CHARACTERIZATION OF TYPICAL
AREAS OF HOUSEHOLD DISTRIBUTION
IN THE RURAL PORTION OF THE
PRAIRIE PROVINCES

Research Report Submitted

to

The Government of Canada

Department of Communications, Ottawa

by

K.J. Fairbairn

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D. Wittkowski

Department of Geography
The University of Alberta

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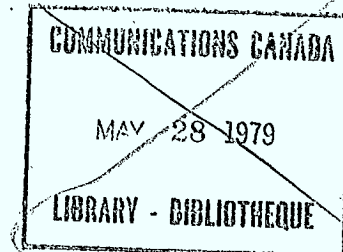PRAIRIE PROVINCES

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EXECUTIVE SUMMARY

The present study comprises one of a number of studies whose general objective is to assist DOC in costing various potential communication systems to serve rural Canada. This study is concerned with the distribution of households in the rural portion of the prairie provinces and specifically its objective is to determine typical cells representing the household distribution in large regions of the prairies. A typical cell is defined as a small, areal unit with a household distribution identical to that of a large region. The study established nine regions in the prairies and nine typical cells representative of each. The regions and the cells were determined from secondary sources which included maps at a variety of scales, aerial photographs, atlases, reports and general literature pertaining to the historical and current development of the prairie provinces.

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CHARACTERIZATION OF TYPICAL AREAS
OF HOUSEHOLD DISTRIBUTION IN THE
RURAL PORTION OF THE PRAIRIE PROVINCES

1. OBJECTIVE OF RESEARCH

The primary objective of this report is to provide the Department of Communications with a set of maps and a generalization procedure that together provide a clear picture of the spatial location of the households throughout the rural portions of the Prairie Provinces. The procedure followed by the contractor to realize this objective consisted of dividing the rural parts of these provinces into regions, each region having a different spatial distribution of households, then determining a representative area or areas (cells) that typify each regional distribution. Further detail is given in Appendix 1, which is a reproduction of the work statement in the original contract. The study was restricted to that part of the Prairie Provinces that is designated as the Department of Communications rural study area (1976 census data for rural [Statistics Canada definition] Canada, minus enumeration areas having a population density of less than one person per square mile, plus urban settlements [Statistics Canada definition] with less than 2,500 people). Figures 1 and 2 show the rural study area. This report and maps are intended to be the demographic component of The Department of Communications' costing studies for various communication system possibilities in rural Canada.

2. DATA AND METHODOLOGY

Two sources of data were used initially:

a) Population densities, by enumeration areas for 1976, provided by Statistics Canada, and

b) Federal electoral district maps with enumeration areas indicated.

On the basis of these maps and data, an initial regional division was established using population density divisions of: -

1 - 10,
10 - 100,
100 - 250,
250 - 1,000 and
1,000 - 2,500 persons per square mile by color

coding the enumeration areas in the rural study area on to the Federal electoral district maps.

These divisions appeared satisfactory in that they identified several major population distribution regions pertinent to the study, viz.

a) Indian Reserves
b) Mennonite Colonies
c) Towns and Villages
d) French 'Long Lot' System
e) Dry Land Farming Areas.

...../2

On the basis of population density only, and at the scale of
the electoral maps, the differences between the various divisions are
relatively clear. For example, the Indian Reserves, Mennonite Colonies,
and the French 'Long Lot' system have population density ranges between
10 and 100 persons per square mile, the Towns and Villages group range
above 250 persons per square mile while the Dry Land Farming Areas have
1 to 10 persons per square mile and are interspersed with areas of less than
one person per square mile.

In Manitoba, in particular, French Long Lots, Indian Reserves,
and Mennonite Colonies stand out very clearly, in density terms, from their
surrounding areas. However, population densities did not distinguish all
of the regional divisions as the variability of densities within each type
meant certain of them did not appear on these maps, e.g. several of the
Indian Reserves and dry land farming areas. A finer division by agricultural
type, also hoped for, was not evident on the basis of density distributions.
Emphasis was then placed on the actual distribution of households as
determined from large scale maps (enumerator maps) and aerial photographs,
and for completeness the history of Prairie settlement and land surveying
was examined. On the basis of this examination the maps, Figures 3 and 4,
Household Regions, were drawn. Additional regions, f) Pioneer Fringe, g)
Typical Section, h) Urban Spread, and i) Irrigation Districts are
identified.

NOTE: When the household data became available a rank order correlation was
run on the population density and household density per census division.
A ρ of 0.9866 was obtained.* This suggests the use of population data
instead of household data is reasonable.

3. DETERMINATION OF TYPICAL CELLS

The materials in the map collection at the University of Alberta
were searched for recent data relating to the regional divisions so that
the typical cells might be established. Materials consulted consisted of
maps at a variety of scales, the national topographic system and county
maps, aerial photographs, agricultural and statistical maps, e.g. Atlas of
Saskatchewan. On the basis of this information, enumeration area maps
were requested from DOC. However, in most cases these contained examples
of households with undesignated occupancy, and therefore they were not as
informative as had been hoped. Nevertheless, the better quality maps were
used in the drawing of the typical cell maps, Figures 5-13. Information
was also requested of Alberta Government Telephones, Alberta Bureau of
Statistics and general reference material in the University libraries. At
AGT maps at 2 inches to the mile showed the location of telephone wires
and the households with telephones; the ABS provide agricultural statistics
which were used to examine the relationship between agricultural type and
settlement density; the library sources provided data relating to the

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* Spearman's rho (ρ) or rank-difference correlation is a nonparametric
   technique and the most common alternative to Pearson's product-moment co-
efficient. When samples are less than 30 this method is subject to less error
than the product-moment correlation. It is used when measurements are ordinal
in scale and in the present context all census divisions in the Prairie Provinces
were ranked according to their population density per square mile (1976) and their
household density per square mile (1976) and the ranks were correlated.

history of settlement, land subdivision and survey information which, in turn, relates to farm size. Typical cells are discussed in the next section.

4. THE TYPICAL CELLS

Figures 1 to 13 in this report are small scale versions of larger maps, copies of which may be obtained, on request, from the Director of the Rural Communications Program, DOC.

The following include a working title for the cell, its locational identification and comments on the factors affecting the household distribution within each area.

i) Mennonite Colonies (Manitoba, Figure 5)

Area: FED 46004

EA's: Parts of 53 - 56 and of 101 - 104.

Base Map: NTS 62H/4   1: 50,000

1. a) shows all-weather roads

b) Mennonite colonies, commonly known as strassendorfs

c) the town of Winkler

d) the village of Haskett.

2. Characterized by:-

a) Strassendorf surrounded by farmlands owned by the Colony. A lack of regular farms is due to exemptions for the Mennonites from the Homestead Act.

b) The example illustrates the problem of adhering to EA boundaries for the definition of the regions. Note from the figure that the central area is Mennonite held property while the remainder is farming on the typical sectional survey lands (defined under survey system).

3. Other Mennonite colonies exhibit the same Strassendorf-farmland relationship.

ii) Indian Reserves (Blackfoot Indian Reserve, Alberta, Figure 6)

Area: FED 48006

EA's: 173-174

Base Map: Statistics Canada Enumeration Area Census map.

1. a) Shows all-weather roads and houses

2. The example is characterized by:

    a) absence of a survey system

    b) many households are accessible only by cart trail or trail

    c) occurrence of clustering and sporadic settlement within the reserve

    d) large areas are uncultivated being left in their native state.

3. a) The Indian reserves are easily recognizable from aerial photographs. Most of them exhibit a wide variation in population density both within and between reserves. the cell shown is considered to be representative.

iii) Dryland Farming (Consul, Saskatchewan Figure 7)

Area: FED 47012

EA's: Parts 63 and 64, all of 65

Base Map: NTS 72F/5 Ed 2

1) Shows a) all-weather roads

            b) houses

            c) hamlet of Senate

            d) village of Consul

2) The cell is typified by:-

    a) Low road densities (in an equivalent area of the sectional survey system the maximum road length would be 361 miles. Here it is 115 miles approx).

    b) Low population densities on large scale maps, e.g. EA scale. Note that this characteristic differentiates dry land farming areas from pioneer fringe areas wherein large areas are unoccupied, (see iv)

    c) All land is either owned or operated under grazing lease.

d) The farms are large reaching up to 30 sections in very dry areas, e.g. less than 12 inches of mean annual precipitation.

e) Per acre investment and productivity are low compared to the provincial averages but per farm investments and productivity are among the top for the province.

f) Population densities of less than one per square mile are common but are not readily discernible from the neighbouring areas with population densities of greater than one per square mile.

3. The region coincides fairly well with the cattle farming region as described by J.A. Riffel, et al., but also it includes some large wheat farms. Note that the foothill areas south of Calgary is also a ranching area and could probably be just as readily classified Dryland or Pioneer Fringe.

iv) <u>Pioneer Fringe</u> (Athabasca, Alberta, Figure 8)

Area: FED 48015

EA's: Parts of 362, 363 and 364

Base maps: NTS 83 - 1/14, Edition 2
Plus county of Athabasca #12, 1975.

1) Shows: a) all-weather roads

b) houses

c) unoccupied lands left to forest and marsh, i.e. non arable.

2) The cell is characterized by: -

a) unoccupied lands

b) lower road densities than the Typical Sections (see v)

c) lower population density on the EA scale than the Typical Sections (see v) attributable to unoccupied lands, not to increasing farm size.

3) The areas were chosen on the basis of the distinguishing feature "unoccupied land". The Pioneer Fringe actually becomes foothills in western Alberta. Not too much significance should be attached to the choice of title for this region (compared with dryland farming). Perhaps "Forest Fringe" or "Northern Fringe" would be equally appropriate.

v) Typical Sections (Sectional Survey System)(Stettler, Alta, Figure 9)

Area: FED 48002

EA's: 101 and 102

Base Map: NTS 83 A/7 Ed. 2

1) Shows: a) all-weather roads

b) houses

c) town of Stettler

d) village of Erskine

2) Characterized by:

a) excellent accessibility to all sections by all-weather roads,

b) a typical housing distribution - i.e.

i) most houses near the road but set back from it, almost always more than 50 feet and often more than 100 feet, the average setback is about 250 feet.

ii) small settlements (e.g. Erskine) tend to raise the household density level.

3) The cell is typical of large portions of the sectional survey lands where almost 100 per cent of the land is arable and homestead size (plus pre-emptions)* proved economically viable.

vi) French Long Lot System (Selkirk, Manitoba, Figure 10)

Area: FED 46009

EA's: 170 to 175, 202, 204 to 224

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* Changes to the Dominion Lands Act of 1872 granted rights of pre-emption to a settler on a homestead (160 acres) whereby he might reserve the adjoining quarter section for purchase at the government price upon the issue of a patent for the original homestead.

Base Maps: NTS 62-½ Ed. 3
                      63-1/3 Ed. 2

1)   Shows all weather roads, houses, urban area, town and
      village.

2)   Shows effect of the peculiar survey system on household
      distribution.   There is a relatively high linear density
      along most of the roads.   Note: Only rural French Long
      Lot Systems with a high linear density are shown in
      Figures 3 and 4.   Many areas were excluded, such as
      Shaftsbury because of the lack of a high linear density
      or because the area has developed into an urban community
      (e.g. St Albert).   Thus the Region includes only those
      lands surveyed by the Long Lot system, exhibiting a high
      linear density, and classified as rural.

vii)   Prairie Town (Rivers, Manitoba, Figure 11)

Area: FED 46005

EA's: 103 - 104

Base Map: Statistic Canada EA census map

1)   Shows   a)   roads

                    b)   households.

      Note that the actual location of the households on each
      block is inaccurate.   However, the number of households
      on each block was known and these have been dotted in.

2)   Characterized by:

      a)   underbound, both with respect to town boundaries
            and EA boundaries,

      b)   vast majority of households are clustered together.
            Sparsely settled or empty blocks exist and every
            household is shown on Figure 11.

3)   All other towns examined exhibited a similar household
      distribution and were underbound.

4)   1976 census data for Alberta towns is provided in 1976
      Census of Canada, Population: Geographic Distributions,
      Municipalities, Census Metropolitan Areas and Census
      Agglomerations, Catalogue 92-806 Bulletin 1.7 and 1971
      population data for towns in all three Prairie Provinces
      is given in 1971 Census of Canada, Population, Census sub-
      divisions (Historical) Catalogue 92-702 Volume 1, Part 1
      (Bulletin 1.1-2) July 1971

viii) <u>Urban Spread</u> (Outskirts of Edmonton, Alberta, Figure 12)

    Area: FED 48015

    EA's: 101 - 111

           01 - 007

           0012

           51 - 73

    Base Map: County of Strathcona, #20, 1976

    1) Shows   a) Half sections divided into small lots. Subdivisions consisting of 20 acre lots or larger are excluded from the cross-hatched areas,

                  b) extensive urbanization near Edmonton.

The spread is due partly to the fact that this area is a pocket of grey-wooded soil and is therefore at an economic disadvantage relative to the surrounding farm areas. The rapid growth of Edmonton is another causative factor.

    2) Calgary exhibits similar growth and spread but to a lesser extent, possibly due to a larger incorporated area. Winnipeg has very limited evidence of the tendency.

ix) <u>Irrigation Districts</u> (Coaldale, Alberta, Figure 13)

    Area: FED 48011

    EA's: 251 - 254

           106 and 108

    Base Maps: NTS, 82 H/15 Ed. 2
                       82 H/10 Ed. 2

           plus Alberta Agricultural Irrigation Districts.

    1) Shows: a) all-weather roads

                 b) households

                 c) town of Coaldale

                 d) city of Lethbridge

2) Characterized by higher household densities, both areal and lineal, compared to either the typical sections or to dry land farming, (but note discussion on linear density analysis - next section).

3) Not all irrigation districts are included. Only those that exhibited high population densities, (10 - 100/sq. mile) Lower density areas within an irrigation district are included in the typical section region.

5. LINEAR DENSITY ANALYSIS

Areas were selected in Alberta using county maps (various dates 1971 - 1977) to examine the linear density of farm houses relative to the area density of farms. Hamlets, villages, crossroad communities containing houses not sited on the owner's farmland, and urban areas were excluded. The locations of the selected counties is shown in Figure 15. The analysis is largely exploratory and by no means should be considered complete.

A farmhouse was considered to be part of a cluster if its nearest neighbor was within 500 feet. A 250 foot limit was first attempted but it was found to eliminate too many choices (i.e. eliminate clusters). A conservative estimate for the number of farm households within 200 feet of each other is less than 2 per cent of the total number of farm households - a conservative upper limit.

The miles of roads examined were distributed equally between east and west directions and north and south directions within each county. Fifty to a hundred miles of road was selected and the farm houses were grouped into isolated or individual farm houses (more than 500 feet from each other) then into clusters of two, three, four and five. There were no clusters of four and one cluster of five. A total of over 500 miles of road in the seven counties was sampled.

Raw Data:

PONOKA   1.57 farms per square mile
100 individual farmhouses/100 miles of road
22.2 clusters of 2/100 miles of road
3.7 clusters of 3/100 miles of road

  TOTAL 155.5 farm houses/100 miles of road

MOUNTAIN VIEW

1.65 farms/ sq. mile
106.5 individual farm houses/100 miles of road
6.5 clusters of 2/100 miles of road
1.3 clusters of 3/100 miles of road

  TOTAL 123.4 farm houses/100 miles of road.

CAMROSE 1.4 farms/ sq. mile
67.9 individual farm houses/100 miles of road
6.2 clusters of 2/100 miles of road
1.2 clusters of 3/100 miles of road
TOTAL 83.9 farm houses/100 miles of road.

ATHABASCA 1.16 farms/square mile
87.1 individual farm houses/100 miles of road
20.4 clusters of 2/100 miles of road
1.1 clusters of 3/100 miles of road

TOTAL 131.2 farm houses/100 miles of road

FORTY MILE 0.35 farm/square mile
57 individual farm houses/100 miles of road
0 clusters of 2/100 miles of road
0 clusters of 3/100 miles of road
TOTAL 57 farm houses/100 miles of road.

LETHBRIDGE

3.12 farms/square mile
2.48 farms/square mile in less dense areas to
4.07 farms/square mile in denser areas
228 individual farm houses/100 miles of road
18.3 clusters of 2/100 miles of road
1.4 clusters of 3/100 miles of road
1.4 clusters of 5/100 miles of road

TOTAL 275.8 farm houses/100 miles of road

LAC STE ANNE

1.22 farms/square mile
102.2 individual farm houses/100 miles
6.7 clusters of 2/100 miles

TOTAL 115.6 farm houses/100 miles

TABLE I

SUMMARY OF RAW DATA

Farms/ Sq. mi	Isolated Individual Farm Houses /100 mi	Clusters of 2/100 miles	Clusters of 3/100 miles	Clusters of 4/100 miles	Clusters of 5/100 miles	Total Farm Houses /100 miles
1.57	100	22.2	3.7	0.0	0	155.5
1.65	106.5	6.5	1.3	0	0	123.4
1.40	67.9	6.2	1.2	0	0	83.9
1.16	87.1	20.4	1.1	0	0	131.2
0.35	57.0	0.0	0.0	0	0	57.0
3.12	228.0	18.3	1.4	0	1.4	275.8
1.22	102.2	6.7	0.0	0	0	115.6

TABLE 2

DATA FOR RANK ORDER CORRELATIONS

Ranks	1	2	3	4	5	6	7
	5	4	7	7	4	3.5	6
	6	6	3	5	4	3.5	4
	4	2	2	4	4	3.5	2
	2	3	6	3	4	3.5	5
	1	1	1	1.5	4	3.5	1
	7	7	5	6	4	7.0	7
	3	5	4	1.5	4	3.5	3

Findings: i)   Spearman Rank Order Correlation Coefficients between column 1 and the other columns are respectively: 0.82, 0.32, 0.83, 0.50, 0.69, 0.68.

ii) There is a positive but lower than expected correlation, apparently due to differences in the road densities and due to the effect of hamlets and villages on enumeration area densities. This tends to support the contention that the regional division should not be made on the basis of population density alone.

iii) The good correlation between columns 1 and 2 shows that the linear density increases with the areal density.

iv) The raw data given above should be considered as a low estimate as it considers farm houses only and not all households. More accurate values for, for example, the number of clusters of 3 households per 100 miles should be obtained, for each typical cell, from Figures 5 to 13.

6.   GENERALIZATION OF TYPICAL CELLS TO REGIONS

It is not possible within the limitations of the method adopted for this study to completely verify whether or not it generates typical cells that are truly representative of the household regions. That would require an inordinate amount of fieldwork instead of a reliance on secondary sources and there then would be no reason to determine typical cells. This was recognized at the commencement of the study so that every effort was made to ensure the household regional divisions were as accurate as possible under these circumstances and that the household distributions in the typical cells were indeed representative. There was constant checking and reference was made to as many sources, for example, maps, diagrams, and aerial photographs, as were at hand. By this means similarities between typical cells in the same regions were recognized.

Nonetheless, a problem that presents itself is that of the scale at which the study has been approached. At a small scale, eg., 1: 2,000,000, or that which covers a large area, local variations in household distributions would be hidden. On the other hand, the typical cells would be regions in themselves, with unique household distributions, if the selected working scale was too large. No maps of the prairie provinces are published at a large scale of 1:10,000, that requested by DOC. Scale then remains a major problem in a spatial analysis such as this.

Household location on the typical cell maps is as accurate as that claimed by the mapping authorities for the base maps used -- ie. very accurate.

Below are measurements of the areal extent of the typical cells presented for this study and of the household regions. In the case of the latter, scale limitations make the measurements approximations. The areal extent of Prairie Towns and Urban Spread has not been calcu- lated.

Typical Cell

Prairie Town	0.54 sq. miles
Typical Sections	69
Pioneer Fringe	625
Dryland Farming	214.5
Mennonite Colonies	133
Irrigation Districts	66
French Longlot System	112
Indian Reserves	134
Urban Spread	23

Totals for Entire Study Area

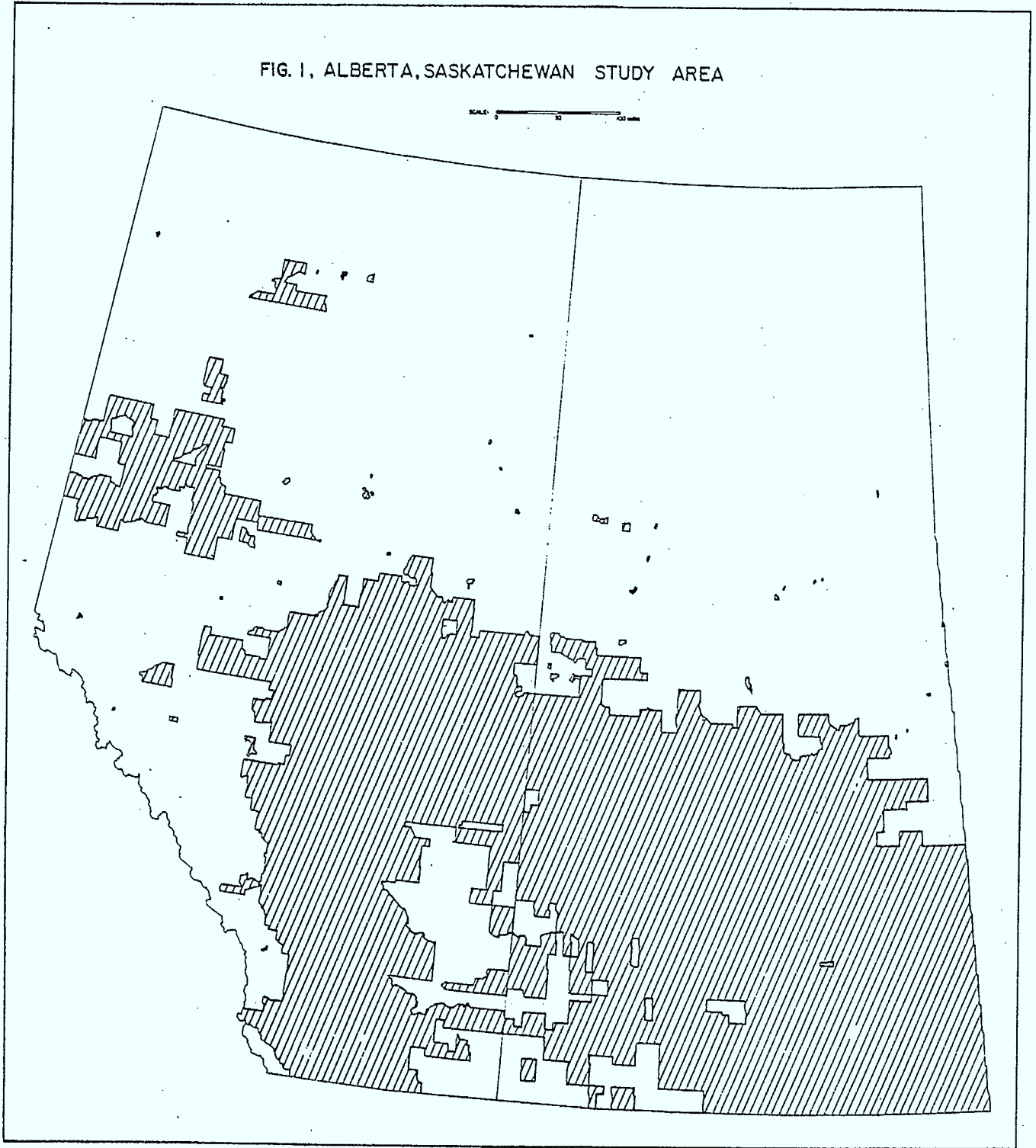|	
Typical Sections	137,000 sq. miles
Pioneer Fringe	56,960
Dryland Farming	25,900
Mennonite Colonies	1,045
Irrigation Districts	750
French Longlot Systems	300
Indian Reserves	5,665

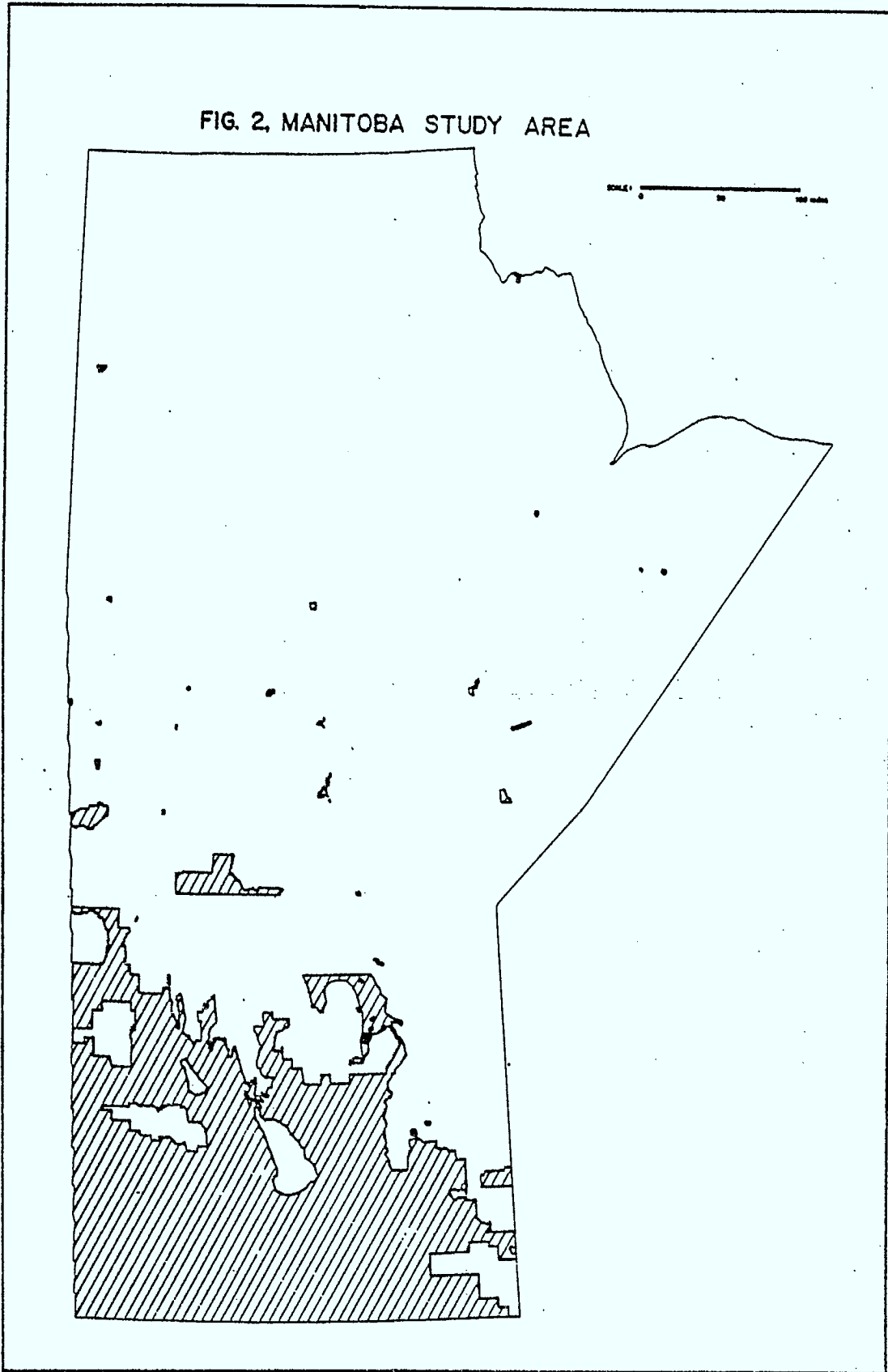FIG. I, ALBERTA, SASKATCHEWAN STUDY AREA

FIG. 2, MANITOBA STUDY AREA

FIG. 3, HOUSEHOLD REGIONS (ALTA., SASK.)

F FRENCH LONGLOT
P PIONEER FRINGE
I INDIAN RESERVES
M MENNONITE COLONIES
T TYPICAL SECTIONS
U URBAN SPRAWL
I IRRIGATION
D DRYLAND
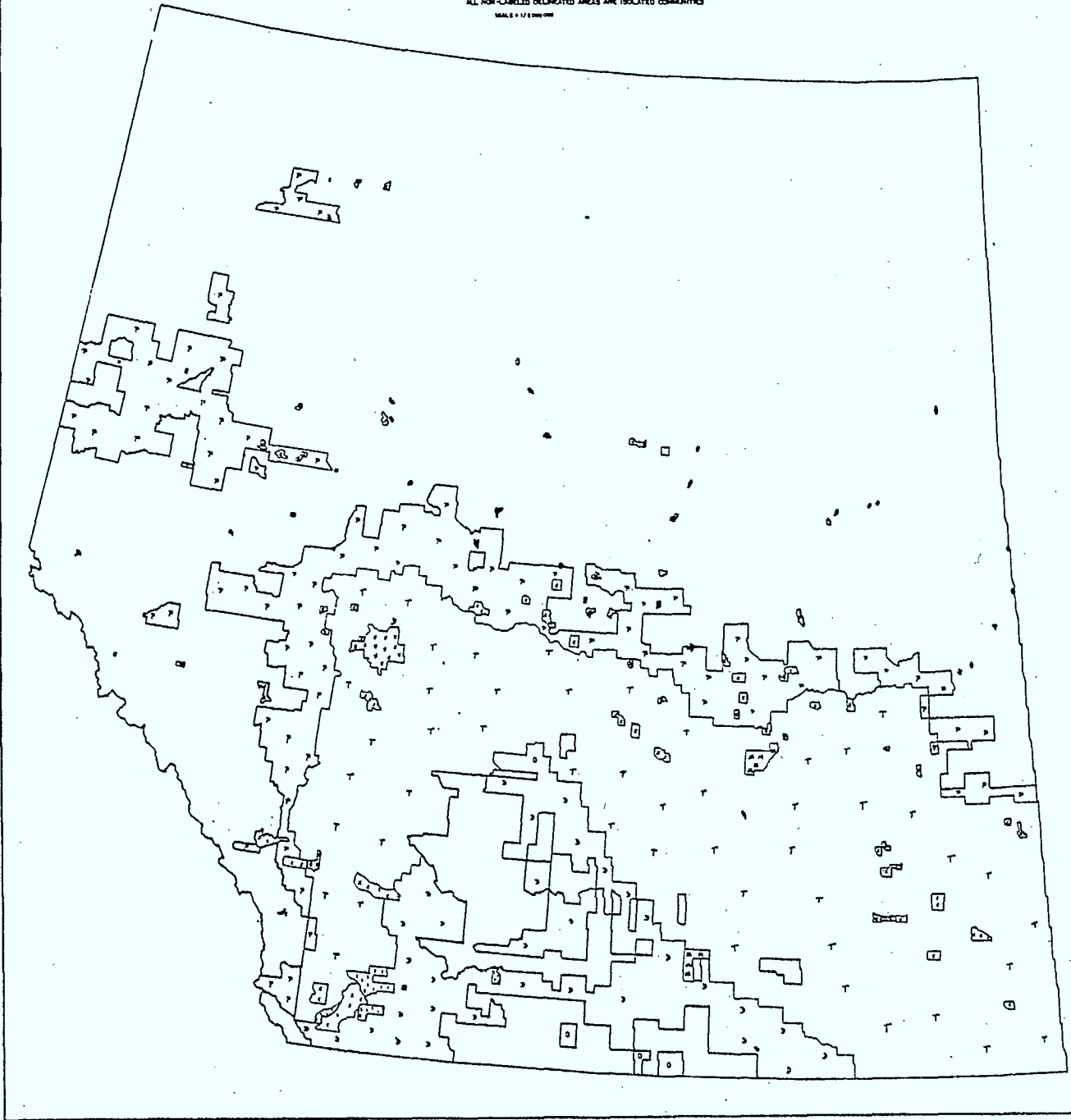ALL NON-LABELED DELINEATED AREAS ARE ISOLATED COMMUNITIES
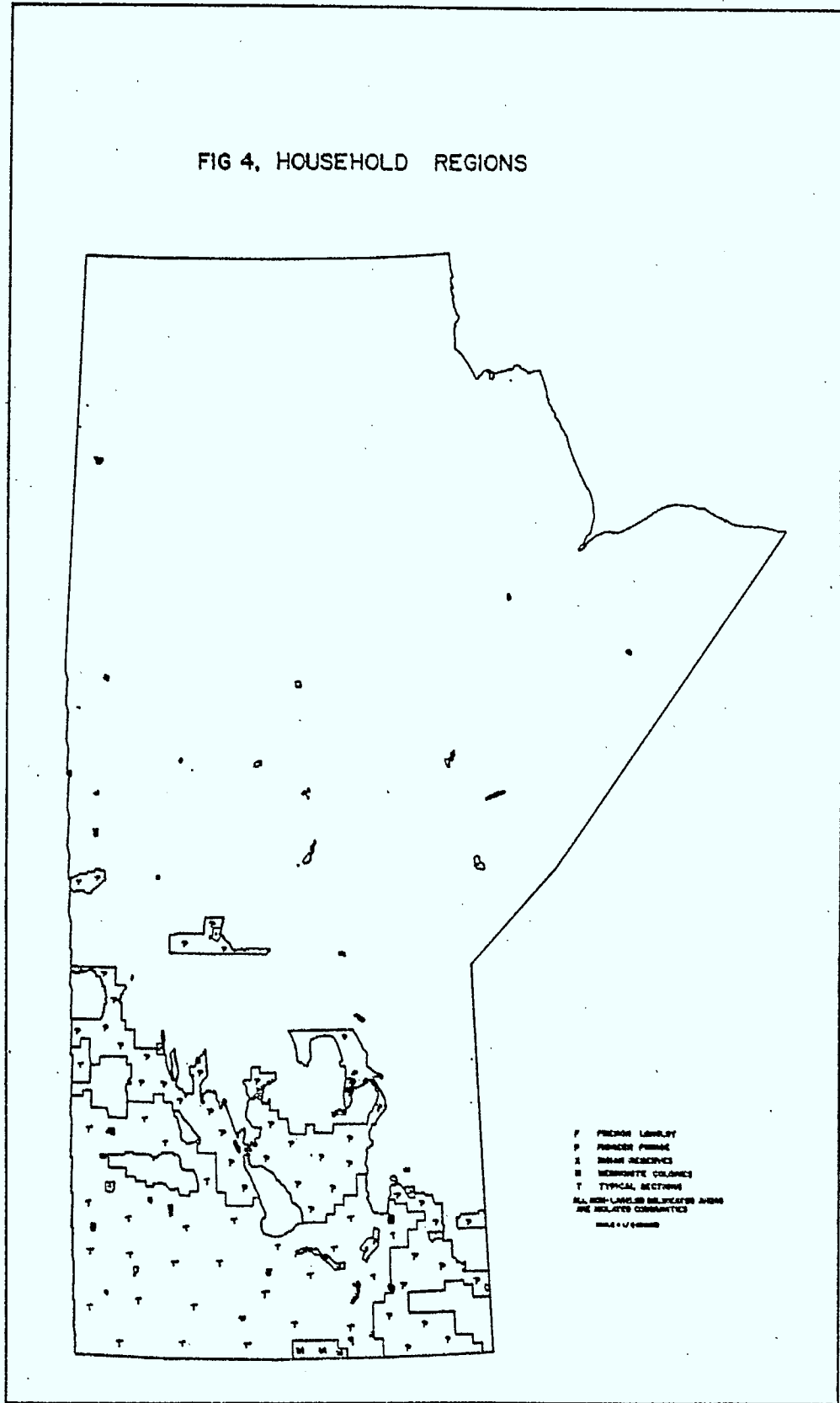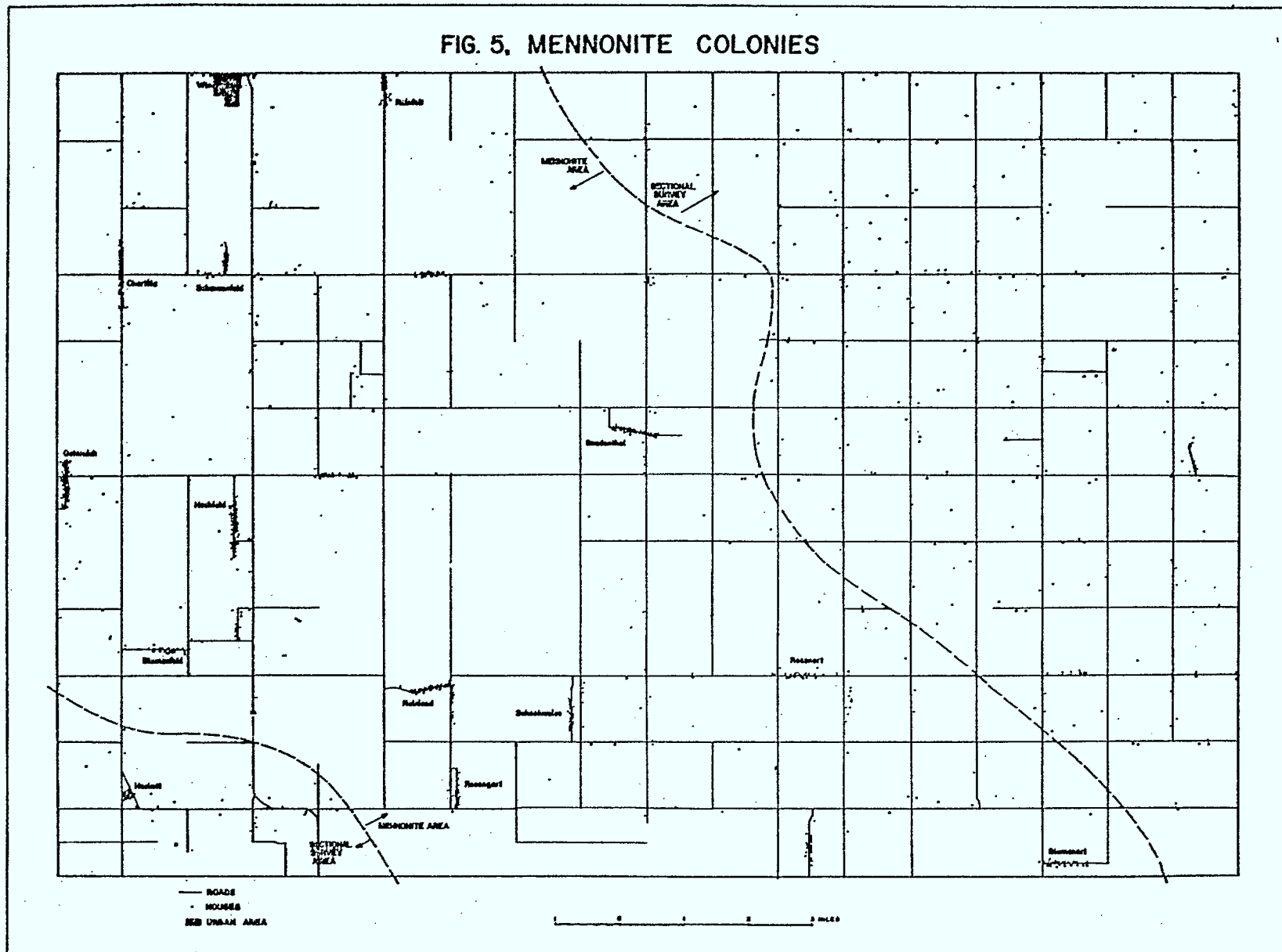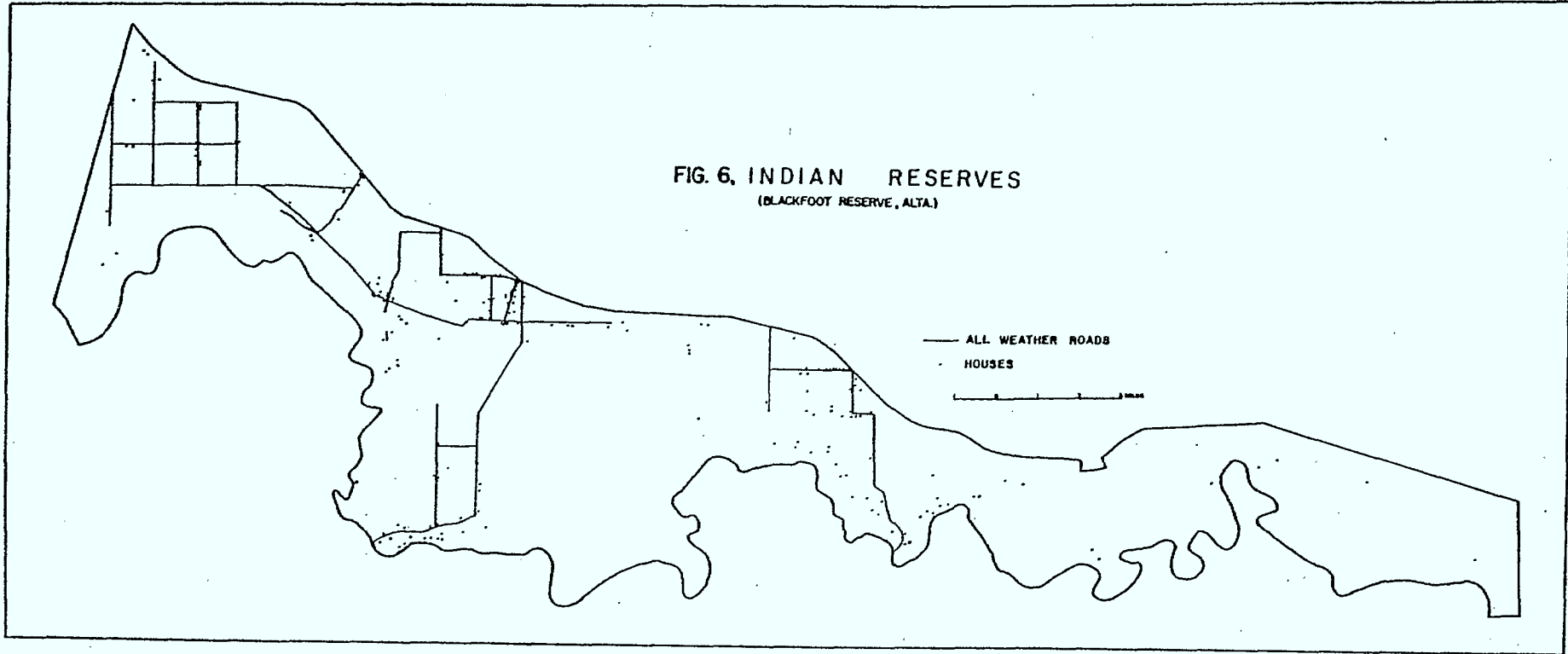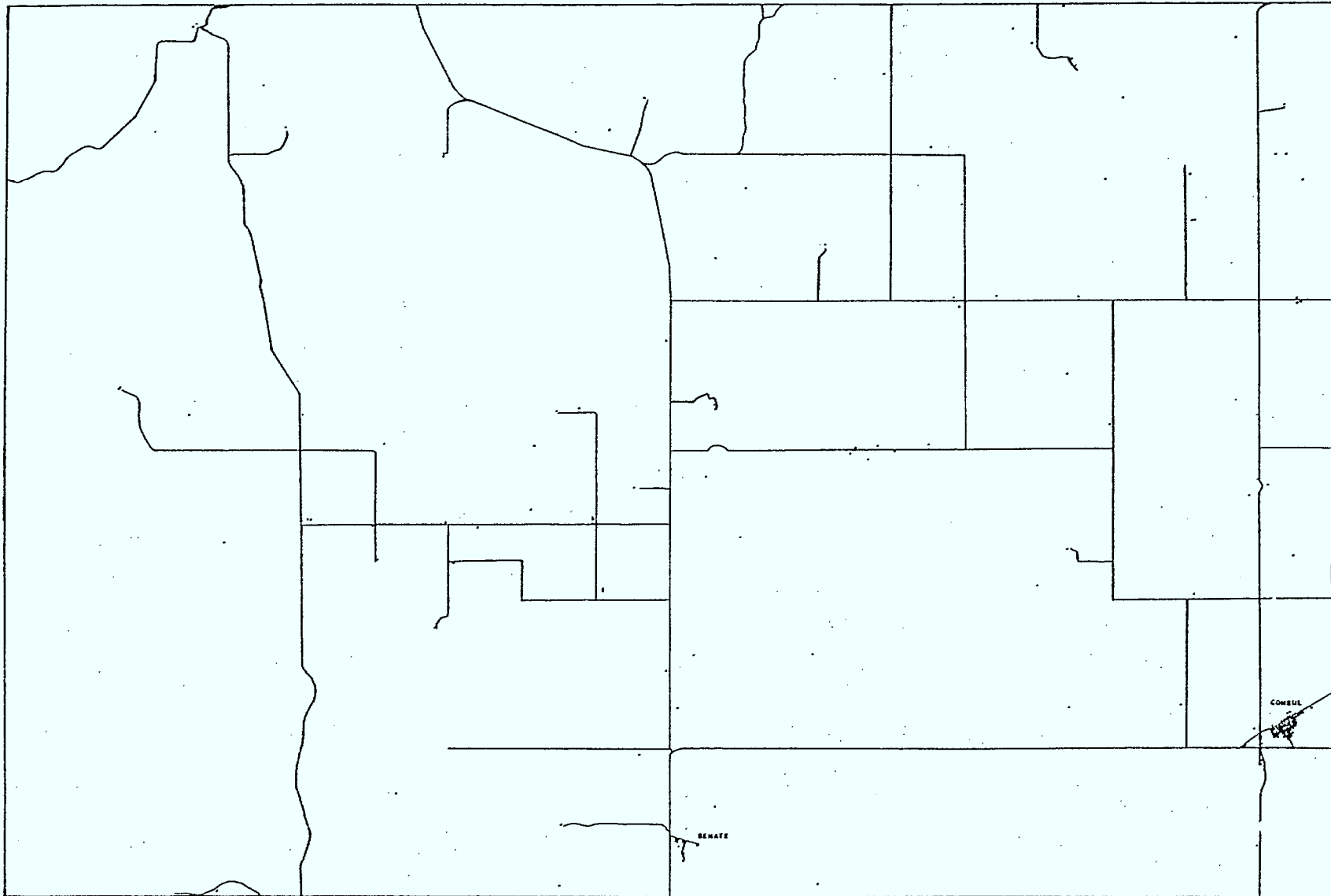SCALE 1:1/2 000 000

FIG 4, HOUSEHOLD REGIONS

FIG. 5, MENNONITE COLONIES

FIG. 6. INDIAN RESERVES
(BLACKFOOT RESERVE, ALTA.)

——— ALL WEATHER ROADS
· HOUSES

FIG. 7, DRYLAND FARMING (CONSUL, SASK)

ROADS
HOUSES

SENATE

CONSUL

1 0 1 2 3 MILES
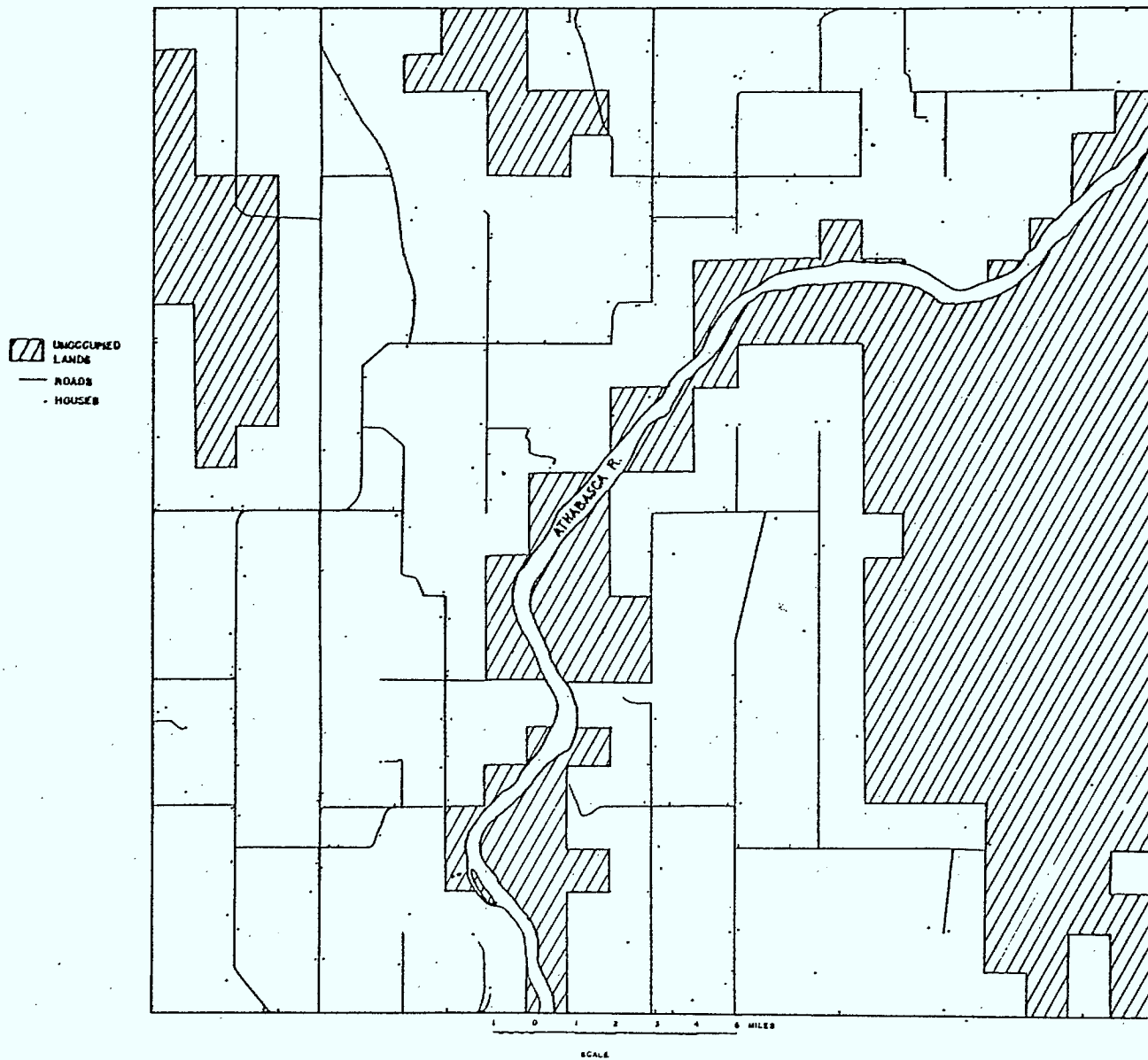
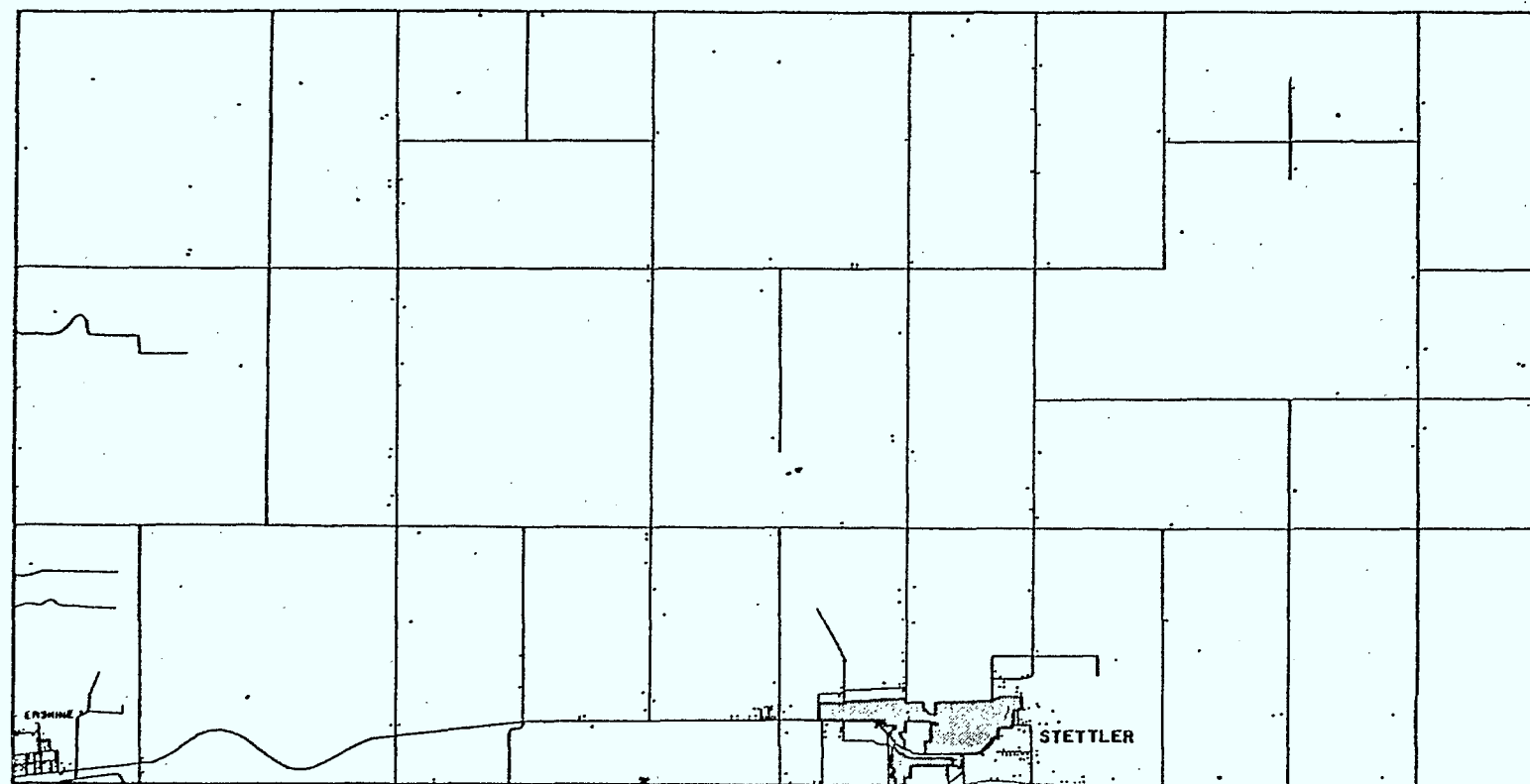FIG. 8, PIONEER FRINGE (ATHABASCA, ALTA.)

UNOCCUPIED LANDS
ROADS
HOUSES

ATHABASCA R.

SCALE

FIG. 9, TYPICAL SECTIONS (STETTLER, ALTA.)
SECTIONAL SURVEY SYSTEM

ERSKINE

STETTLER

▨ URBAN AREA
—— ROAD
· HOUSE

SCALE

1   0   1   2   3 MILES

FIG. 10
FRENCH LONGLOT SYSTEM
(SELKIRK, MAN.)

URBAN AREA
ROAD
HOUSE

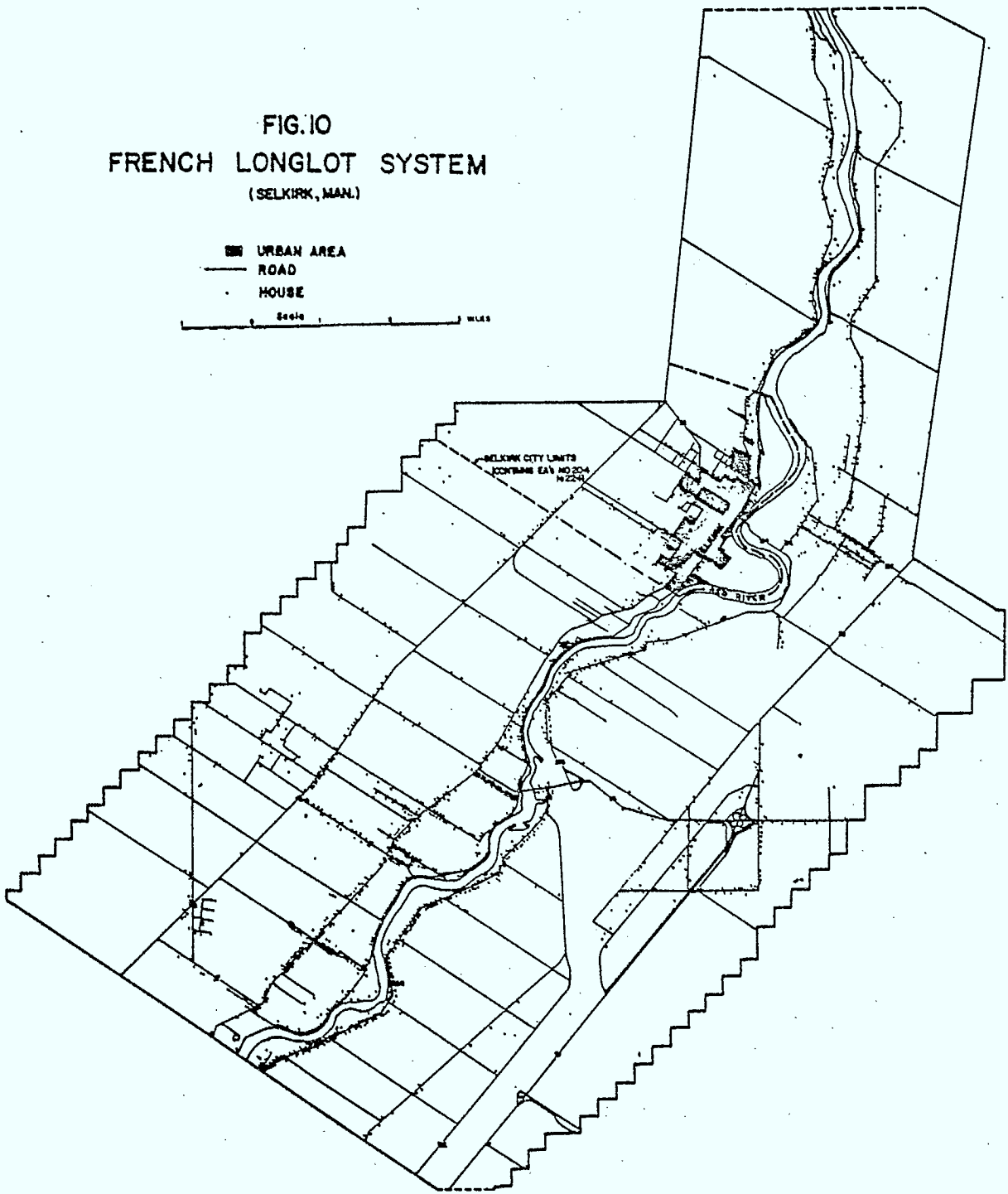Scale   MILES

FIG.11, PRAIRIE TOWN

RIVERS, MANITOBA

MINNEDOSA RIVER
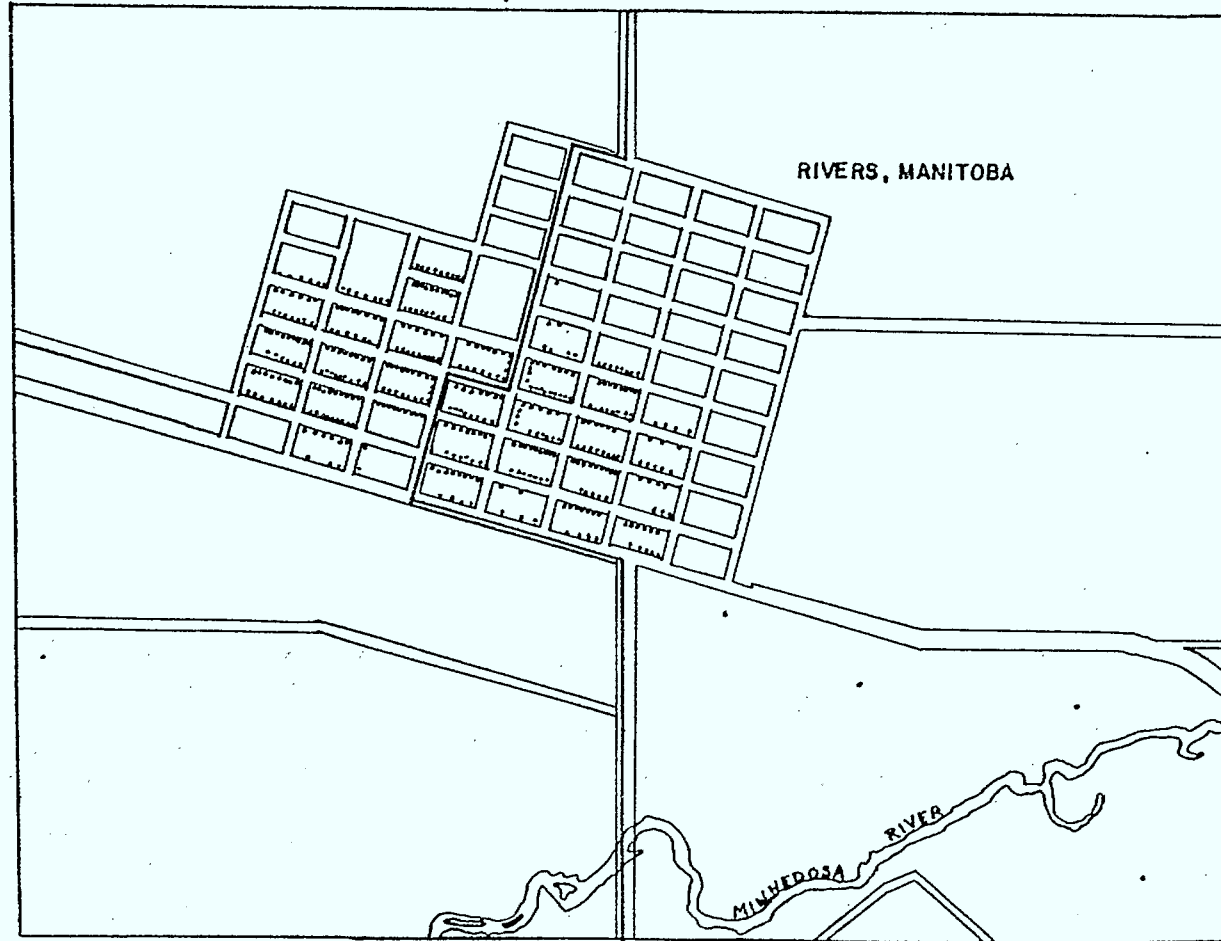
EA BOUNDARY
ROADS
HOUSES

SCALE

0'   2100'

FIG. 12
URBAN SPREAD

☐☑ SUBDIVISIONS
▄▄▄ TOWNS, VILLAGES, or HAMLETS

SCALE

N

CITY OF EDMONTON

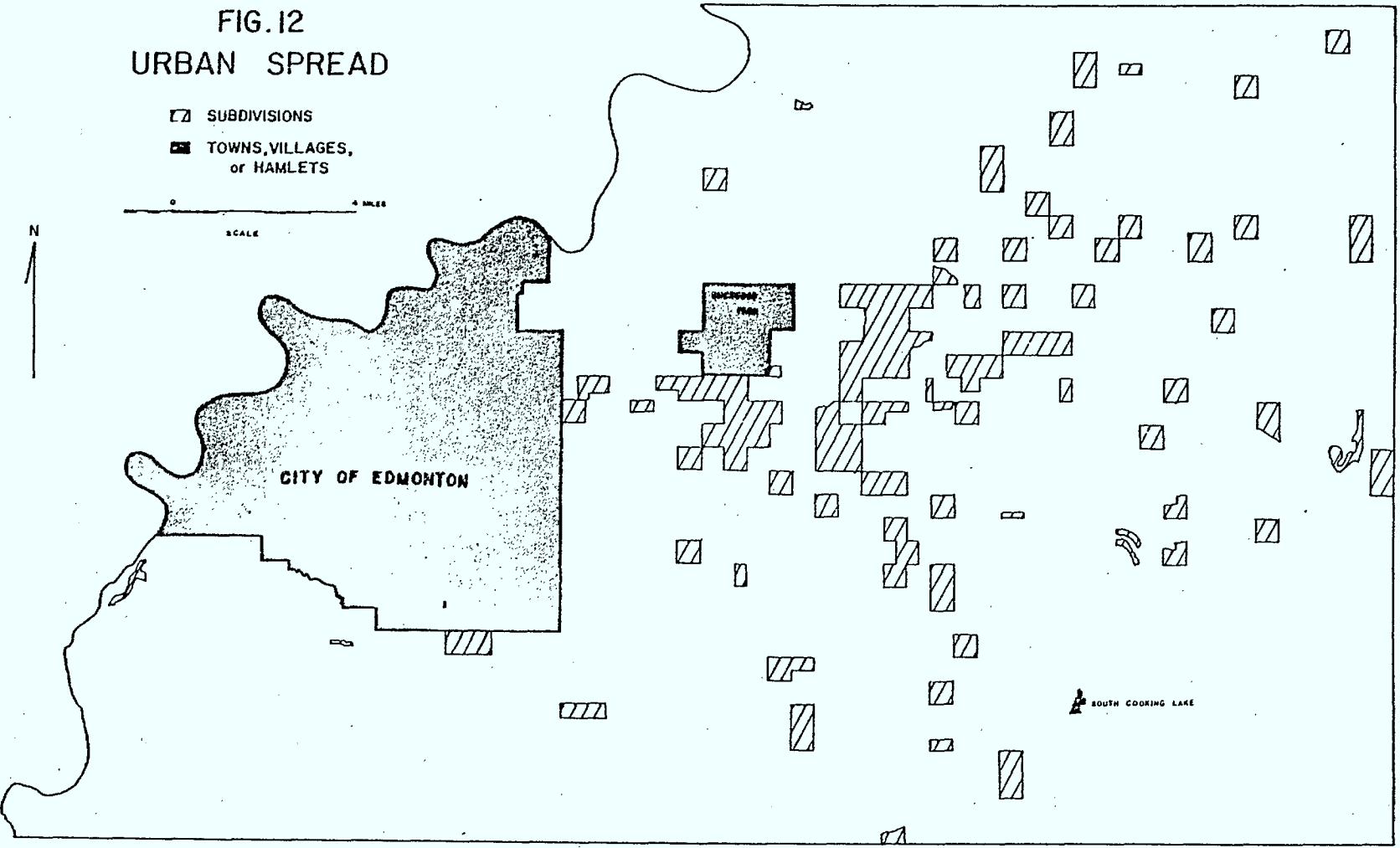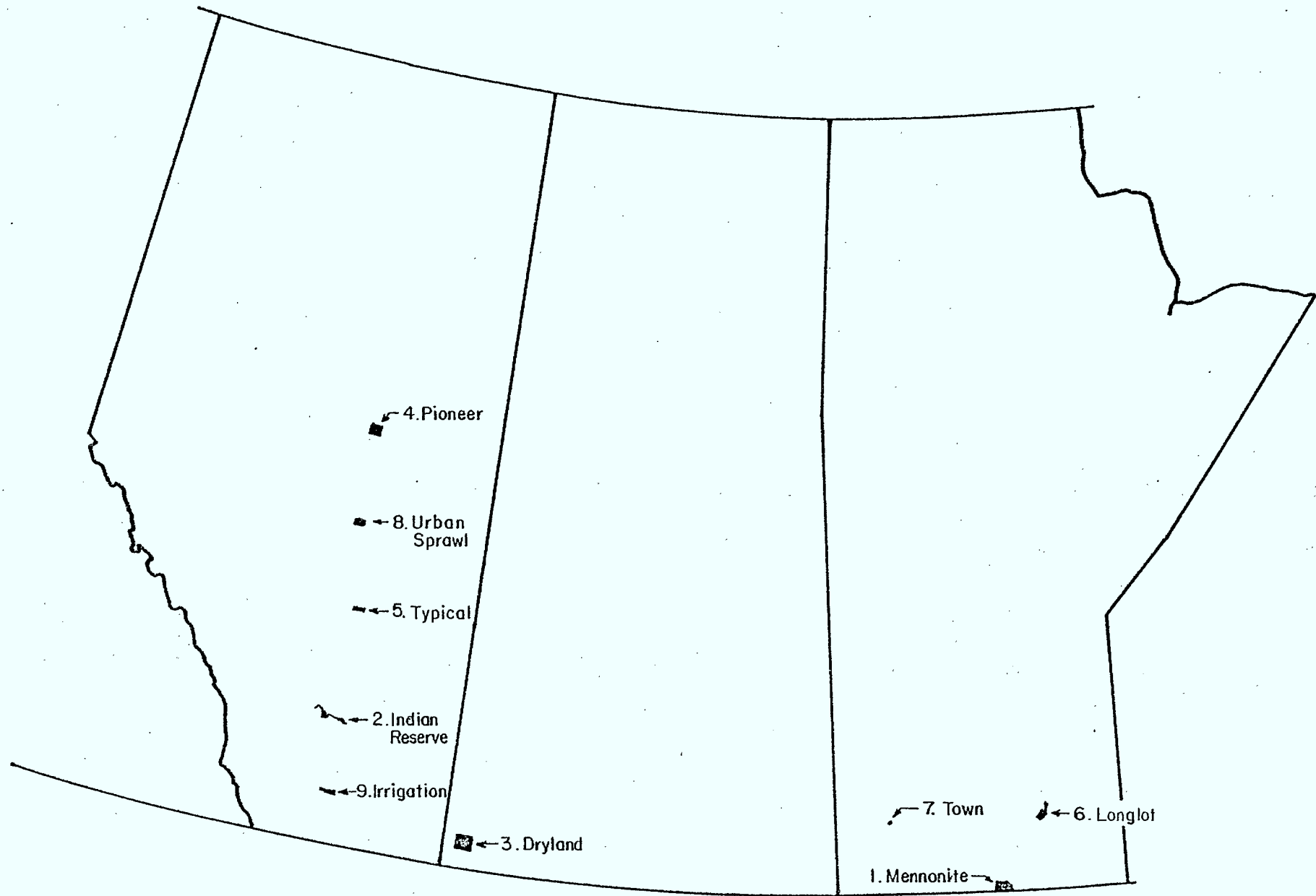SOUTH COOKING LAKE

FIG. 13, IRRIGATION DISTRICTS (COALDALE, ALTA.)

LETHBRIDGE

URBAN AREAS

HOUSE

ROAD

SCALE   0   1   2   3 MILES

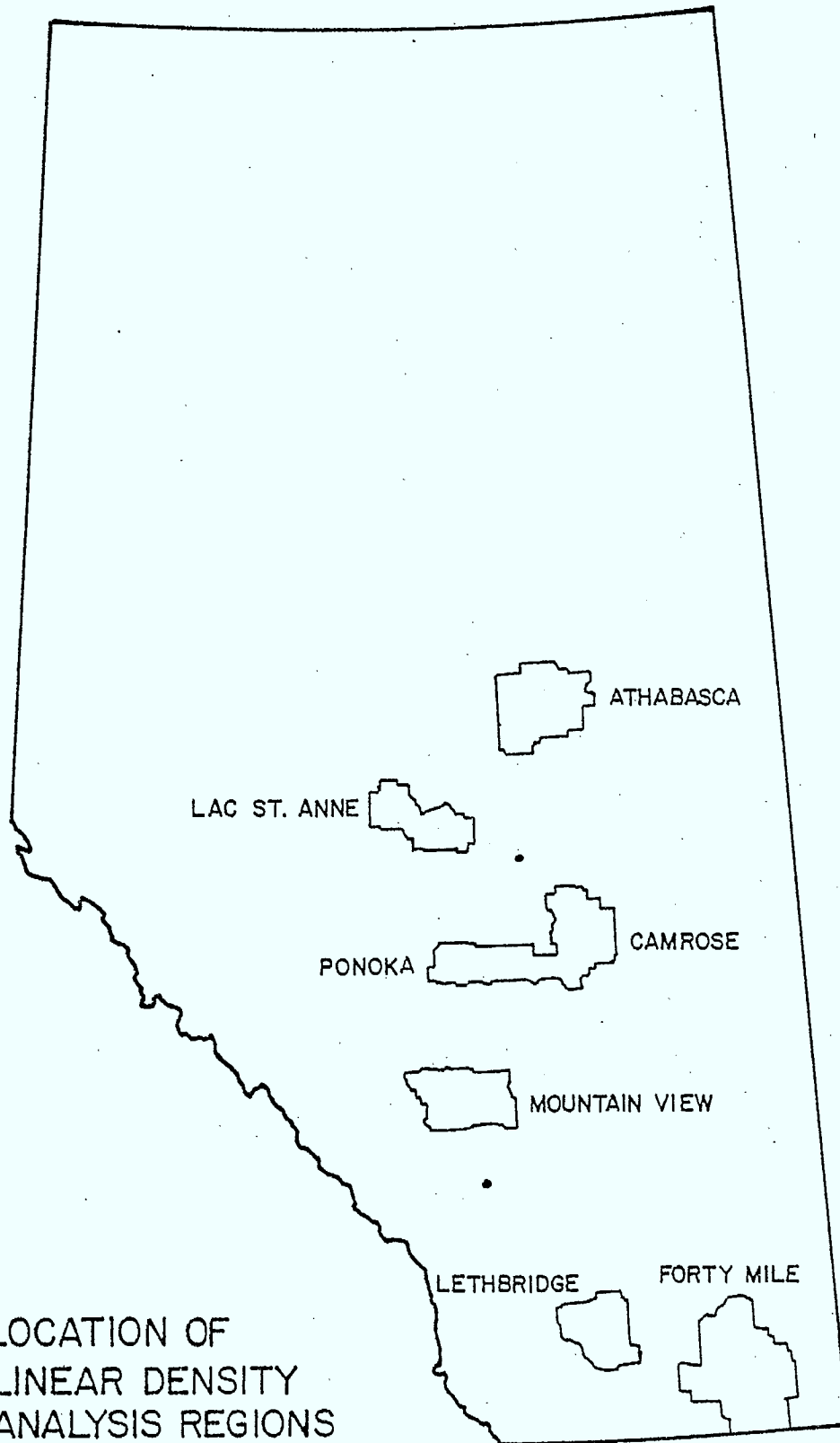FIG. I4, LOCATION OF TYPICAL CELLS

FIG. 15, LOCATION OF
    LINEAR DENSITY
    ANALYSIS REGIONS

Appendix 1

Characteristics of Typical Areas

Household Distribution

Objectives

Assume that it is possible to represent rural Canada as comprising large areas of similar household distribution. Let us define a cell as being the smallest portion of one of these large areas such that the household distribution in the cell is representative of that of the large area. For example, the rural areas of the prairies might be considered as comprising basically two types of cell, one being home town dominated community systems and the other being industry based regions such as the Athabasca tar sand area. The objectives are:

1. To identify the number of different types of cells and the number of cells of each type in the region of concern. Little importance should be placed on cells that typify small segments of the rural population (5% of effort).

2. Since it would be a very large assignment to consider the demographic characterization of every cell in detail, it is necessary to determine a representative cell for each cell type. For example, the community system dominated by Swan River, Alberta might be one suitable choice. If possible, the boundaries of the cell should correspond to the boundaries of enumeration areas or census subdivisions. Guidance regarding choice is to be obtained from the scientific authority and from the recently completed DRCP demographic studies (5% of effort).

3. Determine the geographic distribution of the households for each choice in 2) above.* Possible sources of information include municipality and township maps (taxation, enumeration, planning, etc.), Census Canada enumeration area data, aerial photographs, topographic maps, provincial atlas, hydro maps, telephone maps, etc. Present the data in map format to reveal the spatial distribution of the households throughout each representative cell.** Cross-hatching, symbols and notations must be Xerox-reproducible and the detail must be sufficient to be subsequently used by DRCP for costing broadcast and CATV delivery options (70% of effort).

4. Provide valid comments on how the information presented in 3) can be modified to provide an applicable model for similar cells. A parametric approach is acceptable (10% of effort).

5. Check that the above modelling (1 to 4) can be generalized to provide a fairly reliable picture of the rural population throughout the area (e.g. no. of communities having populations between 50 and 200, total regional rural population, etc.) (5% of effort).

6. Since the above work concerns both population and household densities, provide some discussion of the relationship between these factors that is valid for the areas studied (5% of effort).

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* The range of household densities that are to be considered corresponds to a population density range between 1 and 1000 people/sq. mile or to settlements comprising up to 2500 people. Should the contractor wish to work with dwelling density instead of household density, approval from the scientific authority is required.

** Multi-household dwellings and industrial areas are to be designated appropriately.

CHARACTERIZATION OF TYPICAL AREAS OF
HOUSEHOLD DISTRIBUTION IN THE RURAL ..
-- Fairbairn, K.J.

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	Date Due		
JUN 4 1981			

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