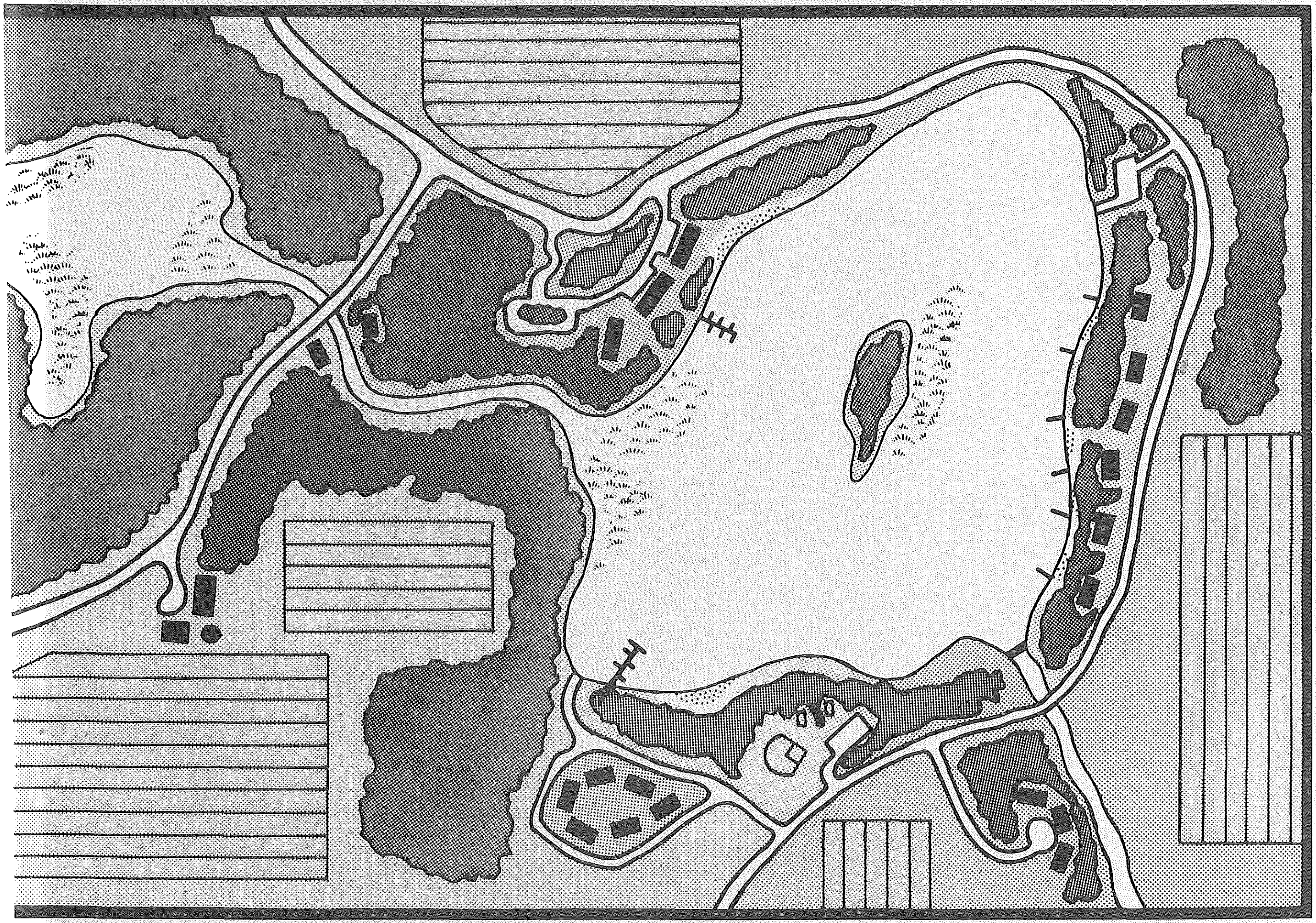
SHORELAND UPDATE

Report Number 5

A RIVER CLASSIFICATION SYSTEM



MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
Division of Waters

FLOOD PLAIN/SHORELAND MANAGEMENT SECTION

1984

UPDATE PROJECT REPORTS

REPORT NUMBER	TITLE
1	Shoreland Management Effectiveness: A Questionnaire Survey of Shoreland Managers
2	Evaluation of Shoreland Management Based On Sample Counties and Townships
3	Local Official Recommendations for Shoreland Program Improvements
4	Shoreland Development Trends
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SHORELAND UPDATE PROJECT

Report No.5

A RIVER CLASSIFICATION SYSTEM

by

Bill Zachmann

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St. Paul, Mn.

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Minnesota Department of Natural Resources

Division of Waters

Flood Plain/Shoreland Management Section

ABSTRACT

The Minnesota Department of Natural Resources (DNR) River Management Policy calls for development of a statewide river classification system to be used for state Shoreland Management Programs. DNR staff examined cultural, physical and development data collected from a sample group of 157 state rivers. 5 river classes were identified and specific management objectives and recommendations were developed to address River Management Policy and Shoreland Management Program intent. Possible methods of implementation of the system at state and local levels are briefly discussed.

ACKNOWLEDGEMENTS

This report represents input from county and city shoreland administrators and DNR staff persons associated with river shoreland management activities. The management strategies are not necessarily endorsed by the DNR or the local units of government where officials participated in the process. It is anticipated that the document will provide river management agencies with a good framework for future river management activities and policies. The efforts of all who participated are appreciated. Special thanks goes to the co-chairpersons of the issue committees and to: Steve Prestin for editing and review; Tim Kelly for data analyses and preparation; Rick Gelbman for data preparation; Joe Stinchfield and T.J. Kelly for review; Jan Lassen and Darcy Pepper for word processing; and Jim Zicopula for graphics.

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SUMMARY

The River Classification System is a method by which state river and stream segments can be classified into 1 of 5 classes. A segment is classified according to the combinations of several factors. The factors, as applied to 40-acre parcels of land that touch the river are: vegetative cover types, combinations of existing land uses, and type of roads and their locations relative to the river and parcels. As applied to all river segments in the state, these factors distinguished between similar and dissimilar river segments, from those with wilderness or near-wilderness environments to those with agricultural or urban environments. This effort identified five classes of state river segments:

River Class

- A: Primitive/Semi-Primitive
- B: Natural/Rural in Forest
- C: Natural in Agriculture
- D: Agriculture
- E: Urban

Once these river classes were identified, a management objective and several recommendations for accomplishing the objective were developed for each of the river classes. Management objectives address maintenance of existing natural features and protecting shoreland resources by minimizing adverse impacts from development activities associated with each class. Management recommendations for each class address appropriate development densities, permitted and non-permitted uses, type and extent of shoreland alteration and river resource protection through use of buffer strips and runoff control or diversion methods and programs. All objectives and recommendations are consistent with the state's Shoreland Management Program authorities.

After river segments were classified, information about the physical characteristics and residential development patterns of state rivers was analyzed. This effort produced additional management recommendations which can be used as overlay management tools independent of the river class and its management objective and recommendations. As a result, an integrated management system is provided for Minnesota's river and stream shoreland resources consistent with state agency responsibilities. A synopsis of the five classes, their management objectives, recommended development densities and associated overlay management recommendations is found on the following page.

Initiating implementation of the River Classification System will be part of the Department of Natural Resources/Division of Waters - Flood Plain/Shoreland Management Section's ongoing workplan in this and future bienniums. Three phases of implementation; river segment classification, adoption of state regulations and adoption of local land use controls are briefly discussed in part IV.

River Classification and Management Synopsis

RIVER CLASSES ASSIGNED TO SEGMENTS

	A Primitive/Semi-Primitive	B Natural/Rural in Forest	C Natural in Agriculture	D Agriculture	E Urban
GENERAL MANAGEMENT OBJECTIVE	Maintain Primitive and Semi-Primitive Character	Maintain Forested Natural/Rural Character	Protect Remaining Natural Areas	Protect River from Impacts of Ag. Development	Protect River from Impacts of Urban Development
RECOMMENDED DEVELOPMENT DENSITIES	Low	Medium	Medium	Medium	High

OVERLAY MANAGEMENT RECOMMENDATIONS FOR ANY CLASSIFIED SEGMENT, SUBJECT TO THE PHYSICAL CHARACTERISTICS AND DEVELOPMENT PATTERNS WITHIN THE SEGMENT

For following condition:

MANAGEMENT RECOMMENDATION BASED ON PHYSICAL CHACTERISTICS

I. Wide and Deep Valleys
II. Wide and Shallow Valleys
} Maintain development density/uses consistent with the applicable river class's management objective and flood plain development requirements.

III. Narrow/No Valleys - Establish blufftop/riverbank setbacks and regulate vegetative/topographic alterations within setbacks and on steep slopes.

IV. High Gradient Segments - Limit development to low density/low impact, recreation/open space uses.

V. Ditched/Channelized Segments - Periodically inspect, & establish/maintain adjacent vegetated buffer strips

VI. Local/Specific Concern Areas - Objectives defined according to local unit specifications.

MANAGEMENT RECOMMENDATIONS BASED ON DEVELOPMENT PATTERNS

1. Identify roaded and buildable shoreland areas to ensure that land use controls can meet management objectives of applicable class. (MOST IMPORTANT FOR CLASSES A, B, C AND E)
2. Identify medium/high quality natural/recreational resource areas to ensure that land use controls will protect these areas from overdevelopment. (MOST IMPORTANT FOR CLASSES B, C AND E)
3. Identify areas having either Wide and Shallow Valleys (Physical Group II) or Narrow/No Valleys (Physical Group III) to ensure that land use controls will address the tendency of these areas to experience more development than areas with other physical characteristics.
4. Monitor seasonal dwellings for change of occupancy to permanent dwellings to ensure that when such changes occur, on-site sewage treatment facilities are adequate or upgraded to handle increased in usage. (MOST IMPORTANT FOR CLASSES A, B, C AND E)

I. INTRODUCTION

The 85,000 square miles of Minnesota are laced with a myriad of rivers, streams, creeks, tributaries and ditches that are collectively referred to as the state's surface watercourses. These watercouses flow into three major continental watersheds, the Mississippi River Basin, the Great Lakes-St. Lawrence River Basin, and the Red River of the North-Hudson Bay Basin. Within the state, nine major drainage basins were mapped into 81 major height-of-land watersheds and further mapped into approximately 5,600 minor height-of-land watersheds, each draining at least five square miles of land.*

Subsequently, 37,793 watercourses, totaling 147,938 kilometers in length (91,444 miles) have been identified.** A watercourse means any channel having definable beds and banks capable of conducting generally confined runoff from adjacent lands. A watercourse may be perennial or intermittent, and for the purpose of the stream inventory, must correspond to a drainage area of at least one square mile.

Statewide, natural resource management for most of these watercourses is primarily the responsibility of two state agencies; the Minnesota Pollution Control Agency (MPCA) and the Department of Natural Resources (DNR). Other federal, state, regional and local level agencies and entities manage portions of the state's watercourses, but their activities are program or area specific and not comparable to the MPCA's and DNR's statewide perspective.

The MPCA's responsibilities of state watercourse management are two fold. First, the agency is the state's permitting authority for domestic, agricultural and industrial treated wastewater discharges to watercourses. Second, it monitors and classifies the water quality of all state watercourses according to specific recreational, domestic and

* Minnesota DNR Watershed Mapping Project, (1979).

** River Kilometer Indexing System, Statistical Summary, SIDRS Report 2005, Minnesota DNR, Office of Planning, September 1981.

industrial water use criteria. Approximately 1275 watercourses have been assigned a specific water quality classification, while the remaining watercourses were assigned an across-the-board 'medium' water quality classification.*

The DNR's responsibilities focus on comprehensive land and water use management for the state's watercourses. Land use management is addressed through the DNR's Flood Plain, Shoreland and Wild and Scenic Rivers Programs and water use management is addressed through permit requirements for Works-in-the-Beds or Appropriation activities of state protected waters. The DNR's River Management Policy** identifies four major river land use management programs and their missions. Of these programs, the Minnesota Shoreland Management Program*** has the responsibility to develop a statewide river classification system which will be used by all DNR river land use management programs. Shoreland Management Program jurisdiction applies to all lands within 300 feet (91.5 meters) of the Ordinary High Water Mark or to the landward extent of the flood plain, whichever is greater.**** In addition, the Shoreland Management Program is applicable to all natural or altered natural watercourses having a drainage area of more than two square miles. Inspection of state 7.5 minute quadrangle topographic maps shows that generally, watercourses with lengths between 6 to 7 miles correspond to basins of 2 or more square miles (approx. 5.12 km.). Reference to the Statistical Summary of the River Kilometer Indexing System reveals that 16,910 state watercourses are 4 km. or greater in length. Therefore, Shoreland Management Program authority for management and classification applies to approximately 45% of the state's 37,793 watercourses.

* Pollution Control Agency Rules, 6 MCAR § 4.8014, 4.8015, 4.8024 and 4.8025.

** Minnesota DNR Policy Number 7, 1981.

*** Minnesota Shoreland Management Act, M.S. 105.485.

****The 100-year flood plain is that land inundated by the 100-year flood, a flood that has a 1% chance of occurring in any given year.

Responses from a questionnaire mailed to state shoreland managers indicated that a greater emphasis should be given to rivers management.* Managers expressed concern about: 1) agricultural uses and their associated impacts (runoff and erosion from feedlots and fields, uncontrolled access of livestock to watercourses); 2) increases of development on rivers as competition for developable lakeshore increases; and 3) land clearing along rivers.

Recommendations from advisory committees comprised of local government officials and DNR managers also focused on the need for a river-oriented classification system to address the concerns mentioned above.**

The primary reason for creating a new river classification system is to provide a framework for application of comprehensive river management objectives and new development standards specifically intended for the state's rivers. The current classification system for rivers is quite general and is actually based on lakeshore management objectives. The statewide river classification system is based on various cultural (land use), physical (geo-topographic) and development (type and extent) phenomena and characteristics of state rivers.

* See Report #1, Effectiveness of Shoreland Management - Questionnaire Response of Shoreland Managers.

** See Report #3, Local Official Recommendations for Shoreland Program Improvements.

II. RIVER SAMPLE GROUP

A recent rivers inventory* compiled a list of 157 rivers, streams and their forks to be studied for future consideration in comprehensive river management programs consistent with the DNR River Management Policy. Table 1 lists these watercourses and Figure 1 shows their location according to the numbers in Table 1.

These watercourses were chosen as the sample group from which specific cultural, physical and development data would be collected to develop a statewide classification system. The group represents approximately 12% of the total length of the state's surface watercourses. In addition, each of the 81 major height-of-land watersheds is represented by at least one watercourse on the list in Table 1. These rivers were divided into 1278 individual river segments.** These segments form the basic unit from which all subsequent data was collected and analyzed.

Initially, it was felt that use of these watercourses for a sample group may possibly bias development of the classification system towards the large and medium sized rivers of the state, since almost all of these sample rivers are over 80 miles (50 km.) in length. The river kilometer indexing system lists 99.5% of the state's watercourses as being less than 50 kilometers in length. It appeared many small rivers and streams, which the classification system must also address, might not be represented by the sample. However, upon actual development of the classification system, this apparent weakness in sample group representation was disregarded for the following reason. As discussed above, the sample group consists of rivers from all the major height-of-land watersheds

* See Statewide Outstanding Rivers Inventory, Project Report, Minn. DNR, March, 1983.

** The methodology for creating the 1278 segments is explained in Appendix I.

Table 1: STATEWIDE OUTSTANDING RIVERS INVENTORY

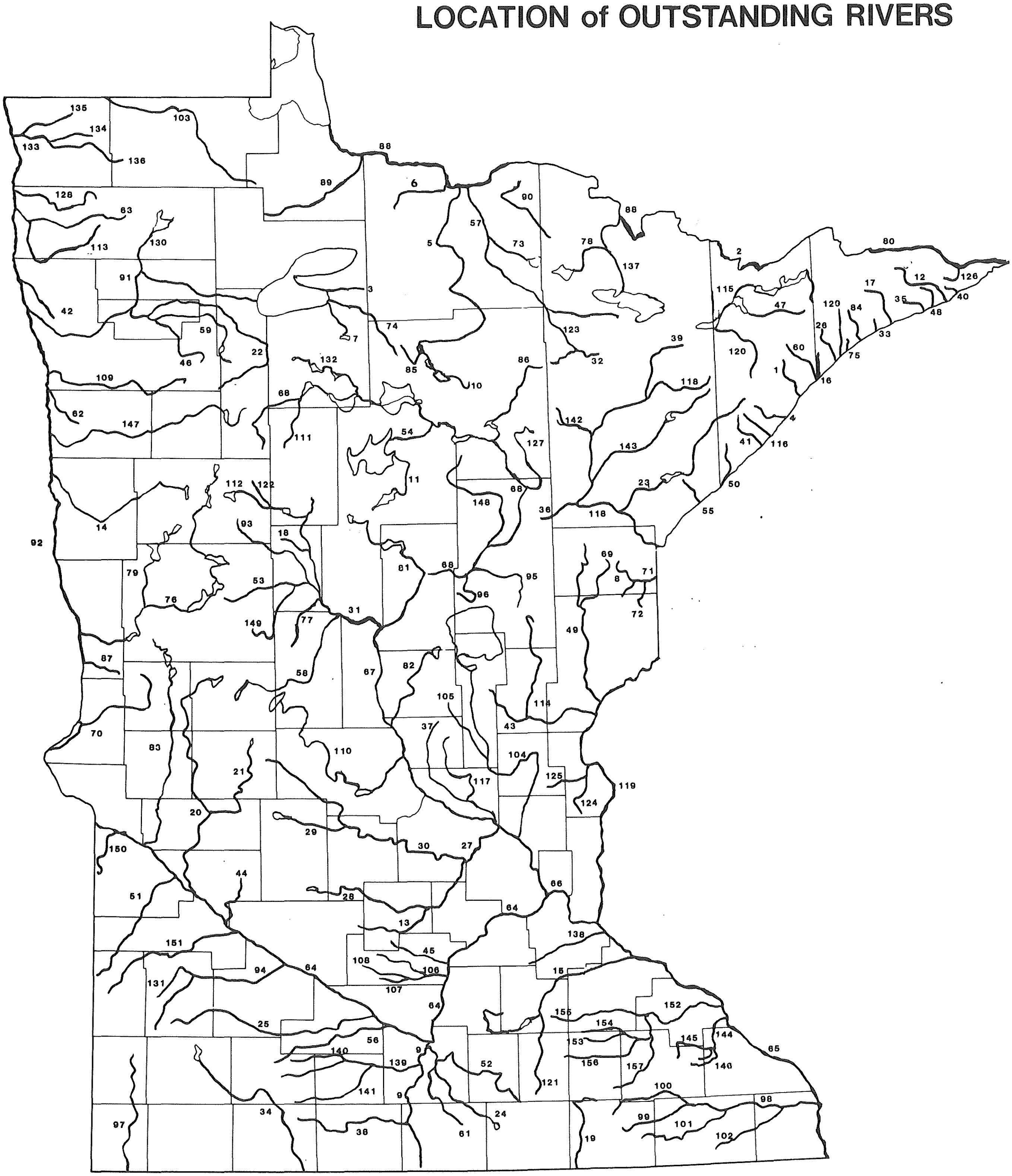
1 Baptism
2 Basswood
3 Battle
4 Beaver
5 Big Fork
6 Black
7 Black Duck
8 Blackhoof
9 Blue Earth
10 Bowstring
11 Boy
12 Brule
13 Buffalo Creek
14 Buffalo
15 Cannon
16 Caribou
17 Cascade
18 Cat
19 Cedar
20 Chippewa
21 Chippewa-East Branch
22 Clearwater
23 Cloquet
24 Cobb
25 Cottonwood
26 Cross
27 Crow
28 Crow South Fork
29 Crow-Middle Fork
30 Crow-North Fork
31 Crow-Wing
32 Dark
33 Deer Yard Creek
34 Des Moines
35 Devils Track
36 East Savanna
37 Elk
38 Elm Creek
39 Embarrass
40 Flute Reed
41 Gooseberry
42 Grand Marais Creek
43 Groundhouse
44 Hawk Creek
45 High Island Creek
46 Hill
47 Isabella
48 Kadunce Creek
49 Kettle
50 Knife
51 Lac qui Parle
52 Le Sueur
53 Leaf
54 Leach Lake
55 Lester
56 Little Cottonwood
57 Little Fork
58 Long Prairie
59 Lost
60 Manitou
61 Maple
62 Marsh
63 Middle
64 Minnesota
65 Mississippi (Lower)
66 Mississippi (Metro)
67 Mississippi (Upper)
68 Mississippi (Headwaters)
69 Moose Horn
70 Mustinka
71 Nemadji
72 Net
73 Nett Lake
74 North Cormorant
75 Onion
76 Otter Tail
77 Partridge
78 Pelican (North)
79 Pelican (South)
80 Pigeon
81 Pine
82 Platte
83 Pomme De Terre
84 Poplar
85 Popple
86 Prairie
87 Rabbit
88 Rainy
89 Rapid
90 Rat Root
91 Red Lake
92 Red River of the North
93 Redeye
94 Redwood River
95 Rice
96 Ripple (Mud)

Table 1 (cont.)

97	Rock	128	Tamarac
98	Root	129	Temperance
99	Root-Middle Branch	130	Thief
100	Root-North Branch	131	Three Mile Creek
101	Root-South Branch	132	Turtle
102	Root-South Fork	133	Two Rivers
103	Roseau	134	Two Rivers-Middle Branch
104	Rum	135	Two Rivers-North Branch
105	Rum-West Branch	136	Two Rivers-South Branch
106	Rush	137	Vermilion (North)
107	Rush-Middle Branch	138	Vermillion (South)
108	Rush-South Branch	139	Watonwan
109	Sandhill	140	Watonwan-North Fork
110	Sauk	141	Watonwan-South Fork
111	Schoolcraft	142	West Swan
112	Shell	143	Whiteface
113	Snake (East)	144	Whitewater
114	Snake (West)	145	Whitewater-North Fork
115	N & S Kawishiwi	146	Whitewater-South Fork
116	Split Rock	147	Wild Rice
117	St. Francis	148	Willow
118	St. Louis	149	Wing
119	St. Croix	150	Yellow Bank
120	Stony	151	Yellow Medicine
121	Straight (South)	152	Zumbro
122	Straight (North)	153	Zumbro (Middle Fork)
123	Sturgeon	154	Zumbro (N. Br. Middle Fork)
124	Sunrise	155	Zumbro (North Fork)
125	Sunrise-North Branch	156	Zumbro (S. Br. Middle Fork)
126	Swamp	157	Zumbro (South Fork)
127	Swan		

Source: Minnesota Department of Natural Resources.

Figure 1.
LOCATION of OUTSTANDING RIVERS



Source: MN DNR.

in the state. Further, by breaking them into many individual segments, the headwater segments in the sample are likely representative of smaller rivers and streams that are not in the sample. Even though the smaller rivers and streams are not being directly counted and measured, the resource type and condition along them is represented by inference from headwater segments. For example, given two rivers in the sample, one in an agricultural region and one in a forested region, each have headwater areas that are indeed similar to the numerous tributaries and small streams that comprise the total forested or agricultural watershed. Therefore, the classes eventually developed will be representative of all known statewide occurrences of cultural, physical and development phenomena associated with rivers, regardless of watercourse size. A chance for error is that some peculiar regional or local phenomena was not sampled or accounted for. To address this possibility, a local/specific management option can be added to the river management efforts. Any peculiarities identified during local level classification system implementation that significantly depart from statewide classes and require special management can thus be addressed.

Cultural data (land use and development patterns, cover types, road accessibility) and physical data (valley width, valley height, river gradient and channel structure) were collected from each of the 1278 segments. Development data was collected on a statewide basis for any stream or river including those in the sample group, where certain levels of development were observed.*

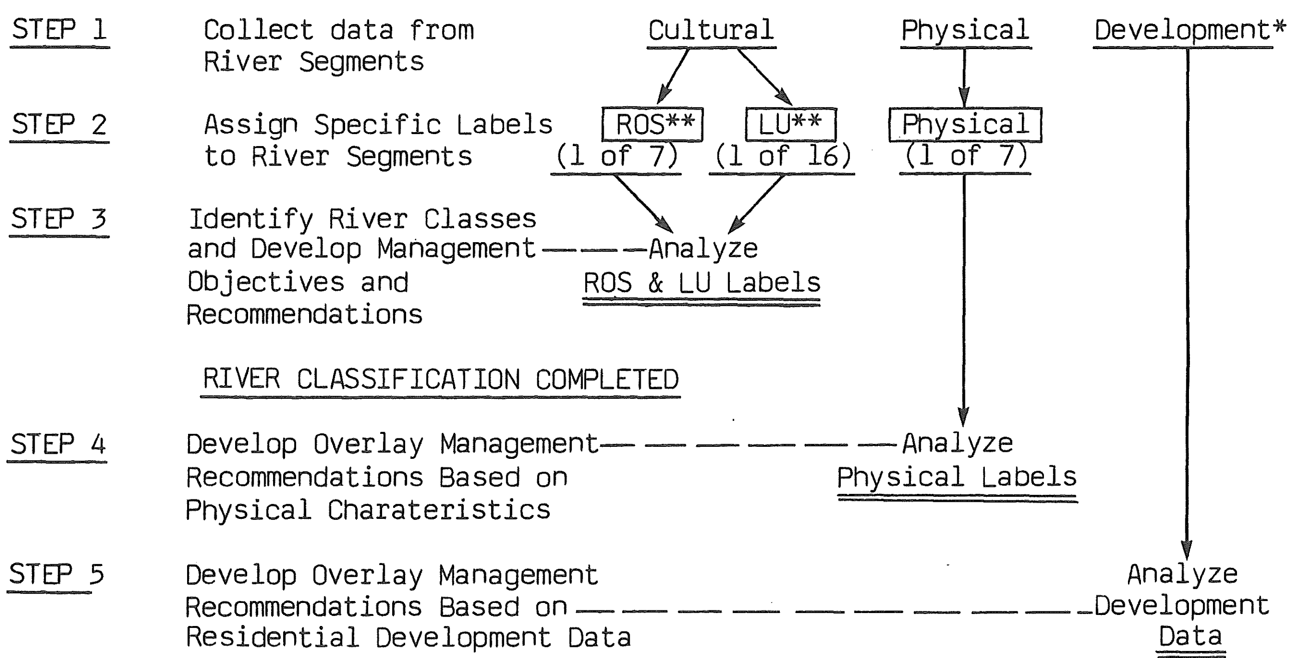
Step by step analysis of the data collected from the river segments was conducted to develop the classification system. The procedure and results of this effort are discussed in part III and implementation of the system is discussed in part IV.

* Detailed explanations of methodologies used in collection of cultural, physical and development data are presented in Appendices II, III, and IV, respectively.

III. RIVER CLASSIFICATION SYSTEM: PROCEDURE AND RESULTS

The river classification system was developed through analysis of specific river resource data coupled with the understanding of the DNR's responsibilities for shoreland resource management. Figure 2, the River Classification and Management System Flow Chart, depicts step-by-step how data were used, first to identify river classes and develop management objectives and recommendations, and second to develop overlay recommendations utilizing data not used in the classification process. It is important to recognize that river classification was completed after Step 3. Steps 4 and 5 did not change the outcome of Step 3, but provided a mechanism by which river class management objectives can be enhanced. This means that recommendations developed during Steps 4 and 5 can 'fine-tune' the objectives developed in Step 3 on a 'where applicable basis', since a statewide classification approach cannot adequately deal with the regional variations of the physical characteristics or development patterns and potentials that Steps 4 and 5 addressed. Therefore, the result is not just a river classification system but actually a total river management system approach. The remainder of this part discusses each step and result of Figure 2.

Figure 2: RIVER CLASSIFICATION AND MANAGEMENT SYSTEM FLOW CHART



FINAL RESULT A 5 component river classification system with management objectives and recommendations for each component, utilizing independent overlay management recommendations for associated physical characteristics and development patterns/potentials of state rivers.

* Development data was also collected from additional rivers and streams besides the sample group of 157 rivers; See Appendix IV.

** 'ROS' and 'LU' Labels refer to the Recreational Opportunity Spectrum and the Land Use Labels, respectively, which are discussed in detail in Appendix II.

A. Step 1 -COLLECT DATA FROM RIVER SEGMENTS

Step 1 involved the collection of cultural, physical and development data. Cultural and physical data were collected from the 1278 river segments, whereas development data was collected from these segments plus additional watercourses not in the sample. Since an explanation of data parameters and collection methods would be lengthy here, the reader is referred to Appendices II, III and IV for detailed discussion.

B. Step 2 - ASSIGN SPECIFIC LABELS TO RIVER SEGMENTS

This step utilized only the cultural and physical data collected in Step 1. Use of the development data was deferred until a later step for two major reasons. First, the general development nature of a river corridor (roaded or non-roaded, percentage of area with development, etc.) is inherent in the cultural data base. Second, unlike the cultural data, the development data consists of specific counts of residential development occurences for a given segment. Therefore, the data is better utilized in a later step for preparation of overlay management recommendations based on specific residential development patterns on rivers. Step 2 assigns three specific labels (two cultural and one physical) to each of the 1278 segments, pursuant to the segment labeling procedure outlined in Appendices II and III. The 3 sets of river segment labels are:

1. Recreational Opportunity Spectrum (ROS) Labels*

   (1 of the following 7 per segment)

   1. Primitive
   2. Semi-Primitive, Remote from Roads
   3. Semi-Primitive, Roaded
   4. Natural, Remote from Roads
   5. Natural, Roaded
   6. Rural
   7. Intensive Land Uses (Urban)

* See Appendix II for discussion of ROS Labels.

2. Land Use (LU) Labels*

(1 of the following 16 per segment)
1 Possible Urban Zone LU Label
4 Possible Cultivation Zone LU Labels**
5 Possible Transition Zone LU Labels
6 Possible Forest Zone LU Labels
(16 Total Labels)

3. Physical Labels***
(1 of the following 7 per segment)
1. Moderately to Very Wide and Deep Valleys
   (>1000m. [3300 ft.] wide & ≥ 26 m. [85.8 ft.] deep)
2. Moderately Wide and Deep Valleys
   (250-1000m. [825-3300 ft.] wide & 26-100m. [85.8-330 ft.] deep)
3. Moderately to Very Wide and Shallow Valleys
   (≥250m. [825 ft.] wide & ≤25m. [82.5 ft.] deep)
4. Narrow and Shallow Valleys
   (<250m. [825 ft.] wide & < 25m. [82.5 ft.] deep)
5. No Valley or Bluff only on one side (Headwaters)
6. Steep Gradient Segments
   (≥3m. fall/river kilometer [≥ 16.6 ft. fall/river mile])
7. Ditched or channelized segments

C. Step 3 - IDENTIFY RIVER CLASSES AND DEVELOP MANAGEMENT OBJECTIVES AND RECOMMENDATIONS

In Step 3, river classes were identified based on analysis of the two cultural labels. A decision was made to use the physical labels in a later step, where independent analysis and discussion of the physical characteristics of rivers could be used to develop an overlay set of management recommendations applicable to any of the river classes identifed in this step. This decision was made after several attempts to classify rivers using all three labels from Step 2 always produced an unmanageable number of classes. Shoreland managers have clearly expressed a need for a classification system tailored to rivers, but indicated the number of classes should be kept to a minimum.****

* See Appendix II for discussion of LU Labels.

** The Land Use Labels are difficult to list in concise terms; please refer to Table 1 in Appendix II for exact interpretation of each label.

*** See Appendix III for discussion of Physical Labels.

**** See Report #3, Local Official Recommendations for Shoreland Program Improvements.

As discussed in Appendix II and shown in Step 2 of the Flow Chart (Figure 2), 1 of 7 Recreational Opportunity Spectrum (ROS) Labels and 1 of 16 Land Use (LU) Labels were assigned to each of the 1278 river segements. Since the objective of this step is to identify river classes based on cultural characteristics, the 7 ROS Labels were cross-tabulated against the 16 LU Labels. The cross-tabulation exercise sought to identify river classes by analyzing the distributions of all of the LU labeled segments within one ROS Label and vice versa.

For example, since a ROS Label 5 indicates a Natural, Forested condition, the distribution of that label within the 16 LU Labels is expected to occur primarily in the forested land use zones of the state. This indeed is the case, demonstrating that the distribution of each ROS label is directly associated with certain LU Labels, thereby reinforcing the accuracy of the individual label given to the segment.

The analysis identified similarities and differences between all of the 16 LU Labels and the 7 ROS Labels to produce a manageable number of river classes. Therefore, even though each LU Label and ROS Label had discreet differences, as discussed in Appendix II, they were arranged into classes which reflect similarities.

For example, 9 river segments could potentially have 9 different LU Labels, say LU Labels 1-9 (agricultural and transitional land use zones). It was more practical to identify them as pertaining to one large agricultural class and develop management objectives based on that class. Additionally, since the LU Labels actually denote differing land uses and landscapes statewide, a river classification system which used groupings of similar uses and landscapes tended to regionalize the classes, aiding in management objective development.

Use of the ROS Labels in the cross-tabulation offered another refinement in class identification related to accessibility. For example, given several segments identified as having a LU Label 10 (Forested), half of them may be in primitive/semi-primitive, natural, inaccessible areas, while the other half may be in natural, but heavily roaded areas. The classification process recognized this so management objectives could then be written to address these distinctions.

Based on the preceding discussion, cross-tabulation analysis of the LU Labels and ROS Labels given to the sample segments was performed. The five river classes that were identified from this process are listed below:

River Classes

A: Primitive/Semi-Primitive
B: Natural/Rural in Forest
C: Natural in Agriculture
D: Agriculture
E: Urban

Once the classes were identified, specific management objectives and recommendations were written for each river class. The management objectives reflect the intent of the state Shoreland Management Program, within the context of general and specific policies regarding land use management as stated in the DNR River Management Policy. Shoreland Update Reports #1, #2 and #3 were also consulted during this step. Descriptions of each class and management objectives and recommendations are found in part III.*

Figure 3, the Statewide Distribution of Sample Segments by River Class shows the percentages of sample segments that comprise each identified class. Photos 1 through 5 depict river reaches typical of the five classes. They should be referenced as the reader follows the remainder of the text in Step 3. Table 2 the ROS LU cross-tabulation of the 1278 river segments, should be consulted while reviewing descriptions of each class, because analysis of this data led to identification of the five classes as shown by the black line divisions in the table.

* Statements about a class's development character are also included in each description. These statements were added to the class description after development data was studied in detail in Step 5. The detailed discussion of development data follows in Step 5.

When reviewing Figure 3, the reader is reminded that the sample group as a whole only represents 12% of the state's surface watercourse length. Therefore, a direct inference that 46.3% of all of the state's surface watercourses are in the Agricultural Class may not be valid. However, as discussed in part II, the sample segment creation process does render the sample representative of all types of statewide river resources. The conclusion that these classes accurately describe the variation of the resource is valid for management purposes.

Figure 4, River Segment Classification (pocket inside back cover) shows segment classifications for the 157 sample rivers. In studying Figure 4, recall that segment classification is assigned based on a plurality of a certain characteristic's occurrence (See Appendix II). Therefore, although a segment may be classified as agricultural, it may have some intensive or natural in agriculture land uses in 40-acre parcels occurring somewhere in the segment. However, since the frequency of their occurrence may not be as high as the agricultural use occurrence, the segment is properly labeled according to the labeling criteria.

Figure 3. Statewide Distribution of Sample Segments by River Class

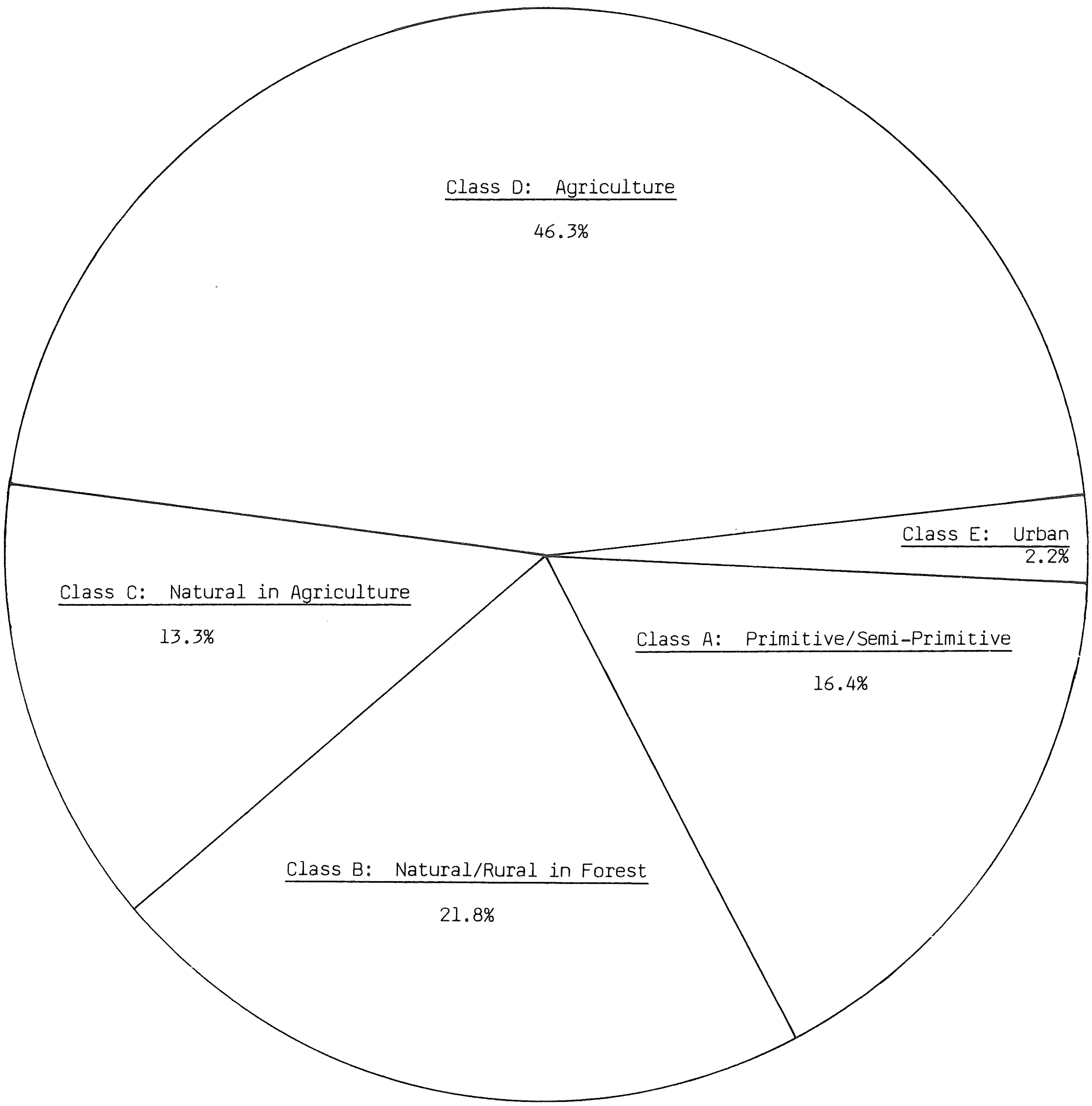


Photo 1. River Class A: Primitive/Semi-Primitive

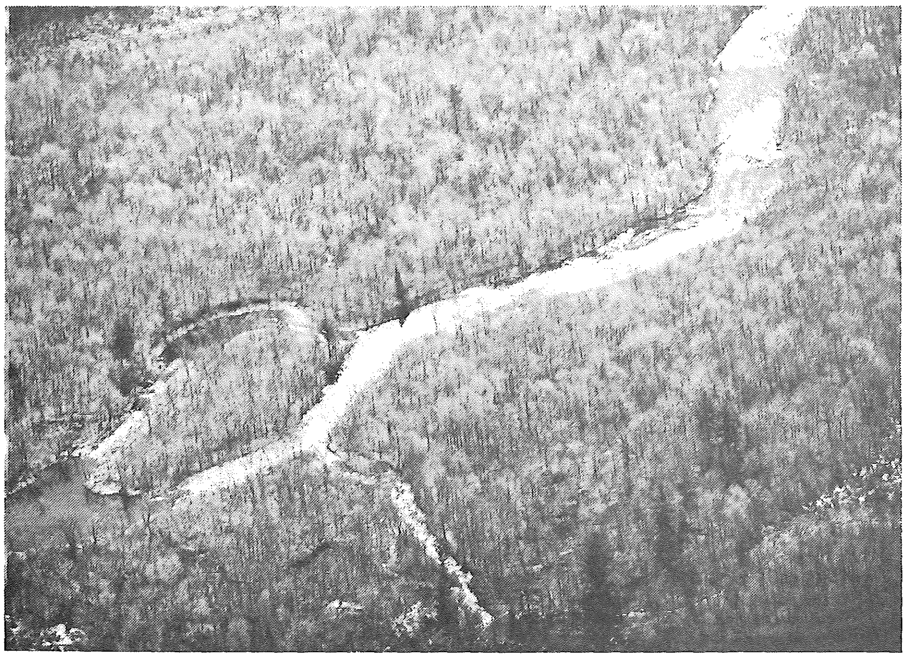


Photo 2. River Class B: Natural/Rural in Forest

Photo 3. River Class C: Natural in Agriculture

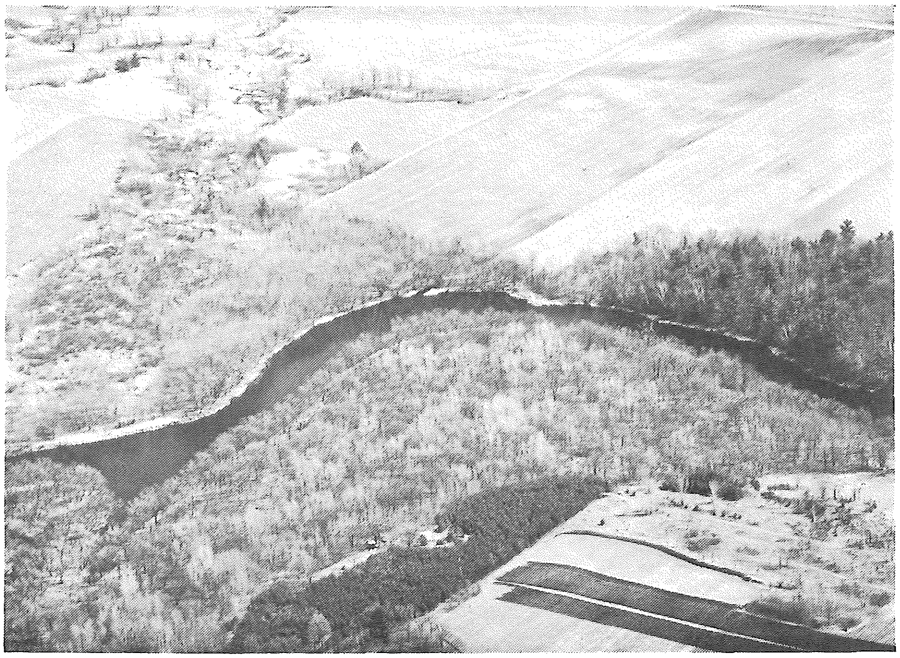


Photo 4. River Class D: Agriculture

Photo 5. River Class E: Urban

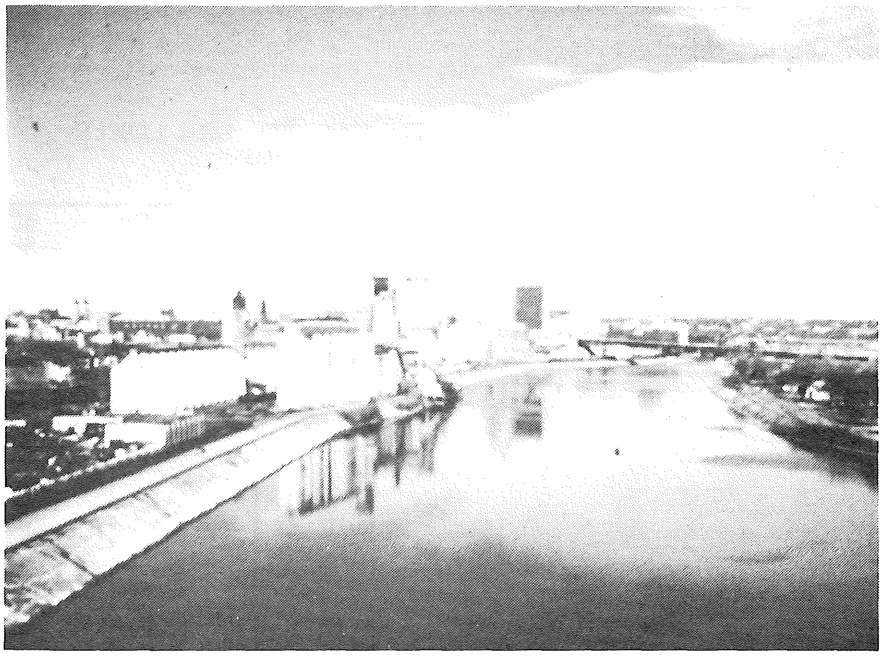


Table 2. ROS-LU LABEL CROSS TABULTION OF THE 1278 RIVER SEGMENTS

(Each cross-tabulation intersection and row or column total shows actual segment counts and the percertage of segments (in parenthesis) for that particular intersection, column or row compared to the total number of segments in the sample).

KEY: Black letters denote river classes

RECREATIONAL OPPORTUNITY SPECTRUM (ROS) LABELS

LAND USE (LU) LABELS	1	2	3	4	5	6	7	ROW TOTAL (%)
1	--	--	--	-- A	1 C (0.08)	92 D (7.20)	-- E	93 (7.28)
2	--	--	--	--	7 (0.55)	116 (9.08)	--	123 (9.62)
3	--	--	--	--	8 (0.63)	148 (11.58)	2 (.16)	158 (12.36)
4	--	--	--	--	2 (0.16)	35 (2.74)	1 (0.08)	38 (2.97)
5	--	--	--	--	20 (1.56)	49 (3.83)	4 (0.31)	73 (5.71)
6	--	2 (0.16)	3 (0.23)	2 (0.16)	92 (7.20)	106 (8.29)	4 (0.31)	209 (16.35)
7	--	2 (0.16)	--	2 (0.16)	11 (0.86)	26 (2.03)	1 (0.08)	142 (3.29)
8	--	--	--	1 (0.08)	13 (1.02)	10 (0.78)	1 (0.08)	25 (1.96)
9	--	1 (0.08)	--	--	16 (1.25)	10 (0.78)	4 (0.31)	31 (2.43)
10	2 (0.16)	57 (4.46)	50 (3.91)	7 (0.55)	186 (14.55)	22 B (1.72)	1 (0.08)	325 (25.43)
11	18 (1.41)	28 (2.19)	20 (1.56)	1 (0.08)	29 (2.27)	--	1 (0.08)	97 (7.59)
12	--	2 (0.16)	1 (0.08)	--	10 (0.78)	2 (0.16)	--	15 (1.17)
13	--	2 (0.16)	--	--	18 (1.41)	1 (0.08)	--	21 (1.64)
14	--	--	1 (0.08)	--	4 (0.31)	--	--	5 (0.39)
15	1 (0.08)	3 (0.23)	4 (0.31)	--	1 (0.08)	5 (0.39)	--	14 (1.10)
16	--	--	--	--	1 (0.08)	--	8 (0.63)	9 (0.70)
COLUMN TOTAL (%)	21 (1.64)	97 (7.59)	79 (6.18)	13 (1.02)	419 (32.79)	622 (48.67)	27 (2.11)	1278 (100)

RIVER CLASS A: Primitive/Semi-Primitive
(210 segments, 16.4% of sample)

Description: River segments in this class are represented by ROS Labels 1-4 and LU Labels 6-15. 80% of the class is represented by segments labeled Semi-Primitive, either remote from roads or roaded, and in the Forest Zone (ROS Labels 2 & 3, LU Labels 10-15). The remaining segments are labeled Primitive, in Forest Zone; Semi-Primitive in Transition Zone; and Natural-Remote from Roads in Transition and Forest Zones. Overall, this class is the least developed and represents the poor to moderately accessible and primitive, semi-primitive to natural segments of rivers in the state, occurring in Forested and Transition Land Use Zones. Inclusion of the ROS Label 4 (Natural, Remote from roads) Transition/Forested Zone segments is justified because they are remote from roads and can be practically managed along with the more primitive and semi-primitive characteristics of the majority of river segments in this class.

Management Objective: Maintain the Primitive to Semi-Primitive, Forested to Natural and poor to moderately accessible characteristics of land along these segments in order to preserve the wilderness or near wilderness attributes of this class.

Recommendations for meeting Objective -

a) Limit shoreland uses to low density/low impact residential/ recreational development or low density planned unit development; and forestry, sand and gravel extraction and agricultural uses.

b) Limit shoreland alterations (vegetative cutting, grading and filling) to absolute minimum necessary consistent with overall management objective, and specifically:

For residential/recreational development; alterations should only be allowed as necessary to adequately develop shoreland areas for intended use. Establish a buffer zone between the river and shoreland district development. Within the buffer zone, clear-cutting of trees should be prohibited, while selective cutting and grading or filling activities in the district should conform to specified guidelines. Vegetative or land alterations outside of the buffer zone but within the shoreland district should also be subject to performance criteria that are consistent with accepted timber management or soil/water conservation practices. All development activities should meet performance criteria designed to minimize adverse impacts to shoreland areas.

For forestry or sand and gravel extraction uses; establish or maintain buffer areas between the shore and these uses, but allow clearcuts of timber up to the shore area only when it can be demonstrated that:

i) unusual or significant erosion/sedimentation problems will not result;

ii) important fish/wildlife habitat or heritage elements* will not be destroyed or lost; and

iii) the cutting plan is beneficial to establishing and/or maintaining of future timber harvests.

For agriculture uses;** establish or maintain vegetated buffer areas between the shore and cropland. Regionally accepted conservation methods (including conservation tillage***) should be utilized and high priority erosion, sedimentation and feedlot problem areas should be identified for elgibility of existing cost-share conservation programs****.

c) Limit the amount of new road development or road improvements in these areas, since new or improved access conditions could attract new or additional development. This recommendation could be best met by careful planning of county/township road systems.

* Heritage elements are defined as known plant or animal communities identified as threatened, endangered or of special concern consistent with local, state and federal preservation programs addressing such elements.

** Although the majority of these segments do not have high incidences of agricultural activities, inclusion of management recommendations for these activities ensures that occasional uses will not be overlooked simply because of class type.

*** Conservation tillage is defined as a method of soil management that leaves various amounts of the previous season's crop residue on the soil surface which usually reduces the rate of soil erosion as compared to rates of erosion from fields where moldboard plowing is practiced.

**** Minnesota Laws 1982, Chapter 512, legislates programs through the Soil and Water Conservation Board.

RIVER CLASS B: Natural/Rural in Forest
(278 segments, 21.8% of sample)

Description: River segments in this class are represented by ROS Labels 5 and 6 (Natural-Roaded and Rural) and only by the Forested Zone LU Labels 10-15. 70% of this class correponds to the ROS Label 5 and LU Label 10 combination, which is land typified by heavily forested, natural-roaded land uses. The remaining 30% of the segments, whether labeled as Natural-Roaded, or Rural are all characterized by forest, forest with water, marsh or open, and occasional urban and extractive uses. Therefore the prevalent landscape and land use character of river shoreland represented by this class is forested existing in accessible Natural-Roaded and Rural ROS areas. Development data indicates this class represents river frontage that is used for permanent rural dwelling. It also has the highest density of seasonal residential development as compared to all other classes.

Management Objective: Maintain the forested natural/rural character of segments represented by this class and ensure that development activities will not alter or degrade the recreational attributes of these segments.

Recommendations for meeting Objective -

a) Limit shoreland uses to medium density/medium impact residential/ recreational or equivalent density planned unit development; and to forestry, sand and gravel extraction or agricultural uses.

b) Limit shoreland alterations (vegetative cutting, grading and filling) to absolute minimum necessary consistent with overall management objective, and specifically:

For residential, recreational, commercial development; alteration should only be allowed as necessary to develop shoreland areas for intended use. Establish a buffer zone between the river and shoreland district development. Within the buffer zone, clear-cutting of trees should be prohibited, while selective cutting and grading or filling activities in the district should conform to specified guidelines. Vegetative or land alterations outside of the buffer zone but within the shoreland district should also be subject to performance criteria that are consistent with accepted timber management or soil/water conservation practices. All development activities should meet performance criteria designed to minimize adverse impacts to shoreland areas.

For forestry or sand and gravel extraction uses; Establish or maintain buffer areas between the shore and these uses, but allow clearcuts of timber up to the shore area only when it can be demonstrated that:

i) unusual or significant erosion/sedimentation problems will not result;
ii) important fish/wildlife habitat or heritage elements will not be destroyed, lost or impaired; and
iii) the cutting plan is beneficial to establishing and/or maintaining future timber harvests.

For agriculture uses; establish or maintain vegetated buffer areas between the shore and cropland. Regionally accepted conservation methods (including conservation tillage) should be utilized and sensitive or highly erodable areas should be identified and receive priority consideration for conservation programs.

RIVER CLASS C: Natural in Agriculture
(170 segments, 13.3% of sample)

Description: River segments in this class are represented by the ROS Label 5 (Natural-Roaded) only. The Cultivated Zone (LU Labels 1-4) accounts for 10.5% of the class and Transition Zone (LU Labels 5-9) accounts for 89.5% of the class. Although the entire class represents areas that have cultivated uses occupying the largest amounts of acreage, the majority of the segments represented by this class are not intensively cultivated. These areas are typifed by rolling, rough or poorly drained land with forest, woodlands and pasture in association with other agricultural activities. Even in the few intensively cultivated areas, scattered pasture, woodlands and forest are typical of the landscape near the river. In all instances, the natural landscape character is in close association with the river. Road accessibility is quite varied, ranging from moderately to very accessible. This class ranks second to river Class B for occurrences of onshore seasonal residential development.

Management Objective: Maintain or enhance the remaining natural areas of land along rivers represented by this class, since the natural areas can be viewed as a beneficial or rare cover type occurring within the surrounding cultivated areas.

Recommendations for meeting Objective -

Protect existing natural areas from encroachment of agricultural uses or other development that will cause erosion/sedimentation, reduce or impair water quality, or generally degrade and diminish existing natural features, and specifically:

For row and field crops; establish or maintain runoff filter strips between the shore and the crop in conjunction with other comprehensive soil conservation practices including conservation tillage methods, where practical and feasible.

For feedlots and pastures; avoid direct runoff of wastes from feedlots or uncontrolled water access from pastures for livestock, when such activity leads to shore and water quality degradation (increased bank sloughing and erosion, loss of protective shore vegetation, water sedimentation and pollution).

(For both of the above activities, identify high priority problem areas eligible for cost share conservation programs.)

For woodlot management and vegetative clearing; follow regionally accepted timber/wood lot management practices and recognize if large scale clearcutting or vegetative clearing will create significant acreage losses in natural areas, or adversely affect fish/wildlife or heritage element habitat.

For other development (residential, recreational, related commercial or industrial, sand and gravel extraction). Plan for medium density single family or cluster development* where shoreland alterations/ development will meet performance criteria designed to minimize vegetative cutting, extractive or industrial use domination of the riverscape, impervious surface coverage and other negative impacts to the area from site development activities.

The overall emphasis is on maintaining the remaining natural appearing shore areas, where the data shows only 13.3% of the river segments in the sample exhibit this characteristic, thereby indicating a rarity of natural riverine areas in the state's cultivated zones.

* The current zoning trend in many agricultural areas is to establish agricultural use zones where additional single family residential uses require large lot sizes. Therefore this objective may be already met or exceeded in several agricultural areas.

RIVER CLASS D: Agriculture

(592 segments, 46.3% of sample)

Description: River segments in this class are represented by the ROS Label 6 (Rural) only. The Cultivated Zone (LU Labels 1-4) accounts for 66% of the class and the Transition Zone (LU Labels 5-9) accounts for 34% of the class. Therefore, 2/3 of the segments are in intensively cultivated zones and 1/3 of the segments are in cultivated areas with scattered forest, marsh and open areas. The distinguishing feature of river segments in this class is the single ROS Label 6, indicating that river segments have a rural, accessible character in the agricultural zones of the state. Development data for this class shows that both permanent and seasonal onshore dwelling occurrences rank low as compared to other classes. Also, the data indicate that a large proportion of permanent development occurrences are incidental to the river resource since the occurrences are usually not river-oriented. This means that development location is not dependent on proximity to the river.

Management Objective: Protect river shoreland represented by this class from additional encroachment or degradation due to intensive agricultural activities or sand and gravel extraction uses. In addition, maintain remaining forested, marsh, or open/undeveloped areas near river shoreland, since these areas are the only remaining riverine natural areas in agricultural use areas.

Recommendations for meeting Objective -

a) Implement comprehensive soil and water protection programs and agricultural development performance standards to address:
   - i) field, pasture and feedlot nutrient runoff
   - ii) field, pasture and feedlot erosion and sedimentation
   - iii) uncontrolled or detrimental access of livestock to river channels
   - iv) woodlot management
   - v) fish/wildlife and heritage element habitat protection
   - vi) sand and gravel extraction uses

   Available federal, state and local funded programs should be considered to implement conservation tillage practices, field and streambank erosion controls and feedlot management programs to meet this objective.

b) Limit the development of non-agricultural lands adjacent to rivers to open space uses, medium density development, or planned unit development consistent with state and local controls currently addressing subdivision development. All development activities should meet performance criteria designed to minimize impacts to shore areas caused by such development.

RIVER CLASS E: Urban

(28 segments, 2.1% of sample)

Description: River segments in this class are represented by any LU Label with a corresponding ROS Label 7 (intensive) or any ROS Label with a corresponding LU Label 16 (urban). From Table II, the cross-tabulation distribution shows that only 1 segment had a ROS Label other than 7. The majority of segments in this class are either in the Transition Zone (LU Label 5-9) or the Urban Zone (LU Label 16), which is expected, because the Cultivated and Forestry Zones typically will not have large occurrences of intensive uses and/or highly accessible areas. Therefore, river segments represented by this class occur within in the state's major urban and urban fringe areas, where varied mixes of recreational, residential, commercial and industrial urban uses are in close proximity to river shore areas and flood plain corridors. As expected, development data for permanent onshore dwelling occurrences ranks this class well above all others.

Management Objective: Minimize the adverse environmental impacts that urban/ intensive land uses and development have on river shore areas represented by this class.

Recommendations for meeting Objective -

Promote comprehensive management programs that address stormwater runoff, wastewater treatment discharges, new urban residential, commercial and industrial developments specifically:

For Stormwater Runoff: Municipalities and surrounding developed county or township areas should establish by ordinance specific regulations which address acceptable threshold level criteria for the control of stormwater runoff to rivers and streams from existing and newly developed urban areas.*

For Wastewater Treatment Discharges: Discharges from municipal treatment plants should be adequately monitored by the Minnesota Pollution Control Agency for water quality compliance pursuant to their Standards and Criteria.

* The Levi-Merriam Bill, H.F. 509, directs the 7 county Metropolitan area communities to form Watershed Management Organizations to address stormwater runoff problems.

For Urban Development: Municipalities and surrounding developed counties and townships should establish specific performance criteria which address: proximity to shore areas; buffer zones between development and the shoreline; density; impervious surface coverages; vegetative management; development design; and provision of recreational opportunities within urban areas.* Where it can be established that urban communities are experiencing continued development growth along river areas, adoption of shoreland ordinances pursuant to the Shoreland Management Act should be given high priority.

* The Cluster Development/Planned Unit Development approach as currently embodied in statewide shoreland regulations and model ordinance addresses such development but may need refinement, based on past experience and data from the Shoreland Update project.

A synopsis of the main highlights of the Management Objectives and recommended development densities for each river class is presented below in Table 3.

Table 3. MANAGEMENT OBJECTIVE (MO) AND DEVELOPMENT DENSITY SYNOPSIS BY RIVER CLASS

	River Class	MO Synopsis	Recommended Development Densities
A.	Primitive/Semi Primitive	Maintain Primitive and Semi-Primitive Character	Low
B:	Natural/Rural in Forest	Maintain Forested Natural/Rural Character and protected recreational attributes	Medium
C.	Natural in Agriculture	Protect remaining natural areas occurring in agricultural zones	Medium
D:	Agriculture	Protect river shoreland from impacts due to intensive agricultural and extractive (sand and gravel) activities	Medium
E.	Urban	Protect river from impacts of Urban Development activities	High

D. Step 4 - DEVELOP OVERLAY MANAGEMENT RECOMMENDATIONS BASED ON PHYSICAL CHARACTERISTICS OF RIVERS

As shown in Figure 2, this step analyzed the Physical Labels assigned to the 1278 segments in Step 2. The purpose of this step was to identify the major types of physio-topographic conditions found along state watercourses. After distinct types were identified, specific recommendations for river management based on the physical characteristics were made. These recommendations can be added in an overlay fashion to the management recommendations for any class, as applicable, during river classification system implementation.

The seven Physical Labels and their descriptions are listed below for review:

Physical Labels***

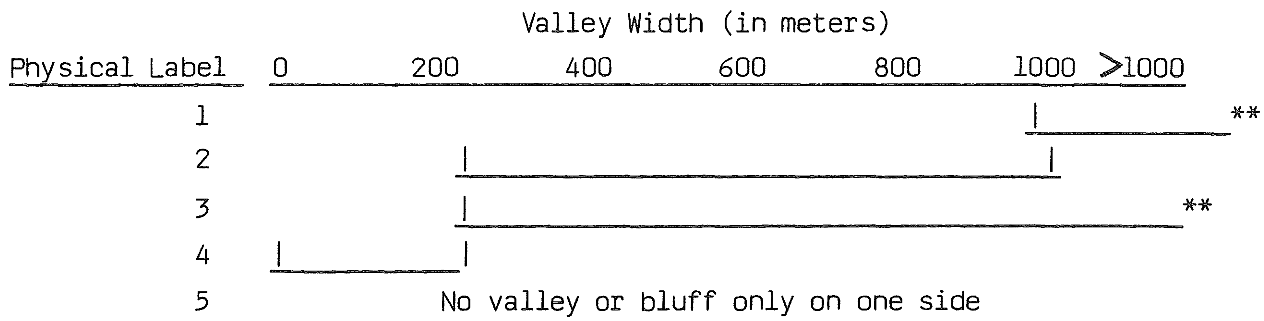
(1 of the following 7 per segment)

1. Moderately to Very Wide and Deep Valleys
   (>1000m. [3300 ft.] wide & ≥26 m. [85.8 ft.] deep)
2. Moderately Wide and Deep Valleys
   (250-1000m. [825-3300 ft.] wide & 26-100m. [85.8-330 ft.] deep)
3. Moderately to Very Wide and Shallow Valleys
   (≥250m. [825 ft.] wide & ≤25m. [82.5 ft.] deep)
4. Narrow and Shallow Valleys
   (<250m. [825 ft.] wide & <25m. [82.5 ft.] deep)
5. No Valley or Bluff only on one side (Headwaters)
6. Steep Gradient Segments
   (≥3m. fall/river kilometer [≥ 16.6 ft. fall/river mile])
7. Ditched or Channelized Segments

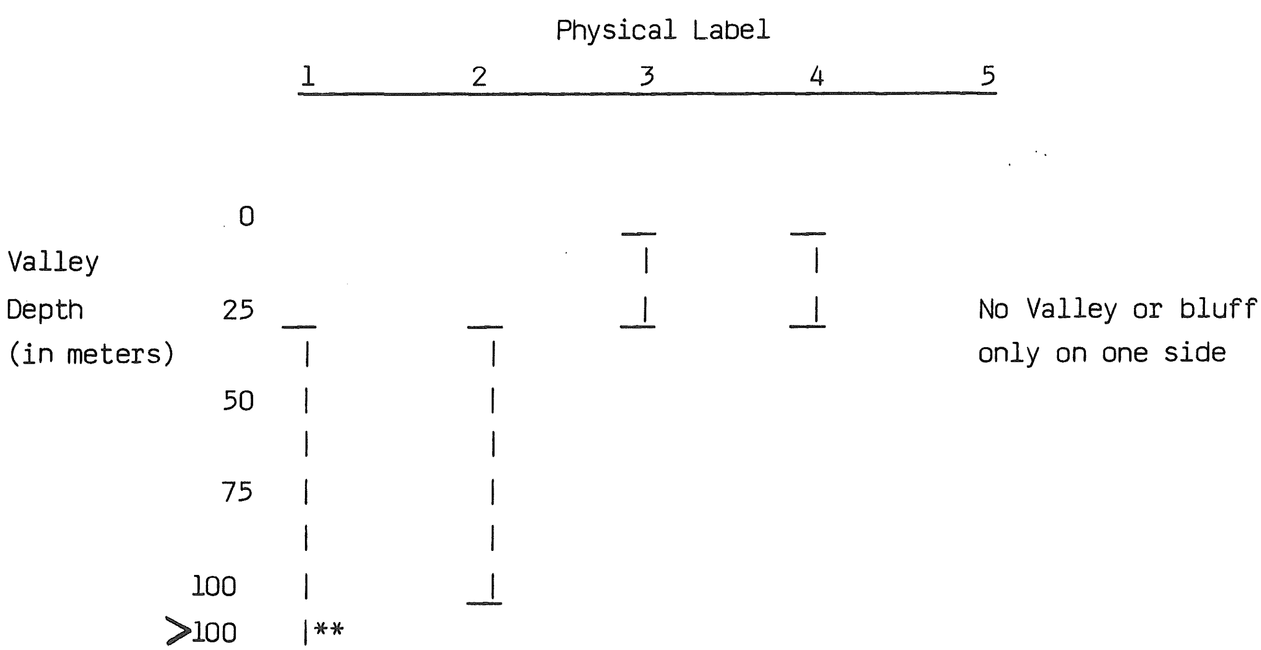
The original intent of creating a set of seven Physical Labels was to provide a way for virtually most any kind of variation in the physio-topographic conditions of state rivers to be identified. However, continued use of the full set of seven labels was too cumbersome for review during this step. Therefore, all of the verbal descriptions and numerical parameters for each label were compared against the other labels for similarities, areas of overlap, or differences, to allow for efficient separation or combination of the labels into discreet groups. Initial review of the seven labels enabled identification of three separate groups. Physical Labels 1 through 5 each address the dimensional characteristics of valley width and depth (where width can be related to shoreland jurisdiction), Physical Label 6 addresses river gradient and Physical Label 7 addresses channel structure. Review of Physical Labels 1-5 suggested that additional combinations and/or separations could be made. Figure 5, Valley Width and Depth Components of Physcial Labels 1-5, was created to assist analysis, and should be consulted during the following discussion. Recall from the Introduction the definition of Shoreland Program jurisdiction. Shoreland extends landward 300 feet (91.5 meters) from the top of the bank of the river or to the landward extent of the flood plain, whichever is greater. Also, Program jurisdiction applies to all rivers and streams having a watershed drainage area of over 2 square miles (5.1 sq. km.). Analysis of Physical Labels considered Program jurisdiction to group the labels. The 300 (91.5 meter) horizontal jurisdiction landward of each bank translates to an average corridor width of 650-700 ft. (197-212 m.). This value is calculated by multiplying the landward dimension by two and adding 50 to 100 ft. (15-30m.) for the channel width. This corridor width can be expected for areas where <u>wide flood plains are non-existent</u>. To simplify analysis, the English measurement system was abandoned in Figure 5 and the corridor width measurement as discussed above was averaged to 200 meters.

Based on the above, Labels 4 and 5 were combined into one group, since the valley width measurement parameter is comparable to or less than a 200 meter corridor. (Physical Label 4 measures valley widths of less than 250 meters and Physical Label 5 indicates no definable valley). This combination represents rivers where bluffs are 50 meters or less in height but usually in close proximity to the channel, thereby being within Program jurisdiction. Areas where only one bluff exists, or where no definable valleys exist are also accounted for. These rivers are likely to be small rivers as well as the upper and intermediate reaches of the state's larger rivers. Therefore, the group also includes the headwater areas of rivers, addressing rivers with 2 or more square miles of drainage, as directed by Program jurisdiction.

Figure 5. VALLEY WIDTH AND DEPTH COMPONENTS OF PHYSICAL LABELS 1-5*



(200 meters = 660 ft.)



(25 meters = 83 ft.)

* To simplify Figure 5, distance measurements use only the metric system; English equivalents are shown for a typical measurement parameter at the bottom of each chart.

** An open-ended line signifies that a maximum limit for the valley width or depth measurement was not specified for the label.

Conversely, Shoreland Program jurisdiction is usually greater than a 200 meter corridor width where a mapped 100-year flood plain extends beyond 300 ft. (91.5 meters) from the bank. This situation is likely to exist in wide river valley areas and at the mouth of most rivers, especially when they discharge into larger river valleys. Physical Labels 1, 2 and 3 all address river valleys with comparable width characteristics (valleys greater than 250m. wide), but whereas Physical Labels 1 and 2 represent deep valleys, Physical Label 3 represents shallow valleys. Thus Labels 1 and 2 are combined into one group and Label 3 is left as a group. In both cases, program jurisdiction will extend to the limit of the 100-year flood plain (providing adequate flood plain mapping exists), but the high bluffs of Labels 1 and 2, and the low bluffs of Label 3 will usually be distant from the channel and beyond Program jurisdiction.

This observation underscores an important legislative constraint of the Program. Comprehensive management of steep slope and blufftop areas with regard to the Shoreland Program's purposes is often desirable. Yet, due to the language of the Shoreland Act, these areas cannot be addressed through a statewide regulatory management effort, and statutory amendments would be needed to correct this constraint.

Lastly, one additional group was created to allow for management of physical characteristics that may be very site specific or peculiar to a particular area of the state. For example, the five groups discussed above are not suited to identifying small scale areas that may warrant concentrated management efforts by local land managers. Areas that could be addressed by this group might be highly erosive soils in shoreland areas, significant point or non-point sources of surface water pollution, certain physio-topographic, cultural, historical or scientific areas of significance not already managed by other local, state or national programs, or any other condition or area that the local manager is aware of that could be managed via the Shoreland Program. The utilization of this group could be at the discretion of the local manager and is identified as a LOCAL-SPECIFIC CONCERN group.

In summary, the Physical Label analysis resulted in the creation of six River Physical Groups. Each group is listed below and is accompanied by the group's percentage share of the total 1278 segments.

PHYSICAL GROUP V - DITCHED/CHANNELIZED SEGMENTS

Description: Ditched or channelized river and stream segments, usually occurring in upper watersheds of agricultural areas to facilitate local field drainage requirements.

Management Recommendations: Periodically inspect segments represented by this group for bank stability and ditch integrity as originally intended. Establish or maintain vegetated buffer strips to protect ditches and water quality. Where areas identified as ditched or channelized are no longer intensively managed for agro-production and have reverted to natural appearing, vegetated areas, manage shoreland district consistent with objectives for applicable river class.

PHYSICAL GROUP VI - LOCAL-SPECIFIC CONCERN

Description: As identified by state/regional/local levels of government administering any aspect of natural or historical resources or water/land use management concerns for the particular shoreland area in question.

Management Recommendation: Objectives at discretion of responsible agency/unit of government as required to manage particular resource, for inclusion in local level land use ordinances. Examples would be for protection of locally significant physical, cultural, historical areas, such as unique exposures of bedrock or original homestead sites, etc., that are not currently being managed by any program.

PHYSICAL GROUP III - NARROW VALLEYS OR NO VALLEYS

Description: Narrow Valleys or no discernible valley; with bluffs low and close to the channel, or only on one side and usually within Shoreland Program jurisdiction. The group represents small rivers and the headwaters or intermediate reaches of most large river systems, where river channels and associated flood plains are usually narrow.

Management Recommendation: Maintain shoreland development at specified setbacks from blufftop areas occurring within the district and prohibit structural placement and vegetative removal and grade/fill activities on steep slopes within the district. All other development not influenced by steep slopes and bluff top areas should be consistent with underlying river class management objectives.

PHYSICAL GROUP IV - HIGH GRADIENT SEGMENTS

Description: Segments where gradients are greater than or equal to 3 meters fall/river kilometer (16.6 ft. fall/river mile).

Management Recommendation: Regulate development of shoreland districts represented by this group to low impact, dispersed recreational use or dedicated open space uses. Unrestricted development in these areas is often undesirable because the areas are often either recreationally significant or extremely unsuitable for development due to thin or fragile soils and very steep slope conditions.

Table 4. RIVER PHYSICAL GROUPS

River Physical Group			Percent of Total Segments In Group
I.	(Labels 1-3)-	Wide and deep valleys: bluffs high & distant; large rivers and mouth of rivers.	7.9
II.	(Label 3) -	Wide and shallow valleys: bluffs, low and distant; medium to large rivers.	19.8
III.	(Labels 4-5)-	Narrow/No valleys: bluffs low or non-existent; headwaters, and small and intermediate rivers.	62.3
IV.	(Label 6)-	High gradient segments.	5.9
V.	(Label 7)-	Ditched or channelized segments.	4.1
VI.	(No Label) -	Local Specific Concern	N/A
			100

To arrive at the percentages shown in Table 4, all segments were first measured for the absence or presence of High Gradient Reaches (Group IV) or Ditched/Channelized Reaches (Group V). If such conditions were not found, the segments were identified according to Groups I, II or III. This was done because all segments can be labeled with any one of the 5 physical labels that comprise Groups I, II and III, regardless of Group IV or V conditions.

Therefore, the two conditions (Group IV or V) had to be singled out before the remaining conditions were tested for.

E. Step 5 - DEVELOP OVERLAY MANAGEMENT RECOMMMENDATIONS BASED ON RESIDENTIAL DEVELOPMENT DATA

This step analyzed the development data collected from river-oriented 40 acre parcels throughout the state. The reader is reminded that unlike the cultural and physical data collection methods, rivers and streams in excess of the orignial 157 sample rivers were also studied for development characteristics. Appendix IV contains a discussion of development data collection methods. In addition, a shoreland residents questionnaire was used to provide additional analysis of river shoreland development trends*. The main purpose of this step was to profile statewide development characteristics and patterns on rivers, and to describe variations of development among the identified river classes from Step 3 and the river physical groups from Step 4**. As stressed earlier, the outcome of the step did not change the river classification system. But, management recommendations developed as a result of this step used in an overlay approach can help manage the development growth of river shoreland areas regardless of the river class for the segment. This capability will become important as management decisions are made during river classification system implementation.

To facilitate analysis and discussion of development data, this step was divided into two sections. Section 1 highlights specific development characteristics and patterns which can be observed from the data. Section 2 offers management recommendations based on the observations noted in Section 1.

* See Report #8, Shoreland Residents - A Questionnaire Survey.

** See Report #4, Shoreland Development Trends, for additional information.

Section 1 - Statewide Development Patterns and User Preferences of Rivers

Several detailed statements can be made concerning river residential development patterns and user preferences. These statements have been organized into 4 major topics. Each topic will be discussed in the order shown in Table 5, River Development Topics.

Table 5. RIVER DEVELOPMENT TOPICS

Topic 1 - Development as a Function of Proximity to Roads and Service Centers

Topic 2 - Development as a Function of River Class

Topic 3 - Development as a Function of Physcial Characteristics

Topic 4 - River Residents Survey

Topic 1. Development as a Function of Proximity to Roads and Service Centers

Perhaps the two most important observations regarding statewide development patterns concern first, how development is related to the proximity and quality of the state road network, and second, the distance of development from the state's Primary Service Centers.* Data clearly shows that as distances from buildable river sites to either one of these variables increase, development occurrences decrease. Table 6, Service Center Access and Road Access to River Residential Development in 1982, shows these relationships.

* Primary Service Centers are defined as areas where the population is usually in excess of 3,000 people and services such as high schools, hospitals, doctors, banking, weekly newspaper, etc., are available (see Figure 6 for the types and distribution of these centers). Service Center classification taken from: N.C. Gustafson. Recent Trends/Future Prospects: A Look at Upper Midwest Population Changes. Upper Midwest Council, Minneapolis, 1973.

Table 6. SERVICE CENTER ACCESS AND ROAD ACCESS TO RIVER

RESIDENTIAL DEVELOPMENT IN 1982

Service Center Access Class	ROAD ACCESS CLASS* High 1	2	3	4	Low 5	Service Center Access Class Row Total
1 (within 5 miles)	15.9T	6.3	0	0	0	22.2
	18.3P	7.3	0	0	0	25.5
	2.9S	.6	0	0	0	3.5
2 (6-15 miles)	33.3	9.1	2.4	.3	0	45.1
	36.4	9.6	1.6	.3	0	48.0
	15.8	6.5	6.7	.3	0	29.3
3 (16-30 miles)	13.2	5.8	2.3	.9	0	22.2
	13.1	4.4	1.1	.3	0	19.0
	13.4	13.4	9.1	4.0	0	39.9
4 (>30 miles)	5.9	2.7	1.2	.8	0	10.5
	4.7	2.1	.4	.3	0	7.5
	12.4	6.1	5.5	3.4	0	27.4
Road Access Class Column Totals	68.3	23.9	5.9	2.0	0	100.0
	72.5	23.4	3.1	1.0	0	100.0
	44.5	26.6	21.3	7.6	0	100.0

TABLE KEY

T - percent of total units
P - percent of permanent units
S - percent of seasonal units

Source: Minnesota DNR

* Road access classes are defined by the parcel's proximity to both gravel and paved roads where '1' is good access and '5' is poor access as follows:

ROAD ACCESS CLASSES

Proximity to Paved Road	Proximity to Gravel Road: Touches Parcel	0-1/2 mile	1/2 to 1 mile	1 mile
Touches parcels	1	1	1	1
0 mile and 1/2 mile	1	3	3	3
1/2 mile and 1 mile	2	3	4	4
1 mile	2	4	5	5

Development occurrences as a function of road proximity shows that 92% of the total river development sampled is attributed to Class 1 & 2, the two best road access classes. This can be observed by adding the Road Access Class Column Totals for Class 1 and 2 (total development: 68.3% + 23.9% = 92.2%). Photos 6 & 7 show dramatically the influence that roads have on development. Notice that the roaded sides of these river segments are developed with several riverfront lots, while the unroaded side remains undeveloped.

Photo 6. Influence of Road Proximity on Development

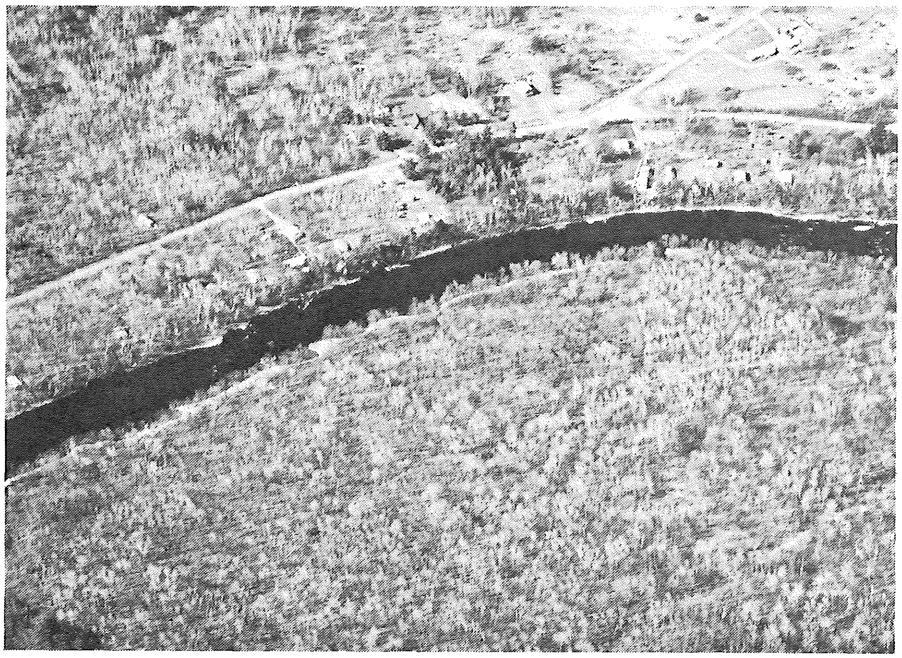
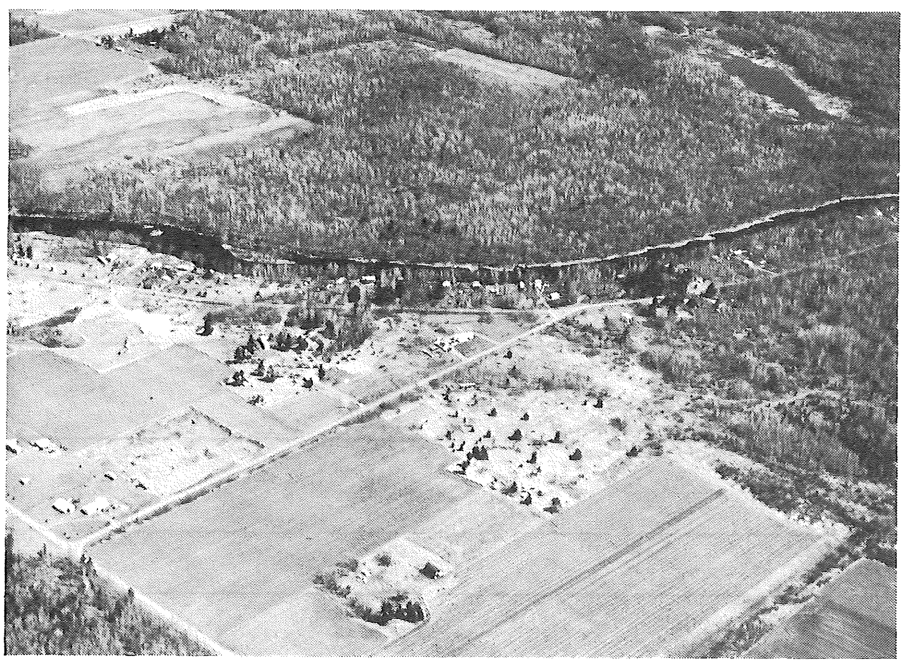


Photo 7. Influence of Road Proximity on Development



There are also differences between seasonal and permanent development occurrences as a function of road proximity. The data clearly shows that permanent development is concentrated in the high road access classes, while seasonal uses are more spread out among all classes. This is logical since most seasonal uses usually occur when road surfaces are free of ice and snow. Also, the seasonal user is more likely to not be bothered by a somewhat longer drive from major state and county roadways to reach a dwelling. The permanent river shoreland dweller has different needs, and is apt to locate closer to roads, especially when considering accessibility during the winter months and spring breakup.

Development occurrences as a function of proximity to service centers are of a different magnitude than road proximity. Table 6 shows four service center access classes, ranging in distances from less than 5 miles to greater than 30 miles. Review of the row totals for the Service Center Access Classes, reveals that 73.5% (Class 1 & Class 2) of the rural permanent development on rivers is within 15 miles of service centers.* In contrast, 67.5% (class 3 & 4) of the seasonal development is located more than 15 miles from service centers.

Notice that the relationship of seasonal development to service center proximity is non-linear. The data indicates Service Center Access Class 3 (16-30 miles) has the single highest percentage (39.9%) of seasonal development.

It is important to note that the types of services seasonal users most often need (groceries, gas, bait and tackle, etc.) are usually found throughout rural/recreational areas, thereby further explaining why seasonal development is prevalent beyond 15 miles from service centers. Clearly, close proximity to service centers is not as important to seasonal dwelling location as it is to permanent dwelling location.

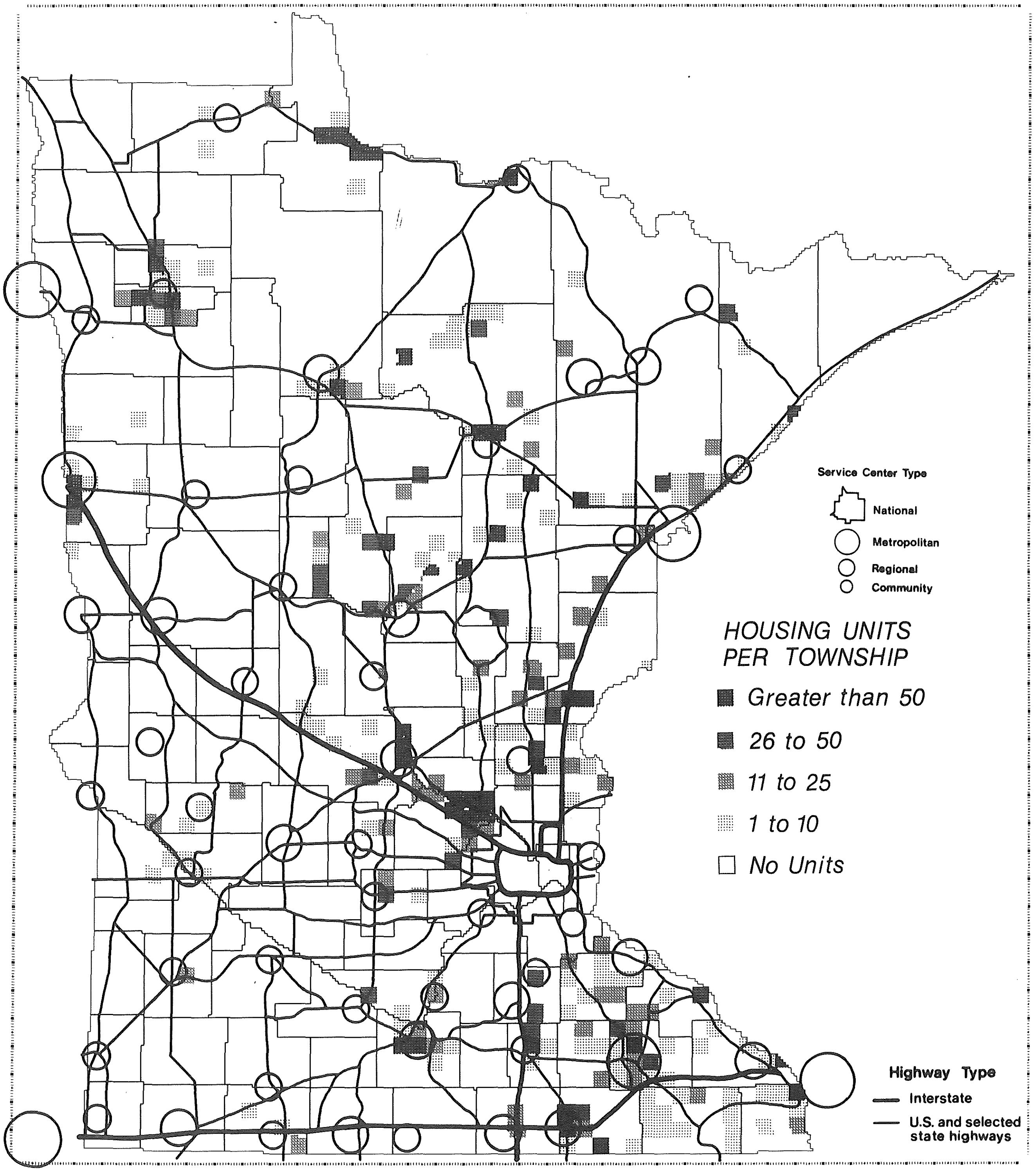
* Had development data been collected for municipal areas, the percentages of total development and total permanent development for service center access class 1 would obviously be higher, thereby changing the rest of the percentages for total and total permanent development for the row totals and producing a true linear relationship.

Figure 6, Residential Development on Selected Rivers, 1982, shows how the statewide pattern of river development is influenced by roads and proximity to service centers. Since not all of the paved state and county roads, or other important county non-surfaced roads can be shown on a map of this scale, serveral townships with development may appear as being distant from roadways. However, reference to a state highway map readily accounts for these townships, since some type of state or county secondary roadway is close to the developed areas.

Additional conclusions about permanent development patterns on rivers as a function of road and service center proximity can be developed by analyzing computer generated state maps showing locations of permanent and seasonal development occurrences. Figure 7, Permanent Residential Development on Selected Rivers, 1982, shows a dominance of permanent occupancy in several areas statewide. These areas are depicted by at least 2 black squares, representing at least 31 river-oriented residences per township, or by areas where several graytone squares representing densities of 21 to 30 or 11 to 20 residences per township are found.

All such areas have two things in common; 1) they are near Primary Service Centers where major employers and services are located (paper mills, schools, large hospitals, major industries, county seats); 2) they usually have excellent road access routes often crossing or paralleling river systems. Typical examples of the most densely populated river areas are rural areas outside the city limits of Austin, St. Cloud, Moorhead, and Baudette. The development character is most often suburban or exurban and residents can easily commute to work, schools and service areas. Permanent development occurring at densities slightly less than the above areas, yet still of regional importance were observed for several additional areas. Typical examples are areas near Mankato, Grand Rapids and Rochester.

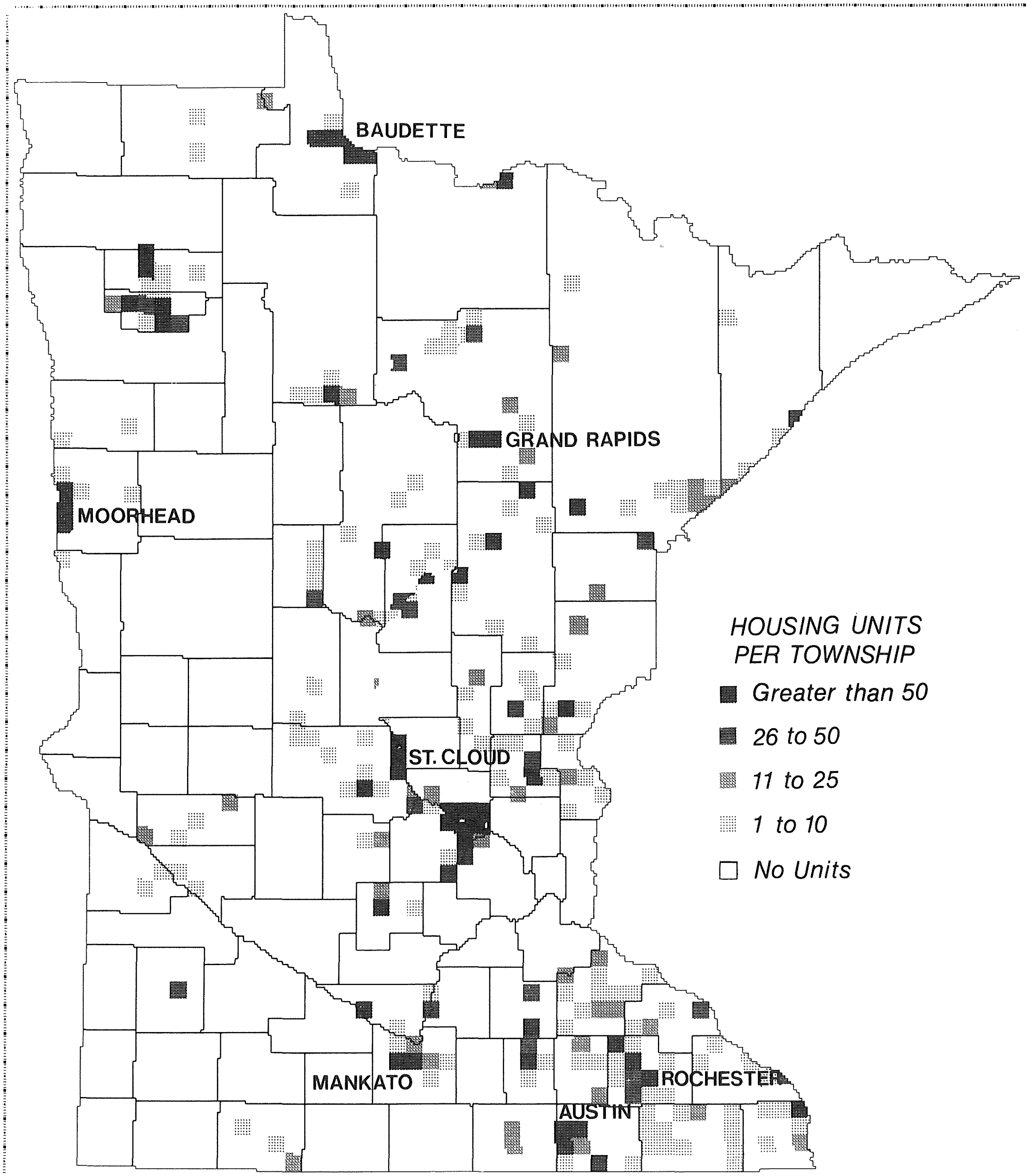
Figure 6. RESIDENTIAL DEVELOPMENT on SELECTED RIVERS, 1982[1]



Source: MN DNR.

1. Development counts generated from county assessor file inspection based on photo interpretation 2 or more residences per 40 on 1977 blue line imagery. See Appendix IV for complete discussion of data collection methods.

Figure 7. PERMANENT RESIDENTIAL DEVELOPMENT on SELECTED RIVERS, 1982[1]



Source: MN DNR.

1. Development counts generated from county assessor file inspection based on photo interpretation 2 or more residences per 40 on 1977 blue line imagery. See Appendix IV for complete discussion of data collection methods.

In summary, river development as a function of proximity to roads and service centers was found to have the following relationships:

1. Road proximity to developable river areas is the single most important factor influencing total residential development anywhere in the state.

2. Permanent development is more concentrated in areas of better road access than seasonal development.

3. Proximity of service centers is considerably less important to seasonal development than road proximity. Proximity to service centers, however is an important factor for understanding the pattern of permanent residential development. As a consequence permanent development densities on rivers were highest for those areas close to the state's Primary Service Centers, especially when in close association with major federal, state and county highways.

Topic 2. Development as a Function of River Class

An analysis of development as a function of river class reveals that significant differences exist between the five river classes when considering total development occurrences. Differences between and within classes were also observed when development occurrences were divided into seasonal or permanent uses.

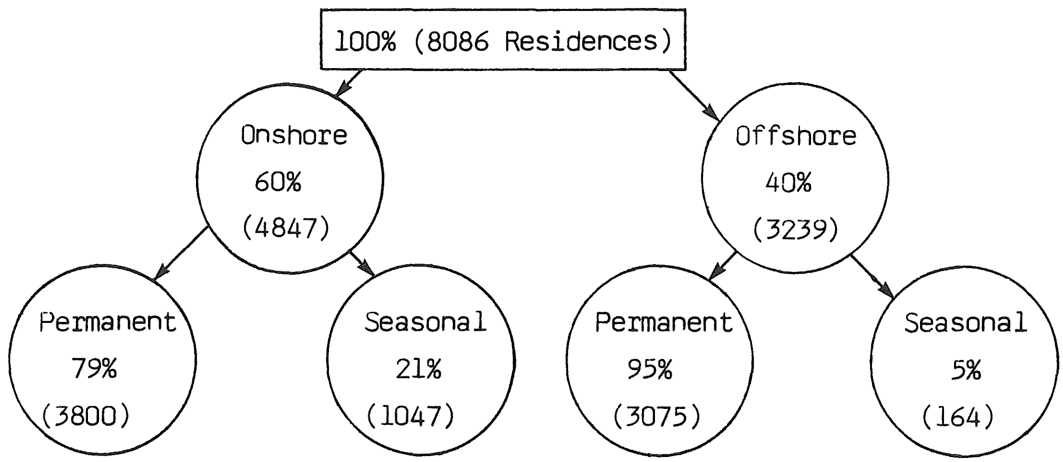
Development data for a given segment was paired with the river class for that segment. Seasonal and permanent occupancy and development site location (onshore vs. offshore)* were the specific types of information considered. Since the analysis uses only the sample river segments and does not consider all of the watercourses from which development data was collected, the development data paired with the sample segments is, in effect, a subset of the statewide development data base. This arrangement does not pose any problems, since the same percentage breakdown for seasonal and permanent uses and onshore/offshore locations are encountered for both the statewide data base and the subset used here.

Figure 8, Total 1982 River Oriented Development, shows the percentages of onshore and offshore development as compared to total development, and the percentages of seasonal and permanent development occurrences within each onshore and offshore group. This data shows that statewide, 60% of residential river development is onshore and 40% is offshore. Within the onshore group, 79% of the dwellings are permanent and 21% are seasonal. The offshore group shows that 95% of the development is permanent and 5% is seasonal**.

* Onshore development location means the ownership parcel touches the river; offshore location means the ownership parcel does not have river frontage but is still within the river-oriented 40-acre parcel.

** The reader is reminded the development data collection procedure only counted development where 2 or more residential units per 40-acre river oriented parcel existed. Therefore, many rural farmsteads and scattered permanent and seasonal dwellings that are the only dwelling structures on river-oriented 40-acre parcel are not accounted for.

Figure 8. TOTAL 1982 RIVER ORIENTED DEVELOPMENT



Source: Minnesota DNR

Consistent with discussion in Topic 1, it is certain that road accessibility is the major factor in location of development occurrences. Onshore development exists because of good road access to developable river sites. Offshore development may occur either where roads do not service onshore ownership parcels, where onshore development has already occurred, or where site characteristics preclude onshore development (floodplain, steep slopes, etc.)

Figure 8 shows that permanent development counts are almost equal for onshore and offshore locations. As indicated in Topic 1, permanent dwellings as a group are often associated with suburban and exurban developments around regional service centers. Therefore, even if onshore parcels are developed or non-developable, it is easy to see why a significant portion of permanent development is offshore, since development areas may still be very attractive (scenic vistas, semi-rural setting, service center proximity, etc.). In other instances, at least some of the permanent development, whether onshore or offshore, is incidental to the river resource. This again would be true near service centers and in some rural agricultural areas of the state. In sum, development data shows that permanent onshore development is not preferred over offshore development to any great extent.

By contrast, seasonal development occurences of onshore locations outnumber seasonal offshore locations by a ratio of more than 6:1 (1047 onshore: 164 offshore), thereby implying a preference for location close to the resource.

From the statewide data base of Figure 8, a subset of development occurrences for the sample segments was obtained. Since the primary purpose of this topic is to analyze river development as a function of river class, the subset data needs to include a large proportion of both seasonal and permanent occurrences.

The remainder of the analysis considered only the onshore 1982 development data. Seasonal counts within the onshore group were so much greater than seasonal counts in the offshore group, that meaningful analysis could not be performed.

The subset data is listed in Table 7, where river class and associated counts of permanent, seasonal and total development occurences are shown. Additional information on the percentages of segments in a given class, and the percent of development counts occurring in a class are also shown. Notice that from a total of 2662 onshore developments, 79% are permanent and 21% are seasonal. Reference to Figure 8 shows that these percentages of seasonal and permanent development in the onshore subset are equal to the statewide percentages for seasonal and permanent onshore development.

The data of Table 7 can be reviewed to provide a wealth of information about development as a function of river class and the importance of the state's river resources to development. For example, Table 7 reveals that 71.8% of the seasonal development occurs in a river class that accounts for only 21.8% of the sample. (See Column 2 and 6.)

For additional analysis about development occurrence as a function of river class, the data from Table 7 were expressed in a way which allowed comparison between the classes. It is obvious from the table that more development exists in Class D than in Class B, but it is difficult to determine if it is simply because Class D is more prevalent than Class B. Therefore, a measure which put all of the classes and their development counts on an equal base was needed. This measure was expressed in terms of an absolute ratio, calculated by dividing the development occurrence percentages of a class by that class's percent share of segments.

Table 7. DEVELOPMENT OCCURRENCES AND PERCENTAGES BY RIVER CLASS

Column: 1 RIVER CLASS	2 % OF SEGMENTS IN CLASS	3 ACTUAL PERMANENT COUNT	4 % OF TOTAL PERMANENT DEVELOPMENT	5 ACTUAL SEASONAL COUNT	6 % OF TOTAL SEASONAL DEVELOPMENT	7 ACTUAL TOTAL COUNT	8 % OF TOTAL DEVELOPMENT
A: Primitive/Semi-Primitive	16.4	8	0.4	30	5.4	38	1.4
B: Natural/Rural in Forest	21.8	552	26.2	397	71.8	949	35.6
C: Natural in Agriculture	13.8	203	9.6	82	14.8	285	10.7
D: Agriculture	46.3	1021	48.4	31	5.6	1052	39.5
E: Urban	2.2	325	15.4	13	2.4	338	12.7
	100%	2109 (Total permanent developments: 79% of total development)	100%	553 (Total seasonal developments: 21% of total development)	100%	2662 (Total developments)	100%

Source: Minnesota DNR

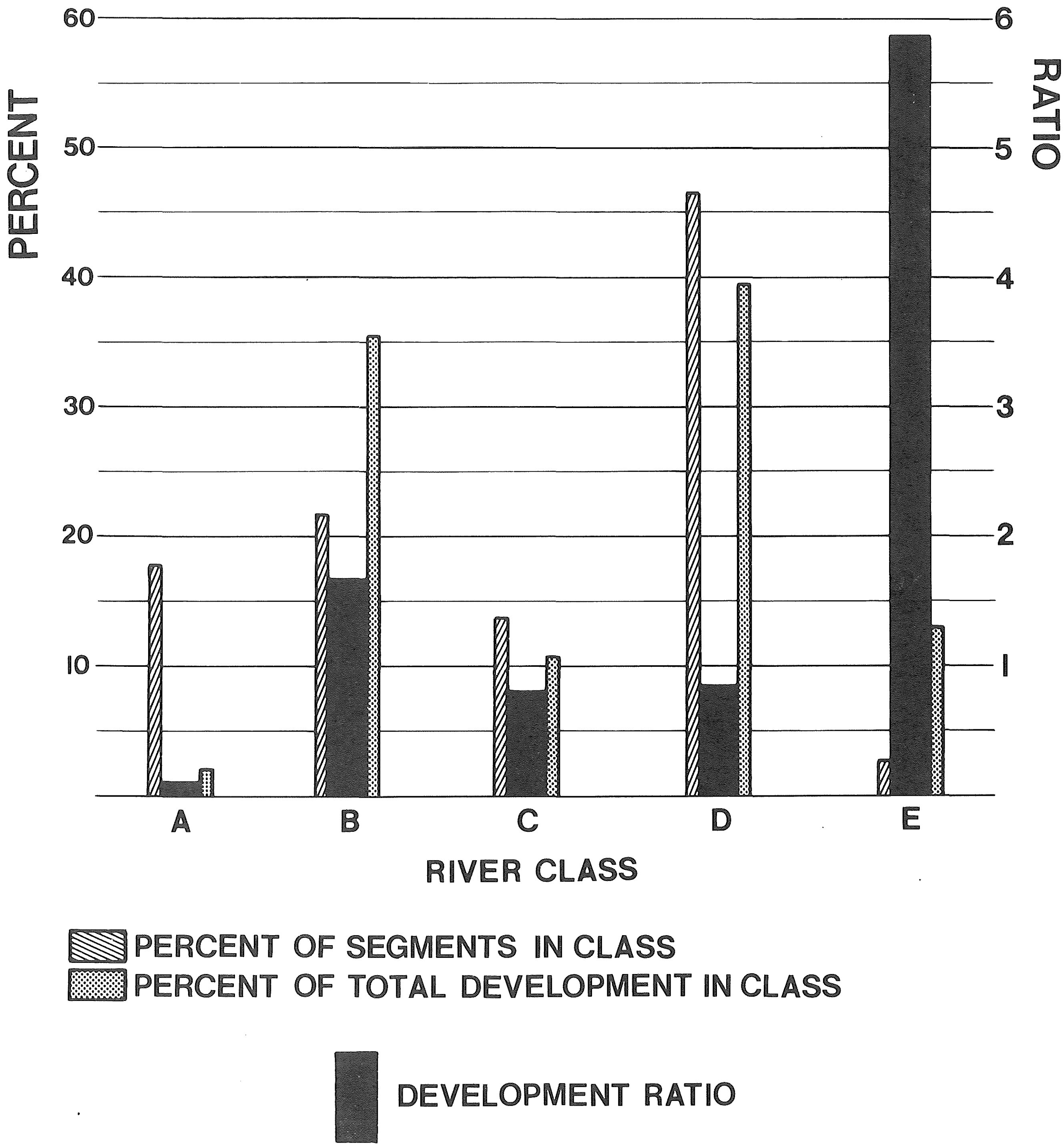
For example, the development ratio for total development in River Class D: Agriculture was obtained by dividing 39.5% (Column 8, Table 7) by 46.3% (Column 2). The result was 0.86. This same procedure was followed for all the development occurrence percentages and classes in Table 7, which eventually allowed the class to class analysis. The results of this effort are best depicted by bar charts, which readily show the differences in magnitude of development ratios for each class. Figure 9 shows the development ratios for total development occurrences in each river class. Also shown is the segment and development percents that pertain to each class, which were used to calculate each class's ratio.

Figure 9 shows that the higher a class's development ratio, the more developed the class is as compared to a class with a lower ratio. Clearly, River Class E: Urban, is the most developed, as was expected.

This method is most helpful in dramatizing the differences between classes with similar numbers of segments. For example, River Classes A and C are relatively equal in occurrence of segments (16.4% vs. 13.8%, respectively), yet the development occurrences and resultant ratios for each class clearly show that River Class C is about eight times more developed.

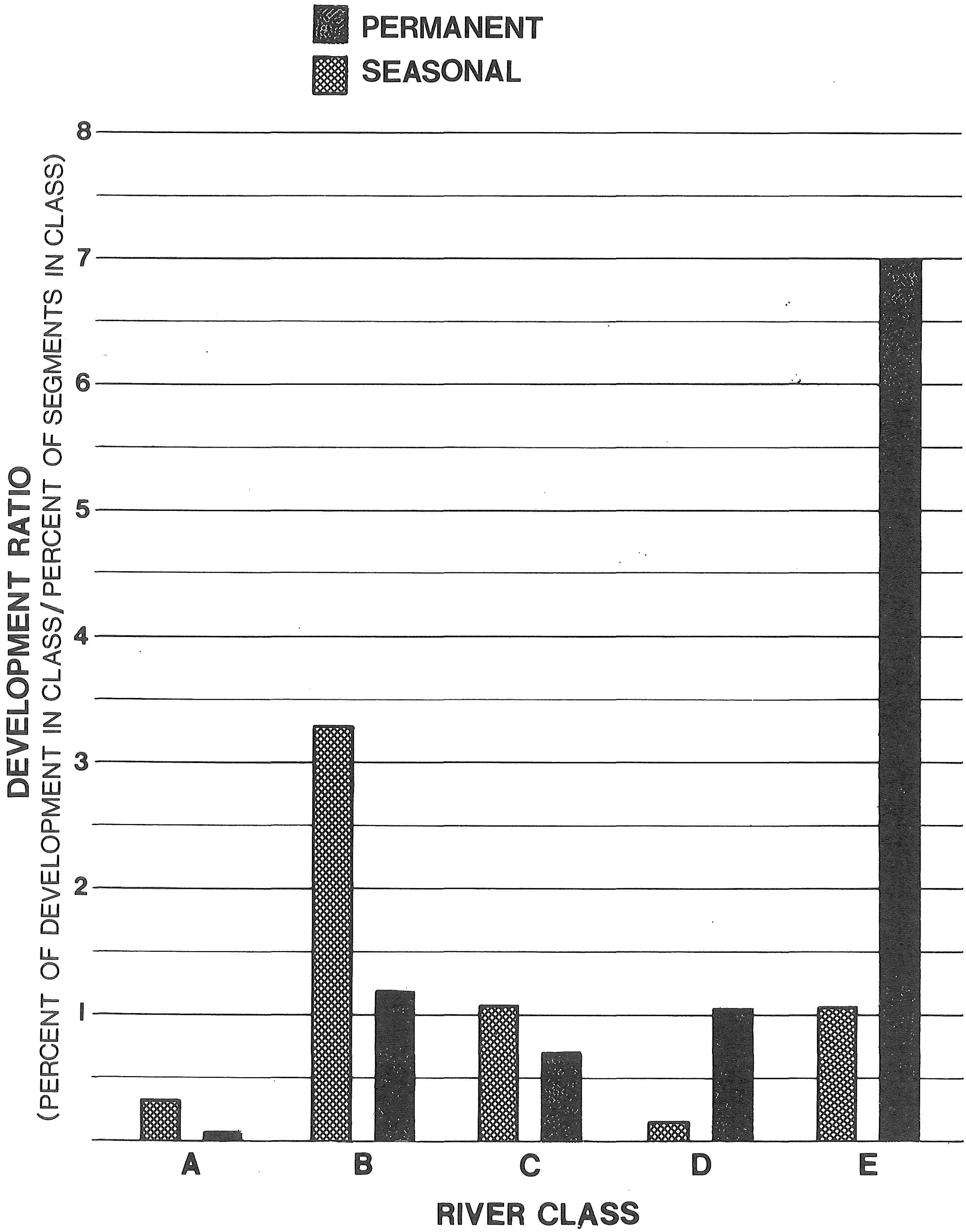
Perhaps the most meaningful information that can be presented using the development ratio approach is when the data are expressed in terms of seasonal and permanent development ratios by river class as is shown in Figure 10. Figure 10 shows that differences between seasonal and permanent development occurrences within a class and between classes are significant. Most noticeable from Figure 10 is the dominance of permanent development ratios over seasonal development ratios in River Classes D and E, and the dominance of seasonal ratios over permanent ratios in River Classes A and B. An important observation is that the seasonal development ratio for River Class B is well above all of the other ratios excepting the permanent development ratio of River Class E. This information confirms earlier statements that Class B is very important recreationally. To a lesser extent both River Classes C and E have moderate seasonal development ratios, indicating they too are of some importance to recreational/seasonal development. In the case of River Class E: Urban, it may seem strange that seasonal uses would be occurring here. However, review of Figure 4, the River Segment Classification

Figure 9. DEVELOPMENT RATIOS for TOTAL DEVELOPMENT OCCURENCES by RIVER CLASS



(PERCENT OF DEVELOPMENT IN CLASS/ PERCENT OF SEGMENTS IN CLASS)

Figure 10. PERMANENT and SEASONAL DEVELOPMENT RATIOS by RIVER CLASS



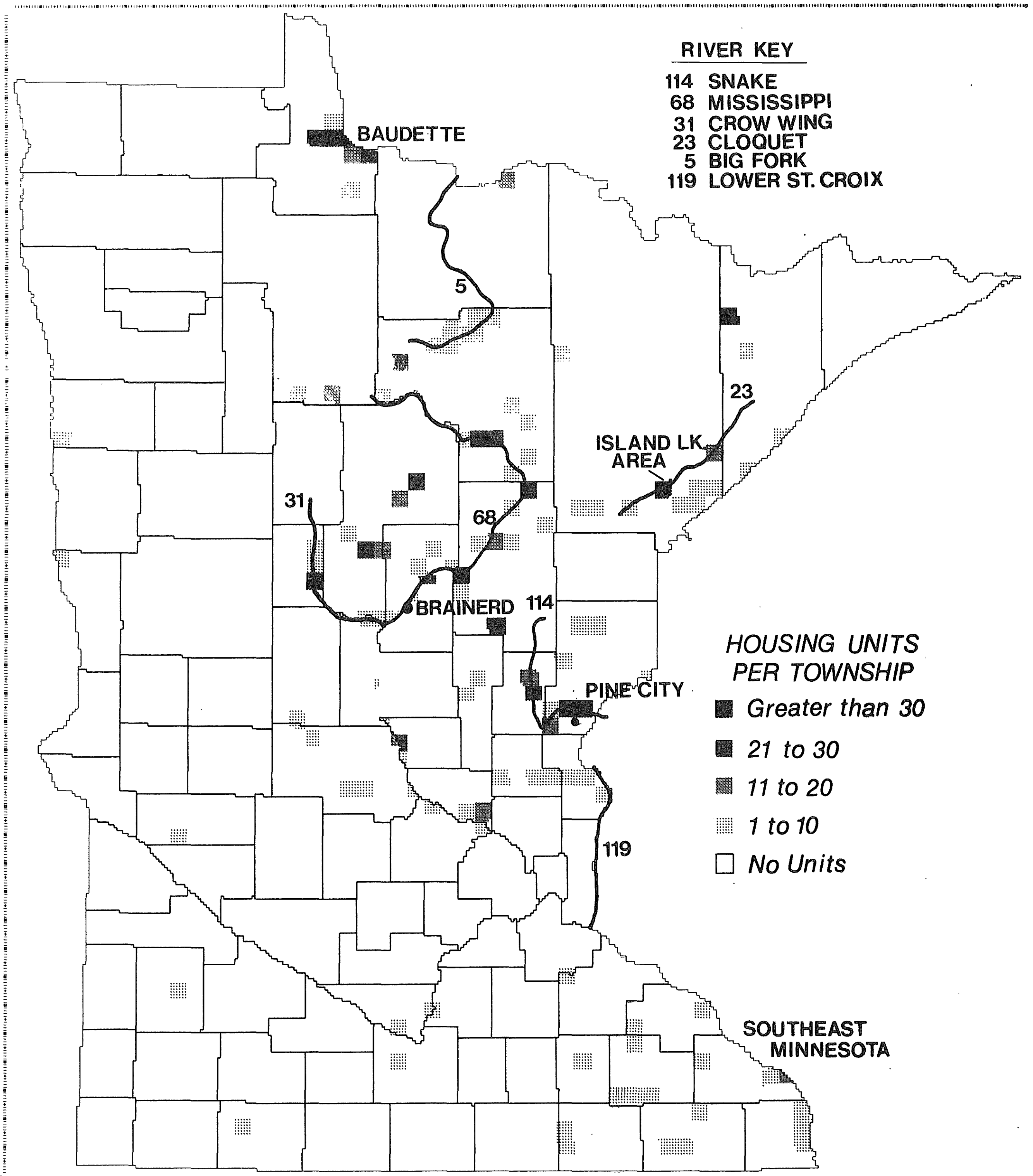
map, shows that some River Class E segments border segments labeled as River Class C: Natural in Agriculture, where seasonal development occurs. Thus, a spillover effect is occuring.

Figure 11, Seasonal Residential Development on Selected Rivers, 1982, shows that certain areas of the state have onshore seasonal occupancy rates that surpass permanent occupany rates for the same area. Areas such as the Snake River in Pine and Kanabec Counties, portions of the Mississippi River in Aitkin and Crow Wing Counties and the Crow Wing River in Cass and Wadena Counties are typical areas with high seasonal occupany rates. Reference to Figure 4, the River Segment Classification map, shows that all of the high seasonal occupany areas mentioned above are on River Class B: Natural/Rural in Forest, or River Class C: Natural in Agriculture, segments. Generally, the greatest concentrations of seasonal river development are found in the north central and northeastern portions of the state.

In some instances, seasonal occupancy rates on rivers seem to be greatly influenced by the river's association with a recreational lake or reservoir system. This characteristic is especially evident near Pine City, where both Pokegama and Cross Lakes are associated with the Snake River. Similar patterns are also observed for the Cloquet River/Island Lake area in St. Louis County, and the wide river areas just upstream of the dam on the Mississippi River in Brainerd.

Further analysis of Figure 11 reveals that seasonal development equals permanent development in some areas, such as the river areas near Baudette, or the areas along the Big Fork River in Itasca County. Another interesting observation is that while seasonal occupancy rates do not surpass the permanent occupancy rates on southeastern Minnesota rivers, seasonal use exhibits a distribution in this area that is uniform, unlike the remainder of the state. The explanation is most likely linked to the area's geomorphic history. During the last glacial period, glaciers did not pass over this area, and, as a result, the area has few lakes. Instead, very scenic, deeply incised and mature river systems are the norm. Therefore, the well-distributed medium density pattern of seasonal development shown for this area in Figure 11 is probably a result of both the area's lack of developable lakeshore and its scenic river valleys.

Figure 11. SEASONAL RESIDENTIAL DEVELOPMENT on SELECTED RIVERS, 1982[1]



Source: MN DNR.

1. Development counts generated from county assessor file inspection based on photo interpretation 2 or more residences per 40 on 1977 blue line imagery. See Appendix IV for complete discussion of data collection methods.

A final area that should be acknowledged as having a significant amount of both seasonal and permanent river residential development is the Lower St. Croix River in Chisago and Washington Counties. Computer mapping limitations for some border area rivers and the fact that development data was not computerized for Washington County resulted in blank areas (no development shown) on Figures 6, 7 and 11. Resource managers familiar with this area can readily attest that this National Scenic Riverway has large concentrations of both seasonal and permanent occupancy. This is easily explained by the area's good road access, proximity to regional service centers and the high quality of real estate in an area of outstanding natural resource value.

In sum, the following statements about onshore versus offshore locations and permanent versus seasonal development as a function of river class can be made:

1. Approximately 60% of the state's river development is onshore and 40% is offshore.

2. Permanent development counts for onshore and offshore locations are nearly equal.

3. Seasonal onshore development outnumbers seasonal offshore development by a ratio of more than 6:1.

4. River Class E: Urban, is by far the most developed class in terms of total and permanent development occurrences.

5. River Class B: Natural/Rural in Forest, is by far the most developed class in terms of seasonal development occurrences.

6. High rates of seasonal development on rivers are likely when the overall resource quality is high, road access is good or the river is associated with large lakes and reservoir systems.

7. Seasonal development rates are low to moderate but generally well distributed throughout the lakeless Southeastern Minnesota area, thereby exhibiting an atypical pattern as compared to the rest of the state.

Topic 3. Development as a Function of Physical Characteristics

Development data analysis must also consider the distribution of development occurrences in relation to the physical characteristics of rivers. To accomplish this analysis, a data base of all of the 40-acre parcels having onshore and offshore development in the 1278 segments was matched to whatever Physical Group (from Step 4) corresponded to segments with developed parcels.

A total of 604 forty acre parcels were tallied against the corresponding Physical Groups for the segment. The method used in Topic 2 to assess development ratios which enabled group to group comparison was also used here. Counts of developed 40-acre parcels per group were divided by the total number of parcels (604) to provide percentages of 40 acre parcels per physical group. These percentages were then divided by the percentage of segments belonging to any one River Physical Group (from Step 4), and the result is a Physical Group Development Ratio. The data is shown in Table 8.

Table 8. PHYSICAL GROUP DEVELOPMENT RATIOS

River Physical Group	% Segments in Group	#40's w/Devel.	% of total 40's w/Devel.	Physical Group Devel. Ratio (%40's/% segments)
I. (Wide & Deep Valleys)	7.9	40	6.6	0.83
II. (Wide & Shallow Valleys)	19.8	161	26.6	1.34
III. (Narrow or No Valleys)	62.3	391	64.7	1.04
IV. (High Gradient)	5.9	9	1.5	0.24
V. (Ditched/Channelized)	4.1	3	0.5	0.12
VI. (Local-Specific Concern)	N/A	-	-	-
	100%	604	100%	

Source: Minnesota DNR

Table 8 demonstrates that over 90% of the development occurs in segments having Wide and Shallow Valleys (Group II) or in segments having Narrow or No Valleys (Group III). Although the most 40's occur in Group III, the development ratio approach indicates that Group II segments are slightly more developed, since the Group II ratio is 1.34 versus a ratio of 1.04 for Group III. Development in Group I (Wide and Deep Valleys) segments is moderate, as indicated by its ratio of 0.83. These findings are expected, since Group I segments represent the major flood prone areas of the state and most development, even if occurring in or near the valley is often beyond the river-oriented 40-acre parcel, otherwise it would undoubtedly be subject to periodic flooding. By contrast, Group II and III river segments are less flood prone and therefore exhibit higher development densities. Finally, River Physical Group IV: High Gradient Segments, and Group V: Ditched/Channelized segments exhibit very low development ratios. Group IV segments usually have limited building sites in river oriented parcels due to topographic constraints, surface bedrock or high gradient segments which are in state or national forests, parks or wasyide areas (for example: North Shore Streams) and are restricted to development. Group V segments are usually in prime agricultural regions, where any residential shore development may be an inappropriate and inefficient land use.

In sum, the analysis of development as a function of physical characteritics along rivers, reveals the following:

1. Nearly 65% of all developed 40 acre parcels occurred in river segments typified by narrow or no valley characteristics (Group III).

2. Using the development ratio approach, the overall density of developed 40-acre parcels is slightly higher for river segments with wide and shallow valley characteritics (Group II) than for segments with narrow or no valley characteristics (Group III).

3. Segments having wide and deep valleys are only moderately developed, which is most likely due to flood plain characteristics of river-oriented parcels. Development in these regions is most often not river oriented even if it occurs in or close to the valley floor or on slopes.

4. Residential development occurrences for high gradient and ditched/channelized segments are low, due mainly to physical constraints and predominance of agricultural uses.

Topic 4. River Residents Survey

A shoreland residents survey was conducted for the Shoreland Update Project which sampled residents from various types of lakes and rivers throughout the state. The main purpose of the survey was to identify differences in user preferences and attitudes in various regions and by resource type, such as the shoreland lake classifications and rivers.* The river reaches chosen for sampling do not necessarily reflect the norm of river reaches in the state. Those conducting the survey desired information from select types of river reaches. The river reaches sampled tended to be those reaches which have significant recreational resource value and support larger populations of seasonal occupants than most state rivers do as a whole. For example, data from a sample population of 122 questionnaires indicated that 60% are permanent residences and 40% are seasonal. This breakdown contrasts sharply with the development data shown in Topic 2, Figure 8, where a population of 8086 residences were divided into 85% permanent and 15% seasonal. Clearly, the results from the residents survey should not be construed to be representative of statewide development on rivers. Yet, certain preferences and attitudes are worth mentioning here, as they may impart knowledge for shoreland managers dealing with specific management problems.

Shoreland Report No. 8, Shoreland Residents - A Questionnaire Survey, discusses survey methodologies, findings and policy implications for shoreland management in detail. However, a list of important river-specific responses, attitudes and preferences taken from Report No. 8 are presented here and each is followed by a commentary relating the information to earlier discussion in Topics 1 and 2.

* The shoreland residents surveyed were from four shoreland groups, namely; 1) Rivers, 2) Natural Environment Lakes, 3) Recreational Development Lakes, and 4) General Development Lakes. The lake types mentioned above are the three existing classes used by the Shoreland Program to identify and classify lakes. In general terms, Natural Environment Lakes have the most restrictive development standards (those lakes are usually the least developed, smaller, more sensitive lakes) and the General Development Lakes have the least restrictive standards (these lakes are usually the most developed, largest, and least sensitive lakes). Recreational Development Lake standards are midway between the former two, and most state rivers utilize General Development standards.

CONCLUSION: 1/4 of all seasonal residents surveyed on lakes and rivers plan to convert their residences into permanent dwellings. Also, 46% of this group intend to do so within the next five years.

COMMENT: Although the statewide data shows that permanent river development is already significantly more than seasonal development, discussion in Topic 2 showed that some individual resource types support a larger share of seasonal use than permanent use. This is especially true for River Class B: Natural/Rural in Forest, where 71.8% of the total seasonal development occurred. Therefore, resource managers can expect a conversion trend to be of significant importance in areas where seasonal occupancy is high. This may be most important for those seasonal use areas which have good year-round road accessibility and are close to major service centers, consistent with discussion in Topic 1.

CONCLUSION: The survey found that DNR Administrative Regions 4 and 5 (Southwest and Southeast Minnesota) support high proportions of permanent dwellings on rivers as compared to the rest of the state.

COMMENT: This information supports findings of the development data discussed in Topic 1, where southern Minnesota Rivers were shown to have high rates of permanent development due to the relationship of major service centers to the region's river network and relative lack of lake resources. Service Centers such as Rochester, Austin, Mankato, Owatonna, Faribault and other similar cities are closely associated with the region's river system. Suburban and rural residential housing developments often offer choice real estate opportunities for persons desiring quality river lots. Also, as mentioned in Topic 2, permanent river development is often incidental to the resource in these areas. Continued permanent development on rivers in these regions may be an important trend based on these observations.

CONCLUSION: Compared to all lake types, rivers exhibit the highest annual average of user days for permanent residents and the lowest annual average of user days for seasonal residents.

COMMENT: This information may simply be a reflection of the State's river development complexion. Rivers have more permanent development than all lake types and also have less seasonal development than all lake types.

CONCLUSION: Shoreland residents were surveyed for their perceptions of shoreline crowding, using a scale of 0 to 7, where 0 = vacant and 7 = packed. The average response to this question from river residents was the lowest as compared to the average response to the same question by lake residents. 62.3% of river residents indicated vacant to near-vacant conditions (choosing a 0, 1 or 2). This percentage was the highest for river residents as compared to the percentages of lakeshore residents choosing the same response values.

By contrast, 13.4% of river residents indicated packed to near-packed conditions (choosing a 5, 6 or 7). This percentage for river residents was slightly higher than the percentage of Natural Environment lake residents, where only 12.2% of this group chose the same values, which was the lowest percentage response for all residents (lake and rivers) surveyed.

COMMENT: This information suggests that even though rivers are heavily developed in and around service center areas, the development is not so concentrated in most of the high quality recreational resource areas to the extent that residents feel crowded. Obviously, there are exceptions, as mentioned earlier where desirable recreational areas such as the Snake River support large concentrations of seasonal use.

Responses to additional questions concerning satisfaction with zoning controls, water-surface use crowding, improvements to public services and other similar issues can be found in Report No. 8, and will not be dealt with here.

Section 2. Development Management Recommendations

The following management recommendations are based on the findings and discussion presented in Topics 1, 2, 3 and 4 of Section A. Recommendations are not made for each summary statement as previously presented, rather either the most important statements or groups of statements combined enabled formulation of the recommendations.

1. Since road proximity was found to be the most important factor influencing river development, shoreland managers should identify and monitor roaded or planned roaded, buildable areas carefully and ensure that adequate zoning controls exist or will be developed consistent with the management objectives for the river class of the area. This is especially important for river segments (regardless of class) meeting the above criteria that are located near regional service centers, because they are the most prone to permanent development.

2. Shoreland managers should identify any areas that have medium to high quality river resource settings (recreational opportunities, naturalness, etc.) good road accessibility and are at virtually any stage of development, and ensure that adequate growth management plans and zoning controls exist to address these areas. The data indicates that the likelihood of new or continued seasonal development in these areas is high. This may be especially important outside of major retail/commercial centers, near river-reservoir lake systems and primarily in River Class B: Natural/Rural in Forest segments and secondarily in River Class C: Natural in Agricultural or River Class E: Urban segments.

3. Shoreland managers should identify areas along wide and shallow river valleys and areas along rivers with narrow or no valleys since they may continue to experience substantially more river-oriented development than river segments typified by any of the other physical characteristics.

4. Shoreland managers should be prepared for a continuation of a trend where seasonal dwellings are converted to permanent dwellings, especially in areas identified pursuant to recommendation #2. New permanent dwellers will expect services that counties and townships may not always be able to supply, such as year-round fire and police protection, meaning roads must be kept open. Perhaps of even greater importance, is that drainfield systems associated with 'conversion' properties will now be subject to continuous effluent loads in place of occassional seasonal use periods. Therefore, shoreland managers should actively monitor areas for conversion activities to ensure proper compliance with sewage treatment ordinances.

IV. IMPLEMENTATION

Implementation of the River Classification System should ideally have three phases. The first phase is the development of specific state river shoreland regulations for each river class management objective, the second phase is the identification of applicable river classes, river physical groups and development patterns at county, township and municipal levels of government and the third phase is local unit of government adoption of ordinances compliant with state regulations. Probable processes for completing each phase of river classification system implementation are briefly discussed in the following paragraphs. Progress reports and project updates prepared by staff assigned to the Shoreland Management Program will address each phase in detail as work is completed.

A. River Shoreland Regulations

This phase of implementation is directly related to the management objectives and recommendations of each river class and the identified physical and development characteristics of rivers. For example, this phase of implementation will be devoted to determining just what the actual dimensional considerations such as lot sizes, setbacks, etc., should be for each river class. Development of appropriate rules, performance criteria and other guidlines will be founded on existing development patterns and densities, local land use plans and input from public participation meetings and county, municipal and state shoreland management staff necessary to effectively manage the resource.

B. River Class Identification

This effort will require preparation and processing of river data by DNR staff followed by review of the data by local government officials. Draft classification lists will be prepared by staff for review at local level public meetings intended to discuss the new classification system.

As discussed in part II, the river classification system was developed from data collected from state rivers identified by the Minnesota Statewide Outstanding Rivers Inventory. It was mentioned that this inventory did not include many of the smaller rivers and streams of the state, therefore precluding data being collected from them during classification system development. The main reason for this approach was that including more streams and thus many more segments to the sample group was unnecessary for identifying the range of state river resources. When the system is ready to be implemented at the local level, a question that may arise is, "How will rivers and streams not in the sample be classified?"

First, cultural data (Land Use and ROS) exists for all of the 40-acre parcels in the state; second, the river kilometer indexing system has identified rivers and streams subject to Shoreland Program jurisdiction; and third, computerized methods can be developed for coupling both data sets in order to produce a listing of information for all river oriented 40-acre parcels on any stream or river in the state. The only task remaining after river classification (recall that rivers are classified solely on cultural characteristics), is to identify the physical characteristics and development patterns that will modify river class management objectives. This latter task is well suited to local level application where local managers can identify these occurrences much more accurately because data resolution and accuracy at local levels will usually be much better than at a statewide level.

Another implementation question that may arise is, "Will five-mile segments be used in all cases, even where streams or rivers to be classified have less than 5, or 5, 10, or 15 mile lengths?" The answer is "No", because segment lengths of 5 miles were only established as part of the sampling technique and that smaller length segments may be better suited to local level classification system implementation. In fact, a great deal of flexibility must be allowed at the local level to determine starting and ending points for segment class assignment. This aspect of implementation is highly dependent on cultural, physical and development characteristics of any particular river, since rivers are linear resources and often thread through many diverse surroundings, demonstrating the need for flexibility in classification implementation.

Finally, the number of streams and rivers to be classified has not been determined. Discussion in the Introduction revealed that approximately 16,190 streams are subject to Shoreland Program jurisdiction. However, several management questions must be discussed to determine the extent of classification system application, since in some cases it may be extremely beneficial to manage to the small stream, 2-acre watershed level (i.e., trout streams) while in other cases, such management may not be appropriate.

C. Ordinance Adoption

The final phase of implementation, ordinance adoption at the local level of government, is likely to be accomplished in the same way previous land management programs have been implemented. Model ordinances, prepared by DNR staff, would be direct outcomes of state adopted regulations. The model ordinances could be adopted as is, or be used as guides if the local unit of government wishes to incorporate the new regulations into existing codified land use controls. Regardless of the actual form in which controls are drafted and adopted by the community, the end result is incorporation of state river regulations addressing the river classes of the community into the community's land use controls.

Doubtless, other questions and challenges will arise during both phases of classification system implementation. However, realizing that the system is new and certainly not intended to be static, will enable all managers and affected individuals ample opportunity to entertain constructive criticisms and suggestions to make implementing the system a reality.

APPENDIX I

RIVER SEGMENT FILE

The 157 rivers, streams and their forks as identified in the Statewide Outstanding River Inventory (Project Report, DNR, March 1983) were used as the sample watercourses in developing the statewide river classification system. For purposes of the river classification effort here, these watercourses were subdivided into segments.

The base file utilized a water oriented data file, contained in the Minnesota Land Management Information System (MLMIS), that identifies river oriented parcels* along permanent watercourses**. The creation of individual segments for each river began at the mouth and continued upstream to the terminus of the permanent watercourse. The average length for each segment is five miles as measured upstream.

The final result of this effort was a file of 1278 individual river segments averaging five miles in length, which formed the basic unit from which subsequent data was collected. Each segment was comprised of an array of river-oriented, 40-acre parcels. Each parcel was located by a public land survey description (that is by a particular county, township, range, section and quarter-quarter). Figure 1 of Appendix I, shows a typical example of a small river with 3 segments and its respective river-oriented 40-acre parcels.

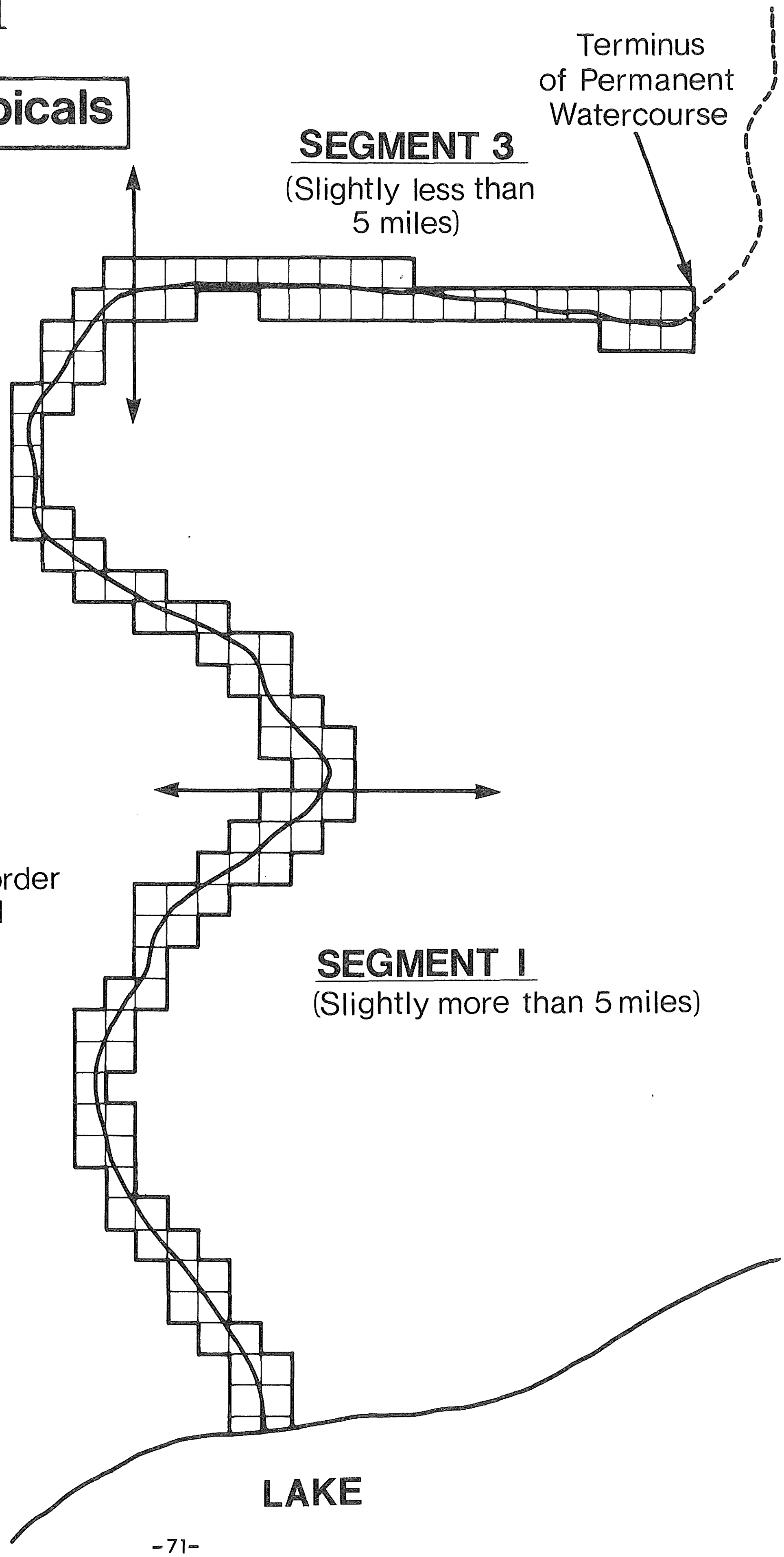
When the river segment file was completed, collection of the cultural, physical and development data began. These efforts are explained in Appendices II, III, and IV.

* A river oriented parcel is defined as a 40-acre public land survey division of land that the watercourse flows through or touches.

** Permanent watercourses are defined as all perenial flowing channels as mapped on 7 1/2 minute USGS topograhic quadrangle maps with a solid blue line. The headwaters of such watercourses are defined as the point where the mapping symbol changes from a solid blue line to a dashed blue line (ephemeral streams).

ure 1- Appendix I

ver Segment Typicals



E

h square within black border
esents a River-Oriented
Acre Parcel

APPENDIX II

CULTURAL DATA

Discussion of the River Classification System refers to the use of cultural data for identifying the sample river segments with a Land Use (LU) Label and a Recreational Opportunity Spectrum (ROS) Label. This appendix will describe in detail how cultural data generated from previous natural resource management studies were used to create the LU and ROS Labeling scheme for the 1278 river segments.

The cultural data comes from the following:

1) Minnesota Land Management Information System (MLMIS)

   The MLMIS land use cover data were interpreted from 1968 and 1969 1:90,000 aerial photographs. The land use data were used to create a Land Use Cover (LUC) variable which characterizes all state Minor Civil Divisions (MCDs)* according to their combinations of land use covers**.

* An MCD is defined as an organized rural township incorporated municipality, or a rural unorganized territory.

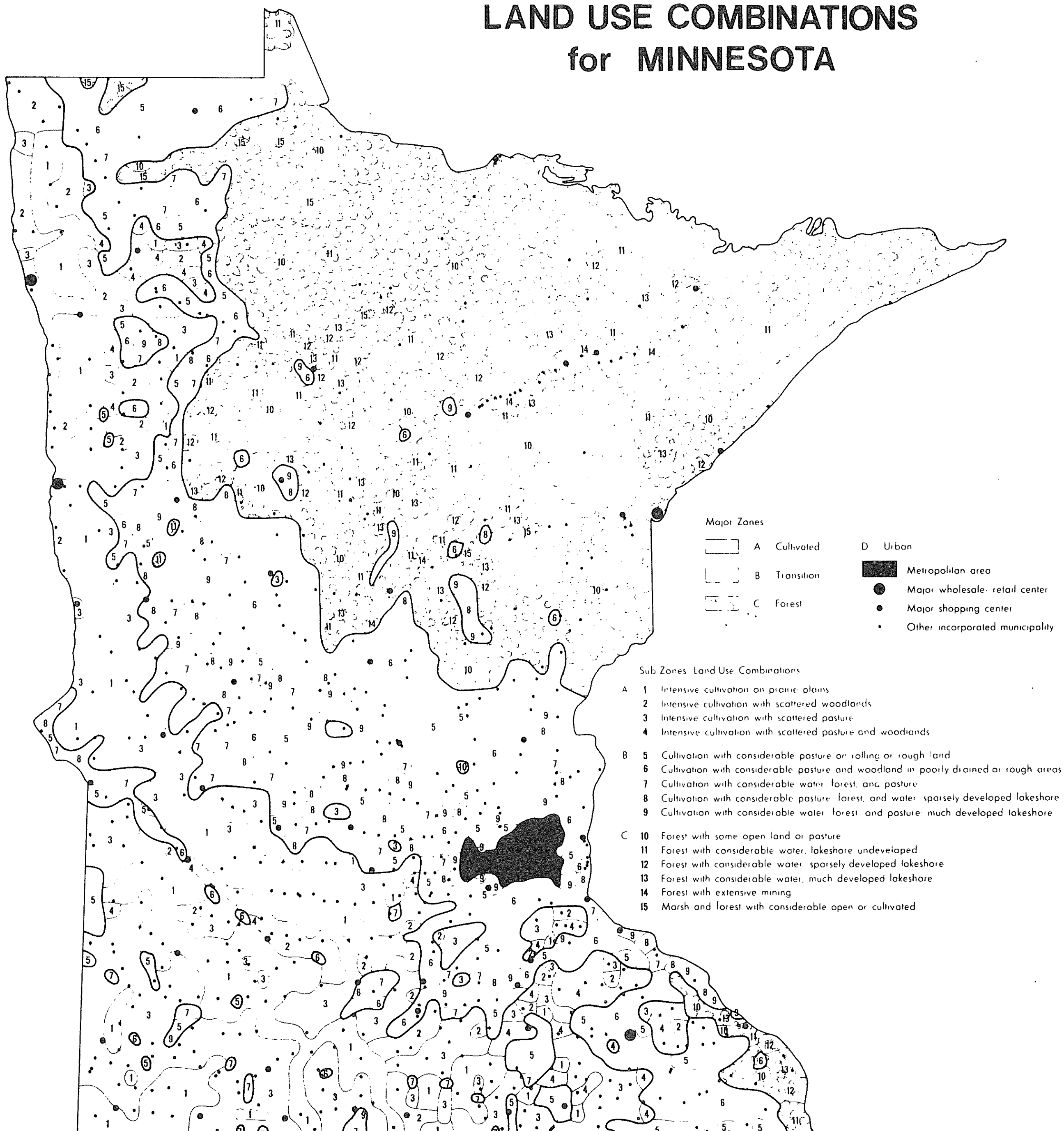
** Perspective on Minnesota Land Use-1974, Report Number 6. Borchert, John R., et al. Minnesota State Planning Agency-University of Minnesota, Center for Urban and Regional Affairs; October, 1974.

The original LUC variable identified 18 distinct LUC types that occur within the state's four major land use zones; 1) Agriculture, 2) Transitional, 3) Forestry and 4) Urban. In essence, the LUC variable "regionalizes" the general setting of a river segment. Figure 1 shows the statewide location of the LUC's and Table 1 lists the landscape descriptions of the LUC types. The river classification effort utilized 16 of the 18 LUC zones, combining LUC 17 and 18 with LUC 16 to produce a single urban LUC.

Data from the LUC variables were used to assign Land Use (LU) Labels to river segments. The LU Label for any given segment corresponded to the LUC descriptor (from Table 1) assigned to the MCD containing the river segment. For example, a river segment entirely within an MCD with a LUC description of 10 (Forest) would be labeled as LU 10. When river sements were in two or more MCD's, the LU label assigned to the segment depended on which MCD contained the majority of the segment. For example, if 75% of a segment was in an MCD with a LUC of 9, a label of LU 9 was assigned to the entire segment. The result was a data file of 1278 LU Labels, one for each river segment based on the LUC descriptors for MCDs.

Figure 1 – Appendix II

LAND USE COMBINATIONS for MINNESOTA



Source: Borchert, John R., et. al.

Table 1 — Land Use Combinations Used to Characterize Different Minor Civil Divisions (Rural Towns and Incorporated Municipalities) in Minnesota

Land Use Combination	Land Use Dominant on Greatest Acreage	Land Uses Present in High Percentage Compared with State Total	Other Land Uses Present in Moderate Percentages Compared with State Totals	Other Uses Present on Small But Significant Acreage	Landscape Description
Cultivated Zone					
1	Cultivation	Cultivation		Open, Extractive	Intensive cultivation on prairie plains
2	Cultivation	Cultivation		Forest, Open, Extractive	Intensive cultivation with scattered woodlands
3	Cultivation	Cultivation	Open	Water, Marsh, Extractive Open	Intensive cultivation with scattered pasture
4	Cultivation	Cultivation	Open	Forest, Marsh, Extractive	Intensive cultivation with scattered pasture and woodlands
Transition Zone					
5	Cultivation		Cultivated, Marsh, Open	Forest, Water, Extractive	Cultivation with pasture on rolling or rough land
6	Cultivation		Forest, Cultivated, Marsh,Open	Water, Urban, Extractive	Cultivation with pasture and woodland on poorly drained or rough areas
7	Cultivation	Water, Marsh	Forest, Cultivation	Open	Cultivation with water, forest, and pasture
8	Cultivation	Water	Forest, Cultivation, Marsh, Open	Urban	Cultivation with forest, pasture, and water; sparsely developed lakeshore
9	Cultivation	Water	Forest, Cultivation, Marsh, Urban, Open	Extractive	Cultivation with water, forest, and pasture; much developed lakeshore
Forest Zone					
10	Forest	Forest	Marsh	Cultivation, Water, Urban, Open	Forest
11	Forest	Forest, Water	Marsh	Open	Forest with lakeshore undeveloped
12	Forest	Forest, Water	Marsh	Urban, Open	Forest with sparsely developed lakeshore
13	Forest	Forest, Water	Urban	Marsh, Extractive, Open	Forest with much developed lakeshore
14	Forest	Forest, Extractive	Water, Urban	Open, Cultivation	Forest with extensive mining
15	Forest	Marsh	Forest, Open	Cultivation	Marsh and Forest
Urban Zone					
16	Urban	Urban	Open	Cultivation, Forest	Urban Development with Scattered Farmlands and Woods
(17) 16	Urban	Urban	Water	Open, Forest	Urban Development with Some Lakeshore
(18) 16	Urban	Urban		Forest, Open, Cultivation	Dense Urban Development

Source: Borchert, John R., et. al.

2) <u>Minnesota DNR Land Suitability Project</u>

The Suitability Project is a multi-faceted program that evaluates and classifies all state-owned DNR-administered land, for its ability to serve a variety of public functions. The information collected from this effort will be used by the DNR to determine best uses of land and aid ongoing natural resource management programs. One aspect of the Suitability project is to assess recreational suitability of DNR-administered lands.

To assess recreational suitability, DNR staff began with an approach called the Recreational Opportunity Specturm (ROS), originally developed by the U.S. Forest Service*. Staff modified the Forest Service approach to fit the range of Minnesota environments and available data.

The Minnesota ROS classes as applied to each river oriented parcel were defined as composites of two variables: 1) accessibility to the road network, and 2) land use/cover. Each of these two variables was initially placed into a continuum of classes (see next three pages) and the composite of the two continua was used to define ROS classes. Road and land use/cover data were taken from the files of the MLMIS.

A. <u>CONTINUUM OF ROAD ACCESSIBILITY CLASSES</u>

Source: 1978 Minnesota Department of Transportation highway maps.

Road types: Controlled access or interstate highway; other four-lane highway; two-lane state or federal highway; two-lane county road; unpaved road; and urban street network.

* ROS Users Guide, United States Department of Agriculture - Forest Service. (Also see: The Recreation Opportunity Spectrum: A Framework for Planning, Management, and Research, General Technical Report PNW-98. Clark, Roger N. and George H. Stankey. USDA-Forest Service, Pacific Northwest Forest and Range Experiment Station, December, 1979.)

Land use/cover Class		Description
1	Natural	100% of the river oriented parcels comprised of forest, marsh or water cover.
2	↓	93% of the river oriented parcels comprised of forest, marsh, or water cover; the remaining parcel could be any other use/cover.
3	↓	75% of the river oriented parcels comprised of forest, marsh, pasture, open, or water cover; the remaining parcels could be any other use/cover.
4	↓	75% of the river oriented parcels comprised of forest, marsh, pasture, open or water or cultivated; the remaining parcels could be any othr use/cover.
5	Artificial	31% of the river oriented parcels comprised of urban residential, urban non-residential, transportation or extractive; the remaining parcels could be any other use/cover.

	Class	Description
1	Inaccessible	Greater than 3 miles from any road
2	↓	Between 1/2 and 3 miles from any road
3	↓	Greater than 1/2 mile from a paved road, but within 1/2 mile of a gravel road
4	Very Accessible	Within 1/2 mile of a paved road, and can also be within 1/2 mile of gravel road

One of the above road accessibility classes was assigned to each 40-acre river-oriented parcel, within a given river segment.

B. CONTINUUM OF LAND USE/COVER CLASSES

Source: Land uses/covers were interpreted from 1968 and 1969 1:90,000 aerial photos (equal to MLMIS data base).

Land uses/covers: forest, marsh, water, pasture or open, urban residential, urban non-residential or mixed residential, transportation, extractive and cultivated.

Based on the mix of the above land use/cover types for all of the river-oriented 40-acre parcels within the segment, a single land use/cover class was assigned to all of the 40-acre parcels in the segment, according to specific class criteria which is listed on the next page. It is important to note that this differs from the MLMIS Land Use Combination (LUC) variables for the following reason: The MLMIS - LUC variable for a given segment is a representation of the land uses/combinations of an entire MCD (all 40-acres cells of a MCD). By contrast, the continuum of land use/cover classes, is directly related to only the 40-acres parcels that are river oriented. The resultant land use/cover class more accurately represents the segment's land use and cover, while the LUC variable helps regionalize the segment in terms of all land uses and landscapes of the state.

At this point, a pair of class descriptions from each continua (road accessibility: land use/cover) existed for each forty-acre parcel within a segment. It must be emphasized that within a given segment, each 40-acre parcel may have 1 of 4 road accessibility class but all parcels in the segment have the same land use/cover class. To establish the ROS Label for each 40-acre parcel in the segment, the criteria listed below were used:

Recreation Opportunity Spectrum (ROS)	- equals -	Road Accessibility Class(es)	- plus -	Land use/cover Class(es)
1	Primitive	1		1
2	Semi-Primitive-Remote from	1		2
	Roads	2		1
		2		2
3	Semi-Primitive-Roaded	3		1
		3		2
4	Natural-Remote from Roads	1		3
5	Natural-Roaded	3		3
		4		1
		4		2
		4		3
6	Rural	Any		4
7	Intensive Land Uses	Any		5

Finally, given that each 40-acre parcel in the segment has a ROS Class, the dominant ROS Class of all 40's for the segment was used to characterize the entire segment.

APPENDIX III

PHYSICAL DATA

This appendix describes the method for collecting physical data from the 1278 river segments.

The data base was compiled from manual measurement of USGS 7 1/2 minute topographic maps for each of the 157 rivers in the sample. Measurements of valley width, valley depth, gradient, and structure (natural meander or channelized) were made.

These measurements were made at the beginning point of each river segment. Valley width and valley depth measurements were made along a transect drawn at right angles to stream flow at the sample point. Gradient and structure were measured over the course of the whole segment. The following paragraphs explain in detail how each of the above variables were measured and how the resultant data were arranged into physical classes for further analysis.

Valley Width

This parameter measured the horizontal distance along the transect between the blufftops associated with a river valley. The blufftops are defined as the point where land slopes change from more than 12% (12 ft. rise for 100 ft. of horizontal distance) to less than 12%. In instances where a blufftop only occurs on one side of the river or blufftops are non-existent (land slopes of less than 12%) the particular condition was noted. (The various breakdowns of valley width classes are listed along with valley depth classes on the last page of this appendix.)

Valley Depth

Valley depth was measured along the transect as the average elevational difference between the left and right blufftops and the left and right bluff bases. Bluff bases are defined as the point at which the slope first changes from less than 12% to more than 12%. In instances where valley depths could not be established (lack of slopes over 12% or only one bluff present) the condition was noted.

River Gradient

This variable was used to identify those segments where high gradients may indicate recreationally significant or environmentally sensitive areas deserving special protection and management. Gradient is defined as the difference in altitude between the beginning and end point of each segment, over the distance from the beginning to the end point of the segment. The result is a value of "X" meters fall/kilometer. Distance measurements were made according to the DNR river kilometer indexing (RKI) system. In the RKI system, distance is measured along the centerline of a stream. A segment was considered as a high gradient segment if the gradient value was greater than or equal to 3 meters fall/river kilometer (16.6 ft. fall/river mile).

River Structure

The river structure variable was used to identify areas of channelized or modified segments as compared to meandering or unmodified segments. The USGS maps were scanned for one mile upstream and downstream of the physical data sampling point. Channelized streams were noted as those that are labeled as ditches or have otherwise been obviously modified.

The final result of Physical data collection from the sample segments is formulation of seven physical labels that describe physical characteristics of Minnesota.

Based on the preceding discussion, the measurements from a segment were compared to the 7 Physical Labels listed below to determine which Label represented the segment's measurements.

1. Moderately to Very Wide and Deep Valleys
   (>1000m. [3300 ft.] wide & ≥26 m. [85.8 ft.] deep)
2. Moderately Wide and Deep Valleys
   (250-1000m. [825-3300 ft.] wide & 26-100m. [85.8-330 ft. deep)
3. Moderately to Very Wide and Shallow Valleys
   (≥250m. [825 ft.] wide & ≤25m. [82.5 ft.] deep)
4. Narrow and Shallow Valleys
   (<250m. [825 ft.] wide & <25m. [82.5 ft.] deep)
5. No Valley or Bluff only on one side (Headwaters)
6. Steep Gradient Segments
   (≥3m. fall/river kilometer [16.6 ft. fall/river mile]
7. Ditched or Channelized Segments

Valley width, depth and river gradient and structure measurements were taken from all segments. However, in order to identify high gradient or channelized segments, all segments were first screened for occurrence of high gradient or channelized conditions. If neither condition occurred (in no case did both occur) the segment's valley width and depth measurements were then labeled according to the remaining 5 labels.

APPENDIX IV

DEVELOPMENT DATA

The development data used in Step 5 were collected at the county level of government, using the following procedure. Staff assigned to the Minnesota Shoreland Update Project obtained the transparencies used to produce the Minnesota Department of Transportation's Blue Line (1977) imagery. (The imagery was obtained from high-altitude, high-resolution panchromatic aerial photography, and the scale of the transparancies and Blue Lines is 1:24,000).

The transparencies were scanned for occurrences of 2 or more residential dwelling sites per river oriented* parcel or recorded government lots for all rivers and streams statewide (in excess of the 157 inventory rivers). Development occurrences were noted according to legal descriptions (county, town, range, section, QQ and Gov. Lot). The resulting list of occurrences was taken to the county assessor's office during 1981 and 1982, where development data maintained at the same level of resolution (40-acre parcel or Government Lot) are more current than the information obtained from the 1977 blue line imagery.

Development occurrences (seasonal or permanent structures within the river oriented parcels) were then recorded consistent with the assessor's records. In cases where new development was observed in parcels adjacent to the original list of parcels prepared from the 1977 imagery, entries of the development occurrences for those parcels were made and other adjacent parcels were scanned until a level of 2 or more developments per parcel was not observed.

This effort produced a computerized list of the numbers of seasonal on-shore and off-shore and permanent on-shore and off-shore residential structures. The occurrences on the list could then be coded to the corresponding river segment when the development occurred on a sample river.

* A river oriented parcel is defined as a 40-acre public land survey division of land that the watercourse touches.

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