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October 1980

Prepared for the U.S. Department of Energy
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SUPPLEMENTAL REPORT ON POPULATION ESTIMATES FOR HANFORD DEFENSE WASTE DRAFT ENVIRONMENTAL IMPACT STATEMENT

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CONTENTS

INTRODUCTION 1

PURPOSE 1

OVERVIEW 1

Comparability of Population Grid Sectors 1

Counties and Population Centers Included in This Study . . 4

Assumptions Used for This Study 4

METHODOLOGY 7

NEW SOURCES OF POPULATION INFORMATION 7

PROCEDURES USED TO DISTRIBUTE 1970 POPULATION 8

PROCEDURES USED TO DISTRIBUTE POPULATION FOR 1980 - 2000 . . 10

1980 Forecasts 10

1990 and 2000 Forecasts 11

PROCEDURES USED TO DISTRIBUTE POPULATION FOR 2010 - 2090 . . 11

PROCEDURES USED TO DISTRIBUTE POPULATION FOR 2990 AND 11990 12

RESULTS 15

POPULATION FORECASTS AND DISTRIBUTIONS AROUND THE 100 N AREA 18

POPULATION FORECASTS AND DISTRIBUTIONS AROUND THE 300 AREA . . 18

REFERENCE LIST 29

INTRODUCTION

This report is similar to earlier populations studies that have predicted populations growth in the area surrounding the Hanford Site (Yandon 1976; Yandon and Landstrom 1980). It predicts population growth within a 50-mile radius of the 100-N Area and within a 50-mile radius of the 300 Area.

PURPOSE

The research reported here supplies population data for ongoing environmental evaluations of the Hanford Site's waste management programs. The population figures in this report will be used to calculate dose to population from waste management operations for up to 10,000 years after 1990.

OVERVIEW

Several reports[a] have predicted population distributions within a 50-mile radius of a number of designated points located on the Hanford Site. These reports predict populations within the 16 compass sectors at 10-mile segments along the 50-mile radius. The resulting grid looks something like a spider web. Figures 1 and 2 show the marked-off population grid sectors for the 100-N Area and 300 Area respectively.

Comparability of Population Grid Sectors

Shifts in the center point of the grid can result in substantial changes in the population density of each of the corresponding grid sectors. This is apparent when comparing the areas surrounding the 100-N and 300 Areas, because the grid is shifted to the southeast. For example, the outermost SSW grid sector in Figure 1 has rather dense population counts because of its proximity to Yakima. The corresponding SSW grid sector in Figure 2 contains significantly less population because it is not influenced by the urban growth

(a) See bibliography Yandon and Landstrom (1980).

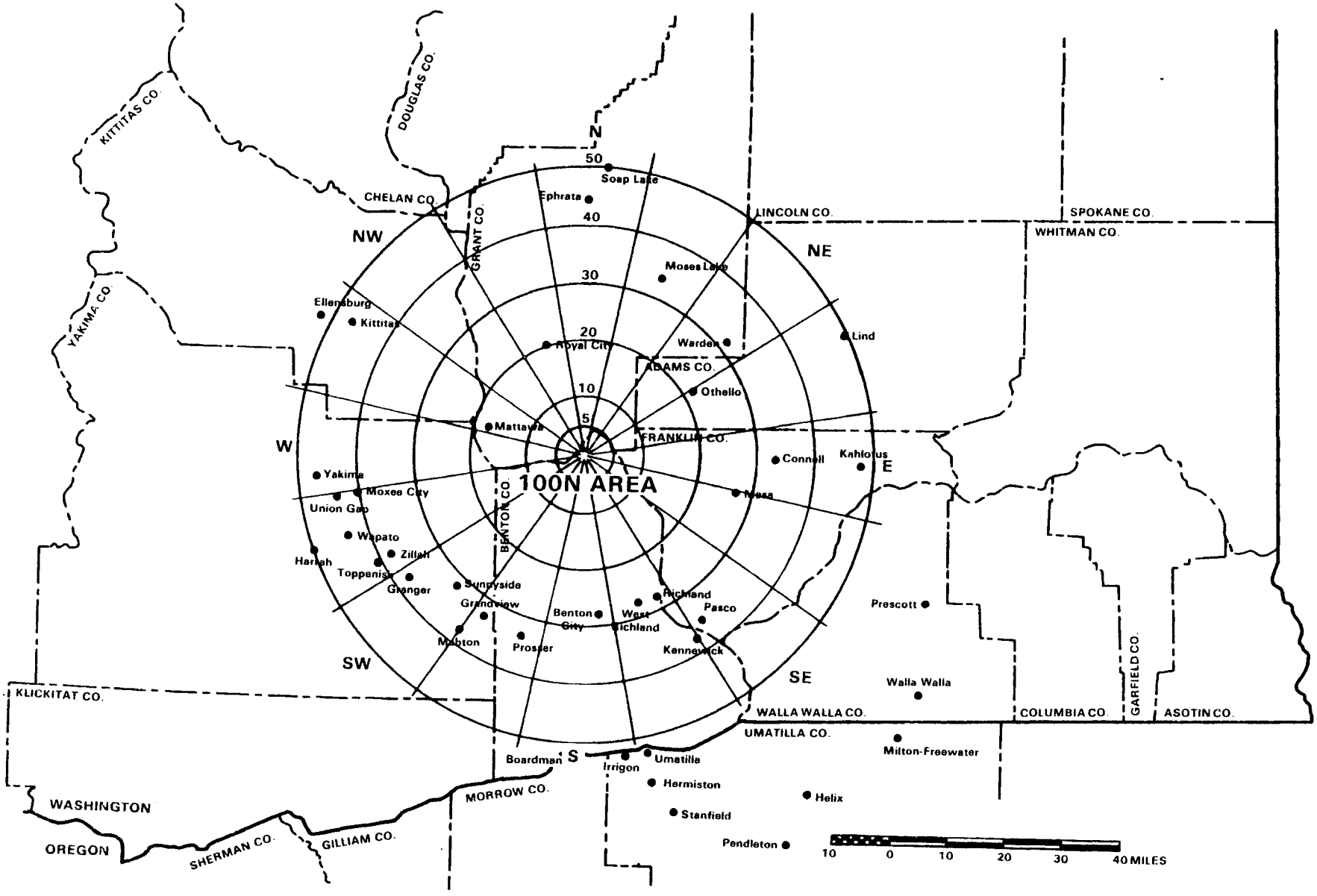

FIGURE 1. Population Study Grid for the 100-N Area

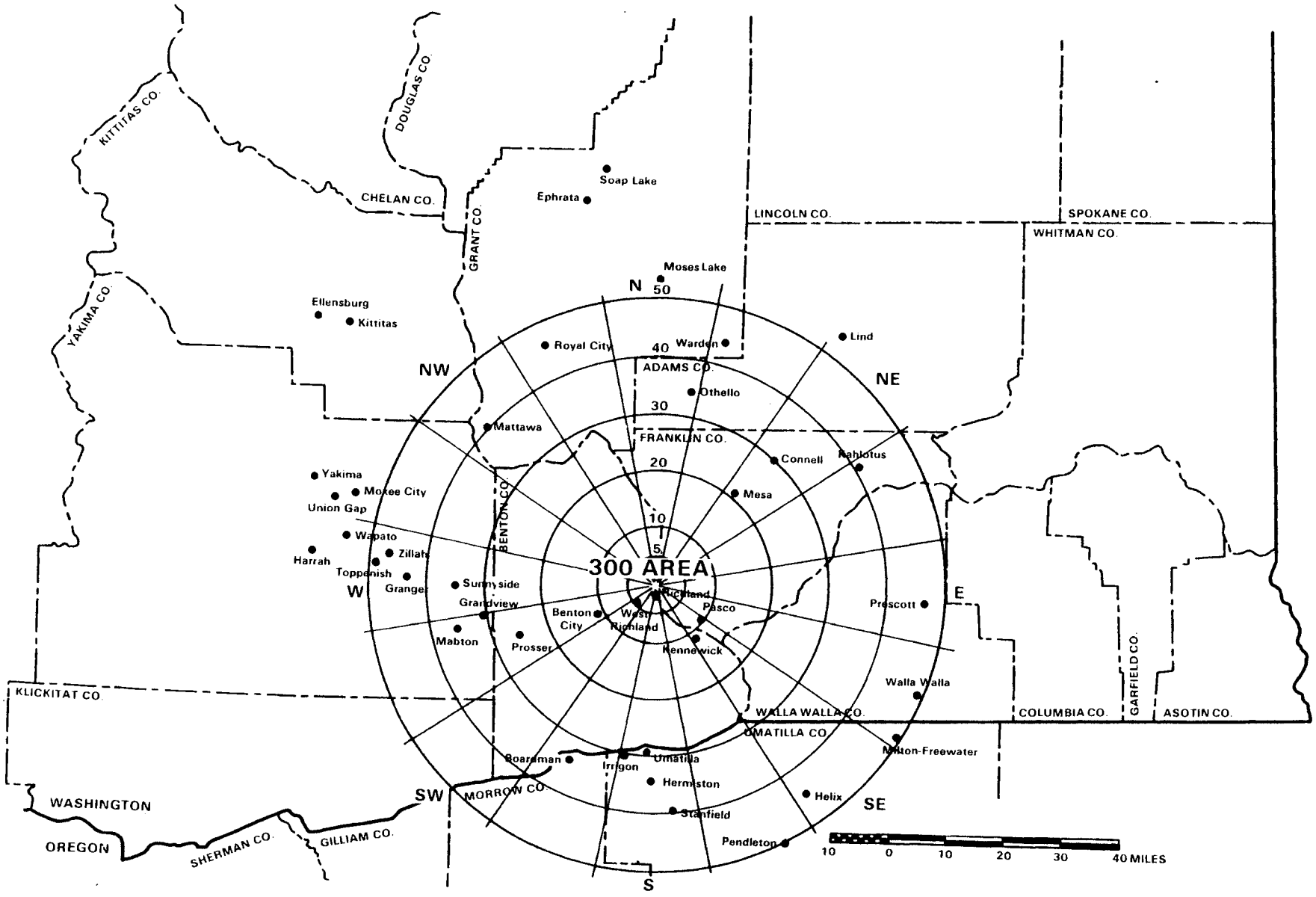

FIGURE 2. Population Study Grid for the 300 Area

around Yakima. Similarly, because the Tri-Cities are located close to the 300 Area, but relatively far from the 100-N Area, the southerly grid sectors on Figure 1 that are located nearer the edge of the grid have much higher population densities than the corresponding sectors in Figure 2. Conversely, those southerly grid sectors that are close to the center in Figure 2 are of much denser population than the same sectors on Figure 1, which contain virtually no population through the year 2030.

Counties and Populations Centers Included in this Study

Both grid centerpoints are located within the Hanford Site. In neither case are there public buildings or access routes used by substantial numbers of inhabitants within the 0-5 mile radius. The 100-N Area is reasonably close to two state highways while the 300 Area lies within 10 miles of the Richland City boundaries.

The two study areas analyzed in this report cover all or parts of the Washington Counties of Adams, Benton, Chelan, Douglas, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima. Two Oregon counties are covered in part: Umatilla and Morrow.

Incorporated communities included in one or both study areas are listed below. The unincorporated areas of Burbank and Finley have been included in Pasco's and Kennewick's populations respectively.

Benton City	Irrigon	Milton-Freewater	Prosser	Umatilla
Boardman	Kahlotus	Moses Lake	Richland	Union Gap
Connell	Kennewick	Moxie	Royal City	Wapato
Ephrata	Lind	Othello	Soap Lake	Warden
Granger	Mabton	Pasco	Stanfield	West Richland
Grandview	Mattawa	Pendleton	Sunnyside	Yakima
Helix	Mesa	Prescott	Toppenish	Zillah
Hermiston				

Assumptions Used for this Study

Assumptions used in this study are similar to those used by Yandon and Landstrom (1980). However, the earlier study tended to underestimate 1980 populations of Benton and Franklin Counties, and so it underestimated the population for all subsequent decades. Therefore, this report uses 1980

population estimates provided by local planning agencies that accurately account for the area's inmigration associated with the area's employment increase. Although some of the new jobs could have been filled by unemployed residents, the employment increase appears to be filled by inmigration because unemployment rates for the two-county area remained at the 1976 level from the period 1976-1979 while during the first half of 1979 employment was 33% above 1976 levels (State of Washington 1979). By using smaller population units (Traffic Analysis Zones or TAZs), where appropriate, this new study more realistically allocates populations to different grid sectors, thus providing a better distribution of the 1980 population and analyzing subsequent forecasts more reliable (BFGC 1980).

No claim of accuracy is made for the data in this report since they are so dependent on unpredictable actions and conditions. However, to provide conservative dose estimates, the data in this report are based on the assumption that the Hanford area populations will experience reasonable and continuous growth throughout the 10,000-year period. The following factors could significantly affect the reliability of this study's predictions:

- The Kennewick-Richland TAZ may not grow to the degree anticipated because inmigrants will choose to reside elsewhere.
- Construction schedules for the Washington Public Power Supply System (WPPSS) plants #1-2-4 may slip and extend foreseeable employment highs and population levels longer than expected to at least 1990.
- Hanford may become a major energy center.
- The Hanford Site may develop as a diversified industrial complex.
- Construction of a North Richland bridge may alter residential population distribution and shift population concentrations by grid sectors.
- Boardman-Umatilla, Oregon energy developments may be shifted to the Washington side of the Columbia River if Oregon siting problems continue.
- Columbia River transportation capability may be improved.
- The construction of Ben Franklin Dam north of the Hanford Site would affect population forecasts and land usage patterns.

- New mineral discoveries in the region would affect land use, water use, and population size.
- Major changes in the area's expected birth/death rate would affect population predictions.
- Major land use shifts and climate change would drastically revise population projections.
- Nuclear and other energy related developments may not be continued in the Hanford Site.
- Economic developments presently anticipated for the Tri-City Area and the basis for the study's population forecasts may not occur. Alternative economic developments may generate higher population levels than are presently justified on the basis of current economic experience and foreseeable developments.

The next section of this report explains the methodology used to predict future populations. The results of the study are summarized in a series of tables at the end of the report.

METHODOLOGY

Three new sources of population information that increase the reliability of the population predictions are explained below. The methodology used to predict population trends from 1980 - 2090 based on the 1970 distributions is detailed. The methodology used to predict population figures for 1,000 and 10,000 years after 1990 is also included because population forecasts far into the future are not based directly on the 1970 population distributions.

NEW SOURCES OF POPULATION INFORMATION

New data was available from several different sources. The first of these sources, and the one most useful for this study are area population and employment forecasts developed by the Washington Department of Transportation in cooperation with local planning agencies for the North Richland Bridge Feasibility Study (1980). These forecasts are based on relatively small Traffic Analysis Zones (TAZs). The TAZ boundaries were selected on a well-defined geographical basis and generally they correspond with Census Bureau Tracts and Districts. Although TAZs vary in geographical area and population size, they are workably small and they faithfully represent population density (BFGC 1980). Furthermore, their small size facilitates accurate allocation of population within the much larger population grid sectors used for this population report.

The second source of newly developed data was the Bonneville Power Administration (BPA) forecasts of the county employment and job opportunities for its service area by five-year intervals from 1980 - 2000 (BPA 1979). The BPA data were based on a well-designed and statistically valid economic model and could be converted into population estimates by using appropriate multipliers. The chief advantage of this procedure is that it accords full weight to an area's inmigration as new job opportunities are created by an expanding economy. Inmigration of this type is characteristic of the Tri-Cities' area, and this model should accurately predict the area's population growth, which has been significantly underestimated in earlier studies.

New population data was also available from the Washington State Office of Financial Management; Population, Enrollment, and Economic Studies Division

(OFM). It provided improved population estimates of Washington cities and counties for the period 1970 - 1979 (OFM 1979). The OFM also provided revised county population forecasts for the years 1980, 1990, and 2000.

Similar data for Oregon cities and counties was provided by the Center for Population Research and Census at Portland State University (CPRC 1978). County population forecasts through the year 2000 were not available for Oregon counties.

Because BPA forecasts gave greater weight to inmigration factors, they were prefered for computing average annual growth rates. However, to be consistent with techniques used by the Washington State Department of Transportation in its TAZ projections, OFM population forecasts were used as control figures for the 1980 population forecast. While a detailed comparison of BPA and TAZ data has not been made because they cover substantially different mixes of geographical area and population, the two series have been generally reviewed, and the conclusion was that the two reasonably agree. Benton and Franklin County TAZ 1980 - 1990 - 2000 population projections were used directly for this report rather than the developing and using a separate Tri-Cities projection, which had been done for the earlier population studies.

The 1980 population forecasts are more reliable because of this new data. In addition, through use of the smaller TAZ, population was more realistically allocated to the population grid sectors, which resulted in a more accurate 1980 population distribution than could be obtained using other data.

PROCEDURES USED TO DISTRIBUTE 1970 POPULATION

Three types of maps were used to make the population distribution. All of the maps were oriented to the same centerpoint and overlaid with the population grid. Each compass sector was divided into population sectors at 5, 10, 20, 30, and 40 miles from the grid center point. Maps used for the study were

- a composite map made from county census maps locating all census districts within a 50-mile radius of the grid centerpoint

- a map of census tracts in Benton and Franklin Counties
- a map of all TAZ in Benton and Franklin Counties.

Data for 1970 was available for each of these population units.

After the grid was located on the maps, population allocations were made for areas outside Benton and Franklin Counties. Population allocations to each grid sector were based on the percentage land area of the particular census districts that comprised that sector. For areas outside cities, the population within each census district was assumed to be evenly distributed. Whenever city counts were part of a census district total, they were subtracted from that total. The remainder of that district's population was assumed to be evenly distributed throughout the district and allocated accordingly. City totals were allocated directly to corresponding grid sectors unless they had to be split among two or more sectors, in which case city population was allocated based on the percentage land area falling into the different sectors.

Whenever possible, Benton and Franklin County area population allocations were based on TAZ maps. Because TAZs are smaller than census districts or tracts, most of them could be allocated directly to their corresponding grid sectors; however, a few TAZs had to be allocated among two or more grid sectors, which was done in the same manner as for city and county census districts. Some judgments in allocation were made for TAZs that had unusual population distributions. Where population data was not available for some TAZs, Benton and Franklin County Census tract information was used. Missing TAZs were assigned to their corresponding census tracts, and then the allocation method outlined above for areas outside Benton and Franklin Counties was used to determine their population distribution.

Because the grid sectors located close to the center point (those at 5 miles and 10 miles) had relatively small populations and land area, their populations were difficult to accurately allocate. Population estimates and allocations for these areas were based on county maps of housing units and area road patterns and on settlement trends in these areas. Allocations to these grid sectors were modified, where necessary, by considering each grid sector's suitability or probability for residential development.

PROCEDURES USED TO DISTRIBUTE POPULATION FOR 1980 - 2000

Forecasts for 1980, 1990, and 2000 are directly based on the methods used for the 1970 distribution. The 2010 - 2090 forecasts are based on U.S. Census Bureau materials (Census Bureau 1975).

For all decades, because of the difficulties of identifying population growth in grid sectors that are sparsely populated and relatively close to the center point without costly field surveys, a number of assumptions were substituted. Among these were that areas within the Hanford Site without any inhabitants would continue to be without inhabitants until at least 2030. Sectors currently sparsely populated would probably have some growth, but their rate of increase would about match their closest sector neighbor. In a few cases, judgments were made that some grid sectors had no potential for residential usage.

1980 Forecasts

Forecasts were made for three different areas: Benton and Franklin Counties, other Washington areas within the grid, and Oregon areas within the grid.

Data for 1980 populations within the various Benton or Franklin County TAZ were allocated to their corresponding grid sectors using the same land area percentages developed for the 1970 distribution. For rural areas of Benton or Franklin County that were not included in TAZs, census tracts were used. The 1980 estimate was extrapolated from the 1970 distribution by multiplying each tract's population figure by its county's average annual percent change in unincorporated populations between 1970 and 1979. That is, the percent of population change throughout the unincorporated areas of the counties was assumed to by uniformly distributed. The tract's populations were then allocated to their corresponding grid sectors.

Population estimates and allocations for Washington rural areas outside Benton and Franklin Counties were extrapolated to 1980 in the same way as non-TAZ rural areas in Benton and Franklin Counties. Population estimates and allocations for Washington cities outside Benton and Franklin Counties were

extrapolated to 1980 by applying their 1978-1979 change reported by the OFM to their estimated 1979 population base (estimated by the same agency). Population allocations were based on the same land area percentages developed for the 1970 distribution.

Population in Oregon rural areas was estimated in the same way as that for the Washington's rural areas outside of Benton and Franklin Counties, except the 1980 extrapolation was based on the total county's population percent change between 1970 - 1978, and not on the unincorporated areas' percent change. Oregon cities had more limited data than Washington cities. Their 1980 forecasts were computed by applying their 1976 - 1978 average annual change to their 1978 population base (Center for Population Research and Census). Population allocations were based on the same land percentages developed for the 1979 distribution.

1990 and 2000 Forecasts

Techniques for 1990 forecasts were very similar to those used for 1980 forecasts. The TAZ population counts were allocated in the same way as the 1970 distribution. For areas not covered by TAZs (including Oregon counties), 1990 populations were forecast by application of their county's 1980 - 1990 average annual change extrapolated to 1990 from the 1980 base. Rates of change were BPA forecasts and were expressed as a compound interest multiplier. Their multipliers were applied to each census district or tract and the population was allocated on the same basis as the 1970 distribution.

The techniques used to estimate population for the year 2000 were the same as those used for 1990 except a different rate for average annual change was used. Estimates from BPA county forecasts were used to determine the average annual change.

PROCEDURES USED TO DISTRIBUTE POPULATION FOR 2010 - 2090

Little economic information is available on which to make populations projections beyond the year 2010. Therefore, estimates are, based on the most optimistic national population growth projections for the years 2010 - 2051 (Census Bureau 1975). Average growth projections used for the years 2010 - 2090 are based on the following assumptions:

- Area population will change in about the same preportion as the rest of the nation. Changes of 0.7% for 2000 - 2010, 0.5% for 2010 - 2020, and 0.2% for 2020 - 2090 were used for this study. These rates of growth were applied to each grid sector. Optimistic growth rates maximize the population figures and result in a higher calculated dose-to-population.
- The area economy will be maturing and will be more diversified than at the present time.
- Irrigation developments will continue, permitting rural areas to grow.

PROCEDURES USED TO DISTRIBUTE POPULATION FOR 2990 AND 11,990

The assumption is made that for these future years, a civilization with economic activities somewhat as we know them today will be continuing, and the study area will support a growing population of reasonably high density.

To develop 2990 population forecasts for the study area, the assumption was made that the grid sectors containing Tri-Cities and surrounding areas will continue to increase more rapidly than other grid sectors. For these rapidly increasing sectors, a tripling between 2030 and 2990 is projected. All other segments are expected to double over the same time period. For the 11,990 forecast all sectors are expected to quadruple in population between 2990 and 11,990.

At both 2990 and 11,990, all Hanford Site-related restrictions are assumed to be gone within a 10-mile radius of the center point and people would move into the area. Growth is assumed to be a mixture of agricultural, commercial, and industrial activity similar to that in the immediate sector in the same compass direction. To estimate the population for 2990, the grid sectors 0 - 5 and 5 - 10 miles in the same compass direction were treated as one sector. The population in that sector was estimated to be half its neighbor in the same compass direction (10 - 20 mile sector). Population was then allocated between the 0 - 5 and 5 - 10 mile grid sectors on the basis of land area. In the year 11,990, population in the 0 - 10 mile grid sectors is calculated the same way, but the population is assumed to be the same, rather than half of the adjacent neighbor.

The following factors were considered when making population estimates for the years 2990 and 11,990:

- The area within the Hanford Site may return to a desert ecology.
- The region may develop into a large metropolitan center.
- More consideration may be given to environmental protection.
- Present Hanford activities may be replaced by a new mix of economic activity.
- New material resource discoveries may support new and increased industrial activity throughout the area.
- Space technology and developments may cause major societal changes.
- Area resources now on reserve status may be used as supplies become limited elsewhere.
- Energy developments may emphasize solar or fusion energy and fossil and nuclear fuels will be used less.
- No serious constraints on water and land availability may emerge to limit population growth.
- Hanford facilities may be dismantled, and agricultural and commercial-industrial developments take place with resulting population growth.

Population estimates for 11,990 were much more speculative than for 2990 and the following additional factors were also considered:

- Several civilizations and Hanford may have come and gone in the 9000 years between 2990 and 11,990.
- The civilization area may have reverted to a more primitive society or become a large metropolitan center.
- Space technology and capability may be even more an important factor than 2990.

Those credible factors that increased population size (and therefore, dose-to-population) were given greater weight because they provide a basis for a more conservative estimate of risk by tending, if anything, to overestimate the dose-to-population for 10,000 years from 1990.

RESULTS

Tables 1 and 2 list the population density for those grid sectors with the greatest density for the study areas centered at the 100-N and the 300 Areas respectively. Because the total population increases, the population density of each grid sector also increases, but rates of increase are not the same. Those sectors that include the Tri-Cities and Yakima have much higher population densities than the surrounding areas. Also, the Tri-Cities' rate of growth is higher than that of Yakima which can be seen by comparing sector SSE 30 - 40 (Tri-Cities) with Sector W 40 - 50 (Yakima) in Table 1. In the future, some sectors may not be as populated as predicted because as a sector becomes increasingly crowded, population spills over into neighboring sectors. However, such spillover does not affect the estimates of the total population within the study area.

TABLE 1. Comparison of Population Densities[a] Around N Reactor Site for Total Area and Most Populated Segments

Segment	1980	2000	2030	2990	11,990
NNE 30-40	138.3	167.1	190.3	300.5	1522.1
SE 30-40	136.3	187.7	213.7	641.0	2563.8
SSE 20-30	156.2	241.5	274.9	824.7	3299.0
SSE 30-40	460.0	586.8	633.9	1991.7	7966.9
SSW 30-40	116.2	148.0	168.4	336.9	1347.5
SW 30-40	111.7	133.3	151.7	303.5	1214.0
WSW 40-50	104.9	125.5	142.9	285.8	1183.1
W 40-50	481.9	576.2	655.9	1311.9	5247.5
TOTAL AREA	43.6	55.0	62.6	145.9	583.4

(a) Persons per square mile.

TABLE 2. Comparison of Population Densities[a] Around 300 Area Site for Total Area and Most Population Segments

Segment	1980	1990	2000	2030	2990	11,990
ESE 40-50	185.3	199.3	208.3	237.1	474.3	1897.1
SE 10-20	446.2	535.0	581.1	661.5	1984.6	7938.3
SSE 10-20	723.5	846.6	910.7	1036.7	3110.2	12440.7
South 0-5	2313.5	2308.8[b]	2336.5	2660.0	5320.0	21280.0
South 5-10	1265.7	1333.9	1361.7	1550.2	4650.6	18602.4
South 30-40	159.2	175.8	190.4	216.7	433.5	1733.9
SSW 5-10	288.6	324.5	368.6	419.5	1258.6	5034.3
SW 5-10	123.9	148.2	351.0	399.5	1198.6	4794.3
West 30-40	112.0	123.7	134.0	152.6	305.1	1270.4
West 40-50	85.1	94.0	101.8	115.9	231.7	926.8
TOTAL AREA	34.3	39.9	44.1	50.2	118.3	473.1

(a) Persons per square mile
(b) Caused by a downward revision of an official TAZ prediction.

Tables 3 and 4 compare population levels and the percent change of the more populated sectors for the decades 1970 - 2000 for the study areas centered at 100-N and 300 Areas respectively.

The greatest rate of population change occurred between 1970 and 1980 for both study areas. The rate of growth is greater for those sectors that include the Tri-Cities. Around the 100-N Area (Table 3), sector SE 30-40 increases its rate of growth between 1980 and 1990, and decreases thereafter. Part of the increase is probably caused by population spillover from grid sector SSE 30-40. The same phenomenon occurs around the 300 Area (Table 4) for grid sector SE 10-20 and spillover from its neighbor SSE 10-20. All four of these grid sectors include the greater Tri-Cities area.

In terms of compass direction around the 100 N Area, SE and SSE dominate population concentrations. Population concentrations are influenced to a much smaller degree by Yakima and its surrounding agricultural areas (W and WSW). Around the 300 Area, ESE, SE, SSE, and S dominate.

TABLE 3. Grid Sectors with Highest Predicted Population Change[a] by Decade, 1970-2000 100 N Area Study Area

Segment	1970 Population	1980 Population	1980 % Change	1990 Population	1990 % Change	2000 Population	2000 % Change
NNE 30-40	16,257	18,996	16.9	20,994	10.5	22,964	9.4
SE 30-40	17,134	18,764	9.5	23,509	25.3	25,787	9.7
SSE 20-30	8,281	15,343	85.3	22,294	45.3	23,715	6.4
SSE 30-40	43,314	63,198	45.9	73,349	16.0	80,131	9.2
SSW 30-40	12,659	15,961	26.1	18,499	15.9	20,330	9.9
SW 30-40	13,105	15,342	17.1	16,914	10.2	18,317	8.2
WSW 40-50	17,140	18,534	8.1	20,481	10.5	22,179	8.3
W 40-50	76,408	85,146	11.4	94,031	10.4	101,811	8.3
TOTAL AREA	276,056	342,816	24.2	396,096	15.5	431,912	9.0

(a) Percent change over previous decade.

TABLE 4. Grid Sectors with Highest Predicted Population Change[a] by Decade, 1970-2000 300 N Area Study Area

Segment	1970 Population	1980 Population	1980 % Change	1990 Population	1990 % Change	2000 Population	2000 % Change
ESE 40-50	25,521	32,748	28.3	35,220	7.6	36,808	4.5
SE 10-20	23,606	26,280	11.3	31,513	19.9	34,227	8.6
SSE 10-20	24,365	42,612	74.9	49,862	17.0	53,640	7.6
South 0-5	6,452	11,336	75.7	11,308	-0.2[b]	11,449	1.2
South 5-10	16,014	18,606	16.2	19,608	5.4	20,017	2.1
South 30-40	11,357	21,868	92.6	24,157	10.5	26,159	8.3
SSW 5-10	2,825	4,243	50.2	5,770	12.4	5,418	13.6
SW 5-10	925	1,821	96.9	2,178	19.6	5,159	236.9
West 30-40	13,195	15,393	16.7	17,003	10.4	18,413	8.3
West 40-50	13,979	15,034	7.6	16,607	10.5	17,983	8.3
TOTAL AREA	195,474	269,361	37.8	313,423	16.4	346,096	10.4

(a) Percent change over previous decade.
(b) Caused by a revision of official TAZ prediction.

POPULATION FORECASTS AND DISTRIBUTIONS AROUND THE 100 N AREA

Tables 5 through 13 present population forecasts and distributions by grid sector for the study area around the 100 N Area. Based on the forecasting methodology used for this study, the population in this area is expected to increase from 342,816 in 1980 to 431,912 in 2000. In the year 11,990, the area's populations is estimated to be 4,582,424.

POPULATION FORECASTS AND DISTRIBUTIONS AROUND THE 300 AREA

Tables 14 through 23 summarize population estimates by grid sectors for the study area around the 300 Area. The population in this area is expected to rise from 269,361 in 1980 to 346,096 in 2000. In the year 11,990, the area's population is estimated to be 3,715,952.

TABLE 5. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 1970

	Interval in Miles						
Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	5	321	536	1900	7489	10251
NNE	0	5	307	751	16257	787	18107
NE	0	5	1209	948	1966	1182	5310
ENE	0	4	626	5045	822	853	7350
EAST	0	4	275	449	1733	672	3133
ESE	0	0	270	1106	479	162	2017
SE	0	0	17	845	17134	5820	23816
SSE	0	0	0	8281	43314	3944	55539
SOUTH	0	0	54	2400	1291	64	3809
SSW	0	0	166	1480	12659	701	15006
SW	0	0	422	3663	13105	2509	19699
WSW	0	79	308	927	5458	17140	23912
WEST	0	5	179	879	1380	76408	78851
WNW	0	5	464	786	682	1221	3158
NW	0	5	13	148	286	385	837
NNW	0	5	297	150	804	4010	5226
TOTAL	0	122	4928	28394	119270	123347	276061

TABLE 6. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 1980

	Interval in Miles						
Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	6	496	699	2481	8589	12271
NNE	0	6	405	981	18996	1041	21429
NE	0	7	1625	1273	2554	1678	7137
ENE	0	5	880	6017	1177	979	9058
EAST	0	5	352	597	2864	711	4529
ESE	0	0	346	1402	613	268	2629
SE	0	0	22	1128	18764	6761	26675
SSE	0	0	0	15343	63198	9031	87572
SOUTH	0	0	68	3544	1656	80	5348
SSW	0	0	208	1769	15961	745	18683
SW	0	0	488	3941	15342	2637	22408
WSW	0	80	369	974	6200	18534	26157
WEST	0	7	191	933	1479	85146	87756
WNW	0	7	616	896	821	1487	3827
NW	0	7	17	184	356	460	1024
NNW	0	6	552	196	982	4577	6313
TOTAL	0	136	6635	39877	153444	142724	342816

TABLE 7. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 1990

	Interval in Miles						
Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	7	548	772	2515	9488	13330
NNE	0	7	453	1083	20944	1171	23708
NE	0	8	1865	1461	2827	2058	8219
ENE	0	6	1090	7407	1438	1205	11146
EAST	0	6	455	764	3695	885	5805
ESE	0	0	447	1812	793	315	3367
SE	0	0	28	1324	23509	7624	32485
SSE	0	0	0	22294	73349	10618	106261
SOUTH	0	0	86	5074	2118	101	7379
SSW	0	0	264	2167	18499	778	21708
SW	0	0	585	4444	16914	2913	24856
WSW	0	81	449	1076	6849	20481	28936
WEST	0	8	211	1015	1617	94031	96882
WNW	0	8	675	949	843	1511	3986
NW	0	8	19	190	368	471	1056
NNW	0	7	610	217	1084	5054	6972
TOTAL	0	146	7785	52049	177412	158704	396096

TABLE 8. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 2000

	Interval in Miles						
Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	8	600	844	2751	10378	14581
NNE	0	8	497	1184	22964	1139	25792
NE	0	9	2062	1616	3095	2318	9100
ENE	0	7	1226	8345	1618	1357	12553
EAST	0	7	508	854	4124	988	6481
ESE	0	0	498	2021	885	340	3744
SE	0	0	31	1491	25787	8559	35868
SSE	0	0	0	23715	80131	11383	115229
SOUTH	0	0	97	5968	2424	114	8603
SSW	0	0	298	2419	20330	896	23943
SW	0	0	648	4843	18317	3154	26962
WSW	0	82	504	1166	7418	22179	31349
WEST	0	9	229	1106	1737	101811	104892
WNW	0	9	731	993	861	1527	4121
NW	0	9	21	195	378	478	1081
NNW	0	8	667	238	1185	5515	7613
TOTAL	0	156	8617	56998	194005	172136	431912

TABLE 9. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 2010

Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	9	643	905	2950	11128	15635
NNE	0	9	533	1270	24623	1221	27656
NE	0	10	2211	1733	3319	2485	9758
ENE	0	8	1315	8948	1735	1455	13461
EAST	0	8	546	916	4422	1059	6951
ESE	0	0	534	2167	949	365	4015
SE	0	0	33	1599	27650	9177	38459
SSE	0	0	0	25428	85920	12205	123553
SOUTH	0	0	104	6399	2599	122	9224
SSW	0	0	320	2594	21799	961	25674
SW	0	0	695	5193	19640	3382	28910
WSW	0	88	540	1250	7954	23781	33613
WEST	0	10	246	1186	1862	109167	112471
WNW	0	10	784	1065	923	1637	4419
NW	0	10	23	209	405	513	1160
NNW	0	9	715	255	1271	5913	8163
TOTAL	0	171	9242	61117	208021	184571	463122

TABLE 10. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 2020

Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	9	676	951	3101	11697	16434
NNE	0	9	560	1335	25882	1283	29069
NE	0	11	2324	1822	3489	2612	10258
ENE	0	8	1382	9406	1824	1529	14149
EAST	0	8	574	963	4648	1113	7306
ESE	0	0	561	2278	998	384	4221
SE	0	0	35	1681	29064	9646	40426
SSE	0	0	0	26728	90314	12829	129871
SOUTH	0	0	109	6726	2732	128	9695
SSW	0	0	336	2727	22914	1010	26987
SW	0	0	731	5459	20644	3555	30389
WSW	0	93	568	1314	8361	24997	35333
WEST	0	11	259	1247	1957	114750	118224
WNW	0	11	824	1119	970	1721	4645
NW	0	11	24	220	426	539	1220
NNW	0	9	752	268	1336	6215	8580
TOTAL	0	180	9715	64244	218660	194008	486807

TABLE 11. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 2030

Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	9	683	961	3132	11814	16599
NNE	0	9	566	1348	26142	1296	29361
NE	0	11	2347	1840	3524	2638	10360
ENE	0	8	1396	9500	1842	1544	14290
EAST	0	8	580	973	4695	1124	7380
ESE	0	0	567	2301	1008	388	4264
SE	0	0	35	1698	29356	9734	40832
SSE	0	0	0	26996	91221	12958	131175
SOUTH	0	0	110	6794	2759	129	9792
SSW	0	0	339	2754	23144	1020	27257
SW	0	0	738	5514	20851	3591	30694
WSW	0	94	574	1327	8445	25248	35688
WEST	0	11	262	1260	1977	115902	119412
WNW	0	11	832	1130	980	1738	4691
NW	0	11	24	222	430	544	1231
NNW	0	9	760	271	1349	6277	8666
TOTAL	0	181	9813	64889	220855	195954	491692

TABLE 12. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 2990

Compass Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	10	726	1021	3328	12552	17637
NNE	0	10	601	1432	27776	1377	31196
NE	0	12	2494	1955	3744	2803	11008
ENE	0	9	1483	10094	1957	1641	15184
EAST	0	9	616	1034	4988	1194	7841
ESE	0	0	602	2445	1071	412	4530
SE	0	0	37	1910	33026	10352	45325
SSE	0	0	0	30371	102624	14587	147573
SOUTH	0	0	117	7219	2931	137	10404
SSW	0	0	360	2926	24591	1084	28961
SW	0	0	784	5859	22154	3815	32612
WSW	0	100	610	1410	8973	26826	37919
WEST	0	12	278	1339	2101	123146	126876
WNW	0	12	774	1291	1941	1847	4985
NW	0	12	26	236	457	578	1309
NNW	0	10	808	288	1433	6669	9208
TOTAL	0	196	10426	70740	242195	209011	532568

TABLE 13. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 2990

Compass Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	18	1366	1922	6264	23628	33198
NNE	0	18	1132	2696	52284	2592	58722
NE	0	22	4694	3680	7048	5276	20720
ENE	0	16	2792	19000	3684	3088	28580
EAST	0	16	1160	1946	9390	2248	14760
ESE	0	0	1134	4602	2016	776	8528
SE	0	0	70	5094	88068	19486	112718
SSE	0	0	0	80988	273663	38874	393525
SOUTH	0	0	220	13588	5518	258	19584
SSW	0	0	678	5508	46288	2040	54514
SW	0	0	1476	11028	41702	7148	61390
WSW	0	188	1148	2654	16890	50496	71376
WEST	0	22	524	2520	3954	231804	238824
WNW	0	22	1664	2260	1960	3476	9382
NW	0	22	48	444	860	1088	2462
NNW	0	9	1520	542	2698	12554	17323
TOTAL	0	353	19626	158472	562287	404868	1145606

TABLE 14. Distribution of Population In 50 Mile Radius of 100 N Area By Population Grid Sector for the Year 11990

Compass Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	72	5464	7688	25056	94512	132792
NNE	0	72	4528	10784	209136	10368	234888
NE	0	88	18776	14720	28192	21104	82880
ENE	0	064	4640	7784	37560	8992	59040
EAST	0	0	4536	18408	8064	3104	34112
ESE	0	0	280	20376	352272	77944	450872
SE	0	0	0	323952	1094652	155496	1574100
SOUTH	0	0	880	54352	22072	1032	78336
SSW	0	0	2712	22032	185152	8160	218056
SW	0	0	5904	44112	166808	28736	245560
WSW	0	752	4592	10616	67560	201984	285504
WEST	0	88	2096	10080	15816	927216	955296
WNW	0	88	6656	9040	7840	13904	37528
NW	0	88	192	1776	3440	4352	9848
NNW	0	36	6080	2168	10792	50216	69292
TOTAL	0	1412	78504	633888	2249148	1619472	4582424

TABLE 15. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 1970

Compass Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	229	757	5419	1725	8130
NNE	17	200	436	528	1169	1896	4246
NE	38	200	709	1831	431	170	3379
ENE	88	201	304	145	460	151	1349
EAST	88	66	26	65	145	558	908
ESE	43	74	176	52	665	25521	26531
SE	83	279	23606	210	588	3671	28437
SSE	105	997	24365	97	592	3896	30052
SOUTH	6452	16014	396	44	11357	1375	35638
SSW	51	2825	200	44	416	526	4062
SW	95	925	1824	680	236	131	3891
WSW	6	352	985	4592	7994	519	14448
WEST	0	132	656	954	13195	13979	28916
WNW	0	0	0	570	1623	1909	4102
NW	0	0	0	87	222	381	690
NNW	0	0	0	19	34	642	695
TOTAL	7026	22265	53912	10675	44546	57050	195474

TABLE 16. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 1980

Compass Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	293	1038	6505	2251	10087
NNE	22	256	559	706	1662	2500	5705
NE	47	256	894	2977	581	240	4995
ENE	44	260	392	186	485	294	1661
EAST	48	71	33	107	316	959	1534
ESE	43	126	89	109	1449	32748	34564
SE	83	892	26280	269	1062	4684	33270
SSE	277	1880	42612	328	714	4207	50018
SOUTH	11336	18606	2138	55	21868	1596	55599
SSW	145	4243	418	55	891	2560	8312
SW	292	1821	2901	866	328	237	6445
WSW	69	341	1218	6123	9787	578	18116
WEST	0	128	823	1138	15393	15034	32516
WNW	0	0	0	690	1751	2026	4467
NW	0	0	0	90	355	452	897
NNW	0	0	0	25	44	1106	1175
TOTAL	12406	28880	78650	14762	63191	71472	269361

TABLE 17. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 1990

Interval in Miles

Compass Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	378	1299	7961	2486	12124
NNE	28	331	723	894	2042	2826	6844
NE	59	331	1155	3847	741	296	6429
ENE	61	335	507	241	593	327	2064
EAST	59	82	43	126	339	1028	1677
ESE	43	126	196	119	1554	35220	37168
SE	124	1975	31513	310	1148	5170	40240
SSE	324	3023	49862	369	788	4648	59014
SOUTH	11308	19608	4015	70	24157	1767	60925
SSW	245	4770	707	70	1035	2971	9798
SW	770	2178	4090	1098	373	273	8782
WSW	1100	2110	1741	7632	10837	641	24061
WEST	150	791	1043	1393	17003	16607	36987
WNW	0	0	0	853	1979	2226	5058
NW	0	0	0	91	392	471	954
NNW	0	0	0	28	48	1222	1298
TOTAL	14271	35660	95883	18440	70990	78179	313423

TABLE 18. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 2000

Interval in Miles

Compass Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	421	1459	8958	2734	13572
NNE	31	369	807	1002	2300	3114	7623
NE	65	396	1288	4292	830	334	7205
ENE	68	373	566	269	650	346	2272
EAST	67	120	48	136	353	1069	1793
ESE	44	151	127	124	1617	36808	38871
SE	148	2700	34227	382	1207	5593	44257
SSE	362	3784	53640	420	854	5033	64093
SOUTH	11449	20017	5396	79	26159	1910	65010
SSW	352	5418	1010	79	1079	3092	11030
SW	1651	5159	4831	1237	399	284	13561
WSW	2110	3120	2045	8561	11746	691	28273
WEST	300	1170	1175	1555	18413	17983	40596
WNW	0	0	0	954	2158	2400	5512
NW	0	0	0	92	429	487	1008
NNWO	0	0	0	31	52	1337	1420
TOTAL	16647	42777	105581	20672	77204	83215	346096

TABLE 19. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 2010

Interval in Miles

Compass Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	451	1564	9605	2932	14552
NNE	33	396	865	1074	2466	3339	8173
NE	70	425	1381	4602	890	358	7726
ENE	73	400	607	288	697	371	2436
EAST	72	129	51	146	379	1146	1923
ESE	47	162	136	133	1734	39467	41679
SE	159	2895	36700	410	1294	5997	47455
SSE	388	4057	57515	450	916	5397	68723
SOUTH	12276	21463	5786	85	28049	2048	69707
SSW	377	5809	1083	85	1157	3315	11826
SW	1770	5532	5180	1326	428	305	14541
WSW	2262	3345	2193	9180	12595	19282	43529
WEST	322	1255	1260	1667	19743	19282	5910
WNW	0	0	0	1023	2314	2573	5910
NW	0	0	0	99	460	522	1081
NNW	0	0	0	33	56	1434	1523
TOTAL	17894	45868	113208	22165	82783	89227	371100

TABLE 20. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 2020

Interval in Miles

Compass Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	474	1644	10096	3082	15296
NNE	35	416	909	1129	2592	3510	8591
NE	74	447	1452	4837	936	376	8122
ENE	77	420	638	303	733	390	2561
EAST	76	136	54	153	398	1205	2022
ESE	49	170	143	140	1823	41485	43810
SE	167	3043	38577	431	1360	6304	49882
SSE	408	4264	60456	473	963	5673	72237
SOUTH	12904	22561	6082	89	29483	2153	73272
SSW	396	6106	1138	89	1216	3485	12430
SW	1861	5815	5445	1394	450	321	15286
WSW	2378	3516	2305	9649	13239	779	31866
WEST	338	1319	1324	1752	20753	20268	45754
WNW	0	0	0	1075	2432	2705	6212
NW	0	0	0	104	484	549	1137
NNW	0	0	0	35	59	1507	1601
TOTAL	18763	48213	118997	23297	87017	93792	390079

TABLE 21. Distribution of Population In 50 Mile Radius of 300 N Area By Population Grid Sector for the Year 2030

Interval in Miles

Compass Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	479	1661	10197	3113	15450
NNE	35	420	918	1140	2618	3545	8676
NE	75	451	1467	4886	945	380	8204
ENE	78	424	644	306	740	394	2586
EAST	77	137	55	155	402	1217	2043
ESE	49	172	144	141	1841	41902	44249
SE	169	3074	38964	435	1374	6367	50383
SSE	412	4307	61063	478	973	5730	72963
SOUTH	13034	22788	6143	90	29779	2175	74009
SSW	400	6167	1149	90	1228	3520	12554
SW	1880	5873	5500	1408	455	324	15440
WSW	2402	3551	2328	9746	13372	787	32186
WEST	341	1332	1337	1770	20961	20471	46212
WNW	0	0	0	1086	2456	2732	6274
NW	0	0	0	105	489	555	1149
NNW	0	0	0	35	60	1522	1617
TOTAL	18952	48696	1201911	23532	87890	94732	393995

TABLE 22. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 2090

Interval in Miles

Compass Direction	0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	509	1765	10834	3308	16416
NNE	37	446	975	1211	2782	3767	9218
NE	80	479	1559	5191	1004	404	8717
ENE	83	451	684	325	786	419	2748
EAST	82	146	58	165	427	1293	2171
ESE	52	183	153	150	1956	44521	47015
SE	180	3266	43835	462	1460	6765	55968
SSE	438	4576	68696	508	1034	6088	81340
SOUTH	13849	25637	6911	96	31640	2311	80444
SSW	425	6938	1221	96	1305	3740	13725
SW	1998	6607	5844	1496	483	344	16772
WSW	2552	3773	2474	10355	14208	836	34196
WEST	362	1415	1421	1881	22271	21750	49100
WNW	0	0	0	1154	2610	2903	6667
NW	0	0	0	112	520	590	1222
NNW	0	0	0	37	64	1617	1718
TOTAL	20138	53917	134340	25004	93384	100656	427439

TABLE 23. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 2990

Compass Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	479	1661	10197	3113	15450
NNE	70	840	1836	2280	5236	7090	17352
NE	150	902	2934	9772	1890	760	16408
ENE	156	848	1288	612	1480	788	5172
EAST	154	274	110	310	804	2434	4086
ESE	98	344	288	282	3682	83804	88498
SE	338	6148	116892	870	2748	12734	139730
SSE	824	8614	183189	956	1946	11460	206989
SOUTH	16068	68364	18429	180	59558	4350	176949
SSW	800	18501	2298	180	2456	7040	31275
SW	3760	17619	11000	2816	910	648	36753
WSW	4804	7102	4656	19492	26744	1574	64372
WEST	682	2664	2674	3540	41922	40942	92424
WNW	0	0	0	2172	4912	5464	12548
NW	0	0	0	210	978	110	2298
NNW	0	0	0	70	120	3044	3234
TOTAL	37904	132220	346552	47064	175780	189486	928988

TABLE 24. Distribution of Population In 50 Mile Radius of 300 Area By Population Grid Sector for the Year 11990

Compass Direction	Interval in Miles 0-5	5-10	10-20	20-30	30-40	40-50	Total
NORTH	0	0	3832	13288	81576	24904	123600
NNE	280	3360	7344	9120	20944	28360	69408
NE	600	3608	11736	39088	7560	3040	65632
ENE	624	3392	5152	2448	5920	3152	20688
EAST	626	1096	440	1240	3216	9736	16344
ESE	392	1376	1152	1128	14728	335216	353992
SE	1352	24592	467568	3480	10992	50936	558920
SSE	3296	34456	732756	3824	7784	45840	827956
SOUTH	104272	273456	73716	720	238232	17400	707796
SSW	3200	74004	9192	720	9824	28160	125100
SW	15040	70476	44000	11264	3640	2592	147012
WSW	19216	28408	18624	77968	106976	6296	257488
WEST	2728	10656	10696	14260	167688	163768	369696
WNW	0	0	0	8688	19648	21856	50192
NW	0	0	0	840	3912	4440	9192
NNW	0	0	0	280	480	12176	12936
TOTAL	151616	528880	1386208	188256	703120	757872	3715952

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