DRAFT

Zumbro River

Resource Analysis

DNR Office of Planning
Rivers Section
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PREFACE

This resource analysis of the Zumbro River was prepared by the Department of Natural Resources, Rivers Section.

The purpose of the Zumbro River resource analysis was twofold: first, to inventory and evaluate the natural resources, cultural resources, existing development and recreation facilities; and second, to determine their need for protection.

Data for the resource analysis were obtained from a variety of sources. The Minnesota Land Management Information System (MLMIS) provided information (based on 40 acre cells) on soil type, vegetation, land use, and land ownership. Additional land use data obtained from 1980 U.S. Agricultural Stabilization Conservation Service (ASCS) colored slides were also coded on the basis of 40 acre cells and added to the MLMIS data. Computer maps based on these data were generated by the DNR, Section of Policy and Research.

The "Environmental Geology of the Zumbro River," a study by the winter quarter 1980 Environmental Geology class of Dr. H. O. Pfannkuch, University of Minnesota, provided data on the geology and hydrology of the river.

Information on forest cover type within the river corridor was provided by DNR area foresters.

Field investigation by DNR river staff included an inventory of the Zumbro from Rochester to Mississippi by canoe, observation of the forks of the Zumbro from roads and bridge crossings, and an aerial flight over the river.

Other data sources included DNR regional staff at Rochester and Lake City, the DNR Division of Waters, The DNR Natural Heritage Program, the state Pollution Control Agency, and the Minnesota Historical Society.

AN OVERVIEW OF THE ZUMBRO RIVER

The Zumbro River is located in southeastern Minnesota. Its 1,428-square-mile watershed encompasses portions of Goodhue, Dodge, Olmsted and Wabasha counties.

The three forks of the Zumbro, the North, Middle and South, are each approximately 50 miles in length. The North Fork begins in southeastern Rice County and flows east to the main stem six miles downstream of Mazeppa. The Middle Fork begins in Dodge County and joins the South Fork south of Zumbro Lake. The South Fork begins in Dodge County and flows north through Rochester to Zumbro Lake. The main stem flows east 55 miles from its junction with the North Fork to join the Mississippi River near Kellogg.

The forks flow primarily through flat agricultural land, although bluffs are located adjacent to the river in some areas. The topography becomes more rugged on the main stem. Between Zumbro Falls and Theilman steep wooded bluffs adjacent to the river rise 150 feet. Between Theilman and Kellogg the floodplain widens and the bluffs appear more distant. The last five miles of river, from Kellogg to the Mississippi, have been channelized. Agriculture is practiced on the uplands and on the floodplain adjacent to the river.

The river valley provides a variety of recreational opportunities, including canoeing, fishing, hunting, camping, trail activities and picnicking. Numerous accesses and parks are located along the river.

The Zumbro River flows through the Richard J. Dorer Memorial Hardwood Forest, the largest state forest in Minnesota. The forest was established in 1961. Its boundaries encompass 38,000 acres of land. The goals of the forest management are to grow, manage and harvest timber and other forest resources, to develop recreation areas, to protect watersheds and to preserve rare plant and animal habitats. Land will be acquired in the pursuit of these goals to achieve the optimum mix of ecological, economic and social factors.

The banks of the Zumbro are generally vegetated and the water quality is good. The forests are predominantly lowland hardwoods and oak. Prairies are located on the steep south- and west-facing slopes. An abundance of wildlife is found in the valley, including some rare species in need of protection. One such species is the wood turtle, whose numbers are declining as its habitat is destroyed. There are also some rare plant species in the valley. The most notable is the Minnesota trout lily, found nowhere in the world except in Goodhue and Rice counties.

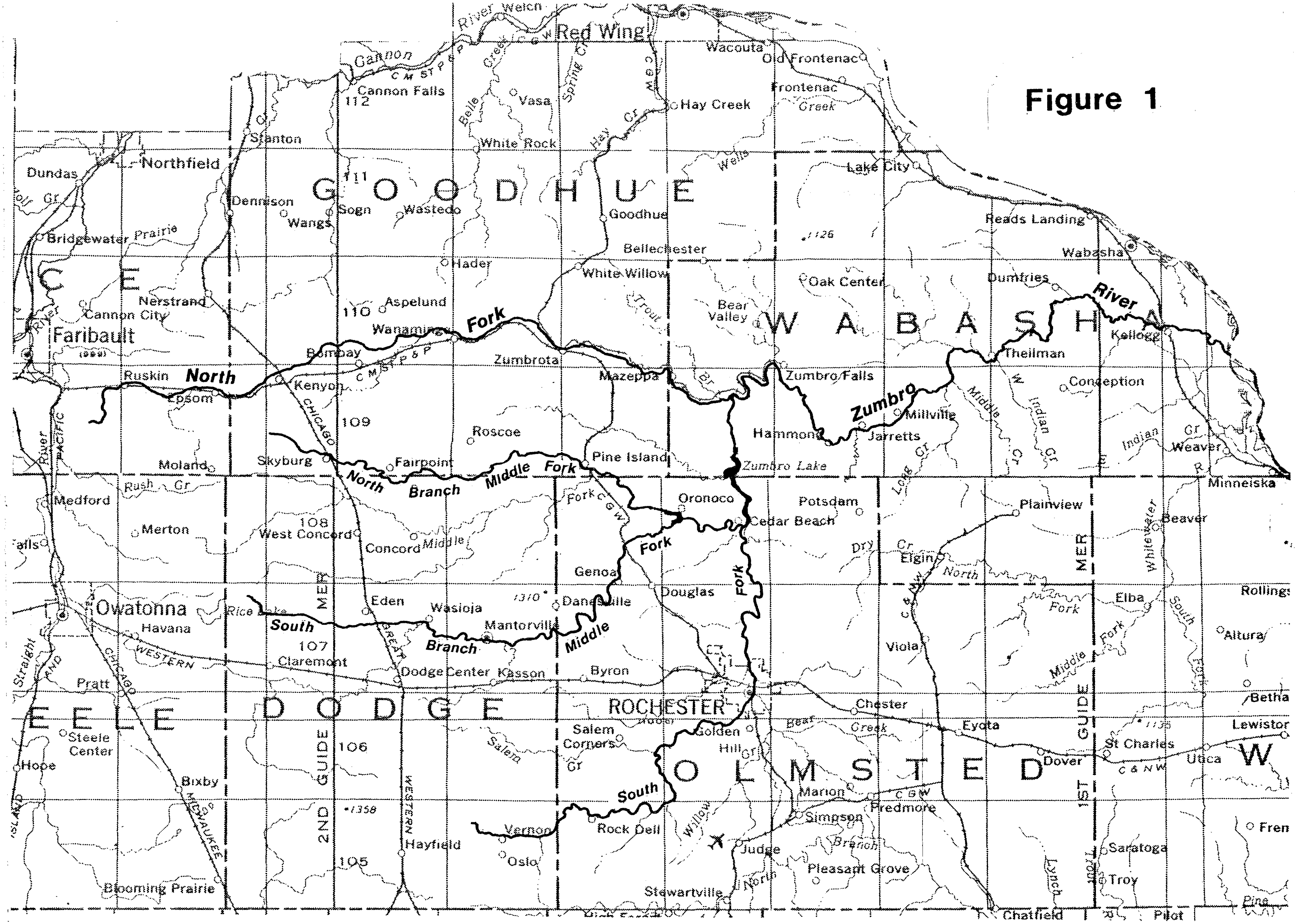


Figure 1

Zumbro River - Location Map

The river flows through a number of communities, which range in size from Rochester, population 54,287, to Millville, population 186. Urban development is limited to these communities and the shore of Zumbro Lake. The many historic sites in the river corridor recall the region's colorful history.

The attributes of the Zumbro River combine to make it one of the outstanding resources of the state. This report describes the Zumbro's resources and discusses those factors which can adversely affect the river.

CLIMATE

The Zumbro River valley is affected by the same weather patterns that affect the climate of the entire state. Minnesota's continental climate is influenced by cold Arctic air masses in the winter and warm Gulf of Mexico air masses in the summer. Because of its southern location in the state, winter temperatures in the Zumbro River valley average 10^{o} warmer than those in the northern third of the state. However, summer temperatures are similar to those of the rest of the state. The annual growing season within the watershed is about 140 days.

Average temperatures (Rochester)	mean minimum	mean maximum
Winter	7^{o}F	25^{o}F
Summer	57^{o}F	81^{o}F

Precipitation directly affects the water flow of the Zumbro River. Flash floods, especially in the Rochester area, are common during spring melt runoff and heavy rainfalls. The average annual precipitation is 28 to 32 inches, 40 percent of which falls during the summer months. Only 20 percent of the total annual precipitation is in the form of snow. For the winter of 1978-79 the average snow depth ranged from 10 to 20 inches.

Several microclimates exist within the Zumbro River valley because of diverse topography, soil and vegetation. The greatest microclimate differences are between the north- and south-facing slopes. The different amounts of solar energy these slopes receive greatly influence the moisture and temperature of the area. South-facing slopes receive the most solar energy, while north-facing slopes receive the least.

Vegetation is the most visible indicator of these differences. Hill prairies, or "goat" prairies, are commonly found on the south- and west-facing slopes, while rich forests of sugar maple and elm are found on the north- and east-facing slopes.

On sunny days, the steep south- and west-facing slopes are continuously exposed to the sun's rays. During the winter this causes the ground to thaw and freeze repeatedly, which, according to one theory, inhibits woody plant growth. During the summer the sun and wind make these slopes hot and dry. These conditions favor prairie plant species.

The north- and east-facing slopes are moister and cooler both in winter and summer, and are thus more suitable for woody plant growth and development.

Another microclimate exists in the valley bottom or floodplain. This area generally has lower temperatures at night, especially in the winter, and much higher temperatures during the day, especially in the summer. Steep slopes protect the valley floor from the cool winds that circulate in the uplands. During the day, the valley air is warmed by the sun. After sunset, cool air from the uplands flows down the slope into the valley and the warm valley air rises. When the warm air and cool air meet, fog is formed in the valley.

Late spring and early fall frosts are common in the valley bottom. In the spring and fall the valley floor rapidly gives off heat on still, cold nights and cold air flows in from surrounding higher levels. This sometimes results in ground temperatures 15^{o} lower than those of the surrounding terrain, resulting in frost pockets and shortening the growing season.

GEOLOGY

Bedrock geology

The Zumbro River has eroded down through 500 feet of rock formations whose characteristics have affected the river's path and the shape of the Zumbro valley. These rocks form the valley walls and cliffs and can occasionally be seen as rock outcrops. Outcrops occur infrequently on the uplands and valley bottom. They are found primarily on the steeper valley slopes. According to a study which mapped outcrops in a portion of the valley, there are 12 outcrops within one mile of the riverbank between Kellogg and Millville, two between Millville and Hammond, 11 between Zumbro Falls and Mazeppa, five between Mazeppa and Zumbrota and three miles upstream of Zumbrota. These outcrops provide information about the geologic history of the area as well as the aesthetic quality of the river.

The bedrock underlying the Zumbro River consists of sedimentary rocks formed during the Paleozoic era between 500 million and 200 million years ago. Oceans covered southeastern Minnesota during the Cambrian and Ordovician periods of the Paleozoic era. The sedimentary rocks formed in these seas are found in the Zumbro valley today. Figure 2 describes these sedimentary rocks. The oldest rock layers are listed first.

The Zumbro valley's width is directly related to the bedrock formations through which the river cut its path. Near Zumbro Falls, where the valley is about a quarter mile wide, the river cuts through the Shakopee-Oneota Formation, which is primarily dolomite. The hardness of the formation is reflected in the steepness of the valley walls. Halfway between Hammond and Millville, where the valley widens to a half mile, the river cuts into the softer Jordan sandstone. The river valley continues to widen through the Jordan and through the St. Lawrence and Franconian formations beneath it. When the river reaches the sandstone Dresbach Formation, between Theilman and Dumfries, it widens still more. On reaching the Mississippi valley near Kellogg, the river valley walls are about 1.5 miles apart.

Figure 2. Bedrock geology.

Rock Formation	Members	Description
Dresbach	Galesville Sandstone	white to light gray medium-grained quartz sandstone; well to moderately well sorted
Franconia	Ironton Sandstone	white medium-grained quartz sandstone with silt; moderately well sorted
	Birkmose	fine-grained quartz sandstone that is worm bored and contains a greenish silicate of iron and potassium (glauconitic); some silty and dolomitic layers are present
	Tomah	fine-grained silty quartz sandstone which contains crystals of feldspar in certain areas, and is locally glauconitic
	Reno	fine-grained quartz sandstone that is worm bored and glauconitic
	Masomanie	thin, cross-bedded quartz sandstone; find to coarse grained and contains dolomite
St. Lawrence (approximately 60 feet thick in the Zumbro area)	Black Earth	a silty or sandy dolomite which contains more than 90% dolomite and is glauconitic
	Lodi	dolomitic siltstone and sandstone with less than 70% dolomite; slightly glauconitic
Jordan (70-100 feet thick)	Van Oser	white or yellow coarse- to medium-grained quartz; commonly exposed in the Zumbro area as a brown, gray or white cliff

Rock Formation	Members	Description
Oneota		light brown or buff dolomite, fine to medium grained; occurs most often as rock outcrops along the Zumbro. Geodes, commonly lined with quartz and less frequently with calcite, are abundant in certain beds. Cavities and caverns have been formed in the dolomite as water circulated through cracks and joints and dissolved the dolomite
Shakopee		Buff-colored dolomite; few exposures in the Zumbro area
St. Peter Sandstone		light yellow or white medium-grained sandstone; does not outcrop along the river, but can be seen on top of bluffs at higher elevations north and south of Hammond

There is an interesting geologic feature near Mazeppa. Oneota dolomite is found at river elevation at Mazeppa. Three miles to the southeast, Jordan sandstone outcrops are present 100 feet above river level. This is unusual in that the Oneota dolomite is younger than the Jordan sandstone and thus should be located above it. One possible explanation is that a fault zone is located in this area. The rock layers fractured, and subsequent movement displaced them.

Surface geology

The Zumbro River is located in the "driftless area," one of the most interesting geologic regions in Minnesota. This area encompasses 10,000 square miles in adjoining parts of Minnesota, Wisconsin, Iowa and Illinois. The driftless area is so called because it was not covered by ice during the most recent glacial advances (the Wisconsin period of glaciation, 100,000-10,000 years ago). However, glacial action is responsible for the formation of the existing landscape features.

During the retreat of the last glacier, the Red River valley to the northwest was occupied by an immense lake, Glacial Lake Agassiz. Blocked by ice to the north, this lake drained southeastward through the Glacial River Warren, carving out the broad valley through which the Minnesota River now flows. The River Warren joined the Mississippi River near the site of Fort Snelling and combined with glacial meltwater draining from the Upper Mississippi and St. Croix basins. This enormous volume of meltwater drained down the course of the present-day Mississippi River, which cut its channel progressively lower. The elevation of the floor of the Mississippi determined the base level to which its tributaries could erode their valleys. Therefore, the Mississippi River tributaries, including the Zumbro, cut correspondingly deep channels into the layers of Paleozoic sedimentary rocks. The lower base level of the Mississippi River, in addition to increased runoff draining down the Zumbro River during glacial times, accounts for the large size and depth of the Zumbro River valley.

As the Wisconsin glacial period was ending and the flow of meltwater was decreasing, the Mississippi and its tributaries, including the Zumbro, deposited much of their load of sediments. Broad floodplains were formed at a level higher than that of the present-day floodplains.

Resumed downcutting left these old valley floors perched as terraces on the sides of the river valley. The terrace materials are predominantly stratified sands and gravels. The most obvious terrace of the Zumbro River is apparent just above the town of Kellogg, at a level roughly 60 feet above the existing floodplain. This particular terrace can be traced upstream as far as Zumbro Falls at decreasing heights above the present-day floodplain. There are also indications of additional, more steeply sloping terraces at higher levels of the valley walls.

The extensive ice advance during the Wisconsin glaciation blanketed surrounding lands with a thick layer of glacial drift. Strong winds blowing off the retreating ice mass picked up large amounts of very fine rock debris from the glacial drift and redeposited it elsewhere. The uplands surrounding the Zumbro River are covered by a widespread layer of this windblown rock flour, called loess. The loess is an unstratified layer of buff-colored silt generally 8 to 10 feet thick. The loess is of Wisconsin age, but may be underlain in places by drift from an earlier period of glaciation, likely either Iowan or Kansan. In most places near the Zumbro River, the loess rests directly on the underlying sedimentary bedrock.

As the Zumbro River leaves its deeply incised valley, it crosses a flat alluvial plain downstream of Kellogg. This alluvial plain represents an old channel of the Mississippi, possibly the main channel at one time, that has since filled in with sediment. Between this relict channel and the present day channel of the Mississippi is an area of low sand hills known as the Sand Prairie. Before the 20th century, the Zumbro River flowed both north and south across this alluvial plain to reach the Mississippi. Examination of aerial photos reveals widespread relict meanders across this plain. In 1909, however, the channel of the Zumbro River was realigned by local interests so that it flowed more or less due east across this alluvial plain and the Sand Prairie to join the Mississippi River. This action reduced flooding somewhat in Kellogg, and opened up the fertile alluvial sediments for agriculture. Between 1954 and 1957, local farmers constructed a series of parallel lines along this lower reach of the river to reduce flooding of the now developed farmland. The channel improvement and levee system were both upgraded by the Corps of Engineers in 1974, principally to reduce flood damages at Kellogg.

Topography

The elevation along the Zumbro River ranges from a maximum of nearly 1,300 feet above sea level at its headwaters to 665 feet above sea level at its confluence with the Mississippi. Over the 49 river miles of the main stem of the Zumbro from Zumbro Falls to the mouth the elevation drops 157 feet. The average gradient in this stretch is 3.2 feet per river mile.

The valley of the lower Zumbro River exhibits very rugged topography. Near Kellogg, the difference in elevation between the valley floor and the upland surface exceeds 500 feet. This elevation difference decreases upstream, to 200 to 300 feet near the community of Zumbro Falls. Near Zumbro Falls the valley displays a V-shaped cross-section, while the lower end of the valley exhibits steep walls separated by a broad, flat floodplain. This is because the deep, V-shaped valley cut into bedrock during Pleistocene times (2 million-70 million years ago) was filled in by river alluvium. In the vicinity of Kellogg, this alluvium exceeds 200 feet in depth.

Accompanying the large elevation differences in the valley of the lower Zumbro River are very steep slopes on the valley walls, some in excess of 100 percent (i.e., greater than 45^{o}). These steep slopes are generally found only on outcrops of bedrock. The slopes of the valley walls are more typically in the 20 to 60 percent range. The gently rolling upland surface is nearly level to moderately steep with slopes of 5 to 20 percent found on the broad upland ridges and bluff tops. The slope of the principal glacial stream terrace just upstream of Kellogg ranges from 0 to 10 percent and averages roughly 5 percent. The slopes of possible additional terrace deposits are somewhat higher, in the 10 to 25 percent range. The floodplain of the Zumbro River, particularly near its confluence with the Mississippi River, is very flat with slopes of less than 5 percent.

Much of the research for this section was done by the winter quarter 1980 Environmental Geology class taught by Dr. H. O. Pfannkuch, Geology and Geophysics Department, University of Minnesota.

SOILS

An inventory and analysis of soils is necessary to understand the potential for agricultural and structural development adjacent to the Zumbro River. Existing and potential erosion, flooding, pollution and other problems can be better understood and predicted from an analysis of soils data.

Figure 3 illustrates the soil landscape units located within one-half mile of each side of the river. The data were obtained from the Minnesota Soil Atlas, St. Paul Sheet, developed by the University of Minnesota Department of Soil Science in cooperation with the U.S. Soil Conservation Service and the Agricultural Experiment Station.

Soil landscape units are groups of soils which have been aggregated because of similarities in subsurface soil texture, surface soil texture, drainage characteristics and surface color. A four-letter symbol is used to represent each soil landscape unit. Each letter represents a description of one of the above four characteristics.

The first letter represents characteristics of the subsurface soil (five feet or deeper):

S sandy
L loamy or silty
R bedrock

The second letter represents the surface soil texture:

S sandy
L loamy or silty
C clayey

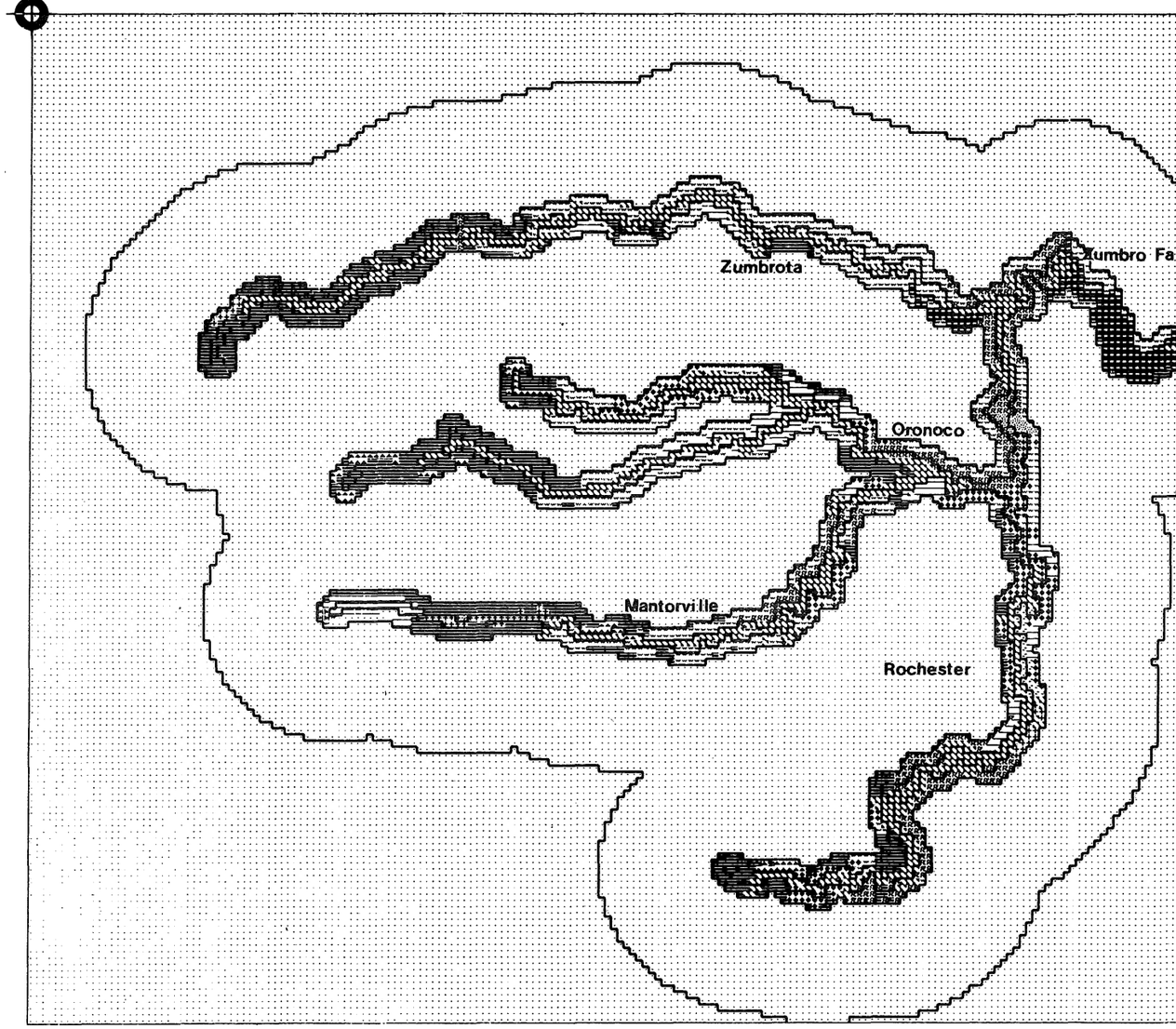


Figure 3

SOIL LANDSCAPE UNITS

DESCRIPTION: A SOIL LANDSCAPE UNIT IS A GROUP OF SOILS GENERALIZED INTO A HOMOGENEOUS UNIT BASED ON SUB-SURFACE SOIL TEXTURE, SURFACE SOIL TEXTURE, DRAINAGE CHARACTERISTICS, AND SURFACE COLOR. COMBINATIONS OF THESE FOUR CHARACTERISTICS DESCRIBE UNIQUE SOIL TYPES IDENTIFIED BY A FOUR-LETTER SOIL CODE KEYED TO THE FOUR SOIL CHARACTERISTICS NOTED ABOVE.

SOURCE DATA: THIS DATA WAS OBTAINED FROM 1970-1976, 1:250,000 PRELIMINARY MINNESOTA SOIL ATLAS SHEETS DEVELOPED BY THE DEPARTMENT OF SOIL SCIENCE, UNIVERSITY OF MINNESOTA, IN COOPERATION WITH THE U.S. SOIL CONSERVATION SERVICE. THE SMALLEST AREA SHOWN IN THE ATLAS FOR WHICH RELIABLE INFORMATION IS AVAILABLE IS APPROXIMATELY 600 ACRES. SOIL UNITS LESS THAN 600 ACRES MAY BE DISPLAYED ON ATLAS MAPS BUT ARE NOT IDENTIFIED WITH COMPLETE CONFIDENCE. SOURCE DATA IS CURRENTLY AVAILABLE AS PUBLISHED MAPS AT A SCALE OF 1:250,000 FROM THE MINNESOTA SOIL ATLAS PUBLISHED BY THE AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF MINNESOTA, OR FROM THE BULLETIN ROOM, COFFEY HALL, UNIVERSITY OF MINNESOTA, ST. PAUL, MN.

DATA CLASSES: DATA IS RECORDED AS A 2-DIGIT CODE OF THE VARIOUS COMBINATIONS OF SOIL TEXTURE, DRAINAGE AND COLOR.

SYMBOL	COUNT	PERCENT	ACRES	LEGEND
0	40447	89.8	1617880.0	
1	380	0.8	15200.0	RLWL
3	926	2.1	37040.0	LLWL
4	46	0.1	1840.0	SSWL
5	5	0.0	200.0	PEAT
10	16	0.0	640.0	LLPL
20	1206	2.7	48240.0	AAAA (ALLUVIAL SOILS)
45	71	0.2	2840.0	LLPD
47	277	0.6	11080.0	SLWD
48	868	1.9	34720.0	LLWD
49	13	0.0	520.0	SSWD
50	57	0.1	2280.0	SLPD
55	303	0.7	12120.0	RLWD
59	449	1.0	17960.0	SSRR (STEEP, STONY, ROCKY LAND)

Figure 3

The third letter represents drainage characteristics:

W	moderately well-, well-and excessively drained soils
P	somewhat poorly, poorly and very poorly drained soils

The color of the surface soil is represented by:

D	dark-colored soils
L	light-colored soils

For example, a soil landscape unit denoted RLWL has a bedrock subsurface, a loamy or silty surface soil, is moderately well, well, or excessively drained and is light colored.

There are three soil landscape units to which this key does not apply. They are SSRR (steep, stony, rocky), AAAA (Alluvial soils) and PEAT (partly decayed plant matter).

Most agricultural land use is located in the LLWD landscape unit, which dominates the upper reaches of the forks of the river. The SSRR soil landscape unit is located downstream of Zumbro Falls, where the steepest bluffs are located. The floodplain areas can be identified by the AAAA (alluvial soils) landscape unit. The Soil Conservation Service has established limitations for development based on soil suitability. Figure 4 illustrates the suitability of the soil landscape units for development. This chart was developed by combining the suitabilities of all the major soil types which compose the soil landscape unit.

Figure 4. Soils suitability; restrictions to structural development.

Soil Landscape Unit	Erosion Hazard	Frost Potential	Buildings Without Basements	Buildings With Basements
RLWL	0-12% slope-slight 12-30%-moderate 30+%-severe	moderate to high	0-8% slope-moderate (shrink-swell, depth to rock) 8-15%-moderate (slope, shrink-swell, depth to rock) 15+%-severe (slope)	0-8% slope-moderate (shrink-swell, depth to bedrock, slope) 8-15%-moderate (depth to bedrock, slope, shrink-swell) 15+%-severe (slope)
LLWL	0-15% slope-slight 15-35%-moderate 35+%-severe	high	2-8% slope-moderate (shrink-swell) 8-15%-moderate (slope, shrink-swell) 15+%-severe (slope)	2-8% slope-slight 8-15%-slope moderate (slope) 15+%-severe (slope)
SSWL	2-12% slope-slight 12-35%-moderate 35+%-severe	low	2-8% slope-slight 8-15%-moderate (slope) 15+%-severe (slope)	2-8% slope-moderate (depth to rock) 8-15%-moderate (depth to rock, slope) 15+%-severe (slope)
PEAT	slight	high	severe (high water table, low bearing capacity, low shear strength, high compressibility)	severe (same as for without basements)
LLPL	slight	high	severe (wetness)	severe (wetness)

Soil Landscape Unit	Sewage Lagoons	Septic Tank Absorption Fields	Permeability
RLWL	0-7% slope-severe (depth to rock, seepage) 7+% - severe (depth to rock, seepage, slope)	0-15% slope-severe (depth to rock, poor filter) 15+% - severe (depth to rock, poor filter, slope)	.6-2.0 in/hr
LLWL	2-7% slope-moderate (seepage, slope) 7+% - severe (slope)	2-8% slope-slight 8-15% - moderate (slope) 15+% - severe (slope)	.6-2.0 in/hr
SSWL	2-7% slope-severe (seepage depth to rock) 7+% - severe (seepage, depth to rock, slope)	2-15% slope-severe (depth to rock, poor filter) 15+% - severe (depth to rock, poor filter, slope)	6.0-20 in/hr
PEAT	severe (high water table, more than 30% organic matter)	severe (high water table, very poorly drained)	
LLPL	severe (wetness)	severe (percs slowly, wetness)	.6-2.0 in/hr

Soil Landscape Unit	Erosion Hazard	Frost Potential	Buildings Without Basements	Buildings With Basements
AAAA alluvial soil	slight	high	severe (floods)	severe (floods)
LLPD		high	severe (ponding, low high strength, floods, wetness, shrink-swell)	severe (ponding, floods, wetness, shrink-swell)
SLWD		low	0-8% slope-slight 8-12%-moderate (slope) 12+%-severe (slope)	0-8% slope-slight 8-12%-moderate (slope) 12+%-severe (slope)
LLWD	0-15% slope-slight 15+%-moderate	high	0-8% slope-slight 8-15% moderate (slope) 15+%-severe (slope)	0-8% slope-slight 8-15%-moderate (slope) 15+%-severe (slope)
SSWD	0-12% slope-slight 12-30%-moderate	low	0-8% slope-slight 8-15%-moderate (slope) 15+%-severe (slope)	0-8% slope-slight 8-15%-moderate (slope) 15+%-severe (slope)
SLPD		moderate to high	severe (wetness)	severe (wetness)

Soil Landscape Unit	Sewage Lagoons	Septic Tank Absorption Fields	Permeability
AAAA (alluvial soil)	 severe (floods, wetness)	rare flooding - moderate (floods, percs slowly) severe (floods, wetness)	0.6-2.0 in/hr
LLPD	severe (ponding, wetness)	severe (percs slowly, ponding, wetness)	.6-2.0 in/hr
SLWD	0-7% slope-severe (seepage) 7+% - severe (seepage, slope)	severe (poor filter)	.6-2.0 in/hr (varies with depth)
LLWD	0-2% slope-moderate (seepage) 2-7% - moderate (seepage, slope) 7+% - severe (slope)	0-8% slope-slight 8-15% - moderate (slope) 15+% - severe (slope)	.6-2.0 in/hr
SSWD	0-7% slope-severe (seepage) 7+% - severe (seepage, slope)	0-15% slope-severe (poor filter) 15+% - severe (poor filter, slope)	varies with depth
SLPD	severe (wetness, seepage)	severe (wetness, poor filter)	.6-2.0 in/hr

Soil Landscape Unit	Erosion Hazard	Frost Potential	Buildings Without Basements	Building With Basements
RLWD		moderate	0-8% slope - moderate (shrink-swell) 8-15%-moderate (shrink-swell, slope) 15+%-severe (slope)	0-8% slope - moderate (depth to rock, shrink-swell) 8-15%-moderate (depth to rock, shrink-swell, slope) 15+%-severe (slope)
SSRR (steep, stony, rocky)	0-14% slope-slight 14-25%-moderate 25+%-severe	high	2-8% slope-moderate (shrink-swell, depth to rock) 8-15% - moderate (shrink-swell, depth to rock, slope) 15+% - severe (slope)	2-15% slope-severe (depth to rock) 15+% - severe (slope, depth to rock)

Soil Landscape Unit	Sewage Lagoons	Septic Tank Absorption Fields	Permeability
RLWD	0-7% slope-severe (depth to rock) 7+% slope-severe (depth to rock, slope)	0-15% slope-severe (depth to rock, percs slowly) 15+% slope-severe (depth to rock, percs slowly, slope)	.6-2.0 in/hr
SSRR (steep, stony, rocky)	2-7% slope-severe (depth to rock, seepage) 7+% - severe (depth to rock, slope)	2-15% slope-severe (depth to rock, slope) 15+% - severe (depth to rock, slope)	.6-2.0 in/hr

HYDROLOGY

Information from recording stations along the Zumbro provide data on streamflow (including maximum, minimum and average discharges) and water level elevations. There are three recording stations in operation along the Zumbro. They are located near Rochester, Zumbro Falls and Kellogg.

Fluctuations in streamflow are caused by many factors, but primarily by precipitation and temperature. The highest flows usually occur in the spring as a result of snowmelt runoff. The greatest monthly fluctuation in discharge occurs in March. Low flows occur as a result of low rainfall, which generally occurs in late summer. Low flows also occur during long periods of below-freezing weather. The least monthly fluctuation in discharge occurs in January. In times of low flow the discharge is sustained by the influx of groundwater. Figure 5 summarizes the streamflow record for the discharges on the Zumbro. A definite flow pattern is difficult to determine because of the variables which affect streamflow.

Figure 5. Streamflow.

Station Location	Maximum Discharge	Minimum Discharge	Average Discharge	Drainage Area	Years of Record
South Fork, near Rochester	30,500 cfs	8.4 cfs	150 cfs	304 sq. mi.	1953-1978
Downstream of confluence of North Fork and South Fork	12,100 cfs	62 cfs	--	821 sq. mi.	1912-1917
Zumbro Falls	35,900 cfs	27 cfs	512 cfs	1,130 sq. mi.	1910-1917 1931-1978
Theilman	33,000 cfs	75 cfs	--	1,320 sq. mi.	1939-1956
Kellogg	16,800 cfs	155 cfs	--	1,400 sq. mi.	1975-1978

When evaluating the recreational and wildlife habitat potential of the Zumbro River, it is important to consider the length of time the discharge is low, moderate or high. A majority of the time, the discharge is between 42 and 280 cfs. This is generally in the winter months. Discharge ranges between 340 and

1,100 cfs 116 days of the year. This relatively moderate flow is more likely to occur from May through September. Although low flows are likely to occur, the flow is generally adequate for recreational use. The yearly discharge is highly variable.

The ratio of maximum to average flow can indicate erosion and flooding problems. The Zumbro has a high ratio. The only other areas of the state with as high or higher ratios are the western reaches of the Minnesota River and rivers along the north shore of Lake Superior, such as the Gooseberry and Baptism. The high ratio is a reflection of the regional topography and other unique geomorphic and geological features of the area. Lack of natural or manmade storage to attenuate runoff causes this region to be highly sensitive to climate irregularities. This accentuates the problems of erosion and flooding.

Flooding has long been a problem along the Zumbro. Floods, many of which are flash floods, commonly occur, threatening riverside communities. Approximately one-third of Rochester, for example, is flood-prone. Rochester's flood-prone area includes 1,800 residences, 200 businesses, 10 public buildings, the city power plant, wastewater treatment plant, water supply system and major streets. A 100-year flood (one that has a 1 percent chance of occurring in any given year) has the potential to cause $56 million in damages in the city of Rochester, according to a study done by the Corps of Engineers.

The city of Rochester will be implementing a flood control program to reduce the flooding hazard. Plans include channel modification of 9.3 miles of the South Fork of the Zumbro River and Cascade and Bear creeks, tributaries to the Zumbro. The channel will be widened and deepened, and levees will be constructed at three locations. The plan also recommends the construction of nine drop structures.

Because of the nature of the topography, there is little lag time between rainstorm and flood. The length of time the floodwaters remain high is also short.

Groundwater

The source of all municipal and industrial water supplies in the Zumbro River valley is groundwater. The Zumbro River watershed has a sufficient groundwater supply of suitable quality to meet the needs of the area. Groundwater is obtained primarily from bedrock.

In some of the western upland areas of the watershed, glacial drift is 40 feet or more thick and contains sand and gravel lenses capable of yielding adequate groundwater supplies for farm, domestic and even small-scale industrial use. Where uplands are covered with thin loess deposits, these fine-grained layers are too thin to be important as sources of water supply, but they do serve as infiltration and recharge areas for the bedrock formations. Terraces developed along the lower Zumbro and the Mississippi River, particularly around Kellogg, consist of gravel and coarse alluvium and may be 65 to 200 feet thick. The terrace deposits contain much water, but seepage contamination from high ground may pollute it.

The Karst-dominated groundwater circulation system of the area is another cause for concern. The Karst area of southeatern Minnesota is characterized by a land surface with numerous depressions or holes which were formed by the action of water dissolving the limestone and bedrock. These dissolved channels and cavities facilitate the spread of pollutants throughout the surface and groundwater system. Polluted surface water can drain into these channels and cavities, which enter directly into undergound drainage pathways leading to groundwater supplies. As previously stated, groundwater sustains low-level flows, so the Zumbro can be polluted in this manner.

In areas where deep sand and gravel are not present, adequate groundwater supplies can be obtained by drilling wells into the bedrock formation of limestone, dolomite or sandstone. The best sources for large municipal and industrial water supplies are the St. Peter sandstone, the Shakopee and Oneota dolomites, the Jordan sandstone, and the top of the Dresbach Formation.

Dams

There are four dams located along the Zumbro River. A 12-foot high concrete spillway dam with earth embankments is located at Mantorville. Its maximum storage capacity is 440 acre-feet and its function is to impound water for recreation. A concrete gravity dam located in Oronoco forms Shady Lake, which is used for recreational purposes. It is 20 feet high and has a maximum storage capacity of 3,700 acre-feet. The possibility of generating hydroelectric power is being considered. Zumbro Lake Dam, located at the north end of Zumbro Lake, is a concrete gravity dam 80 feet high with a maximum storage capacity of 50,000 acre-feet. It is used for generating electric power and there is a plan to increase its hydroelectric capacity. It forms a major recreational lake. Silver Lake Dam is located in Rochester and is of the concrete gravity type. It is 21 feet high and the maximum storage capacity is 1,519 acre-feet. It is used to provide a recreational lake.

WATER QUALITY

The Zumbro River has a 2B water use classification designated by the Pollution Control Agency. This means the water quality is suitable for supporting a warm-water fishery and for recreational activities including swimming.

In general, the headwaters are slow flowing and turbid. From Zumbro Falls to the river's confluence with the Mississippi the water is clearer.

Water quality data for the Zumbro River was collected by the PCA from 1955 to 1965 at three locations. The current sampling site (1973 to the present) is located on the South Fork, three miles north of Rochester. This primary monitoring station collects information on many chemical and biological factors. Since this sampling station is located upstream of Zumbro Lake, much of the data may not reflect true conditions farther downstream, due to the fact that the water quality can change after the river flows through the lake.

The water quality of the Zumbro River is variable because of fluctuation in discharge. Changes in discharge will dilute or concentrate dissolved solids and particulate material. The water is considered very hard due to the fact that the river flows through dolomite bedrock and the groundwater percolates through carbonate bedrock.

Sedimentation is one form of pollution which affects the Zumbro River. Most of the erosion which results in sedimentation occurs on the uplands and in gullies. Streambank erosion is also a problem.

Streambank and gully erosion are caused by high discharge and runoff. Runoff from agricultural land is more severe than runoff from forest or pasture land. The counties through which the Zumbro flows have high soil loss values associated with cropland. Average annual soil loss from cropland ranges from five to seven tons per acre per year in Wabasha and Olmsted counties. These are among the highest soil loss values in the state.

The soil loss is not as great on pasture and open land but is still considered high, particularly in Wabasha County. Average annual soil loss from pasture land is from five to six tons per acre per year in Wabasha County, which is the highest in the state. Soil loss ranges from 3.51 to 4.99 tons per acre per year in Olmsted County. This is considered a medium-high soil loss value. Soil loss from forest land is considered low.

The geology of the area is also a contributing factor to streambank erosion, as some of the bedrock through which the river flows is easily eroded.

Toxic substances, such as pesticides and herbicides, are carried into the river with runoff and may accumulate on the river bottom and in aquatic life. Fertilizers and other nutrients are also washed into the Zumbro. The same nutrients that spur the growth of crops also cause excessive algae and weed growth in water. The concentrations of nutrients are highest in the Zumbro from April to mid-July, when the snow is gone, the soil has thawed and the vegetative canopy which helps protect the cropland from erosion has not yet developed.

Disease-carrying organisms found in manure are also a pollution problem when water runs off feedlots and pastures located adjacent to the river.

Polychlorinated biphenyls (PCBs) are toxic substances used in industry, in electrical transformers, for example. PCBs accumulate in the fatty tissue of fish living in water which has concentrations of PCBs. The use of PCBs was severely restricted in Minnesota in 1978, but they are still present in some wastewater effluents and river bottom sediments. The concentration of PCBs found in fish samples from Zumbro Lake has led to the establishment of fish consumption guidelines by the Minnesota Department of Health. The department has recommended that channel catfish from Zumbro Lake not be eaten because of the PCB levels in fish.

Point source pollution problems are possible in several areas. The Rochester Sewage Treatment Plant is one source. Continual monitoring and an effort to meet state standards indicate that this source of pollution will be brought under control.

Eight municipalities have wastewater disposal facilities which are monitored and which generally meet standards for their emissions. Seven municipalities (Hammond, Millville, Oronoco, Zumbro Falls, Kellog, Theilman and Jarrett) do not have treatment plants. Oronoco is currently constructing a facility which will tie in local industries. Zumbro Falls is currently planning a facility. The PCA has no documentation that indicates a need for any of the other communities to develop a treatment facility.

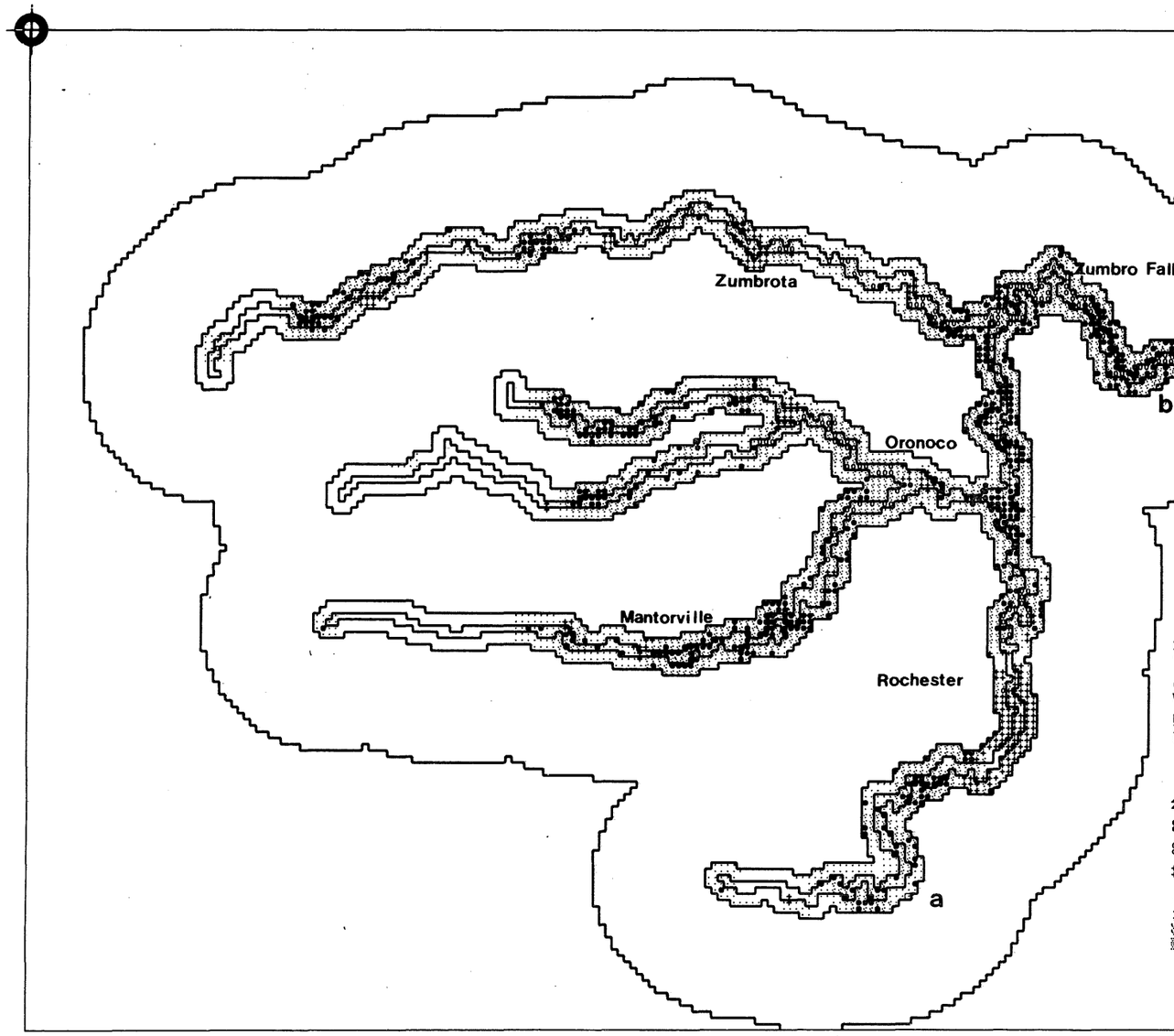


Figure 6

FOREST COVER TYPE AND DENSITY

THIS MAP SHOWS FOREST TYPE AND THE DENSITY OF TREE COVER WITHIN 1/2 MILE OF A NON-FORESTED CELL.

MAPPED BY: MINNESOTA DNR OFFICE OF PLANNING
RESEARCH AND POLICY SECTION DEC. 1980
CONTACT PERSON: RICK GELBMANN 296 7995

SYMBOL	COUNT	PERCENT	ACRES	LEGEND
1	2	0.0	80.0	PINE -PREDOMINANTLY WHITE PINE, RED PINE OR JACK PINE SINGLY OR IN COMBINATION.
3	709	1.6	28360.0	OAK -PREDOMINANTLY NORTHERN RED OAK, WHITE OAK OR BURR OAK, SINGLY OR IN COMBINATION.
4	303	0.7	12120.0	ELM-ASH-COTTONWOOD -PREDOMINANTLY LOWLAND ELM, BLACK ASH, COTTONWOOD, OR RED MAPLE, SINGLY OR IN COMBINATION.
9	266	0.6	10640.0	URBAN AREAS
11	41218	91.6	1648720.0	NON-FORESTED AND OFF-SITE
12	1017	2.3	40680.0	1-12 PERCENT FOREST COVER WITHIN 1/2 MILE
13	1226	2.7	49040.0	13-44 PERCENT FOREST COVER WITHIN 1/2 MILE
14	223	0.5	8920.0	45-72 PERCENT FOREST COVER WITHIN 1/2 MILE
15	13	0.0	520.0	73-96 PERCENT FOREST COVER WITHIN 1/2 MILE

Figure 6

VEGETATION

Before European settlement, the Zumbro River flowed through five different vegetation types: river bottom forest, prairie, Big Woods, oak openings and barrens, and aspen-oak lands.

The river bottom forest was composed of elm, ash, cottonwood, box elder, oak, basswood, silver maple, willow and aspen. This vegetation type was found on the floodplain adjacent to the river and was similar to the community found on the floodplain today.

Upstream of Zumbrota the river flows through an area that was once covered by tall grass paririe. Big bluestem, Indian grass and a rich variety of herbs grew adjacent to the river. This vegetation type was virtually destroyed as the area was converted to agriculture.

Oak openings and aspen-oak lands predominated on the uplands downstream of Zumbrota. The oak openings were composed of scrubby scattered oak trees and groves of oak with a prairie grass understory. The oak openings have disappeared from the Zumbro River valley. Aspen-oak lands were composed of dense aspen with scattered oak, elm, ash and basswood. There are no areas of this type remaining today. Much of the area once covered by this type has been converted to agriculture.

Scattered areas of Big Woods vegetation were also located along the Zumbro. The Big Woods is a term applied to the vegetation type which covered much of central and east central Minnesota. Sugar maple, basswood, oak, elm, ash, ironwood, aspen, birch, cherry, hickory, butternut and black walnut were the species which composed the Big Woods. There are two documented examples of this community remaining along the Zumbro.

Figure 6 illustrates the forest cover type and density within a half mile of each side of the river. Each 40-acre cell that had at least 10 percent crown cover was labeled with a forest cover type.

The percentage of tree cover within a half-mile radius of each unforested cell is also shown on Figure 6. For example, within a half-mile radius of point A on the map, 1 to 12 percent of the area is forested. Within a half-mile radius of point B, 13 to 44 percent of the area is forested.

The predominant forest type along the Zumbro River is oak. The species which compose this type are red oak, white oak and bur oak. Paper birch, elm, basswood, quaking aspen, sugar maple and ironwood are found in the overstory as well. Prickly ash, gray dogwood, raspberry, tick-trefoil, sweet cicely, may apple, wild onion, ferns, wild geranium and false Solomon's seal are commonly found in the understory. On the drier sites, understory species include prickly ash, gooseberry, raspberry, aster, goldenrod and grasses. Approximately 28,360 acres, or 15 percent of the river corridor, is of the oak forest type.

Second in acreage along the river is lowland hardwood forest, comprising elm, ash, cottonwood and silver maple. Box elder, black walnut and black willow occur less frequently. This type occurs along the floodplain. Nettles, wild grape, poison ivy, Virginia creeper and motherwort are understory plants. Approximately 12,120 acres, or 7 percent of the river corridor, are of this type.

There are 80 acres of pine near the mouth of the river. This is a planted pine plantation. The pine forest which gave Pine Island its name (see History section) has been lost to agriculture and development.

There are other plant communities found along the river which do not show up on Figure 6 either because they are not forest types or because they are too small to be classified in the 40-acre cell. Goat prairies are a non-forest community found on the steep south- and west-facing slopes. Species commonly found in these dry prairies include little bluestem, side oats grama, big bluestem, prairie dropseed, panicium, purple prairie clover, pasque flower, aster, flowering spurge, goldenrod, yellow puccoon, lead plant, false boneset and ground cherry.

Small areas of mixed hardwoods, also occur along the river. Dominant trees include sugar maple, basswood, red oak and green ash. Other species occurring are ironwood, paper birch, red elm and slippery elm. Scattered white pines are present. Understory species are the same as those in the oak forest type.

Some small remnants of the Big Woods which have been identified by the Minnesota Heritage Program as meriting special consideration. The Big Woods was dominated by sugar maple, elm, basswood and red oak. This type is located on the cooler, moist, north-facing slopes. The two Big Woods remnants on the Zumbro have not been disturbed by logging or grazing and are good examples of this community.

One five-acre site is located near the confluence of the Middle Fork and the South Fork of the Zumbro, on a steep north-facing slope. Limestone outcroppings also occur on the slope. The area has never been disturbed and a rich non-woody herbaceous ground cover with some northern Minnesota plant species is present.

Another site is located near Shady Lake, just west of Oronoco. This 15-acre site has both the Big Woods community type and an oak community type present on a north-facing slope. A luxuriant herb ground layer is present. Some logging and grazing may have occurred in the past, but the site is largely undisturbed.

Several plant species in southeastern Minnesota merit special consideration, according to the Minnesota Natural Heritage Program. The Heritage Program identifies species which are exemplary, unique, threatened or endangered on a national or statewide basis. The program's aim is to identify these species before they are lost. An effort is needed to save these targeted species for their scientific, educational and aesthetic values, and for other practical uses for them which may be discovered in the future. The species which merit special consideration are classified by the Heritage Program into the following categories:

ENDANGERED

Species that face extirpation in Minnesota in the foreseeable future if efforts are not made to preserve their remaining populations. This category includes species that have been listed as federally endangered.

THREATENED

Species that may become endangered if their populations are significantly reduced. Species assigned to this category might be characterized by:

1. populations that have always been small and any decline in their numbers would be significant; and/or

2. populations that have already undergone an apparant decline and for which any further decline would be detrimental.

Some of these species are included on the federal list of threatened species.

RARE

Species that are not currently endangered or threatened but that by virtue of their limited occurrence warrant close scrutiny. This category includes species for which there is currently no evidence of a decline in species population or for which the decline is not yet considered significant.

STATUS UNDETERMINED

Species that may belong in one of the preceding categories but for which there is too little current information to make a judgment.

SPECIAL CONCERN

Species that do not belong in one of the preceding categories but that do require special attention. Included are:

1. Species subjected to species-specific exploitation (such as ginseng); and
2. species whose habits and habitats lend them to being particularly vulnerable to disturbance.

RECENTLY EXTIRPATED

Species that have disappeared from Minnesota since 1880. Some of the species could perhaps reestablish populations in the state should environmental conditions become more favorable.

Following is a list of rare plants which have been documented as occurring in the Zumbro valley. Other species which may occur along the Zumbro because they have been recorded in similar habitats in other parts of the county also are included in the list.

Rare Plants

Common Name	Scientific Name	Classification	Habitat
Minnesota trout lily	Erythronium propullans	Endangered	moist, shaded woods
Sedge	Carex Davisii	Endangered	floodplain-only 2 known sites in the state
Tubercled orchid	Platanthera flava	Undetermined	boggy, swampy ground
Black-eye susan	Rudbeckia triloba	Rare	woods and moist soils

Other species which may occur

Goldie's fern	Dryopteris goldiana	Rare	wooded slopes
Green dragon	Arisaema Dracontium	Rare	floodplain, moist woods
Grape fern	Botrychium dissectum	Rare	fields and woods
Compass-plant	Silphium laciniatum	Rare	goat prairie
a native mustard	Lesquerella ludoviciana	Endangered	prairie
Lip-fern	Cheilanthes Feei	Rare	limestone exposures
tick-trefoil	Desmodium illinoense	Threatened	goat prairie
ginseng	Panax quinquefolium	Special Concern	cool, moist, deeply shaded woods

The Minnesota trout lily deserves special consideration because it is rare not only in Minnesota, but in all of North America. This plant is a member of the lily family and blooms in early spring. It is found nowhere in the world except Rice and Goodhue counties. The trout lily occurs at only 15 sites, two of which are located along the Zumbro River. They are found on upland slopes leading down to a lower terrace.

The 20-acre Grace Nature Preserve, located approximately 1-1/4 miles southwest of Kenyon, is one of three places in the state the trout lily is protected. There is one additional site in the Zumbrota area where this plant has been documented. Since the Minnesota trout lily is spread by high water, it is possible there are other occurrences in the 20 river miles between Grace Nature Preserve and Zumbrota.

The future of the trout lily is threatened by a number of factors, including certain types of recreational use and development, residential development, construction and land use changes.

Gingseng is another plant which merits special concern. Ginseng has been greatly reduced in numbers because it has been collected and sold for its supposed medicinal value. It can still be harvested for commercial purposes during a special season (from Aug. 15-Dec. 31 in 1979 and 1980). This state season was initiated to comply with federal requirements set to ensure the plant will not be overharvested.

WILDLIFE

The variety of different habitats in the Zumbro River valley-floodplain forest, hardwood forest, goat prairies, riverbanks, wetlands and cropland--support a wide variety of wildlife. Southeastern Minnesota is richer in wildlife species diversity than any other part of the state. The northern limit of several species' ranges occurs here.

Several of the wildlife species in southeastern Minnesota merit special consideration, according to the Minnesota Natural Heritage Program. The Heritage Program identifies species which are exemplary, unique, threatened or endangered on a national or statewide basis. The program's aim is to identify these species' habitats before they are lost. An effort is needed to save these targeted species for their scientific, educational and aesthetic values, and for other practical uses for them which may be discovered in the future. The Heritage Progam's classification system is explained in the Vegetation section.

Mammals

There are six species of mammals which deserve special consideration. The eastern pipistrelle, pocket mouse, harvest mouse, prairie vole, pine vole and spotted skunk all are considered rare.

The eastern pipistrelle is Minnesota's smallest and least common bat. It is found in limestone caves and requires specific temperature and humidity conditions for hibernation.

The pocket mouse is a small, buff-colored mouse with external fur-lined cheek pouches, a feature which no other Minnesota mouse possesses. It is found in sandy open areas. The harvest mouse is a prairie species and is localized in distribution.

The prairie vole is found only in southeastern Minnesota. The pine vole is a burrowing rodent found in a variety of habitats, including fields and hardwood forests. Despite its name, it is infrequently found in pine forests.

The spotted skunk is found in open and semi-open country more frequently than in heavily forested areas. It is less common in the state than the striped skunk.

Amphibians and Reptiles

There are four turtles which deserve special consideration. The wood turtle, false map turtle, and smooth soft-shelled turtle are considered rare. Blanding's turtle is a species of special concern.

The wood turtle is both aquatic and terrestial. It is found in woodlands and meadows in the summer and in wet areas, ponds, streams and swamps during the fall and spring. A unique characteristic of this turtle is its ability to make whistling sounds.

The false map turtle is found almost exclusively in aquatic habitats. It prefers waters with bottom vegetation and is found less frequently in clear water.

The smooth soft-shelled turtle is found in larger streams and lakes, and is seen in open water. Compared with other turtles, it is an excellent swimmer.

Blanding's turtle is generally found in shallow waters of small meandering streams, although the documentation of Minnesota's species is from sandy areas. The turtle lays its eggs in sandy, grassy areas adjacent to wetlands. One of the largest populations of Blanding's turtles is in the Weaver sand dunes area near Wabasha.

The six-lined racer is a swift, slender lizard which will adapt to a variety of habitats, although it prefers hot, dry exposures. The six-lined racer is considered rare. There is a record of this species occurring along the Zumbro River in a gravel pit near the Kruger Recreation Area.

The blue racer and eastern massasauga are two species of snakes considered to be threatened. The common habitat of the blue racer is sandy open areas and gravel hillsides. Blue racers have been observed in the Mississippi bottomlands in southeastern Minnesota. The blue racer is long, slender and swift. The massasauga is a rattlesnake, smaller in size than the timber rattler. It is found only in the Mississippi river bottoms.

The ring-necked snake, classified as rare, is a small nocturnal snake which spends its days under rocks and rotting logs. It is found in wooded areas. The ring-necked snake has been documented along the Zumbro River near Millville.

The common newt, considered rare, lives near ponds and lakes surrounded by wooded land. The life cycle of the newt, which starts in water, continues on land and then returns to water, necessitates that the species be near both habitats.

The bullfrog, the pickerel frog and Blanchard's cricket frog are rare. The bullfrog is the largest frog found in Minnesota. It is solitary, nocturnal and almost completely aquatic.

The pickerel frog prefers cold-water streams with well-vegetated banks, and with rock bottom stretches alternating with muddy bottom stretches. Pickerel frogs could likely be found on the limestone and sandstone hills along the Zumbro River.

The cricket frog is found in small, meandering streams with gravel bottoms which flow through grassy fields. They are hard to collect because of their small size, dull color and leaping ability. This species is documented along the South Fork of the Zumbro River approximately one mile east of Vernon.

Birds

There are two species of birds which should be noted. Canada geese winter on Silver Lake by the thousands. There is open water on Silver Lake all winter long because of thermal discharge by the Silver Lake generating plant. These birds have become a tourist attraction and can be seen often in the vicinity of the Zumbro River.

Wild turkeys are now found in the hardwood forests of the Zumbro valley. Turkeys have been reintroduced to southeastern Minnesota for hunting and the population has grown and thrived. There is good turkey habitat in the Zumbro valley.

Figure 7. Mammals.

An asterisk (*) indicates species which are rare, threatened or of special concern.

Virginia opossum	Didelphis virginiana
masked shrew	Sorex cinereus
pygmy shrew	Microsorex hoyi
short-tailed shrew	Blarina brevicauda
least shrew	Cryptotis parva
common mole	Scalopus aquaticus
little brown bat	Myotis lucifugus
Keen's little brown bat	M. keenii
silver-haired bat	Lasionycteris noctivagans
*eastern pipistrelle	Pipistrellus subflavus
big brown bat	Eptesicus fuscus
red bat	Lasiurus borealis
hoary bat	L. cinereus
white-tailed jackrabbit	Lepus townsendii
eastern cottontail	Sylvilagus floridanus
woodchuck	Marmota monax
thirteen-lined ground squirrel	Citellus tridecemlineatus
Franklin's ground squirrel	C. franklinii
eastern chipmunk	Tamias striatus
red squirrel	Tamiasciurus hudsonicus
gray squirrel	Sciurus carolinensis
fox squirrel	S. niger
southern flying squirrel	Glaucomys volans
northern flying squirrel	G. sabrinus
pocket gopher	Geomys bursarius
*pocket mouse	Perognathus flavescens
beaver	Castor canadensis
*harvest mouse	Reithrodontomys megalotis
prairie white-footed mouse	Peromyscus maniculatus bairdii
northern white-footed mouse	P. leuccopus
red-backed vole	Clethrionomys gapperi
common meadow mouse	Microtus pennsylvanicus
*prairie vole	M. ochrogaster
*pine vole	M. pinetorum
muskrat	Ondatra zibethica
meadow jumping mouse	Zapus hudsonius
raccoon	Procyon lotor
short-tailed weasel	Mustela erminea
long-tailed weasel	M. frenata
least weasel	M. rixosa
mink	M. vison
otter	Lutra canadensis
*spotted skunk	Spilogale putorius
striped skunk	Mephitis mephitis
badger	Taxidea taxus
red fox	Vulpes fulva
gray fox	Urocyon cinereoargenteus
coyote	Canis latrans
bobcat	Lynx rufus
white-tailed deer	Odocoileus virginianus

Figure 8. Amphibians and reptiles.

An asterisk (*) indicates species which are rare, threatened or of special concern.

Turtles	
common snapping turtle	Chelydra serpentina
*wood turtle	Clemmys insculpta
*false map turtle	Graptemys pseudogeographica
map turtle	G. geographica
painted turtle	Chrysemys bellii
*Blanding's turtle	Emys blandingii
*smooth soft-shelled turtle	Trionyx mutica
spiny softshelled turtle	T. spinifera
Lizards	
*six-lined racer	Cnemidophorus sexlineatus
Snakes	
*ring-necked snake	Diadophis punctatus
eastern hog-nosed snake	Heterodon contortrix
western hog-nosed snake	H. nasicus
smooth green snake	Opheodrys vernalis
*blue racer	Coluber constrictor
fox snake	Elaphe vulpina
black pilot snake	E. obsoleta
bull snake	Pituophis saxi
milk snake	Lampropeltis triangulum
common water snake	Natrix sipedon
DeKay's snake	Storeria dekayi
red-bellied snake	S. occipitomaculata
plains garter snake	Thamnophis radix
common garter snake	T. sirtalis
*massasauga	Sistrurus catenatus
timber rattlesnake	Crotalus horridus
Salamanders	
mud puppy	Necturus maculosus
*common newt	Triturus viridescens
tiger salamander	Ambystoma tigrinum
Toads	
American toad	Bufo americanus

Figure 8 Continued

Frogs

*cricket frog	Acris crepitans
spring peeper	Hyla crucifer
common tree frog	H. versicolor
*bullfrog	Rana catesbeiana
green frog	R. clamitans
*pickerel frog	R. palustris
leopard frog	R. pipiens
wood frog	R. sylvatica
chorus frog	Pseudacris triseriata

Figure 9. Birds.

An asterisk (*) indicates species which are rare, threatened or of special concern.

pied-billed grebe
great blue heron
green heron
great egret (common)
black-crowned night heron
least bittern
American bittern
Canada goose
mallard, gadwall
pintail
green-winged teal
blue-winged teal
northern shoveler
wood duck
redhead
ring-necked duck
ruddy duck
hooded merganser
turkey vulture
sharp-shinned hawk
*Cooper's hawk
red-tailed hawk
red-shouldered hawk
broad-winged hawk
Swainson's hawk
marsh hawk
American kestrel
ruffed grouse
*bobwhite
ring-necked pheasant
gray partridge
*king rail
Virginia rail
sora
*common gallinule
American coot
killdeer
American woodcock
common snipe
*upland sandpiper
spotted sandpiper
black tern
rock dove
mourning dove
yellow-billed cuckoo
black-billed cuckoo
screech owl
great horned owl
barred owl
whip-poor-will
common nighthawk
chimney swift
ruby-throated hummingbird
belted kingfisher
common flicker
pileated woodpecker
red-bellied woodpecker
red-headed woodpecker
yellow-bellied sapsucker
hairy woodpecker
downy woodpecker
eastern Kingbird
great crested flycatcher
eastern phoebe
willow flycatcher
least flycatcher
eastern wood pewee
horned lark
tree swallow
bank swallow
rough-winged swallow
barn swallow
cliff swallow
purple martin
blue jay
common crow
black-capped chickadee
*tufted titmouse
white-breasted nuthatch
brown creeper
house wren
long-billed marsh wren
short-billed marsh wren
gray catbird
brown thrasher
American robin

Figure 9. Continued

wood thrush
veery
eastern bluebird
blue-gray gnatcatcher
cedar waxwing
*loggerhead shrike
starling
Bell's vireo
yellow-throated vireo
red-eyed vireo
warbling vireo
prothonotary warbler
blue-winged warbler
yellow warbler
cerulean warbler
chestnut-sided warbler
ovenbird
*Louisiana waterthrush
common yellowthroat
American redstart
house sparrow
bobolink
eastern meadowlark
western meadowlark
yellow-headed blackbird
red-winged blackbird
orchard oriole
northern oriole
Brewer's blackbird
common grackle
brown-headed cowbird
scarlet tanager
cardinal
rose-breasted grosbeak
indigo bunting
dickcissel
pine siskin
American goldfinch
rufous-sided towhee
Savannah sparrow
grasshopper sparrow
*Henslow's sparrow
vesper sparrow
lark sparrow
chipping sparrow
clay-colored sparrow
field sparrow
swamp sparrow
song sparrow

FISH

The deep pools, rocky riffles and steep gradient of the Zumbro River provide excellent habitat for a variety of fish species. The Zumbro harbors good, self-sustaining warm-water fish populations, including largemouth and smallmouth bass, sunfish, channel catfish, bullheads and suckers.

The DNR conducted electrofishing surveys of the Zumbro in 1972 and 1975 to determine the species composition of the river (see Figures 10 and 11). Electrofishing is a sampling technique used to temporarily immobilize fish within a small area by introducing an electric field into the water. Fish then can be netted, identified, weighed, measured and returned to the water unharmed.

Smallmouth bass are the most sought-after game species in the Zumbro. Good smallmouth bass fishing is found below Mazeppa. Anglers also catch largemouth bass, sunfish, channel catfish, suckers and bullheads. According to the DNR area fisheries manager, the Zumbro river is underused by fishermen. The DNR will continue to manage the river for smallmouth bass. No major habitat improvement is planned.

Five fish species found in the Zumbro valley are of special interest, according to the Minnesota Natural Heritage Program. The Ozark minnow and redside dace are species of special concern. The pugnose minnow, black redhorse and crystal darter are rare. (See vegetation section for the definition of the terms special concern and rare).

The Osark minnow's range in Minnesota is limited to the driftless area of the southeastern part of the state. It is locally abundant in small headwater streams. The redside dace, also of special concern, inhabits small, undisturbed streams unaffected by agricultural runoff and siltation. A good population exists in the Middle Fork of the Zumbro River. This fish is found where limestone bedrock is near the surface, where adjacent land use is either forest or pasture and where the stream is spring-fed. The species will not tolerate rapid fluctuations in water level or frequent flash flooding.

The habitat of the pugnose minnow is clear, slow-moving waters with abundant aquatic vegetation. It cannot live in turbid waters. The pugnose is considered rare and is limited in distribution to southeastern Minnesota. The black redhorse, also rare, inhabits clear streams with gravel, rock or sand bottoms. It is found in pools where the current is swift. It has been observed in the South Branch of the Zumbro. The black redhorse cannot tolerate siltation. The crystal darter, rarest of the Minnesota darters, has been observed near the Trunk Highway 61 bridge near Kellogg. All of the crystal darters observed in Minnesota were found around driftwood imbedded in shifting sand bottoms.

Industrial discharges, erosion and runoff from agricultural lands, and unnatural fluctuations in water level pose threats to fish populations. The negative impacts of pollution on fish populations include the destruction of vegetation which is food and cover for fish, the reduced oxygen content of the water, and the toxicity of the pollutant. Pollution not only causes mortality, but can affect morphological and physiological characteristics of fish such as reproduction and growth. There are potential pollution problems on the Zumbro. For example, in August 1980 an industrial discharge into the Zumbro near the junction of the Middle Fork and the North Branch of the Middle Fork killed more than 53,000 fish.

Soil eroded from riverside land may settle to the river bottom or remain in suspension. In either case, there are negative impacts on fish and other aquatic life. Toxic substances and nutrients adhere to sediment and collect on the bottom and in the flora and fauna. The amount of light available to plants is decreased, which leads to a decrease in the amount of food available to fish. Feeding patterns and predator-prey relationships are altered because of the decreased visibility. The characteristics of the stream bottom are also changed as uniform fine particles cover the bottom. This eliminates the habitat of certain species.

Water level fluctuations also affect the ability of some species to survive. Some species cannot tolerate extreme fluctuations. These fluctuations can be caused by the release of water from dams, and by intensive agricultural land use, which decreases the land's ability to hold water after rainfalls and thereby increases runoff.

Water level fluctuations caused by the operation of the dam at the north end of Zumbro Lake create a potential fisheries problem. The flow from the dam ranges from 40 cfs to 100 cfs. A flow of 60 cfs is recommended for a healthy fish population.

Fig. 10. Fish sampled in the South Fork Zumbro River June 20, 1972.

Species	Below Zumbro Lake Power Dam		Confluence of the North Fork and main stem		North Branch above Mazeppa		Below Junction of North Fork		Above Zumbro Falls at Bluff valley		1 mile above Zumbro Falls	
	No.	lbs.	No.	lbs.	No.	lbs.	No.	lbs.	No.	lbs.	No.	lbs.
Largemouth bass	2	5.1										
Smallmouth bass	14	3.5	17	4.2	11	7.6	3	0.8	14	2.8	21	6.0
Carp	48	190.2	10		5		5		24		17	
Northern redhorse	48	50.9	42		24		7		21		9	
Silver redhorse	13	22.7	3		11		1		2		4	
Quillback	13	21.0	5		3						3	
River carpsucker	14	22.8	5		1		2					
White sucker	48	43.9	51		29		18		30		23	
White bass	3	1.0										
Black bullhead	10	1.6										
Northern hogsucker	11	10.6	7		11		6		11		6	
Northern pike	1	3.1										
Common shiner	2	0.3										
Sauger	1	0.5			1	0.6						
Walleye pike					1	2.7	1	0.2				
Spotted sucker					1							
Channel catfish							1	5.8	3	13.9	1	3.6
Drum									2	6.8	2	4.6
Green sunfish									1	0.1		
Northern carpsucker											1	

Fig. 11 Fish sampled in the South Fork Zumbro River, September 15, 16, and 17, 1975.

Species	Below Silver Lake Dam		Below Rochester Sewage Disposal Plant		Halfway between Silver Lake Dam and Zumbro Lake		Co. Rd. 121		Last bridge before Zumbro Lake (CR 121)	
	No.	lbs.	No.	lbs.	No.	lbs.	No.	lbs.	No.	lbs.
Stoneroller	2	0.7	5	tr.*	21	0.6	154	1.8	4	tr.
Carp	11	21.6	10	13.6	37	66.1	35	61.1	7	14.3
Hornyhead chub	15	0.5			5	0.1				
River shiner	4	tr.								
Common shiner	160	3.1	10	0.1	78	3.6	20	1.2	27	0.5
Bigmouth shiner	13	0.1	19	0.1						
Spotfin shiner	74	0.5	24	tr.	183	0.7	73	0.3	145	0.6
Sand shiner	12	0.1	24	0.1	40	0.3	64	0.2	19	tr.
Rosyface shiner	3	tr.			2	tr.	7	0.2	1	tr.
Suckermouth minnow	47	0.4	2	tr.	51	0.7	177	2.4	1	tr.
Bluntnose minnow	77	0.6	2	tr.	19	0.2	3	tr.	13	0.1
Fathead minnow			2	tr.	2	tr.				
Blacknose dace					1	tr.	5	tr.		
Longnose dace			1	tr.	3	tr.	3	tr.		
Creek chub			8	tr.	18	0.2	11	0.1	8	0.1
Quillback carpsucker	1	0.5			6	0.1	6	0.7	11	3.6
White sucker	1	0.5	27	8.7	135	53.0	32	18.5	18	11.1
Northern hog sucker	27	8.7			6	3.2	12	3.8		
Silver redhorse	25	9.9			61	56.9	36	18.3	19	19.0
Shorthead redhorse	1	0.4			33	18.8	15	7.4	2	2.2
Yellow bullhead					2	tr.			2	0.2
Channel catfish	63	2.6			1	5.6	5	8.0	1	tr.
Stonecat	5	0.1							4	0.2
White bass	2	0.1	1	tr.	2	0.8	10	1.3	1	tr.
Rock bass	5	0.4								
Green sunfish	11	0.6	4	0.3	23	1.5	25	1.4		

*trace--less than 0.2 lb.

Figure 12. Fish.

An asterisk (*) indicates species which are rare, threatened or of special concern.

Common Name	Scientific Name
stoneroller	Campostoma anomalum
carp	Cyprinis carpio
hornyhead chub	Nocomis biguttatus
river shiner	Notropis blennius
common shiner	N. cornutus
bigmouth shiner	N. dorsalis
spottail shiner	N. hudsonius
spotfin shiner	N. spilopterus
emerald shiner	N. atherinoides
sand shiner	N. stramineus
mimic shiner	N. volucellus
rosyface shiner	N. rubellus
*Ozark minnow	Dionda nubila
*crystal darter	Ammocrypta asprelle
suckermouth minnow	Phenacobius catostomus
bluntnose minnow	Pimephales notatus
fathead minnow	P. promelas
*pugnose minnow	Opsopoeodus emilae
blacknose dace	Rhinichthys atratulus
longnose dace	R. cataractaee
*redside dace	Clinostomus elongatus
creek chub	Semotilus atromaculatus
river carpsucker	Carpiodes carpio
quillback carpsucker	C. cyprinus
white sucker	Catostomus commersoni
spotted sucker	Minytrema melanops
northern hog sucker	Itypentelium nigricans
northern redhorse	Moxostomus macrolepidotum
silver redhorse	M. anisurum
*black redhorse	Moxostoma duquesnei
shorthead redhorse	M. macrolepidotum
black bullhead	Ictalurus melas
brown bullhead	I. nebulosus
yellow bullhead	I. natalis
channel catfish	I. punctatus
stonecat	Noturus flavus
largemouth bass	Micropterus salmoides
smallmouth bass	M. dolomieui
white bass	Morone chrysops
rock bass	Ambloplites rupestris
orange-spotted sunfish	Lepomis humilis
green sunfish	L. cyanellus
bluegill	L. macrochirus
pumpkinseed	L. gibbosus

Figure 12. Continued

yellow perch	Perca flavescens
black crappie	Pomoxis nigromaculatus
white crappie	P. annularis
log perch	Percina caprodes
sauger	Stizostedion canadense
walleye	S. vitreum
drum	Aplodinotus grunniens
northern pike	Esox lucius

ARCHAEOLOGY

Archaeologists believe the Zumbro River valley was probably first occupied by hunting and gathering people as early as 10,000 to 11,000 years ago.

Thus far, approximately 20 prehistoric sites within the drainage area of the Zumbro River have been registered through the Office of the State Archaeologist. The majority of these sites are single and group mounds, located on terraces and bluffs along the river. Archaeologists believe there are more sites yet to be discovered. Countless sites have been lost in the past to cultivation, development and vandalism.

Archaeological testing in the Zumbro River valley has revealed cultural artifacts, but none are diagnostic of a specific culture.

Although no evidence has yet been found, people of the Big Game, or Paleo-Indian, culture are believed to have occupied this area before 5000 B.C. The Paleo-Indians were nomadic hunters who lived in temporary shelters and small groups. They were skilled stone craftsmen who formed spear points, knives, skin scrapers and punches by flaking and chipping chert, flint and chalcedony.

The Big Game culture was succeeded by the Eastern Archaic culture, which existed from 5000 to 1000 B.C. Eastern Archaic Indians differed from earlier peoples in their tools and foods. These people were seminomadic, shifting their small camps seasonally to take advantage of changing food supplies. In addition to large and small game animals, wild foods such as acorns, cherries and plums were an important part of their diet.

In addition to chipped stone tools, the Eastern Archaic Indians developed techniques for making ground and pecked stone implements. Points, gouges and axes are typical relics.

Eastern Archaic Indians usually buried their dead in shallow graves on high lakeshores, hillsides or glacial knolls.

The Woodland culture, which existed in southeastern Minnesota from about 1000 B.C. to 1000 A.D., is know for its elaborate burial mounds and pottery making, and for the establishment of permanent villages.

Two types of burial mounds were used by the Woodland people. In the primary mound, the entire body was interred in a subsoil pit, below the mound. Grave goods were often buried with the body. The more common secondary mound contained only partial remains of the body. The dead were put on platforms or tied to trees and left in the open for several years before burial. Grave goods rarely accompanied secondary burials.

The use of pottery for storage and cooking vessels was common during the Woodland period. Sand or pulverized granite was mixed with the clay to give it strength, and the pottery was decorated by pressing different shapes into the soft clay before it was fired. In the earlier phases of Woodland culture the pots had a pointed base with a very wide, rounded mouth. By the end of this period, the form had changed to a round globular shape with an indented neck and a flaring rim at the mouth.

The addition of wild rice to the Woodland diet around 800 A.D. resulted in a population surge and the establishment of permanent villages. Raccoon, rabbit, muskrat and beaver continued to be a part of the Woodland diet.

By 1000 A.D. the Mississippian culture had moved to southeastern Minnesota up the Mississippi River from Cahokia, Illinois. This culture was heavily dependent on the cultivation of corn, beans, squash, sunflowers and tobacco. Timbered areas in river bottoms were cleared to plant crops. Hunting and fishing continued to be important. With the stabilization of a food source, villages grew--as many as 600 to 800 people lived in one village. Underground vegetable storage pits were dug throughout the village. These pits were used for refuse after they were no longer fit for storing dried vegetables. Broken tools, pottery shards, animal bones, ashes and other artifacts are found in these pits.

Mississippian pottery differed from the Woodland pottery in shape and in method of decoration. The pottery was tempered with crushed clamshell instead of sand or pulverized granite, and was globular in shape with a rolled or flaring rim and two to four paired handles. It was decorated with wide or narrow incised geometric designs.

Mississippian burial mounds are usually of the primary type, containing grave goods.

HISTORY

The Zumbro has affected the lives and fortunes of those who have lived along it, from the days of the Dakotá Indians to modern Minnesotans.

The river valley was the common hunting ground of two Dakota Indian tribes. The Dakota called the river Wazi-Ojo, "River of the Pines," for the forest it flowed through near Pine Island.

The high bluffs along the Zumbro were used by the Indians as points for signal fires. The river valley was also the avenue of travel for the western tribes traveling to the home of their head chief, Wabasha, near present-day Winona. One such trail ran from Blue Earth to Wabasha, passing present-day West Albany township along the Zumbro river. Another well-marked trail, from Pine Island to Red Wing by way of Zumbrota, was used by the Dakota who spent their summers camped along the Mississippi and their winters in Pine Island.

The Dakota were seminomadic, shifting their camps to take advantage of seasonal food sources. The staples of their diet included deer, ducks and geese, fish and turtles and considerable quantities of vegetable foods such as wild turnip, water lily and wild rice.

Summers were spent camped along the Mississippi River in shelters made of elm bark laid atop a framework of poles. During the summer and early fall the Indians fished, gathered wild vegetables, cultivated small patches of corn, made tools and prepared for the winter hunt.

In October the tribes moved their camp inland for the winter hunt. Tepees made of animal skins were used for shelters. The hunt required the help of every member of the village. The braves were responsible for hunting and bringing back the deer and other game to camp. The women, old men and children were in charge of setting up camp, skinning the game and cutting and drying the meat. The winter hunt usually lasted two to three months. Once the hunt was completed, the Indians moved to a winter camp, in an area where the natural environment provided protection from the harsh Minnesota winters.

One favorite winter camp was Pine Island, named for a large tract of tall pine trees partially encircled by the Middle Fork of the Zumbro River. Seen for a long distance over the prairie, this pine forest had the appearance of an island in the sea. The thick pine branches provided shelter from the bitter winds and snowstorms that whipped across the prairie. When Chief Wacouta, head of the Red Wing band, was asked to sign a treaty to give up homes along the Mississippi River, he replied he would willingly sign if he could have a future home at Pine Island. His request was not granted.

Early spring found the Indians dividing into two groups and moving their camp. One group went to the rivers and wetlands to hunt muskrat for pelts to barter with the white fur traders. The other group headed into the woods to gather maple sap for sugar making. By late spring, the Indians once again packed their belongings and headed for their summer camps along the Mississippi River.

The first white men to see the Zumbro River were probably the French fur traders Groseilliers and Radisson when they made their way up the Mississippi River in the 1650s. From that time until the signing of the Indian land cession treaties in the 1800s, the Zumbro River valley was inhabited only by the Dakota and fur trappers and traders. The French traders called the Zumbro "Riviere des Embarras," meaning River of Difficulties. The river's many snags hindered the canoes of the French voyageurs engaged in the fur trade. Mispronunciation by English-speaking settlers transformed the river's name to Zumbro.

Incessant feuding between the Dakota and Ojibway Indian tribes led in 1825 and 1830 to U.S.-sponsored councils at Prairie du Chien to work out peace guarantees for the region. Neither council achieved its aims, but action taken at the second would affect land holdings in the Zumbro River area for many years.

At the 1830 council at Prairie du Chien a tract of land on the Minnesota side of Lake Pepin was signed away, in effect, to offspring of traders who had intermarried with the Dakota. This area, known as the Wabasha Reservation or Half-Breed Tract, ran through present-day Zumbro Falls village.

This tract of land presented legal problems for federal officials in Washington. First, the mixed bloods for whom this land was set aside did not care to live there. Second, because it was excellent farmland, the land was illegally occupied by a few white settlers.

The situation was ignored until white immigrants began settling next to the river after the treaty of 1851. The half-breed tract was coveted by the whites, who did not officially own it and therefore could not survey the land and claim individual land ownership.

To remedy this situation, a bill was passed in Washington in July 1854 that enabled the government to issue "scrip," or certificates, to the individual half-breeds entitled to land on the tract. The scrip entitled the holder to land on the tract or to equal acreage on other public lands not yet surveyed. The half-breeds, not interested in land within the reservation, gave or sold their scrip to white settlers or traders.

As settlers pushed in from New England and Europe, the Indians continued to move westward. By 1854, all but one band of about 200 Dakota Indians had left the Zumbro River area. In the fall of 1854, they set up camp near Rochester. During the winter an illness swept through the camp, resulting in some deaths. Their bodies were buried in the area now known as Indian Heights.

The mid-1850s were boom settlement years for the Zumbro River valley. The majority of the settlers were New Englanders; Norwegians, Swedes and Germans also came in large numbers. All were seeking farmland. The fertile Zumbro River valley didn't disappoint them. The settlers and farmers in the valley benefited from the 1855-1880 wheat boom in southeastern Minnesota. Villages were started at river fords and developed as ferries were established and bridges were constructed. The towns continued to grow as grist mills and flour mills were erected along the Zumbro River.

As the influx of immigrants began, the territorial government built roads to accommodate them. Zumbrota and Pine Island were located on one of the most important of these roads, that which went from Dubuque, Iowa, to St. Paul. The Dubuque Trail was used by the M.O. Walker Stage Line and settlers in the valley to transport their wheat and other produce.

Other roads were built running east and west along the Zumbro. In some areas, both a high and a low road were built to accommodate the yearly spring floods of the Zumbro.

In the late 1870s the train brought another mode of transportation to the Zumbro River valley. One famous line was the Wabasha to Zumbrota "Bug Line," known as the "Crookedest Railroad in the United States." The track was laid along the north bank of the Zumbro River and contained numerous sharp curves and reverse curves.

As the Milwaukee Road crew was laying track west from Wabasha to Zumbrota, a crew from the North Western Railroad was laying track north from Rochester to Zumbrota. Reaching Zumbrota at the same time, the two crews engaged in a brawl to decide who would lay their tracks at the foot of Main Street. The North Western crew won and laid its ties and rails first. Not to be outdone, the Milwaukee Road crew waited until the other crew went home for dinner. Then they tore up the tracks and laid their own, thus gaining the right of way.

During the railroad's peak two freight trains and one passenger train were run daily along the tracks. As the towns stopped growing and the wheat boom declined, it became less and less profitable to run a train through the valley. The use of the passenger train for short hops declined with the development and use of the automobile. In 1938 the tracks from Wabasha to Zumbro Falls were pulled out. Seventeen years later the tracks from Zumbro Falls to Zumbrota were removed. Today county roads follow the majority of the railroad grade from near West Albany to Zumbro Falls. The rest has been converted to park land, grazing land or woods.

The temperamental Zumbro River caused frequent maintenance problems for the railroad. During heavy rains and spring floods, the river would wash out bridges and push huge chunks of ice or layers of silt onto the tracks. The bridge at Hammond was continually being washed out.

The railroad line was not the only thing affected by the Zumbro River floods. Most of the towns along the river have been flooded or damaged at one time or another by the Zumbro rising out of its banks.

In 1859, the river rose 15 feet above its normal level and flooded Rochester, covered the lowlands in Zumbro Falls and washed away the operations of the Oronoco Mining Company.

In the past 20 years Rochester has been flooded four times. The spring flood of 1962, brought on by heavy rains and rapid snow melt, caused damages estimated at $1.6 million in Rochester. Sixteen years later, a six-inch rain falling in three hours caused the worst flood in the history of Rochester. In some places, roads and buildings 2,000 feet back from the riverbank were either under, or standing in, water. The flood took five lives, forced about 5,000 people to leave their homes and caused damages estimated at $50 million.

The Zumbro's flooding problems were aggravated by the early settlers' land use practices. By the late 1800s the river valleys of southeastern Minnesota were in sad shape. Repeated wheat failures brought on by drought, insects, disease and soil exhaustion prompted farmers to turn to a variety of crops and to livestock raising. They plowed marginal lands on the upland slopes and increased pasturing on hillsides. Steep valley slopes were stripped of trees for lumber and burned over in attempts to establish grass for grazing. Loss of protective vegetation on the bluffs and steep slopes resulted in severe erosion and siltation. Eroded gullies scarred the beautiful valleys and bluffs, and the rocky, swift streams became muddy waters filled with logging debris and silt.

In the mid-1930s Richard J. Dorer saw not only the eroded wasteland of southeastern Minnesota, but also the possibility of restoring it. In 1938 Dorer began working for the Minnesota Department of Conservation on the Whitewater River, south of the Zumbro. He implemented a program to restore the river valley's eroding slopes by planting trees and grasses, filling gullies and introducing sound ecological principles to land management in the area. Within 20 years his efforts began to show results. Stones and gravel had replaced the mud-choked Whitewater River bottom.

After his retirement in 1958, Dorer worked with the Izaak Walton League and the Department of Conservation on a plan for a state forest in southeastern Minnesota. The plan would protect the woodlands, valleys and streams of the entire region, just as his earlier project has protected the Whitewater River. The plan was approved by Conservation Commissioner George Selke. In 1961 the state legislature established the Memorial Hardwood State Forest, renamed the Richard J. Dorer Memorial Forest in 1976.

The lower Zumbro River lies entirely within the Dorer Memorial Forest. Technical advice for private landowners and the promotion of sound forest management practices have restored much of the natural vegetative cover, stabilized the steep slopes and improved the river's water quality.

The following is a brief description of how some of the settlements along the river origninated.

Dodge County, established in 1855, was named in honor of Henry Dodge, governor of Wisconsin.

Concord Township, named after Concord, New Hampshire, was settled in April 1854 and organized in May 1858. The village plat was recorded in June 1856.

Mantorville Township was settled in April 1854, incorporated under legislative acts of 1854 and 1857 and organized in May 1858. The village was platted in 1856 and designated as county seat in 1857. The town was named after three brothers, Peter, Riley and Frank Mantor, who came in 1853 and 1854. Peter Mantor, a leader in founding the site of Mantorville, settled there in 1854 and built a sawmill and gristmill.

Wasioja Township bears the Dakota name for the Zumbro River and was settled in 1854 and organized in 1858. The village of Wasioja was platted in 1856.

Wasioja was a thriving community which reached its height of prosperity in the late 1850s, when the Minnesota Seminary was dedicated and the town's population peaked at 1,000, which made it larger than Rochester, Dodge Center and its rival, Mantorville. The inhabitants looked forward to the coming of the railroad and designation as the county seat. Three major blows initiated Wasioja's decline: it failed to become the county seat; the Civil War took a heavy toll of its men at Chickamauga; and it was bypassed by the railroad.

Goodhue County was established on March 5, 1853 and named in honor of James Madison Goodhue, the first printer and editor in Minnesota.

Kenyon was settled in 1855, platted in 1856 and organized in 1856. It was named after a pioneer merchant, who in 1856 built the first store.

Pine Island was settled in 1854, platted in the winter of 1856-57 and organized in 1856. It was named for a large tract of tall pine trees partially encircled by the middle branch of the Zumbro River. In 1930, it was the "cheese center of Minnesota."

Zumbrota Township, settled in 1854 and organized in 1857, received the name of its village, platted in September 1856. The village of Zumbrota was settled by a small fragment of large company in Massachusetts called Stafford Western Emigration.

Zumbrota is the home of the only covered bridge left in Minnesota. The bridge was first built in the late 1850s so a stagecoach line could operate through the town. In 1869, the bridge was rebuilt and a complete overhead covering was added in 1870 or 1871. From 1869 to 1932, the bridge was the focal point of traffic passing north. The bridge is recorded in the National Register of Historic Places and is now the main attraction at Covered Bridge Park in Zumbrota.

Wanamingo was settled in 1854 by natives of Norway and organized in 1858. The origin and meaning of the name are unknown.

Olmsted County, established February 20, 1855, was named in honor of David Olmsted, the first mayor of St. Paul.

Genoa, first settled in 1856 and platted in 1865, bears the name of an ancient seaport in northern Italy, the birthplace of Columbus.

Oronoco was settled by three bachelors, founded in 1854 and named after the Orinoco River in South America because of the valuable water power of the Middle Branch of the Zumbro River. In 1858 gold was discovered on the Zumbro five miles south of Oronoco. Four men quickly formed the Oronoco Mining Company and built sluices in the fall which were washed away the following spring. The sluices were rebuilt and gold was taken out (enough to make a few gold rings, but not enough to pay for the work involved). Then in June 1859, the Zumbro River put an end to the mining enterprise by flooding and wiping out the operation.

Rochester, also called "The Queen City," was platted in October 1855 and incorporated as a city in August 1858. George Head, who built the first log house in 1854, named it because the rapids of the Zumbro reminded him of the Genese River near Rochester, New York.

Rochester was the crossroads camping spot for wagon trains that rolled into southeastern Minnesota on their way west. Many immigrants remained and the population swelled, from 600 in 1857 to 1500 the following year. In 1858, Rochester became the county seat.

On August 23, 1883 a tornado ripped through the north section of Rochester, killing 26 persons and injuring many others. To handle existing and future medical needs, the Sisters of St. Frances contacted Dr. William W. Mayo. They offered their building and volunteered to start a hospital if the Mayo brothers would direct it. This was the beginning of the famed Mayo Clinic. Over the years, the Mayo doctors recognized the advantages of group practice and medical teamwork in diagnosis and treatment and continued to expand the clinic. Today Rochester is famous worldwide for its medical center.

Wabasha County, established October 27, 1849, commemorates a line of Dakota chiefs who had great influence among the Mississippi Dakota bands.

Hammond, settled in 1856 and incorporated in 1900, was named after its original proprietor, Joseph Hammond. Hammond was situated on an easy ford across the Zumbro known as Lyme's Ford.

Jarrett was originally a ford on the Zumbro where settlers in early days crossed. Jarrett's Ford was named after the nearest dweller, Mr. Jarrett. In 1878 a flour mill was built by Kimball and Kitzman.

Kellogg was founded in 1870 and incorporated in February 1877. Officers of the Chicago, Milwaukee and St. Paul Railway Company named the town after a Milwaukee gentleman who furnished the depot signs. This town was an important shipping point for grain, livestock and farm products until the late 1870s, when business was diverted by the building of the railroad up the Zumbro valley.

Mazeppa was settled and platted in 1855 and incorporated in 1877. Mazeppa was named a Ukrainian hero commemorated by Lord Byron in a poem of the same name. The poem was a favorite of Ira Seeley, who erected the first crude bark cabin. With the building of the railroad in 1878, Mazeppa became an important shipping point for Wabasha and Goodhue counties.

Millville was started in 1870 with the opening of a store by John Henry.

Theilman, platted in 1877, was once a thriving community and convenient trading point for the surrounding areas. Originally called Theilmanton, the town's name was later changed to Theilman in honor of Christian Theilman, through whose influence the railroad station was established.

Zumbro Falls was settled in 1855 by David and Abner Tibbitts and located on an old ford across the Zumbro on the territorial road from Lake City to Rochester. In 1866, Benjamin Clark put in a dam at the rapids which gave the village its name. A gristmill was erected and operated at this location until 1882. Pillars of the old mill are still visible today in low water. The village continued to grow with the building of the railroad and was organized in 1898.

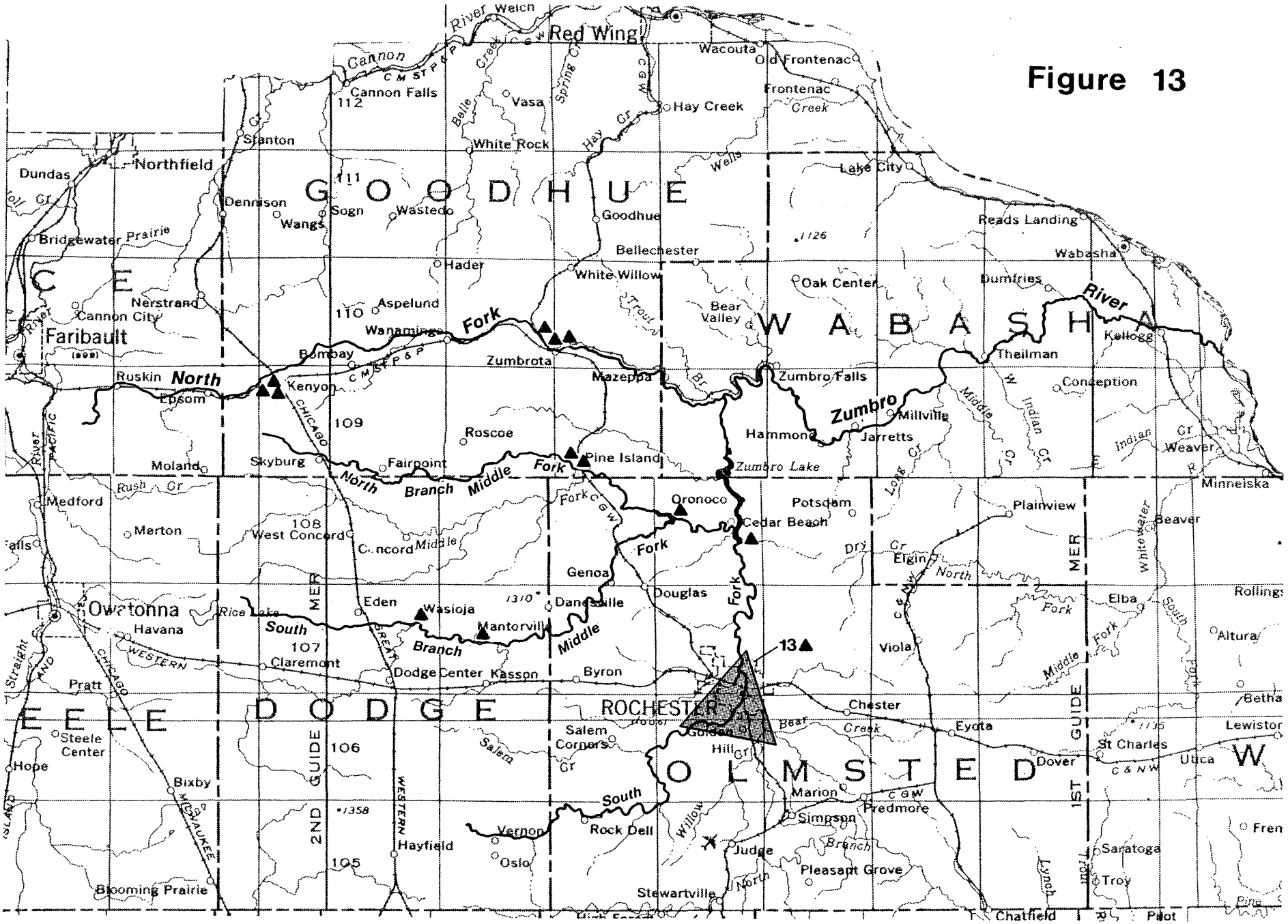
The following sites are in the National Register of Historic Places:

Dodge County

Kasson Water Tower, 4th Ave. NW, Kasson

- local significance
- an example of 19th century engineering skills, the tower is the only structure of its type in the region to remain in an unaltered state since the time of its construction in 1895

Figure 13



Zumbro River

▲ National Historic Sites

Mantorville Historical District, Hwy. 57 and 5th St., Mantorville

- state significance
- 24 structures represent stylistic developments in architecture from log and Greek revival buidlings of the 1850s to the vernacular stone architecture of the Opera House built in 1918

Wasioja Historical District, Co. Rd. 16

- local significance
- example of a near-deserted frontier village in Minnesota; six structures

Goodhue County

Jacob Bringgold House, 314 SW 2nd St., Pine Island

- local significance
- representative of the type of residence in southeastern Minnesota by the end of the 19th century

First Congregational Church of Zumbrota

- 1862; local significance
- one of the oldest standing churches in southeastern Minnesota
- represents important New England contribution to the settlement of the region

Martin Gunderson House, 107 2nd St., Kenyon

- 1890; local significance
- example of 19th century Queen Anne architecture

Dr. Orrin T. Hall House, 206 W. 3rd St., Zumbrota

- 1884; local significance
- example of the houses that the prosperous professional classes in the towns of southeastern Minnesota built in the last quarter of the 19th century

Hauge Lutheran Church, Hwy. 60, Kenyon Township

- local significance
- symbol of one of the two major waves of Norwegian immigration into Goodhue County

Kenyon Opera House, Main St., Kenyon

- 1890; local significance
- outstanding example of the type of cultural and social facilities that emerged in the booming small towns of southeastern Minnesota in the latter half of the 19th century

Opera House Block, Main St., Pine Island

- 1895; local significance
- example of the type of commercial and recreational facilities that appeared in the booming towns of southeastern Minnesota by the end of the 19th century

Pine Island City Hall & Fire Station, Main and 3rd, Pine Island

- 1909; local significance
- example of the type of municipal architecture that flourished in southeastern Minnesota towns in the late 19th and early 20th centuries

Zumbrota Covered Bridge, Hwy. 58, Zumbrota

- 1869; state significance
- only remaining covered bridge in Minnesota; was maintained as a village bridge for more than 50 years, is now retired and resides in Zumbrota City Park

Olmsted County

Chateau Dodge Theatre, 15 1st St. SW, Rochester

- 1927; state significance
- landmark of entertainment for more than half a century in Rochester
- architecturally unique and one of few remaining "atmospheric" theaters

Chicago Great Western R.R. Company Depot, 19 Second St. SE, Rochester
- local significance
- originally built in 1899-1900, relocated between 1902 and 1904.
- Rochester's oldest transportation facility in continuous use; now used for bus service

Frank's Ford Bridge, Co. Rd. 121, Oronoco Twp.
- 1895; local significance
- oldest remaining of six metal through truss highway bridges in the county
- only known truss Horton bridge remaining in the county

Lucius Cutting Barn, 3210 19th St. NW, Rochester
- 1868; local significance
- unusually early and handsome structure associated with agricultural development in Olmsted County
- exclusive use of stone for the walls

Charles H. Mayo House, 419 4th St. SW, Rochester
- 1914-1915; national significance
- first house built by Dr. Charles Mayo

Mayo Clinic-Plummer Bldg., 110 & 115 2nd Ave., Rochester
- 1914; national landmark
- first independent and complete clinic facility built in the United States

Dr. William S. Mayo House, 701 4th St. SW, Rochester
- state significance
- 1916-1938 residence of Dr. Mayo; central tower of five stories

Mayowood, Co. Rd. 122 and Salem Rd. SW, Rochester
- 1911; significant for architecture, landscape architecture and medical science.
- center for social life and scientific life of a growing community

Oronoco School, Co. Rd. 18 at Middle Fork Zumbro River, Oronoco

- 1875; local significance
- fine example of rural community institutional Italianate architecture in an excellent state of preservation

Pierce House, 426 2nd Ave. SW, Rochester

- 1877; local significance
- oldest extant major hotel building in Rochester; bracketed Italianate style

Quarry Hill, 1090 Plummer Lane, Rochester

- state significance
- 1917-1924, house and yard designed and constructed by Dr. Henry S. Plummer
- Dr. Plummer designed buildings, hospital laboratories and clinics at the Mayo Clinic

Rochester Armory, 121 N. Broadway, Rochester

- 1915; local significance
- pristine example of "medieval fortress" school of armory design

Rochester Public Library, 226 2nd St., Rochester

- local significance
- 1936-1937
- well-designed, -executed and -preserved example of Public Works Administration urban architecture; Jacobethan style

Toogood Barns, 16th St., southwest of U.S. 63, Rochester

- local significance
- best preserved stone farm complex located in Minnesota

Timothy Whiting House, 225 1st Ave. NW, Rochester

- 1875; local significance
- residential Italianate architectural design

Wabasha County

Wabasha County has no national historic sites near the Zumbro River.

The State Historical Society has inventoried other sites of potential state and local historic significance, but has not completed an evaluation of them.

PUBLIC OWNERSHIP

There are a number of areas along the Zumbro River which are in public ownership. These areas are administered by the U.S. Fish and Wildlife Service, the Minnesota Department of Natural Resources Divisions of Forestry and Fish and Wildlife, counties and municipalities.

The U.S. Fish and Wildlife Service administers the Upper Mississippi River Federal Wildlife and Fish Refuge. The Zumbro flows through the refuge for three miles before it joins the Mississippi. The refuge extends hundreds of miles along the Mississippi through Minnesota, Wisconsin, Iowa and Illinois. The refuge comprises 194,000 acres of islands, marshes and bottomland forest which provide habitat for numerous wildlife species. It is estimated that there are 270 species of birds, 50 species of mammals, 45 species of reptiles and amphibians and 113 species of fish in the refuge. There are no developments proposed in the area near the Zumbro for the next 20 years.

The Zumbro River in Wabasha and portions of Olmsted, Dodge and Goodhue counties flows through the Richard J. Dorer Memorial Hardwood State Forest. The forest, established in 1961, covers parts of eight southeastern Minnesota counties and encompasses 38,000 acres of land. The purpose of the forest management is to achieve an optimum mix of ecological, economic, social and environmental objectives. The forest is managed for timber and other forest products, for recreation, and for the protection of rare plant and animal species.

There are several parcels of forest land adjacent to the Zumbro which are owned by the state. The two largest parcels are located in Wabasha County. The Kruger Recreation Area includes 1,398 acres of land. Approximately one mile of the Zumbro flows through this parcel. An area known as the Zumbro Bottoms, 2.5 miles downstream, comprises 2,840 acres. Approximately three miles of the Zumbro flow through this area. There are also several smaller parcels next to the river.

There are plans to acquire additional forest lands adjacent to the Zumbro. In Wabasha County there are five areas (27,725 total acres) which have been identified for first priority acquisition.

There are four state wildlife management areas along the Zumbro. The primary purpose of the wildlife management areas is to preserve habitat for both game and nongame wildlife. Other management goals include the conservation of surface water, the preservation of plant communities and open space, the provision of public hunting areas, the provision of outdoor recreation opportunities such as hiking, skiing and fishing, and the provision of environmental education opportunities. The following list shows the size and approximate location of the wildlife management areas adjacent to the Zumbro.

Name of Area	Size (acres)	Closest Community
IWL	80	Oronoco
Mazeppa	3	Mazeppa
Zumbro	20	Dumfries
Schletty	13	Wasioja

The county and municipal parks and accesses are listed in the Recreation section. See Figure 19 for the location of these areas.

POPULATION

The population of the Zumbro River valley has increased in the past decade. The areas that have experienced the most growth are Rochester, the Zumbro Lake area and Pine Island. The remaining towns along the river have realized slight to moderate increases in population (see Figure 14). The populations of Rochester and communities within commuting distance of Rochester are expected to continue growing.

Figure 14. Population.

County	1970	1980	#change	%increase
Dodge	13,000	14,709	1,709	13
Goodhue	34,804	38,735	3,931	11
Olmsted	84,100	91,795	7,695	9
Wabasha	17,200	19,345	2,145	12
City				
Mantorville	479	704	225	46
Kenyon	1,573	1,526	-47	-2.9
Wanamingo	574	713	139	24
Zumbrota	1,929	2,129	200	10
Pine Island	1,640	1,980	340	20
Rochester	53,756	54,287	531	0.98
Oronoco	564	574	10	
Zumbro Falls	203	208	5	2.4
Hammond	179	178	-1	0
Millville	139	186	47	33
Kellogg	403	440	37	9.2
Township (Zumbro Lake area)				
Mazeppa	343	494	151	44
Oronoco	874	1,695	821	93

Increased population in the Zumbro River valley could affect the Zumbro in several ways. One, the river may receive more use by people seeking river recreation opportunities close to home. Two, the wooded uplands near the river may be cleared and developed to accommodate the housing needs of growing communities. Three, as communities along the river grow, effluent from sewage treatment plants will increase, affecting the water quality of the river.

ECONOMY

The economy of the Zumbro River valley is based primarily on agriculture and the production of agricultural products and farm equipment.

Corn and alfalfa are the major crops grown in the basin. Other crops include soybeans, sunflowers, wheat and rye. Livestock activities include dairying, and raising beef cattle and hogs. There are no large-scale feedlot operations adjacent to the Zumbro River.

Agriculture also supports many industries in the area, such as food processing (vegetable canning, dairy products); farm implement sales and service; fertilizer production, sales and storage; and farm building production and sales. The majority of these industries are located in Rochester.

Rochester is considered the industrial center of southeastern Minnesota. The two major employers in the city are International Business Machines and medical facilities which include the Mayo Clinic, St. Mary's Hospital and Methodist Hospital. In addition to providing employment, the world-famous Mayo Clinic each year draws thousands of people for treatment. This influx of people generates thousands of dollars for Rochester and the surrounding area. In 1979, Olmsted County ranked second in the state in tourist-travel expenditures.

Mining in the basin employs a small number of people and is limited primarily to sand and gravel extractions along the river. The sand and gravel is used locally for such things as road maintenance.

Timber production from the Dorer Memorial Hardwood Forest and wood products industries provide some employment. The number of people employed in the forest industry is expected to increase in the future as timber stands improve and trees mature and are harvested.

LAND USE

Land uses for 40-acre parcels were determined from 1980 ASCS aerial colored slides. Dominant land use was defined as the land use comprising the greatest percentage of the 40-acre parcel. Those land uses which occupied the second and third greatest percentages in a 40-acre parcel were also recorded.

Land use categories were defined as follows:

Land Use Category	Definition
Urban	Densely developed residential, commercial, and or industrial.
Cultivated Agriculture	Cultivated, agricultural land use - all crops
Extractive	Gravel and sand pits, quarries and peat mines
Open/Pasture	Areas with mixed grasses, shrubs and trees or grass only or shrubs only, including pastures
Wetland/Forest/Water	Marshes, swamps, sloughs, hardwoods, conifers and mixed open water in the form of lakes, ponds, impoundments and backwaters.

Figure 15 illustrates the dominant land uses along the Zumbro River.

R 80- 240, C 80- 371

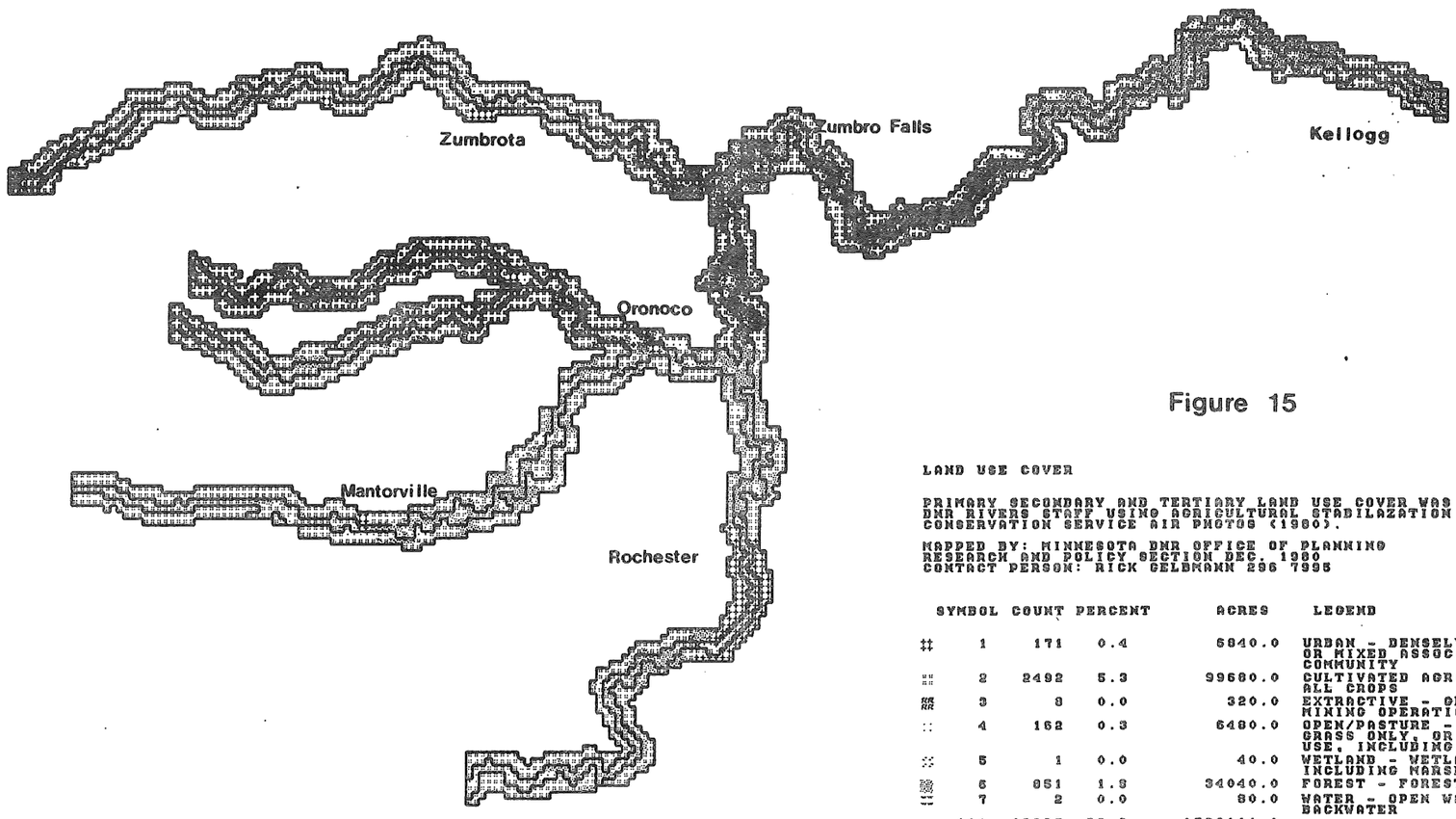


Figure 15

LAND USE COVER

PRIMARY SECONDARY AND TERTIARY LAND USE COVER WAS CODED BY DNR RIVERS STAFF USING AGRICULTURAL STABILAZATION AND CONSERVATION SERVICE AIR PHOTOS (1980).

MAPPED BY: MINNESOTA DNR OFFICE OF PLANNING RESEARCH AND POLICY SECTION DEC. 1980
CONTACT PERSON: RICK GELBMANN 296 7995

SYMBOL	COUNT	PERCENT	ACRES	LEGEND
1	171	0.4	6840.0	URBAN - DENSELY DEVELOPED RESIDENTIAL, COMMERCIAL, INDUSTRIAL OR MIXED ASSOCIATED WITH AN INCORPORATED OR UNINCORPORATED COMMUNITY
2	2492	5.3	99680.0	CULTIVATED AGRICULTURE - CULTIVATED, AGRICULTURAL LAND USE ALL CROPS
3	8	0.0	320.0	EXTRACTIVE - GRAVEL AND SAND PITS, QUARRIES, PEAT MINES,OTHER MINING OPERATIONS
4	162	0.3	6480.0	OPEN/PASTURE - AREAS WITH MIXED GRASS, SHRUBS, TREES, GRASS ONLY, OR SHRUBS ONLY NOT BEING USED FOR ANY INTENSIVE USE, INCLUDING PASTURES
5	1	0.0	40.0	WETLAND - WETLANDS CONTAINING ALL WETLAND VEGETATION TYPES INCLUDING MARSH, SWAMP, SLOUGHS, ETC.
6	851	1.8	34040.0	FOREST - FORESTED AREAS, HARDWOOD,CONIFERS,MIXED
7	2	0.0	80.0	WATER - OPEN WATER IN FORM OF IMPOUNDMENTS, LAKES, PONDS, BACKWATER
100	43325	92.2	1733000.0	

Figure 15

The dominant land uses along the North Fork of the Zumbro are pasture/open or cultivated land. There are four areas of urban nonresidential or mixed residential and urban residential land. These are the towns of Kenyon, Wanamingo, Zumbrota and Mazeppa. There are a few scattered pockets of forested land.

The Middle Fork and its North and South branches exhibit a land use pattern similar to that of the North Fork. Cultivated and pasture/open land represent the major land uses. The communities along this fork include Pine Island, located at the junction of the North Branch and Middle Fork; Mantorville, on the South Branch, and Oronoco, at the junction of the South Branch and Middle Fork.

The city of Rochester is located on the South Fork. The Zumbro River flows through the city where urban nonresidential, mixed residential and urban residential are the predominant land uses. The large amount of development along Zumbro Lake, a nonurban area, places it in the urban residential land use category. The segment of river from its source to Rochester is used primarily for agriculture, both cultivation and pasture. Downstream of Rochester, agriculture is the predominant land use, but there are more scattered areas of forest than along any of the other forks.

There is more forested land along the main stem of the Zumbro than along any of the above mentioned segments. Agriculture is still a major land use, with more pasture/open land than cultivated land. Major communities include Zumbro Falls, Hammond, Millville, Theilman and Kellogg.

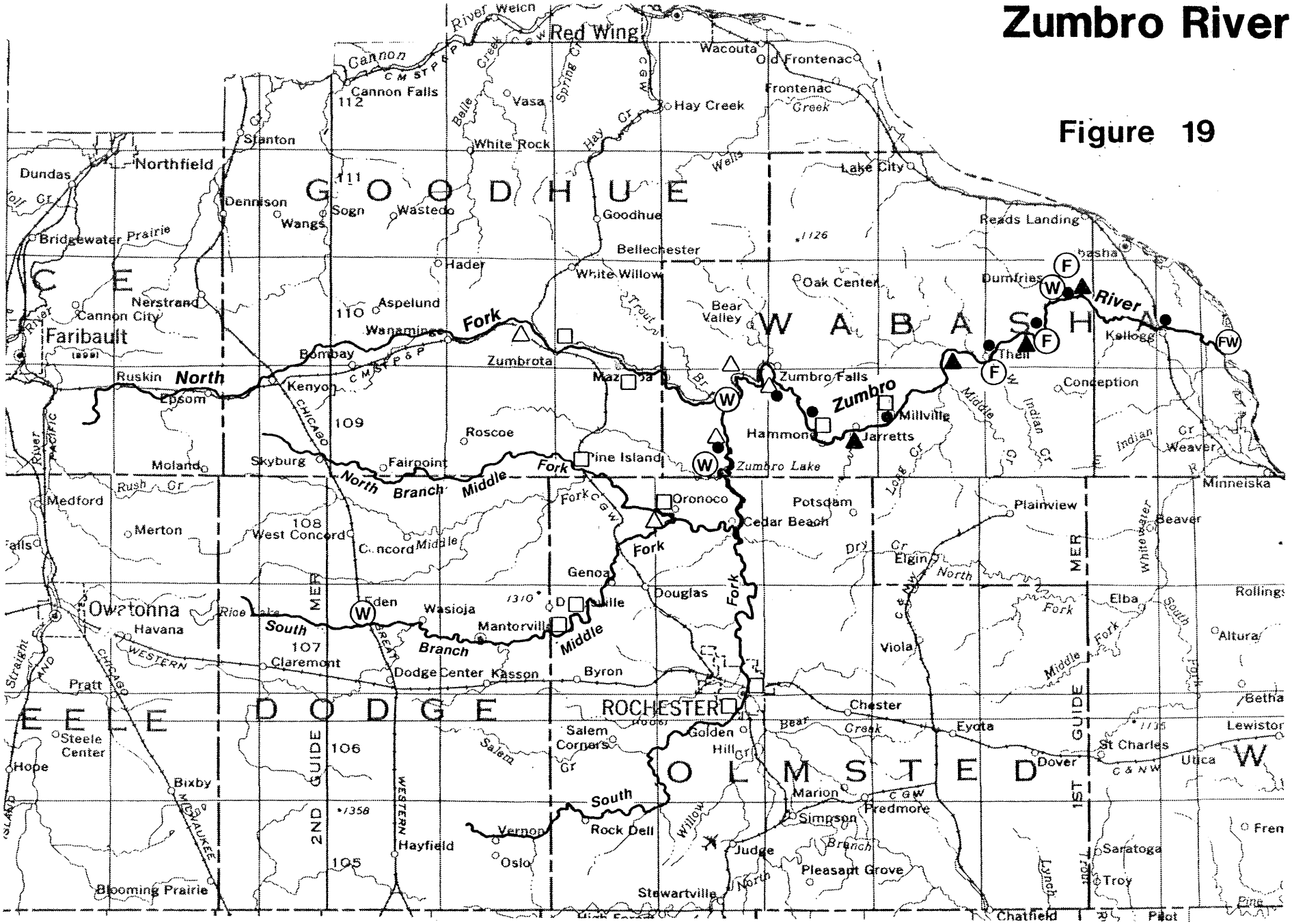
Figure 16 illustrates the dominant, secondary, and tertiary types of land uses based on 40 acre cells.

Figure 16

Land Use	Percentage of the total of 40 acre cells		
	Dominant	Secondary	Tertiary
Urban	4.6	.8	.3
Cultivated Agriculture	67.4	14.7	1.0
Extractive	.2	.9	1.0
Open/Pasture	4.4	7.5	2.1
Wetland	.0	.3	.1
Forest	23.3	34.8	1.9
Water	.1	.2	.3

Zumbro River

Figure 19



DNR

RECREATION SITES

- ▲ Camping
- ■ Rest Area
- ● Access
- □ City/County Park
- △ Private Campground

OWNERSHIP

- (F) DNR Forestry
- (W) State Wildlife Management Area
- (FW) Upper Mississippi Wildlife and Fish Refuge

RECREATION

The Zumbro River valley provides a variety of recreational opportunities, including canoeing, fishing, hunting, camping and winter trail activities.

Canoeing is one of the most popular activities, especially from Zumbro Lake Dam to Kellogg. The moderate current, the absence of difficult rapids and the scenic 150-foot wooded bluffs from Zumbro Lake Dam to Theilman make this stretch ideal for family canoeing. A stretch of mild rapids at Jarrett presents a rocky obstacle course during low water. Downstream of Theilman the stream is filled with numerous snags that require alertness and skill. The current slows down and the floodplain widens as the Zumbro approaches its confluence with the Mississippi.

The water level of the Zumbro is usually low and depends largely on the flow at Zumbro Lake Dam. On weekends, enough water is released from the dam to provide sufficient water for canoeing. The river's level may also rise dramatically, and dangerously, after rainstorms, when flash floods are likely to occur.

In 1976, the legislature designated the Zumbro River as a state canoe and boating route. It is one of four state canoe and boating routes in southeastern Minnesota. In addition to the private facilities along the river, the DNR has developed accesses, campsites and rest areas for river users.

The two most popular day trips for canoeists are from Zumbro Lake Dam to Zumbro Falls and from Zumbro Falls to Hammond. Floating these stretches of river in inner tubes is also popular. Three aerial surveys conducted during the summer of 1980 by DNR Region 5 field staff indicated the river from Zumbro Lake to Hammond is heavily used (see Figure 17).

The survey was conducted on holiday weekends, when the use was probably higher than on an average weekend or weekday. Watercraft counts showed that, in comparison with the other southeastern Minnesota canoe routes, the Zumbro received far more use than the Straight or Root rivers and generally more use than the Cannon River.

Canoes and inner tubes can be rented from outfitters located near Zumbro Lake, Zumbro Falls and upstream of the Kruger Recreation Area. During the summer of 1980, the outfitter at Zumbro Falls rented about 60 canoes per day on an average weekend, and up to 100 canoes per day on a good weekend. A new outfitter at Zumbro Lake Dam rented from 10 to 15 tubes and canoes per day in his first season of operation.

Figure 17. Aerial recreation survey.

DATE	TIME	ROCHESTER TO ZUMBRO LAKE	ZUMBRO LAKE TO ZUMBRO FALLS	ZUMBRO FALLS TO HAMMOND	HAMMOND TO MILLVILLE	MILLVILLE TO MISSISSIPPI
6/21/80	1:30 p.m.	1 Canoe	23 Canoes	36 Canoes	6 Canoes	0 Canoes
		0 Tubes	9 Tubes	45 Tubes	0 Tubes	0 Tubes
7/5/80	1:30 p.m.	0 Canoes	43 Canoes	47 Canoes	6 Canoes	0 Canoes
		0 Tubes	39 Tubes	0 Tubes	0 Tubes	0 Tubes
9/5/80	1:45 p.m.	0 Canoes	3 Canoes	16 Canoes	0 Canoes	0 Canoes
		0 Tubes	0 Tubes	0 Tubes	0 Tubes	0 Tubes

Portions of the forks are also suitable for canoeing. The forks were checked from bridge crossings for adequate water depth and width to float a canoe. However, deadfall and other obstacles to navigation may exist between the check points.

The following stretches of river appeared to have sufficient width and depth to float a canoe:

North Fork - Zumbrota to Main Stem
North Branch, Middle Fork - Pine Island to Oronoco
Middle Branch, Middle Fork - Dodge Co. Rd. 24 to Oronoco
South Branch, Middle Fork - Wasioja to Oronoco
Middle Fork - Oronoco to Zumbro Lake
South Fork - Rock Dell to Zumbro Lake

Powerboating and waterskiing take place on Shady Lake and Zumbro Lake. Both lakes receive heavy use on weekends.

The fishery resource of the Zumbro River is currently underused. Popular fish include smallmouth bass, suckers, channel catfish and sunfish. User conflict between the anglers and the canoeists and innertubers is not a problem. The majority of the fishing takes place in the spring and fall, before and after the canoeists and tubers are on the water.

Hunting opportunities for those seeking deer, grouse and small mammals are excellent in the wooded areas of the J.R. Dorer Memorial State Forest. The forest is also one of the few places in Minnesota where people can hunt wild turkey. Mallard and teal are present along the river for duck hunters.

Picnicking and camping are also popular summer activities. Numerous city parks and a few private campgrounds have been developed along the Zumbro. The natural landscape of the river also encourages nature observation and photography.

Winter recreation activities in the Zumbro River valley include snowmobiling and cross-country skiing. A grant-in-aid trail runs along the south side of the river from Millville to Hammond. The Kruger Recreation Area provides six miles of snowmobile trail and 5.8 miles of cross-country ski trail. The Douglas State Corridor Trail from Rochester to Pine Island crosses the Middle Fork of the Zumbro River.

Figure 18 shows the existing private and public recreational facilities along the Zumbro River.

Figure 18. Existing recreation facilities.

River Mile	Site Identification	Ownership	Operation and Maintenance	Facilities
(Main Stem Zumbro)				
5.2	Access	Private	DNR lease	Access, outhouse, parking
13.0	Kruger Recreation Area	DNR - State Forest	DNR - State Forest	Access, hiking trails, campground, picnic area, outhouses, drinking water, facilities for handicapped
13.2	Bob's Canoe Rental	Private	Private	Canoe rental
18.5	Access	DNR - State Forest	DNR	Access
21.0	Bluff campsite	DNR - State Forest	DNR	Fire ring, picnic tables, outhouse
26.0	Access	DNR	DNR	Access, parking lot
29.0	Campsite	DNR - State Forest	DNR	Fire rings, picnic tables, outhouse
36.0	Reed's Park	Millville	Millville	Access, parking lot, picnic tables, outhouse, drinking water
39.0	Jarrett Campsite	DNR - State Forest	DNR	Picnic table, fire ring, outhouse
41.0	Hammond Village Park	Hammond	Hammond	Access, rest area, outhouse, picnic table, ball park, drinking water
48.2	Sportsman's Park	Private	Private	Campground, canoe rental, access, picnic grounds, drinking water, toilets
52.5	Bluff Valley Campground	Private	Private	Campground, canoe and innter tube rental, toilets

River Mile	Site Identification	Ownership	Operation and Maintenance	Facilities
60.0	Max's Park Place	Private	DNR agreement - Private	Canoe and innter tube rental, campground, access, picnic area, parking, toilets
60.0	Rochester Power Dam Portage	Private	DNR agreement	Path around dam
(North Fork Zumbro)				
61.2	Cooper's Park	Mazeppa	Mazeppa	Picnic tables, toilets
70.9	Covered Bridge Park	Zumbrota	Zumbrota	Campground, picnic area, drinking water, toilets
(Middle Branch, Middle Fork Zumbro)				
72.0	Allis Park	Olmsted County	Olmsted County	Access, outhouse
73.1	Oronoco Park	Oronoco	Oronoco	Drinking water, outhouse, access, campground
73.3	Camp Wazionja	Private	Private	Campground, canoe rental, outhouses
82.0	Pine Island Municipal Park	Pine Island	Pine Island	Picnic areas, parking, toilets, playground
96.5	Mantorville Municipal Park	Mantorville	Mantorville	Recreation area, picnic area, parking, toilets
(South Branch, Middle Fork Zumbro)				
88.0	Oxbow Park	Olmsted County	Olmsted County	Campground, picnic area, drinking water, toilets
(South Fork Zumbro)				
80.1	Silver Lake Park	Rochester	Rochester	Picnic area, playground, parking, toilets
82.0	Soldier's Field Park	Rochester	Rochester	Picnic area, playground, parking, toilets
82.6	Zumbro Municipal Park	Rochester	Rochester	Picnic area, playground, parking, toilets

EXISTING PROTECTION

Existing protection for the Zumbro River valley is limited primarily to county zoning ordinances which include floodplain and shoreland standards. All counties that have land lying within flood-prone areas of land abutting lakes and streams are required to adopt state-approved floodplain and shoreland ordinances (Minn. Stat., Sections 104 and 194.85).

The floodplain ordinances are designed to minimize the damage to property, threat to lives and cost to taxpayers caused by floods. This is accomplished by controlling development in floodplain areas and by ensuring that the development which takes place is properly planned and constructed to prevent and minimize future flood damage.

The shoreland management program provides guidance for the wise use and development of shorelands. It also helps to protect the water quality of lakes and streams and to preserve the economic and natural values of shoreland. All shorelands within 1,000 feet of lakes and within 300 feet of rivers are subject to the shoreland management program. The State of Minnesota has set minimum development standards for lot size, lot shape, vegetative clearing and sewage treatment system setbacks within shoreland areas.

There are several land use activities that are addressed in the floodplain and shoreland ordinances, but specific regulations pertaining to the activities are not always included. These activities include sand and gravel operations, vegetative cutting, grading and filling of natural topography, development on steep slopes and blufflines and new construction or expansion of residential, commercial or industrial uses near the river.

When not properly controlled by local ordinances, these activities could significantly alter the river environment. Elements of this environment include air and water quality, type and distribution of natural vegetation, fish and wildlife habitat, topographical features and the overall visual attributes of the valley. Figure 20 shows how existing county ordinances along the Zumbro River are addressing the land use activities not covered by the floodplain and shoreland programs.

Several sand and gravel operations exist along the South Fork of the Zumbro River. The most noticeable impacts are removal of vegetation, alteration of topography, noise, and erosion and sedimentation where pits are adjacent to the river. Discharge from settling ponds used in washing sand and gravel may have an effect on the water quality of the river.

Three of the four counties along the Zumbro require a conditional use permit for sand and gravel operations. If the extraction includes washing, permits from the DNR Division of Waters and the Pollution Control Agency are requred to take water from the stream and to discharge effluent from settling ponds.

Feedlots located near rivers can have serious effects on the water quality of the stream. Major impacts include trampling of vegetation and compaction of soil, which result in erosion and sedimentation. Water quality is affected when water crossing the feedlot washes off or dissolves pollutants from the manure and enters the river. Pollutants include pathogenic organisms as well as phosphorus and nitrogen. Excess concentration levels of phosphorus and nitrogen in streams can result in algae blooms.

Only one county, Dodge, specifically addresses and prohibits feedlots within 660 feet of the waterline where surface runoff could carry materials into the river.

Improper vegetative cutting for timber harvesting, and clearing for cropland and residential development adjacent to the river and on steep slopes can also adversely affect the river environment. Clearing vegetation from riverbanks and steep slopes exposes the soil to wind and rain, which results in erosion and sedimentation. Siltation occurs when these eroded soils are washed into the river. The effects of siltation include increased turbidity, loss of stream bottom habitat, change in aquatic environment and destruction of aquatic organisms.

All four counties place some restrictions on vegetative cutting within shoreland areas. However, removal of vegetation for timber harvesting, agricultural purposes and development on steep slopes is not specifically mentioned in any of the county ordinances.

Grading and filling in the river valley result in destruction of vegetation, alteration of topography, erosion and sedimentation. Depending on the size of the project and its location, it may or may not have a direct effect on the river. Three of the four counties require a conditional use permit in certain situations. A DNR Division of Waters permit is required for any filling in the floodway.

Filling in the floodway may be permitted by the DNR if the filling is necessary to grade or make minor landscape alterations. Filling is not allowed if it would obstruct in any way the flow of flood water. Filling in the flood fringe is allowed by the counties when accessory to permitted uses.

New construction and expansion of commercial and industrial uses usually involve vegetative cutting and grading and filling. If construction is adjacent to or near a river, erosion and sedimentation may result. Increases in commercial and industrial uses within the river valley may affect the water quality through increased discharges directly into the river or through increased effluent from sewage treatment facilities. Air emissions from commercial and industrial uses will affect the air quality. New construction or expansion of existing facilities will increase the noise level for a period of time.

The majority of existing commercial and industrial uses within the river valley are located adjacent to or within municipalities. Commercial and industrial uses require a conditional use permit in three counties. The fourth county requires a conditional use permit only if the use is within the flood fringe area. Industrial air emissions and discharge are subject to PCA regulations.

Scattered development of single residential homes affects the river environment in several ways. Careless grading, filling and excess removal of vegetative on blufflines, steep slopes and uplands adjacent to the river will result in erosion and sedimentation. Inadequate screening of buildings from the river can destroy the visual attributes of the river valley.

The only specific restrictions the counties place on single residential homes pertain to sewage disposal systems and location of buildings within shoreland areas.

In general, the Zumbro River valley has not been significantly affected by sand and gravel operations, grading and filling, vegetative cutting, feedlots and new construction and expansion of residential, commercial and industrial uses. However, existing county ordinances offer little protection for the river from future land use activities such as these. If these land use activities are conducted without regard for the river environment, the forested bluffs, wildlife habitat, scenic characteristics and recreation opportunities of the Zumbro River valley could easily be destroyed.

Figure 20. Existing Protection.

Land Use Activity	Dodge County	Goodhue County [1]	Olmsted County	Wabasha County[2]
Feedlots	prohibited within 660' of waterline where surface runoff could carry material into river	not specifically addressed	not specifically addressed	not specifically addressed
Sand and gravel operations	conditional use permit; no specific standards set	conditional use permit; no specific standards set	not specifically addressed with respect to streambank	conditional use within floodway
Dumping of solid waste	not specifically addressed; junkyards require conditional use permit	not specifically addressed	special use permit; prohibited in flood plain	PCA approval required within shoreland and floodplain areas
Grading and filling	conditional use permit	conditional use permit required if slope of land is toward public water	permit needed if within shoreland area	filling addressed only in floodplain areas; grading not addressed
Vegetation Alteration	30' wide strip of natural vegetation must be maintained along upland site of mean flow level	addressed only in shoreland areas; not applicable to agricultural land	addressed only in shoreland areas	addressed only in shoreland areas
Farm Cultivation	prohibited within 150' of mean flow level	not addressed	not addressed	not addressed
Development on steep slope and bluff areas	not addressed	not addressed	not addressed	not addressed
Single residential development	shoreland standards restrictions on sewage disposal system	shoreland standards restrictions on sewage disposal system	shoreland standards restrictions on sewage disposal system	shoreland standards restrictions on sewage disposal system
Commercial/ Industrial	conditional use permit	conditional use permit	generally limited to commercial and manufacturing districts	conditional use within floodfringe area
Subdivision	ordinance adopted 1974	ordinance adopted 1977	ordinance adopted 1979	addressed only in shoreland areas

[1]All of the land use activities listed for Goodhue County are specifically addressed and regulated by the Senic and Recreational River Ordinance only for those portions of the county along the Cannon River. The Cannon River Rule (6 MCAR 1.2920) and the Wild and Scenic River Regulations (NR 79-81) apply and are adopted as part of the ordinance.

[2]Wabasha County does not have a countywide zoning ordinance.

Programs and Controls Associated With Rivers

Federal

Clean Water Act of 1977

National Pollutant Discharge Elimination System
- Requires permits for the discharge of wastewater from point sources to surface waters, and state permits for feedlots and on-land disposal of waste water.

208 Program

- Requires comprehensive area wide planning for water quality management throughout the nation.

State

Chapter 104 Flood Plain Management

- Reduces flood damage by regulating development within the floodplain.

Chapter 104.31 Wild and Scenic Rivers Act

- Establishes a land use district within approximately one-quarter mile of each side of designated rivers.
- Provides for uniform minimum standards for lot sizes and widths, building setbacks, sewage disposal systems, vegetative cutting.
- Regulates uses which may harm the river corridor, such as mining, grading and filling, and industrial and commercial uses.
- Authorizes land and scenic easement purchase from willing sellers to protect outstanding river land.
- Authorizes development of recreation sites for river users, and implementation of water surface use regulations where necessary.

Chapter 105.392 Water Bank Program

- Authorizes state to pay landowners not to drain wetlands on their property.

Chapter 105.41 Appropriation and Use of Water

- Requires permit for any activities, such as agricultural, residential, commercial or industrial activities, that would take water from a classified public water.

Chapter 105.42 Permits; Work in Public Waters

- Requires DNR permit for work such as filling, excavating or placing of materials in or on the beds of public waters.

Chapter 105.475 Stream Maintenance Program

- Grants money for cutting and removal of brush and dead or downed trees and for removal of large rocks, concrete, asphalt and scrap materials.

Chapter 105.48 Dam Construction and Maintenance

Chapter 105.482 Dams; Repair, Reconstruction

- Regulates construction, repair and reconstruction of dams.

Chapter 105.485 Regulation of Shoreland Development

- Authorizes state to provide standards and criteria for shoreland development to counties and municipalities.

Chapter 105.64 Drainage or Diversion of Water to Facilitate Mining

- Requires a DNR permit for use of public waters for mining purposes.

Chapter 115 Water Pollution Act

- Authorizes state to administer and enforce all laws relating to the pollution of any of the waters in the state.

- Establishes reasonable pollution standards for any waters of the state.

Of all the federal and state programs and regulations associated directly or indirectly with river protection, the Wild and Scenic Rivers Program is the only one that is comprehensive; that is, it treats the river corridor as a whole. The other regulations are primarily site specific and address a specific problem.

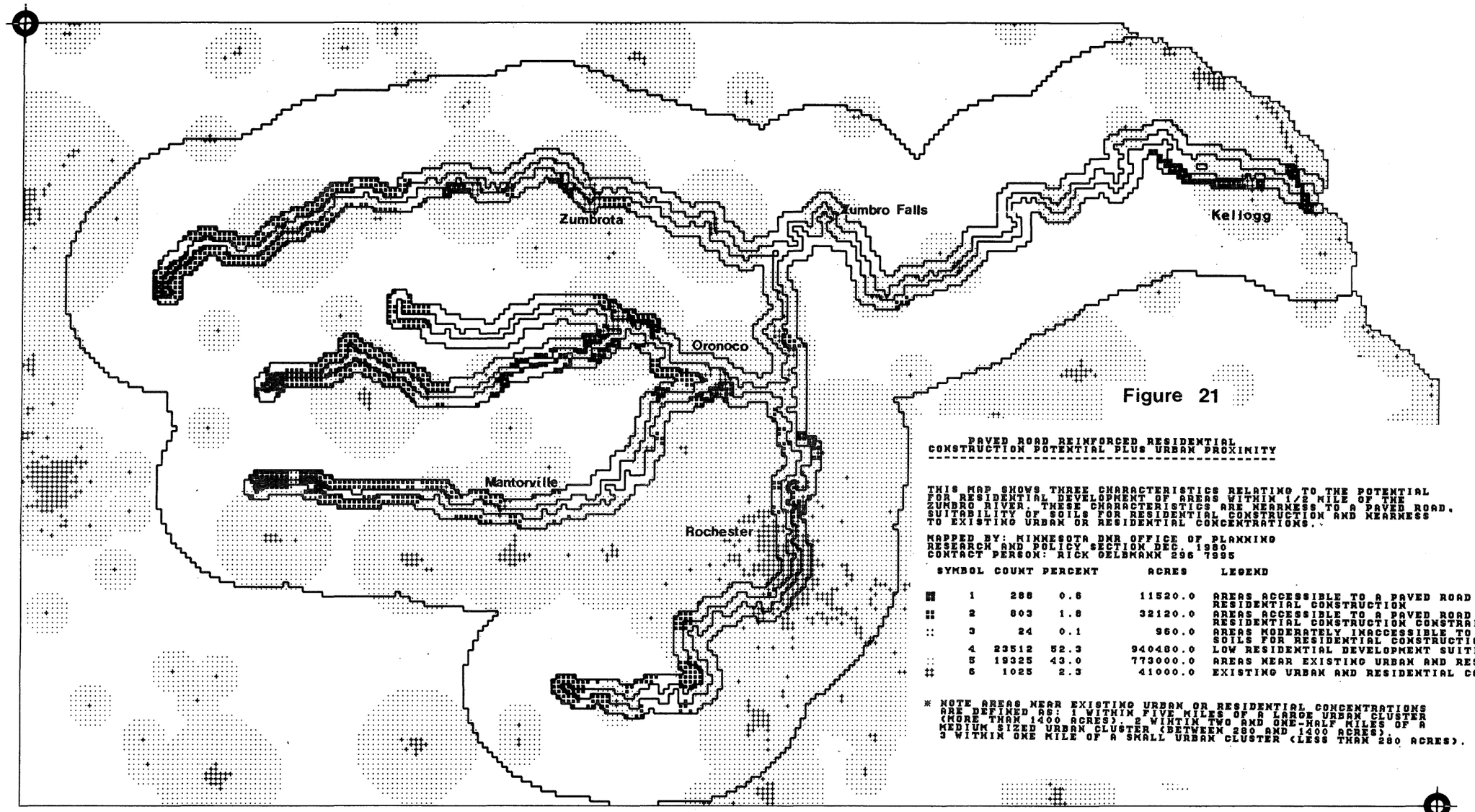


Figure 21

PAVED ROAD REINFORCED RESIDENTIAL CONSTRUCTION POTENTIAL PLUS URBAN PROXIMITY

THIS MAP SHOWS THREE CHARACTERISTICS RELATING TO THE POTENTIAL FOR RESIDENTIAL DEVELOPMENT OF AREAS WITHIN 1/2 MILE OF THE ZUMBRO RIVER. THESE CHARACTERISTICS ARE NEARNESS TO A PAVED ROAD, SUITABILITY OF SOILS FOR RESIDENTIAL CONSTRUCTION AND NEARNESS TO EXISTING URBAN OR RESIDENTIAL CONCENTRATIONS.

MAPPED BY: MINNESOTA DNR OFFICE OF PLANNING
RESEARCH AND POLICY SECTION DEC. 1980
CONTACT PERSON: RICK OELSMANN 296 7995

SYMBOL	COUNT	PERCENT	ACRES	LEGEND
▪	1	288	0.6	11520.0	AREAS ACCESSIBLE TO A PAVED ROAD HAVING SUITABLE SOILS FOR RESIDENTIAL CONSTRUCTION
▪▪	2	803	1.8	32120.0	AREAS ACCESSIBLE TO A PAVED ROAD HAVING SOILS WITH SOME RESIDENTIAL CONSTRUCTION CONSTRAINTS
::	3	24	0.1	960.0	AREAS MODERATELY INACCESSIBLE TO A PAVED ROAD HAVING SUITABLE SOILS FOR RESIDENTIAL CONSTRUCTION.
	4	23512	52.3	940480.0	LOW RESIDENTIAL DEVELOPMENT SUITIBILITY
..	5	19325	43.0	773000.0	AREAS NEAR EXISTING URBAN AND RESIDENTIAL CONCENTRATIONS
#	6	1025	2.3	41000.0	EXISTING URBAN AND RESIDENTIAL CONCENTRATIONS

* NOTE AREAS NEAR EXISTING URBAN OR RESIDENTIAL CONCENTRATIONS ARE DEFINED AS: 1 WITHIN FIVE MILES OF A LARGE URBAN CLUSTER (MORE THAN 1400 ACRES), 2 WITIN TWO AND ONE-HALF MILES OF A MEDIUM SIZED URBAN CLUSTER (BETWEEN 280 AND 1400 ACRES), 3 WITHIN ONE MILE OF A SMALL URBAN CLUSTER (LESS THAN 280 ACRES).

Figure 21

CONCLUSIONS AND RECOMMENDATIONS

Figure 21 illustrates the areas along the Zumbro River which are suitable for residential development and those which are not suitable, based upon three criteria. These criteria are soils suitability, (soil permeability, likelihood of flooding, depth to bedrock), accessibility to paved roads and proximity to population centers. Those areas of Figure 21 which are overlain by the urban proximity pattern are the most likely to experience residential development pressure because they have soils suitable for the development of structures and sewage facilities; they are in close proximity to paved roads, which facilitates commuting to population centers; and they are in close proximity to an urban area.

The areas which are likely to experience the greatest pressure for residential development include:

- the majority of the North Fork upstream of Zumbrota;
- the majority of the Middle Branch of the Middle Fork upstream of Oronoco;
- the South Branch of the Middle Fork upstream of Mantorville;
- the majority of the South Fork downstream of Zumbro Lake; and
- the portion of river between Kellogg and the Upper Mississippi River Federal Wildlife and Fish Refuge.

The areas which are least likely to experience pressure for residential development include:

- the North Fork from Zumbrota downstream to its junction with the main stem;
- from Zumbro Lake to Kellogg; and
- the Middle Fork between Mantorville and Oronoco.

An analysis of cropland suitability was also done (Fig. 22). The source of information for the analysis was the Minnesota Cropland Resources study done by the State Planning Agency. The criteria which were used to determine cropland suitability include soil characteristics and climate variables.

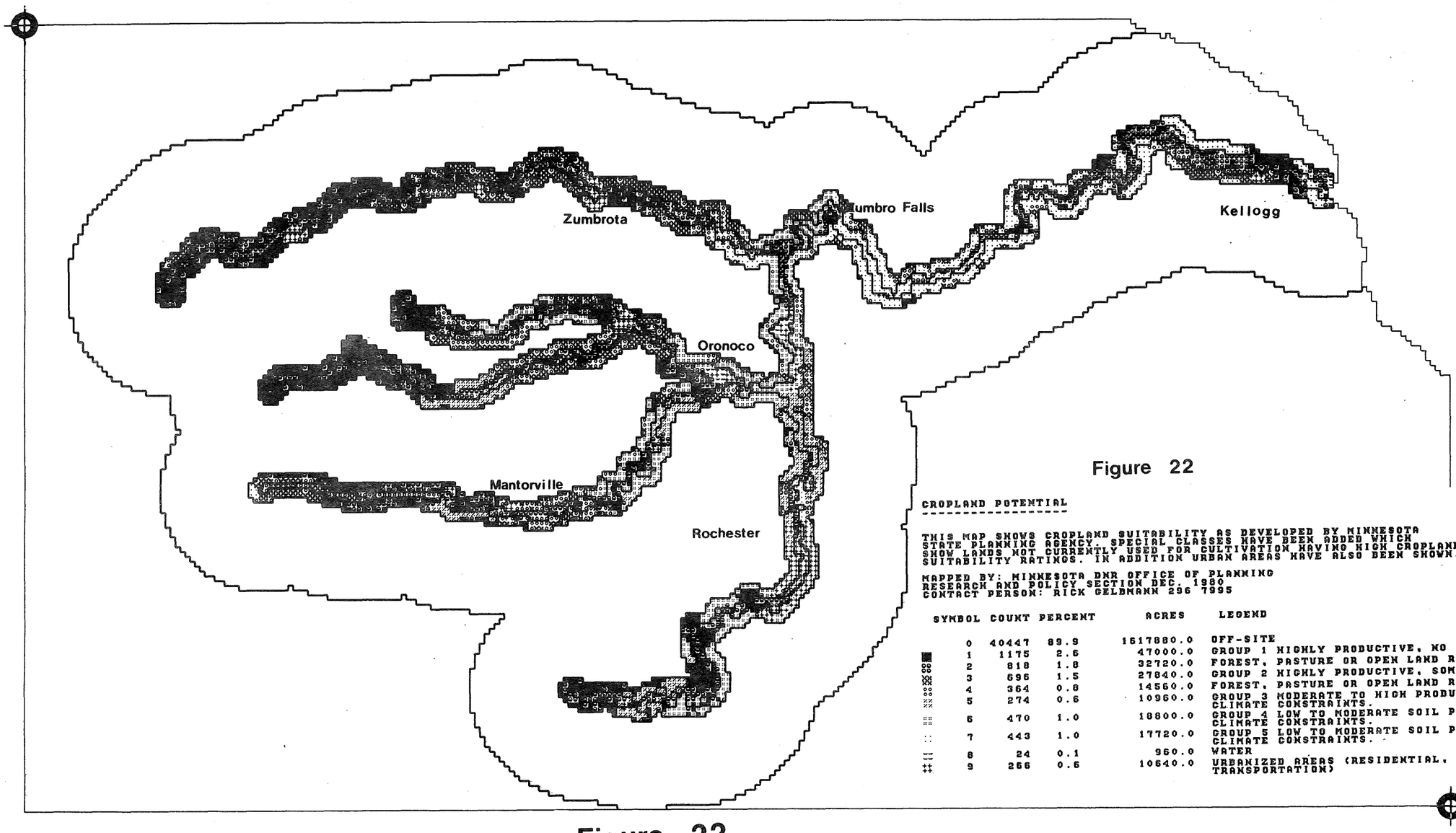


Figure 22

CROPLAND POTENTIAL

THIS MAP SHOWS CROPLAND SUITABILITY AS DEVELOPED BY MINNESOTA STATE PLANNING AGENCY. SPECIAL CLASSES HAVE BEEN ADDED WHICH SHOW LANDS NOT CURRENTLY USED FOR CULTIVATION HAVING HIGH CROPLAND SUITABILITY RATINGS. IN ADDITION URBAN AREAS HAVE ALSO BEEN SHOWN.

MAPPED BY: MINNESOTA DNR OFFICE OF PLANNING
RESEARCH AND POLICY SECTION DEC. 1980
CONTACT PERSON: RICK GELBMANN 296 7995

SYMBOL	COUNT	PERCENT	ACRES	LEGEND
0	40447	89.9	1617880.0	OFF-SITE
1	1175	2.6	47000.0	GROUP 1 HIGHLY PRODUCTIVE, NO CLIMATE CONSTRAINTS
2	818	1.8	32720.0	FOREST, PASTURE OR OPEN LAND RATED IN GROUP 1
3	696	1.5	27840.0	GROUP 2 HIGHLY PRODUCTIVE, SOME CLIMATE CONSTRAINTS
4	364	0.8	14560.0	FOREST, PASTURE OR OPEN LAND RATED IN GROUP 2
5	274	0.6	10960.0	GROUP 3 MODERATE TO HIGH PRODUCTIVITY SOILS WITH LOW TO MODERATE CLIMATE CONSTRAINTS.
6	470	1.0	18800.0	GROUP 4 LOW TO MODERATE SOIL PRODUCTIVITY WITH LOW TO SEVERE CLIMATE CONSTRAINTS.
7	443	1.0	17720.0	GROUP 5 LOW TO MODERATE SOIL PRODUCTIVITY WITH MODERATE TO SEVERE CLIMATE CONSTRAINTS.
8	24	0.1	960.0	WATER
9	266	0.6	10640.0	URBANIZED AREAS (RESIDENTIAL, URBAN NON-RESIDENTIAL OR TRANSPORTATION)

Figure 22

The soil productivity characteristics which were evaluated include soil texture, natural drainage condition, color of the soil (which reflects organic content), slopes, depth of the rooting zone and the phosphorus/potassium content.

Average annual precipitation and growing degree days* were the two climatic variables which were incorporated into the cropland suitability rating.

Land which was open or pasture and privately owned was considered more likely to be cultivated than developed or publicly owned land.

Most of the river corridor has a high potential for cropland development. The areas with the lowest cropland potential include:

-the South Fork from Rochester to Zumbro Lake;

-the South Branch of the Middle Fork downstream of Mantorville and;

-the main stem downstream of Zumbro Falls to the Upper Mississippi River Federal Wildlife and Fish Refuge.

*Growing degree days--heat accumulated during the growing season, defined as the sum of heat over a base temperature for the growing season. The base temperature is the temperature necessary for plant growth to occur.

Figure 23 illustrates those areas with outstanding resource value. Area 1 is a location of a Minnesota trout lily site. The Minnesota trout lily is found nowhere in the world except Rice and Goodhue counties and has been proposed for inclusion on the federal endangered species list.

Area 2 is the location of a Minnesota trout lily site and two other rare plant sites.

Areas 3 and 4 are the locations of remnant Big Woods communities.

In Area 5 steep bluffs are located adjacent to the river. Goat prairies occur on several south- and west-facing bluffs. The least amount of development occurs on this stretch. Several rare plant and animal habitats are located here.

Area 6 is an undisturbed floodplain forest with an abundance of wildlife.

Area 7 also merits special consideration both because it is an area of scenic quality with wooded bluffs and because it includes historic Mantorville.

Area 8 has regional significance in terms of resource value and recreational potential. The City of Rochester and Olmsted County have recognized this and are protecting this segment through land use planning.

The bluffs are an outstanding resource of the Zumbro River valley because of their scenic quality and the plant and animal communities they harbor. The bluffs are sensitive to disturbances: because of the soil type and steep slopes they have a high erosion potential. There are also negative impacts on the water quality associated with erosion. It is recommended that the bluffs be protected from development.

The floodplain areas adjacent to the river provide habitat for diverse plant and animal species. Often, these are the only natural areas remaining, because the majority of the surrounding acreage has been converted to agriculture. These areas are also prone to flash flooding and pose a hazard to developments. It is recommended that the floodplain area be protected from development for these reasons.

There are a number of areas along the Zumbro River which are remnants of Minnesota's presettlement vegetation. There are also a number of rare plants and animals found in the Zumbro valley. It is recommended that these plant communities and rare plant and animal habitats to be preserved and protected.

The surrounding land uses and developments affect the water quality of the Zumbro River. It is recommended that practices be adopted to minimize negative impacts on the water quality. In addition, monitoring these land use practices and point sources of pollution is recommended.

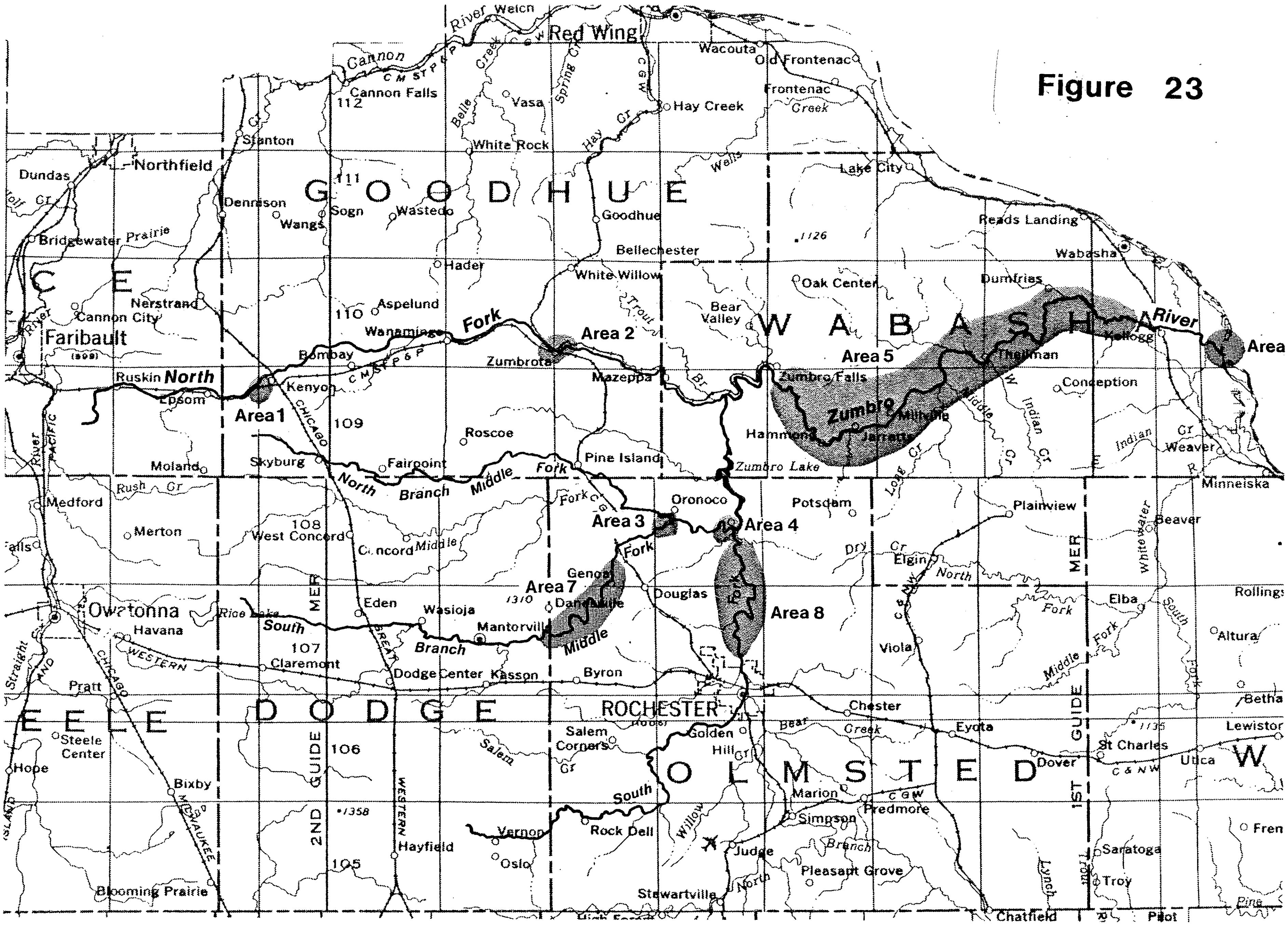
Streambank erosion decreases acreage available for cropland and is a source of pollution and sedimentation. It is recommended that erosion control practices along streambanks be promoted.

There is a need for information on the sources of sediment deposited in the Zumbro and on erosion problems on the uplands as well as in the gullies and along the streambank. It is recommended that studies of the erosion problems and their potential solutions be conducted.

The Zumbro valley is used by fishermen, canoeists, innertubers, campers, hunters and hikers. It is recommended that these recreational opportunities continue to be provided and that actions which will minimize recreation user conflicts be identified and implemented.

There are no data available on the numbers of people who use the river or on who would potentially use the river. It is recommended that data be collected on existing and potential recreational use of the river.

Figure 23



Zumbro River

▒ **Areas with outstanding resource value**

The Zumbro River flows through federal, state, county and municipal lands. It is recommended that intergovernmental cooperation in the management of the river be promoted.

There are a number of outstanding resources in the Zumbro valley which have recreational, scenic, scientific, natural and historic value. It is recommended that these resources be interpreted for the citizens of the state.

Finally, it is recommended that a comprehensive management plan be prepared for the Zumbro River. The plan should address implementation of the above recommendations and identify the appropriate government units to administer protective provisions for the river.

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