Volume 5-Chapter 7

RESIDENTIAL SETTLEMENT PATTERNS: CHARACTERIZATION IMPACTS ANALYSIS

Regional Copper-Nickel Study
Minnesota Environmental Quality Board
Author: Charles O. Lentz*

*Please contact Roy Tull regarding questions or comments on this chapter of the report.

TABLE OF CONTENTS

TABLE OF CONTENTS (contd.)

Volume 5-Chapter 7 RESIDENTIAL SETTLEMENT PATTERNS

7.1 INTRODUCTION AND SUMMARY OF FINDINGS

A major component in the human environment is the location and nature of an individual's place of residence. For the individual the place of residence often becomes the principal focus of that person's perception of their environment and may represent a deliberate statement of lifestyle preference. For society the location and magnitude of residential settlement dicates the types, extent, and costs of services required to be provided to the population.

This chapter characterizes existing areas of residential settlement and describes projected changes in these residential settlement patterns assuming alternative levels and locations of copper-nickel development. This information is then used to assess the potential conflicts between residential land-uses and mining land-uses (a direct impact of copper-nickel development) and the consumption of land in the region (an indirect impact). Other chapters in this volume utilize this information to assess the impacts of residential settlement growth (and corresponding population changes) on regional transportation systems (Chapter 8), on government service costs and revenue impacts (Chapter 13), on local economic changes (Chapter 16), and is combined with other land use changes to produce a possible future picture of overall land-use patterns with and without copper-nickel development (Chapter 3).

Many impacts, especially impacts at the local level, are not presented in this report due to budget limitations and the infeasibility of assessing impacts which are highly variable and would not occur for many years assuming copper-nickel development proceeds. These impacts, such as; the availability of

mortgage funds for new housing construction, the availability of private land in a particular area for residential purposes, or the cost of expanded government services such as increased snowplowing along a stretch of road serving new houses; are best addressed by local planners and planning officials at a time when the impacts can be more reliably determined.

Copper-nickel development, like all mining operations, will be a land and labor intensive industry. In general, residential settlement impacts resulting from copper-nickel development will be of three types. First, the direct consumption of land by the various phases of a copper-nickel operation could conflict with present and future residential land uses in the region (first order impact). Second, the employees of the copper-nickel operation which are new residents of the region will require homes and these new residences will cause a direct consumptive impact on the region's land (second order impact). Third, as growth occurs in the region as a result of copper-nickel development, corresponding growth will occur in the service sector of the economy further increasing residential growth in the region (third order impact).

7.1.1 Characterization

The first portion of this chapter characterizes the types and distribution of existing residential settlement throughout the Study Area. It also includes a brief discussion of past influences on residential settlement patterns, and an analysis of forces currently affecting residential settlement location in the Study Area.

Major features discussed in the characterization portion of this chapter are:

DISTRIBUTION AND GROWTH

1) More than eight out of every ten households (84%) are single-family units

(either a house or a mobile home). Another 6% of households are in structures with two units, and the remaining 10% are in structures of three or more units or of an unknown nature.

2) Almost two thirds (64%) of existing households are located in the southwestern part of the Study Area from Hoyt Lakes to Virginia.

3) Almost one quarter (24%) of existing households are located in the cities of Babbitt and Ely and the rural areas in the northeastern part of the Study Area.

4) Approximately seven out of ten households are currently located in the cities of the Study Area although analysis of building permit information suggests that the rate of growth of rural residential settlement has increased somewhat over the past several years.

5) While the number of households in the Study Area has increased almost 10% since 1970 the population has not increased at the same rate probably due to a decrease in the average size of a household.

6) Most residential settlement growth has occurred in the area of Virginia, Eveleth, and Gilbert. Growth has also occurred in the areas around Aurora, Embarrass, and Ely.

INFLUENCES ON RESIDENTIAL SETTLEMENT LOCATION

1) More than two thirds (71%) of workers in the Study Area live within twelve miles of their place of employment; 90% live within 27 miles of work.

2) Almost half (46%) of all rural households are found within one-half mile of a lake (which is only one quarter of the land area of the Study Area) suggesting that land in proximity to a lake attracts residential settlement. Land within

one quarter mile of a river, on the other hand, attracts a percentage of households which is less than the percentage of all Study Area land which falls in this category.

3) Public land ownership: use of land for mining; and swamps, marshes and bogs appear to substantially curtail residential settlement. This land accounts for roughly 60% of the total regional surface area.

7.1.2 Impacts

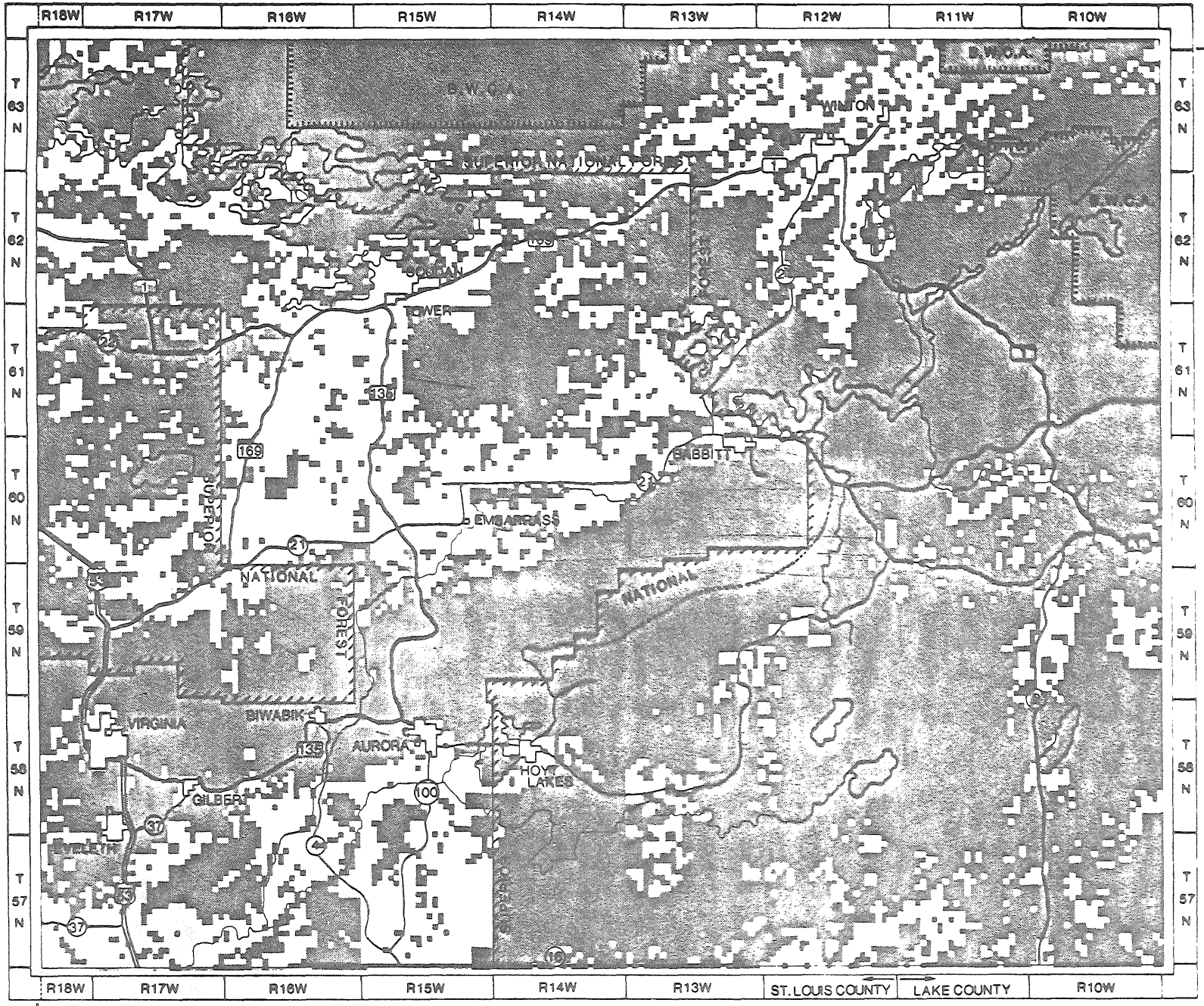
The second major portion of this chapter describes the potential growth of residential settlement in the Study Area resulting from increases in employment opportunities due to possible development of copper-nickel resources in northeastern Minnesota. Based on these projections, potential conflicts between mining and residential land uses, and the consumption of land by new residential settlement are assessed.

Projections of potential residential settlement were predicated on the assumption that only certain types of land would be available for settlement. Land considered available for settlement (Figure 1) was that land which is;
1) privately owned, 2) within one mile of an existing public road, and 3) not presently used for mining purposes. Approximately 30% of the land in the Study Area fits this description and was considered available for settlement.

Forecasts indicate:

RESIDENTIAL SETTLEMENT GROWTH

1) An 8% increase in households in the Study Area over 1976 levels by the mid-1980s is expected to result from expansion in the taconite industry without any marked change in the distribution of that settlement from current patterns.



LEGEND

AVAILABLE LAND

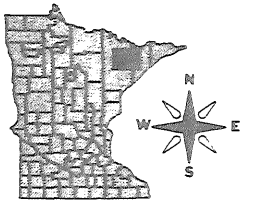
UNAVAILABLE LAND

SOURCES: REGIONAL COPPER-NICKEL STUDY PUBLIC OWNERSHIP MAP MLMIS V55-FILE 5.

BIWABIK IRON FORMATION AND 1.5 MILE BUFFER MAP, MLMIS V88-FILE A.

RCNS ROAD AMENITY MAP, MLMIS V90-FILE A.

RCNS RESIDENTIAL SETTLEMENT MAP, MLMIS V36-FILE 0.



KEY MAP

1 422 400

MILES 0 1 2 3 4 5 10

0 1 2 3 4 5 10 15 KILOMETERS

FIGURE 1

MEQB REGIONAL COPPER-NICKEL STUDY

LAND (WITHIN ONE MILE OF A PUBLIC ROAD) CONSIDERED AVAILABLE FOR RESIDENTIAL SETTLEMENT

2) Residential settlement growth associated with copper-nickel development will tend to concentrate along the Ely-Babbitt corridor in the Embarrass region (including Babbitt and the area immediately east of Babbitt) or in the area from Hoyt Lakes to Virginia depending on the location(s) of future mine develompents.

3) The areas around and including the cities of Ely and Babbitt stand to experience the largest percentage increase in number of households (up to a 75% increase in Ely and 80% in Babbitt) given development of three hypothetical mines evenly distributed north to south along the Duluth Contact. This compares to a projected 32% increase in households in Virginia under the same conditions.

4) Despite potentially large increases in cities such as Ely and Babbitt, the overall distribution of residential settlement will not change drastically unless mine development occurs at only one location along the Duluth Contact.

5) Residential settlement growth in the Study Area of approximately 8,000 new households is projected assuming the development of three hypothetical mines and a single 100,000 mtpy smelter (this would be a 44% increase over projected 1984 levels).

6) There is a projected in and out migration of up to 2,000 construction workers during the first fifteen years of mine development assuming the development of three mines with the start of construction of each mine staggered by five years.

LAND USE CONFLICTS/IMPACTS

1) There is a potential displacement of 76 rural residential structures by mining operations (an additional 1100 households, approximately, in the city of Hoyt Lakes are within the area of potential displacement but are not expected to

be impacted since they do not directly interfere with actual ore removal operations).

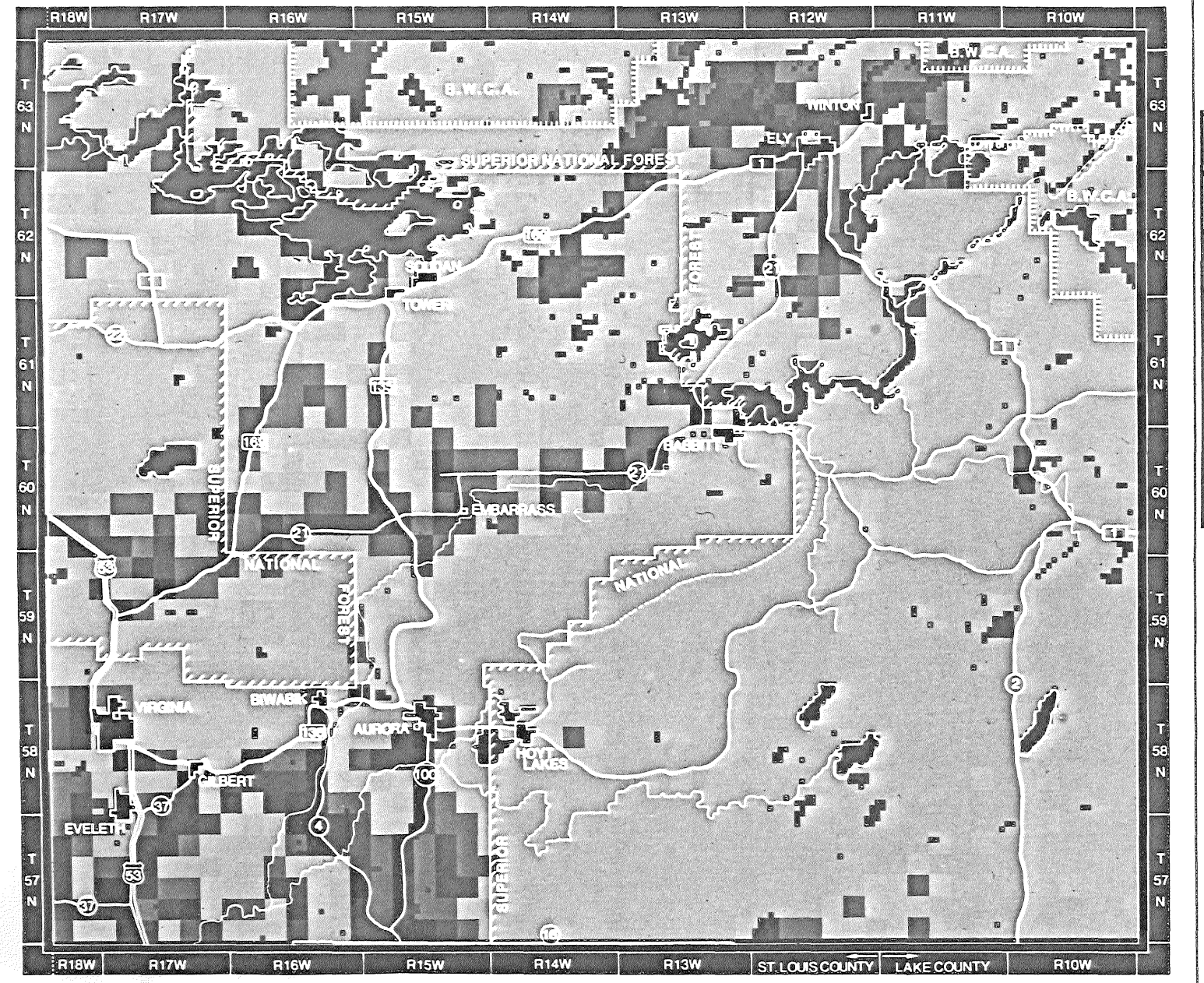
2) 8,200 acres of land may be used for new residences as a result of development at three hypothetical mine locations. This compares to the 23,200 acres of land required directly by the mining operations.

3) Forty percent of the land required for new residential settlement is located in and around the communities of Ely, Babbitt, Tower, Aurora, Hoyt Lakes, Biwabik, Eveleth, Virginia, and Gilbert. Sixty percent of the land required for new settlement is in largely undeveloped rural areas.

While the increase in the number of new residences within the region will be very significant depending on the number and location of copper-nickel operations, the major impacts associated with such residential development will largely be felt through the utilization of the region's resources and infrastructure. Analysis of such impacts is discussed in other chapters of this report.

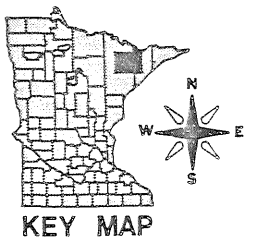
7.2 CHARACTERIZATION OF EXISTING RESIDENTIAL SETTLEMENT PATTERNS IN THE REGIONAL COPPER-NICKEL STUDY AREA

This section provides a baseline characterization of residential settlement patterns in the Study Area. The data generated in this study have been used to project residential settlement patterns which may result from development of copper-nickel resources in northeastern Minnesota. The location of existing residential settlement is an important factor in predicting future settlement patterns for the region and for the assessment of the public health implications of projected emissions of air, water, and noise pollution from copper-nickel development.



LEGEND

- 0 - STRUCTURES
- 1-4 STRUCTURES
- 5-11 STRUCTURES
- 12-20 STRUCTURES
- 21 + STRUCTURES
- URBAN
- WATER



KEY MAP

APPROX. SCALE

MILES

KILOMETERS

FIGURE 2

MEQB REGIONAL COPPER-NICKEL STUDY

1977 RESIDENTIAL DENSITY PER SQUARE MILE

This characterization of residential settlement patterns is based primarily on an inventory of residential structures conducted by the Regional Copper-Nickel Study staff in the summer of 1977 (Figure 2).

Based on the information gathered in the field, the Study Area was divided along existing township lines into five sub-regions which represent areas either of similar settlement types or in the case of undeveloped areas, lack of settlement (Figure 3). These sub-regions have been created solely as an organizational device and do not represent discreet market areas, commuter sheds, or other spatial alignments. Table 1 presents a summary of information for each region compared to the Study Area as a whole.

Table 1

Residential settlement in each of these five sub-regions is described generally in this section in terms of the five following types of settlement:

1) High density-full service communities--These are typically urban areas with a relatively concentrated population. In addition to the residential density, these communities feature identifiable commercial districts offering services beyond gasoline and groceries. Communities of this type in the Study Area are Virginia, Ely-Winton, Eveleth, Aurora, Hoyt Lakes, Babbitt, Biwabik, Gilbert and Tower-Soudan.

2) Medium density-low service communities--These typically suburban areas are smaller, less densely populated, primarily residential areas found in the vicinity of the larger urban areas. Often these settlements are newer than the urban areas and in some cases consist of recently developed subdivisions. This type of development is found only in the general vicinity of Virginia and Eveleth and, to a lesser degree, Ely-Winton.

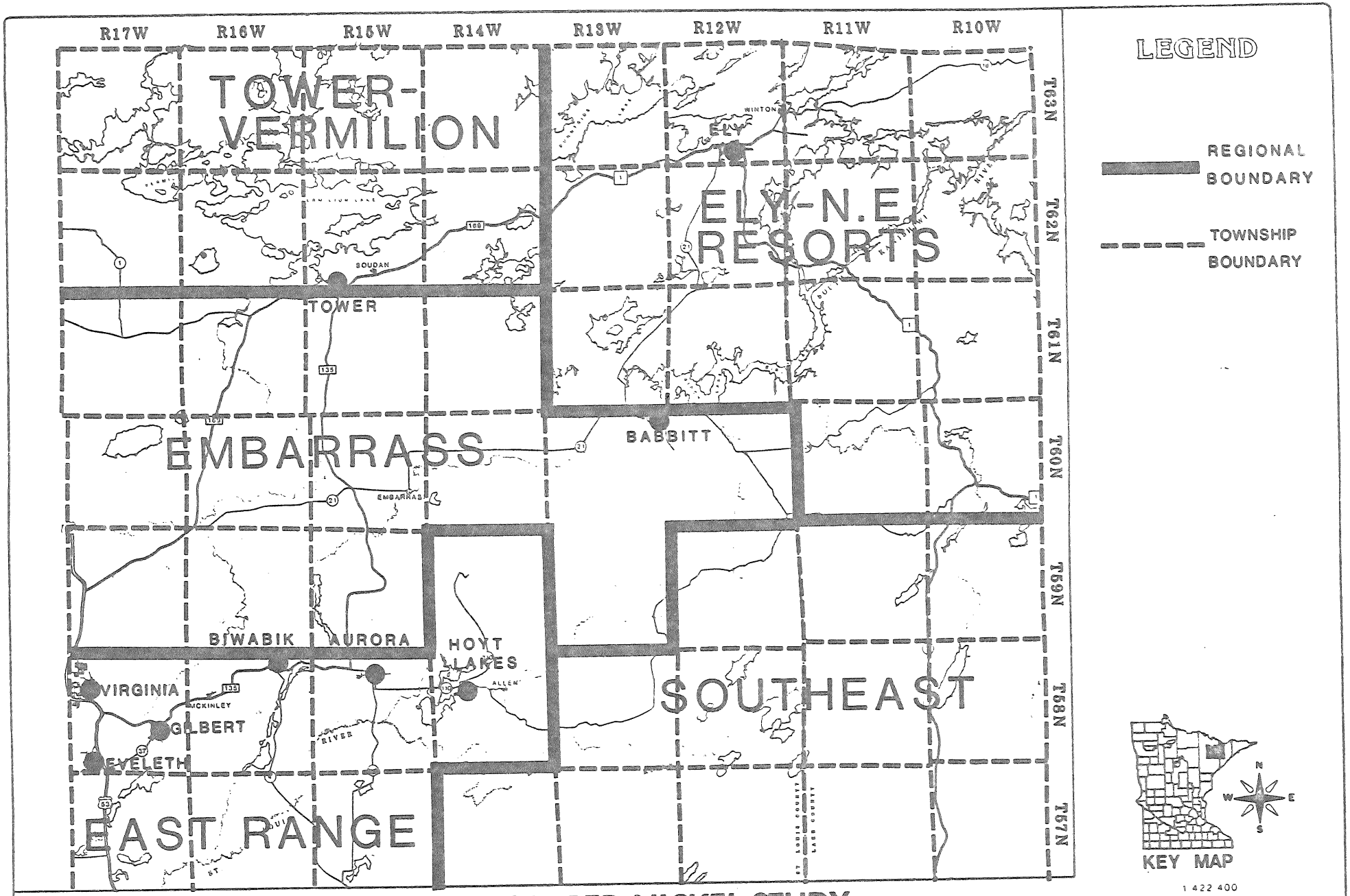


FIGURE 3 MEQB REGIONAL COPPER-NICKEL STUDY

CITIES AND SUB-REGIONS OF THE STUDY AREA

Table 1. Summary of characteristics of Study Area and five sub-regions.

CHARACTERISTIC	ELY-N.E. RESORTS	TOWER-VERMILLION	SOUTHEAST	EMBARRASS	EAST RANGE	STUDY AREA
Area (acres)	394,560	157,440	280,320	327,000	204,840	1,364,160
Estimated year-round population	9,410	1,340	190	6,750	32,470	50,160
Largest community	Ely	Tower	none	Babbitt	Virginia	Virginia
First settlement	Ely	Tower	none	Embarrass	Virginia	Tower
Total # year-round residences	3,140	450	60	2,250	10,830	16,720
% urban residences	56	56	0	43	83	71
% rural residences	44	44	100	57	17	29
Total # 40-acre parcels	9,864	3,936	7,008	8,175	5,121	34,104
% w/1 or more residence	7	11	1	10	19	9
% w/no residence	93	89	99	90	81	91
% privately owned land	25	30	21	55	73	39
% publically owned land	75	70	79	45	27	61
% forest	82	58	88	78	63	77
% water	12	28	3	1	3	8
% swamp	2	7	5	5	4	4
% open/vacant	1	1	*	4	5	2
% mineland	*	*	*	6	11	3
% urban residential	*	*	0	*	2	*
% rural residential	2	3	*	1	4	2
% agricultural	*	1	*	3	8	2
% other	1	1	4	*	*	1

SOURCES: U.S. Dept. of Commerce, revenue sharing program, population estimates, 1976; Regional Copper-Nickel Study residential settlement map, MLMIS V36-File 0; Regional Copper-Nickel Study estimates of rural population and households (see Table 2); Regional Copper-Nickel Study land use map (MLMIS V45-File 0); Public Ownership (BLM) (MLMIS V55-File 5).

*less than 1%.

3) Rural Communities--Rural communities (or hamlets) are small, medium density clusters of residences such as might be found at the intersection of two trunk roads. Typically the only commercial activity present may be a combination gas/grocery type store. Rural communities in the Study Area include Britt, Toimi, Embarrass, Palo, and others.

4) Lakeshore--Lakeshore developments are characterized by houses, cabins and cottages (either year-round or seasonal) which may be found in clusters of either medium or low density. Usually these developments only occur directly on the lakeshore although in certain densely developed lakeshore settlements many homes are not actually on the lakeshore but, rather are found up to 1/4 mile from the lake.

5) Rural Dispersed--Farmsteads began appearing in the Study Area around the turn of the century. New rural dispersed (or highway oriented) development, which is characterized by large lots developed at a very low density along roads and highways is a much more recent settlement type. These are not organized communities or, even typically, clusters of homes, but rather isolated residences which may be either seasonal or year-round homes. Rural dispersed settlement is found most frequently in the southwestern and west central portions of the Study Area.

7.2.1 Past Settlement Patterns

A brief overview of past settlement patterns is necessary to understand existing settlement patterns and to provide additional insight into historical growth factors which may influence future growth.

The location of the iron ore and working mines was the greatest force affecting growth, and early settlement was marked by ties to both mine locations and

amount of ore produced (Webb 1958). City size was directly related to mine size--the larger the mine, the larger the city. In fact, it was not unusual for relatively large towns to grow almost side by side if mines in the area were large, despite the duplication of services.

Apart from incorporated areas, large numbers of people lived in mine "locations" which were a feature of almost every mine (Webb 1958). These were often little more than residential camps and "the group of residences of which it was composed was located as close as possible to the place of work of its inhabitants" (Webb 1958). Locations, which were scattered up and down the range, were established until the 1930s, although most were settled before 1920. Generally, they were built for the sole purpose of providing housing adjacent to the mines for the workers--other possible siting factors were largely ignored.

A number of influences have changed certain characteristics of these settlements over the years, in particular the smaller "locations" that were so directly linked to the source of employment. Webb described the change in population distribution as "dispersion" by which he meant both a physical dispersion and a growing independence of the population from a single source of employment. Webb identified four factors which aided this dispersion.

First, when the local mine either ceased or cut back production, employment had to be found elsewhere although in many instances people would continue living in the same place. It was this process which had the effect of consolidating more of the population into fewer settlements near the largest mines. Second, many foreign born workers, as they adjusted to American ways, became more confident in seeking jobs outside of their immediate community. Third, the children of the workers who lived in the locations, particularly females, had to migrate to

the larger towns to find work. Fourth, the inter-urban train and bus system as well as the automobile, enabled people to leave the isolated settlements and settle further away from the mines or in another city (Webb 1958).

The largest recent settlements on the Range are Hoyt Lakes and Babbitt, the taconite towns created by mining companies in areas which were previously relatively unsettled. They were created in response to the need on the part of the taconite industry for large numbers of workers near their place of employment at its mines and processing facilities. Accordingly, the location of the taconite towns can be seen to be caused by considerations very similar to those operating at the turn of the century.

7.2.2 Existing Settlement Patterns

This section describes, in general terms, the locations, size, and type of settlements in each of the five Study Area sub-regions.

7.2.2.1 Southeastern Sub-Region--The southeastern sub-region (Figure 3) is an area of extensive wetlands--meandering streams, large shallow lakes, and expansive swamps and bogs. Except for the marshes and some cleared land around Toimi, the area is heavily forested with spruce, fir, aspen, and birch (RCNS Land Use Map 1977). Few roads traverse the sub-region and large areas are inaccessible to automobiles and trucks. Roughly 75% is publically owned or managed (Bureau of Land Management Ownership Map MLMIS V55). The greater portion of the area is uninhabitated with the largest number of residential structures found in the Toimi, Cadotte Lake and Bassett Lake areas. The residences in the Toimi area are primarily older farmsteads of the rural dispersed type. Very few of them are still being operated as farms, however, and many of the buildings are deteriorated considerably or have been abandoned altogether. The approximately

forty residences surrounding Cadotte and Bassett lakes are of the lakeshore type.

7.2.2.2 Ely-Northeastern Resort Region--The density of residential settlements in the Ely-Northeastern Resort sub-region ranges from the unsettled and remote canoe country of the BWCA to the high density-full service community at Ely (Figure 2). This is a large area covering eighteen townships and, compared to the western half of the Study Area, remains largely unsettled.

The sub-region is dotted with hundreds of lakes which give it more water amenity land (land either within 1/2 mile of a lake or 1/4 mile of a river or stream) than any other sub-region in the Study Area. There are relatively small amounts of low lying wetlands, however, and the area is heavily forested with white, red and jackpines; aspen; birch; and scattered stands of spruce and fir. Evidence of large tract logging is observable in the eastern portion of the region straddling state trunk Highway 1 and in the far southern portion just southeast of Birch Lake.

There are eight general areas within the sub-region where concentrations of development can be seen; the Ely-Winton urban areas, the Farm and Garden lakes suburban/lakeshore development area, the lakeshore development along Shagawa and Burntside lakes, the lakeshore development along the Eagles Nest Lakes, the lakeshore development along Bear Island Lake, the highway-oriented, rural dispersed development along Highways 1 and 21 between Ely and Babbitt, and the scattered lakeshore cabins east and southeast of Ely in Lake County.

Ely and Winton together have an approximate population of 5240 (U.S. Department of Commerce 1976) and an estimated 1750 housing units (Table 2). This is roughly ten percent of the total population and ten percent of the total number

of housing units in the Study Area. Ely is the second largest city in the Study Area and is a center for wilderness-based recreation as well as the home for many taconite industry employees. Winton, which is three miles northeast of Ely, is an old lumber and mining town. It is a primarily residential community with few commercial services. Figures in Table 2 show that roughly 56% of the residential structures in the Ely-N.E. resort sub-region are found in the Ely-Winton area.

Table 2

East of Ely, along the north shore of White Iron and Farm lakes, there is a concentration of year-round homes mixed with seasonal cabins and resorts. In general, this area contains suburban-style developments and lakeshore homes. Certain portions of this development, particularly away from the lakes, are characterized by small lots creating a relatively high density of development in places.

There is extensive lakeshore development along the southern shores of Shagawa and Burntside lakes. The northern shore of Shagawa is also well developed with lakeshore cabins and resorts. Between 1969 and 1977, more residential construction has occurred along the northshore of Burntside Lake than along the more densely developed south shore (based on comparison of 1969 topographic sheets with field observations made during 1977).

The Eagles-Nest lakes in the westernmost section of the Ely-Northeast Resort sub-region also show a good deal of growth over the years between 1969 and 1977. There are several resorts on the seven lakes in the area (Robinson, Clear, Armstrong, and Eagles Nest lakes Nos. 1,2,3, and 4), but the majority of residences are seasonal homes and private cabins (Waggoner 1977).

Table 2. Estimated Study Area population and households, 1976 (by city and sub-region.[c]

CITY[a]	EST. 1976 POPULATION (year-round)	EST. 1976 HOUSEHOLDS (year-round)	% TOTAL STUDY AREA HOUSEHOLDS
Ely-Winton	5,240	1,750	10
Babbitt	2,890	960	6
Tower	740	250	1
Aurora	2,790	930	6
Hout Lakes	3,720	1,240	7
Biwabik	1,480	490	3
Eveleth	4,670	1,560	9
Virginia	11,730	3,910	23
Gilbert	2,600	870	5
SUB-REGION (rural areas only)[b]			
Ely-N.E. resorts	4,170	1,390	8
Tower-Vermillion	600	200	1
Southeast	180	60	*
Embarrass	3,870	1,290	8
East Range	5,490	1,830	11
TOTAL URBAN	35,860	11,960	71
TOTAL RURAL	14,310	4,770	29
TOTAL STUDY AREA	50,170	16,730	100

Table 2 continued.

SOURCES: [a]Figures for cities derived by dividing U.S. Dept. of Commerce, revenue sharing program population estimates for 1976 by an average household size of 3.0 members (Minnesota Labor Force Survey, Form-1, 1977).

[b]Estimates for the rural areas of the five Study Area sub-regions were produced by determining the approximate number of year-round rural residential structures in the sub-region by subtracting from the gross number of residential structures in a region (Regional Copper-Nickel Study residential settlement map, 1977) the structures which were:

1) outside the Study Area;
2) located within the municipal boundaries of Study Area cities; and
3) determined to be seasonal households based on 1977 information from Northern Electric Cooperative Association (NECA), Minnesota Power and Light Company (MP&L), and the Cooperative Light and Power Association of Lake County.

and multiplying this figure by the average household size of 3.0 members.

[c]All absolute number estimates were rounded to the nearest ten.

*Less than 1%.

About twelve miles south of Ely there are two small lakes, One Pine and Johnson lakes, where some lakeshore development has occurred. Settlement is heaviest along One Pine Lake. Johnson Lake has long been only sparsely settled and new development has been slight over the past several years (Rom 1977).

Bear Island Lake, just south of One Pine and Johnson lakes has a substantial amount of residential settlement along its shores. The eastern shore of the lake is mainly developed by resorts, but the southwestern and western shores of the lake are dotted with lake cabins.

The only rural dispersed settlement in the sub-region is along the two roads which run south from Ely--State Trunk Highway 1 and St. Louis County 21. The development along Highway 21 is heaviest immediately south of Ely. This can almost be considered suburban Ely at some points where the density of settlement is heaviest. About six miles south of Ely on County Road 120 and Forest Road 192, a great deal of new highway oriented residential settlement has occurred since 1969. This area is almost exactly halfway between Ely and Babbitt.

7.2.2.3 Tower-Vermilion Resort Sub-Region--The Tower-Vermilion Resort sub-region is geographically dominated by Lake Vermilion and only two major types of settlement are found within this area--the high density-full service settlement of Tower-Soudan and the lakeshore settlement around Lake Vermilion.

In general, this sub-region is either heavily forested or water-covered. There is, however, a large swamp called "Lost Lake Swamp" in the southern portion of the sub-region. Just west of this swamp is a small area of old farmland where an occasional farmstead or trailer home can be found along the road.

Tower and Soudan are the oldest settlements in the Study Area. They were originally mining towns that housed the workers at the first mines on the Vermilion

Iron Range. Tower had an estimated population of 740 in 1976 and approximately 250 housing units. Recent population figures for Soudan are not available (Table 2).

The lakeshore development is very intensive along the southern shore of Lake Vermilion with a relatively dense concentration of larger homes, resorts, and both year-round and seasonal cabins in the Pike Bay area, where there is a subdivision. Other concentrations of year-round and seasonal homes occur on Echo Point, Birch Point, Fectos Point, and in the Frazer Bay area. Most of these areas were developed before 1950. Resorts are common along the south shore, although development on Birch Point is primarily characterized by private homes.

Further west along the lakeshore, settlement becomes less and less dense. Several newer cabins are found along the more remote roads. Vermilion Lake Indian Reservation is located on the western shore of Pike Bay.

7.2.2.4 Embarrass Sub-Region--Babbitt is the major urban settlement of the Embarrass sub-region. Babbitt, a taconite town established in the mid 1950's, has a population of 2890 (U.S. Department of Commerce 1976) and an estimated 960 housing units. The residential portions of Babbitt are more intimately linked with both Ely and the cities of the East Range but are included in the Embarrass sub-region due to the direct link, via Highway 21, to the area. There are several rural clusters located at Benville, Embarrass, Britt, and Florenton. The rest of the settlement in the sub-region is primarily highway oriented, rural dispersed type. The sub-region is settled throughout, although the density of the settlements is never very high (Figure 2). Most of the terrain in this sub-region is gently rolling and there are areas both of forest and wetland, highland, and lowland. The Embarrass and Pike rivers meander through

the sub-region and have wide, marshy banks. Two large shallow lakes, Big Rice and Little Rice, are located in the western portion of the sub-region.

Benville is a relatively densely settled cluster of roughly forty residences. There are also several small commercial establishments. Most of the development in Benville is of relatively recent origin. Based on comparisons of 1969 topographic sheets with 1977 field observations, 24 out of the 40 residences have been built since 1969.

Embarrass lies about ten miles west of Benville on Highway 21 and is more of a commercial node than a sizeable residential center. Most of the approximately twenty residences in the area are older homes.

Some commercial development and several residences are located at the intersection of St. Louis County Highway 21 and State Trunk Highway 35 (known as "Four Corners").

A cluster of some 35 to 40 residences is located just east of U.S. Highway 53 in the town of Britt. This is also a relatively new development and the structures are often widely separated from one another. About four miles east of Highway 53 and 1/2 mile north of Highway 169 is a loose cluster of homes in the town of Florenton. This settlement is less dense than those at Benville or Britt, but is centered around the old community of Florenton with its cemetery and town hall.

Aside from these rural residential areas and a few mainly commercial nodes (particularly along Highway 53) the residential settlement throughout the sub-region is largely scattered on large lots along the highways and back roads. This is an area of old Finnish farmsteads, and although there is still some

farming taking place, many of the farms are no longer producing crops other than hay. There are very few subdivision type tracts of housing--the majority of the housing is located on lots either leased or purchased from the farmers in the area. Estimates based on information presented in Figure 2 indicate that roughly 70 percent of the residences in this sub-region (outside of Babbitt) were of this highway oriented, dispersed type.

7.2.2.5 East Range Region--The East Range sub-region is the most densely settled of the five sub-regions. This area includes the cities of Hoyt Lakes, Aurora, Biwabik, McKinley, Gilbert, Eveleth, and Virginia and rural clusters at Palo, Pineville, Sparta and Genoa. In addition, there are densely settled areas around several lakes southeast of Virginia and in several places west of Virginia and Eveleth. Furthermore, there is a great deal of highway oriented, dispersed settlement in the farming areas south of Aurora and Biwabik (Figure 2). The entire area is well roaded except for two large swampy areas--one southeast of Ely Lake and north of St. Louis County, Highway 16 and the other southwest of Aurora and northeast of Esquagama Lake. Rural residential development is also located around the numerous lakes scattered throughout the sub-region.

In the eastern portion of the sub-region, southeast of Hoyt Lakes, there is land that is within the Superior National Forest. This area is largely uninhabited and is heavily forested with occasional patches of low lying swampland.

Approximately 9,000 households (80% of the households in the sub-region) are found in the municipalities of Aurora, Biwabik, Eveleth, Gilbert, Hoyt Lakes, and Virginia. Approximately 45% of the households in these six cities are found in Virginia, the "Queen City" of the Iron Range. Sixty-four percent of the

total number of households in the Study Area are found in the East Range sub-region.

There is a considerable amount of suburban development in the area around Virginia and Eveleth. West of Virginia several subdivision style settlements and large apartment complexes are being built. The Midway community between Virginia and Eveleth on Highway 53 is an established suburban development that is showing signs of growth. Immediately north of Iron Junction and just east of Highway 19, a small subdivision is in the early stages of development. Ely Lake, southeast of Virginia-Eveleth, is completely developed around its shore and many of the areas have become suburban with subdivisions extending away from the southeast shore of the lake for several blocks.

More numerous than the suburban developments around Virginia and Eveleth are the many rural places becoming areas of concentrated development. Along St. Louis County Highway 19 on the far western edge of the Study Area there are areas where many small houses and trailer homes have been built--particularly south and west of Eveleth. South of Eveleth, there is older lakeshore development around Long Lake that is showing signs of growth away from the water. The old mining "location" of Sparta is still inhabited and some new homes have been built there. Pineville, another "location" east of Biwabik, has had about ten new residences built there in the past ten years. Finally, south of Aurora along Highway 100, there are indictions that several new small developments are being constructed.

Most of these rural residential settlements are located in places where residential settlement has occurred in the past. There are, however, many residences which are being built in areas that were not previously residential in nature.

This dispersed settlement occurs throughout the region and follows the pattern of old farmland and vacant lands along roads being leased or purchased in large lots for residential settlement. The two areas of the East Range sub-region which are almost exclusively of this type of settlement are in the Palo and Lakeland areas south of Aurora and Biwabik. These areas are or have been primarily agricultural areas but settlement has occurred over the years to the point where there are few roads which do not have residences in addition to farmsteads located along them.

7.2.3 Growth Areas

Figure 4 illustrates the number of year-round, single family residence building permits issued between 1971 and 1976 for those portions of the Study Area which lay within St. Louis County. Specific building permit data were not available for Lake County portions of the Study Area. Most residential growth has occurred in the vicinity of Virginia and Eveleth. Of the 1,431 permits issued in the Study Area from 1971 to 1976, 807 (56% of all permits) were issued in the East Range sub-region (Table 3). Another 348 (24% of all permits) were issued in the Embarrass sub-region. In total, 79% of the permits issued in the Study Area between 1971 and 1976 are in the townships closest to the major mining areas. The total percentage approaches 90% when permits issued by the cities of Ely and Babbitt are included.

Table 3

The growth of rural residential areas compared to growth in the Region's cities can be estimated by observing the differences in the number of building permits issued by the county as opposed to those issued by municipalities.

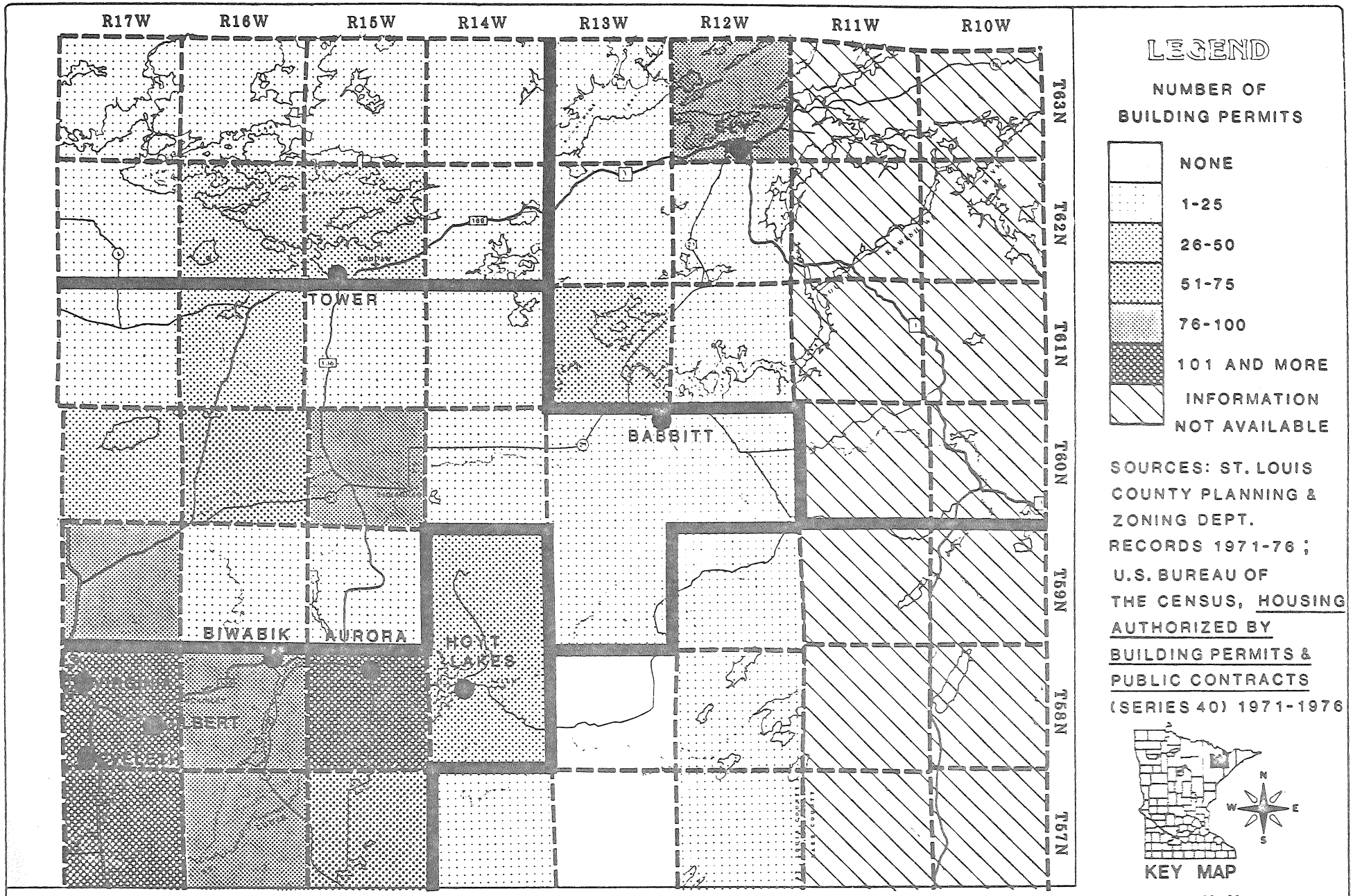


FIGURE 4 **MEQB REGIONAL COPPER-NICKEL STUDY**

COUNTY AND MUNICIPAL BUILDING PERMITS ISSUED FOR YEAR-ROUND, SINGLE-FAMILY HOUSING UNITS, 1971-1976

Table 3. Year-round, single family residence permits issued in five sub-regions by year, 1971-1976 (including municipal permits).

	1971	1972*	1973	1974	1975	1976	TOTALS	% OF TOTALS
Ely-N.E. Resorts	29	11	32	28	43	35	178	12
Tower-Vermillion	10	10	16	15	16	25	92	6
Southeastern	1	1	1	4	13	7	27	**
Embarrass-Pike	37	36	32	56	71	95	327	24
East-Range	72	91	101	123	176	244	807	56
TOTALS	149	149	182	226	319	406	1,431	100
% Increase in Permits Issued	---	0	22	24	41	27		

SOURCES: St. Louis County Planning and Zoning Dept., 1971-1976; U.S. Dept. of Commerce, Bureau of Census, "Housing authorized by building permits and public contracts" (series C-40) 1971-1976.

*Includes seasonal permits.
**less than 1%.

Approximately 25% of all year-round, single family permits were issued by the municipalities of Aurora, Babbitt, Biwabik, Ely, Eveleth, Gilbert, Hoyt Lakes, and Virginia (Table 4).

Table 4

Of the 807 permits issued in the East Range sub-region, 295 (37% of the total permits issued in the East Range sub-region) were issued by the municipalities of Aurora, Biwabik, Eveleth, Hoyt Lakes, Gilbert, and Virginia for residential structures. The remaining 63% of total East Range sub-region permits were issued by St. Louis County for the areas outside of municipal boundaries.

The number of permits issued for seasonal dwellings were highest in the Tower-Vermillion Resorts sub-region where 67% of all permits issued were for seasonal dwellings (Table 5). By comparison, only 3% of permits issued in the East Range sub-region were for seasonal dwellings (Figure 5).

Table 5

Eight townships accounted for 66% of all permits issued by St. Louis County in the Study Area for single family, year-round residences (Table 6, Figure 6). Four of these townships represent urban areas, two are primarily suburban areas, and two contain growing rural communities.

Table 6

Over the past several years the number of rural, non-farm residences has increased considerably. There has also been considerable residential growth in semi-rural, suburban areas.

Table 4. County and municipal single family year-round permits issued by year, 1971-1976.

GOVERNMENT UNIT ISSUING PERMIT	1971	1972	1973	1974	1975	1976	TOTAL	% TOTAL PERMITS
Ely	5	4	7	7	11	5	39	3
Babbitt	0	1	0	4	12	4	21	1
Aurora	5	4	2	4	15	14	44	3
Hoyt Lakes	2	3	0	6	18	15	44	3
Biwabik	0	0	1	1	2	3	7	[b]
Eveleth	2	6	8	12	13	18	59	4
Virginia	9	10	18	17	16	11	81	6
Gilbert	0	6	4	7	12	31	60	4
Urban Totals	23	34	40	58	99	101	355	25
Total county-issued permits in Study Area[a]	126	115	142	168	220	305	1076	75
						TOTAL PERMITS	1431	100

SOURCES: St. Louis County Planning and Zoning Dept., 1971-1976; U.S. Dept. of Commerce, Bureau of the Census, "Housing Authorized by Building Permits and Public Contracts" (series C-40), 1971-1976.

[a]Figures for total county-issued permits include permits issued by St. Louis County for construction in the city of Tower.

[b]Less than 1%.

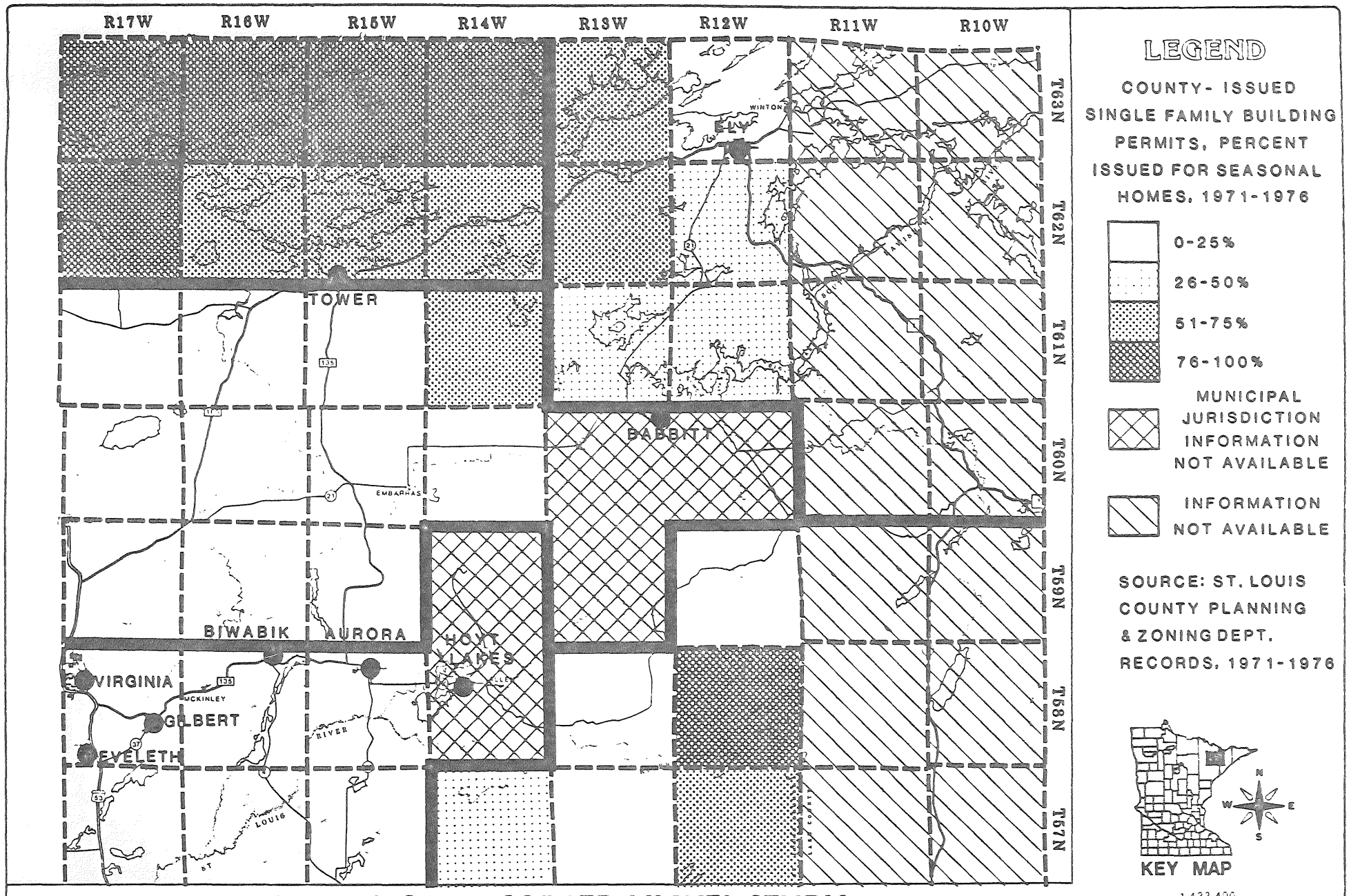


FIGURE 5 **MEQB REGIONAL COPPER-NICKEL STUDY**

TOTAL COUNTY-ISSUED SINGLE FAMILY RESIDENCE BUILDING PERMITS, PERCENT ISSUED FOR SEASONAL HOMES, 1971-1976

Table 5. Percent of all county-issued single family permits issued for seasonal homes, 1971-1976.

SUB-REGION	PERCENT TOTAL PERMITS ISSUED WHICH WERE FOR SEASONAL
Ely-N.E. Resort	39
Tower-Vermilion	67
Southeastern	23
Embarrass	5
East Range	3
Study Area	20

SOURCE: St. Louis County Planning and Zoning Dept., 1971-1976.

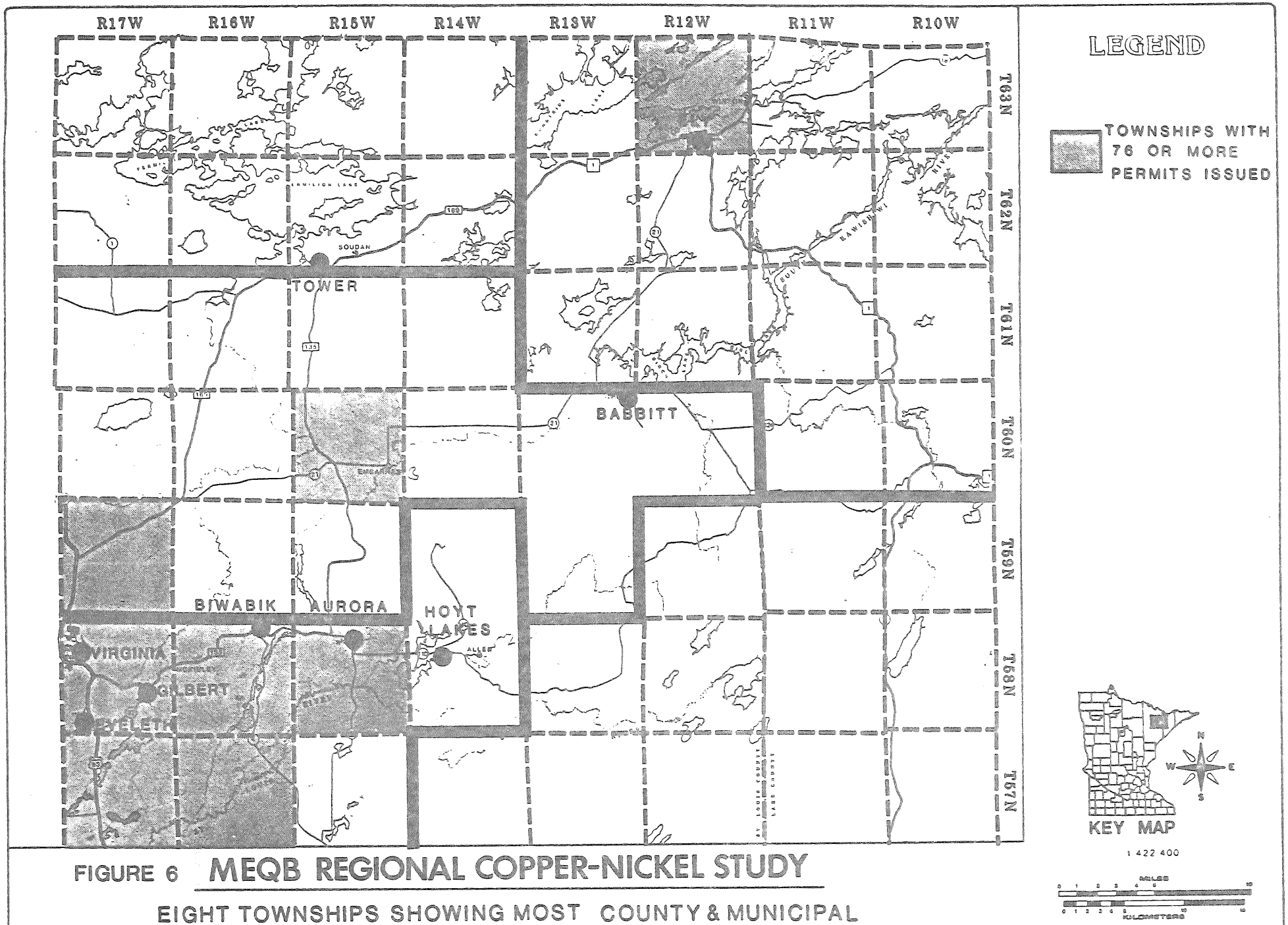


FIGURE 6 **MEQB REGIONAL COPPER-NICKEL STUDY**

EIGHT TOWNSHIPS SHOWING MOST COUNTY & MUNICIPAL SINGLE FAMILY, YEAR-ROUND BUILDING PERMITS ISSUED 1971-1976

Table 6. Eight townships showing most single-family, year-round building permits issued 1971-1976 (county and municipal).

TOWNSHIP	NUMBER SINGLE-FAMILY, YEAR-ROUND PERMITS ISSUED 1971-1976	PERCENT TOTAL PERMITS ISSUED
T58,R17	208	14
T57,R17	170	12
T58,R15	150	10
T58,R16	96	7
T57,R16	85	6
T60,R15	83	6
T63,R12	77	5
T59,R17	77	5
All Other Townships	489	34
TOTAL	1,431	100

SOURCES: St. Louis County Planning and Zoning Dept., 1971-1976; U.S. Dept. of Commerce, Bureau of the Census, "Housing authorized by building permits and public contracts" (series C-40), 1971-1976.

Of the roughly 16,700 housing units in the Study Area, approximately 1,400, or 8% of all housing units have been built since 1971 (St. Louis County building permit data 1971-1976)(Table 7).

Table 7

It is important to note, however, that this growth represents an increase in the number of residential units only and that the actual population of the Study Area remained relatively constant during the years 1970-1976 (U.S. Department of Commerce; Bureau of Census; Revenue Sharing Program). This phenomena can almost directly be attributed to the decrease in the average household size from 3.15 household members in 1970 to 3.0 members in 1976 (U.S. Bureau of Census; Minnesota Labor Force Survey-Form 1 1977).

The data presented in Table 7 indicates that cities in the Study Area are growing slower (on a percentage increase in housing units basis) than the rural areas. Considerable growth, however, is taking place just outside of Virginia and Eveleth, and Ely. This suburban growth probably represents a large proportion of the growth identified as rural in Table 7, as can be seen in Table 6 and Figure 6. The townships located adjacent to Virginia and Eveleth show the most growth in the Study Area.

Other noticeable developments are occurring along the roads and highways throughout the Study Area. Places such as Palo, Lakeland, and the Embarrass sub-region which have been farming areas in the past, seem to be undergoing the most change. The rural type of development occurring in these areas consists of residences, frequently mobile homes, scattered along roads and highways.

Table 7. Estimated increase in households, 1970-1976 by Study Area city and sub-region.

CITY	EST. 1976 HOUSEHOLDS[a]	ESTIMATED HOUSEHOLDS ADDED 1971-1976[b]	% INCREASE IN HOUSEHOLDS 1970-1976
Ely-Winton	1,750	39	2
Babbitt	960	21	2
Tower	250	N.A.	N.A.
Aurora	930	44	5
Hoyt Lakes	1,240	44	4
Biwabik	490	7	1
Eveleth	1,560	59	4
Virginia	3,910	81	2
Gilbert	870	60	7
SUB-REGION (rural areas only)[c]			
Ely-N.E. resorts	1,390	139	11
Tower-Vermilion[d]	450	92	26
Southeast	60	6	11
Embarrass	1,290	327	34
East Range	1,830	512	39
TOTAL URBAN	11,950	355	3
TOTAL RURAL	4,770	1,076	29
TOTAL STUDY AREA	16,720	1,431	9

SOURCES: St. Louis County Planning and Zoning Dept., 1971-1976; U.S. Dept. of Commerce, Bureau of Census, "Housing authorized by building permits and public contracts" (series C-40), 1971-1976.

[a]Number of housing units 1976 (see Table 2)
[b]Based on building permit data 1971-1976.
[c]Includes building permits issued for seasonal homes in 1972.
[d]Includes city of Tower.

Other areas, most noticeably Britt, Florenton, and Benville, in the Embarrass sub-region, are developing as rural residential clusters. These are small clusters of up to 30 to 40 residences, often without any commercial services. These rural clusters are very small and represent only a very limited amount of the growth in the Study Area.

Lakeshore residential settlement, both seasonal and year-round, represents a larger portion of development in the Study Area than do rural communities, although less than either the suburban or highway oriented development. In most townships in the northern parts of the Study Area, building permits for seasonal homes account for more than 50% of all permits issued for single family dwellings (Figure 5).

7.2.4 Factors Affecting the Location of New Residential Settlement

The choice to build or buy a home in a particular area is influenced in general ways by settlement patterns established over many years and by current trends or styles. The decision to settle a specific site is also very much affected by practical considerations. These considerations include the availability of the land, the accessability of the land, water availability, and other amenities. This section describes certain specific constraints and influences on this decision and assesses the degree of its impact on location decisions.

7.2.4.1 Public Land Ownership--The difficulty of acquiring public land for residential development makes it a considerable constraint on potential settlement. County held tax-forfeit lands are the only public holdings where obtaining leases or purchasing rights is possible. Of all rural residential settlement, only 11% is located on publically-owned lands which account for almost 57% of all land in the Study Area (Table 8).

Table 8

7.2.4.2 Water and Wetland Areas--Approximately 12% of the total land in the Study Area is either under water (8%) or defined as being permanently wet (4%-marshlands, spruce bogs, and peat bogs)(Table 9). It is assumed that with sufficient amounts of upland areas available for settlement that permanently wet, low-lying areas would significantly inhibit development.

Table 9

Analysis of the Regional Copper-Nickel Study Land Use map and the Residential Settlement map gives strong support to this assumption. There are only 19 residences outside of urban areas (less than 1% of the total number of rural residences) located on the 4% of the land in the Study Area designated in the Copper-Nickel Study land use inventory as being permanently wet. Many of these residences may actually be on "high-dry" lands, since available soils information does not identify small scale variations.

7.2.4.3 Minelands--Obviously, land used directly in the mining process such as pits, plants, tailings basins, waste rock piles, reservoirs, and support facilities is precluded from being developed for residential purposes. There is a great deal of land not presently in direct use, however, which must also be considered as a constraint to residential settlement. This includes land owned by mining interests which is scheduled either for expansion of mines or for proposed facilities such as tailings basins.

In all, these areas represent approximately 3% percent of the land in the Study Area (Table 9). Information compiled on the basis of 40 acre parcels shows 19

Table 8. Rural residential settlement on public land, 1977.

TYPE OF PUBLIC OWNERSHIP	NUMBER OF RESIDENCES	% TOTAL RURAL RESIDENCES[b]	% TOTAL AREA RCNSA
BWCA	39	*	4
National Forest	286	3	28
State Forest	160	2	7
D.N.R. (other than State Forest)	193	2	5
County Forest	40	*	3
Other County (Tax Forfeit)	143	2	9
Partial Public[a]	27	*	1
Other Public	79	1	1
TOTAL	967	11	57

SOURCES: Regional Copper-Nickel Study Residential Settlement Map, MLMIS V36-File 4; MLMIS Public Ownership Map, V05-File 1.

[a]A governmental agency is part owner of land with poorly documented boundaries, and/or when the percentage ownership of a tract is in question, and/or when the other party or parties with legal claims to the land are not known.

*Less than 1%.

Table 9. Rural residential settlement on selected land uses, 1977.

LAND USE	NUMBER OF RESIDENCES	% TOTAL RURAL RESIDENCES	% TOTAL AREA RCNSA
Mining	19	*	3
Rural residential	4,600	53	2
Agricultural	597	7	2
Open-vacant	446	5	3
Forest	2,232	26	75
Unproductive forested swamps/non-forested swamps-marshes	19	*	4

SOURCES: Regional Copper-Nickel Study land use map (MLMIS-V45, File-0); Regional Copper-Nickel Study residential settlement map (MLMIS-V36, File 0).

*Less than 1%.

residential structures (less than 1% of total rural residential structures) existing on designated mineland.

7.2.4.4 Relief--The greatest amount of rural residential settlement is found on rolling terrain in areas which have been cleared and cultivated such as in the Embarrass sub-region and the Palo area (Table 10). There are large areas of dry, rolling terrain in the southeastern section of the Study Area but this area is heavily forested, virtually roadless, and has soils which are generally considered to be unsuitable for residential development. Relief, considered independently of other natural features, is probably now of little influence to residential settlement.

Table 10

7.2.4.5 Soil Suitability--Soils data presently available for the Study Area is accurate only to the 80 to 160 acre level (except for peat areas which are accurate to the 40-acre level) which makes it useful only in very general terms as a tool for gauging the degree to which soil suitability may influence residential settlement.

The degree of conformity between soils considered good for development and actual settlement seems to be considerably higher in the East Range and Embarrass sub-regions than elsewhere in the Study Area. These are the areas with the largest amount of soils most suited for residential construction and where significant development has occurred.

The lake and resort regions of the north seem to have a large number of residences located on soils considered poor for development. These are mostly lake homes and cabins (Table 11).

Table 10. Rural residential settlement on areas of varying relief, 1977.

RELIEF[a] CHARACTERIZED AS	NUMBER OF RESIDENCES	% TOTAL RURAL RESIDENCES	% TOTAL AREA RCNSA
Rugged	2224	28	31
Very Rugged	0	0	*
Rolling	4439	55	37
Flat	1101	14	26
Relief Not Considered	289	4	4

SOURCES: Soil Conservation Service Data, MLMIS V15; Regional Copper-Nickel Study Residential Settlement Map, MLMIS V36, File 4.

[a] Flat = relief up to 10'
Rolling = relief up to 50'
Rugged = relief up to 100'
Very rugged = relief up to 150'

*Less than 1%.

Table 11

Since detailed soils data are not available, soil suitability data cannot be used in this analysis to establish a supportable relationship between soil suitability and residential settlement.

7.2.4.6 Zoning Ordinances--Residential structures are found in 24 different zoning districts. In addition, 804 structures (10% of total rural residential structures) are found either in areas where zoning maps were unavailable or on the Vermillion Lake Indian Reservation (Table 12). Of the 24 zones where residences were found, 13 specifically permit residential structures, 4 allow them conditionally, 4 prohibit them, and specific provisions concerning residential uses were unavailable for 3.

Table 12

Eighty percent of all rural residential settlement occurs in the 13 zones which specifically permit residential use. Another 8% are found in zones which conditionally allow residential uses (Table 12).

Although these figures seem to give support to the argument that zoning should be considered a constraint to residential settlement, it must be remembered that zoning districts are almost always a reflection of already existing land use patterns. Furthermore, zoning variances are granted and changes in the zoning ordinance itself may be considered by the appropriate legislating bodies.

7.2.4.7 Availability of Electricity--Electrical utilities are required by law to extend services wherever they are requested. The distributors may, however,

Table 11. Rural residential settlement on soils classified suitable or unsuitable for development, 1977.

SOIL TYPE	NUMBER OF RESIDENCES	% TOTAL RURAL RESIDENCES	% TOTAL AREA RCNSA
Suitable for Development[a]	4220	52	24
Unsuitable for Development[a]	3833	48	72

SOURCES: Soil Conservation Service Data, MLMIS V15; Regional Copper-Nickel Study Residential Settlement Map, MLMIS V36-File 4.

[a]Soils classified as suitable or unsuitable on basis of severity of limitations on septic systems and for residential use as determined by U.S. Soils Conservation Service.

Table 12. Rural residential settlement in various zoning districts, 1977.

ZONING DISTRICT DESIGNATION	NUMBER OF RESIDENCES	% OF TOTAL RESIDENCES	% TOTAL AREA RCNSA
Residences Permitted			
St. Louis-Residential, Low Density	2028	25	16
St. Louis-Residential, Medium Density	373	5	2
St. Louis-Residential, High Density	248	3	1
St. Louis-Residential Dev., Lakes & Str.	1123	14	3
St. Louis-General Dev., Lakes & Streams	2116	26	6
Lake-Residential, Low Density	21	*	*
Lake-Rural, Nonfarm Residential	1	*	*
Lake-Residential-Recreation (yr-round)	337	4	1
Lake-Residential-Recreation (seasonal)	22	*	*
Lake-Forest Management, Recreation	101	1	19
Aurora-Residential, Low Density	7	*	*
Eveleth-1 & 2 Family Residential	32	*	*
Babbitt-Rural Residential	93	1	*
Residences Conditionally Permitted			
St. Louis-Commercial	24	*	*
St. Louis-Open Space (vital areas)	179	2	23
St. Louis-Natural Environment, Lakes & Streams	474	6	9
Hoyt Lakes-Conservancy District	6	*	1
Residences Prohibited			
St. Louis-Heavy Industry	21	*	3
Hoyt Lakes-Mineral mining	2	*	1
Gilbert-Mining	36	*	*
Lake-BWCA	5	*	2
Information Unavailable			
Babbitt-Conservancy District	13	*	1
Babbitt-Mineral Mining	2	*	3
Eveleth-Heavy Industry	31	*	*
Zoning Map Unavailable	724	9	2
Vermillion Lake Indian Reservation	34	*	*

SOURCES: Planning and Zoning Depts., St. Louis and Lake counties, 1977; City Clerk Offices, Aurora, Babbitt, Biwabik, Ely, Eveleth, Gilbert, Hoyt Lakes, and Virginia 1977; Regional Copper-Nickel Study Residential Settlement Map, MLMIS V36-File 4.

*Less than 1%.

charge for this extension of services after the first one-fourth mile. Northern Electric Power Co-Operative has indicated that much of its area is well covered by existing lines and that the need to extend services as much as one mile is infrequent (Patee 1977). Furthermore, the utilities will subsequently buy back portions of the line as new customers in the area require service. These findings indicate that electricity is available at a cost throughout the Study Area. For this reason, availability of electricity is considered only as a minor constraint on residential settlement, although in some areas (especially the southeastern sub-region) the cost of extending electric service to more remote areas may discourage settlement.

7.2.4.8 Availability of Water and Sewage Service--Water and sewage service is readily available in the Study Area cities, all of which are served by municipal systems.

Residences in rural areas are entirely dependent on private wells and septic systems. Detailed information on location of aquifers and the suitability of soils for septic systems is presently unavailable, but field experience of Copper-Nickel Study indicates that, except in areas of bedrock outcropping or permanently wet soils, water availability and sufficient septic capacities are at least feasible if not always inexpensive.

7.2.4.9 Road Accessibility--Analysis of mapped data shows an obvious strong relationship between land which is accessible by motor vehicles to the general public and areas of residential settlement.

The designation of accessible land as land within one mile of a roadway is a very liberal one since, as a result, almost 75% of the Study Area can be said to be accessible to motor vehicles. The major areas which are not within road ame-

e ity areas are tracts of National Forest land in the east and far north of the Study Area and the mining company lands straddling the iron ore formation.

7.2.4.10 Water Amenity Areas--The observed incidence of water-oriented residential settlement suggested an assumption that residential settlement would most frequently occur within these water amenity areas. Further analysis of the residential settlement map and water amenity map partially substantiates this assumption.

Excluding urban settlement, 46% of residential settlement occurs within one-half mile of a lake while this land only accounts for about 24% of the total land area in the Study Area (Table 13). It is important to note, however, that these figures include seasonal dwellings which, no doubt, are more frequently found alongside lakes than permanent year-round homes. Nevertheless, it is safe to say that a sizable amount of year-round settlement occurs in these lake amenity areas--particularly in the East Range sub-region in the vicinity of Virginia and Eveleth.

Table 13

The concentration of settlement around lakes is not, however, paralleled by similar concentrated developments within river and stream amenity areas (land within one-fourth mile of a stream or river). Although about 18% of the total land area in the Study Area is within a river or stream amenity area, only an estimated 13% of residences are located there.

Roughly 75 percent of rural residential settlement is found in either lake or river and stream amenity areas demonstrating the attractive qualities of living near water.

Table 13. Rural residential settlement on water amenity land, 1977.

TYPE OF WATER AMENITY LAND	NUMBER OF RESIDENCES	% TOTAL RURAL RESIDENCES	% TOTAL AREA RCNSA
Land within 1/4 mile of a river or stream	1080	13	18
Land within 1/2 mile of a lake	3700	46	24
Land within both 1/4 mile of rivers and 1/2 mile of a lake	542	7	5
Water[a]	740	9	4
TOTALS	6062	75	52

SOURCES: Regional Copper-Nickel Study Residential Settlement Map, MLMIS V36-File 4; Regional Copper-Nickel Study Water Amenity Land Map, MLMIS V32-File 4.

[a]These lakeshore residences are found in parcels which actually contain dry land but were classified as water due to the fact that 50% or more of their surface area is under water.

7.2.4.11 Distance to Work--In the past, the primary influence on settlement patterns along the Mesabi Iron Range was the location of places of employment. The automobile has changed settlement patterns by allowing workers to commute relatively long distances to and from work. This change, however, seems to be one mostly of scale; that is, a high percentage of workers still live close to their place of employment relative to the large area from which it is possible to commute by car.

Table 14 shows the number of estimated workers within the Study Area who traveled a given distance to work. A little more than half (54%) travel no more than seven miles to work and more than two-thirds (71%) travel no more than twelve miles. Slightly less than 90% of the workers live within 27 miles (or 32 minutes) of their place of employment (Tables 14 and 15).

Tables 14 & 15

The pattern illustrated in Figure 7 shows how certain mining companies tend to dominate the mining labor force in their respective areas. Even in Virginia the large majority of mine workers work at one plant (in this case U.S. Steel's Minntac operation). The residential settlement patterns in the Study Area have been, and continue to be, shaped by the location of employment centers.

7.2.4.12 Location of Commercial Services--The effect that the availability of commercial services has on residential settlement patterns is difficult to distinguish from the effects that settlement patterns have on the availability of commercial services. The extent to which Virginia dominates the commercial markets in the Study Area is shown in Table 16. Although only approximately 23% of the population lives in Virginia (11,730 people--1976 U.S. Dept. of Commerce

Table 14. Distance in miles to work.

DISTANCE TO WORK (miles)	ESTIMATED WORKERS WHO TRAVEL THIS DISTANCE	% TOTAL ESTIMATED WORKERS	+ OR - ERROR ON ESTIMATED WORKERS	CUMULATIVE % TOTAL ESTIMATED WORKERS	ESTIMATED MILES COMMUTED ONE-WAY TO WORK[c]	% TOTAL ESTIMATED COMMUTOR MILES	CUMULATIVE % TOTAL ESTIMATED COMMUTOR MILES
Study Area							
0-2	4257	28	5.12	28	5159	3	3
3-7	3946	26	4.98	54	19607	11	14
8-12	2610	17	4.27	71	26133	15	29
13-17	1460	9	3.38	80	21628	12	42
18-27	1492	10	3.42	90	32720	19	61
28+	1554	10	3.50	100	68020[a]	39	100
TOTALS	15319	100			173267	100	
Region 3							
0-2	28208	28	4.34	28	39,715	2	2
3-7	31961	32	4.49	60	149,396	9	11
8-12	12470	12	3.18	73	125,788	8	19
13-17	7022	7	2.46	80	105,085	6	25
18-27	7627	8	2.55	88	162,955	10	35
28+	12228	12	3.16	100	1,077,731[b]	65	100
TOTALS	99516	100			1,660,670	100	

SOURCE: Minnesota Labor Force Survey-Form 1, 1977.
MLFS-1 Survey, 1978.

[a]All trips longer than 60 miles were given a value of 65 miles.
[b]All trips longer than 140 miles were given a value of 150 miles.
[c]Total estimated miles driven on a single, one-way trip to work for all workers in each classification.

Table 15. Travel time to work.

TRAVEL TIME (min.)	ESTIMATED WORKERS WHO TRAVEL THIS DISTANCE	% TOTAL ESTIMATED WORKERS	+ OR - ERROR ON ESTIMATED WORKERS	CUMULATIVE % TOTAL ESTIMATED WORKERS	ESTIMATED MILES COMMUTED ONE-WAY TO WORK[c]	% TOTAL ESTIMATED COMMUTOR MILES	CUMULATIVE % TOTAL ESTIMATED COMMUTOR MILES
Study Area							
0-7	3232	21	4.64	21	14791	5	5
8-12	4071	27	5.04	47	40272	14	19
13-17	2299	15	4.08	62	34492	12	31
18-22	1958	13	3.82	75	39091	13	44
23-32	1989	13	3.84	88	56678	19	64
33+	1770	11	3.66	100	104874[a]	36	100
TOTALS	15319	100			290198	100	
Region 3							
0-7	23608	24	4.06	23	109,807	4	4
8-12	19855	20	3.84	43	198,064	7	11
13-17	16223	16	3.57	60	243,101	9	20
18-22	13075	13	3.25	73	261,019	10	30
23-32	12712	13	3.22	85	355,935	13	43
33+	14043	14	3.37	100	1,519,380[b]	57	100
TOTALS	99516	100			2,687,306	100	

SOURCE: Minnesota Labor Force Survey-Form 1, 1977.

[a]All trips longer than 90 minutes were given a value of 100 minutes.
[b]All trips longer than 180 minutes were given a value of 200 minutes.
[c]Total estimated minutes spent on a single, one-way trip to work for all workers in each classification.

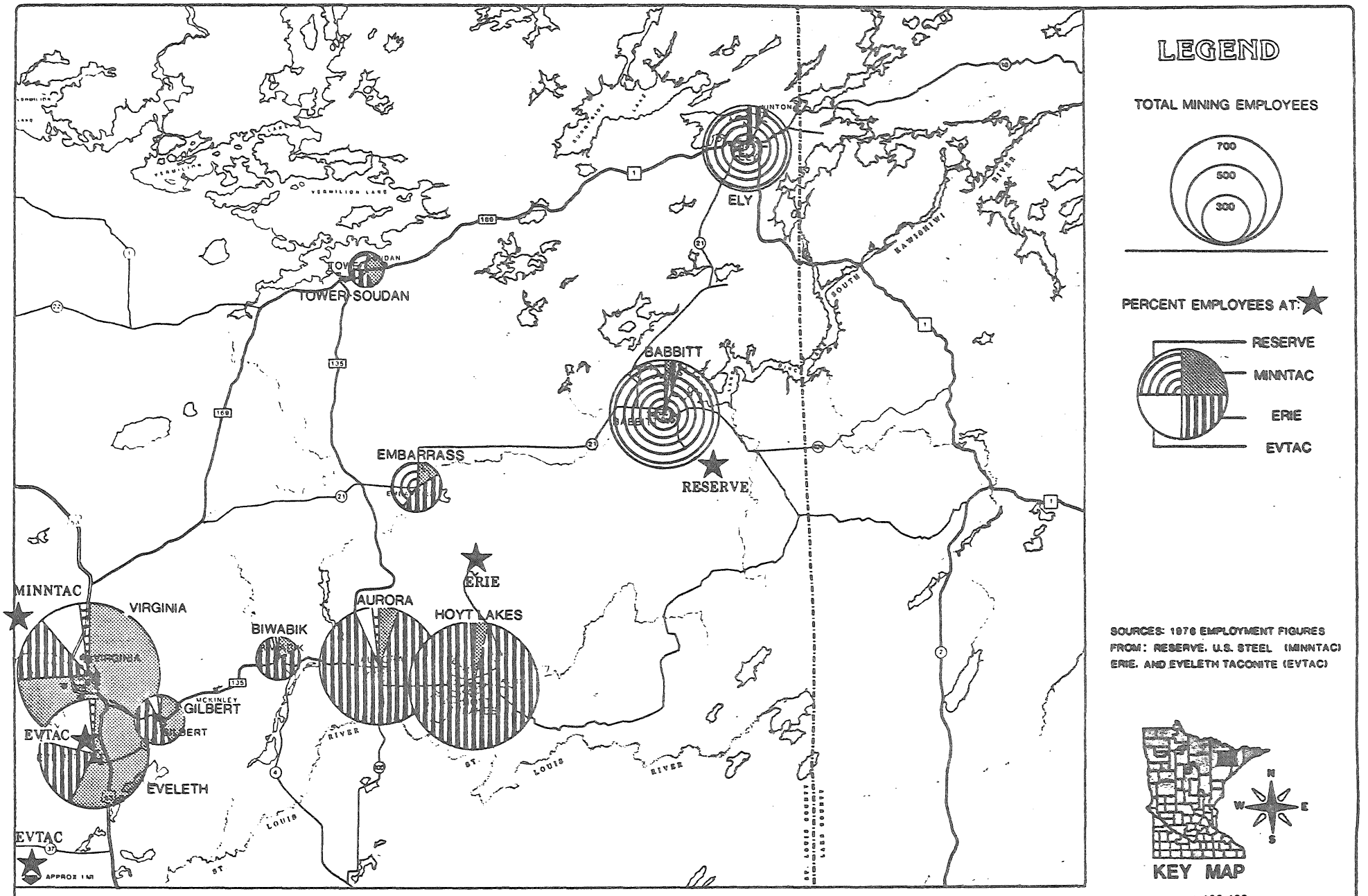


FIGURE 7 MEQB REGIONAL COPPER-NICKEL STUDY

TACONITE EMPLOYMENT

SELECTED COMMUNITIES. SELECTED MINES 1976

estimates), an estimated 37% to 72% of the Study Area total population shops there for various goods and services (MLFS 4, 1977).

Table 16

The estimated market for Ely is indicative of a much more localized market--perhaps due to the relatively longer distances between Ely and the nearest competing commercial center (roughly 40 miles). Ely, which has approximately 10% of the Study Area population, attracted an estimated 9 to 14% of Study Area shoppers.

While Virginia consistently attracts a market larger than its share of the total population and Ely draws shoppers in numbers roughly equal to its share, the remainder of the Study Area towns attract a market that ranges from substantially less than their relative proportion of the population to substantially more. The size of the market drawn to these other towns seems to depend on the goods or service in question.

Certain items and services such as groceries, gasoline, and banking are usually obtained close to home or work (Table 17), and a relatively high percentage of shoppers are estimated to purchase these things in the East Range towns (Table 16). A willingness to travel further for other items (which may or may not be available in a nearby town) such as clothing or medical services, places much of the demand for these particular services on Virginia.

Table 17

Virginia's status as a regional service center (Table 19) is due to the fact that it provides the relatively specialized goods and services for which people

Table 16. Number and percentages of Study Area households which buy certain goods or servics in a particular town.

TOWN WHERE GOODS OR SERVICES ARE PURCHASED	ESTIMATED # HOUSEHOLDS	% TOTAL STUDY AREA HOUSEHOLDS	+ OR - ERROR
Groceries			
Virginia	7775	49	5.87
Ely	1864	12	3.74
East Range Towns[a]	6099	39	5.71
Other Towns[b]	62	*	0.70
Do Not Purchase	----	----	----
TOTAL	15800	100	
Gasoline			
Virginia	5846	37	5.65
Ely	1612	10	3.51
East Range Towns[a]	6652	42	5.79
Other Towns[b]	284	2	1.58
Do Not Purchase	1406	9	3.32
TOTAL	15800	100	
Clothing			
Virginia	11408	72	5.24
Ely	1801	11	3.68
East Range Towns[a]	1153	7	3.07
Other Towns[b]	1217	8	3.15
Do Not Purchase	221	1	1.39
TOTAL	15800	100	
Hardware, Tools, Appliances, Furniture, Auto Supplies			
Virginia	8848	56	5.81
Ely	1801	11	3.68
East Range Towns[a]	3302	21	4.74
Other Towns[b]	569	4	2.13
Do Not Purchase	1280	8	3.21
TOTAL	15800	100	

Table 16 continued.

TOWN WHERE GOODS OR SERVICES ARE PURCHASED	ESTIMATED # HOUSEHOLDS	% TOTAL STUDY AREA HOUSEHOLDS	+ OR - ERROR
Medical-Dental			
Virginia	8437	53	5.84
Ely	2022	13	3.88
East Range Towns[a]	4472	28	5.28
Other Towns[b]	395	2	1.82
Do Not Purchase	474	3	1.96
TOTAL	15800	100	
Banking			
Virginia	6620	42	5.78
Ely	1801	11	3.68
East Range Towns[a]	6620	42	5.78
Other Towns[b]	443	3	1.90
Do Not Purchase	316	2	1.68
TOTAL	15800	100	

SOURCE: Minnesota Labor Force Survey-Form 4, 1977.

[a]Aurora, Biwabik, Babbitt, Eveleth, Gilbert, Hoyt Lakes, Tower, Soudan, Embarrass, Winton.

[b]Includes: Hibbing, Duluth, other St. Louis County, Grand Rapids, International Falls, Twin Cities.

Table 17. Number and percentages of Study Area households which drive a given distance for particular goods or services.

DISTANCE IN MILES TO GOOD OR SERVICE	ESTIMATED # HOUSEHOLDS	% TOTAL HOUSEHOLDS	+ OR - ERROR	CUMULATIVE % TOTAL HOUSEHOLDS
Groceries				
1 or less	7489	47	5.85	47
2-3	2828	18	4.48	65
4-7	2860	18	4.50	83
8-17	1643	10	3.54	94
18 or more	980	6	2.81	100
TOTAL	15800	100		
Gasoline				
1 or less	7963	50	5.88	50
2-3	3128	20	4.66	70
4-7	2781	18	4.45	88
8-17	1438	9	3.35	97
18 or more	490	3	1.99	100
TOTAL	15800	100		
Clothing				
1 or less	4487	28	5.28	28
2-3	2196	14	4.04	42
4-7	2117	13	3.97	56
8-17	2054	13	3.91	69
18 or more	4946	31	5.45	100
TOTAL	15800	100		
Hardware, Tools, Appliances, Furniture, Auto Supplies				
1 or less	5514	35	5.58	35
2-3	2765	17	4.44	52
4-7	2496	16	4.28	68
8-17	2165	14	4.01	82
18 or more	2860	18	4.50	100
TOTAL	15800	100		

Table 17 continued.

DISTANCE IN MILES TO GOOD OR SERVICE	ESTIMATED # HOUSEHOLDS	% TOTAL HOUSEHOLDS	+ OR - ERROR	CUMULATIVE % TOTAL HOUSEHOLDS
Medical-Dental				
1 or less	6241	39	5.74	39
2-3	2544	16	4.31	56
4-7	2907	18	4.53	74
8-17	1912	12	3.78	86
18 or more	2196	14	4.04	100
TOTAL	15800	100		
Banking				
1 or less	7947	50	5.88	50
2-3	2876	18	4.51	68
4-7	2212	14	4.06	82
8-17	1991	13	3.85	95
18 or more	774	5	2.49	100
TOTAL	15800	100		

SOURCE: Minnesota Labor Force Survey-Form 4, 1977.

seem to be willing to travel greater distances. More importantly, because Virginia holds a larger share of the market, it is capable of supporting not only larger numbers of commercial establishments (Table 18) but a wider range of goods. This wide range of goods and services serves as an attraction to residential settlement.

Tables 18 & 19

7.2.4.13 Recreational Areas--With the exceptions of public parks and other publically owned land where residential development has been shown to be precluded, recreational areas (other than lakes, which have been discussed previously) do not seem to be a major force influencing residential within the Study Area. New residents may be attracted to the Study Area as a whole due to the numerous recreational resources available within the region. Since almost 57% of the Study Area is designated as public reserves (for recreation or multiple use in forested areas), recreational amenity lands are ubiquitous. Prospective new residential settlers apparently do not consider proximity to recreational areas an important factor in determining residential site location, because access to recreation lands is not difficult.

7.2.4.14 Summary--Proximity to roads or lakes appears to have a significant attractive effect on residential settlement patterns. Public ownership, mining operations, and wetland areas appear to significantly constrain residential development. Distance to place of employment, while not as severe a constraint on site selection as in the past, still plays a noticeable role in determining settlement patterns.

Other influences such as topography, zoning regulations, and proximity to commercial, health, or recreational facilities appear to have relatively little effect on settlement patterns.

Table 18. Number of selected commercial establishments by city, 1976.

ESTABLISHMENT	AURORA	BABBITT	BIWABIK	ELY	EVELETH	GILBERT	HOYT LAKES	VIRGINIA	TOTAL
Bank	1	1	1	1	2	1	1	3	11
Building Survey	2	0	1	3	1	0	0	3	10
Gasoline	7	3	2	12	10	2	2	21	59
Grocery	4	2	3	5	6	1	1	14	36
Hardware	3	1	1	4	2	2	1	8	22
Mortuary	1	0	0	1	2	1	0	3	8
New Car Dealer	1	0	0	4	4	1	1	5	16
Restaurant	5	3	1	13	10	3	1	27	63
Savings & Loan	0	0	0	1	0	0	0	1	2
Shopping Center	0	1	0	0	0	0	1	2	4
Tavern	3	1	1	5	3	1	0	6	20
TOTAL	27	12	10	49	40	12	8	95	253

SOURCE: Telephone Directories of the above communities.

Table 19. Commercial center hierarchy.

TYPE OF CENTER	CITY-CITIES
Regional Service Center	Virginia-Eveleth
Community Service Center	Ely
Full Convenience Center	Aurora, Hoyt Lakes, Gilbert
Partial Convenience Centers	Babbitt, Biwabik

SOURCE: Upper Midwest Council, "Recent Trends/ Future Prospects--A Look at Upper Midwest Population Changes," 1973.

7.3 IMPACTS OF COPPER-NICKEL MINE DEVELOPMENT ON RESIDENTIAL SETTLEMENT PATTERNS IN THE REGIONAL COPPER-NICKEL STUDY AREA

This section describes the potential impacts of development of the copper-nickel resources in northeastern Minnesota on the location and density of residential settlement in the Regional Copper-Nickel Study Area (Study Area). In general, two major types of impacts are discussed: 1) the growth of settlement in the Study Area as a result of increases in employment opportunities due to Cu-Ni development, including a brief section which addresses the topic of consumption of land by new residential settlement; and 2) the direct impacts on existing and projected residential land uses of direct land consumption by mining.

In looking at the growth of residential settlement expected to result from mining development, an attempt has been made to distinguish between those factors affecting settlement patterns which are truly generic in nature and those which will change with each individual mining proposal. The geographic allocation of new households in the Study Area was accomplished by creating a computerized Residential Settlement Distribution Model which distributed new households to 224 Residential Settlement Model Zones covering the Study Area (Figure 8). For a complete discussion of this modelling procedure see Regional Copper-Nickel Study Level I report, "Description of Residential Settlement Model" by Eric H. Bauman and Anthony Lea, 1979.

Prior to the actual allocation of new households, however, certain assumptions were made regarding the nature of future growth in the region. First, it was assumed that copper-nickel mining development would not begin until 1985. Baseline residential settlement figures were projected for 1984 and include growth up to that time resulting from expansion in the taconite industry. It

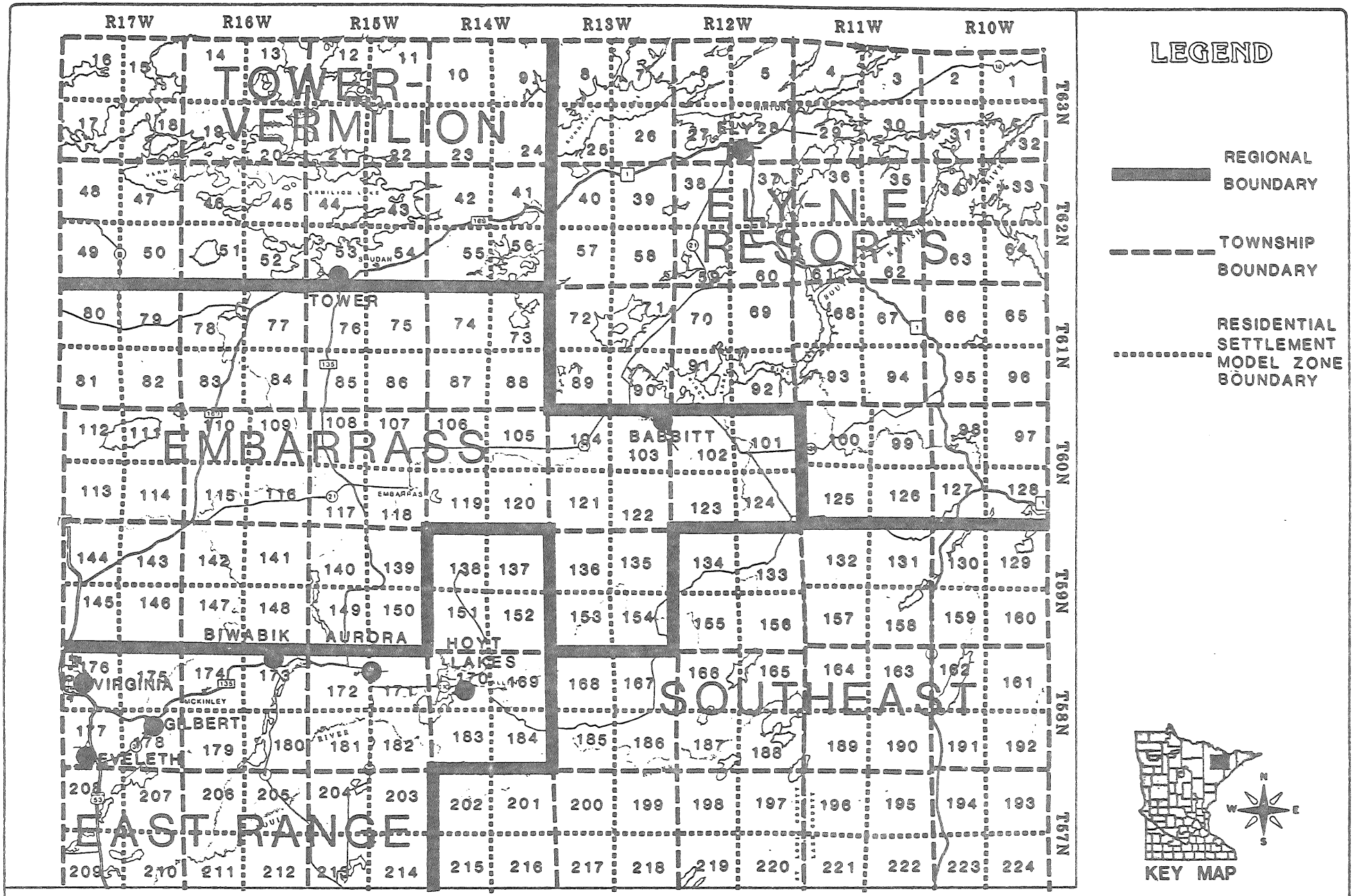


FIGURE 8 **MEQB REGIONAL COPPER-NICKEL STUDY**

CITIES AND RESIDENTAL SETTLEMENT SUB-REGIONS OF THE STUDY AREA
INCLUDING 224 RESIDENTIAL SETTLEMENT MODEL ZONES

was further assumed that while taconite production would continue to expand beyond 1984 this would be due to increased productivity, and as a result, net growth of settlement resulting from growth in the taconite industry would cease by 1985.

Another set of assumptions was built into the model itself. These fundamental assumptions are:

1) distance to work -- it is assumed that workers will live within a reasonable distance of their place of employment; this distance varies with the type of workforce involved;

2) availability of land for residential settlement -- land considered available for residential settlement is land which is privately owned, within one mile of a public road, and not within three miles of an existing or proposed minesite (except for land which is already settled);

3) existing population centers -- it is assumed that a large number of future inmigrants will be attracted to areas which are already centers of population;

4) commercial amenities -- it is assumed that future settlement will tend to occur in areas where commercial services are presently available.

These factors are fundamental in determining the residential settlement patterns of any new population whether that growth is spurred by proposed mining developments.

The distributions described in this report are, however, influenced by factors which are, to varying degrees, tied to specific elements of a given development proposal. The bulk of this section is geared to assessing the impacts on residential settlement patterns of the following factors:

1) the geographical location of the mine -- the location of the proposed mine is central to determining a settlement pattern based on the distance to work assumption contained in the model;

2) the nature of the workforce -- allocation procedures within the model were slighty different for construction, operating, and secondary workforces;

3) a new public road connecting Babbitt & Hoyt Lakes (proposed AMAX road) -- the presence or absence of this proposed road affects settlement patterns by, in some cases, altering the distance necessary to travel to work;

4) the size of the mine development -- the size of the development, specifically the size of workforce required, while not greatly affecting the actual geographic distribution of settlement, does affect the density of settlement in particular areas;

5) the intensity of development -- the intensity of development refers to possibility of several mines operating simultaneously, most likely in different locations along the basal contact of the Duluth Complex;

6) time -- when the various mine developments begin operation will have an effect on when residential growth will occur in different sections of the Study Area and may potentially affect where such growth may occur by establishing locational precedents which may affect later settlement.

Most of the shifts in residential settlement patterns are summarized in this chapter by referring to changes in the number or percentage of new households which occupy a particular city or region of the Study Area. Figure 3 is a map showing the locations of the cities and the boundaries of the regions for which figures are presented.

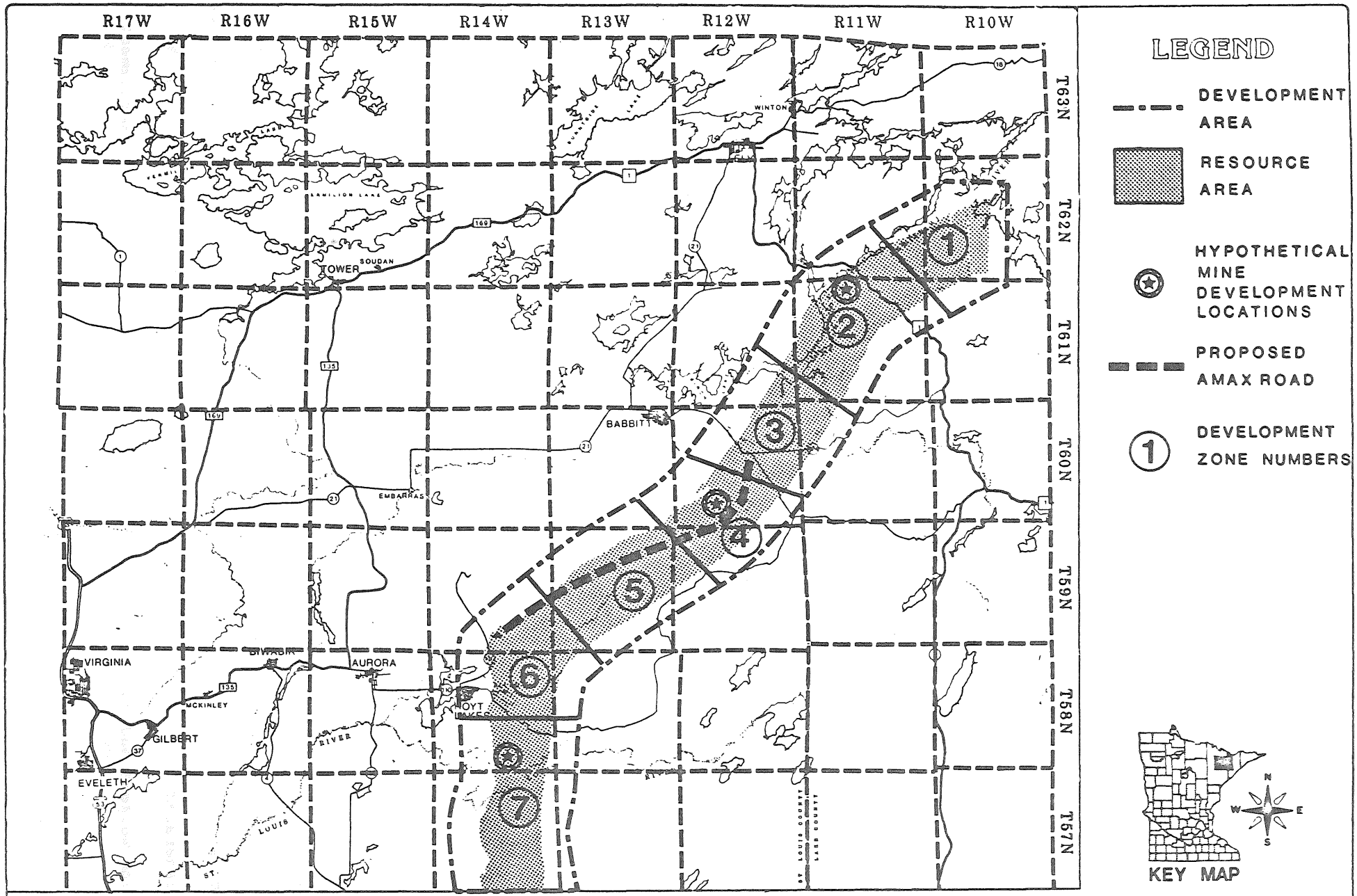


FIGURE 9 **MEQB REGIONAL COPPER-NICKEL STUDY**

COPPER-NICKEL DEVELOPMENT AREA, RESOURCE AREA, AND DEVELOPMENT ZONES INCLUDING LOCATION OF PROPOSED AMAX RD.

Figure 9 illustrates the Copper-Nickel Development Area, the Copper-Nickel Resource Area, and the seven Copper-Nickel Development Zones. The rationale for the establishment of these areas and their boundaries can be found in detail in Volume 5-Chapter 5, Minelands.

7.3.1 Setting the Stage

7.3.1.1 Baseline Distribution of Settlement 1984--Forecasts made with the Regional Copper-Nickel Study Residential Settlement Model and using Regional Copper-Nickel Study projections of manpower needs in the Taconite industry (1976-1984) (see Volume 5-Chapter 5, Minelands) show an increase in households by 1984 of 8% over 1976 levels (Table 20). Distribution of these households is not expected to differ greatly from existing settlement patterns discussed in the first part of this chapter primarily because it is expected that the majority of growth will be a result of expansion in existing employment centers. Table 20 shows the projected 1984 populations and numbers of households in cities and rural areas of the Study Area compared to 1976 levels. The percentages of the total Study Area population living in a given city or residential region remains virtually identical.

Table 20

7.3.1.2 Projected Inmigration Rates--In projecting residential settlement patterns, three separate workforces have been postulated; the temporary construction workforce which builds the facilities, the permanent operating workforce runs the facilities and actually produces the metal, and the secondary workforce generated by the mining development as a result of the demand for services by the workers and the companies. Two variables affecting Residential Settlement

Table 20. Estimated population and households in Study Area cities and sub-regions, 1976 and 1984.

CITY	1976 EST. POP.	1976 EST. HOUSE-HOLDS[a]	1976 % TOTAL STUDY AREA HOUSEHOLDS	1984 EST. POP.	1984 EST. HOUSE-HOLDS	1984 % TOTAL STUDY AREA HOUSEHOLDS	% INCREASE 1976-1984
Ely	5,240	1,750	10	5,550	1,850	10	6
Babbitt	2,890	960	6	3,020	1,010	6	5
Tower	740	250	1	770	260	1	4
Aurora	2,790	930	6	2,990	1,000	6	8
Hoyt Lakes	3,720	1,240	7	3,880	1,290	7	4
Biwabik	1,480	490	3	1,570	520	3	6
Eveleth	4,670	1,560	9	5,240	1,750	10	12
Virginia	11,730	3,910	23	13,260	4,420	25	13
Gilbert	2,600	870	5	2,800	930	5	7
SUB-REGION (rural areas only)							
Ely-N.E. resorts	4,170	1,390	8	4,300	1,430	8	3
Tower-Vermilion	600	200	1	620	210	1	5
Southeast	190	60	*	190	60	*	0
Embarrass	3,860	1,290	8	4,030	1,350	7	5
East Range	5,480	1,830	11	5,810	1,940	11	6
TOTAL URBAN	35,860	11,960	71	39,100	13,030	72	9
TOTAL RURAL	14,300	4,770	29	14,950	4,990	28	5
TOTAL STUDY AREA	50,160	16,730	100	54,050	18,020	100	8

SOURCES: [a]U.S. Dept. of Commerce, Revenue Sharing Program, population estimates, 1976; Regional Copper-Nickel Study estimates of 1976 rural households and population (see Table 2).

[b]Regional Copper-Nickel Study residential settlement model; Reg. Copper-Nickel Study Forecasts of Manpower Needs of Taconite Industry, 1976-1984.

*Less than 1%.

Patterns have been considered for each workforce. These are: 1) the rate at which each workforce generates inmigrants to the Study Area, and 2) the average weighted distance traveled to work for each workforce. In the case of the construction workforce, there is an additional factor affecting settlement patterns namely, the expected out-migration of virtually all those workers who moved in to the Study Area to take construction jobs (a small percentage are projected to become mine operating workers).

The percentage of jobs resulting from Cu-Ni development which will be filled by inmigrants to the area varies between operating, construction, and secondary workforces. In addition, the percentage of total job openings which will be filled by inmigrants varies as the location of the place of employment changes. Two basic factors, each affecting all three workforces, account for these differences. One factor is the proportion of workers in each workforce who will be hired out of the existing Study Area Labor pool. This percentage varies only with workforce type (Tables 21, 22, and 23).

Tables 21, 22, 23

The other factor which affects the inmigration rate of all three workforces is the percentage of workers who will live outside of the Study Area and commute in to jobs. These percentages, which are estimates based on taconite worker commuting data, residential-location preferences expressed by workers surveyed, and an examination of available land and the existing road network within and imediately adjacent to the Study Area, vary not only with the workforce type but with location of the mine as well. For instance, it is expected that a higher percentage of workers at a mine in zone 7, near the southern border of the Study Area, will commute in to the Study Area than will commute to a job located at

Table 21. Sources of employees for construction workforce.

Source	PERCENT OF TOTAL WORKFORCE Zone 2	Zone 4	Zone 7
Males from Study Area Labor Pool[1]	21%	21%	21%
Females from Study Area[2]	1%	1%	1%
Workers Commuting from Outside Study Area[3]	30%	40%	50%
Heads-of-Household[4] In-migrant	48%	38%	28%
TOTAL	100%	100%	100%

Sources: [1]Taconite construction workers survey, 1977.

[2]This estimate is based on a private conversation with the President of the Iron Range Building and Trades Union in September, 1978.

[3]Cu-Ni staff estimate. See Regional Copper-Nickel Study Level I report "Description of the Residential Settlement Model," by Eric H. Bauman and Anthony Lea.

[4]Remaining percentages.

Table 22. Sources of employees for operating workforce.

SOURCE	PERCENT OF TOTAL WORKERS Development Zone 2	Development Zone 4	Development Zone 7
Males from Study Area Labor Pool[1]	15%	15%	15%
Females from Study Area Labor Pool[2]	10%	10%	10%
Construction Crossover Workers from Study Area[3]	- - - - - - - - - VARIABLE - - - - - - - - -		
Construction Crossover Workers Who Were Inmigrants[4]	- - - - - - - - - VARIABLE - - - - - - - - -		
Males commuting from outside Study Area[5]	5%	8%	15%
New Operating Inmigrant Heads-of-Households[6]	- - - - - - - - - VARIABLE - - - - - - - - -		
TOTAL	100%	100%	100%

Sources: [1,2]A survey of the Minnesota taconite companies shows that women comprise an average of 7% of the production/maintenance/office and administration workforce (1978 data). At one plant, the average is expected to be 10% by January, 1979. The total estimate was increased to 10% assuming that female labor force participation will continue to increase in the future.

Further, it was assumed that the male labor force pool would exceed the female rate, 15 percent was assumed.

[3] $\frac{EC \times .12}{OP}$ where: EC = absolute number of Cu-Ni construction workers who are in-commuters or were drawn from existing labor pool.
.12 = Crossover rate to operating workforce (based on a private conversation with the President of the Iron Range Building & Trades Union, May, 1978).
OP = Total number of Cu-Ni operating workers

[4] $\frac{IC \times .12}{OP}$ where: IC = absolute number of inmigrant construction workers

[5]Cu-Ni staff estimate. See Regional Copper-Nickel Study Level I report, "Description of the Residential Settlement Model", by Eric H. Bauman & Anthony Lea.

[6]Remaining percentages

*NOTE: The actual inmigration rate used for the operating workforce is the sum of the percentages obtained for "new operating inmigrants" and "construction crossover inmigrants." To eliminate overestimation of inmigrants, the entire inmigrant construction workforce distribution was considered transient and those construction inmigrants who joined the operating workforce were distributed as operating workers.

Table 23. Sources of employees for secondary workforce.

SOURCE	PERCENT OF TOTAL WORKFORCE					
	Virginia	Eveleth	Gilbert	Biwabik	Aurora	Other Cities
Males and Females from Study Area Labor Pool[1]	20%	20%	20%	20%	20%	20%
Workers Commuting from Outside Study Area[2]	25%	25%	15%	10%	5%	0%
Secondary Jobs Filled by Second Members of new Cu-Ni Operating Households (.4 x new Cu-Ni families)][3]	- - - - - - - - - - - -		VARIABLE		- - - - - - - - - - - -	
Secondary Jobs Filled by Second Members of new Cu-Ni Service Households (1/1.4 x new gross service families)][4]	- - - - - - - - - - - -		VARIABLE		- - - - - - - - - - - -	
Heads-of-Household In-migrant	- - - - - - - - - - - -		VARIABLE		- - - - - - - - - - - -	
TOTALS	100%	100%	100%	100%	100%	100%

Sources: [1]Cu-Ni staff estimates.

[2]Cu-Ni staff estimate based upon (1) shorter average journey-to-work distances for service workers, and (2) hypothesis that service workers tend to live in or immediately adjacent to communities where they are employed in retail stores, and warehouses.

[3]An average of 40% of all households in the State of Minnesota have two or more employed persons. Therefore Cu-Ni staff estimates that some service workers will come from 40% of new in-migrating copper-nickel operating workers households (Minnesota Labor Force Survey, 1977).

[4]Forty percent of new in-migrating households for secondary jobs will also supply a second worker for service jobs.

zone 1 or 2 in the northeastern part of the Study Area due to the distance to work assumption.

In the case of the construction workforce, the portion of the workforce remaining after consideration of these two factors is assumed to be made up of workers who will move into the Study Area to take jobs in the copper-nickel construction workforce.

The operating workforce, however, will also contain a certain number of workers who were originally construction workers but who subsequently crossed over to become mine production workers. Thus, the percentage of the operating workforce made up of workers moving in to the Study Area is equal to the percentage remaining after elimination of in-commuters, workers drawn from the existing labor force, and construction cross-over workers who were not originally inmigrants themselves. These percentages, and their derivations, are summarized in Table 22.

The inmigration rate of the secondary workforce is also affected by certain factors in addition to in-commuting and the percentage of workers drawn from the existing labor pool. A large number of secondary workers are expected to be members of households in which another member is employed either as an operating or secondary worker. The precise percentage of the total secondary workforce which falls into these categories varies slightly with the size of workforce considered. A summary of those factors affecting the secondary workforce inmigration rate is presented in Table 23.

The figures presented in Table 21, 22, and 23 provide the link which relates the number of new households in the Study Area (equal to inmigrating heads-of-households) directly to the size of the total workforce generated by copper-nickel development.

7.3.1.3 Average Distance Traveled To Work (By Workforce)--The distance a worker is willing to commute to a job impacts residential settlement patterns by virtue of its affect on the dispersal of households around an employment center. Generally, a larger number of workers are expected to live close to work than will live further away. This "distance decay" factor is a major component of the Residential Settlement Model. A different distance decay function has been calculated for each workforce category based on the average weighted distance traveled to work by members of that workforce (Table 24).

Table 24

The figure displayed for "all workers" (average weighted distance traveled to work of 11 miles) is the figure used to calculate the decay function associated with the secondary workforce. This is the shortest commuting distance of any of the three workforces. This means that secondary workers have a tendency to live closer to work than either operating or construction workers. The impact of this factor is more completely understood in light of the fact that 98% of all secondary jobs generated in the Study Area are estimated to be located in the nine cities of; Ely, Babbitt, Tower, Aurora, Hoyt Lakes, Biwbik, Eveleth, Virginia, and Gilbert (based on the number of sales and use tax reporting units in the nine cities and rural areas of the study area; MDR 1976). This greatly affects the residential settlement patterns of households moving into the Study Area as a result of the increase in employment opportunities in the secondary workforce.

7.3.1.4 Projected Out-Migration--The out-migration of the construction workforce following completion of construction activity is a prime example of population dynamics expected to take place in the first 10 to 15 years of Cu-Ni

Table 24. Average weighted distances traveled to work.

TYPE OF WORKERS	AVERAGE (MEAN) WEIGHTED DISTANCES
Taconite Workers (including mine administration personnel)	17 miles[a]
All Workers	11 miles[b]
Taconite Construction Workers	25 miles[c]

SOURCES: [a]Derived from tables interpreting taconite employee residence locations generalized to zipcode areas and using the town associated with the zipcode as the residence location. Data from: Hanna Mining Co., U.S. Steel Corp., Pickands-Mather, Inc., Reserve Mining Co., and Oglebay-Norton, 1976. Inland Steel Mining Co. also provided data in 1978.

[b]Derived from tables compiling and interpreting commuting distance data from Minnesota Labor Force Survey-Form 1 (1977).

[c]Derived from taconite construction workers survey sponsored by Regional Copper-Nickel Study, 1977.

development. The size of the construction workforce required in the region will fluctuate greatly from year to year depending on the number of mine developments and their start-up years. It has been assumed (based on a private conversation with the President of Iron Range Building and Trades Union) that only a small number of inmigrating construction workers will remain residents of the Study Area; therefore, a large transient population during the construction phase would be expected.

7.3.2 Distribution of Copper-Nickel Generated Residential Settlement

The distributions of projected residential settlement (equal to the number of inmigrating new households) presented in Figures 10 through 20 and summarized in Table 25 are the principal output of the Residential Settlement Model. The percentage of all inmigrating new households that would settle in any one of the 224 Residential Settlement Model Zones was calculated for each of the three workforce types given a mine development at three locations along the Duluth Contact -- one near the northern end, one at the southern end, and one in the middle-a total of nine distributions. In addition, percentage distributions were calculated for an operating workforce from each of the three mine locations given the presence of a new public access road along the Contact (AMAX has proposed construction of this road).

Table 25

Settlement projections were made from three locations. These projections serve to provide an accurate picture of settlement patterns resulting from a mine development at virtually any location along the Duluth Contact. This is due to the limited access to the proposed mining sites and the consequent similarities

Table 25. Projected distributions of new (Post 1985) residential settlement resulting from mine developments, by city and sub-region.

CITY	PERCENT(%) TOTAL INMIGRATING OPERATING WORKERS (w/AMAX RD) MINE LOCATION Zone 1 or 2	Zone 3,4,or5	Zone 6 or 7	PERCENT(%) TOTAL INMIGRATING OPERATING WORKERS (w/o AMAX RD) MINE LOCATION Zone 1 or 2	Zone 3,4,or5	Zone 6 or 7
Ely	46.6	11.7	0.6	47.0	13.8	0.5
Babbitt	8.2	28.1	1.6	8.2	33.2	0.9
Tower	1.4	1.5	1.0	1.4	1.8	1.0
Aurora	2.0	5.9	18.2	0.7	2.4	19.4
Hoyt Lakes	1.1	7.4	23.1	0.4	1.2	23.3
Biwabik	0.3	1.5	4.7	0.3	0.8	4.7
Eveleth	0.5	2.0	6.1	0.5	1.5	6.2
Virginia	1.5	4.0	10.9	1.6	4.7	11.0
Gilbert	0.2	1.2	3.8	0.2	0.7	3.8
SUB-REGION (rural areas only)						
Ely-N.E. resorts	29.8	17.8	0.9	30.0	21.0	0.4
Tower-Vermillion	2.2	1.3	0.8	2.2	1.7	0.5
Southeast	1.5	1.6	2.0	1.5	1.6	1.9
Embarrass	4.9	11.4	6.9	4.8	13.7	7.0
East Range	0.8	4.6	19.4	1.2	1.9	19.4
TOTAL URBAN	60.8	63.3	70.0	60.3	60.1	70.8
TOTAL RURAL	39.2	36.7	30.0	39.7	39.9	29.2
TOTAL STUDY AREA	100.0	100.0	100.0	100.0	100.0	100.0

Table 25 continued.

CITY	PERCENT(%) TOTAL INMIGRATING CONSTRUCTION WORKER MINE LOCATION Zone 1 or 2	Zone 3,4,or5	Zone 6 or 7	PERCENT(%) TOTAL INMIGRATING SECONDARY WORKER MINE LOCATION Zone 1 or 2	Zone 3,4,or5	Zone 6 or 7
Ely	48.2	16.6	0.9	15.3	13.3	12.1
Babbitt	8.9	28.6	1.2	4.9	6.0	4.4
Tower	1.8	2.1	1.2	1.3	1.3	1.3
Aurora	1.2	3.0	16.4	5.8	5.8	6.8
Hout Lakes	0.7	1.7	20.3	5.0	5.1	5.9
Biwabik	0.4	1.1	4.6	2.4	2.5	2.7
Eveleth	1.0	2.5	8.0	11.1	11.2	11.7
Virginia	3.3	8.3	16.0	27.7	28.0	29.1
Gilbert	0.4	1.0	4.3	4.5	4.5	4.8
SUB-REGION (rural areas only)						
Ely-N.E. resorts	24.3	16.8	0.6	6.8	6.7	5.6
Tower-Vermillion	2.5	1.9	0.9	1.3	1.3	1.0
Southeast	1.4	1.3	1.6	0.2	0.2	0.3
Embarrass	4.7	12.5	7.2	5.7	6.0	5.9
East Range	1.2	2.6	16.8	8.0	8.1	8.4
TOTAL URBAN	65.9	64.9	72.9	78.0	77.7	78.8
TOTAL RURAL	34.1	35.1	27.1	22.0	22.3	21.2
TOTAL STUDY AREA	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE: Regional Copper-Nickel Study Residential Settlement Model.

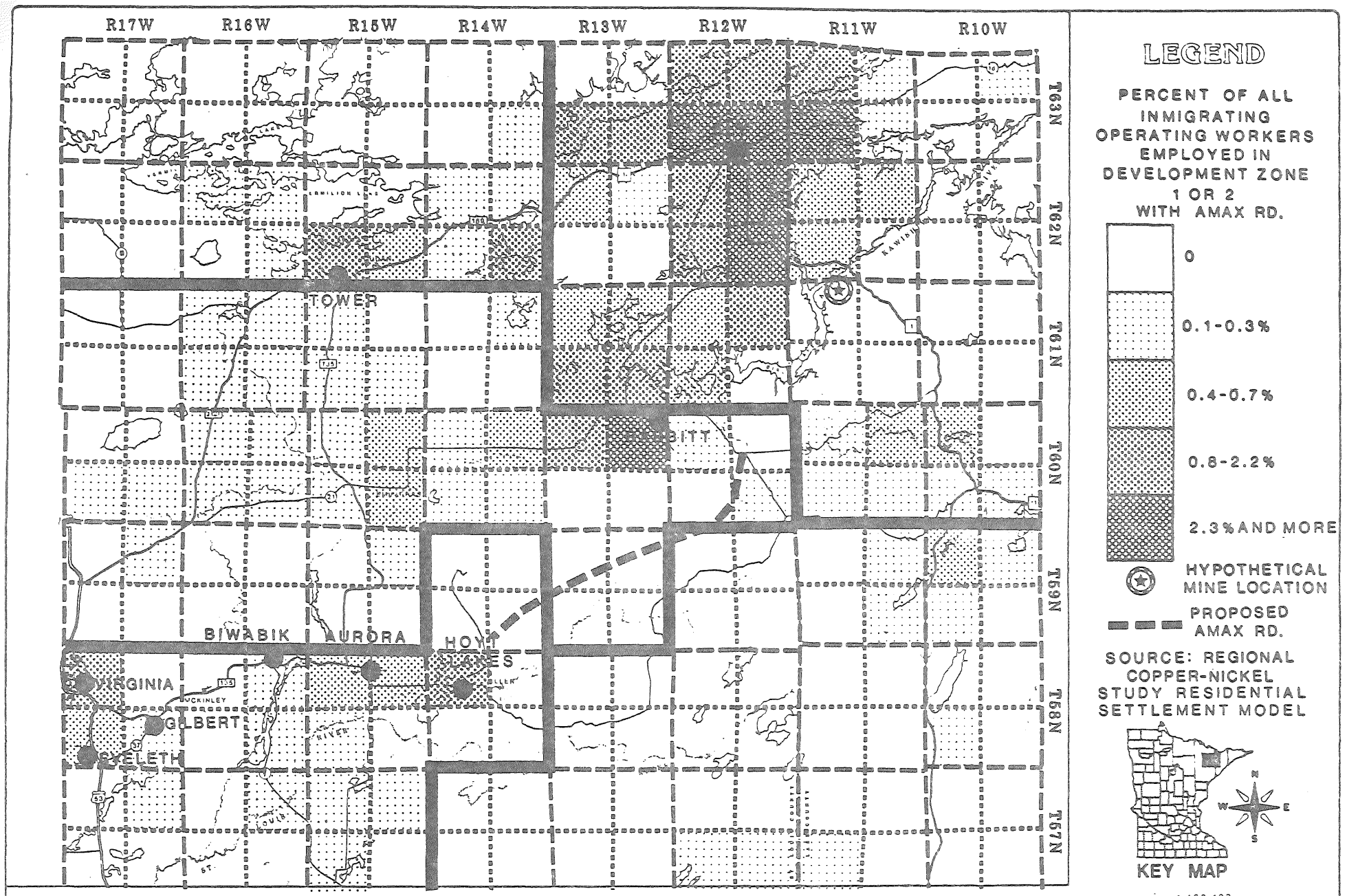


FIGURE 10 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINE OPERATING WORKERS EMPLOYED IN DEVELOPMENT ZONES 1 OR 2 (WITH AMAX ROAD)

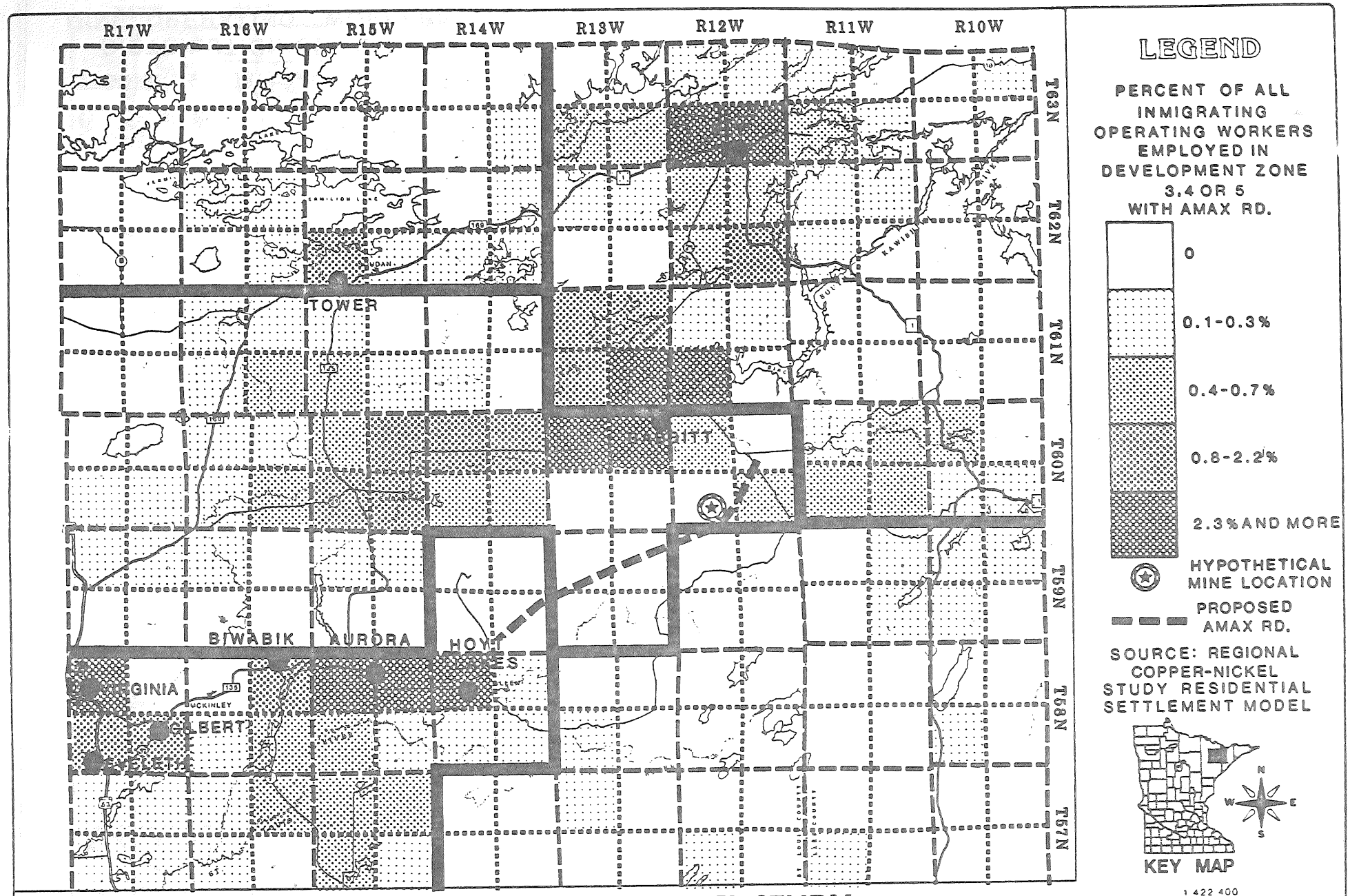
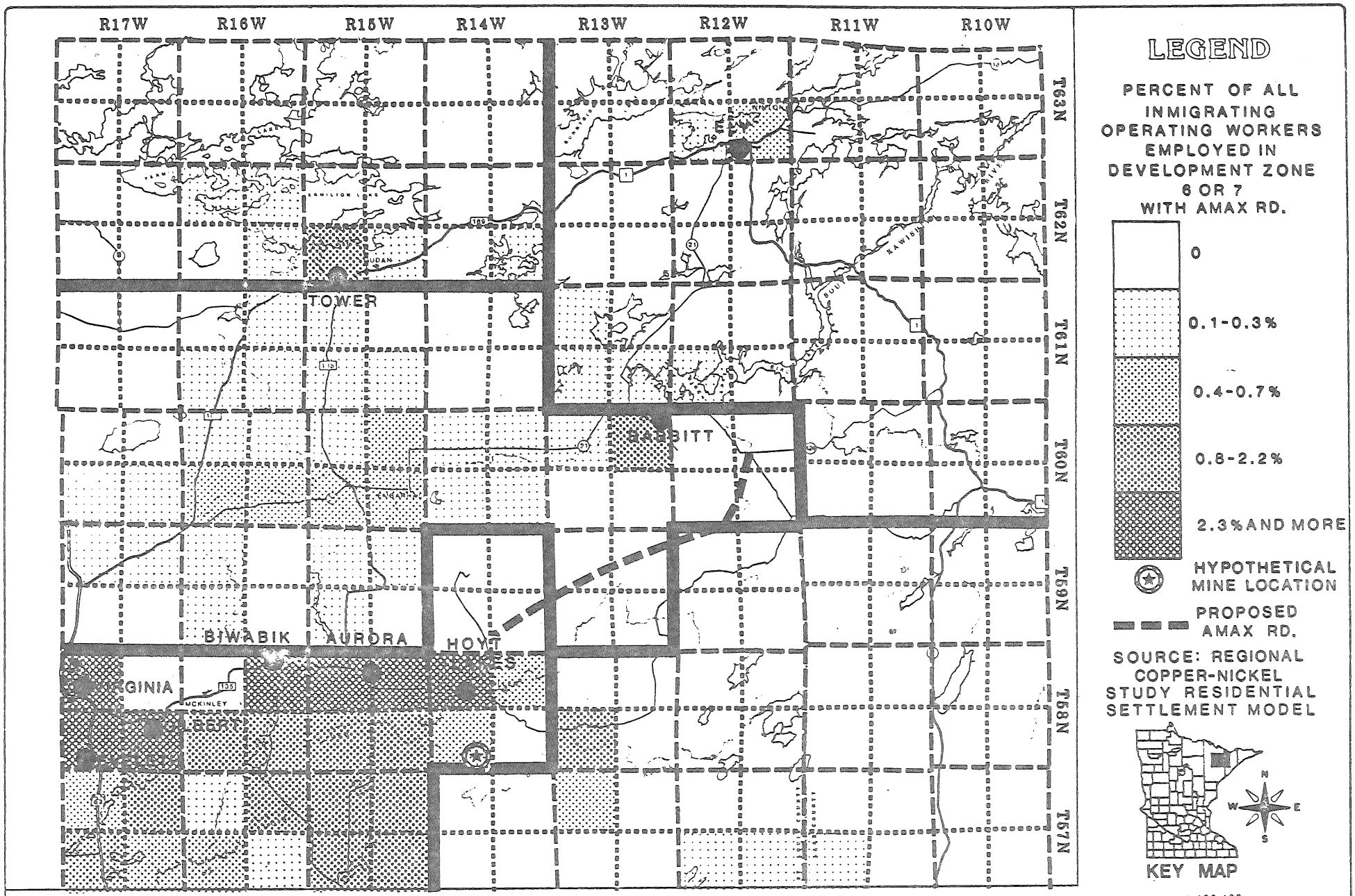


FIGURE 11 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINE OPERATING WORKERS EMPLOYED IN DEVELOPMENT ZONES 3,4 OR 5 (WITH AMAX ROAD)



LEGEND

PERCENT OF ALL INMIGRATING OPERATING WORKERS EMPLOYED IN DEVELOPMENT ZONE 6 OR 7 WITH AMAX RD.

- 0
- 0.1-0.3%
- 0.4-0.7%
- 0.8-2.2%
- 2.3% AND MORE

HYPOTHETICAL MINE LOCATION

PROPOSED AMAX RD.

SOURCE: REGIONAL COPPER-NICKEL STUDY RESIDENTIAL SETTLEMENT MODEL

KEY MAP

1 422 400

MILES

KILOMETERS

FIGURE 12 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINE OPERATING WORKERS EMPLOYED IN DEVELOPMENT ZONES 6 OR 7 (WITH AMAX ROAD)

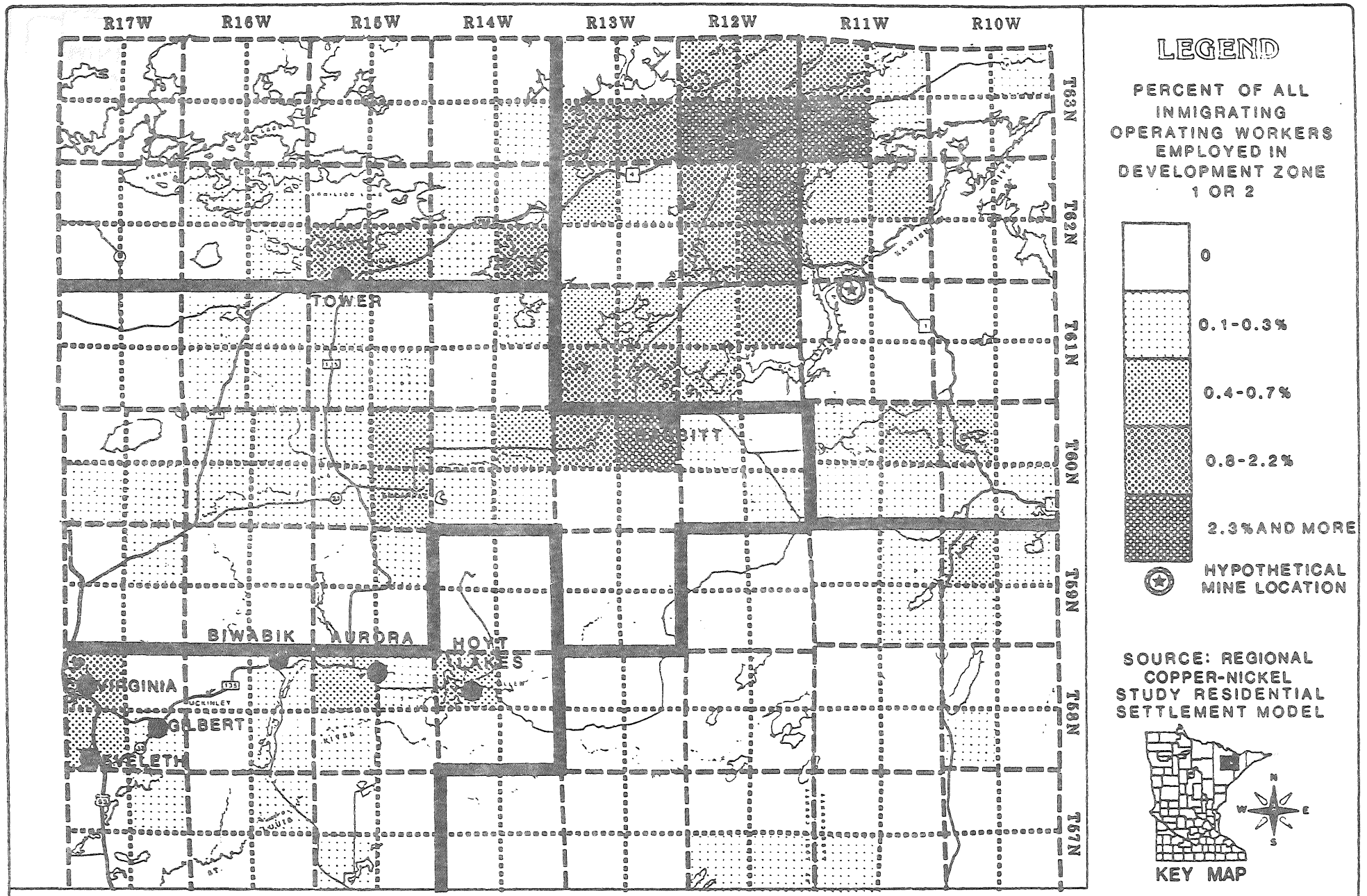


FIGURE 13 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINE OPERATING WORKERS EMPLOYED IN DEVELOPMENT ZONES 1 OR 2 (WITHOUT AMAX ROAD)

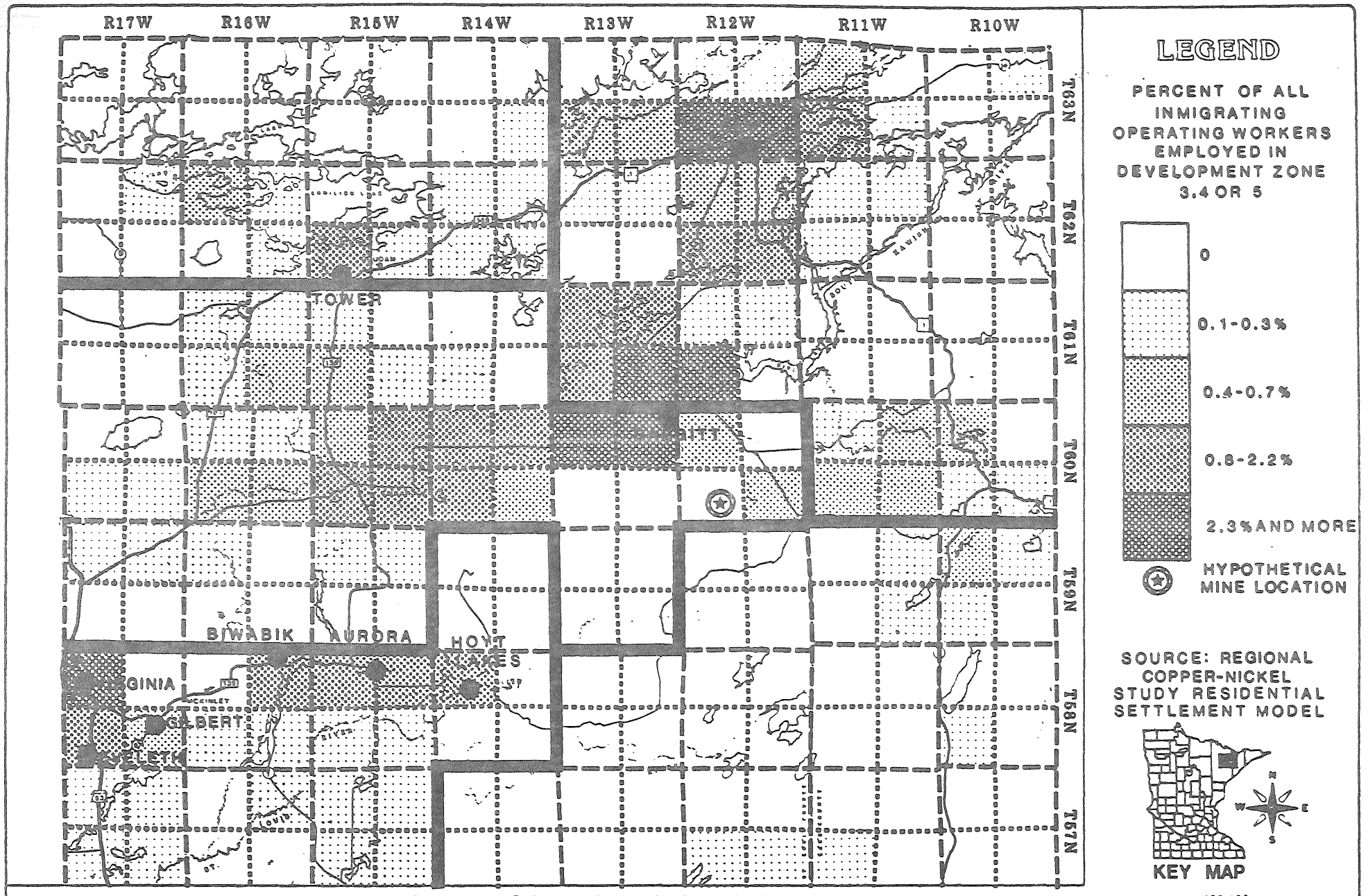


FIGURE 14 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINE OPERATING WORKERS EMPLOYED IN DEVELOPMENT ZONES 3,4 OR 5 (WITHOUT AMAX ROAD)

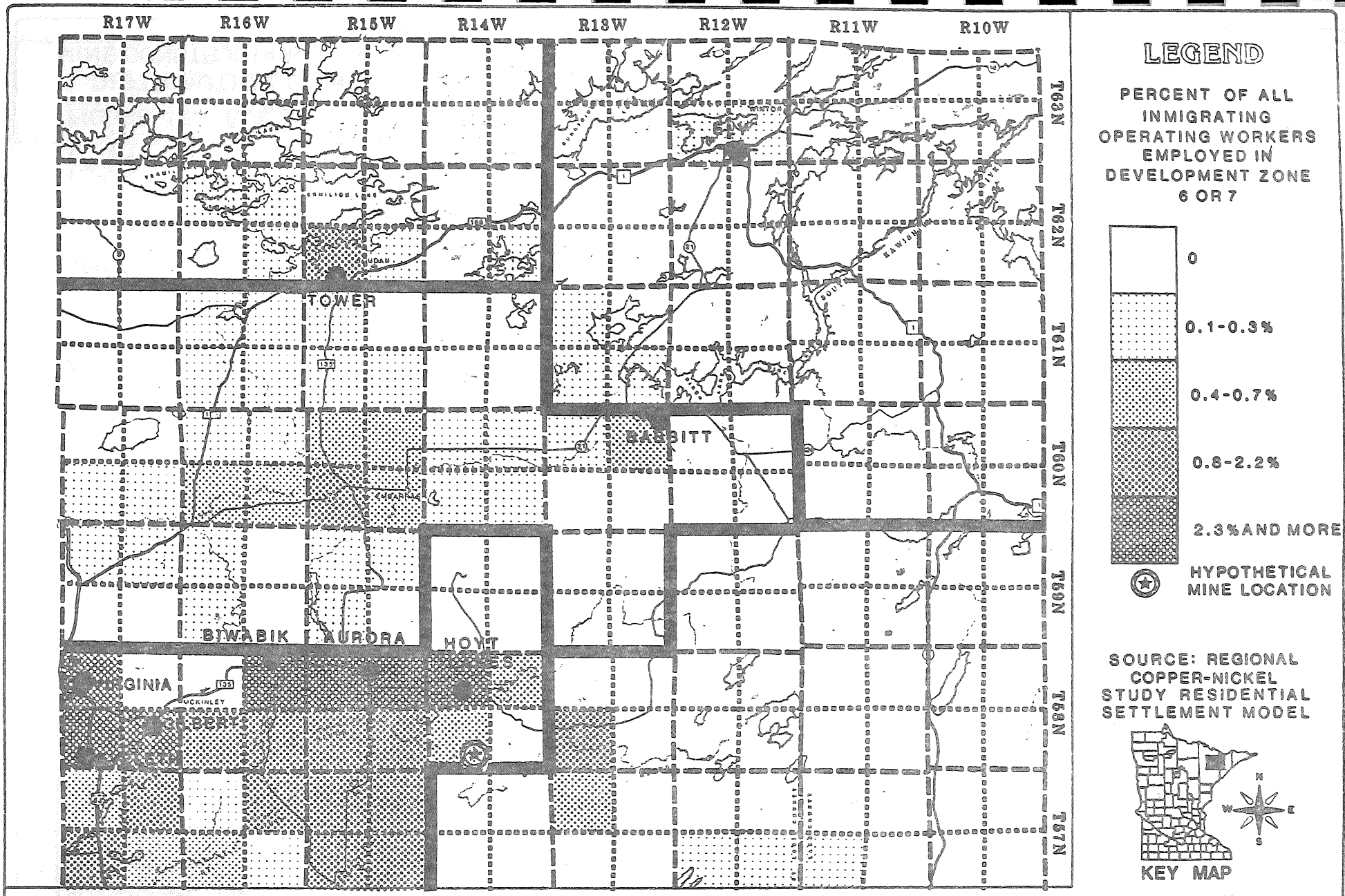


FIGURE 15 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINE OPERATING WORKERS EMPLOYED IN DEVELOPMENT ZONES 6 OR 7 (WITHOUT AMAX ROAD)

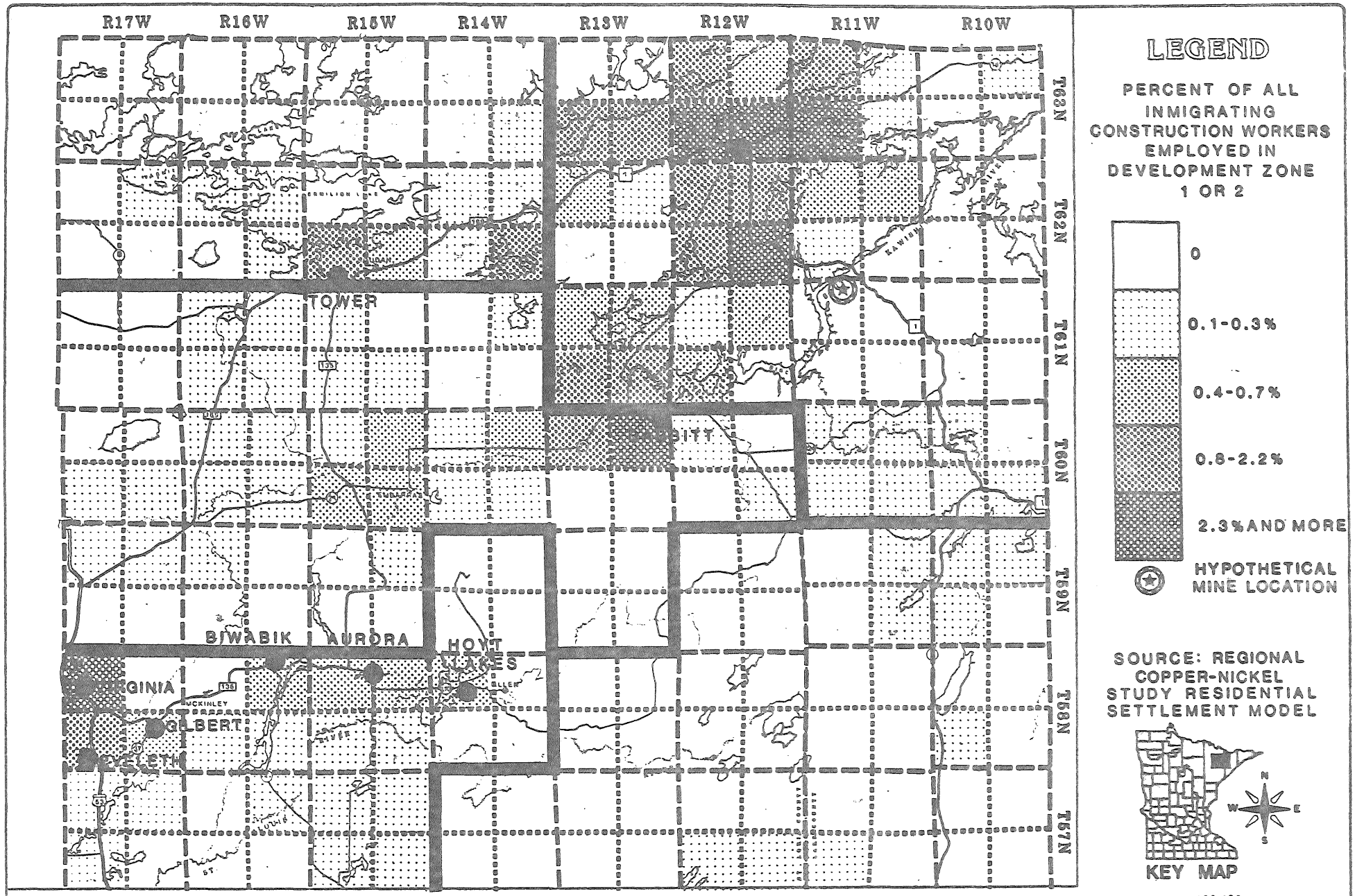


FIGURE 16 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINE CONSTRUCTION WORKERS EMPLOYED IN DEVELOPMENT ZONES 1 OR 2 (WITHOUT AMAX ROAD)

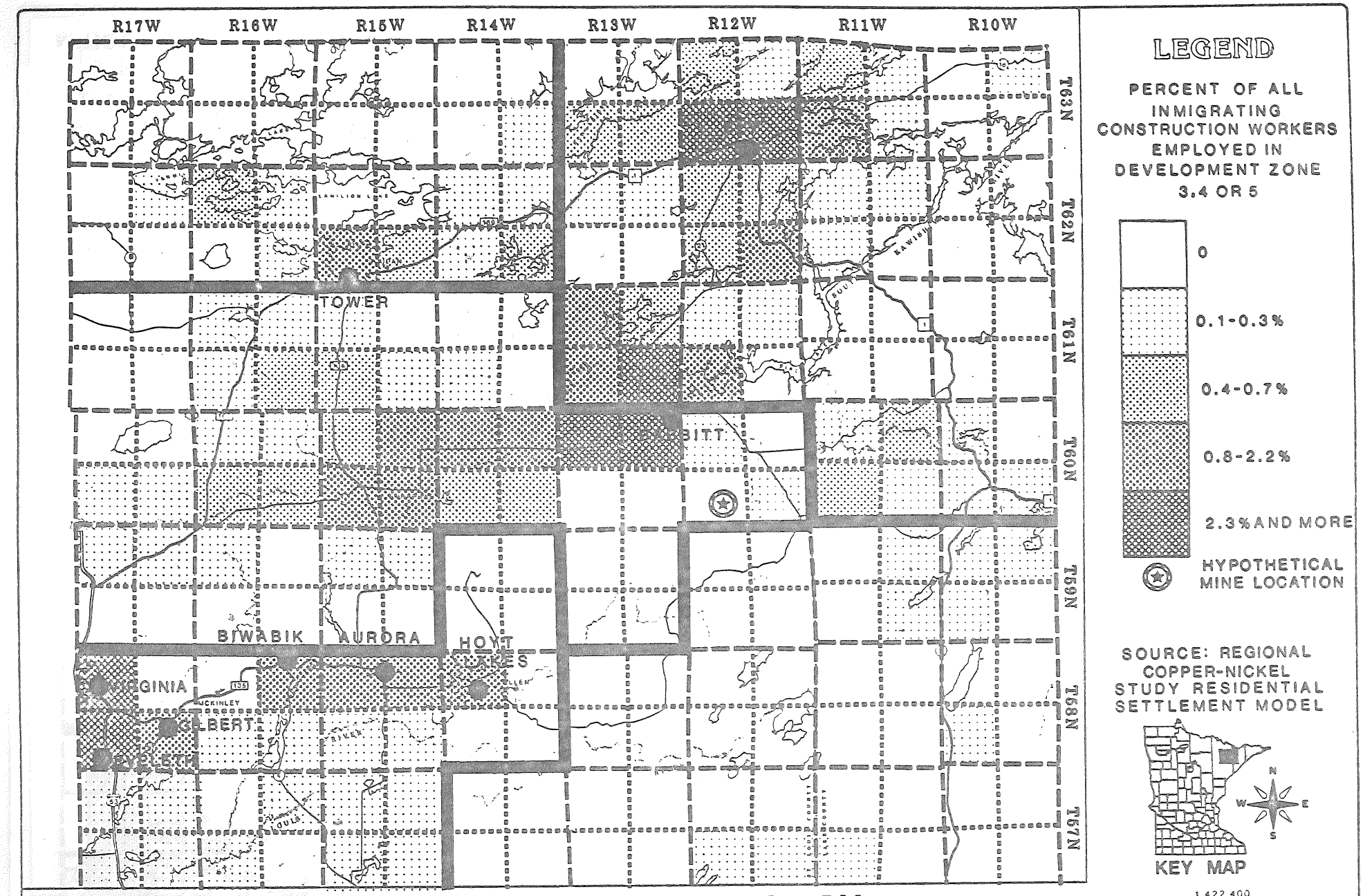


FIGURE 17 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINE CONSTRUCTION WORKERS EMPLOYED IN DEVELOPMENT ZONES 3,4 OR 5 (WITHOUT AMAX ROAD)

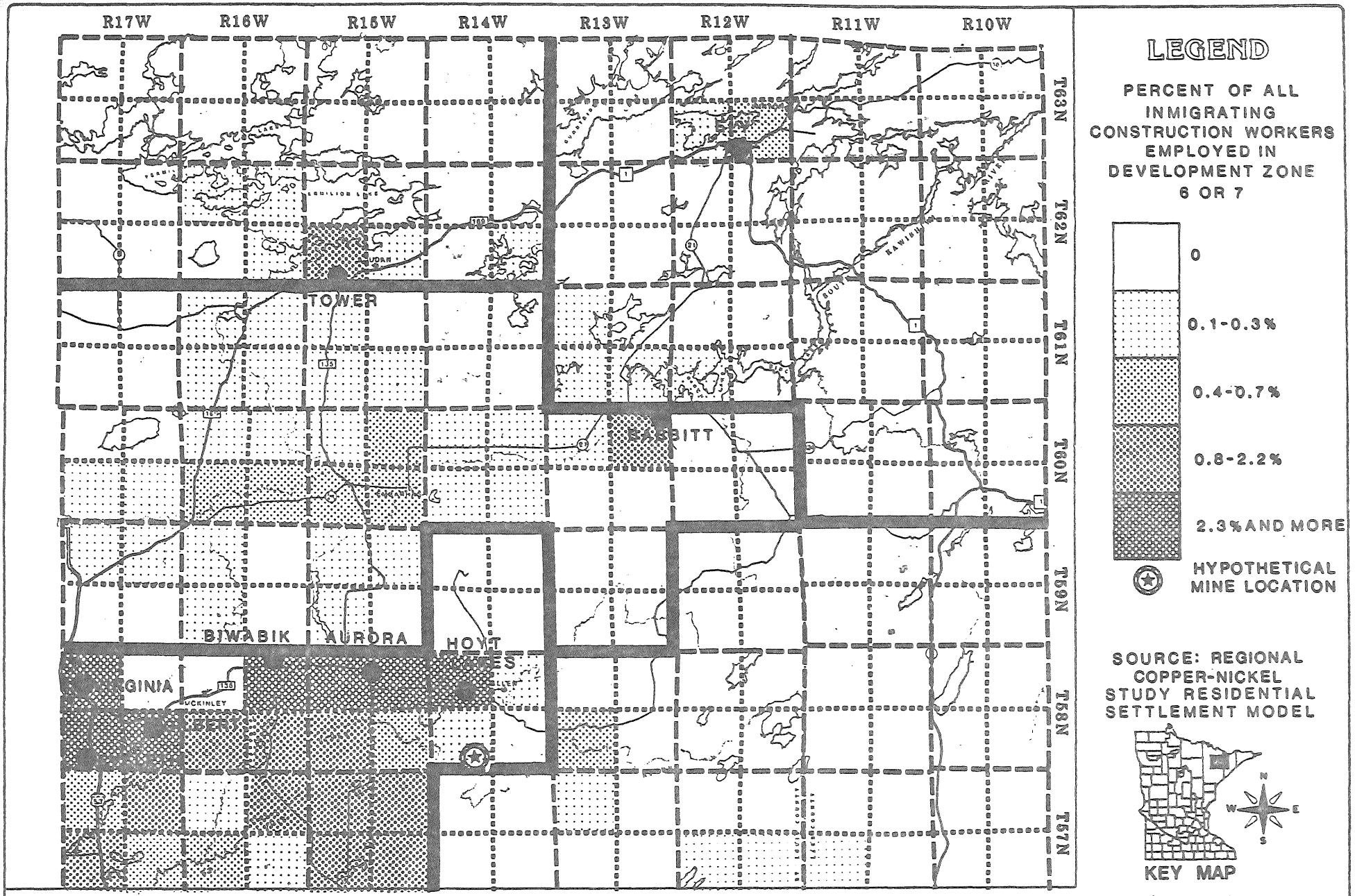


FIGURE 18 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSEHOLDS RESULTING FROM INMIGRATING MINECONSTRUCTION WORKERS EMPLOYED IN DEVELOPMENT ZONES 6 OR 7 (WITHOUT AMAX ROAD)

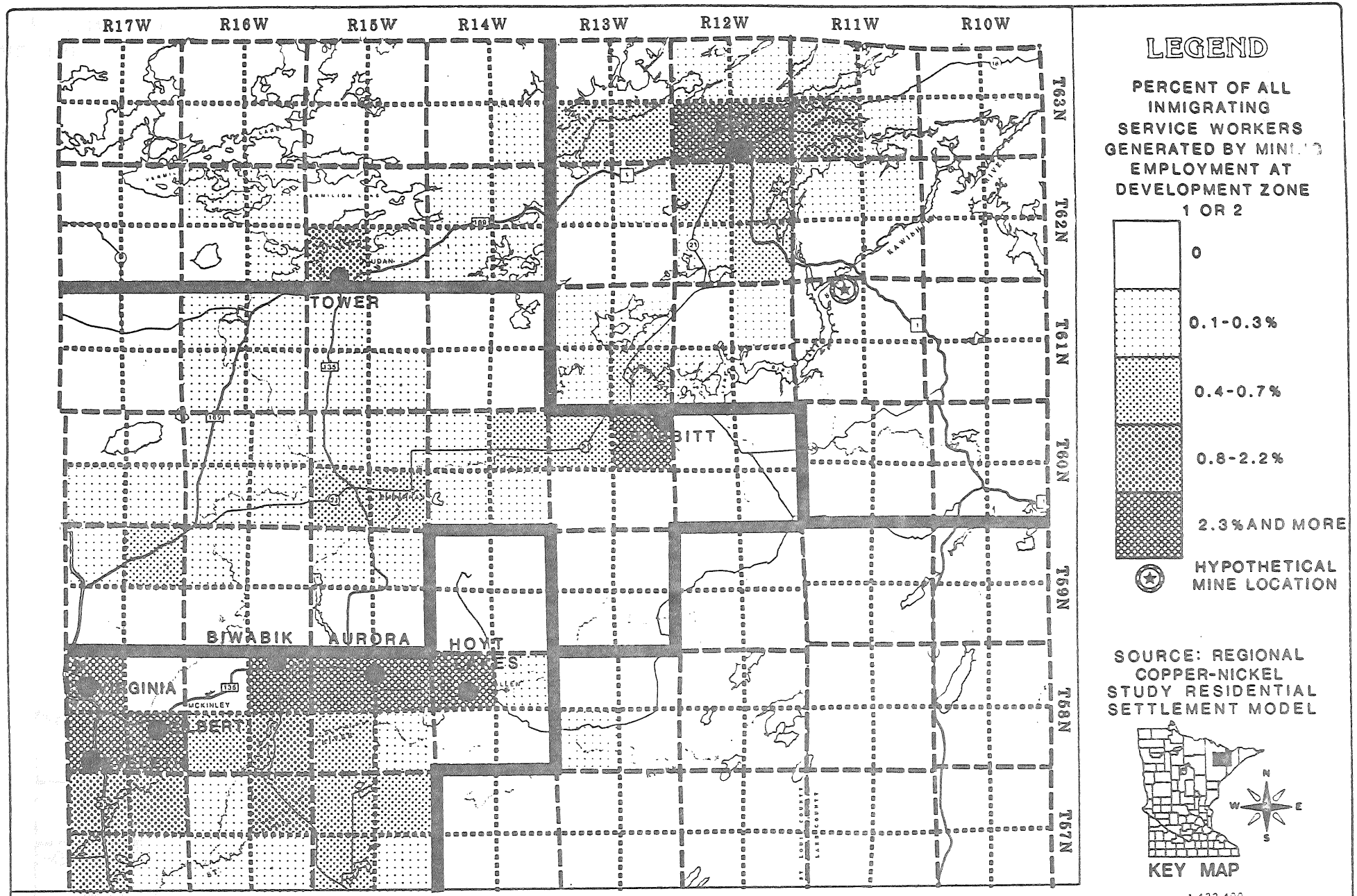


FIGURE 19 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSHOLDS RESULTING FROM INMIGRATING SERVICE WORKERS FILLING JOBS GENERATED BY MINE DEVELOPMENT IN DEVELOPMENT ZONES 1 OR 2 (WITHOUT AMAX ROAD)

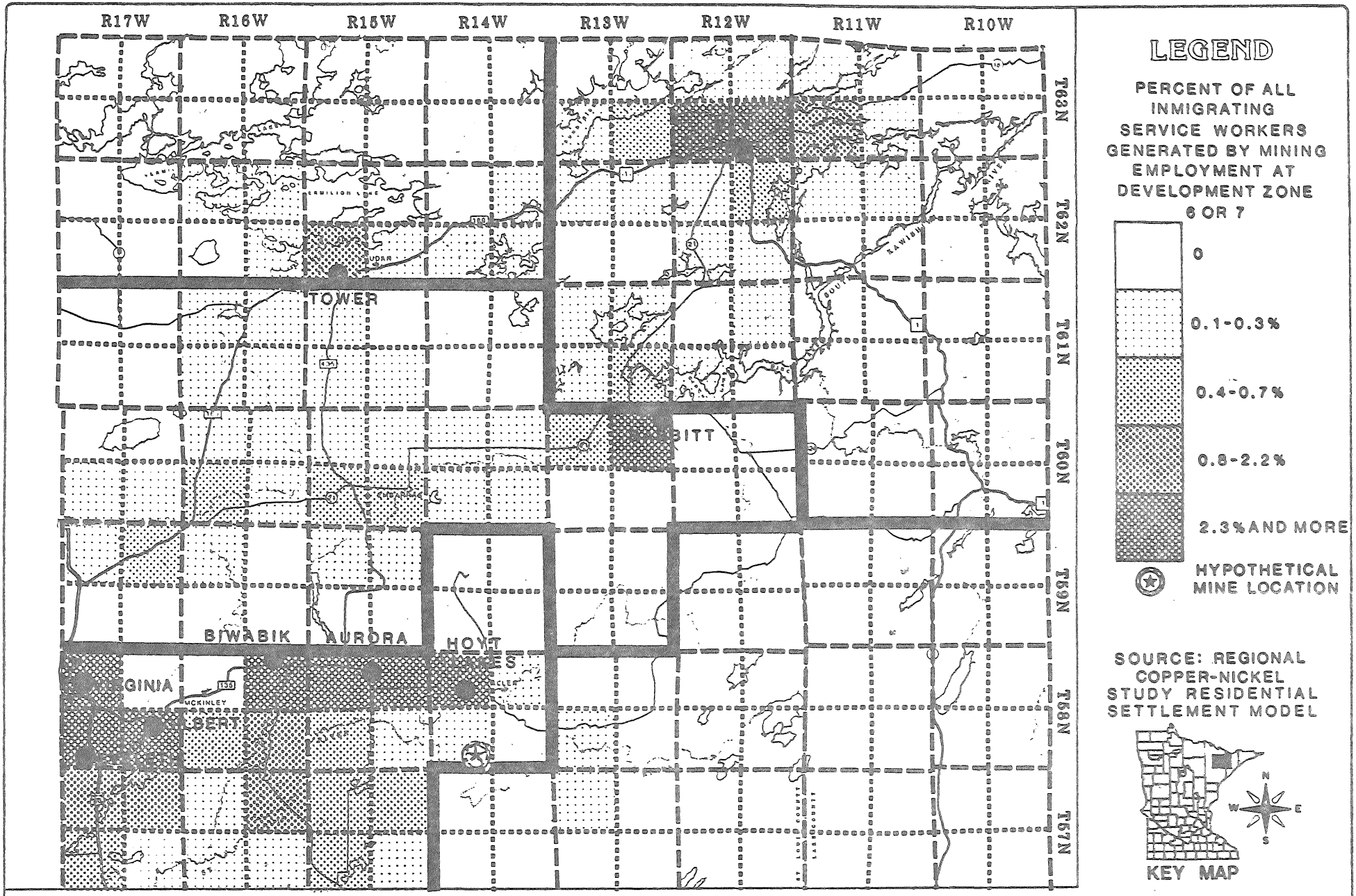


FIGURE 20 **MEQB REGIONAL COPPER-NICKEL STUDY**

DISTRIBUTION OF NEW HOUSHOLDS RESULTING FROM INMIGRATING SERVICE WORKERS FILLING JOBS GENERATED BY MINE DEVELOPMENT IN DEVELOPMENT ZONES 6 OR 7 (WITHOUT AMAX ROAD)

in distance-to-employment center figures for developments in Mine Development Zones 1 or 2; 3, 4, or 5; and 6 or 7.

It is important to note that the patterns established by these percentage distributions do not change as the magnitude of the mining workforce changes, so the impacts of factors such as: 1) the location of the mine; 2) the nature of workforce; and 3) enhanced accessability (specifically in this case the proposed AMAX road) can be directly assessed by observing changes in the percentage of total inmigrant households projected to settle in a given zone, region, or community.

7.3.2.1 Impacts of Mine Location on Residential Settlement Patterns--Employment center location has, perhaps, the single greatest impact on patterns of residential settlement in the Study Area. The expectation that inmigrants will settle within a reasonably short commuting distance of their place of employment operates in this instance to cause the zones displaying the greatest projected increases in settlement to shift from the north of the Study Area to the south of the Study Area as the mine location shifts from Zone 2 to Zone 4 to Zone 7. This shift can easily be seen by comparing the patterns illustrated in Figure 13 with those in Figure 15.

It is immediately apparent after examining Figures 19 and 20, that the distribution of inmigrating secondary workers does not shift considerably given changes in the location of the mining developments. This phenomenon is the result of peculiar characteristics of the secondary workforce which will be discussed in the next section of this chapter. As a result, the discussion below of the impacts of mine location on residential settlement patterns will be presented exclusively in terms of the operating and construction workforces. The relative

shifts caused by mine location in the distribution patterns of these two workforces can, perhaps, be better understood by referring to Table 25. Here it can be seen that, given a mine development in Zone 1 or 2, 47.0% of the inmigrating operating workforce (without AMAX Road) is projected to settle in Ely, whereas given a mine development in either Zone 6 or 7, only 0.5% of the inmigrant workforce is expected to settle in Ely. All cities and regions in the Study Area exhibit the effects of this north-south shift in settlement patterns with the exception of the city of Tower and the southeastern sub-region of the Study Area. The percentage of inmigrants settling in Tower or in the southeastern sub-region changes by no more than eight-tenths of one percent as the mine development is shifted from north to south.

A mine located in Zone 6 or 7 at the southern end of the Copper-Nickel Resource Area adds up to 10% more new settlement to the cities of the Study Area than would a mine located in any of the other five mine development zones. This is a direct result of the proximity of the East Range cities to these zones. The East Range cities (Hoyt Lakes, Aurora, Biwabik, Gilbert, Eveleth, and Virginia) for instance, receive only 3.7% of new operating worker's households when a mine is developed in zones 1 or 2 but 68.4% when the mine development occurs in zones 6 or 7. In addition to the 68.4% of inmigrant operating workers who settle in the East Range cities, 19.4% settle in the rural areas of the East Range region making the total number of new households in the area 87.8% of households generated by the inmigrant operating workers.

The north-south split of new settlement is the least pronounced when development occurs in the middle zones - 3, 4 and 5. Even with a mine development located here however, access to the cities in the southern portion of the Study Area using the present road network is difficult enough to cause the majority of new

settlement to locate in the northern portions of the Study Area (specifically in the Babbitt to Ely corridor following Highways 21 and 1) or west of Babbitt in the Embarrass region (Figures 14 and 17). If, however, settlement is considered with a public access road linking the mine developments in these zones with Hoyt Lakes, the amount of settlement occuring in the East Range--both urban and rural--increases somewhat (Figure 11). Table 26 is a summary of information appearing in Table 25 showing the difference in settlement patterns of inmigrating operating workers employed in either zone 3, 4 or 5 given the presence of absence of the proposed AMAX road.

Table 26

When combined urban and rural settlement is considered, the distribution of settlement to the East Range region in the southern part of the Study Area increases considerably given the presence of the AMAX road. Settlement projections resulting from a mine development in these middle zones, and which were made assuming the presence of the new road along he contact are more evenly distributed north to south than any other projection.

Several areas are projected to receive most of the new settlement. The cities in the Study Area receive most of the projected new settlement - consistently between 60 and 70%. Several rural areas, though, are projected to gain substantial new settlement depending on the size and location of eventual mine developments. Given a mine development in either zones 1 or 2 without the proposed AMAX road, 11% of the new settlement is expected to be located in the rural areas north, west, and east of Ely (Figure 13)--areas where most existing settlement occurs on Burntside, Shagawa and Farm, and Garden lakes (Figure 2). Projected settlement in these areas drops quickly as the proposed mine developments are moved south along the contact.

Table 26. Changes in percent distribution of inmigrating operating workers to selected Study Area cities and sub-regions from Cu-Ni development zones 3, 4, and 5 given the presence or absence of a public access road along the Duluth Contact.

CITY	PERCENT(%) INMIGRATING OPERATING WORKERS W/PUBLIC RD.	PERCENT(%) INMIGRATING OPERATING WORKERS W/O PUBLIC RD.
Ely	11.7	13.8
Babbitt	28.1	33.2
East Range Cities	22.0	11.3
SUB-REGION (Rural only/Rural & Urban)		
Ely-N.E. resorts	17.8/29.5	21.0/34.8
Embarrass	11.4/39.5	13.7/46.9
East Range	4.6/26.6	1.9/13.2

SOURCE: Regional Copper-Nickel Study Residential settlement model.

Settlement in the rural area between Ely and Babbitt along Highways 1 and 21 is expected to increase given mine developments in either the northern two or middle three zones. If the mine development is located in either zone 1 or 2, 12.4% of inmigrating operating workers are expected to settle this area (assuming the proposed AMAX road is not built) (Figure 13) and 8.2% if the mine development is located in either zones 3, 4, or 5 (Figure 14).

A mine development in zones 3, 4 or 5 is expected to cause new settlement in rural areas north of Babbitt along Birch Lake and in the Embarrass region. As much as 13.7% of new settlement resulting from a mine development in these middle zones is expected to be located in the Embarrass region. Projected settlement increases are least for this region when the mine development occurs in zones 1 or 2.

7.3.2.2 Impacts of Workforce Type on Residential Settlement Patterns--
Differences in the distribution of residential settlement resulting from inmigrating operating, construction, or secondary workers are a result of certain assumptions made about these workforces (see sub-section 7.3.1, Setting the Stage).

For example, based on information collected in a survey of taconite construction workers in 1977, it is expected that a somewhat larger percentage of inmigrating construction workers will settle in Study Area cities than will inmigrating operating workers. This is a direct result of the expectation that the construction workforce will be transient residents of the Study Area. For this reason, much of what is projected as "settlement" resulting from inmigrating construction workers will not be settlement of a permanent nature but, rather, an influx of population needing more or less temporary housing. It has been

assumed that housing of this type will be more plentiful in urban areas than rural in part based on the assumption made from observing the taconite expansion process that "construction camps" located in or near the construction site will not be constructed or would not house a significant portion of the temporary construction workforce.

It is in the residential settlement patterns of inmigrating secondary workers that the greatest differences are found. The distribution of inmigrating secondary workers, in fact, bears very little resemblance to settlement patterns of operating or construction workers. This divergence is due to the fact that the growth of a secondary workforce is an indirect result of mining development and is expected to be centered almost exclusively in Study Area cities, whereas both operating and construction workforces are employed directly at the mine sites.

The residential settlement patterns illustrated in Figures 13 and 19 show the result of changing the job location from a single plant in zone 2 to nine urban locations. Operating workers employed in zone 2 are expected to settle predominantly in and around Ely and as far south as Babbitt; very little new residential growth is expected in the East Range cities as a result of this mine development. The service industry growth associated with such a mining development, however, is expected to be centered in areas with existing commercial services--principally the cities in the Study Area. People moving into the Study Area to fill these jobs are expected to settle in a pattern presented in Figure 19. A great deal less settlement of inmigrating secondary workers is expected in rural areas due to their demonstrated tendency to live close to work. In fact, about 78% of projected new settlement of secondary workers is assigned to urban locations compared to as little as 60% of the operating workforce (Table 25).

This assumption concerning the location of service jobs also greatly tempers the effects of mine location on the projected settlement patterns of inmigrating secondary workers. There is, in fact, virtually no difference between the distribution of settlement of new secondary workers generated by mine development in zone 2 (Figure 19) and those generated by mine development in zone 4. And, there are only slight shifts in the locations of projected rural settlement as mining development moves to zone 7 (Figure 20).

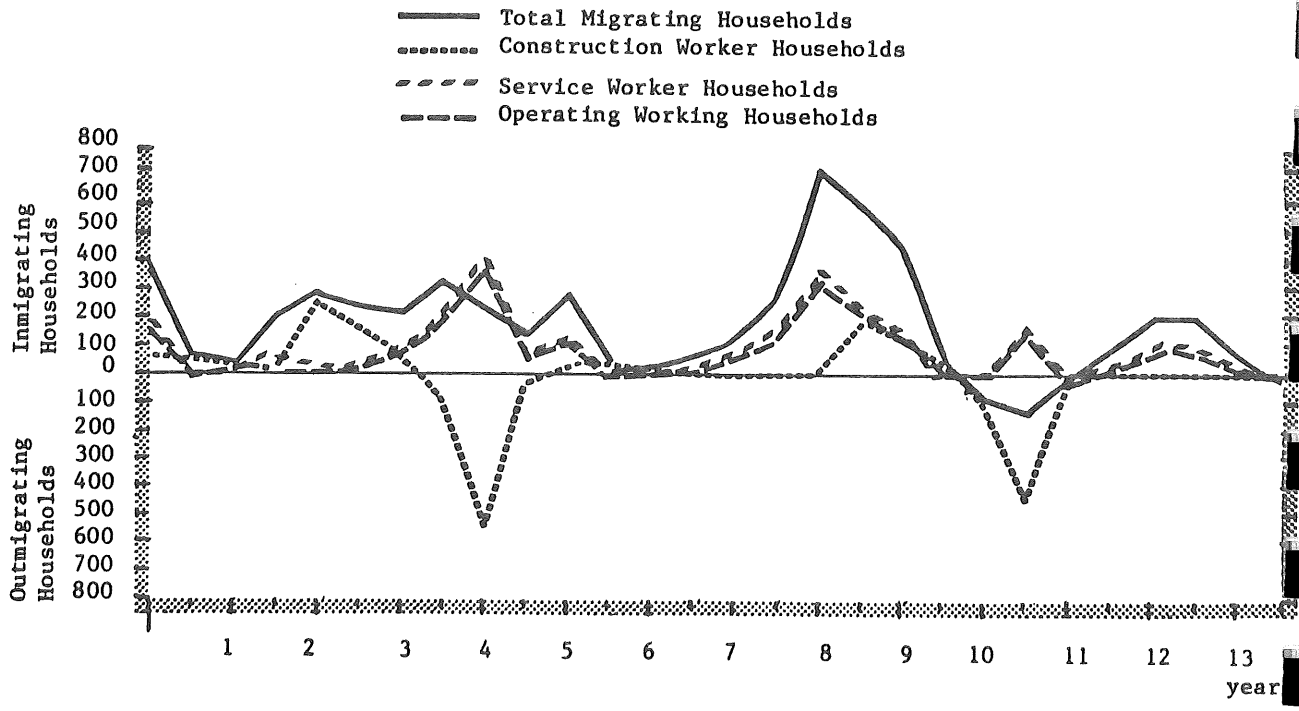
7.3.3 Projected Residential Settlement Resulting From Hypothetical Mine Developments

The settlement projections presented in this section are based on hypothetical mining futures combining developments in various zones at various times. The figures displayed describe settlement in terms of absolute numbers of new households - numbers which have been arrived at by applying percentage distributions to actual workforce estimates.

This expansion process can be used by the reader to project, in terms of absolute numbers, residential settlement in any of the 224 Residential Settlement Model zones for the operating and construction workforces of any size and combination of hypothetical mine developments. Due to the complexities of accurately projecting the number of secondary jobs which will result in new households in the Study Area, only an approximate distribution can be made of secondary worker settlement. The information required for these expansions is supplied in Tables 27 and 32.

Table 27

Figure 27
In and Out Migration of New Households in the Study Area Resulting from "2-Zone" Mine Development Sequence By Workforce Prior to Stabilization in Year 13.5



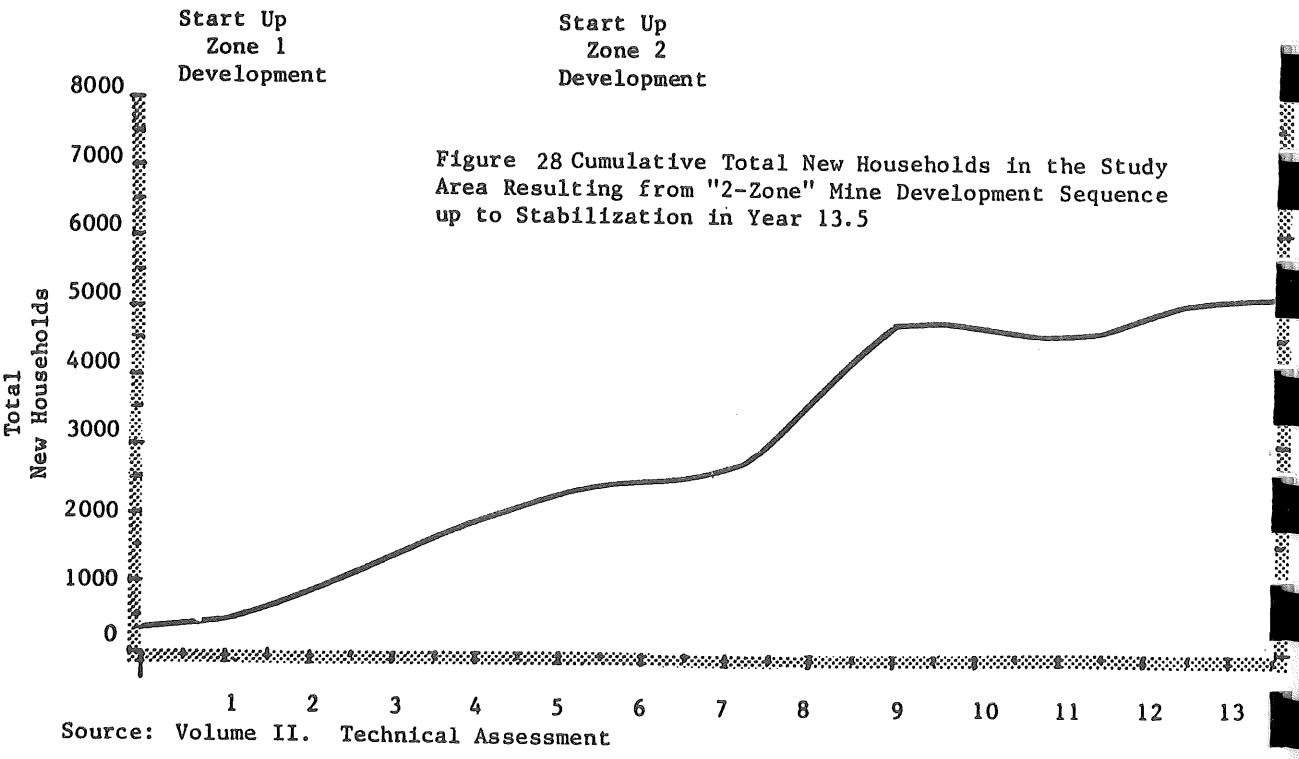


Figure 28 Cumulative Total New Households in the Study Area Resulting from "2-Zone" Mine Development Sequence up to Stabilization in Year 13.5

Source: Volume II. Technical Assessment

To arrive at a figure representing the number of new households expected to settle in a particular Residential Settlement Zone, four steps are necessary:

Step One: Initially, an estimate must be made of the total workforce size for each workforce type. Manpower requirements for the construction and operation of various sizes and types of mines can be found in Volume 2-Chapter 5, Table 11 of this report. Several examples appear in Table 28. Or, estimates of total employment in these two workforces may be independently prepared. To determine the total number of secondary jobs generated by mine development, the estimated total operating workforce size is multiplied by 2.0 (this multiplier was obtained from the regional economic analysis presented in Volume 5-Chapter 15 of this report).

Table 28

Step Two: The general location of the employment center must be chosen so that it can be determined whether it lies in Development zones 1 or 2; Development Zones 3, 4, or 5; or Development Zones 6 or 7.

Step Three: Since only the number of new households in an area is desired, it is necessary to estimate the number of inmigrating households coming from each workforce type. This figure is obtained by applying the appropriate inmigration rates in Table 27 to the projected number of total workers. For example, if the estimated total operating workforce employed in Development Zone 4 is to be 1000, the number of new households expected to settle somewhere in the Study Area would be 650 (65% X 1000).

Step Four: The approximate number of new households which can be expected to settle in a particular Residential Settlement Model zone can be derived by first

Table 28. Selected characteristics of hypothetical mine developments.

SIZE OF FACILITY (mtpy)	TYPE OF FACILITY	PEAK CONSTR. WORKFORCE	OPERATING WORKFORCE	SECONDARY JOBS GENERATED
12.35×10^6 mtpy (ore)	Underground Mine and Mill	1,062	1,857	3,714
16.68×10^6 mtpy (ore)	Combination Open Pit & Underground Mine and Mill	1,408	1,599	3,198
20.00×10^6 mtpy (ore)	Open Pit Mine and Mill	1,515	1,378	2,756
100,000 mtpy (metal)	Smelter/Refinery	1,250	620	1,240

SOURCE: Regional Copper-Nickel Study Volume 2, Technical Assessment.

locating the desired zone in Table 32, then finding the column which corresponds to the appropriate workforce and mine location, and multiplying the figure derived in Step Three by the percentage found there.

7.3.3.1 Hypothetical Mine Developments--Two combinations of three hypothetical mine developments were used as generators of residential settlement patterns. A complete discussion of the hypothetical mine developments may be found in Volume 2-Chapter 5 of this report. A summary of major points concerning residential settlement growth associated with each mine model (particularly the number of workers generated by each development) is presented in Table 28.

The location and intensity of residential settlement growth is in part determined by the location of the mines and/or smelter/refineries (as has been demonstrated above) but the intensity of residential development is also a function of the number of people drawn to the Study Area. This number can vary not only with any single mine development but with the many combinations of the hypothetical developments presented in Table 28.

Two combinations of mine developments have been used to project the residential settlement patterns presented in this section. These two hypothetical development scenarios do not represent actual proposals for mine development but are being used only to illustrate the effects on residential settlement patterns of various sizes of mines, the relative intensity of development, and to introduce the element of time into our consideration of residential growth.

Of the two hypothetical mine development combinations used, one represents the potential impacts of two mines, brought into operation five years apart, located in the northernmost development zones (Figure 9); and the other illustrates the potential impacts of three mines spread out along the Copper-Nickel Resource

Area from north to south. In this second scenario, the mines are also spaced five years apart and the scenario includes a 100,000 ton/year smelter located in Zone 4.

The "2-Zone" development scenario postulates a 16.68 X 10^6 mtpy mine without a smelter in Zone 1 beginning construction in 1985 and a 12.35 X 10^6 mtpy mine without a smelter beginning construction in Zone 2 in 1990. This "2-Zone" development would result in approximately 5,170 new permanent households in the Study Area and 1,172 transient construction worker households.

The "3-Zone" development scenario postulates a 16.68 X 10^6 mtpy mine with a 100,000 ton/year smelter starting construction in Zone 4 in 1985, a 12.35 X 10^6 mtpy mine without a smelter beginning construction in Zone 2 in 1990, and a 20.00 X 10^6 mtpy mine without a smelter starting construction in Zone 7 in 1995. Total projected new households moving to the Study Area as a result of the development of these three mines is 7,962 permanent operating and secondary households and 1,842 transient, construction worker households.

7.3.3.2 Impacts of Mine Size and Multiple Mine Development on Residential Settlement Patterns--The size of an individual mine has no direct impact on the settlement patterns as they were presented in the discussion of percentage distributions; that is, the spatial distribution of new households would not change as the number of inmigrants changed. What would change, of course, is the actual number of new households expected to settle in a particular area. As the size of the inmigrating population increases, this could ultimately lead to higher density settlements in those areas projected to receive the largest percentage share of new households.

Whereas a change of size for any individual mine development could be expected to alter only the magnitude of residential settlement, the development of more than one mine (intensity of development) can be expected to alter both the magnitude (density) of development as well as the overall spatial distribution. In the event of multiple mine development, what occurs, in effect, is a combining of settlement patterns projected for each individual mine. The final impacts of the "2-Zone" or "3-Zone" developments can be assessed simply by visualizing the percentage distributions of operating and service workforces for mines from the appropriate zones superimposed on each other. A majority of the construction workers who were inmigrants during the construction phase of mine development will subsequently emigrate leaving only the operating and secondary workforces as permanent new settlement.

In the case of the "2-Zone" development, the distribution of settlement from Cu-Ni Development Zones 1 and 2 is identical meaning the impact of this development on settlement patterns is, again, one only of magnitude.

However, the "3-Zone" development distributes various sized workforces from the north, south, and middle of the Cu-Ni Resource Area. As a result, the settlement pattern which results is a combination of the distributions presented in Figures 13 through 20.

The eventual total increase in settlement as a result of the 2-Zone and 3-Zone developments as distributed to the Study Area cities and Residential Sub-Regions is displayed in Tables 29 and 30. It can be seen that, predictably, the scenario which concentrates mine development in the northernmost Cu-Ni Development Zones--the "2-Zone" development--distributes a significantly larger percentage of all new households to Ely (30%), for example, than does the "3-Zone" develop-

ment scenario (18%) which has its mine developments strung out along the Contact from far north to far south in the Cu-Ni Resource Area. It is very important to note, however, that while the percentage of total new households which settle in Ely is expected to be greatly different for these two hypothetical developments, the absolute numbers of new households expected to settle in the area are relatively close to one another given the larger number of inmigrants associated with the "3-Zone" development.

Tables 29 & 30

7.3.3.3 Impacts of Time on the Growth of Residential Settlement--The size of the operating workforce of a mine does not reach its peak until approximately the eighth year from the start of the operation for the 12.35×10^6 mtpy and 16.68×10^6 mtpy developments and year five for the 20.00×10^6 mtpy development (Figures 22, 24, and 26). During this lead time growth does not come gradually or even constantly. For example, virtually the entire inmigrant construction workforce has come and gone by year five.

Figures 21, 23, and 25 show the changes in the number of inmigrants and outmigrants associated with a particular workforce for each single mine development. If, as in the "3-Zone" development, three mining operations are begun at five-year intervals, the period of fluctuation and growth in residential settlements is expected to continue for fifteen years. The in and out migration of households associated with the "2-Zone" and "3-Zone" hypothetical mine developments is shown in Figures 27 and 29.

It is important to note, also, that these fluctuations in residential growth occur not only in time but in space as well, depending on the particular mine

Table 29. Projected residential settlement growth resulting from "2-Zone" mine development sequence compared to 1984 baseline by city and sub-region.

	BASELINE				2-ZONE MINE DEVELOPMENT SEQUENCE						
CITY	ESTIMATED HOUSEHOLDS (H.H.) 1976	(A) EST. H.H. 1984	% TOTAL STUDY AREA HOUSEHOLDS 1984	% INCREASE 1976-1984	(B) TOTAL NEW H.H.	% TOTAL STUDY AREA NEW H.H.	# YEARS TO REACH TOTAL NEW H.H.	(A+B) TOTAL H.H.	% TOTAL STUDY AREA HOUSEHOLDS POST DEV.	% INCREASE 1984-NEW TOTAL H.H.	TOTAL POP. POST DEVEL.
Ely	1,750	1,850	10	6	1,559	30		3,410	15	84	10,230
Babbitt	960	1,010	6	5	335	6		1,340	6	33	4,020
Tower	250	260	1	4	52	1		310	1	20	930
Aurora	930	1,000	6	8	180	3		1,180	5	18	3,540
Hoyt Lakes	1,240	1,290	7	4	149	3	13.5	1,440	6	12	4,320
Biwabik	490	520	3	6	73	1		590	3	14	1,770
Eveleth	1,560	1,750	10	12	319	6		2,070	9	18	6,210
Virginia	3,910	4,420	25	13	805	15		5,220	23	18	15,660
Gilbert	870	930	5	7	130	3		1,060	5	14	3,180
SUB-REGION (rural areas only)											
Ely-N.E. resorts	1,390	1,430	8	3	912	18		2,340	10	64	7,020
Tower-Vermillion	200	210	1	5	107	2		320	1	51	960
Southeast	60	60	less than 1	0	44	1	13.5	100	less than 1	73	300
Embarrass	1,290	1,350	7	5	272	5		1,620	7	20	4,860
East Range	1,830	1,940	11	6	233	5		2,170	9	12	6,510
TOTAL URBAN	11,960	13,030	72	9	3,602	70	13.5	16,630	72	28	49,890
TOTAL RURAL	4,770	4,990	28	5	1,568	30	13.5	6,560	28	31	19,680
TOTAL STUDY AREA	16,730	18,020	100	8	5,170	100	13.5	23,190	100	29	69,570

SOURCES: Regional Copper-Nickel Study residential settlement model; Regional Copper-Nickel Study forecasts of manpower needs for taconite industry and hypothetical mining developments; U.S. Dept. of Commerce, revenue sharing program, population estimates 1976; Regional Copper-Nickel estimates of 1976 rural households and population (see Table 2).

Table 30. Projected residential settlement growth resulting from "3-Zone" mine development sequence compared to 1984 baseline by city and sub-region.

	BASELINE				3-ZONE MINE DEVELOPMENT SEQUENCE						
CITY	ESTIMATED HOUSEHOLDS (H.H.) 1976	(A) EST. H.H. 1984	% TOTAL STUDY AREA HOUSEHOLDS 1984	% INCREASE 1976-1984	(B) TOTAL NEW H.H.	% TOTAL STUDY AREA NEW H.H.	# YEARS TO REACH TOTAL NEW H.H.	(A+B) TOTAL H.H.	% TOTAL STUDY AREA HOUSEHOLDS POST DEV.	% INCREASE 1984-NEW TOTAL H.H.	TOTAL POP. POST DEVEL.
Ely	1,750	1,850	10	6	1,420	18		3,270	13	77	9,810
Babbitt	960	1,010	6	5	837	11		1,850	7	83	5,550
Tower	250	260	1	4	86	1		350	1	33	1,050
Aurora	930	1,000	6	8	466	6		1,470	6	47	4,410
Hoyt Lakes	1,240	1,290	7	4	448	6	15.5	1,740	7	35	5,220
Biwabik	490	520	3	6	167	2		690	3	32	2,070
Eveleth	1,560	1,750	10	12	578	7		2,330	9	33	6,990
Virginia	3,910	4,420	25	13	1,427	18		5,850	23	32	17,550
Gilbert	870	930	5	7	247	3		1,180	5	27	3,540
SUB-REGION (rural areas only)											
Ely-N.E. resorts	1,390	1,430	8	3	977	12		2,410	9	69	7,230
Tower-Vermillion	200	210	1	5	125	2		330	1	57	990
Southeast	60	60	less than 1	0	69	1	15.5	130	1	117	390
Embarrass	1,290	1,350	7	5	568	7		1,920	7	42	5,760
East Range	1,830	1,940	11	6	547	7		2,490	10	28	7,470
TOTAL URBAN	11,960	13,030	72	9	5,676	71	15.5	18,710	72	44	56,130
TOTAL RURAL	4,770	4,990	28	5	2,286	29	15.5	7,280	28	46	21,840
TOTAL STUDY AREA	16,730	18,020	100	8	7,962	100	15.5	25,990	100	44	77,940

SOURCES: Regional Copper-Nickel Study residential settlement model; Regional Copper-Nickel Study forecasts of manpower needs for taconite industry and hypothetical mining developments; U.S. Dept. of Commerce, Revenue Sharing Program, population estimates 1976; Regional Copper-Nickel estimates of 1976 rural households and population (see Table 2).

Figure 21.In and Out Migration of New Households in the Study Area Resulting from 12.35 x 10^6 MTPY Mine and Mill in Development Zone 2 Prior to Stabilization in Year 8.5

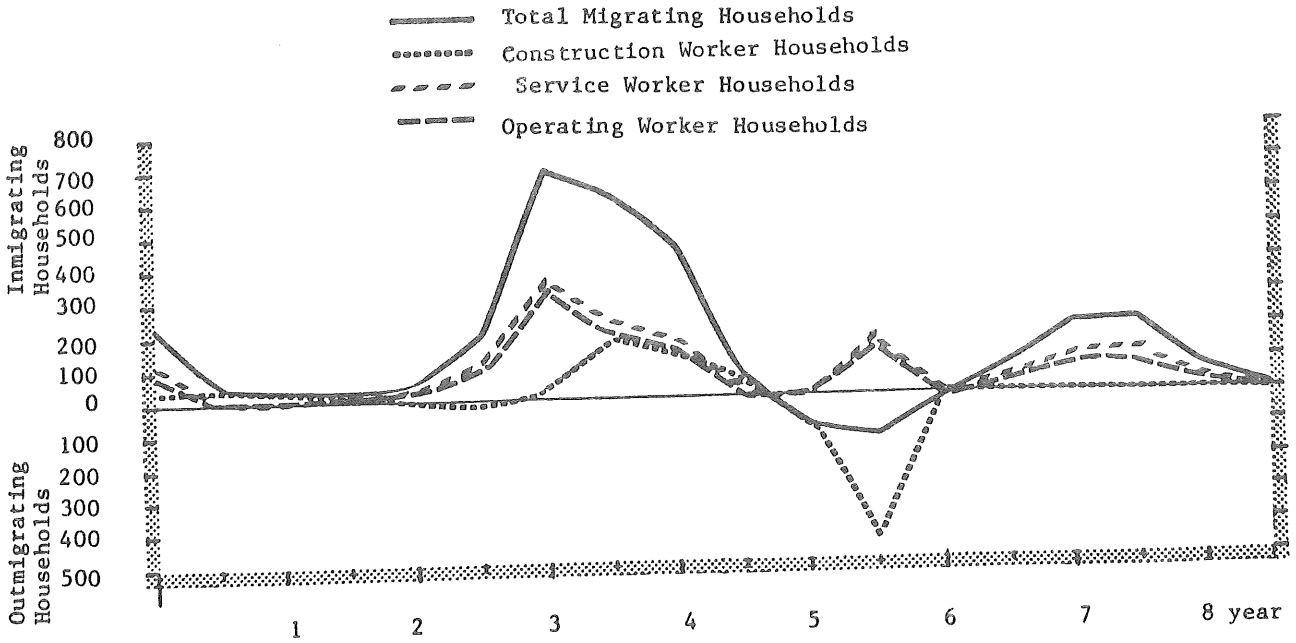
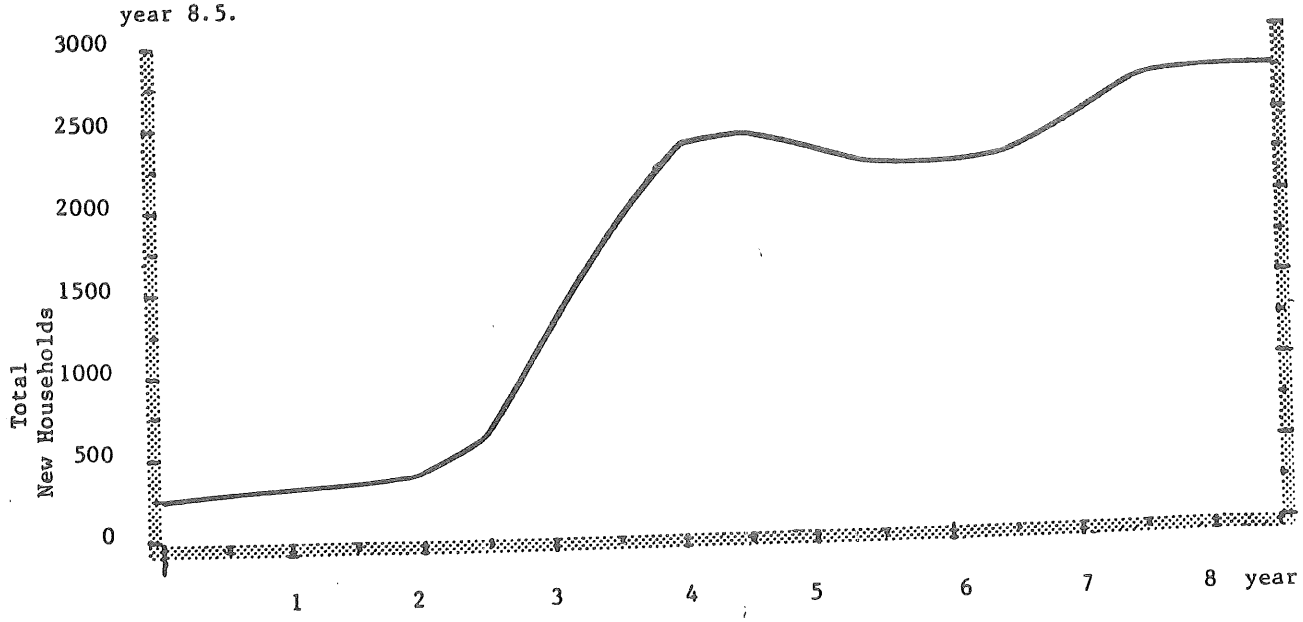


Figure 22 Cumulative Total New Households in the Study Area Resulting From 12.35 x 10^6 MTPY Mine and Mill in Development Zone 2 up to Stabilization in year 8.5.



Source: Volume II: Technical Assessment

Figure 23.
In and Out Migration of New Households in the Study Area Resulting from 16.68 x 10^6 MTPY Mine and Mill with a 100,000 MTPY Smelter in Development Zone 4 Prior to Stabilization in Year 8.5.

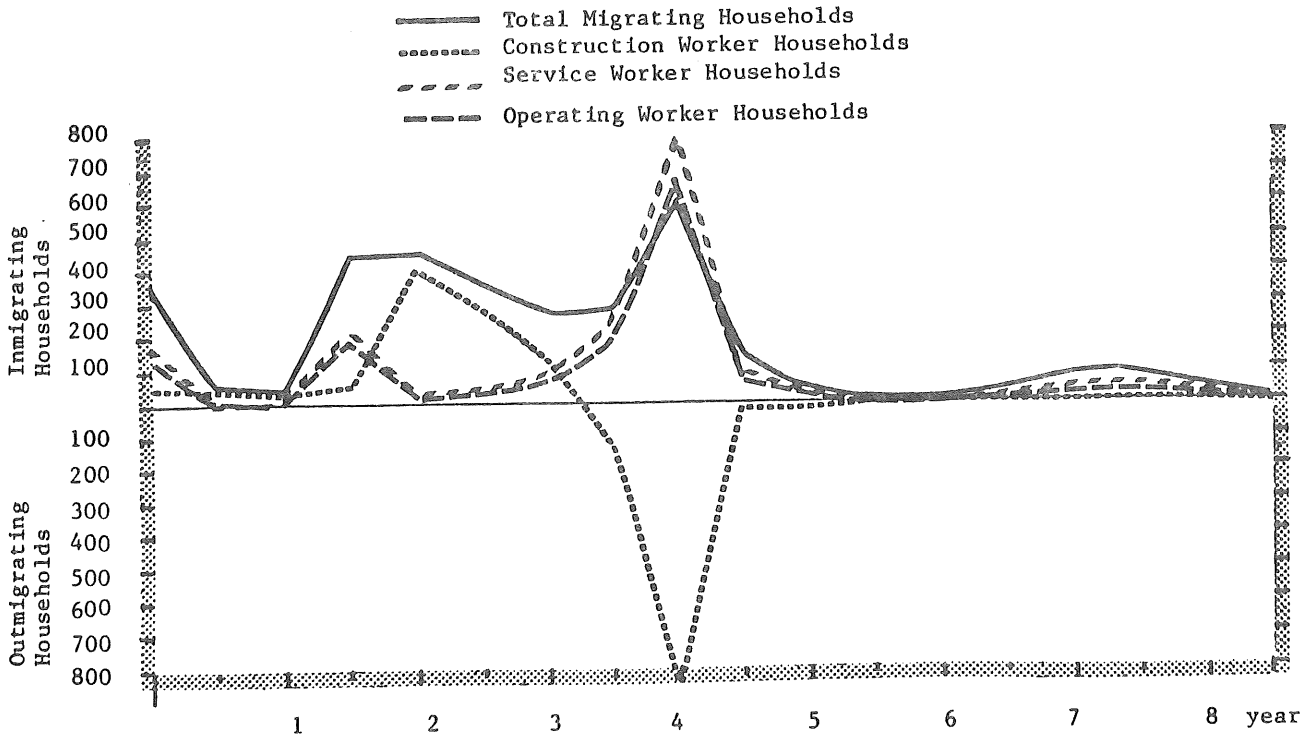
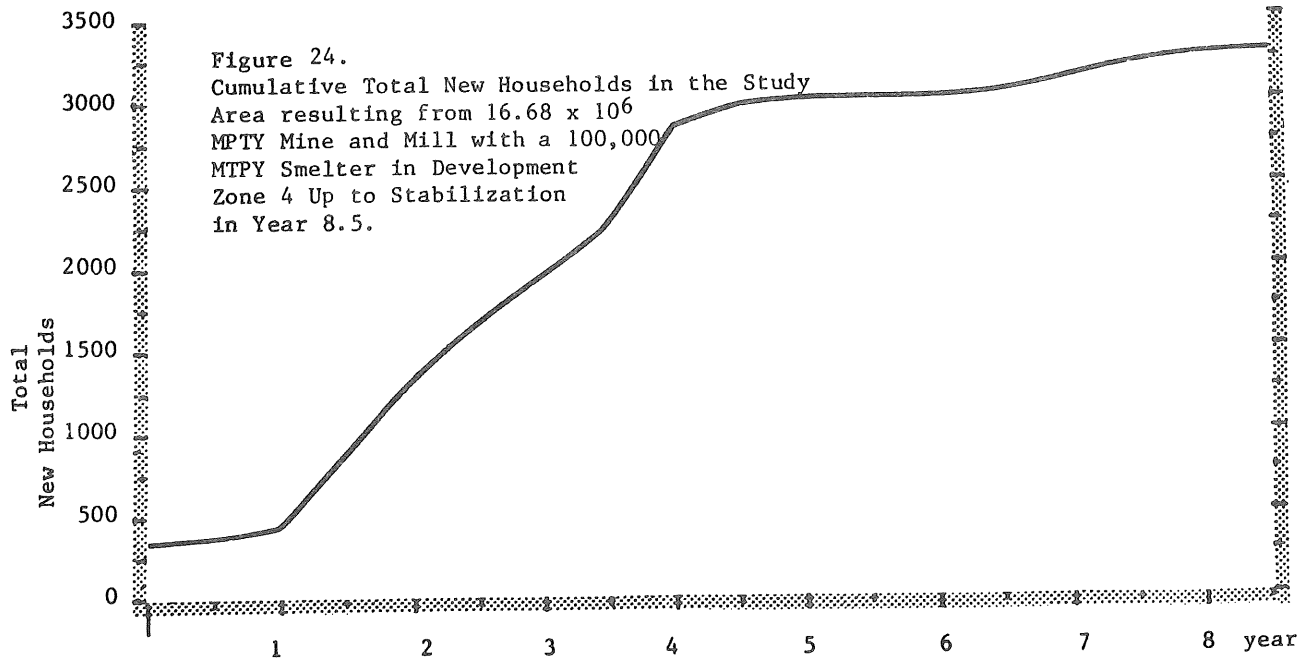


Figure 24.
Cumulative Total New Households in the Study Area resulting from 16.68 x 10^6 MPTY Mine and Mill with a 100,000 MTPY Smelter in Development Zone 4 Up to Stabilization in Year 8.5.



Source: Volume II: Technical Assessment

Figure 25.
In and Out Migration of New Households in the Study Area resulting from 20.00 x 10^6 MTPY Mine and Mill in Development Zone 7 Prior to Stabilization in Year 5.5

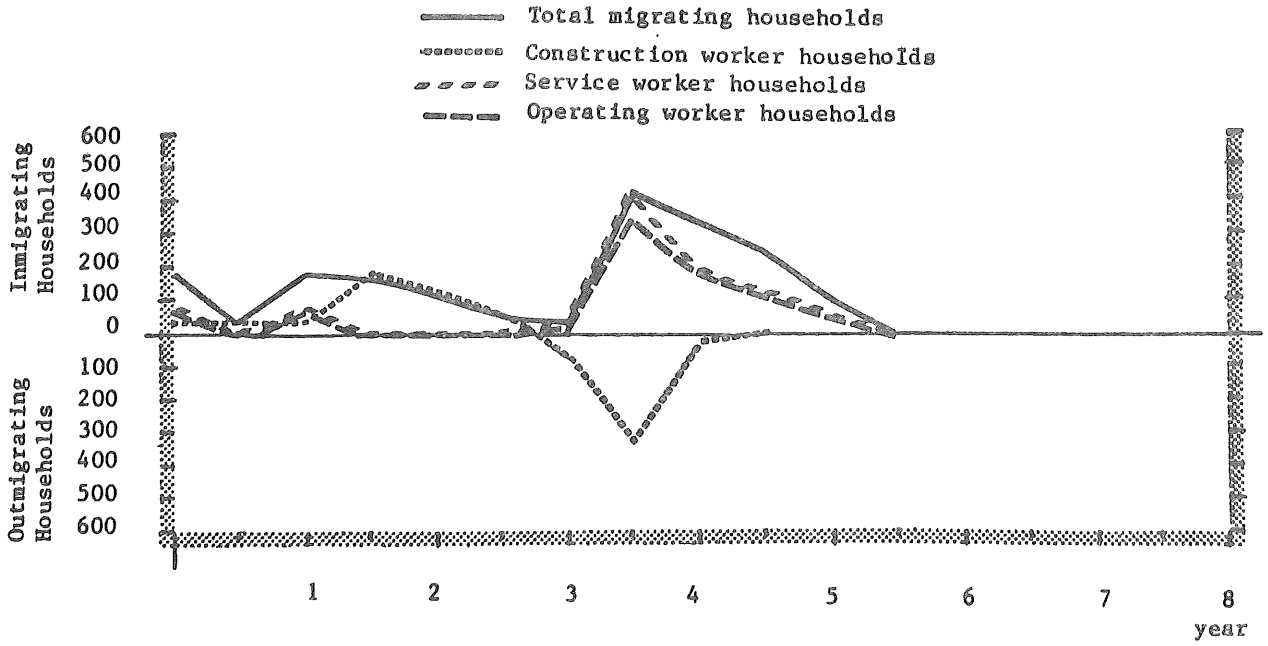
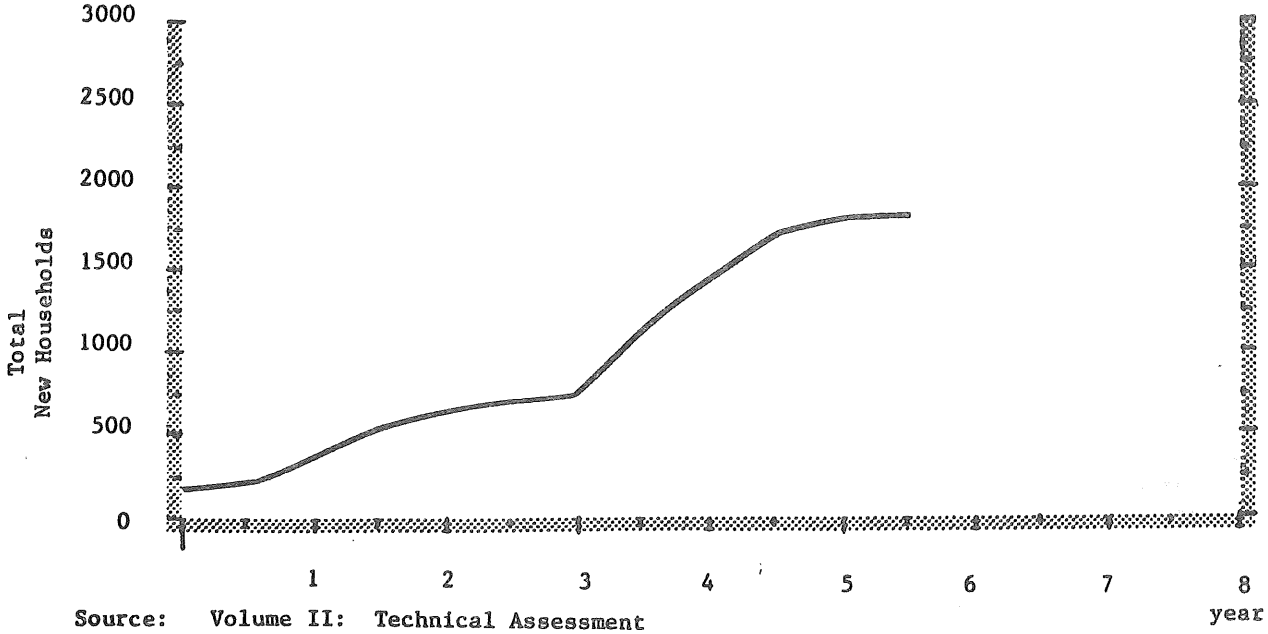
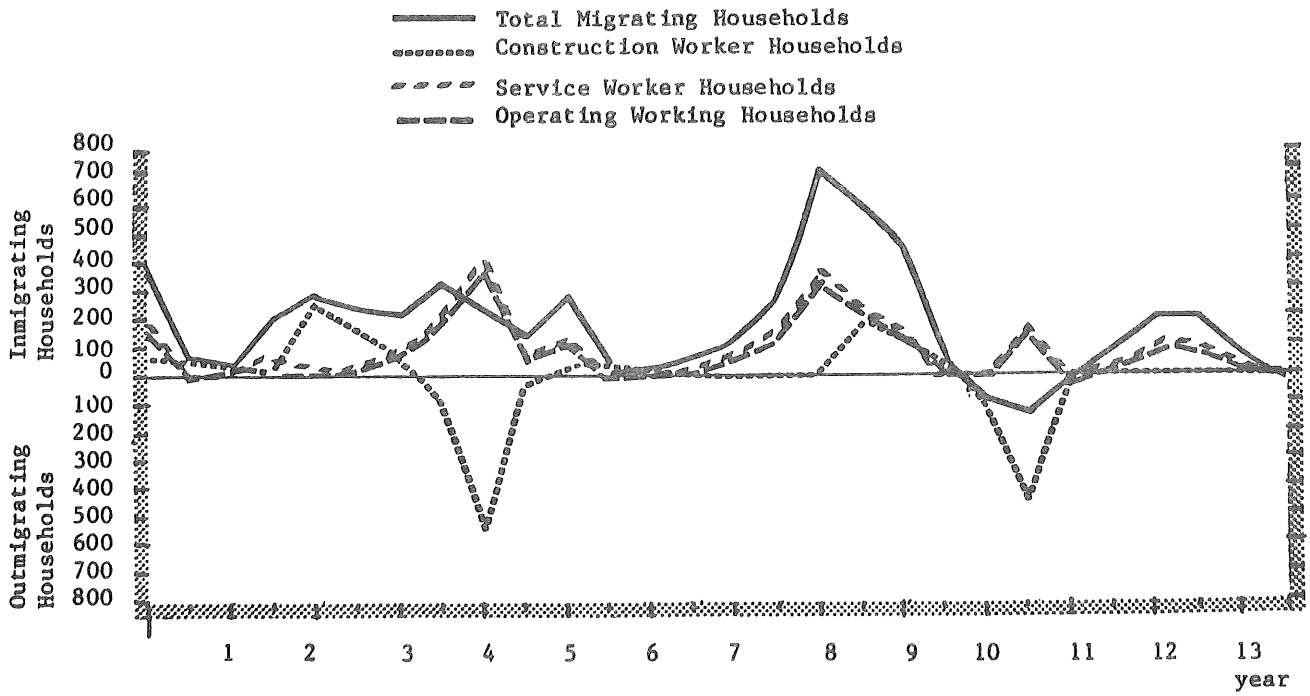


Figure 26.
Cumulative Total New Households in the Study Area Resulting from 20.00 x 10^6 MTPY Mine and Mill in Development Zone 7 Up to Stabilization in Year 5.5



Source: Volume II: Technical Assessment

Figure 27
In and Out Migration of New Households in the Study Area Resulting from "2-Zone" Mine Development Sequence By Workforce Prior to Stabilization in Year 13.5



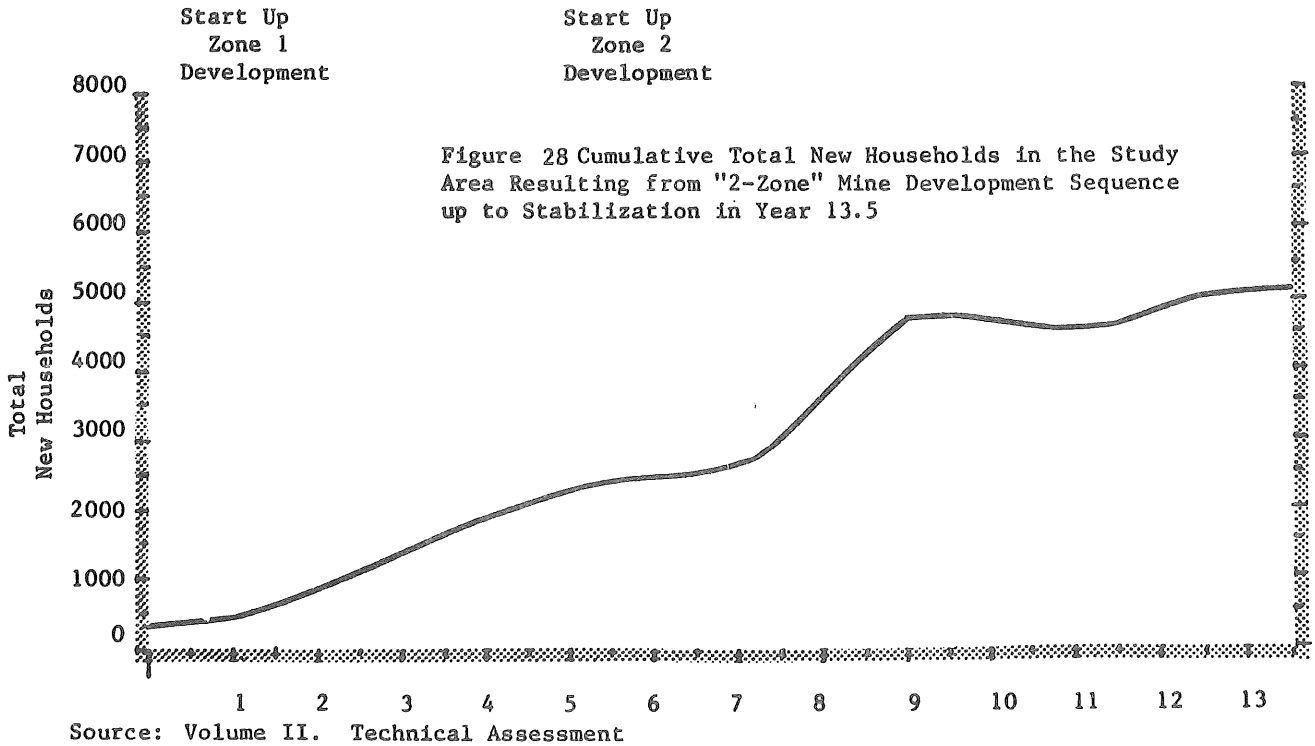


Figure 28 Cumulative Total New Households in the Study Area Resulting from "2-Zone" Mine Development Sequence up to Stabilization in Year 13.5

Source: Volume II. Technical Assessment

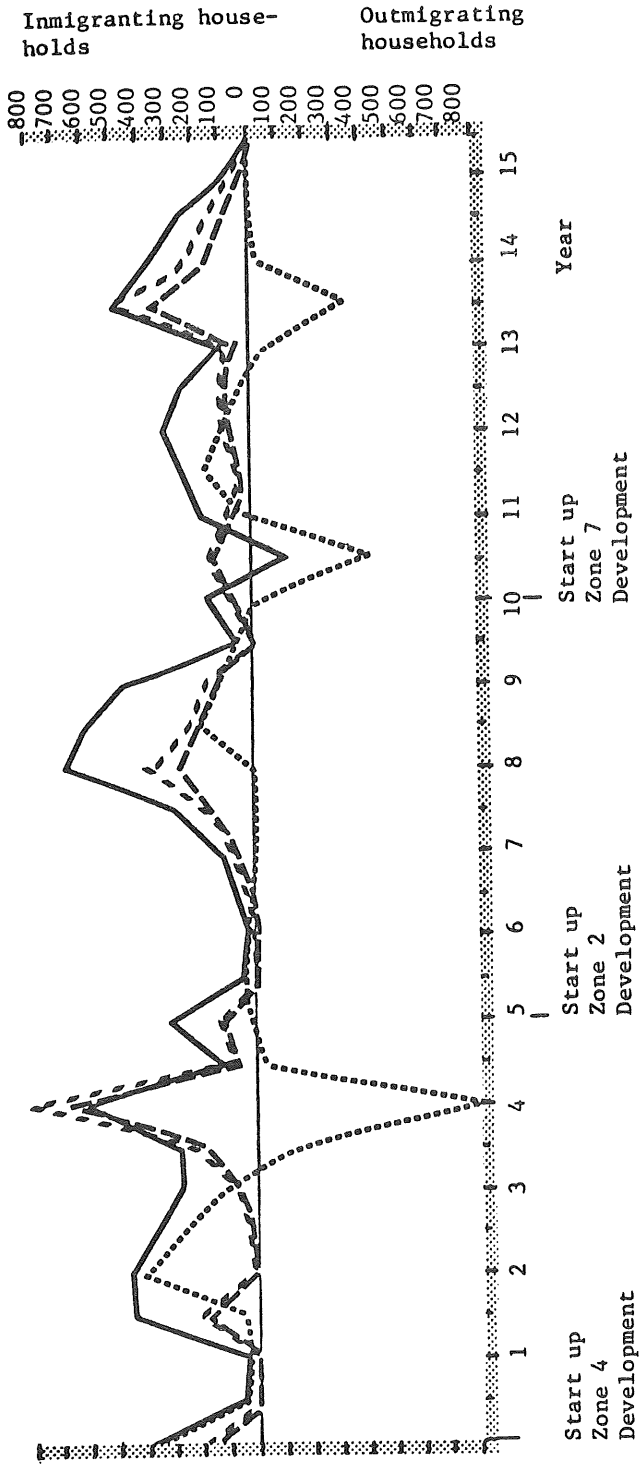


Figure 29 In and out migration of new households resulting from "3-zone" mine development sequence by workforce prior to stabilization in year 15.5.

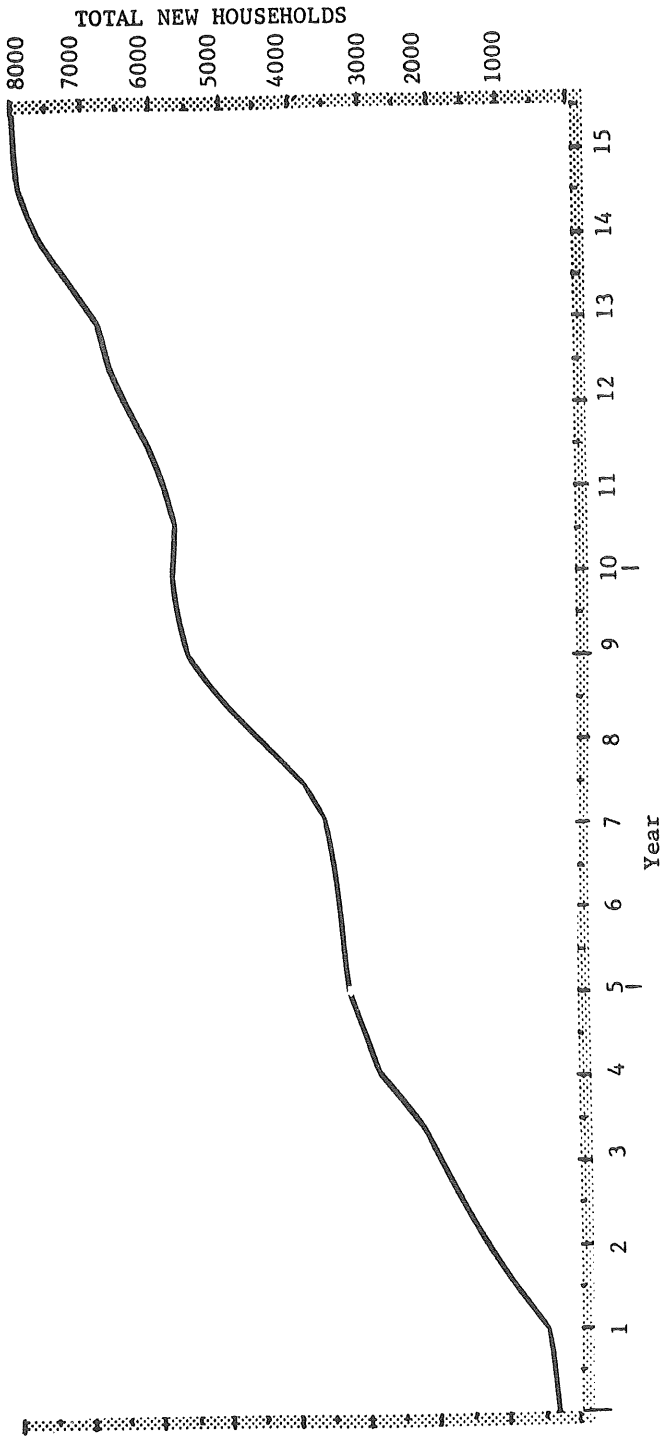


Figure 30 Cumulative total new households resulting from "3-zone" mine development sequence up to stabilization in year 15.5.

Source: Volume II: Technical Assessment

l evelopment schedule. That is to say, certain sections of the Study Area will experience pronounced residential settlement growth at different times. These fluctuations are presented graphically in Figures 31 through 34 which show projected residential settlement growth resulting from the "2-zone" and "3-zone" mine development sequences by city and Study Area sub-region over time.

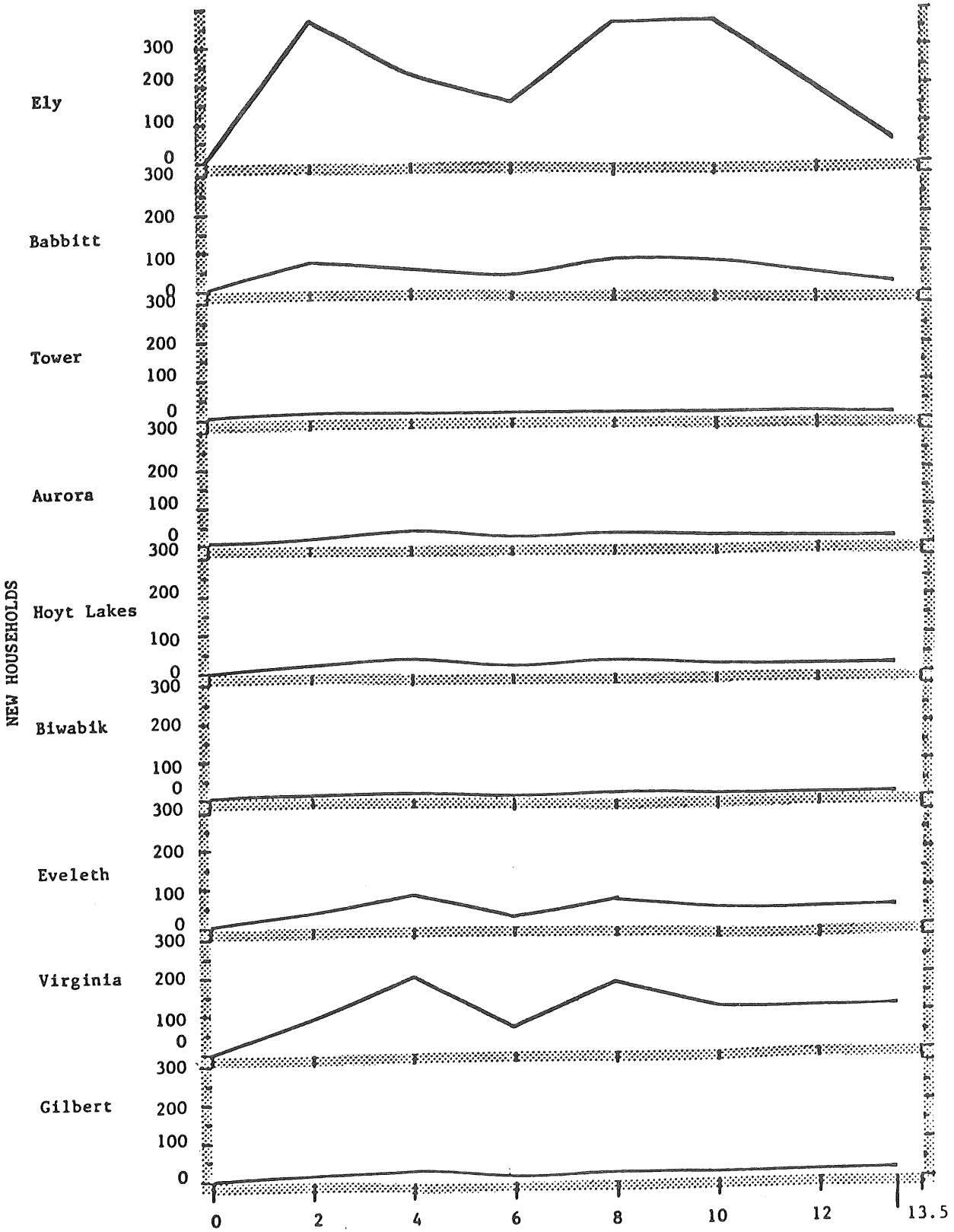
In Figure 33, for instance, it can be seen that while Ely and Babbitt experience the bulk of their growth in the first ten years of development, the cities of the East Range region generally show peak growth around the twelfth or fourteenth year of development. This is, in part, attributable to the shift in the growth of the mining developments themselves from those focusing their growth on the northern portions of the Study Area to those located in the southern Development Zones. However, these spatial fluctuations are also attributable to the basic distributional differences of the workforces being sequenced in time.

These periods of rapid growth could be accompanied by the type of impacts associated with the "boom town" phenomenon. These include the suddenly increased demand on service systems such as water, sewage, and schools (see Chapters 1 and 2 of this volume); the need for local governments to quickly and equitably increase revenues to meet the costs of expanding service facilities (see Chapter 13); and the difficulties in meeting the rapid growth in the demand for housing.

7.3.4 Residential Settlement Land Use Impacts

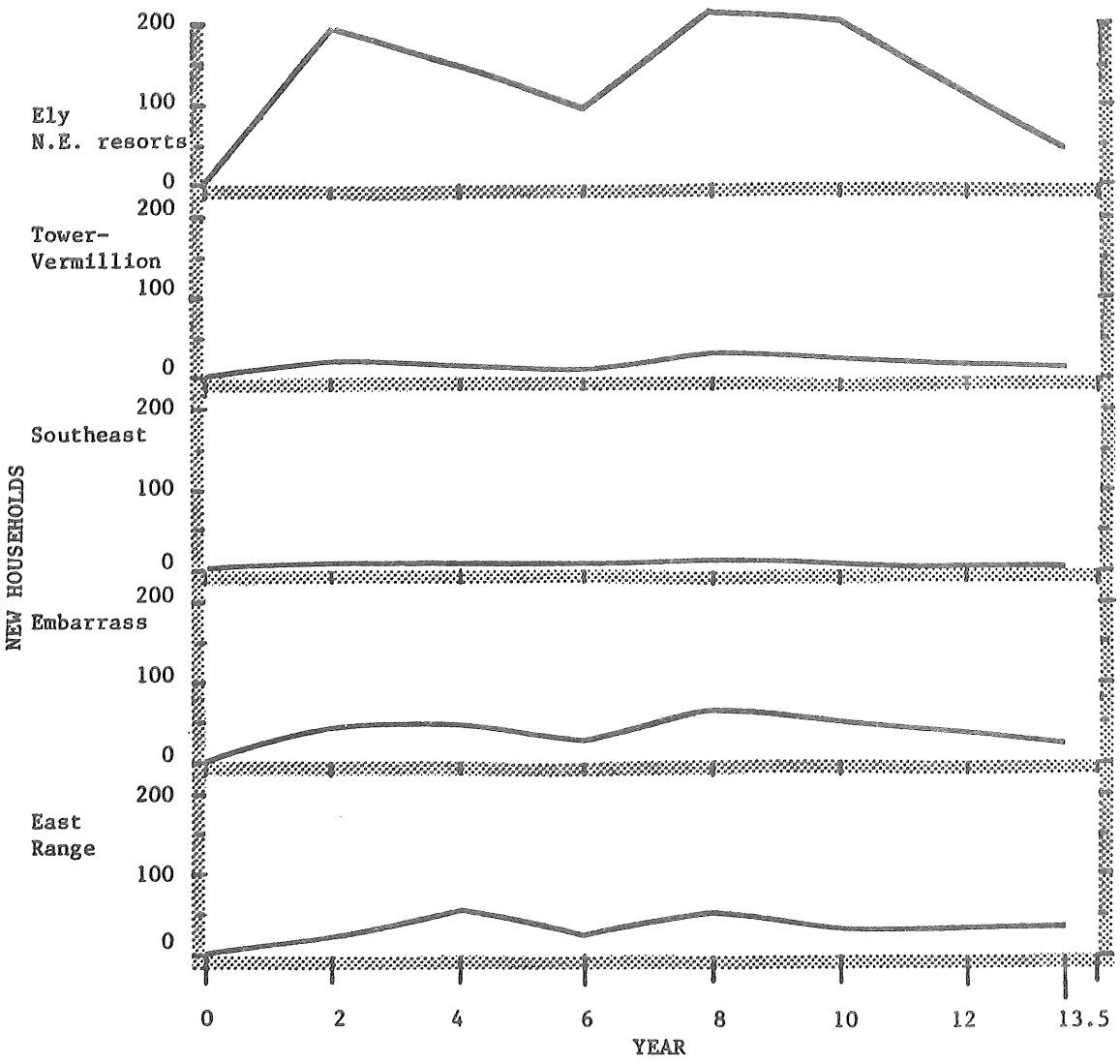
7.3.4.1 Direct Mining Land Use Conflicts With Existing Settlement--Excluding the city of Hoyt Lakes which lies almost entirely within Cu-Ni Development Zone 6, there are 76 residential structures (both seasonal and year round) within the 172,547 acres of the Cu-Ni Development Area (Figure 8). Of these 76 structures,

Figure 31. Projected new residential settlement in the Study Area resulting from "2-Zone" mine development sequence by city.



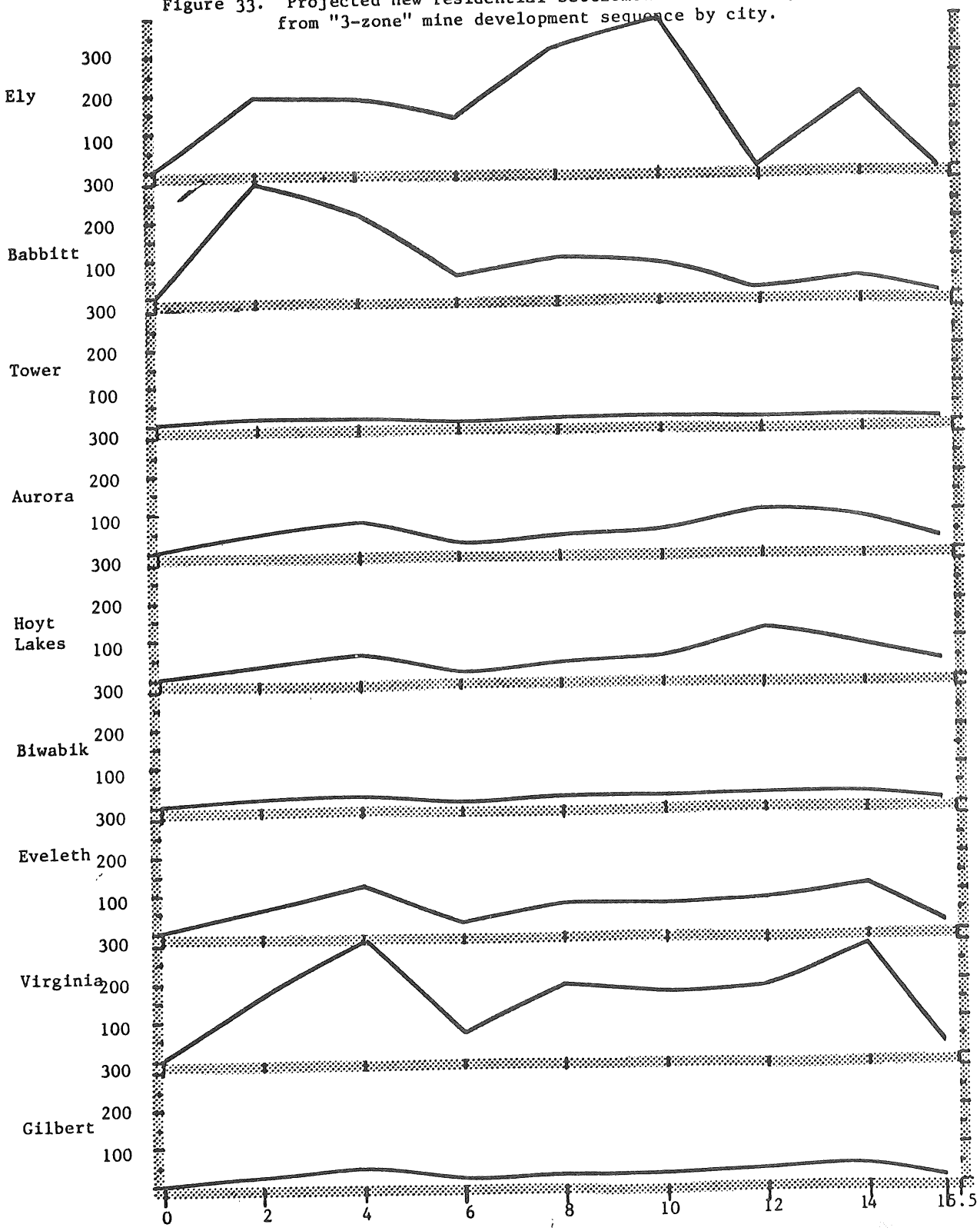
SOURCE: Regional Copper-Nickel Study Residential Settlement Model; Regional Volume II: Technical Assessment

Figure 32. Projected new rural residential settlement in the Study Area resulting from "2-zone" mine development sequence by sub-region.



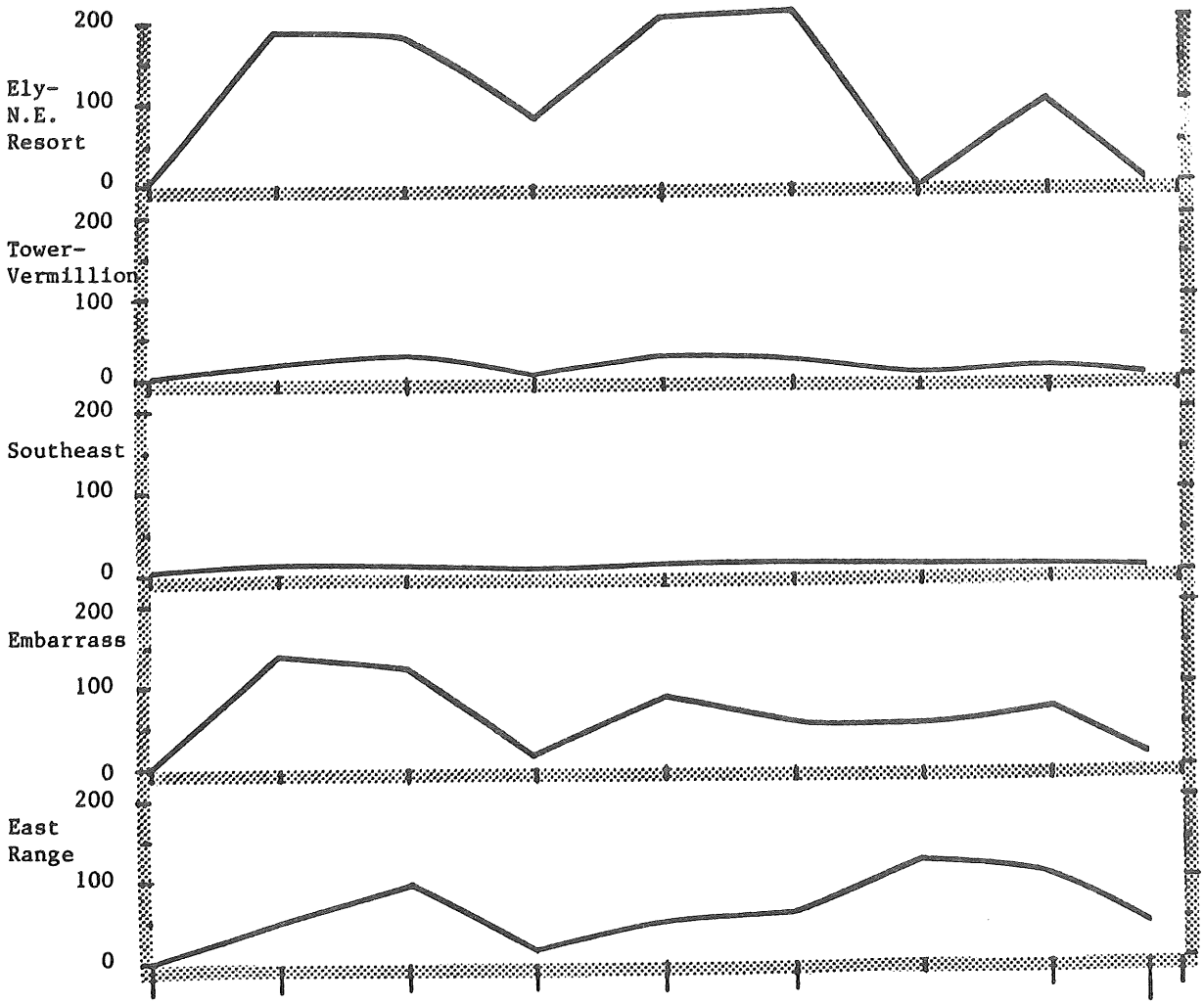
SOURCES: Regional Copper-Nickel Study Residential Settlement Model; Volume II: Technical Assessment

Figure 33. Projected new residential settlement in the Study Area resulting from "3-zone" mine development sequence by city.



SOURCE: Regional Copper-Nickel Study Residential Settlement Model; Volume II: Technical Assessment

Figure 34. Projected new rural residential settlement in the Study Area resulting from "3-zone" mine development sequence by sub-region.



SOURCES: Regional Copper-Nickel Study Residential Settlement Model; Volume II: Technical Assessment

approximately 35 are located along the South Kawishiwi River in Development Zone 2. Eighteen are located along the southern shores of Birch Lake on the outskirts of Babbitt in Zone 3, 8 are located in the community of Allen Jct. about two miles east of Hoyt Lakes in Zone 6, and 7 are situated in a small development on the north shore of Birch Lake again in Zone 3. This is the settlement which is liable to be impacted by direct consumption of land for mine development.

The probability of all these structures being displaced by mine development is extremely slim, however. Estimates are that these 76 homesites occupy roughly 195 acres (based on minimum lot size as established by zoning ordinances).

These figures suggest that direct displacement of existing settlement will occur only when that settlement occupies land which is of the highest value to the mine developers; for example, land directly above or adjacent to the ore deposits themselves. The probability of a residential structure being displaced drops off rapidly as the distance between the structure and the Contact increases. An area extending three miles east of the Contact, known as the Cu-Ni Resource Area, is considered to be the most likely area for processing facilities and the mines themselves to be located. Approximately 41 of the 76 residential structures are located in the Cu-Ni Resource Area. In fact, the 35 or so structures along the South Kawishiwi River in Development Zone 2 are almost immediately atop the Contact. In essence, this greatly increases the likelihood of their displacement in the event of mining development in Zone 2.

For residential structures located further from the Contact, the possibility of displacement depends on the specific siting and extent of necessary mining facilities. Roughly 85% of the city of Hoyt Lakes lies within the Cu-Ni Development

Area. The city occupies approximately 440 acres, or 1% of the 32,476 acres in Development Zone 6. Leaving roughly 32,036 acres of land available for mine development. Even after withholding the 24 acres of Allen Jct., there is expected to be enough unoccupied land available for mine development that conflicts between direct mining and residential land uses are expected to be slight.

7.3.4.2 Direct Mining Land Use Conflicts With Projected Settlement--Using the maximum number of new households projected as a result of the "3-Zone" hypothetical development, eight inmigrating households are projected to settle in Residential Settlement Model Zone 169 (Figure 8). This zone is located east of Hoyt Lakes completely within the Cu-Ni Resource Area and is the zone in which Allen Jct. is located.

The only other Residential Settlement Model Zone which lies entirely inside of the Cu-Ni Development Area and which is projected to be settled by inmigrating households is Zone 124 (Figure 8) where eight households are also projected to settle. In this case, however, all of the land considered available for settlement (privately owned lands within a mile of a public road) are located further than three miles from the Contact decreasing the probability of direct land use conflicts.

In all other instances where settlement has been projected for Residential Settlement Model Zones which may partially lay within the Cu-Ni Development Area, enough land would be available for settlement outside of the Development Area greatly minimizing the possibility of conflicts between mining and future residential land uses.

It also must be noted that the bulk of residential growth associated with Cu-Ni mining development is expected to occur subsequent to acquisition of land for mining development further decreasing the possibilities of direct land use conflicts involving new residential settlement.

7.3.4.3 Estimated Land Consumption by Projected Residential Settlement--Increases in residential settlement of the Study Area will require that land which is not currently used for residential purposes be converted to that use.

In 1976, approximately 28,000 acres of land were used for urban and rural residential purposes. 22,000 of these acres were located outside of urban developments.

The estimated additional land consumed for rural residential settlement resulting from use by the "3-zone" mine development sequence is 8,272 acres (or almost a 30% increase over 1976 levels). This estimate is based on the minimum lot size requirements contained in county and munincipal zoning ordinances.

If the vacancy rate of habitable housing is as low as expected--essentially zero--the increase in urban settlement will mean physical expansion of the cities. Table 31 displays, by city, projected increases in residential settlement and estimated acres consumed by this new settlement (again, based on minimum lot size requirements and assuming all new construction would occur outside of already developed areas).

Tables 31 & 32

Table 31. Estimated amounts of land consumed by new residential settlement resulting from the "3-Zone" development sequence.

	PROJECTED NEW HOUSEHOLDS[a]	ESTIMATED ACRES CONSUMED BY NEW DEVELOPMENT[b]	EST. ACRES URBAN DEV. LAND[c]	PERCENT INCREASE IN DEVELOPED LAND AREA	ACRES OF AVAILABLE LAND[d]	% AVAILABLE LAND CONSUMED
Ely	1,420	781	920	84.9		
Babbitt	837	418	480	87.1		
Tower	86	43	240	17.9		
Aurora	466	405	840	48.2		
Hoyt Lakes	448	340	440	77.3		
Biwabik	167	122	240	50.8		
Eveleth	578	318	720	44.2		
Virginia	1,427	656	1,880	34.9		
Gilbert	247	136	240	56.7		
SUB-REGION (rural areas only)						
Ely-N.E. resorts	977	2,101			61,040	3.4
Tower-Vermillion	125	124			27,600	0.4
Southeast	9	458			27,440	1.7
Embarrass	568	1,383			102,440	1.4
East Range	547	987			57,040	1.7
TOTAL URBAN	5,676	3,219	6,000	53.6		
TOTAL RURAL	2,286	5,053			275,560	1.8
TOTAL STUDY AREA	7,962	8,272	6,000	53.6	275,560	1.8

SOURCES: [a]residential settlement model-"3-Zone" development sequence.
[b]based on distribution of zones permitting residential settlement and the minimum lot size requirements per zone.
[c]Regional Copper-Nickel Study Land Use Map; MLMIS V45-File 0; "Urban" Data Level.
[d]MLMIS V43 masked by V83; "Araz-2".

Table 32. Percent allocation of new households to residential settlement model zones by workforce type and mine location. (Allocations of less than 0.1% were rounded to 0.0%; zones receiving no allocation are indicated accordingly.)

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
1	0.2	0.2	0.2	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.2	0.2	0.2	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
4	1.3	1.3	1.1	0.3	0.3	0.4	0.4	0.3	0.0	0.0	0.0	0.3
5	0.8	0.8	0.6	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.2
6	1.2	1.3	1.1	0.3	0.3	0.3	0.4	0.3	0.0	0.0	0.0	0.3
7												
8												
9												
10		No allocation										
11												
12												
13												
14												
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19												
20												
21		No allocation										
22												
23												

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
24	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
25	1.5	1.5	1.4	0.4	0.4	0.5	0.5	0.4	0.0	0.0	0.0	0.3
26	1.8	1.8	1.6	0.5	0.5	0.6	0.6	0.5	0.0	0.0	0.0	0.4
27	14.0	14.1	14.0	4.8	4.0	4.7	5.4	4.2	0.2	0.2	0.3	3.8
28	32.6	32.9	34.2	10.5	7.7	9.1	11.2	9.1	0.4	0.3	0.6	8.3
29	3.2	3.2	2.8	0.9	0.7	0.9	0.9	0.8	0.0	0.0	0.0	0.7
30	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
31												
32		No allocation										
33												
34												
35	0.4	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
36	0.4	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
37	3.0	3.1	2.3	0.4	0.7	0.8	0.7	0.5	0.0	0.0	0.0	0.4
38	1.3	1.3	1.0	0.4	0.7	0.8	0.7	0.4	0.0	0.0	0.0	0.3
39	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
40	0.6	0.6	0.6	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.2
41	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
42	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
62												
63												
64												
65	No allocation											
66												
67												
68												
69	0.8	0.8	0.6	0.1	0.3	0.3	0.3	0.1	0.0	0.0	0.0	0.1
70	0.4	0.5	0.3	0.0	0.3	0.3	0.2	0.0	0.0	0.0	0.0	0.0
71	0.7	0.7	0.5	0.2	0.8	0.9	0.7	0.2	0.0	0.0	0.0	0.2
72	0.6	0.6	0.5	0.2	1.1	1.3	0.9	0.2	0.1	0.1	0.1	0.2
73	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	No allocation											
75												
76	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.1	0.1	0.1	0.1	0.1
77	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.1	0.1	0.2	0.2
78	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
83	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
84	0.2	0.2	0.2	0.2	0.4	0.5	0.5	0.2	0.3	0.3	0.3	0.2
85	0.2	0.2	0.2	0.2	0.4	0.5	0.5	0.2	0.3	0.3	0.3	0.2
86	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
87	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
88	No allocation											
89	0.9	0.9	0.8	0.3	1.6	1.9	1.5	0.4	0.1	0.1	0.1	0.3
90	1.6	1.7	1.4	0.6	3.0	3.5	2.7	0.6	0.2	0.1	0.1	0.5
91	0.5	0.5	0.4	0.3	2.3	2.7	1.8	0.3	0.1	0.0	0.0	0.2
92 93 94 95 96 97	No allocation											
98	0.7	0.7	0.5	0.0	0.4	0.5	0.3	0.0	0.0	0.0	0.0	0.0
99	0.4	0.4	0.3	0.0	0.5	0.6	0.4	0.0	0.0	0.0	0.0	0.0
100	0.1	0.1	0.1	0.0	0.2	0.3	0.2	0.0	0.0	0.0	0.0	0.0
101	No allocation											
102	0.1	0.1	0.1	0.0	0.4	0.5	0.3	0.0	0.0	0.0	0.0	0.0
103	7.0	7.0	7.7	4.4	24.7	29.1	25.5	5.4	1.4	0.7	1.0	4.0

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
104	1.0	1.0	1.0	0.5	2.6	3.1	2.5	0.6	0.2	0.2	0.2	0.4
105	0.7	0.7	0.7	0.4	1.7	2.1	1.7	0.4	0.2	0.2	0.3	0.3
106	0.3	0.3	0.3	0.2	0.9	1.1	0.9	0.2	0.2	0.2	0.2	0.2
107	0.4	0.4	0.4	0.3	1.0	1.1	1.0	0.3	0.4	0.4	0.4	0.3
108	0.2	0.2	0.2	0.2	0.4	0.5	0.5	0.2	0.3	0.4	0.3	0.2
109	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.1	0.2	0.2	0.2	0.1
110	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1
111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
113	0.1	0.1	0.1	0.3	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.3
114	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
115	0.1	0.1	0.2	0.3	0.3	0.4	0.4	0.3	0.4	0.4	0.4	0.4
116	0.2	0.2	0.2	0.3	0.5	0.6	0.6	0.3	0.4	0.4	0.4	0.3
117	0.3	0.3	0.4	0.4	0.9	1.0	1.0	0.5	0.7	0.8	0.7	0.5
118	0.4	0.4	0.5	0.4	1.1	1.3	1.2	0.5	0.7	0.7	0.7	0.4
119	0.3	0.3	0.3	0.2	0.7	0.8	0.7	0.2	0.2	0.2	0.2	0.2
120	0.2	0.2	0.2	0.1	0.5	0.6	0.5	0.1	0.1	0.1	0.1	0.1
121	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
122	No allocation											
123												
124	0.1	0.1	0.1	0.0	0.4	0.5	0.3	0.0	0.0	0.0	0.0	0.0
125	0.1	0.1	0.1	0.0	0.6	0.7	0.4	0.0	0.0	0.0	0.0	0.0
126	0.2	0.2	0.1	0.0	0.4	0.5	0.3	0.0	0.0	0.0	0.0	0.0
127	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
128	0.2	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
129	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
130	0.4	0.4	0.3	0.0	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0
131	0.1	0.1	0.1	0.0	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0
132												
133												
134	No allocation											
135												
136												
137												
138												
139	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.1
140	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
141	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
142	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
143	0.1	0.1	0.1	0.4	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.4
144	0.0	0.0	0.1	0.3	0.1	0.1	0.2	0.3	0.1	0.2	0.2	0.3
145	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
146	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
147	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0
148	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
149	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0
150												
151												
152												
153	No allocation											
154												
155												
156												
157												
158	0.2	0.3	0.2	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
159	0.2	0.2	0.2	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0
160	No allocation											
161												
162	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
163	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
164												
165												
166	No allocation											
167												
168												
169	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.5	0.5	0.3	0.1
170	1.1	0.4	0.7	4.9	7.2	1.2	1.7	5.0	22.1	22.3	19.7	5.7
171	0.5	0.3	0.5	3.0	3.4	1.0	1.3	2.9	10.5	10.6	9.3	3.4
172	0.4	0.4	0.7	2.8	2.5	1.4	1.7	2.9	7.7	7.8	7.1	3.4
173	0.3	0.3	0.4	2.4	1.5	0.8	1.1	2.5	4.7	4.7	4.6	2.7
174	No allocation											
175	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
176	1.5	1.6	3.3	27.7	4.0	4.7	8.3	28.0	10.9	11.0	16.0	29.1
177	0.5	0.5	1.0	11.1	2.0	1.5	2.5	11.2	6.1	6.2	8.0	11.7
178	0.2	0.2	0.4	4.5	1.2	0.7	1.0	4.5	3.8	3.8	4.3	4.8
179	0.0	0.0	0.1	0.6	0.3	0.1	0.2	0.6	0.9	0.9	0.8	0.6
180	0.1	0.1	0.1	0.8	0.5	0.2	0.3	0.8	1.6	1.7	1.5	0.9
181	0.1	0.1	0.1	0.4	0.4	0.2	0.2	0.4	1.4	1.4	1.1	0.4
182	0.0	0.0	0.1	0.3	0.3	0.1	0.1	0.3	0.9	1.0	0.7	0.3
183	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.5	0.5	0.3	0.1

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
184	No allocation											
185	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.1	1.0	1.0	0.7	0.1
186												
187	No allocation											
188												
189												
190	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
191	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
192	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
193	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
194	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
195	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
196	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
197	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
198	No allocation											
199												
200	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.4	0.4	0.3	0.0
201	No allocation											
202												
203	0.1	0.0	0.1	0.4	0.4	0.1	0.2	0.4	2.2	2.2	1.8	0.4

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
204	0.1	0.0	0.1	0.4	0.4	0.1	0.2	0.4	1.8	1.9	1.5	0.5
205	0.1	0.1	0.1	0.8	0.5	0.2	0.3	0.8	2.2	2.2	2.0	0.8
206	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.3	0.3	0.2	0.1
207	0.1	0.1	0.1	1.0	0.3	0.2	0.2	1.0	1.1	1.1	1.1	1.0
208	0.0	0.0	0.1	0.8	0.2	0.1	0.2	0.8	0.7	0.7	0.7	0.9
209	0.0	0.0	0.1	0.9	0.2	0.1	0.2	0.9	0.9	0.9	1.0	0.9
210	0.0	0.0	0.0	0.3	0.1	0.1	0.1	0.3	0.6	0.6	0.6	0.3
211	0.0	0.0	0.0	0.2	0.1	0.0	0.1	0.2	0.5	0.5	0.4	0.2
212	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1
213	0.1	0.1	0.1	0.5	0.4	0.2	0.2	0.5	2.0	2.1	1?	0.5
214	0.0	0.0	0.1	0.3	0.3	0.1	0.1	0.3	1.7	1.7	1.4	0.3
215	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
216	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
218	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
219	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.3	0.3	0.2	0.0
220	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.0

Table 32 continued.

RESIDENTIAL SETTLEMENT MODEL ZONE	CU-NI DEVELOPMENT ZONE 1, 2				CU-NI DEVELOPMENT ZONE 3, 4, 5				CU-NI DEVELOPMENT ZONE 6, 7			
	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS	% INMIG. OPERAT. WORKERS W/AMAX	% INMIG. OPERAT. WORKERS W/O AMAX	% INMIG. CONSTRUC. WORKERS	% INMIG. SECONDARY WORKERS
221	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0
222	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
223	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
224	No Allocation											

SOURCE: Regional Copper-Nickel Study residential settlement model.

REFERENCES

Aurora, city of. 1976. Zoning ordinance.

Biwabik, city of. 1970. Zoning ordinance.

Continental Telephone Company. 1977. Service maps for Ely, Embarrass, and Palo exchanges. St. Paul, Minn.

-----. 1976. Directories for Aurora, Babbitt, Biwabik, Ely, Eveleth, Gilbert, Hoyt Lakes, and Virginia. St. Paul, Minn.

Cooperative Light and Power Association of Lake County. 1977. Customer records. Two Harbors, Minn.

Ely, city of. 1968. Zoning ordinance.

Eveleth, city of. 1970. Zoning ordinance.

Fayal Township. 1978. Zoning ordinance.

Gilbert, city of. 1976. Zoning ordinance.

Hanna Mining Company. 1976. Employee residence location by zip code area. Hibbing, Minn.

Hoyt Lakes, city of. 1975. Zoning ordinance.

Inland Steel Mining Company. 1978. Employee residence location by zip code area. Virginia, Minn.

Lake County Department of Planning and Zoning. Building permit data 1976-1977.

-----. 1976. Zoning ordinance.

Minnesota Power and Light Company. 1977. Customer records. Duluth, Minn.

Minnesota State Planning Agency, Office of the State Demographer. 1977. Minnesota labor force survey (MLFS) Forms 1 and 4. St. Paul, Minn.

-----. 1969 and 1973. Minnesota Land Management Information System (MLMIS). Public ownership map V05, File 1. St. Paul, Minn.

Northern Electric Cooperative Association. 1977. Customer records.

Oglebay-Norton Mining Company. 1976. Employee residence location by zip code area. Eveleth, Minn.

Pickands-Mather, Inc. 1976. Employee residence location by zip code area. Hoyt Lakes, Minn.

REFERENCES

Regional Copper-Nickel Study. 1978. Land use map. Minnesota Land Management Information Service (MLMIS) V45, File 0. St. Paul, Minn.

------. 1978. Residential settlement map. Minnesota Land Management Information Service (MLMIS) V36, Files 0 and 4. St. Paul, Minn.

------. 1978. Water amenity land map. Minnesota Land Management Information Service (MLMIS) V32, File 4. St. Paul, Minn.

Reserve Mining Company. 1976. Employee residence location by zip code area. Silver Bay, Minn.

Rom, W., former owner Canoe Country Outfitters, Ely, Minn. 1977. Personal communication.

St. Louis County Department of Planning and Zoning. Building permit data 1971-1976. Duluth, Minn.

-----. 1977. Zoning ordinance.

U.S. Department of Agriculture, Soils Conservation Service. 1973. Arrowhead soils map. Minnesota Land Management Information Service (MLMIS) V15. St. Paul, Minn.

U.S. Department of Commerce. 1977. Revenue sharing program population estimates.

U.S. Department of Commerce, Bureau of the Census. Housing authorized by building permits and public contracts (series 40), 1970-1976.

U.S. Department of the Interior, Bureau of Land Management. 1977. Public ownership map for northeastern Minnesota. Minnesota Land Management Information Service (MLMIS) V55, File 5. St. Paul, Minn.

U.S. Department of the Interior, Geological Survey. 1969. Topographic maps for northeastern Minnesota.

United States Steel Corporation. 1976. Employee residence location by zip code area. Mountain Iron, Minn.

Virginia, city of. 1970. Zoning ordinance.

Waggoner, H. Minnesota Department of Natural Resources, District Forester in Tower, Minn. 1977. Personal communication.

Webb, John. 1958. An urban geography of the Minnesota Iron Ranges. Ph.D. Dissertation. University of Minnesota, Minneapolis, Minn.