides than the RSS evacuation model. The RSS consequence model employs an exposure model for an instantaneous point source and thus all released plumes have zero effective lengths. Because of this, evacuating persons overtaken by the cloud in the RSS evacuation model are exposed to the entire cloud at the point overtaken. However, a released cloud of radioactive material would have a finite release duration and a length that depends on the wind speed during and following the release. A person overtaken by the front of the cloud might still escape before being passed by the entire cloud and thus receive only a fraction of the full cloud exposure.* The revised evacuation model assigns the cloud a finite length which is calculated using the assumed release duration and wind speed during the release. To simplify the treatment, the length of the cloud is assumed to remain constant following the release (i.e., the front and back of the cloud travel at the same speed), and the concentration of radioactive material is assumed to be uniform over the length of the cloud. The radial position of evacuating persons, while stationary and in transit, is compared to both the front and the back of the cloud as a function of time to determine a more realistic period of exposure to airborne radionuclides.

The revised treatment calculates the time periods during which people are exposed to radionuclides on the ground while they are stationary and while they

*It is also possible that an evacuating person may travel under the cloud for a long time and thus receive more exposure than if he had remained stationary during the passage of the cloud.

are evacuating. Because radionuclides would be deposited continually from the cloud as it passed a given location, a person while under the cloud would be exposed to ground contamination less concentrated than than if the cloud had completely passed. To account for this, the new model assumes that persons completely passed by the cloud are exposed to the total ground contamination concentration, calculated to exist after complete passage of the cloud, to one-half the calculated concentration when anywhere under the cloud, and to no concentration when in front of the cloud. A more detailed discussion of the models is provided in [16] and [17].

The CRAC2 model of public evacuation requires as input estimates of the delay time before evacuation commences and the evacuation speed. Reexamination of the EPA evacuation data used to develop the WASH-1400 model [18] show that, if a constant evacuation speed was assumed, a distribution of delay times could be estimated. For assumed evacuation speeds of 10 mph or greater, delay times were found to be satisfactorily represented by a normal distribution with 15, 50, and 85 percentile delay times of approximately 1, 3, and 5 hours respectively.

The CRAC2 evacuation model can incorporate this distribution of evacuation delay times by calculating a 30:40:30% weighted sum of consequences for 10 mph evacuations after delays of 1, 3, and 5 hours. The weighted distribution of evacuations is denoted "Summary Evacuation", and was discussed in Sections 2.2 and 2.5.

The CRAC2 model is also capable of considering population sheltering as an emergency protective action. Sheltering would involve the expedient movement of people into basements or masonry buildings, if possible, followed by relocation. Table A.1-3 of Appendix A lists sheltering factors for different regions in the U.S. A discussion of sheltering is provided in [19].

E.7 Updated Cancer Risk Factors

The latent cancer fatality risk factors used in CRAC2 are updated versions of those reported in WASH-1400. The RSS factors assumed a latency period during which the risk of cancer was assumed to be zero, followed by a risk period where the individual is assumed to be at a constant risk (risk plateau). Depending on the type of cancer and the age of the exposed individual, the latency periods ranged from 0 to 15 years and the risk periods ranged from 10 to 30 years. Based on recommendations in BEIR III [20], the factors used in CRAC2 were updated to reflect extension of the risk period to the end of an individual's life for all cancers except leukemia and for all age groups (of exposed individuals) other than those exposed in utero. Table E.7-1 compares the updated factors to those from WASH-1400. The 0-1 year factors are used for external exposures.

Table E.7-1 Expected Total Latent Cancer (Excluding Thyroid) Deaths per 10^6 Man-Rem From Internal Radionuclides Delivered During Specified Periods

	Time Period (years) After Accident								
	0-1	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
WASH-1400									
Leukemia	28.4	27.2	18.7	13.8	9.7	6.8	4.0	1.7	0.5
Lung	22.2	22.2	22.2	14.5	8.1	4.0	1.5	0.2	0
GI Tract[a]	13.6	13.6	13.6	8.9	5.0	2.5	0.9	0.1	0
Pancreas	3.4	3.4	3.4	2.2	1.3	0.6	0.2	0	0
Breast	25.6	25.6	25.6	16.8	9.4	4.6	1.7	0.3	0
Bone	6.9	6.7	5.0	2.6	1.6	0.9	0.4	0.1	0
All Other	21.6	19.8	17.1	11.2	6.3	3.1	1.2	0.2	0
UPDATED WASH-1400 (CRAC2)									
Leukemia	28.4	27.2	18.7	13.8	9.7	6.8	4.0	1.7	0.5
Lung	27.5	27.5	27.5	15.8	8.1	4.0	1.5	0.2	0.0
GI Tract[a]	16.9	16.9	16.9	9.7	5.0	2.5	0.9	0.1	0.0
Pancreas	4.2	4.2	4.2	2.4	1.3	0.6	0.2	0.0	0.0
Breast	31.7	31.7	31.7	18.3	9.4	4.6	1.7	0.3	0.0
Bone	11.1	10.6	7.0	3.0	1.7	0.9	0.4	0.1	0.0
All Other	28.0	26.3	21.1	12.2	6.3	3.0	1.2	0.2	0.0

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Appendix F: Site Availability Maps and Tables

This appendix contains the site availability data that was discussed in Chapter 4.0. Figure F1 shows legally protected and wetland areas in the U. S. where reactor siting would be restricted. Seismic acceleration contours are shown in Figure F2. Figure F4 shows the topographic character of the U. S. in terms of percent land that is gently sloping (gently sloping was defined as less than 8% slope). Figures F3, F5, F6, and F7 show seismic hardening costs, surface, water availability costs, groundwater availability costs, and combined water availability costs (the lesser of surface water and groundwater costs) for the 48 contiguous United States. Associated with these costs are the utility values discussed in Section 4.4.1 of Chapter 4.0. Tables F1.1-F1.5 show the fractions of land, by state, that fall within each of the environmental suitability categories shown in Figures F3-F7.

Figures F8.1-F8.13 show land that would be restricted from reactor siting by standoff distances to cities. The cities and standoff distances considered in each figure are tabulated below.

Figure	Standoff Distance (mile)	Cities (Population ≥)
F8.1	5	25,000
F8.2	10	25,000
F8.3	10	100,000
F8.4	15	100,000
F8.5	25	100,000
F8.6	25	200,000
F8.7	30	200,000
F8.8	40	200,000
F8.9	50	200,000
F8.10	100	200,000
F8.11	125	250,000
F8.12	18	500,000
F8.13	25	1,000,000

Figures F8.11, F8.12, and F8.13 show the restricted areas for the Northeastern U. S. only.

Figures F9.1-F9.26 show areas that would be restricted from reactor siting by population density criteria. These criteria restrict the number of people that can reside in an annulus surrounding a reactor site. The population density restrictions and the annuli considered in each figure are tabulated below. The population restrictions are shown in terms of average population density (people within the annulus/ annulus area).

Figure	Radii of the Annulus (mile)	Average Population Density ($people/mile^2$)
F9.1	0-2	100
F9.2	0-2	250
F9.3	0-2	500
F9.4	0-2	750
F9.5	0-5	100
F9.6	0-5	200
F9.7	0-5	350
F9.8	0-5	500
F9.9	0-10	100
F9.10	0-10	200
F9.11	0-10	350
F9.12	0-10	500
F9.13	0-20	200
F9.14	0-30	500
F9.15	0-30	1000
F9.16	5-10	150
F9.17	5-10	350
F9.18	5-10	500
F9.19	5-20	800
F9.20	10-20	400
F9.21	10-20	500
F9.22	10-20	1000
F9.23	20-30	500
F9.24	20-30	1000
F9.25	30-50	500
F9.26	30-50	1000

Figures 9.3 and 9.4 show restricted areas for the Northeastern U. S. only.

Figures F10.1-F10.4 show areas in the NE U. S. that would be restricted from siting by composite density criteria between 2 and 30 miles of a prospective site. Each criterion would simultaneously restrict the mean population densities within six annuli: 2-3 miles, 2-4 miles, 2-5 miles, 2-10 miles, 2-20 miles, and 2-30 miles. The mean population densities in each of the six annuli can not exceed the prescribed density limits for the site to be acceptable. Figures F10.1, F10.2, F10.3 and F10.4 consider density restrictions of 500, 750, 1000, and 1500 people/mile^2, respectively for the Northeastern U. S.

Figures F11 and F12 show areas in the 48 contiguous United States that would be restricted from reactor siting by the combination of a population density restriction within two miles and a composite population density restriction between 2 and 30 miles of the site. Figure F11 considers a population density restriction of 100 people/mile^2 within 2 miles and a composite population density of 500 people/mile^2. Figure F12 is based on a 250 people/mile^2 density restriction within 2 miles and a composite population density restriction (2-30 miles) of 500 people/mile^2. The 2-30 mile composite restriction is as defined for Figures F10.1-F10.4.

Tables F2.1-F2.24 show the fractions of land available for reactor siting in each state if sector population restrictions are added to a composite population density criterion. These restrictions would limit the number of people that could reside within any sector in each of the composite annuli (see Section 4.5.4 of Chapter 4.0). For these tables, five annuli were considered: 0-2 miles, 0-5 miles, 0-10 miles, 0-20 miles, and 0-30 miles. The allowable populations in each annuli were calculated assuming 250 people/mile^2 between zero and two miles and from 250 to 1500 people/mile^2 in the two to thirty mile region. An acceptable site must satisfy the sector population restriction for each of the composite annuli. The sector population restrictions (fraction of annulus population allowed within the sector), sector widths, and the 2-30 mile average population densities (people within an annulus/annulus area) considered in each table are given below. Tables F2.1-F2.12 show the land areas that are uniquely restricted by the specified criterion. Tables F2.13-F2.24 show the fraction of land available for reactor siting based on the specified criterion.

Table	Width	Sector Population Restrictions	Population Density (2-30 miles) (people/mile^2)
F2.1 & F2.13	22.5°	$\frac{1}{16}, \frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	250
F2.2 & F2.14	22.5°	$\frac{1}{16}, \frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	500
F2.3 & F2.15	22.5°	$\frac{1}{16}, \frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	750
F2.4 & F2.16	22.5°	$\frac{1}{16}, \frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	1500
F2.5 & F2.17	45°	$\frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	250
F2.6 & F2.18	45°	$\frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	500
F2.7 & F2.19	45°	$\frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	750
F2.8 & F2.20	45°	$\frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	1500
F2.9 & F2.21	90°	$\frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	250
F2.10 & F2.22	90°	$\frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	500
F2.11 & F2.23	90°	$\frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	750
F2.12 & F2.24	90°	$\frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{1}{1}$	1500

Tables F3.1-F3.5 show the environmental suitability of land not restricted by each of 5 population siting criteria. (The environmental suitability classifications were discussed in Section 4.4 of Chapter 4.0). These tables show the fraction of land, by state, that 1) lies within each of the five suitability categories and 2) satisfies the population criteria. The population criteria consist of a population restriction within two miles and a composite population restriction within the 2 to 30 mile region. (The annuli considered by the 2 to 30 mile composite population restriction include 2-3 miles, 2-4 miles, 2-5 miles, 2-10 miles, 2-20 miles, and 2-30 miles.) The population criterion considered by each table are tabulated below.

Table	Population Case	0-2 miles (people/mile^2)	2-30 miles (composite) (people/mile^2)
F3.1	1	100	250
F3.2	2	250	500
F3.3	3	500	750
F3.4	4	500	750
F3.5	5	500	1500

Tables F3.6-F3.10 show the effect of applying different population criteria (the five cases considered in Tables F3.1-F3.5) on land available within each of the suitability categories. The suitability category considered in each table is tabulated below.

Table	Environmental Suitability Category
F3.6	low
F3.7	medium-low
F3.8	medium
F3.9	medium-high
F3.10	high

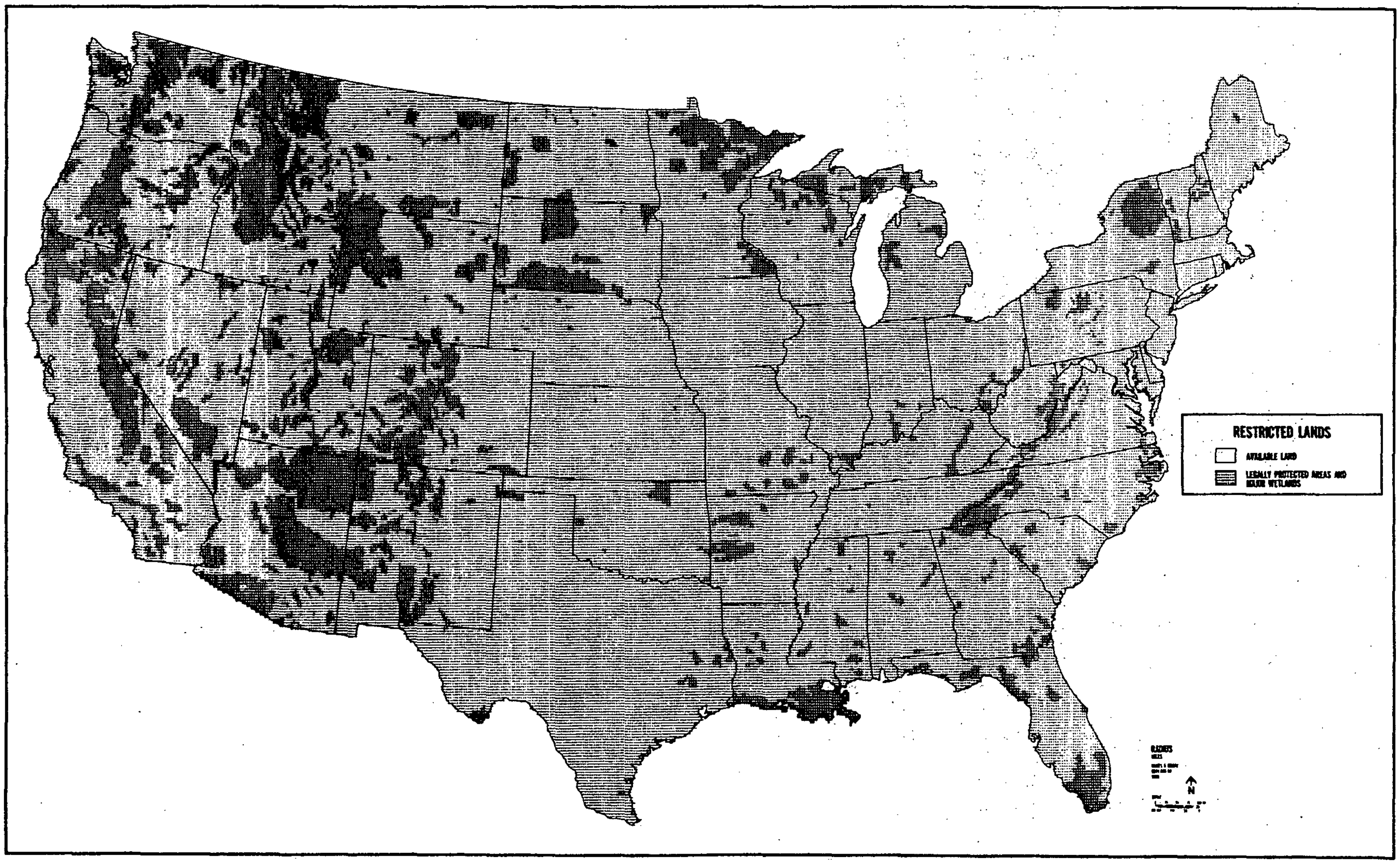

FIGURE F1

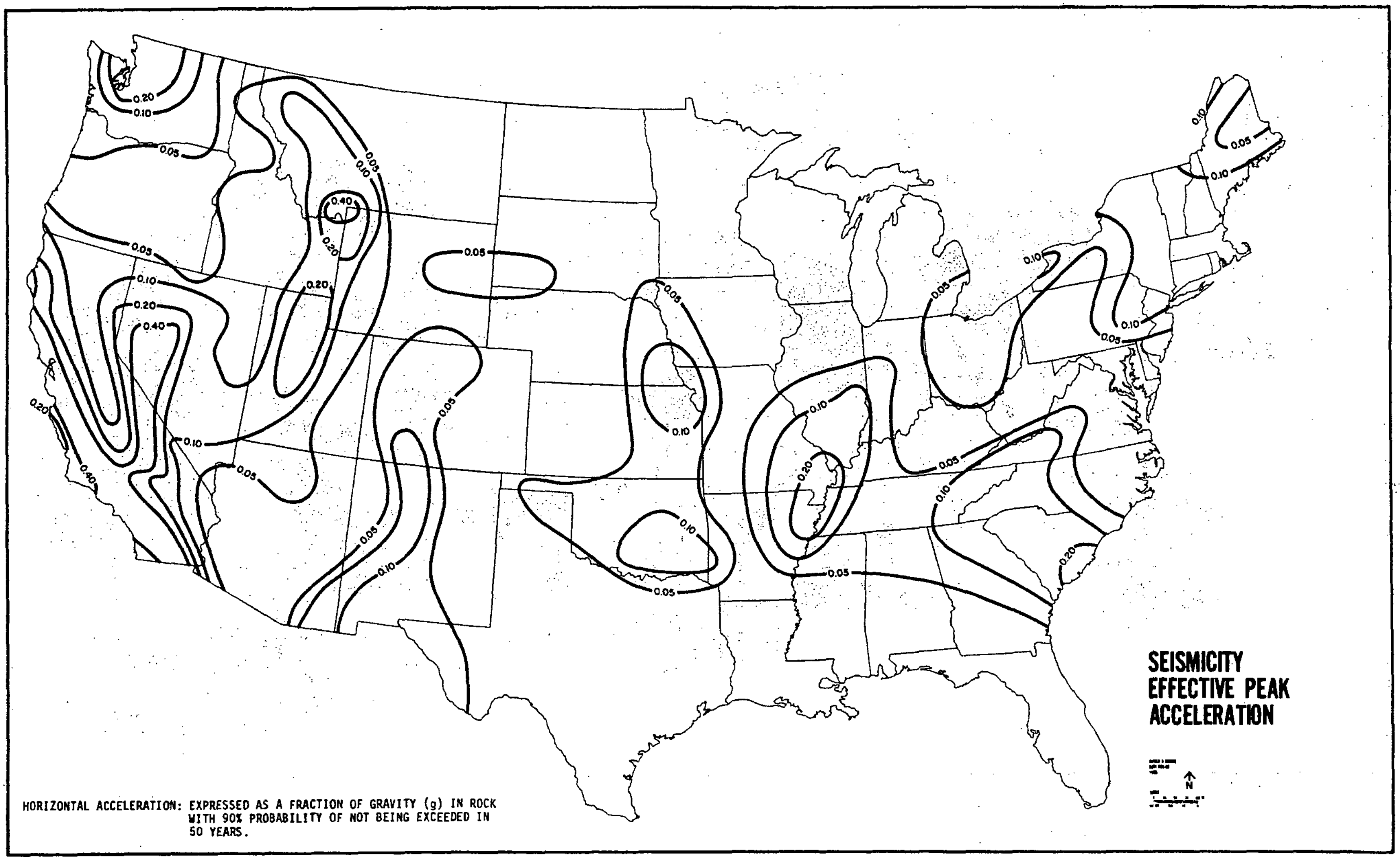
SEISMICITY
EFFECTIVE PEAK
ACCELERATION
HORIZONTAL ACCELERATION: EXPRESSED AS A FRACTION OF GRAVITY (g) IN ROCK WITH 90% PROBABILITY OF NOT BEING EXCEEDED IN 50 YEARS.
0.05
0.10
0.20
0.40
N

FIGURE F2

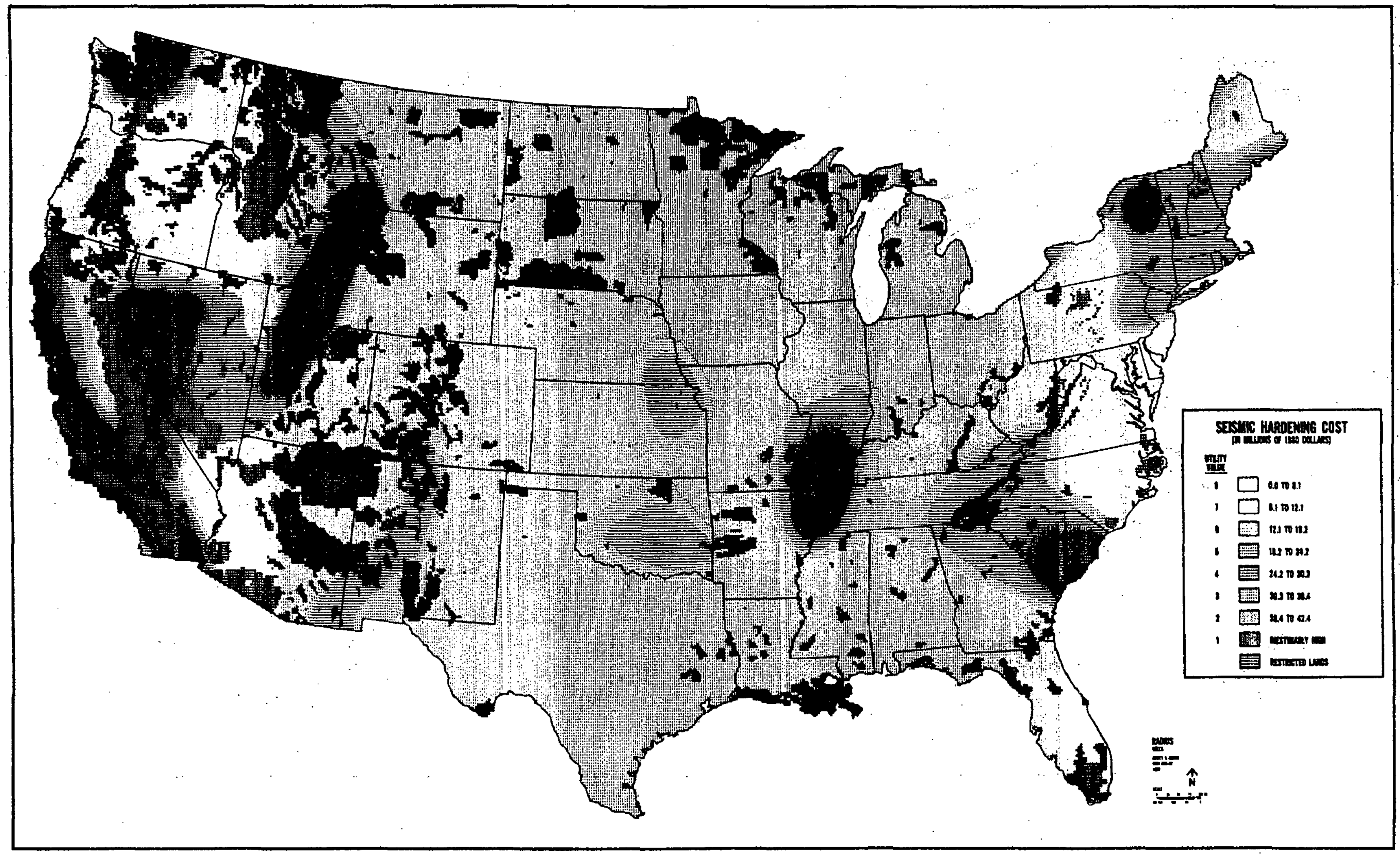
SEISMIC HARDENING COST
7
12.1 TO 18.2
4
24.2 TO 30.3
36.4 TO 42.4
1
RESTRICTED LANDS

FIGURE F3

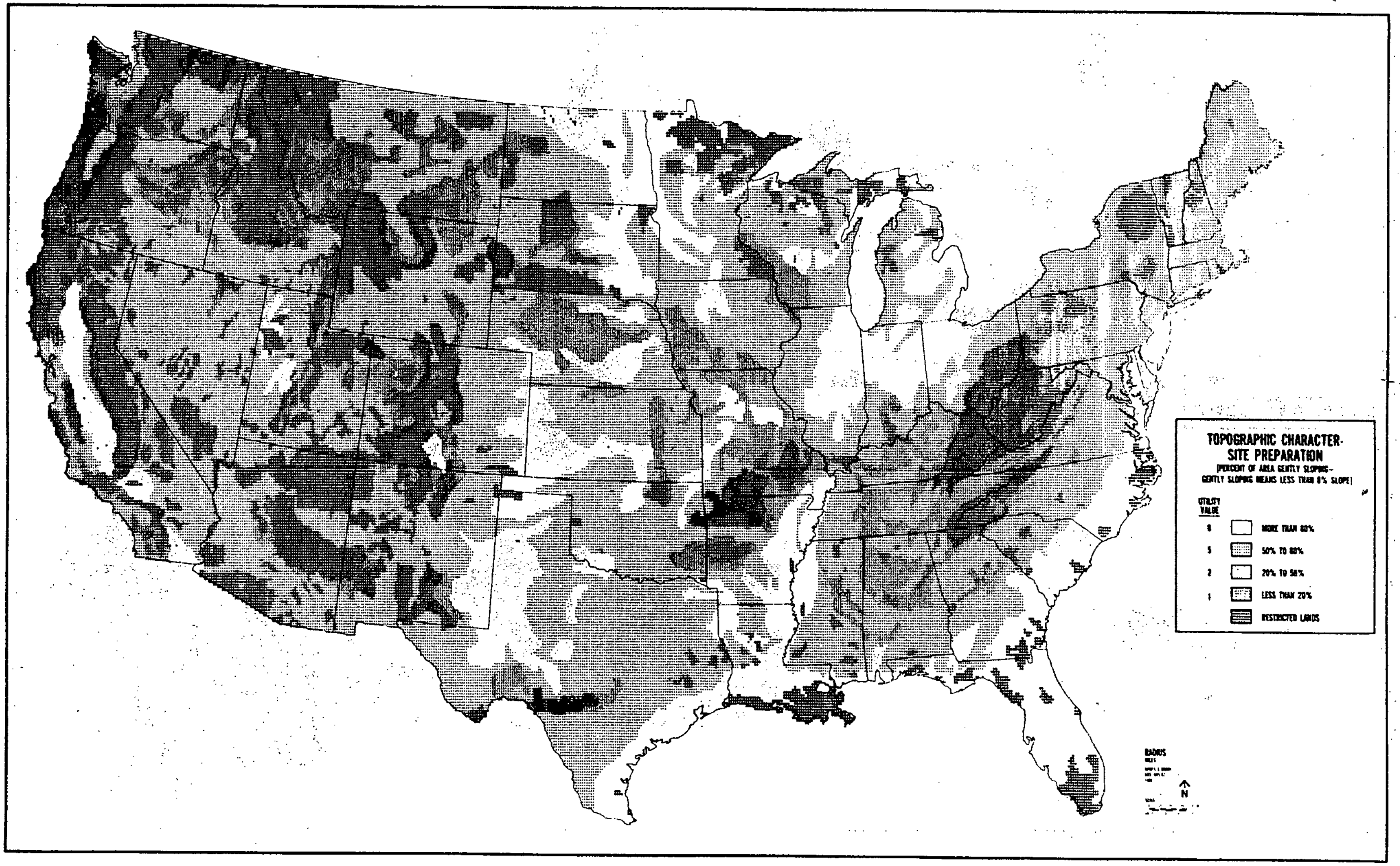
TOPOGRAPHIC CHARACTER-
SITE PREPARATION
(PERCENT OF AREA GENTLY SLOPING—
GENTLY SLOPING MEANS LESS THAN 8% SLOPE)
UTILITY VALUE
8 MORE THAN 80%
5 50% TO 80%
2 20% TO 50%
1 LESS THAN 20%
RESTRICTED LANDS

FIGURE F4

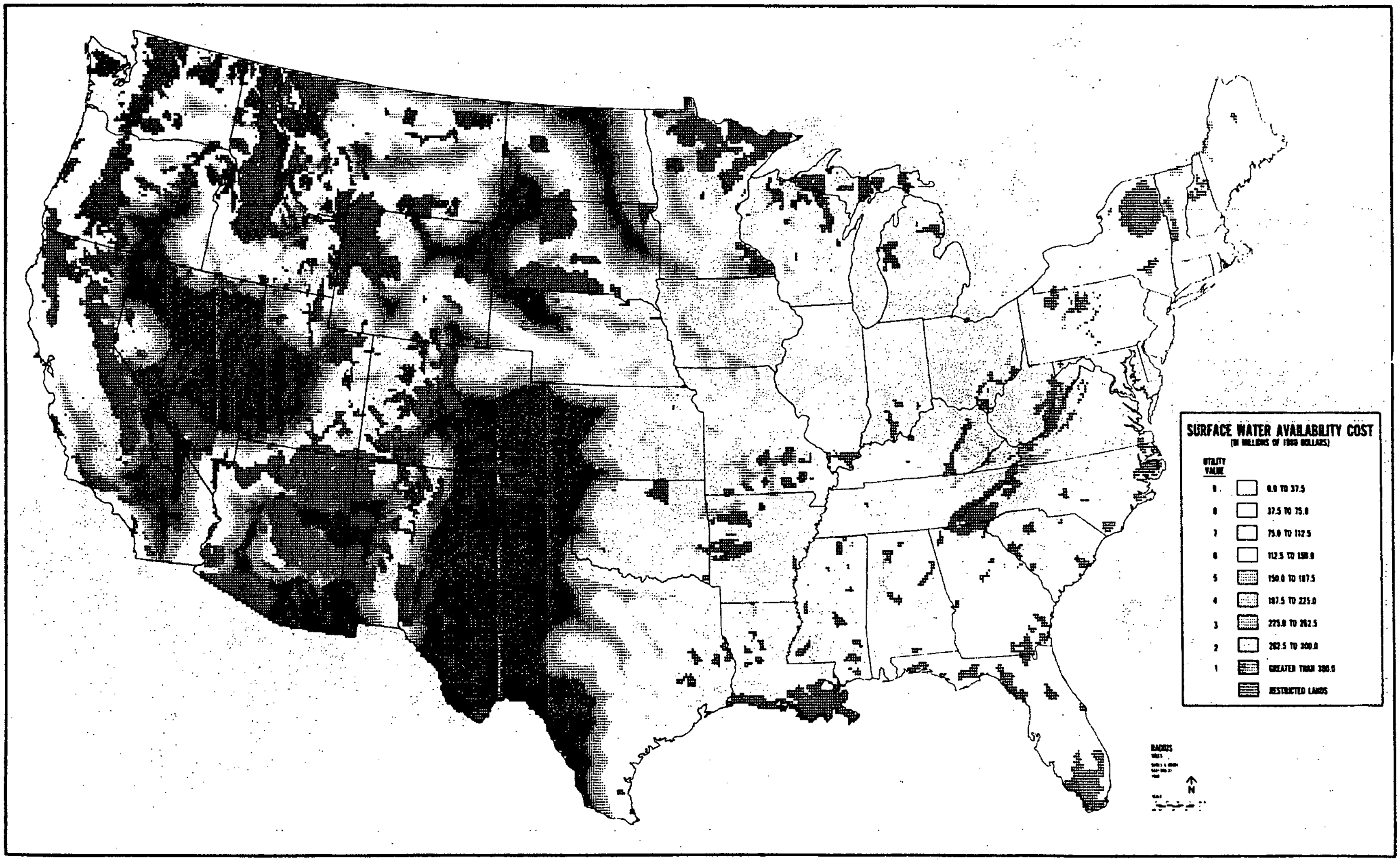
SURFACE WATER AVAILABILITY COST
UTILITY VALUE
0.0 TO 37.5
37.5 TO 75.0
75.0 TO 112.5
112.5 TO 150.0
5
150.0 TO 187.5
4
187.5 TO 225.0
3
225.0 TO 262.5
2
262.5 TO 300.0
1
GREATER THAN 300.0
RESTRICTED LANDS
N

FIGURE F5

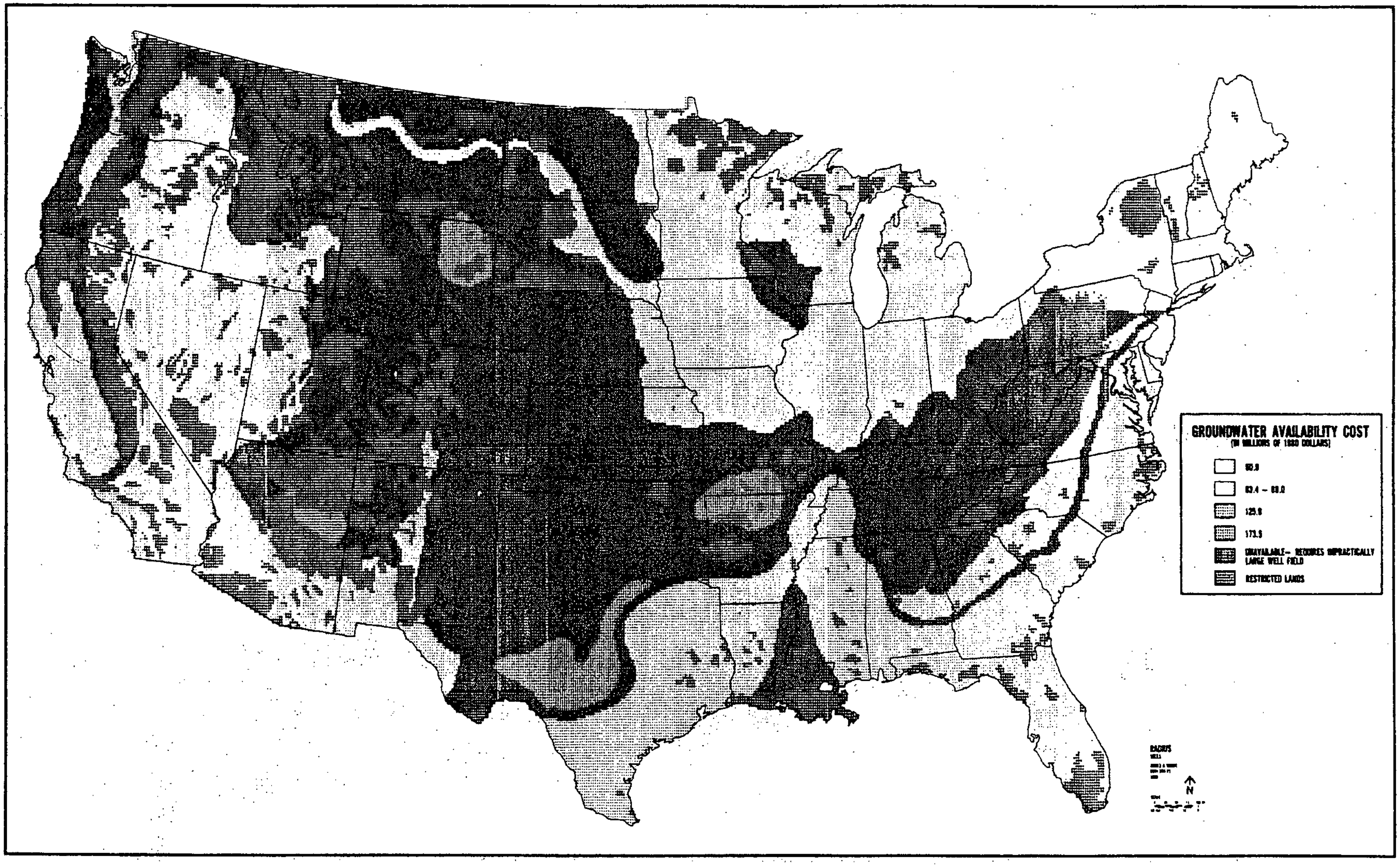
GROUNDWATER AVAILABILITY COST
UNAVAILABLE— REQUIRES IMPRACTICALLY LARGE WELL FIELD
RESTRICTED LANDS

FIGURE F6

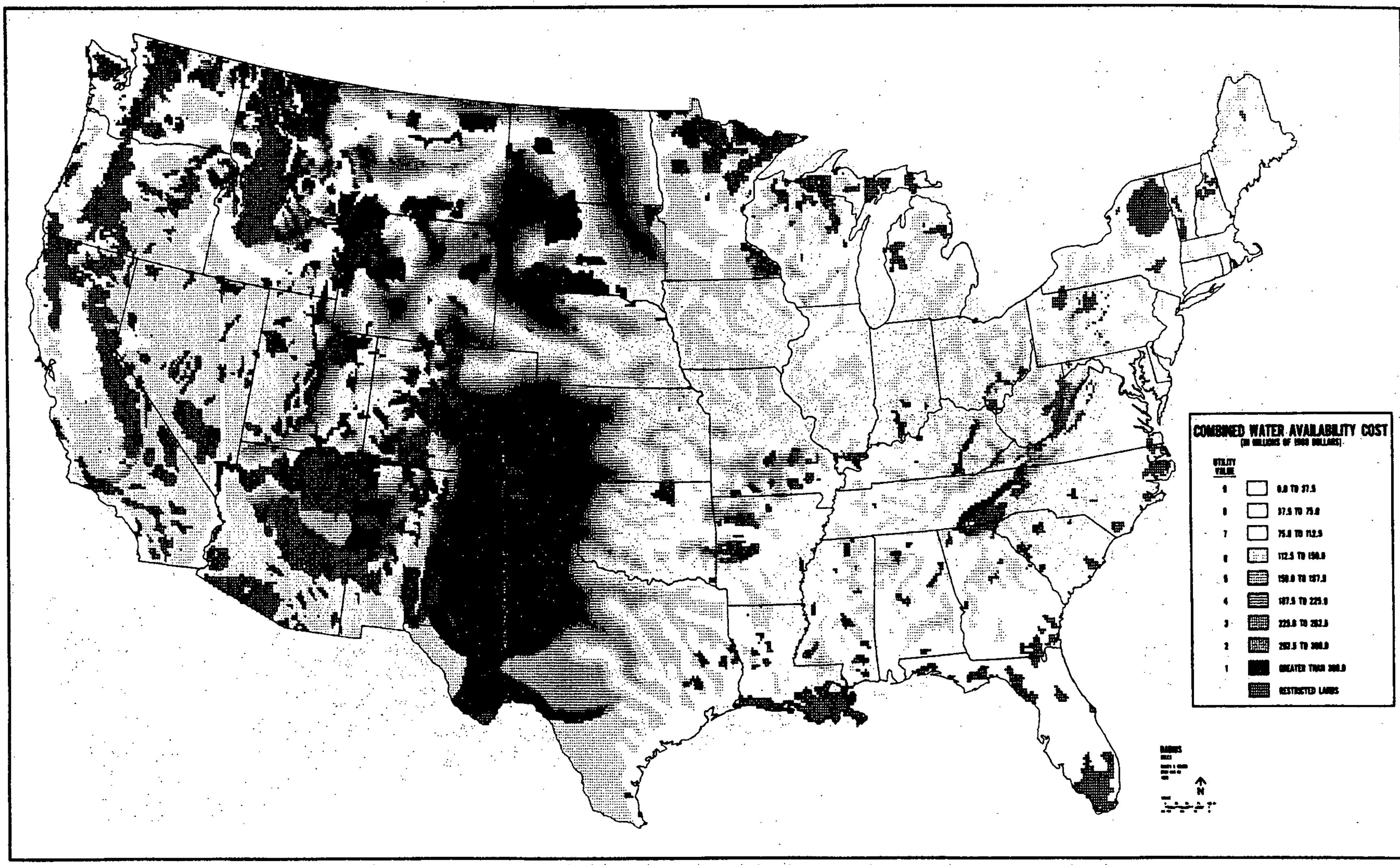
COMBINED WATER AVAILABILITY COST
UTILITY VALUE
9 0.0 TO 37.5
8 37.5 TO 75.0
7 75.0 TO 112.5
6 112.5 TO 150.0
5 150.0 TO 187.5
4 187.5 TO 225.0
3 225.0 TO 262.5
2 262.5 TO 300.0
1 GREATER THAN 300.0
RESTRICTED LANDS
N

FIGURE F7


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
LEGEND

FIGURE F8.1

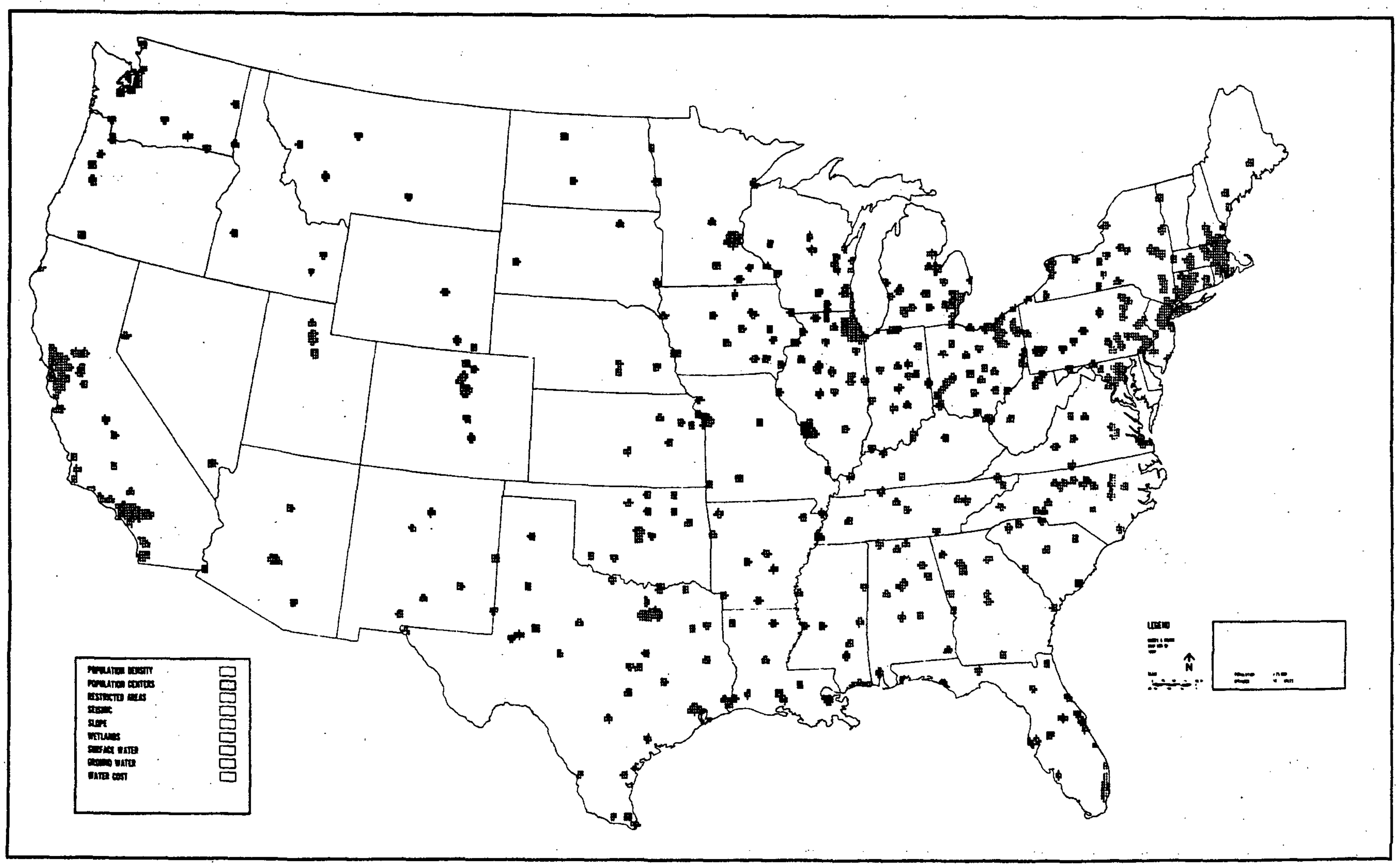
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
LEGEND
N

FIGURE F8.2

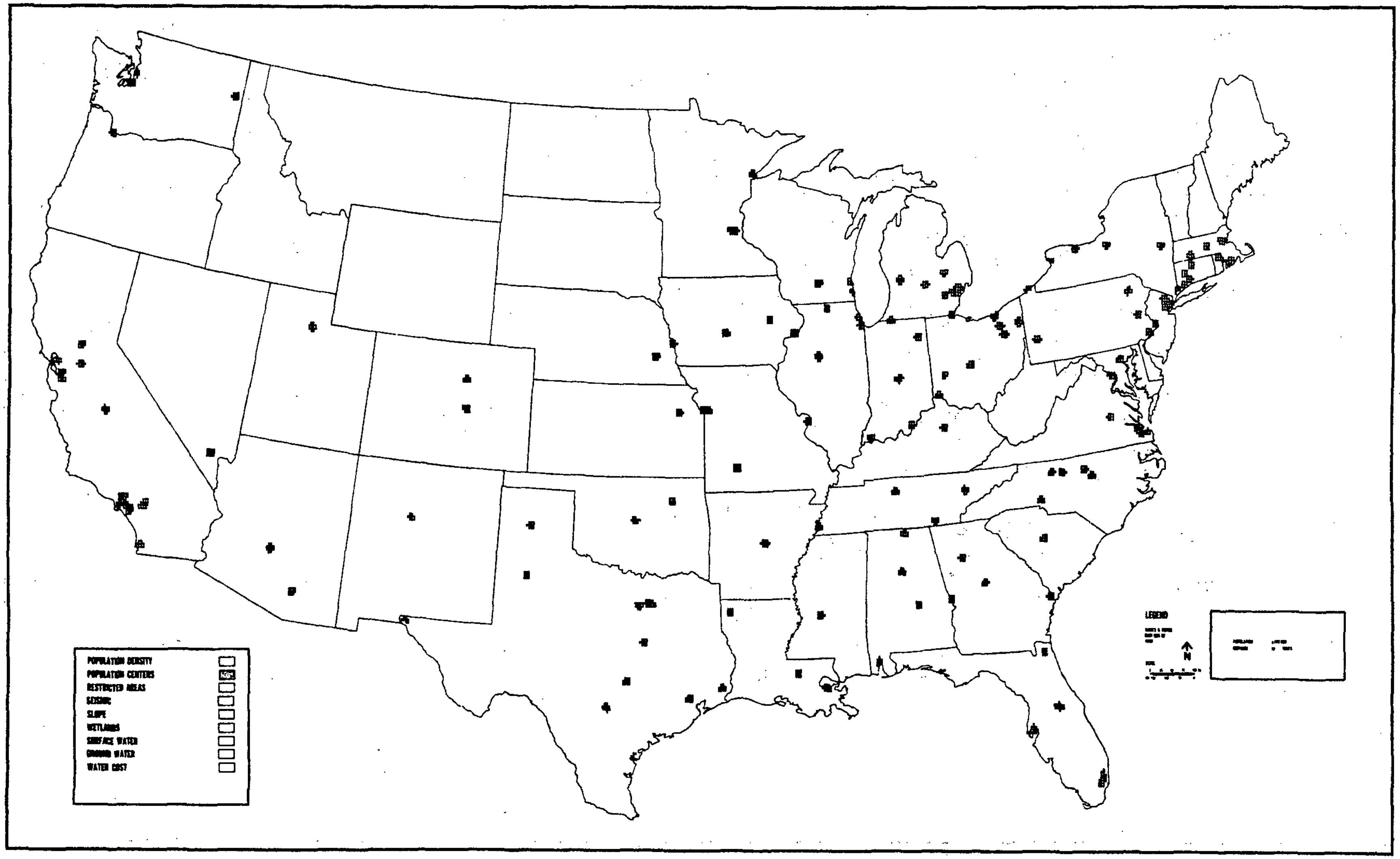
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F8.3

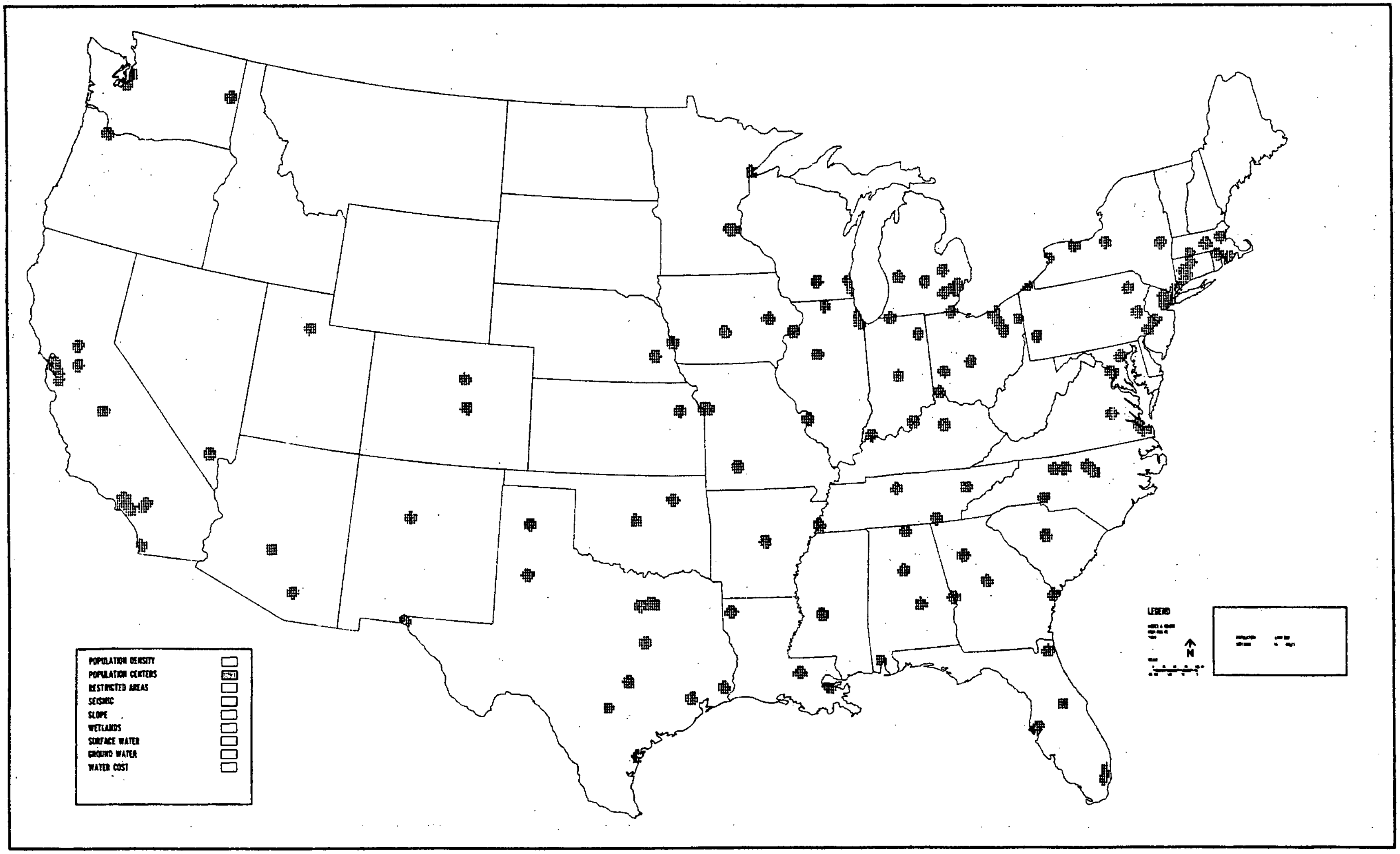
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
LEGEND

FIGURE F8.4

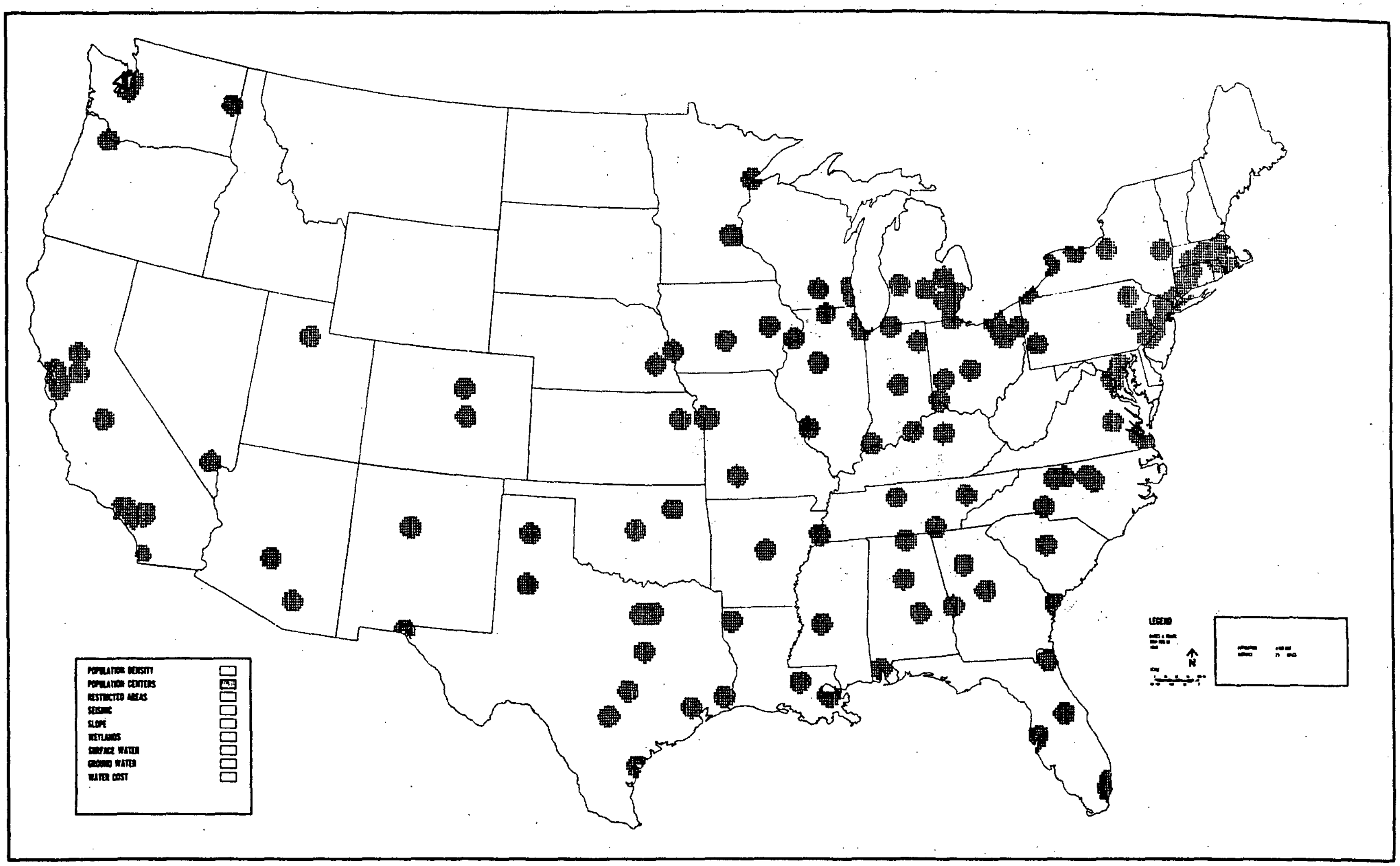
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F8.5


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
LEGEND

FIGURE F8.6

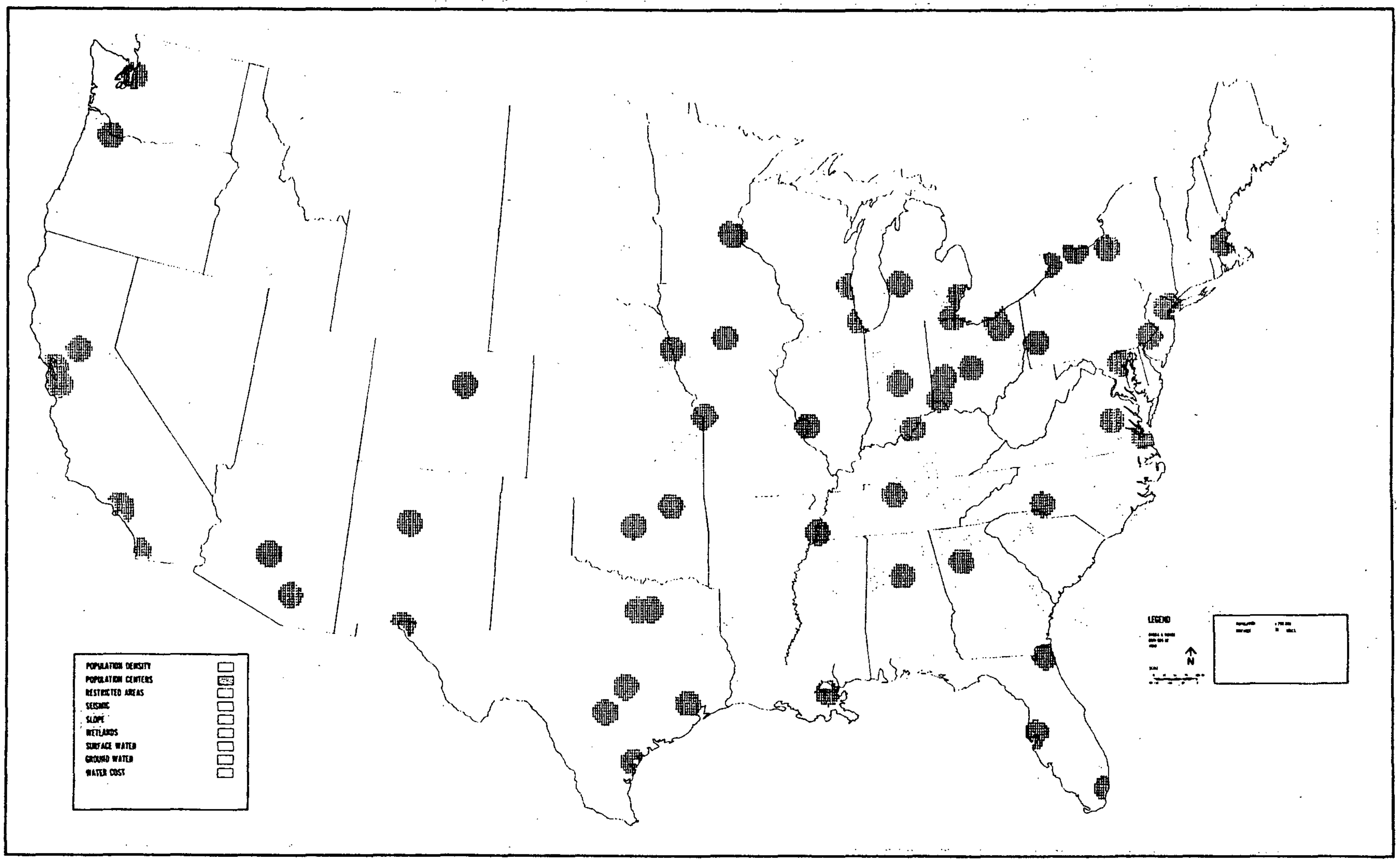
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
LEGEND
N

FIGURE F8.7

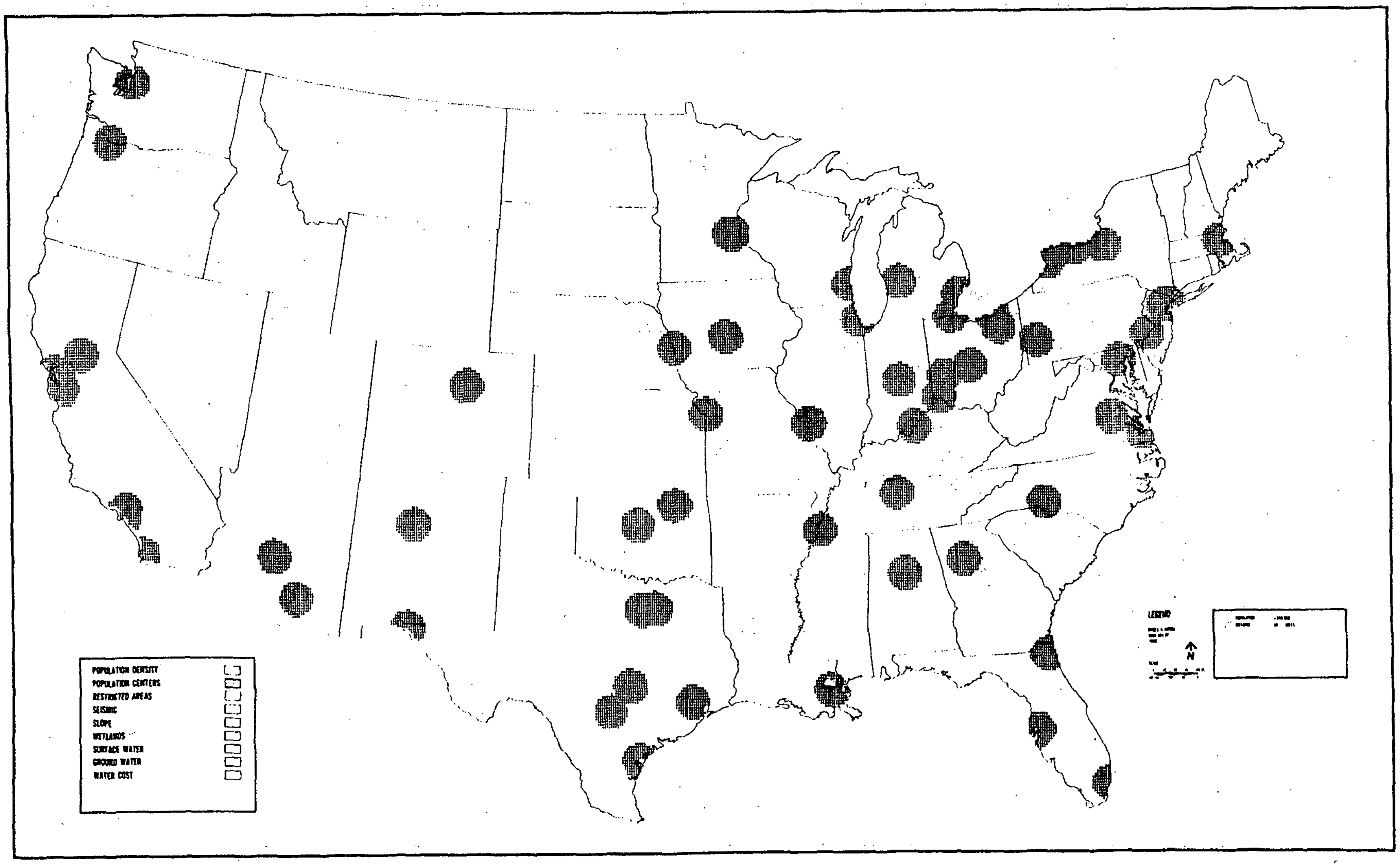
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
LEGEND
N

FIGURE F8.8


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
LEGEND
N

FIGURE F8.9

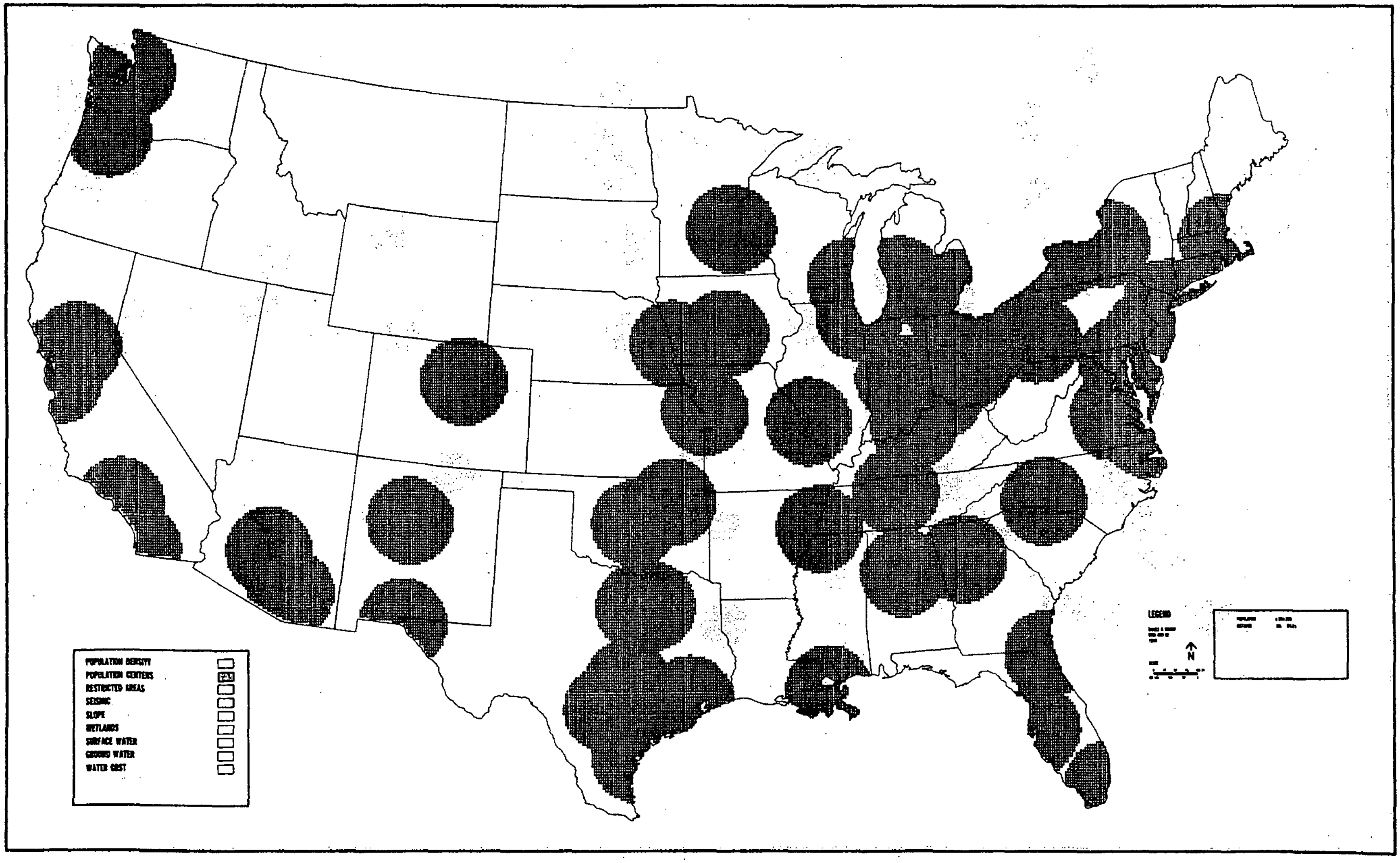
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F8.10

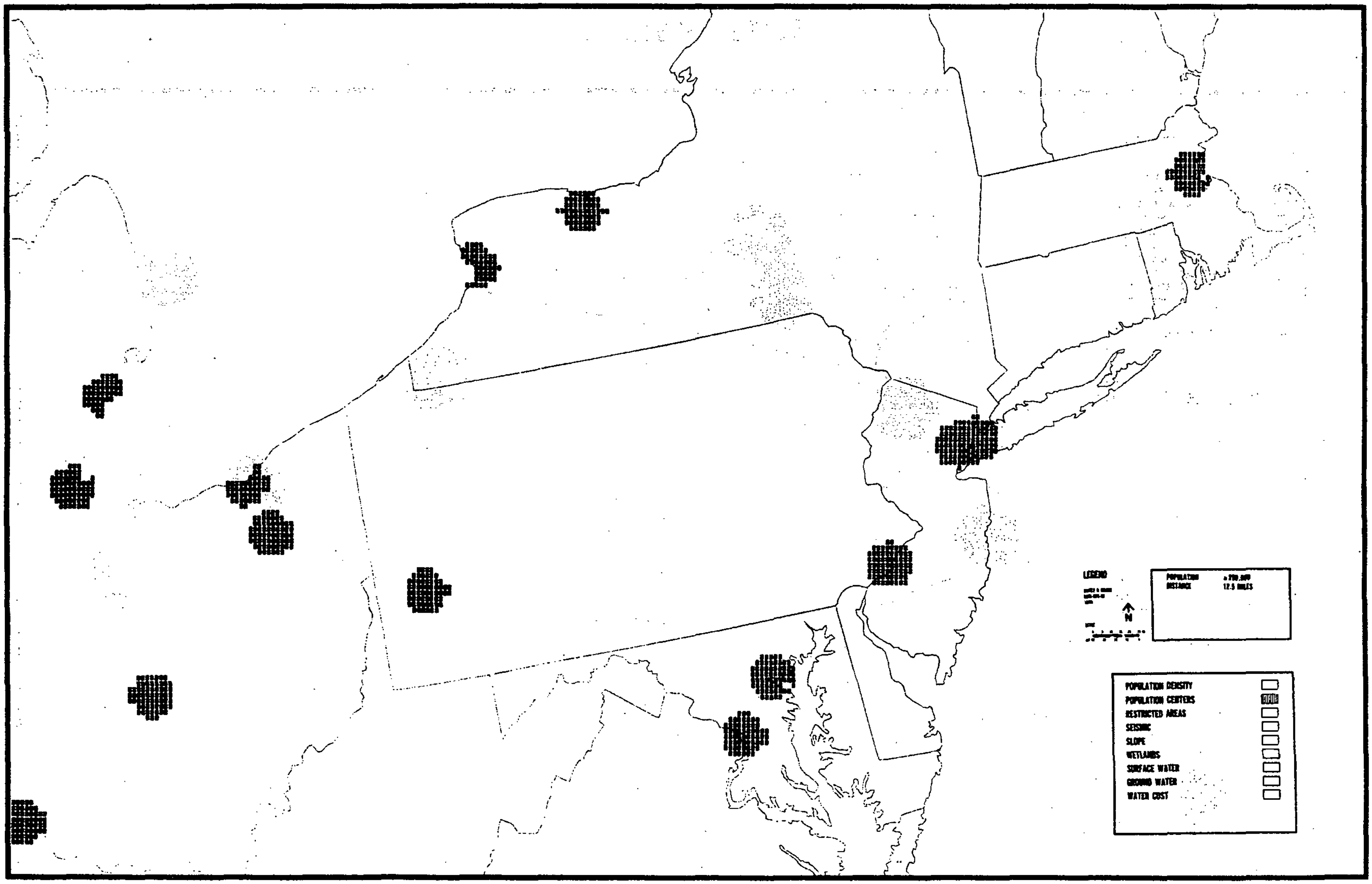
LEGEND
N
POPULATION
DISTANCE
12.5 MILES
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F8.11

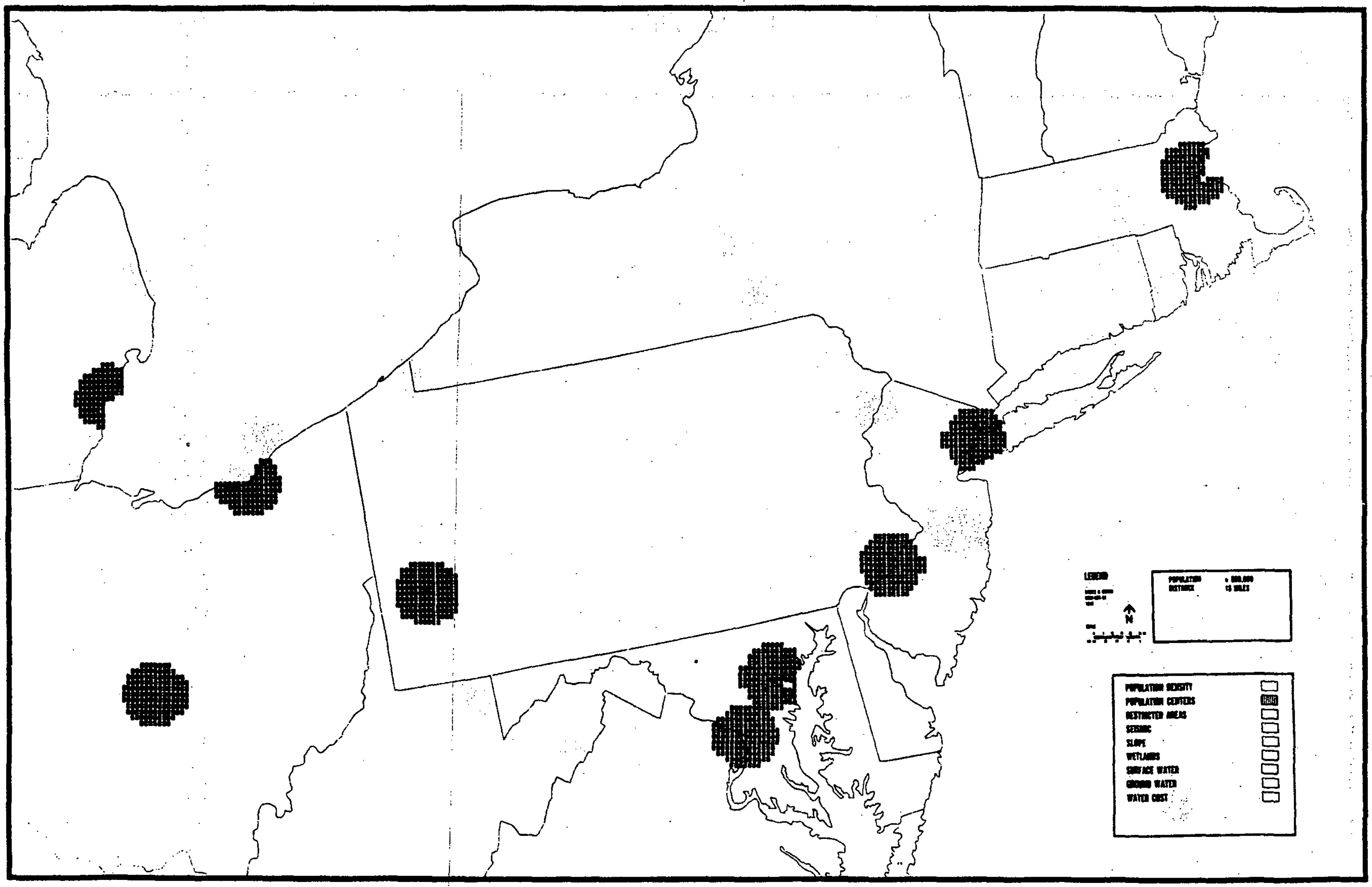
LEGEND
N
POPULATION
DISTANCE
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F8.12

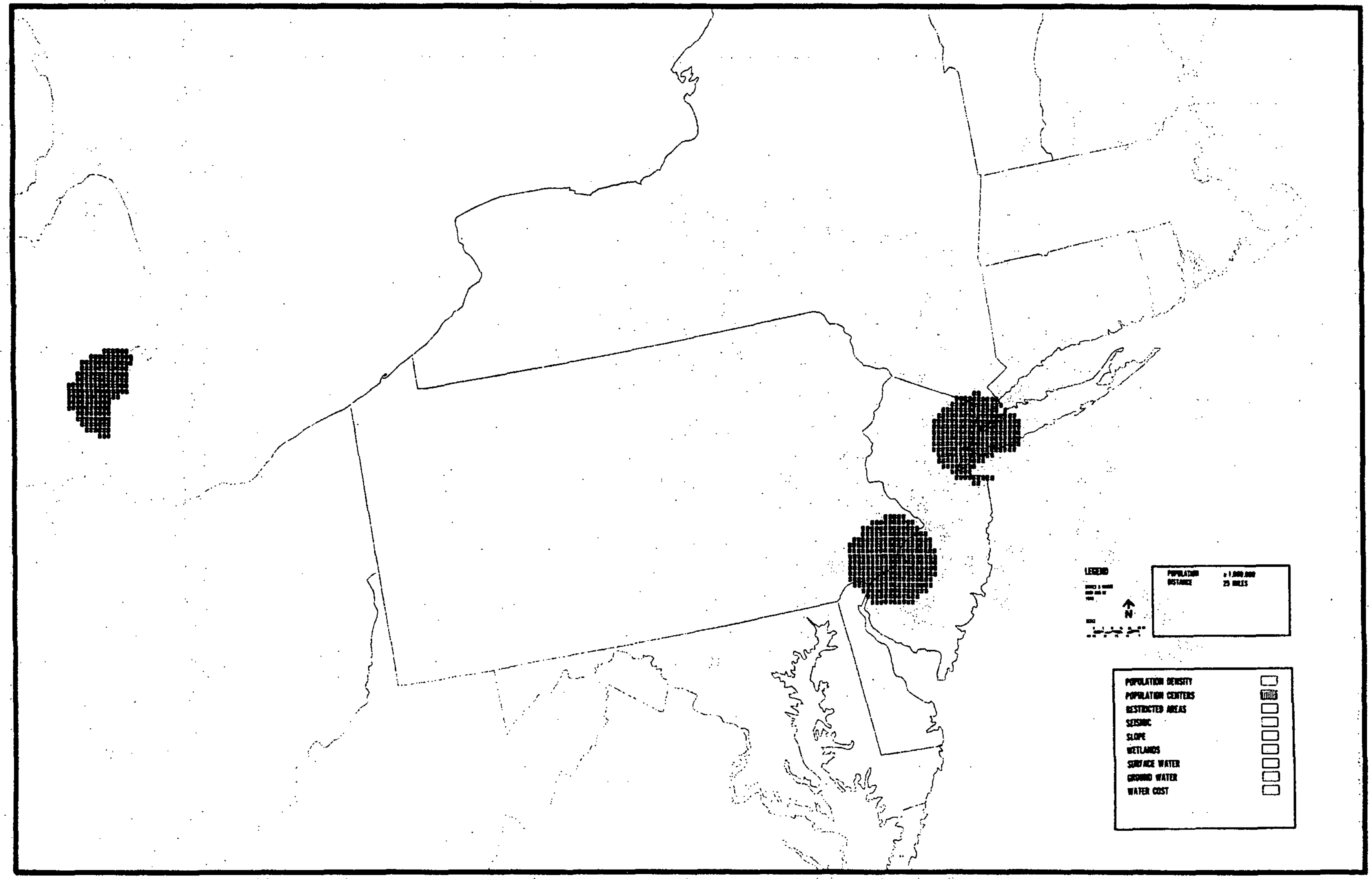
LEGEND
N
POPULATION
DISTANCE
25 MILES
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F8.13

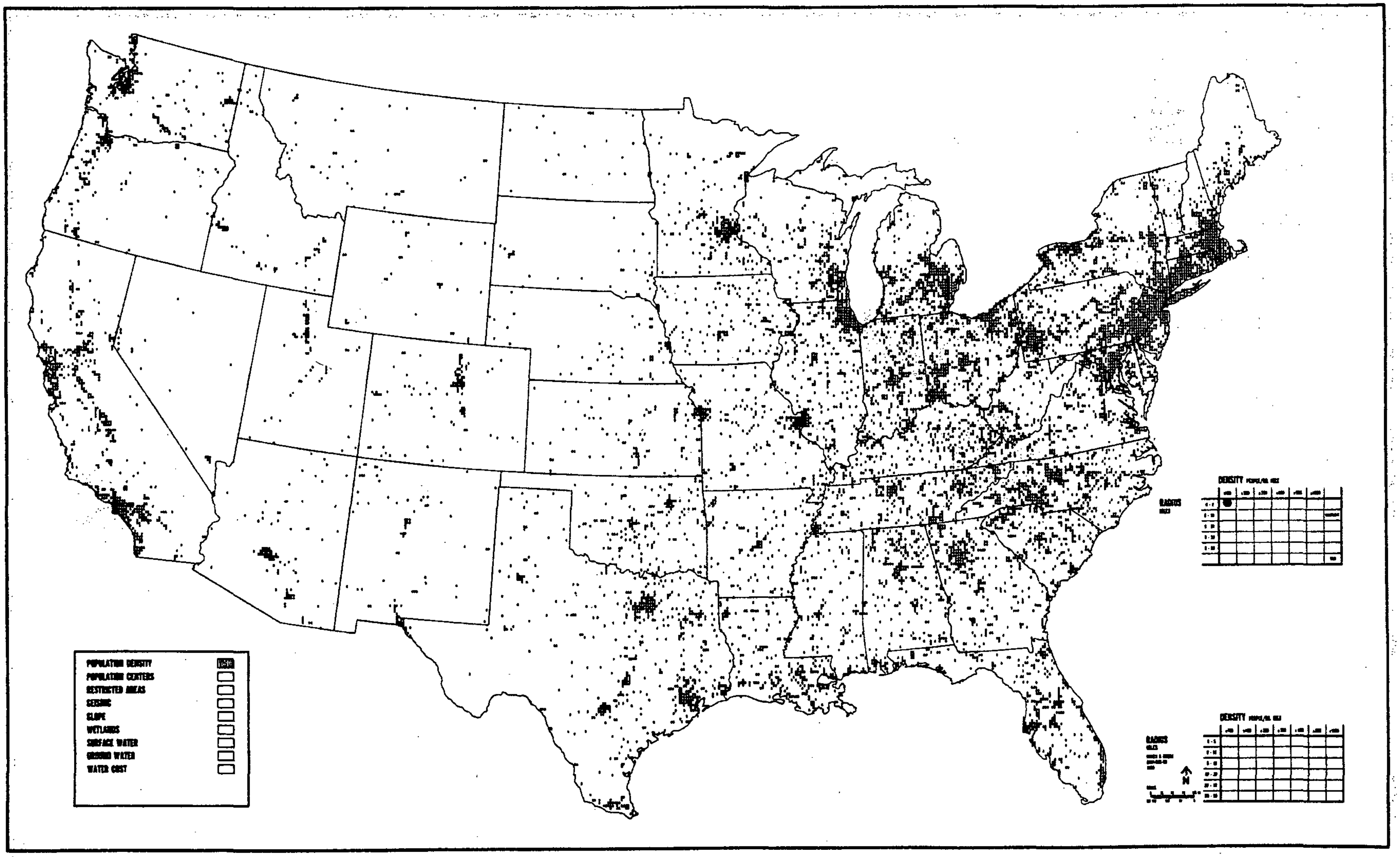
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.1

F-27

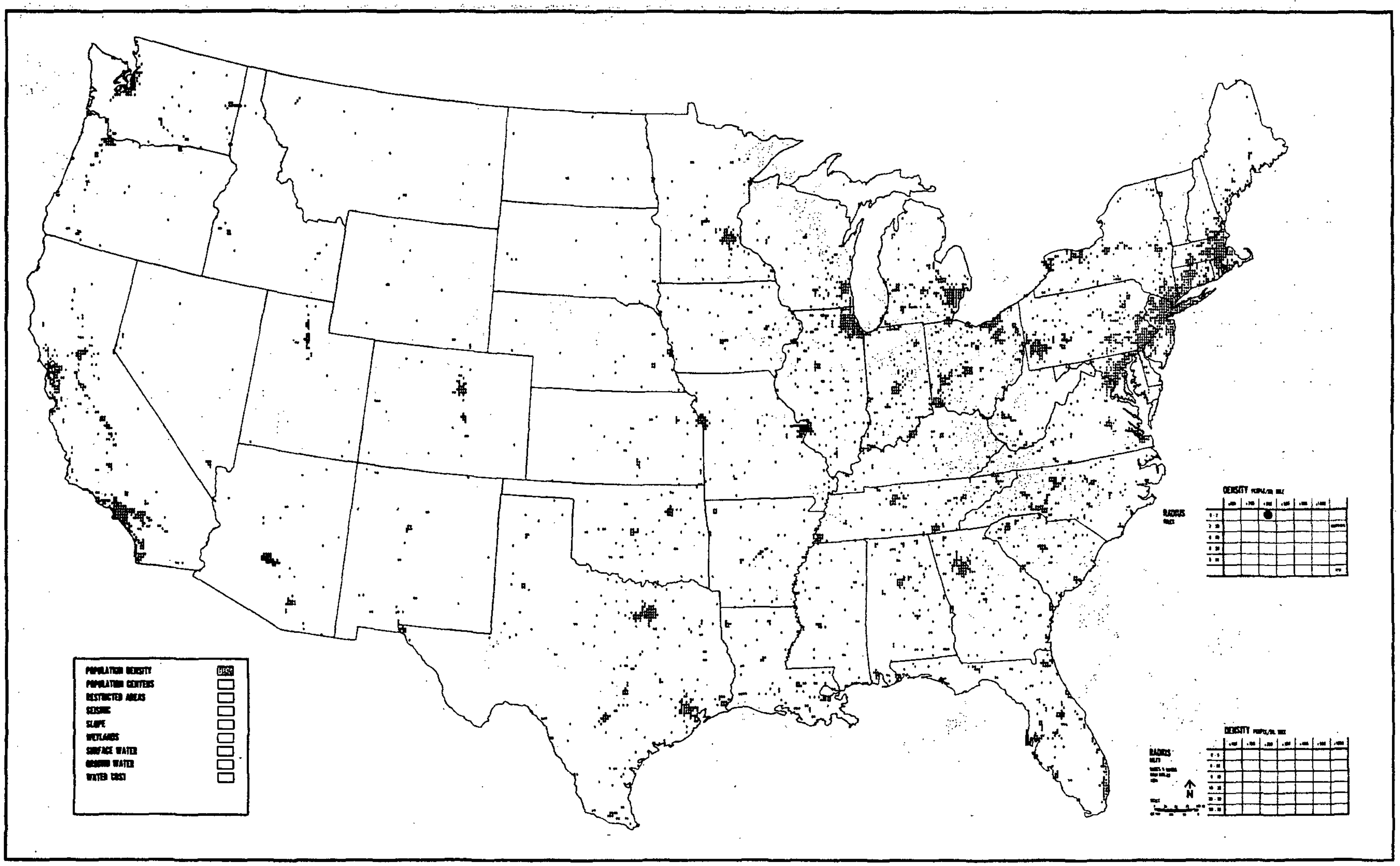

FIGURE F9.2

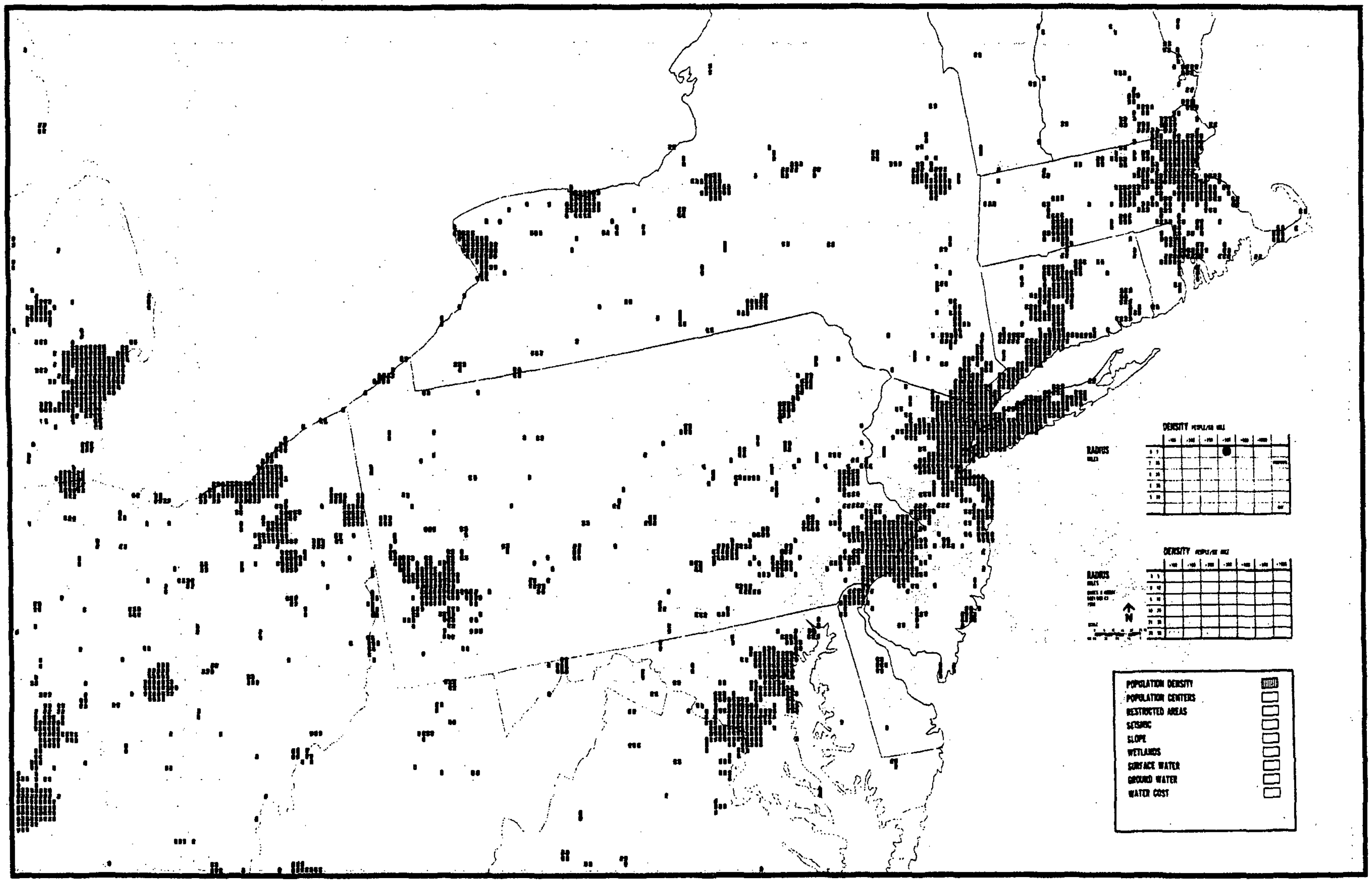
DENSITY
RADIUS
DENSITY
RADIUS
N
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.3

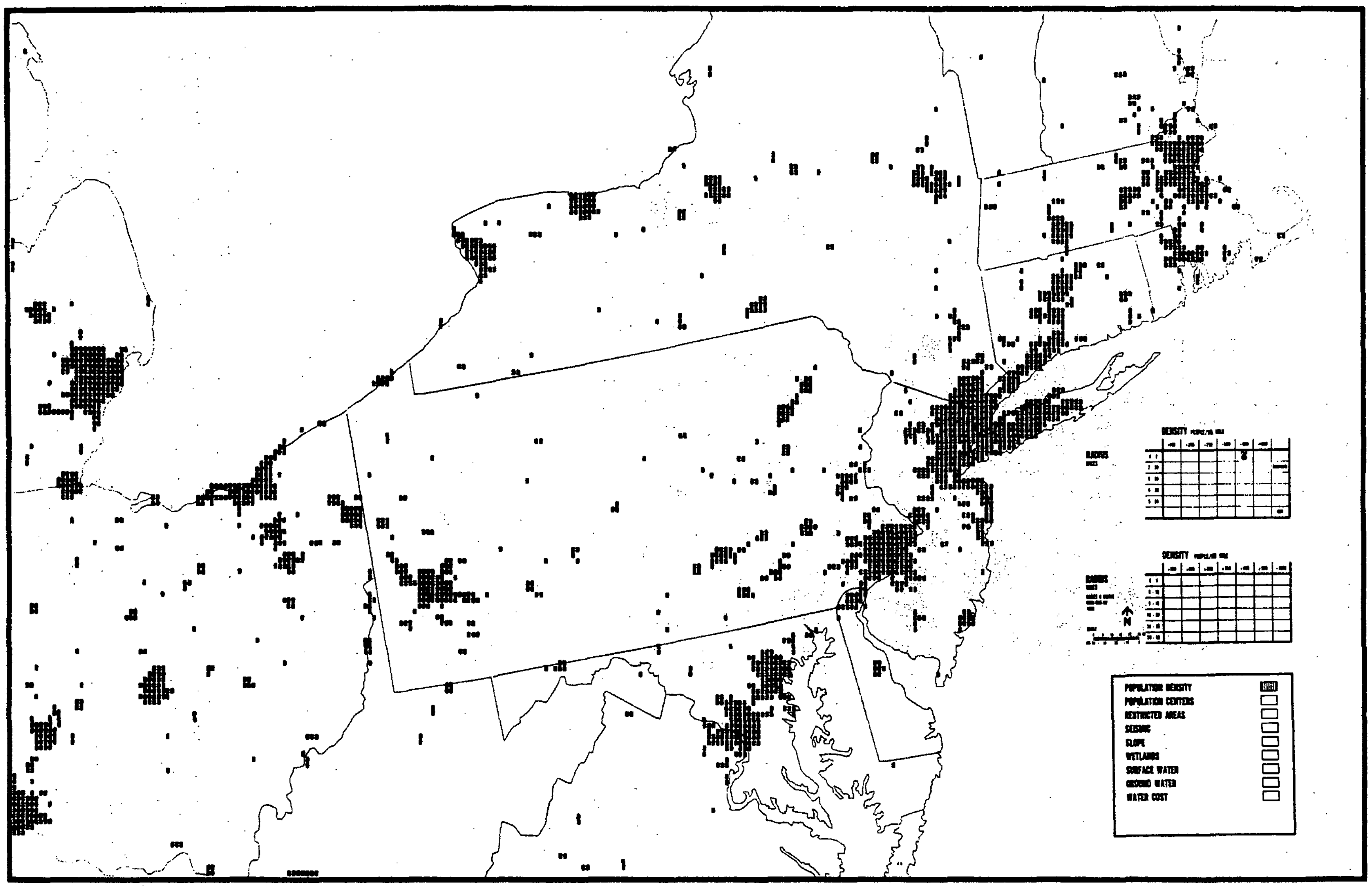
DENSITY
RADIUS
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.4

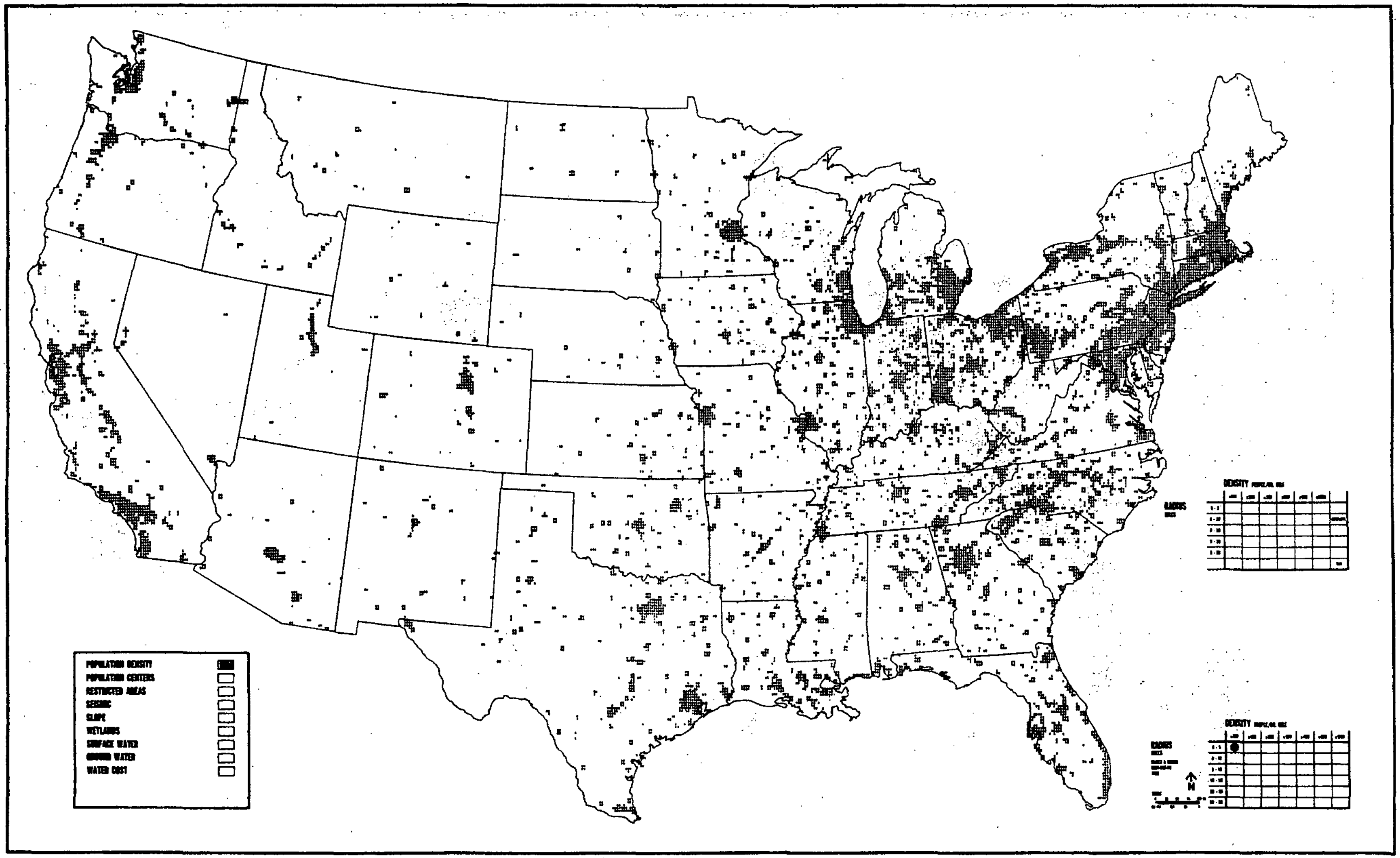
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS

FIGURE F9.5

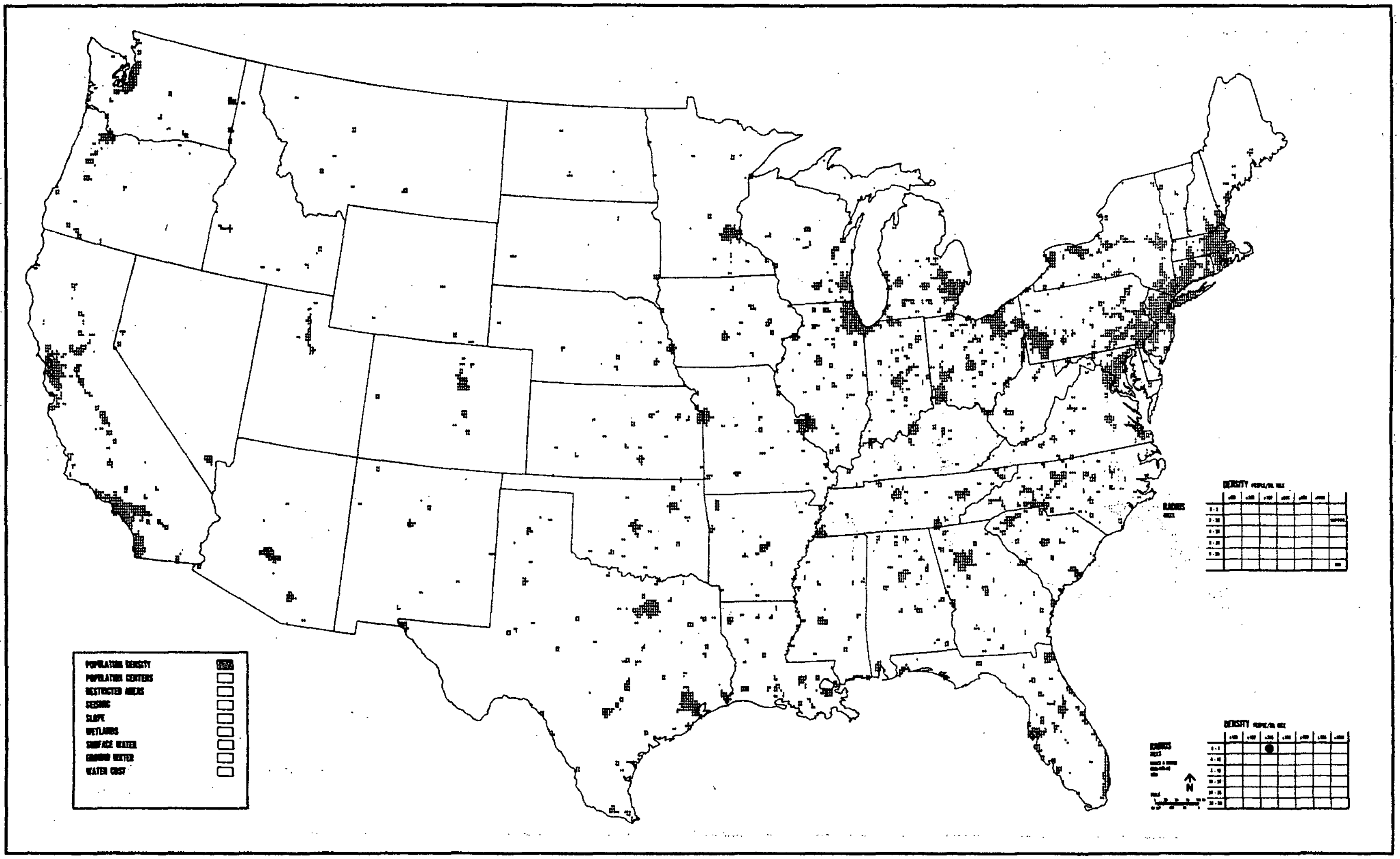
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.6

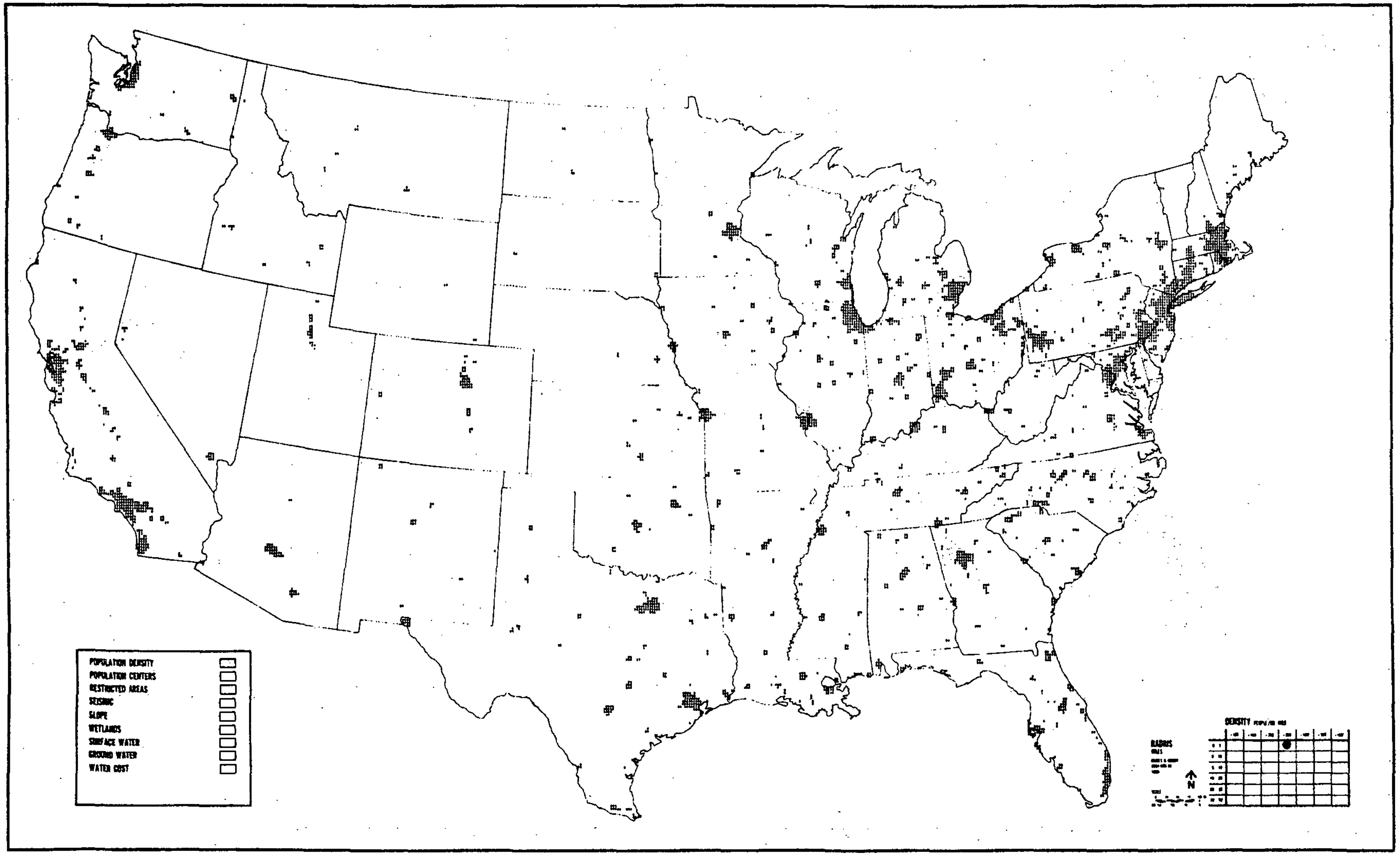
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
N

FIGURE F9.7

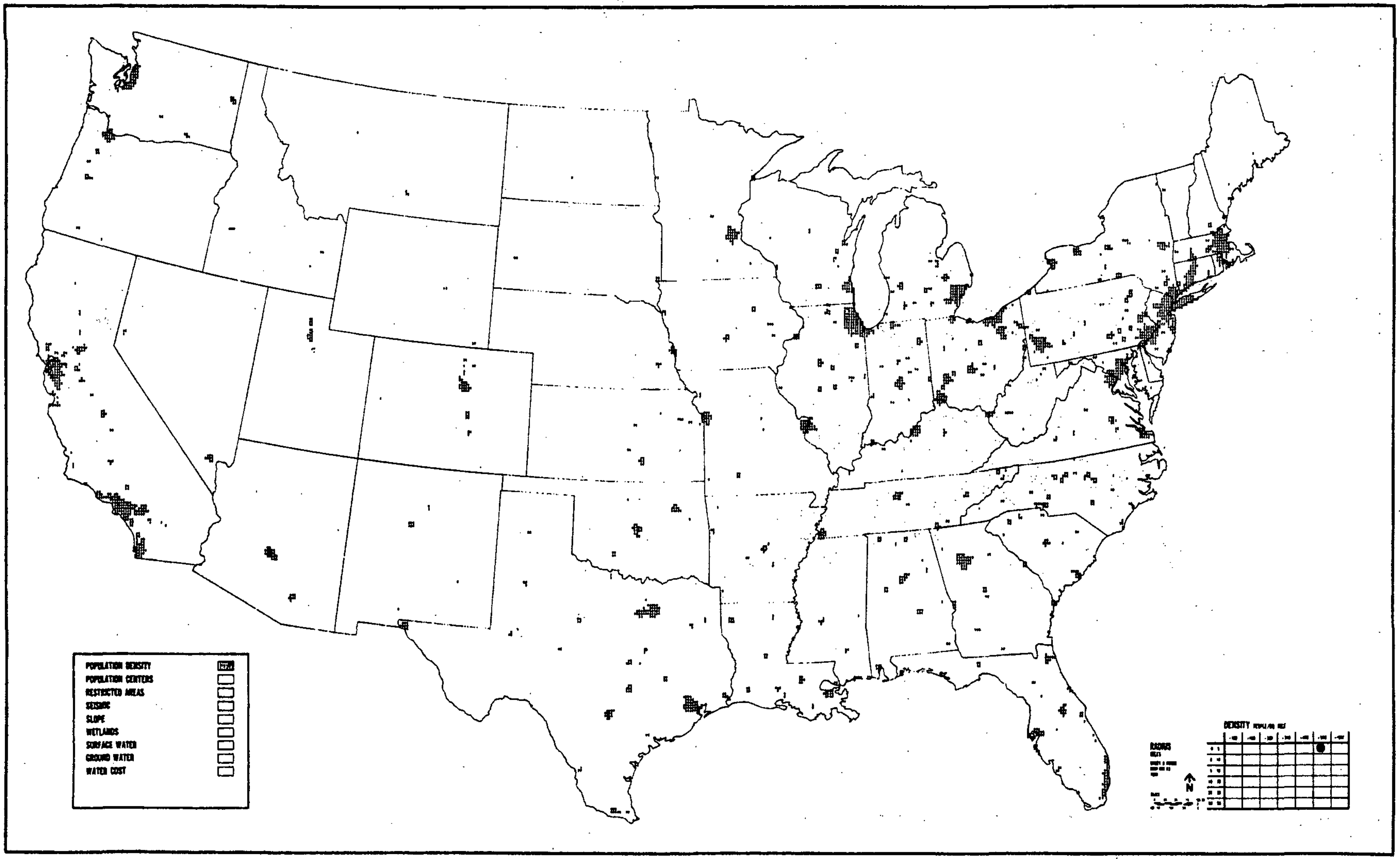
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY

FIGURE F9.8

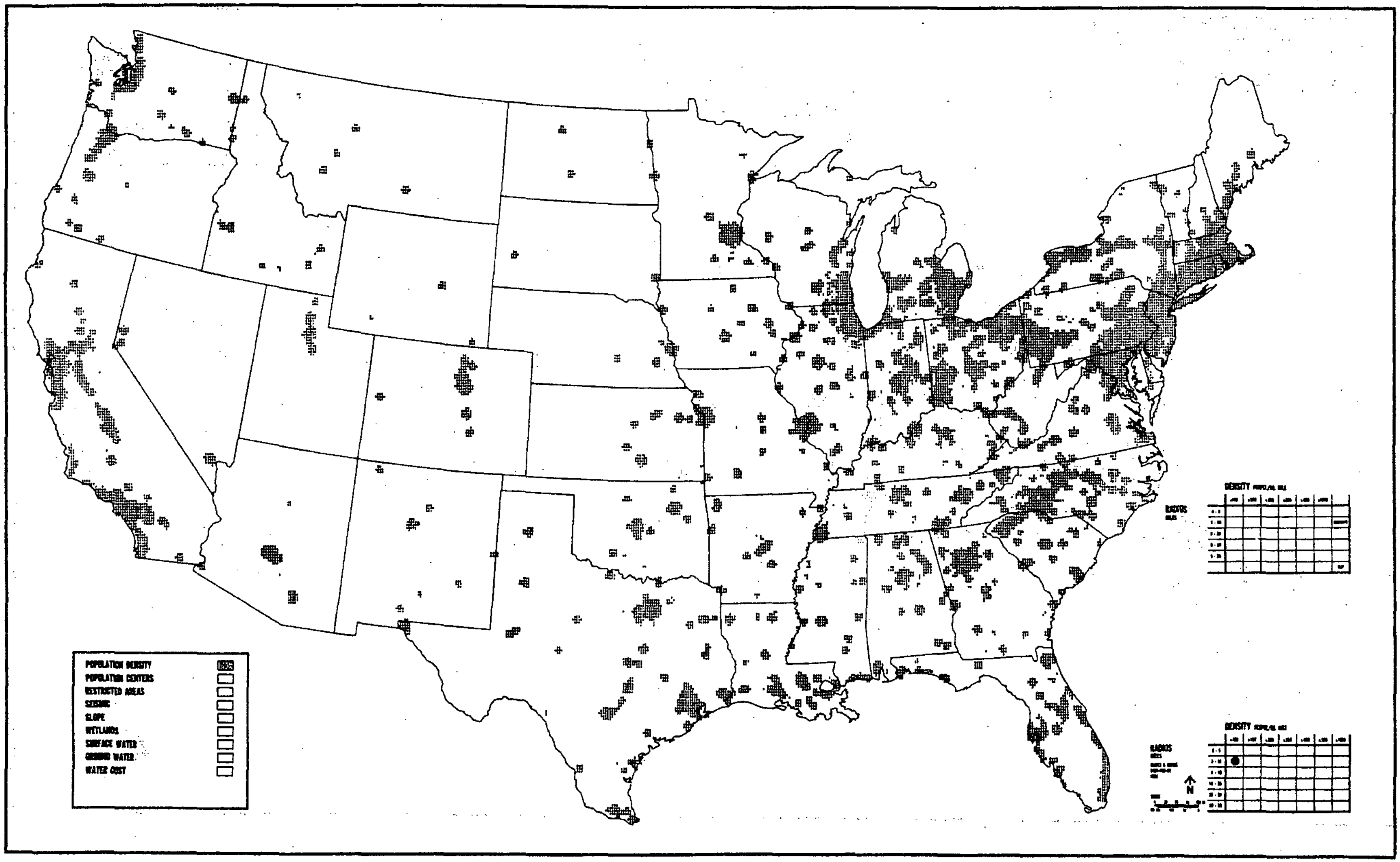
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.9

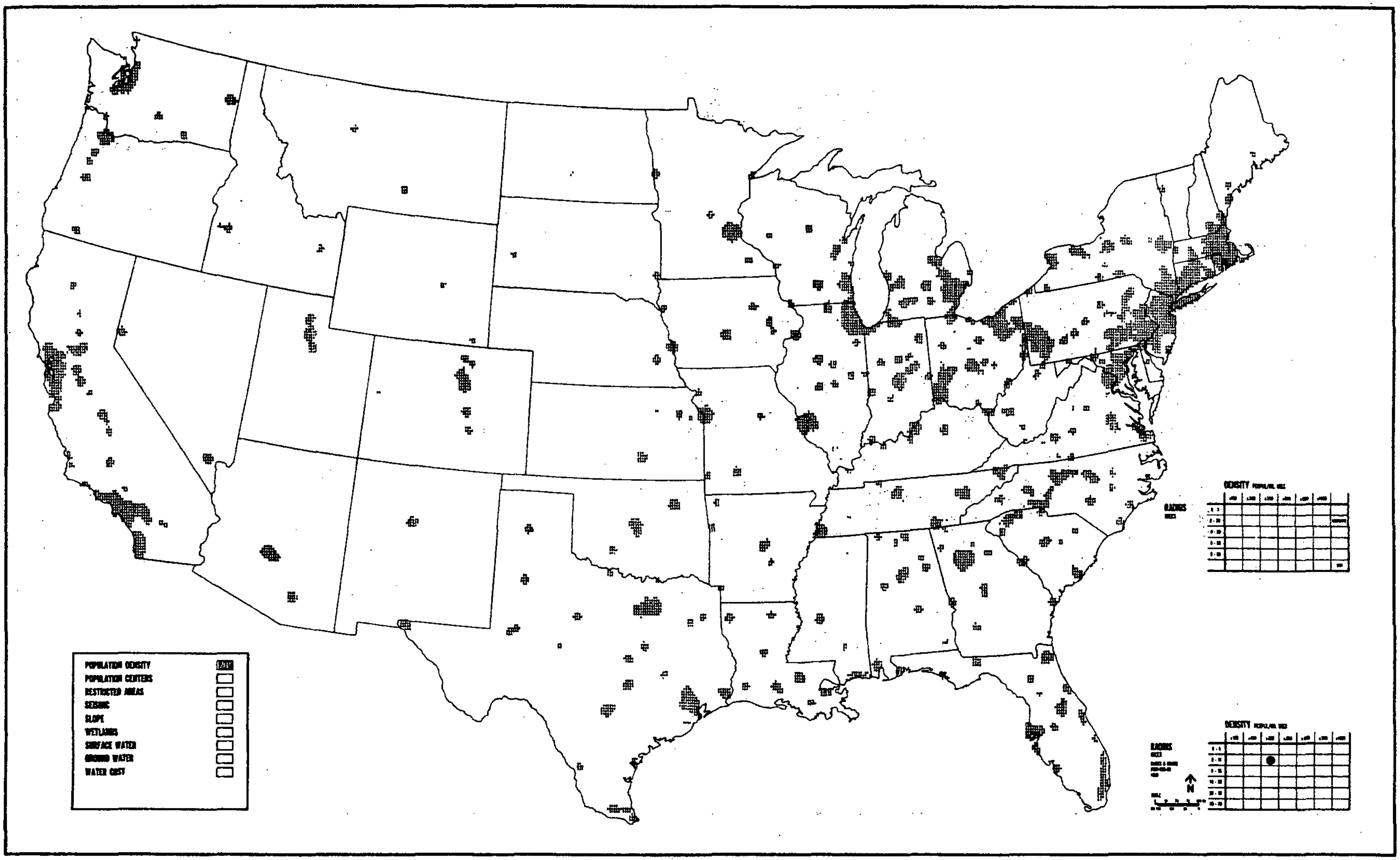
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
DENSITY
N

FIGURE F9.10


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.11

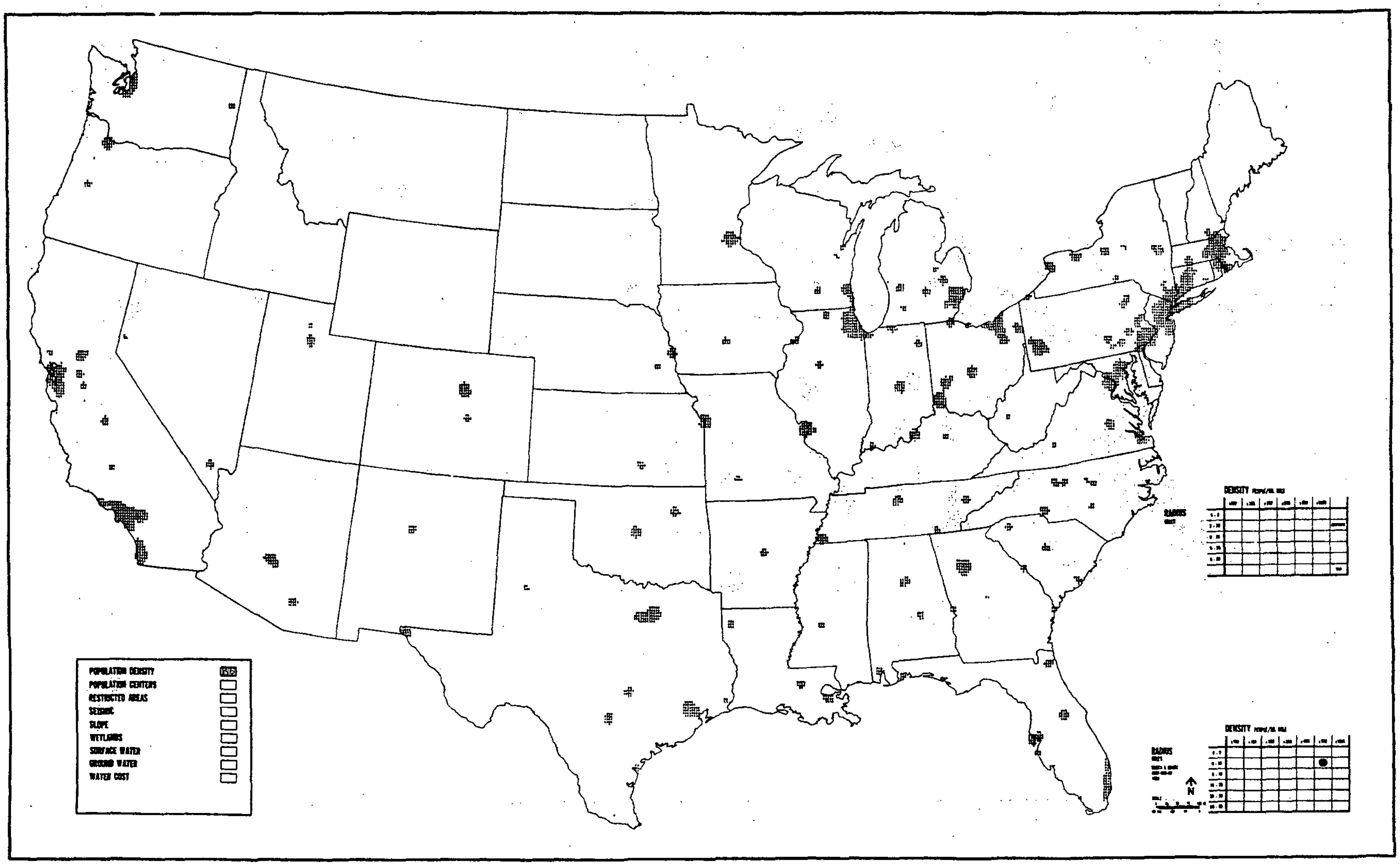
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
N

FIGURE F9.12

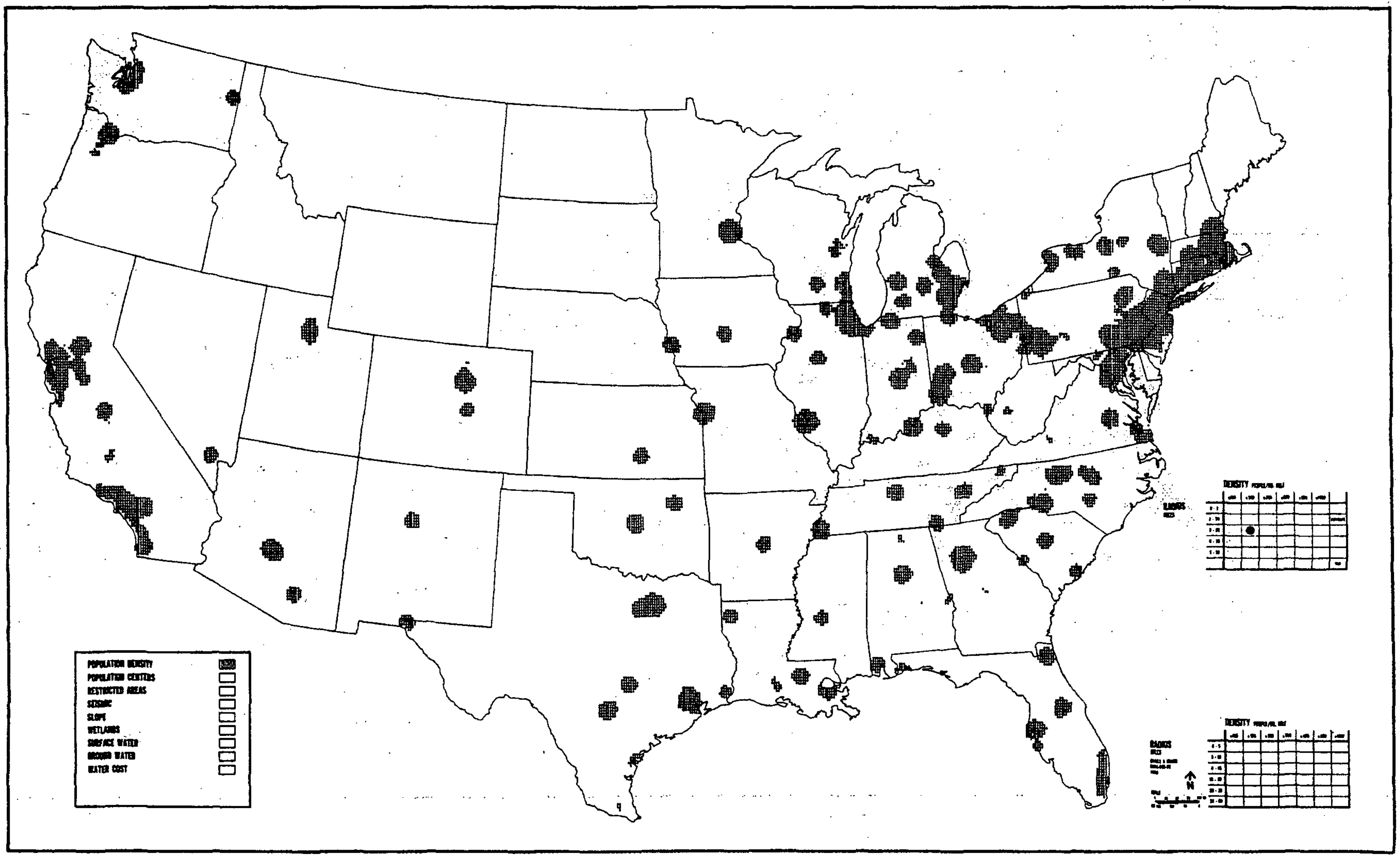
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.13

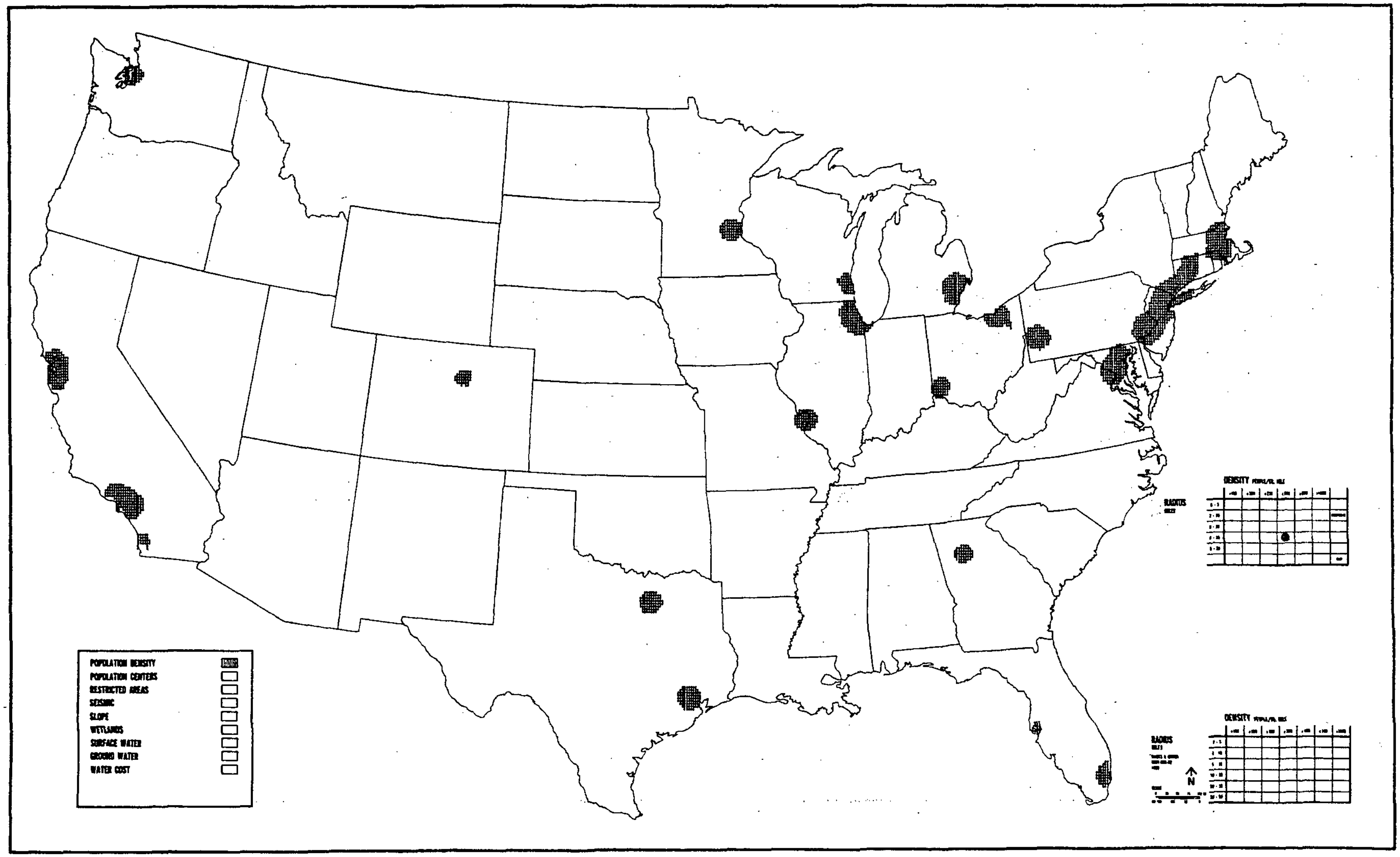
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.14

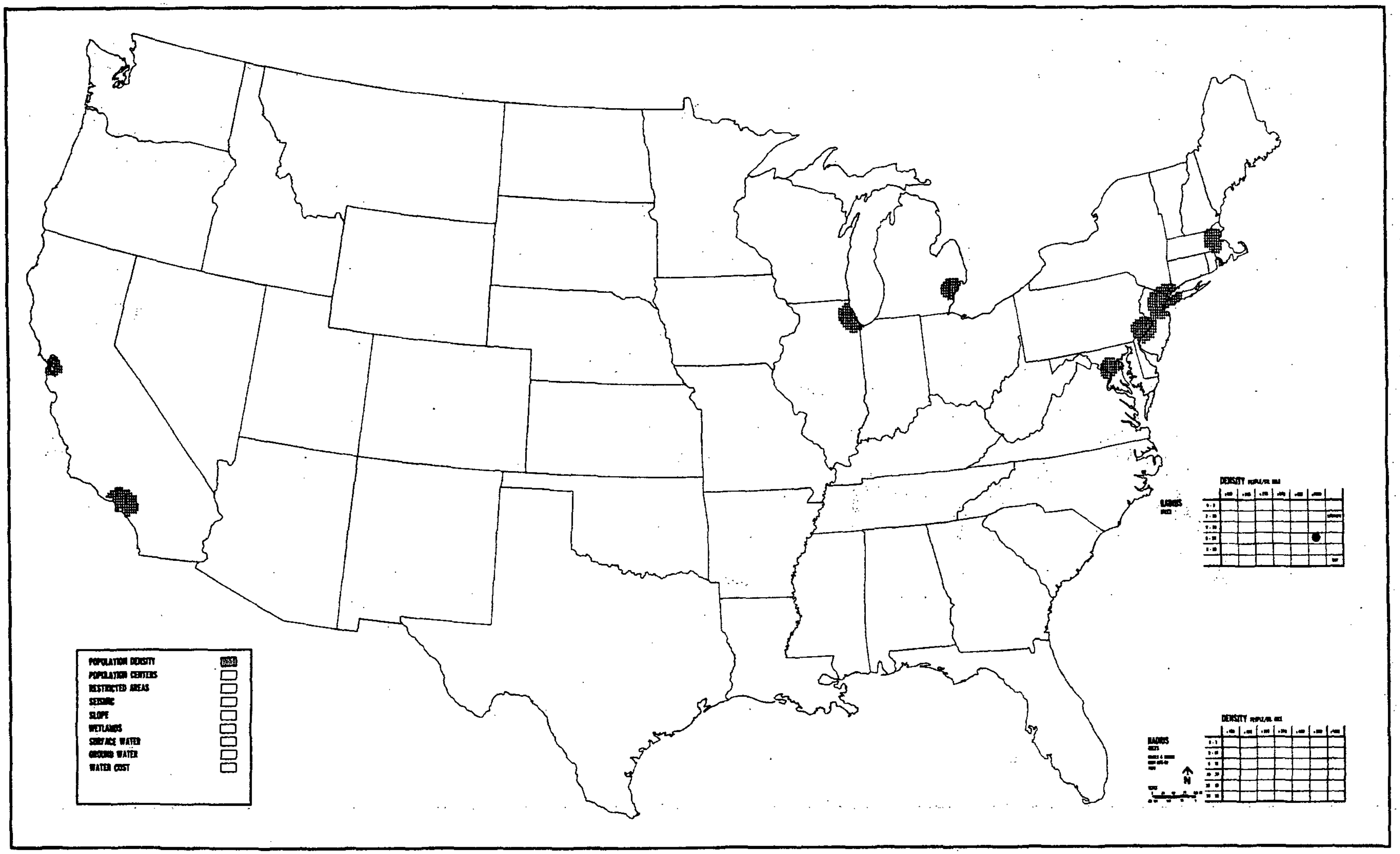
DENSITY
RADIUS
DENSITY
RADIUS
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.15

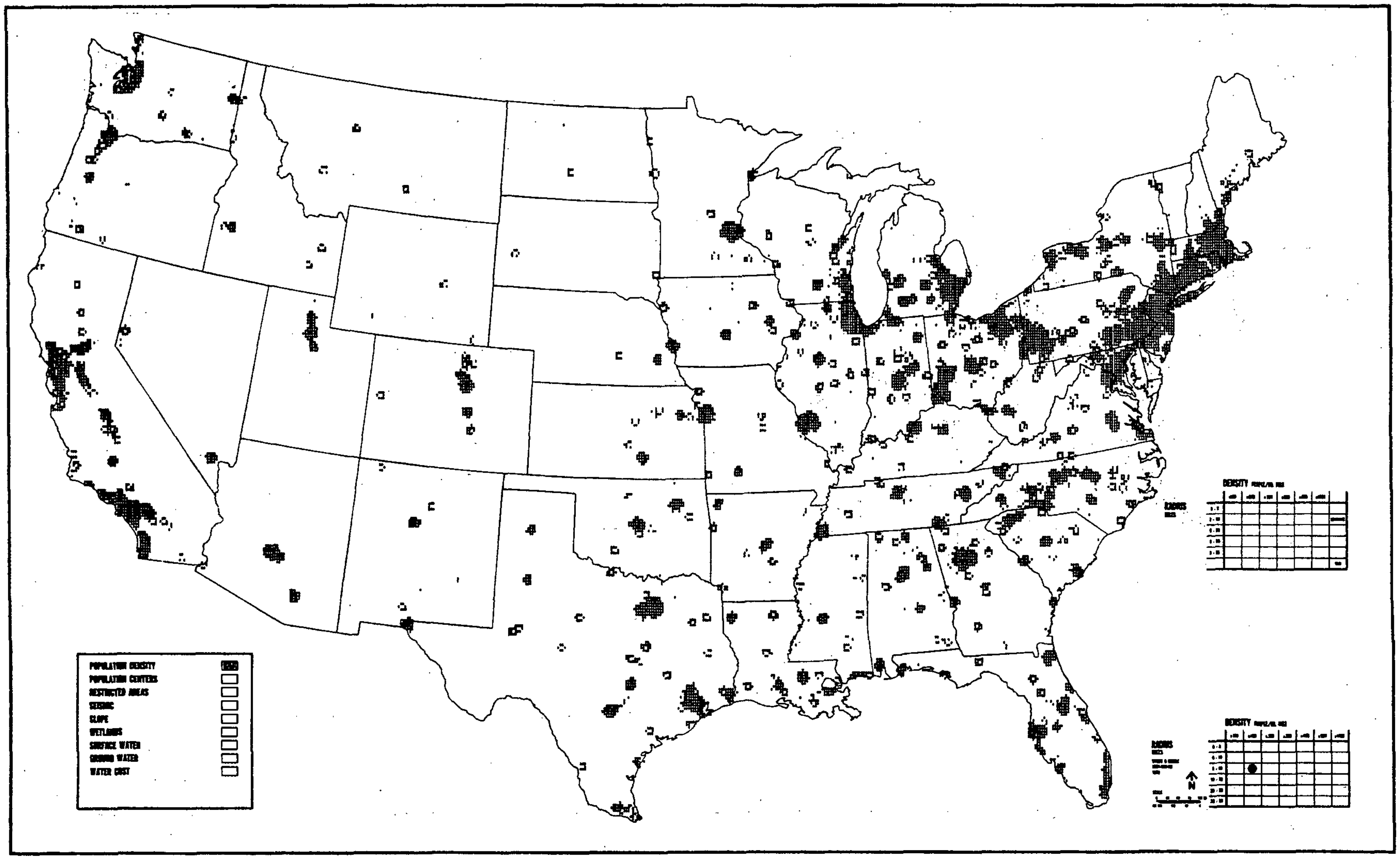
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS

FIGURE F9.16

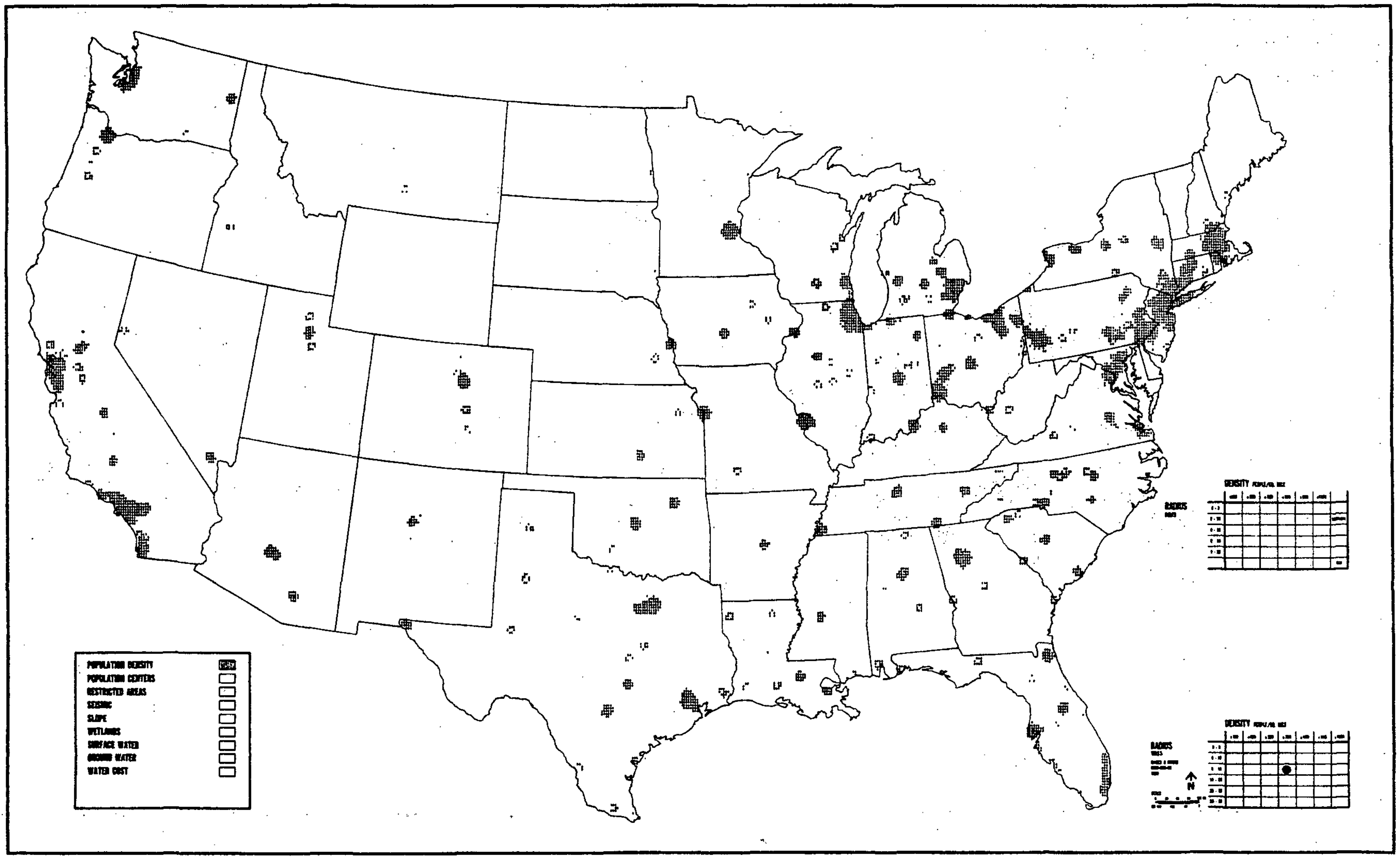
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.17


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS

FIGURE F9.18


DENSITY
RADIUS
DENSITY
RADIUS
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.19


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.20


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.21


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F9.22

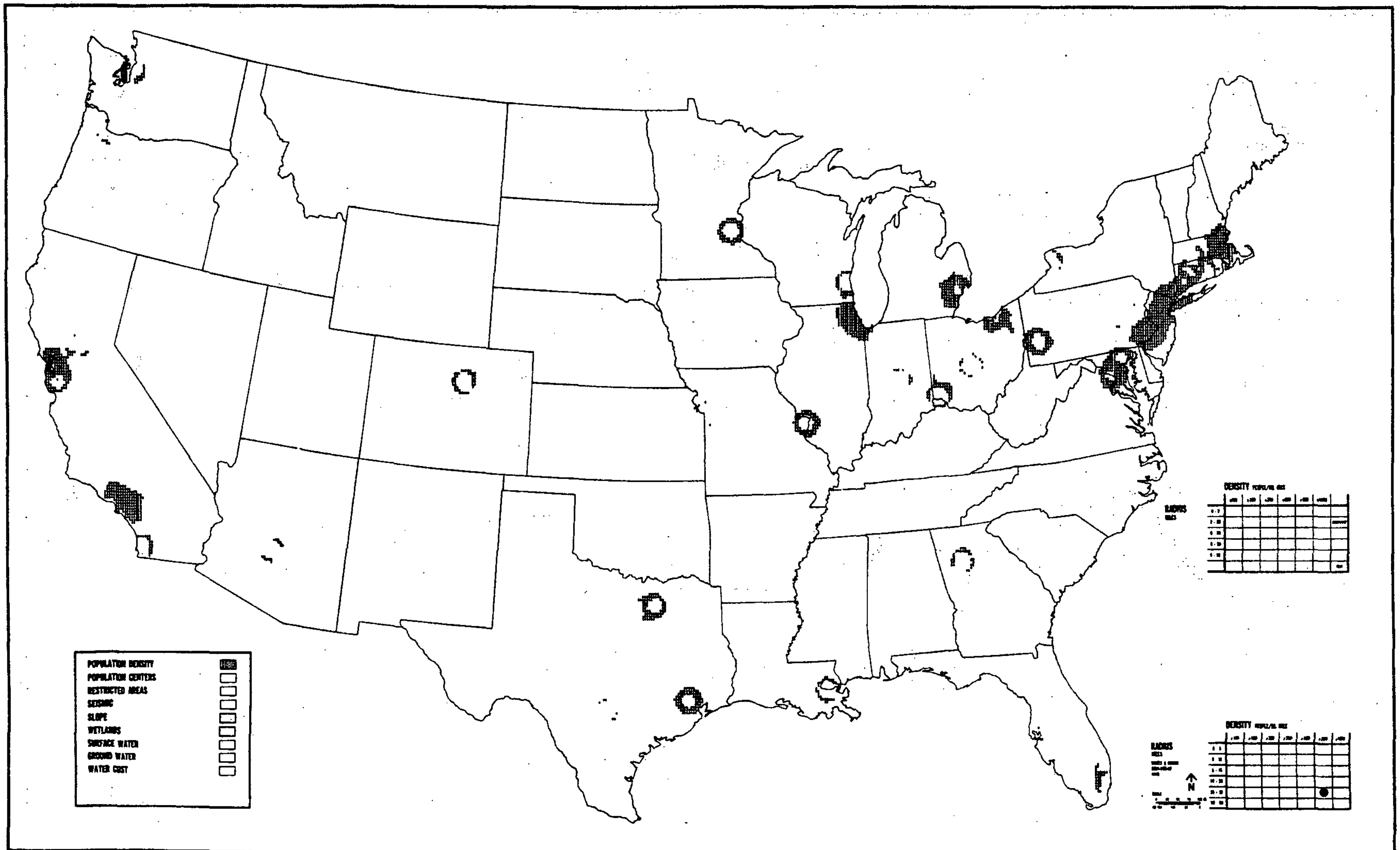
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.23


POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.24

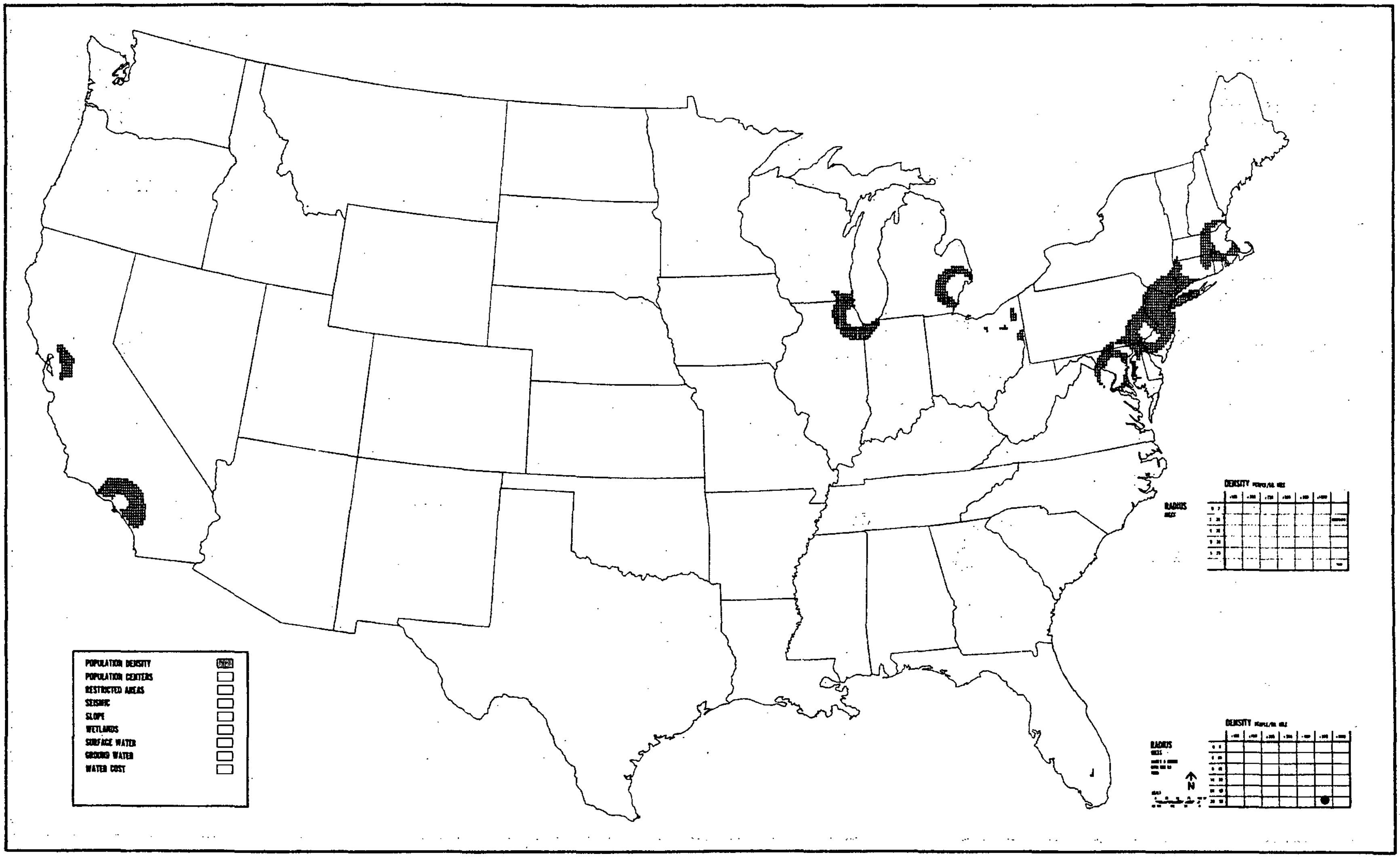
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.25

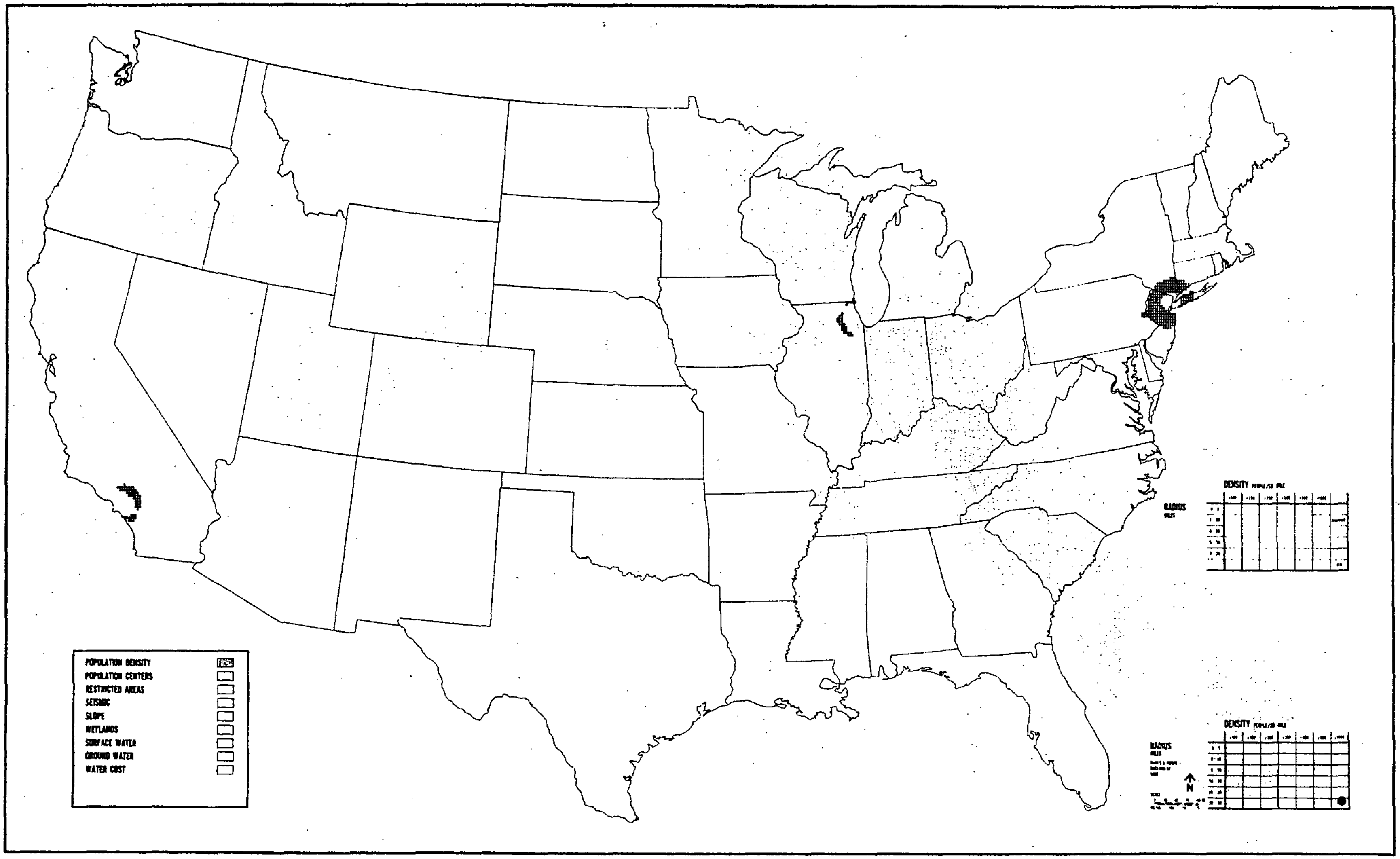
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS
N

FIGURE F9.26

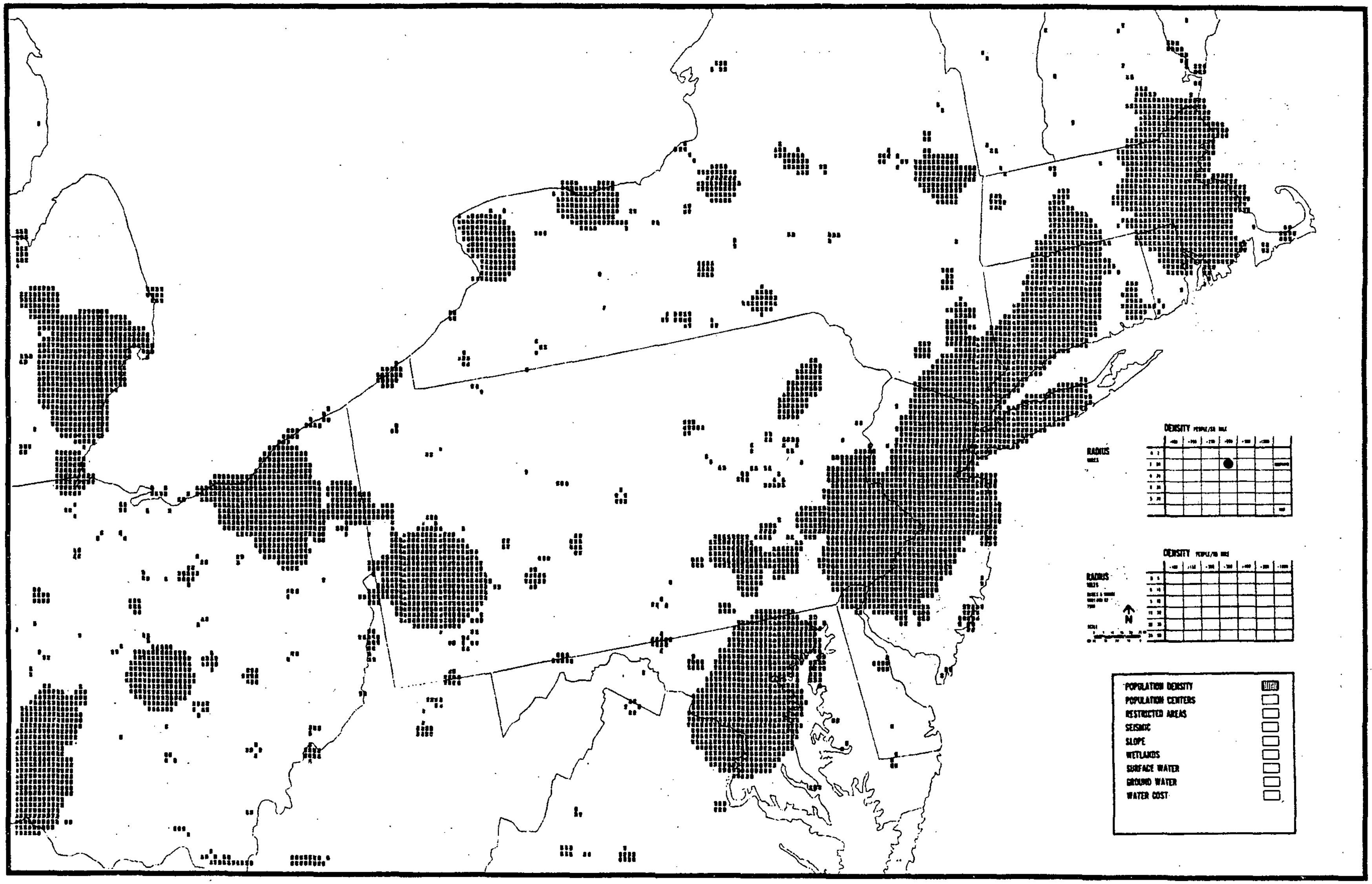
DENSITY
RADIUS
DENSITY
RADIUS
N
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F10.1

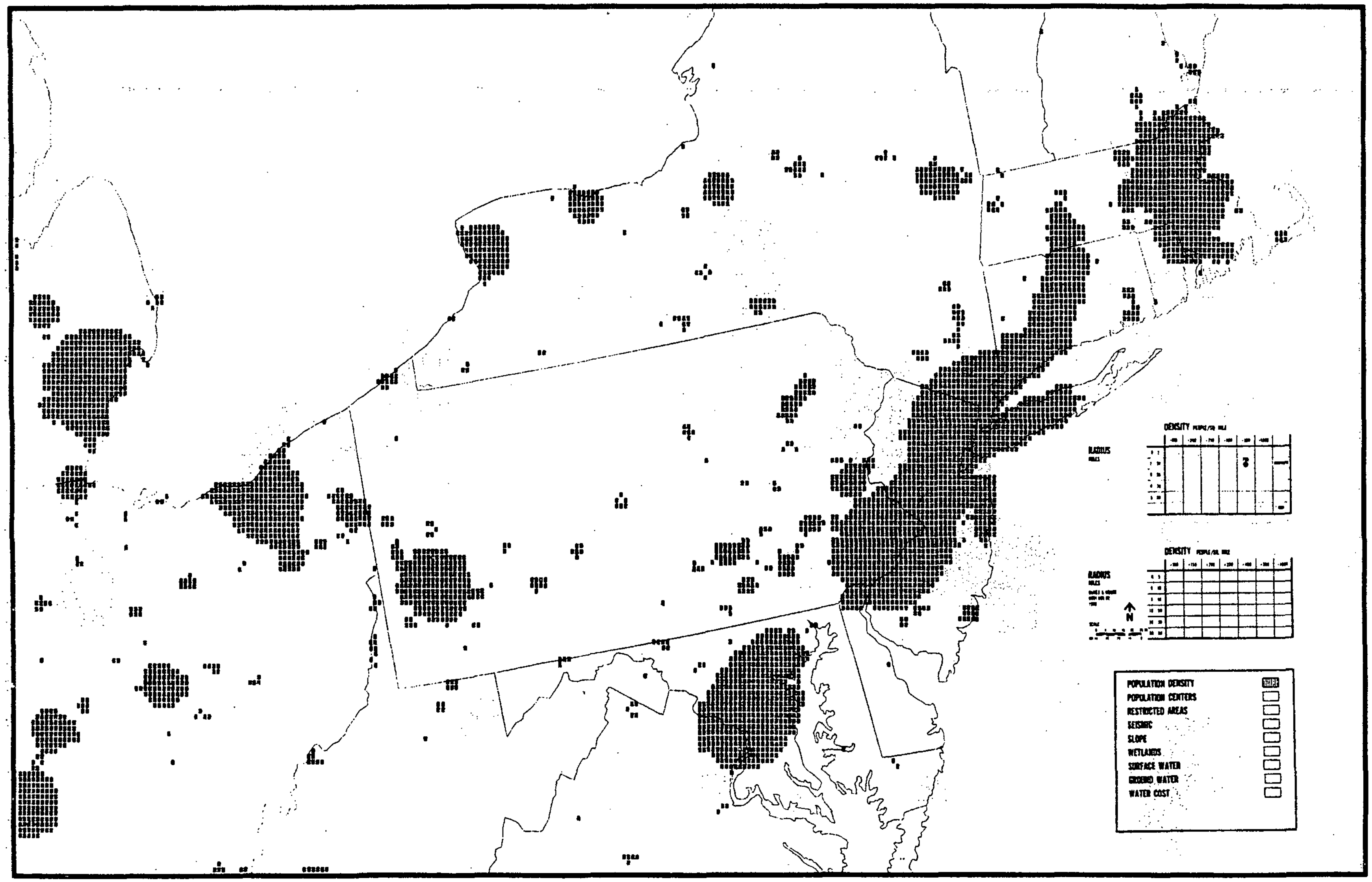
DENSITY
RADIUS
DENSITY
RADIUS
N
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F10-2

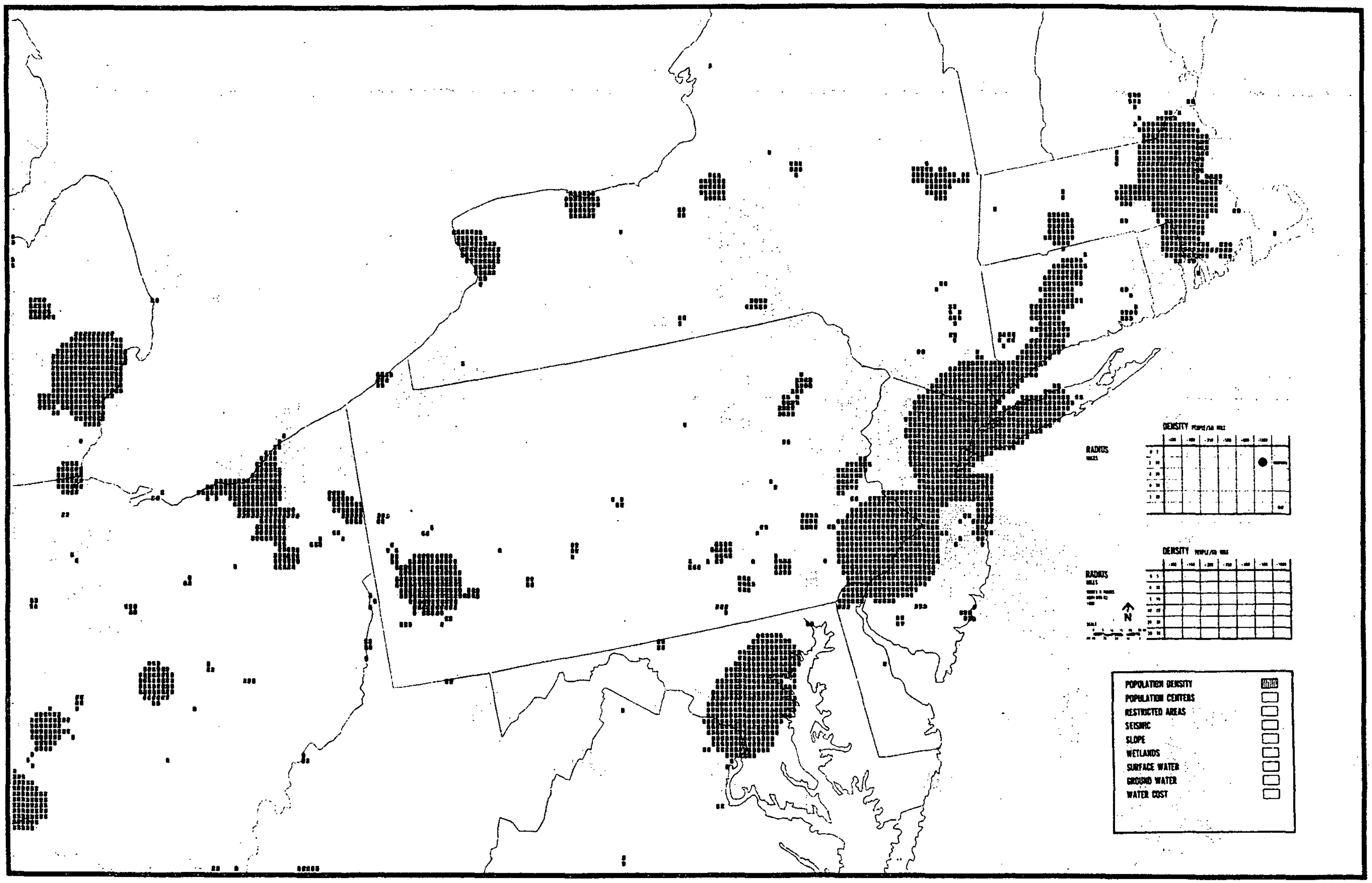
DENSITY
RADIUS
DENSITY
RADIUS
N
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F10.3

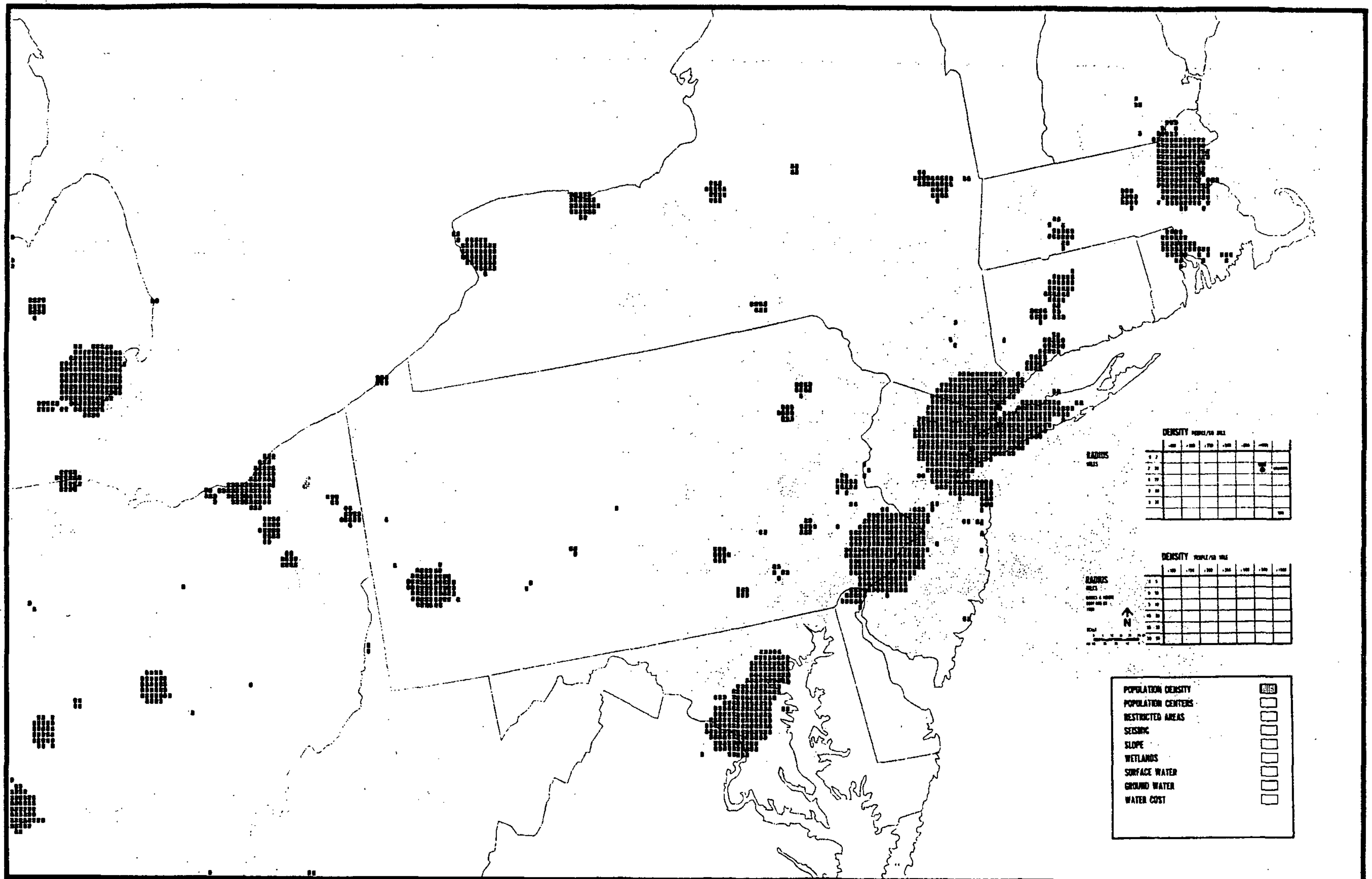
DENSITY
RADIUS
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST

FIGURE F10.4

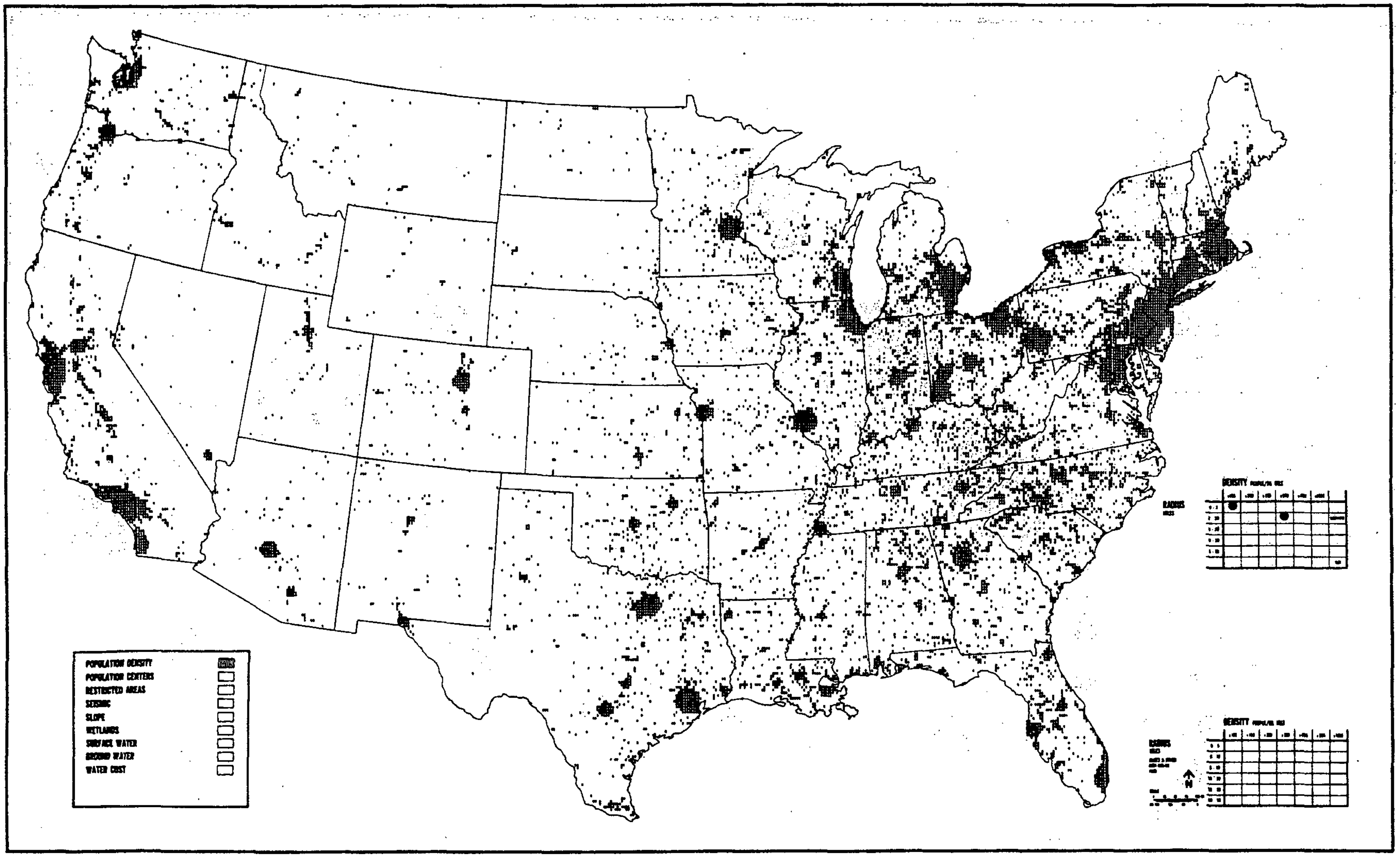
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
N

FIGURE F11

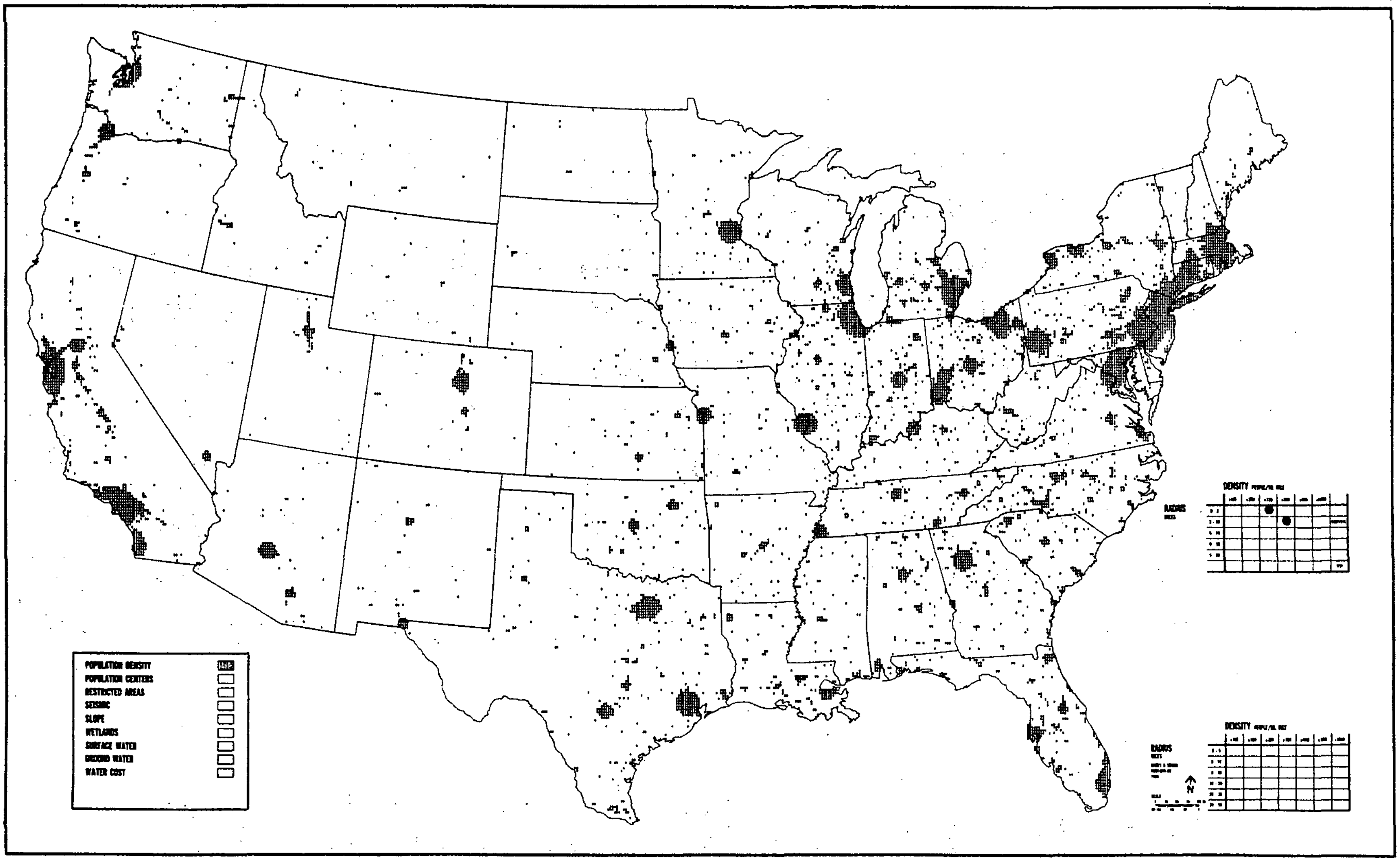
POPULATION DENSITY
POPULATION CENTERS
RESTRICTED AREAS
SEISMIC
SLOPE
WETLANDS
SURFACE WATER
GROUND WATER
WATER COST
DENSITY
RADIUS
DENSITY
RADIUS

FIGURE F12

TABLE F1.1

SEISMIC HARDENING UTILITY FUNCTION ***
COSTS IN MILLIONS OF DOLLARS (1980)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION

	INESTIMABLY HIGH	36 4 TO 42 4	30 3 TO 36 4	24 2 TO 30 3	16 2 TO 24 2	12 1 TO 16 2	6 1 TO 12 1	0 0 TO 6 1	RESTRICTED LAND	
UTILITY VALUE	1	2	3	4	5	6	7	8		
ALABAMA	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	164 0 3%	5702 11 0%	42458 84 7%	2275 4 0%	51907
ARIZONA	222 0 2%	10 0 0%	48 0 0%	97 0 1%	193 0 2%	5838 5 1%	2595 2 3%	45434 40 2%	59405 52 0%	114542
ARKANSAS	6340 11 9%	473 0 9%	521 1 0%	666 1 3%	724 1 4%	1968 3 7%	3744 7 0%	32542 61 1%	6267 11 8%	53259
CALIFORNIA	64028 39 9%	2200 1 4%	2142 1 3%	2895 1 8%	3416 2 1%	8338 5 2%	14195 8 9%	11697 7 3%	51452 32 1%	160362
COLORADO	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	926 0 9%	2152 2 1%	72587 69 6%	28660 27 5%	104325
CONNECTICUT	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	5211 100 0%	0 0 0%	0 0 0%	0 0 0%	5211
DELAWARE	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	2257 98 3%	38 1 7%	2296
FLORIDA	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	46252 77 9%	13105 22 1%	59357
GEORGIA	29 0 0%	434 0 7%	782 1 3%	1409 2 4%	3377 5 8%	14021 23 9%	6707 11 4%	25978 44 3%	9667 16 5%	56604
IDAHO	6736 8 1%	849 1 0%	946 1 1%	1206 1 4%	965 1 2%	2336 2 8%	6755 8 1%	26267 31 4%	37515 44 9%	63548
ILLINOIS	2364 4 2%	975 1 7%	1341 2 4%	1766 3 1%	2606 4 6%	8882 15 7%	5846 10 3%	31391 55 5%	1361 2 4%	56541
INDIANA	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0.0%	608 1 7%	2395 6 5%	32057 88 2%	1322 3 6%	36342
IOWA	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	299 0 5%	1467 2 6%	54301 96 9%	0 0 0%	56067
KANSAS	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0.0%	12188 14 8%	9795 11 9%	60091 73 0%	193 0 2%	82267
KENTUCKY	1283 3.2%	232 0.6%	174 0 4%	212 0 5%	415 1.0%	2683 6 7%	4207 10 4%	28593 71 0%	2470 6 1%	40268
LOUISIANA	0 0 0%	0 0 0%	0 0.0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	33736 70 1%	14417 29 9%	48153
MAINE	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0.0%	10721 31 5%	7981 23 4%	15015 44 1%	357 1 0%	34074
MARYLAND	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0.0%	0 0 0%	0 0 0%	11011 98 7%	145 1 3%	11156
MASSACHUSETTS	0 0 0%	0 0.0%	0 0 0%	0 0 0%	0 0.0%	8627 100 0%	0 0 0%	0 0 0%	0 0 0%	8627
MICHIGAN	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	52156 84 3%	9679 15 7%	61837
MINNESOTA	0 0 0%	0 0 0%	0 0 0%	0 0.0%	0 0 0%	0 0 0%	0 0 0%	60988 71 0%	24926 29 0%	85914
MISSISSIPPI	29 0 1%	125 0 3%	193 0 4%	261 0 5%	338 0 7%	1245 2 6%	2972 6 2%	38880 81 2%	3841 8 0%	47884
MISSOURI	7981 11 4%	589 0 8%	618 0 9%	685 1.0%	926 1 3%	4941 7 1%	7324 10 5%	42354 60 6%	4516 6 5%	69934
MONTANA	1351 0 9%	251 0.2%	376 0 3%	521 0 4%	2036 1 4%	10895 7 3%	6272 4.2%	79595 53 6%	47160 31 8%	148455
NEBRASKA	0 0.0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	5694 7 3%	3628 4 7%	66865 86 0%	1534 2 0%	77721
NEVADA	31565 28 5%	2220 2 0%	2953 2 7%	4767 4 3%	14311 12 9%	17978 16 3%	10692 9 7%	5877 5 3%	20255 18 3%	110618
NEW HAMPSHIRE	0 0 0%	0 0 0%	0 0.0%	0 0 0%	0 0 0%	7595 80 2%	676 7 1%	0 0 0%	1197 12 6%	9468
NEW JERSEY	0 0 0%	0 0.0%	0 0 0%	0 0 0%	0 0.0%	3049 38 1%	936 11 7%	4024 50 2%	0 0 0%	8009
NEW MEXICO	0 0 0%	0 0.0%	0 0.0%	0 0 0%	0 0.0%	18210 15 0%	11792 9 7%	60206 49 5%	31536 25 9%	121744
NEW YORK	0 0.0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	21037 41 9%	7151 14 2%	12101 24 1%	9930 19 8%	50219
NORTH CAROLINA	0 0 0%	0 0 0%	0 0.0%	0 0 0%	154 0 3%	10905 21 5%	4970 9 8%	26113 51 4%	8627 17 0%	50769
NORTH DAKOTA	0 0.0%	0 0 0%	0 0 0%	0 0 0%	0 0.0%	0 0 0%	0 0 0%	64433 90 7%	6572 9 3%	71005
OHIO	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0.0%	0 0 0%	0 0 0%	39507 94 4%	2326 5 6%	41833
OKLAHOMA	0 0 0%	0 0 0%	0 0 0%	0 0.0%	0 0.0%	24617 35 4%	15932 22 9%	25601 36 8%	3464 5 0%	69614
OREGON	0 0 0%	0 0 0%	0 0.0%	0 0 0%	0 0.0%	183 0.2%	454 0 5%	66942 68 4%	30349 31 0%	97928
PENNSYLVANIA	0 0 0%	0 0.0%	0 0 0%	0 0 0%	0 0 0%	6745 14 9%	4449 9 8%	30533 67 4%	3551 7 8%	45278
RHODE ISLAND	0 0 0%	0 0 0%	0 0.0%	0 0 0%	0 0.0%	1206 100 0%	0 0 0%	0 0.0%	0 0 0%	1206
SOUTH CAROLINA	12603 40 4%	1843 5 9%	2548 8 2%	2586 8 3%	5037 16.2%	3908 12 5%	0 0.0%	0 0 0%	2663 8 5%	31188
SOUTH DAKOTA	0 0 0%	0 0.0%	0 0.0%	0 0 0%	0 0.0%	0 0.0%	0 0 0%	54214 70 4%	22793 29 6%	77007
TENNESSEE	3532 8 4%	540 1 3%	569 1 4%	618 1.5%	637 1 5%	12342 29 3%	15508 36 8%	5780 13 7%	2596 6 2%	42122
TEXAS	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	1168 0 4%	262181 97 5%	5491 2 0%	268843
UTAH	17573 20 6%	1274 1 5%	1206 1 4%	1766 2 1%	2210 2 6%	4873 5 7%	5172 6 1%	25553 30 0%	25553 30 0%	85182
VERMONT	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	8830 89 6%	0 0.0%	0 0 0%	1023 10 4%	9853
VIRGINIA	0 0 0%	0 0 0%	0 0.0%	0 0.0%	58 0 1%	5404 13 1%	1583 3 8%	28458 69 1%	5665 13 8%	41165
WASHINGTON	7044 10 2%	396 0 6%	454 0 7%	511 0 7%	647 0 9%	2528 3 6%	5037 7 3%	27937 40 3%	24762 35 7%	69316
WEST VIRGINIA	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	1148 4 8%	1139 4 7%	19097 79 2%	2721 11 3%	24105
WISCONSIN	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	51954 91 2%	5028 8 8%	57022
WYOMING	608 0 6%	299 0 3%	270 0 3%	241 0 2%	299 0 3%	1264 1 3%	3252 3 3%	66527 67 9%	25225 25 7%	97985
TOTAL	163288 5 4%	12710 0 4%	15141 0 5%	20207 0 7%	38349 1 3%	257403 8 5%	183612 6 0%	1791572 58 9%	557672 18 3%	

*** UTILITY VALUES ARE DERIVED FROM MAP OF EFFECTIVE PEAK ACCELERATION EXPRESSED AS %g (GRAVITY) AND ASSOCIATED COSTS OF SEISMIC HARDENING. COSTS ARE RELEVANT TO 1100 MWe PLANT FOR SAFE SHUTDOWN EARTHQUAKE. THE %g HAS A PROBABILITY OF LESS THAN 0 5% OF BEING EXCEEDED IN 50 YEARS. "INESTIMABLY HIGH" REFERS TO AREAS WITH GREATER THAN 60%g. COSTS FOR AREAS WITH 20% TO 60%g WERE DIVIDED INTO EQUAL INTERVALS AND ASSIGNED UTILITY VALUES 2-6

TABLE F1.2

SITE PREPARATION UTILITY FUNCTION ***
PER CENT OF AREA LESS THAN 8% SLOPE (GENTLY SLOPING)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	UNDER 20% OF AREA	20% TO 50% OF AREA	50% TO 80% OF AREA	MORE THAN 80% AREA	RESTRICTED LANDS	
UTILITY VALUE	1	2	5	8		
ALABAMA	0	17360	30069	2403	2075	51907
	0%	33%	58%	5%	4%	
ARIZONA	125	2972	51348	492	59405	114342
	0%	3%	45%	0%	52%	
ARKANSAS	6369	7131	14581	18914	6263	53258
	12%	13%	27%	36%	12%	
CALIFORNIA	26875	21259	35223	25515	51492	160364
	17%	13%	22%	16%	32%	
COLORADO	7286	13626	46822	7932	28660	104326
	7%	13%	45%	8%	27%	
CONNECTICUT	0	2673	2538	0	0	5211
	0%	51%	49%	0%	0%	
DELAWARE	0	0	68	2220	39	2327
	0%	0%	3%	95%	2%	
FLORIDA	0	0	4941	41312	13105	59358
	0%	0%	8%	70%	22%	
GEORGIA	550	5742	30755	15691	5867	58605
	1%	10%	52%	27%	10%	
IDAHO	4362	13809	27860	0	37519	83550
	5%	17%	33%	0%	45%	
ILLINOIS	0	1013	29461	24704	1361	56539
	0%	2%	52%	44%	2%	
INDIANA	0	2557	13317	19146	1322	36342
	0%	7%	37%	53%	4%	
IOWA	0	13896	37249	4922	0	56067
	0%	25%	66%	9%	0%	
KANSAS	0	8502	48540	25032	193	82267
	0%	10%	59%	30%	0%	
KENTUCKY	9785	14678	13056	280	2470	40269
	24%	36%	32%	1%	6%	
LOUISIANA	0	0	9573	24164	14417	48154
	0%	0%	20%	50%	30%	
MAINE	618	11223	21877	0	357	34075
	2%	33%	64%	0%	1%	
MARYLAND	0	1351	5809	3850	145	11155
	0%	12%	52%	35%	1%	
MASSACHUSETTS	0	2741	5887	0	0	8628
	0%	32%	68%	0%	0%	
MICHIGAN	0	0	30166	21992	9679	61837
	0%	0%	49%	36%	16%	
MINNESOTA	0	1187	34817	24984	24926	85914
	0%	1%	41%	29%	29%	
MISSISSIPPI	0	4507	29770	9766	3841	47884
	0%	9%	62%	20%	8%	
MISSOURI	7662	26904	18846	12005	4516	69933
	11%	38%	27%	17%	6%	
MONTANA	3542	41427	56327	0	47160	148456
	2%	28%	38%	0%	32%	
NEBRASKA	0	27097	31546	17544	1534	77721
	0%	35%	41%	23%	2%	
NEVADA	0	2490	87844	29	20255	110618
	0%	2%	79%	0%	18%	
NEW HAMPSHIRE	772	5269	2229	0	1197	9467
	8%	56%	24%	0%	13%	
NEW JERSEY	0	1013	1554	5443	0	8010
	0%	13%	19%	68%	0%	
NEW MEXICO	5250	8849	62638	13471	31536	121744
	4%	7%	51%	11%	26%	
NEW YORK	3136	11252	24926	975	9930	50219
	6%	22%	50%	2%	20%	
NORTH CAROLINA	2461	2586	19454	17640	8627	50768
	5%	5%	38%	35%	17%	
NORTH DAKOTA	0	2432	33370	28632	6572	71006
	0%	3%	47%	40%	9%	
OHIO	9447	154	14649	15257	2326	41833
	23%	0%	35%	36%	6%	
OKLAHOMA	1090	4680	49447	10933	3464	69614
	2%	7%	71%	16%	5%	
OREGON	16695	18789	32096	0	30349	97929
	17%	19%	33%	0%	31%	
PENNSYLVANIA	7054	24743	9891	39	3551	45278
	16%	55%	22%	0%	8%	
RHODE ISLAND	0	0	1206	0	0	1206
	0%	0%	100%	0%	0%	
SOUTH CAROLINA	338	376	11985	15826	2663	31188
	1%	1%	38%	51%	9%	
SOUTH DAKOTA	1274	4169	31874	16897	22793	77007
	2%	5%	41%	22%	30%	
TENNESSEE	1312	19522	17727	965	2596	42122
	3%	46%	42%	2%	6%	
TEXAS	5394	8106	174906	74942	5491	268839
	2%	3%	65%	28%	2%	
UTAH	1708	8386	43483	6051	25553	85181
	2%	10%	51%	7%	30%	
VERMONT	1640	5616	1573	0	1023	9852
	17%	57%	16%	0%	10%	
VIRGINIA	2982	5501	22957	4063	5665	41168
	7%	13%	56%	10%	14%	
WASHINGTON	10277	12555	21722	0	24762	69316
	15%	18%	31%	0%	36%	
WEST VIRGINIA	16936	4072	376	0	2721	24105
	70%	17%	2%	0%	11%	
WISCONSIN	0	10567	33283	8145	5028	57023
	0%	19%	58%	14%	9%	
WYOMING	6253	13105	53403	0	25225	97986
	6%	13%	55%	0%	26%	
TOTAL	161193	415887	1383039	522176	557673	
	5%	14%	45%	17%	18%	

*** SITE PREPARATION UTILITY IS DERIVED FROM A CONSIDERATION OF AN AREA'S TOPOGRAPHIC CHARACTER SOURCE DATA IS A MAP INDICATING % OF AREA THAT IS GENTLY SLOPING (LESS THAN 8% SLOPE) AND CONTAINS 4 CATEGORIES UTILITY VALUES WERE ASSIGNED ON THE BASIS OF RELATIVE DEGREE OF DIFFICULTY FOR ACCESS AND CONSTRUCTION

TABLE 1.3

AGGREGATE WATER (SURFACE & GROUND) UTILITY FUNCTION ***
COSTS IN MILLIONS OF DOLLARS (1980)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	1 (MORE THAN $300 MILL)	2 (262.5 TO 300.0)	3 (225.0 TO 262.5)	4 (187.5 TO 225.0)	5 (150.0 TO 187.5)	6 (112.5 TO 150.0)	7 (75.0 TO 112.5)	8 (37.5 TO 75.0)	9 (4.5 TO 37.5)	RESTRICTED LAND	
UTILITY VALUE	1	2	3	4	5	6	7	8	9		
ALABAMA	0	0	0	0	87	1370	10364	19686	18325	2075	51927
	0%	0%	0%	0%	0%	3%	20%	38%	35%	4%	
ARIZONA	859	376	647	1119	1563	8135	36303	3638	2297	59405	114342
	1%	0%	1%	1%	1%	7%	32%	3%	2%	52%	
ARKANSAS	0	0	0	0	1814	1988	6562	17795	18837	6263	53259
	0%	0%	0%	0%	3%	4%	12%	33%	35%	12%	
CALIFORNIA	0	0	77	473	926	1419	63391	20709	21877	51492	160364
	0%	0%	0%	0%	1%	1%	40%	13%	14%	32%	
COLORADO	29876	2441	2490	3069	4449	5462	11406	11956	4516	28660	104325
	29%	2%	2%	3%	4%	5%	11%	11%	4%	27%	
CONNECTICUT	0	0	0	0	0	0	656	2104	2451	0	5211
	0%	0%	0%	0%	0%	0%	13%	40%	47%	0%	
DELAWARE	0	0	0	0	0	0	0	637	1650	39	2326
	0%	0%	0%	0%	0%	0%	0%	27%	71%	2%	
FLORIDA	0	0	0	0	0	0	10	20632	25611	13105	59358
	0%	0%	0%	0%	0%	0%	0%	35%	43%	22%	
GEORGIA	0	0	0	0	39	376	9505	24125	18692	5867	58604
	0%	0%	0%	0%	0%	1%	16%	41%	32%	10%	
IDAHO	77	309	405	724	868	1361	17438	11908	12941	37519	83557
	0%	0%	0%	1%	1%	2%	21%	14%	15%	45%	
ILLINOIS	0	0	0	0	0	0	10480	26460	18239	1361	56540
	0%	0%	0%	0%	0%	0%	19%	47%	32%	2%	
INDIANA	0	0	0	0	0	0	4680	18721	11619	1322	36342
	0%	0%	0%	0%	0%	0%	13%	52%	32%	4%	
IOWA	0	0	0	0	77	627	26470	19039	9853	0	56066
	0%	0%	0%	0%	0%	1%	47%	34%	18%	0%	
KANSAS	26441	3493	3262	3252	3870	6996	12825	16473	5462	193	82267
	32%	4%	4%	4%	5%	9%	16%	20%	7%	0%	
KENTUCKY	0	0	0	0	560	2171	9322	15353	10393	2470	40269
	0%	0%	0%	0%	1%	5%	23%	38%	26%	6%	
LOUISIANA	0	0	0	0	29	347	4564	12767	16029	14417	48153
	0%	0%	0%	0%	0%	1%	9%	27%	33%	30%	
MAINE	0	0	0	0	0	0	11348	11406	10962	357	34073
	0%	0%	0%	0%	0%	0%	33%	33%	32%	1%	
MARYLAND	0	0	0	0	0	77	1216	2258	7459	145	11155
	0%	0%	0%	0%	0%	1%	11%	20%	67%	1%	
MASSACHUSETTS	0	0	0	0	0	0	1698	2779	4150	0	8627
	0%	0%	0%	0%	0%	0%	20%	32%	48%	0%	
MICHIGAN	0	0	0	0	0	0	10057	19184	22417	9679	61837
	0%	0%	0%	0%	0%	0%	17%	31%	36%	16%	
MINNESOTA	0	0	39	183	463	376	35792	17447	6687	24926	85913
	0%	0%	0%	0%	1%	0%	42%	20%	8%	29%	
MISSISSIPPI	0	0	0	0	87	676	9901	18248	15131	3841	47884
	0%	0%	0%	0%	0%	1%	21%	38%	32%	8%	
MISSOURI	0	0	10	598	3628	5365	19474	20834	15508	4516	69933
	0%	0%	0%	1%	5%	8%	28%	30%	22%	6%	
MONTANA	251	926	3821	6610	9344	13327	25013	23382	18422	47160	148456
	0%	1%	3%	4%	6%	9%	17%	16%	12%	32%	
NEBRASKA	5211	2133	2837	4429	6880	9100	17660	18287	9650	1534	77721
	7%	3%	4%	6%	9%	12%	23%	24%	12%	2%	
NEVADA	0	0	0	0	0	10	86339	3156	859	20255	110619
	0%	0%	0%	0%	0%	0%	78%	3%	1%	18%	
NEW HAMPSHIRE	0	0	0	0	0	0	2123	2702	3445	1197	9467
	0%	0%	0%	0%	0%	0%	22%	29%	36%	13%	
NEW JERSEY	0	0	0	0	0	0	482	2355	5172	0	8009
	0%	0%	0%	0%	0%	0%	6%	29%	65%	0%	
NEW MEXICO	51560	3030	2277	2026	1891	1660	19686	6523	1554	31536	121743
	42%	2%	2%	2%	2%	1%	16%	5%	1%	26%	
NEW YORK	0	0	0	0	0	0	11242	15179	13867	9930	50216
	0%	0%	0%	0%	0%	0%	22%	30%	28%	20%	
NORTH CAROLINA	0	0	10	154	328	647	4449	19300	17254	8627	50769
	0%	0%	0%	0%	1%	1%	9%	38%	34%	17%	
NORTH DAKOTA	11754	6562	7131	6919	5790	4236	11011	6620	4410	6572	71005
	17%	9%	10%	10%	8%	6%	16%	9%	6%	9%	
OHIO	0	0	0	0	367	1679	12448	16492	8521	2326	41833
	0%	0%	0%	0%	1%	4%	30%	39%	20%	6%	
OKLAHOMA	7691	1264	1525	1998	3020	5336	12767	24386	8164	3464	69615
	11%	2%	2%	3%	4%	8%	18%	35%	12%	5%	
OREGON	0	0	0	0	0	425	34952	15643	16559	30349	97928
	0%	0%	0%	0%	0%	0%	36%	16%	17%	31%	
PENNSYLVANIA	0	0	0	0	193	2432	11387	15662	12053	3551	45278
	0%	0%	0%	0%	0%	5%	25%	35%	27%	8%	
RHODE ISLAND	0	0	0	0	0	0	19	415	772	0	1206
	0%	0%	0%	0%	0%	0%	2%	34%	64%	0%	
SOUTH CAROLINA	0	0	0	0	0	203	2760	9862	15701	2663	31189
	0%	0%	0%	0%	0%	1%	9%	32%	50%	9%	
SOUTH DAKOTA	9139	4555	5086	5279	4893	4256	9196	7102	4709	22793	77008
	12%	6%	7%	7%	6%	6%	12%	9%	6%	30%	
TENNESSEE	0	0	0	10	338	1940	9428	16164	11648	2596	42124
	0%	0%	0%	0%	1%	5%	22%	38%	28%	6%	
TEXAS	82295	3474	3406	3648	29519	9071	70474	42528	18933	5491	268839
	31%	1%	1%	1%	11%	3%	26%	16%	7%	2%	
UTAH	608	376	1438	2364	2924	4024	35444	7575	4873	25553	85179
	1%	0%	2%	3%	3%	5%	42%	9%	6%	30%	
VERMONT	0	0	0	0	0	0	4613	2837	1383	1023	9853
	0%	0%	0%	0%	0%	0%	47%	29%	14%	10%	
VIRGINIA	0	0	0	396	1129	2142	6456	12487	12892	5665	41167
	0%	0%	0%	1%	3%	5%	16%	30%	31%	14%	
WASHINGTON	0	0	0	10	183	328	9525	13076	21433	24762	69317
	0%	0%	0%	0%	0%	0%	14%	19%	31%	36%	
WEST VIRGINIA	0	0	0	280	868	2364	5134	7170	5568	2721	24105
	0%	0%	0%	1%	4%	10%	21%	30%	23%	11%	
WISCONSIN	0	0	0	0	116	1235	13394	19802	17447	5028	57022
	0%	0%	0%	0%	0%	2%	23%	35%	31%	9%	
WYOMING	2943	3937	5317	6186	17438	9505	10605	10816	6012	25225	97965
	3%	4%	5%	6%	18%	10%	11%	11%	6%	26%	
TOTAL	228705	32876	39778	49727	103881	110666	740569	653682	522404	557673	
	8%	1%	1%	2%	3%	4%	24%	22%	17%	18%	

*** AGGREGATE WATER COST DERIVATION. LEAST COST ALTERNATIVE WAS DETERMINED FOR COMPOSITE OF GROUNDWATER COST AND SURFACE WATER COST. ESTIMATED GROUNDWATER COSTS FOR MAJOR REGIONS OF THE COUNTRY WERE CALCULATED FROM INFORMATION REGARDING QUALITY, QUANTITY, DEPTH AND SIZE OF WELL-FIELD (PLEASE SEE SURFACE WATER UTILITY TABLE FOR DESCRIPTION OF SURFACE WATER COSTS) AGGREGATE COSTS LESS THAN $300 MILLION WERE DIVIDED INTO 8 EQUAL INTERVALS

TABLE F1.4

SURFACE WATER UTILITY FUNCTION ***
COSTS IN MILLIONS OF DOLLARS (1980)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	MORE THAN $300 MILL.	262.5 TO 300.0	225.0 TO 262.5	187.5 TO 225.0	150.0 TO 187.5	112.5 TO 150.0	75.0 TO 112.5	37.5 TO 75.0	4.5 TO 37.5	RESTRICTED LANDS	
UTILITY VALUE	1	2	3	4	5	6	7	8	9		
ALABAMA	0	0	0	0	125	2731	8965	19686	18325	2075	51907
	0%	0%	0%	0%	0%	5%	17%	38%	35%	4%	
ARIZONA	22012	4777	4364	4333	4140	4815	4362	3638	2297	59405	114343
	19%	4%	4%	4%	4%	4%	4%	3%	2%	52%	
ARKANSAS	0	0	77	473	1264	2374	6176	17795	18837	6263	53259
	0%	0%	0%	1%	2%	4%	12%	33%	35%	12%	
CALIFORNIA	13732	4603	6311	7220	8463	10567	15382	20709	21877	51492	160364
	9%	3%	4%	5%	5%	7%	10%	13%	14%	32%	
COLORADO	29905	2490	2615	3339	4873	5964	10007	11956	4516	28660	104325
	29%	2%	3%	3%	5%	6%	10%	11%	4%	27%	
CONNECTICUT	0	0	0	0	0	0	656	2104	2451	0	5211
	0%	0%	0%	0%	0%	0%	13%	40%	47%	0%	
DELAWARE	0	0	0	0	0	0	0	637	1650	39	2326
	0%	0%	0%	0%	0%	0%	0%	27%	71%	2%	
FLORIDA	0	0	0	0	0	579	4371	15691	25611	13105	59357
	0%	0%	0%	0%	0%	1%	7%	26%	43%	22%	
GEORGIA	0	0	0	0	106	1930	8685	23324	18692	5567	58604
	0%	0%	0%	0%	0%	3%	15%	40%	32%	10%	
IDAHO	77	309	405	1216	3404	6388	9303	11908	12941	37519	83550
	0%	0%	0%	1%	4%	8%	11%	14%	15%	45%	
ILLINOIS	0	0	0	0	0	782	9698	26460	18239	1361	56540
	0%	0%	0%	0%	0%	1%	17%	47%	32%	2%	
INDIANA	0	0	0	0	0	106	4574	18721	11619	1322	36342
	0%	0%	0%	0%	0%	0%	13%	52%	32%	4%	
IOWA	0	0	0	994	4974	8203	13404	19039	9853	0	56067
	0%	0%	0%	2%	9%	15%	24%	34%	18%	0%	
KANSAS	26441	3493	3062	3232	4082	7780	11821	16473	5462	193	82267
	32%	4%	4%	4%	5%	9%	14%	20%	7%	0%	
KENTUCKY	0	0	0	0	540	3171	9322	15353	10393	2470	40269
	0%	0%	0%	0%	1%	8%	23%	38%	26%	6%	
LOUISIANA	0	0	0	0	338	1845	3398	12767	16029	14417	48154
	0%	0%	0%	0%	1%	3%	7%	27%	33%	30%	
MAINE	0	0	10	241	907	3078	7112	11406	10962	357	34073
	0%	0%	0%	1%	3%	9%	21%	33%	32%	1%	
MARYLAND	0	0	0	0	0	390	1004	2258	7459	145	11196
	0%	0%	0%	0%	0%	3%	9%	20%	67%	1%	
MASSACHUSETTS	0	0	0	0	0	106	1592	2779	4150	0	8627
	0%	0%	0%	0%	0%	1%	18%	32%	48%	0%	
MICHIGAN	0	0	0	0	0	1909	9098	19184	22417	9679	61837
	0%	0%	0%	0%	0%	3%	15%	31%	36%	16%	
MINNESOTA	19	212	1245	3619	7102	10432	14224	17447	6687	24926	83913
	0%	0%	1%	4%	8%	12%	17%	20%	8%	29%	
MISSISSIPPI	0	0	0	0	135	2123	8405	18248	15131	3841	47883
	0%	0%	0%	0%	0%	4%	18%	38%	32%	8%	
MISSOURI	0	0	164	1168	3850	8280	15614	20834	15308	4516	69734
	0%	0%	0%	2%	6%	12%	22%	30%	22%	6%	
MONTANA	251	926	4159	8125	11169	14668	20197	23382	18422	47160	148455
	0%	1%	3%	6%	8%	10%	14%	16%	12%	32%	
NEBRASKA	5211	2133	3037	4449	7450	11281	14890	18287	9650	1534	77722
	7%	3%	4%	6%	10%	15%	19%	24%	12%	2%	
NEVADA	66871	4767	4024	3310	3011	2750	2615	3156	899	20235	110618
	60%	4%	4%	3%	3%	2%	2%	3%	1%	18%	
NEW HAMPSHIRE	0	0	0	0	48	290	1785	2702	3445	1197	9467
	0%	0%	0%	0%	1%	3%	19%	29%	36%	13%	
NEW JERSEY	0	0	0	0	0	0	482	2355	5172	0	8009
	0%	0%	0%	0%	0%	0%	6%	29%	65%	0%	
NEW MEXICO	57735	4236	3976	3860	3850	3648	4806	6823	1594	31536	121744
	47%	3%	3%	3%	3%	3%	4%	5%	1%	26%	
NEW YORK	0	0	0	0	212	2393	8637	15179	13867	9930	50218
	0%	0%	0%	0%	0%	5%	17%	30%	28%	20%	
NORTH CAROLINA	0	0	10	134	328	686	4439	19300	17254	8627	50768
	0%	0%	0%	0%	1%	1%	9%	38%	34%	17%	
NORTH DAKOTA	11784	6650	7286	7234	6919	6851	6601	6620	4410	6572	71005
	17%	9%	10%	10%	10%	10%	9%	9%	6%	9%	
OHIO	0	0	0	0	367	2432	11676	16492	8321	2226	41834
	0%	0%	0%	0%	1%	6%	28%	39%	20%	6%	
OKLAHOMA	7691	1864	1325	2094	2924	5536	12767	24386	8164	3464	69615
	11%	3%	2%	3%	4%	8%	18%	35%	12%	5%	
OREGON	7093	2789	3107	3184	3804	5317	10483	15643	16959	30349	97928
	7%	3%	3%	3%	3%	5%	11%	16%	17%	31%	
PENNSYLVANIA	0	0	0	0	494	3522	10036	15642	12053	3551	45278
	0%	0%	0%	0%	1%	8%	22%	35%	27%	8%	
RHODE ISLAND	0	0	0	0	0	0	19	415	772	0	1204
	0%	0%	0%	0%	0%	0%	2%	34%	64%	0%	
SOUTH CAROLINA	0	0	0	0	0	251	2712	9862	15701	2663	31189
	0%	0%	0%	0%	0%	1%	9%	32%	50%	9%	
SOUTH DAKOTA	9148	4595	5086	5404	5655	5934	6601	7102	4709	22793	77007
	12%	6%	7%	7%	7%	8%	9%	9%	6%	30%	
TENNESSEE	0	0	0	10	338	2181	9187	16164	11648	2596	42124
	0%	0%	0%	0%	1%	5%	22%	38%	28%	6%	
TEXAS	113571	7884	8058	9428	12024	19474	31449	42328	16933	5491	266840
	42%	3%	3%	4%	4%	7%	12%	16%	7%	2%	
UTAH	20815	2441	3821	4304	4400	5192	6205	7575	4873	25553	85179
	24%	3%	4%	5%	5%	6%	7%	9%	6%	30%	
VERMONT	0	0	10	318	897	1216	2171	2837	1380	1023	9852
	0%	0%	0%	3%	9%	12%	22%	29%	14%	10%	
VIRGINIA	0	0	0	396	1129	2490	6108	12487	12892	5665	41167
	0%	0%	0%	1%	3%	6%	15%	30%	31%	14%	
WASHINGTON	0	0	0	174	1206	3040	5626	13076	21433	24762	69317
	0%	0%	0%	0%	2%	4%	8%	19%	31%	36%	
WEST VIRGINIA	0	0	0	280	868	2364	5134	7170	5568	2721	24105
	0%	0%	0%	1%	4%	10%	21%	30%	23%	11%	
WISCONSIN	0	0	0	0	125	2818	11802	19802	17447	5026	57022
	0%	0%	0%	0%	0%	5%	21%	35%	31%	9%	
WYOMING	7324	5375	6639	7430	9042	9505	10605	10818	6012	25225	97985
	7%	5%	7%	8%	9%	10%	11%	11%	6%	26%	
TOTAL	398680	58912	69191	86117	119619	195086	384340	647940	522404	557673	
	13%	2%	2%	3%	4%	6%	13%	21%	17%	18%	

*** SURFACE WATER COST DERIVATION: SUITABLE SOURCES ARE OCEANS, GREAT LAKES AND NON-INTERNATIONAL BOUNDARY STREAMS WITH 7-DAY, 10-YEAR LOW FLOW GREATER THAN 300 cfs WITH OR WITHOUT RESERVOIR STORAGE. DISTANCE FROM SOURCES WAS COMPUTED AND COST APPLIED AS $/MILE VARYING WITH TERRAIN RUGGEDNESS AND PENALTY ADDED FOR RESERVOIR NECESSITY. LEAST COST ALTERNATIVE WAS DETERMINED. COSTS LESS THAN $300 MILLION WERE DIVIDED INTO EQUAL INTERVALS.

TABLE F1.5

ENVIRONMENTAL SUITABILITY UTILITY FUNCTION ***
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	LOW	MEDIUM-LOW	MEDIUM	MEDIUM-HIGH	HIGH	RESTRICTED LANDS	
UTILITY VALUE	1	2	3	4	5		
ALABAMA	38	6871	11387	19637	11860	2075	51908
	0%	13%	22%	38%	23%	4%	
ARIZONA	2220	4101	16048	30795	1814	59405	114343
	2%	4%	14%	27%	2%	52%	
ARKANSAS	5211	7614	7788	10190	16193	6263	53259
	10%	14%	15%	19%	30%	12%	
CALIFORNIA	55989	20429	10538	13529	8386	51492	160363
	35%	13%	7%	8%	5%	32%	
COLORADO	32144	14359	11648	13356	4159	28660	104326
	31%	14%	11%	13%	4%	27%	
CONNECTICUT	598	2075	782	1756	0	0	5211
	11%	40%	15%	34%	0%	0%	
DELAWARE	0	0	0	0	2287	39	2326
	0%	0%	0%	0%	98%	2%	
FLORIDA	0	0	0	2133	44120	13105	59358
	0%	0%	0%	4%	74%	22%	
GEORGIA	2634	3754	10721	17187	18422	5867	58605
	5%	6%	18%	29%	31%	10%	
IDAHO	10847	7874	12091	10441	4777	37519	83549
	13%	9%	14%	12%	6%	45%	
ILLINOIS	3609	2345	5086	14475	29664	1361	56540
	6%	4%	9%	26%	52%	2%	
INDIANA	0	579	1988	9679	22774	1322	36342
	0%	2%	5%	27%	63%	4%	
IOWA	10	9476	5124	28940	12516	0	56066
	0%	17%	9%	52%	22%	0%	
KANSAS	15626	27802	15961	15131	7353	193	82266
	19%	34%	19%	18%	9%	0%	
KENTUCKY	4574	10576	12101	8569	1978	2470	40268
	11%	26%	30%	21%	5%	6%	
LOUISIANA	0	0	376	7083	26277	14417	48153
	0%	0%	1%	15%	55%	30%	
MAINE	1845	8463	4979	17274	1756	357	34074
	4%	25%	15%	51%	5%	1%	
MARYLAND	0	347	1081	2036	7846	140	11155
	0%	3%	10%	18%	68%	1%	
MASSACHUSETTS	965	1776	2238	3628	0	0	8627
	11%	21%	26%	42%	0%	0%	
MICHIGAN	0	0	0	17109	35049	9679	61837
	0%	0%	0%	28%	57%	16%	
MINNESOTA	0	261	1978	29075	29634	24926	85914
	0%	0%	2%	34%	35%	29%	
MISSISSIPPI	10	2625	4770	20767	15672	3841	47885
	0%	5%	10%	43%	33%	8%	
MISSOURI	12709	14417	13749	11985	10557	4316	69733
	18%	21%	20%	17%	15%	6%	
MONTANA	13587	27387	30098	23575	6649	47160	148456
	9%	18%	20%	16%	4%	32%	
NEBRASKA	14214	12294	16772	14436	18451	1534	77721
	18%	16%	22%	19%	24%	2%	
NEVADA	37982	18846	27647	5375	511	20255	110616
	34%	17%	25%	5%	0%	18%	
NEW HAMPSHIRE	1476	4448	1090	1235	0	1197	9446
	16%	47%	12%	13%	0%	13%	
NEW JERSEY	347	666	878	676	5443	0	8010
	4%	8%	11%	8%	68%	0%	
NEW MEXICO	47430	18383	19165	4893	338	31534	121743
	39%	15%	16%	4%	0%	26%	
NEW YORK	3632	7778	12024	13964	2992	9930	50220
	7%	15%	24%	28%	6%	20%	
NORTH CAROLINA	3146	1612	4478	13868	19239	8427	50770
	6%	3%	9%	27%	38%	17%	
NORTH DAKOTA	8338	12410	17873	14378	11734	6572	71005
	12%	17%	25%	20%	17%	9%	
OHIO	1496	5075	3632	11319	18065	2326	41833
	4%	12%	8%	27%	43%	6%	
OKLAHOMA	8145	12101	23064	14957	7884	3464	69615
	12%	17%	33%	21%	11%	5%	
OREGON	309	21134	14041	25408	6487	30349	97728
	0%	22%	14%	26%	7%	31%	
PENNSYLVANIA	2760	16106	14380	6398	2113	3551	45276
	6%	36%	32%	14%	5%	8%	
RHODE ISLAND	0	0	434	772	0	0	1206
	0%	0%	36%	64%	0%	0%	
SOUTH CAROLINA	1679	7797	16144	1583	1322	2663	31188
	5%	25%	52%	5%	4%	9%	
SOUTH DAKOTA	11937	7917	11880	12101	11078	22793	77006
	16%	10%	15%	16%	14%	30%	
TENNESSEE	6485	14314	9978	8096	454	2596	42123
	15%	34%	24%	19%	1%	6%	
TEXAS	54220	43969	28440	98190	38253	5491	268839
	20%	16%	11%	37%	14%	2%	
UTAH	18875	13220	12584	10113	4835	25353	85180
	22%	16%	15%	12%	6%	30%	
VERMONT	4256	3001	1457	116	0	1023	9853
	43%	30%	15%	1%	0%	10%	
VIRGINIA	4535	2789	2480	13211	12468	5665	41160
	11%	7%	6%	32%	30%	14%	
WASHINGTON	9515	8299	12227	9602	4912	24762	69317
	14%	12%	18%	14%	7%	36%	
WEST VIRGINIA	4121	10364	6523	145	232	2721	24106
	17%	43%	27%	1%	1%	11%	
WISCONSIN	116	3860	6620	24617	16781	5028	57022
	0%	7%	12%	43%	29%	9%	
WYOMING	17824	13703	20787	15710	4767	25225	97986
	18%	14%	21%	16%	5%	26%	
TOTAL	425114	433093	466810	649193	508122	557673	
	14%	14%	15%	21%	17%	18%	

*** ENVIRONMENTAL SUITABILITY DERIVATION: THREE FACTORS -- SEISMIC HARDENING, SITE PREPARATION AND AGGREGATE WATER AVAILABILITY WERE COMPOSITED ADDING THEIR MAPPED UTILITY VALUES (EACH RANGE 1-9) RESULTING IN A NET UTILITY MAP WITH VALUES FROM 4-25. NET VALUES WERE DIVIDED INTO FIVE CATEGORIES OF APPROXIMATELY EQUAL AREA. BEST 20% COMPOSITE UTILITY WAS ASSIGNED "HIGH" ENVIRONMENTAL SUITABILITY WHILE WORST 20% NET UTILITY WAS ASSIGNED "LOW" SUITABILITY.

TABLE F2.1

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 250 #/SQ.MI. *** SINGLE SECTOR (22.5 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/16 ALLOWABLE POP	> 1/8 ALLOWABLE POP.	> 1/6 ALLOWABLE POP.	> 1/4 ALLOWABLE POP.	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP.	UNIFORM DENSITY	RESTRICTED LANDS *	
ALABAMA	1.0	16550	3802	4072	5674	5288	6388	2355	5703	2075	51907
		31.9%	7.3%	7.8%	10.9%	10.2%	12.3%	4.5%	11.0%	4.0%	
ARIZONA	2.0	44033	830	1303	1978	1071	1727	666	3329	59405	114342
		38.5%	0.7%	1.1%	1.7%	0.9%	1.5%	0.6%	2.9%	52.0%	
ARKANSAS	3.0	23594	3464	4960	4979	3667	2345	820	3165	6263	53237
		44.3%	6.5%	9.3%	9.3%	6.9%	4.4%	1.5%	5.9%	11.8%	
CALIFORNIA	4.0	52978	7180	6417	6485	5365	5501	2142	22803	51492	160363
		33.0%	4.5%	4.0%	4.0%	3.3%	3.4%	1.3%	14.2%	32.1%	
COLORADO	5.0	58527	2596	2972	2528	2200	1756	1139	3947	28660	104325
		56.1%	2.5%	2.8%	2.4%	2.1%	1.7%	1.1%	3.8%	27.5%	
CONNECTICUT	6.0	10	0	10	97	68	19	19	4989	0	5212
		0.2%	0.0%	0.2%	1.9%	1.3%	0.4%	0.4%	95.7%	0.0%	
DELAWARE	7.0	309	77	261	299	386	212	135	608	39	2326
		13.3%	3.3%	11.2%	12.9%	16.6%	9.1%	5.8%	26.1%	1.7%	
FLORIDA	8.0	10769	4757	4101	5510	3397	4034	2287	11397	13105	59357
		18.1%	8.0%	6.9%	9.3%	5.7%	6.8%	3.9%	19.2%	22.1%	
GEORGIA	9.0	16347	4092	5099	7652	5703	5008	1824	7016	5867	58604
		27.9%	7.0%	8.7%	13.1%	9.7%	8.5%	3.1%	12.0%	10.0%	
IDAHO	10.0	35686	2123	2210	1718	1322	1322	444	1206	37519	83550
		42.7%	2.5%	2.6%	2.1%	1.6%	1.6%	0.5%	1.4%	44.9%	
ILLINOIS	11.0	11599	3581	8184	8502	6137	4159	1283	11792	1361	56538
		20.5%	6.3%	14.4%	15.0%	10.9%	7.4%	2.3%	20.9%	2.4%	
INDIANA	12.0	3020	1621	3754	5607	5008	3976	1486	10547	1322	36341
		8.3%	4.5%	10.3%	15.4%	13.8%	10.9%	4.1%	29.0%	3.6%	
IOWA	13.0	26238	2529	8145	6330	4796	3300	917	3812	0	56066
		46.8%	4.5%	14.5%	11.3%	8.6%	5.9%	1.6%	6.8%	0.0%	
KANSAS	14.0	59579	3001	5221	4207	2818	2750	782	3715	193	82266
		72.4%	3.6%	6.3%	5.1%	3.4%	3.3%	1.0%	4.5%	0.2%	
KENTUCKY	15.0	11368	2866	2818	3522	4275	6543	2094	4314	2470	40270
		28.2%	7.1%	7.0%	8.7%	10.6%	16.2%	5.2%	10.7%	6.1%	
LOUISIANA	16.0	11455	2123	3127	4391	4545	3300	1071	3725	14417	48154
		23.8%	4.4%	6.5%	9.1%	9.4%	6.9%	2.2%	7.7%	29.9%	
MAINE	17.0	23334	1438	1978	1843	1621	1602	598	1303	357	34074
		68.5%	4.2%	5.8%	5.4%	4.8%	4.7%	1.8%	3.8%	1.0%	
MARYLAND	18.0	994	608	656	984	907	762	357	5742	145	11155
		8.9%	5.4%	5.9%	8.8%	8.1%	6.8%	3.2%	51.5%	1.3%	
MASSACHUSETTS	19.0	58	193	164	425	338	396	280	6774	0	8628
		0.7%	2.2%	1.9%	4.9%	3.9%	4.6%	3.2%	78.5%	0.0%	
MICHIGAN	20.0	20024	782	3831	4738	4632	3522	1204	13423	9679	61837
		32.4%	1.3%	6.2%	7.7%	7.5%	5.7%	2.0%	21.7%	15.7%	
MINNESOTA	21.0	35280	3078	7209	4294	3107	2490	897	4632	24926	85913
		41.1%	3.6%	8.4%	5.0%	3.6%	2.9%	1.0%	5.4%	29.0%	
MISSISSIPPI	22.0	18258	2345	4265	5269	5838	4101	1062	2905	3841	47884
		38.1%	4.9%	8.9%	11.0%	12.2%	8.6%	2.2%	6.1%	8.0%	
MISSOURI	23.0	33254	3715	7305	6987	4410	3406	984	5356	4516	69933
		47.6%	5.3%	10.4%	10.0%	6.3%	4.9%	1.4%	7.7%	6.5%	
MONTANA	24.0	92206	2191	1631	2374	955	753	367	820	47160	148457
		62.1%	1.5%	1.1%	1.6%	0.6%	0.5%	0.2%	0.6%	31.8%	
NEBRASKA	25.0	63815	540	2577	3127	1882	1525	550	2171	1534	77721
		82.1%	0.7%	3.3%	4.0%	2.4%	2.0%	0.7%	2.8%	2.0%	
NEVADA	26.0	85393	299	753	830	791	878	241	1177	20255	110617
		77.2%	0.3%	0.7%	0.8%	0.7%	0.8%	0.2%	1.1%	18.3%	
NEW HAMPSHIRE	27.0	2818	270	878	897	714	550	241	1901	1197	9466
		29.8%	2.9%	9.3%	9.5%	7.5%	5.8%	2.5%	20.1%	12.6%	
NEW JERSEY	28.0	0	29	68	396	193	241	154	6929	0	8010
		0.0%	0.4%	0.8%	4.9%	2.4%	3.0%	1.9%	86.5%	0.0%	
NEW MEXICO	29.0	80346	1004	1988	1708	1293	1814	579	1476	31536	121744
		66.0%	0.8%	1.6%	1.4%	1.1%	1.5%	0.5%	1.2%	25.9%	
NEW YORK	30.0	5703	1737	3184	4410	4719	4362	1467	14707	9930	50219
		11.4%	3.5%	6.3%	8.8%	9.4%	8.7%	2.9%	29.3%	19.8%	
NORTH CAROLINA	31.0	6919	2567	3464	6041	4902	6794	2345	9110	8627	50769
		13.6%	5.1%	6.8%	11.9%	9.7%	13.4%	4.6%	17.9%	17.0%	
NORTH DAKOTA	32.0	54088	1930	3937	1949	1004	579	473	473	6572	71005
		76.2%	2.7%	5.5%	2.7%	1.4%	0.8%	0.7%	0.7%	9.3%	
OHIO	33.0	1872	2229	3204	4700	4603	3725	1399	17775	2326	41833
		4.5%	5.3%	7.7%	11.2%	11.0%	8.9%	3.3%	42.5%	5.6%	
OKLAHOMA	34.0	39633	3580	5163	4246	4178	4130	1177	4043	3464	69614
		56.9%	5.1%	7.4%	6.1%	6.0%	5.9%	1.7%	5.8%	5.0%	
OREGON	35.0	49794	2345	2779	3532	1756	2007	1206	4159	30349	97927
		50.8%	2.4%	2.8%	3.6%	1.8%	2.0%	1.2%	4.2%	31.0%	
PENNSYLVANIA	36.0	3590	2895	3320	4893	4092	4256	1216	17467	3551	45280
		7.9%	6.4%	7.3%	10.8%	9.0%	9.4%	2.7%	38.6%	7.8%	
RHODE ISLAND	37.0	0	0	0	0	29	39	0	1139	0	1207
		0.0%	0.0%	0.0%	0.0%	2.4%	3.2%	0.0%	94.4%	0.0%	
SOUTH CAROLINA	38.0	5742	2123	2393	3339	4323	4603	1177	4825	2663	31188
		18.4%	6.8%	7.7%	10.7%	13.9%	14.8%	3.8%	15.5%	8.5%	
SOUTH DAKOTA	39.0	46918	1805	1689	1737	647	589	212	618	22793	77008
		60.9%	2.3%	2.2%	2.3%	0.8%	0.8%	0.3%	0.8%	29.6%	
TENNESSEE	40.0	11435	2625	2818	3995	4883	5423	2171	6176	2596	42122
		27.1%	6.2%	6.7%	9.5%	11.6%	12.9%	5.2%	14.7%	6.2%	
TEXAS	41.0	166163	13356	17003	19397	12477	10354	3657	20941	5491	268839
		61.8%	5.0%	6.3%	7.2%	4.6%	3.9%	1.4%	7.8%	2.0%	
UTAH	42.0	52264	463	1390	1081	811	1119	415	2084	25553	85180
		61.4%	0.5%	1.6%	1.3%	1.0%	1.3%	0.5%	2.4%	30.0%	
VERMONT	43.0	3889	579	975	994	994	550	290	560	1023	9854
		39.5%	5.9%	9.9%	10.1%	10.1%	5.6%	2.9%	5.7%	10.4%	
VIRGINIA	44.0	6774	3001	3213	4236	4642	5452	1583	6601	5665	41167
		16.5%	7.3%	7.8%	10.3%	11.3%	13.2%	3.8%	16.0%	13.8%	
WASHINGTON	45.0	22890	2750	3117	3339	2876	2142	1139	6301	24762	69316
		33.0%	4.0%	4.5%	4.8%	4.1%	3.1%	1.6%	9.1%	35.7%	
WEST VIRGINIA	46.0	5076	2519	2287	2876	2741	2741	868	2277	2721	24106
		21.1%	10.4%	9.5%	11.9%	11.4%	11.4%	3.6%	9.4%	11.3%	
WISCONSIN	47.0	19590	3754	5520	6823	5047	3889	1245	6128	5028	57024
		34.4%	6.6%	9.7%	12.0%	8.9%	6.8%	2.2%	10.7%	8.8%	
WYOMING	48.0	65330	1833	1737	1563	782	637	328	550	25225	97985
		66.7%	1.9%	1.8%	1.6%	0.8%	0.6%	0.3%	0.6%	25.7%	
		1405512	113194	163116	182502	148233	137771	49348	282611	557673	
TOTAL		46.2%	3.7%	5.4%	6.0%	4.9%	4.5%	1.6%	9.3%	18.3%	

NOTE: "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/16 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A SINGLE SECTOR OF 22.5 DEGREES.) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION. THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED. IF SECTOR CRITERION IS APPLIED, ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. ** COMPOSITE OF 5 RADII **

TABLE F2.2

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 500 #/SQ.MI. *** SINGLE SECTOR (22.5 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/16 ALLOWABLE POP	> 1/8 ALLOWABLE POP.	> 1/6 ALLOWABLE POP.	> 1/4 ALLOWABLE POP.	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP.	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	24038	3990	3098	4072	4323	4815	2567	3329	2075	51907
		46.3%	6.9%	6.0%	7.8%	8.3%	9.3%	4.9%	6.4%	4.0%	
ARIZONA	2.0	46600	926	1197	1698	1062	984	444	2026	59405	114342
		40.8%	0.8%	1.0%	1.5%	0.9%	0.9%	0.4%	1.8%	52.0%	
ARKANSAS	3.0	30677	666	4661	3812	2866	1737	820	1756	6263	53258
		57.6%	1.3%	8.8%	7.2%	5.4%	3.3%	1.5%	3.3%	11.8%	
CALIFORNIA	4.0	66366	4410	4883	6137	4516	4053	2191	16115	51492	160363
		41.5%	2.8%	3.0%	3.8%	2.8%	2.5%	1.4%	10.0%	32.1%	
COLORADO	5.0	63429	1631	2490	1698	1544	1766	618	2490	28660	104326
		60.8%	1.6%	2.4%	1.6%	1.5%	1.7%	0.6%	2.4%	27.5%	
CONNECTICUT	6.0	10	145	135	357	270	309	251	3735	0	5212
		0.2%	2.8%	2.6%	6.9%	5.2%	5.9%	4.8%	71.7%	0.0%	
DELAWARE	7.0	569	39	241	367	338	164	145	425	39	2327
		24.5%	1.7%	10.4%	15.8%	14.5%	7.1%	6.2%	18.3%	1.7%	
FLORIDA	8.0	20149	3735	3069	4140	2741	2625	2663	7131	13105	59358
		33.9%	6.3%	5.2%	7.0%	4.6%	4.4%	4.5%	12.0%	22.1%	
GEORGIA	9.0	25061	3706	3619	4439	4912	4410	2162	4429	5867	58605
		42.8%	6.3%	6.2%	7.6%	8.4%	7.5%	3.7%	7.6%	10.0%	
IDAHO	10.0	39758	743	1226	1158	1004	965	434	743	37519	83550
		47.6%	0.9%	1.5%	1.4%	1.2%	1.2%	0.5%	0.9%	44.9%	
ILLINOIS	11.0	19570	4333	8724	6350	4178	3175	1013	7836	1361	56540
		34.6%	7.7%	15.4%	11.2%	7.4%	5.6%	1.8%	13.9%	2.4%	
INDIANA	12.0	7083	2490	3860	4941	5259	4092	1998	5298	1322	36343
		19.5%	6.9%	10.6%	13.6%	14.5%	11.3%	5.5%	14.6%	3.6%	
IOWA	13.0	32241	2364	8434	5336	3242	1862	511	2075	0	56065
		57.5%	4.2%	15.0%	9.5%	5.8%	3.3%	0.9%	3.7%	0.0%	
KANSAS	14.0	67396	1467	3754	3049	2268	1554	540	2046	193	82267
		81.9%	1.8%	4.6%	3.7%	2.8%	1.9%	0.7%	2.5%	0.2%	
KENTUCKY	15.0	16839	1457	2065	2490	3937	6080	2248	2683	2470	40269
		41.8%	3.6%	5.1%	6.2%	9.8%	15.1%	5.6%	6.7%	6.1%	
LOUISIANA	16.0	15855	2499	2731	3464	3735	2258	994	2200	14417	48153
		32.9%	5.2%	5.7%	7.2%	7.8%	4.7%	2.1%	4.6%	29.9%	
MAINE	17.0	26229	328	1399	1274	1428	1583	627	849	357	34074
		77.0%	1.0%	4.1%	3.7%	4.2%	4.6%	1.8%	2.5%	1.0%	
MARYLAND	18.0	2123	270	569	1023	897	926	695	4507	145	11155
		19.0%	2.4%	5.1%	9.2%	8.0%	8.3%	6.2%	40.4%	1.3%	
MASSACHUSETTS	19.0	434	222	347	830	618	492	569	5115	0	8627
		5.0%	2.6%	4.0%	9.6%	7.2%	5.7%	6.6%	59.3%	0.0%	
MICHIGAN	20.0	22581	1341	4574	5134	4825	3638	2393	7672	9679	61837
		36.5%	2.2%	7.4%	8.3%	7.8%	5.9%	3.9%	12.4%	15.7%	
MINNESOTA	21.0	41571	1042	5597	3175	2933	2113	907	3329	24726	85913
		48.7%	1.2%	6.5%	3.7%	3.4%	2.5%	1.1%	3.9%	29.0%	
MISSISSIPPI	22.0	24125	1197	3136	4072	5230	3368	1129	1785	3841	47883
		50.4%	2.5%	6.5%	8.5%	10.9%	7.0%	2.4%	3.7%	8.0%	
MISSOURI	23.0	41563	1505	6022	4748	4198	3030	888	3464	4516	69934
		59.4%	2.2%	8.6%	6.8%	6.0%	4.3%	1.3%	5.0%	6.5%	
MONTANA	24.0	96634	203	1197	1148	733	550	338	454	47160	148457
		65.1%	0.1%	0.8%	0.8%	0.5%	0.4%	0.2%	0.3%	31.8%	
NEBRASKA	25.0	66327	1197	2490	2084	1438	1052	347	1052	1534	77721
		85.6%	1.5%	3.2%	2.7%	1.9%	1.4%	0.4%	1.4%	2.0%	
NEVADA	26.0	86059	907	791	878	434	463	222	589	20255	110618
		77.8%	0.8%	0.7%	0.8%	0.4%	0.4%	0.2%	0.5%	18.3%	
NEW HAMPSHIRE	27.0	3619	434	676	637	664	801	347	1090	1197	9467
		38.2%	4.6%	7.1%	6.7%	7.0%	8.5%	3.7%	11.5%	12.6%	
NEW JERSEY	28.0	135	328	396	270	241	290	454	5896	0	8010
		1.7%	4.1%	4.9%	3.4%	3.0%	3.6%	5.7%	73.6%	0.0%	
NEW MEXICO	29.0	83801	425	1158	1862	917	791	309	946	31536	121745
		68.8%	0.3%	1.0%	1.5%	0.8%	0.6%	0.3%	0.8%	25.9%	
NEW YORK	30.0	9669	2258	3223	4111	4833	4864	2528	8801	9930	50219
		19.3%	4.5%	6.4%	8.2%	9.6%	9.7%	5.0%	17.5%	19.8%	
NORTH CAROLINA	31.0	12902	2760	3107	4140	4343	6494	3358	5037	8627	50768
		25.4%	5.4%	6.1%	8.2%	8.6%	12.8%	6.6%	9.9%	17.0%	
NORTH DAKOTA	32.0	58315	482	2306	1476	917	425	154	357	6572	71004
		82.1%	0.7%	3.2%	2.1%	1.3%	0.6%	0.2%	0.5%	9.3%	
OHIO	33.0	7160	1698	3136	4034	5529	4950	2509	10490	2326	41832
		17.1%	4.1%	7.5%	9.6%	13.2%	11.8%	6.0%	25.1%	5.6%	
OKLAHOMA	34.0	47393	1940	3783	3985	3001	2538	1197	2335	3464	69616
		68.0%	2.8%	5.4%	5.7%	4.3%	3.6%	1.7%	3.4%	5.0%	
OREGON	35.0	55266	2065	1592	1969	1457	1293	1525	2413	30349	97929
		56.4%	2.1%	1.6%	2.0%	1.5%	1.3%	1.6%	2.5%	31.0%	
PENNSYLVANIA	36.0	9090	2461	3349	4256	4352	4574	2528	11117	3551	45278
		20.1%	5.4%	7.4%	9.4%	9.6%	10.1%	5.6%	24.6%	7.8%	
RHODE ISLAND	37.0	0	0	10	39	87	106	58	907	0	1207
		0.0%	0.0%	0.8%	3.2%	7.2%	8.8%	4.8%	75.2%	0.0%	
SOUTH CAROLINA	38.0	9756	2133	2519	2461	3339	4169	1505	2644	2663	31189
		31.3%	6.8%	8.1%	7.9%	10.7%	13.4%	4.8%	8.5%	8.5%	
SOUTH DAKOTA	39.0	50759	39	1197	840	521	280	164	415	22793	77008
		65.9%	0.1%	1.6%	1.1%	0.7%	0.4%	0.2%	0.5%	29.6%	
TENNESSEE	40.0	16656	1370	2577	3406	4304	4844	2721	3648	2596	42122
		39.5%	3.3%	6.1%	8.1%	10.2%	11.5%	6.5%	8.7%	6.2%	
TEXAS	41.0	194554	10605	12545	12140	9254	8318	3030	12902	5491	268839
		72.4%	3.9%	4.7%	4.5%	3.4%	3.1%	1.1%	4.8%	2.0%	
UTAH	42.0	53480	1129	1004	1226	733	647	338	1071	25553	85181
		62.8%	1.3%	1.2%	1.4%	0.9%	0.8%	0.4%	1.3%	30.0%	
VERMONT	43.0	5308	0	772	689	878	492	347	347	1023	9852
		53.9%	0.0%	7.8%	7.0%	8.9%	5.0%	3.5%	3.5%	10.4%	
VIRGINIA	44.0	12120	2133	2277	3831	4564	4507	1998	4072	5665	41167
		29.4%	5.2%	5.5%	9.3%	11.1%	10.9%	4.9%	9.9%	13.8%	
WASHINGTON	45.0	28757	1824	2509	2422	2451	1631	1216	3744	24762	69316
		41.5%	2.6%	3.6%	3.5%	3.5%	2.4%	1.8%	5.4%	35.7%	
WEST VIRGINIA	46.0	9399	994	1158	1920	2673	2818	955	1467	2721	24105
		39.0%	4.1%	4.8%	8.0%	11.1%	11.7%	4.0%	6.1%	11.3%	
WISCONSIN	47.0	26566	2229	5153	4970	4391	3184	1592	3908	5028	57021
		46.6%	3.9%	9.0%	8.7%	7.7%	5.6%	2.8%	6.9%	8.8%	
WYOMING	48.0	69663	0	955	733	492	290	222	405	25225	97985
		71.1%	0.0%	1.0%	0.7%	0.5%	0.3%	0.2%	0.4%	25.7%	
		1648335	79720	139711	139287	128934	116370	56769	177165	557673	
TOTAL		54.2%	2.6%	4.5%	4.6%	4.2%	3.8%	1.9%	5.8%	18.3%	

NOTE: "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/16 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A SINGLE SECTOR OF 22.5 DEGREES.) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION. THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED. IF SECTOR CRITERION IS APPLIED, ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. ** COMPOSITE OF 5 RADII **

TABLE F2.3

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 750 #/SQ.MI. *** SINGLE SECTOR (22.5 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/16 ALLOWABLE POP	> 1/8 ALLOWABLE POP.	> 1/6 ALLOWABLE POP.	> 1/4 ALLOWABLE POP.	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP.	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	27435	2972	2760	2895	3667	4993	2654	2856	2075	51907
		52.9%	5.7%	5.3%	5.6%	7.1%	8.8%	5.1%	5.5%	4.0%	
ARIZONA	2.0	47459	1419	1255	1554	589	531	454	1679	59405	114345
		41.5%	1.2%	1.1%	1.4%	0.5%	0.5%	0.4%	1.5%	52.0%	
ARKANSAS	3.0	31845	1062	4217	3435	2586	1467	830	1554	6263	53259
		59.8%	2.0%	7.9%	6.5%	4.9%	2.8%	1.6%	2.9%	11.8%	
CALIFORNIA	4.0	71593	4333	4738	4593	4468	3513	2306	13327	51492	160363
		44.6%	2.7%	3.0%	2.9%	2.8%	2.2%	1.4%	8.3%	32.1%	
COLORADO	5.0	65388	1573	1679	1766	1621	1071	704	1862	28660	104324
		62.7%	1.5%	1.6%	1.7%	1.6%	1.0%	0.7%	1.8%	27.5%	
CONNECTICUT	6.0	87	270	270	309	386	531	415	2943	0	5211
		1.7%	5.2%	5.2%	5.9%	7.4%	10.2%	8.0%	56.5%	0.0%	
DELAWARE	7.0	637	106	232	309	290	154	164	396	39	2327
		27.4%	4.6%	10.0%	13.3%	12.4%	6.6%	7.1%	17.0%	1.7%	
FLORIDA	8.0	25013	2248	3175	2615	1698	2268	2770	6465	13105	59357
		42.1%	3.8%	5.3%	4.4%	2.9%	3.8%	4.7%	10.9%	22.1%	
GEORGIA	9.0	28815	2374	2895	3706	4468	4323	2345	3812	5867	58605
		49.2%	4.1%	4.9%	6.3%	7.6%	7.4%	4.0%	6.5%	10.0%	
IDAHO	10.0	40839	415	1081	753	965	849	444	685	37519	83550
		48.9%	0.5%	1.3%	0.9%	1.2%	1.0%	0.5%	0.8%	44.9%	
ILLINOIS	11.0	25167	2490	7768	5201	4188	2731	1216	6417	1361	56539
		44.5%	4.4%	13.7%	9.2%	7.4%	4.8%	2.2%	11.4%	2.4%	
INDIANA	12.0	9843	1814	3879	4902	4497	3580	2345	4159	1322	36341
		27.1%	5.0%	10.7%	13.5%	12.4%	9.9%	6.5%	11.4%	3.6%	
IOWA	13.0	35647	1554	8019	4314	2808	1390	540	1795	0	56067
		43.6%	2.8%	14.3%	7.7%	5.0%	2.5%	1.0%	3.2%	0.0%	
KANSAS	14.0	69557	1554	3281	2461	1727	1158	589	1747	193	82267
		84.6%	1.9%	4.0%	3.0%	2.1%	1.4%	0.7%	2.1%	0.2%	
KENTUCKY	15.0	18480	1197	1727	2220	3715	5915	2393	2182	2470	40269
		45.9%	3.0%	4.3%	5.5%	9.2%	14.7%	5.9%	5.3%	6.1%	
LOUISIANA	16.0	18943	1486	1978	3049	3165	2220	1042	1853	14417	48153
		39.3%	3.1%	4.1%	6.3%	6.6%	4.6%	2.2%	3.8%	29.9%	
MAINE	17.0	26972	10	1148	1235	1351	1563	647	791	357	34074
		79.2%	0.0%	3.4%	3.6%	4.0%	4.6%	1.9%	2.3%	1.0%	
MARYLAND	18.0	2480	232	618	878	1004	1216	984	3599	145	11156
		22.2%	2.1%	5.5%	7.9%	9.0%	10.9%	8.8%	32.3%	1.3%	
MASSACHUSETTS	19.0	656	405	618	560	415	598	743	4632	0	8627
		7.6%	4.7%	7.2%	6.5%	4.8%	6.9%	8.6%	53.7%	0.0%	
MICHIGAN	20.0	24067	1911	4555	4516	4304	3542	2731	6533	9679	61838
		38.9%	3.1%	7.4%	7.3%	7.0%	5.7%	4.4%	10.6%	15.7%	
MINNESOTA	21.0	43637	261	5472	3040	2876	1998	1148	2557	24926	85915
		50.8%	0.3%	6.4%	3.5%	3.3%	2.3%	1.3%	3.0%	29.0%	
MISSISSIPPI	22.0	25331	1525	2615	3686	4902	3242	1138	1583	3841	47880
		52.9%	3.2%	5.5%	7.7%	10.2%	6.8%	2.4%	3.3%	8.0%	
MISSOURI	23.0	43415	1042	5876	4574	4121	2577	926	2856	4516	69930
		62.1%	1.5%	8.4%	6.5%	5.9%	3.7%	1.3%	4.1%	6.5%	
MONTANA	24.0	97494	0	917	1023	695	434	318	415	47160	148456
		65.7%	0.0%	0.6%	0.7%	0.5%	0.3%	0.2%	0.3%	31.8%	
NEBRASKA	25.0	68033	868	2384	1727	1312	676	338	849	1534	77721
		87.5%	1.1%	3.1%	2.2%	1.7%	0.9%	0.4%	1.1%	2.0%	
NEVADA	26.0	86936	801	733	569	367	309	164	463	20255	110617
		78.6%	0.7%	0.7%	0.5%	0.3%	0.3%	0.1%	0.4%	18.3%	
NEW HAMPSHIRE	27.0	4169	164	550	569	714	782	376	946	1197	9467
		44.0%	1.7%	5.8%	6.0%	7.5%	8.3%	4.0%	10.0%	12.6%	
NEW JERSEY	28.0	482	386	241	347	174	405	540	5433	0	8008
		6.0%	4.8%	3.0%	4.3%	2.2%	5.1%	6.7%	67.8%	0.0%	
NEW MEXICO	29.0	84544	772	1544	859	753	569	318	849	31536	121744
		69.4%	0.6%	1.3%	0.7%	0.6%	0.5%	0.3%	0.7%	25.9%	
NEW YORK	30.0	12091	1737	3165	3783	4613	4449	2827	7623	9930	50218
		24.1%	3.5%	6.3%	7.5%	9.2%	8.9%	5.6%	15.2%	19.8%	
NORTH CAROLINA	31.0	15594	2268	2615	3011	4043	6736	3542	4333	8627	50769
		30.7%	4.5%	5.2%	5.9%	8.0%	13.3%	7.0%	8.5%	17.0%	
NORTH DAKOTA	32.0	59183	0	2239	1554	685	328	145	299	6572	71005
		83.4%	0.0%	3.2%	2.2%	1.0%	0.5%	0.2%	0.4%	9.3%	
OHIO	33.0	9235	1428	3194	4767	5086	4507	3184	8106	2326	41833
		22.1%	3.4%	7.6%	11.4%	12.2%	10.8%	7.6%	19.4%	5.6%	
OKLAHOMA	34.0	50180	1833	3397	2519	2451	2461	1226	2084	3464	69615
		72.1%	2.6%	4.9%	3.6%	3.5%	3.5%	1.8%	3.0%	5.0%	
OREGON	35.0	57398	1361	1486	1573	1081	1090	1602	1988	30349	97928
		58.6%	1.4%	1.5%	1.6%	1.1%	1.1%	1.6%	2.0%	31.0%	
PENNSYLVANIA	36.0	11368	2287	3233	2992	4564	5086	3184	9013	3551	45278
		25.1%	5.1%	7.1%	6.6%	10.1%	11.2%	7.0%	19.9%	7.8%	
RHODE ISLAND	37.0	0	10	29	154	77	125	125	685	0	1205
		0.0%	0.8%	2.4%	12.8%	6.4%	10.4%	10.4%	56.8%	0.0%	
SOUTH CAROLINA	38.0	11754	2287	1650	1602	3117	4178	1640	2297	2663	31180
		37.7%	7.3%	5.3%	5.1%	10.0%	13.4%	5.3%	7.4%	8.5%	
SOUTH DAKOTA	39.0	51193	0	1100	733	434	212	164	376	22793	77005
		66.5%	0.0%	1.4%	1.0%	0.6%	0.3%	0.2%	0.5%	29.6%	
TENNESSEE	40.0	18142	1814	2094	2702	3956	4777	2827	3213	2596	42121
		43.1%	4.3%	5.0%	6.4%	9.4%	11.3%	6.7%	7.6%	6.2%	
TEXAS	41.0	208662	5568	9959	10914	8695	6205	3175	10171	5491	268840
		77.6%	2.1%	3.7%	4.1%	3.2%	2.3%	1.2%	3.8%	2.0%	
UTAH	42.0	54629	811	1100	1052	251	502	357	926	25553	85181
		64.1%	1.0%	1.3%	1.2%	0.3%	0.6%	0.4%	1.1%	30.0%	
VERMONT	43.0	5481	10	714	608	849	492	338	338	1023	9853
		55.6%	0.1%	7.2%	6.2%	8.6%	5.0%	3.4%	3.4%	10.4%	
VIRGINIA	44.0	14552	1486	2200	3213	4101	4400	2104	3445	5665	41166
		35.3%	3.6%	5.3%	7.8%	10.0%	10.7%	5.1%	8.4%	13.8%	
WASHINGTON	45.0	30774	1969	1911	2287	1737	1448	1341	3088	24762	69317
		44.4%	2.8%	2.8%	3.3%	2.5%	2.1%	1.9%	4.5%	35.7%	
WEST VIRGINIA	46.0	10721	145	926	1843	2615	2837	984	1312	2721	24104
		44.5%	0.6%	3.8%	7.6%	10.8%	11.8%	4.1%	5.4%	11.3%	
WISCONSIN	47.0	29095	1554	4777	4207	4352	3184	1679	3146	5028	57022
		51.0%	2.7%	8.4%	7.4%	7.6%	5.6%	2.9%	5.5%	8.8%	
WYOMING	48.0	70262	0	811	492	347	251	232	367	25225	97987
		71.7%	0.0%	0.8%	0.5%	0.4%	0.3%	0.2%	0.4%	25.7%	
		1745298	61812	122845	117671	116880	107473	62288	148018	557673	
TOTAL		57.4%	2.0%	4.0%	3.9%	3.8%	3.5%	2.0%	4.9%	18.3%	

NOTE: "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/16 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A SINGLE SECTOR OF 22.5 DEGREES.) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION. THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED. IF SECTOR CRITERION IS APPLIED, ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. ** COMPOSITE OF 5 RADII **

TABLE F2.4

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 1500 #/SQ.MI. *** SINGLE SECTOR (22.5 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/16 ALLOWABLE POP.	> 1/8 ALLOWABLE POP.	> 1/6 ALLOWABLE POP.	> 1/4 ALLOWABLE POP.	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP.	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	32482	704	1438	1756	3464	4593	2702	2692	2075	51906
		62.6%	1.4%	2.8%	3.4%	6.7%	8.8%	5.2%	5.2%	4.0%	
ARIZONA	2.0	49466	1621	743	454	261	473	482	1438	59405	114343
		43.3%	1.4%	0.6%	0.4%	0.2%	0.4%	0.4%	1.3%	52.0%	
ARKANSAS	3.0	33765	434	3754	2914	2374	1448	830	1476	6263	53258
		63.4%	0.8%	7.0%	5.5%	4.5%	2.7%	1.6%	2.8%	11.8%	
CALIFORNIA	4.0	79535	2750	3591	3242	3136	3088	2548	11020	51492	160362
		49.6%	1.7%	2.2%	2.0%	2.0%	1.9%	1.6%	6.9%	32.1%	
COLORADO	5.0	68226	608	1014	1023	848	936	704	1486	28660	104325
		65.4%	0.6%	1.7%	1.0%	0.8%	0.9%	0.7%	1.4%	27.5%	
CONNECTICUT	6.0	386	309	116	183	405	627	511	2673	0	5210
		7.4%	5.9%	2.2%	3.5%	7.8%	12.0%	9.8%	51.3%	0.0%	
DELAWARE	7.0	811	48	193	251	270	183	164	367	39	2326
		34.9%	2.1%	8.3%	10.8%	11.6%	7.9%	7.1%	15.8%	1.7%	
FLORIDA	8.0	29384	2162	1187	1062	1361	2258	2837	6002	13105	59358
		49.5%	3.6%	2.0%	1.8%	2.3%	3.8%	4.8%	10.1%	22.1%	
GEORGIA	9.0	32279	791	2104	2895	4371	4294	2384	3619	5867	58604
		55.1%	1.4%	3.6%	4.9%	7.5%	7.3%	4.1%	6.2%	10.0%	
IDAHO	10.0	41804	10	830	589	849	830	444	676	37519	83551
		50.0%	0.0%	1.0%	0.7%	1.0%	1.0%	0.5%	0.8%	44.9%	
ILLINOIS	11.0	29712	714	7266	4449	3503	2586	1303	5645	1361	56539
		52.6%	1.3%	12.9%	7.9%	6.2%	4.6%	2.3%	10.0%	2.4%	
INDIANA	12.0	13298	1534	3165	3262	3985	3551	2413	3812	1322	36342
		36.6%	4.2%	8.7%	9.0%	11.0%	9.8%	6.6%	10.5%	3.6%	
IOWA	13.0	38668	473	7488	3445	2403	1361	569	1660	0	56067
		69.0%	0.8%	13.4%	6.1%	4.3%	2.4%	1.0%	3.0%	0.0%	
KANSAS	14.0	72500	502	2789	1515	1448	1100	589	1631	193	82267
		88.1%	0.6%	3.4%	1.8%	1.8%	1.3%	0.7%	2.0%	0.2%	
KENTUCKY	15.0	20429	647	1361	1631	3397	5829	2441	2065	2470	40270
		50.7%	1.6%	3.4%	4.0%	8.4%	14.5%	6.1%	5.1%	6.1%	
LOUISIANA	16.0	21992	39	1399	2297	2972	2210	1062	1766	14417	48154
		45.7%	0.1%	2.9%	4.8%	6.2%	4.6%	2.2%	3.7%	29.9%	
MAINE	17.0	27194	0	1033	1148	1351	1554	656	782	357	34075
		79.8%	0.0%	3.0%	3.4%	4.0%	4.6%	1.9%	2.3%	1.0%	
MARYLAND	18.0	2779	376	550	1226	1071	1042	1216	2750	145	11155
		24.9%	3.4%	4.9%	11.0%	9.6%	9.3%	10.9%	24.7%	1.3%	
MASSACHUSETTS	19.0	1380	473	241	386	463	647	975	4063	0	8628
		16.0%	5.5%	2.8%	4.5%	5.4%	7.5%	11.3%	47.1%	0.0%	
MICHIGAN	20.0	27638	782	3783	3561	4092	3542	3020	5742	9679	61839
		44.7%	1.3%	6.1%	5.8%	6.6%	5.7%	4.9%	9.3%	15.7%	
MINNESOTA	21.0	44622	473	5414	2606	2422	2007	1255	2191	24926	85916
		51.9%	0.6%	6.3%	3.0%	2.8%	2.3%	1.5%	2.5%	29.0%	
MISSISSIPPI	22.0	27792	318	2094	3136	4786	3213	1187	1515	3841	47882
		58.0%	0.7%	4.4%	6.5%	10.0%	6.7%	2.5%	3.2%	8.0%	
MISSOURI	23.0	45345	743	5742	3879	3706	2432	1013	2557	4516	69933
		64.8%	1.1%	8.2%	5.5%	5.3%	3.5%	1.4%	3.7%	6.5%	
MONTANA	24.0	97928	0	840	878	540	367	318	405	47160	148456
		66.0%	0.0%	0.6%	0.6%	0.4%	0.2%	0.2%	0.3%	31.8%	
NEBRASKA	25.0	69605	550	2133	1187	1023	550	338	801	1534	77721
		89.6%	0.7%	2.7%	1.5%	1.3%	0.7%	0.4%	1.0%	2.0%	
NEVADA	26.0	88365	367	376	309	222	183	164	376	20295	110617
		79.9%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.3%	18.3%	
NEW HAMPSHIRE	27.0	4420	10	560	531	676	782	405	888	1197	9469
		46.7%	0.1%	5.9%	5.6%	7.1%	8.3%	4.3%	9.4%	12.6%	
NEW JERSEY	28.0	1042	280	261	386	280	560	1013	4188	0	8010
		13.0%	3.5%	3.3%	4.8%	3.5%	7.0%	12.7%	52.3%	0.0%	
NEW MEXICO	29.0	86165	704	695	463	560	521	318	782	31536	121744
		70.8%	0.6%	0.6%	0.4%	0.5%	0.4%	0.3%	0.6%	25.9%	
NEW YORK	30.0	14861	1448	2557	2847	4323	4294	2963	6996	9930	50219
		29.6%	2.9%	5.1%	5.7%	8.6%	8.6%	5.9%	13.9%	19.8%	
NORTH CAROLINA	31.0	19252	106	1776	2684	3956	6648	3513	4217	8627	50769
		37.9%	0.2%	3.5%	5.2%	7.8%	13.1%	6.9%	8.3%	17.0%	
NORTH DAKOTA	32.0	59801	0	2055	1216	686	270	145	290	6572	71005
		84.2%	0.0%	2.9%	1.7%	0.9%	0.4%	0.2%	0.4%	9.3%	
OHIO	33.0	11812	2026	3146	3127	4381	4391	3503	7122	2326	41834
		28.2%	4.8%	7.5%	7.5%	10.5%	10.5%	8.4%	17.0%	5.6%	
OKLAHOMA	34.0	53200	1119	2094	1853	2374	2384	1249	1882	3464	69615
		76.4%	1.6%	3.0%	2.7%	3.4%	3.4%	1.8%	2.7%	5.0%	
OREGON	35.0	59849	598	907	868	840	1042	1621	1853	30349	97927
		61.1%	0.6%	0.9%	0.9%	0.9%	1.1%	1.7%	1.9%	31.0%	
PENNSYLVANIA	36.0	15102	261	2422	2731	4448	5124	3532	8087	3551	45278
		33.4%	0.6%	5.3%	6.0%	9.9%	11.3%	7.8%	17.9%	7.8%	
RHODE ISLAND	37.0	10	154	87	29	48	116	164	598	0	1206
		0.8%	12.8%	7.2%	2.4%	4.0%	9.6%	13.6%	49.6%	0.0%	
SOUTH CAROLINA	38.0	15083	39	1033	1274	3078	4159	1640	2220	2643	31189
		48.4%	0.1%	3.3%	4.1%	9.9%	13.3%	5.3%	7.1%	8.5%	
SOUTH DAKOTA	39.0	51599	0	917	579	376	212	164	367	22793	77007
		67.0%	0.0%	1.2%	0.8%	0.5%	0.3%	0.2%	0.5%	29.6%	
TENNESSEE	40.0	20931	569	1322	2210	3812	4719	2866	3098	2596	42123
		49.7%	1.4%	3.1%	5.2%	9.0%	11.2%	6.8%	7.4%	6.2%	
TEXAS	41.0	219402	3879	8801	7180	6359	5587	3455	8685	5491	268839
		81.6%	1.4%	3.3%	2.7%	2.4%	2.1%	1.3%	3.2%	2.0%	
UTAH	42.0	55816	1119	473	347	193	502	376	801	25553	85180
		65.5%	1.3%	0.6%	0.4%	0.2%	0.6%	0.4%	0.9%	30.0%	
VERMONT	43.0	5607	10	656	569	830	482	338	338	1023	9853
		56.9%	0.1%	6.7%	5.8%	8.4%	4.9%	3.4%	3.4%	10.4%	
VIRGINIA	44.0	16704	1168	1534	2441	3985	4371	2162	3136	5665	41166
		40.6%	2.8%	3.7%	5.9%	9.7%	10.6%	5.3%	7.6%	13.8%	
WASHINGTON	45.0	33920	1226	1197	1206	1486	1380	1448	2692	24762	69317
		48.9%	1.8%	1.7%	1.7%	2.1%	2.0%	2.1%	3.9%	35.7%	
WEST VIRGINIA	46.0	11126	10	811	1708	2615	2827	984	1303	2721	24105
		46.2%	0.0%	3.4%	7.1%	10.8%	11.7%	4.1%	5.4%	11.3%	
WISCONSIN	47.0	31932	367	4246	3792	4063	3040	1747	2808	5028	57023
		56.0%	0.6%	7.4%	6.7%	7.1%	5.3%	3.1%	4.9%	8.8%	
WYOMING	48.0	70812	0	502	328	328	193	232	367	25225	97987
		72.3%	0.0%	0.5%	0.3%	0.3%	0.2%	0.2%	0.4%	25.7%	
		1855831	32521	99456	87623	104450	104528	65959	131928	557673	
TOTAL		61.0%	1.1%	3.3%	2.9%	3.4%	3.4%	2.2%	4.3%	18.3%	

NOTE: "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/16 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A SINGLE SECTOR OF 22.5 DEGREES.) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION. THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED. IF SECTOR CRITERION IS APPLIED, ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. ** COMPOSITE OF 5 RADII **

TABLE F2.5

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 250 #/SQ. MI. *** DOUBLE SECTOR (45.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/8 ALLOWABLE POP	> 1/6 ALLOWABLE POP.	> 1/4 ALLOWABLE POP.	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP.	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	19647	1554	5616	5944	6813	4555	5703	2075	51907
		37.9%	3.0%	10.8%	11.5%	13.1%	8.8%	11.0%	4.0%	
ARIZONA	2.0	44969	338	1949	1110	1361	1882	3329	59405	114343
		39.3%	0.3%	1.7%	1.0%	1.2%	1.6%	2.9%	52.0%	
ARKANSAS	3.0	28767	762	5616	3426	3387	1872	3165	6263	53258
		54.0%	1.4%	10.5%	6.4%	6.4%	3.5%	5.9%	11.8%	
CALIFORNIA	4.0	59695	1448	7604	5713	6485	5124	22803	51492	160364
		37.2%	0.9%	4.7%	3.6%	4.0%	3.2%	14.2%	32.1%	
COLORADO	5.0	61702	1004	2625	1380	2953	2055	3947	28660	104326
		59.1%	1.0%	2.5%	1.3%	2.8%	2.0%	3.8%	27.5%	
CONNECTICUT	6.0	10	0	29	68	97	19	4989	0	5212
		0.2%	0.0%	0.6%	1.3%	1.9%	0.4%	95.7%	0.0%	
DELAWARE	7.0	444	0	376	280	376	203	608	39	2326
		19.1%	0.0%	16.2%	12.0%	16.2%	8.7%	26.1%	1.7%	
FLORIDA	8.0	13790	2413	5221	4053	4738	4642	11397	13105	59359
		23.2%	4.1%	8.8%	6.8%	8.0%	7.8%	19.2%	22.1%	
GEORGIA	9.0	20535	1399	7218	7083	5944	3542	7016	5867	58604
		35.0%	2.4%	12.3%	12.1%	10.1%	6.0%	12.0%	10.0%	
IDAHO	10.0	38185	154	2972	975	1679	859	1206	37519	83549
		45.7%	0.2%	3.6%	1.2%	2.0%	1.0%	1.4%	44.9%	
ILLINOIS	11.0	17138	1795	8009	6176	6745	3522	11792	1361	56538
		30.3%	3.2%	14.2%	10.9%	11.9%	6.2%	20.9%	2.4%	
INDIANA	12.0	4709	1303	4989	5240	4960	3271	10547	1322	36341
		13.0%	3.6%	13.7%	14.4%	13.6%	9.0%	29.0%	3.6%	
IOWA	13.0	32347	1361	6620	3860	5414	2654	3812	0	56068
		57.7%	2.4%	11.8%	6.9%	9.7%	4.7%	6.8%	0.0%	
KANSAS	14.0	65166	415	4593	2384	3300	2499	3715	193	82265
		79.2%	0.5%	5.6%	2.9%	4.0%	3.0%	4.5%	0.2%	
KENTUCKY	15.0	14272	550	4140	4536	6658	3329	4314	2470	40269
		35.4%	1.4%	10.3%	11.3%	16.5%	8.3%	10.7%	6.1%	
LOUISIANA	16.0	12931	1448	4593	3870	4757	2413	3725	14417	48154
		26.9%	3.0%	9.5%	8.0%	9.9%	5.0%	7.7%	29.9%	
MAINE	17.0	25399	68	2461	1756	1901	830	1303	357	34075
		74.5%	0.2%	7.2%	5.2%	5.6%	2.4%	3.8%	1.0%	
MARYLAND	18.0	1573	48	1255	772	1081	540	5742	145	11156
		14.1%	0.4%	11.2%	6.9%	9.7%	4.8%	51.5%	1.3%	
MASSACHUSETTS	19.0	174	87	309	328	473	482	6774	0	8627
		2.0%	1.0%	3.6%	3.8%	5.5%	5.6%	78.5%	0.0%	
MICHIGAN	20.0	22562	338	4188	4362	4729	2557	13423	9679	61838
		36.5%	0.5%	6.8%	7.1%	7.6%	4.1%	21.7%	15.7%	
MINNESOTA	21.0	42335	1023	5163	3001	2905	1930	4632	24926	85915
		49.3%	1.2%	6.0%	3.5%	3.4%	2.2%	5.4%	29.0%	
MISSISSIPPI	22.0	21954	444	5462	6080	4613	2586	2905	3841	47885
		45.8%	0.9%	11.4%	12.7%	9.6%	5.4%	6.1%	8.0%	
MISSOURI	23.0	41061	704	7344	4314	4169	2470	5356	4516	69934
		58.7%	1.0%	10.5%	6.2%	6.0%	3.5%	7.7%	6.5%	
MONTANA	24.0	94744	811	1940	1448	897	637	820	47160	148457
		63.8%	0.5%	1.3%	1.0%	0.6%	0.4%	0.6%	31.8%	
NEBRASKA	25.0	65475	415	2577	2441	1515	1592	2171	1534	77720
		84.2%	0.5%	3.3%	3.1%	1.9%	2.0%	2.8%	2.0%	
NEVADA	26.0	85885	135	1004	405	975	782	1177	20255	110618
		77.6%	0.1%	0.9%	0.4%	0.9%	0.7%	1.1%	18.3%	
NEW HAMPSHIRE	27.0	3194	116	1090	936	695	338	1901	1197	9467
		33.7%	1.2%	11.5%	9.9%	7.3%	3.6%	20.1%	12.6%	
NEW JERSEY	28.0	0	19	97	290	434	241	6929	0	8010
		0.0%	0.2%	1.2%	3.6%	5.4%	3.0%	86.5%	0.0%	
NEW MEXICO	29.0	82363	125	1882	1013	1708	1640	1476	31536	121743
		67.7%	0.1%	1.5%	0.8%	1.4%	1.3%	1.2%	25.9%	
NEW YORK	30.0	7469	762	4246	4438	4989	3657	14707	9930	50218
		14.9%	1.5%	8.5%	8.9%	9.9%	7.3%	29.3%	19.8%	
NORTH CAROLINA	31.0	8463	1303	5105	6861	7469	3831	9110	8627	50769
		16.7%	2.6%	10.1%	13.5%	14.7%	7.5%	17.9%	17.0%	
NORTH DAKOTA	32.0	58209	618	2586	965	647	936	473	6572	71006
		82.0%	0.9%	3.6%	1.4%	0.9%	1.3%	0.7%	9.3%	
OHIO	33.0	3551	1081	4555	4999	4487	3059	17775	2326	41833
		8.5%	2.6%	10.9%	11.9%	10.7%	7.3%	42.5%	5.6%	
OKLAHOMA	34.0	44081	1727	4526	3677	4487	3609	4043	3464	69614
		63.3%	2.5%	6.5%	5.3%	6.4%	5.2%	5.8%	5.0%	
OREGON	35.0	52149	907	3168	2596	2229	2374	4159	30349	97928
		53.3%	0.9%	3.2%	2.7%	2.3%	2.4%	4.2%	31.0%	
PENNSYLVANIA	36.0	5790	1052	4854	4709	5288	2567	17467	3551	45278
		12.8%	2.3%	10.7%	10.4%	11.7%	5.7%	38.6%	7.8%	
RHODE ISLAND	37.0	0	0	0	10	48	10	1139	0	1207
		0.0%	0.0%	0.0%	0.8%	4.0%	0.8%	94.4%	0.0%	
SOUTH CAROLINA	38.0	7537	454	3426	3735	6031	2519	4825	2663	31190
		24.2%	1.5%	11.0%	12.0%	19.3%	8.1%	15.5%	8.5%	
SOUTH DAKOTA	39.0	48655	724	2036	907	627	647	618	22793	77007
		63.2%	0.9%	2.6%	1.2%	0.8%	0.8%	0.8%	29.6%	
TENNESSEE	40.0	14050	676	4159	4314	6379	3773	6176	2596	42123
		33.4%	1.6%	9.9%	10.2%	15.1%	9.0%	14.7%	6.2%	
TEXAS	41.0	181256	5221	20091	13346	12777	9718	20941	5491	268841
		67.4%	1.9%	7.5%	5.0%	4.8%	3.6%	7.8%	2.0%	
UTAH	42.0	53220	203	1071	714	1226	1110	2084	25553	85181
		62.5%	0.2%	1.3%	0.8%	1.4%	1.3%	2.4%	30.0%	
VERMONT	43.0	4420	511	1090	1177	666	405	560	1023	9852
		44.9%	5.2%	11.1%	11.9%	6.8%	4.1%	5.7%	10.4%	
VIRGINIA	44.0	9525	1110	4178	4999	5722	3368	6601	5665	41168
		23.1%	2.7%	10.2%	12.1%	13.9%	8.2%	16.0%	13.8%	
WASHINGTON	45.0	24974	1592	3175	3156	2885	2470	6301	24762	69315
		36.0%	2.3%	4.6%	4.6%	4.2%	3.6%	9.1%	35.7%	
WEST VIRGINIA	46.0	7141	695	3831	2905	3300	1235	2277	2721	24105
		29.6%	2.9%	15.9%	12.0%	13.7%	5.1%	9.4%	11.3%	
WISCONSIN	47.0	24849	975	7527	4603	5037	2876	6128	5028	57023
		43.6%	1.7%	13.2%	8.1%	8.8%	5.0%	10.7%	8.8%	
WYOMING	48.0	67637	0	2538	676	618	743	550	25225	97987
		69.0%	0.0%	2.6%	0.7%	0.6%	0.8%	0.6%	25.7%	
		1544002	39888	189101	152051	166674	107973	282611	5576/J	
TOTAL		50.8%	1.3%	6.2%	5.0%	5.5%	3.6%	9.3%	18.3%	

NOTE: "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/8 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A DOUBLE SECTOR OF 45.0 DEGREES) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION. THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED. IF SECTOR CRITERION IS APPLIED, ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. ** COMPOSITE OF 5 RADII **

TABLE F2.6

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 500 #/SQ MI *** DOUBLE SECTOR (45.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/8 ALLOWABLE POP	> 1/6 ALLOWABLE POP.	> 1/4 ALLOWABLE POP.	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	26653	1718	3937	5192	5858	3146	3329	2075	51908
		51.3%	3.3%	7.6%	10.0%	11.3%	6.1%	6.4%	4.0%	
ARIZONA	2.0	47353	454	1312	1255	1351	1187	2026	59405	114343
		41.4%	0.4%	1.1%	1.1%	1.2%	1.0%	1.8%	52.0%	
ARKANSAS	3.0	33910	328	4304	2799	2499	1399	1756	6263	53258
		63.7%	0.6%	8.1%	5.3%	4.7%	2.6%	3.3%	11.8%	
CALIFORNIA	4.0	69422	2634	5549	5877	5269	4005	16115	51492	160363
		43.3%	1.6%	3.5%	3.7%	3.3%	2.5%	10.0%	32.1%	
COLORADO	5.0	65224	328	2712	1390	1824	1698	2490	28660	104326
		62.5%	0.3%	2.6%	1.3%	1.7%	1.6%	2.4%	27.5%	
CONNECTICUT	6.0	29	48	232	376	482	309	3735	0	5211
		0.6%	0.9%	4.4%	7.2%	9.3%	5.9%	71.7%	0.0%	
DELAWARE	7.0	656	29	386	347	280	164	425	39	2326
		28.2%	1.2%	16.6%	14.9%	12.0%	7.1%	18.3%	1.7%	
FLORIDA	8.0	23170	840	3773	3725	3821	3792	7131	13105	59357
		39.0%	1.4%	6.4%	6.3%	6.4%	6.4%	12.0%	22.1%	
GEORGIA	9.0	28342	1814	4825	5172	5240	2914	4429	5867	58603
		48.4%	3.1%	8.2%	8.8%	8.9%	5.0%	7.6%	10.0%	
IDAHO	10.0	41099	48	1457	1033	840	811	743	37519	83550
		49.2%	0.1%	1.7%	1.2%	1.0%	1.0%	0.9%	44.9%	
ILLINOIS	11.0	27396	1332	7498	4391	4053	2673	7836	1361	56540
		48.5%	2.4%	13.3%	7.8%	7.2%	4.7%	13.9%	2.4%	
INDIANA	12.0	10731	868	4642	4555	5520	3406	5298	1322	36342
		29.5%	2.4%	12.8%	12.5%	15.2%	9.4%	14.6%	3.6%	
IOWA	13.0	39652	415	6427	2885	2982	1631	2075	0	56067
		70.7%	0.7%	11.5%	5.1%	5.3%	2.9%	3.7%	0.0%	
KANSAS	14.0	70397	290	3349	2133	2277	1583	2046	193	82268
		85.6%	0.4%	4.1%	2.6%	2.8%	1.9%	2.5%	0.2%	
KENTUCKY	15.0	18383	917	2586	3937	6369	2924	2683	2470	40269
		45.7%	2.3%	6.4%	9.8%	15.8%	7.3%	6.7%	6.1%	
LOUISIANA	16.0	18653	338	4343	3358	3368	1476	2200	14417	48153
		38.7%	0.7%	9.0%	7.0%	7.0%	3.1%	4.6%	29.9%	
MAINE	17.0	27474	0	1583	1341	1679	791	849	357	34074
		80.6%	0.0%	4.6%	3.9%	4.9%	2.3%	2.5%	1.0%	
MARYLAND	18.0	2519	106	946	926	1081	926	4507	145	11156
		22.6%	1.0%	8.5%	8.3%	9.7%	8.3%	40.4%	1.3%	
MASSACHUSETTS	19.0	589	106	454	868	753	743	5115	0	8628
		6.8%	1.2%	5.3%	10.1%	8.7%	8.6%	59.3%	0.0%	
MICHIGAN	20.0	25650	907	4989	4931	4864	3146	7672	9679	61838
		41.5%	1.5%	8.1%	8.0%	7.9%	5.1%	12.4%	15.7%	
MINNESOTA	81.0	47430	145	3242	2683	2441	1718	3329	24926	85914
		55.2%	0.2%	3.8%	3.1%	2.8%	2.0%	3.9%	29.0%	
MISSISSIPPI	22.0	26055	579	4815	5443	3686	1679	1785	3841	47883
		54.4%	1.2%	10.1%	11.4%	7.7%	3.5%	3.7%	8.0%	
MISSOURI	23.0	47169	376	5105	3783	3339	2181	3464	4516	69933
		67.4%	0.5%	7.3%	5.4%	4.8%	3.1%	5.0%	6.5%	
MONTANA	24.0	97803	0	1081	656	772	531	454	47160	148457
		65.9%	0.0%	0.7%	0.4%	0.5%	0.4%	0.3%	31.8%	
NEBRASKA	25.0	68843	482	1766	1718	1187	1139	1052	1534	77721
		88.6%	0.6%	2.3%	2.2%	1.5%	1.5%	1.4%	2.0%	
NEVADA	26.0	87072	77	907	685	415	618	589	20255	110618
		78.7%	0.1%	0.8%	0.6%	0.4%	0.6%	0.5%	18.3%	
NEW HAMPSHIRE	27.0	4256	154	820	724	762	463	1090	1197	9466
		45.0%	1.6%	8.7%	7.6%	8.1%	4.9%	11.5%	12.6%	
NEW JERSEY	28.0	270	116	482	309	434	502	5896	0	8009
		3.4%	1.4%	6.0%	3.9%	5.4%	6.3%	73.6%	0.0%	
NEW MEXICO	29.0	84360	203	1505	1583	926	685	946	31536	121744
		69.3%	0.2%	1.2%	1.3%	0.8%	0.6%	0.8%	25.9%	
NEW YORK	30.0	11976	1158	3995	5086	5105	4169	8801	9930	50220
		23.8%	2.3%	8.0%	10.1%	10.2%	8.3%	17.5%	19.8%	
NORTH CAROLINA	31.0	14986	1872	4053	5336	7025	3831	5037	8627	50767
		29.5%	3.7%	8.0%	10.5%	13.8%	7.5%	9.9%	17.0%	
NORTH DAKOTA	32.0	60698	0	1505	878	618	376	357	6572	71004
		85.5%	0.0%	2.1%	1.2%	0.9%	0.5%	0.5%	9.3%	
OHIO	33.0	9747	482	3561	5182	5626	4420	10490	2326	41834
		23.3%	1.2%	8.5%	12.4%	13.4%	10.6%	25.1%	5.6%	
OKLAHOMA	34.0	50383	415	3763	3570	3735	1930	2355	3464	69615
		72.4%	0.6%	5.4%	5.1%	5.4%	2.8%	3.4%	5.0%	
OREGON	35.0	56588	1110	1940	1640	1650	2239	2413	30349	97929
		57.8%	1.1%	2.0%	1.7%	1.7%	2.3%	2.5%	31.0%	
PENNSYLVANIA	36.0	11397	1206	4458	5143	5250	3156	11117	3551	45278
		25.2%	2.7%	9.8%	11.4%	11.6%	7.0%	24.6%	7.8%	
RHODE ISLAND	37.0	0	0	10	48	145	97	907	0	1207
		0.0%	0.0%	0.8%	4.0%	12.0%	8.0%	75.2%	0.0%	
SOUTH CAROLINA	38.0	11030	1052	3291	3976	4622	1911	2644	2663	31189
		35.4%	3.4%	10.6%	12.7%	14.8%	6.1%	8.5%	8.5%	
SOUTH DAKOTA	39.0	51608	0	811	521	569	290	415	22793	77007
		67.0%	0.0%	1.1%	0.7%	0.7%	0.4%	0.5%	29.6%	
TENNESSEE	40.0	18017	550	3792	4786	5607	3127	3648	2596	42123
		42.8%	1.3%	9.0%	11.4%	13.3%	7.4%	8.7%	6.2%	
TEXAS	41.0	207629	2856	13182	9563	9322	7894	12902	5491	268839
		77.2%	1.1%	4.9%	3.6%	3.5%	2.9%	4.8%	2.0%	
UTAH	42.0	54387	434	1090	627	1293	724	1071	25553	85179
		63.8%	0.5%	1.3%	0.7%	1.5%	0.8%	1.3%	30.0%	
VERMONT	43.0	5954	0	695	897	511	425	347	1023	9852
		60.4%	0.0%	7.1%	9.1%	5.2%	4.3%	3.5%	10.4%	
VIRGINIA	44.0	14195	782	3551	5008	5201	2692	4072	5665	41166
		34.5%	1.9%	8.6%	12.2%	12.6%	6.5%	9.9%	13.8%	
WASHINGTON	45.0	30571	540	2663	2374	2557	2104	3744	24762	69315
		44.1%	0.8%	3.8%	3.4%	3.7%	3.0%	5.4%	35.7%	
WEST VIRGINIA	46.0	10673	174	2374	2606	2963	1129	1467	2721	24107
		44.3%	0.7%	9.8%	10.8%	12.3%	4.7%	6.1%	11.3%	
WISCONSIN	47.0	31334	685	5423	4593	3648	2403	3908	5028	57022
		55.0%	1.2%	9.5%	8.1%	6.4%	4.2%	6.9%	8.8%	
WYOMING	48.0	70233	0	743	540	502	338	405	25225	97986
		71.7%	0.0%	0.8%	0.6%	0.5%	0.3%	0.4%	25.7%	
		1761966	28968	145927	136449	140321	91495	177165	557673	
TOTAL		58.0%	1.0%	4.8%	4.5%	4.6%	3.0%	5.8%	18.3%	

NOTE "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/8 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A DOUBLE SECTOR OF 45.0 DEGREES) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION. THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED. IF SECTOR CRITERION IS APPLIED, ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT ** COMPOSITE OF 5 RADII **

TABLE F2.7

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 750 #/SQ MI *** DOUBLE SECTOR (45.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/8 ALLOWABLE POP	> 1/6 ALLOWABLE POP.	> 1/4 ALLOWABLE POP.	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	29934	830	4024	4150	5143	2895	2856	2075	51907
		57.7%	1.6%	7.8%	8.0%	9.9%	5.6%	5.5%	4.0%	
ARIZONA	2.0	48308	598	1505	897	1293	656	1679	59405	114341
		42.2%	0.5%	1.3%	0.8%	1.1%	0.6%	1.5%	52.0%	
ARKANSAS	3.0	35531	492	3628	2712	1959	1119	1554	6263	53258
		66.7%	0.9%	6.8%	5.1%	3.7%	2.1%	2.9%	11.8%	
CALIFORNIA	4.0	75270	1197	5732	4526	5134	3686	13327	51492	160364
		46.9%	0.7%	3.6%	2.8%	3.2%	2.3%	8.3%	32.1%	
COLORADO	5.0	67174	511	1698	1361	1843	1216	1862	28660	104325
		64.4%	0.5%	1.6%	1.3%	1.8%	1.2%	1.8%	27.5%	
CONNECTICUT	6.0	154	106	376	502	685	444	2943	0	5210
		3.0%	2.0%	7.2%	9.6%	13.1%	8.5%	56.5%	0.0%	
DELAWARE	7.0	762	77	376	290	212	174	396	39	2326
		32.8%	3.3%	16.2%	12.4%	9.1%	7.5%	17.0%	1.7%	
FLORIDA	8.0	26422	753	3763	2538	3136	3175	6465	13105	59357
		44.5%	1.3%	6.3%	4.3%	5.3%	5.3%	10.9%	22.1%	
GEORGIA	9.0	32009	357	4246	4738	4844	2731	3812	5867	58604
		54.6%	0.6%	7.2%	8.1%	8.3%	4.7%	6.5%	10.0%	
IDAHO	10.0	41920	125	830	917	888	666	685	37519	83550
		50.2%	0.2%	1.0%	1.1%	1.1%	0.8%	0.8%	44.9%	
ILLINOIS	11.0	32134	907	5674	3850	3841	2355	6417	1361	56539
		56.8%	1.6%	10.0%	6.8%	6.8%	4.2%	11.4%	2.4%	
INDIANA	12.0	13066	540	4767	4786	4584	3117	4159	1322	36341
		36.0%	1.5%	13.1%	13.2%	12.6%	8.6%	11.4%	3.6%	
IOWA	13.0	42547	1062	4574	2827	2065	1197	1795	0	56067
		75.9%	1.9%	8.2%	5.0%	3.7%	2.1%	3.2%	0.0%	
KANSAS	14.0	72008	965	2548	1911	1747	1148	1747	193	82267
		87.5%	1.2%	3.1%	2.3%	2.1%	1.4%	2.1%	0.2%	
KENTUCKY	15.0	20313	193	2384	3754	6186	2818	2152	2470	40270
		50.4%	0.5%	5.9%	9.3%	15.4%	7.0%	5.3%	6.1%	
LOUISIANA	16.0	20564	811	3098	3570	2413	1428	1853	14417	48154
		42.7%	1.7%	6.4%	7.4%	5.0%	3.0%	3.8%	29.9%	
MAINE	17.0	27985	0	1303	1322	1525	791	791	357	34074
		82.1%	0.0%	3.8%	3.9%	4.5%	2.3%	2.3%	1.0%	
MARYLAND	18.0	2885	106	897	897	1148	1476	3599	145	11153
		25.9%	1.0%	8.0%	8.0%	10.3%	13.2%	32.3%	1.3%	
MASSACHUSETTS	19.0	859	174	830	579	724	830	4632	0	8628
		10.0%	2.0%	9.6%	6.7%	8.4%	9.6%	53.7%	0.0%	
MICHIGAN	20.0	27850	926	4622	4854	4101	3271	6533	9679	61836
		45.0%	1.5%	7.5%	7.8%	6.6%	5.3%	10.6%	15.7%	
MINNESOTA	21.0	48414	116	3088	2586	2441	1785	2557	24926	85913
		56.4%	0.1%	3.6%	3.0%	2.8%	2.1%	3.0%	29.0%	
MISSISSIPPI	22.0	28207	280	4082	5008	3320	1563	1583	3841	47884
		58.9%	0.6%	8.5%	10.5%	6.9%	3.3%	3.3%	8.0%	
MISSOURI	23.0	48983	270	4265	4034	3252	1756	2856	4516	69932
		70.0%	0.4%	6.1%	5.8%	4.7%	2.5%	4.1%	6.5%	
MONTANA	24.0	98179	0	917	733	618	434	415	47160	148456
		66.1%	0.0%	0.6%	0.5%	0.4%	0.3%	0.3%	31.8%	
NEBRASKA	25.0	70040	125	2220	1042	1245	666	849	1534	77721
		90.1%	0.2%	2.9%	1.3%	1.6%	0.9%	1.1%	2.0%	
NEVADA	26.0	87719	193	733	367	550	338	463	20255	110618
		79.3%	0.2%	0.7%	0.3%	0.5%	0.3%	0.4%	18.3%	
NEW HAMPSHIRE	27.0	4661	97	618	704	801	444	946	1197	9468
		49.2%	1.0%	6.5%	7.4%	8.5%	4.7%	10.0%	12.6%	
NEW JERSEY	28.0	598	193	396	318	463	608	5433	0	8009
		7.5%	2.4%	4.9%	4.0%	5.8%	7.6%	67.8%	0.0%	
NEW MEXICO	29.0	85354	357	1544	849	840	415	849	31536	121744
		70.1%	0.3%	1.3%	0.7%	0.7%	0.3%	0.7%	25.9%	
NEW YORK	30.0	14678	482	4178	4613	5201	3513	7623	9930	50218
		29.2%	1.0%	8.3%	9.2%	10.4%	7.0%	15.2%	19.8%	
NORTH CAROLINA	31.0	18403	347	4053	4294	6890	3821	4333	8627	50768
		36.2%	0.7%	8.0%	8.5%	13.6%	7.5%	8.5%	17.0%	
NORTH DAKOTA	32.0	61133	0	1573	733	338	357	299	6572	71005
		86.1%	0.0%	2.2%	1.0%	0.5%	0.5%	0.4%	9.3%	
OHIO	33.0	11329	647	4150	5375	5684	4217	8106	2326	41834
		27.1%	1.5%	9.9%	12.8%	13.6%	10.1%	19.4%	5.6%	
OKLAHOMA	34.0	52274	714	3879	2731	2799	1669	2084	3464	69614
		75.1%	1.0%	5.6%	3.9%	4.0%	2.4%	3.0%	5.0%	
OREGON	35.0	58913	135	1756	1293	1698	1795	1988	30349	97927
		60.2%	0.1%	1.8%	1.3%	1.7%	1.8%	2.0%	31.0%	
PENNSYLVANIA	36.0	14378	666	4178	4130	5452	3908	9013	3551	45276
		31.8%	1.5%	9.2%	9.1%	12.0%	8.6%	19.9%	7.8%	
RHODE ISLAND	37.0	0	10	29	125	193	164	685	0	1206
		0.0%	0.8%	2.4%	10.4%	16.0%	13.6%	56.8%	0.0%	
SOUTH CAROLINA	38.0	13549	743	2422	3387	4207	1920	2297	2663	31188
		43.4%	2.4%	7.8%	10.9%	13.5%	6.2%	7.4%	8.5%	
SOUTH DAKOTA	39.0	51965	0	840	482	270	280	376	22793	77006
		67.5%	0.0%	1.1%	0.6%	0.4%	0.4%	0.5%	29.6%	
TENNESSEE	40.0	19937	656	3300	4275	4970	3175	3213	2596	42122
		47.3%	1.6%	7.8%	10.1%	11.8%	7.5%	7.6%	6.2%	
TEXAS	41.0	217173	1361	11020	8396	9640	5587	10171	5491	268839
		80.8%	0.5%	4.1%	3.1%	3.6%	2.1%	3.8%	2.0%	
UTAH	42.0	55381	251	1168	656	782	463	926	25553	85180
		65.0%	0.3%	1.4%	0.8%	0.9%	0.5%	1.1%	30.0%	
VERMONT	43.0	6128	0	676	791	502	396	338	1023	9854
		62.2%	0.0%	6.9%	8.0%	5.1%	4.0%	3.4%	10.4%	
VIRGINIA	44.0	16164	473	3599	4362	5095	2364	3445	5665	41167
		39.3%	1.1%	8.7%	10.6%	12.4%	5.7%	8.4%	13.8%	
WASHINGTON	45.0	32192	830	2268	2374	2104	1698	3088	24762	69316
		46.4%	1.2%	3.3%	3.4%	3.0%	2.5%	4.5%	35.7%	
WEST VIRGINIA	46.0	11561	0	1872	2654	2808	1177	1312	2721	24105
		48.0%	0.0%	7.8%	11.0%	11.6%	4.9%	5.4%	11.3%	
WISCONSIN	47.0	34016	125	4719	4130	3590	2268	3146	5028	57022
		59.7%	0.2%	8.3%	7.2%	6.3%	4.0%	5.5%	8.8%	
WYOMING	48.0	70677	0	733	386	328	270	367	25225	97986
		72.1%	0.0%	0.7%	0.4%	0.3%	0.3%	0.4%	25.7%	
		1849701	19801	131151	121809	129552	82244	148018	557673	
TOTAL		60.8%	0.7%	4.3%	4.0%	4.3%	2.7%	4.9%	18.3%	

NOTE "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/8 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A DOUBLE SECTOR OF 45.0 DEGREES) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION. THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED IF SECTOR CRITERION IS APPLIED. ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. ** COMPOSITE OF 3 RADII **

TABLE F2.8

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 1500 #/SQ MI *** DOUBLE SECTOR (45.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/8 ALLOWABLE POP	> 1/6 ALLOWABLE POP.	> 1/4 ALLOWABLE POP	> 1/3 ALLOWABLE POP	> 1/2 ALLOWABLE POP	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1 0	33958	0	2277	3493	4555	2856	2692	2075	51906
		65 4%	0.0%	4 4%	6 7%	8.8%	5 5%	5.2%	4 0%	
ARIZONA	2 0	50498	328	1119	550	492	511	1438	59405	114341
		44 2%	0.3%	1.0%	0.5%	0.4%	0.4%	1 3%	52 0%	
ARKANSAS	3 0	37201	270	3136	2297	1544	1071	1476	6263	53258
		69.8%	0 5%	5.9%	4 3%	2.9%	2.0%	2 8%	11.8%	
CALIFORNIA	4.0	81842	946	4092	4227	3870	2876	11020	51492	160365
		51.0%	0 6%	2 6%	2 6%	2.4%	1.8%	6.9%	32 1%	
COLORADO	5.0	69229	212	1669	1129	1062	878	1486	28660	104325
		66.4%	0.2%	1.6%	1.1%	1.0%	0.8%	1.4%	27.5%	
CONNECTICUT	6.0	550	203	203	396	647	540	2673	0	5212
		10.6%	3.9%	3.9%	7.6%	12.4%	10.4%	51.3%	0.0%	
DELAWARE	7.0	1013	10	270	232	212	183	367	39	2326
		43.6%	0.4%	11.6%	10.0%	9.1%	7.9%	15.8%	1.7%	
FLORIDA	8.0	31527	58	1805	1525	2229	3107	6002	13105	59358
		53.1%	0.1%	3 0%	2.6%	3.8%	5.2%	10.1%	22.1%	
GEORGIA	9 0	34258	347	3262	4236	4285	2731	3619	5867	58605
		58.5%	0.6%	5.6%	7.2%	7.3%	4.7%	6.2%	10.0%	
IDAHO	10.0	42460	0	704	820	791	579	676	37519	83549
		50.8%	0.0%	0.8%	1.0%	0.9%	0 7%	0 8%	44 9%	
ILLINOIS	11.0	35666	357	5018	3599	2992	1901	5645	1361	56539
		63.1%	0.6%	8.9%	6 4%	5.3%	3.4%	10.0%	2.4%	
INDIANA	12.0	16115	772	3831	3976	3754	2760	3812	1322	36342
		44.3%	2.1%	10.5%	10.9%	10.3%	7.6%	10 5%	3.6%	
IOWA	13.0	45741	39	3715	2393	1496	1023	1660	0	56067
		81.6%	0.1%	6.6%	4.3%	2.7%	1.8%	3.0%	0.0%	
KANSAS	14.0	74913	154	1824	1370	1177	1004	1631	193	82266
		91.1%	0.2%	2.2%	1.7%	1.4%	1.2%	2.0%	0.2%	
KENTUCKY	15.0	21558	357	2007	3445	5665	2702	2065	2470	40269
		53.5%	0.9%	5.0%	8.6%	14.1%	6.7%	5.1%	6.1%	
LOUISIANA	16.0	23112	10	2422	2934	2210	1283	1766	14417	48154
		48.0%	0.0%	5.0%	6.1%	4.6%	2.7%	3.7%	29.9%	
MAINE	17.0	28207	0	1129	1332	1496	772	782	357	34075
		82 8%	0.0%	3 3%	3 9%	4.4%	2 3%	2.3%	1.0%	
MARYLAND	18.0	3271	164	888	1235	1332	1370	2750	145	11155
		29.3%	1.5%	8.0%	11.1%	11.9%	12.3%	24.7%	1.3%	
MASSACHUSETTS	19.0	1824	87	454	444	743	1013	4063	0	8628
		21.1%	1.0%	5.3%	5.1%	8.6%	11.7%	47.1%	0.0%	
MICHIGAN	20.0	31305	97	3773	4101	3821	3320	5742	9679	61838
		50.6%	0.2%	6.1%	6.6%	6.2%	5.4%	9.3%	15.7%	
MINNESOTA	21.0	49533	222	2856	2499	2055	1631	2191	24986	85913
		57.7%	0.3%	3.3%	2.9%	2.4%	1.9%	2.5%	29.0%	
MISSISSIPPI	22.0	29674	222	3320	4757	3059	1496	1515	3841	47884
		62.0%	0.5%	6.9%	9.9%	6.4%	3.1%	3.2%	8.0%	
MISSOURI	23.0	50489	309	4236	3821	2557	1448	2557	4516	69933
		72.2%	0.4%	6.1%	5.5%	3.7%	2.1%	3.7%	6.5%	
MONTANA	24.0	98575	0	917	598	444	357	405	47160	148456
		66.4%	0.0%	0.6%	0.4%	0.3%	0.2%	0.3%	31.8%	
NEBRASKA	25.0	71535	68	1525	1129	608	521	801	1534	77721
		92.0%	0.1%	2.0%	1.5%	0.8%	0.7%	1.0%	2.0%	
NEVADA	26.0	88712	0	521	309	232	212	376	20255	110617
		80.2%	0.0%	0.5%	0.3%	0.2%	0.2%	0.3%	18.3%	
NEW HAMPSHIRE	27.0	4912	10	569	685	743	463	888	1197	9467
		51.9%	0.1%	6.0%	7.2%	7.8%	4.9%	9.4%	12.6%	
NEW JERSEY	28.0	1187	145	357	270	666	1197	4188	0	8010
		14.8%	1.8%	4.5%	3 4%	8.3%	14 9%	52.3%	0.0%	
NEW MEXICO	29.0	87217	0	666	627	579	338	782	31536	121745
		71.6%	0.0%	0.5%	0.5%	0.5%	0.3%	0.6%	25 9%	
NEW YORK	30.0	17515	425	3349	4246	4371	3387	6996	9930	50219
		34.9%	0.8%	6.7%	8.5%	8.7%	6.7%	13.9%	19.8%	
NORTH CAROLINA	31.0	20863	19	2760	3947	6591	3744	4217	8627	50768
		41.1%	0.0%	5.4%	7.8%	13.0%	7.4%	8 3%	17.0%	
NORTH DAKOTA	32.0	61741	0	1168	647	309	280	290	6572	71007
		87 0%	0.0%	1.6%	0.9%	0.4%	0.4%	0.4%	9.3%	
OHIO	33.0	14552	695	4111	4719	4256	4053	7122	2326	41834
		34.8%	1.7%	9.8%	11.3%	10.2%	9.7%	17 0%	5.6%	
OKLAHOMA	34.0	55922	39	2036	2248	2413	1612	1882	3464	69616
		80 3%	0.1%	2 9%	3 2%	3.5%	2.3%	2.7%	5.0%	
OREGON	35.0	60399	261	1409	975	965	1718	1853	30349	97929
		61.7%	0.3%	1.4%	1.0%	1.0%	1.8%	1 9%	31.0%	
PENNSYLVANIA	36.0	17274	97	2808	4304	5230	3928	8087	3551	45279
		38 2%	0.2%	6.2%	9.5%	11.6%	8.7%	17.9%	7.8%	
RHODE ISLAND	37.0	48	97	87	87	116	174	598	0	1207
		4.0%	8.0%	7.2%	7 2%	9 6%	14 4%	49.6%	0.0%	
SOUTH CAROLINA	38.0	15961	0	1341	3078	4043	1882	2220	2663	31188
		51.2%	0 0%	4.3%	9.9%	13 0%	6 0%	7.1%	8 5%	
SOUTH DAKOTA	39 0	52438	0	569	357	232	251	367	22793	77007
		68.1%	0.0%	0.7%	0 5%	0.3%	0.3%	0.5%	29 6%	
TENNESSEE	40.0	22398	193	2220	3841	4719	3059	3098	2596	42124
		53.2%	0 5%	5 3%	9 1%	11.2%	7.3%	7 4%	6 2%	
TEXAS	41 0	226061	1081	9882	7141	5993	4507	8685	5491	268841
		84 1%	0 4%	3.7%	2.7%	2.2%	1 7%	3 2%	2 0%	
UTAH	42 0	56684	357	647	203	463	473	801	25553	85181
		66 5%	0 4%	0.8%	0 2%	0 5%	0.6%	0.9%	30 0%	
VERMONT	43.0	6253	0	569	801	482	386	338	1023	9852
		63.5%	0.0%	5.8%	8 1%	4.9%	3.9%	3 4%	10 4%	
VIRGINIA	44.0	18470	299	2818	3985	4458	2335	3136	5665	41166
		44.9%	0 7%	6 8%	9 7%	10 8%	5 7%	7 6%	13.8%	
WASHINGTON	45 0	35078	415	1718	1669	1322	1660	2692	24762	69316
		50 6%	0 6%	2.5%	2 4%	1 9%	2 4%	3 9%	35 7%	
WEST VIRGINIA	46.0	11898	10	1718	2548	2770	1139	1303	2721	24107
		49 4%	0 0%	7 1%	10 6%	11 5%	4 7%	5 4%	11 3%	
WISCONSIN	47 0	35753	164	4014	3928	3194	2133	2808	5028	57022
		62 7%	0 3%	7 0%	6 9%	5 6%	3 7%	4 9%	8 8%	
WYOMING	48 0	71227	0	386	279	232	251	367	25225	97987
		72.7%	0 0%	0 4%	0 3%	0.2%	0 3%	0 4%	25.7%	
		1946617	9539	102175	107452	107475	77115	131928	557673	
TOTAL		64.0%	0.3%	3 4%	3 5%	3 5%	2 5%	4.3%	18.3%	

NOTE "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e IF > 1/8 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A DOUBLE SECTOR OF 45 0 DEGREES) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED IF SECTOR CRITERION IS APPLIED. ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT ** COMPOSITE OF 5 RADII **

TABLE F2.9

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 250 #/SQ MI. *** "QUAD" SECTOR (90.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/4 ALLOWABLE POP	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	28834	2364	6977	5954	5703	2075	51907
		55.5%	4.6%	13.4%	11.5%	11.0%	4.0%	
ARIZONA	2.0	47575	473	1476	2084	3329	59405	114342
		41.6%	0.4%	1.3%	1.8%	2.9%	52.0%	
ARKANSAS	3.0	37162	318	3985	2364	3165	6263	53257
		69.8%	0.6%	7.5%	4.4%	5.9%	11.8%	
CALIFORNIA	4.0	69268	1805	6996	8000	22803	51492	160364
		43.2%	1.1%	4.4%	5.0%	14.2%	32.1%	
COLORADO	5.0	65958	502	2856	2403	3947	28660	104326
		63.2%	0.5%	2.7%	2.3%	3.8%	27.5%	
CONNECTICUT	6.0	39	10	87	87	4999	0	5212
		0.7%	0.2%	1.7%	1.7%	95.7%	0.0%	
DELAWARE	7.0	936	29	376	338	608	39	2326
		40.2%	1.2%	16.2%	14.5%	26.1%	1.7%	
FLORIDA	8.0	22147	1033	5703	5973	11397	13105	59358
		37.3%	1.7%	9.6%	10.1%	19.2%	22.1%	
GEORGIA	9.0	32154	2384	5983	5201	7016	5867	58605
		54.9%	4.1%	10.2%	8.9%	12.0%	10.0%	
IDAHO	10.0	41553	492	1602	1177	1206	37519	83549
		49.7%	0.6%	1.9%	1.4%	1.4%	44.9%	
ILLINOIS	11.0	29249	1216	7952	4970	11792	1361	56540
		51.7%	2.2%	14.1%	8.8%	20.9%	2.4%	
INDIANA	12.0	12323	1476	5790	4883	10547	1322	36341
		33.9%	4.1%	15.9%	13.4%	29.0%	3.6%	
IOWA	13.0	42074	820	6147	3213	3812	0	56066
		75.0%	1.5%	11.0%	5.7%	6.8%	0.0%	
KANSAS	14.0	71410	569	3098	3281	3715	193	82266
		86.8%	0.7%	3.8%	4.0%	4.5%	0.2%	
KENTUCKY	15.0	21124	830	7073	4458	4314	2470	40269
		52.5%	2.1%	17.6%	11.1%	10.7%	6.1%	
LOUISIANA	16.0	20738	994	4979	3300	3725	14417	48153
		43.1%	2.1%	10.3%	6.9%	7.7%	29.9%	
MAINE	17.0	28603	425	2200	1187	1303	357	34075
		83.9%	1.2%	6.5%	3.5%	3.8%	1.0%	
MARYLAND	18.0	3059	251	1004	955	5742	145	11156
		27.4%	2.2%	9.0%	8.6%	51.5%	1.3%	
MASSACHUSETTS	19.0	482	87	492	791	6774	0	8626
		5.6%	1.0%	5.7%	9.2%	78.5%	0.0%	
MICHIGAN	20.0	28641	704	5201	4188	13423	9679	61836
		46.3%	1.1%	8.4%	6.8%	21.7%	15.7%	
MINNESOTA	21.0	50585	212	2943	2615	4632	24926	85913
		58.9%	0.2%	3.4%	3.0%	5.4%	29.0%	
MISSISSIPPI	22.0	32038	724	5028	3349	2905	3841	47885
		66.9%	1.5%	10.5%	7.0%	6.1%	8.0%	
MISSOURI	23.0	51319	1255	3870	3619	5356	4516	69935
		73.4%	1.8%	5.5%	5.2%	7.7%	6.5%	
MONTANA	24.0	98874	0	926	676	820	47160	148456
		66.6%	0.0%	0.6%	0.5%	0.6%	31.8%	
NEBRASKA	25.0	69567	878	1698	1872	2171	1534	77720
		89.5%	1.1%	2.2%	2.4%	2.8%	2.0%	
NEVADA	26.0	87159	232	714	1081	1177	20255	110618
		78.8%	0.2%	0.6%	1.0%	1.1%	18.3%	
NEW HAMPSHIRE	27.0	4487	347	975	560	1901	1197	9467
		47.4%	3.7%	10.3%	5.9%	20.1%	12.6%	
NEW JERSEY	28.0	29	87	444	521	6929	0	8010
		0.4%	1.1%	5.5%	6.5%	86.5%	0.0%	
NEW MEXICO	29.0	84949	241	1592	1949	1476	31536	121743
		69.8%	0.2%	1.3%	1.6%	1.2%	25.9%	
NEW YORK	30.0	12815	2104	5298	5365	14707	9930	50219
		25.5%	4.2%	10.5%	10.7%	29.3%	19.8%	
NORTH CAROLINA	31.0	16530	1428	8859	6215	9110	8627	50769
		32.6%	2.8%	17.4%	12.2%	17.9%	17.0%	
NORTH DAKOTA	32.0	62146	0	820	994	473	6572	71005
		87.5%	0.0%	1.2%	1.4%	0.7%	9.3%	
OHIO	33.0	10721	1013	5529	4468	17775	2326	41832
		25.6%	2.4%	13.2%	10.7%	42.5%	5.6%	
OKLAHOMA	34.0	52650	376	4748	4333	4043	3464	69614
		75.6%	0.5%	6.8%	6.2%	5.8%	5.0%	
OREGON	35.0	56356	1698	2248	3117	4159	30349	97927
		57.5%	1.7%	2.3%	3.2%	4.2%	31.0%	
PENNSYLVANIA	36.0	11628	1940	6417	4275	17467	3551	45278
		25.7%	4.3%	14.2%	9.4%	38.6%	7.8%	
RHODE ISLAND	37.0	0	0	39	29	1139	0	1207
		0.0%	0.0%	3.2%	2.4%	94.4%	0.0%	
SOUTH CAROLINA	38.0	12535	1013	6311	3841	4825	2663	31188
		40.2%	3.2%	20.2%	12.3%	15.5%	8.5%	
SOUTH DAKOTA	39.0	52226	0	627	743	618	22793	77007
		67.8%	0.0%	0.8%	1.0%	0.8%	29.6%	
TENNESSEE	40.0	20979	888	6465	5018	6176	2596	42122
		49.8%	2.1%	15.3%	11.9%	14.7%	6.2%	
TEXAS	41.0	212696	3667	13558	12487	20941	5491	268840
		79.1%	1.4%	5.0%	4.6%	7.8%	2.0%	
UTAH	42.0	54252	618	936	1737	2084	25553	85180
		63.7%	0.7%	1.1%	2.0%	2.4%	30.0%	
VERMONT	43.0	6958	0	782	531	560	1023	9854
		70.6%	0.0%	7.9%	5.4%	5.7%	10.4%	
VIRGINIA	44.0	16772	1399	6070	4661	6601	5665	41168
		40.7%	3.4%	14.7%	11.3%	16.0%	13.8%	
WASHINGTON	45.0	30967	502	3551	3233	6301	24762	69316
		44.7%	0.7%	5.1%	4.7%	9.1%	35.7%	
WEST VIRGINIA	46.0	12651	907	3377	2171	2277	2721	24104
		52.5%	3.8%	14.0%	9.0%	9.4%	11.3%	
WISCONSIN	47.0	34721	1332	5636	4178	6128	5028	57023
		60.9%	2.3%	9.9%	7.3%	10.7%	8.8%	
WYOMING	48.0	70792	0	618	801	550	25225	97986
		72.2%	0.0%	0.6%	0.8%	0.6%	25.7%	
		1830731	39643	180056	149246	282611	557673	
TOTAL		60.2%	1.3%	5.9%	4.9%	9.3%	18.3%	

NOTE "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/4 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A "QUAD" SECTOR OF 90.0 DEGREES) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED. IF SECTOR CRITERION IS APPLIED, ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT ** COMPOSITE OF 5 RADII **

TABLE F2.10

POPULATION SECTOR ANALYSIS - TOTAL U S.
DENSITY = 500 #/SQ MI *** "QUAD" SECTOR (90 0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/4 ALLOWABLE POP	> 1/3 ALLOWABLE POP	> 1/2 ALLOWABLE POP.	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	35888	376	6253	3985	3329	2075	51906
		69 1%	0.7%	12 0%	7.7%	6 4%	4 0%	
ARIZONA	2.0	49244	936	1168	1563	2026	59405	114342
		43.1%	0 8%	1.0%	1 4%	1 8%	52 0%	
ARKANSAS	3 0	40501	87	2779	1872	1756	6263	53258
		76.0%	0 2%	5 2%	3 5%	3 3%	11 8%	
CALIFORNIA	4.0	79062	1612	6282	5800	16115	51492	160363
		49.3%	1.0%	3.9%	3 6%	10.0%	32 1%	
COLORADO	5.0	69210	193	1776	1998	2490	28560	104327
		66.3%	0.2%	1.7%	1 9%	2.4%	27.5%	
CONNECTICUT	6.0	164	164	482	666	3735	0	5211
		3.1%	3.1%	9.3%	12.8%	71 7%	0 0%	
DELAWARE	7.0	1206	58	347	251	425	39	2326
		51.9%	2.5%	14 9%	10.8%	18.3%	1.7%	
FLORIDA	8.0	28381	811	4642	5288	7131	13105	59358
		47 8%	1.4%	7.8%	8 9%	12 0%	22.1%	
GEORGIA	9.0	38687	309	5259	4053	4429	5867	58604
		66.0%	0.5%	9.0%	6.9%	7.6%	10.0%	
IDAHO	10.0	43435	0	926	926	743	37519	83549
		52 0%	0.0%	1.1%	1.1%	0.9%	44.9%	
ILLINOIS	11.0	38166	463	4738	3976	7836	1361	56540
		67.5%	0.8%	8.4%	7.0%	13.9%	2.4%	
INDIANA	12.0	18991	704	5182	4844	5298	1322	36341
		52.3%	1.9%	14.3%	13.3%	14 6%	3.6%	
IOWA	13.0	48356	193	3291	2152	2075	0	56067
		86.2%	0.3%	5.9%	3.8%	3.7%	0.0%	
KANSAS	14.0	75309	434	1949	2335	2046	193	82266
		91.5%	0.5%	2.4%	2.8%	2.5%	0.2%	
KENTUCKY	15.0	25080	193	6282	3561	2683	2470	40269
		62.3%	0.5%	15.6%	8.8%	6.7%	6.1%	
LOUISIANA	16.0	25765	492	3156	2123	2200	14417	48153
		53.5%	1.0%	6.6%	4.4%	4.6%	29.9%	
MAINE	17.0	30224	0	1669	975	849	357	34074
		88.7%	0.0%	4.9%	2.9%	2.5%	1.0%	
MARYLAND	18.0	4014	222	1081	1187	4507	145	11156
		36.0%	2.0%	9.7%	10.6%	40.4%	1.3%	
MASSACHUSETTS	19.0	1081	261	1139	1033	5115	0	8629
		12.5%	3.0%	13.2%	12.0%	59.3%	0.0%	
MICHIGAN	20.0	33852	1409	4902	4323	7672	9679	61837
		54.7%	2.3%	7.9%	7.0%	12.4%	15.7%	
MINNESOTA	21.0	52766	164	2586	2142	3329	24926	85913
		61.4%	0.2%	3.0%	2.5%	3.9%	29.0%	
MISSISSIPPI	22.0	36052	106	3831	2260	1788	3841	47883
		75.3%	0.2%	8.0%	4.7%	3.7%	8.0%	
MISSOURI	23.0	55661	290	3059	2943	3464	4516	69933
		79.6%	0.4%	4.4%	4.2%	5.0%	6.5%	
MONTANA	24.0	99491	0	647	704	454	47160	148456
		67.0%	0.0%	0.4%	0.5%	0.3%	31.8%	
NEBRASKA	25.0	72385	183	1177	1390	1052	1534	77721
		93.1%	0.2%	1.5%	1.8%	1.4%	2.0%	
NEVADA	26.0	88259	434	347	733	589	20255	110617
		79.8%	0.4%	0.3%	0.7%	0.5%	18.3%	
NEW HAMPSHIRE	27.0	5520	135	868	656	1090	1197	9466
		58.3%	1.4%	9.2%	6.9%	11.5%	12.6%	
NEW JERSEY	28.0	627	261	473	753	5896	0	8010
		7.8%	3.3%	5.9%	9 4%	73.6%	0.0%	
NEW MEXICO	29.0	86821	724	782	936	946	31536	121745
		71.3%	0.6%	0.6%	0.8%	0.8%	25.9%	
NEW YORK	30.0	19474	1187	5385	5443	8801	9930	50220
		38.8%	2.4%	10.7%	10.8%	17.5%	19.8%	
NORTH CAROLINA	31.0	23662	946	7691	4806	5037	8627	50769
		46.6%	1.9%	15.1%	9.5%	9.9%	17.0%	
NORTH DAKOTA	32.0	62947	0	685	444	357	6572	71005
		88.7%	0.0%	1.0%	0.6%	0.5%	9.3%	
OHIO	33.0	16434	1033	5423	6128	10490	2326	41834
		39.3%	2.5%	13.0%	14 6%	25.1%	5.6%	
OKLAHOMA	34.0	56192	1100	3754	2750	2355	3464	69615
		80.7%	1.6%	5.4%	4.0%	3 4%	5.0%	
OREGON	35.0	60689	154	1689	2634	2413	30349	97928
		62.0%	0.2%	1.7%	2.7%	2.5%	31 0%	
PENNSYLVANIA	36.0	18721	1380	6002	4507	11117	3551	45278
		41.3%	3.0%	13.3%	10.0%	24 6%	7.8%	
RHODE ISLAND	37.0	19	10	58	212	907	0	1206
		1.6%	0.8%	4.8%	17.6%	75.2%	0 0%	
SOUTH CAROLINA	38.0	18132	145	5018	2586	2644	2663	31188
		58.1%	0.5%	16.1%	8.3%	8.5%	8 5%	
SOUTH DAKOTA	39 0	52785	0	608	405	415	22793	77006
		68.5%	0.0%	0.8%	0 5%	0.5%	29.6%	
TENNESSEE	40.0	25244	840	5800	3995	3648	2596	42123
		59.9%	2.0%	13 8%	9 5%	8.7%	6 2%	
TEXAS	41.0	229207	1891	9003	10345	12902	5491	268839
		85.3%	0 7%	3 3%	3.8%	4 8%	2 0%	
UTAH	42.0	55816	482	1293	965	1071	25553	85180
		65.5%	0.6%	1.5%	1.1%	1.3%	30 0%	
VERMONT	43.0	7421	29	550	482	347	1023	9852
		75.3%	0.3%	5 6%	4 9%	3 5%	10 4%	
VIRGINIA	44.0	21635	637	5452	3706	4072	5665	41167
		52 6%	1.5%	13 2%	9 0%	9 9%	13 8%	
WASHINGTON	45 0	34692	386	2712	3020	3744	24762	69316
		50.0%	0.6%	3.9%	4 4%	5 4%	35 7%	
WEST VIRGINIA	46.0	15459	0	2750	1708	1467	2721	24105
		64 1%	0.0%	11.4%	7.1%	6 1%	11 3%	
WISCONSIN	47.0	40935	193	3937	3020	3908	5028	57021
		71 8%	0.3%	6 9%	5 3%	6 9%	8 8%	
WYOMING	48 0	71400	0	579	376	405	25225	97985
		72.9%	0 0%	0.6%	0 4%	0 4%	25 7%	
TOTAL		2015062	21627	145462	122968	177165	557673	
		66.3%	0.7%	4 8%	4 0%	5.8%	18 3%	

NOTE. "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i e. IF > 1/4 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A "QUAD" SECTOR OF 90.0 DEGREES.) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION. THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED IF SECTOR CRITERION IS APPLIED. ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. ** COMPOSITE OF 5 RADII **

TABLE F2.11

POPULATION SECTOR ANALYSIS - TOTAL U S
DENSITY = 750 #/SQ MI. *** "QUAD" SECTOR (90.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/4 ALLOWABLE POP	> 1/3 ALLOWABLE POP	> 1/2 ALLOWABLE POP.	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	37838	482	4950	3706	2856	2075	51907
		72.9%	0 9%	9.5%	7.1%	5 5%	4 0%	
ARIZONA	2.0	50614	328	1226	1090	1679	59405	114342
		44 3%	0.3%	1.1%	1 0%	1 5%	52 0%	
ARKANSAS	3 0	41630	203	2075	1534	1554	6263	53259
		78 2%	0 4%	3 9%	2 9%	2 9%	11 8%	
CALIFORNIA	4.0	83820	1033	5008	5684	13327	51492	160364
		52.3%	0.6%	3.1%	3.5%	8.3%	32 1%	
COLORADO	5 0	70300	174	1437	1872	1862	28660	104325
		67 4%	0 2%	1 4%	1.8%	1.8%	27 5%	
CONNECTICUT	6 0	415	193	1023	637	2943	0	5211
		8.0%	3 7%	19.6%	12.2%	56.5%	0 0%	
DELAWARE	7.0	1380	19	280	212	396	39	2326
		59.3%	0.8%	12.0%	9 1%	17.0%	1.7%	
FLORIDA	8.0	31112	1042	3802	3831	6465	13105	59357
		52 4%	1.8%	6 4%	6.5%	10 9%	22.1%	
GEORGIA	9.0	40086	280	4912	3648	3812	5867	58605
		68.4%	0.5%	8 4%	6.2%	6.5%	10.0%	
IDAHO	10.0	43705	0	849	791	685	37519	83549
		52.3%	0.0%	1.0%	0.9%	0.8%	44 9%	
ILLINOIS	11.0	40791	444	3908	3619	6417	1361	56540
		72.1%	0.8%	6.9%	6.4%	11 4%	2.4%	
INDIANA	12 0	21346	733	4719	4063	4159	1322	36342
		58.7%	2.0%	13 0%	11.2%	11.4%	3.6%	
IOWA	13.0	50093	261	2094	1824	1795	0	56067
		89.3%	0.5%	3.7%	3.3%	3.2%	0.0%	
KANSAS	14.0	76650	135	1911	1631	1747	193	82267
		93.2%	0.2%	2.3%	2.0%	2.1%	0.2%	
KENTUCKY	15.0	26036	241	6031	3339	2152	2470	40269
		64.7%	0.6%	15.0%	8.3%	5.3%	6.1%	
LOUISIANA	16.0	27464	10	2702	1708	1853	14417	48154
		57.0%	0.0%	5.6%	3.5%	3.8%	29.9%	
MAINE	17.0	30494	0	1534	897	791	357	34073
		89.5%	0.0%	4.5%	2.6%	2 3%	1.0%	
MARYLAND	18.0	4439	125	1052	1795	3599	145	11155
		39.8%	1.1%	9.4%	16.1%	32 3%	1.3%	
MASSACHUSETTS	19.0	1785	376	820	1013	4632	0	8626
		20.7%	4.4%	9.5%	11.7%	53.7%	0.0%	
MICHIGAN	20.0	36882	222	4429	4092	6533	9679	61837
		59.6%	0.4%	7.2%	6.6%	10.6%	15.7%	
MINNESOTA	21.0	53529	193	2316	2393	2557	24926	85914
		62.3%	0.2%	2.7%	2.8%	3.0%	29.0%	
MISSISSIPPI	22.0	37027	145	3310	1978	1583	3841	47884
		77.3%	0.3%	6 9%	4.1%	3.3%	8.0%	
MISSOURI	23.0	56674	328	3030	2528	2856	4516	69932
		81.0%	0.5%	4.3%	3.6%	4.1%	6.5%	
MONTANA	24.0	99723	0	647	511	415	47160	148456
		67.2%	0.0%	0.4%	0.3%	0.3%	31.8%	
NEBRASKA	25.0	72771	357	1245	965	849	1534	77721
		93.6%	0.5%	1.6%	1.2%	1.1%	2.0%	
NEVADA	26.0	88905	0	550	444	463	20255	110617
		80.4%	0.0%	0.5%	0.4%	0 4%	18.3%	
NEW HAMPSHIRE	27.0	5819	125	820	560	946	1197	9467
		61.5%	1.3%	8.7%	5.9%	10.0%	12.6%	
NEW JERSEY	28.0	1110	97	560	811	5433	0	8011
		13.9%	1.2%	7.0%	10 1%	67 8%	0 0%	
NEW MEXICO	29.0	87892	0	936	531	849	31536	121744
		72.2%	0.0%	0.8%	0.4%	0.7%	25.9%	
NEW YORK	30.0	21954	926	5356	4429	7623	9930	50218
		43.7%	1.8%	10.7%	8.8%	15.2%	19.8%	
NORTH CAROLINA	31.0	26383	29	6765	4632	4333	8627	50769
		52.0%	0.1%	13.3%	9.1%	8.5%	17.0%	
NORTH DAKOTA	32.0	63362	0	347	425	299	6572	71005
		89.2%	0.0%	0.5%	0 6%	0 4%	9.3%	
OHIO	33.0	18750	1148	5867	5636	8106	2326	41833
		44.8%	2.7%	14.0%	13.5%	19.4%	5.6%	
OKLAHOMA	34.0	58132	637	3223	2075	2084	3464	69615
		83 5%	0.9%	4 6%	3.0%	3 0%	5.0%	
OREGON	35 0	61519	174	1650	2248	1988	30349	97928
		62.8%	0.2%	1.7%	2.3%	2 0%	31 0%	
PENNSYLVANIA	36 0	22041	280	5192	5201	9013	3551	45278
		48 7%	0.6%	11 5%	11.5%	19 9%	7 8%	
RHODE ISLAND	37.0	48	10	193	270	685	0	1206
		4.0%	0.8%	16 0%	22 4%	56 8%	0.0%	
SOUTH CAROLINA	38.0	19628	0	4275	2326	2297	2663	31189
		62 9%	0.0%	13.7%	7 5%	7.4%	8.5%	
SOUTH DAKOTA	39.0	53162	0	347	328	376	22793	77006
		69 0%	0 0%	0 5%	0 4%	0.5%	29 6%	
TENNESSEE	40.0	27309	116	5269	3619	3213	2596	42122
		64 8%	0 3%	12 5%	8.6%	7 6%	6 2%	
TEXAS	41.0	234659	1042	9486	7990	10171	5491	268839
		87.3%	0 4%	3.5%	3 0%	3 8%	2 0%	
UTAH	42.0	56588	666	724	724	926	25553	85181
		66.4%	0.8%	0.8%	0 8%	1.1%	30 0%	
VERMONT	43 0	7556	0	482	454	338	1023	9853
		76 7%	0.0%	4 9%	4 6%	3 4%	10 4%	
VIRGINIA	44.0	23121	647	5211	3078	3445	5665	41167
		56.2%	1.6%	12.7%	7 5%	8 4%	13 8%	
WASHINGTON	45.0	36332	454	2306	2374	3088	24762	69316
		52 4%	0.7%	3 3%	3 4%	4 5%	35 7%	
WEST VIRGINIA	46 0	15729	0	2876	1467	1312	2721	24105
		65 3%	0 0%	11.9%	6.1%	5 4%	11 3%	
WISCONSIN	47 0	42315	174	3213	3146	3146	5028	57022
		74.2%	0.3%	5 6%	5 5%	5 5%	8.8%	
WYOMING	48 0	71786	0	280	328	367	25225	97986
		73 3%	0 0%	0 3%	0 3%	0 4%	25 7%	
		2080704	13849	131258	108457	148018	557673	
TOTAL		68.4%	0 5%	4.3%	3 6%	4 9%	18 3%	

NOTE "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i.e. IF > 1/4 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A "QUAD" SECTOR OF 90 0 DEGREES) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED IF SECTOR CRITERION IS APPLIED. ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT ** COMPOSITE OF 5 RADII **

TABLE F2.12

POPULATION SECTOR ANALYSIS - TOTAL U S
DENSITY = 1500 #/SQ MI *** "QUAD" SECTOR (90 0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		AVAILABLE LAND	> 1/4 ALLOWABLE POP	> 1/3 ALLOWABLE POP.	> 1/2 ALLOWABLE POP	UNIFORM DENSITY	RESTRICTED LANDS	
ALABAMA	1.0	39391	0	4536	3213	2692	2075	51907
		75 9%	0 0%	8 7%	6 2%	5 2%	4 0%	
ARIZONA	2 0	51820	318	772	589	1438	59405	114342
		45 3%	0 3%	0 7%	0 5%	1.3%	52 0%	
ARKANSAS	3 0	42499	0	1747	1274	1476	6263	53259
		79 8%	0 0%	3 3%	2 4%	2 8%	11 8%	
CALIFORNIA	4 0	88259	926	4603	4063	11020	51492	160363
		55 0%	0 6%	2 9%	2.5%	6.9%	32 1%	
COLORADO	5.0	71275	589	1187	1129	1486	28660	104326
		68 3%	0 6%	1 1%	1 1%	1 4%	27 5%	
CONNECTICUT	6 0	1255	10	676	598	2673	0	5212
		24 1%	0 2%	13 0%	11 5%	51 3%	0 0%	
DELAWARE	7.0	1467	0	241	212	367	39	2326
		63.1%	0 0%	10 4%	9.1%	15.8%	1 7%	
FLORIDA	8.0	34479	29	2345	3397	6002	13105	59357
		58.1%	0 0%	4 0%	5.7%	10 1%	22 1%	
GEORGIA	9 0	41389	241	4323	3165	3619	5867	58604
		70 6%	0 4%	7.4%	5 4%	6 2%	10 0%	
IDAHO	10.0	43946	0	772	637	676	37519	83550
		52 6%	0.0%	0 9%	0.8%	0 8%	44 9%	
ILLINOIS	11 0	42981	454	3464	2634	5645	1361	56539
		76 0%	0.8%	6 1%	4 7%	10.0%	2.4%	
INDIANA	12.0	23980	135	3889	3204	3812	1322	36342
		66.0%	0 4%	10.7%	8 8%	10.5%	3 6%	
IOWA	13.0	51299	0	1785	1322	1660	0	56066
		91.5%	0.0%	3.2%	2 4%	3.0%	0 0%	
KANSAS	14.0	77866	39	1293	1245	1631	193	82267
		94.7%	0 0%	1.6%	1.5%	2 0%	0 2%	
KENTUCKY	15.0	27097	48	5616	2972	2065	2470	40268
		67.3%	0.1%	13 9%	7 4%	5 1%	6 1%	
LOUISIANA	16.0	28217	0	2306	1448	1766	14417	48154
		58.6%	0.0%	4 8%	3.0%	3.7%	29.9%	
MAINE	17.0	30581	0	1476	878	782	357	34074
		89 7%	0.0%	4.3%	2 6%	2.3%	1.0%	
MARYLAND	18 0	4854	318	1341	1747	2750	145	11155
		43 5%	2.9%	12 0%	15 7%	24.7%	1.3%	
MASSACHUSETTS	19 0	2663	39	685	1177	4063	0	8627
		30 9%	0 4%	7 9%	13 6%	47 1%	0.0%	
MICHIGAN	20.0	38571	116	3802	3928	5742	9679	61838
		62 4%	0.2%	6.1%	6 4%	9.3%	15.7%	
MINNESOTA	21 0	54214	367	2345	1872	2191	24926	85915
		63.1%	0 4%	2.7%	2 2%	2.5%	29 0%	
MISSISSIPPI	22.0	37703	0	3098	1727	1515	3841	47884
		78 7%	0.0%	6 5%	3 6%	3.2%	8.0%	
MISSOURI	23.0	57987	222	2721	1930	2557	4516	69933
		82.9%	0.3%	3 9%	2.8%	3 7%	6.5%	
MONTANA	24.0	100051	0	463	376	405	47160	148455
		67.4%	0 0%	0.3%	0 3%	0.3%	31.8%	
NEBRASKA	25.0	73909	0	859	618	801	1534	77721
		95.1%	0.0%	1.1%	0.8%	1.0%	2 0%	
NEVADA	26 0	89446	0	290	251	376	20255	110618
		80 9%	0 0%	0 3%	0.2%	0.3%	18 3%	
NEW HAMPSHIRE	27.0	6118	0	695	569	888	1197	9467
		64 6%	0.0%	7.3%	6 0%	9.4%	12.6%	
NEW JERSEY	28 0	1602	145	511	1563	4188	0	8009
		20 0%	1.8%	6.4%	19.5%	52.3%	0.0%	
NEW MEXICO	29.0	88404	0	569	454	782	31536	121745
		72.6%	0.0%	0.5%	0 4%	0.6%	25.9%	
NEW YORK	30 0	24907	58	4314	4014	6996	9930	50219
		49 6%	0.1%	8 6%	8.0%	13.9%	19 8%	
NORTH CAROLINA	31.0	27252	0	6485	4188	4217	8627	50769
		53.7%	0 0%	12 8%	8 2%	8.3%	17 0%	
NORTH DAKOTA	32.0	63458	0	357	328	290	6572	71005
		89 4%	0.0%	0 5%	0 5%	0.4%	9 3%	
OHIO	33 0	22861	290	4526	4709	7122	2326	41834
		54 6%	0 7%	10.8%	11.3%	17 0%	5.6%	
OKLAHOMA	34.0	59878	0	2567	1824	1882	3464	69615
		86 0%	0.0%	3 7%	2 6%	2.7%	5.0%	
OREGON	35 0	62744	0	1206	1776	1853	30349	97928
		64 1%	0 0%	1 2%	1 8%	1.9%	31.0%	
PENNSYLVANIA	36 0	23440	318	5172	4709	8087	3551	45277
		51 8%	0 7%	11 4%	10 4%	17 9%	7 8%	
RHODE ISLAND	37 0	270	0	145	193	598	0	1206
		22 4%	0 0%	12 0%	16.0%	49 6%	0.0%	
SOUTH CAROLINA	38.0	20159	0	3995	2152	2220	2663	31189
		64 6%	0.0%	12 8%	6.9%	7.1%	8.5%	
SOUTH DAKOTA	39 0	53297	0	241	309	367	22793	77007
		69.2%	0 0%	0.3%	0 4%	0.5%	29 6%	
TENNESSEE	40 0	28342	0	4757	3329	3098	2596	42122
		67 3%	0 0%	11 3%	7.9%	7 4%	6 2%	
TEXAS	41 0	241327	975	6880	5481	8685	5491	268839
		89 8%	0 4%	2 6%	2 0%	3.2%	2 0%	
UTAH	42 0	57823	0	425	579	801	25553	85181
		67 9%	0 0%	0 5%	0 7%	0 9%	30 0%	
VERMONT	43 0	7585	0	473	434	338	1023	9853
		77 0%	0 0%	4 8%	4 4%	3 4%	10 4%	
VIRGINIA	44 0	25090	58	4613	2606	3136	5665	41168
		60 9%	0 1%	11 2%	6 3%	7 6%	13 8%	
WASHINGTON	45 0	38108	280	1592	1882	2692	24762	69316
		55 0%	0 4%	2 3%	2 7%	3 9%	35 7%	
WEST VIRGINIA	46 0	16038	0	2625	1419	1303	2721	24106
		66 5%	0 0%	10 9%	5 9%	5 4%	11 3%	
WISCONSIN	47 0	43319	203	3098	2567	2808	5028	57023
		76 0%	0 4%	5 4%	4 5%	4 9%	8 8%	
WYOMING	48 0	71912	0	193	290	367	25225	97987
		73 4%	0 0%	0 2%	0 3%	0 4%	25 7%	
		2141133	6178	112074	90981	131928	557673	
TOTAL		70 4%	0 2%	3 7%	3 0%	4 3%	18 3%	

NOTE "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING CRITERIA (i e IF > 1/4 OF THE POPULATION ALLOWED BY A UNIFORM DENSITY CRITERION IS FOUND IN A "QUAD" SECTOR OF 90 0 DEGREES) NUMBERS IN THE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THE GIVEN FRACTIONAL CRITERION THIS LAND IS CONSIDERED AVAILABLE IF THE CRITERION WERE RELAXED IF SECTOR CRITERION IS APPLIED, ASSUME THAT UNIFORM DENSITY CRITERION IS ALSO IN EFFECT ** COMPOSITE OF 5 RADII **

TABLE F2.13

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 250 #/SQ MI *** SINGLE SECTOR (22.5 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		>1/16 POP IN SECTOR	> 1/8 POP. IN SECTOR	> 1/6 POP. IN SECTOR	> 1/4 POP. IN SECTOR	> 1/3 POP IN SECTOR	> 1/2 POP IN SECTOR	UNIFORM DENSITY	NO POP CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	16550	20352	24424	30098	35387	41775	44129	49833	51907
		31.9%	39.2%	47.1%	58.0%	68.2%	80.5%	85.0%	96.0%	100.0%
ARIZONA	2.0	44033	44863	46166	48144	49215	50942	51608	54937	114343
		38.5%	39.2%	40.4%	42.1%	43.0%	44.6%	45.1%	48.0%	100.0%
ARKANSAS	3.0	23594	27059	32019	36998	40665	43010	43830	46995	53258
		44.3%	50.8%	60.1%	69.5%	76.4%	80.8%	82.3%	88.2%	100.0%
CALIFORNIA	4.0	52978	60158	66575	73060	78426	83926	86068	108871	160364
		33.0%	37.5%	41.5%	45.6%	48.9%	52.3%	53.7%	67.9%	100.0%
COLORADO	5.0	58527	61123	64095	66624	68824	70580	71719	75666	104326
		56.1%	58.6%	61.4%	63.9%	66.0%	67.7%	68.7%	72.5%	100.0%
CONNECTICUT	6.0	10	10	19	116	183	203	222	5211	5211
		0.2%	0.2%	0.4%	2.2%	3.5%	3.9%	4.3%	100.0%	100.0%
DELAWARE	7.0	309	386	647	946	1332	1544	1679	2287	2326
		13.3%	16.6%	27.8%	40.7%	57.3%	66.4%	72.2%	98.3%	100.0%
FLORIDA	8.0	10769	15527	19628	25138	28535	32569	34856	46252	59357
		18.1%	26.2%	33.1%	42.4%	48.1%	54.9%	58.7%	77.9%	100.0%
GEORGIA	9.0	16347	20439	25534	33186	38889	43898	45722	52737	58604
		27.9%	34.9%	43.6%	56.6%	66.4%	74.9%	78.0%	90.0%	100.0%
IDAHO	10.0	35686	37809	40019	41736	43058	44380	44824	46031	83550
		42.7%	45.3%	47.9%	50.0%	51.5%	53.1%	53.6%	55.1%	100.0%
ILLINOIS	11.0	11599	15151	23305	31806	37944	42103	43386	55179	56539
		20.5%	26.8%	41.2%	56.3%	67.1%	74.5%	76.7%	97.6%	100.0%
INDIANA	12.0	3020	4642	8396	14002	19011	22986	24472	35020	36342
		8.3%	12.8%	23.1%	38.5%	52.3%	63.3%	67.3%	96.4%	100.0%
IOWA	13.0	26238	28767	36911	43242	48038	51338	52255	56067	56067
		46.8%	51.3%	65.8%	77.1%	85.7%	91.6%	93.2%	100.0%	100.0%
KANSAS	14.0	59579	62580	67801	72008	74826	77576	78358	82073	82266
		72.4%	76.1%	82.4%	87.5%	91.0%	94.3%	95.2%	99.8%	100.0%
KENTUCKY	15.0	11368	14234	17052	20574	24849	31391	33485	37799	40269
		28.2%	35.3%	42.3%	51.1%	61.7%	78.0%	83.2%	93.9%	100.0%
LOUISIANA	16.0	11455	13578	16704	21095	25640	28940	30012	33736	48154
		23.8%	28.2%	34.7%	43.8%	53.2%	60.1%	62.3%	70.1%	100.0%
MAINE	17.0	23334	24772	26750	28593	30214	31816	32414	33717	34074
		68.5%	72.7%	78.5%	83.9%	88.7%	93.4%	95.1%	99.0%	100.0%
MARYLAND	18.0	994	1602	2258	3242	4150	4912	5269	11011	11155
		8.9%	14.4%	20.2%	29.1%	37.2%	44.0%	47.2%	98.7%	100.0%
MASSACHUSETTS	19.0	58	251	415	840	1177	1573	1853	8627	8627
		0.7%	2.9%	4.8%	9.7%	13.6%	18.2%	21.5%	100.0%	100.0%
MICHIGAN	20.0	20024	20805	24636	29375	34007	37529	38735	52158	61837
		32.4%	33.6%	39.8%	47.5%	55.0%	60.7%	62.6%	84.3%	100.0%
MINNESOTA	21.0	35280	38359	45567	49862	52969	55459	56356	60988	85914
		41.1%	44.6%	53.0%	58.0%	61.7%	64.6%	65.6%	71.0%	100.0%
MISSISSIPPI	22.0	18258	20603	24868	30137	35975	40076	41138	44043	47883
		38.1%	43.0%	51.9%	62.9%	75.1%	83.7%	85.9%	92.0%	100.0%
MISSOURI	23.0	33254	36969	44274	51261	55671	59077	60062	65417	69934
		47.6%	52.9%	63.3%	73.3%	79.6%	84.5%	85.9%	93.5%	100.0%
MONTANA	24.0	92206	94396	96027	98401	99356	100109	100476	101296	148456
		62.1%	63.6%	64.7%	66.3%	66.9%	67.4%	67.7%	68.2%	100.0%
NEBRASKA	25.0	63815	64356	66932	70059	71941	73465	74016	76187	77721
		82.1%	82.8%	86.1%	90.1%	92.6%	94.5%	95.2%	98.0%	100.0%
NEVADA	26.0	85393	85692	86445	87275	88066	88944	89185	90363	110618
		77.2%	77.5%	78.1%	78.9%	79.6%	80.4%	80.6%	81.7%	100.0%
NEW HAMPSHIRE	27.0	2818	3088	3966	4864	5578	6128	6369	8270	9467
		29.8%	32.6%	41.9%	51.4%	58.9%	64.7%	67.3%	87.4%	100.0%
NEW JERSEY	28.0	0	29	96	492	685	936	1081	8010	8010
		0.0%	0.4%	1.2%	6.1%	8.6%	11.6%	13.5%	100.0%	100.0%
NEW MEXICO	29.0	80346	81350	83337	85045	86339	88153	88732	90208	121744
		66.0%	66.8%	68.5%	69.9%	70.9%	72.4%	72.9%	74.1%	100.0%
NEW YORK	30.0	5703	7440	10625	15035	19754	24115	25582	40289	50219
		11.4%	14.8%	21.2%	29.9%	39.3%	48.0%	50.9%	80.2%	100.0%
NORTH CAROLINA	31.0	6919	9486	12950	18991	23893	30687	33032	42142	50769
		13.6%	18.7%	25.5%	37.4%	47.1%	60.4%	65.1%	83.0%	100.0%
NORTH DAKOTA	32.0	54088	56018	59955	61905	62908	63487	63960	64433	71005
		76.2%	78.9%	84.4%	87.2%	88.6%	89.4%	90.1%	90.7%	100.0%
OHIO	33.0	1872	4101	7305	12005	16608	20333	21732	39507	41833
		4.5%	9.8%	17.5%	28.7%	39.7%	48.6%	51.9%	94.4%	100.0%
OKLAHOMA	34.0	39633	43213	48375	52621	56800	60930	62107	66151	69615
		56.9%	62.1%	69.5%	75.6%	81.6%	87.5%	89.2%	95.0%	100.0%
OREGON	35.0	49794	52139	54918	58450	60206	62214	63420	67579	97928
		50.8%	53.2%	56.1%	59.7%	61.5%	63.5%	64.8%	69.0%	100.0%
PENNSYLVANIA	36.0	3590	6485	9804	14697	18789	23044	24260	41727	45278
		7.9%	14.3%	21.7%	32.5%	41.5%	50.9%	53.6%	92.2%	100.0%
RHODE ISLAND	37.0	0	0	0	0	29	68	68	1206	1206
		0.0%	0.0%	0.0%	0.0%	2.4%	5.6%	5.6%	100.0%	100.0%
SOUTH CAROLINA	38.0	5742	7865	10258	13597	17920	22523	23700	28525	31189
		18.4%	25.2%	32.9%	43.6%	57.5%	72.2%	76.0%	91.5%	100.0%
SOUTH DAKOTA	39.0	46918	48723	50412	52149	52795	53384	53596	54214	77007
		60.9%	63.3%	65.5%	67.7%	68.6%	69.3%	69.6%	70.4%	100.0%
TENNESSEE	40.0	11435	14060	16878	20873	25756	31179	33350	39526	42122
		27.1%	33.4%	40.1%	49.6%	61.1%	74.0%	79.2%	93.8%	100.0%
TEXAS	41.0	166163	179519	196522	215919	228396	238751	242408	263349	268839
		61.8%	66.8%	73.1%	80.3%	85.0%	88.8%	90.2%	98.0%	100.0%
UTAH	42.0	52264	52728	54117	55198	56009	57128	57543	59627	85181
		61.4%	61.9%	63.5%	64.8%	65.8%	67.1%	67.6%	70.0%	100.0%
VERMONT	43.0	3889	4468	5443	6437	7431	7981	8270	8830	9853
		39.5%	45.3%	55.2%	65.3%	75.4%	81.0%	83.9%	89.6%	100.0%
VIRGINIA	44.0	6774	9775	12989	17225	21867	27319	28902	35502	41167
		16.5%	23.7%	31.6%	41.8%	53.1%	66.4%	70.2%	86.2%	100.0%
WASHINGTON	45.0	22890	25640	28757	32096	34972	37114	38253	44554	69316
		33.0%	37.0%	41.5%	46.3%	50.5%	53.5%	55.2%	64.3%	100.0%
WEST VIRGINIA	46.0	5076	7595	9882	12757	15498	18239	19107	21384	24106
		21.1%	31.5%	41.0%	52.9%	64.3%	75.7%	79.3%	88.7%	100.0%
WISCONSIN	47.0	19590	23343	28863	35686	40733	44622	45866	51994	57022
		34.4%	40.9%	50.6%	62.6%	71.4%	78.3%	80.4%	91.2%	100.0%
WYOMING	49.0	65330	[illegible]	69901	70464	71246	71883	72211	72761	97986
		66.7%	68.5%	70.3%	71.9%	72.7%	73.4%	73.7%	74.3%	100.0%
TOTAL		1405512	1518712	1681820	1864324	2012560	2150329	2199678	2482289	3039964
		46.2%	50.0%	55.3%	61.3%	66.2%	70.7%	72.4%	81.7%	100.0%

NOTE NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED WHENEVER A SECTOR CRITERION IS APPLIED. IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2. 5. 10. 20. 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.14

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 500 #/SQ MI. *** SINGLE SECTOR (22.5 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		>1/16 POP IN SECTOR	> 1/8 POP. IN SECTOR	> 1/6 POP. IN SECTOR	> 1/4 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP IN SECTOR	UNIFORM DENSITY	NO POP CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	24038	27628	30726	34798	39121	43936	46503	49833	51907
		46 3%	53 2%	59 2%	67 0%	75 4%	84 6%	89 6%	96 0%	100 0%
ARIZONA	2.0	46600	47526	48723	50421	51483	52467	52911	54937	114343
		40 8%	41 6%	42.6%	44.1%	45 0%	45.9%	46.3%	48 0%	100 0%
ARKANSAS	3 0	30677	31343	36004	39816	42682	44419	45239	46996	53258
		57.6%	58 9%	67.6%	74.8%	80.1%	83 4%	84.9%	88.2%	100 0%
CALIFORNIA	4.0	66566	70976	75859	81996	86512	90565	92756	108871	160364
		41 5%	44 3%	47.3%	51.1%	53.9%	56 5%	57 8%	67 9%	100 0%
COLORADO	5.0	63429	65060	67550	69248	70792	72558	73176	75666	104326
		60.8%	62 4%	64.7%	66.4%	67.9%	69.5%	70.1%	72 5%	100.0%
CONNECTICUT	6.0	10	154	290	647	917	1226	1476	5211	5211
		0.2%	3.0%	5.6%	12 4%	17 6%	23 5%	28.3%	100.0%	100 0%
DELAWARE	7.0	569	608	849	1216	1554	1718	1862	2287	2326
		24 5%	26.1%	36 5%	52 3%	66 8%	73 9%	80 1%	98 3%	100.0%
FLORIDA	8 0	20149	23884	26952	31092	33833	36458	39121	46252	59357
		33.9%	40.2%	45.4%	52 4%	57 0%	61 4%	65.9%	77.9%	100.0%
GEORGIA	9 0	25061	28767	32385	36824	41736	46146	48308	52737	58604
		42 8%	49.1%	55.3%	62 8%	71.2%	78.7%	82 4%	90.0%	100 0%
IDAHO	10.0	39758	40501	41727	42885	43888	44853	45287	46031	83550
		47.6%	48.5%	49.9%	51 3%	52 5%	53.7%	54.2%	55.1%	100 0%
ILLINOIS	11.0	19570	23903	32627	38976	43155	46330	47343	55179	56539
		34.6%	42.3%	57.7%	68.9%	76.3%	81.9%	83.7%	97.6%	100.0%
INDIANA	12.0	7083	9573	13433	18374	23633	27724	29722	35020	36342
		19.5%	26.3%	37.0%	50.6%	65.0%	76.3%	81.8%	96.4%	100.0%
IOWA	13.0	32241	34605	43039	48375	51618	53480	53992	56066	56066
		57.5%	61.7%	76.8%	86.3%	92.1%	95.4%	96.3%	100.0%	100.0%
KANSAS	14.0	67396	68862	72616	75666	77933	79487	80027	82073	82266
		81.9%	83.7%	88.3%	92.0%	94.7%	96.6%	97.3%	99.8%	100.0%
KENTUCKY	15.0	16839	18296	20362	22851	26788	32868	35116	37799	40269
		41.8%	45.4%	50.6%	56 7%	66.5%	81.6%	87.2%	93.9%	100.0%
LOUISIANA	16.0	15855	18354	21085	24550	28284	30542	31536	33736	48154
		32 9%	38.1%	43 8%	51 0%	58.7%	63.4%	65.5%	70.1%	100 0%
MAINE	17.0	26229	26557	27956	29230	30658	32241	32868	33717	34074
		77.0%	77.9%	82.0%	85.8%	90.0%	94.6%	96.5%	99.0%	100.0%
MARYLAND	18.0	2123	2393	2963	3985	4883	5809	6504	11011	11155
		19 0%	21.5%	26.6%	35.7%	43.8%	52.1%	58.3%	98.7%	100.0%
MASSACHUSETTS	19.0	434	656	1004	1834	2451	2943	3513	8627	8627
		5.0%	7.6%	11.6%	21.3%	28.4%	34.1%	40.7%	100.0%	100.0%
MICHIGAN	20.0	22581	23922	28496	33630	38455	42093	44487	52158	61837
		36.5%	38 7%	46.1%	54 4%	62.2%	68.1%	71.9%	84.3%	100.0%
MINNESOTA	21.0	41871	42914	48511	51685	54638	56752	57659	60988	85914
		48.7%	49.9%	56.5%	60.2%	63.6%	66.1%	67.1%	71.0%	100.0%
MISSISSIPPI	22.0	24125	25322	28458	32530	37760	41128	42257	44043	47883
		50.4%	52.9%	59.4%	67.9%	78.9%	85.9%	88.3%	92.0%	100.0%
MISSOURI	23.0	41563	43068	49090	53837	58035	61065	61953	65417	69934
		59.4%	61.6%	70.2%	77.0%	83.0%	87.3%	88.6%	93.5%	100.0%
MONTANA	24.0	96654	96857	98054	99202	99955	100505	100843	101296	148456
		65.1%	65.2%	66.0%	66.8%	67.3%	67.7%	67.9%	68.2%	100.0%
NEBRASKA	25.0	66527	67724	70213	72298	73736	74788	75135	76187	77721
		85.6%	87.1%	90.3%	93.0%	94.9%	96.2%	96.7%	98.0%	100.0%
NEVADA	26.0	86059	86966	87757	88635	89089	89552	89774	90363	110618
		77.8%	78.6%	79 3%	80 1%	80.5%	81.0%	81.2%	81.7%	100.0%
NEW HAMPSHIRE	27.0	3619	4053	4729	5365	6031	6832	7180	8270	9467
		38.2%	42.8%	49.9%	56 7%	63.7%	72.2%	75.8%	87.4%	100.0%
NEW JERSEY	28.0	135	463	859	1129	1370	1660	2113	8010	8010
		1.7%	5.8%	10.7%	14.1%	17.1%	20.7%	26.4%	100.0%	100.0%
NEW MEXICO	29.0	83801	84225	85383	87246	88162	88954	89262	90208	121744
		68.8%	69.2%	70.1%	71.7%	72.4%	73.1%	73.3%	74.1%	100.0%
NEW YORK	30 0	9669	11927	15150	19261	24096	28960	31488	40289	50219
		19.3%	23.8%	30 2%	38 4%	48.0%	57.7%	62 7%	80.2%	100.0%
NORTH CAROLINA	31.0	12902	15662	18769	22909	27252	33746	37104	42142	50769
		25 4%	30 8%	37.0%	45.1%	53.7%	66.5%	73.1%	83 0%	100.0%
NORTH DAKOTA	32.0	58315	58797	61104	62580	63497	63922	64076	64433	71005
		82.1%	82 8%	86.1%	88 1%	89 4%	90.0%	90.2%	90.7%	100.0%
OHIO	33.0	7160	8859	11995	16029	21558	26509	29018	39507	41833
		17.1%	21 2%	28.7%	38 3%	51.5%	63.4%	69.4%	94.4%	100 0%
OKLAHOMA	34 0	47353	49292	53075	57060	60062	62600	63796	66151	69615
		68 0%	70.8%	76 2%	82.0%	86 3%	89.9%	91.6%	95.0%	100.0%
OREGON	35 0	55266	57331	58923	60892	62349	63642	65166	67579	97928
		56 4%	58 5%	60 2%	62 2%	63 7%	65.0%	66 5%	69.0%	100.0%
PENNSYLVANIA	36.0	9090	11551	14900	19155	23507	28082	30610	41727	45278
		20.1%	25.5%	32 9%	42.3%	51 9%	62.0%	67.6%	92.2%	100 0%
RHODE ISLAND	37.0	0	0	10	48	135	241	299	1206	1206
		0 0%	0.0%	0 8%	4 0%	11.2%	20.0%	24.8%	100 0%	100.0%
SOUTH CAROLINA	38.0	9756	11889	14407	16868	20207	24376	25881	28525	31189
		31 3%	38 1%	46 2%	54 1%	64.8%	78.2%	83.0%	91.5%	100.0%
SOUTH DAKOTA	39 0	50759	50798	51994	52834	53355	53635	53799	54214	77007
		65 9%	66 0%	67 5%	68.6%	69.3%	69.6%	69 9%	70.4%	100.0%
TENNESSEE	40 0	16656	18026	20603	24009	28313	33157	35879	39526	42122
		39 5%	42 8%	48 9%	57 0%	67'2%	78.7%	85 2%	93.8%	100 0%
TEXAS	41.0	194554	205159	217704	229844	239098	247416	250446	263348	268839
		72 4%	76 3%	81 0%	85 5%	88 9%	92.0%	93.2%	98.0%	100 0%
UTAH	42.0	53480	54609	55613	56839	57572	58218	58556	59627	85181
		62 8%	64.1%	65 3%	66.7%	67.6%	68.3%	68 7%	70.0%	100.0%
VERMONT	43 0	5308	5308	6080	6765	7643	8135	8482	8830	9853
		53 9%	53 9%	61 7%	68 7%	77.6%	82 6%	86 1%	89.6%	100 0%
VIRGINIA	44 0	12120	14253	16530	20362	24926	29433	31430	35502	41167
		29 4%	34 6%	40 2%	49 5%	60.5%	71.5%	76 3%	86 2%	100 0%
WASHINGTON	45.0	28757	30581	33090	35512	37963	39594	40810	44554	69316
		41 5%	44.1%	47 7%	51 2%	54 8%	57 1%	58 9%	64 3%	100 0%
WEST VIRGINIA	46.0	9399	10393	11551	13471	16144	18962	19918	21384	24106
		39 0%	43.1%	47 9%	55 9%	67 0%	78.7%	82 6%	88.7%	100 0%
WISCONSIN	47 0	26566	28796	33949	38918	43309	46494	48086	51994	57022
		46 6%	50 5%	59 5%	68 3%	76.0%	81.5%	84 3%	91.2%	100 0%
WYOMING	48 0	69663	69663	70619	71352	71844	72134	72356	72761	97986
		71 1%	71.1%	72 1%	72 8%	73 3%	73 6%	73 8%	74.3%	100 0%
TOTAL		1648335	1728054	1863766	2003049	2131982	2248355	2305123	2482288	3039963
		54 2%	56 8%	61 3%	65 9%	70 1%	74 0%	75 8%	81 7%	100 0%

NOTE NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED WHENEVER A SECTOR CRITERION IS APPLIED. IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2. 5. 10. 20. 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.15

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 750 #/SQ MI *** SINGLE SECTOR (22.5 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/16 POP IN SECTOR	> 1/8 POP IN SECTOR	> 1/6 POP IN SECTOR	> 1/4 POP IN SECTOR	> 1/3 POP IN SECTOR	> 1/2 POP IN SECTOR	UNIFORM DENSITY	NO POP CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	27435	30407	33167	36062	39729	44322	46976	49833	51907
		52.9%	58.6%	63.9%	69.5%	76.5%	85.4%	90.5%	96.0%	100.0%
ARIZONA	2.0	47459	48877	50132	51685	52274	52805	53258	54937	114343
		41.5%	42.7%	43.8%	45.2%	45.7%	46.2%	46.6%	48.0%	100.0%
ARKANSAS	3.0	31845	32907	37124	40559	43143	44612	45442	46995	53258
		59.8%	61.8%	69.7%	76.2%	81.0%	83.8%	85.3%	88.2%	100.0%
CALIFORNIA	4.0	71593	75926	80664	85258	89726	93238	95545	108871	160364
		44.6%	47.3%	50.3%	53.2%	56.0%	58.1%	59.6%	67.9%	100.0%
COLORADO	5.0	65388	66961	68640	70406	72028	73099	73803	75666	104326
		62.7%	64.2%	65.8%	67.5%	69.0%	70.1%	70.7%	72.5%	100.0%
CONNECTICUT	6.0	87	357	627	936	1322	1853	2268	5211	5211
		1.7%	6.9%	12.0%	18.0%	25.4%	35.6%	43.5%	100.0%	100.0%
DELAWARE	7.0	637	743	975	1283	1573	1727	1891	2287	2326
		27.4%	32.0%	41.9%	55.2%	67.6%	74.3%	81.3%	98.3%	100.0%
FLORIDA	8.0	25013	27261	30436	33051	34750	37017	39787	46252	59357
		42.1%	45.9%	51.3%	55.7%	58.5%	62.4%	67.0%	77.9%	100.0%
GEORGIA	9.0	28815	31189	34084	37789	42257	46581	48926	52737	58604
		49.2%	53.2%	58.2%	64.5%	72.1%	79.5%	83.5%	90.0%	100.0%
IDAHO	10.0	40839	41254	42335	43087	44052	44901	45345	46030	83550
		48.9%	49.4%	50.7%	51.6%	52.7%	53.7%	54.3%	55.1%	100.0%
ILLINOIS	11.0	25167	27657	35425	40627	44815	47546	48761	55179	56539
		44.5%	48.9%	62.7%	71.9%	79.3%	84.1%	86.2%	97.6%	100.0%
INDIANA	12.0	9843	11657	15537	20439	24936	28516	30861	35020	36342
		27.1%	32.1%	42.8%	56.2%	68.6%	78.5%	84.9%	96.4%	100.0%
IOWA	13.0	35647	37201	45220	49533	52342	53731	54272	56066	56066
		63.6%	66.4%	80.7%	88.3%	93.4%	95.8%	96.8%	100.0%	100.0%
KANSAS	14.0	69557	71111	74392	76853	78580	79738	80327	82073	82266
		84.6%	86.4%	90.4%	93.4%	95.5%	96.9%	97.6%	99.8%	100.0%
KENTUCKY	15.0	18480	19676	21404	23623	27338	33254	35647	37799	40269
		45.9%	48.9%	53.2%	58.7%	67.9%	82.6%	88.5%	93.9%	100.0%
LOUISIANA	16.0	18943	20429	22407	25457	28622	30841	31884	33736	48154
		39.3%	42.4%	46.5%	52.9%	59.4%	64.0%	66.2%	70.1%	100.0%
MAINE	17.0	26972	26981	28130	29365	30716	32279	32926	33717	34074
		79.2%	79.2%	82.6%	86.2%	90.1%	94.7%	96.6%	99.0%	100.0%
MARYLAND	18.0	2480	2712	3329	4207	5211	6427	7411	11011	11155
		22.2%	24.3%	29.8%	37.7%	46.7%	57.6%	66.4%	98.7%	100.0%
MASSACHUSETTS	19.0	656	1062	1679	2239	2654	3252	3995	8627	8627
		7.6%	12.3%	19.5%	26.0%	30.8%	37.7%	46.3%	100.0%	100.0%
MICHIGAN	20.0	24067	25978	30533	35049	39353	42894	45625	52158	61837
		38.9%	42.0%	49.4%	56.7%	63.6%	69.4%	73.8%	84.3%	100.0%
MINNESOTA	21.0	43637	43898	49369	52409	55285	57282	58431	60988	85914
		50.8%	51.1%	57.5%	61.0%	64.3%	66.7%	68.0%	71.0%	100.0%
MISSISSIPPI	22.0	25331	26856	29471	33157	38060	41302	42460	44043	47883
		52.9%	56.1%	61.5%	69.2%	79.5%	86.3%	88.7%	92.0%	100.0%
MISSOURI	23.0	43415	44458	50354	54928	59048	61625	62561	65417	69934
		62.1%	63.6%	72.0%	78.5%	84.4%	88.1%	89.5%	93.5%	100.0%
MONTANA	24.0	97494	97494	98411	99434	100128	100563	100881	101296	148456
		65.7%	65.7%	66.3%	67.0%	67.4%	67.7%	68.0%	68.2%	100.0%
NEBRASKA	25.0	68033	68901	71285	73012	74324	75000	75338	76187	77721
		87.5%	88.7%	91.7%	93.9%	95.6%	96.5%	96.9%	98.0%	100.0%
NEVADA	26.0	86956	87757	88491	89060	89427	89735	89899	90363	110618
		78.6%	79.3%	80.0%	80.5%	80.8%	81.1%	81.3%	81.7%	100.0%
NEW HAMPSHIRE	27.0	4169	4333	4883	5452	6166	6948	7324	8270	9467
		44.0%	45.8%	51.6%	57.6%	65.1%	73.4%	77.4%	87.4%	100.0%
NEW JERSEY	28.0	482	869	1110	1457	1631	2036	2577	8010	8010
		6.0%	10.8%	13.9%	18.2%	20.4%	25.4%	32.2%	100.0%	100.0%
NEW MEXICO	29.0	84544	85316	86860	87719	88471	89041	89359	90208	121744
		69.4%	70.1%	71.3%	72.1%	72.7%	73.1%	73.4%	74.1%	100.0%
NEW YORK	30.0	12091	13828	16994	20776	25389	29838	32665	40289	50219
		24.1%	27.5%	33.8%	41.4%	50.6%	59.4%	65.0%	80.2%	100.0%
NORTH CAROLINA	31.0	15594	17862	20477	23488	27531	34267	37809	42142	50769
		30.7%	35.2%	40.3%	46.3%	54.2%	67.5%	74.5%	83.0%	100.0%
NORTH DAKOTA	32.0	59183	59183	61422	62976	63641	63989	64134	64433	71005
		83.4%	83.4%	86.5%	88.7%	89.7%	90.1%	90.3%	90.7%	100.0%
OHIO	33.0	9235	10663	13857	18625	23710	28217	31401	39507	41833
		22.1%	25.5%	33.1%	44.5%	56.7%	67.5%	75.1%	94.4%	100.0%
OKLAHOMA	34.0	50180	52013	55410	57929	60380	62841	64066	66151	69615
		72.1%	74.7%	79.6%	83.2%	86.7%	90.3%	92.0%	95.0%	100.0%
OREGON	35.0	57398	58759	60245	61818	62899	63989	65591	67579	97928
		58.6%	60.0%	61.5%	63.1%	64.2%	65.3%	67.0%	69.0%	100.0%
PENNSYLVANIA	36.0	11368	13655	16887	19879	24443	29529	32713	41727	45278
		25.1%	30.2%	37.3%	43.9%	54.0%	65.2%	72.3%	92.2%	100.0%
RHODE ISLAND	37.0	0	10	39	193	270	396	521	1206	1206
		0.0%	0.8%	3.2%	16.0%	22.4%	32.8%	43.2%	100.0%	100.0%
SOUTH CAROLINA	38.0	11754	14041	15691	17293	20410	24588	26229	28525	31189
		37.7%	45.0%	50.3%	55.4%	65.4%	78.8%	84.1%	91.5%	100.0%
SOUTH DAKOTA	39.0	51193	51193	52293	53027	53461	53673	53837	54214	77007
		66.5%	66.5%	67.9%	68.9%	69.4%	69.7%	69.9%	70.4%	100.0%
TENNESSEE	40.0	18142	19956	22050	24752	28709	33486	36313	39526	42122
		43.1%	47.4%	52.3%	58.8%	68.2%	79.5%	86.2%	93.8%	100.0%
TEXAS	41.0	208662	214230	224189	235103	243798	250003	253177	263349	268839
		77.6%	79.7%	83.4%	87.5%	90.7%	93.0%	94.2%	98.0%	100.0%
UTAH	42.0	54629	55439	56339	57591	57842	58344	58701	59627	85181
		64.1%	65.1%	66.4%	67.6%	67.9%	68.5%	68.9%	70.0%	100.0%
VERMONT	43.0	5481	5491	6205	6813	7662	8154	8492	8830	9853
		55.6%	55.7%	63.0%	69.1%	77.8%	82.8%	86.2%	89.6%	100.0%
VIRGINIA	44.0	14552	16038	18238	21452	25553	29954	32057	35502	41167
		35.3%	39.0%	44.3%	52.1%	62.1%	72.8%	77.9%	86.2%	100.0%
WASHINGTON	45.0	30774	32742	34653	36940	38677	40125	41466	44554	69316
		44.4%	47.2%	50.0%	53.3%	55.8%	57.9%	59.8%	64.3%	100.0%
WEST VIRGINIA	46.0	10721	10866	11792	13635	16251	19088	20072	21384	24106
		44.5%	45.1%	48.9%	56.6%	67.4%	79.2%	83.3%	88.7%	100.0%
WISCONSIN	47.0	29095	30648	35425	39633	43985	47169	48848	51994	57022
		51.0%	53.7%	62.1%	69.5%	77.1%	82.7%	85.7%	91.2%	100.0%
WYOMING	48.0	70262	70262	71072	71564	71912	72163	[illegible]	72761	97986
		71.7%	71.7%	72.5%	73.0%	73.4%	73.6%	[illegible]	74.3%	100.0%
TOTAL		1745298	1807107	1929952	2047623	2164506	2271978	2334266	2482287	3039963
		57.4%	59.4%	63.5%	67.4%	71.2%	74.7%	76.8%	81.7%	100.0%

NOTE NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED

TABLE F2.16

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 1500 #/SQ.MI. *** SINGLE SECTOR (22.5 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		>1/16 POP. IN SECTOR	> 1/8 POP. IN SECTOR	> 1/6 POP. IN SECTOR	> 1/4 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP. IN SECTOR	UNIFORM DENSITY	NO POP	CRITERIA NO RESTRICTIONS
ALABAMA	1.0	32482	33186	34624	36381	39845	44438	47140	49833	51907
		62.6%	63.9%	66.7%	70.1%	76.8%	85.6%	90.8%	96.0%	100.0%
ARIZONA	2.0	49466	51087	51830	52284	52544	53017	53500	54937	114343
		43.3%	44.7%	45.3%	45.7%	46.0%	46.4%	46.8%	48.0%	100.0%
ARKANSAS	3.0	33765	34200	37953	40868	43242	44689	45519	46995	53258
		63.4%	64.2%	71.3%	76.7%	81.2%	83.9%	85.5%	88.2%	100.0%
CALIFORNIA	4.0	79535	82286	85837	89079	92215	95303	97851	108871	160364
		49.6%	51.3%	53.5%	55.5%	57.5%	59.4%	61.0%	67.9%	100.0%
COLORADO	5.0	68226	68833	70648	71671	72539	73475	74180	75666	104326
		65.4%	66.0%	67.7%	68.7%	69.5%	70.4%	71.1%	72.5%	100.0%
CONNECTICUT	6.0	386	695	811	994	1399	2027	2538	5211	5211
		7.4%	13.3%	15.6%	19.1%	26.9%	38.9%	48.7%	100.0%	100.0%
DELAWARE	7.0	811	859	1052	1303	1573	1756	1920	2287	2326
		34.9%	36.9%	45.2%	56.0%	67.6%	75.5%	82.6%	98.3%	100.0%
FLORIDA	8.0	29384	31546	32733	33794	35155	37413	40250	46252	59357
		49.5%	53.1%	55.1%	56.9%	59.2%	63.0%	67.8%	77.9%	100.0%
GEORGIA	9.0	32279	33071	35174	38069	42441	46735	49118	52737	58604
		55.1%	56.4%	60.0%	65.0%	72.4%	79.7%	83.8%	90.0%	100.0%
IDAHO	10.0	41804	41813	42643	43232	44081	44911	45355	46030	83550
		50.0%	50.0%	51.0%	51.7%	52.8%	53.8%	54.3%	55.1%	100.0%
ILLINOIS	11.0	29712	30426	37693	42142	45644	48231	49533	55179	56539
		52.6%	53.8%	66.7%	74.5%	80.7%	85.3%	87.6%	97.6%	100.0%
INDIANA	12.0	13298	14832	17997	21259	25244	28796	31208	35020	36342
		36.6%	40.8%	49.5%	58.5%	69.5%	79.2%	85.9%	96.4%	100.0%
IOWA	13.0	38668	39140	46629	50074	52477	53837	54407	56067	56067
		69.0%	69.8%	83.2%	89.3%	93.6%	96.0%	97.0%	100.0%	100.0%
KANSAS	14.0	72500	73002	75791	77306	78754	79854	80442	82073	82266
		88.1%	88.7%	92.1%	94.0%	95.7%	97.1%	97.8%	99.8%	100.0%
KENTUCKY	15.0	20429	21076	22436	24067	27464	33293	35734	37799	40269
		50.7%	52.3%	55.7%	59.8%	68.2%	82.7%	88.7%	93.9%	100.0%
LOUISIANA	16.0	21992	22031	23430	25727	28699	30909	31970	33736	48154
		45.7%	45.8%	48.7%	53.4%	59.6%	64.2%	66.4%	70.1%	100.0%
MAINE	17.0	27194	27194	28226	29375	30726	32279	32935	33717	34074
		79.8%	79.8%	82.8%	86.2%	90.2%	94.7%	96.7%	99.0%	100.0%
MARYLAND	18.0	2779	3156	3706	4931	6002	7045	8260	11011	11155
		24.9%	28.3%	33.2%	44.2%	53.8%	63.1%	74.0%	98.7%	100.0%
MASSACHUSETTS	19.0	1380	1853	2094	2480	2943	3590	4564	8627	8627
		16.0%	21.5%	24.3%	28.7%	34.1%	41.6%	52.9%	100.0%	100.0%
MICHIGAN	20.0	27638	28419	32202	35763	39855	43396	46417	52158	61837
		44.7%	46.0%	52.1%	57.8%	64.5%	70.2%	75.1%	84.3%	100.0%
MINNESOTA	21.0	44622	45094	50508	53114	55536	57543	58797	60988	85914
		51.9%	52.5%	58.8%	61.8%	64.6%	67.0%	68.4%	71.0%	100.0%
MISSISSIPPI	22.0	27792	28110	30204	33341	38127	41341	42528	44043	47883
		58.0%	58.7%	63.1%	69.6%	79.6%	86.3%	88.8%	92.0%	100.0%
MISSOURI	23.0	45345	46088	51830	55709	59415	61847	62860	65417	69934
		64.8%	65.9%	74.1%	79.7%	85.0%	88.4%	89.9%	93.5%	100.0%
MONTANA	24.0	97928	97928	98768	99646	100206	100572	100891	101296	148456
		66.0%	66.0%	66.5%	67.1%	67.5%	67.7%	68.0%	68.2%	100.0%
NEBRASKA	25.0	69605	70155	72288	73475	74498	75048	75386	76187	77721
		89.6%	90.3%	93.0%	94.5%	95.9%	96.6%	97.0%	98.0%	100.0%
NEVADA	26.0	88365	88732	89108	89417	89639	89822	89986	90363	110618
		79.9%	80.2%	80.6%	80.8%	81.0%	81.2%	81.3%	81.7%	100.0%
NEW HAMPSHIRE	27.0	4420	4429	4989	5520	6195	6977	7382	8270	9467
		46.7%	46.8%	52.7%	58.3%	65.4%	73.7%	78.0%	87.4%	100.0%
NEW JERSEY	28.0	1042	1322	1583	1969	2248	2808	3821	8009	8009
		13.0%	16.5%	19.8%	24.6%	28.1%	35.1%	47.7%	100.0%	100.0%
NEW MEXICO	29.0	86165	86869	87564	88027	88587	89108	89427	90208	121744
		70.8%	71.4%	71.9%	72.3%	72.8%	73.2%	73.5%	74.1%	100.0%
NEW YORK	30.0	14861	16308	18866	21713	26036	30330	33293	40289	50219
		29.6%	32.5%	37.6%	43.2%	51.8%	60.4%	66.3%	80.2%	100.0%
NORTH CAROLINA	31.0	19252	19358	21134	23787	27744	34412	37925	42142	50769
		37.9%	38.1%	41.6%	46.9%	54.6%	67.8%	74.7%	83.0%	100.0%
NORTH DAKOTA	32.0	59801	59801	61856	63072	63739	63999	64144	64433	71005
		84.2%	84.2%	87.1%	88.8%	89.8%	90.1%	90.3%	90.7%	100.0%
OHIO	33.0	11812	13838	16984	20111	24492	28882	32385	39507	41833
		28.2%	33.1%	40.6%	48.1%	58.5%	69.0%	77.4%	94.4%	100.0%
OKLAHOMA	34.0	53200	54320	56414	58267	60641	63024	64269	66151	69615
		76.4%	78.0%	81.0%	83.7%	87.1%	90.5%	92.3%	95.0%	100.0%
OREGON	35.0	59849	60448	61395	62223	63063	64105	65726	67579	97928
		61.1%	61.7%	62.7%	63.5%	64.4%	65.5%	67.1%	69.0%	100.0%
PENNSYLVANIA	36.0	15102	15363	17785	20516	24984	30108	33640	41727	45278
		33.4%	33.9%	39.3%	45.3%	55.2%	66.5%	74.3%	92.2%	100.0%
RHODE ISLAND	37.0	10	164	251	280	328	444	608	1206	1206
		0.8%	13.6%	20.8%	23.2%	27.2%	36.8%	50.4%	100.0%	100.0%
SOUTH CAROLINA	38.0	15083	15122	16154	17428	20506	24665	26306	28525	31189
		48.4%	48.5%	51.8%	55.9%	65.7%	79.1%	84.3%	91.5%	100.0%
SOUTH DAKOTA	39.0	51599	51599	52515	53094	53471	53683	53847	54214	77007
		67.0%	67.0%	68.2%	68.9%	69.4%	69.7%	69.9%	70.4%	100.0%
TENNESSEE	40.0	20931	21500	22822	25032	28844	33563	36429	39526	42122
		49.7%	51.0%	54.2%	59.4%	68.5%	79.7%	86.5%	93.8%	100.0%
TEXAS	41.0	219402	223282	232082	239262	245621	251209	254663	263348	268839
		81.6%	83.1%	86.3%	89.0%	91.4%	93.4%	94.7%	98.0%	100.0%
UTAH	42.0	55816	56935	57408	57755	57948	58450	58826	59627	85181
		65.5%	66.8%	67.4%	67.8%	68.0%	68.6%	69.1%	70.0%	100.0%
VERMONT	43.0	5607	5616	6273	6842	7672	8154	8492	8830	9853
		56.9%	57.0%	63.7%	69.4%	77.9%	82.8%	86.2%	89.6%	100.0%
VIRGINIA	44.0	16704	17872	19406	21848	25833	30204	32366	35502	41167
		40.6%	43.4%	47.1%	53.1%	62.8%	73.4%	78.6%	86.2%	100.0%
WASHINGTON	45.0	33920	35145	36342	37548	39034	40414	41862	44554	69316
		48.9%	50.7%	52.4%	54.2%	56.3%	58.3%	60.4%	64.3%	100.0%
WEST VIRGINIA	46.0	11126	11136	11947	13655	16270	19097	20082	21384	24106
		46.2%	46.2%	49.6%	56.6%	67.5%	79.2%	83.3%	88.7%	100.0%
WISCONSIN	47.0	31932	32299	36545	40337	44400	47439	49186	51994	57022
		56.0%	56.6%	64.1%	70.7%	77.9%	83.2%	86.3%	91.2%	100.0%
WYOMING	48.0	70812	70812	71313	71642	71970	72163	72394	72761	97986
		72.3%	72.3%	72.8%	73.1%	73.4%	73.6%	73.9%	74.3%	100.0%
		1855831	1888350	1987803	2075429	2179879	2284405	2350362	2482286	3039963
TOTAL		61.0%	62.1%	65.4%	68.3%	71.7%	75.1%	77.3%	81.7%	100.0%

NOTE: NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.17

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 250 #/SQ.MI. *** DOUBLE SECTOR (45.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/8 POP. IN SECTOR	> 1/6 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP. IN SECTOR	UNIFORM DENSITY	NO POP. CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	19647	21201	26817	32762	39575	44129	49833	51907
		37.9%	40.8%	51.7%	63.1%	76.2%	85.0%	96.0%	100.0%
ARIZONA	2.0	44969	45307	47256	48366	49726	51608	54937	114343
		39.3%	39.6%	41.3%	42.3%	43.5%	45.1%	48.0%	100.0%
ARKANSAS	3.0	28767	29529	35145	38571	41958	43830	46995	53258
		54.0%	55.4%	66.0%	72.4%	78.8%	82.3%	88.2%	100.0%
CALIFORNIA	4.0	59695	61142	68747	74459	80944	86068	108871	160364
		37.2%	38.1%	42.9%	46.4%	50.5%	53.7%	67.9%	100.0%
COLORADO	5.0	61702	62706	65331	66710	69663	71719	75666	104326
		59.1%	60.1%	62.6%	63.9%	66.8%	68.7%	72.5%	100.0%
CONNECTICUT	6.0	10	10	39	106	203	222	5211	5211
		0.2%	0.2%	0.7%	2.0%	3.9%	4.3%	100.0%	100.0%
DELAWARE	7.0	444	444	820	1100	1476	1679	2287	2326
		19.1%	19.1%	35.3%	47.3%	63.5%	72.2%	98.3%	100.0%
FLORIDA	8.0	13790	16202	21423	25476	30214	34856	46252	59357
		23.2%	27.3%	36.1%	42.9%	50.9%	58.7%	77.9%	100.0%
GEORGIA	9.0	20535	21934	29153	36236	42180	45722	52737	58604
		35.0%	37.4%	49.7%	61.8%	72.0%	78.0%	90.0%	100.0%
IDAHO	10.0	38185	38339	41312	42286	43965	44824	46030	83550
		45.7%	45.9%	49.4%	50.6%	52.6%	53.6%	55.1%	100.0%
ILLINOIS	11.0	17138	18933	26943	33119	39864	43386	55179	56539
		30.3%	33.5%	47.7%	58.6%	70.5%	76.7%	97.6%	100.0%
INDIANA	12.0	4709	6012	11001	16241	21201	24472	35020	36342
		13.0%	16.5%	30.3%	44.7%	58.3%	67.3%	96.4%	100.0%
IOWA	13.0	32347	33707	40327	44187	49601	52255	56066	56066
		57.7%	60.1%	71.9%	78.8%	88.5%	93.2%	100.0%	100.0%
KANSAS	14.0	65166	65581	70175	72558	75859	78358	82073	82266
		79.2%	79.7%	85.3%	88.2%	92.2%	95.2%	99.8%	100.0%
KENTUCKY	15.0	14272	14822	18962	23498	30156	33486	37799	40269
		35.4%	36.8%	47.1%	58.4%	74.9%	83.2%	93.9%	100.0%
LOUISIANA	16.0	12931	14378	18972	22842	27599	30011	33736	48154
		26.9%	29.9%	39.4%	47.4%	57.3%	62.3%	70.1%	100.0%
MAINE	17.0	25399	25466	27927	29683	31584	32414	33717	34074
		74.5%	74.7%	82.0%	87.1%	92.7%	95.1%	99.0%	100.0%
MARYLAND	18.0	1573	1621	2876	3648	4729	5269	11011	11155
		14.1%	14.5%	25.8%	32.7%	42.4%	47.2%	98.7%	100.0%
MASSACHUSETTS	19.0	174	261	569	897	1370	1853	8627	8627
		2.0%	3.0%	6.6%	10.4%	15.9%	21.5%	100.0%	100.0%
MICHIGAN	20.0	22562	22899	27088	31449	36178	38735	52158	61837
		36.5%	37.0%	43.8%	50.9%	58.5%	62.6%	84.3%	100.0%
MINNESOTA	21.0	42338	43357	48580	51521	54426	56354	60988	85914
		49.3%	50.5%	56.5%	60.0%	63.3%	65.6%	71.0%	100.0%
MISSISSIPPI	22.0	21934	22398	27860	33939	38552	41138	44043	47883
		45.8%	46.8%	58.2%	70.9%	80.5%	85.9%	92.0%	100.0%
MISSOURI	23.0	41061	41765	49109	53422	57591	60062	65417	69934
		58.7%	59.7%	70.2%	76.4%	82.4%	85.9%	93.5%	100.0%
MONTANA	24.0	94744	95554	97494	98941	99839	100476	101296	148456
		63.8%	64.4%	65.7%	66.6%	67.3%	67.7%	68.2%	100.0%
NEBRASKA	25.0	65475	65890	68467	70908	72423	74015	76187	77721
		84.2%	84.8%	88.1%	91.2%	93.2%	95.2%	98.0%	100.0%
NEVADA	26.0	85885	86020	87024	87429	88404	89185	90363	110618
		77.6%	77.8%	78.7%	79.0%	79.9%	80.6%	81.7%	100.0%
NEW HAMPSHIRE	27.0	3194	3310	4400	5336	6031	6369	8270	9467
		33.7%	35.0%	46.5%	56.4%	63.7%	67.3%	87.4%	100.0%
NEW JERSEY	28.0	0	19	116	405	840	1081	8009	8009
		0.0%	0.2%	1.4%	5.1%	10.5%	13.5%	100.0%	100.0%
NEW MEXICO	29.0	82363	82488	84370	85383	87091	88732	90208	121744
		67.7%	67.8%	69.3%	70.1%	71.5%	72.9%	74.1%	100.0%
NEW YORK	30.0	7469	8231	12477	16936	21925	25582	40289	50219
		14.9%	16.4%	24.8%	33.7%	43.7%	50.9%	80.2%	100.0%
NORTH CAROLINA	31.0	8463	9766	14871	21732	29201	33032	42142	50769
		16.7%	19.2%	29.3%	42.8%	57.5%	65.1%	83.0%	100.0%
NORTH DAKOTA	32.0	58209	58826	61413	62378	63024	63960	64433	71005
		82.0%	82.8%	86.5%	87.8%	88.8%	90.1%	90.7%	100.0%
OHIO	33.0	3551	4632	9187	14186	18673	21732	39507	41833
		8.5%	11.1%	22.0%	33.9%	44.6%	51.9%	94.4%	100.0%
OKLAHOMA	34.0	44081	45809	50334	54011	58498	62107	66151	69615
		63.3%	65.8%	72.3%	77.6%	84.0%	89.2%	95.0%	100.0%
OREGON	35.0	52149	53056	56221	58817	61046	63420	67579	97928
		53.3%	54.2%	57.4%	60.1%	62.3%	64.8%	69.0%	100.0%
PENNSYLVANIA	36.0	5790	6842	11696	16405	21693	24260	41727	45278
		12.8%	15.1%	25.8%	36.2%	47.9%	53.6%	92.2%	100.0%
RHODE ISLAND	37.0	0	0	0	10	58	68	1206	1206
		0.0%	0.0%	0.0%	0.8%	4.8%	5.6%	100.0%	100.0%
SOUTH CAROLINA	38.0	7537	7990	11416	15150	21182	23700	28525	31189
		24.2%	25.6%	36.6%	48.6%	67.9%	76.0%	91.5%	100.0%
SOUTH DAKOTA	39.0	48655	49379	51415	52322	52950	53596	54214	77007
		63.2%	64.1%	66.8%	67.9%	68.8%	69.6%	70.4%	100.0%
TENNESSEE	40.0	14050	14726	18885	23199	29577	33350	39526	42122
		33.4%	35.0%	44.8%	55.1%	70.2%	79.2%	93.8%	100.0%
TEXAS	41.0	181256	186477	206568	219914	232690	242408	263349	268839
		67.4%	69.4%	76.8%	81.8%	86.6%	90.2%	98.0%	100.0%
UTAH	42.0	53220	53422	54494	55208	56433	57543	59627	85181
		62.5%	62.7%	64.0%	64.8%	66.3%	67.6%	70.0%	100.0%
VERMONT	43.0	4420	4931	6022	7199	7865	8270	8830	9853
		44.9%	50.0%	61.1%	73.1%	79.8%	83.9%	89.6%	100.0%
VIRGINIA	44.0	9525	10634	14813	19811	25534	28902	35502	41167
		23.1%	25.8%	36.0%	48.1%	62.0%	70.2%	86.2%	100.0%
WASHINGTON	45.0	24974	26566	29741	32897	35782	38253	44554	69316
		36.0%	38.3%	42.9%	47.5%	51.6%	55.2%	64.3%	100.0%
WEST VIRGINIA	46.0	7141	7836	11667	14572	17872	19107	21384	24106
		29.6%	32.5%	48.4%	60.4%	74.1%	79.3%	88.7%	100.0%
WISCONSIN	47.0	24849	25823	33350	37953	42991	45866	51994	57022
		43.6%	45.3%	58.5%	66.6%	75.4%	80.4%	91.2%	100.0%
WYOMING	48.0	67637	67637	70175	70850	71468	72211	72761	97986
		69.0%	69.0%	71.6%	72.3%	72.9%	73.7%	74.3%	100.0%
TOTAL		1544002	1583878	1772988	1925028	2091704	2199677	2482286	3039962
		50.8%	52.1%	58.3%	63.3%	68.8%	72.4%	81.7%	100.0%

NOTE: NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.18

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 500 #/SQ.MI *** DOUBLE SECTOR (45 0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/8 POP IN SECTOR	> 1/6 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/3 POP IN SECTOR	> 1/2 POP IN SECTOR	UNIFORM DENSITY	NO POP CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	26653	28371	32308	37500	43357	46503	49833	51907
		51.3%	54.7%	62.2%	72.2%	83.5%	89.6%	96.0%	100.0%
ARIZONA	2.0	47353	47806	49118	50373	51724	52911	54937	114343
		41.4%	41.8%	43.0%	44.1%	45.2%	46.3%	48.0%	100.0%
ARKANSAS	3.0	33910	34238	38542	41341	43840	45239	46996	53258
		63.7%	64.3%	72.4%	77.6%	82.3%	84.9%	88.2%	100.0%
CALIFORNIA	4.0	69422	72057	77605	83482	88751	92756	108871	160364
		43.3%	44.9%	48.4%	52.1%	55.3%	57.8%	67.9%	100.0%
COLORADO	5.0	65224	65552	68264	69654	71478	73176	75666	104326
		62.5%	62.8%	65.4%	66.8%	68.5%	70.1%	72.5%	100.0%
CONNECTICUT	6.0	29	77	309	685	1168	1476	5211	5211
		0.6%	1.5%	5.9%	13.1%	22.4%	28.3%	100.0%	100.0%
DELAWARE	7.0	656	685	1071	1419	1698	1862	2287	2326
		28.2%	29.5%	46.1%	61.0%	73.0%	80.1%	98.3%	100.0%
FLORIDA	8.0	23170	24009	27782	31507	35329	39121	46252	59357
		39.0%	40.4%	46.8%	53.1%	59.5%	65.9%	77.9%	100.0%
GEORGIA	9.0	28342	30156	34981	40154	45394	48308	52737	58604
		48.4%	51.5%	59.7%	68.5%	77.5%	82.4%	90.0%	100.0%
IDAHO	10.0	41099	41148	42605	43637	44477	45287	46031	83550
		49.2%	49.2%	51.0%	52.2%	53.2%	54.2%	55.1%	100.0%
ILLINOIS	11.0	27396	28728	36226	40617	44670	47343	55179	56539
		48.5%	50.8%	64.1%	71.8%	79.0%	83.7%	97.6%	100.0%
INDIANA	12.0	10731	11599	16241	20796	26316	29722	35020	36342
		29.5%	31.9%	44.7%	57.2%	72.4%	81.8%	96.4%	100.0%
IOWA	13.0	39652	40067	46494	49379	52361	53992	56067	56067
		70.7%	71.5%	82.9%	88.1%	93.4%	96.3%	100.0%	100.0%
KANSAS	14.0	70397	70686	74035	76167	78445	80027	82073	82266
		85.6%	85.9%	90.0%	92.6%	95.4%	97.3%	99.8%	100.0%
KENTUCKY	15.0	18383	19300	21886	25823	32192	35116	37799	40269
		45.7%	47.9%	54.3%	64.1%	79.9%	87.2%	93.9%	100.0%
LOUISIANA	16.0	18653	18991	23334	26692	30060	31536	33736	48154
		38.7%	39.4%	48.5%	55.4%	62.4%	65.5%	70.1%	100.0%
MAINE	17.0	27474	27474	29056	30397	32077	32868	33717	34074
		80.6%	80.6%	85.3%	89.2%	94.1%	96.5%	99.0%	100.0%
MARYLAND	18.0	2519	2625	3570	4497	5578	6504	11011	11155
		22.6%	23.5%	32.0%	40.3%	50.0%	58.3%	98.7%	100.0%
MASSACHUSETTS	19.0	589	695	1148	2017	2770	3513	8627	8627
		6.8%	8.1%	13.3%	23.4%	32.1%	40.7%	100.0%	100.0%
MICHIGAN	20.0	25650	26557	31546	36477	41341	44487	52158	61837
		41.5%	42.9%	51.0%	59.0%	66.9%	71.9%	84.3%	100.0%
MINNESOTA	21.0	47430	47578	50817	53500	55941	57689	60988	85914
		55.2%	55.4%	59.1%	62.3%	65.1%	67.1%	71.0%	100.0%
MISSISSIPPI	22.0	26055	26634	31449	36892	40578	42257	44043	47883
		54.4%	55.6%	65.7%	77.0%	84.7%	88.3%	92.0%	100.0%
MISSOURI	23.0	47169	47546	52650	56433	59772	61953	65417	69934
		67.4%	68.0%	75.3%	80.7%	85.5%	88.6%	93.5%	100.0%
MONTANA	24.0	97803	97803	98884	99540	100312	100843	101296	148456
		65.9%	65.9%	66.6%	67.1%	67.6%	67.9%	68.2%	100.0%
NEBRASKA	25.0	68843	69326	71092	72809	73996	75135	76187	77721
		88.6%	89.2%	91.5%	93.7%	95.2%	96.7%	98.0%	100.0%
NEVADA	26.0	87072	87149	88056	88741	89156	89774	90363	110618
		78.7%	78.8%	79.6%	80.2%	80.6%	81.2%	81.7%	100.0%
NEW HAMPSHIRE	27.0	4256	4410	5230	5954	6716	7180	8270	9467
		45.0%	46.6%	55.2%	62.9%	70.9%	75.8%	87.4%	100.0%
NEW JERSEY	28.0	270	386	868	1177	1612	2113	8010	8010
		3.4%	4.8%	10.8%	14.7%	20.1%	26.4%	100.0%	100.0%
NEW MEXICO	29.0	84360	84563	86068	87651	88577	89262	90208	121744
		69.3%	69.5%	70.7%	72.0%	72.8%	73.3%	74.1%	100.0%
NEW YORK	30.0	11976	13134	17129	22214	27319	31488	40289	50219
		23.8%	26.2%	34.1%	44.2%	54.4%	62.7%	80.2%	100.0%
NORTH CAROLINA	31.0	14986	16859	20912	26248	33273	37104	42142	50769
		29.5%	33.2%	41.2%	51.7%	65.5%	73.1%	83.0%	100.0%
NORTH DAKOTA	32.0	60698	60698	62204	63082	63700	64076	64433	71005
		85.5%	85.5%	87.6%	88.8%	89.7%	90.2%	90.7%	100.0%
OHIO	33.0	9747	10229	13790	18972	24598	29018	39507	41833
		23.3%	24.5%	33.0%	45.4%	58.8%	69.4%	94.4%	100.0%
OKLAHOMA	34.0	50383	50798	54561	58132	61866	63796	66151	69615
		72.4%	73.0%	78.4%	83.5%	88.9%	91.6%	95.0%	100.0%
OREGON	35.0	56588	57697	59637	61277	62928	65166	67579	97928
		57.8%	58.9%	60.9%	62.6%	64.3%	66.5%	69.0%	100.0%
PENNSYLVANIA	36.0	11397	12603	17061	22205	27454	30610	41727	45278
		25.2%	27.8%	37.7%	49.0%	60.6%	67.6%	92.2%	100.0%
RHODE ISLAND	37.0	0	0	10	58	203	299	1206	1206
		0.0%	0.0%	0.8%	4.8%	16.8%	24.8%	100.0%	100.0%
SOUTH CAROLINA	38.0	11030	12082	15372	19348	23971	25881	28525	31189
		35.4%	38.7%	49.3%	62.0%	76.9%	83.0%	91.5%	100.0%
SOUTH DAKOTA	39.0	51608	51608	52419	52940	53509	53799	54214	77007
		67.0%	67.0%	68.1%	68.7%	69.5%	69.9%	70.4%	100.0%
TENNESSEE	40.0	18017	18567	22359	27145	32752	35879	39526	42122
		42.8%	44.1%	53.1%	64.4%	77.8%	85.2%	93.8%	100.0%
TEXAS	41.0	207629	210486	223668	233231	242553	250446	263349	268839
		77.2%	78.3%	83.2%	86.8%	90.2%	93.2%	98.0%	100.0%
UTAH	42.0	54387	54822	55912	56539	57832	58556	59627	85181
		63.8%	64.4%	65.6%	66.4%	67.9%	68.7%	70.0%	100.0%
VERMONT	43.0	5954	5954	6649	7546	8058	8482	8830	9853
		60.4%	60.4%	67.5%	76.6%	81.8%	86.1%	89.6%	100.0%
VIRGINIA	44.0	14195	14977	18528	23536	28738	31430	35502	41167
		34.5%	36.4%	45.0%	57.2%	69.8%	76.3%	86.2%	100.0%
WASHINGTON	45.0	30571	31112	33775	36149	38706	40810	44594	69316
		44.1%	44.9%	48.7%	52.2%	55.8%	58.9%	64.3%	100.0%
WEST VIRGINIA	46.0	10673	10847	13221	15826	18789	19918	21384	24106
		44.3%	45.0%	54.8%	65.7%	77.9%	82.6%	88.7%	100.0%
WISCONSIN	47.0	31334	32019	37442	42035	45683	48086	51994	57022
		55.0%	56.2%	65.7%	73.7%	80.1%	84.3%	91.2%	100.0%
WYOMING	48.0	70233	70233	70976	71516	72018	72356	72761	97986
		71.7%	71.7%	72.4%	73.0%	73.5%	73.8%	74.3%	100.0%
		1761966	1790938	1936860	2073310	2213636	2305123	2482290	3039964
TOTAL		58.0%	58.9%	63.7%	68.2%	72.8%	75.8%	81.7%	100.0%

NOTE: NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.19

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 750 P/SQ.MI. *** DOUBLE SECTOR (45.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/8 POP. IN SECTOR	> 1/6 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP. IN SECTOR	UNIFORM DENSITY	NO POP. CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	29934	30764	34788	38938	44081	46976	49833	51907
		57.7%	59.3%	67.0%	75.0%	84.9%	90.5%	96.0%	100.0%
ARIZONA	2.0	48308	48906	50412	51309	52602	53258	54937	114343
		42.2%	42.8%	44.1%	44.9%	46.0%	46.6%	48.0%	100.0%
ARKANSAS	3.0	35531	36023	39652	42363	44322	45442	46995	53258
		66.7%	67.6%	74.5%	79.5%	83.2%	85.3%	88.2%	100.0%
CALIFORNIA	4.0	75270	76467	82199	86725	91858	95545	108871	160364
		46.9%	47.7%	51.3%	54.1%	57.3%	59.6%	67.9%	100.0%
COLORADO	5.0	67174	67685	69384	70744	72587	73803	75666	104326
		64.4%	64.9%	66.5%	67.8%	69.6%	70.7%	72.5%	100.0%
CONNECTICUT	6.0	154	261	637	1139	1824	2268	5211	5211
		3.0%	5.0%	12.2%	21.9%	35.0%	43.5%	100.0%	100.0%
DELAWARE	7.0	762	840	1216	1505	1718	1891	2287	2326
		32.8%	36.1%	52.3%	64.7%	73.9%	81.3%	98.3%	100.0%
FLORIDA	8.0	26422	27174	30938	33476	36612	39787	46252	59357
		44.5%	45.8%	52.1%	56.4%	61.7%	67.0%	77.9%	100.0%
GEORGIA	9.0	32009	32366	36612	41350	46195	48926	52737	58604
		54.6%	55.2%	62.5%	70.6%	78.8%	83.5%	90.0%	100.0%
IDAHO	10.0	41920	42045	42875	43792	44679	45345	46030	83550
		50.2%	50.3%	51.3%	52.4%	53.5%	54.3%	55.1%	100.0%
ILLINOIS	11.0	32134	33042	38716	42566	46407	48761	55179	56539
		56.8%	58.4%	68.5%	75.3%	82.1%	86.2%	97.6%	100.0%
INDIANA	12.0	13066	13607	18374	23160	27744	30861	35020	36342
		36.0%	37.4%	50.6%	63.7%	76.3%	84.9%	96.4%	100.0%
IOWA	13.0	42547	43608	48182	51010	53075	54272	56067	56067
		75.9%	77.8%	85.9%	91.0%	94.7%	96.8%	100.0%	100.0%
KANSAS	14.0	72008	72973	75521	77432	79178	80327	82073	82266
		87.5%	88.7%	91.8%	94.1%	96.2%	97.6%	99.8%	100.0%
KENTUCKY	15.0	20313	20506	22890	26644	32829	35647	37799	40269
		50.4%	50.9%	56.8%	66.2%	81.5%	88.5%	93.9%	100.0%
LOUISIANA	16.0	20564	21375	24472	28043	30455	31884	33736	48154
		42.7%	44.4%	50.8%	58.2%	63.2%	66.2%	70.1%	100.0%
MAINE	17.0	27985	27985	29288	30610	32134	32926	33717	34074
		82.1%	82.1%	86.0%	89.8%	94.3%	96.6%	99.0%	100.0%
MARYLAND	18.0	2885	2991	3889	4786	5935	7411	11011	11155
		25.9%	26.8%	34.9%	42.9%	53.2%	66.4%	98.7%	100.0%
MASSACHUSETTS	19.0	859	1033	1862	2441	3165	3995	8627	8627
		10.0%	12.0%	21.6%	28.3%	36.7%	46.3%	100.0%	100.0%
MICHIGAN	20.0	27850	28776	33399	38253	42354	45625	52158	61837
		45.0%	46.5%	54.0%	61.9%	68.5%	73.8%	84.3%	100.0%
MINNESOTA	21.0	48414	48530	51618	54204	56648	58431	60980	85914
		56.4%	56.5%	60.1%	63.1%	65.9%	68.0%	71.0%	100.0%
MISSISSIPPI	22.0	28207	28487	32569	37577	40897	42460	44043	47883
		58.9%	59.5%	68.0%	78.5%	85.4%	88.7%	92.0%	100.0%
MISSOURI	23.0	48983	49254	53519	57553	60805	62561	65417	69934
		70.0%	70.4%	76.5%	82.3%	86.9%	89.5%	93.5%	100.0%
MONTANA	24.0	98179	98179	99096	99829	100447	100881	101296	148436
		66.1%	66.1%	66.8%	67.2%	67.7%	68.0%	68.2%	100.0%
NEBRASKA	25.0	70040	70165	72385	73427	74672	75338	76187	77721
		90.1%	90.3%	93.1%	94.5%	96.1%	96.9%	98.0%	100.0%
NEVADA	26.0	87719	87912	88645	89012	89562	89899	90363	110618
		79.3%	79.5%	80.1%	80.5%	81.0%	81.3%	81.7%	100.0%
NEW HAMPSHIRE	27.0	4661	4757	5375	6080	6880	7324	8270	9467
		49.2%	50.3%	56.8%	64.2%	72.7%	77.4%	87.4%	100.0%
NEW JERSEY	28.0	598	791	1187	1505	1969	2577	8009	8009
		7.5%	9.9%	14.8%	18.8%	24.6%	32.2%	100.0%	100.0%
NEW MEXICO	29.0	85354	85711	87255	88105	88944	89359	90208	121744
		70.1%	70.4%	71.7%	72.4%	73.1%	73.4%	74.1%	100.0%
NEW YORK	30.0	14678	15160	19339	23931	29153	32665	40289	50219
		29.2%	30.2%	38.5%	47.7%	58.1%	65.0%	80.2%	100.0%
NORTH CAROLINA	31.0	18403	18750	22803	27097	33987	37809	42142	50769
		36.2%	36.9%	44.9%	53.4%	66.9%	74.5%	83.0%	100.0%
NORTH DAKOTA	32.0	61133	61133	62706	63439	63777	64134	64433	71005
		86.1%	86.1%	88.3%	89.3%	89.8%	90.3%	90.7%	100.0%
OHIO	33.0	11329	11976	16125	21500	27184	31401	39507	41833
		27.1%	28.6%	38.5%	51.4%	65.0%	75.1%	94.4%	100.0%
OKLAHOMA	34.0	52274	52988	56867	59598	62397	64066	66151	69615
		75.1%	76.1%	81.7%	85.6%	89.6%	92.0%	95.0%	100.0%
OREGON	35.0	58913	59048	60805	62098	63796	65591	67579	97928
		60.2%	60.3%	62.1%	63.4%	65.1%	67.0%	69.0%	100.0%
PENNSYLVANIA	36.0	14378	15044	19223	23353	28805	32713	41727	45278
		31.8%	33.2%	42.5%	51.6%	63.6%	72.3%	92.2%	100.0%
RHODE ISLAND	37.0	0	10	39	164	357	521	1206	1206
		0.0%	0.8%	3.2%	13.6%	29.6%	43.2%	100.0%	100.0%
SOUTH CAROLINA	38.0	13549	14292	16714	20101	24308	26229	28525	31189
		43.4%	45.8%	53.6%	64.4%	77.9%	84.1%	91.5%	100.0%
SOUTH DAKOTA	39.0	51965	51965	52805	53287	53557	53837	54214	77007
		67.5%	67.5%	68.6%	69.2%	69.5%	69.9%	70.4%	100.0%
TENNESSEE	40.0	19937	20593	23893	28168	33138	36313	39526	42122
		47.3%	48.9%	56.7%	66.9%	78.7%	86.2%	93.8%	100.0%
TEXAS	41.0	217173	218534	229354	237950	247590	253177	263348	268839
		80.8%	81.3%	85.4%	88.5%	92.1%	94.2%	98.0%	100.0%
UTAH	42.0	55381	55632	56800	57456	58238	58701	59627	85181
		65.0%	65.3%	66.7%	67.5%	68.4%	68.9%	70.0%	100.0%
VERMONT	43.0	6128	6128	6803	7595	8096	8492	8830	9853
		62.2%	62.2%	69.0%	77.1%	82.2%	86.2%	89.6%	100.0%
VIRGINIA	44.0	16164	16637	20236	24598	29693	32057	35502	41167
		39.3%	40.4%	49.2%	59.8%	72.1%	77.9%	86.2%	100.0%
WASHINGTON	45.0	32192	33032	35290	37664	39768	41466	44554	69316
		46.4%	47.6%	50.9%	54.3%	57.4%	59.8%	64.3%	100.0%
WEST VIRGINIA	46.0	11561	11561	13433	16087	18895	20072	21384	24106
		48.0%	48.0%	55.7%	66.7%	78.4%	83.3%	88.7%	100.0%
WISCONSIN	47.0	34016	34142	38861	42991	46581	48848	51994	57022
		59.7%	59.9%	68.2%	75.4%	81.7%	85.7%	91.2%	100.0%
WYOMING	48.0	70677	70677	71410	71796	72124	72394	72761	97986
		72.1%	72.1%	72.9%	73.3%	73.6%	73.9%	74.3%	100.0%
		1849701	1869505	2000661	2122471	2252019	2334266	2482286	3039963
TOTAL		60.8%	61.5%	65.8%	69.8%	74.1%	76.8%	81.7%	100.0%

NOTE: NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.20

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 1500 #/SQ.MI. *** DOUBLE SECTOR (45.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/8 POP. IN SECTOR	> 1/6 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP. IN SECTOR	UNIFORM DENSITY	NO POP. CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	33958	33958	36236	39729	44284	47140	49833	51907
		65.4%	65.4%	69.8%	76.5%	85.3%	90 8%	96 0%	100 0%
ARIZONA	2.0	50498	50827	51946	52496	52988	53500	54937	114343
		44.2%	44.5%	45.4%	45.9%	46.3%	46.8%	48.0%	100.0%
ARKANSAS	3.0	37201	37471	40607	42904	44448	45519	46995	53258
		69.8%	70.4%	76.2%	80.6%	83.5%	85.5%	88.2%	100.0%
CALIFORNIA	4.0	81842	82787	86879	91106	94975	97851	108871	160364
		51.0%	51.6%	54.2%	56.8%	59.2%	61.0%	67.9%	100.0%
COLORADO	5.0	69229	69441	71111	72240	73301	74180	75666	104326
		66.4%	66.6%	68.2%	69.2%	70.3%	71.1%	72 5%	100.0%
CONNECTICUT	6.0	550	753	955	1351	1998	2538	5211	5211
		10.6%	14.4%	18.3%	25.9%	38.3%	48.7%	100.0%	100.0%
DELAWARE	7.0	1013	1023	1293	1525	1737	1920	2287	2326
		43.6%	44.0%	55.6%	65.6%	74.7%	82.6%	98.3%	100.0%
FLORIDA	8.0	31527	31584	33389	34914	37143	40250	46252	59357
		53.1%	53.2%	56.3%	58.8%	62.6%	67.8%	77.9%	100.0%
GEORGIA	9.0	34258	34605	37867	42103	46388	49119	52737	58604
		58.5%	59.0%	64.6%	71.8%	79.2%	83.8%	90.0%	100.0%
IDAHO	10.0	42460	42460	43164	43985	44776	45355	46031	83550
		50.8%	50.8%	51.7%	52.6%	53.6%	54.3%	55.1%	100.0%
ILLINOIS	11.0	35666	36023	41041	44641	47632	49533	55179	56539
		63.1%	63.7%	72.6%	79.0%	84.2%	87.6%	97.6%	100.0%
INDIANA	12.0	16115	16888	20719	24694	28448	31208	35020	36342
		44.3%	46.5%	57.0%	68.0%	78.3%	85.9%	96.4%	100.0%
IOWA	13.0	45741	45780	49495	51888	53384	54407	56067	56067
		81.6%	81.7%	88.3%	92.5%	95.2%	97.0%	100.0%	100.0%
KANSAS	14.0	74913	75067	76891	78261	79439	80442	82073	82266
		91.1%	91.2%	93.5%	95.1%	96.6%	97.8%	99.8%	100.0%
KENTUCKY	15.0	21558	21915	23922	27367	33032	35734	37799	40269
		53.5%	54.4%	59.4%	68.0%	82.0%	88.7%	93.9%	100.0%
LOUISIANA	16.0	23112	23121	25544	28477	30687	31970	33736	48154
		48.0%	48.0%	53.0%	59.1%	63.7%	66.4%	70.1%	100.0%
MAINE	17.0	28207	28207	29336	30668	32163	32935	33717	34074
		82.8%	82.8%	86.1%	90.0%	94.4%	96.7%	99.0%	100.0%
MARYLAND	18.0	3271	3435	4323	5558	6890	8260	11011	11155
		29.3%	30.8%	38.8%	49.8%	61.8%	74.0%	98.7%	100.0%
MASSACHUSETTS	19.0	1824	1911	2364	2808	3551	4564	8627	8627
		21.1%	22.1%	27.4%	32.6%	41.2%	52.9%	100.0%	100.0%
MICHIGAN	20.0	31305	31401	35174	39276	43097	46417	52158	61837
		50.6%	50.8%	56.9%	63.5%	69.7%	75.1%	84.3%	100.0%
MINNESOTA	21.0	49533	49755	52612	55111	57167	58797	60988	85914
		57.7%	57.9%	61.2%	64.1%	66.5%	68.4%	71.0%	100.0%
MISSISSIPPI	22.0	29674	29896	33215	37973	41032	42528	44043	47883
		62.0%	62.4%	69.4%	79.3%	85.7%	88.8%	92.0%	100.0%
MISSOURI	23.0	50489	50798	55034	58855	61413	62860	65417	69934
		72.2%	72.6%	78.7%	84.2%	87.8%	89.9%	93.5%	100.0%
MONTANA	24.0	98579	98575	99492	100090	100534	100891	101296	148456
		66.4%	66.4%	67.0%	67.4%	67.7%	68.0%	68.2%	100.0%
NEBRASKA	25.0	71535	71603	73128	74257	74865	75386	76187	77721
		92.0%	92.1%	94.1%	95.5%	96.3%	97.0%	98.0%	100.0%
NEVADA	26.0	88712	88712	89234	89542	89774	89986	90363	110618
		80.2%	80.2%	80.7%	80.9%	81.2%	81.3%	81.7%	100.0%
NEW HAMPSHIRE	27.0	4912	4921	5491	6176	6919	7382	8270	9467
		51.9%	52.0%	58.0%	65.2%	73.1%	78.0%	87.4%	100.0%
NEW JERSEY	28.0	1187	1332	1689	1959	2625	3821	8010	8010
		14.8%	16.6%	21.1%	24.5%	32.8%	47.7%	100.0%	100.0%
NEW MEXICO	29.0	87217	87217	87883	88510	89089	89427	90208	121744
		71.6%	71.6%	72.2%	72.7%	73.2%	73.5%	74.1%	100.0%
NEW YORK	30.0	17515	17939	21288	25534	29905	33293	40289	50219
		34.9%	35.7%	42.4%	50.8%	59.6%	66.3%	80.2%	100.0%
NORTH CAROLINA	31.0	20863	20883	23643	27589	34180	37925	42142	50769
		41.1%	41.1%	46.6%	54.3%	67.3%	74.7%	83.0%	100.0%
NORTH DAKOTA	32.0	61741	61741	62908	63555	63864	64144	64433	71005
		87.0%	87.0%	88.6%	89.5%	89.9%	90.3%	90.7%	100.0%
OHIO	33.0	14552	15247	19358	24077	28332	32385	39507	41833
		34.8%	36.4%	46.3%	57.6%	67.7%	77.4%	94.4%	100.0%
OKLAHOMA	34.0	55922	55960	57996	60245	62657	64269	66151	69615
		80.3%	80.4%	83.3%	86.5%	90.0%	92.3%	95.0%	100.0%
OREGON	35.0	60399	60660	62069	63043	64008	65726	67579	97928
		61.7%	61.9%	63.4%	64.4%	65.4%	67.1%	69.0%	100.0%
PENNSYLVANIA	36.0	17274	17370	20178	24482	29712	33640	41727	45278
		38.2%	38.4%	44.6%	54.1%	65.6%	74.3%	92.2%	100.0%
RHODE ISLAND	37.0	48	145	232	318	434	608	1206	1206
		4.0%	12.0%	19.2%	26.4%	36.0%	50.4%	100.0%	100.0%
SOUTH CAROLINA	38.0	15961	15961	17302	20381	24424	26306	28525	31189
		51.2%	51.2%	55.5%	65.3%	78.3%	84.3%	91.5%	100.0%
SOUTH DAKOTA	39.0	52438	52438	53007	53365	53596	53847	54214	77007
		68.1%	68.1%	68.8%	69.3%	69.6%	69.9%	70.4%	100.0%
TENNESSEE	40.0	22398	22591	24810	28651	33370	36429	39526	42122
		53.2%	53.6%	58.9%	68.0%	79.2%	86.5%	93.8%	100.0%
TEXAS	41.0	226061	227142	237023	244164	250157	254663	263349	268839
		84.1%	84.5%	88.2%	90.8%	93.1%	94.7%	98.0%	100.0%
UTAH	42.0	56684	57041	57688	57890	58354	58826	59627	85181
		66.5%	67.0%	67.7%	68.0%	68.5%	69.1%	70.0%	100.0%
VERMONT	43.0	6253	6253	6823	7624	8106	8492	8830	9853
		63.5%	63.5%	69.2%	77.4%	82.3%	86.2%	89.6%	100.0%
VIRGINIA	44.0	18470	18769	21587	25573	30031	32366	35502	41167
		44.9%	45.6%	52.4%	62.1%	72.9%	78.6%	86.2%	100.0%
WASHINGTON	45.0	35078	35493	37210	38880	40202	41862	44554	69316
		50.6%	51.2%	53.7%	56.1%	58.0%	60.4%	64.3%	100.0%
WEST VIRGINIA	46.0	11898	11908	13626	16173	18943	20082	21384	24106
		49.4%	49 4%	56.5%	67.1%	78.6%	83.3%	88.7%	100.0%
WISCONSIN	47.0	35753	35917	39932	43859	47053	49186	51994	57022
		62.7%	63.0%	70 0%	76.9%	82.5%	86.3%	91.2%	100.0%
WYOMING	48.0	71227	71227	71613	71912	72143	72394	72761	97986
		72.7%	72.7%	73.1%	[illegible]	[illegible]	73.9%	74.3%	100.0%
		1946617	1956151	2058327	2165779	2273250	2350363	2482289	3039964
TOTAL		64.0%	64.3%	67.7%	71.2%	74.8%	77.3%	81.7%	100.0%

NOTE: NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.21

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 250 #/BO.MI. *** "QUAD" SECTOR (90.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/4 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP. IN SECTOR	UNIFORM DENSITY	NO POP. CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	28834	31198	38175	44129	49833	51907
		55.5%	60.1%	73.5%	85.0%	96.0%	100.0%
ARIZONA	2.0	47575	48047	49524	51608	54937	114343
		41.6%	42.0%	43.3%	45.1%	46.0%	100.0%
ARKANSAS	3.0	37162	37481	41466	43830	46995	53258
		69.8%	70.4%	77.9%	82.3%	88.2%	100.0%
CALIFORNIA	4.0	69268	71072	78068	86068	108871	160364
		43.2%	44.3%	48.7%	53.7%	67.9%	100.0%
COLORADO	5.0	65958	66460	69316	71719	75666	104326
		63.2%	63.7%	66.4%	68.7%	72.5%	100.0%
CONNECTICUT	6.0	39	48	135	222	5211	5211
		0.7%	0.9%	2.6%	4.3%	100.0%	100.0%
DELAWARE	7.0	936	965	1341	1679	2287	2326
		40.2%	41.5%	57.7%	72.2%	98.3%	100.0%
FLORIDA	8.0	22147	23179	28882	34856	46252	59357
		37.3%	39.1%	48.7%	58.7%	77.9%	100.0%
GEORGIA	9.0	32154	34537	40520	45722	52737	58604
		54.9%	58.9%	69.1%	78.0%	90.0%	100.0%
IDAHO	10.0	41553	42045	43647	44824	46030	83550
		49.7%	50.3%	52.2%	53.6%	55.1%	100.0%
ILLINOIS	11.0	29249	30465	38417	43386	55179	56539
		51.7%	53.9%	67.9%	76.7%	97.6%	100.0%
INDIANA	12.0	12323	13800	19590	24472	35020	36342
		33.9%	38.0%	53.9%	67.3%	96.4%	100.0%
IOWA	13.0	42074	42894	49041	52255	56067	56067
		75.0%	76.5%	87.5%	93.2%	100.0%	100.0%
KANSAS	14.0	71410	71979	75077	78358	82073	82266
		86.8%	87.5%	91.3%	95.2%	99.8%	100.0%
KENTUCKY	15.0	21124	21984	29027	33486	37799	40269
		52.5%	54.5%	72.1%	83.2%	93.9%	100.0%
LOUISIANA	16.0	20738	21732	26711	30012	33736	48154
		43.1%	45.1%	55.5%	62.3%	70.1%	100.0%
MAINE	17.0	28603	29027	31227	32414	33717	34074
		83.9%	85.2%	91.6%	95.1%	99.0%	100.0%
MARYLAND	18.0	3059	3310	4314	5249	11011	11195
		27.4%	29.7%	38.7%	47.2%	98.7%	100.0%
MASSACHUSETTS	19.0	482	569	1062	1853	8627	8627
		5.6%	6.6%	12.3%	21.5%	100.0%	100.0%
MICHIGAN	20.0	28641	29346	34547	38735	52158	61837
		46.3%	47.5%	55.9%	62.6%	84.3%	100.0%
MINNESOTA	21.0	50585	50798	53741	56356	60988	85914
		58.9%	59.1%	62.6%	65.6%	71.0%	100.0%
MISSISSIPPI	22.0	32038	32762	37789	41138	44043	47883
		66.9%	68.4%	78.9%	85.9%	92.0%	100.0%
MISSOURI	23.0	51319	52573	56443	60062	65417	69934
		73.4%	75.2%	80.7%	85.9%	93.5%	100.0%
MONTANA	24.0	98874	98874	99800	100476	101296	148456
		66.6%	66.6%	67.2%	67.7%	68.2%	100.0%
NEBRASKA	25.0	69567	70445	72143	74015	76187	77721
		89.5%	90.6%	92.8%	95.2%	98.0%	100.0%
NEVADA	26.0	87159	87390	88105	89185	90363	110618
		78.8%	79.0%	79.6%	80.6%	81.7%	100.0%
NEW HAMPSHIRE	27.0	4487	4835	5809	6369	8270	9467
		47.4%	51.1%	61.4%	67.3%	87.4%	100.0%
NEW JERSEY	28.0	29	116	560	1081	8010	8010
		0.4%	1.4%	7.0%	13.5%	100.0%	100.0%
NEW MEXICO	29.0	84949	85190	86782	88732	90208	121744
		69.8%	70.0%	71.3%	72.9%	74.1%	100.0%
NEW YORK	30.0	12815	14919	20217	25582	40289	50219
		25.5%	29.7%	40.3%	50.9%	80.2%	100.0%
NORTH CAROLINA	31.0	16530	17959	26817	33032	42142	50769
		32.6%	35.4%	52.8%	65.1%	83.0%	100.0%
NORTH DAKOTA	32.0	62146	62146	62966	63960	64433	71005
		87.5%	87.5%	88.7%	90.1%	90.7%	100.0%
OHIO	33.0	10721	11734	17264	21732	39507	41833
		25.6%	28.1%	41.3%	51.9%	94.4%	100.0%
OKLAHOMA	34.0	52650	53027	57775	62107	66151	69615
		75.6%	76.2%	83.0%	89.2%	95.0%	100.0%
OREGON	35.0	56356	58054	60303	63420	67579	97928
		57.5%	59.3%	61.6%	64.8%	69.0%	100.0%
PENNSYLVANIA	36.0	11628	13568	19985	24260	41727	45278
		25.7%	30.0%	44.1%	53.6%	92.2%	100.0%
RHODE ISLAND	37.0	0	0	39	68	1206	1206
		0.0%	0.0%	3.2%	5.6%	100.0%	100.0%
SOUTH CAROLINA	38.0	12535	13549	19860	23700	28525	31189
		40.2%	43.4%	63.7%	76.0%	91.5%	100.0%
SOUTH DAKOTA	39.0	52226	52226	52853	53596	54214	77007
		67.8%	67.8%	68.6%	69.6%	70.4%	100.0%
TENNESSEE	40.0	20979	21867	28332	33350	39526	42122
		49.8%	51.9%	67.3%	79.2%	93.8%	100.0%
TEXAS	41.0	212696	216363	229921	242408	263349	268839
		79.1%	80.5%	85.5%	90.2%	98.0%	100.0%
UTAH	42.0	54252	54870	55806	57543	59627	85181
		63.7%	64.4%	65.5%	67.6%	70.0%	100.0%
VERMONT	43.0	6958	6958	7739	8270	8830	9853
		70.6%	70.6%	78.6%	83.9%	89.6%	100.0%
VIRGINIA	44.0	16772	18171	24241	28902	35502	41167
		40.7%	44.1%	58.9%	70.2%	86.2%	100.0%
WASHINGTON	45.0	30967	31469	35020	38253	44554	69316
		44.7%	45.4%	50.5%	55.2%	64.3%	100.0%
WEST VIRGINIA	46.0	12651	13558	16936	19107	21384	24106
		52.5%	56.2%	70.3%	79.3%	88.7%	100.0%
WISCONSIN	47.0	34721	36052	41688	45866	51994	57022
		60.9%	63.2%	73.1%	80.4%	91.2%	100.0%
WYOMING	48.0	70792	70792	71410	72211	72761	97986
		72.2%	72.2%	72.9%	73.7%	74.3%	100.0%
TOTAL		1830731	1870373	2050431	2199678	2482288	3039964
		60.2%	61.5%	67.4%	72.4%	81.7%	100.0%

NOTE: NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.22

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 500 #/SQ.MI. *** "QUAD" SECTOR (90.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/4 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP. IN SECTOR	UNIFORM DENSITY	NO POP. CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	35888	36265	42518	46503	49833	51907
		69.1%	69.9%	81.9%	89.6%	96.0%	100.0%
ARIZONA	2.0	49244	50180	51348	52911	54937	114343
		43.1%	43.9%	44.9%	46.3%	48.0%	100.0%
ARKANSAS	3.0	40501	40588	43367	45239	46996	53258
		76.0%	76.2%	81.4%	84.9%	88.2%	100.0%
CALIFORNIA	4.0	79062	80674	86956	92756	108871	160364
		49.3%	50.3%	54.2%	57.8%	67.9%	100.0%
COLORADO	5.0	69210	69403	71178	73176	75664	104326
		66.3%	66.5%	68.2%	70.1%	72.5%	100.0%
CONNECTICUT	6.0	164	328	811	1476	5211	5211
		3.1%	6.3%	15.6%	28.3%	100.0%	100.0%
DELAWARE	7.0	1206	1264	1612	1862	2287	2326
		51.9%	54.4%	69.3%	80.1%	98.3%	100.0%
FLORIDA	8.0	28381	29191	33833	39121	46252	59357
		47.8%	49.2%	57.0%	65.9%	77.9%	100.0%
GEORGIA	9.0	38687	38996	44255	48308	52737	58604
		66.0%	66.5%	75.5%	82.4%	90.0%	100.0%
IDAHO	10.0	43435	43435	44361	45287	46030	83550
		52.0%	52.0%	53.1%	54.2%	55.1%	100.0%
ILLINOIS	11.0	38166	38629	43367	47343	55179	56539
		67.5%	68.3%	76.7%	83.7%	97.6%	100.0%
INDIANA	12.0	18991	19696	24878	29722	35020	36342
		52.3%	54.2%	68.5%	81.8%	96.4%	100.0%
IOWA	13.0	48356	48549	51840	53992	56066	56066
		86.2%	86.6%	92.5%	96.3%	100.0%	100.0%
KANSAS	14.0	75309	75743	77692	80027	82073	82266
		91.5%	92.1%	94.4%	97.3%	99.8%	100.0%
KENTUCKY	15.0	25080	25273	31556	35116	37799	40269
		62.3%	62.8%	78.4%	87.2%	93.9%	100.0%
LOUISIANA	16.0	25765	26258	29413	31536	33736	48154
		53.5%	54.5%	61.1%	65.5%	70.1%	100.0%
MAINE	17.0	30224	30224	31893	32868	33717	34074
		88.7%	88.7%	93.6%	96.5%	99.0%	100.0%
MARYLAND	18.0	4014	4236	5317	6504	11011	11155
		36.0%	38.0%	47.7%	58.3%	98.7%	100.0%
MASSACHUSETTS	19.0	1081	1341	2480	3513	8627	8627
		12.5%	15.5%	28.7%	40.7%	100.0%	100.0%
MICHIGAN	20.0	33852	35261	40163	44486	52158	61837
		54.7%	57.0%	65.0%	71.9%	84.3%	100.0%
MINNESOTA	21.0	52766	52930	55516	57659	60988	85914
		61.4%	61.6%	64.6%	67.1%	71.0%	100.0%
MISSISSIPPI	22.0	36092	36159	39990	42257	44043	47883
		75.3%	75.5%	83.5%	88.3%	92.0%	100.0%
MISSOURI	23.0	55661	55951	59010	61953	65417	69934
		79.6%	80.0%	84.4%	88.6%	93.5%	100.0%
MONTANA	24.0	99491	99491	100138	100842	101296	148456
		67.0%	67.0%	67.5%	67.9%	68.2%	100.0%
NEBRASKA	25.0	72385	72568	73745	75135	76187	77721
		93.1%	93.4%	94.9%	96.7%	98.0%	100.0%
NEVADA	26.0	88259	88693	89041	89774	90363	110618
		79.8%	80.2%	80.5%	81.2%	81.7%	100.0%
NEW HAMPSHIRE	27.0	5520	5655	6523	7180	8270	9467
		58.3%	59.7%	68.9%	75.8%	87.4%	100.0%
NEW JERSEY	28.0	627	888	1361	2113	8010	8010
		7.8%	11.1%	17.0%	26.4%	100.0%	100.0%
NEW MEXICO	29.0	86821	87545	88326	89262	90208	121744
		71.3%	71.9%	72.6%	73.3%	74.1%	100.0%
NEW YORK	30.0	19474	20661	26045	31488	40289	50219
		38.8%	41.1%	51.9%	62.7%	80.2%	100.0%
NORTH CAROLINA	31.0	23662	24607	32299	37104	42142	50769
		46.6%	48.5%	63.6%	73.1%	83.0%	100.0%
NORTH DAKOTA	32.0	62947	62947	63632	64076	64433	71005
		88.7%	88.7%	89.6%	90.2%	90.7%	100.0%
OHIO	33.0	16434	17467	22890	29018	39507	41833
		39.3%	41.8%	54.7%	69.4%	94.4%	100.0%
OKLAHOMA	34.0	56192	57292	61046	63796	66151	69615
		80.7%	82.3%	87.7%	91.6%	95.0%	100.0%
OREGON	35.0	60689	60843	62532	65166	67579	97928
		62.0%	62.1%	63.9%	66.5%	69.0%	100.0%
PENNSYLVANIA	36.0	18721	20101	26103	30610	41727	45278
		41.3%	44.4%	57.7%	67.6%	92.2%	100.0%
RHODE ISLAND	37.0	19	29	87	299	1206	1206
		1.6%	2.4%	7.2%	24.8%	100.0%	100.0%
SOUTH CAROLINA	38.0	18132	18277	23295	25881	28525	31189
		58.1%	58.6%	74.7%	83.0%	91.5%	100.0%
SOUTH DAKOTA	39.0	52785	52785	53393	53799	54214	77007
		68.5%	68.5%	69.3%	69.9%	70.4%	100.0%
TENNESSEE	40.0	25244	26084	31884	35879	39526	42122
		59.9%	61.9%	75.7%	85.2%	93.8%	100.0%
TEXAS	41.0	229207	231098	240102	250446	263349	268839
		85.3%	86.0%	89.3%	93.2%	98.0%	100.0%
UTAH	42.0	55816	56298	57591	58556	59627	85181
		65.5%	66.1%	67.6%	68.7%	70.0%	100.0%
VERMONT	43.0	7421	7450	8000	8482	8830	9853
		75.3%	75.6%	81.2%	86.1%	89.6%	100.0%
VIRGINIA	44.0	21635	22272	27724	31430	35502	41167
		52.6%	54.1%	67.3%	76.3%	86.2%	100.0%
WASHINGTON	45.0	34692	35078	37789	40810	44554	69316
		50.0%	50.6%	54.5%	58.9%	64.3%	100.0%
WEST VIRGINIA	46.0	15459	15459	18210	19918	21384	24106
		64.1%	64.1%	75.5%	82.6%	88.7%	100.0%
WISCONSIN	47.0	40935	41128	45065	48086	51994	57022
		71.8%	72.1%	79.0%	84.3%	91.2%	100.0%
WYOMING	48.0	71400	71400	71979	72356	72761	97986
		72.9%	72.9%	73.5%	73.8%	74.3%	100.0%
		2015062	2036690	2182154	2305121	2482288	3039963
TOTAL		66.3%	67.0%	71.8%	75.8%	81.7%	100.0%

NOTE: NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.23

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 750 #/SQ.MI. *** "QUAD" SECTOR (90.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/4 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP. IN SECTOR	UNIFORM DENSITY	NO POP. CRITERIA	NO RESTRICTIONS
ALABAMA	1.0	37838	38320	43271	46976	49833	51907
		72.9%	73.8%	83.4%	90.5%	96.0%	100.0%
ARIZONA	2.0	50614	50942	52168	53258	54937	114343
		44.3%	44.6%	45.6%	46.6%	48.0%	100.0%
ARKANSAS	3.0	41630	41833	43907	45442	46995	53258
		78.2%	78.5%	82.4%	85.3%	88.2%	100.0%
CALIFORNIA	4.0	83820	84852	89861	95545	108871	160364
		52.3%	52.9%	56.0%	59.6%	67.9%	100.0%
COLORADO	5.0	70300	70474	71931	73803	75664	104326
		67.4%	67.6%	68.9%	70.7%	72.5%	100.0%
CONNECTICUT	6.0	415	608	1631	2268	5211	5211
		8.0%	11.7%	31.3%	43.5%	100.0%	100.0%
DELAWARE	7.0	1380	1399	1679	1891	2287	2326
		59.3%	60.2%	72.2%	81.3%	98.3%	100.0%
FLORIDA	8.0	31112	32154	35956	39787	46232	59357
		52.4%	54.2%	60.6%	67.0%	77.9%	100.0%
GEORGIA	9.0	40086	40366	45278	48926	52737	58604
		68.4%	68.9%	77.3%	83.5%	90.0%	100.0%
IDAHO	10.0	43705	43705	44854	45345	46030	83550
		52.3%	52.3%	53.7%	54.3%	55.1%	100.0%
ILLINOIS	11.0	40791	41234	45143	48761	55179	56539
		72.1%	72.9%	79.8%	86.2%	97.6%	100.0%
INDIANA	12.0	21346	22079	26798	30861	35020	36342
		58.7%	60.8%	73.7%	84.9%	96.4%	100.0%
IOWA	13.0	50093	50354	52448	54272	56067	56067
		89.3%	89.8%	93.5%	96.8%	100.0%	100.0%
KANSAS	14.0	76650	76785	78696	80327	82073	82266
		93.2%	93.3%	95.7%	97.6%	99.8%	100.0%
KENTUCKY	15.0	26036	26277	32308	35647	37799	40269
		64.7%	65.3%	80.2%	88.5%	93.9%	100.0%
LOUISIANA	16.0	27464	27474	30176	31884	33736	48154
		57.0%	57.1%	62.7%	66.2%	70.1%	100.0%
MAINE	17.0	30494	30494	32028	32926	33717	34074
		89.5%	89.5%	94.0%	96.6%	99.0%	100.0%
MARYLAND	18.0	4439	4564	5616	7411	11011	11155
		39.8%	40.9%	50.3%	66.4%	98.7%	100.0%
MASSACHUSETTS	19.0	1785	2162	2982	3995	8627	8627
		20.7%	25.1%	34.6%	46.3%	100.0%	100.0%
MICHIGAN	20.0	36882	37104	41534	45625	52158	61837
		59.6%	60.0%	67.2%	73.8%	84.3%	100.0%
MINNESOTA	21.0	53529	53722	56038	58431	60988	85914
		62.3%	62.5%	65.2%	68.0%	71.0%	100.0%
MISSISSIPPI	22.0	37027	37178	40482	42460	44043	47883
		77.3%	77.6%	84.5%	88.7%	92.0%	100.0%
MISSOURI	23.0	56674	57003	60033	62561	65417	69934
		81.0%	81.5%	85.8%	89.5%	93.5%	100.0%
MONTANA	24.0	99723	99723	100370	100881	101296	148436
		67.2%	67.2%	67.6%	68.0%	68.2%	100.0%
NEBRASKA	25.0	72771	73128	74373	75338	76187	77721
		93.6%	94.1%	95.7%	96.9%	98.0%	100.0%
NEVADA	26.0	88905	88905	89455	89899	90363	110618
		80.4%	80.4%	80.9%	81.3%	81.7%	100.0%
NEW HAMPSHIRE	27.0	5819	5944	6765	7324	8270	9467
		61.5%	62.8%	71.5%	77.4%	87.4%	100.0%
NEW JERSEY	28.0	1110	1206	1766	2577	8010	8010
		13.9%	15.1%	22.0%	32.2%	100.0%	100.0%
NEW MEXICO	29.0	87892	87892	88828	89359	90208	121744
		72.2%	72.2%	73.0%	73.4%	74.1%	100.0%
NEW YORK	30.0	21954	22880	28236	32665	40289	50219
		43.7%	45.6%	56.2%	65.0%	80.2%	100.0%
NORTH CAROLINA	31.0	26383	26412	33177	37809	42148	50769
		52.0%	52.0%	65.3%	74.5%	83.0%	100.0%
NORTH DAKOTA	32.0	63362	63362	63709	64134	64433	71005
		89.2%	89.2%	89.7%	90.3%	90.7%	100.0%
OHIO	33.0	18750	19898	25768	31401	39507	41833
		44.8%	47.6%	61.6%	75.1%	94.4%	100.0%
OKLAHOMA	34.0	58132	58768	61992	64066	66151	69615
		83.5%	84.4%	89.0%	92.0%	95.0%	100.0%
OREGON	35.0	61519	61692	63343	65591	67579	97928
		62.8%	63.0%	64.7%	67.0%	69.0%	100.0%
PENNSYLVANIA	36.0	22041	22320	27512	32713	41727	45278
		48.7%	49.3%	60.8%	72.3%	92.2%	100.0%
RHODE ISLAND	37.0	48	58	251	521	1206	1206
		4.0%	4.8%	20.8%	43.2%	100.0%	100.0%
SOUTH CAROLINA	38.0	19628	19628	23903	26229	28525	31189
		62.9%	62.9%	76.6%	84.1%	91.5%	100.0%
SOUTH DAKOTA	39.0	53162	53162	53509	53837	54214	77007
		69.0%	69.0%	69.5%	69.9%	70.4%	100.0%
TENNESSEE	40.0	27309	27425	32694	36313	39526	42122
		64.8%	65.1%	77.6%	86.2%	93.8%	100.0%
TEXAS	41.0	234659	235701	245187	253177	263349	268839
		87.3%	87.7%	91.2%	94.2%	98.0%	100.0%
UTAH	42.0	56588	57253	57977	58701	59627	85181
		66.4%	67.2%	68.1%	68.9%	70.0%	100.0%
VERMONT	43.0	7556	7556	8038	8492	8830	9853
		76.7%	76.7%	81.6%	86.2%	89.6%	100.0%
VIRGINIA	44.0	23121	23768	28979	32057	35502	41167
		56.2%	57.7%	70.4%	77.9%	86.2%	100.0%
WASHINGTON	45.0	36332	36786	39092	41466	44554	69316
		52.4%	53.1%	56.4%	59.8%	64.3%	100.0%
WEST VIRGINIA	46.0	15729	15729	18605	20072	21384	24106
		65.3%	65.3%	77.2%	83.3%	88.7%	100.0%
WISCONSIN	47.0	42315	42489	45702	48848	51994	57022
		74.2%	74.5%	80.1%	85.7%	91.2%	100.0%
WYOMING	48.0	71786	71786	72066	72394	72761	97986
		73.3%	73.3%	73.5%	73.9%	74.3%	100.0%
		2080704	2094548	2225812	2334266	2482288	3039964
TOTAL		68.4%	68.9%	73.2%	76.8%	81.7%	100.0%

NOTE: NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED. WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F2.24

POPULATION SECTOR ANALYSIS - TOTAL U. S.
DENSITY = 1500 #/SQ MI *** "QUAD" SECTOR (90.0 DEGREES)
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION		> 1/4 POP. IN SECTOR	> 1/3 POP. IN SECTOR	> 1/2 POP. IN SECTOR	UNIFORM DENSITY	NO POP	CRITERIA NO RESTRICTIONS
ALABAMA	1.0	39391	39391	43927	47140	49833	51907
		75.9%	75.9%	84.6%	90.8%	96.0%	100.0%
ARIZONA	2.0	51820	52139	52911	53500	54937	114343
		45.3%	45.6%	46.3%	46.8%	48.0%	100.0%
ARKANSAS	3.0	42499	42499	44245	45519	46995	53258
		79.8%	79.8%	83.1%	85.5%	88.2%	100.0%
CALIFORNIA	4.0	88259	89185	93788	97851	108871	160364
		55.0%	55.6%	58.5%	61.0%	67.9%	100.0%
COLORADO	5.0	71275	71864	73051	74180	75666	104326
		68.3%	68.9%	70.0%	71.1%	72.5%	100.0%
CONNECTICUT	6.0	1255	1264	1940	2538	5211	5211
		24.1%	24.3%	37.2%	48.7%	100.0%	100.0%
DELAWARE	7.0	1467	1467	1708	1920	2287	2326
		63.1%	63.1%	73.4%	82.6%	98.3%	100.0%
FLORIDA	8.0	34479	34508	36853	40250	46252	59357
		58.1%	58.1%	62.1%	67.8%	77.9%	100.0%
GEORGIA	9.0	41389	41630	45953	49118	52737	58604
		70.6%	71.0%	78.4%	83.8%	90.0%	100.0%
IDAHO	10.0	43946	43946	44718	45355	46030	83550
		52.6%	52.6%	53.5%	54.3%	55.1%	100.0%
ILLINOIS	11.0	42981	43435	46899	49533	55179	56539
		76.0%	76.8%	82.9%	87.6%	97.6%	100.0%
INDIANA	12.0	23980	24115	28004	31208	35020	36342
		66.0%	66.4%	77.1%	85.9%	96.4%	100.0%
IOWA	13.0	51299	51299	53085	54407	56067	56067
		91.5%	91.5%	94.7%	97.0%	100.0%	100.0%
KANSAS	14.0	77866	77904	79198	80442	82073	82266
		94.7%	94.7%	96.3%	97.8%	99.8%	100.0%
KENTUCKY	15.0	27097	27145	32762	35734	37799	40269
		67.3%	67.4%	81.4%	88.7%	93.9%	100.0%
LOUISIANA	16.0	28217	28217	30523	31970	33736	48154
		58.6%	58.6%	63.4%	66.4%	70.1%	100.0%
MAINE	17.0	30581	30581	32057	32935	33717	34074
		89.7%	89.7%	94.1%	96.7%	99.0%	100.0%
MARYLAND	18.0	4854	5172	6514	8260	11011	11155
		43.5%	46.4%	58.4%	74.0%	98.7%	100.0%
MASSACHUSETTS	19.0	2663	2702	3387	4564	8627	8627
		30.9%	31.3%	39.3%	52.9%	100.0%	100.0%
MICHIGAN	20.0	38571	38687	42489	46417	52158	61837
		62.4%	62.6%	68.7%	75.1%	84.3%	100.0%
MINNESOTA	21.0	54214	54580	56925	58797	60988	85914
		63.1%	63.5%	66.3%	68.4%	71.0%	100.0%
MISSISSIPPI	22.0	37703	37703	40800	42828	44043	47883
		78.7%	78.7%	85.2%	88.8%	92.0%	100.0%
MISSOURI	23.0	57987	58209	60930	62860	65417	69934
		82.9%	83.2%	87.1%	89.9%	93.5%	100.0%
MONTANA	24.0	100051	100051	100514	100891	101296	148456
		67.4%	67.4%	67.7%	68.0%	68.2%	100.0%
NEBRASKA	25.0	73909	73909	74768	75386	76187	77721
		95.1%	95.1%	96.2%	97.0%	98.0%	100.0%
NEVADA	26.0	89446	89446	89735	89986	90363	110618
		80.9%	80.9%	81.1%	81.3%	81.7%	100.0%
NEW HAMPSHIRE	27.0	6118	6118	6813	7382	8270	9467
		64.6%	64.6%	72.0%	78.0%	87.4%	100.0%
NEW JERSEY	28.0	1602	1747	2258	3821	8009	8009
		20.0%	21.8%	28.2%	47.7%	100.0%	100.0%
NEW MEXICO	29.0	88404	88404	88973	89427	90208	121744
		72.6%	72.6%	73.1%	73.5%	74.1%	100.0%
NEW YORK	30.0	24907	24965	29278	33293	40289	50219
		49.6%	49.7%	58.3%	66.3%	80.2%	100.0%
NORTH CAROLINA	31.0	27252	27252	33736	37925	42142	50769
		53.7%	53.7%	66.5%	74.7%	83.0%	100.0%
NORTH DAKOTA	32.0	63458	63458	63815	64144	64433	71005
		89.4%	89.4%	89.9%	90.3%	90.7%	100.0%
OHIO	33.0	22861	23150	27676	32385	39507	41833
		54.6%	55.3%	66.2%	77.4%	94.4%	100.0%
OKLAHOMA	34.0	59878	59878	62445	64269	66181	69615
		86.0%	86.0%	89.7%	92.3%	95.0%	100.0%
OREGON	35.0	62744	62744	63951	65726	67579	97928
		64.1%	64.1%	65.3%	67.1%	69.0%	100.0%
PENNSYLVANIA	36.0	23440	23758	28931	33640	41727	45278
		51.8%	52.5%	63.9%	74.3%	92.2%	100.0%
RHODE ISLAND	37.0	270	270	415	608	1206	1206
		22.4%	22.4%	34.4%	50.4%	100.0%	100.0%
SOUTH CAROLINA	38.0	20159	20159	24154	26306	28525	31189
		64.6%	64.6%	77.4%	84.3%	91.5%	100.0%
SOUTH DAKOTA	39.0	53297	53297	53538	53847	54214	77007
		69.2%	69.2%	69.5%	69.9%	70.4%	100.0%
TENNESSEE	40.0	28342	28342	33100	36429	39526	42122
		67.3%	67.3%	78.6%	86.5%	93.8%	100.0%
TEXAS	41.0	241327	242302	249182	254664	263349	268839
		89.8%	90.1%	92.7%	94.7%	98.0%	100.0%
UTAH	42.0	57823	57823	58247	58826	59627	85181
		67.9%	67.9%	68.4%	69.1%	70.0%	100.0%
VERMONT	43.0	7585	7585	8058	8492	8830	9853
		77.0%	77.0%	81.8%	86.2%	89.6%	100.0%
VIRGINIA	44.0	25090	25148	29761	32366	35502	41167
		60.9%	61.1%	72.3%	78.6%	86.2%	100.0%
WASHINGTON	45.0	38108	38388	39980	41862	44554	69316
		55.0%	55.4%	57.7%	60.4%	64.3%	100.0%
WEST VIRGINIA	46.0	16038	16038	18663	20082	21384	24106
		66.5%	66.5%	77.4%	83.3%	88.7%	100.0%
WISCONSIN	47.0	43319	43521	46619	49186	51994	57022
		76.0%	76.3%	81.8%	86.3%	91.2%	100.0%
WYOMING	48.0	71912	71912	72105	72394	72761	97986
		73.4%	73.4%	73.6%	73.9%	74.3%	100.0%
		2141133	[illegible]	[illegible]	2350363	2482287	3039963
TOTAL		70 [illegible]	[illegible]	[illegible]	77.3%	81.7%	100.0%

NOTE NUMBERS IN THE COLUMNS REPRESENT THE AMOUNT OF LAND THAT IS CONSIDERED TO BE AVAILABLE IF THE GIVEN CRITERION IS APPLIED WHENEVER A SECTOR CRITERION IS APPLIED, IT IS ASSUMED THAT A UNIFORM DENSITY CRITERION IS ALSO IN EFFECT. CRITERIA WERE APPLIED TO 5 RADII (2, 5, 10, 20, 30) INDIVIDUALLY AND THE RESULTS COMPOSITED.

TABLE F3.1

POPULATION CASE 1 and
ENVIRONMENTAL SUITABILITY LEVELS ***
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	LOW SUITABILITY	MEDIUM-LOW	MEDIUM SUITABILITY	MEDIUM-HIGH	HIGH SUITABILITY	DENSITY RESTRICTIONS	DENS & LAND RESTRICT	RESTRICTED LANDS	
ALABAMA	48	5250	8830	15758	8954	10962	164	1911	51907
	0%	10%	17%	30%	17%	21%	0%	4%	
ARIZONA	2113	3831	15517	27502	1727	4246	1931	57504	114341
	2%	3%	14%	24%	2%	4%	2%	50%	
ARKANSAS	4680	6958	6321	8975	14195	5657	106	6157	53259
	9%	13%	12%	17%	27%	11%	0%	12%	
CALIFORNIA	40520	16772	9052	10596	4844	27086	3271	48221	160364
	25%	10%	6%	7%	3%	17%	2%	30%	
COLORADO	29876	13616	10654	12487	3763	5269	876	27782	104325
	29%	13%	10%	12%	4%	5%	1%	27%	
CONNECTICUT	0	106	29	29	0	5047	0	0	5211
	0%	2%	1%	1%	0%	97%	0%	0%	
DELAWARE	0	0	0	0	1216	1071	0	39	2326
	0%	0%	0%	0%	52%	46%	0%	2%	
FLORIDA	0	0	0	1689	29008	15556	2065	11040	59356
	0%	0%	0%	3%	49%	26%	3%	19%	
GEORGIA	2220	2625	6890	12873	15739	12391	598	5269	58605
	4%	4%	12%	22%	27%	21%	1%	9%	
IDAHO	10451	7556	11561	9920	4150	2393	212	37307	83550
	13%	9%	14%	12%	5%	3%	0%	45%	
ILLINOIS	2799	1457	3792	11831	19618	15681	97	1264	56539
	5%	3%	7%	21%	35%	28%	0%	2%	
INDIANA	0	434	1216	6321	12506	14543	48	1274	36342
	0%	1%	3%	17%	34%	40%	0%	4%	
IOWA	10	9023	4603	25756	10094	6581	0	0	56067
	0%	16%	8%	46%	18%	12%	0%	0%	
KANSAS	15546	26354	15208	13375	5674	5915	0	193	82265
	19%	32%	18%	16%	7%	7%	0%	0%	
KENTUCKY	3377	8376	9418	5597	917	10113	521	1949	40268
	8%	21%	23%	14%	2%	25%	1%	5%	
LOUISIANA	0	0	347	6475	20226	6687	3609	10808	48152
	0%	0%	1%	13%	42%	14%	7%	22%	
MAINE	1197	8309	4574	14784	1602	3252	0	357	34075
	4%	24%	13%	43%	5%	10%	0%	1%	
MARYLAND	0	212	627	39	3435	6697	29	116	11155
	0%	2%	6%	0%	31%	60%	0%	1%	
MASSACHUSETTS	203	647	0	347	0	7430	0	0	8627
	2%	7%	0%	4%	0%	86%	0%	0%	
MICHIGAN	0	0	0	11580	22533	18046	251	9428	61838
	0%	0%	0%	19%	36%	29%	0%	15%	
MINNESOTA	0	232	1390	25650	26180	7537	704	24222	85915
	0%	0%	2%	30%	30%	9%	1%	28%	
MISSISSIPPI	0	2355	4294	18036	13249	6108	145	3696	47883
	0%	5%	9%	38%	28%	13%	0%	8%	
MISSOURI	11406	12400	13539	10171	9235	8666	68	4449	69934
	16%	18%	19%	15%	13%	12%	0%	6%	
MONTANA	13288	27107	29683	23276	6311	1631	241	46918	148455
	9%	18%	20%	16%	4%	1%	0%	32%	
NEBRASKA	14157	12236	16019	13365	17196	3213	10	1525	77721
	18%	16%	21%	17%	22%	4%	0%	2%	
NEVADA	37365	18846	27570	4719	463	1399	425	19831	110618
	34%	17%	25%	4%	0%	1%	0%	18%	
NEW HAMPSHIRE	1322	3474	696	58	0	2760	0	1197	9467
	14%	37%	7%	1%	0%	29%	0%	13%	
NEW JERSEY	0	68	0	0	627	7315	0	0	8010
	0%	1%	0%	0%	8%	91%	0%	0%	
NEW MEXICO	46831	17939	18258	4449	222	2509	1052	30484	121744
	38%	15%	15%	4%	0%	2%	1%	25%	
NEW YORK	2654	4989	7189	5443	753	19261	415	9515	50219
	5%	10%	14%	11%	1%	38%	1%	19%	
NORTH CAROLINA	2374	685	1911	6630	14378	16164	1129	7498	50769
	5%	1%	4%	13%	28%	32%	2%	15%	
NORTH DAKOTA	8241	12207	17476	14147	11194	1168	29	6543	71005
	12%	17%	25%	20%	16%	2%	0%	9%	
OHIO	1119	3735	1737	3204	7778	21934	608	1718	41833
	3%	9%	4%	8%	19%	52%	1%	4%	
OKLAHOMA	7923	11329	19570	12709	7016	7604	290	3175	69616
	11%	16%	28%	18%	10%	11%	0%	5%	
OREGON	251	19869	12256	24926	4101	6176	232	30118	97929
	0%	20%	13%	25%	4%	6%	0%	31%	
PENNSYLVANIA	1226	9196	7035	1554	376	22340	174	3377	45278
	3%	20%	16%	3%	1%	49%	0%	7%	
RHODE ISLAND	0	0	0	68	0	1139	0	0	1207
	0%	0%	0%	6%	0%	94%	0%	0%	
SOUTH CAROLINA	1090	5365	11348	965	984	8772	212	2451	31187
	3%	17%	36%	3%	3%	28%	1%	8%	
SOUTH DAKOTA	11686	7334	11368	11947	10605	1274	164	22629	77007
	15%	10%	15%	16%	14%	2%	0%	29%	
TENNESSEE	4275	9563	7865	5568	125	12130	357	2239	42122
	10%	23%	19%	13%	0%	29%	1%	5%	
TEXAS	53065	41331	26730	83916	29442	28863	347	5143	268837
	20%	15%	10%	31%	11%	11%	0%	2%	
UTAH	16521	12941	12420	10084	4815	2847	917	24636	85181
	19%	15%	15%	12%	6%	3%	1%	29%	
VERMONT	3821	2538	1013	68	0	1390	125	897	9852
	39%	26%	10%	1%	0%	14%	1%	9%	
VIRGINIA	3532	1959	1776	9592	7595	11049	830	4835	41168
	9%	5%	4%	23%	18%	27%	2%	12%	
WASHINGTON	5182	7488	10403	8926	3908	8646	357	24405	69315
	7%	11%	15%	13%	6%	12%	1%	35%	
WEST VIRGINIA	3503	8145	4429	48	68	5192	48	2673	24106
	15%	34%	18%	0%	0%	22%	0%	11%	
WISCONSIN	116	3628	5674	20091	12246	10239	241	4786	57021
	0%	6%	10%	35%	21%	18%	0%	8%	
WYOMING	17611	13520	20564	15469	4449	1148	154	25071	97966
	18%	14%	21%	16%	5%	1%	0%	26%	
TOTAL	381599	382005	400812	531013	373547	413309	23024	534650	
	13%	13%	13%	17%	12%	14%	1%	18%	

*** POPULATION CASE 1 COMPOSITE

RADIUS 0 - 2 MILES/DENSITY 100 PERSONS PER SQUARE MILE
RADIUS 2 - 30 MILES/DENSITY 250 PERSONS PER SQUARE MILE

POPULATION CASE 1 IS 1st IN THE AMOUNT OF LAND IT CONSTRAINS

TABLE F3.2

POPULATION CASE 2 and
ENVIRONMENTAL SUITABILITY LEVELS ***
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	LOW SUITABILITY	MEDIUM-LOW	MEDIUM SUITABILITY	MEDIUM-HIGH	HIGH SUITABILITY	DENSITY RESTRICTIONS	DEN & LAND RESTRICT	RESTRICTED LANDS	
ALABAMA	58	6331	10596	18596	10683	3599	25	2026	51921
	0%	12%	20%	36%	21%	7%	0%	4%	
ARIZONA	2171	4082	15855	28902	1756	2171	521	98654	114342
	2%	4%	14%	25%	2%	2%	0%	51%	
ARKANSAS	4979	7392	7373	9843	15411	1956	48	6215	53298
	9%	14%	14%	18%	29%	4%	0%	12%	
CALIFORNIA	44593	18924	9968	11918	6562	16907	1645	49951	160364
	28%	12%	6%	7%	4%	11%	1%	31%	
COLORADO	30996	13925	11040	13143	3956	2606	154	28556	104324
	30%	13%	11%	13%	4%	2%	0%	27%	
CONNECTICUT	193	676	329	203	0	3812	0	0	5212
	4%	13%	6%	4%	0%	73%	0%	0%	
DELAWARE	0	0	0	0	1862	425	0	39	2326
	0%	0%	0%	0%	80%	18%	0%	2%	
FLORIDA	0	0	0	1930	36564	7759	1033	12072	59358
	0%	0%	0%	3%	62%	13%	2%	20%	
GEORGIA	2596	3426	9196	15247	17418	4854	183	5684	58604
	4%	6%	16%	26%	30%	8%	0%	10%	
IDAHO	10702	7768	11918	10239	4516	888	66	37452	83551
	13%	9%	14%	12%	5%	1%	0%	45%	
ILLINOIS	3281	1959	4420	13452	23738	8309	10	1351	56541
	6%	3%	8%	24%	42%	15%	0%	2%	
INDIANA	0	502	1776	8714	18345	5684	10	1312	36343
	0%	1%	5%	24%	50%	16%	0%	4%	
IOWA	10	9409	4941	27811	11484	2413	0	0	56068
	0%	17%	9%	50%	20%	4%	0%	0%	
KANSAS	15758	27194	15778	14359	6610	2374	0	193	82266
	19%	33%	19%	17%	8%	3%	0%	0%	
KENTUCKY	4381	10287	11435	7556	1341	2779	77	2393	40249
	11%	26%	28%	19%	3%	7%	0%	6%	
LOUISIANA	0	0	376	6871	23961	2528	1293	13124	48153
	0%	0%	1%	14%	50%	5%	3%	27%	
MAINE	1235	8444	4883	16415	1727	1013	0	357	34074
	4%	25%	14%	48%	5%	3%	0%	1%	
MARYLAND	0	318	897	328	4912	4555	0	145	11155
	0%	3%	8%	3%	44%	41%	0%	1%	
MASSACHUSETTS	791	1457	135	917	0	5327	0	0	8627
	9%	17%	2%	11%	0%	62%	0%	0%	
MICHIGAN	0	0	0	15015	28921	8222	87	9592	61837
	0%	0%	0%	24%	47%	13%	0%	16%	
MINNESOTA	0	251	1640	27753	27831	3513	116	24810	85914
	0%	0%	2%	32%	32%	4%	0%	29%	
MISSISSIPPI	0	2548	4719	20072	14600	2104	39	3802	47884
	0%	5%	10%	42%	30%	4%	0%	8%	
MISSOURI	12188	13500	14832	11088	10065	3744	0	4516	69933
	17%	19%	21%	16%	14%	5%	0%	6%	
MONTANA	13423	27319	29992	23440	6514	608	39	47121	148456
	9%	18%	20%	16%	4%	0%	0%	32%	
NEBRASKA	14205	12275	16444	14012	18065	1187	0	1534	77722
	18%	16%	21%	18%	23%	2%	0%	2%	
NEVADA	37732	18846	27618	4999	492	676	29	20226	110618
	34%	17%	25%	5%	0%	1%	0%	18%	
NEW HAMPSHIRE	1457	4188	946	454	0	1226	0	1197	9468
	15%	44%	10%	5%	0%	13%	0%	13%	
NEW JERSEY	0	318	29	68	1679	5915	0	0	8009
	0%	4%	0%	1%	21%	74%	0%	0%	
NEW MEXICO	47198	18181	18702	4690	309	1129	203	31334	121746
	39%	15%	15%	4%	0%	1%	0%	26%	
NEW YORK	3242	6581	10210	9303	1428	9525	77	9853	50219
	6%	13%	20%	19%	3%	19%	0%	20%	
NORTH CAROLINA	2943	1255	3590	10876	17843	5636	241	8386	50770
	6%	2%	7%	21%	35%	11%	0%	17%	
NORTH DAKOTA	8328	12342	17534	14321	11474	434	0	6572	71005
	12%	17%	25%	20%	16%	1%	0%	9%	
OHIO	1448	4719	2770	6147	13259	11165	241	2084	41833
	3%	11%	7%	15%	32%	27%	1%	5%	
OKLAHOMA	8125	11821	21925	14166	7575	2538	68	3397	69615
	12%	17%	31%	20%	11%	4%	0%	5%	
OREGON	290	20998	13413	25244	5076	2557	29	30320	97927
	0%	21%	14%	26%	5%	3%	0%	31%	
PENNSYLVANIA	2258	12854	10258	3542	1081	11734	48	3503	45278
	5%	28%	23%	8%	2%	26%	0%	8%	
RHODE ISLAND	0	0	125	212	0	868	0	0	1205
	0%	0%	10%	18%	0%	72%	0%	0%	
SOUTH CAROLINA	1544	6871	14552	1361	1259	2943	29	2634	31189
	5%	22%	47%	4%	4%	9%	0%	8%	
SOUTH DAKOTA	11792	7450	11484	12053	10895	540	46	22745	77007
	15%	10%	15%	16%	14%	1%	0%	30%	
TENNESSEE	5771	13047	9264	7083	280	4082	48	2548	42127
	14%	31%	22%	17%	1%	10%	0%	6%	
TEXAS	53934	42865	27966	91617	33138	13828	77	5414	268839
	20%	16%	10%	34%	12%	5%	0%	2%	
UTAH	17833	13192	12516	10113	4825	1148	367	25186	85182
	21%	15%	15%	12%	6%	1%	0%	20%	
VERMONT	4150	2847	1322	87	0	425	56	945	9834
	42%	29%	13%	1%	0%	4%	1%	10%	
VIRGINIA	4352	2546	2316	12043	9940	4304	251	5414	41169
	11%	6%	6%	29%	24%	10%	1%	13%	
WASHINGTON	7044	8029	11590	9341	4294	4256	77	24685	69316
	10%	12%	17%	13%	6%	6%	0%	36%	
WEST VIRGINIA	3947	9901	5426	135	183	1592	10	2712	24106
	16%	41%	23%	1%	1%	7%	0%	11%	
WISCONSIN	116	3802	6379	22755	14697	4246	87	4941	57023
	0%	7%	11%	40%	26%	7%	0%	9%	
WYOMING	17727	13616	20709	15556	4642	511	25	25196	97982
	18%	14%	21%	16%	5%	1%	0%	26%	
TOTAL	402791	414228	439406	593990	441827	190657	7374	550302	
	13%	14%	14%	20%	15%	6%	0%	18%	

*** POPULATION CASE 2 COMPOSITE

RADIUS 0 - 2 MILES/DENSITY 250 PERSONS PER SQUARE MILE
RADIUS 2 - 30 MILES/DENSITY 500 PERSONS PER SQUARE MILE

POPULATION CASE 1 IS 2nd IN THE AMOUNT OF LAND IT CONSTRAINS

TABLE F3.3

POPULATION CASE 3 and
ENVIRONMENTAL SUITABILITY LEVELS ***
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	LOW SUITABILITY	MEDIUM-LOW	MEDIUM SUITABILITY	MEDIUM-HIGH	HIGH SUITABILITY	DENSITY RESTRICTIONS	DEN. & LAND RESTRICT	RESTRICTED LANDS	
ALABAMA	56	6398	10731	18527	10876	2943	14	2099	51507
	0%	12%	21%	36%	21%	6%	0%	4%	
ARIZONA	2171	4082	15874	29268	1805	1727	423	59781	114347
	2%	4%	14%	26%	2%	2%	0%	52%	
ARKANSAS	5047	7421	7538	9291	15517	1612	46	6219	53257
	9%	14%	14%	19%	29%	3%	0%	12%	
CALIFORNIA	46301	19223	10055	12275	7044	13573	1197	50296	160049
	29%	12%	6%	8%	4%	9%	1%	31%	
COLORADO	31295	13992	11213	13192	3985	1968	125	28535	104325
	30%	13%	11%	13%	4%	2%	0%	27%	
CONNECTICUT	357	1023	454	338	0	3042	2	0	5212
	7%	20%	9%	6%	0%	58%	0%	0%	
DELAWARE	0	0	0	0	1911	376	0	39	2326
	0%	0%	0%	0%	82%	16%	0%	2%	
FLORIDA	0	0	0	1930	37423	6900	551	12555	59358
	0%	0%	0%	3%	63%	12%	1%	21%	
GEORGIA	2615	3484	9467	15536	17660	3976	164	5703	56605
	4%	6%	16%	27%	30%	7%	0%	10%	
IDAHO	10712	7768	11927	10306	4574	743	48	37471	83545
	13%	9%	14%	12%	5%	1%	0%	45%	
ILLINOIS	3349	2142	4574	13693	24675	6745	10	1351	56529
	6%	4%	8%	24%	44%	12%	0%	2%	
INDIANA	0	511	1805	8907	19319	4478	10	1312	36342
	0%	1%	5%	25%	53%	12%	0%	4%	
IOWA	10	9409	4960	28024	11677	1988	0	0	56068
	0%	17%	9%	50%	21%	4%	0%	0%	
KANSAS	15778	27300	15787	14494	6784	1930	0	193	82266
	19%	33%	19%	18%	8%	2%	0%	0%	
KENTUCKY	4381	10326	11561	7874	1496	2162	68	2403	40271
	11%	26%	29%	20%	4%	5%	0%	6%	
LOUISIANA	0	0	376	6890	24376	2094	955	13462	48153
	0%	0%	1%	14%	51%	4%	2%	28%	
MAINE	1235	8444	4883	16511	1727	917	0	357	34074
	4%	25%	14%	48%	5%	3%	0%	1%	
MARYLAND	0	318	946	618	5452	3677	0	145	11156
	0%	3%	8%	6%	49%	33%	0%	1%	
MASSACHUSETTS	830	1534	376	1110	0	4757	0	0	8627
	10%	18%	4%	13%	0%	55%	0%	0%	
MICHIGAN	0	0	0	15343	29867	6948	77	9602	61837
	0%	0%	0%	25%	48%	11%	0%	16%	
MINNESOTA	0	251	1737	28130	28178	2692	106	24820	85914
	0%	0%	2%	33%	33%	3%	0%	29%	
MISSISSIPPI	0	2586	4786	20140	14832	1698	39	3802	47883
	0%	5%	10%	42%	31%	4%	0%	8%	
MISSOURI	12294	13799	14957	11204	10152	3011	0	4516	69933
	18%	20%	21%	16%	15%	4%	0%	6%	
MONTANA	13471	27338	29992	23440	6552	502	39	47121	148455
	9%	18%	20%	16%	4%	0%	0%	32%	
NEBRASKA	14205	12275	16550	14089	18152	917	0	1534	77722
	18%	16%	21%	18%	23%	1%	0%	2%	
NEVADA	37789	18846	27618	5086	492	531	10	20246	110618
	34%	17%	25%	5%	0%	0%	0%	18%	
NEW HAMPSHIRE	1457	4217	1023	540	0	1033	0	1197	9467
	15%	45%	11%	6%	0%	11%	0%	13%	
NEW JERSEY	0	405	97	87	2046	5375	0	0	8010
	0%	5%	1%	1%	26%	67%	0%	0%	
NEW MEXICO	47227	18248	18760	4738	318	917	154	31382	121744
	39%	15%	15%	4%	0%	1%	0%	26%	
NEW YORK	3291	6697	10509	10007	1534	8251	77	9853	50219
	7%	13%	21%	20%	3%	16%	0%	20%	
NORTH CAROLINA	2963	1293	3696	11377	18046	4767	222	8405	50769
	6%	3%	7%	22%	36%	9%	0%	17%	
NORTH DAKOTA	8328	12352	17534	14321	11512	386	0	6572	71005
	12%	17%	25%	20%	16%	1%	0%	9%	
OHIO	1448	4806	2885	7739	14157	8473	212	2113	41833
	3%	11%	7%	19%	34%	20%	1%	5%	
OKLAHOMA	8135	11860	22031	14301	7604	2220	68	3397	69616
	12%	17%	32%	21%	11%	3%	0%	5%	
OREGON	299	21027	13500	25273	5423	2055	19	30330	97925
	0%	21%	14%	26%	6%	2%	0%	31%	
PENNSYLVANIA	2374	13693	10876	3966	1322	9496	39	3513	45279
	5%	30%	24%	9%	3%	21%	0%	8%	
RHODE ISLAND	0	0	261	328	0	618	0	0	1207
	0%	0%	22%	27%	0%	51%	0%	0%	
SOUTH CAROLINA	1573	7073	14803	1370	1255	2451	29	2634	31188
	5%	23%	47%	4%	4%	8%	0%	8%	
SOUTH DAKOTA	11821	7450	11503	12063	10924	454	48	22745	77006
	15%	10%	15%	16%	14%	1%	0%	30%	
TENNESSEE	5915	13336	9399	7286	290	3300	48	2548	42122
	14%	32%	22%	17%	1%	8%	0%	6%	
TEXAS	54069	43116	28053	93103	34084	10924	39	5452	268843
	20%	16%	10%	35%	13%	4%	0%	2%	
UTAH	18046	13192	12526	10113	4825	926	232	25322	85182
	21%	15%	15%	12%	6%	1%	0%	30%	
VERMONT	4178	2856	1341	87	0	367	46	975	9857
	42%	29%	14%	1%	0%	4%	0%	10%	
VIRGINIA	4362	2586	2355	12217	10297	3686	193	5472	41165
	11%	6%	6%	30%	25%	9%	0%	13%	
WASHINGTON	7527	8058	11725	9399	4439	3406	46	24714	69316
	11%	12%	17%	14%	6%	5%	0%	36%	
WEST VIRGINIA	3947	10007	5722	135	183	1390	10	2712	24107
	16%	42%	24%	1%	1%	6%	0%	11%	
WISCONSIN	116	3802	6388	23276	15064	3349	77	4950	57022
	0%	7%	11%	41%	26%	6%	0%	9%	
WYOMING	17737	13635	20719	15575	4661	434	29	25196	97985
	18%	14%	21%	16%	5%	0%	0%	26%	
TOTAL	406711	418199	443843	604417	452510	156613	5482	552196	
	13%	14%	15%	20%	15%	5%	0%	18%	

*** POPULATION CASE 3 COMPOSITE

RADIUS 0 - 2 MILES/DENSITY 250 PERSONS PER SQUARE MILE
RADIUS 2 - 30 MILES/DENSITY 750 PERSONS PER SQUARE MILE

POPULATION CASE 1 IS 3rd IN THE AMOUNT OF LAND IT CONSTRAINS

TABLE F3.4

POPULATION CASE 4 and
ENVIRONMENTAL SUITABILITY LEVELS ***
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	LOW SUITABILITY	MEDIUM-LOW	MEDIUM SUITABILITY	MEDIUM-HIGH	HIGH SUITABILITY	DENSITY RESTRICTIONS	DENS + LAND RESTRICT	RESTRICTED LANDS	
ALABAMA	58	6514	11030	19175	11300	1756	10	2065	51409
	0%	13%	21%	37%	22%	3%	0%	4%	
ARIZONA	2210	4092	15980	29481	1805	1370	116	59290	114344
	2%	4%	14%	26%	2%	1%	0%	52%	
ARKANSAS	5105	7546	7604	10065	15739	936	19	6244	53258
	10%	14%	14%	19%	30%	2%	0%	12%	
CALIFORNIA	47285	19686	10200	12506	7363	11831	1062	50431	160364
	29%	12%	6%	8%	5%	7%	1%	31%	
COLORADO	31498	14002	11252	13230	4024	1662	58	28603	104327
	30%	13%	11%	13%	4%	2%	0%	27%	
CONNECTICUT	405	1322	540	434	0	2509	0	0	5210
	8%	25%	10%	8%	0%	48%	0%	0%	
DELAWARE	0	0	0	0	2007	280	0	39	2326
	0%	0%	0%	0%	86%	12%	0%	2%	
FLORIDA	0	0	0	2046	39025	5182	425	12680	59358
	0%	0%	0%	3%	66%	9%	1%	21%	
GEORGIA	2644	3667	9930	15990	17930	2572	97	5771	58606
	5%	6%	17%	27%	31%	4%	0%	10%	
IDAHO	10779	7797	12014	10354	4642	444	10	37510	83550
	13%	9%	14%	12%	6%	1%	0%	45%	
ILLINOIS	3484	2200	4690	14070	25486	5250	10	1351	56541
	6%	4%	8%	25%	45%	9%	0%	2%	
INDIANA	0	521	1930	9283	20275	3011	0	1322	36342
	0%	1%	5%	26%	56%	8%	0%	4%	
IOWA	10	9457	5018	28477	11918	1187	0	0	56067
	0%	17%	9%	51%	21%	2%	0%	0%	
KANSAS	15807	27493	15874	14716	6958	1226	0	193	82267
	19%	33%	19%	18%	8%	1%	0%	0%	
KENTUCKY	4555	10490	11773	8145	1544	1293	29	2441	40270
	11%	26%	29%	20%	4%	3%	0%	6%	
LOUISIANA	0	0	376	7025	24993	1341	743	13674	48152
	0%	0%	1%	15%	52%	3%	2%	28%	
MAINE	1245	8453	4941	16878	1756	444	0	357	34074
	4%	25%	15%	50%	5%	1%	0%	1%	
MARYLAND	0	338	1004	743	5761	3165	0	145	11156
	0%	3%	9%	7%	52%	28%	0%	1%	
MASSACHUSETTS	917	1640	540	1438	0	4092	0	0	8627
	11%	19%	6%	17%	0%	47%	0%	0%	
MICHIGAN	0	0	0	15951	31237	4970	0	9679	61837
	0%	0%	0%	26%	51%	8%	0%	16%	
MINNESOTA	0	261	1776	28516	28477	1959	39	24887	85915
	0%	0%	2%	33%	33%	2%	0%	29%	
MISSISSIPPI	0	2615	4873	20429	15073	1052	0	3841	47883
	0%	5%	10%	43%	31%	2%	0%	8%	
MISSOURI	12516	13983	15112	11348	10335	2123	0	4516	69933
	18%	20%	22%	16%	15%	3%	0%	6%	
MONTANA	13529	27348	30069	23469	6581	299	0	47160	148455
	9%	18%	20%	16%	4%	0%	0%	32%	
NEBRASKA	14214	12284	16627	14137	18316	608	0	1534	77720
	18%	16%	21%	18%	24%	1%	0%	2%	
NEVADA	37847	18846	27638	5105	511	415	10	20246	110618
	34%	17%	25%	5%	0%	0%	0%	18%	
NEW HAMPSHIRE	1476	4371	1071	714	0	637	0	1197	9466
	16%	46%	11%	8%	0%	7%	0%	13%	
NEW JERSEY	0	511	145	154	2316	4883	0	0	8009
	0%	6%	2%	2%	29%	61%	0%	0%	
NEW MEXICO	47324	18296	18866	4777	318	627	48	31488	121744
	39%	15%	15%	4%	0%	1%	0%	26%	
NEW YORK	3416	6967	11020	11001	1689	6195	10	9920	50218
	7%	14%	22%	22%	3%	12%	0%	20%	
NORTH CAROLINA	3078	1448	4092	12284	18586	2654	87	8540	50769
	6%	3%	8%	24%	37%	5%	0%	17%	
NORTH DAKOTA	8338	12381	17544	14321	11541	309	0	6572	71006
	12%	17%	25%	20%	16%	0%	0%	9%	
OHIO	1467	5008	3117	8347	15015	6552	106	2220	41832
	4%	12%	7%	20%	36%	16%	0%	5%	
OKLAHOMA	8145	11976	22330	14494	7720	1486	19	3445	69615
	12%	17%	32%	21%	11%	2%	0%	5%	
OREGON	299	21085	13780	25322	5674	1419	0	30349	97928
	0%	22%	14%	26%	6%	1%	0%	31%	
PENNSYLVANIA	2548	14504	11850	4536	1515	6774	19	3532	45278
	6%	32%	26%	10%	3%	15%	0%	8%	
RHODE ISLAND	0	0	290	405	0	511	0	0	1206
	0%	0%	24%	34%	0%	42%	0%	0%	
SOUTH CAROLINA	1650	7344	15170	1486	1293	1583	0	2663	31189
	5%	24%	49%	5%	4%	5%	0%	9%	
SOUTH DAKOTA	11870	7488	11532	12072	11001	251	0	22793	77007
	15%	10%	15%	16%	14%	0%	0%	30%	
TENNESSEE	6137	13896	9554	7691	357	1891	19	2577	42122
	15%	33%	23%	18%	1%	4%	0%	6%	
TEXAS	54204	43367	28274	94445	34856	8203	39	5452	268840
	20%	16%	11%	35%	13%	3%	0%	2%	
UTAH	18200	13201	12564	10113	4835	714	174	25379	85180
	21%	15%	15%	12%	6%	1%	0%	30%	
VERMONT	4227	2934	1370	87	0	212	10	1013	9853
	43%	30%	14%	1%	0%	2%	0%	10%	
VIRGINIA	4487	2692	2432	12574	10625	2692	68	5597	41167
	11%	7%	6%	31%	26%	7%	0%	14%	
WASHINGTON	7826	8183	11870	9534	4555	2586	29	24733	69316
	11%	12%	17%	14%	7%	4%	0%	36%	
WEST VIRGINIA	4072	10219	6012	135	203	743	0	2721	24109
	17%	42%	25%	1%	1%	3%	0%	11%	
WISCONSIN	116	3831	6523	23758	15392	2374	58	4970	57022
	0%	7%	11%	42%	27%	4%	0%	9%	
WYOMING	17775	13655	20738	15623	4690	280	19	25206	97985
	18%	14%	21%	16%	5%	0%	0%	26%	
TOTAL	410763	423912	450935	616884	465237	114556	3333	554346	
	14%	14%	15%	20%	15%	4%	0%	18%	

*** POPULATION CASE 4 COMPOSITE

RADIUS 0 - 2 MILES/DENSITY 500 PERSONS PER SQUARE MILE
RADIUS 2 - 30 MILES/DENSITY 750 PERSONS PER SQUARE MILE

POPULATION CASE 1 IS 4th IN THE AMOUNT OF LAND IT CONSTRAINS

TABLE F3.5

POPULATION CASE 5 and
ENVIRONMENTAL SUITABILITY LEVELS ***
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	LOW SUITABILITY	MEDIUM-LOW	MEDIUM SUITABILITY	MEDIUM-HIGH	HIGH SUITABILITY	DENSITY RESTRICTIONS	DENS + LAND RESTRICT	RESTRICTED LANDS	
ALABAMA	58	6552	11117	19232	11435	1438	0	2275	51907
	0%	13%	21%	37%	22%	3%	0%	4%	
ARIZONA	2210	4092	15990	29838	1809	1004	69	59336	114345
	2%	4%	14%	26%	2%	1%	0%	52%	
ARKANSAS	5124	7566	7662	10065	15865	714	15	6244	53255
	10%	14%	14%	19%	30%	1%	0%	12%	
CALIFORNIA	49572	19853	10306	12825	7652	8666	569	50923	160363
	31%	12%	6%	8%	5%	5%	0%	32%	
COLORADO	31758	14050	11426	13278	4072	1081	46	28612	104329
	30%	13%	11%	13%	4%	1%	0%	27%	
CONNECTICUT	473	1534	647	801	0	1756	0	0	5211
	9%	29%	12%	15%	0%	34%	0%	0%	
DELAWARE	0	0	0	0	2065	222	0	39	2326
	0%	0%	0%	0%	89%	10%	0%	2%	
FLORIDA	0	0	0	2055	40192	4005	116	12989	59357
	0%	0%	0%	3%	68%	7%	0%	22%	
GEORGIA	2644	3696	10200	16222	18046	1930	48	5819	58605
	5%	6%	17%	28%	31%	3%	0%	10%	
IDAHO	10798	7807	12034	10374	4661	357	10	37510	83551
	13%	9%	14%	12%	6%	0%	0%	45%	
ILLINOIS	3493	2268	4815	14185	26383	4034	10	1351	56539
	6%	4%	9%	25%	47%	7%	0%	2%	
INDIANA	0	550	1969	9389	20883	2229	0	1322	36342
	0%	2%	5%	26%	57%	6%	0%	4%	
IOWA	10	9457	5057	28593	12034	917	0	0	56068
	0%	17%	9%	51%	21%	2%	0%	0%	
KANSAS	15807	27628	15884	14871	7054	830	0	193	82267
	19%	34%	19%	18%	9%	1%	0%	0%	
KENTUCKY	4555	10499	11879	8280	1660	926	29	2441	40269
	11%	26%	29%	21%	4%	2%	0%	6%	
LOUISIANA	0	0	376	7025	25322	1013	511	13906	48153
	0%	0%	1%	15%	53%	2%	1%	29%	
MAINE	1245	8453	4941	16994	1756	328	0	357	34074
	4%	25%	15%	50%	5%	1%	0%	1%	
MARYLAND	0	338	1013	1351	6446	1862	0	145	11155
	0%	3%	9%	12%	58%	17%	0%	1%	
MASSACHUSETTS	926	1698	1148	2104	0	2750	0	0	8626
	11%	20%	13%	24%	0%	32%	0%	0%	
MICHIGAN	0	0	0	16453	32202	3503	0	9679	61837
	0%	0%	0%	27%	52%	6%	0%	16%	
MINNESOTA	0	261	1824	28499	28757	1448	19	24907	85915
	0%	0%	2%	33%	33%	2%	0%	29%	
MISSISSIPPI	10	2625	4912	20506	15208	782	0	3841	47884
	0%	5%	10%	43%	32%	2%	0%	8%	
MISSOURI	12574	14118	15237	11551	10364	1573	0	4516	69933
	18%	20%	22%	17%	15%	2%	0%	6%	
MONTANA	13558	27367	30069	23478	6991	232	0	47160	148855
	9%	18%	20%	16%	4%	0%	0%	32%	
NEBRASKA	14214	12284	16627	14214	18345	502	0	1534	77720
	18%	16%	21%	18%	24%	1%	0%	2%	
NEVADA	37886	18846	27638	5201	511	280	10	20246	110618
	34%	17%	25%	5%	0%	0%	0%	18%	
NEW HAMPSHIRE	1476	4371	1081	859	0	482	0	1197	9466
	16%	46%	11%	9%	0%	5%	0%	13%	
NEW JERSEY	87	550	396	357	3561	3059	0	0	8010
	1%	7%	5%	4%	44%	38%	0%	0%	
NEW MEXICO	47353	18306	18933	4796	338	482	29	31507	121744
	39%	15%	16%	4%	0%	0%	0%	26%	
NEW YORK	3464	7199	11464	11580	1776	4806	10	9920	50219
	7%	14%	23%	23%	4%	10%	0%	20%	
NORTH CAROLINA	3078	1467	4207	12593	18808	1988	68	8560	50769
	6%	3%	8%	25%	37%	4%	0%	17%	
NORTH DAKOTA	8338	12381	17553	14359	11590	212	0	6572	71005
	12%	17%	25%	20%	16%	0%	0%	9%	
OHIO	1486	5018	3146	9525	15701	4632	106	2220	41834
	4%	12%	8%	23%	38%	11%	0%	5%	
OKLAHOMA	8145	11976	22494	14639	7768	1129	19	3445	69615
	12%	17%	32%	21%	11%	2%	0%	5%	
OREGON	299	21085	13886	25341	5935	1033	0	30349	97928
	0%	22%	14%	26%	6%	1%	0%	31%	
PENNSYLVANIA	2615	15073	12498	5008	1660	4912	19	3532	45277
	6%	33%	28%	11%	4%	11%	0%	8%	
RHODE ISLAND	0	0	376	473	0	357	0	0	1206
	0%	0%	31%	39%	0%	30%	0%	0%	
SOUTH CAROLINA	1669	7421	15401	1496	1293	1245	0	2663	31189
	5%	24%	49%	5%	4%	4%	0%	9%	
SOUTH DAKOTA	11898	7488	11541	12072	11030	183	0	22793	77005
	15%	10%	15%	16%	14%	0%	0%	30%	
TENNESSEE	6166	14050	9660	7778	376	1496	10	2586	42122
	15%	33%	23%	18%	1%	4%	0%	6%	
TEXAS	54223	43483	28390	95516	35840	5896	29	5462	268839
	20%	16%	11%	36%	13%	2%	0%	2%	
UTAH	18393	13201	12564	10113	4835	321	48	25505	85180
	22%	15%	15%	12%	6%	1%	0%	30%	
VERMONT	4227	2943	1399	97	0	164	10	1013	9853
	43%	30%	14%	1%	0%	2%	0%	10%	
VIRGINIA	4487	2702	2441	12806	11069	1998	48	5616	41167
	11%	7%	6%	31%	27%	5%	0%	14%	
WASHINGTON	8309	8222	12005	9544	4603	1872	0	24762	69317
	12%	12%	17%	14%	7%	3%	0%	36%	
WEST VIRGINIA	4072	10248	6195	145	203	521	0	2721	24105
	17%	43%	26%	1%	1%	2%	0%	11%	
WISCONSIN	116	3831	6533	24000	15749	1766	29	4999	57023
	0%	7%	11%	42%	28%	3%	0%	9%	
WYOMING	17785	13684	20748	15633	4709	203	19	25206	97987
	18%	14%	21%	16%	5%	0%	0%	26%	
TOTAL	414601	426238	455642	626314	476153	83339	1901	555775	
	14%	14%	15%	21%	16%	3%	0%	18%	

*** POPULATION CASE 5 COMPOSITE

RADIUS 0 - 2 MILES/DENSITY 500 PERSONS PER SQUARE MILE
RADIUS 2 - 30 MILES/DENSITY 1500 PERSONS PER SQUARE MIL

POPULATION CASE 1 IS [illegible] IN THE AMOUNT OF LAND IT CONSTRAINS

TABLE F3.6

ENVIRONMENTAL SUITABILITY AND POPULATION CASES 1 - 5 ***
[illegible] HIGH SUITABILITY [illegible]
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	AVAILABLE LAND	POPCASE 1	POPCASE 2	POPCASE 3	POPCASE 4	POPCASE 5	OTHER SUITABILITIES	RESTRICTED LANDS	
ALABAMA	8984	1696	193	425	135	425	37573	2075	51952
	17%	3%	0%	1%	0%	1%	73%	4%	
ARIZONA	1727	29	46	0	0	10	53122	59405	114342
	2%	0%	0%	0%	0%	0%	46%	52%	
ARKANSAS	14195	1216	106	222	125	358	30833	6263	53255
	27%	2%	0%	0%	0%	1%	58%	12%	
CALIFORNIA	4844	1718	482	318	290	733	100485	51492	160362
	3%	1%	0%	0%	0%	0%	63%	32%	
COLORADO	3763	193	29	39	48	87	71507	28662	104326
	4%	0%	0%	0%	0%	0%	69%	27%	
CONNECTICUT	0	0	0	0	0	0	5211	0	5211
	0%	0%	0%	0%	0%	0%	100%	0%	
DELAWARE	1216	647	48	97	56	222	0	39	2327
	52%	28%	2%	4%	2%	10%	0%	2%	
FLORIDA	29008	7556	859	1602	1160	3926	2133	13105	59359
	49%	13%	1%	3%	2%	7%	4%	22%	
GEORGIA	19739	1679	241	270	116	376	34315	5867	58603
	27%	3%	0%	0%	0%	1%	59%	10%	
IDAHO	4150	367	58	68	19	116	41254	37519	83551
	5%	0%	0%	0%	0%	0%	49%	45%	
ILLINOIS	19618	4140	917	811	897	3281	25315	1361	56342
	35%	7%	2%	1%	2%	6%	45%	2%	
INDIANA	12506	5838	975	955	608	1891	12246	1322	36341
	34%	16%	3%	3%	2%	5%	34%	4%	
IOWA	10094	1390	193	241	116	482	43350	0	56066
	18%	2%	0%	0%	0%	1%	78%	0%	
KANSAS	5674	736	174	174	97	299	74720	193	82267
	7%	1%	0%	0%	0%	0%	91%	0%	
KENTUCKY	917	825	154	48	116	318	35821	2470	40269
	2%	1%	0%	0%	0%	1%	89%	6%	
LOUISIANA	20226	3735	415	618	328	955	7459	14417	48153
	42%	8%	1%	1%	1%	2%	15%	30%	
MAINE	1602	125	0	29	0	0	31961	357	34074
	5%	0%	0%	0%	0%	0%	94%	1%	
MARYLAND	3435	1476	540	309	685	1100	3464	145	11154
	31%	13%	5%	3%	6%	10%	31%	1%	
MASSACHUSETTS	0	0	0	0	0	0	8627	0	8627
	0%	0%	0%	0%	0%	0%	100%	0%	
MICHIGAN	22533	6388	946	1370	965	2847	17109	9679	61837
	36%	10%	2%	2%	2%	5%	28%	16%	
MINNESOTA	26180	1650	347	299	280	897	31334	24926	85913
	30%	2%	0%	0%	0%	1%	36%	29%	
MISSISSIPPI	13249	1351	232	241	135	463	28371	3841	47883
	28%	3%	0%	1%	0%	1%	59%	8%	
MISSOURI	9235	830	87	183	29	193	54860	4516	69933
	13%	1%	0%	0%	0%	0%	78%	6%	
MONTANA	6311	203	39	29	10	58	94647	47160	148457
	4%	0%	0%	0%	0%	0%	64%	32%	
NEBRASKA	17196	868	87	164	29	106	57736	1534	77720
	22%	1%	0%	0%	0%	0%	74%	2%	
NEVADA	463	29	0	19	0	0	89851	20255	110617
	0%	0%	0%	0%	0%	0%	81%	18%	
NEW HAMPSHIRE	0	0	0	0	0	0	8270	1197	9467
	0%	0%	0%	0%	0%	0%	87%	13%	
NEW JERSEY	627	1052	367	270	1245	1882	2567	0	8010
	8%	13%	5%	3%	16%	23%	32%	0%	
NEW MEXICO	222	87	10	0	19	0	89870	31536	121744
	0%	0%	0%	0%	0%	0%	74%	26%	
NEW YORK	753	676	106	154	87	1216	37297	9930	50219
	1%	1%	0%	0%	0%	2%	74%	20%	
NORTH CAROLINA	14378	3464	203	540	222	531	22803	8627	50768
	28%	7%	0%	1%	0%	1%	45%	17%	
NORTH DAKOTA	11194	280	39	29	48	145	52699	6572	71006
	16%	0%	0%	0%	0%	0%	74%	9%	
OHIO	7778	5481	897	859	685	2364	21442	2326	41832
	19%	13%	2%	2%	2%	6%	51%	6%	
OKLAHOMA	7016	560	29	116	48	116	58267	3464	69616
	10%	1%	0%	0%	0%	0%	84%	5%	
OREGON	4101	975	347	251	261	753	60891	30349	97928
	4%	1%	0%	0%	0%	1%	62%	31%	
PENNSYLVANIA	376	704	241	193	145	454	39613	3551	45277
	1%	2%	1%	0%	0%	1%	87%	8%	
RHODE ISLAND	0	0	0	0	0	0	1206	0	1206
	0%	0%	0%	0%	0%	0%	100%	0%	
SOUTH CAROLINA	984	270	0	39	0	29	27203	2663	31188
	3%	1%	0%	0%	0%	0%	87%	9%	
SOUTH DAKOTA	10605	290	29	77	29	48	43136	22793	77007
	14%	0%	0%	0%	0%	0%	56%	30%	
TENNESSEE	125	154	10	68	19	77	39073	2596	42122
	0%	0%	0%	0%	0%	0%	93%	6%	
TEXAS	29442	3696	946	772	984	2413	225096	5491	268840
	11%	1%	0%	0%	0%	1%	84%	2%	
UTAH	4815	10	0	10	0	0	54793	25553	85181
	6%	0%	0%	0%	0%	0%	64%	30%	
VERMONT	0	0	0	0	0	0	8830	1023	9853
	0%	0%	0%	0%	0%	0%	90%	10%	
VIRGINIA	7595	2345	357	328	444	1399	23035	5665	41166
	18%	6%	1%	1%	1%	3%	56%	14%	
WASHINGTON	3908	386	145	116	48	309	39642	24762	69316
	6%	1%	0%	0%	0%	0%	57%	36%	
WEST VIRGINIA	68	116	0	19	0	29	21153	2721	24106
	0%	0%	0%	0%	0%	0%	88%	11%	
WISCONSIN	12246	2451	367	328	357	1033	35213	5028	57023
	21%	4%	1%	1%	1%	2%	62%	9%	
WYOMING	4449	193	19	29	19	58	67994	25225	97986
	5%	0%	0%	0%	0%	0%	69%	26%	
TOTAL	373547	67677	11282	12729	10914	31971	1974162	557673	
	12%	2%	0%	0%	0%	1%	65%	18%	

NOTE: "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING POPULATION CRITERIA. THE NUMBERS IN THE POPULATION CASE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THAT CRITERION

TABLE F3.7

ENVIRONMENTAL SUITABILITY AND POPULATION CASES 1 - 5 ***
<<<<< MEDIUM-HIGH SUITABILITY >>>>>
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	AVAILABLE LAND	POPCASE 1	POPCASE 2	POPCASE 3	POPCASE 4	POPCASE 5	OTHER SUITABILITIES	RESTRICTED LANDS	
ALABAMA	15759	2837	232	347	58	429	30176	2075	51908
	30%	5%	0%	1%	0%	1%	58%	4%	
ARIZONA	27502	1399	367	212	357	917	24123	59401	114342
	24%	1%	0%	0%	0%	1%	21%	52%	
ARKANSAS	8975	868	48	174	0	125	36805	6263	52259
	17%	2%	0%	0%	0%	0%	69%	12%	
CALIFORNIA	10596	1322	357	232	318	704	95342	51492	160367
	7%	1%	0%	0%	0%	0%	59%	32%	
COLORADO	12487	656	48	39	48	77	62310	28662	104379
	12%	1%	0%	0%	0%	0%	60%	27%	
CONNECTICUT	29	174	135	97	367	955	3455	0	5212
	1%	3%	3%	2%	7%	18%	66%	0%	
DELAWARE	0	0	0	0	0	0	2287	39	2326
	0%	0%	0%	0%	0%	0%	98%	2%	
FLORIDA	1689	241	0	116	10	77	44122	13105	59358
	3%	0%	0%	0%	0%	0%	74%	22%	
GEORGIA	12873	2374	290	454	232	965	35551	5867	58605
	22%	4%	0%	1%	0%	2%	61%	10%	
IDAHO	9920	318	68	48	19	68	35589	37519	83549
	12%	0%	0%	0%	0%	0%	43%	45%	
ILLINOIS	11831	1621	241	376	116	290	40704	1361	56540
	21%	3%	0%	1%	0%	1%	72%	2%	
INDIANA	6321	2393	193	376	106	290	25341	1322	36342
	17%	7%	1%	1%	0%	1%	70%	4%	
IOWA	25756	2055	212	454	116	347	27126	0	56066
	46%	4%	0%	1%	0%	1%	48%	0%	
KANSAS	13375	984	135	222	154	261	66942	193	82265
	16%	1%	0%	0%	0%	0%	81%	0%	
KENTUCKY	5597	1959	318	270	135	290	29230	2470	40269
	14%	5%	1%	1%	0%	1%	73%	6%	
LOUISIANA	6475	396	19	135	0	58	26653	14417	48153
	13%	1%	0%	0%	0%	0%	55%	30%	
MAINE	14784	1631	97	367	116	280	16444	357	34076
	43%	5%	0%	1%	0%	1%	48%	1%	
MARYLAND	39	290	290	125	408	685	8975	145	11157
	0%	3%	3%	1%	5%	6%	80%	1%	
MASSACHUSETTS	347	569	193	328	666	1525	4999	0	8627
	4%	7%	2%	4%	8%	18%	58%	0%	
MICHIGAN	11580	3435	328	608	502	656	35049	9679	61837
	19%	6%	1%	1%	1%	1%	57%	16%	
MINNESOTA	25650	2104	376	386	183	396	31893	24926	85914
	30%	2%	0%	0%	0%	0%	37%	29%	
MISSISSIPPI	18036	2036	68	290	77	261	23276	3841	47885
	38%	4%	0%	1%	0%	1%	49%	8%	
MISSOURI	10171	917	116	145	203	434	53432	4516	69934
	15%	1%	0%	0%	0%	1%	76%	6%	
MONTANA	23276	164	0	29	10	97	77721	47160	148457
	16%	0%	0%	0%	0%	0%	52%	32%	
NEBRASKA	13365	647	77	48	77	241	61731	1534	77720
	17%	1%	0%	0%	0%	0%	79%	2%	
NEVADA	4719	280	87	19	97	174	84986	20255	110619
	4%	0%	0%	0%	0%	0%	77%	18%	
NEW HAMPSHIRE	58	396	87	174	145	376	7035	1197	9468
	1%	4%	1%	2%	2%	4%	74%	13%	
NEW JERSEY	0	68	19	68	203	318	7334	0	8010
	0%	1%	0%	1%	3%	4%	92%	0%	
NEW MEXICO	4449	241	48	39	19	97	85316	31536	121745
	4%	0%	0%	0%	0%	0%	70%	26%	
NEW YORK	5443	3860	704	994	579	2384	26325	9930	50219
	11%	8%	1%	2%	1%	5%	52%	20%	
NORTH CAROLINA	6630	4246	502	907	309	975	28574	8627	50770
	13%	8%	1%	2%	1%	2%	56%	17%	
NORTH DAKOTA	14147	174	0	0	39	19	50055	6572	71006
	20%	0%	0%	0%	0%	0%	70%	9%	
OHIO	3204	2943	1592	608	1177	1795	28188	2326	41833
	8%	7%	4%	1%	3%	4%	67%	6%	
OKLAHOMA	12709	1457	135	193	145	318	51193	3464	69614
	18%	2%	0%	0%	0%	0%	74%	5%	
OREGON	24926	318	29	48	19	68	42171	30349	97928
	25%	0%	0%	0%	0%	0%	43%	31%	
PENNSYLVANIA	1554	1988	425	569	473	1390	35329	3551	45279
	3%	4%	1%	1%	1%	3%	78%	8%	
RHODE ISLAND	68	145	116	77	68	299	434	0	1207
	6%	12%	10%	6%	6%	25%	36%	0%	
SOUTH CAROLINA	965	396	10	116	10	87	26943	2663	31190
	3%	1%	0%	0%	0%	0%	86%	9%	
SOUTH DAKOTA	11947	106	10	10	0	29	42113	22793	77006
	16%	0%	0%	0%	0%	0%	55%	30%	
TENNESSEE	5568	1515	203	405	87	318	31430	2596	42122
	13%	4%	0%	1%	0%	1%	75%	6%	
TEXAS	83916	7701	1486	1341	1071	2634	165198	5491	268838
	31%	3%	1%	0%	0%	1%	61%	2%	
UTAH	10084	29	0	0	0	0	49514	25553	85180
	12%	0%	0%	0%	0%	0%	58%	30%	
VERMONT	68	19	0	0	10	19	8714	1023	9853
	1%	0%	0%	0%	0%	0%	88%	10%	
VIRGINIA	9592	2451	174	357	232	405	22292	5665	41168
	23%	6%	0%	1%	1%	1%	54%	14%	
WASHINGTON	8926	415	58	135	10	58	34952	24762	69316
	13%	1%	0%	0%	0%	0%	50%	36%	
WEST VIRGINIA	48	87	0	0	10	0	21240	2721	24106
	0%	0%	0%	0%	0%	0%	88%	11%	
WISCONSIN	20091	2663	521	482	241	618	27377	5028	57021
	35%	5%	1%	1%	0%	1%	48%	9%	
WYOMING	15469	87	19	48	10	77	57051	25225	97986
	16%	0%	0%	0%	0%	0%	58%	26%	
TOTAL	531013	62975	10433	12468	9432	22882	1833100	557672	
	17%	2%	0%	0%	0%	1%	60%	18%	

NOTE "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING POPULATION CRITERIA. THE NUMBERS IN THE POPULATION CASE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THAT CRITERION

TABLE F3.8

ENVIRONMENTAL SUITABILITY AND POPULATION CASES 1 - 5 ***
<<<<< MEDIUM SUITABILITY >>>>>
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	AVAILABLE LAND	POPCASE 1	POPCASE 2	POPCASE 3	POPCASE 4	POPCASE 5	OTHER SUITABILITIES	RESTRICTED LANDS	
ALABAMA	8830	1766	135	299	87	270	36446	2275	51909
	17%	3%	0%	1%	0%	1%	74%	4%	
ARIZONA	15517	338	19	106	10	58	38890	59405	114343
	14%	0%	0%	0%	0%	0%	34%	52%	
ARKANSAS	6321	1052	135	97	58	125	39206	6267	53255
	12%	2%	0%	0%	0%	0%	74%	12%	
CALIFORNIA	9052	917	87	145	106	232	98334	51492	160365
	6%	1%	0%	0%	0%	0%	61%	32%	
COLORADO	10654	386	174	39	174	222	64016	28660	104327
	10%	0%	0%	0%	0%	0%	61%	27%	
CONNECTICUT	29	299	125	87	106	135	4429	0	5210
	1%	6%	2%	2%	2%	3%	85%	0%	
DELAWARE	0	0	0	0	0	0	2287	39	2326
	0%	0%	0%	0%	0%	0%	98%	2%	
FLORIDA	0	0	0	0	0	0	46252	13105	59357
	0%	0%	0%	0%	0%	0%	78%	22%	
GEORGIA	6890	2306	270	463	270	521	42016	5867	58603
	12%	4%	0%	1%	0%	1%	72%	10%	
IDAHO	11561	357	10	87	19	58	33939	37519	83551
	14%	0%	0%	0%	0%	0%	41%	45%	
ILLINOIS	3792	627	154	116	125	270	50093	1361	56536
	7%	1%	0%	0%	0%	0%	89%	2%	
INDIANA	1216	560	29	125	39	19	33032	1322	36342
	3%	2%	0%	0%	0%	0%	91%	4%	
IOWA	4603	338	19	58	39	68	50942	0	56067
	8%	1%	0%	0%	0%	0%	91%	0%	
KANSAS	15208	569	10	87	10	77	66112	193	82266
	18%	1%	0%	0%	0%	0%	80%	0%	
KENTUCKY	9418	2036	106	212	106	222	25698	2470	40268
	23%	5%	0%	1%	0%	1%	64%	6%	
LOUISIANA	347	29	0	0	0	0	33360	14417	48153
	1%	0%	0%	0%	0%	0%	69%	30%	
MAINE	4574	309	0	58	0	39	28738	357	34075
	13%	1%	0%	0%	0%	0%	84%	1%	
MARYLAND	627	270	48	58	10	68	9930	145	11156
	6%	2%	0%	1%	0%	1%	89%	1%	
MASSACHUSETTS	0	135	241	164	608	1110	6369	0	8627
	0%	2%	3%	2%	7%	13%	74%	0%	
MICHIGAN	0	0	0	0	0	0	52158	9679	61837
	0%	0%	0%	0%	0%	0%	84%	16%	
MINNESOTA	1390	251	97	39	48	154	59010	24926	85915
	2%	0%	0%	0%	0%	0%	69%	29%	
MISSISSIPPI	4294	425	68	87	39	58	39073	3841	47885
	9%	1%	0%	0%	0%	0%	82%	8%	
MISSOURI	13539	1293	125	154	125	511	49669	4516	69932
	19%	2%	0%	0%	0%	1%	71%	6%	
MONTANA	29683	309	0	77	0	29	71198	47160	148456
	20%	0%	0%	0%	0%	0%	48%	32%	
NEBRASKA	16019	425	106	77	0	145	59415	1534	77721
	21%	1%	0%	0%	0%	0%	76%	2%	
NEVADA	27570	48	0	19	0	10	62715	20255	110617
	25%	0%	0%	0%	0%	0%	57%	18%	
NEW HAMPSHIRE	656	290	77	48	10	10	7180	1197	9468
	7%	3%	1%	1%	0%	0%	76%	13%	
NEW JERSEY	0	29	68	48	251	482	7131	0	8009
	0%	0%	1%	1%	3%	6%	89%	0%	
NEW MEXICO	18258	444	58	106	68	232	71043	31536	121745
	15%	0%	0%	0%	0%	0%	58%	26%	
NEW YORK	7189	3020	299	511	444	560	28265	9930	50216
	14%	6%	1%	1%	1%	1%	56%	20%	
NORTH CAROLINA	1911	1679	106	396	116	270	37664	8627	50769
	4%	3%	0%	1%	0%	1%	74%	17%	
NORTH DAKOTA	17476	58	0	10	10	19	46860	6572	71005
	25%	0%	0%	0%	0%	0%	66%	9%	
OHIO	1737	1033	116	232	29	386	35975	2326	41834
	4%	2%	0%	1%	0%	1%	86%	6%	
OKLAHOMA	19570	2355	106	299	164	569	43087	3464	69614
	28%	3%	0%	0%	0%	1%	62%	5%	
OREGON	12256	1158	87	280	106	154	53538	30349	97928
	13%	1%	0%	0%	0%	0%	55%	31%	
PENNSYLVANIA	7035	3223	618	975	608	1891	27377	3551	45278
	16%	7%	1%	2%	1%	4%	60%	8%	
RHODE ISLAND	0	125	135	29	87	58	772	0	1206
	0%	10%	11%	2%	7%	5%	64%	0%	
SOUTH CAROLINA	11348	3204	251	367	232	743	12381	2663	31189
	36%	10%	1%	1%	1%	2%	40%	9%	
SOUTH DAKOTA	11368	116	19	29	10	39	42634	22793	77009
	15%	0%	0%	0%	0%	0%	55%	30%	
TENNESSEE	7865	1399	135	154	106	318	29548	2596	42121
	19%	3%	0%	0%	0%	1%	70%	6%	
TEXAS	26730	1235	87	222	116	270	234688	5491	268839
	10%	0%	0%	0%	0%	0%	87%	2%	
UTAH	12420	97	10	39	0	19	47044	25553	85182
	15%	0%	0%	0%	0%	0%	55%	30%	
VERMONT	1013	309	19	29	29	58	7373	1023	9853
	10%	3%	0%	0%	0%	1%	75%	10%	
VIRGINIA	1776	540	39	77	10	39	33022	5665	41168
	4%	1%	0%	0%	0%	0%	80%	14%	
WASHINGTON	10403	1187	135	145	135	222	32327	24762	69316
	15%	2%	0%	0%	0%	0%	47%	36%	
WEST VIRGINIA	4429	1197	97	290	183	328	14861	2721	24105
	18%	5%	0%	1%	1%	1%	62%	11%	
WISCONSIN	5674	704	10	135	10	87	45374	5028	57022
	10%	1%	0%	0%	0%	0%	80%	9%	
WYOMING	20564	145	10	19	10	10	52004	25225	97987
	21%	0%	0%	0%	0%	0%	53%	26%	
TOTAL	400812	38592	4440	7094	4713	11165	2015479	557673	
	13%	1%	0%	0%	0%	0%	66%	18%	

NOTE: "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING POPULATION CRITERIA THE NUMBERS IN THE POPULATION CASE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THAT CRITERION

TABLE F3.9

ENVIRONMENTAL SUITABILITY AND POPULATION CASES 1 - 5 ***
<<<<< MEDIUM-LOW SUITABILITY >>>>>
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	AVAILABLE LAND	POPCASE 1	POPCASE 2	POPCASE 3	POPCASE 4	POPCASE 5	OTHER SUITABILITIES	RESTRICTED LANDS	
ALABAMA	5290	1052	97	116	39	318	42962	2075	51909
	10%	2%	0%	0%	0%	1%	83%	4%	
ARIZONA	3831	251	0	10	0	10	50836	59405	114343
	3%	0%	0%	0%	0%	0%	44%	52%	
ARKANSAS	6958	434	29	125	19	48	39387	6262	53256
	13%	1%	0%	0%	0%	0%	74%	12%	
CALIFORNIA	16772	2152	299	463	164	579	88442	51492	160363
	10%	1%	0%	0%	0%	0%	55%	32%	
COLORADO	13616	309	68	10	48	309	61306	28660	104326
	13%	0%	0%	0%	0%	0%	59%	27%	
CONNECTICUT	106	569	347	299	212	540	3136	0	5209
	2%	11%	7%	6%	4%	10%	60%	0%	
DELAWARE	0	0	0	0	0	0	2287	39	2326
	0%	0%	0%	0%	0%	0%	98%	2%	
FLORIDA	0	0	0	0	0	0	46252	13105	59357
	0%	0%	0%	0%	0%	0%	78%	22%	
GEORGIA	2625	801	58	183	29	58	48983	5867	58604
	4%	1%	0%	0%	0%	0%	84%	10%	
IDAHO	7556	212	0	29	10	68	38156	37519	83550
	9%	0%	0%	0%	0%	0%	46%	45%	
ILLINOIS	1457	502	183	58	68	77	52834	1361	56540
	3%	1%	0%	0%	0%	0%	93%	2%	
INDIANA	434	68	10	10	29	29	34441	1322	36343
	1%	0%	0%	0%	0%	0%	95%	4%	
IOWA	9023	386	0	48	0	19	46590	0	56066
	16%	1%	0%	0%	0%	0%	83%	0%	
KANSAS	26354	840	106	193	135	174	54272	193	82267
	32%	1%	0%	0%	0%	0%	66%	0%	
KENTUCKY	8376	1911	39	164	10	77	27223	2470	40270
	21%	5%	0%	0%	0%	0%	68%	6%	
LOUISIANA	0	0	0	0	0	0	33736	14417	48153
	0%	0%	0%	0%	0%	0%	70%	30%	
MAINE	8309	135	0	10	0	10	25254	357	34075
	24%	0%	0%	0%	0%	0%	74%	1%	
MARYLAND	212	106	0	19	0	10	10663	145	11155
	2%	1%	0%	0%	0%	0%	96%	1%	
MASSACHUSETTS	647	811	97	87	58	77	6851	0	8628
	7%	9%	1%	1%	1%	1%	79%	0%	
MICHIGAN	0	0	0	0	0	0	52158	9679	61837
	0%	0%	0%	0%	0%	0%	84%	16%	
MINNESOTA	232	19	0	10	0	0	60727	24926	85914
	0%	0%	0%	0%	0%	0%	71%	29%	
MISSISSIPPI	2355	193	39	29	10	0	41418	3841	47885
	5%	0%	0%	0%	0%	0%	86%	8%	
MISSOURI	12400	1100	299	183	135	299	51000	4516	69932
	18%	2%	0%	0%	0%	0%	73%	6%	
MONTANA	27107	212	19	10	19	19	73909	47160	148455
	18%	0%	0%	0%	0%	0%	50%	32%	
NEBRASKA	12236	39	0	10	0	10	63893	1534	77722
	16%	0%	0%	0%	0%	0%	82%	2%	
NEVADA	18846	0	0	0	0	0	71516	20255	110617
	17%	0%	0%	0%	0%	0%	65%	18%	
NEW HAMPSHIRE	3474	714	29	154	0	97	3802	1197	9467
	37%	8%	0%	2%	0%	1%	40%	13%	
NEW JERSEY	68	251	87	106	39	116	7344	0	8011
	1%	3%	1%	1%	0%	1%	92%	0%	
NEW MEXICO	17939	241	48	48	10	77	71825	31536	121744
	15%	0%	0%	0%	0%	0%	59%	26%	
NEW YORK	4989	1592	116	270	232	579	32511	9930	50219
	10%	3%	0%	1%	0%	1%	65%	20%	
NORTH CAROLINA	685	869	39	154	19	145	40530	8627	50768
	1%	1%	0%	0%	0%	0%	80%	17%	
NORTH DAKOTA	12207	135	10	29	0	29	52023	6572	71005
	17%	0%	0%	0%	0%	0%	73%	9%	
OHIO	3735	984	87	203	10	77	34412	2326	41834
	9%	2%	0%	0%	0%	0%	82%	6%	
OKLAHOMA	11329	492	39	116	0	125	54050	3464	69615
	16%	1%	0%	0%	0%	0%	78%	5%	
OREGON	19869	1129	29	58	0	48	46445	30349	97927
	20%	1%	0%	0%	0%	0%	47%	31%	
PENNSYLVANIA	9196	3657	840	811	569	1033	25621	3551	45278
	20%	8%	2%	2%	1%	2%	57%	8%	
RHODE ISLAND	0	0	0	0	0	0	1206	0	1206
	0%	0%	0%	0%	0%	0%	100%	0%	
SOUTH CAROLINA	5365	1505	203	270	77	376	20728	2663	31187
	17%	5%	1%	1%	0%	1%	66%	9%	
SOUTH DAKOTA	7334	116	0	39	0	29	46696	22793	77007
	10%	0%	0%	0%	0%	0%	61%	30%	
TENNESSEE	9363	3484	290	560	154	463	25013	2596	42123
	23%	8%	1%	1%	0%	1%	59%	6%	
TEXAS	41331	1524	251	251	116	482	219383	5491	268839
	15%	1%	0%	0%	0%	0%	82%	2%	
UTAH	12941	251	0	10	0	19	46407	25553	85181
	15%	0%	0%	0%	0%	0%	54%	30%	
VERMONT	2538	309	10	77	10	98	5829	1023	9894
	26%	3%	0%	1%	0%	1%	59%	10%	
VIRGINIA	1959	389	39	106	10	87	32713	5665	41168
	5%	1%	0%	0%	0%	0%	79%	14%	
WASHINGTON	7488	540	29	125	39	77	36255	24762	69315
	11%	1%	0%	0%	0%	0%	52%	36%	
WEST VIRGINIA	8145	1756	106	212	29	116	11020	2721	24105
	34%	7%	0%	1%	0%	0%	46%	11%	
WISCONSIN	3628	174	0	29	0	29	48134	5028	57022
	6%	0%	0%	0%	0%	0%	84%	9%	
WYOMING	13523	97	19	19	29	19	59058	25222	97986
	14%	0%	0%	0%	0%	0%	60%	26%	
TOTAL	382005	32221	3981	5713	2328	6812	2049232	557673	
	13%	1%	0%	0%	0%	0%	67%	18%	

NOTE "AVAILABLE LAND" IS THAT AVAILABLE UNDER THE MOST CONSTRAINING POPULATION CRITERIA THE NUMBERS IN THE POPULATION CASE COLUMNS REPRESENT THAT LAND UNIQUELY CONSTRAINED BY THAT CRITERION

TABLE F3.10

ENVIRONMENTAL SUITABILITY AND POPULATION CASES 1 - 5 ***
<<<<< LOW SUITABILITY >>>>>
STATE AREAS IN SQUARE MILES AND % OF STATE

TABULATION	AVAILABLE LAND	POPCASE 1	POPCASE 2	POPCASE 3	POPCASE 4	POPCASE 5	OTHER SUITABILITIES	RESTRICTED LANDS	
ALABAMA	46	10	0	0	0	0	49773	2075	51908
	0%	0%	0%	0%	0%	0%	96%	4%	
ARIZONA	2113	58	0	39	0	10	52718	59405	114343
	2%	0%	0%	0%	0%	0%	46%	52%	
ARKANSAS	4680	299	68	58	19	87	41785	6263	53259
	9%	1%	0%	0%	0%	0%	78%	12%	
CALIFORNIA	40520	4072	1708	984	2287	6417	52882	51492	160362
	25%	3%	1%	1%	1%	4%	33%	32%	
COLORADO	29876	1119	299	203	261	386	43522	28660	104326
	29%	1%	0%	0%	0%	0%	42%	27%	
CONNECTICUT	0	193	164	48	68	125	4613	0	5211
	0%	4%	3%	1%	1%	2%	89%	0%	
DELAWARE	0	0	0	0	0	0	2287	39	2326
	0%	0%	0%	0%	0%	0%	98%	2%	
FLORIDA	0	0	0	0	0	0	46252	13105	59357
	0%	0%	0%	0%	0%	0%	78%	22%	
GEORGIA	2220	376	19	29	0	10	50083	5867	58604
	4%	1%	0%	0%	0%	0%	85%	10%	
IDAHO	10451	251	10	68	19	48	35184	37519	83550
	13%	0%	0%	0%	0%	0%	42%	45%	
ILLINOIS	2799	482	68	135	10	116	51370	1361	56341
	5%	1%	0%	0%	0%	0%	91%	2%	
INDIANA	0	0	0	0	0	0	35020	1322	36342
	0%	0%	0%	0%	0%	0%	96%	4%	
IOWA	107	0	0	0	0	0	56057	0	56067
	0%	0%	0%	0%	0%	0%	100%	0%	
KANSAS	15946	212	19	29	0	19	66247	193	82265
	19%	0%	0%	0%	0%	0%	81%	0%	
KENTUCKY	3377	1004	0	174	0	19	33225	2470	40269
	8%	2%	0%	0%	0%	0%	83%	6%	
LOUISIANA	0	0	0	0	0	0	33736	14417	48153
	0%	0%	0%	0%	0%	0%	70%	30%	
MAINE	1197	39	0	10	0	0	32472	357	34075
	4%	0%	0%	0%	0%	0%	95%	1%	
MARYLAND	0	0	0	0	0	0	11011	145	11156
	0%	0%	0%	0%	0%	0%	99%	1%	
MASSACHUSETTS	203	589	39	87	10	39	7662	0	8629
	2%	7%	0%	1%	0%	0%	89%	0%	
MICHIGAN	0	0	0	0	0	0	52158	9679	61837
	0%	0%	0%	0%	0%	0%	84%	16%	
MINNESOTA	0	0	0	0	0	0	60988	24926	85914
	0%	0%	0%	0%	0%	0%	71%	29%	
MISSISSIPPI	0	0	0	0	10	0	44033	3841	47884
	0%	0%	0%	0%	0%	0%	92%	8%	
MISSOURI	11406	782	106	222	58	135	52708	4516	69933
	16%	1%	0%	0%	0%	0%	75%	6%	
MONTANA	13288	135	48	58	29	29	87709	47160	148456
	9%	0%	0%	0%	0%	0%	59%	32%	
NEBRASKA	14157	48	0	10	0	0	61972	1534	77721
	18%	0%	0%	0%	0%	0%	80%	2%	
NEVADA	37365	367	58	58	39	97	52380	20255	110619
	34%	0%	0%	0%	0%	0%	47%	18%	
NEW HAMPSHIRE	1322	135	0	19	0	0	6794	1197	9467
	14%	1%	0%	0%	0%	0%	72%	13%	
NEW JERSEY	0	0	0	0	87	261	7662	0	8010
	0%	0%	0%	0%	1%	3%	96%	0%	
NEW MEXICO	44831	367	29	97	29	77	42778	31536	121744
	38%	0%	0%	0%	0%	0%	35%	26%	
NEW YORK	2634	589	48	125	48	68	36757	9930	50219
	5%	1%	0%	0%	0%	0%	73%	20%	
NORTH CAROLINA	2374	369	19	116	0	68	38996	8627	50769
	5%	1%	0%	0%	0%	0%	77%	17%	
NORTH DAKOTA	8241	87	0	10	0	0	56095	6572	71005
	12%	0%	0%	0%	0%	0%	79%	9%	
OHIO	1119	328	0	19	19	10	38011	2326	41832
	3%	1%	0%	0%	0%	0%	91%	6%	
OKLAHOMA	7923	203	10	10	0	0	58006	3464	69616
	11%	0%	0%	0%	0%	0%	83%	5%	
OREGON	251	39	10	0	0	10	67270	30349	97929
	0%	0%	0%	0%	0%	0%	69%	31%	
PENNSYLVANIA	1226	1033	116	174	68	145	38967	3551	45280
	3%	2%	0%	0%	0%	0%	86%	8%	
RHODE ISLAND	0	0	0	0	0	0	1206	0	1206
	0%	0%	0%	0%	0%	0%	100%	0%	
SOUTH CAROLINA	1090	454	29	77	19	10	26846	2663	31188
	3%	1%	0%	0%	0%	0%	86%	9%	
SOUTH DAKOTA	11686	106	29	48	29	39	42277	22793	77007
	15%	0%	0%	0%	0%	0%	55%	30%	
TENNESSEE	4275	1496	145	222	29	318	33042	2596	42123
	10%	4%	0%	1%	0%	1%	78%	6%	
TEXAS	53065	868	135	135	19	97	209029	9491	268839
	20%	0%	0%	0%	0%	0%	78%	2%	
UTAH	16521	1312	212	154	193	482	40752	29553	85179
	19%	2%	0%	0%	0%	1%	48%	30%	
VERMONT	3821	328	29	48	0	29	4574	1023	9852
	39%	3%	0%	0%	0%	0%	46%	10%	
VIRGINIA	3532	820	10	125	0	68	30948	5665	41168
	9%	2%	0%	0%	0%	0%	75%	14%	
WASHINGTON	5182	1862	482	299	482	1206	35039	24762	69314
	7%	3%	1%	0%	1%	2%	51%	36%	
WEST VIRGINIA	3503	444	0	125	0	48	17264	2721	24105
	15%	2%	0%	1%	0%	0%	72%	11%	
WISCONSIN	116	0	0	0	0	0	51878	5028	57022
	0%	0%	0%	0%	0%	0%	91%	9%	
WYOMING	17611	116	10	39	10	39	54937	25225	97987
	18%	0%	0%	0%	0%	0%	56%	26%	
TOTAL	381599	21192	3919	6054	3842	10512	2057177	557673	
	13%	1%	0%	0%	0%	0%	68%	18%	

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Technical guidance to support the formulation and comparison of possible siting criteria for nuclear power plants has been developed for the Nuclear Regulatory Commission by Sandia National Laboratories. Information has been developed in four areas: (1) consequences of hypothetical severe nuclear power plant accidents, (2) characteristics of population distributions about current reactor sites, (3) site availability within the continental United States, and (4) socioeconomic impacts of reactor siting.

The impact on consequences of source term magnitude, meteorology, population distribution and emergency response have been analyzed. Population distributions about current sites were analyzed to identify statistical characteristics, time trends, and regional differences. A site availability data bank was constructed for the continental United States. The data bank contains information about population densities, seismicity, topography, water availability, and land use restrictions. Finally, the socioeconomic impacts of rural industrialization projects, energy boomtowns, and nuclear power plants were examined to determine their nature, magnitude, and dependence on site demography and remoteness.

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