Volume 5-Chapter 1

HUMAN POPULATIONS

Minnesota Environmental Quality Board
Regional Copper-Nickel Study
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REGIONAL COPPER-NICKEL STUDY REPORT OUTLINE

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A NOTE ABOUT UNITS

This report, which in total covers some 36 chapters in 5 volumes, is both international and interdisciplinary in scope. As a result, the problem of an appropriate and consistent choice of units of measure for use throughout the entire report proved insurmountable. Instead, most sections use the system of units judged most common in the science or profession under discussion. However, interdisciplinary tie-ins complicated this simple objective, and resulted in the use of a mix of units in many sections. A few specific comments will hopefully aid the reader in coping with the resulting melange (which is a reflection of the international multiplicity of measurement systems):

1) Where reasonable, an effort has been made to use the metric system (meters, kilograms, kilowatt-hours, etc.) of units which is widely used in the physical and biological sciences, and is slowly becoming accepted in the United States.

2) In several areas, notably engineering discussions, the use of many English units (feet, pounds, BTU's, etc.) is retained in the belief that this will better serve most readers.

3) Notable among the units used to promote the metric system is the metric ton, which consists of 2,205 pounds and is abbreviated as mt. The metric ton (1,000 kilograms) is roughly 10% larger (10.25%) than the common or short ton (st) of 2,000 pounds. The metric ton is quite comparable to the long ton (2,240 pounds) commonly used in the iron ore industry. (Strictly speaking, pounds and kilograms are totally different animals, but since this report is not concerned with mining in outer space away from the earth's surface, the distinction is purely academic and of no practical importance here).

4) The hectare is a unit of area in the metric system which will be encountered throughout this report. It represents the area of a square, 100 meters on a side (10,000 m^2), and is roughly equivalent to 2½ acres (actually 2.4710 acres). Thus, one square mile, which consists of 640 acres, contains some 259 hectares.

5) Where electrical energy is converted to thermal units, a conversion factor of 10,500 BTU/kWH is used. This means that the energy lost to waste heat in a central power plant is included, assuming a generating efficiency of 32.5%.

The attached table includes conversion factors for some common units used in this report. Hopefully, with these aids and a bit of patience, the reader will succeed in mastering the transitions between measurement systems that a full reading of this report requires. Be comforted by the fact that measurements of time are the same in all systems, and that all economic units are expressed in terms of United States dollars, eliminating the need to convert from British Pounds, Rands, Yen, Kawachas, Rubles, and so forth!

<u>Conversions for Common Metric Units Used in the Copper-Nickel Reports</u>

1 meter (m)	=	3.28 feet = 1.094 yards
1 centimeter (cm)	=	0.3937 inches
1 kilometer (km)	=	0.621 miles
1 hectare (ha)	=	10,000 sq. meters = 2.471 acres
1 square meter (m^2)	=	10.764 sq. feet = 1.196 sq. yards
1 square kilometer (km^2)	=	100 hectares = 0.386 sq. miles
1 gram (g)	=	0.037 oz. (avoir.) = 0.0322 Troy oz.
1 kilogram (kg)	=	2.205 pounds
1 metric ton (mt)	=	1,000 kilograms = 0.984 long tons = 1.1025 short tons
1 cubic meter (m^3)	=	1.308 yd^3 = 35.315 ft^3
1 liter (l)	=	0.264 U.S. gallons
1 liter/minute (l/min)	=	0.264 U.S. gallons/minute = 0.00117 acre-feet/day
1 kilometer/hour (km/hr)	=	0.621 miles/hour
1 kilowatt-hour (kWH)	=	10,500 BTU (for production of electricity at 32.5% conversion efficiency)
degrees Celsius (^oC)	=	(5/9)(degrees Fahrenheit -32)

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1.1 INTRODUCTION AND SUMMARY

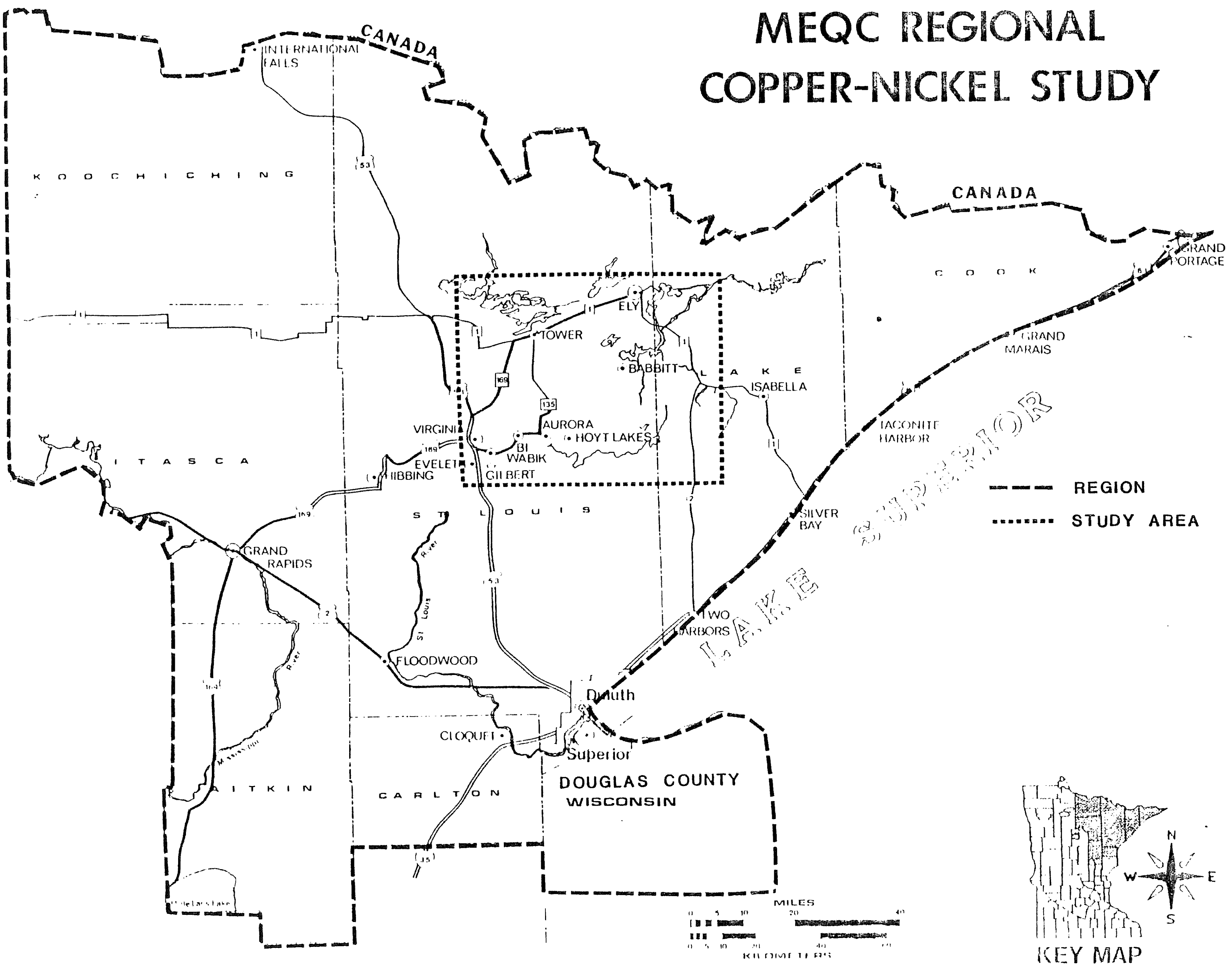
Should copper-nickel mining develop, it may cause change in the Study Area population and its age distribution. These changes would come through the movement of people and resulting changes in the concentration of people in different age groups. Population change would affect local government transportation, housing, land use, schools, and business development. For example, many public and private services are structured according to age groups. Children and young adults need schools. Families require housing which, in turn, requires streets and utilities. Older people require more medical care and special housing, such as nursing homes.

Figure 1 is a map of two areas: the "Study Area" which surrounds the known copper-nickel bearing Duluth gabbro and the large region which is composed of seven Minnesota counties plus Douglas County, Wisconsin. The majority of the impact analysis is in the Study Area with some consideration being given to the larger region.

Figure 1

In view of these potential implications for copper-nickel development, this chapter examines the population changes which may occur. Population characteristics examined include population size and its age composition. Changes in these characteristics are related to the timing and magnitude of copper-nickel development. At this time, it is not possible to predict just when and how fast copper-nickel development will proceed, therefore, alternative hypothetical development scenarios are evaluated for their potential impacts (Volume 2-Chapter

FIGURE 1



MEQC REGIONAL
COPPER-NICKEL STUDY
CANADA
INTERNATIONAL FALLS
KOOCHICHING
CANADA
GRAND PORTAGE
COOK
GRAND MARAIS
ELY
TOWER
BABBITT
LAKE
ISABELLA
AURORA
HOYT LAKES
WABIK
GILBERT
HIBBING
ITASCA
ST LOUIS
TACONITE HARBOR
SILVER BAY
REGION
STUDY AREA
GRAND RAPIDS
LAKE SUPERIOR
TWO HARBORS
FLOODWOOD
Duluth
CLOQUET
Superior
DOUGLAS COUNTY
WISCONSIN
AITKIN
CARLTON
MILES
KILOMETERS
KEY MAP
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W
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5). The methodology and key assumptions used in obtaining these results are also reviewed.

The Study Area baseline population, without copper-nickel development, is expected to peak in the late 1980s at about 55,000 persons and decline thereafter as a result of anticipated increase in labor productivity, particularly in the taconite industry. Increased labor productivity would require fewer employees to produce projected output levels. By 1995, Study Area population is projected to return to its 1970 level, about 49,000 persons.

Computer simulated demographic projections of regional population impacts likely to occur as a result of copper-nickel development indicate that, under the assumptions incorporated in the model, there will be significant population growth within the Study Area. The increase in Study Area population could range from 13,600 to 18,000 persons ten years after the beginning of production of a single large integrated (mine, mill, smelter and refineries) copper-nickel operation. This would amount to 27 to 36 percent of projected Study Area baseline population for that point in time, 1995. The copper-nickel related population growth will serve to make the Study Area population as a whole younger than the baseline population, should significant development not occur in the region.

Multiple operation development has the potential for extremely rapid population growth in the Study Area. Computer simulation indicates that with four fully integrated copper-nickel operations, the Study Area population could double by the year 1995, ten years after the first of the operations begins production. A scenario of two fully integrated operations would negate the projected downturn in Study Area baseline population and provide significant growth in the region as well.

1.2 REGIONAL DEMOGRAPHIC CHARACTERISTICS

1.2.1 Past Population Conditions

1.2.1.1 Trends--The historical population fluctuations in the Iron Range and northeastern Minnesota have been well-documented. These "boom/bust" cycles are typical of a resource extraction-based economy which has been and remains largely dependent on the availability and economic viabilty of ferrous ores and timber.

Like the Arrowhead Region, the Study Area communities experienced rapid early growth between 1890 and 1921, followed by periods of stagnation or decline until iron demands, precipitated by World War II, resulted in a short period of renewed growth (Table 1). With the depletion of natural iron ores (hematite) and a forest products industry weakened by increased scarcity of prime timber, an overall population decline ensued during the post war period. Concurrently, Minnesota population as a whole increased. The twin catalysts of large-scale taconite development and the phenomenal post war increase in birth rate reversed this trend for most of the Range communities during the 1950s. Significantly, however, Ely and Eveleth on the East Range continued to decline, although at reduced rates.

Table 1

The period from 1950 to 1960 was characterized by unequal distribution of growth within the Arrowhead Region and the East Range within the Study Area.

A similar picture of uneven distribution of population change is evident in the 1960-1970 population data, although a general decline for the Arrowhead Region is mirrored by similar declines at the subregional and community levels. The

Table 1. Population changes, 1940-1970.

PLACE	1940	1950	1940-1950 CHANGE IN%	1960	1950-1960 CHANGE IN%	1970	1960-1970 CHANGE IN%
Minnesota	2,792,000	2,982,483	+ 6.8	3,413,864	+14.5	3,804,971	+11.5
Arrowhead Region[a]	308,906	305,885	- 1.0	344,957	+12.8	329,603	- 4.5
Koochiching County	16,930	16,910	- 0.1	18,190	+ 7.6	17,131	- 5.8
Itasca County	32,996	33,321	+ 1.0	38,006	+14.1	35,530	- 6.5
Aitkin County	17,865	14,327	-19.8	12,162	-15.1	11,403	- 6.2
Carlton County	24,212	24,584	+ 1.5	27,932	+13.6	28,072	+ 0.5
Cook County	3,030	2,900	- 4.3	3,377	+16.4	3,423	+ 1.4
Lake County	6,956	7,781	+11.9	13,702	+76.1	13,351	- 2.6
St. Louis County	206,917	206,062	- 0.4	231,588	+12.4	220,693	- 4.7
St. Louis County, excl. Duluth	105,852	101,551	- 4.0	124,704	+22.8	120,115	- 3.8
Duluth, City of	101,065	104,511	+ 3.4	106,884	+ 2.3	100,578	- 5.9
Virginia, City of	12,264	12,486	+ 1.8	14,034	+12.4	12,450	-11.3
Eveleth, City of	6,887	5,872	-14.7	5,721	- 2.6	4,721	-17.5
Gilbert, City of	2,504	2,247	-10.3	2,591	+15.3	2,287	-11.7
Biwabik, City of	1,304	1,245	- 4.5	1,836	+47.5	1,483	-19.2
Aurora, City of	1,528	1,371	-10.3	2,799	+104.2	2,531	- 9.6
Hoyt Lakes, City of	27	20	-25.9	3,186	+15,830.0	3,634	+14.1
Babbitt, City of	118	117	- 0.8	2,587	+2,111.1	3,076	+18.9
Ely, City of	5,970	5,474	- 8.3	5,438	- .7	4,904	- 9.8

SOURCE: U.S. Bureau of Census, 1940-1970.

[a]Koochiching, Itasca, Aitkin, Carlton, Cook, Lake, and St. Louis counties.

population of Babbitt, Hoyt Lakes, and several of the suburban townships increased at a rate well above the state and national averages. This growth can be reasonably attributed to the localized prosperity brought about by the rapid development of the taconite facilities at Babbitt and Hoyt Lakes and the suburbanization in nearby townships. Population decreases in the rest of the area were due to a decreasing birthrate and outmigration, particularly in certain age groups.

At the onset of the 1970s, the general decline of the Iron Range was predicted to continue. Population projections were radically altered, however, when announcements of major taconite expansions were made by several Iron Range mining companies. These expansions were predicted to increase mining employment by over 4,000 workers, with an increase of over 8,000 temporary construction jobs.

Population changes for the eight Study Area communities have occurred in disparate patterns since 1970 in terms of direction and rates of change (Table 1). While all of the towns are dependent on a resource based economy, the differentiation caused by the presence or absence of taconite mining, the rate of decline of the natural iron ore and timber industries, and the effects of a regional business and service hierarchy have resulted in many local variations of population change. In looking at these communities, no one population change factor can be separated out, except in the case of the area's two new towns, Babbitt and Hoyt Lakes, whose origin, sustenance, and growth have depended almost exclusively on the taconite industry. Population change in rural areas with resource-based economies is almost exclusively the product of changes in employment opportunity.

Another critical growth factor for several of the communities is the availability of land suitable for development. In a number of towns--especially Virginia, Eveleth, Biwabik, and Gilbert--room for expansion within present corporate boundaries is limited or nonexistent due either to existing development or to direct and indirect encroachment on potential sites by active mining. Several of these towns are like islands in appearance, surrounded by vast mine pits and overburden dumps. More favorable conditions for growing room exist presently in Hoyt Lakes, Babbitt, and Ely.

1.2.1.2 Age Structure--Basic demographic features of Study Area communities--in this case, age structure--have often been radically altered by economic "boom and bust" cycles. These "boom" cycles were sparked by the openings of new mining operations, expansion or revitalization of existing operations, or accelerated demand for a mineral product. Cessation or diminution of an important base industry (e.g. forestry or hematite mining) has resulted in "bust" cycles or recessions. With this economic volatility, a community's age structure can be fundamentally altered within ten years. In light of this situation, an analysis of the area's age structure for a 20-year period is sufficient only to develop generalized commentary.

Between the three census dates (1950, 1960, 1970), the eight Study Area communities profiled in this report show a continuing trend toward an aging population with little mitigation from the influx of newcomers. Other communities in the Iron Range, however, have undergone a definite rejuvenation as a younger working force with young families has responded to the expanded employment opportunities provided by taconite development.

The different rates and circumstances of population change for each of the towns has created a marked difference in their age structures as indicated by their dependency ratios shown in Table 2. The dependency ratio relates the percentage of people over 65 and under 20 to that of the supporting ages--20 to 64 (thus, a dependency ratio of 75 means there are 75 people over 65 and under 20 for every 100 who are 20 to 64). Ely and Eveleth, for example, had the lowest number of inhabitants under age 20 per 100 working age persons (64), and Hoyt Lakes had the highest number of inhabitants in this group (115). Concurrently, more elderly persons per 100 persons aged 20 to 64 resided in Ely, Eveleth, and Virginia than the other towns (29, 34, and 30, respectively).

Table 2

These differences have substantial ramifications for a town, requiring either an orientation toward providing higher levels of services uniquely required by youth (schools, recreational facilities) or the elderly (nursing home and medical care, public transportation, etc.) and concommitant municipal expenditures. The presence of higher-than-average numbers of youth or elderly can affect the ability of a town, to respond adequately and in a timely manner to the additional demands for goods and services created by a rapid influx of newcomers composed largely of young adults or young families. This situation has developed in the Range to some degree with recent taconite plant expansions, and could be exacerbated by copper-nickel development if adequate planning and preparation does not occur.

Since a large portion of Babbitt and Hoyt Lakes' workforce is employed in a single industry with a low turnover rate, a significant turnover of the population in these communities is not occuring. This means that as these communities mature there will be a steady reduction of the "minors" age group with a corresponding decrease in the dependancy ration for this category. This condition can already be seen in these communities by their declining school enrollments.

Table 2. Study Area, county, and state dependency ratios.

	MINORS[a]			AGED[b]			COMBINED[c]		
	1950	1960	1970	1950	1960	1970	1950	1960	1970
State	61	81	82	16	21	22	77	102	104
St. Louis Co.	55	79	79	17	23	24	72	102	101
Aurora	56	83	76	17	14	13	73	97	89
Babbitt	--	131	110	--	2	2	--	132	111
Biwabik	55	78	78	21	21	24	76	98	102
Ely	54	64	64	13	21	29	67	85	93
Eveleth	52	66	64	21	30	32	73	96	96
Gilbert	53	84	76	18	27	19	71	112	95
Hoyt Lakes	--	121	115	--	1	2	--	123	117
Virginia	49	72	67	18	27	30	67	99	97

SOURCE: U.S. Bureau of Census, 1950-1970.

[a] $\frac{\text{Persons aged 0-19}}{\text{persons aged 20-64}}$

[b] $\frac{\text{Persons aged 65+}}{\text{persons aged 20-64}}$

[c] $\frac{\text{Persons aged 0-19 + 65+}}{\text{persons aged 20-64}}$

1.2.2 Projected Population Without Copper-Nickel Development

1.2.2.1 Methodology and Assumptions behind SIMLAB Population Projections--Changes in demographic characteristics were forecast for the Copper-Nickel Study using the University of Minnesota Regional Development Simulation Laboratory (SIMLAB). This is a computer based regional economic-demographic model which allows the user to forecast the effects of alternative assumptions on the course of future regional development. The model is called a simulation model because it forecasts the effects of hypothetical situations or scenarios supplied by the user. The model consists primarily of mathematical expressions representing regional inter-industry linkages and relationships between production by regional industries and their national and regional markets, production per worker, employment, earnings, labor force, and population (Volume 5-Chapter 15). The computer simulation model used for projecting population changes is not a causal explanation of population changes. Rather, it is an accounting system for the effects of the assumptions just discussed. If the assumptions are accurate, then projections made using the simulation approach will be accurate.

The principal assumption made in the SIMLAB population projections is that regional labor force and population change in response to job opportunities created by copper-nickel development. Other assumptions are made about changes in birth rates, death rates, and other demographic characteristics which are calculated using information from the 1970 Census (U.S. Department of Commerce 1972) the Minnesota State Demographer (personal communication, 1978) and the Minnesota Department of Health (personal communication, 1978, based on a special computer run). In the SIMLAB model these assumptions are taken into account as outside influences which are not determined by the copper-nickel development, but which have a role in determining what the development effects may be.

Base Year Regional Population by Age and Sex--The SIMLAB model projects future developments in regional population characteristics as changes from the characteristics of the regional population in the base year 1970. These characteristics, particularly age-sex composition, are important during the initial part of computer simulation of the period under study in determining births, deaths, and size of the regional labor force. Gradually, the importance of initial characteristics diminishes as population composition changes because of the joint effects of births, deaths, and migration due to economic opportunities associated with a changing regional economy. For the Copper-Nickel Study, the 1970 base year population by age and sex is from the 1970 Census (U.S. Department of Commerce, 1972-1).

Regional Birth Rate--The regional birth rate is the number of births per 1,000 females per year at each age level between 14 and 50 years as reported for the Minnesota Arrowhead Region by the Minnesota Department of Health (personal communication). Each year during the computer simulation run the number of births is added to the regional population starting with the base year population.

Regional Death Rate--The regional death rate is the number of persons in each age-sex class who are expected to die each year as reported by the Minnesota Department of Health (personal communication). The expected yearly number of deaths in each age-sex class is subtracted from the regional population in that age-sex category starting with the base year population.

Labor Force Participation Rate--The labor force participation rate is the proportion of the regional population age 16 and over which is either working or seeking work. Individual decisions concerning the value of leisure, the number of years of education, the number of children, early versus late retirement, and other work criteria determine the labor force participation rate. Over the period 1980 to 2000, it was assumed that the regional labor force participation rate will change to reflect increasing participation of young people and women in the labor force and, at the same time, to reflect increasing desire for leisure time by working-age males. Thus, participation rates by young people and women are assumed to increase while working-age male participation rates are assumed to decline slightly toward the end of the century. Study Area labor participation rates fluctuate above and below the age-sex specific statewide average rates, but generally the labor force participation in the Study Area is lower than the rates for the state as a whole.

In the simulation model, multiplication of the labor force participation rate in each age-sex category by the regional population in each age-sex category, after births and deaths are taken into account, gives an estimate of the size of the regional labor force available for work. This estimate is a critical part of socio-economic impact analysis. If employment increases due to copper-nickel development could be met from the existing population, then development would not cause a population increase. Short-term increases in the labor force could occur if job seekers inmigrate in anticipation of available work or if the required copper-nickel related skills and training is not available in the existing workforce.

<u>Occupational Distribution of the Regional Labor Force</u>--In the regional model, the labor force is divided into nine occupations as follows:

1) Professional, technical

2) Managerial, except farm

3) Sales workers

4) Clerical and kindred

5) Craftsmen and foremen

6) Operators

7) Laborers, except farm

8) Service workers

9) Farm

During simulation runs, the number of employees in each occupation required by each industry is calculated and compared with the number available in the regional labor force. If more are required than are available it is assumed that workers in that occupation inmigrate to take the job openings. If fewer are required than are available, it is assumed that some but not all the unemployed outmigrate in search of jobs.

Inmigrant Dependent Rate--Each inmigrant arriving in the region in response to job opportunities created by copper-nickel development is assumed to bring an estimated 1.75 dependent persons with him/her. The estimate of 1.75 dependent persons was arrived at by calibrating the SIMLAB model to 1977 Study Area population data from the Minnesota State Demographer (personal communication, 1978). Since inmigrants are assumed to be seeking work, each is considered to be a head-of-household. Thus, the inmigrant dependent rate is the average household size of inmigrants less one person (the inmigrating employee). The simulation model is constructed so that the spouse of the inmigrating employee is taken into account in calculating available labor force in the year following inmigration.

Inmigrant Age-Sex Distribution--The age-sex distribution of inmigrants is assumed to be the same as those who inmigrated to the region over the period 1965-1970.

This amounts to assuming that persons who inmigrate in response to opportunities created by copper-nickel development would have demographic characteristics similar to those who found the region sufficiently attractive to migrate there in the five years prior to the most recent census, in 1970 (U.S. Department of Commerce, 1972-2). The simulation model multiplies the total number of inmigrants by the inmigrant age-sex distribution in order to arrive at estimates of the number of inmigrants in each age-sex category. These are then added to the corresponding regional population age-sex categories. The simulation model assumes that no inmigrants die or give birth until the year after they arrive.

Worker Incommuting and Outcommuting--Incommuting can augment the Study Area labor force so that in effect, there can be more jobs in the Study Area than there are people living there who are available for work. Outcommuting makes the opposite case of more people than jobs possible. Both incommuting and outcommuting occur in the Study Area. As a result of a study of 1976 taconite industry employee commuting, all impact estimates for the Study Area are based on the assumption that 25 percent of the jobs created by copper-nickel development would be filled by commuters from outside the area.

Worker Productivity--Study Area population and employment are projected to increase until the mid-1980's as the taconite industry slowly expands. After 1986, even though taconite production will continue to expand, taconite employment will level off and begin to decline, given projected increases in taconite industry production per worker. The improved productivity per worker means fewer workers per ton of pellets produced because of new equipment, new mining technology, and/or mechanization of tasks now performed by workers.

The historical record shows that production per worker in the crude iron ore industry increased 214 percent between 1957 and 1970 (U.S. Department of Labor, 1977). This data includes but is not confined to, the existing taconite industry since some natural ores are also classified as crude ore and production of these is being phased out in Minnesota. Nonetheless, production per worker has doubled in less than 20 years in the taconite industry.

The SIMLAB assumption that taconite industry production per worker will increase by 80 percent in the thirty year period 1970-2000 is modest in comparison (U.S. Department of Labor, 1975). Indeed, it could be too modest because the taconite industry is highly energy intensive. If energy prices were to increase greatly, the taconite industry may respond by investing in energy-saving technology. This technology may also reduce labor requirements (Kakela, 1978)

Should changes in taconite worker productivity occur, then the projected 1995 Study Area population is about the same as it was in 1970. Population would peak in 1990 and then decline to 1995 because of the lagged population response to a mid-1980's peak in Study Area economic activity

1.2.2.2 Baseline Projection of Study Area Population without Copper-Nickel Development--Future development of the Study Area economy, in the absence of copper-nickel development, is highly dependent on the taconite (and other iron ores) industry. Projections of taconite expansion are shown in Table 3, based on industry estimates presented at the MPL certificate of need hearings (1977) and correspondence with taconite industry spokesmen.

Table 3

Productivity per worker is assumed to increase based on historic trends. Baseline projections without copper-nickel development are presented in Table 4.

Table 4

Table 3. Existing and potential taconite production capacities (by company), 1976-2000.

COMPANY	1976	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000
	TOTAL PRODUCTION CAPACITY (in million metric tons) PER YEAR																								
Within Study Area																									
U.S. Steel (MINNTAC)	12.75	12.75	12.75	18.87							?[b]			24.9											?
Reserve Mining	11.02																								?
Erie Mining	10.81																								?
Inland Steel			2.65			?[b]				5.3															?
Eveleth Taconite & Eveleth Expansion	3.1	6.1	?[b]	6.7						?							9.8								?
Jones & Laughlin										4.3															?
Hibbing Taconite (Biwabik Operations)																				?		5.1[a]			?
Outside Study Area																									
Hanna Mining (Butler & National Plants)	5.61	8.77				9.9	9.9	12.7	12.7	15.6		15.6	15.6		19.8										?
Hibbing Taconite		5.5	5.5	7.1	7.1	8.2																			?

SOURCE: Direct testimony and hearing transcripts from rehearing on Certificate of Need for Minnesota Power and Light, and United Power Association, 1977.

[a]Regional Copper-Nickel Study assumption that project could potentially occur. Hearing transcript indicates a potential 1985-87 start-up date. Company has more recently announced that the project has been indefinitely postponed.

[b]Indicates that the specific transition or start-up year has not been identified, but will generally be within one or two years of the year where a question mark appears.

Table 4. Regional Copper-Nickel Study Area baseline population and employment estimates.

YEAR	POPULATION	TOTAL EMPLOYMENT	IRON ORE EMPLOYMENT
1970	48,419	19,362	6,382
1977	51,194	24,334	7,752
1980	51,301	26,039	8,127
1981	51,579	26,660	8,257
1982	51,954	27,346	8,345
1983	52,523	28,027	8,435
1984	53,211	28,749	8,523
1985	54,396	29,581	8,601
1986	54,506	29,734	8,336
1987	54,950	29,982	8,080
1988	54,902	30,014	7,831
1989	54,622	29,874	7,590
1990	54,177	29,555	7,345
1995	49,611	27,056	5,234
2000	42,987	24,215	3,703

SOURCE: SIMLAB 1979.

Study Area population and employment is projected to increase until the mid-1980s as the taconite industry slowly expands. After 1986, even though taconite production will continue to expand, taconite employment will level off and begin to decline because projected increases in production per worker will require fewer workers per ton of ore produced. Production per worker may increase because of better equipment, improved mining technology, and/or mechanization of tasks now performed by workers.

By the year 1995, Study Area population is projected to be about equal to the 1970 population. However, it will be higher in 1990 because of the lingering effects of the mid-1980s peak in Study Area economic activity. Higher labor force participation rates expected at the end of the century make it possible to have a larger workforce than in 1970.

Population for Region III (without Douglas County, Wisconsin) as projected by the Office of the State Demographer shows a pattern similar to that of the Study Area (Table 5). Population is estimated to rise very slowly until 1985 and then decline to a level below the 1970 population by the year 2000. However, the population estimate for 1977, derived from a survey of Region III households (State Demographer 1978), indicates population growth in Region III substantially greater than previous projections.

Table 5

Figure 2 graphically presents the projections of baseline population as estimated by SIMLAB (Study Area) and the State Demographer (Region).

Figure 2

Table 5. Region III (without Douglas County, Wisconsin) baseline population estimates.

YEAR	POPULATION
1970	329,603
1975	331,146
1977*	337,000
1980	330,295
1985	332,554
1990	332,354
1995	330,206
2000	325,409

SOURCE: State Demographer 1975.

*1977 figure based on estimate from household survey conducted by the State Demographer's Office in 1977.

FIGURE 2

BASELINE POPULATION PROJECTIONS

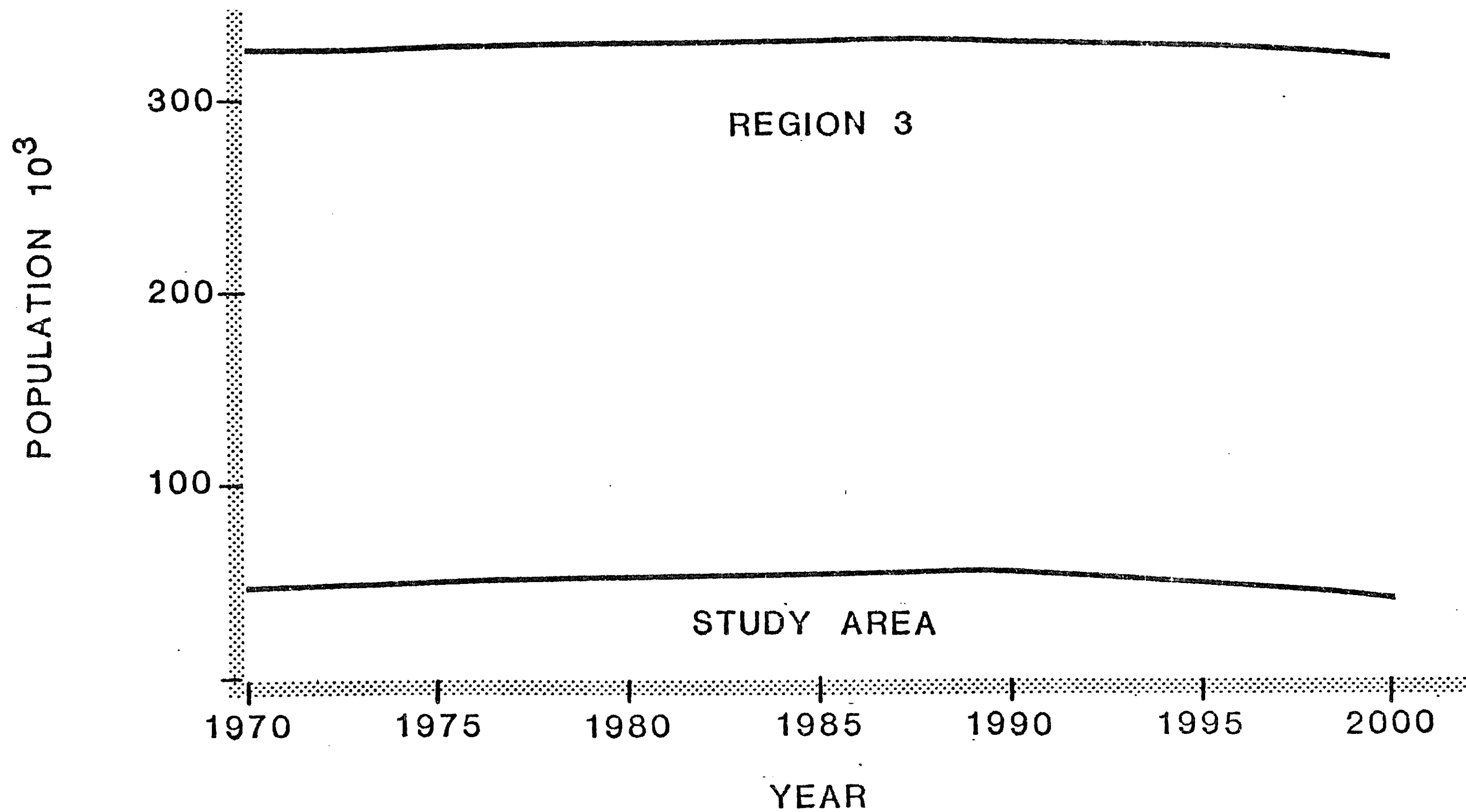


Figure 3 shows the age structure of the baseline population for the Study Area and the Region (without Douglas County, Wisconsin) for 1977. It shows that both the Study Area and Region III populations are older than the state population as a whole.

Figure 3

Study Area copper-nickel development in the 1980s and 1990s will occur within the always-changing baseline economy. Thus, the effects of copper-nickel development must be measured against this moving background. The population changes due to potential copper-nickel development scenarios are presented relative to the baseline forecasts in section 1.4.

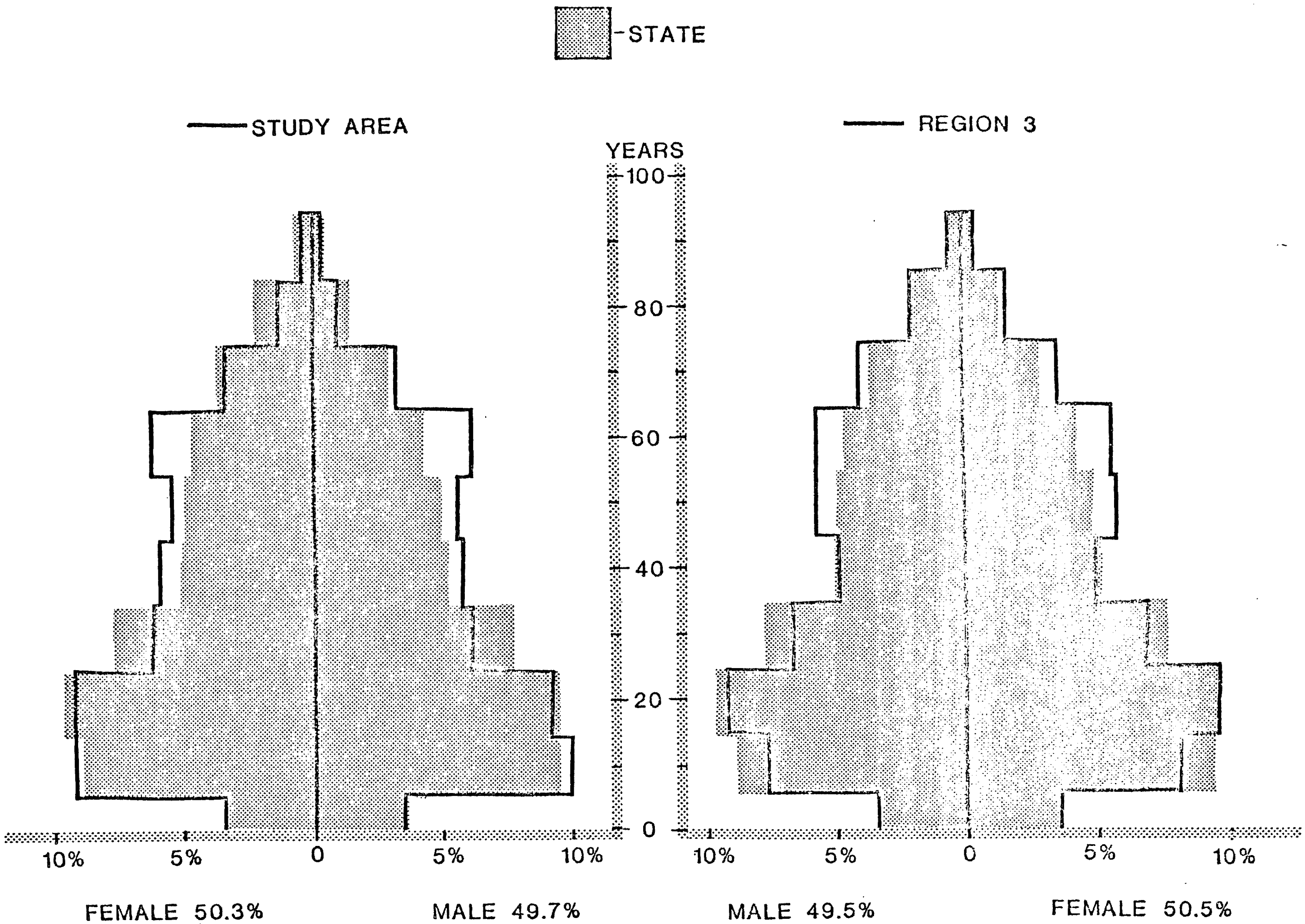
1.3 COPPER-NICKEL DEVELOPMENT SCENARIOS

A development scenario is an assumption about future copper-nickel development. There are a number of possible minesites being explored and evaluated by different firms. These minesites, if opened, would vary in profitability because of differing ore grades, management policy, capital investment, and ore accessibility. Profitability differences and different management views of the best time to risk a new venture suggests that the mines will be opened at different times. Thus, realistic alternative scenarios deal not only with the number of developments, but also their size and sequence of starting dates. Analysis of all possibilities is not feasible, therefore, a set of scenarios is selected to demonstrate the range of possible impacts.

In the analysis presented here, the scenarios are as follows. First, single mine development scenarios are presented. These consist of an open pit mine producing 20 million mtpy of ore, an underground mine producing 12.35 million mtpy of ore,

FIGURE 3

BASELINE POPULATION AGE STRUCTURE (1977)



and an open pit/underground combination mine producing 16.68 million mtpy of ore. All operations are assumed to include concentrating mills and smelter/refineries (Volume 2-Chapter 5). Each alternative complex is assumed to be the only development in the Study Area. Table 3 summarizes the major factors associated with the mine models which can effect regional population conditions.

Table 6

Second, forecast of population changes caused by multiple-mine combinations are presented. This set of scenarios (Table 10) generates forecasts representing a larger range of impacts. The estimated impacts on the Study Area population are presented in Tables 7 through 14. Industry and other economic factors underlying these impact forecasts and further discussion pertaining to regional socio-economic changes is presented in Volume 5-Chapter 15 of this report.

1.3.1 Use of Baseline Projections for Impact Analysis

Baseline projections of population characteristics that were presented in the previous section were made using assumptions concerning future regional development in the absence of copper-nickel development. Thus, the baseline projections provide a reference plane for impact estimates which are presented as deviations from the reference projections. The SIMLAB procedure for making the baseline projections is based on assumptions concerning the future expansion of the taconite industry (Volume 5-Chapter 5, section 5.5) and on historic trends in other socio-economic variables. The procedure for generating the impact estimates takes into account indirect and/or induced effects as well as the direct effects of copper-nickel development. The different categories of effects are defined below. Interpretation of SIMLAB output consists of direct comparison of baseline and development projections with any differences being interpreted as the impacts of development.

1.3.2 Interpretation of Direct, Indirect, and Induced Impacts

Direct impacts of copper-nickel development are defined to be employment and earnings at the mine/mill and smelter/refinery complex and purchases of supplies, materials, and services by the mining operation from the Study Area suppliers. SIMLAB forecasts of direct impacts are based on development models presented in Volume 2-Chapter 5. SIMLAB also forecasts indirect and induced impacts. Indirect impacts include increased employment and earnings in the Study Area industries selling goods and services to firms directly effected by the copper-nickel industry. Induced effects include increases in earnings and employment in Study Area industries selling goods and services to area households. Induced effects occur because of direct and indirect impacts on Study Area employment, earnings, and population.

Interpretation of the direct impacts depends on how the copper-nickel workers come to be employed there. If all come from outside the region to take copper-nickel employment, then they represent a net increase in area employment and earnings. They and their dependents also represent a net increase in the area population as well, provided there is no outmigration. If copper-nickel employment simply results in a redistribution of existing regional labor force with jobs vacated in other industries, then there are no direct employment or associated population impacts, only possible net increases in earnings. Or, if all copper-nickel jobs are filled from among the area unemployed, then there is a net direct increase in employment and earnings, but no net impact on population characteristics since no one moved into the region. In reality, events will be

Table 6. Summary of mine model economic factors.

	20,000,000 mtpy OPEN PIT SCENARIO	16,680,000 mtpy COMBINATION SCENARIO	12,350,000 mtpy UNDERGROUND SCENARIO
Employment			
Operation			
Peak	2,071	2,287	2,584
Length	27 yr	27 yr	26 yr
Payroll ($ million)	40.8	46.3	52.8
Average salary ($)	19,680	20,220	20,440
Construction			
Peak	2,547	2,307	1,800
Length	4 yr	5 yr	5 yr
Payroll ($ million)	62.4	56.5	44.1
Average salary ($)	24,500	24,500	24,500
Capital Investment			
Mine/Mill ($ million)	300.2	301.6	243.8
Smelter/Refinery ($ million)	324.2	324.2	324.2
Total ($ million)	624.4	625.8	568.0
Gross Output ($ million)[a]	285.1	285.1	285.1
Earnings ($ million)[a]	30.4	33.6	37.9
Operating Expenditures[b] ($ million)	56.1	58.7	61.5

[a]$1970, all other in 1977 terms.
[b]Other than employee compensation.

combinations of all three possible events, which is taken into account by the SIMLAB model. The model forecasts inmigration of new workers only if the existing regional labor force is not large enough to fill available openings. Available openings are forecast by occupation and compared with available workers by occupation so no special assumptions about occupational mobility are made. The key assumption is that all jobs are filled, by inmigration if necessary.

Once all jobs are filled, and inmigration, births, and deaths are estimated, the SIMLAB model estimates changes in demographic characteristics such as population and population age-sex distribution resulting from the inmigration.

1.3.3 Potential Impacts of Copper-Nickel Development

The Study Area population impacts due to copper-nickel development described here must be considered estimates of potential effects. The potential effects will not be realized until housing and essential public services become available, events which require public policy decisions that cannot be forecast. Similarly, employment impacts are estimates of potentials to the extent that public policy decisions concerning, for example, zoning and the environment, are required before development.

Potential impacts depend heavily on the development scenario assumed. In the following discussion, alternative scenarios are divided into two groups. One group consists of three alternative single mine/mill with smelter/refinery scenarios. The other group includes alternative multiple mine scenarios, some of which include smelter/refineries and some which do not.

1.3.4 A Single Mine/Mill Integrated With Smelter/Refinery

Three potential integrated mine/mill with smelter/refinery scenarios have been identified (Volume 2-Chapter 5). These are open pit, underground, and combination open pit/underground operations. Study Area impacts from these operations would result from both construction and operation of these mining enterprises.

1.3.4.1 Impacts from Construction--Construction of alternative fully integrated mining operations is assumed to commence in 1982. This maybe the earliest possible date given the time needed for planning and design and for review by appropriate government agencies. However, this assumption is not critical to the results presented here because, as can be seen in Table 4, the Study Area population will be fairly stable during the late 1980s in the absence of copper-nickel development. Relative to the stable baseline, copper-nickel development commencing anytime in the late 1980s would have nearly the same potential effects as those reported here.

Table 7

SIMLAB simulations of the potential effects from construction of each alternative fully integrated single mine operation are presented in Table 7. The different alternatives have different potential effects and the projected potential effects change from year to year during the construction phase. The construction phase lasts four years in the case of the open pit and combination operations and five years for the underground mine. Once initial site preparation is finished, the construction workforce would be increased, resulting in greater impacts than in the first year.

Greater impacts would occur after the first year of construction because the Study Area economy responds to the stimulus from construction with additional

Table 7. Copper-nickel development impacts on Study Area population for various construction scenarios.

BASELINE POPULATION		CONSTRUCTION IMPACTS[a]					
		Open Pit		Combination		Underground	
Year	Population	Total Pop. Impact	Percent of Baseline	Total Pop. Impact	Percent of Baseline	Total Pop. Impact	Percent of Baseline
1982	51,954	545	1.0	398	0.8	289	0.6
1983	53,523	2,673	5.1	927	1.8	532	1.0
1984	53,211	6,213	11.7	4,758	8.9	647	1.2
1985	54,396	6,407	11.8	5,887	10.8	3,143	5.8
1986	54,506	1,597	2.9	326	0.6	4,450	8.2

1985 BASELINE AGE STRUCTURE		PEAK CONSTRUCTION IMPACT AGE STRUCTURE					
		Open Pit (1984)		Combination (1985)		Underground (1986)	
Age	Population	Total Pop. Impact	Percent of Baseline	Total Pop. Impact	Percent of Baseline	Total Pop. Impact	Percent of Baseline
1-5	5,457	93	1.7	175	3.2	131	2.4
6-17	9,105	1,687	18.5	1,510	16.6	1,151	12.6
18-24	5,958	1,012	17.0	918	15.4	667	11.2
25-34	10,029	1,688	16.8	1,582	15.8	1,212	12.1
35-59	15,752	1,558	9.9	1,530	9.7	1,169	7.4
60-64	2,576	159	6.2	147	5.7	111	4.3
65+	5,519	16	0.3	25	0.5	9	0.2
TOTAL	54,396	6,213	11.4	5,887	10.8	4,450	8.2

SOURCE: SIMLAB 1979.

[a]All construction assumed to commence in 1982.

buildings, equipment and employees in those Study Area industries serving the construction industry and the households of construction workers. By the time the construction workforce reaches a peak in two years in the open pit scenario, four years in the underground scenario, or three years in the combination scenario, the potential population impact from construction is substantial. Also, significant differences occur in peak year construction impact among the three scenarios.

For all three alternatives, population impacts would be relatively small and would scarcely exceed the workforce at the copper-nickel site in the first year of construction. Workforce forecasts assuming present-day construction worker productivity are from Volume 2-Chapter 11. These estimates were then adjusted in SIMLAB to reflect the level of construction worker productivity expected to prevail at the time of construction. Resulting 1982 first-year construction workforce projections are 298 in the open pit scenario, 178 in the underground scenario, and 229 in the combination scenario.

The largest first year workforce would be employed in construction of the open pit mine. A relatively large first year workforce are employed in this scenario for stripping off overburden. As a result, first year effects on Study Area population are largest in the open pit scenario. The open pit mine in the combination scenario is much smaller, so fewer first-year workers are required for stripping. And, only a few workers are needed to begin the shaft for the underground part of the combination scenario. Thus, the effects from the combination scenario are smaller than in the open pit case. First-year effects are smallest in the underground senario because only a relatively small workforce is needed to begin the mine shaft.

After the first year, differences among the three alternative integrated scenarios persist because of differences in the magnitude and timing of construction activity. For example, construction in the open pit scenario has the largest peak impact because the scenario would require the largest expenditure and workforce in a single year. This would happen because the open pit scenario would require the largest and most expensive concentrating mill to process the largest volume of ore. Peak workforce forecasts are 2,545 workers in the open pit scenario in 1984, 1,987 workers in the underground scenario in 1986, and 2,050 workers in the combination scenario in 1985. Resulting peak year effects on Study Area population are shown in Table 7.

The mining scenarios assume that full-scale operation begins the year after construction is finished. During the transition period, the lingering effects of the construction activity mingle with the emerging impacts of mine operation. In the computer simulations, a clear picture of mine operation effects begins to emerge during the second year of full-scale operation. The analaysis of effects in the study resumes with the second year of mine operation.

1.3.4.2 Impact of Single Mine Operation--Table 8 shows potential Study Area population impacts for each of the three integrated mining scenarios in the second year of full-scale operation, as well as in 1990, 1995, and the year 2000. Impacts in the second year of operation represent the initial effects of mine operation. Forecasts of impacts in subsequent years are made because the Study Area economy is constantly changing and the role of copper-nickel mining in determining Study Area population and the overall level of employment changes as well.

Table 8

Table 8. Copper-nickel development impacts on Study Area population for various operation scenarios.

BASELINE POPULATION		OPERATION IMPACTS					
		Open Pit		Combination		Underground	
Year	Population	Total Pop. Impact	Percent of Baseline	Total Pop. Impact	Percent of Baseline	Total Pop. Impact	Percent of Baseline
1987	54,950	10,840	19.7	12,862	23.4	11,756	21.4
1990	54,177	12,336	22.8	14,546	26.8	14,481	26.7
1995	49,611	13,599	27.4	17,167	34.6	18,022	36.3
2000	42,987	11,581	26.9	15,000	34.9	17,089	39.8

1995 BASELINE AGE STRUCTURE		1995 OPERATION IMPACT AGE STRUCTURE					
		Open Pit		Combination		Underground	
Age	Population	Total Pop. Impact	Percent of Baseline	Total Pop. Impact	Percent of Baseline	Total Pop. Impact	Percent of Baseline
1-5	4,638	1,478	31.9	1,925	41.5	2,012	43.4
6-17	9,761	1,950	20.0	2,574	26.4	2,968	30.4
18-24	2,714	2,102	77.0	2,019	74.4	2,012	74.1
25-34	6,629	1,509	22.8	2,307	34.8	3,118	47.0
35-59	18,256	6,633	36.3	7,811	42.8	7,252	39.7
60-64	2,403	343	14.3	430	17.9	442	18.4
65+	5,210	67	1.3	101	1.9	128	2.5
TOTAL	49,611	13,599	26.9	17,167	34.9	18,022	39.8

SOURCE: SIMLAB 1979.

The second year of full-scale operation is assumed to be 1987 for the open pit and combination scenarios, and 1988 for the underground mine. Second-year workforce estimates are 2,162 (open pit), 2,685 (underground), and 2,387 (combination). With the largest workforce, the underground scenario would have the largest impact on Study Area population were it not for the projected decline in taconite employment between 1987 and 1988. The taconite industry has 249 fewer employed in 1988 (see Table 4) and the decline in taconite employment has negative effects on the Study Area population which partly offset the population impact of the underground copper-nickel operation. This trend persists until 1995.

During the second year of operation, the three scenarios have different impacts on the number of young children aged 0 to 5 and on the number of persons age 65 and over living in the Study Area. There are more additional young children projected for the open pit scenario because of the lingering effects of the construction phase peak. The combination mine, with the second largest peak impact during construction, has the second largest incremental effect on the number of young children.

1.3.4.3 Impacts From Single Mine Development on the Northeast Minnesota Arrowhead Region--Not all potential impacts would be confined to the Study Area because a number of industries serving the mining industry, as well as some retailing and service industries serving Study Area households, are located outside. In addition, there is the possibility that all potential impacts on the Study Area may not be realized because of the possible constraints to Study Area population expansion. Thus, there is a potential for impacts in the Arrowhead Region which surrounds the primary Study Area (Figure 1). A computer simulation with the fully integrated copper-nickel open pit scenario was made to generate information on the potential for impacts outside the primary Study Area (Table 9).

The larger region represented in Table 9 includes Douglas County, Wisconsin (Superior, Wisconsin), because it is economically integrated with the northeast Minnesota Arrowhead Region.

Table 9

As can be seen by comparing Table 9 with Table 8, impacts on the larger region are somewhat greater. This, as already indicated, is to be expected because some firms serving industry and household in the Study Area are located outside, in the larger region.

In 1987, copper-nickel impacts within the Study Area accounts for 52 percent of the total population impact in the Region as a whole, but by the year 2000 the Study Area accounts for 84 percent of the total population impact in the Region. This phenomenon of growing concentration of impact in the Study Area over time is seen for economic indicators as well (see Volume 5-Chapter 15), and can be explained by two factors. As time passes, more and more employees of the operation are expected to locate nearer to their place of work. This will tend to concentrate the population impacts. Also, more and more service industries will shift to the Study Area as it and the copper-nickel industry grow. This, too, will attract to the Study Area population which at one time would reside elsewhere in the Region.

1.3.5 Impacts From Multiple Mine Development

Copper-nickel mining may involve development and operation of more than one open pit, underground, or combination open pit/underground mine. Some of these

Table 9. Copper-nickel development impacts on Region III plus Douglas County, Wisconsin, population for the operation of the open pit scenario.

BASELINE POPULATION		OPERATION IMPACTS	
Year	Population	Total Population Impact	Percent of Baseline
1987	402,027	16,039	4.0
1990	406,474	14,858	3.7
1995	386,683	15,913	4.1
2000	341,091	13,455	3.9

1995 BASELINE AGE STRUCTURE		1995 OPERATION AGE STRUCTURE	
Age	Population	Total Population Impact	Percent of Baseline
1-5	38,605	1,681	4.3
6-17	75,433	2,267	3.0
18-24	28,111	2,101	7.5
25-34	56,463	1,508	2.7
35-59	130,869	7,891	6.0
60-64	15,032	396	2.6
65+	42,170	69	0.2
TOTAL	386,683	15,913	4.1

SOURCE: SIMLAB 1979.

operations could be fully integrated to include a smelter/refinery located within the Study Area. To estimate the potential effects of multiple mine development, four scenarios were evaluated using SIMLAB. Table 10 shows the kind of mine involved, whether a smelter/ refinery is assumed to be present, and the date on which production is assumed to begin. Other scenarios are possible, but the four selected serve to demonstrate the range of possible impacts.

Table 10

The scenarios are reasonable, given present knowledge about Minnesota and national resources, projected prices, and the growing concern for domestic sources of these primary metals. Minnesota's mineral resources represent 6 percent of the U.S. copper resource, 60 percent of the U.S. nickel resource, and 75 percent of the U.S. cobalt resource. By the projected start-up date of the late 1980s for a Minnesota copper-nickel operation, there will be no other domestic source of nickel or cobalt. Further, the demand for domestic copper is expected to outrun capacity in the very near future. Minnesota's resource is a viable alternative for closing the gap between domestic supply of these minerals and their projected domestic demands.

Impacts from construction of the first mining operation in each multiple mine scenario have been excluded from the following discussion. Construction impacts of the first operation in every case would be very nearly the same as impacts from construction of the single mining operations already discussed. Impacts from construction of mining operations <u>subsequent</u> to the first operation are included in the multiple mine impact estimates. This must be done because the SIMLAB model represents interactions in the Study Area economy which make it impossible to meaningfully separate the effects of operation of one mine while

Table 10. Some alternative multiple-mine scenarios.

ALTER-NATIVE	DESCRIPTION	START[a] PRODUCTION
I	Open pit mine/mill, no smelter/refinery in Study Area	1985
	Combination mine/mill, no smelter/refinery in Study Area	1987
	Underground mine/mill, no smelter/refinery in Study Area	1993
	Combination mine/mill, no smelter/refinery in Study Area	1996
II	Open pit mine/mill, with smelter/refinery in Study Area	1985
	Combination mine/mill, with smelter/refinery in Study Area	1986
	Underground mine/mill, with smelter/refinery in Study Area	1990
	Combination mine/mill, with smelter/refinery in Study Area	1993
III	Combination mine/mill, with smelter/refinery in Study Area	1987
	Underground mine/mill, no smelter/refinery in Study Area	1995
IV	Underground mine/mill, no smelter/refinery in Study Area	1990
	Combination mine/mill, no smelter/refinery in Study Area	1997

[a]Dates given do not reflect specific proposals but are for analysis purposes only.

another is under construction. Potential impacts of mine operation alone are represented by impact estimates after the last mine is in operation.

1.3.5.1 Alternative I: Four Mines Without Smelter/Refineries--Potential demographic impacts of four mines, with no smelter/refineries located in the Study Area, are shown in Table 11. All impact forecasts are for the year following mine start-up in order to allow time for adjustments in the Study Area economy.

Table 11

Data in Table 11 reveal that this scenario has potential for generating extreme changes in the Study Area population. For example, by the year 1997, the total population change due to copper-nickel mine development exceeds total population in the baseline. By the year 2000, the estimated potential impact is almost twice the baseline total.

The SIMLAB model may or may not be able to accurately forecast changes as extreme as those shown in Table 10 for the year 2000, but forecasts for 1994 and 1997 appear to be reasonable, based on comparison of projected taconite and copper-nickel employment and its relation to population. There is relatively little information available which can be used to test the validity of the impact forecasts, but the results of the four-mine simulations suggest that the SIMLAB impact forecasts are reasonable. In the year 1994, when the third mine is in operation (see Table 11), projected iron ores industry (taconite) employment is 6,440 persons and projected copper-nickel industry employment is about 5,660 persons (Volume 5-Chapter 15, Regional Economics). At this point, the forecast potential impact is 35,400 persons, somewhat less than the baseline population

Table 11. Copper-nickel development impacts on Study Area population for multiple mine alternative I.

BASELINE POPULATION		ALTERNATIVE IMPACTS	
Year	Population	Total Population Impact	Percent of Baseline
1986	54,506	9,303	17.1
1988	54,902	16,219	29.5
1994	50,728	35,403	69.8
1997	47,150	53,607	113.7
2000	42,987	73,603[a]	171.2[a]

199$ BASELINE AGE STRUCTURE		1994 ALTERNATIVE I AGE STRUCTURE	
Age	Population	Total Population Impact	Percent of Baseline
1-5	4,977	3,490	70.1
6-17	9,696	6,466	66.7
18-24	2,887	4,678	162.0
25-34	7,500	8,498	113.3
35-59	17,977	10,819	60.2
60-64	2,433	841	34.6
65+	5,258	611	11.6
TOTAL	50,728	35,403	69.8

SOURCE: SIMLAB 1979.

[a]SIMLAB output questionable, see page 24.

projection. In the baseline, the iron ores industry is the principal economic activity in the Study Area and it must support most of the population in the baseline scenario. In the development scenario, iron ores and copper ores share that role about equally; so, it is reasonable to expect that the potential Study Area population would about double in the copper-nickel development scenario and this is the SIMLAB forecast. This result is repeated in 1997, when copper-nickel employment exceeds iron ores employment by 1,700 persons and the projected development scenario population impact is slightly more than the baseline population level.

However, the accuracy of the impact forecast for the year 2000 is doubtful. In this year, copper-nickel employment exceeds iron ores employment by 2,100 persons, and projected population impacts is nearly twice the baseline level. In fact, in the SIMLAB computer run, population continued to increase explosively after the year 2000 even though there is no further copper-nickel development in the scenario. The conclusion is that the SIMLAB model has limits. Up to the point where development scenarios cause population to double, it works reasonably well. After that, its accuracy is subject to question. However, in this case the predictions may be interpreted qualitatively as suggesting that construction and operation of four copper-nickel mines in the Study Area in an eleven-year time span has the potential for causing very extreme changes in regional population and even more extreme changes at the local level (see Volume 5-Chapter 7 on local population changes).

1.3.5.2 Alternative II: Four Mines With Smelter/Refineries--Potential demographic impacts from four mines with smelter/refineries located in the Study Area are shown in Table 12. Although the timing of development in this scenario is slightly different (see Table 10), the principal reason for the slightly larger impacts relative to those in the previous scenario is the additional employment in the smelter/refineries. As in the discussion of Alternative I, the estimates of potential impacts appear to be accurate up to the point where the impact about equals the baseline population. Thus, in this scenario, estimated impacts for 1997 and 2000 must be regarded as questionable. As in Alternative I, the results may be interpreted qualitatively as suggesting that there is a potential for extreme changes stemming from this much development in the period of time specified by the scenarios.

Table 12

1.3.5.3 Alternative III: Two Mines, One Smelter/Refinery--Potential demographic impacts from Alternative III are shown in Table 13. In this scenario, there would be two mines. Concentrate from one mine/mill would be processed in a smelter/refinery located within the Study Area. Concentrate from the other mine/mill would be shipped outside the Study Area. This scenario has significantly less potential for extreme effects than Alternatives I and II, as comparison with Tables 11 and 12 reveals. By the year 2000, employment in the copper-nickel industry would be about 4,400 persons, or only about 800 persons less than projected employment in the iron ores industry at that time. However, in this scenario, approximately equal employment in the two mining industries does not generate the large potential impacts that occurred in Alternatives I and II. The reason is that copper-nickel development occurs much more slowly in Alternative III with more time elapsing between the opening of the first mine and the second. Slower development reduces the effects of expenditures by households of copper-nickel industry employees on Study Area employment and population, resulting in smaller indirect and induced impacts.

Table 12. Copper-nickel development impacts on Study Area population for multiple mine Alternative II.

BASELINE POPULATION		ALTERNATIVE II IMPACTS	
Year	Population	Total Population Impact	Percent of Baseline
1986	54,506	13,175	24.2
1988	54,902	16,176	29.5
1991	53,462	46,018	86.1
1994	50,729	76,235[a]	150.3[a]
2000	42,987	221,360[a]	514.9[a]

1991 BASELINE AGE STRUCTURE		1991 ALTERNATIVE II AGE STRUCTURE	
Age	Population	Total Population Impact	Percent of Baseline
1-5	5,746	3,553	61.8
6-17	9,319	9,615	103.2
18-24	3,605	6,338	175.8
25-34	9,705	11,794	121.5
35-59	17,163	13,116	76.4
60-64	2,533	1,095	43.2
65+	5,391	507	9.4
TOTAL	53,462	46,018	86.1

SOURCE: SIMLAB 1979.

[a]SIMLAB output questionable, see page 24.

Table 13

1.3.5.4 Alternative IV: Two Mines, No Smelter/Refineries--Potential impacts from Alternative IV are presented in Table 14. In this scenario, there are mines with concentrating mills and no smelter/refineries. Potential impacts in this slow-growth situation are the smallest of the multiple mine scenarios. The lack of smelters in the Study Area reduces the population impact by 38 percent in the year 2000 (a population change of 9,593 people).

Table 14

1.4 CONCLUSIONS

The forecasts of total primary Study Area population in the seven copper-nickel development scenarios are plotted in Figure 4. As explained in the text, the forecasts for the multiple mine alternatives do not include the impacts of constructing the first mine in the multiple scenario because these impacts would be very nearly the same as the impacts from construction in the single-mine scenarios.

Figure 4

Examination of the graph reveals that the seven scenarios do indeed cover a wide range of possible impacts. Perhaps the most interesting results are those from multiple mine Alternative III and IV. The forecast population impacts from these two scenarios suggest that, should either of these developments occur, the result would be to stabilize the Study Area population. However, stabilization would only occur if increases in production per worker in the iron ore and industry

Table 13. Copper-nickel development impacts on Study Area population for multiple mine Alternative III.

BASELINE POPULATION		ALTERNATIVE III IMPACTS	
Year	Population	Total Population Impact	Percent of Baseline
1988	54,902	11,922	21.7
1990	54,177	13,509	24.9
1996	48,413	20,392	42.1
2000	42,987	25,402	59.1

2000 BASELINE AGE STRUCTURE		2000 ALTERNATIVE III AGE STRUCTURE	
Age	Population	Total Population Impact	Percent of Baseline
1-5	2,856	2,981	104.4
6-17	9,170	3,589	39.1
18-24	2,470	3,159	127.9
25-34	2,421	5,421	223.9
35-59	18,278	9,053	49.5
60-64	2,853	614	21.5
65+	4,939	585	11.8
TOTAL	42,987	25,402	59.1

SOURCE: SIMLAB 1979.

Table 14. Copper-nickel development impacts on Study Area population for multiple mine Alternative IV.

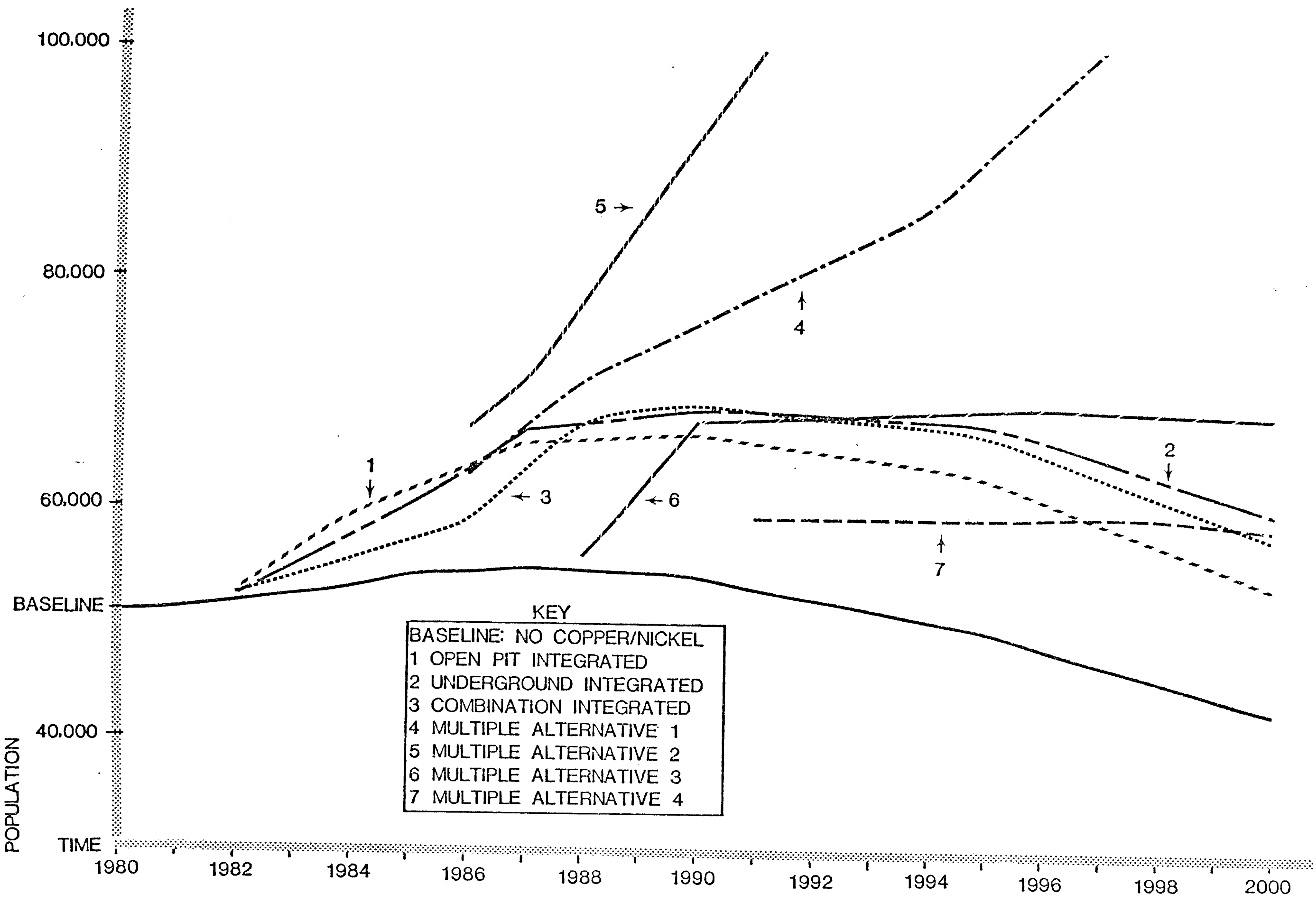
BASELINE POPULATION		ALTERNATIVE IV IMPACTS	
Year	Population	Total Population Impact	Percent of Baseline
1991	53,462	5,745	10.7
1995	49,611	9,661	19.5
1998	45,797	13,700	29.9
2000	42,987	15,809	36.8

2000 BASELINE AGE STRUCTURE		2000 ALTERNATIVE IV AGE STRUCTURE	
Age	Population	Total Population Impact	Percent of Baseline
1-5	2,856	1,815	63.6
6-17	9,170	2,503	27.3
18-24	2,470	2,162	87.5
25-34	2,421	3,552	146.7
35-59	18,278	5,011	27.4
60-64	2,853	373	13.1
65+	4,939	393	8.0
TOTAL	42,987	15,809	36.8

SOURCE: SIMLAB 1979.

FIGURE 4

REGIONAL COPPER-NICKEL STUDY AREA
POTENTIAL COPPER-NICKEL MINING IMPACTS ON TOTAL POPULATION
ALTERNATIVE DEVELOPMENT SCENARIOS



take place. Should productivity increases become reality, the Study Area population may slowly decline, as shown in the baseline projection, unless copper-nickel development or, other development unforeseen at present, creates new job openings. On the other hand, if iron ores industry productivity increases do not occur, then Study Area population total will not bend downward over time as in the baseline projection. Under these circumstances, Study Area population without copper-nickel development will be stable or increase slowly and total population would increase in all the copper-nickel development scenarios.

The projected influx of copper-nickel related population could significantly change on the age structure of the Study Area and the region. The baseline population of the two regions had higher than statewide average concentration of older people--aged 39 and over. The estimates of age structure for the mid- to late-1990s shows an influx of younger population as a result of development. The construction phase of development significantly increases the number of people in the 6-17, 18-24, and 25-34 age groups, while operation-related population will significantly increase the number of people in the 0-5, 18-24, and 35-59 age groups by the 1990s.

As a result of development, then, the regional population will become more balanced and the dependency ratio (ratio of people aged 0-17 and 65 and over to people aged 18-64) will become more favorable.

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