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MLMIS DATA COLLECTION

PROCEDURE MANUAL

CURA
RESOURCE COLLECTION

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INTRODUCTION

The Minnesota Lakeshore Development Study and the Minnesota Land Management Information System (MLMIS) Study are two research projects conducted through the University of Minnesota to investigate two of Minnesota's most valuable resources---lakes and land.

To conduct these studies, it was necessary to 1) collect data from a variety of different sources; 2) make the information from each source compatible by use of a common data cell, or geographic unit; and 3) integrate the information.

The data cell selected was the smallest consistent unit of the federal township and range land-survey system---the 40-acre parcel. This parcel size and description is the lowest common denominator of most public records dealing with land. Most blocks of land, whether publicly or privately owned, have these lines, or segments of them, as boundaries. The majority of Minnesota's roads run along these lines. The lines are reflected in agricultural areas as field lines, in forested areas as timber-cutting boundaries, and in urban areas as city blocks. They help to describe the manner in which people have divided the land and shaped the landscape of Minnesota. These forty-acre parcels or government lots can be aggregated to create larger data units. Individual government lots can be combined to describe the shoreland of an entire lake. Forty-acre parcels and government lots can be combined to create survey townships, local government, or county units. As these data units are aggregated they become compatible with an increasing number of data sources which can then be used in conjunction with the newly acquired data. The following text summarizes the data collection procedures used in these studies.

LAKESHORE STUDY PROCEDURES

INTRODUCTION

There are 1,923 lakes covered in the Minnesota Lakeshore Development Study. Most of these are Minnesota's major recreational lakes and contain almost 2/3 of the state's water acreage. The study included all lakes with a basin acreage of more than 150 acres which are not completely in government ownership. Lakes completely within state parks, state wildlife management areas, national wildlife refuges, Indian reservations, the Boundary Waters Canoe Area and the seven-county Twin City Metropolitan area were omitted as well as all rivers, Lake Superior and 358 dry or partially dry lake basins. Twenty-three counties in Minnesota were eliminated because they had no lake basins that met these criterion. Most of the data collected in the Minnesota lakeshore study was done at the forty-acre parcel or government lot level. These data can be aggregated to the lake level for summary purposes. Other data such as depth, size and lake ecology class were collected only at the lake level.

LOCATION

Lake Identification (two columns) - Each lake in the survey has been given a unique identification number. The first part of the number indicates the county (1-87, numbered alphabetically) in which the lake is located. The second part indicates the specific lake within the county. The lake identification numbers are found in Conservation Department Bulletin No. 25, "An Inventory of Minnesota Lakes."

Watershed Identification (two columns) - The Department of Natural Resources has also delineated 39 watersheds in Minnesota. The watershed each lake lies within is indicated by numbers from 1-39 (two columns). This information was taken from Figure 5, "Hydrologic Atlas of Minnesota", Bulletin No. 10, Division of Waters, Department of Conservation (April 1959).

Minor Civil Division Number (three columns) - Each data unit was also assigned a Minor Civil Division (MCD) identification number to identify the local government unit which controls each section of shoreline. These are the same numbers as used by U.S. Bureau of the census.

Latitude-Longitude (six columns) - The latitude and longitude of each data unit was also determined and recorded. This makes it possible to determine the relative location (down to the level of the 40-acre parcel) of any of the resources included within the study (3 for latitude, 3 for longitude).

Lot Number (four columns) - Each 40-acre parcel or government lot was given a unique consecutive number starting from the northeast corner of each lake. These parcels or lots have recently been converted to the same format as the MLMIS Study so they can be used in conjunction with a wider variety of data.

PHYSICAL CHARACTERISTICS

Size (five columns) - The size of each lake basin included in the study (to the nearest 10 acres) was taken from the Department of Conservation Bulletin No. 25 "An Inventory of Minnesota Lakes."

Depth (two columns) - The maximum depth of the study lakes was recorded to the nearest 10 feet. The information was taken from lake maps made available by the Department of Conservation, Division of Game and Fish. Depth was recorded in single digit fashion (i.e. 7 = 70 feet). A zero (0) indicated that no depth information was available.

Ecology (one column) - The Lakeshore Study used eight of the Minnesota Department of Natural Resources, Division of Game and Fish, lake ecology classes. These classes are based on differing dominant fish communities found in lakes due to the character of the lake water, organisms, lake basins, and surroundings.

0	No Data
1	Reclaimed Trout
2	Soft-Water Walleye (Saganaga)
3	Hard-Water Walleye (Mille Lacs)
4	Bass-Panfish-Walleye (Miltona)
5	Bass-Panfish
6	Bullhead-Panfish
7	Winterkill-Roughfish (Waterfowl)
8	Lake Trout

Shore Length (three columns) - The lot shore length was determined from maps drawn from large-scale aerial photographs. The parcel or lot boundaries were delineated on these maps. The shore length was determined to the nearest hundred feet for each parcel or lot. The shore lengths for each lot were aggregated and converted to miles to determine the shoreline length for each lake.

Soil Groupings (one column) - Soil information was obtained from the Soils Department of the University of Minnesota (Agricultural Experiment Station) and from the Soil Conservation Service. The Boundaries of soils groups were put on maps and the dominant group for each parcel or government lot was recorded. Because the Soils Department and SCS use different classification grouping these were combined into new classes for the purposes of the lakeshore study.

Soil Conservation Service Soil Groupings

Lakeshore Study Class	SCS Map Number
(1)	1. <u>Wet Soils</u> : Organic soils, marsh, mineral soils of all textures, poor and very poorly drained.
(2)	2. <u>Clay Soils</u> : Clay till and lacustrine clays. This will include soils as fine textured as Hibbing and finer. Well to somewhat poorly drained.
(3)	3. <u>Loamy Soils</u> : Loams, silt loams, sandy loams, light clay loams and light silty clay loams. Well and moderately well drained.
(4)	4. <u>Sandy and Gravelly Soils</u> : Loamy sands and coarser textures. Excessively to moderately well drained.
(5)	5. <u>Alluvial Soils</u> : All textures to be mapped only on bottomlands along river and streams.
(6)	6. Bedrock:
(1)	12. Wet, deep peat, and floating bogs located between present lake shore (blue line) and old shore line (also blue line).
(7)	26. Boulders - Bedrock - Soil

Soils Department Soil Grouping

Lakeshore Study Class	Soils Dept. Map Number
(1)	1. Organic soils and marsh Wet mineral soils
(1)	2. Coarse - sand - loamy sand - gravel - sandy loam.
(1)	3. Fine - loam and finer.
(2)	4. Finer textured - clay till - lacustrine clay and silt.
(3)	5. Red and brown candy loam till.
(3)	6. Buff calcareous loam and clay loam till and loess.
(4)	7. Gravelly soils.
(4)	8. Sandy soils.
(5)	9. Alluvial land; floodplain.
(6)	10. Bedrock.

Forest Survey (three columns)

Forest surveys were conducted from low level aerial photographs by the College of Forestry, University of Minnesota. Three variables were collected: tree size, tree density, and tree type. The dominant forest survey classification was recorded for each parcel or lot.

Around each lake the area 2 chains back from the lakeshore will be surveyed to determine tree size, density, and type (2 ch. min.)

Tree Size - Crown Size (1 column)

- 0 No trees, grass, marsh
- 1 Sapling (small trees): 1.0 - 4.9 inch trunk diameter. 1'-20'(seedlings)
- 2 Pole timber (medium trees): softwood, 5-9 inch trunk diameter:
hardwood, 5-11 inch trunk diameter. 20' - 40' (narrow crown)
- 3 Saw timber (large trees): softwood, over 9 inch diameter; hardwood,
over 11 inch diameter. 40'+ (wide crown)
- 4 Exceptionally large trees

Tree Density - Closure BA (1 column)

- 0 No trees
- 1 Understocked 0-10%. Less than 100/acre.
- 2 Poor - medium stocking, crown cover 10-69% (low to medium density)
- 3 Well stocked, crown cover 70+ percent and over (high density) 1000/acre maximum

Tree Type (1 column)

- 0 No trees
- 1 Coniferous
- 2 Light bark deciduous (birch, aspen).
- 3 Dark bark deciduous
- 4 Coniferous and light bark deciduous; 50% and more must be conifers
- 5 Coniferous and dark bark deciduous; very uncommon
- 6 Plantation
- 7 Coniferous, light and dark bark deciduous (mixture of everything)
- 8 Lowland brush + marsh

Slope (two columns)

On-shore and off-shore slope were determined from aerial photographs and the dominant class was recorded.

Land slope is to be measured 2 chains in from shoreline (1 column)

		<u>max. per chain</u>	<u>max. per 2 chains</u>
1	Steep, greater than 20% slope	--	--
2	Gentle, from 5 to 19 percent slope	13'	23'
3	Flat, less than 5 percent slope	3½'	7'

Lake Bottom is to be measured 2 chains out from the shoreline (1 column)

- 1 Steep, greater than 20 percent slope.
- 2 Gentle, from 5 to 19 percent slope
- 3 Flat, less than 5 percent slope.

Aquatic Vegetation (one column)

The existence of aquatic vegetation was also determined from aerial photographs.

Existence of aquatic vegetation within 2 chains of the shore (3 classes).

- 1 No weeds
- 2 Some weeds
- 3 Many weeds

DEVELOPMENT

Dwellings and Resorts

Development information was gathered for seasonal homes, permanent homes, and resorts on all lakeshore frontage on study lakes for the years 1954 and 1967. This information was collected from county assessor's records and from Minnesota Highway Department county highway maps in counties with few lakes and little lakeshore development. The total number of seasonal and permanent homes and resorts were collected for each data unit on study lakes. Homesteaded structures were classified as permanent homes, while recreational and non-homesteaded structures were considered seasonal. Structures designated as commercial were considered to be resorts.

In addition to the above data, which was collected for all data units on all the study lakes, information from a sample of the data units was also collected. The study lakes were stratified by size into five classes. A 20 percent random sample was taken for the lakes in all but the largest lake size class. All lakeshore property owners on these lakes were surveyed. For lakes in the largest lake size class, all lakeshore property owners in every fifth data unit were surveyed. Information collected in this survey included 1) value of the land and buildings (information taken from county assessors records) and 2) information gathered through questionnaires sent to lake home owners. This information included numbers of lakeshore residents and visitors, activities on the shore and water, and reasons for choice of location.

Road Accessibility

The accessibility of each data unit was determined by measuring the shortest road distance from the unit to the nearest gravel road, paved road and state or federal highway over the best existing routes. 1967 Minnesota Highway Department county highway maps were used in these calculations.

Gravel - Any unsurfaced road (1 column)

Distance
Class

0	Gravel not the nearest road.
1	Gravel road within or touching the government lot.
2	Gravel road not within or touching the government lot, but less than one mile away.
3	Gravel road from 1-2.9 miles away.
4	Gravel road from 3-4.9 miles away.
5	Gravel road from 5-9.9 miles away.
6	Gravel road from 10-14.9 miles away.
7	Gravel road from 15-19.9 miles away.
8	Gravel road over 20 miles away.

Paved - not state or federal highway (1 column)

Distance
Class

0	Paved not nearest road or not on route to state or federal highway
1	Paved road within or touching the government lot.
2	Paved road not within or touching the government lot but less than one mile away.
3	Paved road from 1-2.9 miles away.
4	Paved road from 3-4.9 miles away.
5	Paved road from 5-9.9 miles away.
6	Paved road from 10-14.9 miles away.
7	Paved road from 15-19.9 miles away.
8	Paved road over 20 miles away.

Paved State or Federal Highway (1 column)

Distance
Class

- 0 State and Federal highway not paved.
- 1 Paved State and Federal highway within or touching government lot.
- 2 Paved State and Federal highway not within or touching the government lot but less than one mile away.
- 3 Paved State and Federal highway from 1-2.9 miles away.
- 4 Paved State and Federal highway from 3-4.9 miles away.
- 5 Paved State and Federal highway from 5-9.9 miles away.
- 6 Paved State and Federal highway from 10-14.9 miles away.
- 7 Paved State and Federal highway from 15-19.9 miles away.
- 8 Paved State and Federal highway over 20 miles away.

Gravel State and Federal Highway (1 column)

Distance
Class

- 0 State and Federal paved
- 1 Gravel State and Federal highway within or touching government lot.
- 2 Paved State and Federal highway not within or touching the government lot but less than one mile away.
- 3 Gravel State and Federal highway from 1-2.9 miles away.
- 4 Gravel State and Federal highway from 3-4.9 miles away
- 5 Gravel State and Federal highway from 5-9.9 miles away.
- 6 Gravel State and Federal highway from 10-14.9 miles away.
- 7 Gravel State and Federal highway from 15-19.9 miles away.
- 8 Gravel State and Federal highway over 20 miles away.

MLMIS PROCEDURES

INTRODUCTION

The primary goal of the MLMIS study is to provide Minnesota public officials with a quantitative statewide perspective on land use and thereby assist them in making decisions that affect the environment. MLMIS will do this by providing these decision makers with extensive information on present land use, plus selected economic and social data.

Most of the data contained in the MLMIS study was collected at the 40-acre parcel level. Land use, ownership, water orientation and soil types were collected using the 40-acre parcel as the basic data unit. These data units can be aggregated to the township, Minor Civil Division, or county levels. By aggregating to these larger data units other sources of data such as the U.S. Census or county assessment records become compatible with the data collected by MLMIS.

LOCATION CODES

County Number (2 columns)

Counties are numbered consecutively in alphabetical order from 1 through 87.

M.C.D. Number (3 columns)

The Minor Civil Division number is derived from a national numbering system used by the Bureau of the Census to identify minor civil divisions (local government units). Minor Civil Divisions are numbered in alphabetical order within counties.

Latitude and Longitude (10 columns)

The latitude and longitude is determined at the central point of each township or municipality. Latitude is preceded by 4 and longitude is preceded by 9 (except for small portion of Cook County).

Procedure for Latitude-Longitude, MCD Number, and Centroid Identification

The basic units used for area identification are township and range number combinations. (T & R combinations)

I. T & R Combinations

- A. Note all combinations of T & R numbers within the county-- all possible combinations of these numbers must define the entire land area of the county.
- B. Using highway and MCD maps, note which township(s) is/are fully or partially included within a specific T & R combination.

Possibilities under I.B.:

Case 1: T & R combination is a square (36 sections) and only 1 division is shown on MCD map for this combination.

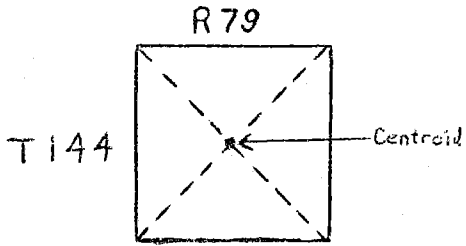


Figure 1

- a. Select proper MCD number for this division from MCD book.
- b. Centroid for this division is the point of intersection of the diagonals (Fig. 1)

NOTE: If land area under question is described as "unorganized territory" or is not visible on MCD map, its MCD number is within the category of "remainder of county."

Case 2: T & R combination is a square or a rectangle and it is cut by divisions on the MCD map. (Fig. 2)

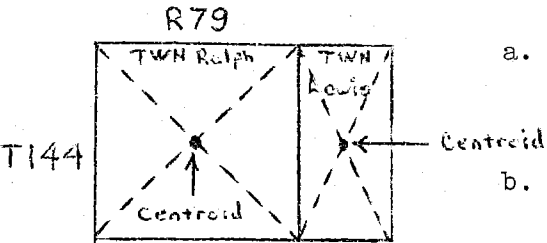


Figure 2

- a. Different MCD numbers can be found in MCD book for Ralph and Lewis, although both Ralph and Lewis have the same T & R number.
- b. Two centroids are located by diagonal method (as in case 1), one for Ralph and one for Lewis.

Case 3: T & R combination is any shape and is included, according to division on MCD map, with a different T & R combination. (Fig. 3)

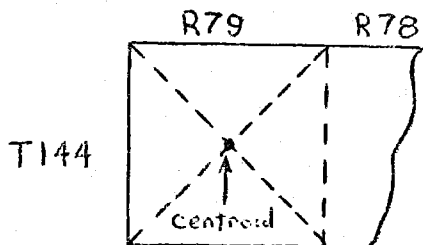
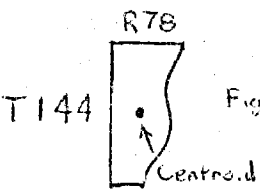


Figure 3

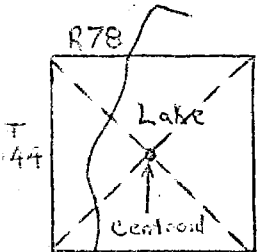
- a. The same MCD number is used for T 144 - R 79 & T 144 - R 78. (MCD number found in MCD book under "Mangle")
- b. Centroid for T144 - R 79 is located by diagonal method. Centroid for T 144 - R 78 discussed below.

Centroid for T 144 - R 78



Case (a) If the eastern border of T 144 - R 78 is a county, state, or nation border, the centroid should be eyed in, within the boundaries of T 144 - R 78. (Fig. 4)

Case (b) If the eastern border of T 144 - R 78 is a lakeshore, complete the square and locate centroid by diagonal method. (Fig. 5) (Complete the square - extend township boundaries to size of normal township)



Exception to Case (b)

Figure 5 If when completing the square you intersect a county, state, or national border, only extend lines to and not beyond this border. Locate centroid according to area now cut off.

Case 4: T & R combination is entirely covered by water

- a. MCD number is included under "remainder of county" in MCD book.
- b. Locate centroid as in case 1,2 or 3 above. Be careful not to extend this township over a county, state, or national boundary.

II. Municipalities

A. Nearly all municipalities have MCD Numbers in MCD book under their names. If they do not have an MCD number, forget them.

Case 1: Municipality locate entirely within a T & R combination.

- a. Select proper MCD number
- b. Eye in centroid according to boundaries of the municipality.

Case 2: Municipality located in more than one T & R combination. (Fig. 6)

- a. MCD number is identical for the same municipality, regardless of whether it is divided by a T or R line.
- b. Centroids are located as in (Fig. 6). One centroid is needed for each part of a municipality in each T & R combination.

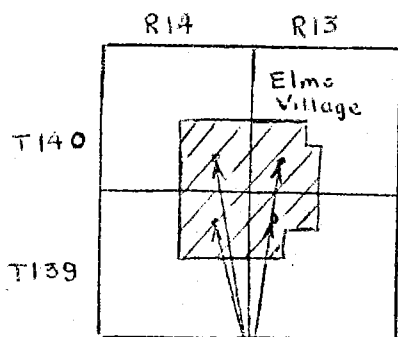


Figure 6

NOTE: The differentiation between municipalities and townships (non-municipalities) can only be found through MCD numbers. Therefore, it will be necessary to separate the municipalities and identify them on the computer tape for programming purposes. If a case exists (as in Fig. 6), the overall centroid for the municipality can be found by averaging the separate centroids.

Township - Range Number (6 columns)

Each township or 6 x 6 mile square in the state is identified by a unique set of numbers according to the federal township and range survey system. The township number indicates relative position east-west. Another digit is added, either a "1" or a "2" to indicate that a township is respectively east or west of the fifth principal meridian which runs north-south through Cook County in northeastern Minnesota.

Section Number (2 columns)

Within a township each square mile or section is numbered from 1 through 36 in a consistent pattern.

Parcel Identification Number (2 columns)

Each regular section or square mile is broken down into 16 forty acre parcels or quarter - quarter sections.

To simplify coding procedures the legal description of land inside sections was digitized.

Figure A

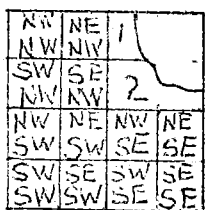


Figure B

22	21	20	11
23	24	302	102
32	31	42	41
33	34	43	44

Figure A shows the legal description of a section with meandered water.

Figure B shows the same section digitized. The letters have been replaced by numbers as follows:

- NE =1
- NW =2
- SW =3
- SE =4
- Lot 1 = 01

Government Lot (2 columns)

Government lots are parcels of land which are not exactly 40 acres. These can generally be found along meandered lakes and rivers, and along the northern and western tiers of parcels in a township. If a government lot extends into more than one 40 acre parcel, it must be noted on each corresponding punch card (or I.D. sheet). One card cannot represent more than one parcel, even though more than one parcel may be included within a government lot.

Government Lots

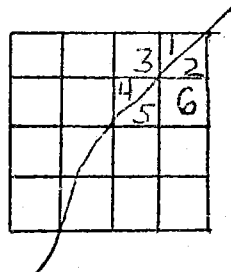
EXAMPLE:

21	22	12	11
2		1	
13	23	13	14
31	32	42	41
33	34	43	44

Government lot 1 would be noted on both the parcel 11 and 12 cards; government lot 2 would be noted on both parcels 21 and 22.

If there is more than one government lot in a parcel, then a separate card for each government lot, or portion of a government lot, in that parcel must be made. Where there is more than one government lot in a parcel, there will be a corresponding number of cards for that parcel.

EXAMPLE: River



In the case of this meandered river, there would be two cards marked for parcels 11 and 13 with the proper (different) government lot numbers on each. Cards for the NE quadrant would be marked as follows:

- 11017
- 11027
- 12037
- 13047
- 13057
- 14067

Land Use (1 column)

Land use as determined from the aerial photographs falls into one of nine categories:

1. Forested
2. Cultivated
3. Water
4. Swamp, marsh
5. Residential
6. Extractive
7. Open
8. Urban - non-residential
9. Transportation

Interpretation Procedure

Aerial photographs and recording maps are prepared for interpretation by outlining townships in red. This facilitates grid placement and reduces recording errors.

The aerial photographs are interpreted by a three man team; two interpreters and a map recorder. Double interpretation facilitates accuracy. The basic unit of interpretation is the township, within which section lines are followed. Each regular section is divided into sixteen forty acre parcels through the use of mylar grids.

Photographs have overlapping coverage for a stereo effect.

Fieldchecking is used to assure ground truth and interpretation accuracy in ambiguous areas.

High altitude (45,000 ft.) aerial photographs (stereo pairs) flown by Mark Hurd Inc. and financed in part by the Minnesota Highway Department, the State Planning Agency and the Upper Great Lakes Regional Commission were used to determine land use for forty acre parcels.

Definitions and Explanations of Calling

- a. Forty - the basic unit of land in this study consists of 40 acre parcels or 1/16 of a section. Field lines and cut lines are used to determine forty boundaries wherever possible; a transparent grid is used in areas where such lines are lacking. For purposes of this study it is assumed that forties cover all surface area including meandered water bodies.
- b. Dominant use - that land use class which covers the largest percentage of the surface area of a forty.
- c. In the "water" and "wet" classes, the concept of "permanency" is incorporated into the system to distinguish normal surface configurations from flooded situations.
- d. Any forty with a shore adjoining a water body covering 10 acres or more is designated as "water oriented." The interpreters will circle the land use code on every water oriented 40. This will be coded in column 34 "parcel I.D. number".

Criteria for Land Use Identification from Air Photographs

- a. Forested - A forty in which the dominant land use consists of deciduous trees, coniferous trees, and lowland brush. To be considered forested, a land area must contain a scattering of trees with at least 10% crown cover.

Problems:

1. Some difficulty is experienced distinguishing between short trees and "open" land.
 2. In some areas tree canopies descend gradually into swamps so that a boundary between the two is difficult to identify.
- b. Cultivated - A forty in which the dominant land use consists of land which has been recently tilled and/or harvested mechanically.

Problems:

1. Frequently it is difficult to distinguish between "cultivated" land and abandoned fields or "open" land.
 2. In some areas dark tone caused by burning or wetness is confused with "cultivated" land.
 3. Farmsteads are included as "cultivated" land when this inclusion makes "cultivated" the dominant use.
- c. Water - A forty in which the dominant land use consists of open and permanent water.

Problems:

1. Some trouble is experienced in determining "water" in areas of flooding.
2. In a few instances limited difficulty is encountered in determining shorelines when ice is present.

- d. Marsh - A forty in which the dominant land use consists of non-forested, vegetated areas which are permanently wet.

Examples: Marshes, meadows, bogs, sloughs, etc.

Problems:

1. There is some difficulty determining edges of "wet" areas when slope is gentle.
2. Flooding causes some difficulty in determining "wet" areas.
3. See Number 2 under "Forested."

- e. Urban Residential - A forty containing five or more residential buildings and no commercial buildings.

Examples: Seasonal and permanent lakeshore homes, resorts, mobile homes, and residential dwellings containing small businesses.

Problems:

1. Because of the size of structures, it is difficult to distinguish between "residential" buildings and non-residential buildings such as churches, town halls, filling stations, apartment buildings, etc.
2. It is sometimes hard to distinguish between "residential" mobile homes area and a mobile home sales establishment.
3. Occasionally residential structures are not distinguishable because they are covered by tree canopies.

- f. Extractive - A forty in which the dominant land use consists of the extraction of minerals, including ancillary facilities.

Examples: Mines, tailings, gravel pits, quarries, crusheries, storage facilities, etc.

- g. Pasture and Open - A forty in which the dominant land use consists of uses not covered by the other classes.

Examples: Grazing land, transitional upland brush, highway and railway right-of-way, abandoned farmland, meadows, beaches, rock outcrops, lawns, etc.

Problems:

1. There is difficulty in areas of transition between open and "wet", "forest", and "cultivated" areas (see preceding explanations of these classes).

- h. Urban Non-Residential or Mixed Residential - A forty containing at least one commercial, industrial, or institutional development, but which may or may not contain residential development.

Examples: Schools, factories, hospitals, nurseries, cemeteries, golf courses, gun clubs, athletic fields, organized recreational facilities, business districts, churches, filling stations, government buildings, warehouses, storage tanks, grain elevators, military installations, sewage disposal facilities, fish rearing areas, radio and television stations, drive-in theaters, state and county garages, prisons, motels, nursing homes, junk yards, and rail stations.

Problems:

1. There is some difficulty in distinguishing between small structures in this class and "residential" structures (see previous "residential" explanation).
- i. Transportation - A forty in which the dominant land use consists of facilities for the conveyance of people and/or materials.

Examples: Airports, railyards, highway interchanges, right-of-way.

Spatial Distribution of Calling Time

It took on the average 26 minutes to interpret the land use in each township. This interpretation was done by two interpreters and did not include field checking, report writing or laying out of photos and maps.

The range of interpretation time for townships in the northern part of Minnesota ranged from five minutes to 110 minutes work time for two photo interpreters. These time variances were grouped into five classes from very fast to very slow. (Table A)

TABLE A

Distribution of Townships By Interpretation
Speed and Interpretation Problems

	Percent of twps. by speed class	Mean Nos. of Physical- Cultural problems affecting interpretation time
Very Fast (5-10 Minutes)	12	0.8
Fast (11-20 Minutes)	26	1.3
Medium (21-35 Minutes)	30	1.6
Slow (36-60 Minutes)	27	2.1
Very Slow (61 + Minutes)	$\frac{5}{100\%}$	2.0

This time and problem distribution was determined from a 1/3 systematic sample of the townships in Northern Minnesota.

This time range is primarily accounted for by the physical-cultural characteristics of each township. Five factors were isolated by the interpreters as having the most effect on interpretation time: Beach ridges, open-cultivated decisions, forest-swamp decisions, and marsh-open decisions, forest-open decisions. Urban areas were in the very slow category, but because there were so few in the northern part of the state they added little time to the total job.

The distribution of townships by interpretation speed show that about 2/5 took less than 20 minutes to interpret, all but 5% less than one hour. In general, the more interpretation problems a township had, the more time it took to interpret it.

TABLE B

Occurrence of Interpretation
Problems within each Speed Class

	Very Fast	Fast	Medium	Slow	Very Slow	Total
Beach Ridge	3%	7%	5%	5%	12%	4%
Open-Cultivated	20	46	67	77	82	37%
Swamp-Open	13	32	40	63	53	25%
Forest-Swamp	37	30	33	32	18	22%
Forest-Open	8	16	17	22	47	<u>12%</u> 100%

Table B shows the occurrence of interpretation problems within each speed class.

Three factors had a major impact on interpretation time. These were the making of open-cultivated, swamp-open, and forest-open decisions. In the very slow calling times, 4/5 of the townships had open-cultivated decisions, and about one-half had forest-open or swamp-open decisions.

These figures imply that areas of recent farm abandonment and areas with low value farm land (grazing) or with swamp are the hardest to interpret.

Map A shows roughly the spatial distribution of interpretation time for the Northern part of the state. Interpretation time was slow in the farmed moraine areas with lakeshore settlement in the eastern agricultural fringes of the Red River Valley and the Iron Range. Interpretation time was medium in the forested areas with lakeshore development, fast in forested areas with lakes and very fast in pure forest or cultivated areas.

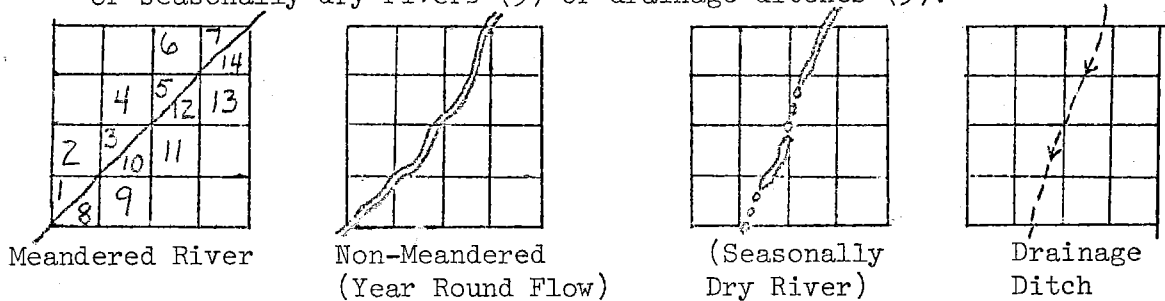
WATER ORIENTATION (1 column)

The fifth digit in the parcel I.D. code refers to the water orientation of each parcel. The code for water orientation is as follows:

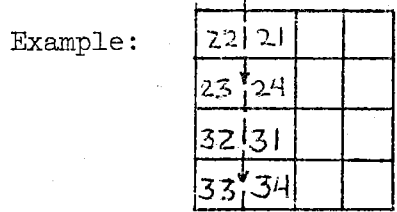
- 1) Government lot or 40 acre parcel is on an island
- 2) Government lot or 40 acre parcel is on a meandered lake
- 4) Government lot or 40 acre parcel is on a non-meandered lake
- 7) Government lot or 40 acre parcel is on a meandered river
- 8) Government lot or 40 acre parcel is on a non-meandered river that flows year round
- 9) Government lot or 40 acre parcel is on a drainage ditch or non-meandered river that is seasonally dry

A lake is meandered (2) only if it has government lots surrounding it. All other lakes are non-meandered (4).

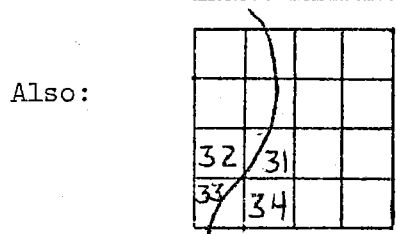
A river is meandered (7) only if it has government lots surrounding it. All other rivers are either non-meandered rivers that flow year round (8) or seasonally dry rivers (9) or drainage ditches (9).



If a drainage ditch or river flows on the boundary between two or more 40's, code the 40's accordingly.



Code: 21,22,23,35,31,32,33,34, as 9 or Drainage Ditch

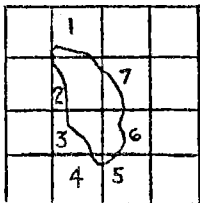


code both 32 and 34 (assume that 31 & 33 were coded as 9)

PROBLEM:

How to determine the boundaries of Government lots when a lake has dried up.

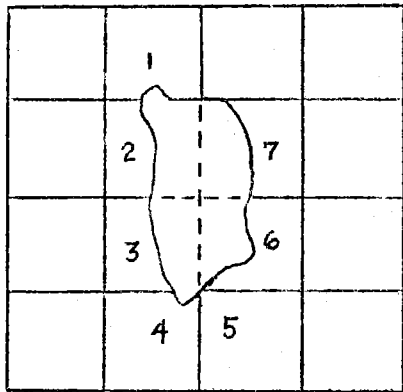
EXAMPLE



(As shown on County Highway Maps)

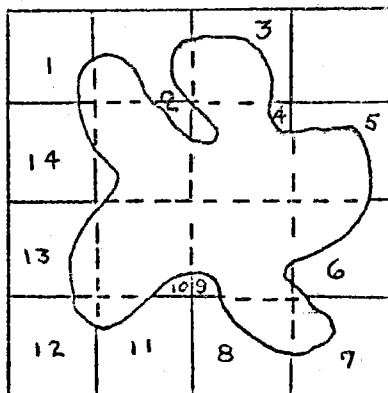
What to do?

Correct way:



- | | |
|----------|----------|
| 11 - | 31 - 030 |
| 12 - | 32 - |
| 13 - 070 | 33 - |
| 14 - | 34 - 040 |
| 21 - 010 | 41 - 060 |
| 22 - | 42 - |
| 23 - | 43 - 050 |
| 24 - 020 | 44 - |

On more difficult sections:



- | | |
|----------|----------|
| 11 - | 31 - 100 |
| 12 - 030 | 32 - 130 |
| 13 - 020 | 33 - 120 |
| 14 - 040 | 34 - 110 |
| 14 - 050 | |
| 21 - 020 | 41 - 060 |
| 22 - 010 | 42 - 090 |
| 23 - 140 | 060 |
| 24 - 140 | 43 - 080 |
| 020 | 44 - 070 |

FEDERAL OWNERSHIP

Ownership maps were obtained from federal agencies in order to determine parcels which are managed by the federal government. Both fee title and easement were coded. Because the basic data unit is the forty-acre parcel, it is possible to have multiple owners on a single parcel. As state and county ownership is added the ownership records will be expanded to include multiple owners.

In cases where the government agency did not manage the entire parcel, a "2" was added to the ownership code to indicate only partial ownership.

U.S. Forest Service

"01" Boundary Waters Canoe Area (B.W.C.A.)

Ownership is recorded from Forest Service ownership maps.

The B.W.C.A. is in the counties of Cook, Lake, and St. Louis. All parcels owned by the Forest Service within the B.W.C.A. are coded "01" in columns 34 and 35.

"02" Other National Forests

All parcels owned by the Forest Service outside of the B.W.C.A. are also coded from Forest Service ownership maps. Such parcels are found in the counties of:

Cook
Lake Superior National Forest
St. Louis

Itasca
Beltrami Chippewa National Forest
Cass

All such parcels are coded "02" in columns 34 and 35.

"03" Bureau of Land Management (B.L.M.)

The B.L.M. is currently conducting an extensive study of all its ownership in Minnesota. This study is not yet completed for all counties. Copies of reports for those completed counties are filed with the Department of Conservation Division of Lands and Forests. With the exception of holdings in Koochiching county, most of the

B.L.M. ownership consists of small islands. Only islands that were over ten acres or were meandered government lots were recorded for ownership.* Islands under 10 acres that were not government lots were not recorded. All government lots were recorded regardless of size.

The following counties have B.L.M. ownership for which data was recorded:

Becker
Clay
Grant
Koochiching
Ottertail
Pope
Lake of the Woods

Parcels owned by the B.L.M. that were recorded were coded with an "03" in columns 34 and 35.

* Islands under ten acres are not recorded by the Land Use Study.

Bureau of Sports, Fisheries and Wildlife

National Wildlife Refuges

Data on National Wildlife Refuges was collected from the Bureau of Sports, Fisheries and Wildlife regional office at Fort Snelling. This ownership consists of:

"04" "14" National Wildlife Refuges

	<u>COUNTY</u>
Agassiz	Marshall
Sherburne	Sherburne
Rice Lake	Aitkin
Tamarac	Becker
	Mille Lac

Other

Pipestone National Monument	Pipestone
Fish Hatchery	Kandiyohi

An "04" is coded in columns 34 and 35 of all parcels owned by the National Wildlife Refuges division of the Bureau of Sports, Fisheries and Wildlife. "14" is coded for those parcels where only flowage rights are owned.

The National Wildlife Refuges also leases to the State of Minnesota land within the Beltrami Island Settler Relocation Project for the purposes of waterfowl production. This land is located in Roseau, Lake of the Woods, and Beltrami Counties. All such parcels are coded "15" in columns 34 and 35.

"05" "06" Waterfowl Production Areas

The Bureau of Sports, Fisheries and Wildlife is conducting an extensive wetlands purchasing program outside of the wildlife refuges. These parcels are located in the counties of:

Becker	Grant	Ottertail	Swift
Big Stone	Jackson	Polk	Traverse
Clay	Kandiyohi	Pope	Wilkin
Cottonwood	Lac Qui Parle	Stearns	Yellow Medicine
Douglas	Mahnomen	Stevens	

This data was also recorded from the Bureau of Sports, Fisheries and Wildlife regional offices at Fort Snelling.

Parcels owned in fee title by the Bureau are coded with an "0" in columns 34 and 35. Parcels with easements alone purchased by the Bureau are coded "06" in columns 34 and 35.

Corps of Engineers

Data on Corps of Engineers ownership was obtained from land ownership records prepared by the Corps reality office in the St. Paul Post Office Building. Corps of Engineer ownership is within the counties of:

Wabasha	Cass
Goodhue	Crow Wing
Winona	Itasca
Ottertail	Aitkin

"11" "12" "13" Bureau of Indian Affairs

There are seven Indian Reservations and four Souix communities in Minnesota.

<u>Reservation</u>	<u>County</u>
White Earth	Becker Mahnomen Clearwater
Nett Lake	Koochiching St. Louis

<u>Reservation</u>	<u>County</u>
Grand Portage	Cook
Fond Du Lac	Carlton St. Louis
Mille Lac	Mille Lac Cass
Red Lake	Itasca Beltrami

Of these reservations, five were completely mapped by the Indian Service in Bemidji:

Grand Portage
Fond Du Lac
Mille Lac
Nett Lake
Red Lake

Ownership maps provided by the Bureau were used for these five reservations. All parcels that were designated "tribal" land by the Bureau were coded with a "11" in columns 34 and 35. All parcels designated as "allotted" land by the Bureau were coded "12" in columns 34 and 35. All other Indian owned parcels being neither "tribal" nor "allotted" were coded "13".

For those reservations for which Indian Bureau ownership maps were unavailable, Iron Range Resources and Rehabilitation (I.R.R.R.C.) ownership maps were used. These maps were printed on a Highway Department county base map which show the limits of Indian lands. All parcels shown as Indian lands on the I.R.R.R.C. maps do not show the difference between "tribal" and "allotted" lands so that for these reservations all Indian lands are coded as other Indian Lands (code 13).

All lands within the four Sioux communities are coded "13" in columns 34 and 35.

STATE AND COUNTY OWNERSHIP

The state and county owned land in Minnesota is being recorded by the Department of Natural Resources and the State Planning Agency. The Department of Natural Resources is coding all land managed by the Department and by the counties. The State Planning Agency is coding all other state owned land by agency. When completed these records will be merged with the MLMIS records of federal ownership.

State Lands

State Division of Lands and Forests plus Division of Waters, Soils, and Minerals

- 20 Lands and Forests within State Forests
- 21 Lands and Forests outside of State Forests
- 22 Waters, Soils, and Minerals
- 23 Others

State Division of Game and Fish

- 30 Division of Game Lands
- 31 Division of Fish Lands
- 32 Law Enforcement (Public Access)

State Department of Parks and Recreation

- 40 State Parks Monuments, and Historic Sites
- 41 Other

State Department of Highways

- 50 Roadside Parks
- 51 Other Land Adjacent to Lakes and Streams
- 52 Maintenance and Garage Sites
- 53 Gravel Pits
- 54 Other Highway Department

Other State Agencies

- 60 Military Affairs
- 61 Agriculture
- 62 Corrections
- 63 Welfare
- 64 University of Minnesota
- 65 Aeronautics
- 66 State Colleges
- 67 Junior Colleges
- 68 Other

County Lands

- 70 County Forest
- 71 Tax Forfeit outside of County Forest

In addition to the managing agency, mineral ownership and means of acquisition will be coded for state and county owned land.

The state's interest in mineral ownership:

<u>Code</u>	
1	State owns surface and minerals
2	State owns minerals only
3	State owns surface only
4	State owns surface; mineral ownership uncertain
5	State owns neither surface nor minerals
6	State owns minerals; surface ownership uncertain
7	State does not own surface; mineral ownership uncertain

The state land class which shows the state's interest in the parcel:

<u>Code</u>	
1	Trust Fund includes: <ul style="list-style-type: none">a. School Landsb. Indemnity Schoolc. Swampd. Internal Improvementse. Universityf. Transferred Collegeg. Transferred Schoolh. Agricultural Collegei. Public Building
2	Consolidated Conservation
3	Tax Forfeited
4	Acquired
5	Leased from Federal
6	Leased from Private
7	Other <ul style="list-style-type: none">Volstad and possibly other additions

For the area encompassed by the USGS Brainerd Sheet and the eastern portion of the Fargo Sheet, the geomorphic regions and soil landscape units were coded. This data is adapted from Miscellaneous Report 90, Minnesota Soil Atlas - Brainerd Sheet, Agricultural Experiment Station, University of Minnesota.

Coding Legend for Geomorphic Regions (Columns 23-25)

- 010 Agassiz Lacustrine Plain (Red River Valley)
- 020 Fergus Falls (Young Gray Drift) Till Plain
- 030 Alexandria Moraine Complex
- 040 Detroit Lakes Pitted Outwash Plain
- 050 Mahnomen Lacustrine Plain
- 060 Henning Till Plain
- 071 Wadena Drumlin Area
- 072 Todd Drumlin Area
- 073 Cass Crimlin Area
- 080 Park Rapids - Staples Outwash Plain
- 090 St. Croix Moraine Complex
- 101 Pine River Drumlin Area
- 102 Darling Drumlin Area
- 103 Brainerd-Pierz Drumlin Area
- 110 Itasca Moraine Complex
- 120 Stewart Lake Till Plain
- 130 Crow Wing Outwash Plain
- 140 Mille Lacs Moraine

Coding Legend for Soils (Columns 39-40)

- 11 SSWD Sandy over sandy, well drained, dark colored soils
- 12 SSPD Sandy over sandy, poorly drained, dark colored soils
- 13 SSWL Sandy over sandy, well drained, light colored soils
- 14 SSPL Sandy over sandy, poorly drained, light colored soils

- 21 SLWD Loamy over sandy, well drained, dark colored soils
- 22 SLPD Loamy over sandy, poorly drained, dark colored soils
- 23 SLWL Loamy over sandy, well drained, light colored soils
- 24 SLPL Loamy over sandy, poorly drained, light colored soils

- 31 LSWD Sandy over loamy, well drained, dark colored soils
- 32 LSWL Sandy over loamy, well drained, light colored soils
- 33 LSPL Sandy over loamy, poorly drained, light colored soils

- 41 LLWD Deep silty or loamy, well drained, dark colored soils
- 42 LLPD Deep silty or loamy, poorly drained, dark colored soils
- 43 LLWL Deep silty or loamy, well drained, light colored soils
- 44 LLPL Deep silty or loamy, poorly drained, light colored soils

- 52 CLPD Silty or loamy over clayey, poorly drained, dark colored soils
- 53 CLWL Silty or loamy over clayey, well drained, light colored soils
- 54 CLPL Silty or loamy over clayey, poorly drained, light colored soils

- 61 CCWD Clayey over clayey, well drained, dark colored soils
- 62 CCPD Clayey over clayey, poorly drained, dark colored soils

MLMIS used the forty-acre parcel as its basic data unit. By aggregating these units to a higher level such as the Minor Civil Division or the county, the MLMIS data becomes compatible with data collected by other state and federal research projects and agencies. The following is a list of other data which have been used by the MLMIS Study. This is not a complete list. There is much more additional data collected routinely by agencies in both the state and federal governments which is adaptable to the MLMIS framework.

Data Collected At Minor Civil Division Level

U.S. Census 1960 and 1970

Rapid Analysis Fiscal Tool (RAFT) (CURA)

Tax Exempt Property	Personal Property
Expenditures	Receipts
Income	Value
Homestead Credit	Sales Ratio
Mill Rates	

Crop and Livestock Reporting Services (Department of Agriculture)

Total Land in Farms	Potatoes
Corn for Grain	Peas
All other Corn	Cabbage
Soy Beans	Onions
Oats	Alfalfa Hay
Barley	All other tame Hay
Flax	Wild Hay
Spring Wheat	Red Clover Seed
Duram Wheat	Timothy Seed
Rye	Sweet Clover Seed
Sunflowers	Alfalfa Seed

Hens and Pullets	Grain Fed Steers and Heifers
Ewes	Spring Sows Farrowed
Milk Cows 2 yrs. +	Fall Sows Farrowed
Beef Cows 2 yrs. +	Hogs Marketed for Slaughter
Other Cows	

+ Any data at 40 level