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Abstract. A field survey was begun in 1986 to determine the status of prairie vegetation on railroad rights-of-way in Wisconsin. Two % of 849 sample points located at 1.6 km intervals along railroads were found to contain relatively high quality prairie, and 23 % contained slightly degraded prairie. A significant proportion of these remnants contained mesic prairie, a community type which today is almost non-existent in Wisconsin and neighboring states. The linearity and fragmented state of these remnants, however, increase their susceptibility to invasion by woodland edge species. The lack of management that accompanies railroad abandonment has dramatically affected the ability of these prairie remnants to sustain themselves. This paper discusses the impact railroads have had on prairie remnants by examining 1) construction and abandonment trends, 2) the management history of railroad rights-of-way based on survey observations and interviews with maintenance personnel, and 3) the importance of the management techniques utilized through the 1950s in the preservation of prairie remnants.

Key Words. railroad, abandonment, prairie relicts, prairie remnants, rights-of-way, management, Wisconsin

INTRODUCTION

Remnants within railroad rights-of-way (ROW) have been found in all states that are recognized as containing portions of the original tallgrass prairie. These remnants tend to occur in patches and may extend for a few hundred meters or several kilometers, often to end abruptly in exotic grasses or trees and shrubs. While conducting a survey to determine the extent and quality of prairies still remaining along ROW, the authors became curious as to the effects that the construction and management of railroads must have had on the continuing existence of prairies that bordered them. This seemed particularly important because of the scarcity of remnants found along railroads and the potential for their loss as railroad companies halt management and abandon lines.

In the past 30 years, railroad companies increasingly abandoned lines that were no longer economically efficient. Management of vegetation ceases in railroad ROW with abandonment. Management generally maintained open community habitats, and as management ends, the invasion of canopy species often begins immediately. The extent to which vegetation management by railroad companies aids or impairs the stability of open grassland communities is important in understanding the effect high rates of abandonment may have on prairie remnants. The extent to which abandonment of lines and their management impact on desired native vegetation in ROW is of immediate concern if such remnants are to be preserved and acquired for conservation.

This paper will review survey results of the status of railroad prairies located in southern Wisconsin and then examine the methods used in the construction and management of railroads and adjacent ROW in the survey area. The paper will also review abandonment history and conclude by discussing the impacts that management and abandonment have had on these prairie relicts.

METHODS

A field survey was initiated in 1986 to determine the status of prairie vegetation in ROW of Wisconsin. About 2,100 km of ROW were surveyed that were built prior to 1901 and occurred within the prairie regions south of the tension zone of Wisconsin as delineated by Finley (1976) (Figure 1). Sampling points were located every 1.6 km along both abandoned and active railroad lines. A distance of 0.4 km was covered in each direction, and notes were taken on the vegetation type. If prairie was found, several walk-throughs were conducted to note the species and their relative abundance.

FIG. 1. Wisconsin presettlement vegetation map of both prairie and savanna combined occurring south of the tension zone. Stippled areas equal areas either in prairie or savanna. Adapted from Finley (1976).

Construction, management, and abandonment histories were investigated by reviewing historical records and government documents and through interviews conducted with former and current railroad personnel. Literature was of limited value as it did not address specific management techniques for an area. Early records by many of the railroad companies no longer exist or are scattered throughout cities of the Midwest. Railroad personnel generally did not seem to know of specific record locations. The majority of information discussed in this paper has been gathered from the interviews which have been corroborated by other individuals or writings.

RESULTS

Survey of Southern Wisconsin Railroads

A number of articles have discussed the importance of preserving railroad prairie remnants (Reed and Schwarzmeier 1978, Borowske and Heitlinger 1980, White 1986). This survey of Wisconsin rail-

road ROW suggests that another major reason for preservation is the ability of remnants to represent prairie communities and species no longer found elsewhere in the landscape.

Approximately 1,600 km of railroads were surveyed during the summers of 1986 and 1987. Each sampling point in the survey was placed into a category based on the number of grass and forb species it contained, the percentage of native species found, and the length of the area. Using the criteria outlined in Table 1, 2% of the 849 stops were categorized as a class 1, 7.5% as class 2, 15.5% as class 3, and 75% as class 4.

Table 1. Site category definitions of prairie remnant survey.

Site categories	*Definition*	*Proportion of total remnants*
		----------%----------
1	3 grass species >15 forb species >75% vegetative cover >0.4 km	2.0
3	grass species 10-15 forb species 50-75% vegetative cover 0.2-0.4 km	7.5
3	2 grass species 5-10 forb species 25-50% vegetative cover 60-220 m	15.5
4	1 grass species <5 forb species <25% vegetative cover <60 m	75.0

Although all types of prairie communities were found in the ROW mesic prairie dominated the class categories; 69%, 55%, and 65% for class 1, 2, and 3, respectively. This high abundance of mesic prairies is unique, because they are quite rare due to their high agricultural productivity.

Railroad Construction

Railroad construction began in Wisconsin between 1840 and 1850. By 1860, 1,341 km of track had been laid (Wisconsin Transportation Planning Program 1983). After the Civil War, with substantial land grant offerings available, the length of Wisconsin track increased 89% to a peak of 12,098 km in 1921. During this time, a three-fold increase in farms occurred, which were dependent on cities growing in tandem with the railroads.

In southern Wisconsin much of the land adjacent to railroad lines was in prairie until the late 1800s. These remnants were preserved through railroad ownership which isolated the ROW from agricultural use and development. By 1900 much of the land in southern Wisconsin was involved in cultivated agriculture, severely limiting the number of prairie sites available to reinvade disturbed railroad sites.

The amount of surface disturbance created over the 12 to 31 m wide ROW varied depending on construction needs. Early construction was kept to the actual rail bed. As technologies and the financial status of the railroads improved, road beds were raised creating damage to plant communities through direct disturbance of the soil and through the altering of the drainage pattern. Scattered damage to soils and vegetation occurred outside of the immediate construction zone with the erection of housing for equipment and personnel. Before 1900 rapid revegetation of ROW occurred wherever the adjacent land cover was still in prairie (Vestal 1918). However, it is likely that those plants which recolonized the sites, often from seeds and rootstocks, were a select group and did not represent the total original site vegetation. These field observations support Thomson's (1940) suggestions that trains, which travelled these lines, also transported and dropped native and exotic seeds along the tracks through the freighting of marsh hay. This dispersal of seed would further alter the prairie composition found along the tracks.

Management History

Management objectives.

Management objectives for the railroads were 1) to maintain open sight lines, 2) to remove physical obstacles, and 3) to reduce friction on track rails caused by adjacent grasses and herbs leaning onto the rails. The removal of tall material close to the rails, including the tall prairie grasses, was important so the trains could move smoothly over the tracks.

Management treatments.

Railroads utilized four main management treatments, each of which had a significant impact on the number and quality of prairie remnants still in existence. The four management treatments used were steaming, cutting, burning, and treating vegetation with herbicide.

Vegetation management between the late 1800s and the 1950s was labor intensive. It consisted largely of hand cutting, but a number of companies also used steam directed from locomotives onto the tracks to remove encroaching plants. Cutting often occurred from fence row to fence row with particular emphasis on vegetation growing close to the tracks. From the early 1900s to the 1960s major Wisconsin railroad lines, such as Chicago North Western (CNW), employed five to six road masters, or maintenance personnel, for each 8 to 16 km section of line. It was during this time that Shimek (1931) and others reported finding high quality tracts of prairie along 30- to 60-year-old railroads.

After World War II as people began to build on and cultivate open lands, state and local governments pressured companies to control accidental fires (Lanz 1985). Vegetation control as a means to eliminate wildfire became a fourth goal of maintenance. The railroads continued the practice of intensive brush control by annual cutting and controlled burns through the 1950s. Both manual cutting of brush and burning were typically done from fence line to fence line. Later as brushing machines became prevalent, maintenance was restricted to 3 m or less on either side of the track.

Brush was typically cut in winter and left where it had fallen until it was burned along with the vegetation in the right-of-way the following year. Prescribed burns typically occurred in the fall, as spring and summer were reserved for track maintenance and reconstruction.

As the intensity of management began to drop due to rising labor costs and declining revenues during the 1950s and 1960s, aromatic oils became the predominant treatment for ROW vegetation. After 1960 sprays were targeted for the center of the track, approximately 2 m on either side, and 1.5 m above the ground. The 12 m remaining on either side of the road were then mowed. From 1960 to 1968 intense brush killers, such as prometon [2,4-bis(isopropylamino)-6-methoxy-*s*-triazine], were used with observations that such treatments readily killed large trees and shrubs but did not eliminate sprouting. Soil sterilants were used by some companies within 100 m of bridge and road crossings.

A fifth technique was used by some lines for controlling vegetation along tracks. Two meter swaths were plowed or disked on either side of the tracks.

Current management varies among lines. Many lines use herbicide treatments on brush only at intersections and bridges, conducting mechanical maintenance along the line only when needed. Other lines use herbicides along the entire track length and still others disk along each side of the track. Management is typically greatest on the major freight lines. In contrast, the major short line operator in Wisconsin remarked that brush maintenance was at least five years behind schedule.

Interviews with former road masters yielded information, still relevant today, on remnant stability in geographic regions. For

example, according to one interviewee, brush was not a problem along major lines west of Montfort in southwestern Wisconsin. The land remained open with little management. This area presently contains drier prairie sites and sandy sites. Although limited both in number, several lengthy and relatively high quality remnants occur along this track. In the Madison area, along the same track, brush was said to be aggressive, requiring frequent removal. This is still true today and has been a major problem in preserving remnants in this area.

Wildfires

In addition to prescribed management, many ROW burned by accident. In 1929, 11% of wildfires in Wisconsin were caused by trains (Wisconsin State Conservation Department 1946-1966). This figure rose to 16% in 1936 and continued to rise into the 1960s when railroads caused between 30 and 40 of all wildfires (Wisconsin State Conservation Department 1946-1966) (Figure 2). Railroads went from being the fourth or fifth cause of wildfires to the number one cause during the 1960s and 1970s (Figure 3). Fires in nonforested areas typically comprised 60 % or more of wildfires in the state each year. Grass was the initial starting fuel for more than 80% of these fires (Wisconsin State Conservation Department 1946-1966, Wisconsin Department of Natural Resources 1967-1987).

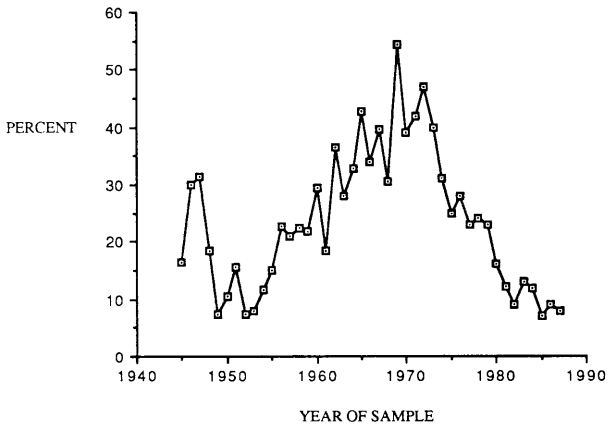

FIG. 2. Percent of Wisconsin wildfires caused by railroads for the years 1945 to 1987.

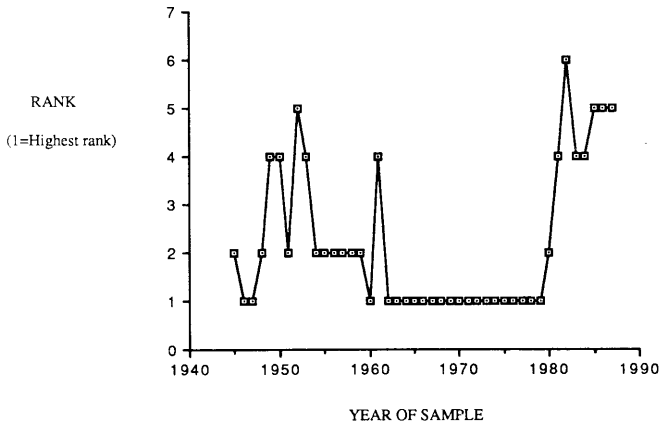

FIG. 3. Ranking of railroads as a cause of all wildfires in Wisconsin for the years 1945 to 1987.

A daily fire log, found during the vacating of a depot in Eau Claire, Wisconsin, contained fire records from 1915 to 1958 for four CNW lines. The recordings in the log indicate that many sections along lines may have burned at least once every two years. In addition to providing dates, locations, and causes of fires, the daily fire log provided the acreage that burned and the type of fuel existing at the burn location. Our searches for additional logs have not been successful.

Prescribed burning of ROW seldom resulted in wildfires. In 1946 three out of 470 fires were started during prescribed burns, and 463 fires were started from train exhaust and movement (Wisconsin State Conservation Department 1947). The trend of over 90% of the railroad-related wildfires starting from train movement and exhaust has remained constant. Causes of railroad-related wildfires were typically linked to poorly maintained wheels and exhaust systems. During the mid-1950s railroad companies began to switch from steam locomotives to diesel. It was assumed by most fire prevention officials that this switch would result in fewer fires. However, in 1955 railroad-caused fires rose 3.4% with 61.9% of the fires originating from the ejection of burning carbon deposits released by diesel engines (Wisconsin State Conservation Department 1956). A major cause of fire came from one type of diesel engine that vented the crankcase down onto the tracks. It was not uncommon to have 150 ignitions of ROW vegetation by such engines in a single day.

In 1958 the Annual Wisconsin Forest Fire Report noted that the curtailment of the number of ROW maintenance crews and an increase in the distances assigned to each crew had affected fire prevention efforts of eliminating natural fuels. Recommendations of the 1960 Railroad Fire Conference sponsored by the Michigan Department of Conservation were for companies to fireproof their ROW and to cut down on the fire-causing characteristics of diesel locomotives. The railroad fire prevention inspector stated that the present methods of prescribed burns were slow, unsatisfactory, and expensive; because of this ROW burning has nearly been abandoned (Wisconsin State Conservation Department 1962). The State of Wisconsin, however, began a few years later to pressure railroad companies to conduct prescribed burns. In the majority of its fire reports the Wisconsin State Conservation Department and later the Department of Natural Resources cited a need for properly cleaned and burned ROW. Few companies gave in to this pressure but some did apply greater use of herbicides and brush cutting on troublesome lines. The type and degree of management varied greatly among the companies.

In response to high rates of escaped wildfires, the Milwaukee Road in 1974 disked its ROW in Monroe, Juneau, and Columbia counties, all areas where prairie remnants would have been expected to be found (Wisconsin Department of Natural Resources 1975). Annual state fire reports encouraged disking elsewhere. In 1977 new forest fire laws required that fire-prone ROW be burned and cleared of debris at least once each year (Wisconsin Department of Natural Resources 1978). In 1981 as railroad fires began to decline, due to improvements in engine design, a special committee recommended that coordination of ROW management begin with the State Scientific Areas Director to deal with remnant prairie populations (Wisconsin Department of Natural Resources 1982).

Abandonment

Abandonments began almost immediately after the start of railroad construction but have become increasingly more frequent since 1934. Between 1920 and 1982 Wisconsin railroad mileage declined by 37% (Wisconsin Transportation Planning Project 1983). Thirty percent or more of this decline occurred in the last two decades of this period.

Until the 1970s the majority of abandoned lines were returned to adjacent land owners. These were quickly cultivated and used to increase or connect agricultural lands. Over the last two decades, however, federal and state laws have given first option of purchase to the state (East Central Wisconsin Regional Planning Commission 1978, Wisconsin Transportation Planning Project 1983). In

Wisconsin state options to acquire these lands are first considered by the Department of Transportation and then considered by other state agencies including the Department of Natural Resources. Wisconsin has converted approximately 720 km of track to biking and pedestrian trails, which includes several large stretches of prairies of various quality.

Cessation of Management

The time length of the abandonment process may have a tremendous impact on the vegetative condition of a prairie remnant. Ten years or more may pass from the time a company begins to contemplate abandonment to the time abandonment actually occurs. The legal abandonment process typically takes three years or more to occur. However, most rail companies after determining that a line is no longer economically productive will halt the majority of maintenance activities well in advance of the actual abandonment. During this time significant encroachment of shrubs or weedy species can occur.

The results of an abrupt halt in management are readily apparent on remnants along many lines. The Sugar River State Trail between New Glarus and Brodhead follows a rail line built in 1887 and abandoned in 1972. Along the line are considerable tracts of class 1 to class 3 prairies. Invading into a section of good prairie is a stand of black oak (*Quercus velutina* Lam.). The ages of these trees, which range between 22 and 25 years, would suggest that maintenance of this line was discontinued before 1965. The last major industry along the line ended operations in 1962. Freight earnings for the rail line dropped by $300,000 the next year. Due to this loss of revenue the rail line began preparing for abandonment in the early 1960s, although abandonment was not granted until 1972 (Lanz 1985).

Other lines show similar histories. In 1981 the Military Ridge route between Madison and Dodgeville was abandoned, however, according to maintenance personnel all management along this line had ended by 1974. A railroad line near Cambria, Wisconsin has proposed abandonment for the past decade. In 1979 the prairies along this line were rated fair to excellent by personnel of the Department of Natural Resources. Their report also notes concern for potential invasion by black locust (*Robinia pseudoacacia* L.) and grey dogwood [*Cornus foemina* subsp. *racemosa* (Lam.) J.S. Wils.]. A 1986 visit to the semi-active site found remnants in poor condition being replaced by solid stands of black locust saplings and grey dogwood.

SUMMARY AND DISCUSSION

In recent years the value of prairie remnants along railroad tracks has come into question. In view of the costs and logistics involved in acquiring and maintaining these remnants relative to the purchase of additional land of more pristine stands, one must ask if they are worth saving. Part of this concern may be linked to views on the inability of highly fragmented habitats to sustain themselves. How well the theories of island biogeography and fragmented habitats apply to the plant species in small prairie remnants has not been determined (Noss 1983 and 1987, Simberloff and Gottelli 1984, Wilcove 1987). Many small prairie remnants with a relatively high diversity of prairie forbs and grasses still exist while other nearby remnants are highly degraded.

Prairie remnants east of the Mississippi River are typically small, less than 0.5 ha to about 400 ha. These remnants are generally surrounded by distinctly different land uses that can have a detrimental impact on the health of a prairie. The potential effects of severe fragmentation include the inability to recover from internal disturbances due to wildlife or climatic elements, poor competitive ability with edge species, and loss of diversity in insect and wildlife populations resulting in lower dispersal rates of pollens and seeds. Although a number of sites found along railroads appear to be not changing, at least some form of management is needed to maintain most sites as open communities.

These studies to date suggest that management along with construction has been significant to the existence, composition, and quality of remnants. Activities that have been and are still significant in preserving or slowing decline in remaining prairies are linked to maintaining ROW as open space devoid of trees and brush. These include:

(1) The isolation of ROW lands in Wisconsin (many which included prairie) from agriculture and industrial development in the mid to late 1800s.

(2) Maintenance of railroad ROW (prescribed burns and brush cutting) that kept many areas free of brush and trees. Prairie communities remained fairly stable in many of these locations. Unfortunately due to rising labor costs, burning was not continued even though former road masters believed it provided the greatest brush control of the tools used.

(3) Wildfires, often started by trains, which would burn an area as frequently as once every two years and remove or set back brush and cool season plants.

Although railroads did maintain open ROW, particularly during the first part of this century, both management and construction had several undesirable effects on the quality and quantity of prairie remaining along railroads.

(1) Brush and ties which were allowed to lay in the ROW throughout a growing season would severely limit the growth of many plant species, and the burning of this debris created hot smoldering fires that would kill buds and roots that were normally resistant to fire.

(2) Annual fall burning would also affect species composition significantly. Studies indicate that annual fall burning may favor an increase in forb diversity (Kline 1986) and lower production of the warm season grasses (Hulbert 1986). The annual fall burns conducted by railroad maintenance crews in prairie areas would most likely have affected long-term species composition.

(3) Wildfires helped to maintain open communities and attempts to eliminate or reduce these fires have had a negative impact on the prairie. For example, the use of herbicides in this endeavor did not only impact and eliminate specific species but also opened the soil to reinvasion by pioneering plants. Since prairies no longer exist adjacent to the railroads, species that move into these exposed soils are often undesirable opportunists. An increase in brush invasion after the use of herbicides was noted by one former maintenance officer during our interviews. During our surveys we noticed that areas adjacent to bridges and crossroads, which typically were treated with soil sterilants, consisted of bare soil or were dominated by pioneering weed species.

(4) Another method noted for controlling ROW vegetation and limiting wildfires was plowing. Our survey noted that this method is still continuing today and in at least one instance we noted the recent destruction of a large stretch of prairie due to plowing.

Lack of management can often be as detrimental to remnants as the wrong type of management. More than 30% of Wisconsin's remaining railroads have been abandoned in the past three decades. Some of these lines are reopened as state subsidized short lines, but the majority of these lines receive little ROW maintenance. Prairie remnants along these short lines have rapidly become invaded and engulfed by brush in the past ten years. This leaves us with the problem of how to go about acquiring and managing these sites from an administrative standpoint. From our studies we believe that our involvement in management needs to begin soon after a company contemplates abandonment, but few agencies are willing to put time into managing land they do not own. Garden clubs and volunteer groups in Grant, Rock, and Green counties of Wisconsin have successfully organized work parties to manage prairie remnants in ROW that have been neglected by the railroads. However, volunteer groups willing to do this are few and other types of management plans need to be sought.

Site histories help to explain the present conditions of railroad prairies. Site histories can also help in making decisions as to which remnants have the greatest chance of being saved or even rejuvenated; and site histories may also help us determine which types of management have been most successful in maintaining prairie. Additional studies are needed, however, to determine if management of these narrow and unbuffered strips of prairie are actually preserving them or simply slowing their decline.

LITERATURE CITED

Borowske, J., and M. Heitlinger, M. 1980. A survey of native prairie remnants on railroad rights-of-way in Minnesota. Transportation Research Record 822: Landscape and Environmental Design. Transportation Research Board. National Academy of Science.

East Central Wisconsin Regional Planning Commission. 1978. Rail characteristics of East Central Wisconsin.

Finley, R. 1976. Original vegetation cover of Wisconsin. North Central Forest Experimental Station. USDA Forest Service, St. Paul, Minnesota.

Hulbert, L. 1986. Fire effects on tallgrass prairie. Pages 138-142. *In* G.K. Clamby and R.H. Pemble (eds.). The prairie: past, present and future. Proceedings of the Ninth North American Prairie Conference. Tri-College University Center for Environmental Studies, Fargo, North Dakota.

Kline, V. 1986. Response to sweet clover (*Melilotus alba* Desr.) and associated prairie vegetation to seven experimental burning and mowing treatments. Pages 149-152. *In* G.K. Clamby and R.H. Pemble (eds.). The prairie: past, present and future. Proceedings of the Ninth North American Prairie Conference. Tri-College University Center for Environmental Studies, Fargo, North Dakota.

Lanz, D. 1985. Railroads of Southern and Southwestern Wisconsin. Ski Printers, Blanchardville, Wisconsin.

Noss, R. 1983. A regional landscape approach to maintain diversity. BioScience 33:700-706.

Noss, R. 1987. Protecting natural areas in fragmented landscapes. Natural Areas Journal 7:2-13.

Reed, D., and J. Schwarzmeier. 1975. The prairie corridor concept: possibilities for planning large scale preservation and restoration. Pages 158-165. *In* D.C. Glenn-Lewin and R.Q. Landers, Jr. (eds.). Proceedings of the Fifth Midwest Prairie Conference. Iowa State University. Ames.

Shimek, B. 1931. The relation between the migrant and native flora of the prairie region. University of Iowa Studies in Natural History 14:10-16.

Simberloff, D., and N. Gotelli. 1984. Effects of insularization on plant species richness in the prairie-forest ecotone. Biological Conservation 29:27-46.

Thomson, J.W. 1940. Relict prairie areas in central Wisconsin. Ecological Monographs 10:685-717.

Vestal, A. 1918. Invasion of forest land by prairie along railroads. Illinois Academy of Science 11:126-128.

White, J. 1986. Why bother to protect prairies along railroads. Pages 172-173. *In* G.K. Clamby and R.H. Pemble (eds.). The prairie: past, present and future. Proceedings of the Ninth North American Prairie Conference. Tri-College University Center for Environmental Studies, Fargo, North Dakota.

Wilcove, D.S. 1987. From fragmentation to extinction. Natural Areas Journal 7:23-21.

Wisconsin Department of Natural Resources. 1967-1987. Annual Wisconsin forest fire reports. Madison, Wisconsin.

Wisconsin State Conservation Department. 1946-1966. Annual Wisconsin forest fire reports. Madison, Wisconsin.

Wisconsin Transportation Planning Program. 1983. The Wisconsin state rail plan 1983 update. Wisconsin Department of Transportation-Division of Planning and Budget, Madison, Wisconsin.