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A CLASSIFICATION MANUAL FOR LAND COVER & LAND USE IN MINNESOTA

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A CLASSIFICATION MANUAL FOR LAND COVER AND LAND USE IN MINNESOTA

State Planning Agency
15 Capitol Square Building
St. Paul, Minnesota 55101

Funding for Preparation and Publication by:
Legislative Commission on Minnesota Resources
Room B-46 State Capitol
1978

ABSTRACT

In the summer of 1977 the Minnesota State Planning Agency (MSPA), with the help of an interagency advisory committee, began to compile a manual for land cover and land use classification in Minnesota. The chief objective of the manual is the standardization of terms used to describe land cover and use so that the studies and inventories of various units of government in Minnesota may be comparable and compatible.

It is the concensus of the MSPA and the advisory committee that a two-part classification scheme with separate cover and use sections is the most desirable format for Minnesota classification requirements. The manual contains two hierarchical levels of terms for both the cover and use sections and describes the procedure for extending the classifications to Level III and succeeding levels when such extension is required. Standardization of the classifications includes only the two levels presented.

The first section of the manual describes the development of the classifications and the considerations that influenced its design. The second and third sections present the cover and use classifications, respectively.

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SECTION I

INTRODUCTION

Section I: INTRODUCTION

Background

The need for a standard land use/cover classification scheme has been recognized for some time by state, local and private agencies that use land use and cover information. In 1974, the Minnesota Land Management Information System (MLMIS)* started work on a manual of standard use and cover schemes. The results of these efforts, two separate but parallel classification systems, are the organizational basis for the manual presented here.

The Department of Natural Resources (DNR) has long employed special purpose use and cover schemes for the classification the Department routinely requires in wildlife and forestry management and outdoor recreation planning. Their classification requirements also figure in this manual.

The State Planning Agency (SPA) is investigating alternative photo-interpretation methods and classification schemes to interpret land use change that has occurred since the publication of the Minnesota Land Use Map, which displays 1969 land use and cover patterns. This work has provided the first opportunity to test the usefulness of the classifications.

Finally, others in various public and private planning capacities have contributed to the manual. As a result, the use and cover classifications reflect as much as possible the varying needs of the planning community in Minnesota.

Purpose

The standardization of land use and cover terms is an important step in the statewide effort to share land use information. Unless terms used to describe Minnesota's land are commonly understood and applied, the classification work of different planners will be mutually independent. Rarely can one classification scheme satisfy the requirements of an area as heterogeneous and as large as Minnesota. Because of the diversity of classification requirements and the diversity of landscapes a dual use/cover classification system is proposed. This approach is unique. Among the existing federal and state classifications reviewed, no others incorporate two distinct use and cover classifications. Most, following the lead of the United States Geological Survey's recent publication, combine use and cover in one document.* This is true also of the recent classifications developed in Florida, Michigan and Wisconsin. Standardization of land use and cover classification is possible only if the vast majority of classification needs are accommodated, and this seems most likely with a dual system. Accordingly, a dual system is proposed because it can most easily accommodate:

1. classification studies of varying cost and effort;
2. classification requirements for landscapes of different character (for example, rural extensive uses versus urban intensive uses);
3. the variety of information resources available for land use and land cover inventories; and
4. differing study purposes.

Another aspect of the attempt to standardize classification terms and procedures is the

*In 1974 MLMIS was a project with the Center For Urban and Regional Affairs, University of Minnesota; it is currently a division of the Minnesota State Planning Agency.

*James R. Anderson et al., *A Land Use and Land Cover Classification System for Use with Remote Sensor Data,* Geological Survey Professional Paper 964 (Washington: United States Government Printing Office, 1976).

review and revision of the classification in response to application experiences. Review and revision will be required because land classification methods and remote sensing technology are in flux. With increasing remote resolution and further advances in interpretation accuracy, classification needs may change. Recommended changes to this first edition of the classification should be submitted to the State Planning Agency's Land Management Information Center.

Potential Benefits of the Classification System

Planners and land managers at all levels of government in Minnesota have something to gain from using standard terminology to describe land use and land cover. Under a system of standardized land use/land cover classification, completed studies become a cumulative record of land use and cover character and change. State agencies that have responsibilities for land management will benefit because a standardization of terms among agencies will facilitate data sharing and its collection and storage. Local land planners and public officials will benefit because standardized information acquired from any source will be easier to use and interpret. Examples of information local levels of government might acquire from state agencies are summary and overview data at county and regional scales. Also, land cover data from satellite imagery in standard format may be useful to officials of local levels of government as these materials become more widely available. Typically, the flow of land use information has been from the local to the state level. Standardization of land use and cover terms may help to increase information flow in both directions - local levels to state and state to local levels.

*See Appendix for guidelines.

Basis for Standardization

The basis for statewide standardization of land use and cover classification has two parts. First, the terms applied to uses and cover must be commonly understood and applied. That is the emphasis of the present effort. Second, and more difficult, the interpretation procedures for determining the boundaries and dominant use or cover of land should ideally be standardized. This is a goal to work toward, but it will be slow in coming because of differences in the scale of studies, in the resolution of sources of information used (for example, high altitude photography compared to field reconnaissance) and in the homogeneity of cover or use per unit area in different parts of the state (a 40 acre parcel in the Red River Valley, for example, is more homogeneous that a 40 in rural northern Minnesota). It is urged that users of this classification scheme document and strictly adhere to the interpretation rules adopted for their classification effort.*

The two levels of the dual classification presented here are generally compatible with systems currently in use. At the third and successive levels, the user may devise suitable categories as long as they may be aggregated to form the first and second level categories presented here (see the Appendix for examples of the process for extending the classifications). Two examples of systems compatible with the present classification are county zoning land use classifications and Department of Natural Resources schemes for classifying forestry and wildlife lands. The commonly employed categories in county zoning classifications, including open space, floodplain, agricultural districts, residential and others, have their counterparts in the land use classification, though in some cases the

category name is different. Areas classified and managed by the DNR are accommodated by parts of both the use and cover classifications in the present system. Outdoor recreation, forestry, wildlife production, and reserved land and water are found in the **NATURAL RESOURCE AREAS** primary category of the land use classification, and resource categories such as forest, shrub, and herbaceous cover types are found in the cover section.

Operational Definitions of Land Cover and Land Use Classifications

The separate use and cover sections are significantly different in purpose and scope.* This is reflected in the definitions adopted for each classification. **Land Cover** refers to the "form" of those features covering the earth's surface, including vegetation, bare land, water, and artificial constructions, that are typically identified from satellite or air photography imagery. **Land Use** refers to the "function" attributed to land or water. An area is said to have a use if a private or public party has developed a management plan or policy for its exploitation, or if use can be clearly inferred from visible activity on land. This definition of land use includes so-called passive uses such as preservation or conservancy status. Land and water areas where there are no apparent management plans or policies are still inventoried but are put into a separate category entitled **UNCLASSIFIABLE.**

The land use classification is for studies and inventories requiring information on the kind of exploitation of land or activities conducted on land. The land cover classification is designed for use in resource studies under circumstances requiring information on vegetative or other land cover, as distinct from land use. In some cases, the user may find it necessary to devise a classification scheme that is a mixture of land use and land cover terms. This might occur in impact studies for which cover information is needed to document impacts of the destruction of vegetation and land use data is required to identify agricultural or residential use impacts of a proposed development. Because the two parts of the classification system are mutually exclusive in meaning and system of numbering, using parts of both should cause no problems of logic or consistency.

The information sources used for each of the two classification sections differ too. Satellite imagery and aerial photography are the chief sources of data for land cover classification. Images are available from federal, state and private sources; a complete listing of those is contained in the Minnesota State Planning Agency's *Inventory of Aerial Photography and Other Remotely Sensed Imagery of Minnesota* (June 1977).* **Other** sources of cover information are soils and vegetation maps.

Land use information sources are necessarily more varied, because air photo interpretation of complex and intensive land uses is difficult at any scale. When detailed information is required the classifier must turn to such sources as tax records, building permits, facility licensing records, field work, zoning maps, and agency records such as land classification.

The United States Geological Survey has developed guidelines for relating levels of classification to the scale of remotely sensed information (satellite imagery and air

*See Figure 1 for a summary comparison.

*Copies are available at the Documents Section, 140 Centennial Building, St. Paul, Minnesota 55155.

photograph) that are generally appropriate to Minnesota's classification. The guidelines apply most directly to land cover classification because its data sources are chiefly remote sensing devices. Land use classification will typically require a variety of sources of information.

Relationship Between Classification Level and Remote Sensing Data Source*

Classification Level	*Data Source*
I	LANDSAT type of data
II	High-altitude data at 40,000 ft. or above (less than 1:80,000 scale)
III	Medium-altitude data taken between 10,000 and 40,000 ft. (1:20,000 to 1:80,000 scale)
IV	Low-altitude data taken below 10,000 ft. (more than 1:20,000 scale)

*Anderson, op. cit., footnote p. 1 above.

No concrete rule can be stated regarding the number of levels that can be employed at different mapping scales, because this can vary widely. In general, however, maps at very small scale, for example a 1:4,000,000 page sized map of Minnesota, can accommodate information at level I only. At the other end of the continuum of map scale, a county highway map or new topographic sheet (1:60,000 to 1:100,000) represent scales where level I information alone would be inappropriate and information at levels II, III, and IV might be represented easily. At most scales of study it should be expected that for some purposes very little detail is required (few levels of classification employed) and for other much detail (and extended levels of classification) will prove necessary. To give a current example, the State of Minnesota Land Use Map (1969) at 1:500,000 scale is comprised of information at level I and II and a few categories at level III of the present classification.

Sections II and III document the land cover and land use classifications, respectively. Each section includes a list of level I and II classifications, definitions of each classification, and a classification example. The study area for the sample classification is shown in Figure 2.

Figure 1: Summary Comparison of Land Cover and Land Use Classifications

Land Cover Scheme

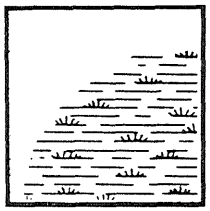
Land Use Scheme

APPLICATION

IDENTIFICATION OF SURFACE FEATURES

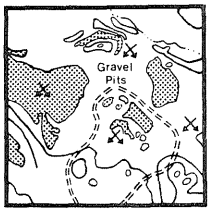


80.1 *Lakes*

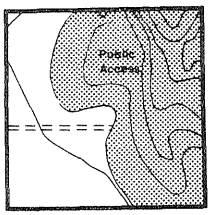


90.1 *Emergent Wetlands*

IDENTIFICATION OF ACTIVITY/MANAGEMENT



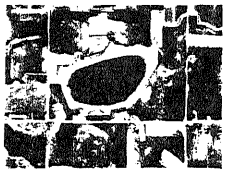
01.3 *Industrial*



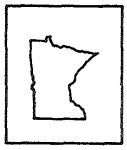
02.1 *Outdoor Recreation*

DATA SOURCES

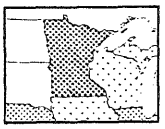
SINGULAR

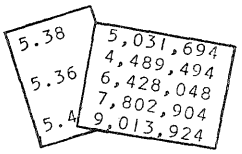


REMOTE SENSING



MULTIPLE



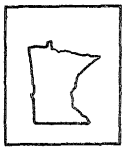




MAPS

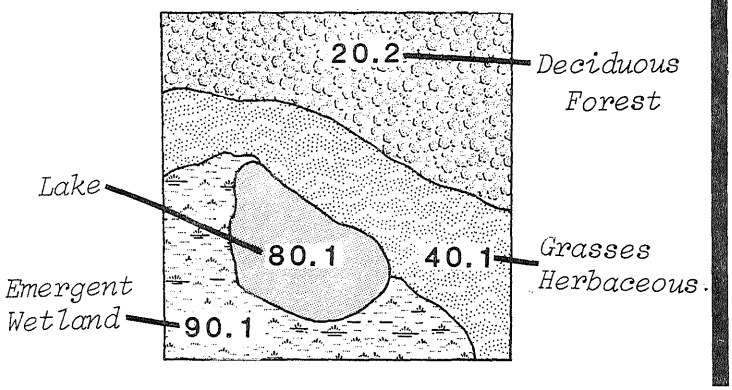
RECORDS

FIELDWORK



MAPPED PRODUCT

COMPLETE



INCOMPLETE

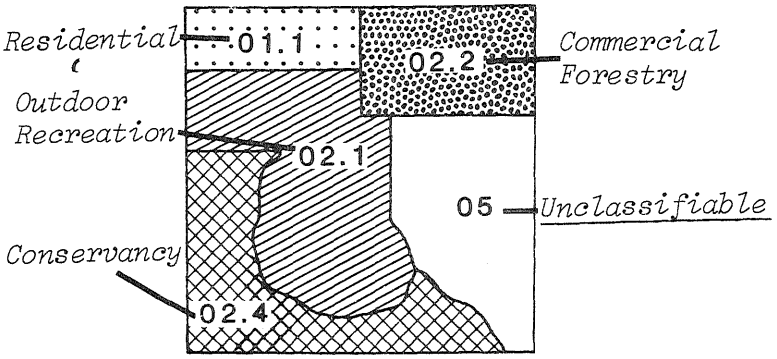
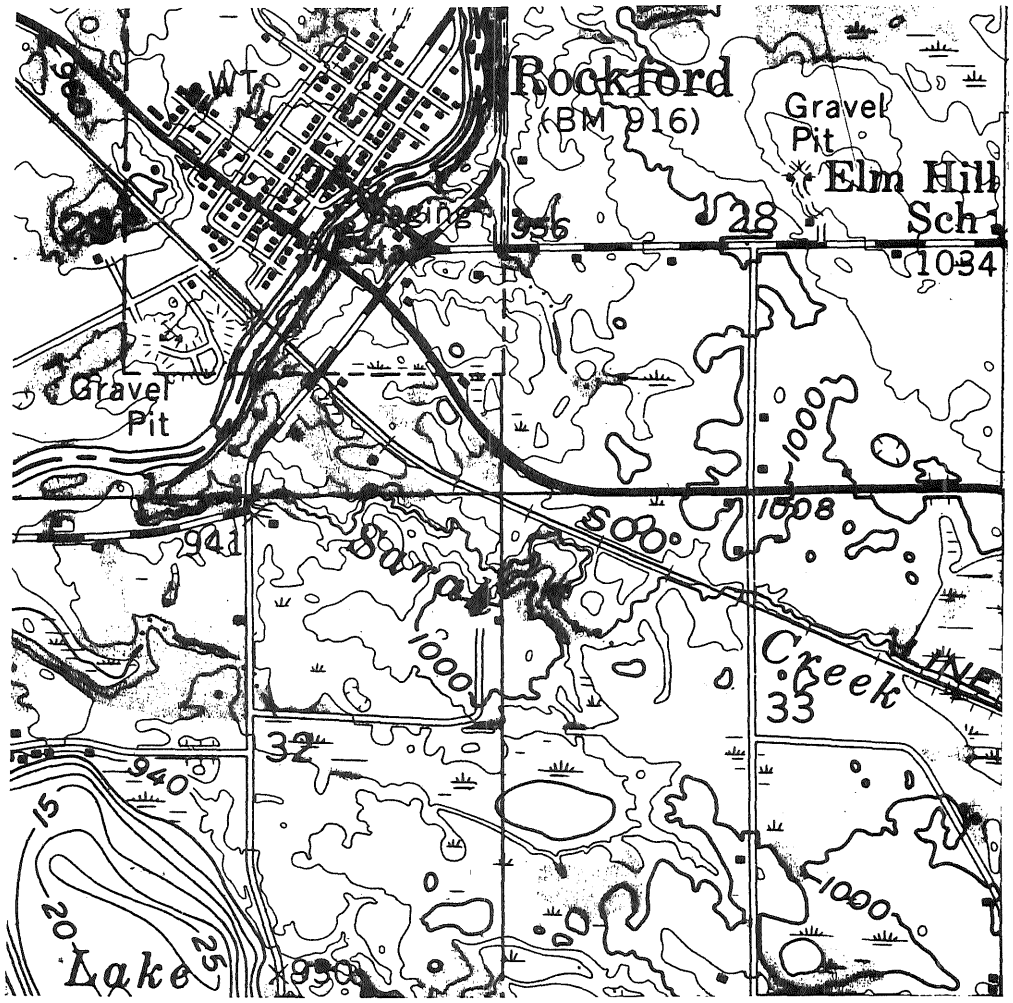


Figure 2: Classification Example Study Area

USGS TOPOGRAPHIC SHEET



This study area is a four square mile site near Rockford in the south-central portion of Minnesota. It was selected because of its diverse land cover and land use that illustrates the classification schemes. The scale of the maps and photos is 1:24,000 or 1 = 2000 . This would allow classification to level III, although these examples show level I and II. Minimum units mapped are 5 acres for extensive resources and 1 acre for intensive sites. An area is required to be only 75% homogeneous for a particular classification. Computer entry is not anticipated.

SECTION II
LAND COVER CLASSIFICATION

Section II: LAND COVER CLASSIFICATION - LEVELS I and II

20 *FOREST*
- 20.1 *Conifer*
- 20.2 *Deciduous*
- 20.3 *Conifer and Deciduous Mixed*

30 *SHRUB*
- 30.1 *Evergreen*
- 30.2 *Deciduous*
- 30.3 *Evergreen and Deciduous Mixed*

40 *HERBACEOUS*
- 40.1 *Grasses (or Graminoids)*
- 40.2 *Herbs (broadleaved herbs)*
- 40.3 *Mosses*
- 40.4 *Mixed Grasses-Herbs and Mosses*

50 *CULTIVATED VEGETATION*
- 50.1 *Row Crops*
- 50.2 *Closely-Grown Crops*
- 50.3 *Other Cultivated (orchards, vineyards, horticultural plantings)*

60 *BARE LAND*
- 60.1 *Bedrock*
- 60.2 *Rocks, Gravel or Sand*
- 60.3 *Soil*

70 *STRUCTURED/PAVED*
- 70.1 *Low Impermeability*
- 70.2 *Medium Impermeability*
- 70.3 *High Impermeability*

80 *WATER*
- 80.1 *Lakes and Reservoirs*
- 80.2 *Streams and Canals*
- 80.3 *Bays & Estuaries*
- 80.4 *Intermittent Streams*
- 80.5 *Drainage Ditches*

90 *WETLAND*
- 90.1 *Emergent*
- 90.2 *Submergent*

100 *UNCLASSIFIABLE*

General Description

The land cover classification is a hierarchical system with nine level I categories and their associated level II subdivisions. Level I categories are intended to be roughly equivalent to each other in importance and/or level of generalization. They describe those broad classes of Minnesota cover that can hardly be further generalized.* In other words, level I terms are the most general practical categories in which land cover in Minnesota can be described. Level II distinguishes more specific cover types, such as deciduous forested and brush lands and cultivated crops (see outline).

Five of the level I categories describe vegetated cover types and permit the classification of all major classes of plants in the state. This includes agricultural crops, considered "cultivated cover" here, and not "agricultural land" (which is not a cover but a use). The *WETLAND* category is different in structure from the other vegetated terms and it requires extension of the classification into level III and IV to describe tree or shrub types specifically (see Appendix for how this might be done).

The three non-vegetated categories classify the balance of land cover. *BARE LAND* should be used to account for sand, soil, rocks, and gravel, whatever their origin. Fallow and idle agricultural land with no vegetation cover would be classified bare along with gravel pits and quarries. *STRUCTURED/PAVED* is used for all impermeable surfaces that are paved or have artificial constructions covering them. This category might be useful in impact studies requiring information on possible loss of groundwater recharge capacities or increased run-off effects due to paved or structured surfaces. *Permeability classes* form the second level here. *Water* at level II identifies major types of water surface configurations. Lake types (hardwater, softwater, etc.) could form level III for level II, *Lakes.* Similarly, streams might be classified at level III for water quality, gradient, volume of flow and so forth. Finally, *UNCLASSIFIABLE* is the category to use when the cover features are too obscure to identify or are ambiguous.

Except for unidentified (coded *UNCLASSIFIABLE*) cover features the cover classification, in contrast to the land use classification, permits the complete mapping of an area. The land use classification, because its definition stipulates proof of activity or management to classify a use, may not permit the complete mapping classification of a study area. This is especially true for areas of extensive (as opposed to intensive) land uses.

The numbering system is designed for easy extension of the two levels presented. For example, level III extension of *Deciduous Forest,* 20.2, would be numbered 20.2.1, 20.2.2, 20.2.3 and so on. The whole number to the left of the first decimal is level I, the first digit to the right of the first decimal is level II, and to the right of the second decimal is level III. If more than nine categories are encountered at any level the numbering continues, e.g. 20.2.15 . . .; and subdivisions of that example would begin: 20.2.15.1. The Land Use Classification numbering system is handled the same way.

*For example, to aggregate the categories Forest, Shrub, Herbaceous, and Cultivated Herbaceous into a more general category, Vegetated, produces a category too vague and general to be useful.

LAND COVER DEFINITIONS

20 *FOREST*

Land covered by at least 10% tree crown coverage as interpreted in satellite images or air photos.

20.1 *Conifer*

Land dominantly forested with needle-leaf species such as pine, fir, and spruce.

20.2 *Deciduous*

Land dominantly forested with broadleaf species that shed leaves in the fall season.

20.3 *Conifer and Deciduous Mixed*

Land on which both coniferous and deciduous trees occur and neither predominates.

30 *SHRUB*

Land covered with low, woody vegetation such as Dogwood, Raspberry, or American Yew.

30.1 *Evergreen*

Land covered with predominantly needleleaf species.

30.2 *Deciduous*

Land dominantly covered with deciduous species.

30.3 *Evergreen & Deciduous Mixed*

Land covered with a mixture of needleleaf and deciduous species on which neither predominates.

40 *HERBACEOUS*

Land dominantly covered by vegetation whose stems wither to the ground at the end of the growing season, including grasses, broadleaved herbs, and mosses.*

40.1 *Grasses*

Land covered with grasses and other narrow leaved plants like sedges, rushes, and arrow grass.

40.2 *Herbs*

Land predominantly covered with broadleaved herbaceous plants.

40.3 *Mosses*

Land covered predominantly with mosses or liverwort types.

40.4 *Mixed Grasses, Herbs and Mosses*

Land covered with grasses, herbs, and mosses on which neither type predominates.

50 *CULTIVATED VEGETATION*

Land cover consisting of cultivated crops.

*Mosses are included in herbaceous cover even though not technically herbs.

50.1 *Row Crops*
Cultivated crops planted in rows.

50.2 *Closely Grown Crops*
Land covered with cultivated crops not grown in rows.

50.3 *Other Cultivated*
Land covered predominantly by orchard or vineyard plantings, horticultural crops, or by other cultivated cover not included in 50.1 or 50.2

60 *BARE LAND*
Land without cover or vegetation

60.1 *Bedrock*
Land on which bare rock is at or above the ground surface.

60.2 *Rocks, Gravel or Sand*
Land covered with rocks, gravel or sand.

60.3 *Soil*
Land covered with topsoil.

70 *STRUCTURED/PAVED*
Land covered by impermeable surfaces such as structures and pavement.*

70.1 *Low Impermeability*
Land on which impermeable surfaces account for 25-39% of land area, typical of newer suburban development densities.

70.2 *Medium Impermeability*
Land on which impermeable surfaces account for 40-70% of land area, typical of inner-city residential districts.

70.3 *High Impermeability*
Land on which impermeable surfaces account for over 71% of land area, typical of inner-city industrial districts and commercial districts.

80 *WATER***
Water bodies and courses.

80.1 *Lakes and Reservoirs*
Water basins without appreciable current.

80.2 *Streams and Canals*
Linear water courses with current.

80.3 *Bays and Estuaries*
Embayments and arms, respectively, in large lakes.

80.4 *Intermittent Streams*
Streams with dry beds part of the year.

*Impermeability classes adopted from Soil Conservation Service data.

**A number of detailed water classifications exist that could be used to extend this two level scheme; among these is the Minnesota Department of Natural Resources water classification.

80.5 *Drainage Ditches*
Linear channels constructed to drain wet soils.

90 *WETLANDS*
Areas inundated by surface ground water with a frequency sufficient to support hydrophytic vegetation that requires saturated or seasonally saturated soil conditions.

90.1 *Emergent*
Hydrophytic vegetation that grows above water.

90.2 *Submergent*
Hydrophytic vegetation that grows beneath water surface.

100 *UNCLASSIFIABLE*
Land on which the cover cannot be identified.

Land Cover Coding Example

Land cover, to recall the definition is defined as the surface features on the land, usually interpreted from air photography or satellite images. Interpretation is based on the characteristics of the form of surface features and not on apparent or implied land uses occurring on land. The interpretation in the example was carried out using an air photo only.

The area coded in Figure 3 is Rockford, MN and the area to the south and east of the town. Rockford is situated on the Crow River in a farming region about 30 miles west of the Twin Cities. Wooded tracts remain along the river corridor, in woodlots, and in a county park reserve (not coded because a reserve is a **use.**) Rockford, itself, has been interpreted *STRUCTURED/PAVED* in two categories of cover impermeability, low (70.1) for the residential parts and medium (70.2) for the central business district.

Deciduous tree species appear to comprise all of the tracts of wooded land in the example and are coded 20.2. A small tract of what looks to be shrub cover (30.2) lies just north of a small lake (80.1) at lower center of the figure. Another small area of shrub is at extreme right center.

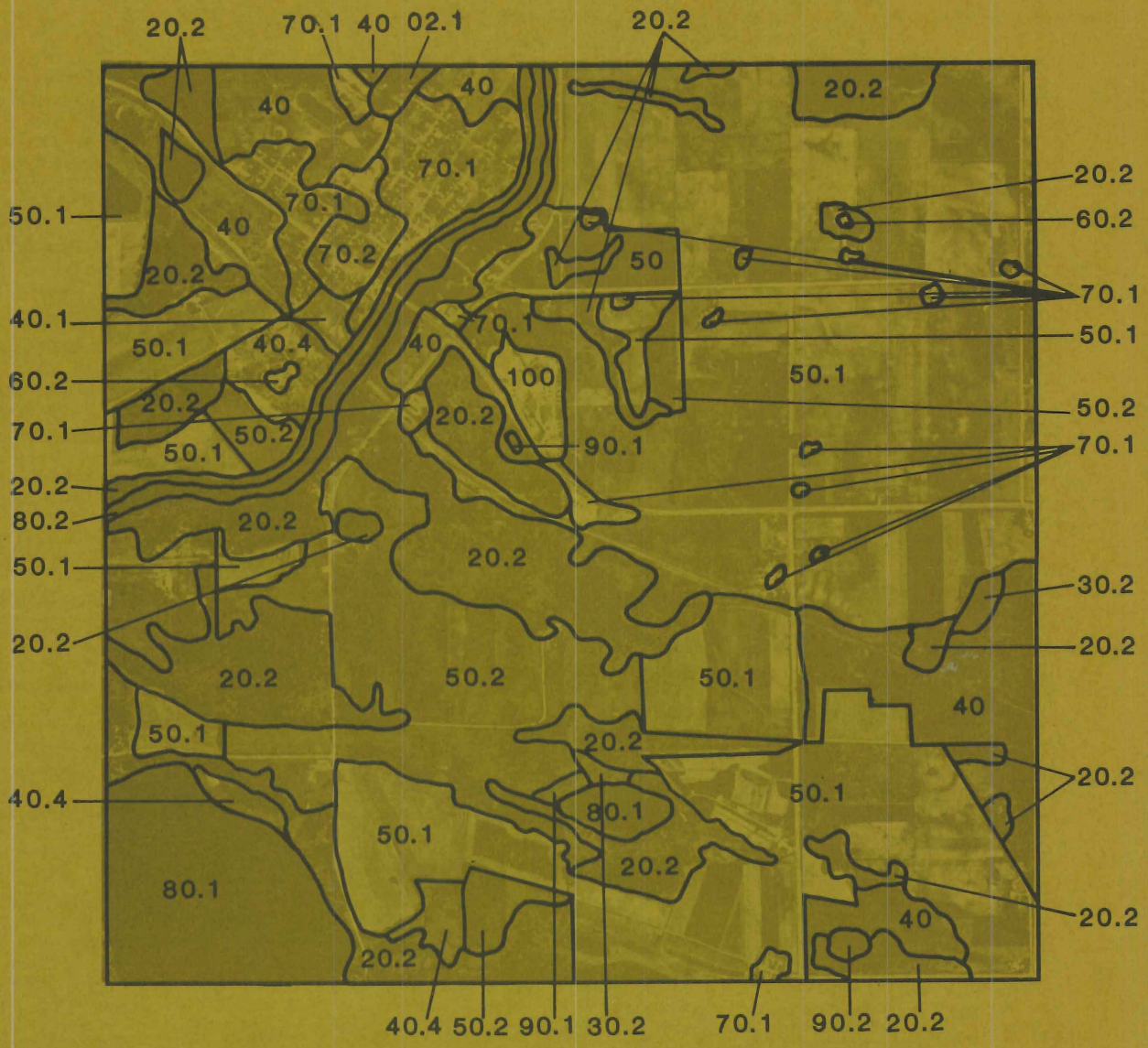
HERBACEOUS cover (40), too indefinite an image to interpret in more detail, is located at extreme lower right, lower center, and upper left and middle of Figure 2. Two areas that look like mixed grasses and herbs, 40.4 are found in the lower left quadrant of Figure 2. *CULTIVATED VEGETATION* (50), both *Crops* (50.1) and *Closely Grown* (50.2), comprise more than half of the area in the figure.

A few patches of *BARE LAND* (60.2), probably gravel pits but unidentifiable without other data, are found at upper right and middle left of the figure. An area at center that may be bare land but is too vague a feature to interpret is coded 100, *UNCLASSIFIABLE.*

Farm buildings and homes at right center and upper right of the figure are coded 70.1, the *Low Impermeability* category of *STRUCTURED/PAVED.*

The Crow River and two lakes in the figure are coded 80.2 and 80.1, respectively. A water feature at extreme lower right may be either a small pond or a wetland was interpreted as a wetland with *Submergent* vegetation, 90.2

Figure 3: Land Cover Classification Example



20.2 *FOREST - Deciduous*
30.2 *SHRUB - Deciduous*
40 *HERBACEOUS*
40.1 *HERBACEOUS - Grasses*
40.4 *HERBACEOUS - Mixed Grasses, Herbs & Mosses*
50 *CULTIVATED VEGETATION*
50.1 *CULTIVATED VEGETATION - Row Crops*
50.2 *CULTIVATED VEGETATION - Closely Grown Crops*
60.2 *BARE LAND - Rocks, Gravel or Sand*
70.1 *STRUCTURED/PAVED - Low Impermeability*
70.2 *STRUCTURED/PAVED - Medium Impermeability*
80.1 *WATER - Lakes*
80.2 *WATER - Streams and Canals*
90.1 *WETLANDS - Emergent*
90.2 *WETLANDS - Submergent*
100 *UNCLASSIFIABLE*

SECTION III
LAND USE CLASSIFICATION

Section III: LAND USE CLASSIFICATION - LEVELS I AND II

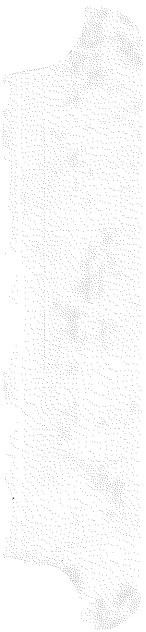
01 *BUILT-UP*
- 01.1 *Residential*
- 01.2 *Commercial*
- 01.3 *Industrial*
- 01.4 *Transportation-Communications-Utilities*
- 01.5 *Institutional/Government Facilities*
- 01.6 *Administrative Offices*

02 *NATURAL RESOURCE AREAS*
- 02.1 *Outdoor Recreation*
- 02.2 *Forest Production*
- 02.3 *Wildlife Production*
- 02.4 *Conservancy*

03 *AGRICULTURE*
- 03.1 *Cropland*
- 03.2 *Pasture*
- 03.3 *Animal Husbandry*
- 03.4 *Long Term Specialty Crops*
- 03.5 *Farm Buildings*
- 03.6 *Idle Land*

04 *VACANT-TRANSITIONAL*
- 04.1 *Land*
- 04.2 *Structures*

05 *UNCLASSIFIABLE*



General Description

The land use classification has a structure of two levels similar to the land cover system, but has fewer primary categories. Level I categories describe the broad classes of Minnesota land use that are roughly equivalent to each other in importance or scale. Level II categories are names of the more specific types of land uses subsumed by the level I classes.

BUILT-UP is about equivalent to urban land uses but includes uses located outside of urban areas; for example, rural residential or rural industrial development. Because they are functionally similar, offices and office complexes of all types of activities are categorized under *Administrative Offices.* Note also that utilities corridors (wires, pipelines, etc.) are placed under *Transportation-Communication-Utilities,* while utilities processing or generating sites (power plants, waste treatment facilities, etc.) are placed under the *Industrial* category.

NATURAL RESOURCE AREAS include the extensive land uses of recreation, forest and wildlife production, and preservation, whether under private or public management. Any land or water with no apparent use or management is coded *UNCLASSIFIABLE* in keeping with the definition of land use adopted here.

AGRICULTURE categories at level II include pasture, cropland, and animal production land uses and to these are added specialty crops, including orchards and horticultural uses, as well as the buildings associated with agricultural land uses.

When land or structures are in apparent transition from one use to another (e.g. former farmland about to be subdivided) the *VACANT-TRANSITIONAL* category is used. When land uses cannot be determined through records or inference the *UNCLASSIFIABLE* category is invoked.

There is no water category in the use classification because water is a cover and not a use characteristic. However, water features that have a discernible use (for example, in transportation, industry, or outdoor recreation) may be coded with the appropriate land use classification term. Water features without use are coded *UNCLASSIFIABLE.* When water features must be mapped in a use survey, the category from the cover classification may be used.

LAND USE DEFINITIONS

01 *BUILT-UP*

Land used for urban type functions wherever they are located.

01.1 *Residential**

The use of land for dwelling units whether urban, or rural, or seasonally occupied. This includes all intensities of housing from high-rise to farmsteads.

01.2 *Commercial*

The use of land for all forms of sales, including wholesaling, selling of goods and/or product services, including enclosed participatory sports and entertainment, and lodging. Commercial headquarters offices are in *Administrative Offices, below.***

01.3 *Industrial*

The use of land for extraction (mining and quarrying) or transformation of materials, fabrication of products and/or for long-term storage of products. Includes utilities generation and processing sites.

01.4 *Transportation-Communications-Utilities*

The use of land as corridors for movement of people, signals or materials, including related terminals and parking facilities.

01.5 *Institutional/Government Facilities*

The use of land for public and private facilities for education, health, or assembly; for cemeteries and related facilities; for all government facilities except public utilities and outdoor recreation; and military and correctional facilities.

01.6 *Administrative Offices*

The use of land for the administrative offices of any enterprise, public or private, including service offices, insurance company offices, corporate or company headquarters offices, and the offices of government agencies. Government offices are to be understood as distinct from schools, clinics and hospitals, and other public facilities not engaged in administrative tasks.

02 *NATURAL RESOURCE AREA*

Areas in which land uses are characterized by their dependence on the natural resource features of land, other than agricultural land uses.

02.1 *Outdoor Recreation*

The use of land or water for outdoor sports and recreation facilities, camping and picnicking, parks, nature exhibits, and for the preservation of historical landmarks and other cultural amenities.

02.2 *Forest Production*

The use of land to produce crops of merchantable wood.

*Third level *Residential* would be numbered 01.1.1, 01.1.2 . . . 01.1.5 and so on. This numbering system applies to all categories.

**The administrative offices of any enterprise are classified under *Administrative Office*, 01.6.

02.3 *Wildlife Production*
The use of land or water for the protection and propagation of wildlife, including refuges, sanctuaries, and private lands so used.

02.4 *Conservancy*
Lands or waters used to preserve notable natural systems, including public and districts, scientific and natural areas, wilderness areas, and wild and scenic rivers.

03 *AGRICULTURE*
The use of land for agricultural production including farm buildings.

03.1 *Cropland*
Land used for the production of commercial crops.

03.2 *Pasture*
The use of land for permanent pasture.

03.3 *Animal Husbandry*
Land used for feedlots, dairying or other animal production purposes.

03.4 *Long Term Specialty Crops*
The use of land as orchards, vineyards, nurseries, and horticultural operations to produce such crops as mint, sod, berries, flowers, fruits, nuts and ornamental plants.

03.5 *Farm Buildings*
Associated farm structures including sheds, silos, and other farm buildings other than animal husbandry buildings (above) and farm houses (see *Residential*).

03.6 *Idle Land*
Agricultural land in fallow or idle condition.

04
VACANT-TRANSITIONAL
Land or structures in transition from one use to another.

04.1 *Land*

04.2 *Structures*

05 *UNCLASSIFIABLE*
Land which is not known to be committed to an activity or management policy

Land Use Coding Example

In this example land use (Figure 4) is interpreted for the same area used in the land cover coding example (Figure 3). As might be the case in an actual coding exercise, data in addition to the air photo are employed. A topographic sheet and a map of the Hennepin County Park Reserve District augment the basic air photo in this example. In an actual exercise county land use plans, the Rockford municipal plan, county highway maps, and other sources might be added to the data base for further detail in interpretation.

A comparison of Figure 3 and Figure 4 reveals a very different pattern of coded polygons. Also, the number of identified polygons in Figure 4 (land use) is much less than in Figure 3 (land cover). This is partly the result of the fewer primary categories in the land use classification as compared to land cover and partly because a single land use category may subsume many categories of land cover. A good example is the large block of County Park Reserve land in Figure 4, coded 02.1, *Outdoor Recreation,* which in Figure 3 is shown to be comprised of forested, herbaceous, cultivated herbaceous, and water and wetland cover types.

Another reason for the simpler patterns in Figure 3 stems from the definition of land use, which specifies that land and water without apparent use or management is left unclassified. In Figure 4 a number of parcels with no apparent use have been coded 05, *UNCLASSIFIABLE.* These may be found at upper right, upper left, middle, and lower right of the figure.

The Crow River, coded 02.1, *Outdoor Recreation,* would have been unclassified if evidence of its use as a state of Minnesota designated canoe route were not available. The forested corridor on the left bank of the stream is left unclassified, because no apparent use for the land exists. In reality, shoreland ordinances may well document a use for the river corridor lands.

The *BUILT-UP* area of Rockford shows predominantly *Residential* (01.1). The central business district is coded 01.2, *Commercial,* and two gravel pits (identified from the topographic sheet), one southwest of town, another at top right, are coded 01.3, *Industrial.* Highways and roads are ignored in the example but at a different scale would be coded 01.4, *Transportation-Communication-Utilities.*

Agricultural uses, including *Cropland* (03.1), *Pasture* (03.2), and *Farm Buildings* (03.5) are located at upper and lower right and upper left of the figure. No attempt was made to identify farm homes (which would have been coded *Residential,* (01.1)) from farm buildings in the example.

One *VACANT-TRANSITIONAL* (04) is interpreted in the center of the figure, though more information might well reveal it to have a current use.

Figure 4: Land Use Classification Example



04 *VACANT-TRANSITIONAL*
05 *UNCLASSIFIABLE*
01.1 *BUILT-UP - Residential*
01.2 *BUILT-UP - Commercial*
01.3 *BUILT-UP - Industrial*
01.5 *BUILT-UP - Institutional/Government Facilities*
02.1 *NATURAL RESOURCES AREA - Outdoor Recreation*
03.1 *AGRICULTURE - Cropland*
03.2 *AGRICULTURE - Pasture*
03.5 *AGRICULTURE - Farm Buildings*

APPENDIX



Preliminary Steps in a Classification Procedure

A few suggestions for the systematic application of the classification are:

1. Clearly define and prioritize goals of the classification project.
2. Identify project constraints (money and time). Constraints may require a detailed or generalized classification project. Constraints to some extent determine sources of information uses.
3. Choose data sources, based on purposes and project resources (whether, for example, air photos alone or extensive use of permit records, tax data, and so on). The nature of data sources helps determine the resolution of mapping and the size of the minimum unit area classified.
4. Choose classification section or sections (use or cover or parts of both) appropriate to constraints, data, and purposes.
5. Determine coding procedures. Some users are interested in gathering data on the dominant land use or vegetative cover type in a given area, ignoring all other uses or cover types of smaller areal extent. This is often the easiest way to assign a single code to a given land unit which has a variety of uses and cover types. In other cases, however, it may be more useful to assign to each unit the code of **every** type of land use or cover present in that unit. Percentage figures can also be added. One coding procedure in use calls for assigning a forestry code to all units that have at least a 10% tree crown cover. That is the standard adopted here. Another example of a decision rule for coding that is in current use (Minnesota Land Use Map) states that land may be classified residential only if five or more residences occupy a 40 acre parcel. Classification efforts using different cell or parcel minimum sizes should determine similar decision rules appropriate to their studies. The coding procedure is open to considerable adaptation, but it must be definitively stated and solidly adhered to once it is established. Note also that coding procedures are often limited by the data source, e.g., it is not possible to code undergrowth types from aerial photos that depict only dense tree cover. Some of the criteria for documenting procedures are as follows:

a) Identify the smallest unit area considered for mapping and the amount of homogeneity required.
b) Identify the critical mass of a cover or use for intensive, as opposed to extensive, land covers or land uses; if classification rules include preferential decisions for some intensive types it should be specified that there are "over-ride" categories. (e.g. a rule might stipulate that in an area where houses occur in a forested area that it be classified residential)
c) Specify whether the inventory is intended for computer cell coding or manual overlay mapping; if computer oriented specify cell or polygon minimum size and decision rule (dominant, etc.) for entry.

Extending the Classifications

The land cover and land use classifications can be extended to the third level and beyond, depending on the user's purposes and requirements for detail. Extension is accomplished by selecting the categories desired at the third level and continuing the numbering system to accommodate the added categories. Figure 5 demonstrates how this might be done for categories from each of the classifications.

In the first example, *Residential* (a level II land use category under *BUILT-UP*) is extended first into Urban, Rural, and Seasonal, a breakdown that might be useful in a study of relative growth rates of the three kinds of residential development. The second *Residential* extension emphasizes the distinction between single and multiple family dwellings, as does the third, which more completely summarizes the range of possible types of dwelling units. A fourth level extension that might be added to any of the third level *Residential* alternatives shown is the breakdown:

Wood Frame Construction
Masonry Construction
Precast/Poured Concrete
Metal Frame Construction
Other Construction Materials
Undetermined Construction Materials

In the second example, the land cover level category, *Conifer,* is shown extended in three possible ways. Fourth level extensions might involve commercial forest categories such as cover size, cover density, site index or physiographic class, or simply the extension of the categories to the species level, depending on project purposes.

The final example, again from the cover classification, shows a possible extension of the *WETLANDS* category, which is subdivided at level II into *Emergent* and *Submergent* vegetation categories. In the example, *Emergent* vegetation is further subdivided into three categories of vegetation taken from level I categories of cover, but assigned new numbers reflecting their new status as third level members. Each of these might be further subdivided, using categories supplied in the classification, or devising new ones.

Figure 5

EXAMPLE 1

01 *BUILT-UP*
- 01.1 *Residential*
  - 01.1.1 *Urban*
  - 01.1.2 *Rural*
  - 01.1.3 *Seasonal*

01 *BUILT-UP*
- 01.1 *Residential*
  - 01.1.1 *One Complete Dwelling Unit*
  - 01.1.2 *Multiple Dwelling Unit*
  - 01.1.3 *Residential Accessory Buildings*

Three alternative third level extensions of *Residential* category in the land use classification.

01 *BUILT-UP*
- 01.1 *Residential*
  - 01.1.1 *Single Family*
  - 01.1.2 *Two Family*
  - 01.1.3 *Multi-Family*
  - 01.1.4 *Mobile Home*
  - 01.1.5 *Group Quarters*
  - 01.1.6 *Land Under Residential Development (construction underway)*

EXAMPLE 2

20 *FOREST*
- 20.1 *Conifer*
  - 20.1.1 *Pines*
  - 20.1.2 *Upland Conifers*
  - 20.1.3 *Lowland Conifers*
  - 20.1.4 *Miscellaneous Conifers*

Three alternative third level extensions of *Conifer* category in the land cover classification.

20 *FOREST*
- 20.1 *Conifer*
  - 20.1.1 *Pine*
  - 20.1.2 *Spruce*
  - 20.1.3 *Fir*
  - 20.1.4 *Cedar*

20 *FOREST*
- 20.1 *Conifer*
  - 20.1.1 *Upland*
  - 20.1.2 *Lowland*

EXAMPLE 3

90 *WETLANDS*
- 90.1 *Emergent*
  - 90.1.1 *Narrow leaf*
  - 90.1.2 *Broad leaf*
  - 90.1.3 *Lowland shrubs*
- 90.2 *Submergent*
  - 90.2.2 *Shallow water*
  - 90.2.3 *Floating bed*

90 *WETLANDS*
- 90.1 *Emergent*
  - 90.1.1 *Herbs, grasses, rushes, mosses*
  - 90.1.2 *Shrubs*
  - 90.1.3 *Trees*
- 90.2 *Submergent*
  - 90.2.1 *Algal and moss beds*
  - 90.2.2 *Floating Bed*
  - 90.2.3 *Vascular beds*

Two alternative third level extensions of WETLANDS category in the land cover classification.