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FLOODLAND AND SHORELAND DEVELOPMENT GUIDE



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Special acknowledgement is hereby given to William J. Kockelman, former Chief of the SEWRPC Community Assistance Division for his contribution to this Guide.

PLANNING GUIDE

NUMBER 5

CODE: _____

**FLOODLAND AND SHORELAND
DEVELOPMENT GUIDE**

Prepared by the
Southeastern Wisconsin Regional Planning Commission
Old Courthouse
Waukesha, Wisconsin 53186

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PREFACE

This publication is the fifth in a series of planning guides prepared by the Southeastern Wisconsin Regional Planning Commission for distribution to cities, villages, towns, and counties within the seven-county Region.

The purpose of this Guide is threefold: first, to explain the need for floodland and shoreland protection; second, to explain the methods and devices available to prevent flood damage and protect water quality; and third, to present model regulations and suggested devices to accomplish the purposes of, and meet the requirements of, the State Water Resources Act of 1965 and to implement the adopted regional, watershed, and district land use plans.

Accordingly, this Guide contains a discussion of floodland and shoreland problems; a comprehensive enumeration of flood damage prevention and shoreland protection methods; suggested floodland and shoreland delineation procedures; special floodland and shoreland regulations for incorporation into zoning, land division, and building ordinances; and model sanitary and aquatic recreation ordinances. This Guide has been reviewed and approved by the SEWRPC Technical Advisory Committee on Natural Resources and Environmental Design, which consists of representatives from those federal, state, and local agencies of government having active land and water resource planning and management programs underway within the Region. The membership of this important Committee is set forth in Appendix Q to this Guide.

This Guide is not intended to be applied indiscriminately without regard for local conditions; nor is it intended to be a substitute for necessary professional planning, engineering, and legal advice at the local level. It assumes the existence of duly constituted local zoning, planning, health, building, and water patrol agencies charged with carrying out the local zoning, planning, health, building, and water regulatory functions and is intended to assist these local agencies in the performance of their duties. The state floodplain and shoreland management programs require that local units of government must submit all proposed floodland and shoreland ordinances and related maps and supporting engineering data to the State Department of Natural Resources for review and comment prior to local adoption. If the methods and procedures set forth in this Guide are carefully followed, approval of the ordinances by the State Department of Natural Resources should ordinarily be forthcoming.

This Guide was prepared by the Community Assistance Division of the Southeastern Wisconsin Regional Planning Commission, and communications or questions concerning the content and use of this Guide should be addressed to that Division. It is the hope of the Commission that this publication may be a helpful and informative aid to those interested in preventing flood damage and protecting shoreland areas so as to create a safer, more prosperous, and more attractive environment within the Region.

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Chapter I

INTRODUCTION

The natural resources of the Region are vital elements to its economic development and to its ability to provide a safe, healthful, and pleasant environment for human life. Natural resources not only condition but are conditioned by regional growth and urbanization. Any meaningful effort to guide rural and urban development at the state, county, and local levels of government in the public interest must, therefore, recognize the existence of a limited natural resource base to which urban and rural development must be adjusted if serious environmental problems are to be avoided. This is particularly true in southeastern Wisconsin where an increasing number of urbanites are becoming year-round residents of outlying areas of the Region, seeking not only the varied recreational opportunities offered by these areas but also the feeling of open space, which these areas lend to urban development.

The surface and subsurface water resources of the Region are two particularly important elements of the natural resource base, influencing both rural and urban development within the Region. Areawide urbanization within the Region has increased the demand for potable water, industrial processing and cooling water, and water for the dilution of sewage effluent. It has increased the demand for aquatic recreation and greatly intensified the conflicts between the various uses of water associated with urban land uses and between these urban water uses and those associated with rural agricultural land uses, including irrigation and livestock watering. The fullest and wisest use of the regional water resources will be required as urbanization proceeds within the Region if serious environmental and developmental problems are to be avoided. The protection of both the quantity and quality of the regional water resources against unnecessary depletion, deterioration, and destruction is essential to the sound social and economic development of the entire Region and to the maintenance of a healthy and pleasant environment for life within the Region.

REGIONAL SETTING

The seven-county Southeastern Wisconsin Region is comprised of Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha Counties. Exclusive of Lake Michigan, this Region has a total land and inland water area of 2,689 square miles. It is the most intensively developed area of the state, encompassing only 5 percent of the area of the state but containing over 40 percent of the population, over 50 percent of the resident manufacturing employment, and over 46 percent of the real property valuation of the state. The population of the Region, estimated at 1,800,000 in 1967, has increased over the past century at a rate generally higher than that of the state or the nation. The Region contains the twelfth largest city in the nation. Many of the most important industrial areas and heaviest population concentrations in the Midwest are located within 250 miles of the Region, and over 31 million people reside within this radius.

The entire Region is rapidly becoming a single metropolitan complex of highly concentrated urban land uses interspersed by large areas of mixed rural-urban land uses, with a resultant varied demand upon both the quantity and quality of the regional surface and subsurface water resources. Rapid population growth and urbanization within the Region have intensified the demand for conversion of floodlands into sites for homes, stores, and factories. At the same time, urban development in headwater areas of the regional watersheds has increased storm water runoff, which in turn, has been accompanied by increased soil erosion and stream and lake sedimentation. Population growth and urbanization has also intensified certain water uses requiring a high level of water quality, while at the same time municipal sewage treatment facilities, industrial operations, private on-site sewage disposal facilities, and storm sewerage facilities serving new urban population concentrations have contributed to a marked decline in water quality (see Figure 1).

Almost all of the Region is within the "day-use" area; that is, within 50 miles of urban concentrations of over one million people. The surface water resources of the Region are, therefore, subject to an intensive recreational demand and are being called upon, and will continue to be called upon, to serve the rapidly increasing aquatic recreation needs of the Kenosha, Racine, Milwaukee, and Chicago urbanized areas.



Figure 1
URBANIZING REGION

Scattered low-density urban development within the Region has intensified the demand for the conversion of floodlands and shorelands into sites for homes, stores, and factories and has thereby brought extended lengths of stream banks and shorelines under the often deteriorating and destructive influence of urban development. Because of its scattered and sprawling nature, this kind of development is usually forced to rely on on-site soil absorption sewage disposal systems rather than on public sanitary sewers. Since most floodlands consist of soils ill-suited for the absorption of septic tank effluent, the continued placement of private on-site sewage disposal systems on such lands can only lead to a continued deterioration of water quality in the Region.

Agriculture also is placing a sustained and, in some cases, increasing demand on the land and water resources of the Region. The intensity of the use of agricultural lands is increasing, and ever larger quantities of water are being used to irrigate field and specialty crops. Agriculturists are discovering that supplemental water helps prevent frost damage, improves carrying capacity, ensures against drought, increases yield, and improves the quality of a crop. The conflicts between urban, recreational, and agricultural water uses may be expected to continue to intensify, and, without proper planning for the wise use and protection of the regional water resources, become increasingly costly and mutually destructive.

RESOURCE BASE

The land and water resources of the Southeastern Wisconsin Region, upon which these urban, recreational, and agricultural resource demands will be made, are limited. The Southeastern Wisconsin Regional Planning Commission has conducted extensive inventories of the streams, lakes, wetlands, woodlands, wildlife habitat, soils, historic sites, existing and potential park lands, and existing land use within the Region. Based upon analyses of the information provided by these inventories, primary and secondary environmental corridors have been delineated which encompass the best remaining elements of the regional natural resource base (see Map 1). As the Commission has concluded:

... It is imperative that all of the primary corridors be preserved and protected. If man is to sustain himself within the Region at a reasonable level of amenity, there is a 'point of no return' with respect to the deterioration and destruction of the underlying resource base, beyond which that base can no longer meet the demands upon it without a reduction in the standard of human life.¹

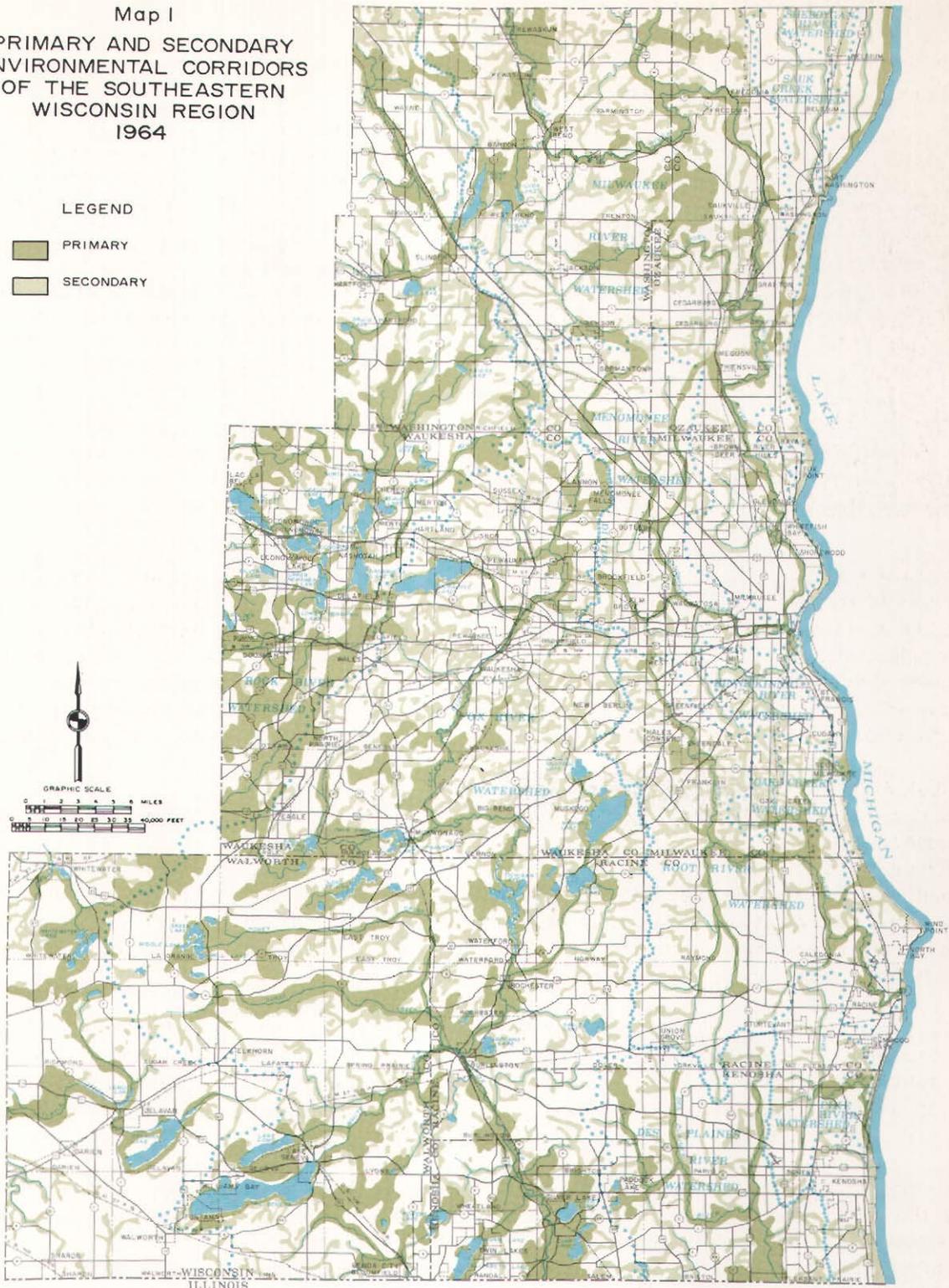
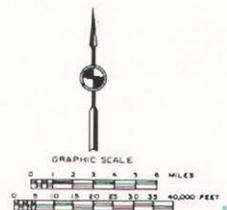
These environmental corridors generally encompass most of the undeveloped floodlands and shorelands within the Region and are particularly attractive to urban development because of the unique resource values contained therein. That these areas do attract urban development has been clearly established by the Commission historic land use development study.² The primary environmental corridors contain 311,000 acres (485.94 square miles) of land and water surface area and comprise about 18 percent of the

¹SEWRPC Planning Report No. 7, Volume 1, *Inventory Findings--1963*, (1965), p. 77.

²*Ibid.*, p. 80

Map I
 PRIMARY AND SECONDARY
 ENVIRONMENTAL CORRIDORS
 OF THE SOUTHEASTERN
 WISCONSIN REGION
 1964

- LEGEND
- PRIMARY
 - SECONDARY



Approximately one-sixth of the Region lies within primary environmental corridors, which encompass almost all of the best remaining woodlands and wetlands, the best remaining wildlife habitat areas, and many of the significant topographical and geological features remaining in the Region. These primary corridors, together with the secondary corridors, also encompass almost all of the streams and lakes and most of the undeveloped floodlands and shorelands of the Region. The preservation of these environmental corridors in compatible open uses is essential to maintaining the overall quality of the environment within the Region.

total area of the Region. Recent floodland studies completed within the Region by the Commission³ and by the U. S. Army Corps of Engineers⁴ indicate that the floodlands of the Root River and its major tributaries encompass 13.28 square miles of land and comprise about 6.7 percent of the total area of the watershed and that the floodlands of the Des Plaines River and its major tributaries encompass 9.43 square miles of land and comprise about 7.0 percent of the total area of the watershed within the Region. These percentages are in close accord with national data, which indicates that on the average floodlands may be expected to comprise about 6 percent of the total area of a watershed.⁵

Watersheds

As shown on Map 2, the Region contains all or portions of 11 major watersheds, as well as a number of small local streams draining the lakeshore plain immediately adjacent to the Lake Michigan shoreland, the tributary areas of which together may be considered to comprise a twelfth watershed. The areal extent of each of the 153 civil divisions of the Region within each of these watersheds as of January 1, 1967, is set forth by county in Appendix A to this Guide.

Streams, Lakes, and Ponds

The Region contains 164 named streams and 82 unnamed streams having a combined total length of 1,118 miles,⁶ which together with the lakes and ponds comprise the drainage systems of the aforementioned 12 watersheds. The name, general location, body of water to which it is tributary, surface width, length, area, and gradient of each stream within the Region are listed by county in Appendix B to this Guide.

The Region also contains 268 named and 84 unnamed lakes and ponds having together an overall total surface area of 39,897 acres (62.33 square miles, or about 2 percent of the total area of the Region).⁷ The name, location, surface width, length, area, maximum depth, shoreline length, shore development ratio, and public frontage of each named and unnamed lake and pond within the Region are listed by county in Appendices C and D to this Guide, respectively.

Water Related Problems

The streams, lakes, ponds, and tributary watersheds of the Region lie in a geographic area that has an average annual precipitation ranging from about 27 inches in the northeastern portion to 33 inches in the southwestern portion of the Region. Recorded extremes, however, of only 19.52 inches in 1932 and of 43.57 inches in 1938 illustrate the considerable range in deviation from average rainfall amounts which may occur. During any year there is less than a 50 percent probability of receiving an inch of rainfall, the amount considered ideal for many crops, during any given week of the growing season.

Too little and too much surface water in a given year are fairly common phenomena in the Region, and relatively large variations in streamflows occur within its confines. The streamflow of the Fox River at Wilmot in Kenosha County, for example, has varied from a mere trickle to a flow of over 7,500 cubic feet per second. During low-flow conditions, the flow of the Root River is sustained almost entirely by liquid wastes of municipal and industrial origin. High-flow conditions generally occur within the Region during March and April when snowmelts and spring rains occur together causing flood conditions. Low-flow conditions generally prevail during July, August, and September when demand for available water is high for livestock watering, recreation, and irrigation. High-flow conditions are more directly related to floodland use problems, while low-flow conditions are more directly related to water pollution problems associated with recreational, navigational, and waste assimilation uses of the streams and with shoreland uses depending upon high levels of surface water quality.

³SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed (1966).

⁴U. S. Department of the Army, Corps of Engineers, Flood Plain Information Report on the Des Plaines River, Illinois and Wisconsin, (March 1966).

⁵Hopkins, B. Thomas, Civil Engineering, American Society of Civil Engineers (February 1968).

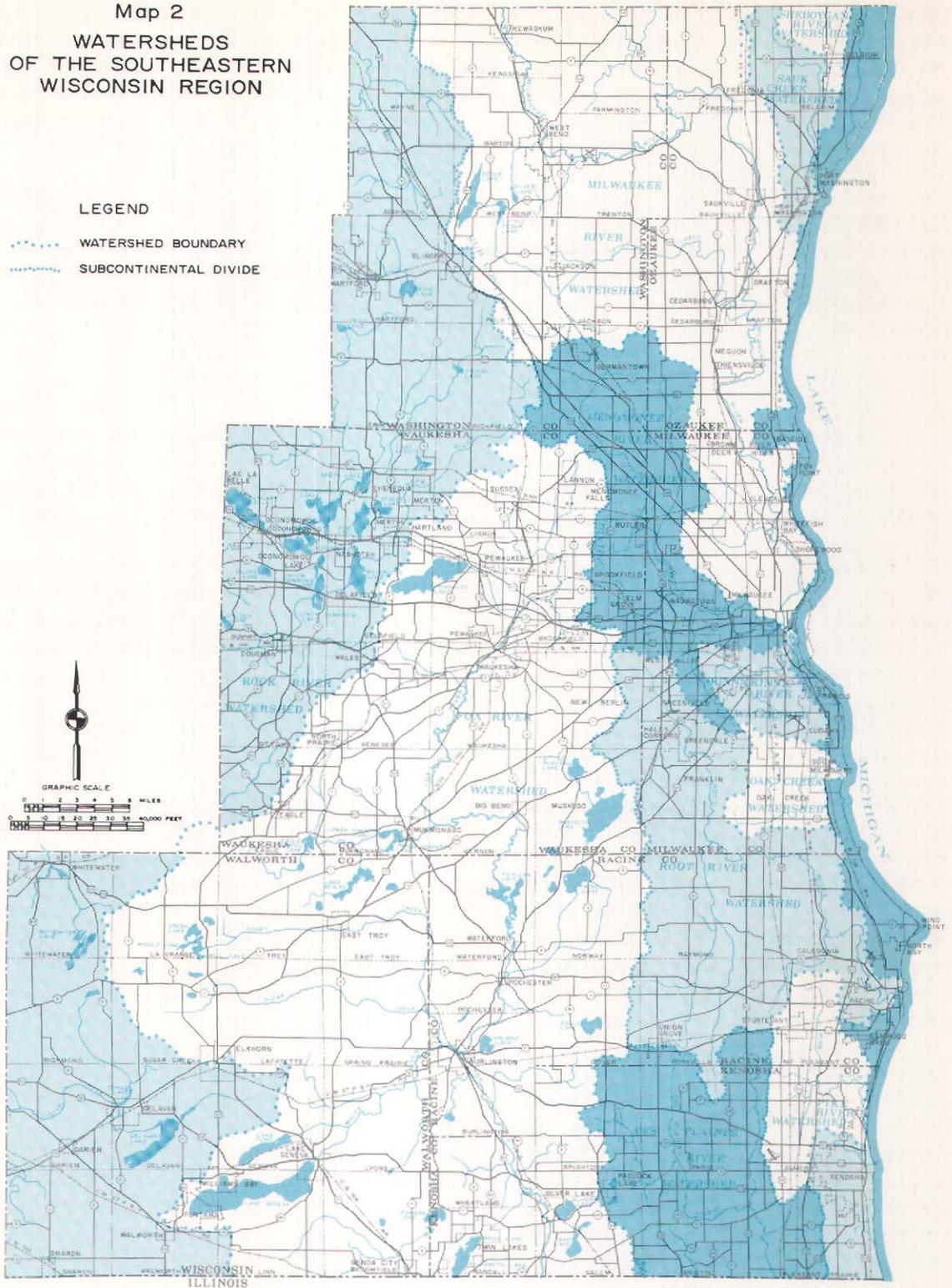
⁶Wisconsin Conservation Department, Surface Water Resources for each county in the Southeastern Wisconsin Region (1961-1963).

⁷Ibid., footnote 6.

Map 2
**WATERSHEDS
 OF THE SOUTHEASTERN
 WISCONSIN REGION**

LEGEND

-  WATERSHED BOUNDARY
-  SUBCONTINENTAL DIVIDE



Southeastern Wisconsin is a water-rich Region. It receives an average of about 30 inches of precipitation annually and contains 268 named and 84 unnamed lakes and ponds, having together an overall total surface area of 38,124 acres. The Region also contains 164 named streams and 82 unnamed streams, having together an overall total length of 1,118 miles. The streams, lakes, and ponds together comprise the drainage systems of the 12 major watersheds within the Region.

NATIONAL, STATE, AND REGIONAL ATTENTION

The indiscriminate erection of structures on floodlands, with the attendant increase in flood losses, and the despoilation of shorelands, with the attendant deterioration of water quality, have recently received increasing attention at the state and national level. This attention has resulted in the issuance of a presidential executive order on the prevention of flood damage and in the enactment of federal and state water resource protection legislation.

The President of the United States, as a result of a report on federal flood control policies, issued Executive Order 11296⁸ directing the heads of all federal executive agencies to provide leadership in preventing uneconomical uses and development of the nation's floodlands; requiring all federal agencies to evaluate flood hazards associated with federal development proposals; and requiring all federal grant, loan, and mortgage insurance agencies to evaluate flood hazards insofar as practical to preclude the uneconomical, hazardous, and unnecessary use of floodlands.

The Congress of the United States acted to amend the Federal Water Pollution Control Act⁹ by passage of the Water Quality Act of 1965¹⁰ to provide that, if the states do not establish and adopt water quality standards applicable to interstate waters, the Secretary of the U. S. Department of Health, Education, and Welfare shall promulgate such standards. These standards are to be such as to protect the public health and welfare and enhance the quality of water, taking into consideration the needs for public water supplies, wildlife propagation, recreational, agricultural, industrial, and other legitimate water uses.

The Wisconsin Legislature acted to adopt the Water Resources Act of 1965 (Chapter 614, Laws of 1965). The full purpose of this Act, which grants to counties, cities, and villages shoreland regulatory powers and to the state floodland regulatory powers, is set forth in Appendix E to this Guide. Pursuant to this Act, the State Department of Natural Resources prepared and promulgated floodplain and shoreland management programs (see Appendices F and G). This Act further provides that, if counties do not adopt shoreland regulations and if counties, cities, and villages do not adopt floodland regulations which meet state standards by January 1, 1968, the State Department of Natural Resources is required to adopt such regulations.

The Southeastern Wisconsin Regional Planning Commission has prepared, adopted, and certified to affected local units of government regional, watershed, and district land use plans which have as one of their objectives the protection and wise use of the natural resources, including streams, inland lakes, wetlands, woodlands, and wildlife. These plans recommend that most of the floodlands and shorelands within the Region be placed in environmental corridors; recommend a spatial distribution of urban land uses which would permit over 95 percent of the future urban development within the Region to be served by centralized public water supply and sanitary sewerage systems; and contain specific recommendations for the implementation of these plans, including the adoption of floodland and shoreland regulations by county and local units of government within the Region.

CONCLUSION

The importance of the underlying and sustaining natural resource base to the continued health and vitality of the Region and to its sound social and economic development; the urgent need to protect and conserve that resource base as urbanization proceeds on an areawide basis within the Region; the rapid intensification of water and water-related resource problems within the Region, including flooding and pollution; and the increasing national and state concern over these problems dictate that the counties, cities, villages, and towns comprising the Region give serious consideration to these problems and to floodland and shoreland regulation as steps toward their abatement.

The Southeastern Wisconsin Regional Planning Commission has prepared this Guide to assist the people of the Region and their elected and appointed officials in becoming more aware of floodland, shoreland, and

⁸*Federal Register*, Volume 31, No. 155 (August 11, 1966).

⁹*Public Law 84-660*, 33 U.S.C. 466, et seq.

¹⁰*Public Law 89-234*, enacted October 2, 1965.

water quality problems and more familiar with the methods and devices for preventing flood damage and protecting shoreland and water quality. To this end, this Guide includes suggested zoning districts, special floodland and shoreland regulations, and model ordinances (Appendices H through M) that will enable the local units of government to: 1) meet the requirements of the State Water Resources Act of 1965, and 2) implement the land and water-related use recommendations set forth in the adopted regional, watershed, and district comprehensive plans.

Attainment of the objectives of the State Water Resources Act of 1965 and implementation of the land and water use plans prepared by the Commission will result in the protection and preservation of the resource base and of the economic vitality of the Region, as well as of its beauty, not only for the people of today but for countless generations yet to come (see Figure 2).

Figure 2
PROTECTION OF AESTHETIC AND RECREATIONAL VALUES



The aesthetic and recreational values of the natural resource base are as essential to the spiritual and mental well-being of individual human beings as the industrial and commercial values of that resource base are essential to the economic well-being of society. This is particularly true in highly urbanizing regions where man, through cutting, clearing, filling, and building, has greatly altered and, in some cases, completely destroyed the natural environment. While the resulting urban environment may meet man's economic and social needs, the remaining natural environment is essential to the fulfillment of man's spiritual needs. The protection and preservation of the natural beauty and resources found in floodland and shoreland areas thus becomes increasingly important as the process of urbanization moves rapidly forward. Once man destroys these natural resources, they are lost forever. Unless historic trends are reversed, the countless generations yet to come can expect to receive an ever-diminishing natural resource inheritance.

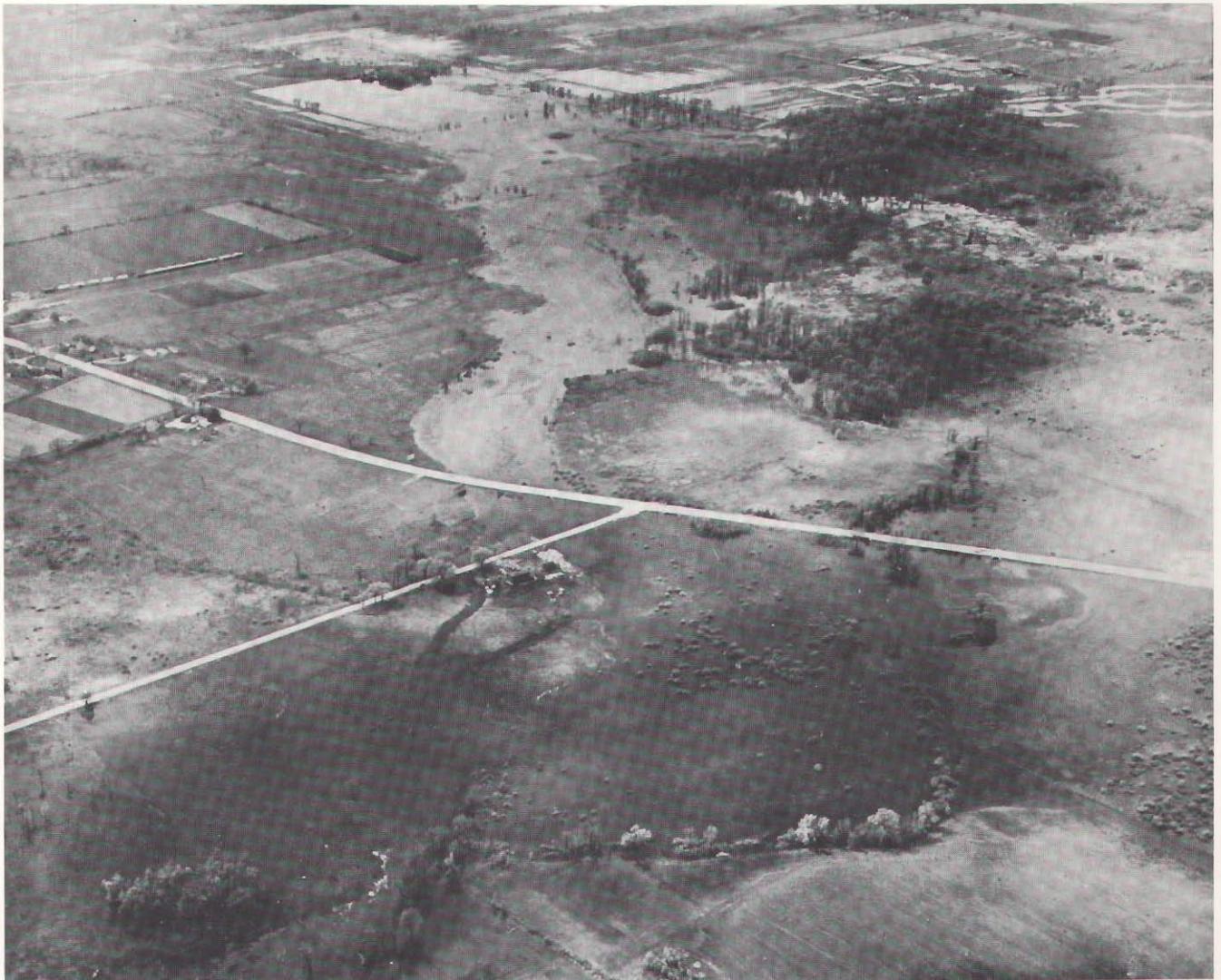
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Chapter II FLOODLAND PROBLEMS

INTRODUCTION

Floods are a natural and normal occurrence. Streams have from time immemorial periodically overflowed their banks and taken possession of their natural floodplains and floodways. Typically, a stream will occupy some portion of its floodplain area about once every two or three years. Greater floods occur at less frequent intervals, and a stream will occupy the greater part of its floodplain area about once every 100 years. Inundation of the natural floodlands occurs when the amount of water entering the stream channel is greater than the hydraulic capacity of that channel (see Figure 3). Floods will vary in size, area

Figure 3
PERIODIC INUNDATION OF FLOODLANDS



The above photograph shows the extent of the 1960 flood of the Fox River in a portion of the Town of Brookfield, Waukesha County. This particular flood event was determined to have an approximate 50-year recurrence interval in this portion of the watershed. In other words, a flood of this magnitude has a 2 percent probability of occurring in any year. If extremely expensive expenditures for flood control works are to be avoided, urban development must be adjusted to this periodic need for floodwater movement and storage.

inundated, suddenness, duration, and frequency with natural and certain man-made conditions. The natural conditions include the total amount of rainfall and snowmelt, the intensity and geographic distribution of that rainfall and snowmelt, storm patterns, antecedent moisture conditions, temperature, and season of the year, as well as the physical features of the watershed, including topography, soils, geology, and drainage pattern. The man-made conditions include the various rural and urban land uses, changes in drainage, and other factors that affect storm water runoff.

Before the advent of intensive urban development within the Region, such flooding was usually accepted as a natural course of events; and it was recognized that the streams would in time revert to their normal channels, leaving the adjacent floodlands dry and suitable for certain agricultural or other compatible uses. As urbanization proceeded within the Region, man began to encroach increasingly upon the floodlands with incompatible urban land use developments. While many of the original settlements within the Region were located on high ground near rivers and creeks, settlements soon spread to nearby areas, including low-lying floodlands; and homes, stores, and factories were erected either to take advantage of level lands or to capitalize on close-in sites.

Increasing urbanization in southeastern Wisconsin continues to result in urban development being allowed to preempt the natural floodways and floodplains of the streams, often without regard to the periodic flood hazards and concomitant dangers to property, health, and life (see Figure 4). For example, the flood damages incurred during the March-April 1960 floods within the Region were about \$372,000 in the Root River watershed,¹ almost one-half million dollars in the Fox River watershed,² and \$436,000 in the Milwaukee River watershed.³ These damages, as demonstrated in these watershed studies, may be expected to triple with the coming of the next major flood having 1960 flood proportions if land use development is allowed to continue on an unplanned and uncontrolled basis on the floodlands of the Region.



Figure 4
URBAN DEVELOPMENT ON FLOODLANDS

Urban development in southeastern Wisconsin has been allowed to preempt the natural floodplains of the streams in many areas without regard to the inevitable periodic flood hazards and concomitant dangers to property, health, and life. The fact that such development is continuing to take place despite the known hazards was one of the factors that led the Wisconsin Legislature in the Laws of 1965 to, in effect, require local enactment of adequate floodplain zoning ordinances.

Instead of adjusting the land uses permitted within the natural floodlands to the needs of the streams at certain periods of the year, the practice quite commonly has been to permit, often inadvertently, all types of urban development within the floodlands, thus bringing the natural needs of the streams into conflict with the activities of man and thereby creating serious flood problems. According to historic records, there have been at least 17 damaging floods in the City of Waukesha alone since 1868; yet development of floodlands continues.

¹SEWRPC Planning Report No. 9, *A Comprehensive Plan for the Root River Watershed* (1966), p. 219.

²SEWRPC Planning Report No. 12, Volume 1, *A Comprehensive Plan for the Fox River Watershed* (1968).

³U. S. Department of the Army, Corps of Engineers, *Survey Report for Flood Control on Milwaukee River and Tributaries, Wisconsin* (November 1964).

The amount of damage caused by floodwaters varies with the velocity and depth of the floodwaters and with the length of time the floodwaters remain near the crest or peak stage. A flood which recedes rapidly after reaching its peak may do relatively little damage to properly protected structures, whereas a flood of long duration or high velocity may cause heavy damage despite any attempts at protection (see Figure 5). The most devastating floods within the Region have most often occurred during early spring thaws when warm spring temperatures and heavy rainfalls have combined with rapid snowmelts, ice jams, and high rates of runoff over frozen ground to cause floods of disaster proportions.

Figure 5
RURAL FLOOD DAMAGE

This flood flow, which is undercutting trees and croplands, is the accumulative result of the discharge from a multitude of farm rivulets and from agricultural and urban drains. Intelligent water control measures must involve the entire watershed, including the upland areas, and not just the main stream channels.



In addition to the inconvenience, hardship, danger, economic loss, and heartaches caused to occupants of floodlands during floods, floodwaters also cause disruption of utility and transportation services; health and safety hazards; damage to industries, businesses, residences, and agricultural operations; and other economic losses. These problems can be caused indirectly by seepage, sanitary sewer or septic tank system backup, erosion, siltation, and water pollution, as well as by direct inundation and by the force of the moving floodwaters.

In watershed planning work, it is common practice to classify flood damage into public and private sectors. For the purposes of this Guide, however, this distinction will not be made, since this Guide is concerned primarily with the losses incurred by the community as a whole.

UTILITY AND TRANSPORTATION SERVICE DISRUPTION

Floodwaters may undermine and carry away electric power transmission and telephone line poles, resulting in both power and communication failures. Public sewage treatment facilities, when inundated, also become inoperative, causing backup and resulting in health hazards. During the March 1960 flood, the Root River backed water into the outfall sewer of the Village of Greendale municipal sewage treatment plant, thereby interrupting plant operations. Often as a safety precaution, utilities are shut off in areas where homes are surrounded by floodwaters. This occurred during the 1960 Fox River flood in an area in the City of Waukesha bounded by Barstow Street, Corrina Boulevard, Baxter Street, and the River. In cold weather the discontinuance of utility service may result in the loss of heat and require the evacuation of homes in areas not directly flooded. In the City of Burlington, floods have necessitated gas main reconstruction and gas meter relocation.

Floodwaters often cause streets, bridges, and underpasses to become impassable (see Figure 6), resulting in economic loss and hazards to life, health, and safety due to interruption of emergency vehicle service. The three-day closure of USH 41 by floodwaters in March-April 1960, for example, resulted in road

Figure 6
TRANSPORTATION DISRUPTION



This photograph of a subdivision within the Region illustrates the disruptive effect that floodwaters can have on transportation facilities. Not only is this disruption often a nuisance but, through the hindrance of emergency services, it may also seriously endanger property, health, and life.

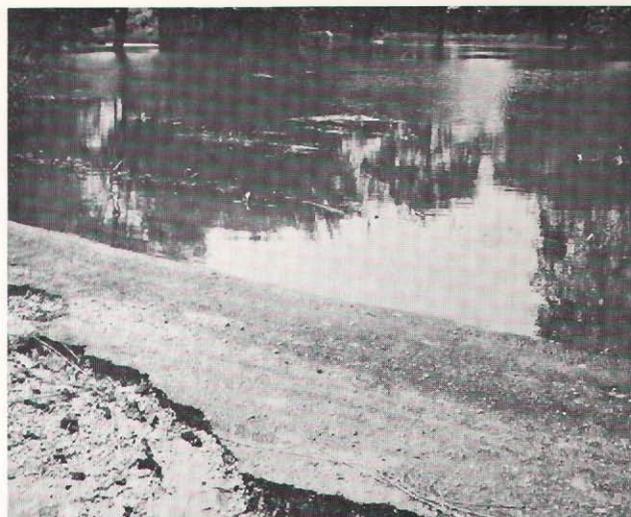
user detour costs of \$58,400.00; and bridges and roadways on W. Oakwood Road, W. Drexel Avenue, and W. County Line Road in the City of Franklin have been overtopped by floodwaters, causing disruption of normal traffic flow. During the peak of the March-April 1960 flood on the Fox River, at least 20 major streets and highways within the watershed were closed to traffic for one or more days. STH 50 in the Town of Wheatland was closed for an entire day; CTH SS in the Town of Pewaukee and CTH Y in the City of Brookfield were closed for three days; and a bridge failure on Davidson Road in the Town of Brookfield necessitated closure of the road for a period of about two weeks. Roadways are often damaged due to saturation of the roadbed and washing of the embankments, and this damage results in increased maintenance costs (see Figure 7). Vehicles attempting to traverse overtopped bridges and roads may have their electrical systems grounded or experience brake malfunctioning, with attendant inconvenience, damage, and even loss of life. Rainbow Airport in the City of Franklin has experienced flooding of its runways annually. The July 1938 flood on the Fox River destroyed three bridges of the Chicago, Milwaukee, St. Paul and Pacific Railway line between Elkhorn and Lyons; and certain town roads in the Town of Spring Prairie were closed to traffic for periods up to six months because of bridge washouts.

HEALTH AND SAFETY HAZARDS

The location of public facilities, such as schools, hospitals, and fire stations, on floodlands that form isolated island areas during floodtimes may disrupt important community services and seriously impair the public welfare. Buildings and structures in such isolated areas may be destroyed indirectly, as was a home in the Oakwood Point development on the Fox River floodlands in the Town of Wheatland, which burned to the ground due to a flood-induced electrical fire and inability of fire engines to reach the flood isolated area.

Figure 7
ROADBED DESTRUCTION

The improper location of roadways in floodlands can lead to serious flood damage. Periodic roadbed saturation and embankment washing inevitably lead to increased road maintenance costs.



The storage of flammables, certain chemicals, petroleum products, garbage or other refuse, explosives, or unanchored buoyant materials which may be spilled, loosened, or carried away by floodwaters often lead to both health and safety hazards. Floating debris may damage structures and utility lines and obstruct the flow of floodwaters. Floodwaters may cause on-site sewage disposal facilities to become inoperative and may cause untreated sewage to backup into the home. Public sewage treatment plants often bypass untreated sewage during flood flows and thereby, at least temporarily, create severe health hazards. Backup of sanitary sewer systems into homes, restaurants, and places of public assemblage create public health hazards. Public water supply systems may become contaminated by polluted floodwaters and create serious public health hazards.

High waters often necessitate the evacuation of residences for health and safety reasons. For example, most of the residences in that area of the City of Racine lying north of N. Rupert Boulevard and east of Graham Street were evacuated from their homes during the 1960 flood on the Root River; and emergency shelter, food, and clothing had to be provided by relief organizations.

RESIDENTIAL, INDUSTRIAL, AND COMMERCIAL LOSSES

Floodwaters may fill the basements of homes causing damage to foundations, electrical equipment, heating units, and articles stored within the basement (see Figure 8). Fuel oil storage tanks may float loose, rupture, and spill oil over the interior of buildings. Basements constructed on permeable sands and silts of floodlands are particularly susceptible to damage from seepage through walls. Hydrostatic pressure may collapse foundation walls and cause severe structural damage. Nearly 500 families in 17 communities were directly affected by residential flooding on the Fox River in 1960. In this same year, 268 residences in the City of Racine experienced basement flooding due to seepage and sanitary sewer backup; and about 40 homes were without heat in the City of Waukesha for more than 24 hours. Water entering the first floor may cause heavy damage to furniture, walls, and floors (see Figure 9).

Lake Como in Walworth County rose to a height of more than three feet above its spillway crest during the 1960 Fox River flood, resulting in inundation of shoreland residences and backup of their septic tank sewage disposal systems. Receding streams carrying heavy silt loads may leave behind a layer of muck in homes and on surrounding grounds. Reoccurrent flood damages to residential structures may result in a cycle of deterioration, reduced marketability, and increased depreciation. It is significant to note that, during the Fox River flood damage survey, many damagees declared that intangible damage, such as mental aggravation, was the most severe form of flood damage experienced.

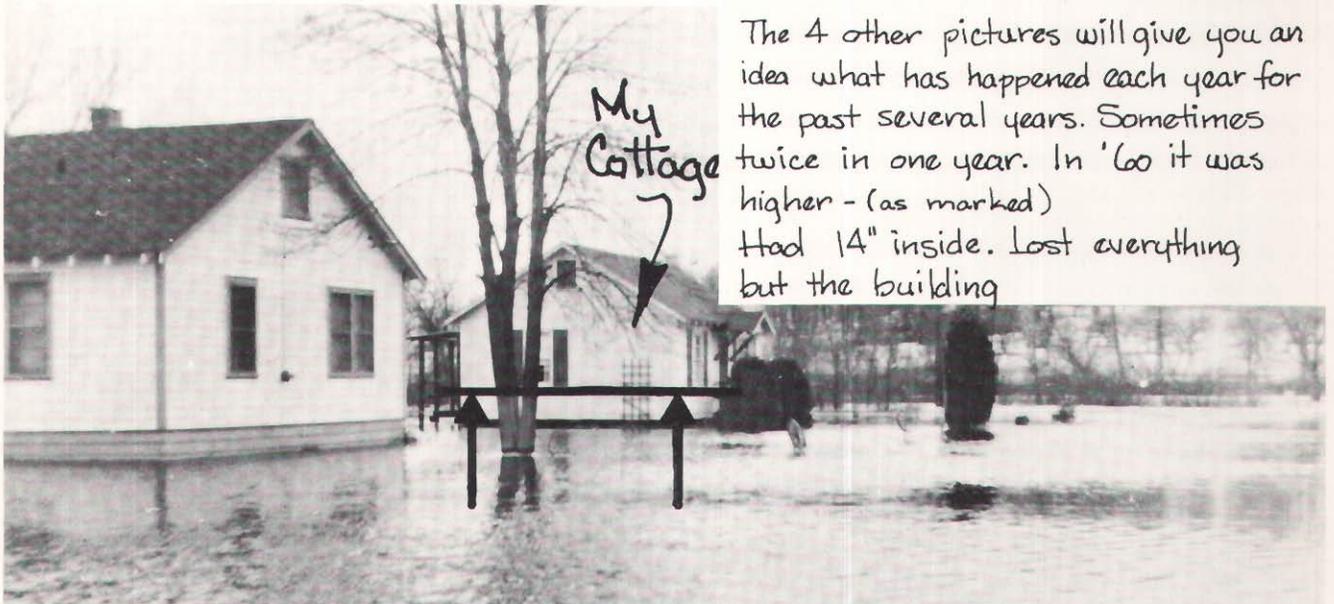
During floodtime industries and businesses often are forced to close down or to interrupt their services, thereby affecting wages, sales, and production because of utility outages, transportation disruption, or health and safety hazards (see Figure 10). For example, 42 commercial establishments reported losses from the 1960 flood on the Fox River, with one incurring a loss of over \$20,000.

Figure 8
BASEMENT FLOOD DAMAGE



Homes built in floodlands, such as the one pictured above, are subject to periodic basement flooding. Besides the obvious nuisance created by such flooding, severe and costly damage may be done to the foundations of the homes, to electrical and heating equipment, and to articles stored within the basement.

Figure 9
FIRST-FLOOR FLOOD DAMAGE



Floodwaters entering the first floor of homes may cause heavy damage to furniture, walls, and floors, with attendant high monetary losses. Many damagees within the Region, however, have declared that the attendant intangible heartache and mental aggravation were more severe forms of flood damage than the tangible monetary losses.

Figure 10
COMMERCIAL FLOOD LOSSES

When urban development is allowed to preempt natural floodplains, industries and businesses located therein may not only experience heavy direct flood damage to buildings, machinery, and stock but may be forced to suspend operations during flood time, thereby adversely affecting wages, production, and sales. These indirect flood losses may have widespread economic repercussions throughout a community.



AGRICULTURAL AND OTHER LOSSES

Agricultural

Floodwaters may cause damage to agricultural crops and disrupt farming operations (see Figure 11). An early flood may allow time for replanting of a crop, the yield of which may be equal to the crop destroyed with only the cost of replanting representing the flood loss. A mid-season flood may allow the production of a lesser value crop, such as hay; however, late season floods shortly before harvest may cause a complete loss with no opportunity for replanting. Truck crops, such as cabbage and potatoes, may be severely damaged by only a few inches of standing water; however, oats and soybeans can survive flood inundations that would destroy truck crops. Corn is more flood tolerant, and certain types of hay and pasture are very flood tolerant.



Figure 11
AGRICULTURAL CROP DAMAGE

Flooding of agricultural lands often results in severe crop damage and economic loss. Late season flooding often means a complete loss of crops with no opportunity for replanting.

Floodwaters may also cause farm drainage tile backup, which may result in delayed tillage and harvest operations; soil loss due to erosion; and silt deposition on pasture, forage, and field crops, making them unpalatable to livestock. Livestock permanently sheltered or restrictively fenced in floodland areas may drown or be severely injured. Farm buildings, equipment, bridges, roads, fences, and stored feed may also be damaged. Flooding of agricultural bottom lands during other than the crop season is not necessarily detrimental as deposits of rich, fine-grain alluvial sediment can renew and enrich the soil. On the other hand, the scouring of fields by floodwaters or deposition of sterile sand and gravel can be harmful.

Other Losses

Flooding has a semidirect impact on neighboring properties and on the community tax base, for in areas subject to flooding, the residential structures may not be fully repaired. A cycle of deterioration may thus begin which, in turn, may lead to neighborhood blight, reduced valuation, and lower tax return to the municipality. Depreciation losses may be considerable as property values after inundation are reduced by the amount of money which will have to be expended for flood repairs and floodproofing.

Certain local public flood losses may be incurred, including damages to public property, road and bridge repairs, cleanup operations, and emergency measures, such as basement pumping, relief services, ice jam blasting, road and rail traffic rerouting, sandbagging, floodfighting, temporary floodproofing, and evacuation.

In addition, each taxpayer in the United States pays a part of the cost of individual flood relief and reconstruction assistance provided by various federal agencies, such as floodfighting by the U. S. Army Corps of Engineers; emergency loans by the Farmers Home Administration and Small Business Administration; rescue and direct relief from the Army, Navy, Coast Guard, Public Health Service, Food and Drug Administration, Consumer Marketing Service, Agricultural Stabilization and Conservation Service, and the American Red Cross (under national charter); and public works reconstruction grants from the Office of Emergency Planning, Corps of Engineers, Bureau of Public Roads, and the Community Facilities Administration.

AGGRAVATION OF FLOOD CONDITIONS

Flood conditions will be aggravated by urbanization within a watershed or drainage basin, by the acceleration of floodwaters, by the impedance of floodwaters, and by the reduction of floodwater storage capacity. The water retention capacity of upland areas of a drainage basin may be drastically reduced by the conversion of certain rural land uses to urban uses. Large areas of land covered by impervious surfaces and devoted to trafficways, drainageways, parking areas, sidewalks, roof surfaces, and their related storm water drainage systems will increase the amount and rate at which storm water runoff will occur and may significantly increase downstream flood peaks.

Urban development of a formerly agricultural drainage area has two major effects on hydrologic relationships: the rainfall-runoff relationship is modified as a result of increased impervious area and changed land use in the remaining pervious areas, and the time of concentration of the drainage area is modified as a result of decreased hydraulic friction and improved drainage facilities. Urbanization of headwaters of a drainage basin may decrease the time needed for water to reach the main stream and, therefore, increase the peak discharge of storm water runoff. As urban development continues to occur within a watershed, the total quantity of annual runoff will be increased, the flood storage retention capacities decreased, and the storm water movement increased.⁴

Commission studies indicate that continued urbanization within the Root River watershed will cause up to a 15 percent increase in the peak flows of snowmelt-rainfall floods and up to a 70 percent increase in the peak flows of summer rainfall floods. Although the summer rainfall flood peaks will be greatly increased by urbanization, they will remain substantially less than those of the spring snowmelt-rainfall floods.⁵

⁴SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed (1966), p. 51.

⁵*Ibid.*, p. 219.

Floodland Encroachments

Filling of floodlands and the construction of buildings thereon contribute substantially to the impeding of drainage and the reduction of floodwater storage capacity, which may result in higher upstream and downstream flood stages. The floodlands of the Milwaukee River below Saukville, for example, contain about 1,100 residences and about 100 commercial and public buildings. About 40 percent of the floodlands in the lower Milwaukee River watershed have been converted from the natural floodwater storage function to residential and industrial uses.

The movement of floodwater in the floodways can be severely impeded by: channel alterations; encroachments, such as wharves, dams, and piers; silt deposition; deposition of debris; landfills; poor channel maintenance; accumulation of floating debris; vegetative growth in the channel; and by the erection of structures, including culverts and bridges, all of which tend to obstruct or retard the free movement of floodwaters in the floodways, increase flood-flow velocities, and create significant backwater effects. Encroachments in the channel can also impair navigation or render it hazardous. Bridges, right-of-way embankments, and utility crossings may also contribute to flooding by acting as partial dams, which increase floodland area, flood-flow velocities, and downstream erosion.

Sediment

Every stream carries some sediment as a product of natural bank and channel erosion. The sediment load will vary with the topography of the tributary watershed, the soils covering that area, the season, and the human activities occurring within the tributary watershed. Through deposition in channels, sediment reduces hydraulic capacities and contributes to flooding. Floods may spread polluted sediment over soils and carry such sediment into homes and stores with resultant monetary losses and health hazards. Perhaps its most extensive damage is the reduction of lake and reservoir capacity by deposition (see Figure 12).

Figure 12
SEDIMENTATION PROBLEMS



The deposition of sediment can aggravate flood conditions by reducing the capacity of reservoirs and the ability of streams to carry floodwaters. In addition, sediment may destroy fish spawning grounds and reduce water depths for recreational use. Floods may spread polluted sediment over soils and carry such sediment into homes and stores, with resultant monetary losses and health hazards.

FUTURE TRENDS

The Commission estimates that the population of the Region will increase by one million persons from 1963 to 1990 and that to accommodate this increase in population, over 71,000 acres of land will have to be converted from rural to urban use within the Region.⁶ As a result of this anticipated population increase, pressure for use of floodlands can be expected to increase because of the usually level terrain found in the floodlands; proximity to existing residential, commercial, and industrial development; availability; and relatively low land value.

As a result of this increased pressure, improper development of floodlands can be expected to continue to take place in the absence of soundly conceived and enforced floodland regulations, especially where indifferent sellers, uninformed buyers, or lack of local public and private flood damage prevention programs combine to encourage such development (see Figure 13). The development of floodlands, because of their availability at low purchase prices, becomes merely the subsidizing of the landowner and developer by the general public when flood control project, emergency relief, and rehabilitation funds are later expended to alleviate, correct, or prevent flood losses.

CONCLUSION

If flood-vulnerable development, such as homes, stores, and factories and appurtenant road and utility facilities, is allowed to continue to occur in floodlands within the Region, an increase in flood damage, health and safety hazards, and utility and transportation disruption can be expected. Only the adoption and administration of an effective flood damage prevention program based upon comprehensive land and water use plans and sound land use regulations will provide for the reduction or elimination in flood losses that is needed.

⁶SEWRPC Planning Report No. 7, Volume 3, *Recommended Regional Land Use and Transportation Plans--1990 (1966)*, p. 4.

Figure 13
FLOODLANDS FOR SALE



Although floodlands, such as the one pictured above, obviously cannot be sold for development while inundated by floodwaters, many such sales are made in dry periods. The problem is largely one of indifferent sellers, uninformed buyers, and lack of adequate and well-publicized information concerning the location and extent of floodlands.

Chapter III

SHORELAND PROBLEMS

INTRODUCTION

A delicate, complex biotic¹ relationship exists between the natural conditions of shorelands, the adjacent stream and lake waters, and the wildlife supported by such lands and waters. This biotic relationship is greatly affected by the use made of the shorelands, the type of shoreland cover, and man-made influences upon the amount and quality of surface and subsurface drainage in the shoreland areas. The quality of the total environment around streams and inland lakes depends to a considerable extent upon maintaining this biotic relationship in a healthy state. This fact should be the cause of considerable concern within southeastern Wisconsin where the streams and inland lakes serve both as a most important recreational asset and as a focal point for high-value urban development. Failure to use properly the shoreland areas of the streams and lakes will inevitably lead to a deterioration of the total environment for life within the Region and the destruction of the recreational and aesthetic assets sought and treasured by a large segment of the population.

A particularly close relationship exists between ground and surface waters in shoreland areas. The natural flow of a stream or level of a lake is normally determined by direct precipitation, surface runoff, basin storage, and ground water seepage. In southeastern Wisconsin, the base flow of perennial streams and lake water levels are determined under natural conditions largely by ground water seepage into the channel or lake. During periods of heavy runoff, stream and lake levels rise, temporary bank storage occurs, normal ground water gradients may be reversed, and ground water recharge may occur. After dissipation of runoff, water in the temporary bank storage moves back into the stream channel or lake; and the ground water basin storage then again contributes to streamflows and lake levels. This complex interchange of ground and surface water may carry polluted surface waters into the ground water reservoir or discharge polluted ground water into the surface waters. The effects may extend for considerable distances along stream channels or lake shores, depending upon local conditions. Where lake levels are sustained primarily by ground water seepage from a localized ground water basin, water withdrawn from the ground water reservoir may affect the lake levels unless returned to the ground water reservoir. Yet such waters will have been "used" and may carry pollutants.

A very delicate balance must be struck between shoreland development and the ability of the supporting resource base to sustain this development. Soil types, slopes, and erosion factors throughout an entire tributary drainage basin, including the shoreland area, determine runoff characteristics that ultimately affect streamflow, ground water recharge rates, and water quality. The intrusion of man and his rural and urban activities interrupt, disturb, and may destroy these delicate relationships. Some activities, as for example, the filling of wetlands, may upset the balance more drastically than other more limited activities, as for example, flow regulation. This chapter discusses those activities of man that commonly occur within shoreland areas and the problems which these activities may occasion if improperly planned and developed.

DREDGING, DRAINING, FILLING, AND CLEARING

Dredging

Wildlife, such as fish, fowl, and certain mammals, requires undisturbed natural feeding, shelter, and procreation areas for healthful survival. Indiscriminate dredging of streams, dredging and lagooning of wetlands, and placement of dredged material on the shorelands disturb stream bottoms, destroy natural banks, may result in scour and sedimentation, contribute to water turbidity, reduce the natural setting,

¹*Biotics is the science of vital activities. As the term biotic is used herein, it refers to specific relationships which must exist between the animals and plant life of an area and the physical conditions in that area if a healthy mode of life is to be sustained.*

and destroy or impair the wildlife habitat. Improper strip mining or other mineral extraction operations along the shorelands or in the beds of streams and lakes may leave the shoreland and related water areas unusable for any other beneficial use and may result in severe surface and ground water pollution.

Draining and Filling

Shoreland areas contain much of the remaining wetlands in the Southeastern Wisconsin Region, which support a wide variety of plant life and are essential to the maintenance of certain types of fish and other wildlife. These wetlands also assist in the stabilization of streamflows and lake levels; trap, store, and remove plant nutrients in runoff, thereby improving water quality by reducing water enrichment and obnoxious weed and algae growth; contribute to the atmospheric oxygen supply; provide floodwater storage; and reduce sedimentation. Wetlands usually release the stored nutrients during spring runoff with high streamflows.

The draining of these wetlands for agricultural purposes or filling for building sites completely and irretrievably destroys their natural value. If such draining and filling is done ill-advisedly, only marginal agricultural lands and unsuitable building sites may be created. Serious sedimentation problems and fire hazards may also result. The extent to which such activities may take place within an urbanizing region is indicated by the fact that less than one-half of the wetlands which existed when settlement by Europeans took place remain today in the Fox River watershed. The development of wetlands for agricultural and urban use also brings about an increased rate of decomposition of organic materials, so that seepage and runoff from these soils may contain large quantities of nitrogen and phosphorus, which may result in over-fertilization of adjoining surface waters.² The Wisconsin Natural Resources Committee of State Agencies has noted with alarm the damaging effects of wetland drainage, soil erosion, and pollution upon the natural habitat of fish and wildlife.³

Cutting and Clearing

Shoreland areas also contain much of the woodland cover remaining within the Region, as well as many areas too steep to farm or develop properly for urban uses.⁴ The cutting or clearing of such woodlands on steep slopes may cause serious soil erosion and sedimentation problems (see Figure 12), reduce wildlife cover and food sources, permit additional nutrients and other pollutants to run off into surface waters, and may destroy the natural scenic values of shoreland areas (see Figure 14). Erosion and sedimentation reduce the surface water quality and seriously impair certain recreational uses such as bathing and fishing. Cutting of trees that afford shade to streams may result in increased water temperatures and thereby contribute to the impairment of certain beneficial water uses, including cooling and the maintenance of desirable forms of aquatic life.

AGRICULTURAL OPERATIONS

Certain agricultural operations may contribute to shoreland problems. Poor farming practices, including uncontrolled cattle watering and feeding (see Figure 15); overgrazing of pastures and woodlands; spreading of manure on frozen ground; and tillage of steep slopes, erodable lands, or soils with limited capabilities without application of proper soil and water conservation practices (see Figure 16) may contribute to stream bank destruction, silting of drainage ditches (see Figure 17), presence of animal fecal wastes in waters, fertilization of waters, soil erosion, and stream sedimentation, with concomitant reduction in water quality and unattractive land use and vegetative cover in the shoreland areas. The common practice of spreading manure daily results in its placement on frozen ground for almost five months of the year. Spring rains and snowmelts cannot enter frozen soils; and, therefore, runoff carrying the soluble constituents of the manure results in relatively large nutrient discharges into surface waters. It has been estimated that manured land is the source of almost 10 percent of the total nitrogen and over 21 percent of the total phosphorus reaching Wisconsin surface waters.⁵

²Corey, Richard B.; Hasler, Arthur D.; Lee, G. Fred; Schraufnagel, F. H.; and Wirth, Thomas L., Excessive Water Fertilization, Report to the Water Subcommittee, Natural Resources Committee of State Agencies (1967), p. 1.

³Wisconsin Natural Resources Committee of State Agencies, The Natural Resources of Wisconsin (1956).

⁴SEWRPC Planning Report No. 7, Volume 1, Inventory Findings--1963 (1965), p. 17.

⁵*Ibid.*, footnote 2, Table 6, p. 35.

Figure 14
DESTRUCTION OF SCENIC VALUES



The loss of woodland and brush cover along shorelands not only contributes to the deterioration of the complex biotic relationship existing in shoreland areas but it also destroys the scenic value of the shorelands. The dumping of rubbish and other waste materials in floodlands and stream beds also contributes substantially to the destruction of scenic values.

Figure 15
UNCONTROLLED CATTLE WATERING

Improper rural, as well as urban, development can result in the deterioration of the physical environment of a watershed. Improper farming practices, as, for example, allowing livestock to trample stream banks into muddy bars, result in soil erosion and downstream sedimentation, may block navigation, and contribute to water pollution.

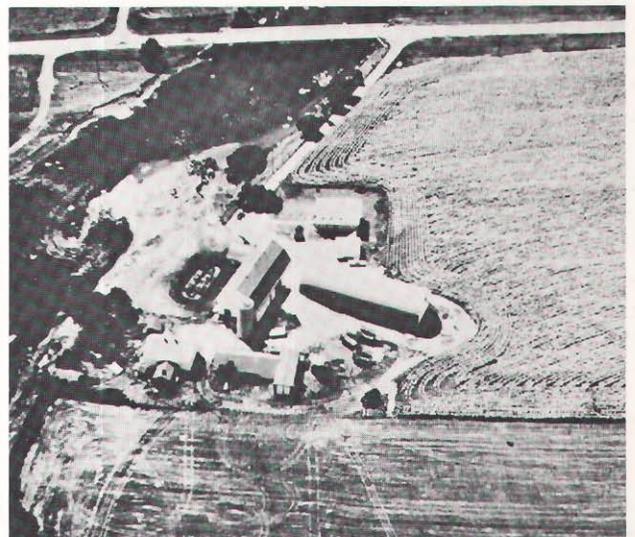
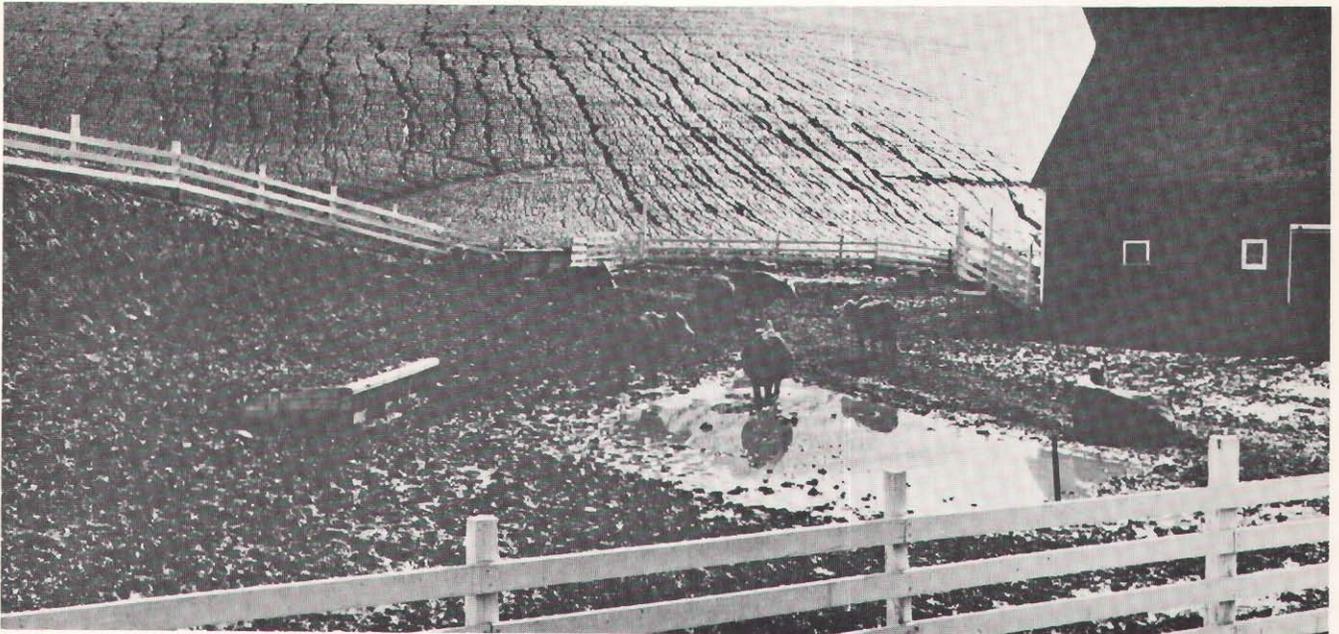


Figure 16
POOR AGRICULTURAL OPERATIONS



Improper tillage of steep slopes without attention to good soil and water conservation practices may result in soil erosion and stream sedimentation, presence of animal fecal wastes in waters, and fertilization of waters, with a resultant reduction in water quality.

Figure 17
SILTING OF DRAINAGE DITCHES



Poor soil and water conservation practices may result in serious damage to roads and drainage ditches through siltation.

Other agricultural operations in shoreland areas, although generally considered to be good farm practices, may also cause problems. These include the draining of high-water-table soils, the improper use of chemical fertilizers, and the overuse of poisons to retard or eliminate weeds and reduce insect and other pest populations. These fertilizers and poisons may seep, leak, or percolate into the ground water and run off into the surface waters, where they contribute to overfertility, excessive algae growth, and a toxic environment for fish and other aquatic life. Pesticides may also be transported by air currents, may travel great distances, and may persist in water or soil for long periods of time. Residues in trace amounts have been detected in most major rivers, ground waters, fresh water fish, migratory birds, wild mammals, and shellfish. New and exotic chemicals are continually being developed, used, and disposed of even though the effects of these chemicals on man and on his environment may not be well understood. The use of chemical fertilizers, herbicides, and pesticides may cause even more severe water quality problems when coupled with poor farm practices, at least insofar as the runoff of some of the fertilizers and poisons can be prevented by good soil and water conservation practices.

SEDIMENT

Sediment, defined as very fine soil particles maintained in suspension in water by the upward components of turbulent currents or by colloidal suspension, may also be regarded as a water pollutant. Every stream carries some sediment as a product of natural bank and channel erosion. The sediment load will vary with the topography of the tributary watershed, the soils covering that area, the season, and the human activities occurring within the tributary watershed. Poor land management practices, both rural and urban, within a watershed can greatly increase soil erosion and the quantities of soil contained in runoff waters and may create a serious water pollution problem in receiving streams and lakes. Sediment retards photosynthesis, on which desirable forms of plant life depend for growth and manufacture of oxygen; smothers fish spawning beds, killing both fish and fish food organisms; replaces healthy forms of plant and animal life with fungus and tubific worms, and generally upsets the ecological balance of a healthy stream or lake (see Figure 12).

INTENSIVE DEVELOPMENT

Both intensive rural and urban development⁶ have substantially reduced the natural shoreland growth and cover within the Region. Early shoreland dwellers sought isolation, and their cabins were usually placed at relatively great distances from each other. The conversion of existing seasonal cottages to year-round residences, the erection of additional dwellings on shoreland lots of inadequate widths and areas, and buildings located on steep slopes or distinctly visible from the water have or will effectively obliterate the remaining shoreland growth. In some parts of the Region, the first ring of crowded structures along a shoreline has been followed by a second and even a third ring (see Figure 18). The desire of shoreland

⁶*Intensive urban development may be defined as development of an area for urban uses at densities of 2,500 persons per gross square mile or more or on net lot sizes that average one acre or less in area per dwelling unit. Development at this density normally requires the installation of public water supply and sanitary sewer systems.*

Figure 18
INTENSIVE SHORELAND DEVELOPMENT

The natural beauty and cover of shoreland areas are often effectively obliterated by intensive shoreland development for what is essentially urban use. Very often in the Region, structures are crowded in rings along shoreland areas. This type of development effectively destroys the delicate biotic relationship existing naturally between shoreland growth and cover, water areas, and wildlife.



residents for a wider view of the water and the land requirements for roadways, driveways, parking areas, drainage systems, filter fields, structures, and related accessory residential uses, such as paths, steps, outdoor laundry drying areas, boathouses, piers, and tennis courts, to service the shoreland residences almost decimate the remaining shoreland trees and shrubbery (see Figure 19).

Heavy grading during building site development (see Figure 20) and cutting and filling during road construction subject shorelands to heavy erosion and surface waters to unnecessary siltation (see Figure 21). As previously noted, this removal of natural cover, along with building site preparation and road construction (see Figure 22), may substantially reduce wildlife habitat, cause soil erosion and sedimentation, and impair water quality.

Perhaps even more significant is the attendant loss of the very environmental characteristics sought by shoreland, stream, and lake users; namely: quiet, beauty, natural colors, wildlife sounds, lapping waters, dust-free breezes, sheltered coves, rich dense vegetation, cool clear water, proximity to nature, and the smells of natural vegetation. It has been contended that people seek water frontage as much or more for aesthetic values as for fishing or swimming.⁷ The appearance of multi-color structures or mobile homes in a monotonous row or ring, some garish, some substandard, many on small, narrow, or shallow lots; the proximity of vehicular street noises; and the development of non-water-related commercial activities attracted to the area are all incompatible with the natural setting that is essential to certain forms of true "re-creation." The need for a safe, healthy, contemplative, and "re-creative" environment is thus eventually unfilled.

The adverse effect of intensive shoreland development on water quality may also be aggravated by the use of private sewage disposal systems. Intensive development dependent upon the shallow ground water aquifer may result in a continued decline of ground water levels and interrelated surface water levels. Widespread use of on-site soil absorption sewage effluent disposal systems can also be expected to subject these shallow aquifers to pollution and to create serious attendant health hazards.

Aquatic Recreation

Innumerable recreational uses of streams and lakes are possible, such as water skiing, speedboating, bathing, underwater swimming, sail boating, fishing, duck hunting, and wildlife observation. Many of these recreational uses are incompatible and often come into conflict with each other, depending upon the size, shape, depth, or other physical or ecological characteristics of the water resource. For example, water skiing requires between 20 and 40 acres per boat, whereas fishing requires a minimum of one acre per boat.⁸ Motor boat travel through weed beds tends to damage submerged and destroy emergent species of aquatic plants. Speedboat movement through bathing, diving, fishing, or mooring areas is dangerous and irritating and, in shallow water areas, may cause turbidity, shoreline erosion, or damage to docks, marinas, and boats. Spillage or leakage of fuel and lubricants may cause unsightly oil slicks and seriously interfere with swimming and wildlife.

Public and Private Use Conflicts

The Wisconsin doctrine of law that the state holds its natural lakes in trust for the public and the paramount rights of the public to certain uses of navigable streams results in a conflict between the public use of water and the private use of abutting shorelands. The attraction for public recreational use of a stream or lake almost completely surrounded by private landholdings and lacking adequate public access may result in the overuse of existing public or private access facilities, trespassing on private property, or the dangerous entry off bridges into streams connecting such waters.

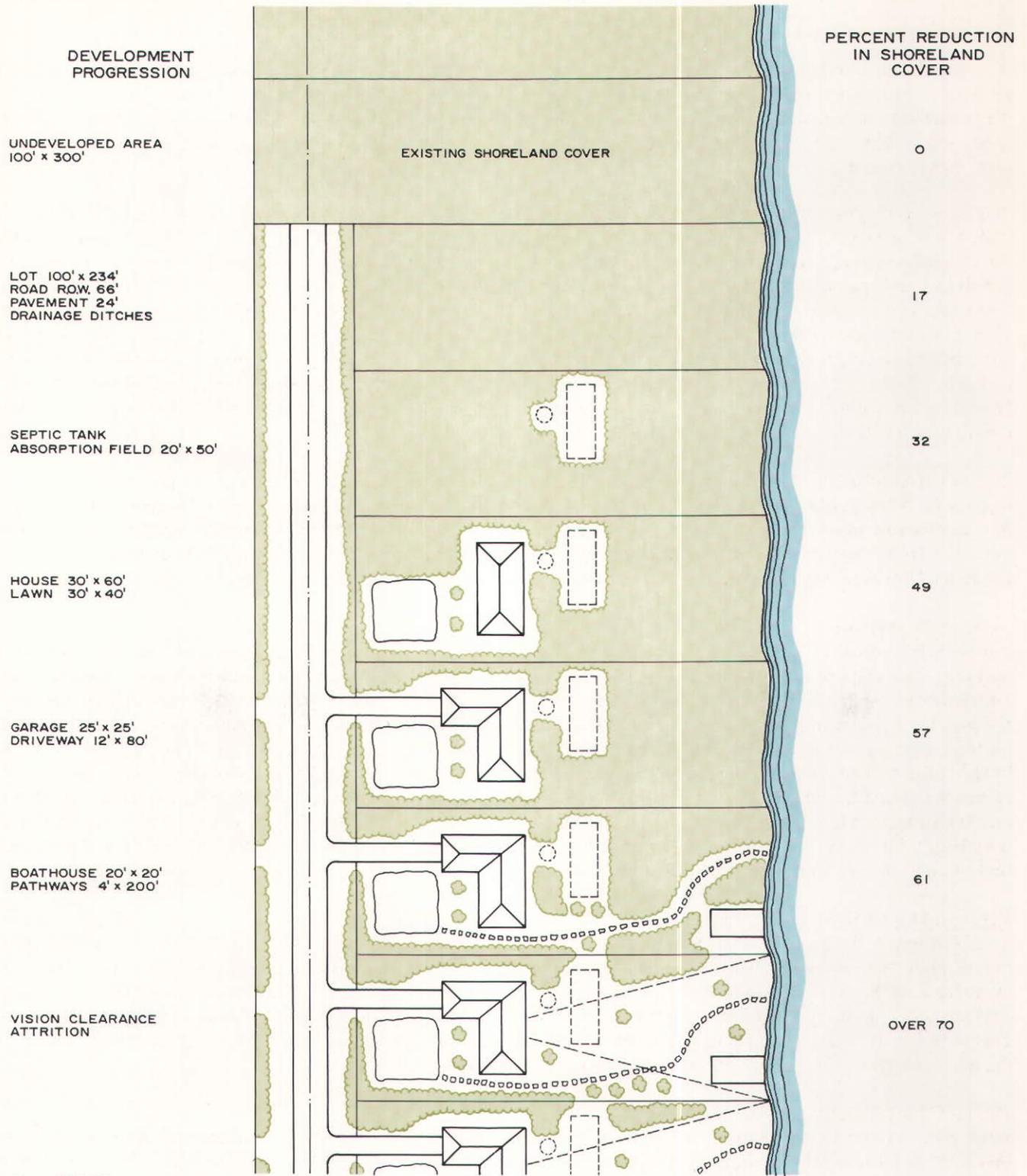
PRIVATE SEWAGE TREATMENT

Among the several private sewage treatment systems available to shoreland residences, the on-site septic tank and soil absorption system is the one most commonly used. Sewage from water closets, showers, food

⁷Threinen, C. W., Some Spatial Aspects of Aquatic Recreation, Wisconsin Conservation Department Report No. 6 (1961).

⁸Wisconsin Conservation Department, Lake and Stream Classification Recommendations Nos. 7 and 8 (1963, 1965).

Figure 19
TYPICAL SHORELAND COVER REDUCTION



Source: SEWRPC.

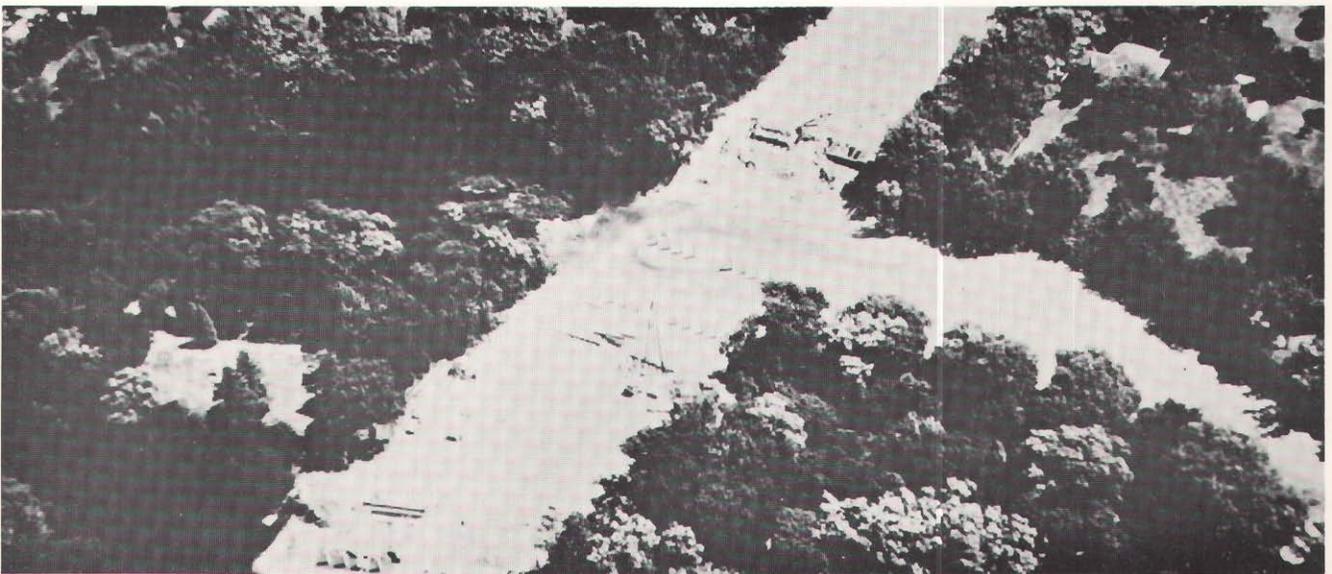
The desire of shoreland residents for a view of the water, together with the requirements for roadways, driveways and parking areas, drainage systems, filter fields, structures, and related accessory uses, such as outdoor laundry drying areas and boathouses, will completely destroy shoreland trees and shrubbery if lot sizes are inadequate.

Figure 20
POOR PRIVATE DEVELOPMENT PRACTICES



Poor subdivision layout and design, attendant heavy grading, and excessive destruction of natural cover during site development may subject shorelands to severe soil erosion and receiving surface waters to heavy and unnecessary siltation, with impairment of water quality and reduction of flood discharge capacity.

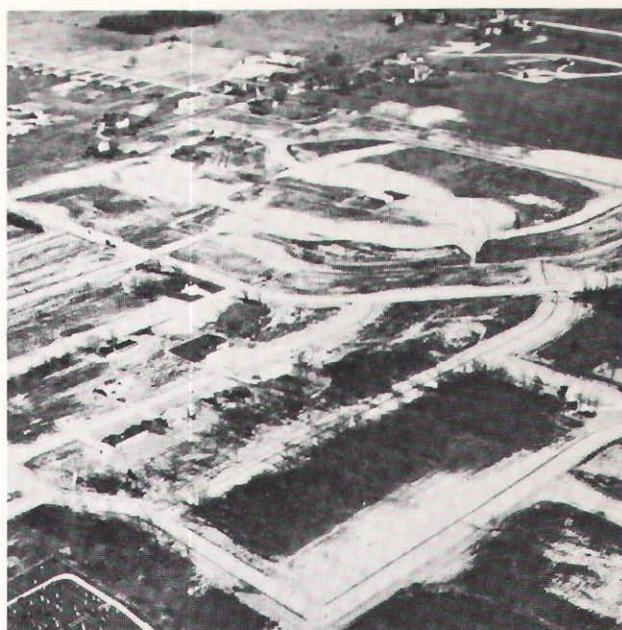
Figure 21
POOR PUBLIC DEVELOPMENT PRACTICES



Major public works construction is an activity of modern man which has a significant impact on the water quality and flow regimen of a stream. The brown river of silt streaming from this bridge construction site constitutes a form of water pollution and may result in impairment of downstream channel capacities, smother desirable forms of aquatic plant and animal life, and contribute to aquatic weed problems. In addition, the construction of a major public works facility, such as this freeway, will directly affect the amount and rate of storm water runoff, which the streams of the watershed must carry, and may indirectly affect both the quantity and quality of water to be carried in the streams by encouraging intensive urban development.

Figure 22
MAJOR LAND USE CONVERSION

Changes in land use, particularly the conversion of land from agricultural to urban use, have many far reaching impacts on the resources and flow regimen of a watershed. Increasing quantities of destructive sediments are being contributed to streams and lakes from agricultural lands, urban land division, highway construction sites, and from improperly maintained road ditches and stream banks. The effects of land-scraping operations in new subdivision construction are apparent from this view of new urban development in the Region. Although siltation from such construction sites may be only temporary, increased runoff and decreased ground water replenishment will be permanent features of the urban development.



waste grinders, sinks, dishwashers, and clothes washers is conveyed to a "septic tank," which conditions the sewage by settling and bacterial decomposition and, if sized and operating properly, passes on a relatively clear liquid effluent to a shallow subsurface soil absorption area called the "filter field." Here the effluent is discharged into the soil where it is absorbed and acted upon by aerobic and anaerobic bacteria, which causes an oxygenizing, stabilizing, and purifying action. Contrary to popular belief, septic tanks do not accomplish a high degree of bacteria removal. Although the sewage undergoes treatment in passing through the tank, this does not mean that infectious agents will be removed; and therefore, septic tank effluents cannot be considered safe from a public health standpoint. The liquid that is discharged from a tank is in some respects more objectionable than that which goes in, as it is septic and malodorous.⁹

This system, even when located, sized, installed, operated, and maintained properly, is a poor and temporary sewage disposal system at best. Its widespread use in shoreland areas may contribute to a reduction in water quality in several ways:

1. High-water tables in shoreland areas may interfere with the proper operation of septic tank systems, both by preventing the proper hydraulic operation of the system and by preventing the aerobic decomposition of the sewage effluent. Aerobic bacteria are those bacteria requiring the presence of oxygen for life. These bacteria abound in the soil to the depth of about three feet, depending upon soil characteristics and depth to water table, and cause an oxygenizing or stabilizing action on the sewage effluent while it remains in the top aerated layers of the soil. Effluent discharged directly into the ground water body or into the soil below the upper aerated layers as, for example, into seepage pits, does not receive the benefit of this aerobic action and is likely to contaminate nearby water.¹⁰
2. The soil absorption process does not remove certain nutrients, vitamins, viruses, and chemicals which may reach ground or surface waters and contribute to fertilization of waters, excessive algae growth, and health hazards especially on lakes. Porous soils, such as sands and gravels, may permit pollutants to travel several hundred feet.¹¹

⁹U. S. Department of Health, Education, and Welfare, Public Health Service, *Manual of Septic-Tank Practice*, Publication No. 526, U. S. Government Printing Office, (revised 1967), p. 29.

¹⁰U. S. Department of Agriculture, *Farmstead Sewage and Refuse Disposal*, Agricultural Information Bulletin No. 274, U. S. Government Printing Office, (1963), p. 3.

¹¹*Ibid.*, footnote 10, p. 1.

3. Septic tanks require periodic inspection and removal of scum and sludge. Neglect of such clearing eventually results in the scum and sludge washing out with the effluent and clogging the absorptive soil pores.
4. Filter fields laid within soils that are being drained by unrecorded agricultural drain tile systems may result in the rapid transmission of the effluent into the surface waters before being properly treated.

In addition to the above limitations of operative septic tank and absorption systems, many such systems are improperly located, sized, or installed and may, therefore, constitute a particularly serious source of water pollution as follows:

1. Filter fields located on slopes in excess of 12 percent may cause partially treated effluent to seep to a down-slope surface.¹² Terraces or series systems used to overcome steep slope limitations result in a reduction of ground cover, loss of natural setting, and greater susceptibility to erosion.
2. Filter fields located on floodlands, wetlands, or high-water-table areas do not operate properly during all or parts of each year and result in solids clogging the absorptive soil pores.
3. Filter fields located near bedrock result in a lateral flow and eventual discharge of improperly treated effluent at outcroppings onto the surface. Filter fields located on excessively well-drained soils, over creviced or fractured rock, or near ground water level may result in partially treated effluent rapidly reaching ground water supplies.
4. Filter fields located on tight or slowly permeable soils do not percolate properly and result in the effluent rising to the surface, where it ponds or drains into surface waters.
5. Septic tanks inadequately sized so as not to detain at least 36 hours of sewage flow do not permit the necessary settling and decomposition, thereby causing the scum and sludge to wash out with the effluent and clog the absorptive soil pores.
6. Septic tanks and filter fields improperly installed, for example, with too shallow an outlet tee, too fine a filter bed material, a field too close to tree roots, or with an uncovered tile field, will result in earlier saturation, clogging, and disruption of the system.

Malfunctioning soil absorption sewage disposal systems produce an untreated effluent containing coliform bacteria and permit such effluent to seep, drain, wash, or percolate into ground or surface water supplies. Such conditions may cause fertilization of surface water with excessive algae growth, turbidity, and impairment of the water quality for various types of recreation uses and may result in health hazards, including danger of cholera, typhoid, paratyphoid, dysentery, and hepatitis.

Some plumbing systems installed in violation of the State Division of Health rules discharge untreated sewage directly into a stream or lake without use of any septic tank system (see Figure 23). For example, the former State Board of Health in a recent lake survey report¹³ completed for a lake within the Region concluded that:

1. Practically all of the 85 improved properties in the survey area were "... in violation of one or more provisions of Section H 62.20 of the Wisconsin Administrative Code, including the use of cesspools, illegal in Wisconsin"

¹²U. S. Department of Agriculture, *Soils Suitable for Septic Tank Filter Fields*, Agricultural Information Bulletin No. 243, U. S. Government Printing Office, (1961), p. 7.

¹³Wisconsin State Board of Health, *Survey of Private Sewage Disposal Systems at Water Front Properties, Lake Como, Walworth County* (1967).

Figure 23

INOPERATIVE SEPTIC TANK SEWAGE DISPOSAL SYSTEMS

Septic tank sewage disposal system filter fields located on shoreland areas having a high-water table or covered by soils having a slow permeability will result in poor operation of the sewage disposal system during all or part of each year and may thereby contribute to water pollution and the creation of a public health hazard.



2. "That probably no more than two of the total number of lots surveyed are suitable for development because of high ground water conditions, unfavorable soil types, and in a few cases excessive slopes."
3. "That in past years there has been apparently no enforcement of the State Code pertaining to private sewerage systems"

Such systems are often illegally pumped out directly into a stream or lake, are pumped out onto the surface of the ground so that the effluent flows into surface waters, or are connected to a farm or other drain tile which directly transmits the untreated effluent into the surface water drainage system (see Figure 24). The type of inconvenience and health hazards occasioned by such septic systems have received widespread publicity in southeastern Wisconsin, as illustrated by the newspaper article in Figure 25.



Figure 24

ILLEGAL DISCHARGE OF SEPTIC TANK EFFLUENT

Inoperative or malfunctioning soil absorption sewage disposal systems often result in effluent from septic tanks being discharged into roadside ditches, in which it creates a public health hazard and from which it may pollute surface water resources.

Septic Tanks May Close Public Beach

A summer survey of residential septic systems near the north end of Little Muskego Lake has resulted in 45 "abate nuisance" notices and probably will require the closing of a public swimming beach.

The results of the survey, taken by summer employees of the county health department, have been reported to the Board of Health.

Herbert E. Ripley, director of environmental health, said he has already begun to get cooperation from some of the home owners involved.

Some didn't know they had bought homes with illegal septic systems, Ripley said.

The Health Department surveyors checked all the homes on Linnie Lac, a small lake in New Berlin, Jewel Creek and the north end of Little Muskego. About 160 homes were involved.

Homes further removed from the waters, but which could still pollute the waters with improper sewage disposal, were not included in the survey, Ripley said.

Twenty-two properties discharge household wastes directly into Jewel Creek or the north end of Little Muskego, the survey revealed. Of those, nine discharge sewage wastes and 13 laundry wastes.

Four more have septic

systems which allow sewage to accumulate on the surface of the ground, then to flow or be washed into the water, Ripley said.

Six others allow laundry wastes to enter the creek in the same way. The other 13 septic system problems are on Linnie Lac.

As a result of the violations, the water at the north end of Little Muskego have too high a bacteria count for safe swimming, Ripley said.

A bathing beach is operated on an island located just off the point where Jewel Creek enters the lake. Formerly known as Hardtke's Beach, the recrea-

tion area is now called Idle Isle.

Though the beach doesn't contribute to the pollution, it may be pollution's first victim. Ripley said steps would be taken to prohibit swimming at the beach after he has conferred with Corp. Counsel Willis Zick about procedures.

Only after the sewage problems are solved — a lengthy process — could it be reopened, Ripley said.

Department policy is first to seek voluntary cooperation from the offending home owners. Only if that fails will formal, 30-day notices be sent and subsequent court action be taken, Ripley said.

Source: *Waukesha Freeman* August 10, 1967

Often enterprising developers or misinformed local officials believe that by simple filling lowlands become suitable for soil absorption sewage disposal systems. This is a dangerous misconception, as shown by a recent state survey¹⁴ of private sewage disposal systems located in selected shoreland areas throughout the state, including two areas in southeastern Wisconsin. This survey found that all areas developed by placing fill over peat or muck contained malfunctioning septic and soil absorption systems.

STORM WATER

The older types of combined sewer systems existing in certain urban areas of the Region are designed to bypass untreated sanitary and storm sewage during periods of heavy rainfall or snowmelt directly to streams or lakes. Heavy rainfalls or snowmelts may also surcharge separate sanitary sewerage systems and result in the bypassing of pumping stations and sewage treatment facilities and the discharging of raw sewage to streams and lakes. In addition, roadway and urban storm water drainage systems serving intensively developed areas carry storm water runoff, which may be high in biochemical oxygen demand, coliform bacteria, suspended solids, chlorides, and nutrients, to streams and lakes. It has been estimated that urban runoff is the source of over 5 percent of the total nitrogen and 10 percent of the total phosphorus reaching Wisconsin's surface waters.¹⁵ These percentages are probably much higher in highly urbanized areas, such as southeastern Wisconsin. This pollution of the storm water runoff is the result of certain types of gardening, private property maintenance, and public highway maintenance practices demanded by the public today. Chemical de-icers placed upon street and highway surfaces are transported to surface waters during spring rains and snowmelts. Over 77,000 tons of chlorides were applied to the streets and highways of Milwaukee County alone during the 1964-1965 winter season.¹⁶ The deleterious effect of such runoff upon stream waters is much less than upon relatively closed bodies of water, such as lakes, where such pollutants are retained, concentrated, and not diluted or flushed away by high-volume streamflows.

¹⁴Wisconsin Department of Health and Social Services, *Summary Report of a Survey of Private Sewage Disposal Systems Serving Water Front Properties* (November 13, 1967).

¹⁵Corey, Richard B.; Hasler, Arthur D.; Lee, G. Fred; Schraufnagel, F. H.; and Wirth, Thomas L., *Excessive Water Fertilization*, Report to the Water Subcommittee, Natural Resources Committee of State Agencies (1967), Table 6, p. 35.

¹⁶Schraufnagel, F. H., *Chlorides*, Wisconsin Committee on Water Pollution (1965).

PUBLIC SEWAGE TREATMENT

Although vastly superior in every respect to private sewage disposal systems because of their size, state regulation, and operator competence, centralized public sewage treatment facilities are still a major source of water pollution within the Region.¹⁷ For example, 14 separate municipal sewage treatment plants discharged partially treated wastes into the Milwaukee River. Together these plants contribute a treated load of nutrient materials equivalent to the raw sewage of a city of about 30,000 people.

A state task force on "Control Techniques and Research on Water Fertilization" stated that:

Domestic sewage, even when treated to a point where the effluent is sparkling clear—in fact, suitable for trout rearing, contributes a major source of nitrogen and phosphorus. These two elements are generally considered the most important contributors to excess fertilization of Wisconsin waters. Conventional treatment facilities are presently removing less than half of these nutrients¹⁸

Sewage treatment plants which are located on floodlands, underdesigned, overused, inefficiently operated, poorly maintained, or connected to sanitary sewer systems with high infiltration rates may result in untreated or undertreated sewage entering the surface waters of the Region. Wastes from such plants contain pollutants, such as detergents, chlorides, nitrates, and phosphorus, and also contribute to an increase in color level, turbidity, biochemical oxygen demand, temperature, and coliform bacteria of the receiving streams. These additions and changes to the physical, chemical, and biological character of the surface waters cause health hazards; result in excessive algae growth; destroy the aesthetic character of the shoreland area; and reduce the number of recreational, industrial, and agricultural uses to which the waters can be put, such as cooling, processing, swimming, fishing, aquatic life, irrigation, and livestock watering, as well as cooking, washing, drinking, and brewing. Pollution may so impair desirable forms of aquatic life that bloodworms, sludgeworms, leeches, and maggots sometimes become the only life that can survive.

Many of the streams in the Region do not have sufficient flow during periods of dry weather to dilute and assimilate adequately any sizeable effluent loads. For example, during dry weather over one-half of the flow of the Pewaukee River downstream from the Village of Pewaukee sewage treatment plant is comprised of sewage treatment plant effluent, while the entire dry weather flow of portions of the Root River is composed entirely of sewage treatment plant effluent. Extreme low flows and temporary dry-bed conditions have the added adverse effect of fostering weed growth.

WASTE DISPOSAL

Certain industrial, municipal, agricultural, and domestic wastes are discharged directly into streams or lakes or placed upon the surface in such a manner as to seep, drain, percolate, or wash into ground or surface waters. Certain industrial operations including gas works, coke ovens, steel plants, metal cleaning, chemical manufacturing, mineral washing, and electroplating discharge wastes directly to surface waters by accidental spillage or by poorly operated or underdesigned treatment facilities. Some industrial wastes are discharged through illegally installed outfalls directly into a stream or lake without any treatment. Certain pollutants, such as chromium, cyanide, fluoride, sodium, sulfate, chloride, and oil, commonly originating from industrial operations are toxic to plants, wildlife, fish, and other aquatic life (see Figure 26). Oil impairs all water uses, poisons livestock, creates navigation hazards, asphyxiates fish, imparts an oily taste to food products, causes boiler feed water to overheat, prevents oil-coated waterfowl from flying, disrupts the aquatic food chain, and destroys all the aesthetic recreational qualities of water.

¹⁷SEWRPC Technical Report No. 4, Water Quality and Flow of Streams in Southeastern Wisconsin (1966), p. 320.

¹⁸*Ibid.*, Footnote 15, p. 1.

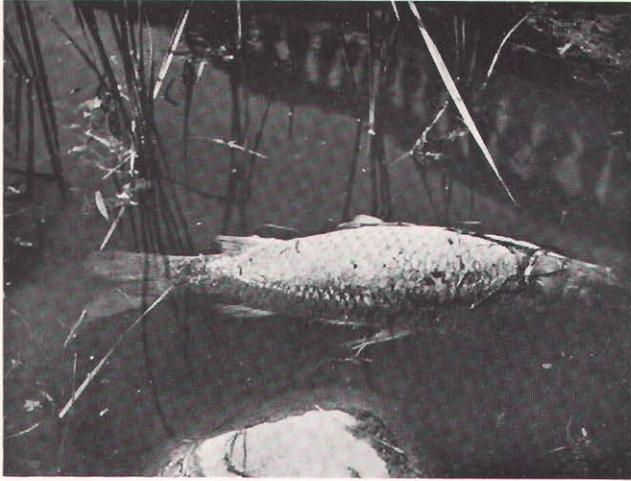


Figure 26
TOXIC POLLUTANTS

Industrial, municipal, and agricultural wastes that are discharged directly into streams or lakes or which seep, drain, or wash into ground or surface waters may seriously endanger fish and wildlife. These wastes may contain pollutants that are highly toxic to plants, wildlife, fish, and other aquatic life.

The dumping of materials, such as refuse, rubbish, garbage, or other wastes, on sloping lands (see Figure 27) or the filling of low-lying lands, such as wetlands, lowers the aesthetic value of shoreland areas; destroys wildlife habitat; and reduces the natural water storage capacity. Subsequent hydraulic action, such as runoff, percolation, leaching, and flooding, may wash such wastes or their components downhill into the ground water table or out into the stream or lake, thereby reducing ground and surface water quality in the shoreland areas. Abandoned gravel pits and stone quarries are often used for rubbish and garbage disposal operations. Shallow aquifers, such as the dolomite within the Southeastern Wisconsin Region, are particularly susceptible to pollution from seepage of such waste materials indiscriminately and improperly dumped into these pits and quarries. In addition, certain industrial wastes may cause an increase in color, turbidity, and biochemical oxygen demand of the ground waters.

Figure 27
SHORELAND RUBBISH DUMP

The dumping of refuse, rubbish, garbage, or other wastes in shoreland areas destroys their aesthetic value and may impair water quality.



Agricultural operations, such as commercial feed lots, creameries, and food processing, may contribute wastes into streams by direct discharge, runoff, or inadequate treatment, which contributes nitrates, phosphorus, or animal fecal wastes to the streams, thereby causing excessive algae growth or health hazards.

Domestic wastes, such as garbage and rubbish, not properly handled or disposed attracts rodents and flies and may become aesthetically unpleasing to the eyes and noses of residents in intensely developed shoreland areas. The placing of large amounts of such wastes on steep slopes or in low-lying wetlands will result in a reduction of ground and surface water quality because of drainage, seepage, or washing. In addition, there is the common and ubiquitous littering of the waters and shores by ignorant, uncouth, or insensitive users (see Figure 28).



Figure 28
SHORELAND LITTERING

Navigable surface waters, which in Wisconsin are held in trust by the state for the use and enjoyment of all its citizens, have in some areas become, in the absence of firm guidelines for proper utilization and development, a dumping ground for trash and rubbish and a disposal area for liquid wastes.

Sludge, scum, or effluent pumped from septic or holding tanks by commercial tank truck operators may be illegally discharged into ditches, dry runs, or watercourses or placed upon lands whose slopes, frozen condition, or soil absorption characteristics are such that the sludge, scum, and effluent reaches ground or surface waters.

WATER WITHDRAWAL

Certain minimum streamflows and lake levels are necessary for many beneficial water uses, such as waste assimilation, commercial navigation, recreation, wildlife habitat, and aesthetic enjoyment, as well as protection of property values. The excessive withdrawal of water during dry seasons from the shallow aquifers by private water supply systems may have an adverse effect upon stream water flows and lake levels. Summer conditions of low flow and high temperatures are especially critical with respect to the effects of thermal pollution.

The withdrawal of waters from streams or lakes for irrigation, cooling, or processing is sometimes done without a permit from the proper state agency and often in quantities that impair desirable streamflow, lake levels, and aquatic life balance, thereby contributing to waste assimilation problems, loss of property values, recreational use impairment, and destruction of wildlife. Even intensive livestock watering when permitted on very small streams may reduce streamflow sufficiently to affect adversely other water uses.

WATER QUALITY

The natural quality of surface waters in southeastern Wisconsin presents no serious problem for any reasonable potential water use. The aforementioned activities of man in the shoreland areas, namely, dredg-

ing, dumping, tree cutting, agricultural operations, intensive urban development, and sewage and waste disposal, have all resulted in an impairment or destruction of the water quality for some or all beneficial uses. Often the adverse effect of man's activities goes unnoticed for long periods of time. A special state task force recently concluded that excessive fertilization is a growing problem and is resulting in serious water quality deterioration and that "Often this problem is insidious and makes deep wounds before being detected."¹⁹

The existing level of stream water quality within the Region has been established by a recently completed study of the Regional Planning Commission. This study involved the establishment of 87 stream sampling stations on 43 streams, the collection of stream water quality and streamflow data, the selection of water quality standards, the application of such standards to the data to establish feasible water uses, and the correlation of the present stream quality and streamflow with distribution of population and sources of pollution.²⁰ The Commission's technical report on water quality and streams concluded that stream pollution may be considered to be occasionally or persistently severe in all of the 12 major watersheds of the Region, that such stream pollution has impaired or prohibited certain beneficial water uses, that the pollution is directly related to urbanization, that the major waste sources are industry and public sewage treatment plants, and that pollution is also related to storm water runoff and inadequate soil absorption sewage disposal systems.

FUTURE TRENDS

The increases in population, urbanization, income, leisure time, and individual mobility anticipated by the Regional Planning Commission will contribute to additional pressure for shoreland conversion and development within the Region. Such development at high densities and without proper sewage disposal facilities will contribute to further shoreland growth removal, wildlife habitat destruction, and water quality deterioration.

The Commission has prepared forecasts of the future levels of water quality which may be expected to occur in all of the major streams of the Region in the absence of any converted water quality management programs. This forecast of water quality indicates, for example, that the Fox River above Waukesha will not be suitable for fish, wildlife, recreation, or even aesthetic uses because of low dissolved oxygen levels and septic conditions, with associated offensive odors, that will prevail by 1990. If disinfection by chlorination of sewage effluent is not practiced, the Fox River from the Village of Waterford to the state line will not be suitable for recreational uses because of a high coliform count. The volume of domestic sewage will not only become greater with increasing population within the watershed but the accelerated use of the plant nutrient phosphorus in synthetic detergents for laundry and kitchen uses will also add to the problem of overfertilization.²¹

Heavy leisure-type recreational demands on water resources will increasingly come into conflict with industrial and agricultural water needs in rapidly urbanizing areas. For example, 40 years ago the Milwaukee River provided an excellent recreational facility for swimming, fishing, and boating. These uses have almost entirely disappeared with the river becoming, during late summer and fall, a putrid flow of decaying algae, dead fish, and turbid waters. Because of its attractiveness and convenient location,²² the upper Milwaukee River watershed is experiencing an exceptionally high recreation demand, not only by visitation from the Milwaukee metropolitan area but also from the Chicago metropolitan area. This is illustrated by a statement made in a recent report of the U. S. Department of the Interior, Bureau of Outdoor Recreation:

¹⁹*Ibid.*, Footnote 15, p. 4.

²⁰*Ibid.*, Footnote 17.

²¹Corey, Richard B.; Hasler, Arthur D.; Lee, G. Fred; Schraufnagel, F. H.; and Wirth, Thomas L., Excessive Water Fertilization, Report to the Water Subcommittee, Natural Resources Committee of State Agencies (1967).

²²Two million persons reside within a 30-mile radius of the watershed, while six million reside within a 150-mile radius.

On a typical summer weekend, 409 acre Long Lake is crisscrossed by water skiers, speckled by fishermen, and crowded with bathers. Private and state owned beaches, launching facilities, and picnic areas overflow weekly ... Mauthe Lake Recreation facilities (Northern Unit of the Kettle Moraine State Forest) bulge with an excess of 10,000 users per weekend.²³

The shortage of public recreational facilities and the intensive development of existing public and private facilities, along with the shoreland urbanization, result in damaging of flora, harrassment of fish and game, and a general deterioration of the recreation resources, with an accompanying lack of appreciation or awareness of nature's needs. Unfortunately, far too often weed choked areas, the stench of decaying algae and fish, curtailment of water sports, losses in property values, water supply taste, odor, and filtration problems and the change from aesthetic values to nuisances are the only results that finally bring the matter to the attention of the citizen.

CONCLUSION

If such widespread practices as indiscriminate dredging, draining, filling, tree cutting, and shrubbery clearing; poor soil and water conservation; indiscriminate use of fertilizers, herbicides, and pesticides; unplanned and unregulated intensive development; inadequate sewage treatment, uncontrolled waste disposal, and water withdrawal continue, then the further destruction of shoreland growth, wildlife habitat, and water quality may be expected. This will inevitably result in a severe deterioration of the total environment in the Southeastern Wisconsin Region. Only the adoption and administration of effective water management programs based upon comprehensive land and water use plans will provide the shoreland and related water quality protection that is needed.

²³U. S. Department of the Interior, Bureau of Outdoor Recreation, *A Preliminary Report on the Outdoor Recreation Needs of the Milwaukee River Basin (1966)*.

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Chapter IV

FLOOD DAMAGE PREVENTION

INTRODUCTION

The various methods and devices available for the prevention of flood damage are so directly dependent upon the use to be made of the floodlands that any sound flood damage prevention program must be based upon a comprehensive land use planning program. The conduct of such a program on a regional and watershed basis is the first step in achieving or restoring a balance between the use of land in, and the hydrologic requirements of, floodlands. Therefore, in this chapter the need for a comprehensive land use plan upon which to base a logical, practical, and economic selection of methods and devices for flood damage prevention will be discussed, as well as the methods and devices themselves.

COMPREHENSIVE LAND USE PLANNING

Prior to the selection of any particular method or device for the prevention of flood damage, it is necessary to identify the type, amount, and spatial location of the land uses required to meet existing and anticipated land use demands within the floodlands. This requires the conduct of a comprehensive land use planning program which accurately establishes the existing land use pattern and the physiographic and cultural features influencing land use development in the region of which the floodlands are an integral part; estimates the probable future demand for the various land uses within that region; formulates area-wide land use development objectives and standards; and designs a future land use pattern to best meet these objectives and standards in light of existing development, factors affecting land use development, and costs attendant to such development. The end product of such a land use planning program is a comprehensive land use plan which sets forth community development aspirations in terms of a physical land use development pattern. Within the frame of reference provided by such a land use plan, a community can intelligently formulate floodland use regulations and development policies and can, with the aid of substantive technical data, determine the areas in which flood hazards exist and indicate the most appropriate uses of such areas in the best interests of the entire community.

A comprehensive land use plan has been prepared and adopted by the Commission as a framework around which subregional, watershed, and local community land use plans, as well as areawide facility and utility plans, including flood control plans, can be prepared. The adopted Regional Land Use Plan¹ recommends that all of the floodlands within the seven-county Southeastern Wisconsin Region be protected from incompatible development as integral parts of either primary or secondary environmental corridors (see Map 1) and further recommends specific zoning districts which, if properly applied to the floodlands, would result in significant flood damage prevention; in protection of certain important elements of the natural resource base, including water quality; and in partial satisfaction of the growing need for park and open-space lands within the Region.

A comprehensive watershed plan, which contains coordinated proposals for land use development, flood control, and pollution abatement and which serves to refine and detail the regional land use plan in the stream valley areas, has also been prepared and adopted by the Commission for the Root River basin. Such watershed plans are also under preparation for the Fox and Milwaukee River basins within the Region. The plans produced by these programs will include specific proposals for the proper utilization of floodlands so as to prevent flood damage. The watershed as a planning unit and its relationship to the Region and to the watershed planning problem, together with the watershed planning process and the basic principles underlying this process, are thoroughly discussed in Chapter II of SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed, pp. 9-15.

¹SEWRPC Planning Report No. 7, Volume 3, Recommended Regional Land Use and Transportation Plans--1990 (1966).

Water Use Planning

Land use plans must be carefully developed along with, and be properly related to, water use plans. It would be illogical to propose, for example, that certain floodlands be used for park and recreational purposes without at the same time establishing water quality standards applicable to the streams and lakes involved that would accommodate recreational uses and devising specific plans for achieving these standards. Therefore, land and water use plans must be prepared together and carefully adjusted to the ability of the resource base to sustain the proposed land and water use patterns. The water use plans are best prepared on a watershed basis; and, for this reason, the mutual adjustment of land and water use proposals is best accomplished as part of a comprehensive watershed planning program.

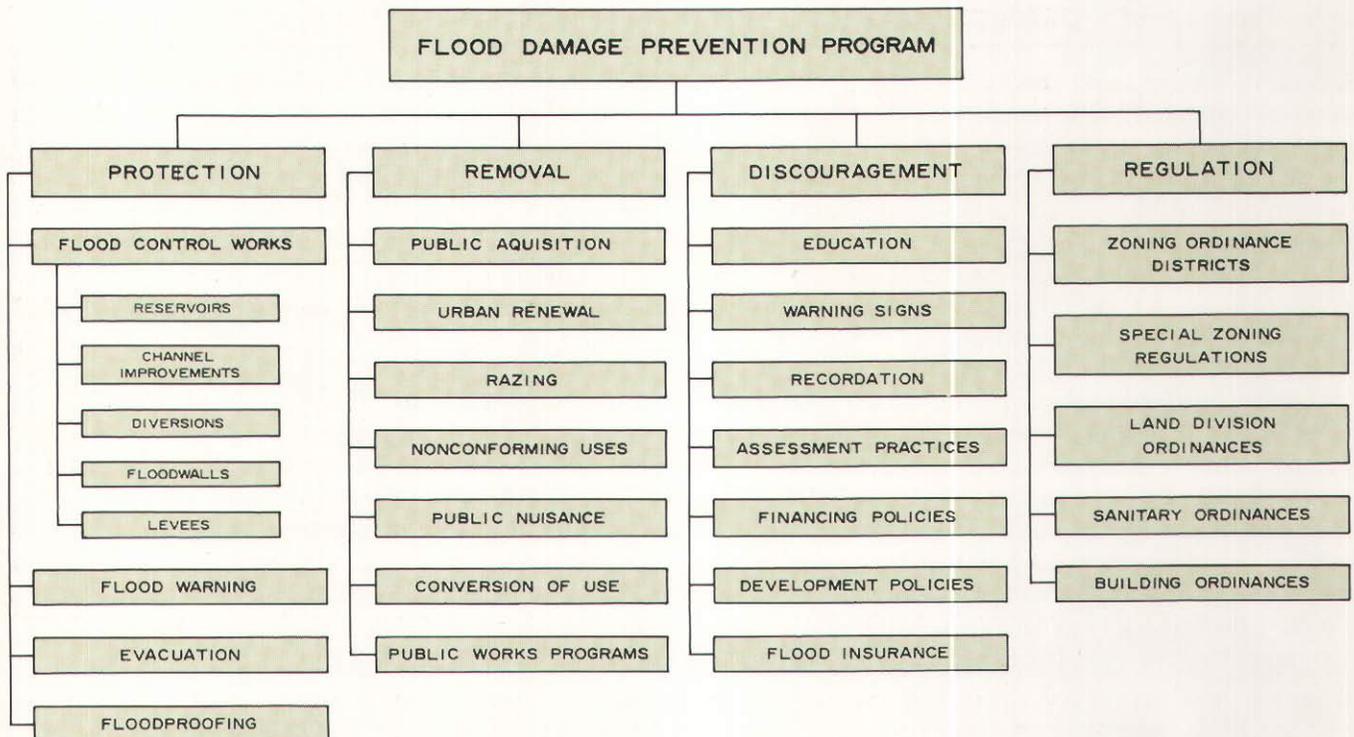
Flood Damage Prevention Program

Once a comprehensive land use plan and a related water use plan have been prepared and adopted, numerous methods and devices for preventing flood damage are available. These include the protection, removal, discouragement, and regulation of certain types of development in floodland areas, as summarized in Figure 29. The relationship of floodland regulations to a land use plan and its implementation by a zoning ordinance are graphically shown in Figure 30.

PROTECTION OF EXISTING DEVELOPMENT

Flood-vulnerable development has occurred and may continue to occur on certain lands within the Region subject to periodic inundation. Such development has been profitable to certain types of land speculators and irresponsible developers, even though it imposes heavy burdens on society. For both economic and humane reasons, local, state, and federal units and agencies of government may find it necessary to protect existing floodland development. Such protection may be accomplished by such methods and devices as flood control works, flood warning, temporary evacuation, and floodproofing.

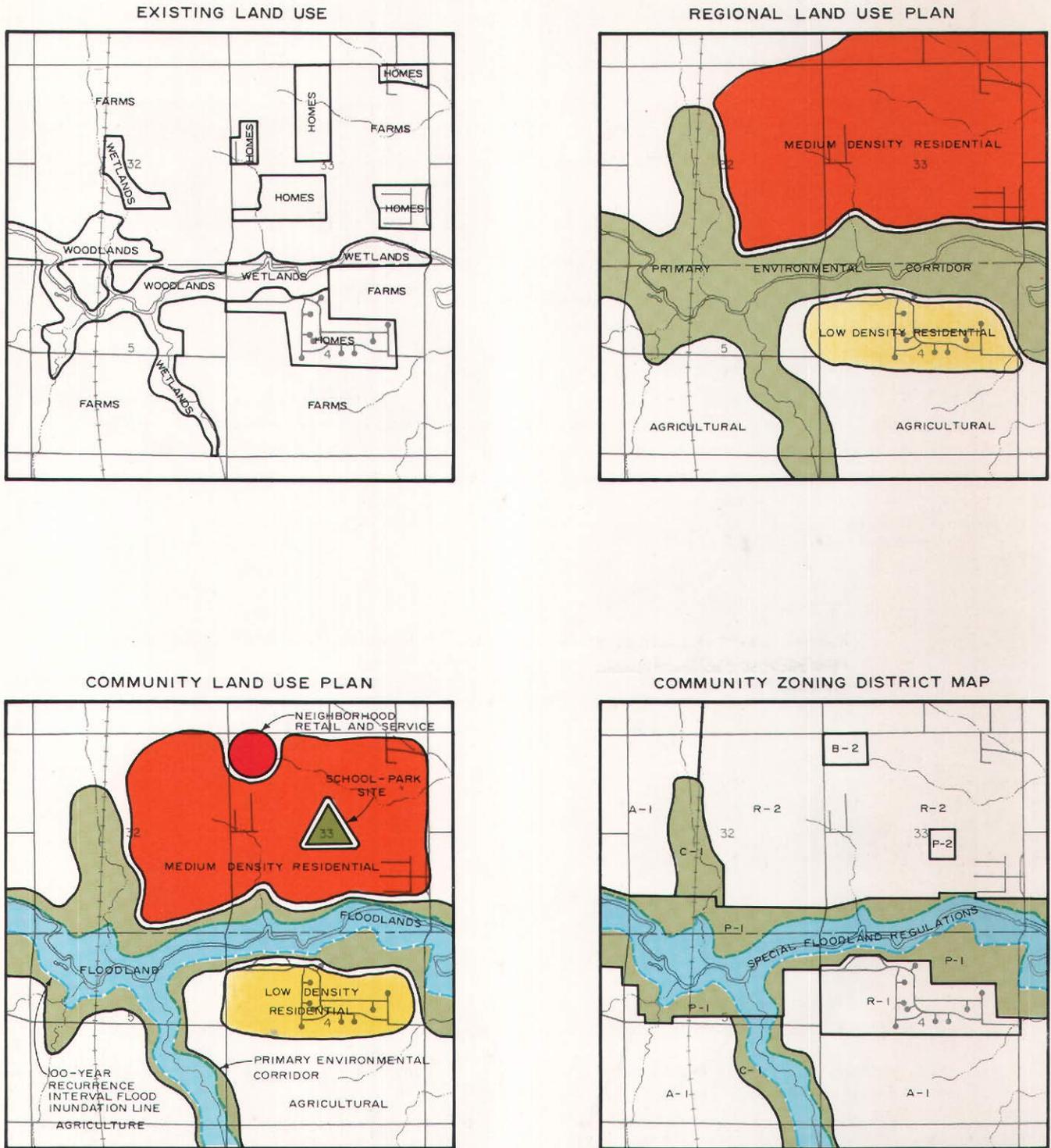
Figure 29
ELEMENTS OF A FLOOD DAMAGE PREVENTION PROGRAM



Source: Adapted by SEWRPC from materials published by the Tennessee Valley Authority and the U.S. Army Corps of Engineers.

Figure 30

RELATION OF FLOODLAND REGULATIONS TO THE LAND USE PLAN AND ZONING DISTRICT MAP



Source: SEWRPC.

The above figures illustrate the relationship which should exist between floodlands and the regional land use plan, the community land use plan, and the community zoning district map. Adequate and proper flood damage abatement and resource protection require that local land use regulatory powers be applied in rural as well as urban areas. Conservancy (C-1) zoning districts, public and private park (P-1) districts, and special floodland regulations may all be effectively used to prevent flood damages and to protect environmental corridors. As urbanization proceeds within a watershed, public acquisition of most of the lands zoned for park purposes is the most effective way of preventing flood-vulnerable development from occurring on floodlands.

Flood Control Works

Damages from floods often lead to highly vocal and tenacious demands for public works programs to protect existing development through the construction of structures and improvements, such as: dams, ditches, canals, sluices, holding basins, and detention reservoirs; channel deepening (see Figure 31), straightening, widening, and paving; bypass or diversion channels, dikes, revetments, floodwalls, levees, and underground drainage facilities (see Figures 32 and 33); or combinations of several of these types of public works.

Figure 31
OPEN CHANNEL IMPROVEMENT

Failure to protect drainageways and floodlands from urban encroachments brings an increasing demand for flood damage prevention through the construction of expensive public works. Channel deepening, widening, and paving is one form of such public works construction. It may, if improperly planned and designed, disrupt the urban community and create unsightly and dangerous waterways.

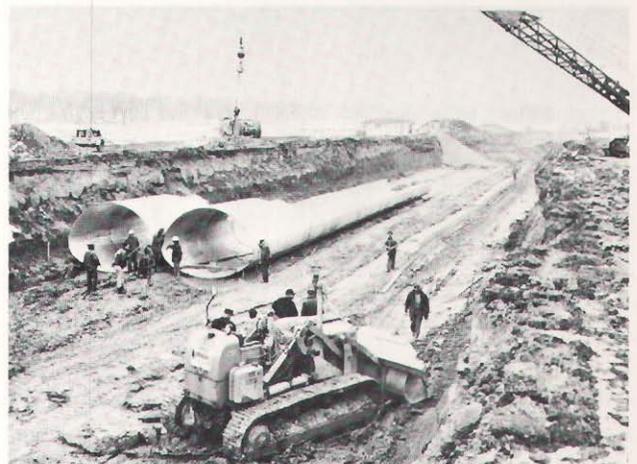


Figure 33
MAJOR DRAINAGE STRUCTURE

The reservation of adequate land for the location and construction of necessary drainage and flood control works through the preparation of long-range comprehensive watershed plans will reduce land acquisition and construction costs attendant to such works and will minimize the disruption of neighboring development.

Figure 32
MAJOR STORM SEWER CONSTRUCTION

The massive nature of even relatively minor drainage and flood control works results in high land acquisition and construction costs and may commit a community to large capital outlays. These outlays can only serve to abate but not to eliminate flood problems.



As urban development proceeds on an areawide basis over a large region, such an approach can only become self-defeating, since the number of persons and value of property in the path of floodwaters tend to increase at a more rapid rate than that at which protection through public works construction can be afforded. Such public works programs must be extensive and consequently are very expensive. For example, levees to be effective must be of substantial construction; continuous throughout areas of low banks; set back to allow for high-water flows; and include provisions for pumpage of interior drainage.

The costs of constructing single-purpose flood control structures and improvements may often be more than the benefits incurred by the reduction in flood damage risk alone. Multiple-purpose structures and improvements, however, having other beneficial purposes in addition to flood control, such as low-flow augmentation or recreation, may overcome this problem and prove economically feasible when evaluated within the context of an overall comprehensive watershed plan which includes both land and water use considerations (see Figure 34).

Figure 34
MULTIPLE USE OF PUBLIC LANDS

Drainage and flood control improvements can often be incorporated into multipurpose park and parkway development through long-range comprehensive watershed planning efforts. In a rapidly urbanizing area, public land acquisition and multi-purpose improvements can become economically feasible when evaluated the basis of an overall watershed plan which includes both land and water use considerations.



Often the actions and improvements of upstream communities commit downstream communities to certain public works programs. Channel improvements, for example, may increase downstream flood peaks and require public expenditures for downstream flood control works. Some flood control works, such as dams and levees, may actually encourage the development of floodlands in anticipation of additional works being constructed and may delude the general public into believing that the flood problem has been eliminated, rather than simply abated, by newly constructed works. Such works do not prevent damage from great and infrequent floods that exceed the design flood, often with catastrophic effects. The intelligent exercise of floodland use regulations in conjunction with these works is, therefore, still required.

Flood Warning and Evacuation

Reliable and timely flood warning can be coupled with temporary evacuation of people and damageable materials from floodlands so as to protect the safety and welfare of the community and reduce property damage. The U. S. Environmental Science Services Administration, Weather Bureau, can provide comprehensive flash-flood warning services for certain streams by the use of radar that is designed specifically for detection of severe weather and the forecast of precipitation intensity. In areas where the time interval between the onset of rainfall and ensuing flood is short, radar information relayed immediately to residents of downstream areas can result in savings of life and movable property.

The U. S. Weather Bureau, Airport Station, Milwaukee, issues "advisories" on anticipated heavy rainfall, based on information relayed from the Chicago Station, which may be useful to local residents in anticipating flash-flooding along streams. The U. S. Weather Bureau can also provide flood forecasts based on analyses of antecedent conditions, such as soil moisture, frost depth, and snowpack, correlated with weather forecasts of temperature and precipitation. The hydrologic characteristics of the streams in the Southeastern Wisconsin Region, however, do not generally lend themselves to reliable forecasts of stage heights in this manner.

Floodproofing

Existing structures that cannot be economically removed from, or which of necessity must be erected on, floodplains, such as certain public utilities, navigation facilities, or transshipment depots and warehouses, should be floodproofed to prevent or reduce flood damage. Such floodproofing should only be considered, however, where floods having low stage, low velocity, and short duration are to be experienced and never within the floodway itself.

Floodproofing measures range from structural modifications through installation of special equipment or materials to operational and management safeguards. The structural modifications and special installation methods are the most desirable as they would not depend upon any warning, judgment, decision, or action to put them into effect. Many of these methods are thoroughly discussed and illustrated in a publication entitled Introduction to Floodproofing.²

The feasibility of structural modifications and the applicability of special flood protective equipment and materials depend upon the materials, age, and design features, as well as on the existing and proposed use of the structure or building to be floodproofed; and such modification should be considered and made only under the guidance of a professional engineer who has carefully inspected and surveyed the premises. Structural modifications include the reinforcing of basement walls and the underpinning of floors to withstand the hydrostatic pressures of floodwaters; permanent sealing of all exterior openings to basements with impervious materials; use of masonry construction; erection of low flood walls; erection of permanent water-tight bulkheads, shutters, and doors; treatment of exposed timber; and, where possible, the elevation of the lowest floor, flood-vulnerable utilities, and access roads at least two feet above the 100-year recurrence interval flood level.

Installation of special equipment or application of special materials may include the following: use of waterproof cement in laying floor covering; provision of adequate fuse protection; anchorage of all buoyant tanks; sealing of basement walls on the outside with special paints, membranes, asphalt, or quick-set hydraulic compounds; installation of special electric or gasoline-fueled automatic sump pumps; installation of automatic horizontal swing-check valves to prevent sewer backup; installation of seal-tight windows and doors or placement of flood shields over windows and doors; and the use of wire-reinforced glass. It is important to note that the improper use of devices such as check valves and seal-tight windows and doors, may result in high hydrostatic pressure levels and serious structural damage in the form of collapsed walls and ruptured floors.

Operational and management safeguards include special actions during floods or in anticipation of floods, such as: the removal of valuable items from flood-vulnerable areas or the elevation of such items above flood levels; the waterproofing, disconnection, elevation, or removal of all electrical equipment from flood-vulnerable areas; the avoidance of the use of flood-vulnerable areas, such as basements, for living, sleeping, or cooking functions; temporary removal or waterproofing of merchandise; postponement of orders or rescheduling of freight shipments to reduce amount of damageable goods on hand; operation of emergency pump equipment; closing of backwater sewer valves; placement of threaded floor drain pipes; placement of movable water-tight bulkheads against doors and large windows; counterflooding to equalize hydrostatic pressures; erection of sandbag levees; and the shoring of weak walls or other structural elements.

The floodproofing of existing on-site soil absorption systems is sometimes suggested, but the only proper corrective measure is the substitution of an alternate disposal system, such as a public sanitary sewer system or holding tank.

REMOVAL OR CONVERSION OF EXISTING DEVELOPMENT

Persistent and frequent damage or danger to human life from flooding can sometimes be avoided best by permanent evacuation of the floodlands through complete removal of structures or through the conversion of the structures to some less flood-vulnerable use. The feasibility of such action is dependent upon the

²Schaefer, John R., and Associates, Introduction to Floodproofing, University of Chicago (1967).

value of the structures in the floodlands, their adaptability to floodproofing, their effect upon the movement of floodwaters, flood stage height and floodwater storage, and upon sufficient citizen interest and concern to permit local public officials to take the necessary action. Special attention should be given to the removal of structures within the floodways because of their effect upon flood stage and flow. Methods for such evacuation, removal, or conversion include: public acquisition, urban renewal, razing, nonconforming use provisions in zoning ordinances, public nuisance actions, and conversion of use.

Public Acquisition

The most positive way in which the evacuation, removal, or conversion of floodlands can be achieved and development of the cleared land subsequently controlled in the public interest is through public purchase of such lands by a local or state unit or agency of government. The procurement of the floodlands may be accomplished through negotiation, condemnation, default as a result of tax delinquency, dedication, and donation. The governmental agency may then sell or lease some or all of the acquired floodlands, imposing restrictions on its development for uses which are flood-vulnerable. Agricultural land might be acquired and then leased for a similar use, thereby absorbing some of the costs while protecting the floodlands from development.

This method is most appropriate in urban or urbanizing areas where public park lands are needed for, and desired by, the community. The Milwaukee County Park Commission has been acquiring properties in floodlands of streams and watercourses for many years, and recommendations for the public acquisition of a parkway system in Milwaukee and Racine Counties along the floodlands of the Root River are contained in the comprehensive plan for the Root River watershed. In addition, this plan proposes the removal of 23 houses within the City of Greenfield and 35 houses within the City of Racine which are subject to first-floor inundation by the 100-year recurrence interval flood within the watershed and reuse of the floodland for public park and recreation purposes.³

Several federal and state grant programs are available to assist communities in the acquisition of the floodlands for public park and recreation purposes. These programs include the State Outdoor Recreation Aid Program and the Federal Open-Space, Land and Water Conservation, and Greenspan Programs authorized under Section 66.36 of the Wisconsin Statutes, the Federal Housing Act of 1961, the Federal Land and Water Conservation Fund Act of 1965, and the Federal Food and Agricultural Act of 1965, respectively. In addition, the watershed development projects administered by the U. S. Department of Agriculture, Soil Conservation Service, can provide federal financial assistance toward the acquisition of land for watershed development.

The acquisition of less-than-fee interest in floodlands may be considerably cheaper and may result in the floodlands being put to proper use more rapidly. Such interest may be in the form of scenic easements for vista protection, conveyance of development rights to assure continuance of private parks and open spaces, and grants of various public accesses and development rights for construction and use of park facilities. The advantages of the use of easement to regulate floodland uses are important. The purchase of easements or certain development rights gives to the public rights to limit development of the land in question to certain uses. The owner, at the same time, receives just compensation for the release of these rights. The cost of the compensation for this partial taking of rights should be significantly less than the cost of the outright purchase of the land in fee simple. Moreover, only the required property rights need be taken, leaving the rest to be exercised by the private owner. The establishment of easement lines need not be based on documented flood data since the use rights are purchased by agreement and not regulated by the police power. The use of such easement will require periodic inspections by a designated official and may require enforcement by the unit of government holding the easement.

Urban Renewal

Public or private redevelopment of floodland areas can be achieved by the purchasing of land that has been determined to be blighted or deteriorated, including floodlands, then clearing the land and redeveloping it in a safer and more appropriate manner. The existence of blight can sometimes be traced to periodic flooding and the historic development of floodplain areas in the absence of sound floodland use regulations.

³SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed (1966), p. 185.

The Federal Urban Renewal Program offers communities an opportunity for such redevelopment by providing certain grants for the cost of project execution and relocation of families and businesses. The net project cost or loss for determining the amount of a federal urban renewal grant is the total of expenditures for project execution activities plus the value of local non-cash grants-in-aid less the proceeds from the disposition of the land. For communities under 50,000 people, the federal share of this loss is three-fourths. The local contribution may be made in cash or credits from public improvements made by the community that are related to the urban renewal project. The cost of relocating families and businesses is borne entirely by the Federal Government.

Razing

Buildings on lands subject to periodic flood damage often go unrepaired after a flood, and this begins a cycle of deterioration. Section 66.05 of the Wisconsin Statutes grants municipalities the power to:

... order the owner of premises upon which is located any building or part thereof ... which in its judgment is so old, dilapidated or has become so out of repair as to be dangerous, unsafe, insanitary, or otherwise unfit for human habitation, occupancy or use, and so that it would be unreasonable to repair the same, to raze and remove such building or part thereof, ... or where there has been a cessation of normal construction of any building or structure for a period of more than 2 years, to raze and remove such building or part thereof

Such buildings also are deemed to constitute a public nuisance and may be proceeded against under Chapter 280 of the Wisconsin Statutes by both counties and municipalities.

In addition, this section of the Statutes provides that:

If the owner fails or refuses to comply within the time prescribed, the inspector of buildings or other designated officer shall cause such building or part thereof to be razed and removed either through any available public agency or by contract or arrangement with private persons, or closed if unfit for human habitation, occupancy or use. The cost of such razing and removal or closing shall be charged against the real estate upon which such building is located and shall be a lien upon such real estate, and shall be assessed and collected as a special tax.

Nonconforming Uses

The adoption of a proper zoning ordinance and the application of zoning districts and floodland regulations may make some existing uses nonconforming. Nonconforming uses are those uses in existence at the time of the adoption of a zoning ordinance that do not conform to the use restrictions of the ordinance. For example, if a zoning ordinance prohibits residential uses on floodlands, existing residences in the floodland would become nonconforming uses.

Section 62.23(7)(h) of the Wisconsin Statutes provides that, in the case of cities, villages, and towns with zoning ordinances adopted under city planning powers, nonconforming uses existing at the time the zoning ordinance takes effect:

... may be continued although such use does not conform with the provisions of the ordinance. Such nonconforming use may not be extended. The total structural repairs or alterations in such a nonconforming building shall not during its life exceed 50 percent of the assessed value of the building unless permanently changed to a conforming use. If such nonconforming use is discontinued for a period of 12 months, any future use of the building and premises shall conform to the ordinance.

Public Nuisance

The deposition of materials and the construction or placement of structures in stream beds may not only impair navigation but may reduce the channel or floodway cross section of the stream, which would cause higher flood stages, increase the floodplain area, and increase flood damages in affected channel reaches.

Chapter 30 of the Wisconsin Statutes 1965, Volume 3, provides that it is unlawful to deposit materials or place structures upon the bed of navigable waters where no bulkhead line has been established or beyond an established bulkhead line without a permit from the State Department of Natural Resources.⁴ The local units of government are, moreover, required to promptly report every violation which occurs or which it has reason to believe is likely to occur within their municipal boundaries. Every such violation has been declared to be a public nuisance and may be enjoined or abated by action at the suit of the state or any citizen thereof.

Recently the Wisconsin Legislature, in Section 87.30(2) of the Wisconsin Statutes, declared that every structure, building, fill, or development placed or maintained within any floodplain in violation of a zoning ordinance adopted under a county, city, or village zoning ordinance is a public nuisance and may be enjoined or abated by action of the state, any municipality, or any citizen thereof (see Appendix E).

Conversion of Use

Flood-vulnerable land uses existing on floodlands, as well as non-specialized improvements and structures, can be voluntarily converted to non-vulnerable uses. For example, farm feed storage buildings can be converted to sheds housing certain farm equipment which would not be damaged by floodwaters or disrupt the farm operation by being temporarily unavailable; and tilled lands may be used for pasture or sown to crops that are more flood tolerant, such as oats, soybeans, corn, or hay or placed in one of the federal soil reserve programs administered by the U. S. Agricultural Stabilization and Conservation Service. These programs include the Conservation Reserve, Feed Grain, and Cropland Adjustment Programs authorized under the Federal Soil Bank Act of 1956, the Federal Feed Grain Act of 1961, and the Federal Food and Agricultural Act of 1965, respectively.

Public Works Programs

The reconstruction of existing public works located on floodlands, such as roads, bridges, utilities, and community facilities, for reasons of functional or structural obsolescence may afford an opportunity to reduce the risk of flood damage. This can be accomplished by elevating roads and utilities above peak flood stages, incorporating floodproofing measures into the design, or relocating the works in areas not subject to flooding.

DISCOURAGEMENT OF DEVELOPMENT

Several methods or devices may be used to discourage development of floodlands. These include educational programs, warning signs, recordation, tax assessment practices, financing policies, public development policies, and flood insurance.

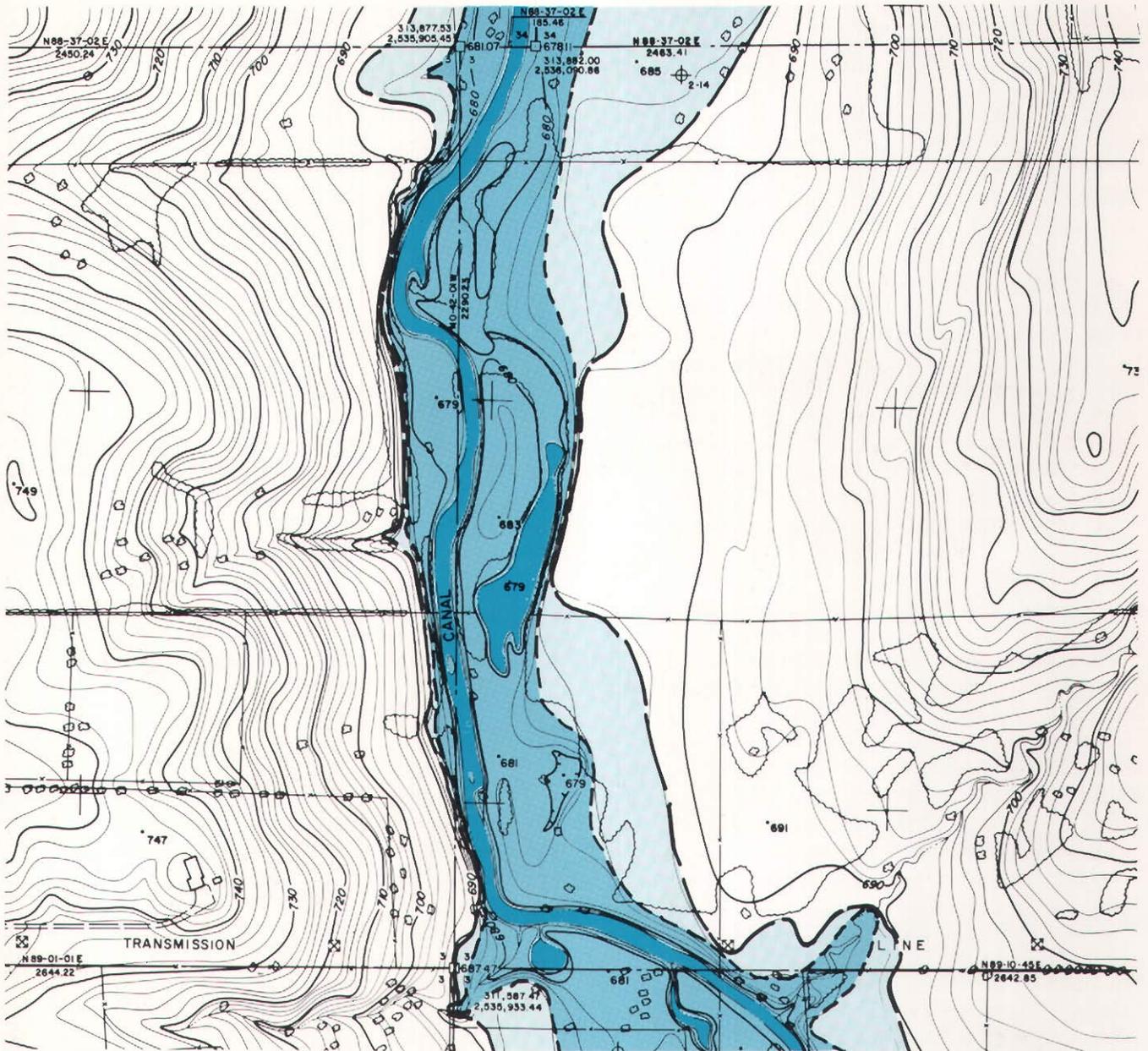
Education

The use of educational programs to bring flood information to the attention of the public is based upon the assumption that prudent, reasonable, and responsible citizens upon being advised of flood hazards would be reluctant to risk property losses and expose their families to the heartaches that may accompany flood losses. Since any program of land use control will in the last analysis depend upon the support of an informed public, the use of educational measures is of great importance.

The preparation, announcement, and dissemination of flood hazard maps is one of the most effective means of informing the public about flood hazards. Such flood hazard maps have been prepared by the Commission for the entire Root River system and are being prepared for the Fox and Milwaukee River systems at a scale of 1" = 2000' and at a scale of 1" = 200' for selected reaches of the main stems (see Map 3). Flood hazard maps have also been prepared by the U. S. Army Corps of Engineers at the request of the Commission for the Des Plaines River at a scale of 1" = 2000' (see Map 4). All of these maps have been or will be announced by special letters to public officials, news and feature articles, bimonthly regional newsletters, and annual conferences. Such maps also have been or will be distributed to all public officials concerned within the watersheds. This announcement and distribution should be supplemented by the posting of such maps in city, village, and town hall meeting rooms and building inspector offices and distribution to lending and mortgage insurance agencies.

⁴Formerly this function was assigned to the Wisconsin Public Service Commission.

Map 3 TYPICAL LARGE SCALE SEWRPC FLOOD HAZARD MAP



LEGEND

- DENOTES 100 YEAR FLOOD INUNDATION LINE
- DENOTES 10 YEAR FLOOD INUNDATION LINE

Flood hazard maps at a scale of 1" = 200', with a vertical contour interval of two feet, have been prepared by the Commission for certain stream channel radius within the Region. These maps are based upon a unique system of survey control which provides a monumented point of known elevation above mean sea level datum and of known horizontal position on both the State Plane Coordinate and the U. S. Public Land Survey Systems at one-half mile intervals through the entire area mapped. These maps permit the accurate correlation of property boundary lines with hydrographic and topographic data so necessary to the proper enactment and enforcement of floodland and shoreland regulations and permit lines established on the map during adoption of the regulations to be accurately re-established on the ground during enforcement.

Map 4

TYPICAL U.S. ARMY CORPS OF ENGINEERS FLOOD HAZARD MAP

CORPS OF ENGINEERS

U.S. ARMY

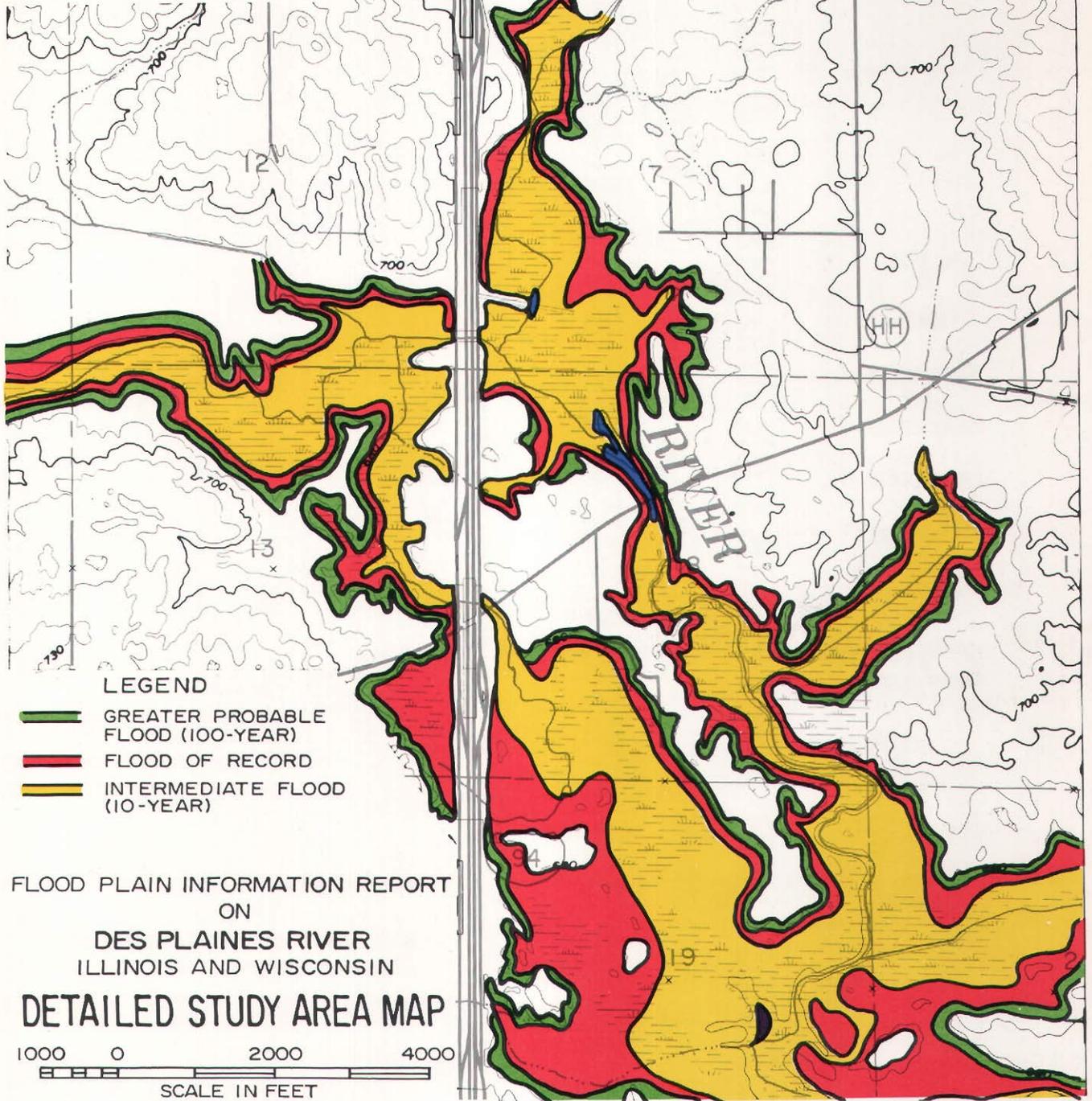
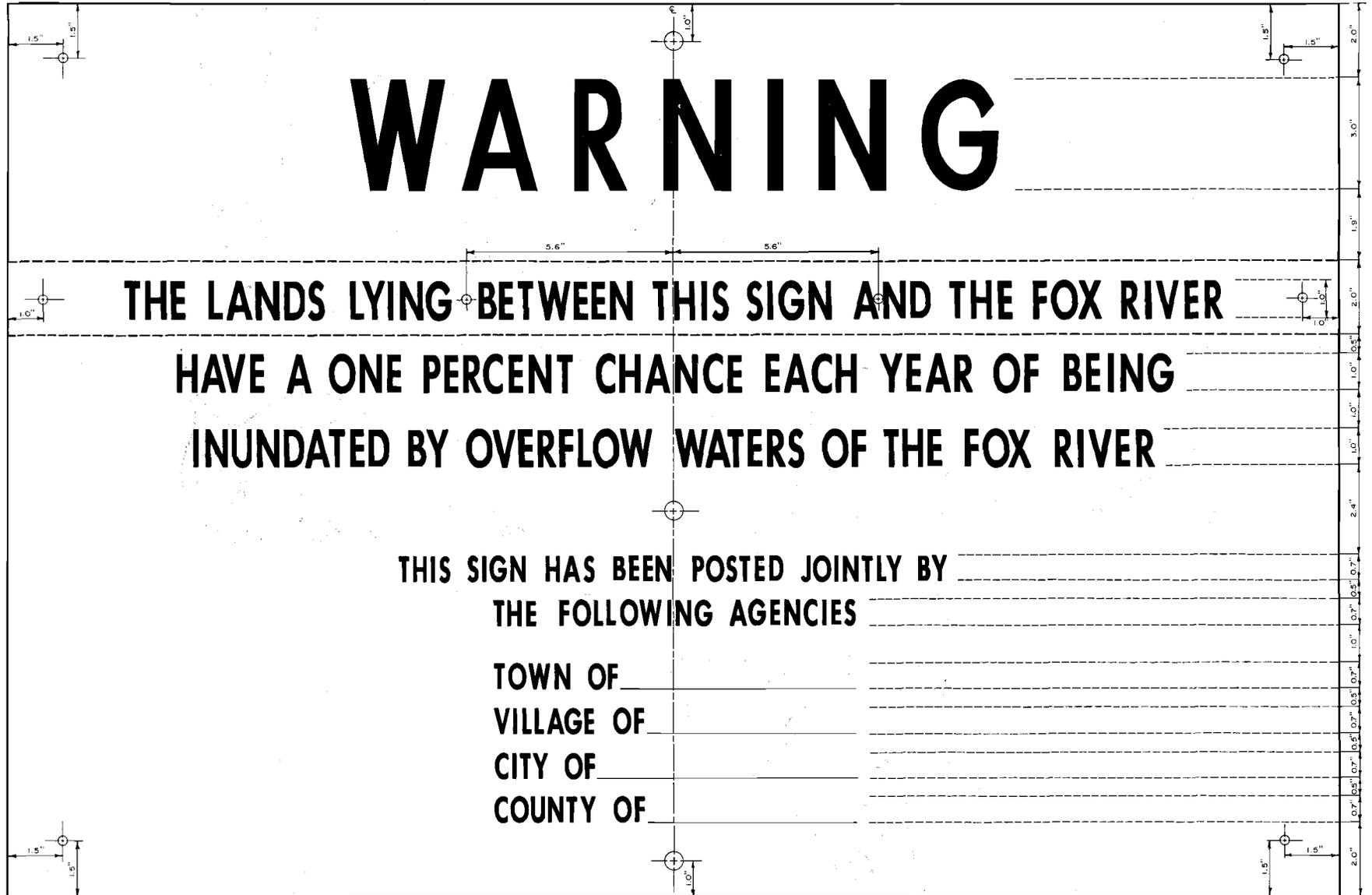


PLATE 16

The U. S. Department of the Army, Corps of Engineers, is authorized by Section 206 of the Flood Control Act of 1960 (Public Law 86-645) to compile and publish upon request information on floods and flood hazards, including identification of areas subject to flooding, so as to encourage prudent use of floodlands. The Corps at the request of the Southeastern Wisconsin Regional Planning Commission extended its Des Plaines River floodplain investigation into the Southeastern Wisconsin Region and has completed and published an excellent report containing the results of this investigation, including flood hazard maps as shown above.

Figure 35
FLOOD WARNING SIGN SPECIFICATIONS



NOTES

Material for signs shall be No. 12 U.S. standard sheet steel with fused porcelain finish, white background and black letters. Width and length dimensions are to be 24 inches by 36 inches respectively.

All mounting holes shall be fitted with brass or cadmium-plated zinc eyelets. The three vertical holes shall be of sufficient size to accommodate a 1/2-inch bolt. The four horizontal and four corner holes shall be of sufficient size to accommodate 1/4-inch screws. Spacing of holes shall be in accordance with the dimensions as shown on the drawing.

Source: Adapted by SEWRPC from flood warning signs developed by the U.S. Department of the Interior, Bureau of Reclamation.

The first line of lettering below "WARNING" will be omitted from the sign and put on a detachable plate. The detachable plate (indicated by the dashed lines on the drawing) shall be of the same material, quality, color and letters as the sign. The 1/4-inch holes on the plate shall be drilled and eyelets installed so as to match the 1/4-inch holes on the sign. The general arrangement of wording shall be as shown on the drawing. Size and weight of letters shall be approximately as shown. Style of letters and spacing shall be in accordance with the best sign making practice.

Bolts for mounting the sign to the post shall be 1/2-inch by 7-1/2-inch galvanized steel with hexagonal head and each shall be complete with hexagonal nut and one steel lock washer.

Screws similar to a "Sems" for mounting the additional data on the sign shall be 1/4-inch by 3/4-inch galvanized steel with rounded slotted head and each shall be complete with hexagonal nut and one steel lock washer.

Warning Signs

Warning signs may be used to draw public attention to flood hazardous areas, especially the attention of those prudent potential land purchasers or developers who inspect a site and its environs before purchase. Such signs should be located, based upon adequate flood data, in areas where they can be readily seen by potential buyers and developers and may best be posted along the 100-year recurrence interval flood inundation boundaries where such boundaries intersect public right-of-way lines. A suggested plan and specifications for such a warning sign are shown in Figure 35, and Figure 36 illustrates such a sign being erected on a right-of-way line.

Warning signs may also take other forms, such as a rubber stamp impression placed on subdivision plats and building and zoning permits stating that the subdivision, site, or lot is located in an area subject to flooding at some specified frequency.

Figure 36
FLOOD WARNING SIGN LOCATION

Warning signs may be used to attract attention to flood hazardous areas, especially the attention of those prudent potential land purchasers or developers who inspect a site and its vicinity before purchase.



Recordation

It would be very desirable if flood hazard maps at a scale of at least 1" = 200' could be recorded with the Register of Deeds within each county where such maps had been prepared. The flood hazard maps could be accompanied by a list of the quarter section or subdivision affected and a special request made for entry into the quarter-section tract index. This type of recording would result in the abstract of the title of each property affected containing an entry referencing the flood hazard. Subsequent conveyances and title opinions would therefore also mention the flood hazard, thereby alerting both the land purchaser and the local assessor. Section 59.51 of the Wisconsin Statutes requires the Register of Deeds to record only those maps authorized by law to be recorded in his office. Such maps do not include flood hazard maps but do include final plats and certified survey maps. Therefore, the adoption of those floodland regulations set forth in Appendix J of this Guide and the Model Land Division Ordinance prepared by the Commission would result in the recordation of such flood hazard data in the Register of Deeds office in each county.

Tax Assessment Practices

Real property taxation assessment is an important factor influencing land use patterns. In urban and urbanizing areas, real property appraisals, assessments, and resulting tax rates tend to reflect the high demand for land that results in owners of undeveloped floodlands attempting to relieve tax burdens by conveying nonproductive floodlands for development. The educational, warning, and recordation programs previously mentioned should alert local property tax assessors to those properties subject to flood hazards and should result in lower assessments, which would reduce the economic pressure on the owner to convert floodlands to urban uses.

Much discussion has been given to the idea that some form of tax relief should be provided for lands subject to flooding for the purpose of encouraging certain non-flood-vulnerable uses in these areas. The assessment of lands retained in open use by private owners in conformance with adopted land use plans could reflect this fact and provide a value and rate to compensate for the profit that could be realized through conversion to more flood-vulnerable uses. At the same time, floodlands that are developed contrary to the adopted plan could be assessed at a value and taxed at a rate high enough to recover the public burden of protecting such development. Such assessment practices, however, would require both statutory and constitutional amendments in Wisconsin.

It should also be noted that, if the construction of public works for flood damage prevention becomes necessary, Chapter 87 of the Wisconsin Statutes authorizes the creation of a Flood Control Board having special assessment powers. Thus, the cost of the flood control works may be assessed against those parcels of land that will directly or indirectly benefit by such works. This possibility of an unexpected assessment against property should be reflected in property values and their appraisal for tax purposes.

Financing Policies

Almost all building or construction today involves loans or mortgages by private lenders, many of which are insured by the Federal Housing Administration, Farmers Home Administration, or Veterans Administration. Knowledge on the part of these private lenders and federal agencies of the flood hazards involved and the adoption by such lenders and agencies of policies denying loans or loan insurance for construction on floodlands would significantly discourage floodland development. An example of a private lending agency acting in this manner is the Board of the Citizens Bank of Mukwonago, which carefully considers the flood hazard risk prior to approving financing for the purchase or development of floodlands along the Fox River.

Public Development Policies

The availability of utilities and other community facilities in floodland areas serves to attract subdividers, developers, and home purchasers. Of great importance to the discouragement of such development is the adoption of, and adherence to, certain public development policies covering the extension of public utilities, such as water supply and sanitary sewer systems, and the construction of community facilities, such as schools and streets.

Metropolitan and municipal utilities can design and install public water supply and sanitary sewer systems so as to preclude the provision of such services to urban development proposed to be located on floodlands. Such action has been recommended to all local units of government within the Region as part of the implementation of the Regional Land Use Plan.⁵

Local governing bodies and agencies can adopt and announce policies that they will not authorize, finance, or construct community facilities, such as roads and schools, to serve floodlands. Such actions must be taken well in advance of development pressures and must be used along with other methods, such as removal and regulatory programs, to ensure success.

Flood Insurance

The indemnification of property owners who suffer flood damage would promote highly undesirable and unwarranted floodland development. A combination of floodplain occupancy charges and flood insurance, however, could be used to discourage the development of floodlands or to create economic incentives to adjust floodland uses to the flood hazards involved.

Flood insurance has been traditionally unavailable from private sources because floods lack the essentially random nature necessary to a sound insurance program. The American Insurance Association has reported that:

... flood insurance covering fixed-location properties in areas subject to recurrent floods cannot feasibly be written because of the virtual certainty of loss, its catastrophic nature, and the reluctance or inability of the public to pay the premium charge required to make the insurance self-sustaining.⁶

It appears that flood insurance can be sold at feasible rates only with sizeable government subsidies. This type of subsidy is unpopular with those outside the flood hazard areas since the costs must be borne by the general public. The Federal Flood Indemnity Administration, created and authorized by the Flood Insur-

⁵SEWRPC Planning Report No. 7, Volume 3, Recommended Regional Land Use and Transportation Plans--1990 (1966) p. 128.

⁶American Insurance Association, Studies of Floods and Flood Damages 1952-1955, (New York: 1956).

ance Act of 1956 to conduct an experimental flood insurance program, became inactive in 1957 when Congress failed to appropriate money for its operation. Crop insurance is available for floodlands from the Federal Government; and the U. S. Department of Agriculture, Federal Crop Insurance Corporation, is empowered to insure or reinsure producers of agricultural commodities against loss by drought, flood, hail, wind, frost, or other unavoidable causes.

A national task force on a federal flood control policy has recommended that a study of the feasibility of an "occupancy charge indemnification fund" be carried out so as to result in a practical national program for flood insurance.⁷ One of the objectives of this recommended study would be to achieve a sensible use of floodlands that would be equally or more important than the indemnification of loss. Such an objective would be accomplished by requiring each new development to pay an annual charge in proportion to its hazard plus any associated cost the occupancy causes others. The task force anticipated that the following benefits would result from such a program:

1. Floodplain occupants would assume their appropriate responsibilities.
2. Development on floodplains would be precluded unless the advantages were expected to equal or exceed the total cost to the public, the developer, and others affected.
3. Support would be forthcoming for appropriate regulations to reduce the cost of floodplain occupancy.⁸

Unless premiums are properly related to the risk involved, flood insurance is really a taxation measure.

REGULATION OF USES IN FLOODLANDS

It is costly to undertake public works programs for the protection of floodland development, difficult to remove or convert existing development, and unrealistic to assume that all future flood-vulnerable development will be discouraged on floodlands by indirect action. The prohibition and regulation of flood-vulnerable uses under local police powers is, therefore, the most efficient, economical, and logical method of preventing flood damage.

Generally, the use of floodways should be restricted to open uses, such as parks, drive-in theaters, parking lots, outside storage areas, and certain structures that can withstand flood velocity without obstructing floodwater movement. The use of floodplains should also be limited to open uses, but certain other uses that are not flood vulnerable and are limited in areal extent may be permitted if regulated so as not to result in a significant reduction of floodwater storage capacity and a significant increase in flood levels. Although isolated filling operations on floodplains may cause little problem, numerous individual fills may in the aggregate significantly reduce floodwater storage capacity and increase flood stage height. Therefore, the U. S. Army Corps of Engineers has stated that "The best rule is to avoid any filling of the flood plain . . ."⁹

The devices for prohibiting or regulating floodland development include selection and application of zoning districts that are compatible with the flood hazards involved and the incorporation of floodland regulations into zoning, land division, sanitary, and building ordinances. Such regulations involve the use of the local police power so as to provide safe and healthful standards for the prudent occupancy of floodlands. The placement of parks and parkways upon official maps is also an effective way of preserving for public acquisition or private dedication those floodlands which are part of a comprehensive park, parkway, or drainage system. The use of this device is thoroughly discussed in SEWRPC Planning Guide No. 2, Official Mapping Guide, 1964.

⁷*Communication from the President of the United States, A Unified National Program for Managing Flood Losses, House Document No. 468, U. S. Government Printing Office, (1966).*

⁸*Ibid.*, footnote 7.

⁹*U. S. Department of the Army, Corps of Engineers, Flood Plain Information Report on the Des Plaines River, Illinois and Wisconsin, (March 1966), p. 26.*

Bulkhead line ordinances authorized under Section 30.11 of the Wisconsin Statutes for the purpose of maintaining the navigability of public waters may also be used by local units of government to prevent encroachments into floodways. Section 30.12 of the Wisconsin Statutes makes it unlawful to deposit any materials or place any structure upon the bed of any navigable water where no bulkhead line has been established or beyond a lawfully established bulkhead line.

Zoning Ordinance Districts

Zoning ordinances are public laws which regulate and restrict the use of land, water, air, and structures in the public interest under a local unit of government's police powers. Properly prepared zoning ordinances consist of two parts:

1. A text setting forth regulations which apply to various zoning districts or problem areas, such as floodlands or shorelands.
2. A map delineating the boundaries of the various districts or areas to which the regulations apply.

Zoning is the most readily available and the most widely accepted technique for the control of development in floodlands. It provides a three-prong attack on the problem by:

1. Averting potential damage through the restriction of future development of vacant floodlands.
2. Limiting intensification of existing development in flood hazard areas.
3. Limiting the repair and reconstruction of damaged structures.

The most common general zoning districts which generally contain uses compatible with flood hazards are agricultural, conservancy, and park districts (see Appendix H). These districts permit such uses as general farming, woodlands, and public and private recreational uses. The application of these districts to floodlands is shown in Figure 37. The general zoning district regulations must be supplemented by the incorporation of floodland regulations into the zoning ordinance text so as to prohibit those agricultural, conservancy, and park uses which would be flood vulnerable. For example, the zoning and use of floodlands for agricultural purposes should be so regulated as to prohibit farm dwellings, the permanent sheltering or restrictive confinement of animals, and tillage of the floodways without proper soil conservation practices. Those floodlands which must be zoned for commercial and industrial purposes because of proximity to existing development should be so regulated as to permit only parking and outside storage and to prohibit the storage of buoyant, flammable, and explosive materials. Certain selected floodlands adjacent to proposed residential development may be placed in a planned residential district provided development regulations are imposed so that such floodlands are reserved or dedicated for public or private neighborhood park lands to serve the adjoining residential development.

In lieu of the use of compatible zoning district and floodland regulations, special zoning districts, such as floodplain and floodway districts may be utilized. These are discussed in Chapter VIII and presented in Section 3.8 of Appendix A of SEWRPC Planning Guide No. 3, Zoning Guide, 1964. The special zoning districts have the major disadvantage of possibly permitting certain uses that are not flood vulnerable, such as commercial parking, which may be incompatible with permitted uses in adjacent general zoning districts, such as high-value single-family residences.

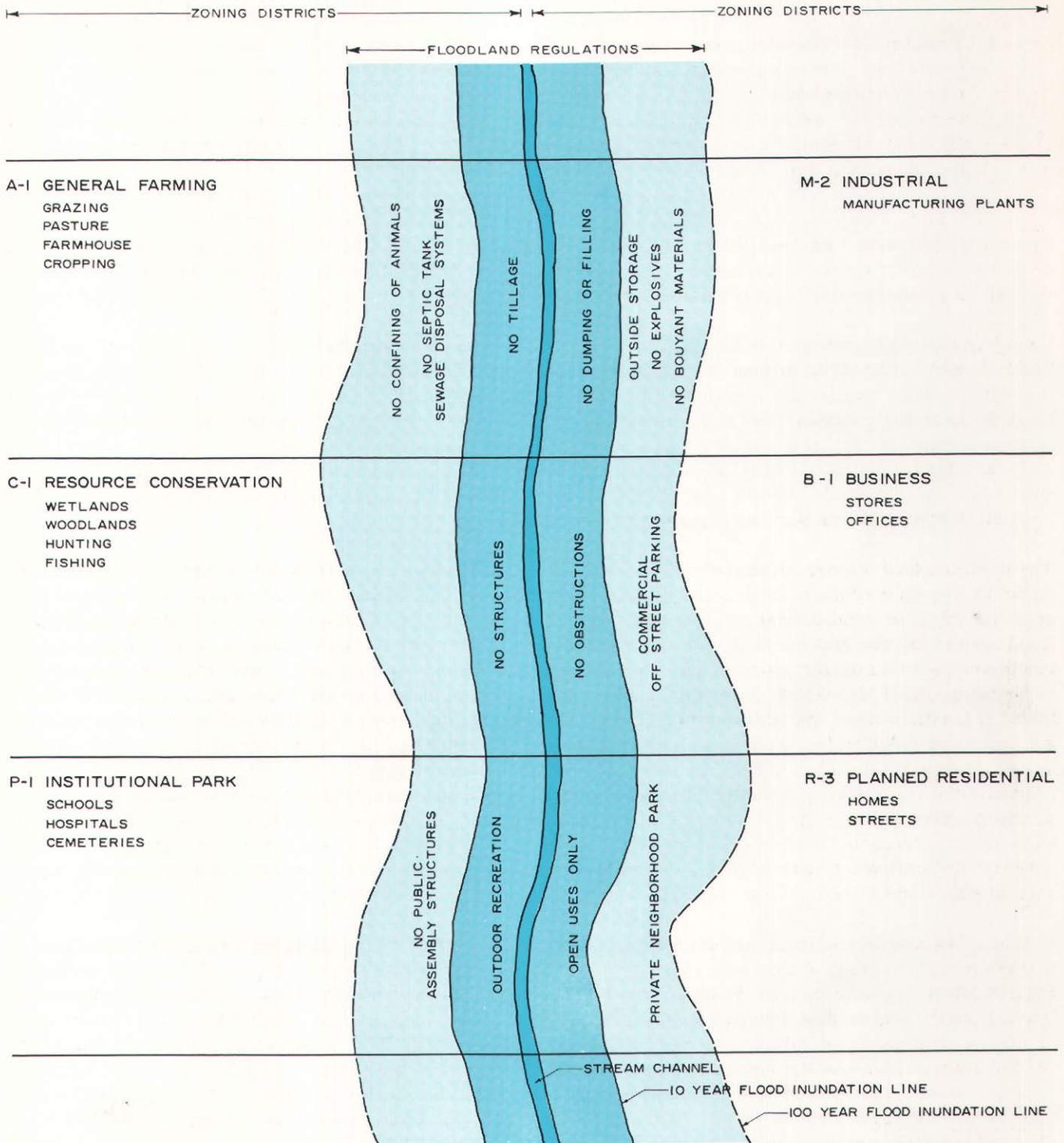
Special Zoning Regulations

Regulations concerning the use of floodlands in zoning ordinances should be imposed in addition to the basic use and site regulations and should be designed to accomplish the following:

1. Prohibit certain uses and structures that are not flood vulnerable within the floodplain and floodway, such as on-site sewage disposal facilities; residential uses; sheltering and confining of animals; and the storage of buoyant, flammable, and explosive materials.

Figure 37

RELATIONSHIP BETWEEN ZONING DISTRICTS AND FLOODLAND REGULATIONS



Source: SEWRPC

The above figure illustrates how zoning districts can be used along with special floodland regulations to avoid improper and unwise use of floodlands. Agricultural, conservancy, and park zoning districts are the most common districts which generally permit uses compatible with the flood hazards existing in floodland areas. Floodlands which must be zoned for commercial and industrial uses because of existing or committed development should be so regulated as to permit only parking and open storage in the flood hazard areas and to prohibit the storage of buoyant, flammable, and explosive materials. The use of special floodland regulations in conjunction with regular zoning districts can achieve floodland objectives while obviating the need for special floodway and floodplain districts.

2. Regulate all other uses and structures within the floodplain to ensure floodproofing and so as not to impede drainage, reduce storage capacity, increase peak flood discharges, or raise flood-water elevations.
3. Prohibit all uses and structures within the floodway, such as filling, dumping, bridge embankments, permanent structures, and private roads that would obstruct the floodway, increase flood-flow velocities or flood stage, or retard the movement of floodwaters.
4. Prohibit dumping, filling, and the erection of all structures within the channel that might obstruct the average annual flow or flood flows and prohibit all bulkheads, wharves, and piers not erected in accordance with state regulations or local pierhead and bulkhead ordinances.

Appendix I contains such floodland regulations as should be added to the SEWRPC Model Zoning Ordinance or other properly prepared zoning ordinance to achieve sound floodland regulations. Figure 37 shows the relationship between floodland regulations and zoning districts.

Land Division Ordinances

Land division ordinances are an important but less frequently used method to control the development of floodlands. Such regulations govern the design and improvement of land subdivision platting layouts and, as such, are an important plan implementation device. They may be used to prohibit the subdivision of lands not suited to the uses intended by the subdivider and to require the proper improvement of the streets and other public ways and building sites prior to dedication and sale. They may be used to prohibit the subdivision of floodlands and the alteration of floodplains and floodways or to require the provision of flood protective measures for the building sites being created.

The past practice of permitting the platting, subdividing, or other division of floodlands into building sites tends to create a public liability and severe problems for public officials and society as a whole. The approval of such subdivisions, the acceptance of public rights-of-way, and the extension of utilities by local governing bodies, coupled with the developer's investment in road and site improvement and the erection of several dwellings, provide local officials and their legal, planning, and engineering staffs with a dilemma. This dilemma concerns the legality, reasonableness, and economy of applying zoning and other regulations that would prohibit further development on these floodlands. This dilemma could be avoided by prohibiting the creation of building sites in these areas.

Such prohibitions could be accomplished by a land division ordinance, which should be designed to accomplish the following:

1. Prohibit the creation of building sites on floodlands subject to the 100-year recurrence interval flood.
2. Require the delineation and designation of all floodlands on all plats and certified survey maps.
3. Require dedication or reservation of all such floodlands for public or private park purposes or other neighborhood or community purposes.
4. Require the design and construction of all public and private roads, bridges, and other facilities so as to withstand flood velocities, prevent isolation, utility outages, and disruption of transportation and so as not to obstruct floodwaters, increase flood-flow velocities or flood stage height, or retard the movement of floodwaters.
5. Require dedication of, or easements along, those drainageways necessary to adequately drain the watershed basin.

Appendix H contains such floodland regulations as should be added to the SEWRPC Model Land Division Ordinance or other properly prepared subdivision control ordinance.

Sanitary Ordinances

Sanitary ordinances are public laws adopted by local units of government under their police powers to protect the health of the citizens within their jurisdiction. Such ordinances can be effectively used to eliminate the health problems occasioned by the disruption of a private sewage disposal system or contamination of a private water supply system that may be caused by inundation of such systems. For example, on-site soil absorption sewage disposal systems, such as privies, septic tanks, absorption fields, seepage beds, and seepage pits, do not function during floodtimes; and the transmission of solid sewage into soil absorption areas results in the clogging and malfunctioning of such systems. The location and construction of such sewage disposal and water supply systems can best be regulated by a sanitary ordinance similar to the model ordinance, set forth in Appendix K, which is designed to:

1. Require a sanitary permit prior to the installation of any system or to the construction or modification of any building, with the application for such permit showing the floodplain boundaries.
2. Prohibit on-site soil absorption sewage disposal systems and private water supply systems on floodlands.
3. Require the replacement of existing on-site sewage disposal systems lying in floodlands with alternate systems, such as public sanitary sewerage or holding tanks.

Building Ordinances

Building ordinances are public laws adopted by local units of government under the police powers to ensure the safety of structures within their jurisdiction. Such ordinances can be effectively used to ensure that structures, such as buildings, bridges, and roads, are protected from flood damage and are constructed in such a way as to avoid aggravation of flood problems. Those structures that must be erected on floodlands should be carefully designed and constructed to ensure their soundness, the safety of their occupants, and the protection of their contents during floodtime. The design and construction of such structures can best be regulated by building ordinances containing floodland regulations similar to those set forth in Appendix L, which are designed to accomplish the following:

1. Require foundation, base supports, footings, and other anchorage to withstand flood-flow velocities and hydrostatic pressures; and require the use of materials that will not deteriorate or otherwise be damaged under submerged conditions.
2. Require all floors and flood-vulnerable utilities to be at an elevation of at least two feet above the level of the 100-year recurrence interval flood. In addition, the ground level surrounding any building shall be raised to an elevation of no less than one foot above the level of the 100-year recurrence interval flood for a horizontal distance of at least 15 feet from the outer face of the building walls.
3. Require appropriate floodproofing measures, including structural modifications and installation of special equipment.
4. Require bridge and culvert openings to have adequate openings to pass high-flood flows and all structures to be designed to maximize the passage of ice floes and other debris.

CONCLUSION

Various methods and devices are available for preventing flood damage, such as the protection, removal, discouragement, and regulation of certain types of development in floodland areas. Specific methods and devices that may be used in any flood damage prevention program include flood control works; evacuation; floodproofing; public acquisition; urban renewal; razing; education; financing; public development policies; flood insurance; and zoning, land division, sanitary, and building ordinances.

A logical, practical, and economic selection of those specific methods and devices for a flood damage prevention program must be based upon a comprehensive land use plan properly related to a water use plan. These land and water use plans must be prepared together and carefully adjusted to the capability of the resource base to sustain the proposed land and water use patterns, which are best prepared for an entire watershed.

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Chapter V

SHORELAND AND WATER QUALITY PROTECTION

INTRODUCTION

The use of lands within a watershed and more particularly within shoreland areas of a watershed is directly and intimately related to the quality of the surface and ground waters within the watershed. Shoreland uses affect and are, in turn, affected by water quality levels in the adjoining streams and lakes. Any consideration of shoreland protection, therefore, must include consideration of related surface water quality. Accordingly, this chapter discusses those methods and devices available for protecting water quality, as well as shorelands. The necessity for comprehensive land and water use plans upon which to logically, practically, and economically base methods and devices for shoreland and water quality protection is also touched upon.

COMPREHENSIVE WATER USE PLANNING

Prior to the selection of methods and devices for the protection of surface water quality, it is necessary to specify the desired uses to be made of each stream and lake within a watershed, as well as to establish the existing and anticipated demands to be made upon these surface water resources. This designation of water use objectives is a prerequisite for the sound formulation of supporting water quality standards, the intelligent preparation of water management plans and programs, and the implementation of such plans and programs.

Water Uses

The following ten beneficial water uses have been selected by the Commission for use in comprehensive plan preparation within the Southeastern Wisconsin Region:¹

1. Municipal (public) water supply.
2. Industrial water supply.
3. Cooling.
4. Waste assimilation.
5. Livestock and wildlife watering.
6. Irrigation.
7. Preservation and enhancement of aquatic life.
8. Recreation (full- and partial-body contact).
9. Navigation (commercial).
10. Aesthetics.

The Commission formulates water use objectives as an integral part of its comprehensive watershed planning programs. This formulation of objectives is accomplished through the local watershed advisory committees created by the Commission to assist in its watershed planning programs and is thereby accomplished in close cooperation with state and local public officials and interested citizen groups. These water use objectives then become important inputs to the plan design, test, and evaluation process. The

¹SEWRPC Technical Report No. 4, Water Quality and Flow of Streams in Southeastern Wisconsin (1966), p. 20.

Commission has, for example, recommended the following water use objectives for the Root River: partial-body contact recreation; preservation of facultative fishlife, wildlife, and livestock watering; and an aesthetic setting for residential and recreational land development.² Similarly, full- and partial-body contact recreation and preservation of aesthetic values are being recommended as water use objectives for all of the 45 major lakes³ in the Fox River watershed.

The Commission's water use objectives are entirely advisory to the federal, state, and local agencies of government concerned and to interested citizen groups. The State Department of Natural Resources is empowered and directed under Section 144.025(2) of the Wisconsin Statutes to formulate no later than July 1, 1968, a long-range, comprehensive state water resources plan for each region⁴ to guide the development, management, and protection of the state's water resources. This Department is thus empowered legally to establish water use objectives for all of the surface waters of the state. The Department has established such objectives for interstate waters as required by the Federal Water Quality Act of 1965 (Sec. 10, P. L. 84-660) and is in the process of preparing such water use objectives for intrastate waters. The water uses, for example, proposed by the state for the Root River include partial-body contact recreation and preservation of fish and other aquatic life and are consistent with the recommendations of the Commission in this respect. The state's water use objectives may be changed as a result of subsequent data and recommendations arising from further research and planning efforts, including the completion of comprehensive watershed planning programs.

Water Quality Standards and Parameters

The application of water use objectives to streams and lakes requires the formulation of supporting water quality standards for each potential beneficial use. The standards must be expressed in terms of measurable physical, chemical, biochemical, and bacteriological water characteristics. These characteristics must be selected from literally hundreds available and should be those that most affect the usefulness of water to man. The Commission has selected the following 34 parameters to describe the stream water quality in southeastern Wisconsin and to serve on a selected basis as supporting standards for recommended water use objectives:⁵

- | | |
|------------------------------|-------------------------------------|
| 1. Alkalinity M | 11. Color |
| 2. Alkalinity P | 12. Cyanide |
| 3. Bicarbonate | 13. Detergents (synthetic) |
| 4. Biochemical Oxygen Demand | 14. Dissolved Oxygen |
| 5. Calcium | 15. Dissolved Solids |
| 6. Calcium Hardness | 16. Fluoride |
| 7. Carbonate | 17. Hardness |
| 8. Chloride | 18. Hexavalent Chromium |
| 9. Chromium | 19. Hydrogen Ion Concentration (pH) |
| 10. Coliform Bacteria | 20. Iron |

²SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed (1966), p. 149.

³Major lakes are defined as those having an average surface area of 50 acres or more.

⁴The Southeastern Wisconsin Region is coterminous with Region 2 established by the State Department of Natural Resources on October 21, 1966, in accordance with Section 144.025(4) of the Wisconsin Statutes 1965, Volume 3.

⁵SEWRPC Technical Report No. 4, Water Quality and Flow of Streams in Southeastern Wisconsin (1966), pp. 9,10.

- | | |
|---------------------------|--------------------------|
| 21. Magnesium | 28. Phosphorus |
| 22. Magnesium Hardness | 29. Silica |
| 23. Manganese | 30. Sodium |
| 24. Nitrate | 31. Specific Conductance |
| 25. Nitrite | 32. Sulfate |
| 26. Noncarbonate Hardness | 33. Temperature |
| 27. Oil | 34. Turbidity |

In addition to the foregoing parameters, sediment, defined as very fine soil particles held in suspension in water by the upward components of turbulent currents or by colloidal suspension, may also be regarded as a water pollutant and the amount present in water as an indication of its quality for certain uses. Certain levels or concentrations of these selected parameters must not be exceeded or, in some cases, must be met if a water use objective is to be achieved. These standards are set forth in Table 1 for each of the major beneficial water uses which may be adopted as water use objectives.

For example, the parameter "coliform bacteria" is composed of a group of microscopic organisms that occur in the intestinal tract of human beings and of other warm-blooded animals. The presence of coliform bacteria in streams is generally considered to be an indication of pollution if the coliform counts are persistently high and appear to be closely associated to man-related waste sources, such as to the effluent of a sewage treatment plant, or to the fecal wastes from other warm-blooded animals, such as a herd of cattle occupying agricultural lands along a stream or lake. Therefore, a coliform bacteria count greater than 5,000⁶ is considered to render stream or lake waters unsafe for partial-body contact recreation, such as fishing. A coliform bacteria count greater than 2,400 is considered to render such water unsafe for whole-body contact recreation, such as bathing, water skiing, or snorkeling.

Land Use Planning

It should again be stressed here that water use plans must be carefully developed along with, and properly related to, land use plans and that this is best accomplished under comprehensive regional and watershed planning programs. Land uses must be carefully adjusted to stream and lake capabilities, including waste assimilation capacities. Land uses and supporting facilities and activities outside shoreland areas but within the tributary watershed, as well as within the immediate shoreland areas themselves, such as road construction, subdivision development, farm practices, and drainage systems, can contribute to the deterioration of surface water quality. Therefore, comprehensive watershed planning must include a consideration of both land and water use on a basinwide basis.

The adopted regional land use plan⁷ includes proposals for placing all of the remaining undeveloped shorelands within the seven-county Southeastern Wisconsin Region in either primary or secondary environmental corridors (see Map 1) and makes specific zoning recommendations to protect these corridors. If properly applied by the local units of government, these zoning recommendations would result in the attainment of a high level of shoreland and water quality protection.

Comprehensive watershed planning programs have been completed by the Commission for the Root River basin and are underway for the Fox and Milwaukee River basins. These plans include recommendations for surface water pollution abatement, including proposals for the use, protection, and enhancement of

⁶Coliform bacteria is measured in MFCC/100 ml; that is, Membrane Filter Coliform Count per 100 milliliters.

⁷SEWRPC Planning Report No. 7, Volume 3, Recommended Regional Land Use and Transportation Plans--1990 (1966).

Table I
WATER QUALITY STANDARDS^a FOR MAJOR WATER USES

Parameter ^b	Municipal (Public) Water Supply		Industrial Water Supply												Cooling	
	Raw	Treated	Baking	Boiler Feed (pressure in psi)				Brewing	Carbonated Beverages	Dairy Industry	Food Canning and Freezing	Food Equipment Washing	Industrial Process Water (general)	Laundry		Tanning
				0-150	150-250	250-400	>400									
Silica	--	--	--	40	20	5	1	50	--	--	--	0.2	--	--	--	--
Iron	--	0.3	0.2	--	--	--	--	0.1	0.2	0.3	0.2	0.2	0.2	0.2-1.0	2.0	0.5
Manganese	--	0.05	0.2	--	--	--	--	0.1	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.5
Chromium (hex.)	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	--	--	--	--	--	--	--	100-500	--	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bicarbonate	--	--	--	50 ^c	30 ^c	5 ^c	0 ^c	--	--	--	--	--	--	--	--	--
Carbonate	--	--	--	200	100	40	20	50-68	--	--	--	--	--	--	--	--
Sulfate	--	250	--	--	--	--	--	250	60	--	--	--	--	--	--	--
Chloride	50-250	250	--	--	--	--	--	250	30	--	250	250	--	--	--	--
Fluoride	1.7	1.7	--	--	--	--	--	1.0	--	1.0	1.0	--	--	--	--	--
Nitrite	--	--	--	--	--	--	--	0	--	0	--	--	--	--	--	--
Nitrate	--	45	--	--	--	--	--	10 ^d	--	30	15	--	--	--	--	--
Phosphorus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cyanide	--	0.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oil	--	--	--	--	--	--	--	0	--	--	--	--	1.0	--	--	--
Detergents	--	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dissolved Solids	--	500	--	--	--	--	--	500-1500	850	--	850	850	750	--	--	--
Hardness	--	--	--	80	40	10	2	250	180	75-400	10	--	50	513	1,000	--
Alkalinity (total)	--	--	--	--	--	--	--	75-150	128	--	--	--	60	185	--	--
pH	6.0-9.0	--	--	8.0M	8.4M	9.0M	9.8M	6.5-7.0	--	--	7.5M	--	5.0-9.0	6.0-6.8	6.0-9.0	5.0-9.0
Specific Conductance	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Color	20-150	15	10	80	40	5	2	10	0	--	20	50	--	100	--	--
Turbidity	10-250	5	10	20	10	5	1	10	2	--	10	250	--	20	50	--
Biochemical Oxygen Demand	--	3.0-4.0	--	--	--	--	--	--	--	--	--	10	--	--	--	--
Dissolved Oxygen	--	4.6-6.5	--	2.0 ^c	0.2 ^c	0.0 ^c	0.0 ^c	--	--	--	--	1.0M	--	--	--	--
Coliform Count	5,000	1	--	--	--	--	--	--	--	100	1	5,000	--	--	--	--
Temperature (°F)	--	65	--	--	--	--	--	--	--	--	--	80	--	--	--	<90

Table I (continued)
WATER QUALITY STANDARDS^a FOR MAJOR WATER USES

Parameter ^b	Waste Assimilation	Livestock and Wildlife Watering	Irrigation	Preservation and Enhancement of Aquatic Life			Recreation		Navigation (commercial)	Aesthetics
				Tolerant	Fish Facultative	Intolerant	Whole Body Contact	Partial Body Contact		
Silica	--	--	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--	--	--
Chromium (hex.)	--	--	--	0.5	0.5	0.5	--	--	--	--
Calcium	--	--	--	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--	--	--
Bicarbonate	--	--	--	--	--	--	--	--	--	--
Carbonate	--	--	--	--	--	--	--	--	--	--
Sulfate	--	--	--	--	--	--	--	--	--	--
Chloride	--	1,500	--	500	500	500	--	--	--	--
Fluoride	--	--	--	--	--	--	--	--	--	--
Nitrite	--	--	--	--	--	--	--	--	--	--
Nitrate	--	--	--	--	--	--	--	--	--	--
Phosphorus	--	--	--	--	--	--	--	--	--	--
Cyanide	--	--	--	0.025	0.025	0.025	--	--	--	--
Oil	--	--	--	--	--	--	--	--	--	1.0
Detergents	--	--	--	3.5	3.5	2.0	--	--	--	--
Dissolved Solids	--	7,000	2,000	--	--	--	--	--	--	--
Hardness	--	--	--	--	--	--	--	--	--	--
Alkalinity (total)	--	--	--	--	--	--	--	--	--	--
pH	--	5.0-9.0	--	6.0-9.0	6.0-9.0	6.0-9.0	--	5.0-9.0	5.0-9.0	--
Specific Conductance	--	--	3,000	--	--	--	--	--	--	--
Color	--	--	--	--	--	--	--50	--	--	--
Turbidity	--	250	--	250	250	250	50	250	--	--
Biochemical Oxygen Demand	--	--	--	--	--	--	--	--	--	--
Dissolved Oxygen	--	--	--	3.0M ^e	4.0M ^e	5.0M	3.0M	3.0M	1.0M	--
Coliform Count	--	--	--	--	--	--	2,400	5,000	--	--
Temperature (°F)	--	--	--	90	85	80	<90	<90	--	--

^a Water quality standards adopted from data obtained from five authoritative sources, as discussed on page 20 of SEWRPC Technical Report No. 4, *Water Quality and Flow of Streams in Southeastern Wisconsin, 1966*. Limits are recommended maximum or maximum permissible values, except minimum limits which have the suffix M. Several standards are presented as a range of limiting values.

^b The limiting values of the chemical, physical, biochemical, and bacteriological parameters are expressed in ppm (mg/l) except pH specific conductance, color, turbidity, coliform count, and temperature. For an explanation of the limiting values of these excepted parameters, see Chapter IV of SEWRPC Technical Report No. 4, *Water Quality and Flow of Streams in Southeastern Wisconsin, 1966*.

^c Limits applicable only to feed water entering boiler, not to original water supply.

^d Nitrate as NO₃-N.

^e Sixteen hours maximum exposure at indicated concentration.

Source: Table based in part upon data compiled by SEWRPC.

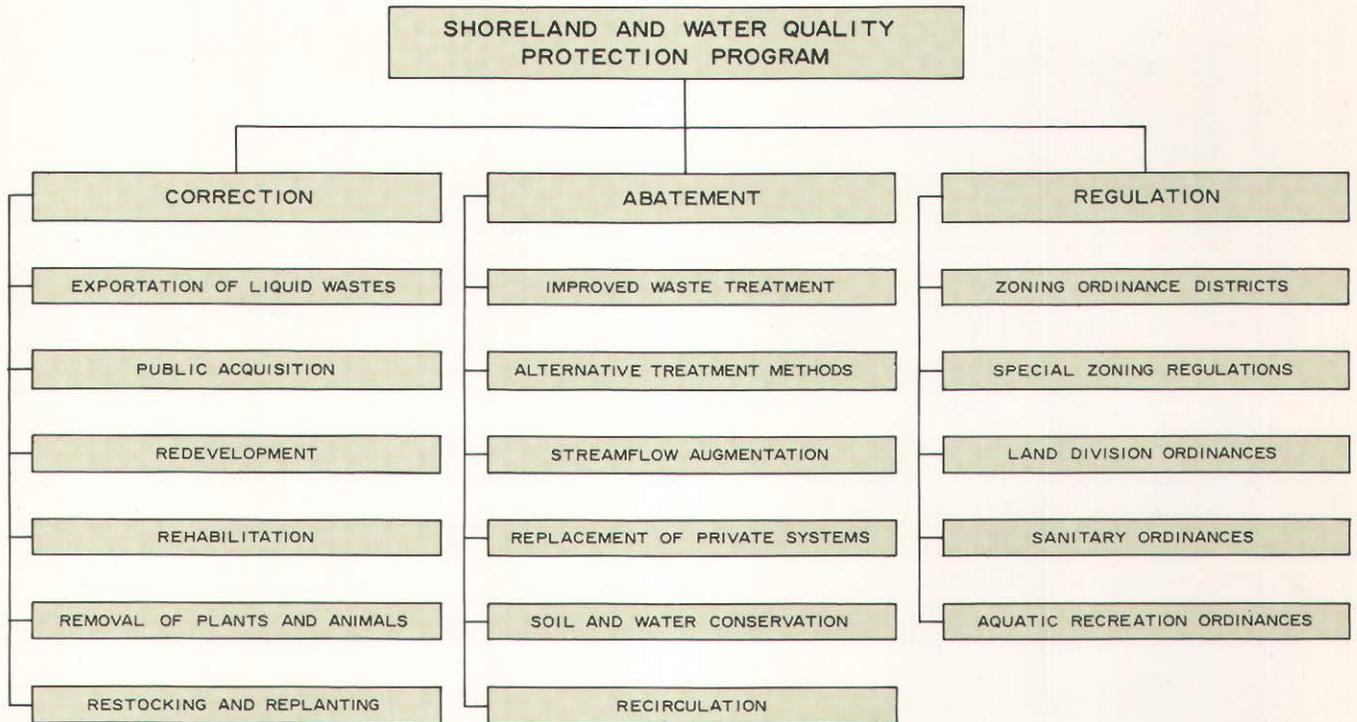
lakes, as well as streams. The watershed as a planning unit, its relationship to the Region, the watershed planning problem, planning process, and basic principles are all thoroughly discussed in Chapter II, pages 9 through 15, of the Commission's report on the Root River watershed.⁸

Water Management Program

Once a comprehensive water use plan and related land use plan have been prepared, applicable water quality objectives selected, and standards related to these water use objectives adopted, numerous methods and devices for protecting water quality are available. These include the correction, abatement, and prevention of water pollution and the regulation of shoreland uses, as summarized in Figure 38. The relationship of shoreland regulations to a land use plan and its implementation through a zoning ordinance are graphically illustrated in Figure 39.

Figure 38

ELEMENTS OF A SHORELAND AND WATER QUALITY PROTECTION PROGRAM



Source: SEWRPC.

CORRECTION OF EXISTING SHORELAND PROBLEMS

Certain existing land and water uses may have such an adverse effect upon water quality because of their nature or magnitude that it becomes necessary to inaugurate costly remedial or rehabilitation measures. Such measures may include exportation of liquid wastes; public acquisition of shoreland areas; redevelopment of existing urban land uses; and rehabilitation of streams and lakes, including removal of undesirable plants and animals, restocking with fish and game, and replanting of shoreland areas.

Exportation of Liquid Wastes

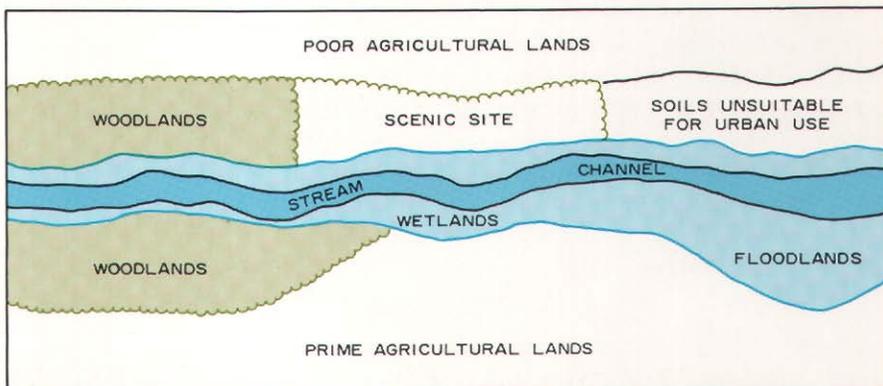
The exportation of liquid wastes from one watershed or drainage basin to another may be advantageous where the waste assimilation capacity of the receiving stream system is greater than that of the generating watershed. The advantage of such exportation may include the concentration of wastes at larger centralized treatment plants where more efficient plant operation may be achieved and where improved treatment

⁸SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed (1966).

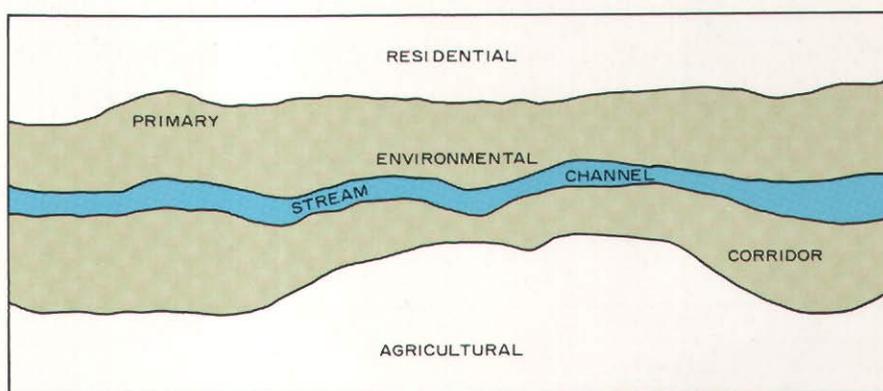
Figure 39

RELATION OF SHORELAND REGULATIONS TO THE LAND USE PLAN AND ZONING DISTRICT MAP

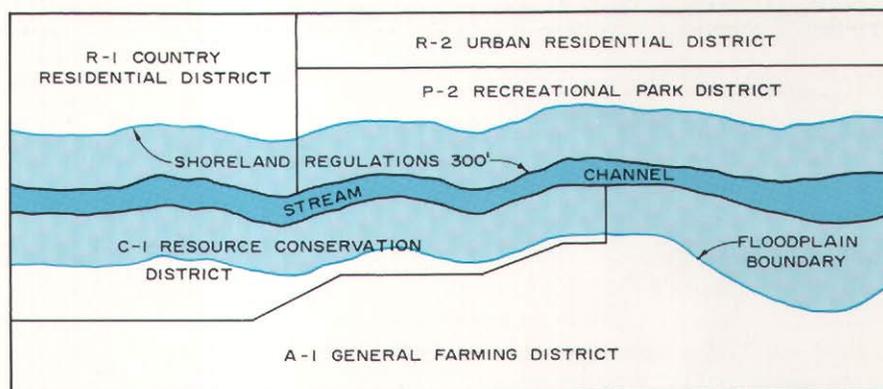
NATURAL RESOURCE INVENTORY



LAND USE PLAN



ZONING MAP



Source: SEWRPC

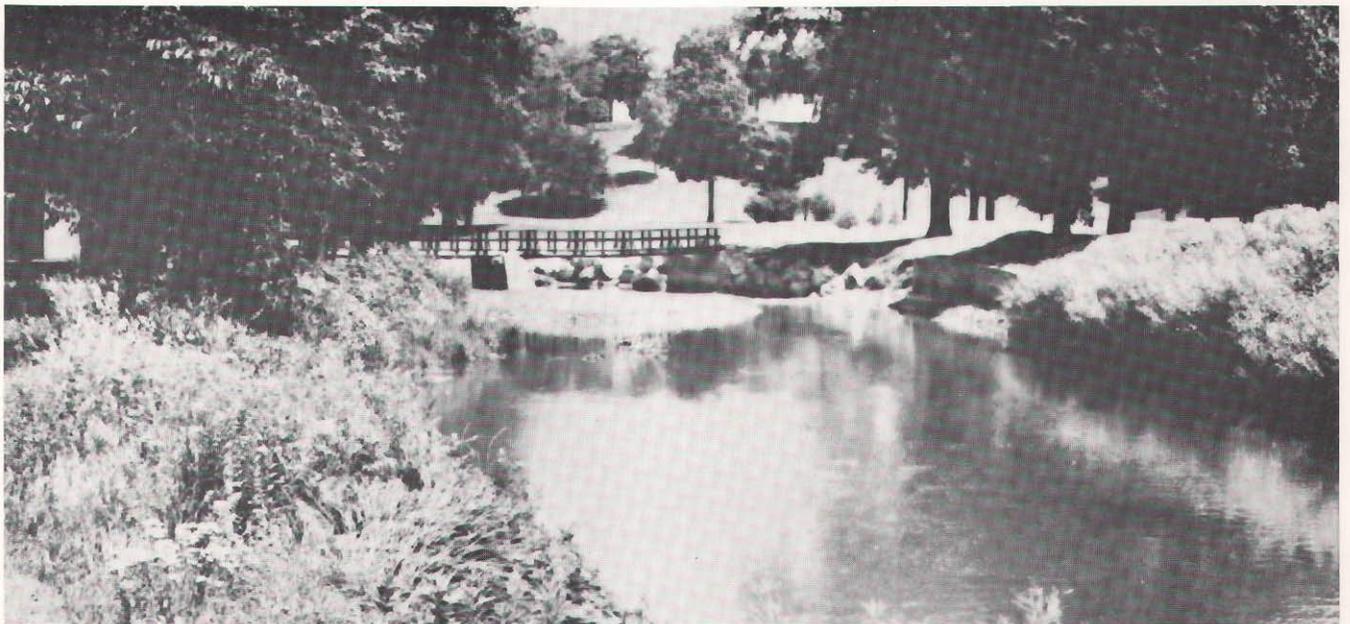
The above figure illustrates how a natural resource inventory, a land use plan, a zoning district map, and special shoreland regulations are utilized to achieve the protection and preservation of shorelands and related water quality. Generally, shorelands should be restricted to certain open uses, such as wildlife preserves, park lands, certain agricultural uses, woodlands, wetlands, and low-density residential uses, so that the natural terrain, cover, wildlife, and aesthetic setting are least disturbed. The area in green on the above zoning district map is the area to which special shoreland zoning regulations apply.

methods may be more readily and economically effected. For example, the Commission has recommended the transmission of wastes from the Caddy Vista Sanitary District in the Root River basin to the Milwaukee County metropolitan sewerage system.⁹ Careful attention must be given in such exportation to the rights of those riparian owners which may be affected by the diversion. The legal ramifications of such inter-basin diversions are discussed in Chapter X of the Commission's report on water law.¹⁰

Public Acquisition of Shoreland Areas

The most positive way to protect shoreland areas is the purchase of such lands by a municipal, county, or state unit of government. This method is most appropriate in urban and urbanizing areas where public park lands are needed for, or desired by, the community (see Figure 40). Such recommendations were made for the continuation of the county parkway system in Milwaukee and Racine Counties along the shorelands of the Root River as part of the Commission comprehensive watershed plan for the Root River.

Figure 40
SHORELAND PARK DEVELOPMENT



The most positive way to protect shoreland areas is the purchase of such lands for public use by a municipal, county, or state unit of government. This method is most appropriate in urban and urbanizing areas where park lands are needed by the community. Such recommendations for the continuation of the county parkway system in Milwaukee and Racine Counties along the Root River were made as part of the Commission's Comprehensive Watershed Plan for the Root River watershed.

It has been suggested that one-fourth of the shoreline of every inland lake be in public ownership, with a large part of this amount used for fish, wildlife, and aesthetic purposes.¹¹ Several federal and state grant programs are available to assist communities in the acquisition of such lands for public park and recreation purposes. These grant programs include the Federal Open-Space, the Federal Land and Water Conservation Fund, the Federal Greenspan, and the State Outdoor Recreation Aid Programs, previously mentioned as aids in the acquisition of floodlands. Other acquisition possibilities include tax defaults, donations, condemnation, and dedication. Shorelands acquired but not used for public purposes may be leased or conveyed and accompanied by restrictions requiring that the use of such lands be compatible with shoreland protection.

⁹SEWRPC Planning Report No. 9, *A Comprehensive Plan for the Root River Watershed* (1966), p. 211.

¹⁰SEWRPC Technical Report No. 2, *Water Law in Southeastern Wisconsin* (1966).

¹¹Threinen, C. W., *Some Spatial Aspects of Aquatic Recreation*, Wisconsin Conservation Department, Report No. 6 (1961).

The acquisition of less-than-fee interest in shorelands may be considerably cheaper than outright purchase and may, therefore, result in the shorelands being put to proper use more rapidly. Such interest may be in the form of scenic easements for vista protection, conveyance of development rights to assure continuance of private parks and open spaces, and grants of various public accesses and development rights for the construction and use of park facilities. The protection of those shorelands by cities, villages, and towns for public park or parkway purposes can be accomplished through the use of local official mapping powers granted under Section 62.23(6) of the Wisconsin Statutes, which are thoroughly discussed in SEWRPC Planning Report No. 2, Official Mapping Guide, 1964.

Redevelopment

Redevelopment of shoddy, intensive, poorly designed, inadequately served, and generally obsolescent shoreland developments by private investors and public agencies can correct many existing shoreland problems. These problems include small and irregular lots, decimated shore cover, unsightly individual piers, poorly laid out and constructed roads, inadequate soil absorption sewage disposal systems, and conflicts between public water users and private shoreland owners. Figure 41 provides an example of shoreland redevelopment for a typically obsolescent existing shoreland development. In any shoreland redevelopment project, the primary objective should be to restore the original environmental quality found along the shoreline. This usually requires that redevelopment programs include replanting of shore cover. Trees, shrubbery, and other shoreland cover must be restored where land use conversion has destroyed the natural biotic relationships existing between the natural soil, water, flora, and fauna. The Federal Urban Renewal Program offers communities an opportunity for shoreland redevelopment by providing grants for the cost of project execution and the relocation of families and businesses.

Rehabilitation

The restoration of streams or the reversal of lake eutrophication may be accomplished by various methods, including flushing of streams or the artificial aeration of an entire lake. Continuous vertical mixing and aeration with compressed air results in an accelerated oxidation of plant and animal deposition and may improve water quality. Overflowing may also benefit water quality when surplus waters are drawn from the bottom of lakes where they are richer in nutrients than the surface waters.

Lake bottoms are often depositories of nutrient compounds, and portions may be resuspended and redissolved, rendering the waters susceptible on a continuing basis for new algae growth. Therefore, the dredging of streams and shallow portions of lakes, although expensive, may be necessary to achieve land and water use objectives.

"The Story of Cedar Creek" (Appendix N) illustrates how streams can be aesthetically improved by the coordinated efforts of local citizens. It should be stressed that this type of clean-up program is most effective when a part of a comprehensive program to restore a stream or lake to desirable multi-purpose uses.

Removal of Plants and Animals

Rooted vegetation utilizes dissolved nutrients in the water, and both aquatic plants and fish flesh contain nitrogen and phosphorus. The harvesting of undesirable plants and animals is one means to offset the impact of nitrogen and phosphorus and contribute to the de-fertilization and eventual aesthetic improvement of lakes. Even though the removal of plants would affect only a fraction of a lake's nutrient content, nuisance odors and interference with boating, fishing, and water contact sports may be temporarily eliminated.

Harvesting machines are available which can cut up to four tons of drained aquatic plants per hour. Various algicides, such as chlorine gas, copper sulfate, benzenes, aromatic solvents, and sodium arsenite, are available and have been used for aquatic plant control. Many such algicides are poisonous, toxic to fish, or have other limitations and should, therefore, be used only with the advice and assistance of the State Department of Natural Resources.

Restocking and Replanting

Once the shorelands have been planted, water quality improved and protected, and undesirable plants and animals removed, restocking with desirable species of fish and game may be undertaken. Such restocking

should be made with the advice and assistance of the State Department of Natural Resources. For example, Pell Lake in Walworth County has been recommended for reintroduction of game fish, including northern pike, largemouth bass, and bluegills.¹²

The preservation of wildlife, water quality for aquatic recreational uses, and the aesthetic character of shoreland areas requires the protection and maintenance of the existing shoreland growth and cover and may require tree and shrubbery restoration where land use conversion has already drastically disrupted the natural soil, water, flora, and fauna relationships. The purpose of such restoration is to provide shoreland cover, wildlife habitat, prevent erosion, reduce stream and lake sedimentation, and improve the aesthetic appearance of the shoreland areas. Such restoration can be accomplished by replanting suitable types of grasses, shrubs, vines, and trees protected from livestock, with runoff water diverted from actively eroding gullies before planting.

ABATEMENT OF WATER POLLUTION

Many of the causes of water pollution can be alleviated, reduced, or abated by certain methods or practices, which include improved waste treatment, alternative methods of treatment, low streamflow augmentation, replacement of private waste disposal systems, and good soil and water conservation practices.

Improved Waste Treatment

Improvement in the treatment of wastes is often the most practical method of reducing municipal water pollution. Such improvement may be accomplished by attention to the proper design, use, operation, and maintenance of existing treatment systems or the provision of higher levels of treatment than are now being used. For example, the Commission has recommended, as part of the Root River pollution abatement program,¹³ that a duck farm, a state institution, and a municipality provide for improvements in the degree of treatment given their commercial, institutional, and municipal sewage.

Conventional improvements in the degree of treatment include: the use of chemical precipitants; activated sludge; charcoal, carbon, or sand filters; disinfection or chemical dosage of effluents; aeration; lagooning, seepage, polishing, evaporation, or stabilization ponds; spray irrigation with evaporation, seepage, or transpiration; and the liquification of manure with storage and release after thaw. The lowering of the temperature of cooling water discharged to streams and lakes will prevent thermal pollution. Such lowering of temperature can be accomplished by recirculation of cooling water until it reaches air temperature. Various methods of improved or additional sewage treatment are under study. These include vinyl-lined aeration pond systems, plant-soil filtration systems, gamma ray treatment for disinfection, transportation of sludge to farm lands,¹⁴ and evaporation.¹⁵

A thorough discussion of the various methods for the removal of nutrients that cause overfertilization, such as further treatment by chemical, biochemical, modified activated sludge processes, and harvesting, can be found in a recent report to a State Water Subcommittee on excessive water fertilization.¹⁶ Combined sewers may be replaced by separate systems, one for sanitary sewage and one for storm water runoff. A demonstration project jointly financed by the Federal Government and the City of Milwaukee involves the discharge of excess combined sewer flows during wet weather into a large holding tank for sedimentation and disinfection prior to return to the sewer system for conveyance to the sewage treatment plant after attenuation of high flows.

¹²Wisconsin Department of Natural Resources, Division of Conservation, and SEWRPC, Pell Lake, Walworth County, Lake Use Report No. FX-37 (1967).

¹³SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed (1966), p. 212.

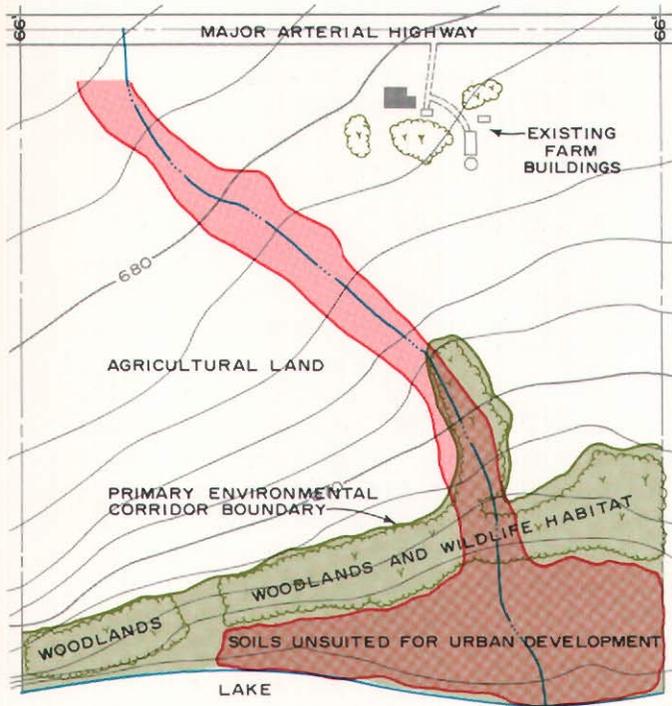
¹⁴Commerce Clearing House, Inc., Water Control News, Volume 2, Nos. 10, 14, 17, 25, and 36 (1967, 1968).

¹⁵Farin, William G., "'Flambeau Paper's New Solution to Sulphate Waste Liquor Disposal,'" Paper Trade Journal, January 17, 1966.

¹⁶Corey, Richard B.; Hasler, Arthur D.; Lee, G. Fred; Schraufnagel, F. H.; and Wirth, Thomas L., Excessive Water Fertilization, Report to the Water Subcommittee, Natural Resources Committee of State Agencies (1967).

Figure 41 SHORELAND REDEVELOPMENT

Redevelopment of obsolescent shoreland development can correct many existing shoreland problems, such as small, irregular, and inadequate lot sizes; decimated shore cover; multiple piers that are often unsightly and in disrepair; poorly located and constructed roads; and inoperative soil absorption sewage disposal systems. The following figures illustrate how these problems can be overcome through public and private redevelopment action.



PRE-SHORELAND DEVELOPMENT NATURAL RESOURCE BASE

The natural resources of a 40-acre tract as they existed prior to shoreland development are shown in the adjacent figure. The first 200 to 500 feet of shoreland consisted of woodlands; natural wildlife habitat; and a large area of soils unsuited for urban development serviced by private soil absorption sewage disposal systems. The remaining acreage was being farmed. The natural resource elements found along the lake shore formed a primary environmental corridor, which should have been protected from incompatible development.

EXISTING SHORELAND DEVELOPMENT

The same 40-acre tract is shown here as it has developed up to the present time. The shoreland development pictured is typical of the type of development that has taken place over the years around many of the lakes within the Southeastern Wisconsin Region. This type of shoreland development is characterized by small and generally inadequate lots laid out along the shoreline without regard to the protection of the resource base. The primary environmental corridor identified in the preceding figure has been effectively destroyed by such development. Much of the shore cover has been cut and cleared for home sites and roads, the wildlife habitat has been destroyed, and private soil absorption sewage disposal systems have been placed on unsuitable soils. Many of the individual piers are unsightly and in disrepair. The remaining acreage continues to be farmed. The statutory shoreland boundary is shown on the figure and identifies the area required to be regulated under the State Water Resources Act of 1965.

Source: SEWRPC

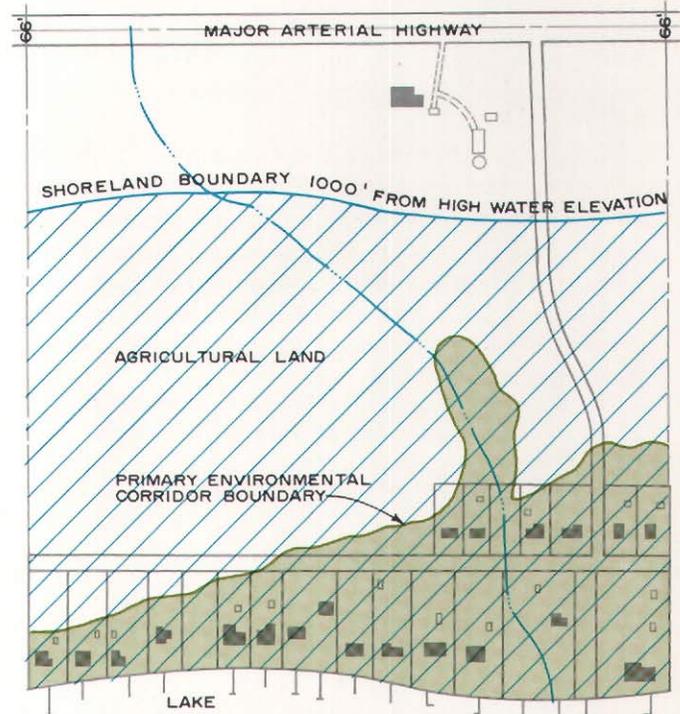
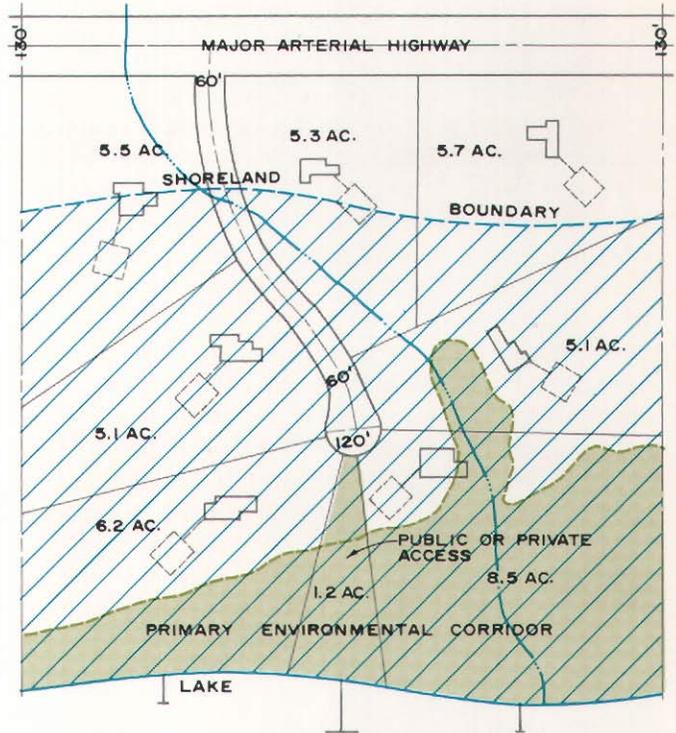


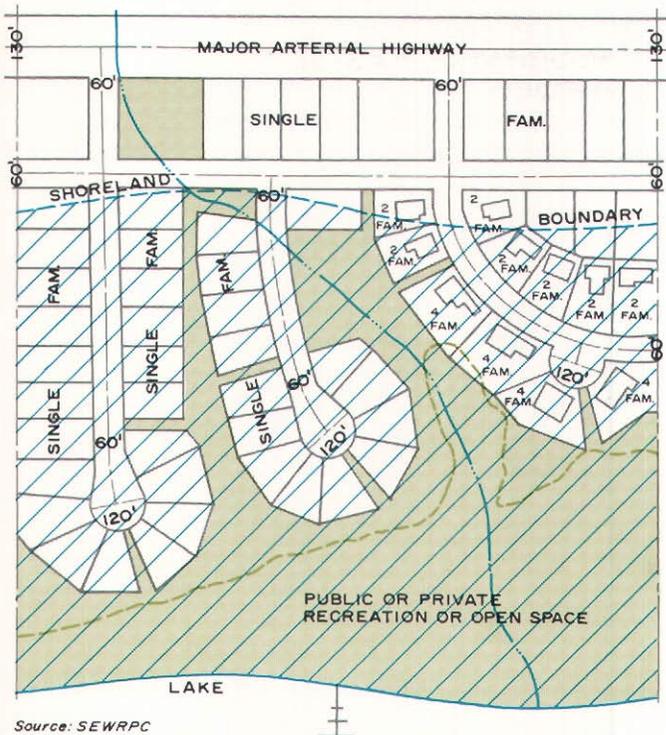
Figure 41 (continued)

FUTURE SHORELAND REDEVELOPMENT
WITHOUT PUBLIC SANITARY SEWER

Redevelopment of obsolescent and improper shoreland development can correct existing shoreland problems. Such redevelopment may become feasible if adjacent undeveloped lands are included so as to provide a parcel of land of adequate size for good redevelopment. An alternative redevelopment plan for the entire 40-acre tract is shown here. This alternative assumes that public sanitary sewer service is not available. In order to attain the shoreland protection objectives outlined in this Guide, this redevelopment plan calls for development on lots at least five acres in size. A common access to the lake is provided for the lots not adjacent to the lake. The private sewage effluent disposal fields have been properly placed on areas covered by suitable soils. The natural resource elements originally found in the environmental corridor along the shoreline can be restored over time through replanting and proper conservation practices. This alternative, while highly desirable in terms of meeting the shoreland protection objectives set forth in this Guide, would, in most cases, probably not be economically feasible without a publicly subsidized renewal program.



FUTURE SHORELAND REDEVELOPMENT
WITH PUBLIC SANITARY SEWER



Source: SEWRPC

This alternative shoreland redevelopment plan assumes the availability of public sanitary sewer. Again, the entire 40-acre tract has been shown in order to provide a parcel of adequate size for good redevelopment. Because of the assumed availability of public sanitary sewer service, a more intensive redevelopment can take place and still be compatible with environmental corridor and shoreland protection objectives. Provision is made for both single-family and low-density multi-family redevelopment. As in the previous redevelopment plan, all prior shoreland development has been removed. The remaining undeveloped area should be reserved for either public or private recreation and open-space use. In this way, shoreland restoration can take place through replanting and proper soil and water conservation practices. Redevelopment, such as this, can restore much of the original environmental quality of the shorelands within the Region and can contribute to the growth and stability of the local property tax base.

Alternative Treatment Methods

Several alternative methods of waste collection and treatment are available that offer some promise for pollution abatement. Many of these methods are still too expensive, require a change in either the type or level of the "standard of living," or are still in the experimental stage. These methods include a vacuumatic waste collection system in which sanitary wastes are separated from kitchen and wash waters and the former piped separately to a treatment plant, while the latter are reused for irrigation,¹⁷ chemical closets, gas toilets, and holding tanks.

Several state and federal grant and tax relief programs are available to provide substantial financial assistance to public bodies and private corporations for the construction of new treatment facilities and other pollution abatement or prevention projects. These include State Water Resource Programs administered by the State Department of Natural Resources under Sections 71.05(1)(b)5 and 144.21 of the Wisconsin Statutes 1965, Volume 3; the Federal Water Pollution Control Program administered by the Federal Water Pollution Control Administration under the Federal Water Pollution Control Act of 1961, as amended; and the Federal Small Towns and Rural Groups Program administered by the U. S. Department of Agriculture under the Consolidated Farmers Home Administration Act of 1961, as amended.

Streamflow Augmentation

Augmentation of low streamflows may be desirable for the purposes of diluting sewage effluent, maintaining recreational and aesthetic use of the stream, and discouraging weed growth. Such augmentation may be accomplished by diversions from other water abundant streams, pumpage from deep aquifers, or storage of flood flows in reservoirs for release during dry seasons. For example, a multi-purpose reservoir was proposed on the Root River,¹⁸ which would serve to augment low streamflows and provide recreational use opportunities and a focal point for high-value residential development.

Replacement of Private Waste Disposal Systems

The replacement of on-site soil absorption sewage disposal systems or other private waste disposal systems with public sewerage systems is often the most effective method of reducing domestic and industrial water pollution. The preface to the U. S. Public Health Service Manual of Septic-Tank Practice emphasizes:

... that connection to an adequate public sewerage system is the most satisfactory method of disposal of sewage. Every effort should be made, therefore, to secure public-sewer extensions. Where connection to a public sewer is not feasible and when a considerable number of residences are to be served, consideration should be given next to the construction of a community sewerage system and treatment plant.¹⁹

This manual was based in large measure on the results of extensive research studies carried on at the Robert A. Taft Sanitary Engineering Center and was prepared under the advisory assistance of the Joint Committee on Rural Sanitation, which included membership from the U. S. Department of Agriculture, Soil Conservation Service; American Public Health Association; Conference of Municipal Public Health Engineers; and the Portland Cement Association.

Public sewerage service may be available through extensions of existing systems owned by municipalities or sanitary districts or by metropolitan sewerage districts. New metropolitan sewerage districts may be formed pursuant to Section 66.20 of the Wisconsin Statutes; and new town sanitary districts, pursuant to Sections 60.30 and 60.31 of the Wisconsin Statutes. The Commission, for example, has recommended that the City of Racine and the Towns of Caledonia and Mount Pleasant provide for the connection of the Frank Pure Food Company industrial waste disposal system to the City of Racine's existing sanitary sewer system.

¹⁷Pedrero, Ing. Vicenti S., "A New Approach to the Problem of Domestic Pollution," Urban Land, September 1965.

¹⁸SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed (1966), p. 211.

¹⁹U. S. Department of Health, Education, and Welfare, Public Health Service, Manual of Septic Tank Practice, Publication No. 526, (U. S. Government Printing Office), (Revised 1967), p. 5.

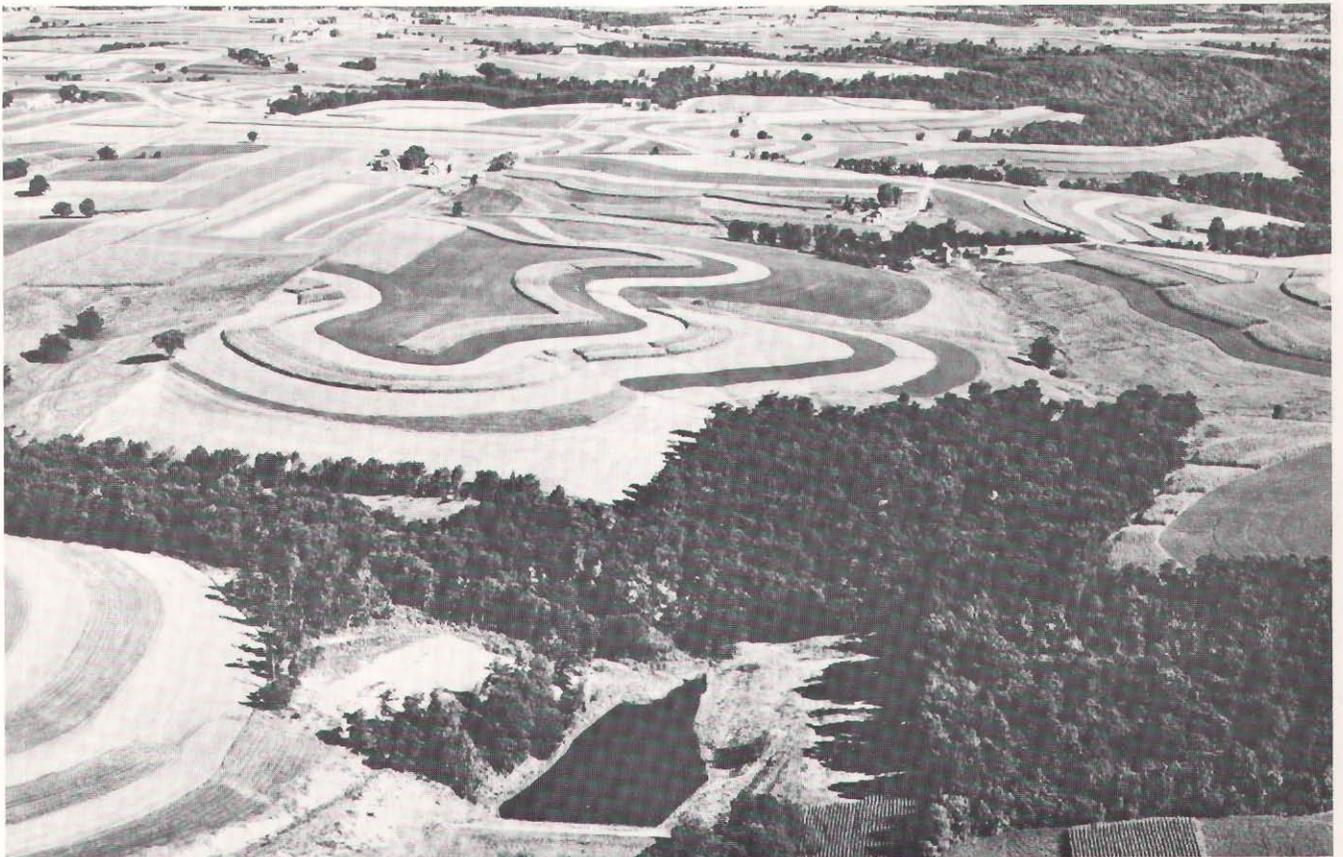
Two federal grant programs provide for financial assistance of up to 50 percent of the cost of installing public sanitary sewer systems. These programs are the Sewer Facilities Program administered by the U. S. Department of Housing and Urban Development under the Housing and Urban Development Act of 1965 and the Small Towns and Rural Groups Program administered by the U. S. Department of Agriculture under the Consolidated Farmers Home Administration Act of 1961, as amended.

Any city or village or any town having a population of more than 7,500 and a public water supply or sanitary sewer system may, by ordinance adopted pursuant to Section 144.06 of the Wisconsin Statutes, require that buildings used for human habitation and located adjacent to water or sewer mains be connected to such mains.

Soil and Water Conservation

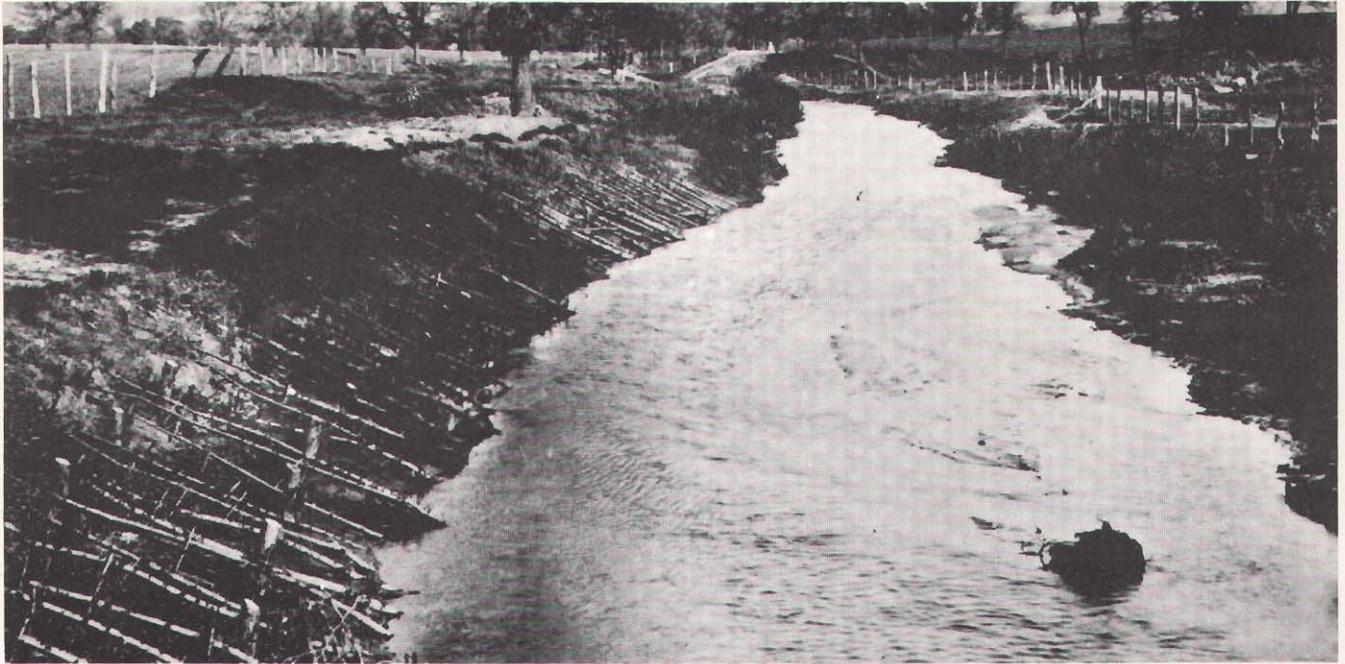
Good soil and water conservation methods and practices can do much to reduce erosion; sedimentation; and runoff of manure, chemical fertilizers, and poisons, such as pesticides and herbicides. Such methods include the construction of upland water control structures, such as terraces, terrace outlets, erosion control spillways, dikes, ponds, sediment basins, and diversion channels. Such practices include contour tillage; grassed waterways; contour strip cropping (see Figure 42); controlled livestock watering; tree planting; bank erosion structures; windbreak planting; and stabilization of stream banks by fencing, sloping and planting of special plants, trees, and grasses (see Figure 43). The installation of farm manure holding tanks to avoid the necessity of spreading manure on frozen ground can significantly contribute to the reduction of nutrients to surface waters.

Figure 42
CONTOUR STRIP CROPPING



Contour strip cropping within a watershed can reduce soil erosion and runoff into surface waters of manure, chemicals, herbicides, fertilizers, and pesticides.

Figure 43
STREAM BANK STABILIZATION



Stream bank stabilization by fencing, sloping, and planting can prevent bank erosion, sedimentation, and water pollution.

PREVENTION OF SHORELAND PROBLEMS

It is costly to undertake those measures necessary to correct shoreland problems or reduce water pollution. The prohibition and regulation under local police powers of certain uses is the most efficient, economical, and logical method of preventing shoreland problems and protecting water quality. Generally, shorelands should be restricted to certain open uses, such as wildlife preserves, park lands, certain agricultural uses, woodlands, wetlands, and very low-density residential use, so that the natural terrain, cover, wildlife, and aesthetic setting are least disturbed. It has been recommended, for example, that the shorelines of streams having a width less than 200 feet should not be divided into building sites, built upon, or settled and that at least 25 percent of the shore frontage of lakes be preserved in a wild state.²⁰

The devices for prohibiting or regulating shoreland development include the selection and application of zoning districts that are compatible with shoreland and water quality protection (see Figure 39) and the incorporation of shoreland and water use regulations into zoning, land division, sanitary, and boating ordinances. Such ordinances involve the use of the local police power so as to provide attractive shorelands, wildlife protection, and a safe and adequate supply of water for beneficial uses and have been introduced in the previous chapter of this Guide on floodland regulations.

Zoning Ordinance Districts

The most common zoning districts which generally contain uses compatible with shorelands are park, conservancy, agricultural, and certain residential districts, such as recommended for the environmental corridors proposed by SEWRPC.²¹ These districts, as set forth in Appendix H, would permit such uses as public and private recreation (see Figure 44), sustained yield forestry, general agriculture, and very low-density residential developments. These districts should be applied to shorelands in accordance with those standards relative to shoreland protection recommended by the Commission (see Appendix O).

²⁰Wisconsin Conservation Department, *Lake and Stream Classification Recommendations Nos. 7 and 8* (1963, 1965).

²¹SEWRPC Planning Report No. 7, Volume 3, *Recommended Regional Land Use and Transportation Plans--1990* (1966), p. 122.

Figure 44
PUBLIC AND PRIVATE RECREATIONAL USES

Since park and recreation lands must be provided in an urbanizing area to meet the outdoor recreational needs of the citizens, the application of public and private recreational zoning districts to shorelands may be most appropriate. Use of such districts in advance of urbanization can do much to protect and preserve prime recreational lands for later acquisition and development for recreational use.



These districts must be supplemented by the incorporation of shoreland regulations into the zoning ordinance text so as to regulate certain permitted uses that would destroy the shoreland character or impair water quality. For example, the use of shorelands for agricultural purposes should be so regulated as to prevent additional clearing, restrict grazing on steep slopes, and provide for controlled livestock watering.

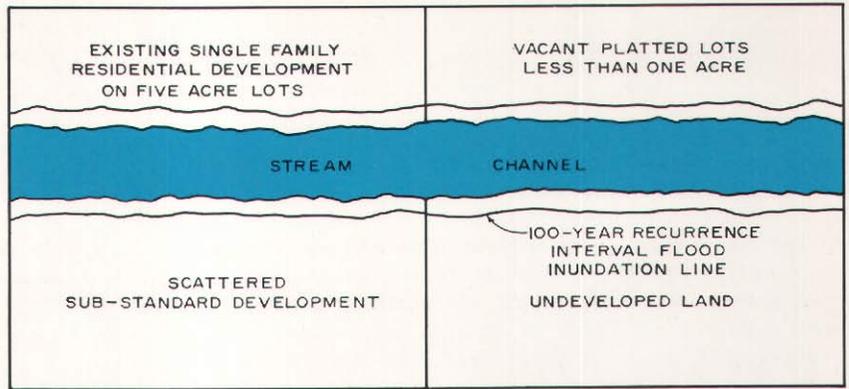
Those shorelands which must be zoned for residential purposes because of commitments made by local governing bodies or the existence of public or private improvements will present the most difficult problem. Such areas can be divided into the following types of development and carefully prepared residential zoning districts applied to each:

1. Existing scattered low-density residential development on lots or parcels three acres or greater in net area to be served by soil absorption sewage disposal systems may be placed in a country residential district, requiring a minimum lot area per dwelling unit of three to five acres.
2. Existing residential development on lots or parcels ranging in size from one to three acres in net area can be placed in a shoreland residential district to be served by soil absorption sewage disposal systems provided that the soils are suitable for the use of such systems.
3. Existing residential development on soils unsuitable for soil absorption sewage disposal systems or on lots or parcels of less than one acre in net area should be placed in an urban residential district to be served by public water and sanitary sewer systems, and no further development should be permitted without such public utility services.
4. Existing substandard development that would justify redevelopment and areas committed to residential development but as yet undeveloped should be placed in a planned residential district to be served by public water supply and sanitary sewer systems and should be so designed as to place the first 200 to 500 feet of shoreland area into common public or private park area, to which all lots would have convenient access. Generally, this common park or open-space area should coincide with the environmental corridors as delineated by the Regional Planning Commission. Where public water supply and sanitary sewer services are not available, very low-density residential development on lots having a minimum area of five acres can be permitted, providing the soils are suitable for private absorption sewage disposal systems (see Figures 41 and 45).

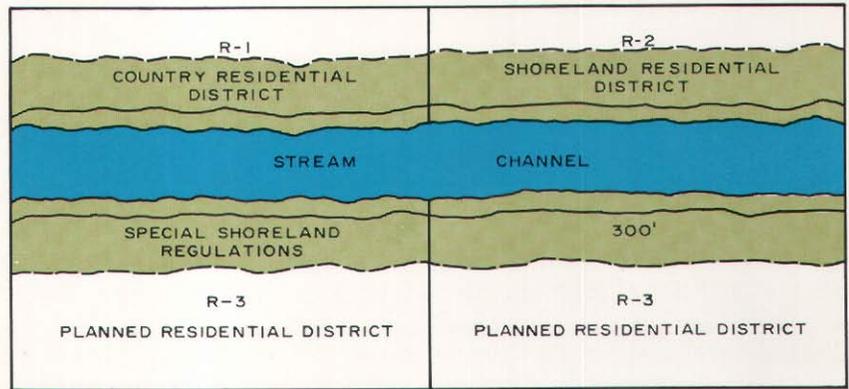
Figure 45

SHORELAND ZONING DISTRICTS APPLICABLE TO RESIDENTIAL DEVELOPMENT

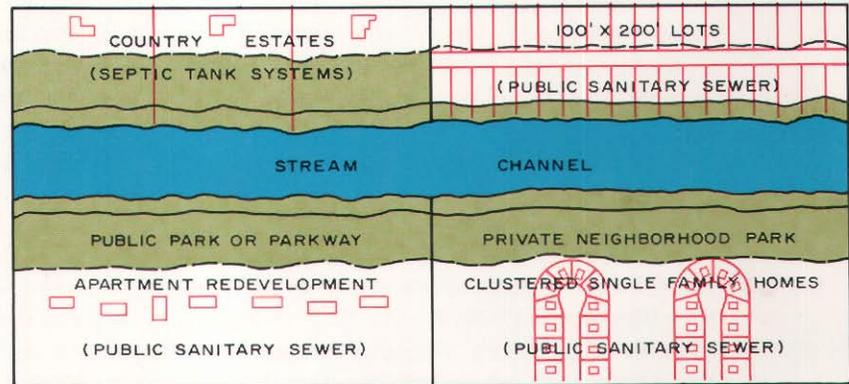
EXISTING LAND USE



ZONING DISTRICT MAP



ANTICIPATED DEVELOPMENT



Source: SEWRPC

Particularly difficult design, environmental, and developmental problems are posed by existing and committed residential development on shorelands. The above figure illustrates how three residential zoning districts can be applied to such existing and committed residential areas on shorelands. Unsewered, low-density, residential development is generally compatible with shoreland protection objectives, provided that the soils are suitable for the use of septic tank systems and the structures are properly located. Planned residential districts may be appropriate for redevelopment of existing substandard development and for new development if public sanitary sewer service is available. In the above figure, such planned residential districts have been used for both apartment redevelopment and for clustered single-family homes. In both instances, the development is served by public sanitary sewer; and shoreland protection objectives are essentially met. Only in the instance of existing platted lots of less than an acre are the shoreland objectives substantially compromised.

Planned residential districts, in which "clusters" of homes or apartment buildings are located away from the stream or lake shores, have certain advantages for shoreland protection, in addition to decreasing the per capita cost of providing supporting urban services, such as mail delivery, public sanitary sewer, water service, street maintenance, and school bussing. These advantages include the opportunity to retain much of the shoreland area in its natural state, reduce the conflict between the private shoreland owners and public water users, and increase the number of private owners with water access rights. The application of these districts and regulations to shorelands and careful enforcement of such regulations by local officials or conscientious compliance with the spirit of such regulations by developers can result in the shorelands remaining in their natural state, as shown in Figure 2.

These aforementioned zoning districts (see Appendix H) must be supplemented by the incorporation of shoreland regulations into the zoning ordinance text so as to regulate certain permitted uses which would destroy the shoreland character or impair water quality.

Special Zoning Regulations

Special zoning regulations governing the use of shorelands can be the most effective way of prohibiting or regulating those uses which would destroy the shoreland character or impair water quality. Such regulations should be designed to accomplish the following:

1. Regulate tree cutting, shrubbery clearing, and removal of other desirable vegetation; and regulate earth movements, such as filling, road grading, excavation, dredging, and lagooning so as to prevent erosion and sedimentation and protect wildlife habitat and scenic quality.
2. Regulate the location of all structures so as to preserve the scenic quality.
3. Require all tillage, grazing, and livestock watering to be carried out in accordance with good soil and water conservation standards.
4. Regulate the withdrawal and discharge of water so that water quality will not be impaired.
5. Require adequate lot area and width so as to preserve scenic quality and accommodate adequate soil absorption sewage disposal systems.
6. Require private recreation and commercial facilities to obtain a conditional use permit.

Appendix I contains suggested shoreland regulations which may be incorporated into the SEWRPC Model Zoning Ordinance or other properly prepared zoning ordinance to achieve the foregoing objectives.

Land Division Ordinances

The creation of properly designed, surveyed, and monumented shoreland lots; the installation of adequate street and utility systems; and the provision of well-located public or private park lands to serve these lots will contribute immeasurably to the protection of shorelands and water quality. This protection can be obtained by a land division ordinance, which should be designed to accomplish the following:

1. Require the platting and monumentation of all building sites created in shoreland areas and the delineation of all floodland and shoreland boundaries, together with the location, area, depth, and type of existing and proposed soil absorption sewage disposal systems on both preliminary and final plats and on certified survey maps.
2. Require the design of lot, block, and street layouts so as to minimize disruption of the natural terrain, tree removal, and shrubbery clearing; provide access for all residential sites to public or private park lands; provide screening of the development from water users; and reduce the conflict between private shoreland owners and public water users.
3. Require the dedication or reservation of certain shorelands for drainage, stream bank protection, or community or neighborhood park land purposes.

4. Require installation of public sanitary sewer systems where lots having a net area of one acre or less per dwelling unit are to be platted or where the soils are not suitable for use of soil absorption sewage disposal systems.
5. Require the erection of soil and water conservation structures and the adherence to grading and excavating practices that will not result in erosion or sedimentation.

Appendix J contains suggested shoreland regulations which may be incorporated into the SEWRPC Model Land Division Ordinance or other properly prepared subdivision control ordinance to achieve the foregoing objectives.

Sanitary Ordinances

In addition to requiring proper sizing, location, design, operation, and maintenance of all soil absorption sewage disposal systems or, where this is not possible, the installation of public sanitary sewer systems, additional sanitary regulations are necessary in shoreland areas because of the proximity of ground water and the immediate harm caused by malfunction of septic systems or by the rupture or infiltration of sewer systems. Such provisions should be designed to accomplish the following:

1. Require a sanitary permit prior to the installation of any septic tank system or the construction or modification of any building, with the application for such permit showing topography, soil types, ground water level, and shoreland boundaries.
2. Prohibit soil absorption waste disposal systems on excessively well-drained soils, on steep slopes, where creviced or fractured rock is near the surface, or where high or fluctuating water tables are in evidence; and require corrective measures where land is steeply sloping or has slow permeability.
3. Specify certain minimum distances that septic tanks and soil absorption areas must be located from stream and lake banks, ground water tables, and bedrock.
4. Require the replacement of existing inoperative sewage disposal systems with alternative systems, such as public sanitary sewerage, holding tanks, or gas incinerators.
5. Prohibit the location, storage, or discharge of wastes that would impair water quality.

Such regulations should equal or exceed the minimum standards required or recommended by the State Division of Health, the State Department of Natural Resources, the Federal Housing Administration, the U. S. Department of Agriculture, and the U. S. Public Health Service (see Table 2). Appendix H contains a Model Sanitary Ordinance, which may be used to achieve the foregoing objectives in shoreland areas.

Aquatic Recreation Ordinances

Regulations governing aquatic recreation activities on streams and lakes can also be helpful in preventing water pollution and overuse of water resources and in reducing the conflict between private shoreland owners and public water users. A thorough discussion of the factors, standards, and practical considerations for regulating aquatic uses may be found in a bulletin of the American Institute of Park Executives, entitled Lake Zoning for Recreation.²² Such regulations should be designed to accomplish the following:

1. Restrict certain recreational uses, such as speedboating and water skiing, to those bodies of water capable of supporting such uses safely.
2. Prohibit use of residential watercraft that are not equipped with sealed sanitary facilities.

²²Wilson, George T., Lake Zoning for Recreation, American Institute of Park Executives, Inc., Bulletin No. 44 (1964).

Table 2
COMPARATIVE WELL AND SEPTIC SYSTEM REGULATIONS^a

Item	Federal Housing Administration	U. S. Public Health Service	U. S. Department of Agriculture	Wisconsin Administrative Code	Wisconsin Shoreland Protection Ordinance	SEWRPC Model Sanitary Ordinance	Walworth County Sanitary Ordinance	Bayfield County Sanitary Ordinance
WELL distance from:								
Building	--	--	--	2	2	2	2	2
Property Line	10	--	--	--	--	10	10	--
Septic Tank	50	50	50	25	25	50	50	50
Deep Absorption System	100 ^b	100	100	50	50	100	75	100
Shallow Absorption System	100 ^b	100	100	50	50	100	75	100
Water-tight Sewer Lines	10	--	--	8	8	10	8	8
Other Sewer Lines	50	50	--	15	15	15	15	15
SEPTIC TANK distance from:								
Building	5	5	5	--	10	10	10	5
Well	50	50	50	25	25	50	50	50
Cistern	--	--	50	10	10	50	50	10
Property Line	10	10	--	2	10	10	10	10
Surface Water	--	50	--	--	25	100	50	25
Capacity (gallons)	900 ^c	900 ^c	900 ^c	500 ^d	750 ^d	1000 ^d	1000 ^d	750 ^d
DEEP ABSORPTION SYSTEM^e distance from:								
Building	20	20	--	25	25	25	25	25
Well	100 ^{b, f}	100 ^f	--	50	50	100 ^g	75	100 ^f
Spring	--	--	100	--	--	100	75	--
Cistern	--	--	--	25	25	25	25	25
Property Line	10	10	--	5	10	20	20	10
Surface Water	--	50	--	25	50	100	50	50
Near Steep Areas Sloping Toward Surface Waters	--	--	--	--	25	50	50	25
Ground Water	2	4	4	3 ^h	3	4	4	4
Impervious Material	4	4	4	3 ^h	3	4	4	4
Maximum Percolation Rate ⁱ	30	30	30	--	30	30	--	30
SHALLOW ABSORPTION SYSTEM^j distance from:								
Building	5	20	10	25	25	25	25	25
Well	100 ^b	100	100	50	50	100	75	100
Spring	--	--	100	--	--	100	75	--
Cistern	--	--	--	25	25	25	25	25
Property Line	5	5	10	5	10	20	20	10
Surface Water	--	50	50	25	50 ^k	100	50	50
Near Steep Areas Sloping Toward Surface Waters	--	--	--	--	25	50	50	25
Ground Water	2	4	4	3 ^h	3	4	4	4
Impervious Materials	4	4	4	3 ^h	3	4	4	4
Maximum Percolation Rate ⁱ	60	60	60	90	60	60	--	60
SOIL RESTRICTIONS applicable to:								
Floodlands	Yes	--	Yes	Yes ^h	Yes ^l	Yes	Yes	Yes
High-Water Tables	Yes	--	Yes	Yes ^h	Yes ^m	Yes ⁿ	Yes	Yes
Marsh and Swamp Lands	Yes	--	Yes	--	Yes ^m	Yes ⁿ	Yes	Yes
Rock Formations	Yes ^f	Yes ^f	Yes	Yes ^h	Yes ^m	Yes ⁿ	Yes	Yes
Steep Lands	Yes ^o	Yes ^o	Yes ^o	Yes ^h	Yes ^p	Yes ^p	Yes	Yes
Excessive Drainage	--	--	--	--	Yes ^q	Yes ^q	--	--
Tiled Areas	--	--	--	--	--	Yes	--	--
SOIL TEST requirements:								
Number of Percolation Tests Within Absorption Area	1 ^r	6	6	-- ^s	3	6	3	3
Number of Soil Boring Tests Within the Absorption Area	-- ^t	--	--	-- ^u	--	2	--	--
Depth of Such Boring	6 ^v	--	--	8	--	8	--	--

Table 2
FOOTNOTES

^aThe above regulations were taken from the following publications:

1. Federal Housing Administration, Minimum Property Standards for One and Two Living Units, "Individual Water-Supply and Sewage-Disposal Systems," Chapter XI, FHA No. 300, November 1966.
2. U. S. Department of Health, Education, and Welfare, Manual of Septic-Tank Practice, Public Health Service Publication No. 526, Revised 1967.
3. U. S. Department of Agriculture, "Soils Suitable for Septic Tank Filter Fields," Agricultural Information Bulletin No. 243, GPO 1961; "Farmstead Sewage and Refuse Disposal," Agricultural Information Bulletin No. 274, GPO 1963.
4. Wisconsin Administrative Code, "Well Construction and Pump Installation," Chapter RD 12, Register, June 1967, No. 138; "Sewage Treatment and Disposal Systems," Section H 62.20, Register, April 1962, No. 76; "Subdivisions Not Served by Public Sewers," Chapter H 65, Register, August, 1968, No. 152.
5. State Department of Natural Resources and the University of Wisconsin, Wisconsin Shoreland Protection Ordinance, December 1967.
6. Model Sanitary Ordinance, Appendix I, SEWRPC Planning Guide No. 5, Floodland and Shoreland Development Guide, 1968.
7. Sanitary Ordinance, Walworth County, Wisconsin, September 1966.
8. Sanitary Ordinance, Bayfield County, Wisconsin, November 1966.

^bThis distance may be reduced to 50 feet when extensive, continuous, impervious strata of clay, hardpan, rock, or other material separates the well from the absorption system. However, when existing wells are involved or exceptionally coarse soil formations encountered, the 100-foot distance should be increased.

^cA 900-gallon capacity septic tank is recommended for three bedrooms and 1,000 gallons or more for four bedrooms.

^dCapacity to be increased for each person over six serviced by the system in accordance with Section H 62.20(1)(e)1 of the Wisconsin Administrative Code.

^eA deep absorption system disposes of sewage effluent through the bottom and sides of a hole or trench at a depth of more than three feet below the natural undisturbed surface.

^fSeepage pits are not acceptable in limestone areas nor in localities where shallow wells are used.

^gDeep absorption systems are prohibited where any well is less than 50 feet deep within 500 feet of the system.

^hIn subdivisions 90 percent of the minimum lot area of each lot shall be at least two feet above the apparent high-water elevation of any stream or lake and 80 percent shall be at least three feet and 20 percent shall be at least six feet above the highest ground water level. Eighty percent of the minimum lot area of each lot shall have at least three feet and 20 percent shall have at least six feet of soil cover over bedrock. Fifty percent of the minimum lot area of each lot shall have ground slopes not exceeding 20 percent for class 1 lots, 15 percent for class 2 and 3 lots, and 10 percent for class 4 lots. In addition, each lot must meet certain continuous area requirements.

ⁱTime in minutes required for water to fall one inch.

^jA shallow absorption system disposes of sewage effluent through the bottom and sides of a hole or trench at a depth of three feet or less below the natural undisturbed surface.

^kShallow absorption systems receiving effluent from two or more dwellings shall be located at least 100 feet from a lake or watercourse.

^lDeep absorption systems are prohibited on floodlands, but septic tanks may be floodproofed, and shallow absorption systems may be placed on filled floodlands.

^mSoil absorption systems are prohibited in shoreland areas where bedrock is within six feet of ground surface or where ground water is within three feet of ground surface.

ⁿSoil absorption systems are prohibited where bedrock or ground water is within eight feet of the natural undisturbed surface.

^oSerial distribution systems should be used wherever the absorption field area falls greater than six inches in any direction.

^pSoil absorption systems are prohibited in shoreland areas where slopes are 12 percent or more.

^qDeep absorption systems shall not be installed in areas where the percolation rate is greater than one inch of fall in ten minutes.

^rA greater number of percolation tests may be required depending upon soil or site conditions.

^sIn subdivisions one percolation test per acre shall be made where marked variations in soil permeability occur.

^tIn subdivisions one soil boring test per each five acres shall be made, except where soil conditions indicate a greater number is needed.

^uIn subdivisions one soil boring test for each acre shall be made where marked variations in soil or water levels occur.

^vThis depth is to be measured below the bottom of the absorption area.

Note: All numbers refer to minimum horizontal or vertical distances in feet except where noted.

Source: SEWRPC.

3. Prohibit littering or dumping on the waters or ice.
4. Designate specific times and areas for speedboating and water skiing so as to avoid disruption of swimming, fishing, wildlife habitat, and other beneficial water uses requiring safety and quiet.
5. Effectuate the stream and lake classification recommendations prepared and approved by the State Department of Natural Resources.

Appendix M contains a Model Aquatic Recreation Ordinance, which may be used to achieve the foregoing objectives.

CONCLUSION

Various methods and devices are available for the protection of shorelands and related water quality, such as the correction, abatement, and prevention of pollution and related shoreland problems. Specific methods and devices which may be used in any water management program include exportation of liquid wastes; public acquisition of shoreland; redevelopment; rehabilitation; restocking; replanting; improved or altered waste treatment methods; streamflow augmentation; good soil and water conservation practices; and zoning, land division, sanitary, and aquatic recreation ordinances.

A logical, practical, and economical selection of these specific methods and devices for water management programs must be based upon a comprehensive water use plan properly related to a land use plan. These water and land use plans must be prepared together and carefully adjusted to the capability of the resource base to sustain the proposed land and water use patterns, which are best prepared for an entire watershed.

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Chapter VI

STATUTORY AUTHORITY

INTRODUCTION

Local units of government are creatures of the state and must obtain authority to adopt the floodland and shoreland regulations discussed in Chapters IV and V of this Guide from the Wisconsin Legislature through enabling acts. Such enabling legislation has been enacted for zoning, land division, sanitary, building, and aquatic recreation ordinances; and most of this state enabling legislation has been set forth and discussed in various previous publications of the Southeastern Wisconsin Regional Planning Commission.¹

This chapter sets forth the statutory authority for local regulations for flood damage prevention and for shoreland and water quality protection, lists state regulatory powers for such prevention and protection, and discusses some of the legal considerations pertinent to the proper application of such local and state regulations. Various implementation devices available for flood damage prevention and shoreland and related water quality protection, together with related financial assistance programs, are set forth in Tables 3 and 4.

LOCAL FLOODLAND REGULATION POWERS

The Wisconsin Legislature has granted several police powers to counties, cities, villages, and towns, which implicitly or explicitly authorize floodland regulations. These police powers include the adoption and enforcement of zoning, land division, sanitary, and building ordinances.

Zoning Ordinances

The enabling legislation granting power for local zoning regulations contains a clause stating that such regulations are for the general purpose of promoting the health, safety, and general welfare of the community,² and the Wisconsin Legislature has declared in the case of the city enabling act that such regulations shall be liberally construed in favor of the city. In addition, county and town zoning enabling legislation specifically authorizes the regulation of areas in or along natural watercourses in which trade, industries, filling, dumping, and the erection of structures or the location of a building may be prohibited or restricted. These implicit and explicit grants of floodland zoning powers to local units of government are confirmed by the wording contained in the State Water Resources Act of 1965 (see Appendix E).

The Wisconsin Legislature has also authorized counties, cities, villages, and towns, with the approval of the State Department of Natural Resources, to establish bulkhead lines³ along navigable waters beyond which material may not be deposited.

Land Division Ordinances

Section 236.45(1) of the Wisconsin Statutes, which contains the enabling legislation for all local land division regulations, contains a declaration of legislative intent that the purposes of such regulations are "to secure safety from fire, panic and other dangers;" and "to facilitate adequate provision for ... other public requirements;" all of which can be construed to include safety from flooding.

¹*Planning Guide Nos. 1, 3, and 4, Land Development Guide, Zoning Guide, and Organization of Planning Agencies, and Technical Report Nos. 2 and 6, Water Law in Southeastern Wisconsin and Planning Law in Southeastern Wisconsin.*

²*Sections 59.97(1)(c), 60.74(1)(a) 3, 61.35, and 62.23(7), Wisconsin Statutes 1965.*

³*Section 30.11, Wisconsin Statutes 1965, Volume 3.*

TABLE 3
IMPLEMENTATION AND FINANCIAL ASSISTANCE
FOR FLOOD DAMAGE PREVENTION PROGRAMS

Objective	Device or Action Available	Applicable Unit of Government	Statutory Authority ^a	Financial Assistance	Reviewing, Cooperating, or Administering Agency	
Protection of Existing Development	Flood Control Works	Soil and Water Conservation Districts	s. 92.08	Federal Flood Control Funds	U. S. Army District Engineers	
				Federal Public Works and Loans	U. S. Economic Development Administration	
				Federal Resource Conservation and Development Grants	U. S. Soil Conservation Service	
		Flood Control Boards	c. 87	Federal Multiple-Purpose Watershed Program		
		--			State Department of Natural Resources	
	Storm Water Drainage	Utility Districts	s. 66.072	Drainage Improvement Grants	U. S. Army District Engineers	
		Drainage Boards	c. 88			
		Towns, Villages, and Cities	ss. 60.18 (12), 61.36, and 62.11 (5)			
		Metropolitan Sewerage Commissions	ss. 59.96 (6), 66.20 et seq.			
		Town Sanitary Districts	s. 60.30 et seq.	Federal Rural Loans	U. S. Farmers Home Administration	
			Federal Sewer Facility Grants	U. S. Department of Housing and Urban Development		
	Flood Warnings	U. S. Department of Commerce	--	Flood Forecasting Program	U. S. Weather Bureau	
	Evacuation Measures	U. S. Department of the Army	--	Emergency Operations Program	U. S. Army District Engineers	
Removal of Existing Development	Acquisition for Park Purposes	State	ss. 23.09 (7) (d), 23.09 (16), and 27.01	Federal Open-Space Grants	U. S. Department of Housing and Urban Development	
				State Outdoor Recreation Aids	State Department of Natural Resources	
		Municipalities ^b		ss. 27.065, 27.08, and 27.13	Federal Land and Water Conservation Funds	--
	Public Redevelopment	Villages and Cities		ss. 66.43, 66.431, 66.435, and 66.436	Federal Cropland Adjustment Grants	U. S. Agricultural Stabilization and Conservation Service
					Federal Rural Renewal Loans	U. S. Farmers Home Administration
				Federal Urban Renewal Beautification, Insurance, Rehabilitation, and Code Enforcement Programs	U. S. Department of Housing and Urban Development	

Table 3 (continued)

Objective	Device or Action Available	Applicable Unit of Government	Statutory Authority ^a	Financial Assistance	Reviewing, Cooperating, or Administering Agency
Removal of Existing Development	Razing	Municipalities ^b	s. 66.05 c. 280	Federal Demolition Grants	U. S. Department of Housing and Urban Development
	Nonconforming Uses	Municipalities ^b	ss. 59.97 (10), 60.75 (6)(b), 61.35, and 62.23 (7) (h)	--	--
	Nuisance Removal	Municipalities ^b State	s. 87.30 (2) s. 30.15 (4)	--	--
Discouragement of New Development	Warning Signs	Municipalities ^b	ss. 59.07 (5), 60.18 (3), 61.34 (1), and 62.11 (5)	--	--
	Recordation	Municipalities ^b	s. 236.45 (2)	Federal Mortgage Financing Insurance	U. S. Federal Housing Administration
	Financing Policies	U. S. Department of Housing and Urban Development	--		
Regulation of Development	Bulkhead Lines	Municipalities ^b	ss. 30.11 and 30.12	--	State Department of Natural Resources
	Dam Construction, Operation, and Abandonment	State	s. 31.04 et seq.	--	State Department of Natural Resources
	Exclusive Zoning Districts	Municipalities ^b	ss. 59.97, 60.75, 61.35, and 62.23 (7)	--	State Department of Natural Resources
	Floodland Use Regulations		State		
	Land Division Regulations	Municipalities ^b	s. 236.45	--	--
	Building Regulations	Municipalities ^b	ss. 59.07 (51), 60.18 (12), 61.34 (1), 61.35, 62.23 (9) (a), and 66.058	--	--
	Sanitary Regulations		County Boards of Health	s. 140.09	--
State			ss. 144.025 (2) (q) and 144.045	--	State Department of Natural Resources

^a *Wisconsin Statutes 1965 (Volumes 1, 2, and 3) as amended by Chapters 75, 77, 83, 87, and 327, Laws of Wisconsin, 1967.*

^b *Municipalities include counties, towns, villages, and cities.*

TABLE 4
IMPLEMENTATION AND FINANCIAL ASSISTANCE
FOR SHORELAND AND WATER QUALITY PROTECTION PROGRAMS

Objective	Device or Action Available	Applicable Unit of Government	Statutory Authority ^a	Financial Assistance	Reviewing, Cooperating, or Administering Agency		
Correction	Collection of Sewage	Utility Districts	s. 66.072	State Water Resource Protection Loans	State Department of Natural Resources		
		Town Sanitary Districts	s. 60.30 et seq.				
		Towns, Villages, and Cities	ss. 60.18 (12), 61.36, 62.18, 66.076 (1), and 66.077 (1)				
		State	s. 144.07			Federal Intercepting Sewer Grants	U. S. Federal Water Pollution Control Administration
		Metropolitan Sewerage Districts	ss. 59.96 (6), 66.20 et seq. and 66.30 et seq.			Federal Rural Assistance Program	U. S. Farmers Home Administration
	Public Park Acquisition and Replanting	State		ss. 23.09 (7) (d), 23.09 (16), and 27.01	Federal Sewer Facility Grants	U. S. Department of Housing and Urban Development	
					Federal Cropland Adjustment Grant	U. S. Agricultural Stabilization and Conservation Service	
		Municipalities ^b		ss. 27.065, 27.08, and 27.13	Federal Forestry Programs	U. S. Forest Service	
					Federal Open-Space Grants	U. S. Department of Housing and Urban Development	
					Federal Historic Preservation Grants	U. S. Department of Housing and Urban Development	
					State Outdoor Recreation Aids	State Department of Natural Resources	
					Federal Land and Water Conservation Funds		
	Public Redevelopment	Villages and Cities		ss. 66.43, 66.431, 66.435, and 66.436	Federal Rural Renewal Loans	U. S. Farmers Home Administration	
					Federal Urban Renewal, Beautification, Insurance, Rehabilitation, and Code Enforcement Programs	U. S. Department of Housing and Urban Development	
					Federal Demolition Grant		
Removal of Aquatic Plants	Town Sanitary Districts		s. 60.306	Federal Aquatic Plant Control Funds	U. S. Army District Engineers		
	State		s. 144.025 (2) (i)				

Table 4 (continued)

Objective	Device or Action Available	Applicable Unit of Government	Statutory Authority ^a	Financial Assistance	Reviewing, Cooperating, or Administering Agency		
Abatement	Improved Sewage Treatment and Streamflow Augmentation	Town Sanitary Districts	s. 60.30 et seq.	Federal Waste Treatment Grants	U. S. Federal Water Pollution Control Administration		
		Utility Districts	s. 66.072	Federal Treatment Facility Grants	U. S. Department of Housing and Urban Development		
		Towns, Villages, and Cities	ss. 60.18 (12), 61.36, and 62.18				
		State	s. 144.07	State Tax Exemption and Deduction Program	State Department of Natural Resources and State Division of Health		
		Metropolitan Sanitary Districts	ss. 59.96 (6), 60.30 et seq. and 66.20 et seq.			Federal Rural Loans and Grants	U. S. Farmers Home Administration
						Federal Water Quality Program	U. S. Army District Engineers
						State Water Resource Protection Loans	State Department of Natural Resources
	Replacement of Private Waste Disposal Systems	Towns, Villages, and Cities	s. 144.06	--	--		
	Soil and Water Conservation Practices	Municipalities ^b	ss. 60.29 (44) and 66.34	--	--		
				Soil and Water Conservation Districts	s. 92.08 et seq.	Federal Agricultural Conservation Grants and Loans	U. S. Agricultural Stabilization and Conservation Service
		Federal Resource Conservation and Development Grants	U. S. Soil Conservation Service				
		Federal Multiple-Purpose Watershed Programs					
	Nuisance Removal	State	ss. 30.125, 144.025 (2) (k) and (r) and 144.536	--	State Department of Natural Resources		
				Local Boards of Health	ss. 146.13 and 146.14	--	
		Town Sanitary Districts					
Towns, Villages, and Cities		s. 66.052					
Prevention	Waste Disposal Regulations	State	ss. 23.095, 29.288, 29.29 (3) and (4), 144.025 (2), (c), (d) and (1) 144.26, 144.05, 144.045, 144.555, 144.43 and 947.047	--	State Department of Natural Resources		

Table 4 (continued)

Objective	Device or Action Available	Applicable Unit of Government	Statutory Authority ^a	Financial Assistance	Reviewing, Cooperating, or Administering Agency	
Prevention	Grading, Top Soil Removal, Stream Alteration, Water Withdrawal or Diversion, and Lake Bed Removal	State	ss. 30.18 et seq. and 144.025(2)(e)	--	State Department of Natural Resources	
	Exclusive Zoning Districts	Municipalities ^b	ss. 59.97, 60.74, 61.35, and 62.23(7)	--	--	
	Special Shoreland Use Regulations	Counties		ss. 59.971 and 144.26(1) and (2)	State Administration and Enforcement Grants	State Department of Natural Resources
		Villages and Cities		ss. 144.26(1) and (2)		
		State		ss. 59.971(6) and 144.46		
		Cooperative Contract Commissions		ss. 59.971(4)(a) and 66.30		
		Regional Planning Commissions ^c		ss. 59.971(4)(a) and 66.945		
	Land Division Regulations	Municipalities ^b		ss. 144.26(2)(e), 59.971(4)(a), and 236.45	--	--
		State		s. 236.13(2m)	--	State Department of Natural Resources and State Division of Health
	Sanitary Regulations	Municipalities ^b		ss. 59.07(51), 60.18(12), 61.34(1), 62.11(5), and 146.13	--	--
		County Boards of Health		ss. 140.09 and 146.13		
		State		ss. 144.025(2)(q), 144.03, 144.045, and 144.20	--	State Department of Natural Resources and State Division of Health
	Aquatic Recreation Regulations	State		s. 30.50 et seq.	--	State Department of Natural Resources
Municipalities ^b			ss. 30.77(3) and 144.26	State Water Safety Patrol Aids		
Soil and Water Conservation Regulations	Soil and Water Conservation Districts		s. 92.09 et seq.	State Conservation Aid	State Soil and Water Conservation Board	

^a Wisconsin Statutes 1965 (Volumes 1, 2, and 3) as amended by Chapters 75, 77, 83, 87, 185, 224, and 327, Laws of Wisconsin, 1967.

^b *Municipalities include counties, towns, villages, and cities.*

^c *When authorized by a county, village, or city to administer their shoreland regulations.*

Source: SEWRPC.

Sanitary and Building Ordinances

The Wisconsin Statutes, in setting forth the general powers of the county board, which include adoption of building and sanitary ordinances, states that such powers shall be broadly and liberally construed and limited only by express language.⁴ County Boards of Health created pursuant to Section 140.09 of the Wisconsin Statutes may also adopt regulations to improve and protect the public health, which can be reasonably construed to include sanitation regulations applicable to floodlands.

Sections 61.34(1) and 62.11(5) of the Wisconsin Statutes empower villages and cities to act for the health, safety, and general welfare of the public and to carry out their powers by regulation limited only by express language; and the Wisconsin Supreme Court has held that villages may enact ordinances for the promotion of health and sanitation.⁵ Cities are specifically empowered by Section 62.23(9) of the Wisconsin Statutes to establish the position of building inspector and to enforce ordinances relating to buildings by means of a building permit. This power is also granted to villages by Section 61.35 of the Wisconsin Statutes. Sections 60.18(12) and 60.29(13) authorize town boards to exercise all powers relating to villages when directed by resolution at an annual town meeting, and Section 60.18(3) of the Wisconsin Statutes authorizes the qualified electors of each town at any annual town meeting to make orders conducive to the welfare of the town. Such language would seem to include special sanitation and construction regulations applicable to floodlands, and a recent law report of the Commission concluded that local building and safety codes also have potential for the effective regulation of construction in floodplains.⁶

LOCAL SHORELAND REGULATION POWERS

Cities, villages, and towns have been granted, as part of their broad statutory grant of authority, sufficient police power to regulate for the public health, safety, and general welfare.⁷ Certainly some shoreland and water quality protection measures would be authorized under these broad police powers.

Zoning Ordinances

The State Water Resources Act of 1965 (see Appendix E) specifically authorizes municipal zoning regulations for shorelands; and Section 144.26(2)(c) of the Wisconsin Statutes defines municipality as meaning a county, city, or village. Section 59.971 of the Wisconsin Statutes specifically authorizes counties to enact shoreland zoning ordinances separately from comprehensive zoning ordinances in unincorporated areas and without town board approval (see Appendix E).

Land Division Ordinances

The shoreland regulations authorized by the State Water Resources Act of 1965 have been defined in Section 144.26(2)(e) of the Wisconsin Statutes so as to include land division regulatory powers delegated by law to counties, cities, and villages, thereby making Chapter 236, and more specifically Section 236.45, of the Wisconsin Statutes applicable to shorelands. In addition, Section 59.971(3) of the Wisconsin Statutes specifically grants to counties the power to exercise all of its land division regulatory powers in shoreland areas (see Appendix E).

Purpose

The purposes of such zoning and land division regulations in shoreland areas are specified in Section 144.26(1) of the Wisconsin Statutes as follows:

1. Maintain safe and healthful conditions.
2. Prevent and control water pollution.

⁴Section 59.07, Wisconsin Statutes 1965.

⁵*Voss v. Lenerz*, 256 Wis. 183, 40 N.W. 2d 519 (1950).

⁶SEWRPC Technical Report No. 2, Water Law in Southeastern Wisconsin (1966).

⁷Sections 60.18(3), 61.34(1), and 62.11(5), Wisconsin Statutes 1965.

3. Protect spawning grounds, fish and aquatic life.
4. Control building sites, placement of structures, and land uses.
5. Reserve shore cover and natural beauty.

The State Department of Natural Resources is required by Section 144.26(5)(a) of the Wisconsin Statutes to prepare a comprehensive plan as a guide for the application of municipal ordinances regulating shorelands, and such plan is to be governed by standards which prefer the following shoreland uses:

1. Domestic uses.
2. Uses not inherently a source of pollution.
3. Location of uses tending to minimize the possibility of pollution.
4. Dispersion of uses.

The State Department of Natural Resources is also required by Section 144.26(6) of the Wisconsin Statutes to prepare and provide to counties, cities, and villages recommended standards for navigable water protection regulations that meet the objectives of the State Water Resources Act, with particular attention to the following:

1. Safe and healthful conditions for the enjoyment of aquatic recreation.
2. Demands of water traffic, boating, and water sports.
3. Capability of the water resource.
4. Proper operation of septic tank disposal fields.
5. Building setbacks from the water.
6. Preservation of shore growth and cover.
7. Conservancy uses for low-lying lands.
8. Layouts for residential and commercial development.

The State Department of Natural Resources has prepared and promulgated floodplain and shoreland management programs. Excerpts from these programs relating to the criteria and standards are contained in Appendices F and G.

Sanitary and Aquatic Recreation Ordinances

The purpose of the State Water Resources Act, to maintain healthful conditions and prevent water pollution, would seem to infer the necessity of sanitation regulations in shoreland areas; and this is confirmed by Items 1 and 4 above relating to healthful recreation and septic tank systems. The objectives of the State Water Resources Act, to maintain safe conditions and protect spawning grounds, would suggest the need for aquatic recreation regulations; and this is confirmed by Items 1, 2, and 3 above relating to safe recreation, water traffic demands, and water resource capabilities.

Section 30.77(3) of the Wisconsin Statutes authorizes any city, village, or town to adopt certain aquatic recreation regulations provided that all municipalities having jurisdiction on a given lake have enacted identical regulations. This statute further provides that, if any county operates a marina development adjacent to any waters or lake, such regulatory authority shall exclusively vest in the county insofar as the local regulations relate to the development, operation, and use of the marina and its adjoining waters.

STATE FLOODLAND REGULATION POWERS

The Wisconsin Legislature has granted several powers to various state agencies that can affect development on floodlands. The State Department of Natural Resources⁸ is empowered to regulate the erection of structures and the deposition of materials in navigable waters.⁹ The State Department of Industry, Labor, and Human Relations¹⁰ has been given certain building and safety code powers, and the State Division of Health¹¹ has been given certain powers with respect to subdivision plat approval. These powers could be reasonably extended to include rules pertaining to the safety, accessibility, and health of floodland development.¹²

Where a county, city, or village has not adopted reasonable and effective floodplain regulations by January 1, 1968, Section 87.30(1) of the Wisconsin Statutes (see Appendix E) directs the State Department of Natural Resources to adopt such regulations after a public hearing. In addition, the costs of the necessary floodplain determination and ordinance promulgation and enforcement by the state shall be assessed and collected as taxes from county, city, or village by the State. The State's Flood Plain Management Program includes general criteria (see Appendix F) for meeting the requirements of the State Water Resources Act of 1965. These state criteria would require that cities, villages, and counties supplement their zoning ordinances with land division, building, and sanitary regulations.

STATE SHORELAND REGULATION POWERS

The Wisconsin Legislature by enactment of the State Water Resources Act of 1965 transferred the various water pollution and other regulatory functions of the Public Service Commission, former State Board of Health, and former State Committee on Water Pollution to the State Department of Resource Development, since renamed the State Department of Natural Resources.

As a result, the State Department of Natural Resources now regulates: the diversion of surplus waters; the use of water for irrigation or other agricultural purposes; the construction or enlargement of those waterways specified in Section 30.19 of the Wisconsin Statutes; the grading or removal of top soil where exposed areas exceed 10,000 square feet; the changing of stream courses; the removal of stream and lake bed materials; the removal of lake bed material so as to restore areas to recreational use; and the construction, operation, maintenance, and abandonment of dams on navigable waters.¹³

In addition to the above powers, the State Water Resources Act of 1965 assigned the following new shoreland and water quality protection powers and duties to the State Department of Natural Resources:¹⁴

1. Adopt rules setting standards of water quality to be applicable to the waters of the State¹⁵ and issue orders and adopt rules for the construction, installation, use and operation of systems, methods, and means of preventing and abating pollution of the waters of the state.

⁸The State Reorganization Act, Chapter 75, Laws of Wisconsin 1967, has resulted in the renaming of the State Department of Resource Development, State Industrial Commission, and State Board of Health.

⁹Sections 30.11 through 30.16, Wisconsin Statutes 1965, Volume 3.

¹⁰*Ibid.*, footnote 8.

¹¹*Ibid.*, footnote 8.

¹²SEWRPC Technical Report No. 2, Water Law in Southeastern Wisconsin (1966), pp. 42-44.

¹³Chapters 30 and 31, Wisconsin Statutes 1965, Volume 3.

¹⁴Section 144.025(2), Wisconsin Statutes 1965, Volume 3.

¹⁵The State Department of Natural Resources has prepared and promulgated water use and quality standards for interstate waters as Chapters RD 2 and 3 of the Wisconsin Administrative Code and is in the process of preparing such uses and standards for intra-state waters.

2. Consult and advise on the best method of disposing of sewage or refuse and supervise chemical treatment of waters and furnish equipment for the purpose of suppressing algae, aquatic weeds, and other nuisance-producing plants and organisms.
3. Order or cause the abatement of any nuisance, such as the discharge of untreated domestic sewage or pumpage from septic tanks, dry wells, or cesspools into any surface water or drainage ditch or any source of filth or cause of sickness caused by improper sewage disposal facilities.
4. Prohibit the installation or use of septic tanks in any area where their use would impair water quality.¹⁶
5. Order sewage treatment systems secured, altered, extended, replaced, or constructed within a specified time if a nuisance or menace to health or comfort tends to be created.

This Department has also been given the power under Section 59.971(6) of the Wisconsin Statutes to adopt shoreland ordinances where counties have not adopted such an ordinance by January 1, 1968, or where the Department after notice and hearing determines that the county ordinance fails to adequately protect shoreland and water quality. The cost of the promulgation and enforcement of this ordinance by the state would be assessed and collected as taxes from the county. In addition, the Wisconsin Legislature recently created Section 144.46 of the Wisconsin Statutes, which prohibits solid waste disposal sites and facilities in floodland and shoreland areas except by a permit issued by the State Department of Natural Resources. The State's Shoreland Management Program includes general criteria (see Appendix G) for meeting the requirements of the State Water Resources Act of 1965. These state criteria require that counties enact land division and sanitary ordinances, as well as shoreland zoning ordinances.

DEFINITIONS

The definition of the terms "floodlands" and "shorelands" becomes very important to both the legality of floodland and shoreland regulations and the determination of those lands which are to be the subject of local or state floodland or shoreland regulations. Because the Wisconsin Statutes relate the definition of the term "shorelands" to navigable bodies of water, proper discussion of the definition of the term "shorelands" requires also a discussion of the definition of navigable waters, including navigable streams, lakes, and ponds.

Floodlands

Section 87.30(1) of the Wisconsin Statutes does not precisely define floodlands but speaks only of those areas within a stream valley within which "serious (flood) damage may occur" or "appreciable (flood) damage is likely to occur." In urbanizing areas, such as the Southeastern Wisconsin Region, the statutory description of floodlands is not adequate per se for floodland determination and the precise delineation so necessary for effective and legal administration of floodland regulations. As a watershed or drainage basin urbanizes and the hydraulic characteristics of the stream are altered, additional areas of the stream valley become subject to flooding; and it becomes necessary to regulate the entire potential, as well as existing, floodland areas.

Floodlands may be defined as those parts of a stream valley which are periodically subject to inundation. It is apparent that this definition raises an important question concerning the frequency of inundation, which must be resolved before the floodlands can actually be determined and police power regulations applied to their use. Conceptually, floodlands in southeastern Wisconsin may be divided into three areas, based upon differing degrees of flood hazard:

¹⁶The Commission has recommended to the State Department of Natural Resources that it prohibit septic tank systems on soils within the Region that have "very severe limitations" for such systems, as established in the regional soil survey, or where ground or surface waters would be subject to contamination. The Commission has also recommended prohibiting septic systems on soils that have "severe limitations" for such systems, as established in the regional soil survey, unless such limitations are overcome. See *SEWRPC Planning Report No. 7, Volume 3, Recommended Regional Land Use and Transportation Plans--1990*, (1966), p. 124.

1. That area of the stream valley normally occupied by the stream under average annual flow conditions. This area has the primary functions of drainage and navigation.
2. That area of the stream valley, including the channel, wherein periodic inundation occurs and flood depths and velocities are highest and most damaging. This area has the primary function of effectively carrying and discharging floodwaters.
3. That relatively level area of the stream valley, beyond the area required to carry and discharge floodwaters, wherein periodic inundation occurs but wherein the flood depth and velocities are generally low. This area has the primary function of storing floodwaters.

In order to relate the necessary land use regulations in a reasonable manner to the different flood characteristics and hazards associated with each of these three stream valley areas, the Commission recommends that the floodland area of a stream valley be identified and divided into three regulatory areas as follows:

1. The channel area, defined as that portion of the floodlands normally occupied by a stream of water under average annual high-water-flow conditions.
2. The floodway area, defined as that portion of the floodlands, including the channel, required to carry and discharge the 100-year recurrence interval flood. If development and fill are to be prohibited in the floodplain, the floodway may be delineated as that area subject to inundation by the 10-year recurrence interval flood.
3. The floodplain area, defined as that portion of the floodlands, excluding the floodway, subject to inundation by the 100-year recurrence interval flood or, where such data is not available, by the maximum flood of record.¹⁷

This delineation should be based upon careful hydrologic and hydraulic engineering studies. Further discussion of the engineering methods available for such delineation follows in Chapter VII of this Guide.

Shorelands

Unlike floodlands, which must be determined on the basis of careful hydrologic and hydraulic engineering studies, shorelands have been given a statutory definition. Sections 144.26(2)(g) and 59.971(1) of the Wisconsin Statutes (see Appendix E) define shorelands as all that area lying within the following distances from the normal high water elevation of all natural lakes and of all streams, ponds, sloughs, flowages, and other waters which are navigable under the laws of the State of Wisconsin: 1,000 feet from the shoreline of a lake, pond, flowage, or glacial pot hole lake and 300 feet from the shoreline of the stream or to the landward side of the floodplain, whichever is greater (see Figure 46).

The Wisconsin Legislature has not defined the term "normal high-water elevation"; however, the Wisconsin Supreme Court has held that the ordinary "high-water mark" of a navigable stream means:

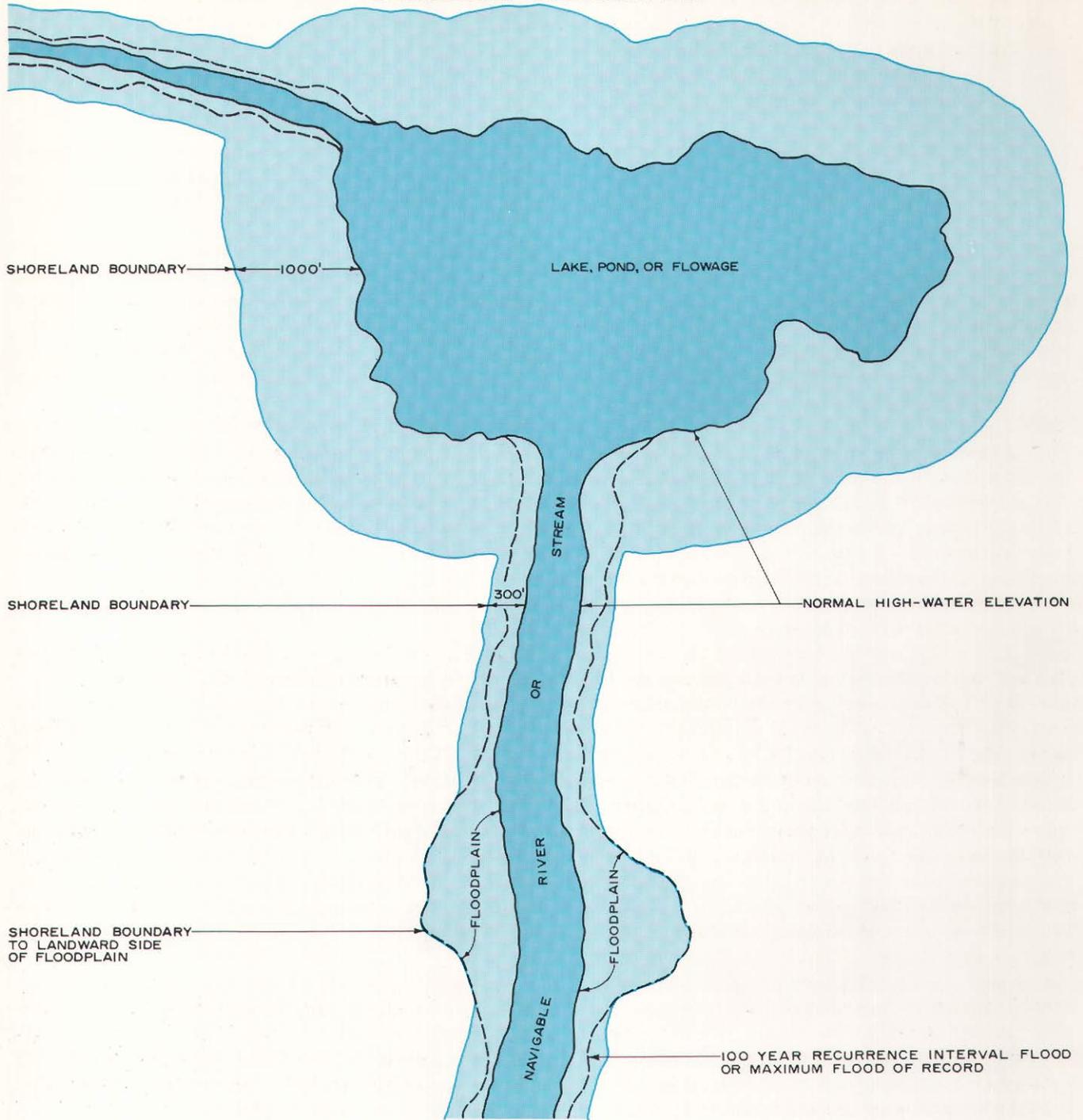
... the point up to which the presence of the water is so continuous as to leave a distinct mark by erosion, destruction of vegetation, or other easily recognized characteristics; and where the bank at a particular place is of such character that the high water mark cannot be easily determined, other places on the bank may be resorted to for the determination of the high water mark.¹⁸

Further discussion of the technical methods available for shoreland delineation in accordance with the statutory definition follows in Chapter VII of this Guide. It should be noted that the floodland and shoreland areas, as defined by the Wisconsin Statutes, are not mutually exclusive areas. The shoreland area along navigable waters always includes the floodlands, as shorelands have been so defined.

¹⁷SEWRPC Technical Report No. 2, *Water Law in Southeastern Wisconsin* (1966), p. 32.

¹⁸*Diana Shooting Club v. Husting*, 156 Wis. 261, 145 N.W. 817 (1914).

Figure 46
SHORELAND DELINEATION



Source: SEWRPC.

As defined in the Wisconsin Statutes, shorelands include all areas within 1,000 feet of the shoreline of a lake, pond, or flowage and 300 feet of the shoreline of a stream or to the landward side of the floodplain, whichever is greater. The protection of these shoreland areas through adequate regulations governing land use, structures, shore cover, and natural beauty is essential to the preservation of the Region's land and water resources.

Navigable Waters

The Navigable Waters Protection Law, Section 144.26 of the Wisconsin Statutes (see Appendix E), authorizes municipal shoreland regulations relating to lands under, abutting, or lying close to navigable waters and defines navigable waters as meaning:

1. Lakes Michigan and Superior.
2. All natural inland lakes within Wisconsin.
3. All streams, ponds, sloughs, flowages, and other waters within Wisconsin which are navigable under the laws of the state.

The definition of the clause "navigable under the laws of this state" becomes very important to both the legality of shoreland regulations and the determination of those shorelands which are to be the subject of state and local regulations. The Wisconsin Legislature, in Section 30.10 of the Wisconsin Statutes, has declared navigable waters to include all streams, lakes, sloughs, bayous, and marsh outlets which are "navigable-in-fact."

The Wisconsin Supreme Court has held that "... any stream is navigable-in-fact which is capable of floating any boat, skiff, or canoe of the shallowest draft used for recreation purposes."¹⁹ By use of this generous recreational boating test of "navigability," virtually all natural lakes and ponds in the state became "navigable-in-fact." Man-made lakes or reservoirs caused by damming a stream or otherwise impounding a natural flow of water are also considered navigable. It should be noted that the stream, lake, or pond does not have to be capable of floating a boat, skiff, or canoe every day of the year or every rod of its length or surface area in order to be considered navigable.²⁰

Navigable Streams

Although the Wisconsin Supreme Court decision cited above is good law, it is not sufficiently precise to enable local technicians to determine readily which streams and watercourses are navigable for the purpose of shoreland regulation. For the purpose of obtaining reasonable as well as practical, uniform, and readily enforceable shoreland regulations, it is recommended that navigable streams be initially defined as all those streams designated as perennial streams²¹ on the U. S. Geological Survey topographic quadrangle maps. In some cases, there may be certain streams shown on these maps as perennial which are in fact not navigable or shown as intermittent which are in fact navigable. Resolution of these special cases will require actual observations to be made in the field. Problems of this kind should be referred for determination to the State Department of Natural Resources.

Navigable Lakes and Ponds

The Wisconsin Supreme Court has not been called upon to distinguish a lake from a pond, and it is reasonable that no legal significance would attach to such a distinction.²²

The Wisconsin Supreme Court has held that lakes were navigable where there was evidence that the lakes were from three to 25 feet deep, that the passage between lakes was two feet deep, that light boats could be used thereon, and that people had fished therein for many years²³ but were not navigable where they were small, landlocked, spring-fed, and in no substantial sense connected with, or part of, a transportation route or chain of lakes and rivers.²⁴

¹⁹*Muench v. Public Service Commission*, 281 Wis. 492, 53 N.W. 2d 514 (1952).

²⁰SEWRPC Technical Report No. 2, *Water Law in Southeastern Wisconsin*, (1966), p. 16.

²¹The U. S. Geological Survey defines "perennial stream" as one which contains water most of the year except for infrequent and extended periods of drought. These perennial streams are shown by solid blue lines on USGS topographic quadrangle maps.

²²*Ibid.*, footnote 20.

²³*Power v. Voss*, 217 Wis. 415, 259 N.W. 413 (1935).

²⁴*Lundberg v. University of Notre Dame*, 231 Wis. 187, 282 N.W. 70 (1938).

For the purpose of obtaining reasonable as well as practical, uniform, and readily enforceable shoreland regulations, it is recommended that attention be given to regulating those lakes and ponds in the Region which are connected by navigable streams and all other lakes and ponds not so connected which have a surface area of five or more acres in extent and which are three or more feet deep and are sustained by a natural supply of water.

A local unit of government may well decide to include lakes and ponds smaller than five acres in surface area or less than three feet deep. Such decision should take into consideration fish-kill conditions; connection of such lake or pond to another navigable lake or to a navigable stream; available water resources; water recreation demands; wildlife habitat; public ownership of shorelands; and other economic, topographic, historical, and scenic characteristics of the lake or pond. It is important to note that all decisions concerning the navigability of a body of water are subject to review and determination by the State Department of Natural Resources.

LEGALITY OF FLOODLAND AND SHORELAND REGULATIONS

It is well settled in law that municipal ordinances are constitutional as a valid exercise of the police power when reasonably related to the public health, safety, or general welfare. In addition, the Wisconsin Supreme Court has stated that the police power is not limited to regulations designed to promote public health, morals, or safety nor suppression of what is offensive, disorderly, or unsanitary but extends to dealing with existing conditions so as to bring out of them the greatest welfare of the people by promoting public convenience or general prosperity.²⁵

Floodland and shoreland regulations if properly drafted may be expected, therefore, to be upheld as valid so long as the regulations comply with the following three statutory requirements:

1. Are authorized by adequate state enabling legislation.
2. Are comprehensive.
3. Are applied uniformly to all areas having a similar hazard or problem and are not limited to small selected areas.²⁶

and with the following three constitutional requirements:

4. Do not amount to a "taking" of land without just compensation.
5. Are consistent with the legal requirements of due process.
6. Are reasonably related to the public health, safety, or general welfare.²⁷ (It is prudent and often vital that this relationship be documented by factual data having a historic or scientific basis.)

Zoning is a matter within the discretion of the local legislative body. The Wisconsin Supreme Court has held that, if such discretion is not abused, the reviewing court must uphold the validity of the regulations²⁸ and that, if their validity is fairly debatable, it should be upheld and the court should not substitute its judgment for that of the municipality.²⁹ However, the reasonableness of the regulation is of paramount importance. With respect to floodlands, the regulations must, first of all, be based upon adequate, factual,

²⁵*State ex rel. Saveland Park Holding Corp. v. Wieland*, 269 Wis. 262, 69 N.W. 2d 217 (1955).

²⁶*Durham, Flood Control Via the Police Power*, 107 *University of Pennsylvania Law Review* 1098 (1959).

²⁷*Jefferson County v. Timmel*, 261 Wis. 39, 51 N.W. 2d 518 (1952).

²⁸*Eggebeen v. Sonnenburg*, 239 Wis. 213, 1 N.W. 2d 84, 138 A.L.R. 495 (1942).

²⁹*State ex rel. American Oil Co. v. Bessent*, 27 Wis. 2d 537, 135 N.W. 2d 317 (1965).

substantive data concerning the particular flood hazard involved; and the areal extent and elevation of the floodplains and floodways must be realistically based upon the best available data. Secondly, the floodland boundaries should be clearly and precisely delineated in order to permit the zoning inspector to make intelligent decisions regarding individual parcels of land. Finally, the ordinance must clearly define the uses which are permitted or prohibited on the floodlands.

For example, in a Connecticut case, the defendant established an encroachment line along a river following a disastrous flood. The line crossed the plaintiff's land and left only 60 square feet upon which a structure could be erected without special permission. The plaintiff applied for permission to place a large building on the land, but the defendant denied the request on the grounds that the building would impair the capacity of the channel in time of flood. In upholding the defendant's action, the court stated:

Reasonable regulation of the size and area of buildings and of the type of material used in them and the method of construction has long been recognized as legally proper The trial court found that the encroachment lines as established . . . accord with sound engineering principles and statutory requirements, and were designed to reduce hazard to life and property in the event of recurring floods. The Commission did not abuse its powers in proceeding by way of regulation rather than by way of eminent domain.³⁰

In another Connecticut case, however, the Court found the floodland regulations, as applied to plaintiffs' properties, unconstitutional because: plaintiffs' use was restricted to parks, wildlife sanctuaries, farming, and accessory parking; the town had previously levied a sewer assessment of over \$11,000 against one of the plaintiffs; and one of the plaintiffs' experts testified that agriculture was not a practical use and that the regulations caused a 75 percent depreciation in property value.³¹

From a comparison of these two cases, it may be seen that the Court based its decision upon the particular application of the regulations to a specific parcel of land in question. Therefore, it is recommended that floodland and shoreland regulations be carefully related to the flood hazard or the type of resource protection desired and be applied, in addition, to the basic zoning district regulations.

Zoning District Versus Additional Regulation

In considering floodland and shoreland zoning regulations, a difficult choice arises between two substantially different alternative approaches. The simpler approach, which may be satisfactory in primarily rural and previously unzoned areas, consists of creating and applying special floodland and shoreland zoning districts and accompanying regulations. This approach is not satisfactory in urbanizing or previously zoned areas for the following reason. In attempting to increase the number of uses permitted in floodland or shoreland zoning districts so as to meet the Court's due process objections in the above cited Connecticut case, the zoning practitioner runs the risk of creating mixed, incompatible, and strip zoning problems. For example, non-flood-vulnerable commercial off-street parking areas and industrial storage yards are acceptable uses of floodplains; however, to use a floodplain zoning district which permits these uses would result in the usurping of the floodplains by mixed incompatible uses, stripped up and down a stream, some of which would be unsightly and none of which would properly implement comprehensive land or water use plans. Therefore, it is recommended that the comprehensive zoning districts be used to implement the comprehensive community, watershed, and regional plans and that additional floodland and shoreland regulations be used, properly related to the flood hazard and type of resource protection desired.

A danger in using special floodland and shoreland use regulations in addition to the regulations of the basic underlying zoning district is that facts applicable to a particular parcel of land in the floodland or shoreland areas may, unless provision is made for an adjustment in the regulations to account for such facts, render the floodland and shoreland regulations invalid as to the parcel of land in question. This disadvantage may be overcome by authorizing the Board of Zoning Adjustment to modify the regulations for particular parcels where the facts so warrant.

³⁰Vartelas v. Water Resources Commission, 146 Conn. 650, 153 A. 2d 822 (1959).

³¹Dooley v. Town Plan and Zoning Commission, 151 Conn. 304, 197 A. 2d 770 (1964).

Private Property Rights

The zoning districts and floodland and shoreland regulations previously discussed in Chapters IV and V of this Guide and set forth in Appendices H through L will reduce the so-called beneficial uses to which a landowner may put his property. These types of regulations become necessary as conflicting demands compete for fixed or diminishing resources, such as land, water, air, fauna, and flora. For example, the industrialist's, sportsman's, or poet's rights in the processing, fishing, or aesthetic uses of water come into immediate conflict with the rights of a landowner to indiscriminately clear abutting shorelands, fill marshlands, or neglect to treat wastes adequately, thereby destroying wildlife habitat and impairing water quality. Chief Justice Shaw of the Massachusetts Supreme Court stated the principles of private and public rights clearly as follows:

We think it is a settled principle, growing out of the nature of well ordered civil society, that every holder of property, however absolute and unqualified may be his title, holds it under the implied liability that his use of it may be so regulated that it shall not be injurious to the equal enjoyment of others having an equal right to the enjoyment of their property, nor injurious to the rights of the community

There are two reasons of great weight for applying this strict construction of the constitutional provision to property in land: 1st, such property is not the result of productive labor, but is derived solely from the State itself, the original owner; 2nd, the amount of land being incapable of increase, if the owners of large tracts can waste them at will without State restriction, the State and its people may be helplessly impoverished and one great purpose of government defeated.³²

Chapter IV of the Commission technical report on planning law discusses these limitations on the rights of private property owners; and a similar conclusion has been reached by the Wisconsin Supreme Court, namely:

The rights of the citizens of the State to enjoy our navigable streams for recreational purposes, including the enjoyment of scenic beauty, is a legal right that is entitled to all the protection which is given financial rights.³³

Often irresponsible landowners, mineral extraction operators, subdividers, and other land developers abandon almost irremediable problems, such as badly eroded slopes, depleted farm lands, and unrestored gravel pits, to already overworked local officials or ask other innocent heavily taxed citizens to solve their problems with local, state, and federal aids.

Public Water Rights

The state holds the beds underlying navigable waters in trust for all its citizens, subject only to the qualification that a riparian owner on the bank of a navigable stream has a qualified title to the center thereof.³⁴ These riparian rights are, in turn, subject to the public rights of navigation with all its incidents, which include boating, bathing, fishing, hunting, and recreation.³⁵ The bed and waters of an inland lake, no matter what its size, belong to the state for the use of the public; and the riparian owners have no exclusive right of hunting or fishing thereon.³⁶

³²*Commonwealth v. Alger*, 7 Cush. 53 Mass. (1851).

³³*Muench v. Public Service Commission*, 281 Wis. 492, 53 N.W. 2d 514 (1952).

³⁴*Ibid.*, footnote 33.

³⁵*Munninghoff v. Wisconsin Conservation Commission*, 255 Wis. 252, 38 N.W. 2d 712 (1949).

³⁶*Ne-Pee-Nauk Club v. Wilson*, 96 Wis. 290, 71 N.W. 661 (1887).

The public may enjoy its rights to use navigable streams and lakes only by remaining within the limits of the stream or lake either by use of a boat or by wading or otherwise. An entry upon the shorelands constitutes trespass if permission to do so cannot be had from the shoreland owner. If access can be had to a navigable stream or lake from a public highway or by other legal means, then the riparian owners can exercise no restraint over a person wading or boating in the stream.

The public has the right to use the water up to the water line. When the water recedes, the rights of the public recede with the water; and when the water rises and extends to the ordinary high-water mark, the public rights to use the water are extended accordingly. Therefore, public water users never have the right to use a strip of land along the shore.

CONCLUSION

The Wisconsin Legislature has historically granted several police powers to counties, cities, villages, and towns, which implicitly or explicitly authorize floodland regulations. These police powers include the adoption and enforcement of zoning, land division, sanitary, and building ordinances. In addition, the State Water Resources Act of 1965 has authorized counties, cities, and villages to enact shoreland zoning and land division ordinances. The purpose and intent of this new state law is such as to reasonably imply that sanitary and aquatic recreation ordinances could also be used to protect the shoreland areas and water quality.

This new law gives to the state power to adopt floodland regulations in the event that counties, cities, and villages do not adopt adequate regulations for those streams where serious damage may occur and also the power to adopt shoreland regulations when counties have not acted to adopt such regulations.

Floodlands should for regulatory purposes be divided into three areas; namely, channel, floodway, and floodplain, each defined on the basis of differing flood hazards through careful engineering studies. Shorelands are determined by certain specified statutory distances from waters which are navigable-in-fact. Navigable waters have been defined by the Wisconsin Supreme Court as waters which are capable of floating any boat, skiff, or canoe used for recreation purposes.

The validity of floodland and shoreland regulations should be upheld by the courts, provided such regulations: are authorized by legislation; are comprehensive; are uniform; do not constitute a taking without compensation; are consistent with due process; and are reasonably related to general welfare, which should be documented by sound historic or engineering data. The rights of the citizen to enjoy navigable waters is a legal right in Wisconsin, providing he does not trespass on the owner's shoreland.

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Chapter VII

FLOODLAND AND SHORELAND DELINEATION

INTRODUCTION

The proper determination and accurate delineation of those floodlands and shorelands, the use of which are to be regulated in the public interest by local or state units of government, are very important to the legality of such regulations and to the acceptance of the regulations by the landowners and general public. In order to effectuate land and water use regulations in floodland and shoreland areas, the boundaries of such areas must be carefully determined and either delineated on a map, monumented in the field, or adequately described in some other way.

This determination and delineation involve two aspects: a legal one and a physical one. The legal definitions of floodlands and shorelands were discussed in Chapter VI of this Guide. The purpose of this chapter is to discuss the methods of physically determining the boundaries of such lands, together with the kinds and sources of information available to the local units of government within the Southeastern Wisconsin Region to assist them in the delineation of floodlands and shorelands.

CHANNEL DETERMINATION

In Chapter VI of this Guide, it was recommended that lands subject to periodic inundation, that is, floodlands, be divided for the purpose of land use regulation into three areas: channel, floodway, and floodplain. It was further recommended that the channel zone be defined as that portion of the stream valley normally occupied by the stream under average annual high-flow conditions. The boundaries of the channel zone may be determined by the use of aerial photographs, U. S. Geological Survey or other general-purpose topographic maps, special planning base maps, or by field inspection and mapping. Prints of ratioed, enlarged low-altitude photographs at a scale of 1" = 400' and county planning base maps at a scale of 1" = 2000' are available for the entire seven-county Southeastern Wisconsin Region from the Commission at the cost of reproduction¹ (see Maps 5 and 6). USGS 7 1/2 minute topographic quadrangle maps at a scale of 1" = 2000' may be purchased from the Wisconsin Geological Survey, University of Wisconsin, Madison, Wisconsin; the Milwaukee Map Service and Star Map Service stores in Milwaukee, Wisconsin; or may be borrowed from the Commission.

Where the stream has sharp, pronounced banks, it will ordinarily be possible through analyses of stage records, testimony of knowledgeable people, and field inspection of vegetation and physical markings and characteristics of the banks to establish and delineate the "normal" high-water mark or, as the Commission has recommended, the "average annual" high-water elevation along the course of a stream as the outer limits of the stream bed or channel. The Wisconsin Public Service Commission has defined "normal high-water mark" as that point on the stream bank where the permanent terrestrial vegetation ends and the permanent aquatic vegetation begins.² In most cases, banks marking the limits of the channel zone will be clearly evident and readily mapped. Where a stream flows through a wetland area, however, the task of delineating the channel will be much more difficult.

FLOODWAY AND FLOODPLAIN DETERMINATION

In Chapter VI of this Guide, it was recommended that the floodway be defined as that portion of the stream valley, including the channel, subject to inundation by the 10-year recurrence interval flood and that the floodplain be defined as that portion of the stream valley, excluding the floodway, subject to inundation by the 100-year recurrence interval flood or, if such data is not available, by the maximum flood of record.

¹See *SEWRPC Newsletter*, May-June 1967, Volume 7, No. 3.

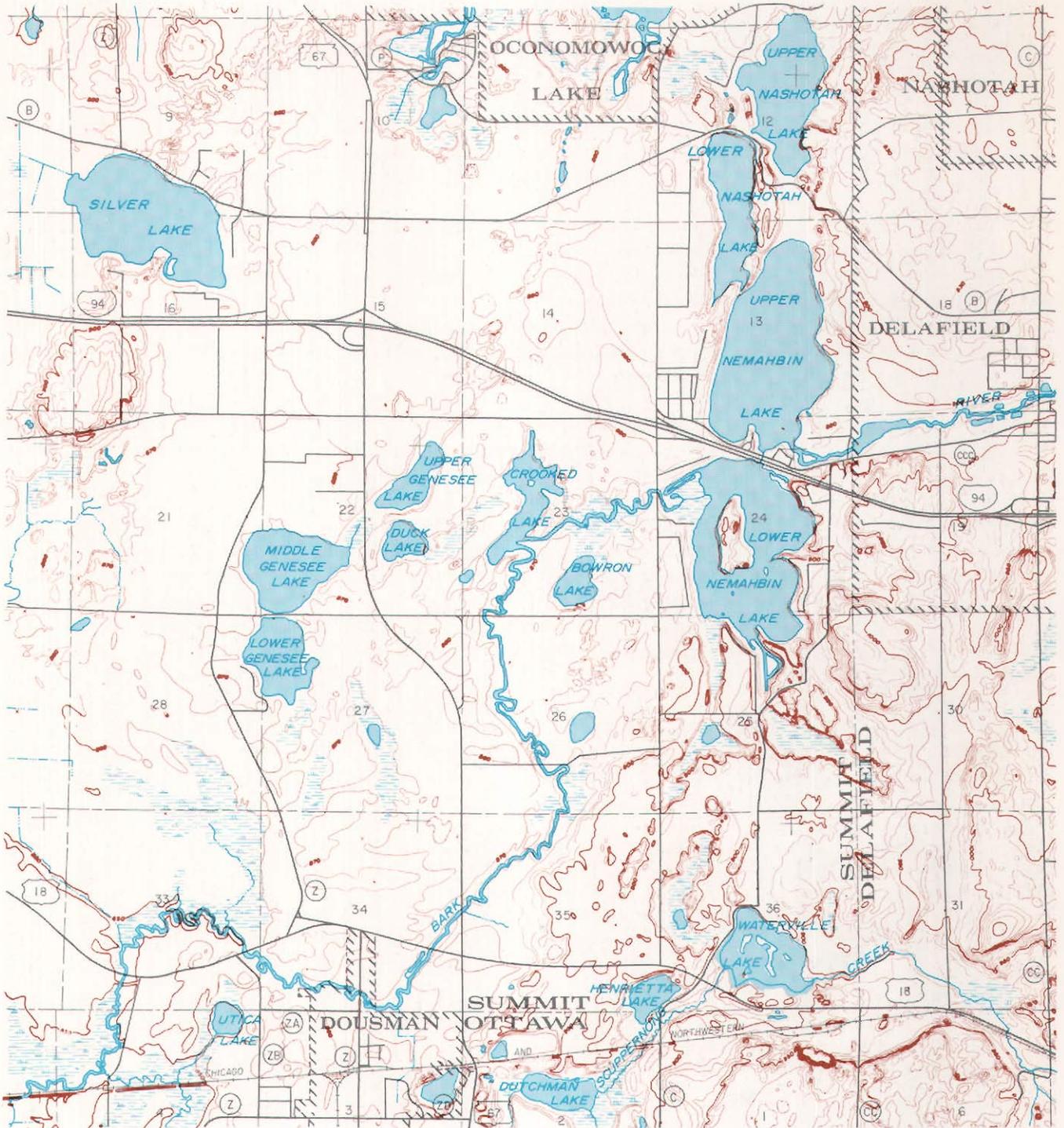
²*SEWRPC Technical Report No. 2, Water Law in Southeastern Wisconsin (1966)*, p. 18.

Map 5
TYPICAL AERIAL PHOTOGRAPH OF LAKE AND STREAM SHORELINES



Prints of aerial photographs at a scale of 1" = 400' covering the entire Region are available from the Southeastern Wisconsin Regional Planning Commission to assist local units of government in the determination and delineation of stream and lake shorelines.

Map 6
 TYPICAL BASE MAP SHOWING LAKE AND STREAM SHORELINES



County and town base maps at scales of 1" = 2000' and 1" = 1000' are available from the Southeastern Wisconsin Regional Planning Commission to assist local units of government in the determination and delineation of lake and stream shorelines.

In applying these recommended definitions, it must be recognized that other floods could be used as a basis for establishing the outer limits of the floodlands, such as the maximum flood of record,³ the regional flood,⁴ the standard project flood,⁵ the maximum probable flood,⁶ or a design flood⁷ of any specified recurrence interval.

The flood used for floodland delineation should be dictated by careful consideration of such factors as the data available and the characteristics of the watershed under consideration and is as much a matter of economics and public policy as it is a matter of engineering practice. Sound planning and engineering practices dictate that the flood used to delineate floodlands for land use regulation have a specified recurrence interval so that a sound economic analysis of the costs and benefits of alternative plan designs can be made and the advantages and disadvantages of various levels and combinations of police power regulation, public acquisition, and public construction for flood damage abatement and prevention can be fully analyzed.

In its comprehensive watershed studies, the Commission utilizes 100- and 10-year recurrence interval floods to delineate the floodplain and floodway areas, respectively. The Commission 100-year recurrence interval design flood is analytically derived, using the best engineering procedures applicable to the particular watershed under study, and is very similar to, but not identical with, the regional flood often used for floodland delineation elsewhere. The use of the 10-year recurrence interval flood as the basis for floodway delineation has the advantage of providing a practical, economical, and readily reproducible engineering procedure for such delineation.

It should be used, however, only when the floodland regulations envision retaining the entire floodplain area in essentially open use, as do the model ordinances and special regulations recommended by the Commission. If development and fill are to be permitted in the floodplain areas, then the ability of the floodway, as delineated by the 10-year recurrence interval flood inundation lines, to carry and discharge the 100-year recurrence interval flood without significantly increasing upstream or downstream flood stages should be checked by further hydraulic investigations conducted by a qualified professional engineer before being used as a basis for delineating the floodway. It is extremely important to note in this connection that the effects of a single encroachment upon flood elevations will normally be insignificant. It is, therefore, necessary to investigate the effect of additional similar encroachments along a significant reach of the stream channel on the hydraulic grade line of the 100-year recurrence interval flood, before permitting any encroachment.

There are several methods and various sources of information available to delineate lands subject to periodic inundation. These methods and information sources range from the detailed engineering studies and flood overflow maps prepared by the Commission, as an integral part of a comprehensive watershed

³The maximum flood of record is defined as the largest known and recorded flood event. It may have been a very rare event because of its great magnitude or only slightly greater than floods that occur fairly frequently. Changes which have occurred within the watershed since this historic event may markedly affect the nature of a similar future event, either increasing or decreasing the stage and discharge.

⁴The regional flood is defined as a flood comparable to the largest known floods on similar streams in the immediate region. Such floods are usually developed by plotting peak discharges against drainage areas for similar streams in a region to obtain an experience line.

⁵The standard project flood is defined as the largest flood that can be expected to develop with the coincidence of the most critical conditions that actually have been experienced over a wide area. It is determined analytically and is used by the U. S. Army Corps of Engineers, as a design flood in highly developed areas.

⁶The maximum probable flood is defined as the largest flood that can be expected, assuming maximum simultaneous occurrence of all theoretically possible flood-producing factors in the watershed area. It would be catastrophic in nature and for economic reasons has little bearing on floodland use regulation or even engineering design except for determining spillway capacities of major dams.

⁷A design flood is defined as a flood of specified recurrence interval against which protection will be provided through land use regulation and engineering works.

planning program, through the Flood Plain Information Reports prepared by the U. S. Army Corps of Engineers, the flood hazard maps prepared by the U. S. Geological Survey, and the detailed operational soil surveys prepared by the U. S. Soil Conservation Service to field inspections, recorded historic flood heights, and aerial photographs taken at the time of flooding.

Detailed Engineering Studies

Experience has indicated that in a rapidly urbanizing area, such as southeastern Wisconsin, careful hydrologic and hydraulic engineering studies are necessary to a proper delineation of floodway and floodplain boundaries for land use regulation and floodplain management purposes. Such studies should collect data on the hydrologic and hydraulic characteristics of the stream system, including: channel, floodway, and floodplain profiles and cross sections; dimensions and elevations of bridges, culverts, and water control structures; and historic flood height and discharge measurements from which flood magnitudes, expected flood frequencies, stage-discharge relationships, flood profiles, and flood overflow maps can be derived. The collection of such data requires the installation and operation of a stream gaging network consisting of staff gages, flood crest gages, and continuous flow recording gages, as well as the analysis of existing hydraulic, hydrologic, and meteorologic data.

A physical inventory of the stream channel should be made as a part of such flood studies so as to determine existing flow capacities and obtain pertinent data on culverts and bridges, including the number and width of spans and deck and guard rail elevations; on dams and encroachments, including heights and elevations of overflow sections; on historic high-water marks; and on stream profiles and cross sections showing the dimensions and bed elevations of the main channel and its relationship to the natural floodplains at critical locations along the course of the stream.

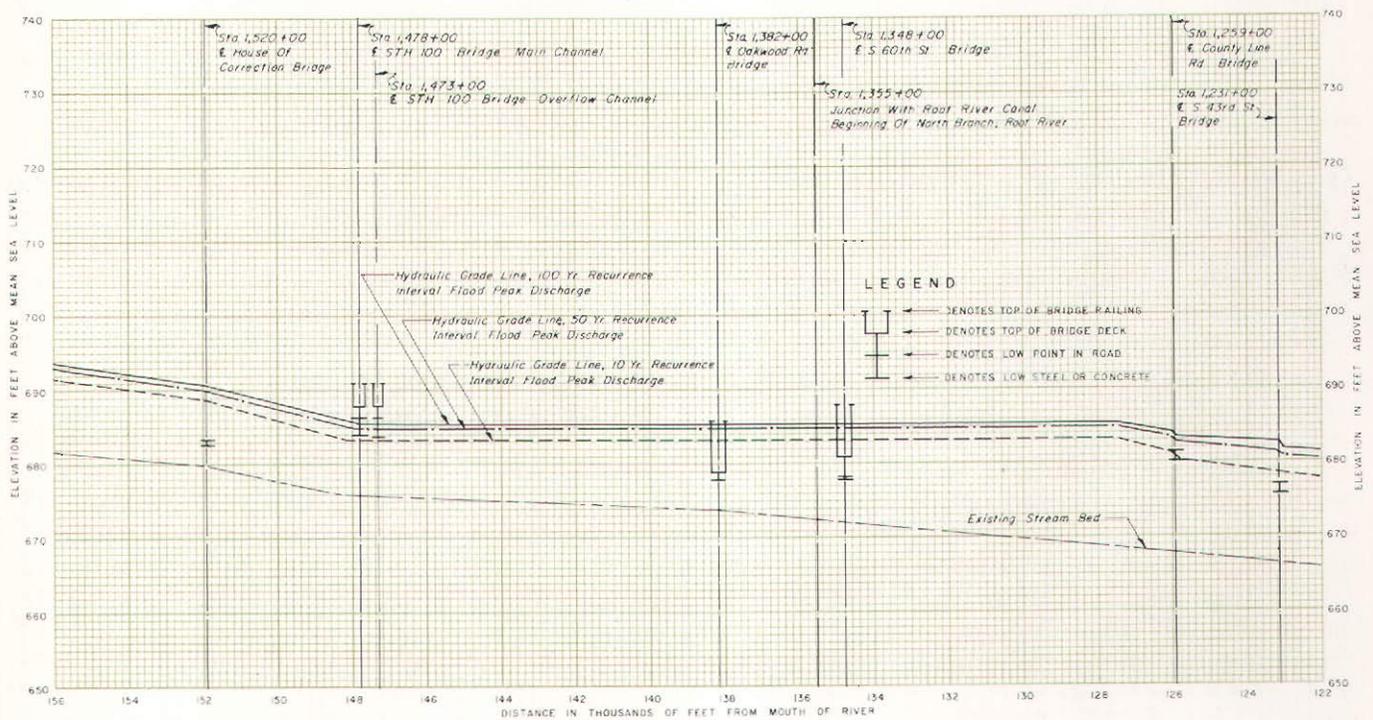
A most important characteristic of floods is the probability or risk of their occurrence. Probability or risk is defined as the chance of occurrence in any year of a flood equalling or exceeding a specified magnitude. Probability may be expressed as a decimal, fraction, or as a recurrence interval. The latter is defined as the average time interval between floods of a given magnitude and is equal to the reciprocal of the probability. For example, a 100-year recurrence interval flood will, on the average over a long period of time, occur only once in every 100 years and, therefore, has a 1 percent chance of occurring in any one year. A long and continuous record of river stage and discharge is the best basis for determination of flood frequency. Where such discharge records do not exist, it becomes necessary to make statistical inferences as to flood frequency from other sources, such as climatological records or periodic measurements of river water levels.

It must also be recognized that the flood potential of a stream may be changed markedly by changes in land use within the tributary watershed or by man-made improvements in channel capacity. The possibility of such changes must be carefully considered and analyzed in any floodland delineation effort. Changes which may markedly affect historic flood hazards include the construction of storage reservoirs, natural or man-made channel modifications, the construction of flood walls and levees, or the construction of encroachments on the natural floodway. Changing land use within a watershed, particularly within smaller watersheds, may also have a marked effect on flood hazards by increasing the volume of floodwaters to be handled and decreasing the time of concentration to any given point on the channel system. A discussion of the effects of urbanization on flooding is included on pages 51-53 of SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed.

In a rapidly urbanizing region, such as southeastern Wisconsin, the studies required to properly delineate floodways and floodplains are best carried out as integral parts of comprehensive watershed planning studies. The actual delineation of these districts should be based upon the establishment of a design high-water level or stage along the perennial stream channels which relates the flood discharge to corresponding water surface elevations under anticipated, as well as existing, land use and water control facility development within the tributary watershed, as indicated by the watershed development plans. Stream water levels are a function of discharge; channel, floodway, and floodplain shape, slope, and friction; and capacity of structures, all of which vary along the length of a channel. It is, therefore, necessary to calculate stage-discharge relationships at many points along the channel systems for which floodland maps are desired and from these to prepare high-water surface profiles along the stream channels.

This is done in southeastern Wisconsin by the Commission with the aid of a hydrologic simulation model, which permits floods of varying magnitudes to be simulated for conditions of present and possible future land use and water control facility development. High-water surface and stream bed profiles have been prepared for the 10-, 50-, and 100-year recurrence interval flood peak discharges on the Root River (see Figure 47); and similar profiles are being prepared for the Fox and Milwaukee Rivers. These profiles are accompanied by tables setting forth hydraulic data for each bridge crossing the channel, including the bridge location, floodwater overbank depth, and floodwater depth over road at bridge (see Table 5), and can be used, in conjunction with a good topographic map, to delineate the floodways and floodplains. This data is very useful to private land developers, surveyors, and engineers, as well as to public works engineers, in the design of replacement bridges and culverts and in the design and layout of land development projects.

Figure 47
HIGH WATER AND STREAM BED PROFILES
 OF THE
ROOT RIVER
 FROM STA. 1,220+00 TO STA. 1,560+00
 RACINE AND MILWAUKEE COUNTY, WISCONSIN
 SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION
 DRAWN: H.A.R. DATE: 11 JULY 1966
 CHECKED: K.W.B. DATE: 11 JULY 1966
 HYDRAULIC GRADE LINES REPRESENT PEAK DISCHARGE CONDITIONS
 OCCURRING UNDER 1990 LAND USE CONDITIONS



NOTE: International Great Lakes Datum (1955) = Mean Sea Level Datum (1929 Adjustment) - 1.3 feet.
 Milwaukee Metropolitan Sewerage Commission Datum = Mean Sea Level Datum (1929 Adjustment) - 580.560.
 Racine City Datum = Mean Sea Level Datum (1929 Adjustment) - 580.710.
 Source: Harza Engineering Company, SEWRPC.

High-water surface and stream bed profiles have been prepared by the Commission for the 10-, 50-, and 100-year recurrence interval flood peak discharges on the Root River; and similar profiles are being prepared for the Fox and Milwaukee Rivers. These profiles are accompanied by tables setting forth hydraulic data for each bridge crossing the channel, including the bridge location, floodwater overbank depth, and floodwater depth over road at bridges. These profiles and data can be used, in conjunction with a good topographic map, to delineate the floodways and floodplains.

Table 5
HYDRAULIC ANALYSIS SUMMARY
Root River Main Stem
(100-Year Recurrence Interval Flood, 1990 Conditions)

Location	Construction Date of Existing Bridge	Recommended Design Frequency (years)	Replacement Required by Application of Standard	Bank Full Discharge (CFS)	Instantaneous Peak Discharge (CFS)	Elevation of Water Level, Feet Above (msl) ^a	Overbank Depth (feet)	Existing Waterway Opening		Replacement Waterway Opening	
								Bridge Head Loss (feet)	Depth on Road at Bridge (feet)	Bridge Head Loss (feet)	Depth on Road at Bridge (feet)
W. County Line Road	1910 ^b	50	Yes	520	8,600	684.3	9.6	0.4	2.4	0.6	0.8
S. 43rd Street	1910 ^b	50	Yes	1,210	8,600	683.0	8.0	0.1	4.8	1.0	1.5
W. County Line Road	1910	50	Yes	720	8,570	680.0	5.7	0.1	5.7	0.7	0.9
USH 91	1931	10	Yes	720	8,570	680.0	10.4	0.1	5.0	1.6	5.0
IH 9W	1983	100	No	720	8,570	678.3	10.4	0.1	-5.6	--	--
CTH V	1927	50	Yes	580	8,780	674.6	7.8	0.1	3.8	0.8	0.6
C. M. St. P. & P. R.R.	1900	--	--	165	8,790	672.0	9.4	0.6	-11.0	--	--
Howell Avenue (STH 38)	1929	50	Yes	270	9,090	671.6 ^c	9.9	0.1	3.9	0.7	1.1
S. Nicholson Road	1918	50	Yes	360	9,340	671.6	10.6	0.1	3.6	1.0	1.1
C. & NW. R.R.	1912	--	--	750	9,330	668.4	7.4	0.1	-8.6	--	--
E. Seven Mile Road	1960	50	No ^d	870	9,325	668.2	8.5	0.1	1.3	0.7	-1.8
E. Six Mile Road	1940 ^b	50	No	1,020	9,310	666.9	8.4	0.5	-0.1	--	--
E. Five Mile Road	1950	50	Yes	1,710	9,235	665.8	8.0	0.1	3.0	0.8	0.8
E. Four Mile Road	1950	50	No	4,350	9,160	659.8	3.2	1.6	-1.5	--	--
Johnson Park	--	--	--	710	10,000	658.2	10.2	0.1	9.2	--	--
Johnson Park	--	--	--	1,090	10,000	649.2	7.2	0.1	2.5	--	--
STH 31	--	50	No	1,780	9,980	643.0	7.4	0.6	-3.0	--	--
STH 38	--	50	No	20,000+	9,980	632.0	-4.0	1.0	-6.3	--	--
Racine Country Club	--	--	--	1,890	9,930	618.0	4.5	2.5	-1.3	--	--
Racine Country Club	--	--	--	570	9,930	604.9	4.9	0.1	3.6	--	--
Park Bridge	1938	--	--	2,340	9,920	596.2	6.2	0.1	2.8	--	--
Spring Street	1920	50	Yes	1,750	9,920	594.5	6.8	0.7	2.3	0.7	-0.5
Liberty Street	1905	10	No	1,650	4,750	592.3 ^c	4.0	0.1	1.9	--	--
Glen Street	1948	--	--	1,900	5,150	592.4 ^c	3.5	0.3	1.6	--	--
Parkwise Bridge	1925	--	--	600	4,500	592.2 ^c	8.1	0.3	1.7	--	--
Park Bridge	1905	10	No	1,420	5,150	591.8 ^c	4.1	1.1	-3.8	--	--
6th Street	1928	10	No	7,500	9,920	591.5 ^c	1.8	0.1	0.1	--	--

^aMilwaukee Metropolitan Sewerage Commission Datum = Mean Sea Level Datum -580.560 feet; City of Racine Datum = Mean Sea Level Datum -580.710 feet.

^bExact date of construction unestablished; date estimated by on-site inspection of structure.

^cWater surface elevation includes effect of backwater from downstream bridges or from Lake Michigan.

^dBridge waterway opening adequate; elevation of roadbed required.

Source: SEWRPC Planning Report No. 9, A Comprehensive Plan For The Root River Watershed, July 1966, p. 260.

The Commission watershed studies also include the preparation of small-scale flood hazard maps delineating the 100-year recurrence interval flood inundation lines. These maps have a scale of 1" = 2000', with a vertical contour interval of 10 feet, and cover the entire river system of the watersheds involved. The Commission, as a part of its watershed studies, provides a network of vertical survey control along the major stream channels in the form of second-order spirit-level bench marks referred to mean sea level datum. These may be used by local surveyors and engineers, together with the flood profiles, to refine the mapped floodland boundaries.

The Commission also prepares large-scale flood hazard maps showing the 10- and 100-year recurrence interval flood inundation lines. These maps have a scale of 1" = 200', with a vertical contour interval of two feet, and are based upon a unique monumented system of survey control that provides a point of known elevation above mean sea level datum and of known horizontal position on both the State Plane Coordinate and U. S. Public Land Survey Systems at one-half mile intervals throughout the entire area mapped. The establishment of this control system requires the recovery or relocation and monumentation of all section and quarter-section corners within the area to be mapped and the utilization of these corners as stations in second-order traverse and spirit-level nets tied to the National Geodetic Datum. The control traverses establish the exact lengths and bearings of all quarter-section lines, as well as the geographic positions and elevations of the monumented public land survey corners themselves in the form of state plane coordinates.⁸ These large-scale maps are prepared for selected areas of the stream system where urbanization is considered imminent or where water control facility construction has been proposed by the Commission (see Map 3). Similar mapping is in progress on the Fox and Milwaukee River systems⁹ (see Map 7).

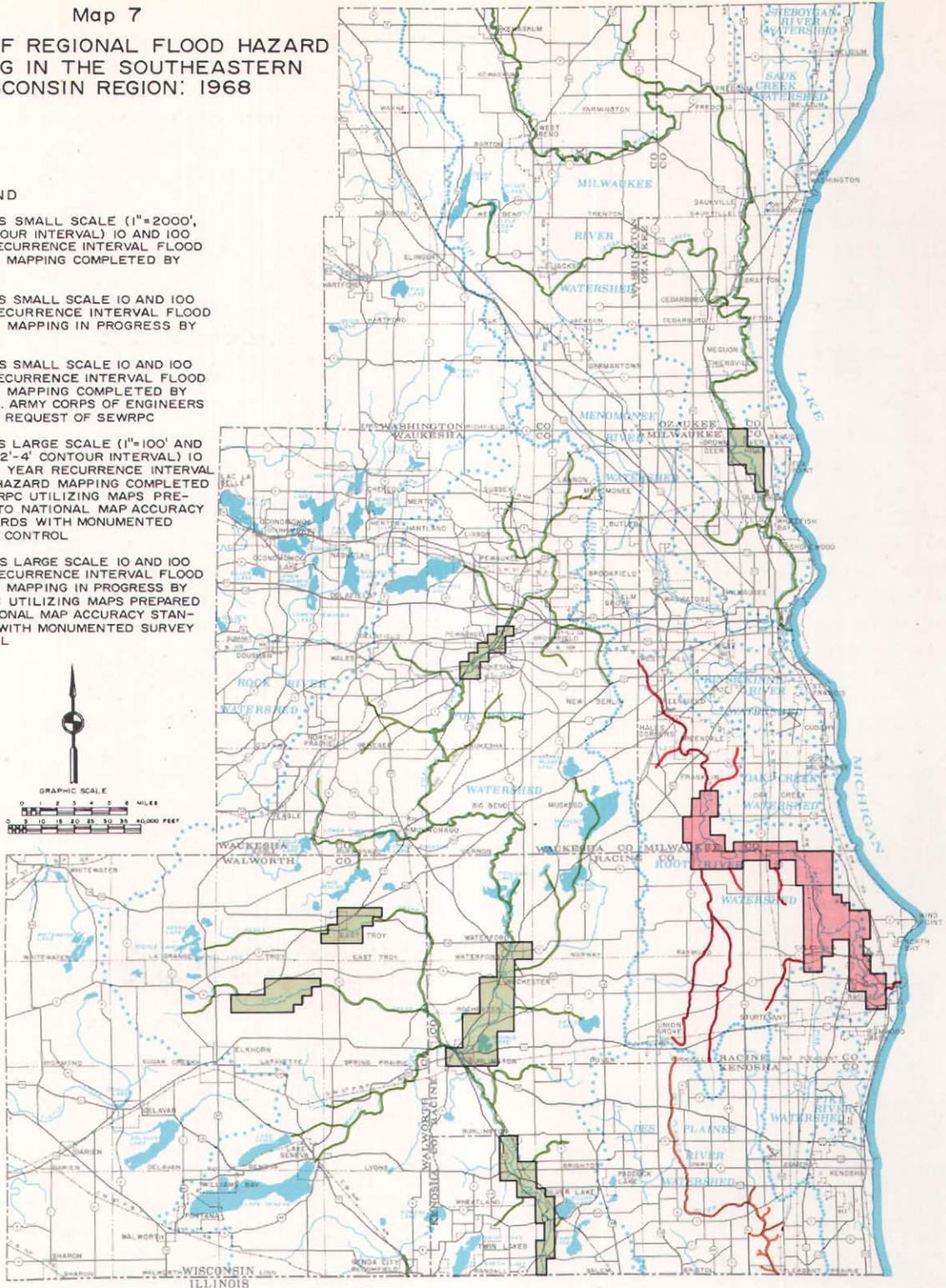
⁸This system of survey control is thoroughly discussed in SEWRPC Planning Guide No. 2, Official Mapping Guide (1964).

⁹Fox River flood hazard maps are scheduled for completion early in 1969. Milwaukee River flood hazard maps are scheduled for completion in 1971.

Map 7
 STATUS OF REGIONAL FLOOD HAZARD
 MAPPING IN THE SOUTHEASTERN
 WISCONSIN REGION: 1968

LEGEND

-  DENOTES SMALL SCALE (1"=2000', 10' CONTOUR INTERVAL) 10 AND 100 YEAR RECURRENCE INTERVAL FLOOD HAZARD MAPPING COMPLETED BY SEWRPC
-  DENOTES SMALL SCALE 10 AND 100 YEAR RECURRENCE INTERVAL FLOOD HAZARD MAPPING IN PROGRESS BY SEWRPC
-  DENOTES SMALL SCALE 10 AND 100 YEAR RECURRENCE INTERVAL FLOOD HAZARD MAPPING COMPLETED BY THE U.S. ARMY CORPS OF ENGINEERS AT THE REQUEST OF SEWRPC
-  DENOTES LARGE SCALE (1"=100' AND 1"=200', 2'-4' CONTOUR INTERVAL) 10 AND 100 YEAR RECURRENCE INTERVAL FLOOD HAZARD MAPPING COMPLETED BY SEWRPC UTILIZING MAPS PREPARED TO NATIONAL MAP ACCURACY STANDARDS WITH MONUMENTED SURVEY CONTROL
-  DENOTES LARGE SCALE 10 AND 100 YEAR RECURRENCE INTERVAL FLOOD HAZARD MAPPING IN PROGRESS BY SEWRPC UTILIZING MAPS PREPARED TO NATIONAL MAP ACCURACY STANDARDS WITH MONUMENTED SURVEY CONTROL



The above map shows the extent of flood hazard mapping accomplished to date by the Southeastern Wisconsin Regional Planning Commission and the U. S. Army Corps of Engineers. Flood hazard maps showing 10- and 100-year recurrence interval flood hazard lines are prepared for all major streams and watercourses by the Commission at a scale of 1" = 2000' as part of the comprehensive watershed planning programs. Such mapping is complete for the Root River watershed and is currently underway for the Fox and Milwaukee River watersheds. The U. S. Army Corps of Engineers has completed similar mapping for the Des Plaines River watershed in response to a request by the Commission. As shown, the Commission also prepares, as a part of its watershed planning programs, large-scale (1" = 100' and 1" = 200') flood hazard maps of selected stream reaches which are expected to be subject to particularly rapid urbanization.

The large- and small-scale flood hazard maps prepared by the Commission provide the following important information:

1. A definitive description of the natural and man-made features of the stream valley being considered, including specific information about relief; location and orientation of real property boundary lines; and the location and elevation of such man-made features as highways, railroads, and principal buildings and structures.
2. A means for relating information collected in the flood studies to the geographic area from which the information was taken, thereby providing correlation between floods and other studies, such as demographic, economic, resource, land use, and transportation.
3. A basis for the preparation and administration of floodland and shoreland regulations to be operative in the channel, floodway, and floodplain areas.

In addition, the large-scale flood hazard maps prepared by the Commission permit the accurate correlation of property boundary lines and hydrographic and topographic data so necessary to the proper enactment and enforcement of floodland and shoreland regulations. The maps permit lines established on the map during adoption of the regulations to be accurately re-established on the ground during enforcement and, to this end, are designed not only to reflect accurately both topographic and cadastral field conditions but also permit the ready and accurate reproduction on the ground of lines shown on the maps. Copies of these maps are available from the Commission at the cost of reproduction and have been provided to all local units of government within the areas affected. Control survey summary diagrams and dossier sheets for each control survey station have also been published by the Commission in SEWRPC Technical Report No. 7, Horizontal and Vertical Survey Control in Southeastern Wisconsin, 1968.

Floodplain Information Reports

The U. S. Department of the Army, Corps of Engineers, is authorized by Section 206 of the Flood Control Act of 1960 (Public Law 86-645) to compile and publish upon request information on floods and flood hazards, including identification of areas subject to flooding, so as to encourage the most prudent use of floodlands. The Corps, at the request of the Southeastern Wisconsin Regional Planning Commission, extended their Des Plaines River floodplain investigation into the Southeastern Wisconsin Region and has completed and published an excellent report containing the results of this investigation.¹⁰

This report covers the Des Plaines River floodlands from Riverside, Illinois, to the headwaters in Kenosha and Racine Counties (see Map 7) and includes colored maps at a scale of 1" = 2000' showing the areas inundated by the maximum flood of record, which in Kenosha and Racine Counties was the summer flood of 1938; the 100-year recurrence interval flood, which would produce stages one to two feet higher than the maximum flood of record; and the intermediate flood of March 1948, which has a recurrence interval of approximately 10 years.¹¹ The greater probable (100-year) and intermediate (10-year) flood boundaries are equivalent to those recommended by the Commission for floodway and floodplain delineation (see Map 4).

The floodland delineation did not consider the possible effects of any changes in flow regimen due to urbanization or water control facility construction. If Kenosha and Racine Counties and the Towns of Somers, Pleasant Prairie, Bristol, Paris, and Yorkville effectively implement the applicable regional and district land use plans, however, the Corps of Engineers report on the Des Plaines River floodlands will be adequate as a basis for land use regulation and floodplain management programs designed to prevent future increases in flood damage within this basin. The results of the Corps report have been incorporated into the maps, studies, plans, and implementation devices prepared by the Commission as a part of the Com-

¹⁰U. S. Department of the Army, Corps of Engineers, Flood Plain Information Report on the Des Plaines River, Illinois and Wisconsin, (March 1966).

¹¹*Ibid.*, footnote 10.

prehensive Plan¹² for the Kenosha Planning District.¹³ The 10- and 100-year recurrence interval flood boundaries have been shown on all of the District base maps, and special floodland restrictions related to these flood boundaries have been incorporated into both the zoning and land division ordinances recommended for adoption by the City of Kenosha and the Towns of Somers and Pleasant Prairie.

Copies of the Corps report are available from the U. S. Department of the Army, Corps of Engineers, Chicago, Illinois, or on a loan basis from the Commission and have been distributed by the Corps through the Commission to all local units of government affected.

Flood Hazard Maps

In 1959 the U. S. Department of Interior, Geological Survey, was authorized to prepare flood inundation maps and to publish these as hydrological investigation atlases. These atlases contain hydrological data for evaluating the depth and frequency of flooding, flood profiles, and a colored U. S. Geological Survey 7 1/2 minute topographic quadrangle map showing the boundaries of flooded areas. The flood inundation lines shown may be those of selected historic floods or floods of a given frequency. No such hydrological investigation or flood hazard maps have been prepared by the U. S. Geological Survey for the Southeastern Wisconsin Region. The U. S. Geological Survey, as part of their cooperative program with the State Department of Natural Resources, will prepare flood hazard maps for the Rock River but does not at this time anticipate mapping any tributaries within the Region.

The Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566, 68 Stat. 666, as amended) authorizes the U. S. Department of Agriculture to provide technical and financial assistance to local organizations for flood prevention and agricultural water management, including the full cost of necessary engineering studies. Technical and financial assistance is also available for other purposes, such as recreation and fish and wildlife. The U. S. Department of Agriculture, Soil Conservation Service, has participated actively in the comprehensive watershed planning programs of the Commission, including the conduct of necessary detailed soil surveys and the hydrologic and hydraulic studies necessary to delineate floodlands.

Detailed Operational Soil Survey

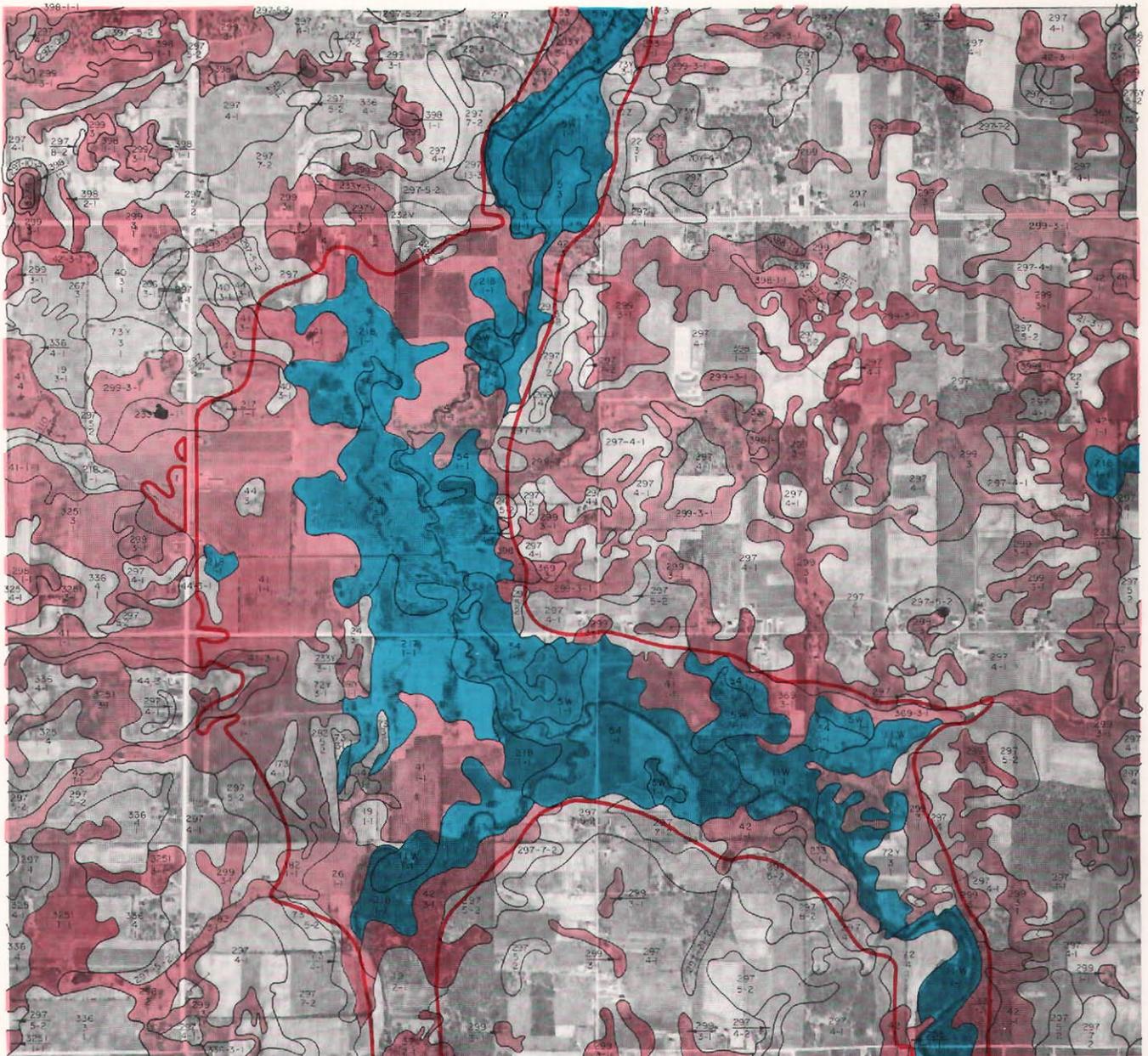
The U. S. Department of Agriculture, Soil Conservation Service, has for many years provided farmers with soil surveys and analyses pertaining to the capabilities of such soils for agricultural and forestry purposes. Recently the Service, upon the request of the Southeastern Wisconsin Regional Planning Commission, completed a detailed operational soil survey of the entire seven-county planning Region. The results of this survey include soil survey field sheets (see Map 8) and a description of each soil series, water management characteristics of each soil type, and interpretive ratings of each soil type for various rural and urban uses. The results of the survey have been published in SEWRPC Planning Report No. 8, Soils of Southeastern Wisconsin, 1966.

The soil survey field sheets contain much data useful in shoreland and floodland determination and delineation. For example, these field sheets, in addition to showing the type, boundaries, slopes, and erosion factor of soils, show canals, wetlands, intermittent and perennial streams, lakes, and ponds. The soil descriptions contain information that can be used to assist in determining and delineating floodlands since soils which are subject to flooding, overwash, ponding or which have high or fluctuating water tables are described. Those water management characteristics of the soils, such as hydrologic soil groups, are extremely useful in preparing the detailed hydrologic and hydraulic engineering studies previously described as essential to sound floodland determination in southeastern Wisconsin. In addition, the Soil Conservation Service has prepared flood hazard analyses for soils subject to flooding and ponding (see Appendix P).

¹²SEWRPC Planning Report No. 10, A Comprehensive Plan for the Kenosha Planning District (1967).

¹³The Kenosha Planning District includes all that area in Kenosha County lying east of IH 94 and west of Lake Michigan, including the City of Kenosha and the Towns of Somers and Pleasant Prairie.

Map 8
TYPICAL SOIL FLOOD HAZARD MAP



LEGEND

- DENOTES SWAMPS, MARSHES, ORGANIC MATERIALS OR SOILS THAT ARE SUBJECT TO FLOODING OR OVERFLOW
- DENOTES SOILS THAT HAVE A FLUCTUATING OR HIGH WATER TABLE OR ARE SUBJECT TO A PONDING, OVERWASH, OR RUNOFF HAZARD
- DENOTES 100 YEAR RECURRENCE INTERVAL FLOOD INUNDATION LINE

The 100-year recurrence interval flood boundaries for a portion of the Root River are shown here overlaid on a soil survey field sheet. The soils shown in blue are those that have a severe flooding hazard as interpreted by the U.S. Soil Conservation Service. The soils shown in red are those that have high or fluctuating water tables. If soil surveys are to be used to delineate floodlands, both those soils having flooding hazards and those having high or fluctuating water tables must be included; and the soils data must be carefully analyzed in conjunction with good topographic maps and, where possible, historic flood inundation records. Only in this way can a meaningful correlation between soils data and floodlands be achieved.

The interpretive ratings for various rural and urban uses provided as a part of the soil survey are also an invaluable aid for the planning and regulation of shorelands so as to avoid erosion, water pollution, and preserve or restore shoreland cover. The limitations of the various soils for road construction, residential development with soil absorption sewage disposal systems, woodlands, recreation, wildlife, and shrub, vine, and tree planting are also described in the aforementioned Planning Report No. 8.

Areas which are frequently flooded are blanketed with a layer of alluvial sediments. These sediments, being of recent origin, are recognizably different from soils which are not flooded. Soils with differing morphological characteristics are delineated on the soil survey field sheets (see Map 8), and it is possible to recognize soil areas which have been flooded frequently. Therefore, it was originally thought that the soil survey and analyses could be used directly for the determination of historic flood inundation lines. In southeastern Wisconsin, however, where many low terraces and low-lying upland soils that are naturally well drained exist, it was found that such soils did not contain the alluvial soil deposits necessary for a flood hazard interpretation even though periodically flooded.

An analysis of the use of soil information for floodland determination, conducted by Dr. John M. Cain on the Des Plaines River, found that, in addition to organic and alluvial soils, many of the high-water table soils and the well-drained and moderately well-drained soils of fluvial origin lie within the 100-year recurrence interval flood hazard lines. Only a very small percentage of well-drained or moderately well-drained till soils are included, however, within these flood boundaries; and Dr. Cain concluded that alluvial soils represent areas "that would be overtopped frequently" and, if high-water table soils are included, the floodlands so delineated become "reasonably close to the area representing the maximum flood of record."¹⁴

Other studies of the use of detailed soil survey data to determine floodlands have also been made. One of these studies of selected areas of the Root River indicated that the 10- and 100-year recurrence interval flood inundation lines could not be delineated by use of the soil data alone.¹⁵

Map 8 shows the 100-year recurrence interval flood boundaries of the Root River overlaid on a soil survey field sheet. The soils colored blue are those which the U. S. Soil Conservation Service has interpreted as having a severe flooding hazard (see Appendix P). Only when those soils having moderate flooding hazards and high or fluctuating water tables, shown colored in red, are included does a meaningful correlation between the soils and flood boundaries occur. It is, therefore, recommended that the detailed operational soil survey and analyses be used to determine lands subject to flooding only in conjunction with U. S. Geological Survey 7 1/2 minute topographic quadrangle maps and historic flood inundation records. It is further recommended that floodlands so delineated be revised when additional hydrologic and hydraulic engineering data become available as part of the comprehensive watershed planning programs of the Commission.

The Commission has entered into an interagency Memorandum of Understanding with the U. S. Department of Agriculture, Soil Conservation Service; the Wisconsin Cooperative Extension Service; and the seven county soil and water conservation districts comprising the Region. Under this agreement the U. S. Soil Conservation Service provides technical services in the application of the soil surveys. These services include: the conduct of on-site soil investigations in areas where additional detail is desirable or where questionable soil characteristics are involved; the provision of technical advice as to means for overcoming soil limitations for specific uses; and the provision of assistance in interpreting the detailed soil survey sheets and in making use of the various analyses.

¹⁴Cain, John Manford, *A Critical Analysis of the Use of Soil Survey Information in Preparation and Implementation of Land Use Plans*, Unpublished Thesis, Water Resource Center, University of Wisconsin (1967).

¹⁵Parker, Dale Edward, *Use of Soil Mapping Units and Aerial Photographs to Delineate Flood Plains in a Glaciated Area*, Unpublished Thesis, Water Resource Center, University of Wisconsin (1968).

The Town of Cedarburg has made use of these materials to determine the floodlands and the shorelands for zoning purposes. Map 9, prepared under the Commission Community Assistance Program, shows the floodlands determined on the basis of soil type, flood hazard, soil slope, topographic maps, and historic flood information. The shorelands and zoning district boundaries were then subsequently determined by reference to these floodland boundaries.

Copies of the soil survey field sheets at a scale of 1" = 2000'¹⁶ and selected analyses are available from the Commission at the cost of reproduction. Loan copies and assistance in their use are also available from the U. S. Soil Conservation Service Work Unit Conservationists assisting each County Soil and Water Conservation District and from county agricultural agents.

Historic Flood Information

Historic flood information is available from newspaper files and records of local land surveyors and public works engineers and may be obtained by interviewing knowledgeable local public officials and residents. Under a program conducted by the State Highway Commission of Wisconsin, in cooperation with county highway commissioners and town chairmen, areas where inundation has taken place adjacent to state trunk highways, county trunk highways, and town roads were mapped in Kenosha, Ozaukee, Racine, Walworth, and Washington Counties. These maps have been published by the Southeastern Wisconsin Regional Planning Commission in SEWRPC Planning Report No. 5, The Natural Resources of Southeastern Wisconsin, 1963.

SHORELAND DETERMINATION

In Chapter VI of this Guide, it was pointed out that shorelands have been defined by the Wisconsin Legislature as those lands lying within the following distances from the normal high-water elevation: 1,000 feet from the shoreline of lakes, ponds, flowages, and glacial pot hole lakes and 300 feet from the shoreline of the stream or to the landward side of the floodplain, whichever is greater (see Figure 46).

Lakes and Ponds

The lakes, ponds, flowages, and glacial pot hole lakes for which shoreland regulations are to be enacted may be determined by the use of aerial photographs (see Map 5), county planning base maps prepared by the Commission (see Map 6), field inspection or by reference to the "Surface Water Resources" reports published for each county by the State Department of Natural Resources. A list of lakes and ponds derived from these reports and Commission watershed studies is set forth in Appendices C and D of this Guide. The availability of aerial photographs and base maps from the Commission was discussed at the beginning of this chapter. Once those lakes and ponds to be regulated are selected by the local unit of government, it is a relatively simple matter to delineate on a good base map of adequate scale the shoreland area as a band 1,000 feet in width extending from the average annual or normal high-water elevation. The State Department of Natural Resources and the State Public Service Commission have both defined the "normal" high-water elevation of lakes as that point at which the waters remain long enough to cause an observable change in vegetative type and density of growth. These state agencies attempt to establish in the field those points where the permanent terrestrial vegetation ends and the permanent aquatic vegetation begins.¹⁷

Streams and Floodplains

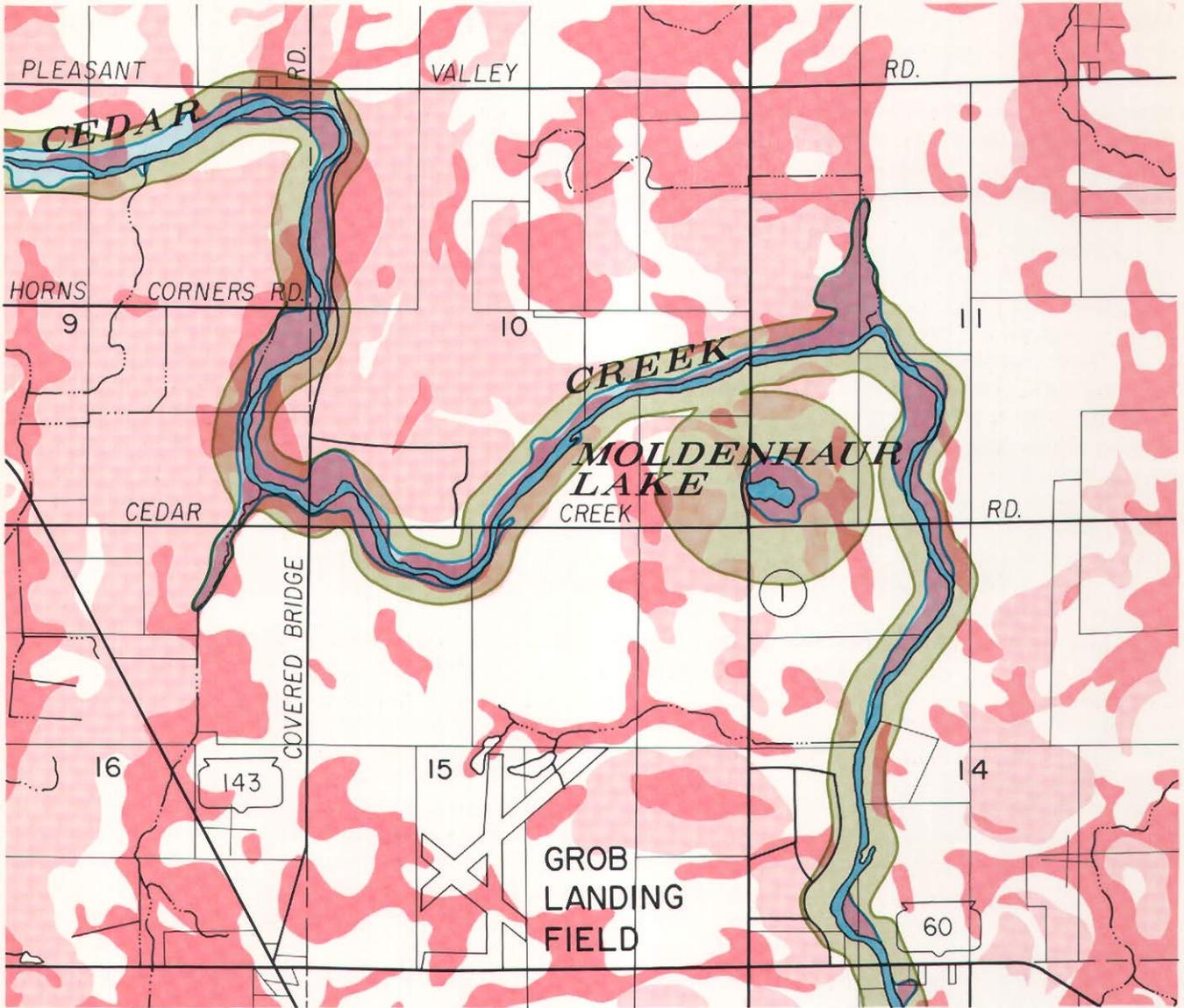
It is recommended that initially those watercourses designated as perennial streams on the U. S. Geological Survey 7 1/2 minute topographic quadrangle maps be made the subject of shoreland regulations affecting navigable streams. The determination and delineation of the floodplains are necessary, however, before the shoreland area can be properly delineated, as such shoreland area may in places follow a line 300 feet from the channel limits and in places the floodplain boundary, whichever is greater (see Figure 46).

¹⁶The Soil survey field sheets for all of Racine, Walworth, Washington, and Waukesha Counties and certain other areas have been enlarged to, and are available at, a scale of 1" = 1000'.

¹⁷SEWRPC Technical Report No. 2, Water Law in Southeastern Wisconsin (1966), p. 18.

Map 9

TYPICAL TOWN FLOOD HAZARD AND SHORELAND MAP



LEGEND

- SOILS THAT HAVE SEVERE LIMITATIONS FOR SEPTIC SYSTEMS.
- SOILS THAT HAVE VERY SEVERE LIMITATIONS FOR SEPTIC SYSTEMS.
- SHORELAND BOUNDARIES
- FLOODLANDS BASED ON SOIL, HISTORIC AND TOPOGRAPHIC DATA
- STREAMS AND LAKES

Shown on the above portion of a base map of the Town of Cedarburg are delineations of floodlands made on the basis of analyses of soil type and slope, flood hazard, topographic, and historic flood information. The map also shows the delineations of stream and lake shorelands. These delineations form the basis for the application of floodland and shoreland regulations in the Town.

Chapter VIII ADOPTION AND ADMINISTRATION

INTRODUCTION

Chapters IV and V recommend the adoption of the floodland and shoreland zoning districts, model ordinances, and special regulations contained in Appendices H through M to this Guide in order to prevent flood damage and protect shoreland and related water quality. These recommended regulations must be adapted to the needs and resources of the community, adopted by the local governing body, and administered and enforced by designated local officials. This chapter discusses the adapting agencies, adoption procedures, and enforcement methods.

RESPONSIBILITY

The zoning districts, ordinances, and special floodland and shoreland regulations suggested in Appendices H through M must not only be adapted to the type of land and water resources within each community but must also be carefully related to the quality and type of information available for the delineation of the floodlands and shorelands to be protected. The local planning agency is the most logical agency to be assigned the responsibility for preparing the regulations necessary to meet the State Water Resources Act of 1965. A local building or health agency, where such agencies exist, can be assigned the responsibility for the preparation of the local building and sanitary ordinances, respectively. Model ordinances creating city, village, town, and county planning agencies are contained in Appendices D and E of SEWRPC Planning Guide No. 4, Organization of Planning Agencies, 1964.

Assistance

In the preparation of floodland and shoreland regulations, the local planning agency should obtain the review, advice, and assistance of all local, areawide, state, and federal technical and professional personnel that may be available. Agencies and personnel which can help include the following:

- | | |
|---|--|
| 1. U. S. Department of Agriculture, Soil Conservation Service | Work Unit Conservationist |
| 2. U. S. Army Corps of Engineers | District Engineer |
| 3. U. S. Department of the Interior, Geological Survey | District Chief |
| 4. State Department of Natural Resources | Hydrologic, Hydraulic, and Sanitary Engineers |
| 5. State University Cooperative Extension | County Agents and Resource Specialists |
| 6. State Geological and Natural History Survey | State Geologist |
| 7. Regional Water Resources Advisory Boards | Sanitarians and Sanitary Engineers |
| 8. Areawide Agencies | Metropolitan Sewerage Commission Engineers and SEWRPC Planners and Engineers |
| 9. County Agencies | Highway Commissioners; Planners; Corporation Counsels; Water Patrolmen; Nurses; Sanitarians; and Building, Zoning, and Sanitary Inspectors |
| 10. Municipal Agencies | Attorneys; Public Works Directors; City Engineers; Planners; Building, Sanitary, and Zoning Inspectors; and Water Patrolmen |

Cooperation and Coordination of Efforts

Each local planning agency should enlist the cooperation of other local agencies by keeping such agencies advised of progress in the preparation of the floodland and shoreland regulations and by requesting their review and comments on such regulations before adoption. Such agencies include at the county level the Soil and Water Conservation District Supervisors, Health Committee, Building Committee, Sheriff's Office, and the Highway Committee and at the municipal level the Park Board and the Departments of Public Works, Engineering, Health, Building, and Recreation.

Review and Approval

The state floodplain and shoreland management programs require that local units of government must submit all proposed floodland and shoreland ordinances and related maps and supporting engineering data to the State Department of Natural Resources for review and comment prior to local adoption. If the methods and procedures set forth in this Guide are carefully followed, approval of the ordinances by the State Department of Natural Resources should ordinarily be forthcoming.

ADOPTION PROCEDURES

The procedures for adopting floodland and shoreland regulations vary with each type of regulatory ordinance used. Different review, notice, hearing, publication, promulgation, and approval procedures are specified for each by the Wisconsin Statutes.

Zoning Regulations

The procedure for the adoption of county floodland zoning, as distinguished from the procedures for the adoption of county shoreland zoning, is not clear in one respect. Under the standard county zoning procedures set forth in Section 59.97(6) of the Wisconsin Statutes, under which county floodland zoning powers are authorized, county zoning regulations and zoning districts are subject to town disapproval. However, Section 87.30 of the Wisconsin Statutes, which grants floodland zoning powers to the state if County Boards fail to act, may imply that the right of Town Board disapproval does not apply to floodland zoning. Therefore, County Boards should carefully consider this important procedural question before deciding whether to submit floodland zoning provisions to the Town Boards for formal legal review.

Counties may then decide to prepare and adopt floodland regulations and those zoning districts applicable to floodlands by following the standard amendment procedures set forth in Section 59.97(6) of the Wisconsin Statutes. Under these procedures the floodland regulations would be submitted to the towns affected; and if a majority of the town boards do not file a disapproving resolution within 40 days following transmittal, the regulations would become effective.¹ Or counties may decide to prepare and adopt floodland regulations in a manner identical to those specified below for county shoreland zoning regulations.

The procedures for enacting county shoreland regulations, pursuant to Section 59.971 of the Wisconsin Statutes, differ significantly from the standard zoning procedure in the following ways:

1. Those zoning districts and regulations applicable to the shoreland area are to be enacted separately from the regular county zoning ordinance. All the other provisions of Section 59.97 of the Wisconsin Statutes, however, including those pertaining to amendments, appeals, nonconforming uses, enforcement, and protest, apply to the shoreland districts and regulations.
2. The delineation on maps of such shoreland zoning districts, as well as the regulations and amendments pertaining thereto, are not subject to the approval or disapproval of any town board.
3. Such shoreland districts and regulations supersede all provisions of the county ordinance enacted under Section 59.97 of the Wisconsin Statutes that relate to shorelands.

¹Senate Bill No. 517 (1967) would have clarified the floodland zoning procedures by expressly providing that there be no requirement for town approval of the county zoning ordinance where floodlands were concerned.

It is most desirable to have one comprehensive zoning ordinance so as to avoid duplication and confusion. Therefore, even though the zoning districts and regulations applicable to shorelands must be enacted separately, in accordance with Section 59.971(1) of the Wisconsin Statutes, they should be so designed and numbered as to be readily incorporated into the regular county zoning ordinance and have been so set forth in Appendices H and I.

Shoreland regulations and applicable zoning districts enacted by cities and villages, pursuant to Section 144.26 of the Wisconsin Statutes, would be adopted in accordance with the procedures set forth for regular zoning ordinances in Section 62.23(7) of the Wisconsin Statutes.

Land Division Regulations

Floodland and shoreland regulations which are to be included as part of a county, city, or village land division ordinance can be adopted in the same way as an ordinary ordinance. However, Section 236.45(4) of the Wisconsin Statutes requires that:

1. The governing body shall receive the recommendation of its planning agency before adoption of such ordinance or amendment thereto.
2. A public hearing shall be held on such ordinance with a Class 2 Notice² given.
3. The adopted ordinance shall be published in a form suitable for public distribution.

Building and Sanitary Ordinances

Floodland and shoreland regulations which are included as part of local building and sanitary ordinances may be adopted by counties, cities, and villages as ordinary ordinances in accordance with Sections 59.07(51),³ 61.50, and 62.11(4) of the Wisconsin Statutes, respectively.

Aquatic Recreation Ordinances

Certain recreational water use regulations may be adopted by counties,⁴ cities, villages, and towns as ordinary ordinances except that Section 30.77 of the Wisconsin Statutes requires that:

1. Such regulations shall not be contrary or inconsistent with Chapter 30 of the Wisconsin Statutes relating to boating.
2. The area to be patrolled must be defined by the State Department of Natural Resources.
3. Local regulations of boats on inland lakes must be adopted by all cities, villages, and towns having jurisdiction on the waters of such lakes.
4. All such regulations shall be prominently posted at all public access points and filed with the State Department of Natural Resources.

ENFORCEMENT

Preparation, adoption, and promulgation of floodland and shoreland regulations will not in itself result in the prevention of flood damage and the protection of shorelands and related water quality without adequate enforcement procedures and personnel. The proper enforcement of floodland and shoreland regulations requires issuance of zoning, building, and sanitary permits, as well as the review and approval of all land divisions, along with the full- or part-time employment of various zoning, building, and sanitary inspectors and water patrolmen. In addition, proper land division review and approval require the retention of the services of professional planning, engineering, and legal personnel.

²A Class 2 Notice indicates that the required publication of a legal notice must appear at least twice in accordance with Chapter 985 of the Wisconsin Statutes, with the last notice appearing at least one week before the hearing.

³Chapter 87, Laws of Wisconsin 1967, has amended this section to eliminate the requirement that the cost of administering and enforcing such regulations shall be paid only from permit fees.

⁴Counties have this authority only on those lakes and adjoining waters where the county operates a marina.

Permits, Plats, and Inspectors

The SEWRPC Model Zoning Ordinance, which is set forth as Appendix A, SEWRPC Planning Guide No. 2, Zoning Guide, 1964, into which the floodland and shoreland regulations in Appendix I are to be incorporated, provides for a zoning permit and refers to, and assumes the appointment of, zoning inspectors to enforce such ordinance. The SEWRPC Model Land Division Ordinance, which is set forth as Appendix F, SEWRPC Planning Guide No. 1, Land Development Guide, 1963, into which the floodland and shoreland regulations in Appendix J are to be incorporated, provides for preliminary plat, final plat, and certified survey map review and approval and refers to, and assumes the creation of, a local planning agency to administer such ordinance. The Model Sanitary Ordinance (Appendix K) provides for sanitary permits and creates the position of a sanitary inspector and refers to, and assumes the creation of, a local health agency. The floodland regulations (Appendix L), which should be incorporated into existing building ordinances, refers to, and assumes the use of, building permits, the appointment of a local building inspector, and the creation of a local building agency. The Model Aquatic Recreation Ordinance (Appendix M) refers to, and assumes the creation of, a water patrol in accordance with Section 30.79(4) of the Wisconsin Statutes.

Access

Local inspectors must have access to premises and structures, including buildings, to be able to effectively determine compliance with zoning, land division, building, and sanitary ordinances. Such access should be specifically authorized in the ordinance and be limited to such inspections at reasonable hours as are deemed necessary to ensure compliance with the applicable ordinance. Recently, two U. S. Supreme Court cases held that "... a search of private property without proper consent is 'unreasonable' unless it has been authorized by a valid search warrant"⁵ and "... as a practical matter ... warrants should normally be sought only after entry is refused"⁶

The Wisconsin Legislature responded to these decisions by providing for a special inspection warrant, which shall be issued for inspection of personal or real properties which are not public buildings only upon showing that consent to enter for inspection purposes has been refused.⁷ An access provision reflecting the aforementioned decisions and incorporating the special inspection warrant has been included in the model ordinances in Appendices I through L. Water Patrolmen have been specifically empowered to stop and board watercraft for the purpose of enforcing aquatic recreation ordinances.⁸

Monitoring

In addition to the inspections and water patrols necessary to enforce properly the recommended shoreland regulations, it also becomes necessary to provide for a continuous water quality monitoring program, such as that conducted by the State Department of Natural Resources on a periodic basis for selected watersheds and by the Commission on all 44 streams within the seven-county Southeastern Wisconsin Region from January 1964 to February 1965, and on a continuing basis since then under a cooperative agreement with the State Department of Natural Resources.

Cooperation

Often floodland and shoreland regulations and monitoring programs can be more effectively and economically conducted, administered, and enforced through cooperative agreements between several units of government. Section 66.30 of the Wisconsin Statutes provides that any municipality, including counties, cities, villages, and towns, and regional planning commissions may contract with one another to create cooperative contract commissions for the joint exercise of any power or duties required by statute. Sec-

⁵Camara v. Municipal Court of the City and the County of San Francisco, 387 U. S. 523, 18 L. Ed. 2nd 930, 87 S. Ct. (1967).

⁶See v. City of Seattle, 387 U. S. 541, 18 L. Ed. 2nd 943, 87 S. Ct. Rep. 1737 (1967).

⁷Section 963.10, Chapter 85, Laws of Wisconsin 1967.

⁸Section 30.79(3), Wisconsin Statutes, 1965.

tion 59.971 of the Wisconsin Statutes specifically authorizes the use of such a cooperative contract commission provided it is effectuated by an ordinance. Appendix A of SEWRPC Technical Report No. 6, Planning Law in Southeastern Wisconsin, is a model agreement creating such a cooperative contract commission which may be adapted to ordinance form.

Financial Assistance

Adequate financing of local enforcement programs is essential to effectively administer and enforce floodland and shoreland regulations. Section 144.26(4) of the Wisconsin Statutes authorizes grants-in-aid for the administration and enforcement of county shoreland regulations, subject to the finding of the State Department of Natural Resources that there are in effect regulations that are properly administered and enforced and meet the standards and criteria of the State Water Resources Act of 1965. The amount of the grant is determined by the State Department of Natural Resources taking into account the miles of shoreline and acres of shoreland protected, the number of permits, and the number of counties participating in a cooperative intercounty program established under Section 66.30 of the Wisconsin Statutes.

Section 30.79 of the Wisconsin Statutes authorizes aids to counties, cities, villages, and towns toward the cost of operating and maintaining a water safety patrol. Such program is administered by the State Department of Natural Resources; and the amount of financial aid is based upon 75 percent of the net cost directly attributed to the operation and maintenance of the water safety patrol, including a reasonable amount for depreciation of equipment but after deduction of any fines or forfeitures received.

Educational Program

Often there is a considerable gap between the information, policies, and regulations available to prevent flood damage and protect shorelands and water quality on one hand and the public understanding, official action, and actual enforcement of such regulations on the other hand. Those communities in which floodland and shoreland regulations will be most effective are those where public interest has been developed and maintained. Strong and active citizen conservation and anti-pollution groups will be of tremendous value in this respect; but the potential contributions of other business and civic groups that may also have an interest in the economic health, aesthetic appearance, and general welfare of the community, such as lending institutions, chambers of commerce, and service clubs, should not be overlooked. Knowledgeable explanations and unbiased information of floodland and shoreland regulations by competent, efficient, reasonable inspectors and other local officials will also assist greatly in obtaining the necessary support of the citizenry.

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Chapter IX

SUMMARY AND CONCLUSIONS

INTRODUCTION

The rapid population growth and urbanization forecast to occur within the Southeastern Wisconsin Region over the next two decades will make very great demands upon the limited natural resource base of this Region. This rapid population growth and urbanization within the Region will intensify the demand for the conversion of floodlands to incompatible urban land uses. It will increase the demands upon the water resources of the Region and multiply conflicts within and between land and water uses. The indiscriminate erection of homes, stores, and factories on floodlands and the despoilation of shoreland and related water quality will inevitably result in the destruction of certain irreplaceable elements of the resource base, a deterioration of the overall quality of the environment for life within the Region, and a demand for expensive public flood control and pollution abatement projects.

The problems of mounting flood losses and increasing water pollution have received both national and state attention and have resulted in a Presidential executive order on flood control policy, the enactment by the Congress of the United States of the Federal Water Quality Act of 1965, and the adoption by the State Legislature of Wisconsin of the State Water Resources Act of 1965.

FLOODLAND PROBLEMS

In the absence of sound land and water use planning and plan implementation, urbanization in southeastern Wisconsin will continue to result in urban development being allowed to preempt natural floodways and floodplains without regard to the periodic flood hazards and concomitant dangers to property, health, and life. In addition to the inconvenience, hardship, danger, economic loss, and heartaches caused to occupants of floodlands during floodtime, floodwater also causes disruption of utility and transportation services; health and safety hazards; and damage to industries, businesses, residences, and agricultural operations, as well as other economic losses.

If flood-vulnerable development is allowed to continue to occur on the floodlands of the Region, a rapid increase in flood damages and attendant health and safety hazards can be expected. This will lead inevitably to a demand for the construction of expensive public flood protection works, and the construction of such works will become self-defeating as development continues in the floodlands. Only the adoption and administration of an effective flood damage prevention program based upon comprehensive land and related water use plans will provide for the elimination or reduction in flood losses that is needed within the Region.

SHORELAND PROBLEMS

There is a delicate, complex, biotic relationship between the natural condition of shorelands, adjacent streams and lakes, and the vegetation and wildlife supported by such lands and waters. The intrusion of man and his rural and urban activities interrupt, disturb, and may destroy these delicate relationships. This intrusion and disruption may be caused by indiscriminate dredging, draining, filling, tree cutting, and shrubbery clearing; uncontrolled livestock watering and overgrazing; manure spreading on frozen ground; careless use of pesticides, herbicides, and chemical fertilizers; inoperative septic systems; poor municipal sewage treatment; dumping or discharge of industrial wastes; and excessive water withdrawal, as well as by poorly planned, incompatible land use development. The increases in population, urbanization, income, leisure time, and individual mobility forecast for the Region will result in additional pressure for shoreland conversion and development within the Region. Such development will result in further destruction of shoreland cover and wildlife habitat and, without adequate provision for sewage disposal, in the destruction of water quality. Only the adoption and administration of an effective water management program, based upon comprehensive water and related land use plans, will provide the shoreland and related water quality protection that is needed.

FLOOD DAMAGE PREVENTION

Once a comprehensive land and water use plan has been prepared and adopted, numerous methods and devices are available to local units of government for preventing future flood damage and abating existing flood damage potential. These include the protection, removal, discouragement, and regulation of certain types of rural and urban development in floodland areas. Specifically, such methods and devices include flood control works; evacuation; floodproofing; public acquisition of floodlands; urban renewal; razing; educational programs; warning signs; intelligent assessment practices; proper financing and public development policies; flood insurance; and zoning, land division, sanitary, and building ordinances.

SHORELAND AND WATER QUALITY PROTECTION

Once a comprehensive land and water use plan has been prepared and adopted, numerous methods and devices are available to local units of government for the protection of shorelands and related water quality. As part of a comprehensive water management program, these include the correction, abatement, and prevention of water pollution and related shoreland problems. Specifically, such methods and devices include exportation of liquid wastes; public acquisition of shorelands; redevelopment; rehabilitation; restocking; replanting; improved or alternative waste treatment methods; streamflow augmentation; soil and water conservation practices; and zoning, land division, sanitary, and aquatic recreation ordinances.

STATUTORY AUTHORITY

The State Water Resources Act of 1965 grants to counties, cities, and villages new powers having as their purpose the improvement of water quality, the preservation of shoreland cover, the protection of wildlife, and the enhancement of aquatic recreation. In addition, the Wisconsin Legislature has authorized the State Department of Natural Resources to adopt floodland regulations where serious flood damage may occur if the county, city, or village has not adopted adequate regulations. The State Department of Natural Resources is also authorized to adopt shoreland regulations in unincorporated areas if counties do not adopt adequate regulations meeting the purposes of the Water Resources Act.

DEFINITIONS AND DELINEATION

The Wisconsin Legislature has not defined specifically the word "floodplain"; and the Commission has, therefore, recommended that the lands subject to flooding be divided into three regulatory areas—the channel, the floodway, and the floodplain—based upon the differing characteristics, functions, and hazards of these three portions of a stream valley.

The Commission has further recommended that the floodplains in southeastern Wisconsin be defined as that area of a stream valley inundated by the 100-year recurrence interval flood, as determined by detailed hydrologic and hydraulic engineering studies, and that the floodway be defined as that area of the stream valley required to carry and discharge the floodwaters of the 100-year recurrence interval flood. If development and fill are to be prohibited in the floodplain, the floodway may be delineated as the area inundated by the 10-year recurrence interval flood.

The engineering data necessary for the delineation of floodplains and floodways are presently available for the Root and Des Plaines River watersheds and will be available within the year for the Fox River watershed and within two years for the Milwaukee River watershed. On those streams where such data are not available, other information that is available may be used in the interim for the delineation of floodlands. This information includes aerial photographs, detailed operational soil surveys and analyses, U. S. Geological topographic quadrangle maps, historic flood records, and field surveys. All of these materials should be used in combination for the most effective results.

The Wisconsin Legislature has defined the term "shorelands" as that area extending 1,000 feet from the shoreline of lakes and flowages and 300 feet from the shorelines of navigable streams or to the landward side of the floodplain, whichever is greater. Navigable waters have been defined by the Wisconsin Supreme Court as those waters which are navigable-in-fact; that is, any waters which are capable of floating any boat, skiff, or canoe of the shallowest draft used for commercial or recreation purposes during at least part of the year. This definition also extends to any navigable lakes. Within the Region all of the streams, lakes, and ponds set forth in Appendices B, C, and D should be considered by the local units of government for floodland and shoreland protection.

MODEL ORDINANCES

The prohibition and regulation of flood-vulnerable uses and certain shoreland and water abuses under local police powers are the most logical, most efficient, and most economical ways of preventing flood damage and protecting shoreland and water quality. Appendices H through M of this Guide contain suggested zoning districts, model ordinances, and special floodland and shoreland regulations which may be adopted or incorporated into the Commission's model ordinances or other properly prepared ordinances. These suggested zoning districts, model ordinances, and floodland and shoreland regulations will not only meet the requirements of the State Water Resources Act of 1965 and the state floodplain and shoreland management programs but will meet the regional development objectives and standards set forth in the adopted regional, watershed, and district plans and will substantially assist in implementing those plans. These model zoning districts, special regulations, and model sanitary and aquatic recreation ordinances together comprise very important elements of comprehensive floodland damage prevention and shoreland protection programs.

The adaptation of such districts, regulations, and ordinances to meet local needs and resources is the responsibility of local agencies, which can obtain assistance in carrying out this responsibility from various federal, state, regional, and local technicians. Some caution must be exercised in such adaptation as adoption procedures for these types of regulations vary from the procedures used in adopting regular ordinances. Some state financial assistance is available for the enforcement of pollution prevention and water safety regulations.

CONCLUSIONS

The adopted regional, watershed, and district land use plans each identify the primary environmental corridors within the Region and contain recommendations for the protection of these corridors. It is imperative that these primary environmental corridors and the prime elements of the natural resource base contained therein be preserved and protected if the quality of the environment within the Region is to be maintained and if further deterioration and destruction of the underlying and sustaining natural resource base is to be avoided. Floodlands and shorelands comprise important integral elements of the primary environmental corridors; and, consequently, both rural and urban development on the floodlands and shorelands must be carefully regulated.

To the maximum extent possible and practicable, all of the floodlands within the environmental corridors should be kept in open uses and much of the remaining undeveloped shorelands within such corridors should be kept in their natural state. It is primarily for these reasons that the Commission has recommended the zoning districts, model ordinances, and special floodland and shoreland regulations set forth in Appendices H through M of this Guide.

The adoption and enforcement of these zoning, land division, sanitary, building, and aquatic recreation regulations and the proper application of these zoning districts to the environmental corridors within the Region by the local units of government will not only meet the purposes and specific requirements of the State Water Resources Act of 1965 in regard to the prevention of flood damage and protection of shoreland and related water quality but will greatly assist in the implementation of adopted regional, watershed, and district land use plans.

Implementation of these plans will provide for a safer, healthier, more economical settlement pattern, as well as a more pleasant environment for life within the Region, not only for the people of today but for countless future generations (see Figure 2). Failure to implement these plans will inevitably result in further intensification of environmental problems within the Region, further deterioration and destruction of the natural resource base, and eventually in a reduction in the standard of human life within the Region.

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APPENDICES

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Appendix A
Areal Extent of Civil Divisions within Each Watershed
in the Southeastern Wisconsin Region

Table A-1
AREAL EXTENT OF EACH COUNTY BY WATERSHED WITHIN
THE SOUTHEASTERN WISCONSIN REGION: JANUARY 1967

County	Total County Area Square Miles	County Area By Watershed							
		Des Plaines River ^a		Fox River ^a		Kinnickinnic River		Minor Tributaries To Lake Michigan	
		Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Kenosha	278.28	122.85	91.96	96.46	10.28	--	--	26.99	28.87
Milwaukee	242.19	--	--	0.47	0.05	25.66	100.00	18.22	19.49
Ozaukee	234.49	--	--	--	--	--	--	27.44	29.35
Racine	339.87	10.74	8.04	164.44	17.52	--	--	20.84	22.29
Walworth	578.08	--	--	341.46	36.37	--	--	--	--
Washington	435.50	--	--	0.31	0.03	--	--	--	--
Waukesha	580.66	--	--	335.59	35.75	--	--	--	--
Region	2,689.07	133.59	100.00	938.73	100.00	25.66	100.00	93.49	100.00

County	County Area By Watershed							
	Menomonee River		Milwaukee River ^a		Oak Creek		Pike River	
	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Kenosha	--	--	--	--	--	--	29.79	59.31
Milwaukee	55.75	40.97	56.97	13.24	26.29	100.00	--	--
Ozaukee	11.58	8.51	150.54	34.99	--	--	--	--
Racine	--	--	--	--	--	--	20.44	40.69
Walworth	--	--	--	--	--	--	--	--
Washington	32.52	23.90	222.76	51.77	--	--	--	--
Waukesha	36.23	26.62	--	--	--	--	--	--
Region	136.08	100.00	430.27	100.00	26.29	100.00	50.23	100.00

County	County Area By Watershed							
	Rock River ^a		Root River		Sauk Creek		Tributary To ^a Sheboygan River	
	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Kenosha	--	--	2.19	1.11	--	--	--	--
Milwaukee	--	--	58.83	29.80	--	--	--	--
Ozaukee	--	--	--	--	33.72	100.00	11.21	100.00
Racine	--	--	123.41	62.51	--	--	--	--
Walworth	236.62	38.64	--	--	--	--	--	--
Washington	179.91	29.38	--	--	--	--	--	--
Waukesha	195.84	31.98	13.00	6.58	--	--	--	--
Region	612.37	100.00	197.43	100.00	33.72	100.00	11.21	100.00

^aIncludes only that area of the watershed within the seven county Southeastern Wisconsin Region.

Source: SEWRPC.

Table A-2
AREAL EXTENT OF CIVIL DIVISIONS IN KENOSHA COUNTY BY WATERSHED: JANUARY 1967

Civil Division	Total Civil Division Area Square Miles	Civil Division Area By Watershed									
		Des Plaines River		Fox River		Minor Tributaries To Lake Michigan		Pike River		Root River	
		Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
City											
Kenosha	13.00	0.01	0.01	--	--	11.47	12.27	1.52	3.03	--	--
Villages											
Paddock Lake	1.60	1.60	1.20	--	--	--	--	--	--	--	--
Silver Lake	1.42	--	--	1.42	0.15	--	--	--	--	--	--
Twin Lakes	5.73	--	--	5.73	0.61	--	--	--	--	--	--
Towns											
Brighton	36.00	15.19	11.37	20.81	2.22	--	--	--	--	--	--
Bristol	36.11	36.11	27.03	--	--	--	--	--	--	--	--
Paris	36.02	33.83	25.32	--	--	--	--	--	--	2.19	1.11
Pleasant Prairie	37.45	22.38	16.75	--	--	12.41	13.27	2.66	5.29	--	--
Randall	18.23	--	--	18.23	1.94	--	--	--	--	--	--
Salem	33.33	7.19	5.38	26.14	2.79	--	--	--	--	--	--
Somers	35.26	6.54	4.90	--	--	3.11	3.33	25.61	50.99	--	--
Wheatland	24.13	--	--	24.13	2.57	--	--	--	--	--	--
Total	278.28	122.85	91.96	96.46	10.28	26.99	28.87	29.79	59.31	2.19	1.11

Source: SEWRPC.

Table A-3
AREAL EXTENT OF CIVIL DIVISIONS IN MILWAUKEE COUNTY BY WATERSHEDS: JANUARY 1967

Civil Division	Total Civil Division Area Square Miles	Civil Division Area By Watersheds					
		Fox River		Kinnickinnic River		Minor Tributaries To Lake Michigan	
		Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Cities							
Cudahy	4.77	--	--	1.89	7.37	2.64	2.82
Franklin	34.63	0.47	0.05	--	--	--	--
Glendale	5.93	--	--	--	--	0.08	0.09
Greenfield	12.08	--	--	2.48	9.66	--	--
Milwaukee	95.96	--	--	18.06	70.38	4.23	4.52
Oak Creek	28.41	--	--	--	--	3.03	3.24
St. Francis	2.56	--	--	0.87	3.39	1.69	1.81
South Milwaukee	4.80	--	--	--	--	1.60	1.71
Wauwatosa	13.23	--	--	--	--	--	--
West Allis	11.38	--	--	1.79	6.98	--	--
Villages							
Bayside	2.31	--	--	--	--	1.68	1.80
Brown Deer	4.37	--	--	--	--	--	--
Fox Point	2.87	--	--	--	--	1.66	1.78
Greendale	5.55	--	--	--	--	--	--
Hales Corners	3.21	--	--	--	--	--	--
River Hills	5.32	--	--	--	--	1.21	1.29
Shorewood	1.58	--	--	--	--	0.13	0.14
West Milwaukee	1.11	--	--	0.57	2.22	--	--
Whitefish Bay	2.12	--	--	--	--	0.27	0.29
Total	242.19	0.47	0.05	25.66	100.00	18.22	19.49

Table A-3 (continued)

Civil Division	Civil Division Area By Watersheds							
	Menomonee River		Milwaukee River		Oak Creek		Root River	
	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Cities								
Cudahy	--	--	--	--	0.24	0.91	--	--
Franklin	--	--	--	--	2.50	9.51	31.66	16.04
Glendale	--	--	5.85	1.36	--	--	--	--
Greenfield	3.13	2.30	--	--	0.22	0.84	6.25	3.16
Milwaukee	32.12	23.60	37.50	8.72	2.83	10.77	1.22	0.62
Oak Creek	--	--	--	--	17.30	65.80	8.08	4.09
St. Francis	--	--	--	--	--	--	--	--
South Milwaukee	--	--	--	--	3.20	12.17	--	--
Wauwatosa	13.23	9.72	--	--	--	--	--	--
West Allis	6.64	4.88	--	--	--	--	2.95	1.49
Villages								
Bayside	--	--	0.63	0.15	--	--	--	--
Brown Deer	--	--	4.37	1.01	--	--	--	--
Fox Point	--	--	1.21	0.28	--	--	--	--
Greendale	0.09	0.07	--	--	--	--	5.46	2.77
Hales Corners	--	--	--	--	--	--	3.21	1.63
River Hills	--	--	4.11	0.95	--	--	--	--
Shorewood	--	--	1.45	0.34	--	--	--	--
West Milwaukee	0.54	0.40	--	--	--	--	--	--
Whitefish Bay	--	--	1.85	0.43	--	--	--	--
Total	55.75	40.97	56.97	13.24	26.29	100.00	58.83	29.80

Source: SEWRPC.

Table A-4
AREAL EXTENT OF CIVIL DIVISIONS IN OZAUKEE COUNTY BY WATERSHED: JANUARY 1967

Civil Division	Total Civil Division Area Square Miles	Civil Division Area By Watersheds									
		Minor Tributaries To Lake Michigan		Menomonee River		Milwaukee River		Sauk Creek		Tributary To Sheboygan River	
		Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Cities											
Cedarburg	2.20	--	--	--	--	2.20	0.51	--	--	--	--
Mequon	46.88	3.73	3.99	11.58	8.51	31.57	7.34	--	--	--	--
Port Washington	2.39	1.09	1.16	--	--	--	--	1.30	3.86	--	--
Villages											
Bayside	0.09	0.09	0.10	--	--	--	--	--	--	--	--
Belgium	0.59	0.03	0.03	--	--	--	--	0.04	0.12	0.52	4.64
Fredonia	1.05	--	--	--	--	0.93	0.22	0.12	0.36	--	--
Grafton	1.70	--	--	--	--	1.70	0.39	--	--	--	--
Saukville	1.29	--	--	--	--	1.29	0.30	--	--	--	--
Thiensville	1.03	--	--	--	--	1.03	0.24	--	--	--	--
Towns											
Belgium	36.99	13.38	14.31	--	--	--	--	12.92	38.31	10.69	95.36
Cedarburg	27.93	--	--	--	--	27.93	6.49	--	--	--	--
Fredonia	35.18	--	--	--	--	28.18	6.55	7.00	20.76	--	--
Grafton	21.98	2.99	3.20	--	--	18.13	4.21	0.86	2.55	--	--
Port Washington	20.09	6.13	6.56	--	--	2.49	0.58	11.47	34.01	--	--
Saukville	35.10	--	--	--	--	35.09	8.16	0.01	0.03	--	--
Total	234.49	27.44	29.35	11.58	8.51	150.54	34.99	33.72	100.00	11.21	100.00

Source: SEWRPC.

Table A-5
AREAL EXTENT OF CIVIL DIVISIONS IN RACINE COUNTY BY WATERSHED: JANUARY 1967

Civil Division	Total Civil Division Area Square Miles	Civil Division Area By Watershed									
		Des Plaines River		Fox River		Minor Tributaries To Lake Michigan		Pike River		Root River	
		Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Cities											
Burlington	3.04	--	--	3.04	0.32	--	--	--	--	--	--
Racine	12.51	--	--	--	--	6.26	6.69	0.20	0.40	6.05	3.07
Villages											
Elmwood Park	0.15	--	--	--	--	0.15	0.16	--	--	--	--
North Bay	0.11	--	--	--	--	0.11	0.12	--	--	--	--
Rochester	0.39	--	--	0.39	0.04	--	--	--	--	--	--
Sturtevant	1.55	--	--	--	--	--	--	1.55	3.08	--	--
Union Grove	0.70	0.38	0.28	--	--	--	--	--	--	0.32	0.16
Waterford	1.17	--	--	1.17	0.13	--	--	--	--	--	--
Wind Point	1.23	--	--	--	--	1.23	1.32	--	--	--	--
Towns											
Burlington	38.74	--	--	38.74	4.13	--	--	--	--	--	--
Caledonia	47.14	--	--	--	--	10.53	11.26	--	--	36.61	18.54
Dover	36.14	1.92	1.44	31.58	3.36	--	--	--	--	2.64	1.34
Mount Pleasant	38.29	2.82	2.11	--	--	2.56	2.74	18.69	37.21	14.22	7.20
Norway	35.72	--	--	35.62	3.79	--	--	--	--	0.10	0.05
Raymond	35.37	--	--	1.74	0.19	--	--	--	--	33.63	17.03
Rochester	17.53	--	--	17.53	1.87	--	--	--	--	--	--
Waterford	34.63	--	--	34.63	3.69	--	--	--	--	--	--
Yorkville	35.46	5.62	4.21	--	--	--	--	--	--	29.84	15.12
Total	339.87	10.74	8.04	164.44	17.52	20.84	22.29	20.44	40.69	123.41	62.51

Source: SEWRPC.

Table A-6
AREAL EXTENT OF CIVIL DIVISIONS IN WALWORTH COUNTY BY WATERSHED: JANUARY 1967

Civil Division	Total Civil Division Area Square Miles	Civil Divisions Area By Watersheds			
		Fox River		Rock River	
		Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Cities					
Delavan	2.88	--	--	2.88	0.47
Elkhorn	4.05	1.50	0.16	2.55	0.42
Lake Geneva	3.39	3.39	0.36	--	--
Whitewater	4.14	--	--	4.14	0.68
Villages					
Darien	0.64	--	--	0.64	0.10
East Troy	1.18	1.18	0.13	--	--
Fontana	3.39	3.17	0.34	0.22	0.04
Genoa City	0.99	0.99	0.11	--	--
Sharon	0.87	--	--	0.87	0.14
Walworth	1.07	0.12	0.01	0.95	0.16
Williams Bay	2.79	2.63	0.28	0.16	0.03
Towns					
Bloomfield	35.32	35.32	3.76	--	--
Darien	35.30	--	--	35.30	5.76
Delavan	32.31	0.60	0.06	31.71	5.18
East Troy	34.81	34.81	3.71	--	--
Geneva	32.75	20.37	2.17	12.38	2.02
Lafayette	35.11	34.62	3.69	0.49	0.08
La Grange	35.82	28.05	2.99	7.77	1.27
Linn	34.11	32.09	3.42	2.02	0.33
Lyons	35.98	35.98	3.83	--	--
Richmond	36.17	0.40	0.04	35.77	5.84
Sharon	35.67	--	--	35.67	5.82
Spring Prairie	36.10	36.10	3.84	--	--
Sugar Creek	34.98	26.20	2.79	8.78	1.43
Troy	35.64	35.64	3.80	--	--
Walworth	30.75	7.27	0.77	23.48	3.83
Whitewater	31.87	1.03	0.11	30.84	5.04
Total	578.08	341.46	36.37	236.62	38.64

Source: SEWRPC.

Table A-7
AREAL EXTENT OF CIVIL DIVISIONS IN WASHINGTON COUNTY BY WATERSHED: JANUARY 1967

Civil Division	Total Civil Division Area Square Miles	Civil Division Area By Watershed							
		Fox River		Menomonee River		Milwaukee River		Rock River	
		Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Cities									
Hartford	2.07	--	--	--	--	--	--	2.07	0.34
West Bend	4.55	--	--	--	--	4.55	1.06	--	--
Villages									
Germantown	34.33	--	--	29.84	21.93	4.49	1.04	--	--
Jackson	0.51	--	--	--	--	0.51	0.12	--	--
Kewaskum	1.01	--	--	--	--	1.01	0.23	--	--
Slinger	1.60	--	--	--	--	--	--	1.60	0.26
Towns									
Addison	36.02	--	--	--	--	0.12	0.03	35.90	5.96
Barton	21.32	--	--	--	--	20.01	4.65	1.31	0.21
Erin	36.04	--	--	--	--	--	--	36.04	5.89
Farmington	36.77	--	--	--	--	36.77	8.55	--	--
Germantown	1.77	--	--	0.80	0.59	0.97	0.23	--	--
Hartford	34.76	--	--	--	--	--	--	34.76	5.68
Jackson	36.07	--	--	--	--	36.07	8.38	--	--
Kewaskum	23.32	--	--	--	--	23.32	5.42	--	--
Polk	34.59	--	--	--	--	24.39	5.67	10.20	1.67
Richfield	36.34	0.31	0.03	1.88	1.38	4.32	1.00	29.83	4.87
Trenton	35.73	--	--	--	--	35.73	8.30	--	--
Wayne	35.77	--	--	--	--	8.62	2.00	27.15	4.43
West Bend	22.93	--	--	--	--	21.88	5.09	1.05	0.17
Total	435.50	0.31	0.03	32.52	23.90	222.76	51.77	179.91	29.38

Source: SEWRPC.

Table A-8
AREAL EXTENT OF CIVIL DIVISIONS IN WAUKESHA COUNTY BY WATERSHED: JANUARY 1967

Civil Division	Total Civil Division Area Square Miles	Civil Division Area By Watersheds							
		Fox River		Menomonee River		Rock River		Root River	
		Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed	Square Miles	Percent of Watershed
Cities									
Brookfield	25.34	12.08	1.29	13.26	9.74	--	--	--	--
Delafield	10.17	0.18	0.02	--	--	9.99	1.63	--	--
Muskego	35.47	31.63	3.37	--	--	--	--	3.84	1.94
New Berlin	36.75	26.93	2.87	0.66	0.49	--	--	9.16	4.64
Oconomowoc	3.78	--	--	--	--	3.78	0.62	--	--
Waukesha	7.83	7.83	0.83	--	--	--	--	--	--
Villages									
Big Bend	0.57	0.57	0.06	--	--	--	--	--	--
Butler	0.78	--	--	0.78	0.57	--	--	--	--
Chenequa	4.65	--	--	--	--	4.65	0.76	--	--
Dousman	0.56	--	--	--	--	0.56	0.09	--	--
Eagle	0.98	0.94	0.10	--	--	0.04	0.01	--	--
Elm Grove	3.25	--	--	3.25	2.39	--	--	--	--
Hartland	1.76	0.15	0.02	--	--	1.61	0.26	--	--
Lac La Belle	0.48	--	--	--	--	0.48	0.08	--	--
Lannon	2.51	2.51	0.27	--	--	--	--	--	--
Menomonee Falls	33.50	15.69	1.67	17.81	13.09	--	--	--	--
Merton	2.25	--	--	--	--	2.25	0.37	--	--
Mukwonago	1.50	1.50	0.16	--	--	--	--	--	--
Nashotah	1.63	--	--	--	--	1.63	0.27	--	--
North Prairie	0.56	0.56	0.06	--	--	--	--	--	--
Oconomowoc Lake	3.09	--	--	--	--	3.09	0.50	--	--
Pewaukee	1.94	1.94	0.21	--	--	--	--	--	--
Sussex	1.21	1.21	0.13	--	--	--	--	--	--
Wales	1.10	0.46	0.05	--	--	0.64	0.10	--	--
Towns									
Brookfield	7.77	7.56	0.80	0.21	0.15	--	--	--	--
Delafield	23.33	14.86	1.59	--	--	8.47	1.38	--	--
Eagle	35.25	20.33	2.17	--	--	14.92	2.44	--	--
Genesee	34.42	28.87	3.07	--	--	5.55	0.91	--	--
Lisbon	35.17	22.45	2.39	0.26	0.19	12.46	2.03	--	--
Merton	28.83	1.45	0.15	--	--	27.38	4.47	--	--
Mukwonago	35.29	35.29	3.76	--	--	--	--	--	--
Oconomowoc	33.76	--	--	--	--	33.76	5.51	--	--
Ottawa	36.01	3.14	0.33	--	--	32.87	5.37	--	--
Pewaukee	31.54	31.54	3.36	--	--	--	--	--	--
Summit	31.71	--	--	--	--	31.71	5.18	--	--
Vernon	34.90	34.90	3.72	--	--	--	--	--	--
Waukesha	31.02	31.02	3.30	--	--	--	--	--	--
Total	580.66	335.59	35.75	36.23	26.62	195.84	31.98	13.00	6.58

Source: SEWRPC.

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Appendix B

Streams in the Southeastern Wisconsin Region

Table B-1
STREAMS IN KENOSHA COUNTY, WISCONSIN^a

Name	General Location (Municipality)	Tributary To	Average ^b Surface Width ^c (Feet)	Surface Length (Miles)	Surface Area ^c (Acres)	Average ^b Gradient ^d (Feet/mile)
Barnes Creek	T/Pleasant Prairie	Lake Michigan	4	1.40	0.70	28.50
Bassett Creek	T/Randall	Fox River	4	4.50	2.20	11.10 ^e
Brighton Creek	T/Brighton	Des Plaines River	4	7.80	3.80	9.00
Des Plaines River Center Branch	T/Paris, Bristol	Des Plaines River	4	6.70	3.20	12.00
East Branch	T/Pleasant Prairie, Somers	Des Plaines River	6	10.00	7.30	4.50
Main Branch	T/Pleasant Prairie, Bristol	Illinois River	8	17.50	12.80	2.10
Dutch Gap Canal	T/Bristol	Illinois River	10	4.00	4.80	2.50
Fox River	T/Wheatland, Salem	Illinois River	180	12.00 ^e	402.00	0.70 ^e
Hoosier Creek	T/Brighton	Fox River	8	4.00	3.90	5.00
Kenosha South Creek	T/Pleasant Prairie	Lake Michigan	3	1.10	0.40	27.00
Lower Pleasant Prairie Ditch	T/Pleasant Prairie	Des Plaines River	4	2.10	1.00	19.00
New Munster Creek	T/Wheatland	Fox River	5	2.80	1.70	21.40
Palmer Creek	T/Wheatland	Fox River	5	3.70	2.30	17.60
Peterson Creek	T/Wheatland, Brighton	Fox River	6	6.50	4.40	6.90 ^e
Pike Creek	T/Somers	Lake Michigan	3	1.60	0.50	12.50
Pike River	T/Somers	Lake Michigan	10	12.70	15.20	2.10
Salem Branch	T/Salem, Bristol	Des Plaines River	3	3.00	1.10	6.70
Trevor Creek	T/Salem	Fox River	3	3.30	1.20	24.20
Upper Pleasant Prairie Ditch	T/Pleasant Prairie	Des Plaines River	10	1.70	2.00	5.90

^aIncludes only those watercourses having a perennial flow or those intermittent streams that have been named.

^bAverages computed from the total of all measurements taken on both sides of all bridge crossings.

^cData for stream widths and areas were obtained from field observation and aerial photos, dated September and October 1956 for Kenosha County.

^dThe average gradient of each stream was obtained by dividing the difference in elevations of the mouth and headwaters by the distance between them obtained from U.S. Geological Survey topographic maps.

^eA revised figure has been provided from more recent and detailed SEWRPC comprehensive watershed planning programs.

Source: SEWRPC.

Table B-2
STREAMS IN MILWAUKEE COUNTY, WISCONSIN^a

Name	General Location (Municipality)	Tributary To	Average ^b Surface Width ^c (Feet)	Surface Length (Miles)	Surface Area ^c (Acres)	Average ^b Gradient ^d (Feet/mile)
Honey Creek	C/West Allis	Menomonee River	12	8.38	12.20	10.50
Indian Creek	V/River Hills	Milwaukee River	7	1.89	1.60	15.90
Kinnickinnic River	C/Milwaukee, West Allis	Milwaukee River	19	6.89	15.90	10.20
Lincoln Creek	C/Glendale, Milwaukee	Milwaukee River	24	7.13	20.70	8.10
Little Menomonee River	C/Milwaukee	Menomonee River	16	6.75	13.20	16.40
Menomonee River	C/Wauwatosa, Milwaukee	Milwaukee River	40	13.13	63.50	9.10
Milwaukee River	C/Milwaukee, V/Brown Deer	Lake Michigan	101	15.38	188.30	4.80
Oak Creek	C/Franklin, Oak Creek	Lake Michigan	16	12.12	23.20	9.90
Root River	C/West Allis, Oak Creek	Lake Michigan	18	18.88	41.20	3.70
Root River Canal	C/Franklin	Root River	10	1.39	1.70	3.60
Underwood Creek	C/West Allis	Menomonee River	10	3.28	4.00	17.40
Wilson Park Creek	C/Milwaukee	Kinnickinnic River	10	4.10	5.00	6.10
Wood Creek	C/Milwaukee	Menomonee River	4	0.75	0.40	53.30
Root River - Hales Corners	V/Hales Corners, Greendale	Root River	8	0.35	0.40	14.00
Root River - Whitnall Park	C/Franklin	Root River	12	2.57	3.80	9.60

^aIncludes only those watercourses having a perennial flow or those intermittent streams that have been named.

^bAverages computed from the total of all measurements taken on both sides of all bridge crossings.

^cData for stream widths and areas were obtained from field observation and aerial photos, dated June 1956 for Milwaukee County.

^dThe average gradient of each stream was obtained by dividing the difference in elevations of the mouth and headwaters by the distance between them obtained from U.S. Geological Survey topographic maps.

Source: SEWRPC.

Table B-3
STREAMS IN OZAUKEE COUNTY, WISCONSIN^a

Name	General Location (Municipality)	Tributary To	Average ^b Surface Width ^c (Feet)	Surface Length (Miles)	Surface Area ^c (Acres)	Average ^b Gradient ^d (Feet/mile)
Cedar Creek	T/Cedarburg	Milwaukee River	69	15.70	131.30	9.55
Little Menomonee River	C/Mequon	Menomonee River	6	3.60	1.90	22.22
Milwaukee River	T/Saukville	Lake Michigan	140	34.80	590.50	4.14
North Branch, Cedar Creek	T/Saukville	Cedar Creek	5	1.00	0.60	1.00
North Branch, Milwaukee River	T/Fredonia	Milwaukee River	47	0.90	5.10	13.16
Pigeon Creek	C/Mequon	Milwaukee River	8	2.40	2.30	12.50
Sauk Creek	T/Fredonia	Lake Michigan	22	13.00	34.70	16.19
Silver Creek	T/Fredonia	Milwaukee River	23	1.10	3.10	1.00
Sucker Creek	T/Fredonia	Lake Michigan	6	8.60	6.30	10.44
USPLS Section, Town & Range						
12-9-21	C/Mequon	Milwaukee River	11	1.80	2.40	8.60
29-9-21	C/Mequon	Little Menomonee River	6	3.10	2.30	10.80
35-9-21	C/Mequon	Milwaukee River	4	2.10	1.00	2.38
36-9-21	C/Mequon	Milwaukee River	4	0.40	0.20	1.00
18-9-22	C/Mequon	Lake Michigan	4	1.70	0.80	58.80
4-12-22	T/Belgium	Onion River	4	1.00	0.50	2.00
20-12-22	T/Belgium	Onion River	3	0.30	0.10	11.20
20-12-22	T/Belgium	Sauk Creek	5	2.70	2.20	7.41
33-9-22	T/Cedarburg	Cedar Creek	7	1.80	1.50	25.00
7-10-21	T/Cedarburg	Milwaukee River	2	2.10	0.50	10.00
2-12-21	T/Fredonia	Sauk Creek	8	4.90	5.30	13.27
2-12-21	T/Fredonia	Random Lake	3	0.30	0.10	15.00
2-12-21	T/Fredonia		5	0.20	0.10	7.50
7-12-21	T/Fredonia		2	0.10	0.10	1.00
7-12-21	T/Fredonia		4	2.20	1.10	18.18
3-12-22	T/Fredonia	Milwaukee River	5	2.20	1.30	13.86
7-11-21	T/Saukville	Milwaukee River	3	1.80	0.70	25.70
27-11-21	T/Saukville	Milwaukee River	16	1.00	1.90	10.00
36-11-21	T/Saukville	Milwaukee River	1	1.00	0.10	10.00
28-11-22	T/Saukville	Lake Michigan	2	0.40	0.30	17.00

^aIncludes only those watercourses having a perennial flow or those intermittent streams that have been named.

^bAverages computed from the total of all measurements taken on both sides of all bridge crossings.

^cData for stream widths and areas were obtained from field observation and aerial photos, dated May 1956 for Ozaukee County.

^dThe average gradient of each stream was obtained by dividing the difference in elevations of the mouth and headwaters by the distance between them obtained from U.S. Geological Survey topographic maps.

Source: SEWRPC.

Table B-4
STREAMS IN RACINE COUNTY, WISCONSIN^a

Name	General Location (Municipality)	Tributary To	Average ^b Surface Width ^c (Feet)	Surface Length (Miles)	Surface Area ^c (Acres)	Average ^b Gradient ^d (Feet/mile)
Bohner Creek-Spring Branch (Spring Brook) ^e	T/Burlington	Fox River	6	4.20	3.05	7.00
Browns Lake Outlet (Part Hoosier Creek) ^e	T/Burlington	Fox River	14 ^f	3.50 ^f	11.28 ^f	8.40 ^f
Eagle Lake Outlet (Eagle Creek) ^e	T/Rochester, Dover	Fox River	8	5.50 ^f	4.85	6.90 ^f
E. Eagle Lake Ditch ^g	T/Dover	Eagle Lake	3	1.00	0.36	15.00
E. Wind Lake Canal (Wind Lake Drainage Canal) ^e	T/Norway	Fox River	28	7.30 ^f	22.91	0.80 ^f
Fox River	T/Waterford	Illinois River	160	20.20 ^f	328.88	1.50 ^f
Goose Ditch	T/Norway	E. Wind Lake	12	2.85	4.15	2.00
Honey Creek	T/Burlington	Fox River	38	2.80 ^f	6.91	1.10 ^f
Hoods Creek ^g	T/Mt. Pleasant	Root River	12	7.00	10.18	--
Hoosier Creek	T/Burlington	Fox River	14 ^f	3.50 ^f	11.28 ^f	8.40 ^f
Husher Creek	T/Calendonia	Root River	5	3.50	2.12	14.30
Long Lake Channel ^g	T/Burlington	Fox River	8	0.50	0.48	15.00
Muskego Creek (Part Wind Lake Drainage Canal) ^e	T/Rochester, Dover	Fox River	40	7.30	35.39	0.80 ^f
Pike River (North Branch)	T/Mt. Pleasant	Lake Michigan	6	4.70	3.42	11.70
Raymond Creek ^g	T/Yorkville	Root River	6	1.60	1.16	20.00
Root River	T/Yorkville, C/Racine	Lake Michigan	45	32.60	165.96	5.50
Tichigan Creek	T/Waterford	Fox River	6	1.60	1.16	5.00
White River	T/Burlington	Fox River	100	1.00	12.12	10.80 ^f

^aIncludes only those watercourses having a perennial flow or those intermittent streams that have been named.

^bAverages computed from the total of all measurements taken on both sides of all bridge crossings.

^cData for stream widths and areas were obtained from field observation and aerial photos, dated September and October 1956 for Racine County.

^dThe average gradient of each stream was obtained by dividing the difference in elevations of the mouth and headwaters by the distance between them obtained from U.S. Geological Survey topographic maps.

^eNames used from U.S. Geological Survey topographic quadrangle maps.

^fA revised figure has been provided from more recent and detailed SEWRPC comprehensive watershed planning programs.

^gNamed intermittent streams.

Source: SEWRPC

Table B-5
STREAMS IN WALWORTH COUNTY, WISCONSIN^a

Name	General Location (Municipality)	Tributary To	Average ^b Surface Width ^c (Feet)	Surface Length (Miles)	Surface Area ^c (Acres)	Average ^b Gradient ^d (Feet/mile)
Baker Creek	T/Sugar Creek	Sugar Creek	9	1.80	1.90	11.10
Bloomfield Creek	T/Lyons	White River	6	3.50	2.50	5.70
Bluff Creek	T/Whitewater	Whitewater Creek	10	2.00	2.40	5.00
Como Creek	T/Geneva	White River	14	3.80	6.40	7.30 ^e
Darien Creek	T/Darien	Ladd Creek	12	5.30	7.70	15.10
Honey Creek	T/Spring Prairie	White River	24	24.00 ^e	54.70	4.90 ^e
Horton Creek	T/Whitewater	Cravath Lake	11	4.70	6.30	12.80
Indian Run Creek	T/Lyons	White River	6	2.50	1.80	36.00
Jackson Creek	T/Delavan	Delavan Lake	18	2.30	5.00	10.70
Ladd Creek	T/Darien	Turtle Creek	12	7.40	10.80	10.10
Lightbody Creek	T/Linn	Lake Geneva	2	0.60	0.20	41.60
Mukwonago River	T/Troy	Fox River	14	2.30 ^e	2.50	2.00
Nippersink Creek	T/Bloomfield	Fox River	12	5.20	14.50	4.80
Northeast Branch	T/Bloomfield	Nippersink Creek	14	4.70	7.30	2.00
West Branch	T/Bloomfield	Nippersink Creek	9	7.40	8.80	9.50
Ore Creek	T/Lyons	White River	12	3.60	5.20	27.80
1st Branch	T/Lyons	Ore Creek	8	2.70	2.50	44.40
2nd Branch	T/Lyons	Ore Creek	4	2.80	1.20	23.20
Piscasaw Creek	T/Sharon	Kishwaukee River	15	2.20	4.00	9.10
Spring Brook	T/Spring Prairie	Sugar Creek	12	3.50	5.10	57.10
Spring Creek	T/East Troy	Honey Creek	8	3.50	3.40	8.60
Spring Valley Creek	T/Lyons	White River	8	6.00	5.80	11.60
Steel Brook	T/La Grange	Scuppernong River	3	2.00	0.70	14.00
Sugar Creek	T/Spring Prairie	Honey Creek	18	25.30 ^e	42.50	4.70 ^e
Turtle Branch	T/Delavan, Richmond	Comus Lake	20	6.50	15.80	1.00
Turtle Creek	T/Darien, Delavan	Rock River	45	13.00	70.90	2.40
White River	T/Lyons	Fox River	45	19.00 ^e	66.20	5.20 ^e
Whitewater Creek	T/Whitewater	Whitewater Lake	25	4.30	13.00	7.00
Williams Bay Creek	T/Linn	Lake Geneva	5	1.10	0.70	10.00

^aIncludes only those watercourses having a perennial flow or those intermittent streams that have been named.

^bAverages computed from the total of all measurements taken on both sides of all bridge crossings.

^cData for stream widths and areas were obtained from field observation and aerial photos, dated June and October 1956 for Walworth County.

^dThe average gradient of each stream was obtained by dividing the difference in elevations of the mouth and headwaters by the distance between them obtained from U.S. Geological Survey topographic maps.

^eA revised figure has been provided from more recent and detailed SEWRPC comprehensive watershed planning programs.

Source: SEWRPC.

Table B-6
STREAMS IN WASHINGTON COUNTY, WISCONSIN^a

Name	General Location (Municipality)	Tributary To	Average ^b Surface Width ^c (Feet)	Surface Length (Miles)	Surface Area ^c (Acres)	Average ^b Gradient ^d (Feet/mile)
Allenton Creek	T/Addison	Rock River	6	2.50	1.80	15.00
Ashippun River	T/Erin	Rock River	11	9.60	12.80	6.00
Bark River	T/Richfield	Rock River	12	2.50	3.60	2.00
Cedar Creek	T/Jackson	Milwaukee River	32	15.80	61.30	12.70
North Branch	T/Jackson	Cedar Creek	10	6.30	7.60	4.80
Cedarburg Creek	T/Jackson	Cedar Creek	7	3.00	2.50	6.70
Coney Creek	T/Richfield	Oconomowoc River	2	6.20	1.50	15.20
Engmon Creek	C/West Bend	Silver Creek	5	1.50	0.90	16.00
Erler Outlet	T/Farmington	Milwaukee River	10	1.30	1.60	28.50
Evergreen Creek	T/Jackson	Cedar Creek	4	4.90	2.40	16.70
Flynn Creek	T/Erin	Oconomowoc River	12	4.50	6.60	23.40
Goldendale Creek	V/Germantown	Menomonee River	8	2.00	1.90	20.00
Junk Creek	T/Barton	Milwaukee River	3	0.80	0.30	20.00
Kewaskum Creek	T/Kewaskum	Milwaukee River	12	6.40	9.30	14.00
Kohlsville River	T/Wayne	Rock River	12	7.90	11.50	17.00
Kressin Branch	T/Jackson	Cedar Creek	12	4.70	6.80	2.00
Lehner Outlet	T/Polk	Cedar Creek	7	2.00	1.70	27.50
Limestone Creek	T/Addison	Rock River	17	5.80	12.00	13.00
Little Cedar Creek	T/Jackson	Cedar Creek	9	6.00	6.50	18.00
Little Oconomowoc River	T/Erin	Oconomowoc River	13	2.50	3.90	7.00
Mason Creek	T/Erin	Oconomowoc River	4	1.70	0.80	5.80
Meadow Brook Creek	T/Richfield	Bark River	20	1.00	2.40	1.00
Menomonee River	T/Germantown	Milwaukee River	18	6.20	13.50	2.00
Milwaukee River	T/Farmington	Lake Michigan	83	25.80	259.50	6.00
East Branch	T/Kewaskum	Milwaukee River	42	6.00	30.50	2.00
North Branch	T/Farmington	Milwaukee River	53	8.30	53.30	2.00
West Branch	T/Kewaskum	Milwaukee River	8	4.50	4.40	13.30
Myra Creek	T/Trenton	Milwaukee River	6	2.60	2.60	11.50
Nolan Creek	T/Wayne	Rock River	10	1.40	1.70	12.10
Oconomowoc River	T/Richfield, Erin	Rock River	15	9.10	16.50	6.00
Polk Springs Creek ^e	T/Jackson	Cedar Creek	--	1.60	--	20.00
Quas Creek	T/Trenton, West Bend	Milwaukee River	11	5.90	7.90	22.40
Rock River, East Branch	T/Wayne	Rock River	33	15.50	62.00	3.00
Rubicon River	T/Hartford	Rock River	17	5.70	11.70	9.00
Silver Creek	T/Barton	Milwaukee River	9	4.00	4.40	23.00
Stony Creek	T/Farmington	Milwaukee River	11	9.40	12.50	10.00
Wallace Creek	T/Farmington	Milwaukee River	12	8.60	12.50	11.50
Wayne Creek	T/Wayne	Kohlsville River	9	5.60	6.10	25.00
Willow Creek	T/Germantown	Menomonee River	12	2.30	3.30	4.40

^aIncludes only those watercourses having a perennial flow or those intermittent streams that have been named.

^bAverages computed from the total of all measurements taken on both sides of all bridge crossings.

^cData for stream widths and areas were obtained from field observation and aerial photos, dated May and June 1956 for Washington County.

^dThe average gradient of each stream was obtained by dividing the difference in elevations of the mouth and headwaters by the distance between them obtained from U.S. Geological Survey topographic maps.

^eNamed intermittent stream.

Source: SEWRPC.

Table B-7
STREAMS IN WAUKESHA COUNTY, WISCONSIN^a

Name	General Location (Municipality)	Tributary To	Average ^b Surface Width ^c (Feet)	Surface Length (Miles)	Surface Area ^c (Acres)	Average ^b Gradient ^d (Feet/mile)
Artesian Brook	T/Vernon	Fox River	3	2.00	0.70	7.40
Ashippun River	T/Oconomowoc	Rock River	27	9.50	31.10	2.00
Audley Creek	T/Delafield	Bark River	3	1.20	0.40	2.00
Bark River	T/Ottawa	Rock River	17	24.60	50.70	5.10
Battle Creek	T/Summit	Oconomowoc River	3	3.60	1.30	3.60
Beulah Lake Outlet	T/Mukwonago	Mukwonago River	25	1.00	3.00	2.00
Brandy Brook	T/Genesee	Pebble Creek	4	4.80 ^e	0.70	7.10 ^e
Fox River	T/Vernon	Illinois River	65	49.00 ^e	359.20	1.70 ^e
Genesee Creek	T/Waukesha	Fox River	27	6.00	19.60	8.00
Horseshoe Brook ^f	T/Vernon	Fox River	--	1.50	--	6.00
Jericho Creek	T/Eagle	Mukwonago River	7	6.10 ^e	4.20	18.30 ^e
Kruger Brook	T/Vernon	Fox River	2	0.50	0.10	8.00
Lannon Creek	V/Menomonee Falls	Fox River	5	2.00	1.20	10.00
Little Oconomowoc River	T/Merton	Oconomowoc River	6	3.10	2.30	19.40
Mason Creek	T/Merton	Oconomowoc River	8	3.50	3.40	7.00
Menomonee River	V/Menomonee Falls	Lake Michigan	26	6.20	19.50	19.40
Mill Brook	T/Vernon	Fox River	12	8.50	12.40	9.40
Mill Creek	T/Waukesha	Pebble Brook	12	5.50 ^e	4.10	14.50 ^e
Mukwonago River	T/Vernon	Fox River	42	14.60 ^e	49.40	2.30 ^e
Muskego Creek	C/Muskego	Fox River	8	1.50	1.50	<1.00
Oconomowoc River	T/Summit	Rock River	70	14.30	121.30	5.90
Pebble Brook	T/Vernon	Mill Brook	18	8.00 ^e	2.80	5.60 ^e
Pebble Creek	T/Waukesha	Fox River	10	5.00 ^e	7.90	5.10 ^e
Pewaukee River	T/Pewaukee	Fox River	45	6.40 ^e	26.20	5.70 ^e
Poplar Creek	T/Brookfield	Fox River	26	7.50	23.60	1.90 ^e
Red Wing Creek	T/Waukesha	Pebble Brook	2	1.50	0.40	5.00
Ripple Brook	T/Vernon	Fox River	4	0.50	0.20	4.00
Rosenow Creek	T/Oconomowoc	Oconomowoc River	4	3.60	1.70	5.00
School Section Ditch	T/Eagle	Bark River	8	5.10	5.00	2.50
Scuppernong River	T/Eagle	Bark River	15	5.50	9.70	3.60
Scuppernong Creek	T/Ottawa	Bark River	13	9.50	14.90	13.20
Spring Creek	T/Brookfield	Menomonee River	5	5.00	3.00	14.00
Underwood Creek	V/Elm Grove	Menomonee River	8	0.70	0.70	7.10
Wales Creek	T/Mukwonago	Scuppernong River	5	1.60	1.00	6.00
Zion Creek	T/Mukwonago	Pewaukee River	4	1.50	0.70	10.00
3 Unnamed	--	Ashippun River	--	2.10	1.00	11.00
2 Unnamed	--	Bark River	--	4.50	3.00	9.00
8 Unnamed	--	Fox River	--	13.20	5.00	10.00
6 Unnamed	--	Genesee Creek	--	10.00	11.00	19.00
4 Unnamed	--	Menomonee River	--	9.80	3.00	20.00
2 Unnamed	--	Mill Creek	--	2.00	1.00	--
2 Unnamed	--	Mukwonago River	--	1.40	2.00	--
10 Unnamed	--	Muskego Creek	--	13.80	5.00	5.00
2 Unnamed	--	Oconomowoc River	--	3.80	1.00	13.00
5 Unnamed	--	Pebble Brook	--	4.50	1.00	--
1 Unnamed	--	Pebble Creek	--	1.20	1.00	--
4 Unnamed	--	Pewaukee River	--	9.30	4.00	15.00
3 Unnamed	--	Poplar Creek	--	9.40	5.00	5.00
2 Unnamed	--	Scuppernong River	--	5.60	4.00	--
3 Unnamed	--	Scuppernong Creek	--	2.90	2.00	--
5 Unnamed	--	Spring Creek	--	10.90	5.00	10.00

^aIncludes only those watercourses having a perennial flow or those intermittent streams that have been named.

^bAverages computed from the total of all measurements taken on both sides of all bridge crossings.

^cData for stream widths and areas were obtained from field observation and aerial photos, dated June and July 1956 for Waukesha County.

^dThe average gradient of each stream was obtained by dividing the difference in elevations of the mouth and headwaters by the distance between them obtained from U. S. Geological Survey topographic maps.

^eA revised figure has been provided from more recent and detailed SEWRPC comprehensive watershed planning programs.

^fNamed intermittent stream.

Source: SEWRPC.

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Appendix C

Named Lakes and Ponds in the Southeastern Wisconsin Region

Table C-1
NAMED LAKES AND PONDS IN KENOSHA COUNTY, WISCONSIN^a

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage Length (Miles)	Date of Sampling
	Municipality ^b	U.S. Public Land Survey Section, Town, and Range								
Barber Pond	T/Bristol	30-1-21	0.06	0.08	2.40	20	--	--	--	3/19/60
Benedict Lake	T/Bloomfield	19-1-18;								
	T/Randall	24-1-19	0.25	0.80	78.00 ^f	37	2.50	1.89	0.02	3/19/60
Benet/Shangrila Lake	T/Salem	31-1-20;								
	T/Bristol	36-1-21	0.60	1.00	153.60	24	5.40	3.11	0.12	3/19/60
Camp Lake	T/Salem	21, 28, 29-1-20	0.97	1.50	461.00 ^f	17	3.95	1.28	0.45	3/19/60
Center Lake	T/Salem	15, 16, 21-1-20	0.30	0.90	129.00 ^f	30	3.16	2.19	0.09	3/19/60
Cross Lake	T/Salem	35, 36-1-20	0.30	0.50	87.00 ^f	35	1.40	1.10	--	3/19/60
Dyer Lake	T/Wheatland	30-2-19	0.25	0.40	56.00 ^f	13	1.20	1.18	--	3/19/60
Elizabeth Lake	V/Twin Lakes	28, 29, 32-1-19	0.80	1.90	638.00 ^f	38	5.40	1.55	0.07	3/19/60
Flanagan Lake	T/Brighton	19, 30-2-20	0.15	0.16	11.00	24	0.50	1.07	--	3/19/60
George Lake	T/Bristol	20, 29-1-21	0.30	0.40	58.80	16	1.18	1.10	0.05	3/19/60
Hooker Lake	T/Salem	11-1-20	0.20	0.40	87.00	24	1.90	1.41	0.02	3/19/60
Kull Lake	T/Salem	4-1-20	0.16	0.18	13.00	14	0.55	1.09	--	3/19/60
League Lake	T/Brighton	35-2-20	0.12	0.24	14.40	21	0.60	1.13	--	3/19/60
Lilly Lake	T/Wheatland	11-1-19	0.40	0.50	87.00 ^f	6	1.30	1.03	0.13	3/19/60
Marie Lake	V/Twin Lakes	21, 28-1-19	0.60	1.10	310.00 ^f	38	3.40	1.47	0.15	3/19/60
Montgomery Lake	T/Salem	12, 13, 14-1-20	0.20	0.40	45.60	23	1.40	1.48	0.02	3/19/60
Mud Lake	T/Bristol	32-1-21	0.09	0.11	21.50	14	0.70	1.07	--	3/19/60
Paasch Lake	T/Bristol	29, 30-1-21	0.08	0.10	14.70	9	0.60	1.12	--	3/19/60
Paddock Lake	V/Paddock Lake	2-1-20	0.50	0.60	112.00	32	2.00	1.35	0.04	3/19/60
Peat Lake	T/Salem	32-1-20	0.10	0.30	6.40	5	0.50	1.55	--	3/19/60
Powers Lake	T/Randall	18-1-18;								
	T/Bloomfield	13-1-19	0.70	1.30	459.00 ^f	34	4.70	1.64	0.15	3/19/60
Rock Lake	T/Salem	34-1-20	0.25	0.30	45.60	33	1.00	1.06	0.08	3/19/60
Silver Lake	T/Salem	8, 9, 16-1-20	0.80	1.30	464.00 ^f	43	4.10	1.29	0.11	4/15/60
Voltz Lake	T/Salem	36-1-20	0.38	0.42	52.00 ^f	24	1.40	1.62	--	3/19/60

^a Adapted from the Surface Water Resources publications prepared by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated September and October 1956, for Kenosha County.

^d Maximum depth was measured from the surface elevation existing on date sampled.

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

^f A revised figure has been provided from more recent and detailed SEWRPC comprehensive watershed planning programs.

Source: Surface Water Resources of Kenosha County, 1961.

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Table C-2
NAMED LAKES AND PONDS IN MILWAUKEE COUNTY, WISCONSIN^a

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development Ratio ^e	Public Frontage Length (Miles)	Date of Sampling
	Municipality ^b	U. S. Public Land Survey Section, Town and Range								
Bishop Lake	C/Franklin	3-5-21	0.12	0.19	8.00	35	0.41	1.52	--	4/7/64
Boerner Botanical Gardens	V/Hales Corners	32-6-21	0.08	0.15	7.67	3	0.41	1.06	0.41	9/23/63
Boerner Botanical Gardens	V/Hales Corners	32-6-21	0.03	0.07	1.30	4	0.19	1.19	0.19	9/23/63
Boerner Botanical Gardens	V/Hales Corners	32-6-21	0.02	0.15	1.91	5	0.28	1.45	0.28	9/23/63
Brown Deer Park Pond	V/Brown Deer	13-8-21	0.07	0.17	3.70	6	0.46	1.66	0.46	8/15/62
Dineen Pond	C/Milwaukee	10-7-21	0.04	0.11	2.36	6	0.28	1.30	0.28	9/23/63
Dumkes Lake	C/Franklin	19-5-21	0.10	0.15	6.60	11	0.40	1.12	--	5/4/64
Estabrook Pond	C/Milwaukee	5-7-22	0.03	0.08	1.13	6	0.20	1.34	0.20	10/18/63
Grant Park Pond	C/S. Milwaukee	1-5-22	0.03	0.05	0.80	6	0.17	1.34	0.17	8/15/62
Greenfield Park Pond	C/West Allis	6-6-21	0.12	0.15	5.10	5	0.50	1.58	0.50	8/16/62
Holler Park Pond	C/Milwaukee	29-6-22	0.04	0.06	0.50	5	0.16	1.61	0.16	9/23/63
Humboldt Park Pond	C/Milwaukee	9-6-22	0.08	0.14	4.80	5	0.40	1.38	0.40	8/15/62
Jackson Park Pond	C/Milwaukee	12-6-21	0.07	0.19	5.20	9	0.50	1.56	0.50	8/15/62
Jacobus Park Pond	C/Wauwatosa	27-7-21	0.02	0.07	0.66	5	0.17	1.49	0.17	9/23/63
Juneau Park Pond	C/Milwaukee	21-7-22	0.06	0.43	11.00	12	1.00	2.16	1.00	8/15/62
Kosciusko Park Pond	C/Milwaukee	5-6-22	0.05	0.10	2.80	5	0.30	1.33	0.30	8/15/62
Linden Pond	V/River Hills	7-8-22	0.05	0.15	2.20	15	0.39	1.83	--	8/15/62
McCarty Park Pond	C/West Allis	9-6-21	0.09	0.14	0.90	3	0.18	1.42	0.18	10/18/62
McGovern Park Pond	C/Milwaukee	35-8-21	0.07	0.20	4.40	4	0.67	2.15	0.67	8/15/62
Menomonee Parkway Pond	C/Wauwatosa	8-7-21	0.04	0.13	1.80	4	0.34	1.81	0.34	8/16/62
Mitchell Park Pond	C/Milwaukee	31-7-22	0.06	0.12	3.60	8	0.31	1.13	0.31	8/15/62
Monastery Lake	C/Franklin	8-5-21	0.13	0.23	12.30	30	0.60	1.22	--	8/16/62
Mud Lake	C/Franklin	1-5-21	0.07	0.15	4.00	17	0.27	1.00	--	8/16/62
New Zoo Pond	C/Milwaukee	32-7-21	0.09	0.11	4.90	11	0.40	1.29	0.40	9/23/63
North Golf Course Pond	C/Milwaukee	7-8-21	0.02	0.05	0.64	4	0.12	1.07	0.12	9/23/63
North Golf Course Pond	C/Milwaukee	7-8-21	0.06	0.12	2.58	8	0.32	1.42	0.32	9/23/63
North Golf Course Pond	C/Milwaukee	7-8-21	0.02	0.12	0.99	4	0.26	1.86	0.26	9/23/63
Noyes Park Pond	C/Milwaukee	21-8-21	0.02	0.06	0.59	1	0.17	1.58	0.17	9/23/63
Oak Creek Pond	C/S. Milwaukee	11-5-22	0.07	0.16	4.40	10	0.34	1.16	0.34	8/15/62
Root River Parkway Pond	C/Franklin	3-5-21	0.08	0.25	7.60	17	0.58	1.50	0.58	8/15/62
Saveland Park Pond	C/Milwaukee	17-6-22	0.03	0.03	0.43	6	0.10	1.09	0.10	10/18/63
Schroedel Pond	C/Milwaukee	18-8-21	No maps available		5.00	8	0.45	1.50	--	8/16/62
Scout Lake	V/Greendale	35-6-21	0.10	0.19	8.00	20	0.50	1.26	0.50	8/16/62
Sheridan Park Pond	C/Cudahy	24-6-22	0.04	0.07	1.20	8	0.20	1.30	0.20	8/15/62
Ueihlein Pond	V/River Hills	12-8-21	0.03	0.08	1.20	8	0.30	1.95	--	8/15/62
Underwood Creek Pond	C/Wauwatosa	20-7-21	0.04	0.11	2.22	1	0.30	1.44	0.30	9/23/63
Washington Park Pond	C/Milwaukee	23,24-7-21	0.15	0.30	11.70	6	0.80	1.67	0.80	10/18/63
Whitnall Park Lake	C/Franklin	5-6-21	0.12	0.28	12.50	10	0.70	1.41	0.70	8/16/62
Wilson Park Pond	C/Milwaukee	19-6-22	0.13	0.20	7.20	5	0.60	1.60	0.60	8/16/62
Wood Hospital Pond	C/Milwaukee	35-7-21	0.06	0.07	1.30	4	0.26	1.63	0.26	8/16/62

^a Adapted from the Surface Water Resources publications prepared by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated June 1956, for Milwaukee County.

^d Maximum depth was measured from the surface elevation existing on date sampled.

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

Source: Surface Water Resources of Milwaukee County, 1963.

Table C-3
NAMED LAKES AND PONDS IN OZAUKEE COUNTY, WISCONSIN^a

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage Length (Miles)	Date of Sampling
	Municipality ^b	U. S. Public Land Survey Section, Town, and Range								
Big Bienborn Lake	T/Saukville	20-11-21	0.16	0.20	12.20	30	0.58	1.10	--	5/8/63
Cedarburg Pond	C/Cedarburg	26-10-21	0.09	0.48	14.80	7	1.30	2.40	0.28	5/14/63
Cedarburg Stone Quarry	T/Cedarburg	35-10-21	0.09	0.16	6.20	10	0.50	1.46	--	5/14/63
Chair Factory Millpond	V/Grafton	24-10-21	0.04	0.46	5.50	7	0.98	2.98	--	6/16/64
Daly Lake	T/Saukville	9,16-11-21	0.12	0.21	13.20	8	0.60	1.19	--	5/7/63
Donut Lake	T/Saukville	29-11-21	0.08	0.10	3.60	3	0.30	1.07	--	5/14/63
Fromm Pit	C/Mequon	10-9-21	0.08	0.10	3.60	28	0.28	1.07	--	5/24/63
Grafton Millpond	V/Grafton	24-10-21	0.08	0.69	24.90	8	2.72	3.89	0.13	6/16/63
Hannenman Lake	T/Cedarburg	3-10-21	0.08	0.12	6.00	18	0.40	1.43	--	5/14/63
Hansen Lake	T/Saukville	4-11-21	0.08	0.12	6.00	9	0.35	1.02	--	5/7/63
Huiras Lake	T/Fredonia	15,16-10-21	0.11	0.47	25.60	7	1.20	1.68	--	5/7/63
Lime Kiln Millpond	T/Grafton	25-10-21	0.03	0.25	4.00	7	0.55	1.95	--	6/16/64
Little Bienborn Lake	T/Saukville	20-11-21	0.07	0.10	4.80	29	0.36	1.18	--	5/8/63
Long Lake	T/Saukville	28,29-11-21	0.15	0.57	34.40	5	1.50	1.84	--	5/14/63
Ludowissi Lake	T/Fredonia	1-12-21	0.11	0.13	10.70	25	0.54	1.18	--	5/7/63
Moldenhauer Lake	T/Cedarburg	11-10-21	0.04	0.12	2.60	32	0.40	1.77	0.01	5/8/63
Mud Lake	T/Saukville	32-11-21	0.69	0.99	245.40	4	3.11	1.41	3.00	5/14/63
Pit Lake	C/Mequon	7-9-22	0.12	0.62	35.40	14	1.50	1.81	--	5/24/63
Roeckl Lake	T/Saukville	19-11-21	0.07	0.10	3.20	12	0.37	1.52	--	5/8/63
Spring Lake	T/Fredonia	2,3-12-21	0.25	0.55	66.40	20	1.70	1.49	0.01	5/7/63
Thiensville Millpond	V/Thiensville	23-9-21	0.06	1.28	45.10	8	3.02	3.20	0.25	6/16/64

^a Adapted from the Surface Water Resources publications prepared by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated May 1956, for Ozaukee County.

^d Maximum depth was measured from the surface elevation existing on date sampled.

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

Source: Surface Water Resources of Ozaukee County, 1963.

**Table C-4
NAMED LAKES AND PONDS IN RACINE COUNTY, WISCONSIN^a**

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage Length (Miles) ¹	Date of Sampling
	Municipality ^b	U. S. Public Land Survey Section, Town, and Range								
Bohner Lake	T/Burlington	17, 18, 19, 20-2-19	0.17	0.60	124.00	30	1.88	1.17	--	4/14/60
Brock Lake	T/Rochester	16-3-19	--	--	13.20	10	0.75	1.47	--	5/3/60
Browns Lake	T/Burlington	27, 28, 33, 34-3-19	0.90	1.10	396.00 ^f	44	5.00	1.82	--	4/15/60
Buena Lake	T/Waterford	14, 23, 26, 35-4-19	0.28	0.60	241.00 ^f	8	3.90	2.68	--	5/2/60
Delmonte Lake	T/Rochester	18-3-19	--	--	4.60	--	0.40	--	--	--
Eagle Lake	T/Dover	21, 22, 27-3-20	0.83	1.27	520.00 ^f	15	4.33	1.37	--	4/15/60
Echo Lake	T/Burlington	29, 30-3-19	--	--	71.00 ^f	9	5.60	3.96	--	5/3/60
Frieda Lake	T/Rochester	20-3-19	--	--	11.00	23	0.50	1.02	--	4/14/60
Kee Nong Go Mong Lake	T/Norway	6, 7-4-20	0.33	1.70	87.00 ^f	26	2.17	1.58	--	4/14/60
Long Lake	T/Burlington	16-3-19;								
	T/Rochester	20, 21-3-19	0.30	0.97	124.00 ^f	5	2.50	1.61	--	4/14/60
Overson Pond	T/Norway	34-4-20	--	--	18.00	1	0.80	1.35	--	--
Rockland Lake	T/Burlington	33-3-19	0.20	0.42	44.80	26	1.34	1.43	--	4/14/60
Rodgers Pond	T/Burlington	11-2-19	--	--	11.00	7	0.40	--	--	--
Tahoe Lake	T/Rochester	18-3-19	--	--	5.60	--	0.40	--	--	--
Tichigan Lake	T/Waterford	11, 12, 13, 14-4-19	0.50	1.40	891.00 ^{f, g}	63	4.75 ^g	2.07	--	5/2/60
Waubesee Lake	T/Norway	7, 8, 17, 18-4-20	0.40	0.70	129.00 ^f	73	2.30	1.70	--	5/3/60
Wind Lake	T/Norway	3, 4, 8, 9, 10, 16, 17-4-20	1.16	1.88	936.00 ^f	47	5.75	1.40	--	5/2/60

^a Adapted from the Surface Water Resources publications prepared by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated September and October 1956, for Racine County.

^d Maximum depth was measured from the surface elevation existing on date sampled.

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

^f A revised figure has been provided from more recent and detailed SEWRPC comprehensive watershed planning programs.

^g Tichigan Lake plus the (Illinois) Fox River widespread.

Source: Surface Water Resources of Racine County, 1961.

Table C-5
 NAMED LAKES AND PONDS IN WALWORTH COUNTY, WISCONSIN^a

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage Length (Miles)	Date of Sampling
	Municipality ^b	U. S. Public Land Survey Section, Town, and Range								
Army Lake	T/East Troy	16-4-18	0.30	0.40	78.00 ^f	17	1.40	1.14	0.01	6/9/60
Beulah Lake	T/East Troy	4,8,9,17-4-18	1.30	2.60	837.00 ^f	58	1.53 ^f	2.54	0.02	5/13/60
Booth Lake	T/Troy	13,24-4-17	0.40	0.60	108.00	24	1.50	1.08	0.30	5/13/60
Cedar Grove Millpond	T/LaGrange	36-4-16	0.10	0.20	12.00	6	1.10	2.27	--	10/28/60
Como Lake	T/Geneva	27,28,32-2-17	0.60	3.40	2,260.00 ^f	8	8.00	1.75	0.01	5/13/60
Comus Lake	T/and C/Delavan	7,8,18-2-16	0.20	2.00	117.00	8	5.10	3.36	0.15	4/20/61
Cravath Lake	C/Whitewater	4,9-4-15	0.20	0.90	65.00	10	2.50	2.21	0.02	5/12/60
Delavan Lake	T/Delavan	21,22,28-2-16	1.20	5.80	2,072.00	56	17.70	2.77	0.60	5/13/60
Geneva Lake	C/Lake Geneva	35,36-2-17; 1,2-2-17								5/13/60
	T/Linn	1,2,3,4,5,7,8,9,10,11,12-1-17								
	V/Williams Bay	6,13-1-17; 12-1-16								
	V/Fontana-on-the Lake	13,14,11,12-1-16; 18-1-17								
	T/Walworth	11,12-1-16	2.10	7.60	5,262.00 ^f	135	20.10	2.03	1.50	5/13/60
Green Lake ^g	T/LaGrange	26-4-16	0.80	1.20	311.00 ^f	57	4.00	1.67	--	6/13/60
Hilburn Pond	T/East Troy	22-4-18	0.10	0.20	17.00	3	0.80	1.38	0.40	10/28/60
Honey Lake	T/Spring Prairie	13-3-18	0.40	0.40	42.00	9	1.40	1.54	0.15	6/20/60
Ivanhoe Lake	T/Lyons	34-2-18	0.10	0.40	41.00	11	1.00	1.11	0.01	6/20/60
LaGrange Lake	T/LaGrange	7,18-4-16	--	--	55.00	4	1.80	1.73	--	--
Lauderdale Lakes ^g	T/LaGrange	10,11-4-16	--	--	809.00	57	14.10	3.54	0.02	6/13/60
Lorraine Lake	T/Richmond	9-3-15	0.60	1.00	133.00	8	3.20	1.98	--	6/10/60
Lower Whitewater Lake	T/Richmond	3-4-15	0.50	0.90	137.00	8	3.40	2.07	3.40	6/10/60
Lulu Lake	T/Troy	2-4-17	0.40	0.60	84.00 ^f	40	1.50	1.10	--	6/13/60
Lyons Millpond	T/Lyons	10,15-2-18	0.10	0.20	12.00	3	1.10	2.27	0.01	10/28/60
Middle Lake ^g	T/LaGrange	35-4-16	0.50	1.80	259.00 ^f	42	5.30	2.36	--	6/13/60
Mill Lake ^g	T/LaGrange	35,36-3,4-16	0.80	1.10	271.00 ^f	44	4.80	2.12	0.02	6/13/60
Mud Lake	T/East Troy	18-4-18	0.20	0.20	23.00	12	0.70	1.04	--	6/9/60
North Lake	T/Sugar Creek	5-3-16	0.50	1.30	244.00 ^f	11	4.80	2.48	0.01	6/9/60
Peil Lake	T/Bloomfield	15-1-18	0.40	0.50	86.00 ^f	13	1.80	1.24	1.60	6/20/60
Peters Lake	T/Troy	17-4-17	0.30	0.40	64.00 ^f	8	1.20	1.11	--	5/13/60
Pickereel Lake	T/Troy	13-4-17	0.20	0.30	27.00	31	0.70	1.10	--	--
Pleasant Lake	T/LaGrange	24-4-16	0.50	0.70	155.00 ^f	29	2.70	1.65	0.15	6/13/60
Potters Lake	T/East Troy	10,11-4-18	0.40	0.80	162.00 ^f	26	2.10	1.22	0.05	6/13/60
Silver Lake	T/Sugar Creek	14-3-16	0.30	0.60	85.00 ^f	4	1.50	1.15	0.08	--
Swift Lake	T/Troy	8-4-17	0.20	0.30	17.00	12	0.70	1.21	--	6/13/60
Tombeau Lake	T/Bloomfield	24-1-18	0.20	0.20	32.00	26	1.60	2.02	0.02	6/20/60
Trapp Lake	C/Whitewater	9,10-4-15	0.40	0.80	115.00	6	2.90	1.93	0.08	5/12/60
Turtle Lake	T/Richmond	11,12,14-3-15	0.30	0.90	140.00	35	2.60	1.73	--	6/10/60
Wandawega Lake	T/Sugar Creek	1,2-3-16	0.30	0.70	119.00	9	2.10	1.37	0.02	6/13/60
Whitewater Lake	T/Whitewater	34,35-3,4-15	0.60	2.60	640.00	38	9.80	2.80	0.80	5/12/60

^a Adapted from the Surface Water Resources publications prepared by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated June and October 1956, for Walworth County.

^d Maximum depth was measured from the surface elevation existing on date sampled.

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

^f A revised figure has been provided from more recent and detailed SEWRPC comprehensive watershed planning programs.

^g Part of Lauderdale Lake.

Source: Surface Water Resources of Walworth County, 1961.

Table C-6
 NAMED LAKES AND PONDS IN WASHINGTON COUNTY, WISCONSIN^a

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage Length (Miles)	Date of Sampling
	Municipality ^b	U. S. Public Land Survey Section, Town, and Range								
Amy Bell Lake	T/Richfield	25-9-19	0.10	0.30	31.00	40	1.00	1.28	--	7/21/60
Bark Lake	T/Richfield	26-9-19	0.10	0.70	65.00	32	1.80	1.59	0.10	7/21/60
Barton Pond	T/West Bend	11-11-19	0.20	0.50	51.00	7	1.20	1.20	0.25	4/6/62
Beck Lake	T/Erin	27-9-18	0.20	0.30	16.00	7	0.60	1.07	--	8/23/60
Big Cedar Lake	T/Polk C/West Bend	5-10-19; 20,29,30,31,32- 11-19	0.70	4.10	1,004.00	105	10.00	2.25	0.02	7/21/60
Brickyard Lake	T/Barton	1-11-19	0.04	0.05	0.80	4	0.13	1.04	--	4/19/62
Druid Lake	T/Erin	6-9-18	0.40	0.60	124.00	40	1.70	1.09	0.01	8/16/60
Einey Lake	T/Farmington	29-12-20	0.20	0.20	18.00	-- ^f	1.00	1.68	--	7/13/60
Erler Lake	T/Farmington	27-12-20	0.30	0.30	35.00	38	0.90	1.02	--	7/13/60
Lake Five	T/Richfield	32-9-19	0.40	0.70	102.00	23	1.90	1.35	--	7/20/60
Friess Lake	T/Richfield	17-9-19	0.30	0.80	119.00	51	2.30	1.51	0.04	7/21/60
Gilbert Lake	T/West Bend	17-11-19	0.20	0.80	40.00	7	1.80	2.03	--	8/23/60
Green Lake	T/Farmington	33-12-20	0.30	0.70	82.00	35	2.10	1.65	--	7/14/60
Hackbarth (Little Silver Lake)	T/West Bend	22-11-19	0.10	0.20	9.00	35	0.40	1.07	--	8/15/60
Hartford Millpond	C/Hartford	21-10-18	0.10	0.40	11.00	8	0.90	1.94	0.05	8/15/62
Hasmer Lake	T/Polk	13-10-19	0.20	0.20	13.00	27	0.60	1.19	--	8/8/60
Hawthorn Lake	T/Trenton	36-11-20	0.10	0.20	8.00	12	0.50	1.26	--	4/19/62
Hickey Lake	T/Erin	25-9-18	0.13	0.15	10.20	14	0.50	1.12	--	6/15/62
Keown Lake	T/Trenton	32-11-20	0.20	0.05	0.80	15	0.21	1.68	--	8/9/60
Kewaskum Millpond	V/Kewaskum	9-12-19	0.02	0.50	5.40	8	1.00	3.07	0.40	4/6/60
Kohlsville Millpond	T/Wayne	27-12-18	0.05	0.13	4.00	7	0.33	1.18	0.10	8/16/60
Lehner Lake	T/Polk	22-10-19	0.10	0.10	4.00	25	0.60	2.14	--	8/9/60
Leinberger Lake	T/Barton	1-11-19	0.10	0.30	9.00	34	0.50	1.18	--	4/19/62
Lent Lake	T/Polk	15-10-19	--	--	8.00	7	--	--	--	4/19/62
Lenwood Lake	T/Trenton	6-11-20	0.10	0.20	14.00	35	0.60	1.15	--	8/15/60

Table C-6 (continued)

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage Length (Miles)	Date of Sampling
	Municipality ^b	U. S. Public Land Survey Section, Town, and Range								
Little Cedar Lake	T/West Bend	33-11-19	0.50	1.30	259.00	55	4.00	1.77	--	8/15/60
Little Drickens Lake	T/Barton	26-12-19	0.10	0.20	9.00	20	0.40	1.43	--	7/12/60
Little Friess Lake (Bony)	T/Richfield	17-9-19	0.20	0.20	14.00	30	0.53	1.03	--	7/21/60
Lohr Pond	T/Hartford	35-10-18	0.10	0.18	6.70	8	0.46	1.27	--	8/16/60
Loew Lake (Lowe)	T/Erin	25-9-18	0.30	0.40	25.00	24	0.90	1.31	--	7/20/60
Lucas Lake	T/West Bend	22-11-19	0.30	0.70	73.00	15	2.80	2.33	--	8/15/60
Malloy Lake	T/Erin	21-9-18	0.10	0.20	5.00	24	0.40	1.28	--	7/20/60
Mayer Millpond (Meyer)	T/Richfield	9-9-19	0.04	0.13	2.20	4	0.41	1.97	--	6/15/62
Mayfield Pond	T/Polk	14-10-19	0.10	0.30	8.00	4	0.60	1.48	--	8/9/60
McConville Lake	T/Erin	22-9-18	0.10	0.40	14.00	30	0.80	1.52	--	8/23/60
Miller Lake	T/Farmington	30-12-19	0.04	0.13	3.20	16	0.33	1.32	--	6/15/60
Mud Lake	T/Richfield	24-9-19	0.07	0.18	5.40	6	0.46	1.41	--	4/19/62
Mud Lake	T/Polk	19-10-19	0.20	0.30	23.00	5	0.80	1.19	--	4/19/62
Mueller Lake	T/Polk	5-10-19	0.13	0.16	10.00	33	0.53	1.20	--	8/23/60
Murphy Lake	T/Erin	21-9-18	0.10	0.30	16.00	37	0.70	1.24	--	7/20/60
Newburg Pond	T/Trenton	12-11-20	0.03	0.50	7.00	8	1.03	2.78	0.01	8/23/60
Pike Lake	T/Hartford	23-10-18	1.10	1.20	522.00	45	3.80	1.19	0.01	6/27/60
Proschinger Lake	T/Trenton	22-11-20	0.10	0.20	6.00	23	0.41	1.19	--	8/23/60
Quas Lake	T/West Bend	34-11-19	0.10	0.17	7.10	12	0.40	1.07	--	8/23/60
Radtke Lake	T/Trenton	27-11-20	0.10	0.20	10.00	25	0.50	1.12	--	8/23/60
Rockfield Quarry Pond	T/Germantown	9-9-20	0.15	0.16	2.60	27	0.27	1.20	--	4/19/62
Silver Lake	T/West Bend	27-11-19	0.40	1.00	119.00	45	2.60	1.70	--	8/15/60
Smith (Drickens) Lake	T/Barton	26-12-19	0.40	0.70	77.00	5	1.70	1.38	0.01	7/12/60
Tillie (Tily) Lake	T/Polk	13-10-19	0.20	0.20	12.00	50	0.50	1.03	--	8/8/60
(Lake) Twelve	T/Farmington	12-12-20	0.30	0.50	56.00	20	1.10	1.05	--	7/13/60
Wallace Lake	T/Trenton	6-11-20	0.20	0.50	50.00	35	1.20	1.72	0.01	8/15/60
Werner Pond	T/Hartford	25-10-18	0.20	0.30	9.00	8	0.70	1.66	--	8/16/60
West Bend Pond	C/West Bend	13-11-19	0.40	0.90	73.00	9	2.50	2.09	0.04	4/6/62

^a Adapted from the Surface Water Resources publications prepared by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated May and June 1956, for Washington County.

^d Maximum depth was measured from the surface elevation existing on date sampled.

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

^f Not measured.

Source: Surface Water Resources of Washington County, 1963.

Table C-7
 NAMED LAKES AND PONDS IN WAUKESHA COUNTY, WISCONSIN^a

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage Length (Miles)	Date of Sampling
	Municipality ^b	U. S. Public Land Survey Section, Town, and Range								
Applebecker Millpond	T/Delafield	19-7-18	0.11	0.30	11.90	5	0.75	1.55	--	10/12/60
Ashippun Lake	T/Oconomowoc	15-8-17	0.35	1.05	84.00	40	1.50	1.17	0.33	2/9/61
Beaver Lake	T/Merton	27,28-8-18	0.70	1.09	316.00	49	3.60	1.45	--	2/13/61
Beaver Dam Lake	T/Eagle	6-5-17	0.45	0.77	36.00	--	2.27	2.70	--	2/20/63
Big Bend Pond	V/Big Bend	24-5-19	0.10	0.15	7.00	10	0.43	1.16	--	1/30/63
Big Muskego Lake	C/Muskego	13,14,22,23,27-5-20	1.47	3.40	2,260.00	26	17.70	2.66	--	10/11/60
Brown Lake	T/Mukwonago	30-5-18	0.13	0.19	11.50	40	0.54	1.14	--	10/11/60
Buth Lake	T/Summit	27-7-17	0.06	0.11	3.50	5	0.29	1.11	--	9/27/62
Cornell Lake	T/Merton	20,21-8-18	0.20	0.53	41.00	12	1.60	1.78	--	2/13/61
Crooked Lake	T/Summit	23-7-17	0.30	0.60	58.00	16	2.30	2.16	--	9/21/60
Denoon Lake	C/Muskego	31,32-5-20	0.45	0.74	162.00	60	2.40	1.35	--	10/18/60
Duck Lake	T/Summit	22-7-17	0.20	0.23	22.10	1	0.50	1.03	--	10/12/60
Dutchman Lake (Lad)	T/Ottawa	2-6-17	0.15	0.38	33.00	42	1.00	1.24	--	1/23/61
Eagle Spring Lake	T/Eagle	35,36-5-17	0.55	0.85	227.00	12	4.00	1.89	0.03	10/18/60
Egg Lake	T/Summit	22,23-7-17	0.04	0.08	2.10	3	0.25	1.23	--	10/12/60
Etter Lake	T/Delafield	25-7-18	0.08	0.25	10.50	3	0.56	1.27	--	2/5/63
Florence Lake	T/Oconomowoc	36-8-17	0.19	0.30	19.00	36	0.90	1.47	0.38	2/7/61
Forest Lake	T/Merton	31-7,8-18	0.15	0.57	41.00	17	1.30	1.45	--	2/13/61
Fowler Lake	C/Oconomowoc	33-8-17	0.35	0.60	78.00	50	1.70	1.37	0.15	9/22/60
Funks Millpond	T/Merton	15-8-18	0.08	0.76	31.00	5	1.94	2.14	--	2/5/63
Garvin Lake	T/Merton	30,31-8-18	0.14	0.33	17.00	36	0.80	1.38	--	2/13/61
Genesee Millpond	T/Genesee	27-6-18	0.07	0.17	4.10	5	0.39	1.37	--	2/5/63
Golden Lake	T/Summit	30,31-7-17	0.43	1.30	250.00	46	3.40	1.53	--	1/23/61
Henrietta Lake	T/Summit	35-7-17	0.18	0.29	23.00	6	0.80	1.19	--	1/23/61
Hogan Lake	T/Mukwonago	31-5-18	0.05	0.17	8.00	3	0.90	2.28	--	2/5/63
Hunter Lake	T/Ottawa	11-6-17	0.16	0.60	65.00	36	1.90	1.68	--	1/24/61
Keesus Lake	T/Merton	11,14-8-18	0.71	0.90	237.00	42	5.00	2.32	0.04	2/13/61
Lac La Belle Lake	V/Lac La Belle	19,20-8-17;								
	T/Oconomowoc	29,30,32-8-17	1.10	2.65	1,117.00	46	8.70	1.47	0.16	6/27/60
Lannon (County Park) Pond	V/Germantown	18-8-20	0.17	0.20	15.50	45	0.82	1.52	0.82	1/30/63
Larkin Lake	T/Ottawa	15-6-17	0.23	0.33	33.00	4	0.90	1.12	--	1/24/61
Leota Lake	T/Summit	20-7-17	0.09	0.17	8.30	12	0.51	1.26	--	9/27/62
Linnie Lac Lake	C/New Berlin	36-6-20	0.05	0.19	6.00	6	0.53	1.54	--	2/5/63
Little Muskego Lake	C/Muskego	4,9-5-20	1.10	1.50	506.00 ^f	65	5.70	1.90	0.01	10/18/60
Lower Genesee Lake	T/Summit	27,28-7-17	0.32	0.45	66.00	44	1.40	1.23	0.14	10/12/60
Lower Kelly Lake	C/New Berlin	36-6-20	0.08	0.08	3.00	36	0.28	1.15	--	1/30/63
Lower Nashotah Lake	T/Summit	12,13-7-17	0.25	0.83	90.00	43	2.00	1.50	--	9/21/60
Lower Nemahbin Lake	T/Summit	24,25-7-17	0.67	1.00	271.00	36	3.30	1.43	0.03	9/21/60
Lower Phantom Lake	T/Mukwonago	26,35-5-18	0.63	0.79	433.00 ^f	10	3.30	1.81	0.03	10/18/60
Merton Millpond	V/Merton	13-8-18;								
	T/Lisbon	18-8-18	0.10	0.80	38.00	8	1.80	2.08	0.03	2/13/61
Middle Genesee Lake	T/Summit	21,22-7-17	0.43	0.55	102.00	38	1.60	1.13	0.13	10/12/60
Monches Millpond	T/Merton	2-8-18	0.09	0.33	16.20	2	0.89	1.29	--	2/5/63
Monterey Millpond	T/Oconomowoc	9-8-17	0.03	0.25	30.00	8	1.82	2.37	0.01	1/25/63
Moose Lake	T/Merton	19,30-8-18	0.20	0.83	81.00	61	2.30	1.82	--	2/13/61
Mud Lake	T/Merton	31-8-18	0.14	0.25	10.00	8	0.70	1.18	--	2/13/61
Mukwonago Park Pond	V/Mukwonago	29-5-18	0.05	0.08	1.40	5	0.23	1.01	0.23	1/30/63
Nagawicka Lake	C/Delafield	8,17-7-18	1.05	2.80	957.00	90	8.60	1.98	0.27	10/12/60
North Lake	T/Merton	16,21-8-18	0.67	1.37	437.00	78	5.30	1.81	0.02	10/23/60
Oconomowoc Lake	V/Oconomowoc Lake	2,3-7-17	1.05	1.24	767.00	62	7.00	1.80	--	9/22/60
Okauchee Lake	T/Oconomowoc	25,36-8-18;								
	T/Merton	30-8-18	1.85	1.90	1,187.00	94	15.00	3.20	0.08	10/11/60
Ottawa Lake (Lean)	T/Ottawa	34-6-17	0.15	0.33	28.00	20	1.00	1.35	1.00	1/24/61
Pewaukee Lake	T/and V/Pewaukee	7,8-7-19;								
	T/Delafield	13,14,15,22,23,24-7-18	1.20	4.50	2,493.00 ^f	45	13.20	1.94	0.56	9/22/60

Table C-7 (continued)

Name	Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage Length (Miles)	Date of Sampling
	Municipality ^b	U. S. Public Land Survey Section, Town, and Range								
Pine Lake	V/Chenequa	28, 29, 32-8-18	0.89	2.37	703.00	85	7.30	1.96	0.01	9/23/60
Pretty Lake	T/Ottawa	28-6-17	0.30	0.40	64.00	35	1.20	1.07	0.02	1/24/61
Rainbow Springs Lake	T/Mukwonago	31-5-18	0.20	0.43	35.00	12	1.60	1.93	--	2/5/63
Reagon Lake	T/Ottawa	23-6-17	0.20	0.23	12.00	26	0.50	1.03	--	1/24/61
Roxy Pond	T/Mukwonago	29-5-18	0.15	0.30	17.00	8	0.80	1.38	0.80	1/30/63
Saratoga Lake	C/Waukesha	35-7-19	0.07	1.61	24.30	7	3.40	4.82	1.14	1/24/61
Saylesville Millpond	T/Genesee	24, 25-6-18	0.28	0.73	66.00	5	2.20	1.93	--	2/20/63
School Section Lake	T/Ottawa	16, 17-6-17	0.55	0.60	125.00	12	1.90	1.21	0.05	1/24/61
Scuppernong Millpond	T/Ottawa	10-6-17	0.12	0.24	12.90	4	0.73	1.45	--	1/24/61
Silver Lake	T/Summit	9, 16-7-17	0.56	0.97	222.00	44	2.70	1.29	0.01	10/12/60
Spahn Lake	T/Summit	25-7-17	0.07	0.11	4.00	5	0.33	1.18	--	9/27/62
Spring Lake	T/Mukwonago	4, 9-5-18	0.35	0.77	107.00 ^f	20	2.20	1.57	--	10/18/60
Spring Lake	V/Dousman	36-6-17	0.13	0.23	14.10	8	0.66	1.25	--	9/27/62
Summit Dump Pond	T/Summit	29-7-17	0.04	0.08	2.10	3	0.22	1.08	0.10	9/27/62
Sybil Lake	T/Summit	28-7-17 ✓	0.04	0.10	2.10	--	0.28	1.38	--	9/27/62
Tierney Lake	T/Oconomowoc	36-8-17	0.15	0.26	15.00	5	0.60	1.11	--	2/7/61
Upper Genesee Lake	T/Summit	22-7-17	0.18	0.43	35.00	34	1.10	1.33	--	10/12/60
Upper Kelly Lake	C/New Berlin	31, 36-6-20, 21	0.09	0.25	11.70	31	0.90	1.14	--	1/30/63
Upper Nashotah Lake	T/Summit	12-7-17	0.42	0.80	133.00	53	2.30	1.42	--	9/21/60
Upper Nemahbin Lake	T/Summit	13, 24-7-17	0.59	1.10	283.00	61	2.90	1.23	0.09	9/21/60
Upper Oconomowoc Lake	V/Oconomowoc Lake	35-8-17	0.23	0.45	42.80	11	1.55	1.69	--	2/20/63
Upper Phantom Lake	T/Mukwonago	34, 35-5-18	0.40	0.73	111.00	29	2.10	1.42	0.04	10/18/60
Utica Lake	T/Ottawa	4-6-17;								
	T/Summit	33-7-17	0.17	0.18	15.00	26	0.60	1.11	--	2/20/63
Waterville Pond	T/Summit	36-7-17	--	0.95	68.40	12	1.87	1.58	--	1/25/63
Widgeon Lake (Bowrans)	T/Summit	23-7-17	0.20	0.30	25.00	25	0.80	1.19	--	10/12/60
Wood Lake	T/Mukwonago	33-5-18	0.18	0.22	19.00	23	0.70	1.15	--	1/25/63

^a Adapted from the Surface Water Resources publications prepared by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated June and July 1956, for Waukesha County.

^d Maximum depth was measured from the surface elevation existing on date sampled.

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

^f A revised figure has been provided from more recent and detailed SEWRPC comprehensive watershed planning programs.

Source: Surface Water Resources of Waukesha County, 1963.

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Appendix D

Unnamed Lakes and Ponds in the Southeastern Wisconsin Region

Table D-1
UNNAMED LAKES AND PONDS IN OZAUKEE COUNTY, WISCONSIN^a

Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage (Miles)
Municipality ^b	U. S. Public Land Survey Section, Town, and Range							
C/Mequon	15-9-21	0.08	0.20	7.6	5	0.63	1.61	--
C/Mequon	36-9-21	0.16	0.45	48.5	13	1.36	1.34	--
C/Mequon	7-9-22	0.10	0.12	5.0	14	0.50	1.60	--
C/Mequon	7-9-22	0.10	0.18	6.4	13	0.50	1.39	--
T/Cedarburg	3-10-21	0.05	0.06	1.6	17	0.20	1.11	--
T/Fredonia	2-12-21	0.04	0.07	1.3	2	0.30	1.86	--
T/Fredonia	5-12-21	0.06	0.08	2.8	6	0.31	1.28	--
T/Fredonia	14-12-21	0.08	0.12	4.5	14	0.40	1.43	--
T/Fredonia	19-12-23	0.17	0.19	23.0	47	0.68	1.02	--
T/Saukville	5-11-21	0.09	0.12	4.2	4	0.35	1.25	--
T/Saukville	17-11-21	0.18	0.18	12.4	5	0.50	1.03	--
T/Saukville	19-11-21	0.06	0.10	2.4	16	0.30	1.51	--
T/Saukville	20-11-21	0.03	0.08	1.6	6	0.25	1.26	--
T/Saukville	20-11-21	0.05	0.15	3.6	5	0.32	1.14	--
T/Saukville	20-11-21	0.10	0.20	10.2	13	0.60	1.35	--
T/Saukville	20-11-21	0.06	0.08	2.2	5	0.25	1.26	--
T/Saukville	21-11-21	0.07	0.15	5.2	31	0.50	1.60	--

^a Adapted from *Surface Water Resources* publications by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated May 1956, for Ozaukee County.

^d Maximum depth was measured from the surface elevation existing on date sampled (see Appendix C, Table C-3).

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

Source: *Surface Water Resources of Ozaukee County, 1963.*

Table D-2
UNNAMED LAKES AND PONDS IN WASHINGTON COUNTY, WISCONSIN^a

Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage (Miles)
Municipality ^b	U. S. Public Land Survey Section, Town, and Range							
T/Barton	4-11-19	0.09	0.12	4.7	--	0.43	1.42	--
T/Barton	11-11-19	0.05	--	2.2	8	--	--	8.00
T/Polk	19-10-19	0.05	--	2.0	25	--	--	--
T/Polk	33-10-19	0.05	0.08	2.7	--	0.27	1.17	--
T/Richfield	8-9-19	0.03	0.06	0.8	6	0.16	1.28	7.40
T/Trenton	28-11-20	0.11	0.22	7.4	--	0.56	1.47	--
T/Trenton	32-11-20	0.04	0.08	1.2	--	0.20	1.30	--

^a Adapted from Surface Water Resources publications by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated May and June 1956, for Washington County.

^d Maximum depth was measured from the surface elevation existing on date sampled (see Appendix C, Table C-6).

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

Source: Surface Water Resources of Washington County, 1963.

Table D-3
UNNAMED LAKES AND PONDS IN WAUKESHA COUNTY, WISCONSIN^a

Location		Surface Width ^c (Miles)	Surface Length ^c (Miles)	Surface Area ^c (Acres)	Maximum Depth (Feet) ^d	Shoreline Length (Miles)	Shore Development (Ratio) ^e	Public Frontage (Miles)
Municipality ^b	U. S. Public Land Survey Section, Town, and Range							
C/Muskego	32-5-20	0.08	0.15	6.3	14	0.41	1.17	--
T/Eagle	28-5-17	0.06	0.16	4.0	3	0.37	1.32	0.37
T/Eagle	28-5-17	0.03	0.03	0.7	3	0.14	1.20	--
T/Genesee	22-6-18	0.03	0.06	0.9	5	0.20	2.61	--
T/Oconomowoc	9-8-17	0.03	0.06	0.9	2	0.20	1.51	--
T/Oconomowoc	13-8-17	0.05	0.11	2.1	18	0.29	1.44	--
T/Oconomowoc	13-8-17	0.03	0.04	0.7	10	0.16	1.33	--
T/Oconomowoc	13-8-17	0.05	0.10	3.5	13	0.33	1.25	--
T/Oconomowoc	13-8-17	0.12	0.18	6.3	22	0.53	1.60	--
T/Oconomowoc	13-8-17	0.07	0.09	2.8	18	0.36	1.53	--
T/Oconomowoc	14-8-17	6.23	1.05	27.0	3	1.05	2.06	--
T/Oconomowoc	14-8-17	0.08	0.15	4.0	3	0.50	1.78	--
T/Oconomowoc	14, 23-8-17	0.20	0.23	16.0	4	0.70	1.25	--
T/Oconomowoc	15, 22-8-17	0.11	0.11	9.0	3	1.10	2.62	--
T/Oconomowoc	15-8-17	0.11	0.11	3.5	4	0.50	1.03	--
T/Oconomowoc	22-8-17	0.04	0.07	1.5	3	0.20	1.17	--
T/Oconomowoc	22-8-17	0.10	0.16	4.0	4	0.50	1.78	--
T/Oconomowoc	23-8-17	0.05	0.13	3.2	4	0.38	1.51	--
T/Oconomowoc	23-8-17	0.05	0.10	2.1	4	0.28	1.38	--
T/Oconomowoc	23-8-17	0.03	0.04	0.8	3	0.17	1.35	--
T/Oconomowoc	23-8-17	0.30	0.40	31.0	15	1.30	1.67	--
T/Oconomowoc	24-8-17	0.03	0.03	0.7	3	0.17	1.44	--
T/Oconomowoc	24-8-17	0.05	0.06	1.9	4	0.21	1.09	--
T/Oconomowoc	25-8-17	0.07	0.17	6.0	4	0.35	1.02	--
T/Oconomowoc	25, 26-8-17	0.10	0.19	10.0	4	0.45	1.02	--
T/Oconomowoc	26-8-17	0.80	0.38	13.0	3	0.90	1.78	--
T/Oconomowoc	36-8-17	0.14	0.17	9.0	2	0.65	1.55	--
T/Oconomowoc	36-8-17	0.13	0.13	8.0	4	0.45	1.14	--
T/Oconomowoc	36-8-17	0.01	0.01	0.4	2	0.10	1.00	--
T/Ottawa	2-6-17	0.10	0.12	5.0	--	0.33	1.05	--
T/Ottawa	16-6-17	0.17	0.12	10.1	22	0.50	1.12	--
T/Ottawa	22-6-17	0.09	0.12	3.2	2	0.43	1.72	--
T/Ottawa	34-6-17	0.07	0.09	3.2	6	0.30	1.20	0.25
T/Ottawa	34-6-17	0.05	0.21	4.4	8	0.46	1.56	--
T/Summit	1-7-17	0.13	0.14	7.9	3	0.46	1.17	--
T/Summit	10-7-17	0.14	0.22	12.8	5	0.70	1.40	--
T/Summit	26-7-17	0.09	0.17	7.6	11	0.45	1.16	--
T/Summit	31-7-17	0.08	0.13	4.9	16	0.36	1.16	--
T/Summit	36-7-17	0.05	0.11	2.8	6	0.30	1.28	--
T/Summit	36-7-17	0.03	0.17	2.8	3	0.37	--	--

^a Adapted from Surface Water Resources publications by the Wisconsin Conservation Department for each county in the Southeastern Wisconsin Region (1961-1963).

^b Location is based upon corporate limits as of January 1, 1967.

^c Lake lengths, widths, and areas used in this comparison were taken from aerial photographs, dated June and July 1956, for Waukesha County.

^d Maximum depth was measured from the surface elevation existing on date sampled (see Appendix C, Table C-7).

^e Shore development ratio is a convenient expression of the degree of regularity or irregularity of shoreline. Generally, the higher the ratio, the greater the biological productivity of the lake. S.D.R. = Length of shoreline of lake of given area divided by circumference of circle with same area. An "S.D.R." of 1.00 equals a circular lake.

Source: Surface Water Resources of Waukesha County, 1963.

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Appendix E
Excerpts from the State Water Resources Act of 1965

Section 1. STATEMENT OF POLICY AND PURPOSES.

Continued pollution of the waters of the state has aroused widespread public concern. It endangers public health and threatens the general welfare. A comprehensive action program directed at all present and potential sources of water pollution whether home, farm, recreational, municipal, industrial or commercial is needed to protect human life and health, fish and aquatic life, scenic and ecological values and domestic, municipal, recreational, industrial, agricultural and other uses of water. The purpose of this act is to grant necessary powers and to organize a comprehensive program under a single state agency for the enhancement of the quality management and protection of all waters of the state, ground and surface, public and private. To the end that these vital purposes may be accomplished, this act and all rules and orders promulgated pursuant thereto shall be liberally construed in favor of the policy objectives set forth in this act. In order to achieve the policy objectives of this act, it is the express policy of the state to mobilize governmental effort and resources at all levels, state, federal and local, allocating such effort and resources to accomplish the greatest result for the people of the state as a whole. Because of the importance of Lakes Superior and Michigan and Green Bay as vast water resource reservoirs, water quality standards for those rivers emptying into Lakes Superior and Michigan and Green Bay shall be as high as is practicable.

59.971 ZONING OF SHORELANDS ON NAVIGABLE WATERS.

(1) To effect the purposes of s. 144.26 and to promote the public health, safety and general welfare, counties may, by ordinance enacted separately from ordinances pursuant to s. 59.97, zone all lands (referred to herein as shorelands) in their unincorporated areas within the following distances from the normal high-water elevation of navigable waters as defined in s. 144.26 (2) (d): 1,000 feet from a lake, pond or flowage; 300 feet from a river or stream or to the landward side of the flood plain, whichever distance is greater. If the navigable water is a glacial pothole lake, the distance shall be measured from the high-water mark thereof.

(2)(a) Except as otherwise specified, all provisions of s. 59.97 apply to ordinances and their amendments enacted under this section, but they shall not require approval or be subject to disapproval by any town or town board.

(b) If an existing town ordinance relating to shorelands is more restrictive than an ordinance later enacted under this section affecting the same shorelands, it continues as a town ordinance in all respects to the extent of the greater restrictions, but not otherwise.

(c) Ordinances enacted under this section shall accord and be consistent with any comprehensive zoning plan or general zoning ordinance applicable to the enacting counties, so far as practicable.

(3) All powers granted to a county under s. 236.45 may be exercised by it with respect to shorelands, but it must have or provide a planning agency as defined in s. 236.02(1).

(4)(a) Section 66.30 applies to this section, except that for the purposes of this section any agreement under s. 66.30 shall be effected by ordinance. If the municipalities as defined in s. 144.26 are served by a regional planning commission under s. 66.945, the commission may, with its consent, be empowered by the ordinance of agreement to administer each ordinance enacted hereunder throughout its enacting municipality, whether or not the area otherwise served by the commission includes all of that municipality.

(b) Variances and appeals regarding shorelands within a county are for the board of adjustment for that county under s. 59.99, and the procedures of that section apply.

(5) An ordinance enacted under this section supersedes all provisions of an ordinance enacted under s. 59.97 that relate to shorelands.

(6) If any county does not adopt an ordinance by January 1, 1968, or if the department, after notice and hearing, determines that a county has adopted an ordinance which fails to meet reasonable minimum stan-

dards in accomplishing the shoreland protection objectives of s. 144.26(1), the department shall adopt such an ordinance. As far as possible, s. 87.30 shall apply to this subsection.

87.30 FLOOD PLAIN ZONING.

(1) State Powers. If any county, city or village does not adopt a reasonable and effective flood plain zoning ordinance by January 1, 1968, the department shall, upon petition of an interested state agency, a municipality, 12 or more freeholders, or upon its own motion as soon as practicable and after public hearing, determine and fix by order the limits of any or all flood plains within such county, city or village within which serious damage may occur. Thereafter the department shall as soon as practicable after public hearing adopt a flood plain zoning ordinance applicable to such county, city or village. Thirty days' notice of all hearings on flood plain determination or zoning before the department shall be given to the county, city or village clerk, the clerks of all towns where lands may be affected, to the highway commission and to the conservation commission. Each state agency mentioned shall keep an official record of all proceedings. Exhibits and testimony shall be a part of the official record. Failure of a county, city or village to adopt a flood plain zoning ordinance for an area where appreciable damage from floods is likely to occur or to adopt an ordinance which will result in a practical minimum of flood damage in an area shall be prima facie proof of the necessity for action specified herein by the department. The department shall make a decision in writing of insufficiency of any county, city or village flood plain zoning ordinance before adopting an ordinance superseding such county, village or city ordinance. All final orders, determinations or decisions made under this subsection shall be subject to review under ch. 227 and be effective 20 days after the same have been served unless such order, determination and decision specifies a different date upon which the same shall be effective. Such flood plain determination and zoning ordinance shall be of the same effect as if adopted by the county, city or village. Thereafter it is the duty of the county, city, village and town officials to administer and enforce the ordinance in the same manner as if the county, city or village had adopted it. Flood plain determinations and zoning ordinances so adopted may be modified by the county, city or village concerned only with the written consent of the department except that nothing in this subsection shall be construed to prohibit a county, city, village or town from adopting a flood plain ordinance more restrictive than that adopted by the state. The cost of such flood plain determination and ordinance promulgation and enforcement by the state shall be assessed against the county, city or village concerned and collected in substantially the same manner as other taxes levied by the state.

(2) Enforcement and Penalties. Every structure, building, fill, or development placed or maintained within any flood plain in violation of a zoning ordinance adopted under this section, or ss. 59.97, 61.35 or 62.23 is a public nuisance and the creation thereof may be enjoined and maintenance thereof may be abated by action at suit of any municipality, the state or any citizen thereof. Any person who places or maintains any structure, building, fill or development within any flood plain in violation of a zoning ordinance adopted under this section, or ss. 59.97, 61.35 or 62.23 may be fined not more than \$50 for each offense. Each day during which such violation exists is a separate offense.

144.26 NAVIGABLE WATERS PROTECTION LAW.

(1) To aid in the fulfillment of the state's role as trustee of its navigable waters and to promote public health, safety, convenience and general welfare, it is declared to be in the public interest to make studies, establish policies, make plans and authorize municipal shoreland zoning regulations for the efficient use, conservation, development and protection of this state's water resources. The regulations shall relate to lands under, abutting or lying close to navigable waters. The purposes of the regulations shall be to further the maintenance of safe and healthful conditions; prevent and control water pollution; protect spawning grounds, fish and aquatic life; control building sites, placement of structure and land uses and reserve shore cover and natural beauty.

¹Chapter 614, Laws of 1965, published in Volume 3, *Wisconsin Statutes 1965*.

Appendix E (continued)

(2) In this section, unless the context clearly requires otherwise:

(a) 'Subcommittee' means the water subcommittee of the natural resources committee of state agencies.

(b) 'Department' means the Department of Natural Resources.

(c) 'Municipality' or 'municipal' means a county, village or city.

(d) 'Navigable water' or 'navigable waters' means Lake Superior, Lake Michigan, all natural inland lakes within Wisconsin and all streams, ponds, sloughs, flowages and other waters within the territorial limits of this state, including the Wisconsin portion of boundary waters, which are navigable under the laws of this state.

(e) 'Regulation' refers to ordinances enacted under ss. 59.971 and 62.23(7) and means shoreland subdivision and zoning regulations which include control of uses of lands under, abutting or lying close to navigable waters for the purposes specified in sub. (1), pursuant to any of the zoning and subdivision control powers delegated by law to cities, villages and counties.

(f) 'Water resources,' where the term is used in reference to studies, plans, collection of publications on water and inquiries about water, means all water whether in the air, on the earth's surface or under the earth's surface. 'Water resources' as used in connection with the regulatory functions under this section means navigable waters.

(g) 'Shorelands' means the lands specified under par. (e) and s. 59.97(1).

(5)(a) The department shall prepare a comprehensive plan as a guide for the application of municipal ordinances regulating navigable waters and their shorelands as defined in this section for the preventive control of pollution. The plan shall be based on a use classification of navigable waters and their shorelands throughout the state or within counties and shall be governed by the following general standards:

1. Domestic uses shall be generally preferred.

2. Uses not inherently a source of pollution within an area shall be preferred over uses that are or may be a pollution source.

3. Areas in which the existing or potential economic value of public, recreational or similar uses exceeds the existing or potential economic value of any other use shall be classified primarily on the basis of the higher economic use value.

4. Use locations within an area tending to minimize the possibility of pollution shall be preferred over use locations tending to increase that possibility.

5. Use dispersions within an area shall be preferred over concentrations of uses or their undue proximity to each other.

(b) The department shall apply to the plan the standards and criteria set forth in sub. (6).

(6) Within the purposes of sub. (1) the department shall prepare and provide to municipalities general recommended standards and criteria for navigable water protection studies and planning and for navigable water protection regulations and their administration. Such standards and criteria shall give particular attention to safe and healthful conditions for the enjoyment of aquatic recreation; the demands of water traffic, boating and water sports; the capability of the water resource; requirements necessary to assure proper operation of septic tank disposal fields near navigable waters; building setbacks from the water; preservation of shore growth and cover; conservancy uses for low lying lands; shoreland layout for residential and commercial development; suggested regulations and suggestions for the effective administration and enforcement of such regulations.

Appendix F
Excerpts from the State's Flood Plain Management Program

General Criteria for Flood Plain Regulations

A. PURPOSES AND OBJECTIVES

The purpose of these criteria is to provide a uniform basis for the preparation and implementation of sound flood plain regulations for Wisconsin rivers and streams in order to:

1. Protect human life and health.
2. Minimize expenditures of public monies for costly flood control projects.
3. Minimize rescue and relief efforts, generally undertaken at the expense of the general public.
4. Minimize business interruptions, Closing of factories and businesses, disruption of transportation routes, and interference with utility services result in loss of wages, sales and production.
5. Minimize damage to public facilities on the flood plains such as water mains, sewer lines, streets and bridges. These facilities are repaired at the expense of the general public.
6. Help maintain a stable tax base by the preservation or enhancement of property values for future flood plain developments. In addition, development of future flood blight areas on flood plains will be minimized and property values and the tax base adjacent to the flood plains will be preserved.
7. To discourage the victimization of unwary land and home buyers.

To accomplish the foregoing objectives, provisions in flood plain zoning and other flood plain management practices and the administration and enforcement thereof shall, among other things:

1. Reduce the hazard of floods to life and property through:
 - a. prohibiting certain uses which are dangerous to life or property in time of flood.
 - b. restricting uses which would be hazardous to the public health in time of flood.
 - c. restricting uses which are particularly susceptible to flood damage, so as to alleviate hardship and reduce demands for public funds for relief and protection.
 - d. requiring permitted flood plain uses, including public facilities which serve these uses to be protected against floods, thereby providing flood protection at the time of initial construction.
2. Protect the storage capacity of flood plains, and assure retention of sufficient floodway area to convey flood flows which reasonably can be expected to occur, through:
 - a. regulating, filling, dumping, dredging and alteration of channels by deepening, widening or relocating.
 - b. prohibiting unnecessary encroachments in floodways.
 - c. encouraging open space uses such as agricultural and recreational.

B. REGIONAL FLOOD

1. The regional flood is a flood determined by the Division of Resource Development which is representative of large floods known to have occurred generally in Wisconsin and reasonably characteristic of what can be expected to occur on a particular stream. The regional flood generally will have an average frequency in the order of the one hundred (100) year recurrence interval flood determined from an analysis of floods on a particular stream and other streams in the same general region.

The Division of Resource Development methods and techniques to ascertain the magnitude of the regional flood and application thereof shall be uniform throughout the state.

2. Local units of government can and in some cases will be encouraged to anticipate floods in excess of the regional flood in local regulations.

C. FLOOD PLAIN DELINEATION

1. The regional flood generally shall serve as a basis for delineation of the minimum limits of the flood plains for regulatory purposes.
2. Where technical information is available to ascertain the magnitude of floods larger than the regional flood that could be expected to occur (such as the standard project flood or the maximum probable flood), the flood plain limits of these large

floods shall be reflected on the official zoning district maps for public informational purposes.

3. The best possible engineering and other techniques should be utilized in locating the flood plain limits on an official zoning district map. Where there may be a conflict between the flood plain limits illustrated on the map and actual field conditions, the elevations from the flood profile shall be the governing factor in locating the regulatory flood plain limits on the ground.

D. FLOODWAY DELINEATION

1. The delineation of the floodway shall be based on the channel of the river or stream and those portions of the adjoining flood plains which are reasonably required to carry and discharge the regional flood.
2. The determination of the floodway limits shall be based on hydraulic and engineering studies.

E. REGULATORY FLOOD PROTECTION ELEVATIONS

1. The regulatory flood protection elevation shall correspond to a point not less than two feet above the water surface profile associated with the regional flood.
2. Where floodway encroachments are permitted, the increase in water surface elevations attributable to permitted floodway encroachments shall be reflected in the regulatory flood protection elevations.
3. The regulatory flood protection elevations shall be clearly lettered at identifiable positions on the official zoning district map consistent with the water surface profile of the regional flood, or the profile shall be attached to and made part of the official zoning district map.

F. FLOODWAY ENCROACHMENTS

1. Any increase in flood stages attributable to encroachments on the floodway of any river or stream shall not exceed 0.50 foot in urban areas and 1.00 foot in rural areas in any one reach or for the cumulative effect of several reaches of a river or stream for the regional flood.
2. Floodway encroachments shall be:
 - a. based on a uniform degree of encroachment for a significant reach on both sides of a river or stream;
 - b. based on hydraulic and engineering studies;
 - c. be consistent with local comprehensive planning.

G. AREAS BETWEEN FLOODWAY OR ENCROACHMENT LIMITS AND/OR LEVEES

1. Permitted Uses

- a. open space uses having a relatively low flood damage potential such as those associated with agriculture, recreation, parking, storage yards, certain sand and gravel operations;
- b. certain structures accessory to permitted open space uses if the structures are designed, constructed and placed on the lot so as to offer the minimum obstruction to flood flows;
- c. channel uses permitted by the Public Service Commission pursuant to sections 30.11, 30.12, and 30.15 of the Wisconsin Statutes.

2. Prohibited Uses

- a. any fill, deposit, obstruction, excavation, storage of materials, or structure which acting alone or in combination with existing or future similar works could adversely affect the efficiency or the capacity of the floodway or adversely affect existing drainage courses or facilities. The determination of these effects shall be based on the assumption that the flood plain or floodway encroachment resulting from any proposed fill, obstruction, or structures will extend for a significant reach of the stream together with an encroachment equal in degree on the opposite side of the stream;
- b. structures that are (1) designed for human habitation, (2) associated with high flood damage potential, (3) not connected with permitted open space uses, and (4) structures consistent with open space uses that could obstruct flood flows in accordance with above part (a) of this subsection;
- c. storage of materials that are buoyant, flammable, explosive, or injurious to human, animal or plant life; and
- d. open space uses that are not in harmony with and may be detrimental to the uses permitted in the adjoining district.

Appendix F (continued)

H. AREAS LANDWARD OF FLOODWAY OR ENCROACHMENT LIMITS

1. General

- a. All flood plain developments should be consistent with a local comprehensive plan. In the absence of a formal plan, developments shall be in harmony with and not detrimental to the uses permitted in the adjoining district.
- b. Flood plain developments shall not adversely affect the efficiency of or unduly restrict the capacity of the channels or floodways of any tributaries to the main stream, drainage ditches, or any other drainage facilities or systems.
- c. Flood plain developments shall not materially affect the storage capacity of the flood plains, particularly in flood plain areas upstream from urban areas. The determination of these effects shall be based on the assumption that the flood plain or floodway encroachment resulting from any proposed fill, obstruction, or structures, etc. will extend for a significant reach of the stream together with an encroachment equal in degree on the opposite side of the stream.

2. Urban Residential Areas

- a. The first floor or basement floor of any building or structure to be erected, constructed, reconstructed, altered, or moved on the flood plain shall be placed on fill at or above the regulatory flood protection elevation.
- b. Fill elevation shall be not less than one foot above the regional flood elevation plus any increases in elevation permitted in "F. FLOODWAY ENCROACHMENTS" of these criteria and the fill shall extend at such elevation at least 15 feet beyond the limits of any structure of building erected thereon.

3. Rural Seasonal or Permanent Residences

- a. The first floor and any floor of a basement of a building or structure used for human habitation or associated with a high flood damage potential to be erected, constructed, reconstructed, altered, or moved on the flood plain shall be at or above the regulatory flood elevation.
- b. If rural seasonal or permanent residences are served by public facilities such as water or sewer lines, criteria for urban residential areas shall apply.

4. Commercial Areas

Commercial areas generally are to be constructed on fill with no first floor or basement floor below the regulatory flood elevation. Certain yards, parking lots, and other auxiliary land uses may be at lower elevations. However, no such area in general use by the public shall be inundated to a depth greater than two feet or subjected to flow velocities greater than four feet per second upon the occurrence of the regional flood.

5. Manufacturing and Industrial Areas

Protection methods utilizing fill, levees, floodwalls, and flood proofing measures for buildings, structures, and appurtenant works are to be provided to the regulatory flood protection elevation. Interference with normal plant operations is to be minimized, especially for streams having protracted flood durations. A lesser degree of protection may be permissible for storage yards, parking lots, and other auxiliary uses compatible with these criteria.

6. Public Utilities, Streets and Bridges

- a. When failure or interruption of public facilities would result in danger to the public health or safety, or where such facilities are essential to the orderly functioning of the area, protection to the level of the regulatory flood protection is to be provided.
- b. Where failure or interruption of service would not endanger life or health, a lesser degree of protection may be provided for minor or auxiliary roads or utilities.
- c. Public utilities, roads, and bridges on the flood plain should be designed to minimize increases in flood elevations and should be compatible with the local comprehensive flood plain development plan.

7. Storage of Materials

Any storage of materials that are buoyant, flammable, explosive, or in times of flooding, could be injurious to human, animal, or plant life, should be at or above the regulatory flood protection elevations.

I. FLOOD PROOFING MEASURES

When these criteria permit flood proofing measures such as those listed below, these measures shall be designed consistent with flood velocities, depths, forces, and other factors associated with the regional or regulated flood. A plan or document certified by a registered professional engineer that the flood proofing measures are adequately designed shall be submitted to the local unit of government prior to any authorization therefor.

1. Anchorage of structures to foundations.
2. Installation of watertight doors, bulkheads and shutters.
3. Reinforcement of walls to resist water pressures.
4. Use of paints, membranes or mortars to reduce seepage of water through walls.
5. Addition of mass or weight to structures to resist flotation.
6. Installation of pumps to lower water levels in structures.
7. Construction of water supply and waste treatment systems to prevent the entrance of flood waters.
8. Pumping facilities for subsurface drainage systems for buildings to relieve external foundation wall and basement floor pressures.
9. Cutoff valves on sewer lines or the elimination of gravity flow basement drains.

J. FLOOD PROTECTIVE OR CONTROL WORKS FOR URBAN AREAS

1. Levees or Floodwalls

- a. The criteria for 'Floodway Encroachments' generally shall be applicable to levees or floodwalls.
- b. The minimum height and design of any levee or floodwall shall be based on the flood profile of the regional flood confined between the levees or floodwalls, plus three feet of freeboard or the standard project flood confined between the levees or floodwalls, whichever provides the greater protection from floods.
- c. Increases in flood stages resulting from any levee or floodwall in excess of the allowable increases in 'Floodway Encroachments' or these criteria shall be contained within the upstream extent of any levee or floodwall.
- d. Flood plain developments landward of any levee or floodwall shall be compatible with provisions for interior drainage and designated ponding areas associated with any levee or floodwall.
- e. The general criteria for 'Areas Landward of Floodway or Encroachment Limits' shall apply for flood plain developments until such time as the levees and floodwalls are constructed and operative.

2. Reservoirs and Channel Improvements

Any regulatory flood protection elevations or floodway or encroachment limits based on any proposed reservoir or channel improvements shall not be effective until the reservoir or channel improvements are constructed and operative.

K. MODIFICATIONS OR ADDITIONS TO EXISTING STRUCTURES

1. Areas Between Floodway or Encroachment Limits and Levees

No modifications or additions to any structure that are not in compliance with permitted floodway uses are permitted unless such modification will decrease the flood damage potential of the structure or cause the structure to decrease the degree of obstruction to flood flows.

2. Areas Landward from Floodway or Encroachment Limits

- a. Any modifications or additions to any structure generally shall be in compliance with the general criteria for flood plain regulation.
- b. Where compliance with applicable criteria results in undue hardship, the following shall apply:
 1. any modifications or additions to any structure for human habitation or with a high flood damage potential shall be protected to the regulatory flood protection elevation by acceptable flood proofing measures. In accordance with Section "I. FLOOD PROOFING MEASURES" of these criteria.
 2. modifications or additions for other structures may be permitted at elevations lower than the regulatory flood protection elevation if such modification or addition will not be subjected to high flood depths or flood velocities and will not require the installation of public facilities.

Appendix F (continued)

3. any modification involving the internal use of an existing building not in compliance with these criteria may be permitted if such use will not endanger human lives, increase the flood damage potential by the occurrence of the regional flood, or require the installation of public facilities.
 3. Any modifications or additions to existing structures also shall comply with the statutory provisions for non-conforming uses.
- L. THE REMOVAL OF DESIGNATED FLOOD PLAIN LIMITS
- The flood plain designation on zoning district maps shall not be removed from any area unless it can be shown that the area is filled to an elevation two feet above the flood profile for the standard project flood.
- M. CERTIFICATION OF COMPLIANCE
- In urban areas and where practicable in rural areas, no vacant land shall be occupied or used and no building hereafter erected, altered or moved shall be occupied until the applicant submits to the local zoning administrator or building inspector a certification by a registered professional engineer or land surveyor that the finished fill and building floor elevations and other flood plain regulatory factors were accomplished in compliance with appropriate flood plain zoning provisions and other flood plain regulations.
- N. PUBLIC INFORMATION
1. Where possible, flood limits should be marked on the ground. Markers should be set to show both the depth of inundation and the area affected.
 2. All available information in the form of maps, engineering data, and regulations should be freely and widely distributed.
 3. All legal descriptions of property transferred in the flood plain area should include information relative to the zoning classification.

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Appendix G
Excerpts from the State's Shoreland Management Program

Shoreland Regulation Standards and Criteria

1. Establishment of appropriate districts

Shoreland areas can usually be covered by regulations appropriate to wetlands (Conservancy District), Recreation-Residential Districts, and General Purpose Districts. Where detailed planning has been accomplished, other types of districts may also be desirable.

2. Establishment of subdivision regulations

The county must establish a procedure for county review and approval or disapproval of all proposals for the division of a tract of land that creates three (3) or more parcels or building sites of five (5) acres each or less within a five year period.

No subdivision may be eligible for approval if the subdivision

- a. Is likely to result in hazard to the health, safety or welfare of future residents
- b. Fails to maintain proper relation to adjoining areas
- c. Does not provide public access to navigable waters, as required by law.
- d. Does not provide for adequate storm drainage facilities
- e. Violates any state law or administrative code provision

3. Establishment of land use regulations

The ordinances adopted must provide sufficient control of the use of shorelands to afford the protections of water quality specified in the statute. The controls must include the following:

- a. The minimum lot size must afford protection against danger to health and excessive hazard of pollution of the body of water.
 - (1) Lots served by public sewer will normally have a minimum width of 65 feet and a minimum area of 10,000 square feet.
 - (2) Lots not served by public sewer will have a minimum width of 100 feet and a minimum area of 20,000 square feet.
 - (3) Larger dimensions shall be required, if the specified minimums do not afford adequate protection against pollution of the water.
- b. The permitted location of buildings and structures must be such as to conform to health requirements and to preserve natural beauty. This will normally require a setback of 75 feet from the

normal high water line. Structures are also subject to flood-plain management regulations.

- c. The regulation of the cutting of trees and shrubbery so as to protect scenic beauty, control erosion and reduce flow of effluents or nutrients from the shoreland. For example, in the strip 35 feet inland from the normal high water mark, no more than 30 feet in any 100 feet should be clear cut. In other areas, tree and shrub cutting should be governed by consideration of the effect on water quality and should be in accord with accepted management practices.
- d. Filling, grading, lagooning and dredging may be permitted only in accord with state law and where protection against erosion, sedimentation, and impairment of fish and aquatic life has been assured.

4. Establishment of sanitary protections

The protection of health and the preservation and enhancement of water quality require special shoreland regulations. In part these are provided by statutes and administrative code, but some should be reiterated in regulations adopted by the county.

- a. Where public water supply systems are not available, private well construction will conform to the Wisconsin Administrative Code.
- b. Where a public sanitary sewer is not available, construction and operation of private sewage disposal systems shall comply fully with Wisconsin Statutes and the Administrative Code.

5. Adoption of administrative and enforcement provisions

Inasmuch as the shoreland regulations are useful only to the extent they are applied, it is essential that the regulations provide for

- a. An administrator
- b. A permit system
- c. An exception procedure (subject to timely review by the Division of Resource Development)
- d. A Board of Adjustment

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Introduction to Appendices H through M

In the following suggested zoning district regulations, model ordinances, and special floodland, shoreland, and water use regulations where the local unit of government, governing body, its agencies, or officials appear in italics, the appropriate unit, body, agency, or official should be substituted to relate to, and meet the needs and desires of, the local community; and where statute numbers appear in italics, the appropriate enabling statute number should be substituted. Other words, numbers, terms, or paragraphs appearing in italics are suggested and may be increased or adjusted and, where inapplicable, omitted to best meet the needs and desires of the individual community.

These districts and regulations are set forth in a section and subsection form convenient for incorporation into the SEWRPC Model Zoning and Land Division Ordinances or other properly prepared ordinances. It should be stressed that the district regulations in Appendix M must be supplemented by the special floodland and shoreland regulations in Appendix I, which are in addition to the regulations of the basic underlying comprehensive zoning district.

This Guide is not intended to be applied indiscriminately without regard for local conditions; nor is it intended to be a substitute for necessary professional planning, engineering, and legal advice at the local level. It assumes the existence of duly constituted local agencies charged with carrying out the local zoning, planning, health,

building, and water regulatory functions and is intended to assist these local agencies in the performance of their duties. These zoning districts, model ordinances, and special floodland and shoreland regulations were prepared by the Community Assistance Division of the Southeastern Wisconsin Regional Planning Commission; and any communications or questions concerning the content and use of these materials should be addressed to that Division.

It is extremely important to note that the suggested districts and regulations are intended only as guides to be used by local units of government in the formulation of their floodland and shoreland regulations. Competent legal, engineering, and planning assistance should be obtained in conjunction with the use of these suggested regulations by local communities in the formulation of actual regulations carefully fitted to the local needs.

The state floodplain and shoreland management programs require that local units of government must submit all proposed floodland and shoreland regulations and related maps and supporting engineering data to the State Department of Natural Resources for review and comment prior to local adoption. If the methods, procedures, zoning districts, model ordinances, and special floodland and shoreland regulations set forth in this Guide are carefully followed, approval of such regulations by the State Department of Natural Resources should ordinarily be forthcoming.

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Appendix H Zoning District Regulations for Floodland and Shoreland Areas

The following zoning district regulations have been designed to replace or be added to those districts listed in the Model Zoning Ordinance set forth in Appendix A of SEWRPC Planning Guide No. 3, Zoning Guide, 1964, or other properly prepared zoning ordinances. These district regulations must be supplemented by the additional floodland and shoreland regulations set forth in Appendix I of this Guide so as to prevent flood damage, preserve shoreland cover, and protect water quality. The use of these additional regulations, along with the appropriate zoning districts, obviates the necessity for special floodway and floodplain zoning districts.

A-1 General Farming District (Replacement)

Principal Uses Apiculture; dairying; floriculture; forestry; grazing; greenhouses; hay; livestock raising with herds of less than twenty-five (25) head per forty (40) acres; orchards; paddocks; pasturage; plant nurseries; poultry raising of flocks of less than five hundred (500) birds per forty (40) acres; raising of cash grain crops, mint, grass, seed crops, silage, tree fruits, nuts and berries, and vegetables; stables; truck farming; and viticulture. Farm dwellings for those resident owners and laborers actually engaged in a principal use are accessory uses to the farm operation but shall comply with all the provisions of the Rural Residential District. Existing dwellings not accessory to any farm operation and farm dwellings remaining after consolidation of neighboring farms are permitted but shall comply with all the provisions of the Rural Residential District. Not more than one (1) roadside stand on any one farm shall be permitted as an accessory use.

Conditional Uses Airports; airstrips; animal hospitals; commercial egg production; commercial raising of animals, such as dogs, foxes, goats, mink, pigs, and rabbits; condenseries; creameries; farm drainage tile; feed lots; hatching or butchering of fowl; landing fields; livestock raising with herds of twenty-five (25) head or more per forty (40) acres; migratory laborers' housing; poultry raising with flocks of five hundred (500) birds or more per forty (40) acres; and sod farming.

<u>Farm</u>	Width	Minimum	1,000 ft.
	Area	Minimum	40 acres
<u>Structure</u>	Height	Maximum	50 ft.
<u>Yards</u>	Shore	Minimum	400 ft.
	Street	Minimum	100 ft.
	Rear	Minimum	100 ft.
	Side	Minimum	100 ft.

A-2 Truck Farming District (Addition)

Principal Uses Apiculture, floriculture, greenhouses, horticulture, nurseries, orchards, paddocks, raising of cash crops, raising of horses not to exceed three (3) head for each five (5) acres, truck farming, and viticulture. Farm dwellings for those resident owners and laborers actually engaged in a principal use are accessory uses to the farm operation but shall comply with all the provisions of the Rural Residential District. Existing dwellings not accessory to any farm operation or dwellings remaining after consolidation neighboring farms are permitted but shall comply with all the provisions of the Rural Residential District. Not more than one (1) roadside stand on any one farm shall be permitted as an accessory use.

<u>Farm</u>	Width	Minimum	300 ft.
	Area	Minimum	10 acres
<u>Structure</u>	Height	Maximum	50 ft.

<u>Yards</u>	Shore	Minimum	400 ft.
	Street	Minimum	100 ft.
	Rear	Minimum	100 ft.
	Side	Minimum	100 ft.

B-5 Water-Oriented Business District (Addition)

Principal Uses Existing water-oriented commercial uses, such as bait shops, bath-houses, bathing and fishing areas on lakes and streams, boat and marine sales, boat launching areas, boat liveries, boat storage, repair and service marinas, dance halls, fishing equipment sales, hotels, motels, resorts, restaurants, and taverns.

Conditional Uses Extension of, or the creation of, new principal uses listed above.

<u>Lot</u>	Width	Minimum	150 ft.
	Area	Minimum	40,000 sq. ft.
<u>Structure</u>	Height	Maximum	35 ft.
<u>Yards</u>	Shore	Minimum	150 ft.
	Street	Minimum	50 ft.
	Rear	Minimum	50 ft.
	Side	Minimum	50 ft.

C-1 Resource Conservation District (Replacement)

Principal Uses Fishing; flood overflow and flood-water storage; hunting; navigation; pedestrian and equestrian trails; preservation of scenic, historic, and scientific areas; public fish hatcheries; soil and water conservation practices; sustained yield forestry; stream bank and lakeshore protection; water retention ponds; and wildlife areas.

Conditional Uses Boating, drainageways, game farms, grazing, orchards, shooting preserves, swimming, truck farming, utilities, water measurement and water control facilities, and wildcrop harvesting. The above uses shall not involve drainage; dumping; filling; tilling; mineral, soil, or peat removal; or any other use that would substantially disturb or impair the natural fauna, flora, watercourses, water regimen, or topography.

Structures None permitted except accessory to the principal or conditional uses.

P-1 Institutional Park District (Replacement)

Principal Uses Public and private institutional uses, such as schools; colleges; universities; hospitals; sanitariums; religious, charitable, and penal institutions; cemeteries; and crematories.

Conditional Uses All structures and improvements.

<u>Development Area</u>	Minimum	20 acres
<u>Structure</u>	Height	Maximum 50 ft.
<u>Yards</u>	Shore	Minimum 400 ft.
	Street	Minimum 100 ft.
	Rear	Minimum 100 ft.
	Side	Minimum 100 ft.

P-2 Recreational Park District (Addition)

Principal Uses Public and existing private recreational uses, such as arboretums, bathing, boating, cycling, fishing, horse riding, marinas, swimming, skating, sledding, skiing, nature trails, and hiking.

Appendix H (continued)

Conditional Uses. Extension of existing, or the creation of new, private recreational uses; all public and private recreational or assembly structures; golf courses; camp grounds; playgrounds; driving ranges; polo fields; swimming pools; zoological and botanical gardens; athletic fields; lodges; picnic areas; archery and firearm ranges; and outdoor theaters.

Development Area Minimum 20 acres

Structure Height Maximum 35 ft.

Yards Shore Minimum 400 ft.
Street Minimum 100 ft.
Rear Minimum 100 ft.
Side Minimum 100 ft.

R-1 Country Residential District (Replacement)

Principal Uses One-family dwellings on estate lots and sustained yield forestry.

Conditional Uses Stables, nurseries, and orchards.

Lot Width Minimum 300 ft.
Area Minimum 5 acres

Building Height Maximum 35 ft.
Area Minimum 1,800 sq. ft. with at least 1,200 sq. ft. on first floor

Yards Shore Minimum 200 ft.
Street Minimum 100 ft.
Rear Minimum 100 ft.
Side Minimum 50 ft.

R-2 Shoreland Residential District (Replacement)

Principal Uses One-family dwellings on shoreland lots previously created by a duly recorded legally existing subdivision plat, in which street improvements have been previously completed or in which a uniform residential density of at least one (1) dwelling for each two (2) acres of gross subdivision area exists at the time of adoption of this Ordinance.

Lot Width Minimum 75 ft. (public sewerage)
Minimum 150 ft. (septic system)
Minimum 10,000 sq. ft. (public sewerage)
Minimum 40,000 sq. ft. (septic system)

Building Area Minimum 1,200 sq. ft. with at least 1,000 sq. ft. on the first floor

Yards Shore Minimum 50 ft. (public sewerage)
Minimum 100 ft. (septic system)
Street Minimum 35 ft. (public sewerage)
Minimum 50 ft. (septic system)
Rear Minimum 50 ft. (public sewerage)
Minimum 100 ft. (septic system)
Side Minimum 10 ft. (public sewerage)
Minimum 25 ft. (septic system)

R-3 Planned Residential District (Replacement)

Principal Uses Row-housing, apartments, and clustered one-family lot developments, all served by a public sanitary sewer system.

Conditional Uses All structures and improvements.

Development Area Minimum 10 acres in one ownership.
Width Minimum 450 ft.

Park Land Area Minimum 20 percent of the development area.

Lot Area Minimum 4,000 sq. ft. per row-house
8,000 sq. ft. for one-family dwellings

Width Minimum 120 ft. for 1 1/2 story row-houses
Minimum 65 ft. for one-family dwellings

Building Area Minimum 600 sq. ft. for each apartment
Minimum 1,000 sq. ft. for row-houses
Minimum 1,200 sq. ft. for one-family dwellings

Width Minimum 30 ft. for each row-house

Height Maximum 30 ft.

Rooms All living rooms shall have windows opening onto a yard.

Yards Shore Minimum 200 ft.
Street Minimum 30 ft.
Rear Minimum 50 ft.
Side Minimum 30 ft. from street rights-of-way, from exterior property lines of the development, and between buildings.

Appendix I
Special Floodland and Shoreland Regulations to be Incorporated into Zoning Ordinances

The following sections and subsections have been designed to replace or be added to those regulations found in the Model Zoning Ordinance set forth in Appendix A of SEWRPC Planning Guide No. 3, Zoning Guide, 1964, or other properly prepared zoning ordinances. These floodland and shoreland regulations are in addition to the zoning district regulations set forth in Appendix H of this Guide.

SECTION 1.0 INTRODUCTION

SECTION 1.1 Authority (Replacement)

This Ordinance is adopted under the authority granted by Sections 59.97, 59.971, 59.99, 87.30 (2), and 144.26 of the Wisconsin Statutes and amendments thereto. The County Board of Supervisors of the County of _____ do ordain as follows:

SECTION 1.3 Intent (Addition)

Secure Safety from flooding, water pollution, contamination, and other hazards.

Prevent Flood Damage to persons and property and minimize expenditures for flood relief and flood control projects.

Obtain the Wise Use, conservation, development, and protection of the County's water, soil, wetland, woodland, and wildlife resources according to their capabilities.

Further the Maintenance of safe and healthful water conditions.

Prevent and Control Erosion, sedimentation, and other pollution of surface and subsurface waters.

Preserve Shore Growth and Cover and promote the natural beauty of the County.

Protect Fish and Animal Life, including their spawning, nesting, resting, nursing, and feeding areas.

Implement those municipal, county, watershed, and regional comprehensive plans or components of such plans adopted by the County.

SECTION 1.4 Greater Restrictions (Addition)

Where a Town Ordinance is more restrictive than this Ordinance in relation to floodlands and shorelands, only its greater restrictions are effective.

SECTION 1.6 Severability and Non-Liability (Addition)

The County does not guarantee, warrant, or represent that only those areas designated as floodlands will be subject to periodic inundation and hereby asserts that there is no liability on the part of the County Board of Supervisors, its agencies, or employees for any flood damages that may occur as a result of reliance upon, and conformance with, this Ordinance.

SECTION 1.7 Repeal (Addition)

All Other Ordinances enacted by the County under Section 59.97 of the Wisconsin Statutes relating to floodlands and shorelands are hereby superseded.

SECTION 1.9 Effective Date (Addition)

Shoreland Regulations contained herein shall not require approval or be subject to disapproval of any Town¹

SECTION 2.0 GENERAL PROVISIONS

SECTION 2.1 Jurisdiction (Replacement)

The provisions of this Ordinance shall apply to all structures, land, water, and air within the unincorporated areas of _____ County, Wisconsin.

SECTION 2.2 Compliance (Replacement)

No structure, land, water, or air shall hereafter be used and no structure or part thereof shall hereafter be located, erected, moved, reconstructed, extended, enlarged, converted, or structurally altered without a Zoning Permit, except minor structures, and without full compliance with the provisions of this Ordinance and all other applicable local, county, and state regulations.

The Zoning Inspector, with the aid of the Sheriff and the Corporation Counsel, shall accept all applications, issue or deny all Zoning Permits, investigate all complaints, give notice of violations, and enforce the provisions of this Ordinance.

Access. The Zoning Inspector shall have access to premises and structures during reasonable hours to make those inspections as deemed necessary by him to ensure compliance with this Ordinance. If, however, he is refused entry after presentation of his identification, he shall procure a special inspection warrant in accordance with Section 963.10 of the Wisconsin Statutes, except in cases of emergency.

SECTION 2.3 Zoning Permit (Addition)

Plat of Survey prepared by a land surveyor registered in Wisconsin, showing the location of the high-water elevation, channel, floodway, floodplain, and shoreland boundaries.

SECTION 2.4 Site Regulations (Addition)

Width and Area of all lots not served by a public sanitary sewer system or other approved system shall be sufficient to permit the use of an on-site soil absorption sewage disposal system designed in accordance with the County Sanitary Ordinance but in no case shall be less than one hundred and fifty (150) feet in width and forty thousand (40,000) square feet in area.

Land or Lot Divisions shall be approved by the County Planning Agency prior to the issuance of a Zoning Permit for any development of said division and shall be subject to all City, Village, Town, and County ordinances applicable to such land division.

SECTION 2.6 Sanitary Regulations (Addition)

No private water supply or waste disposal systems or parts thereof shall be located, installed, moved, reconstructed, extended, enlarged, converted, substantially altered, or their use changed without a Sanitary Permit and without full compliance with the County Sanitary Ordinance.

No Zoning Permit shall be issued until a safe and adequate water supply and sewage disposal system are assured and a Sanitary Permit is issued.

SECTION 2.7 Floodland Regulations (Addition)

In addition to any other applicable use, site, or sanitary regulations, the following regulations shall apply to floodlands:

Within the Floodplains. Dumping, filling, on-site sewage disposal facilities, residential uses, basements, permanent public assembly structures, and permanent sheltering and restricted confining of animals are prohibited.

Within the Floodways. In addition to the above prohibition, all structures are prohibited except navigational structures, public water measuring and control facilities, bridges, and utilities.

Within the Channels. In addition to the above restrictions, the erection of all structures in the channel shall require a permit from the state agency having jurisdiction pursuant to Section 30.12(2) of the Wisconsin Statutes. All bulkheads, wharves, and piers shall comply with bulkhead or pierhead lines established by any municipality pursuant to Sections 30.11 or 30.13 of the Wisconsin Statutes.

¹For requirements concerning town approval of shoreland regulations, see discussion in Chapter VI of this report.

Appendix I (continued)

SECTION 4.10 Floodland Uses (Addition)

The following uses are conditional uses and may be permitted as specified:

Floodplain Uses not prohibited in Section 2.6 of this Ordinance provided they are permitted in the zoning district and the applicant can show that such use or improvement will not impede drainage, will not substantially reduce the floodwater storage capacity of the floodplain, will not cause ponding, and will not significantly raise floodwater elevations. This is based on the assumption that there will be an Equal Degree of Encroachment extending for a significant Reach on both sides of the stream. Such uses shall not involve the storage of materials that are buoyant, flammable, explosive, or injurious to human, animal, or plant life. All structures shall be floodproofed; and all buildings shall have their lowest floor and their heating, electrical, and other vital utility facilities constructed at an elevation of no less than two (2) feet above the level of the one hundred (100)-year recurrence interval flood or, if this is unknown, five (5) feet above the maximum flood of record. In addition, the ground level surrounding any building should be raised to an elevation no less than one (1) foot above the level of the one hundred (100)-year recurrence interval flood for a horizontal distance of at least fifteen (15) feet from the outer face of the building walls.

Floodway Uses not prohibited in Section 2.6 of this Ordinance, such as outdoor recreation, parking lots, storage yards, navigational structures, public water measuring and control facilities, bridges and utilities, provided such uses are permitted in the zoning district and the applicant can show that such use or improvement will not obstruct the floodway, increase flood flow velocities, increase the flood stage, or retard the movement of floodwaters. All structures shall be floodproofed and constructed so as not to catch or collect debris nor be damaged by floodwaters. Such uses shall not involve the storage of materials that are buoyant, flammable, explosive, or injurious to human, animal, or plant life.

The Board of Zoning Adjustment shall request a review of each such floodland use by the State Department of Natural Resources and await their recommendations before taking final action but not to exceed sixty (60) days. A copy of the Board's decision on such application shall be forwarded by the Secretary of the Board to the Department of Natural Resources and the Region 2 Water Resources Advisory Board within ten (10) days of such decision.

SECTION 4.11 Shoreland Uses (Addition)

The following uses are conditional uses and may be permitted as specified:

Tree Cutting and Shrubbery Clearing not prohibited in Section 2.7 of this Ordinance, provided that such cutting and clearing shall not exceed thirty (30) percent of the lot or tract and shall be so regulated as to prevent erosion and sedimentation, preserve and improve scenic qualities, and during foliage substantially screen any development from stream or lake users. Paths and trails shall not exceed ten (10) feet in width and shall be so designed and constructed as to result in the least removal and disruption of shoreland cover and the minimum impairment of natural beauty.

The Board of Zoning Adjustment shall request a review of such tree cutting and shrubbery clearing in excess of one (1) acre by the State Department of Natural Resources and await their recommendations before taking final action but not to exceed sixty (60) days.

Earth Movements, such as grading, topsoil removal, stream course changing, road cutting, waterway construction or enlargement, removal of stream or lake bed materials, excavation, channel clearing, ditching, drain tile laying, dredging, lagooning, and soil and water conservation structures, provided that such uses are so regulated as to prevent erosion and sedimentation and to least disturb the natural fauna, flora, watercourse, water regimen, and topography.

The Board of Zoning Adjustment shall request a review of such earth movement by the County Soil and Water Conservation District Supervisors and the State District Fish and Game Managers and a review of each such cutting and clearing from the State District Forester and await their recommendations before taking final action but not to exceed sixty (60) days.

SECTION 6.0 MODIFICATIONS

SECTION 6.2 Yards (Addition)

Boathouses accessory to residential uses may be located within a shore yard but shall be no closer than twenty (20) feet² to the average annual high-water elevation of the stream, lake, pond, or wetland; shall not exceed one (1) boathouse on the premises for each shoreland lot; shall not exceed a height of fifteen (15) feet above the high-water elevation; shall not exceed two hundred and fifty (250) square feet in horizontal area covered; and shall not be closer than fifteen (15) feet to any side lot line.

Shore Yards may be reduced to the average of the shore yards existing on the abutting properties within a distance of one hundred (100) feet of the subject site but shall not be reduced to less than fifty (50) feet.

SECTION 7.0 SIGNS

SECTION 7.2 Signs Excepted (Addition)

All signs are prohibited in all Agricultural, Conservancy, Park, and Residential Districts except the following:

Recreational Directory Signs not to exceed two (2) in number, indicating the direction and distance to a specific cottage, resort, residence, or recreation facility, and not to exceed two (2) square feet in display area.

SECTION 7.3 Signs Permitted (Addition)

Signs are permitted in only the Business and Industrial Districts subject to the following restrictions:

Shoreland Signs visible to stream or lake users at any time of the year shall not exceed twenty-five (25) square feet in area on one side nor fifty (50) square feet in area on all sides for any one premise, shall not exceed a height of twenty (20) feet above the high-water elevation and shall not be located closer than fifty (50) feet to any side lot lines. Such signs shall not contain, include, or be illuminated by a flashing light or be composed of any animated part.

SECTION 8.0 NONCONFORMING USES, STRUCTURES, AND LOTS

SECTION 8.1 Existing Nonconforming Uses (Addition)

Repairs and Alterations permitted under the provisions of this ordinance to nonconforming uses on floodlands shall be floodproofed.

SECTION 9.0 PERFORMANCE STANDARDS

SECTION 9.1 Compliance (Replacement)

This Ordinance permits specific uses in specific districts; and these performance standards are designed to limit, restrict, and prohibit the effects of those uses outside their premises or district. All structures, lands, air, and waters shall hereafter, in addition to their use, site, and sanitary, floodland, and shoreland regulations, comply with the following performance standards.

SECTION 9.5 Water Quality Protection (Replacement)

No activity shall locate, store, discharge, or permit the discharge of any treated, untreated, or inadequately treated liquid, gaseous, or solid materials of such nature, quantity, obnoxiousness, toxicity, or temperature that might run off, seep, percolate, or wash

²This distance may be varied by the Board of Zoning Adjustment in accordance with Section 11.4 of this Ordinance. In no case, however, should boathouses be allowed to project beyond the shoreline.

Appendix I (continued)

into surface or subsurface waters so as to contaminate, pollute, or harm such waters or cause nuisances, such as objectionable shore deposits, floating or submerged debris, oil or scum, color, odor, taste, or unsightliness or be harmful to human, animal, plant, or aquatic life.

In Addition, no activity shall withdraw water or discharge any liquid, gaseous, or solid materials so as to exceed, or contribute toward the exceeding of, the minimum standards and those other standards and the application of those standards set forth in Chapter RD 2 of the Wisconsin Administrative Code for the following waters and their uses:

Water Body	Water Use
Lake Michigan (Open Water) ³	Trout, public water supply, aquatic life
All Lakes ³	Whole body-contact recreation
Des Plaines River (Main Stem)	Partial body-contact recreation and aquatic life
Turtle Creek (Main Stem)	Partial body-contact recreation and aquatic life
Root River	Partial body-contact recreation and aquatic life
Cedar Creek	Full body-contact recreation, aquatic life, cooling, and industrial

SECTION 11.0 BOARD OF ZONING ADJUSTMENT

SECTION 11.1 Establishment (Replacement)
 There is hereby established a Board of Zoning Adjustment for the County for the purpose of hearing appeals and applications and granting variances and exceptions to the provisions of this Ordinance in harmony with the purpose and intent of this Ordinance.

SECTION 11.4 Powers (Addition)
Conditional Uses. To hear and grant or deny applications for conditional use permits as provided in Section 4.0 of this Ordinance.

Shoreland Areas. To hear and authorize appeals for variances where special conditions, such as terrain, cover, or nearby existing or potential land or water uses, indicate that a shoreland regulation is more stringent than that required to meet the purposes of Section 144.26 of the Wisconsin Statutes, which are to prevent and control erosion and sedimentation, to prevent pollution, to preserve shore cover, and to protect fish and aquatic life.

No Variance shall have the effect of permitting any use in a district that is prohibited in that district; nor of permitting standards lower than those required by the Wisconsin Statutes, the Wisconsin Administrative Code or the State Department of Natural Resources; nor of permitting the elevation of any building lying on floodlands to be lower than that specified in this Ordinance.

SECTION 11.4 Powers (Replacement)
Variances. To hear and authorize appeals for variances where, owing to special conditions, a literal enforcement will result in practical difficulty or unnecessary hardship. Such variance shall not be contrary to the public interest and shall be so conditioned that the spirit and purposes of this Ordinance shall be observed and the public safety, welfare, and justice secured.

Interpretations. To hear and decide applications for interpretations of the zoning regulations and the location of the boundaries of the Zoning district, floodlands, and shorelands after the County Zoning Agency has made a review and recommendation. Floodland and shoreland boundaries shall be altered by the Board of Zoning Adjustment only when the applicant presents evidence that clearly and conclusively establishes that the location as shown on the zoning map is incorrect.

³The above listed lakes shall not be used for industrial cooling or processing, direct access, livestock watering or feeding, irrigation, and waste assimilation.

SECTION 11.6 Hearings (Addition)
 Due Notice of all hearings on appeals for variances to the floodland and shoreland provisions of this Ordinance shall be given to the State Department of Natural Resources and the Region 2 Water Resources Advisory Board.

SECTION 11.8 Decision (Addition)
 A Copy of all decisions granting or denying a variance to the floodland and shoreland provisions of this Ordinance and all conditional use permits granted shall be transmitted by the Secretary of the Board to the State Department of Natural Resources and the Region 2 Water Resources Advisory Board within ten (10) days.

SECTION 12.0 CHANGES AND AMENDMENTS

SECTION 12.5 Hearings (Addition)
 Due Notice of all public hearings on petition for changes to district boundaries lying in floodland and shoreland areas or amendments to regulations affecting floodlands and shorelands shall be transmitted to the State Department of Natural Resources and the Region 2 Water Resources Advisory Board.

SECTION 12.6 County Board Action (Replacement)
 Following such hearing and after careful consideration of the County Zoning Agency's recommendation, the County Board shall vote on the passage of the proposed change or amendment.

The County Zoning Agency's recommendation shall only be overruled by three-fourths (3/4) of the full County Board membership.

Amendments to Regulations or changes to districts affecting shorelands shall not require the approval, or be subject to the disapproval, of any town.⁴

A Copy of the Amendment changing district boundaries lying in floodland and shoreland areas or regulations affecting floodlands and shorelands shall be transmitted by the County Clerk to the State Department of Natural Resources and the Region 2 Water Resources Advisory Board within ten (10) days.

SECTION 13.0 DEFINITIONS (Addition)

Bulkhead Line
 A boundary line established along any section of the shore of any navigable waters by a municipal ordinance approved by the State Department of Natural Resources, pursuant to Section 30.11 of the Wisconsin Statutes. Filling and development is only permitted to the landward side of such bulkhead line.

Channel
 Those floodlands normally occupied by a stream of water under average annual high-water flow conditions while confined within generally well-established banks.

Conservation Standards
 Guidelines and specifications for soil and water conservation practices and management enumerated in the Technical Guide prepared by the U.S. Department of Agriculture, Soil Conservation Service, for the County, adopted by the County Soil and Water Conservation District Supervisors, and containing suitable alternatives for the use and treatment of land based upon its capabilities, from which the landowner selects that alternative which best meets his needs in developing his soil and water conservation plan.

Flood
 A temporary rise in streamflow or stage in lake level that results in water overtopping the banks and inundating areas adjacent to the stream channel or lake bed.

Flood Profile
 A graph showing the relationship of the floodwater surface elevation for a flood event of a specified recurrence interval to the stream bed and other significant natural and man-made features along a stream.

⁴For requirements concerning town approval of shoreland regulations, see discussion in Chapter VI of this report.

Appendix I (continued)

Flood Stage

The elevation of the floodwater surface above an officially established datum plane. In southeastern Wisconsin it is recommended that the datum plane used be Mean Sea Level, 1929 Adjustment.

Floodplain

Those floodlands, excluding the floodway, subject to inundation by the 100-year recurrence interval flood or, where such data is not available, the maximum flood of record.

Floodproofing

Measures designed to prevent or reduce flood damage for those uses which cannot be removed from or which, of necessity, must be erected on floodplains, ranging from structural modifications, through installation of special equipment or materials, to operation and management safeguards, such as the following: reinforcing of basement walls; underpinning of floors; permanent sealing of all exterior openings; use of masonry construction; erection of permanent water-tight bulkheads, shutters, and doors; treatment of exposed timbers; elevation of flood-vulnerable utilities; use of waterproof cement; adequate fuse protection; anchoring of buoyant tanks; sealing of basement walls; installation of sump pumps; placement of automatic swing-check valves; installation of seal-tight windows and doors; installation of wire-reinforced glass; location and elevation of valuable items; waterproofing, disconnecting, elevation, or removal of all electrical equipment; avoidance of the use of flood-vulnerable areas; temporary removal or waterproofing of merchandise; postponement of orders or rescheduling of freight shipments; operation of emergency pump equipment; closing of backwater sewer valves; placement of plugs in floor drain pipes; placement of movable water-tight bulkheads; counter-flooding; erection of sandbag levees; and the shoring of weak walls or other structures.

Floodway

Those floodlands, including the channel, required to carry and discharge the 100-year recurrence interval flood. If development and fill are to be prohibited in the floodplain, the floodway may be delineated as that area subject to inundation by the 10-year recurrence interval flood.

High-Water Elevation

The average annual high-water level of a pond, stream, lake, flowage, or wetland referred to an established datum plane or, where such elevation is not available, the elevation of the line up to which the presence of the water is so continuous as to leave a distinct mark by erosion, change in, or destruction of, vegetation or other easily recognized topographic, geologic, or vegetative characteristics.

Pierhead Line

A boundary line established along any section of the shore of any navigable waters by a municipal ordinance approved by the State Department of Natural Resources, pursuant to Section 30.13 of the Wisconsin Statutes. Piers and wharves are only permitted to the landward side of such pierhead line unless a permit has been obtained pursuant to Section 30.12(2) of the Wisconsin Statutes.

Reach

A longitudinal segment of a stream generally including those floodlands wherein flood stages are primarily and commonly controlled by the same man-made or natural obstructions to flow.

Shore Yards

A yard extending across the full width or depth of a lot, the depth of which shall be the minimum horizontal distance between a line intersecting both side lot lines at the same angle and containing the point of the high-water elevation of a pond, stream, lake, or wetland nearest the principal structure and a line parallel thereto containing the point of the principal structure nearest the high-water line.

Shorelands

Those lands lying within the following distances: one thousand (1,000) feet from the high-water elevation of navigable lakes, ponds, and flowages and three hundred (300) feet from the high-water elevation of navigable streams or to the landward side of the floodplain, whichever is greater.

Shorelines

The intersection of the land surfaces abutting lakes, ponds, streams, flowages, and wetlands with the average annual high-water elevation.

Storage Capacity

The volume of space available above a given cross-section of a floodplain for the temporary storage of floodwater. The storage capacity will vary with stage.

Wetlands

Those lowlands which are partially or wholly covered by marshland flora and generally covered by shallow standing water, or those lowlands which are wet and spongy due to a high-water table.

Zoning Inspector

A person recommended by the County Zoning Agency and appointed by the County Board of Supervisors to administer and enforce this Ordinance. Reference to the Zoning Inspector shall be construed to include duly appointed Deputy Inspectors.

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Appendix J
Special Floodland and Shoreland Regulations to be Incorporated into Land Division Ordinances

The following sections and subsections have been designed to replace or be added to those regulations found in the Model Land Division Ordinance set forth in Appendix A of SEWRPC Planning Guide No. 1, Land Development Guide, 1963, or other properly prepared subdivision control ordinances.

SECTION 1.0 INTRODUCTION

SECTION 1.1 Authority (Replacement)

This Ordinance is adopted under the authority granted by Sections 59.971(3), 144.26, and 236.45 of the Wisconsin Statutes and amendments thereto. The County Board of Supervisors of the County of _____ do ordain as follows:

SECTION 1.3 Intent (Addition)

Secure Safety from flooding, water pollution, disease, and other hazards.

Prevent Flood Damage to persons and properties and minimize expenditures for flood relief and flood control projects.

Obtain Dedication of floodland and certain shoreland areas for public and semipublic recreational uses to best meet the public demand for aquatic recreation with the least disturbance to shoreland owners.

Prevent and Control Erosion, sedimentation, and other pollution of surface and subsurface waters.

Preserve Shore Growth and Cover and promote the natural beauty of the County.

Restrict Building Sites on floodlands and shorelands or in other areas poorly suited for development.

Implement those municipal, county, watershed, or regional comprehensive plans or their components adopted by the County.

SECTION 1.6 Severability and Non-Liability (Addition)

The County does not guarantee, warrant, or represent that only those areas designated as floodlands will be subject to periodic inundation and hereby asserts that there is no liability on the part of the Board of Supervisors, its agencies, or employees for any flood damages that may occur as a result of reliance upon, and conformance with, this Ordinance.

SECTION 2.0 GENERAL PROVISIONS

SECTION 2.1 Jurisdiction (Replacement)

The provisions of this Ordinance shall apply to all land and water within the County except as it applies to divisions of tracts of land into less than five (5) parcels for:

Transfers of Interests in land by will or pursuant to court order.

Leases for a term not to exceed ten (10) years, mortgages, or easements.

Sale or Exchange of parcels of land between owners of adjoining property if additional lots are not thereby created and the lots resulting are not reduced below the minimum sizes required by this Ordinance, County Zoning or Sanitary Ordinances, or other applicable laws or ordinances.

SECTION 2.2 Compliance (Addition)

State Department of Natural Resource Rules setting water quality standards, preventing and abating pollution, and regulating septic systems.

Comprehensive Plans or components of such plans prepared by state, regional, county, or municipal agencies duly adopted or acknowledged by the County Board of Supervisors.

All Applicable County Regulations, including zoning, sanitary, building, and official mapping ordinances.

Section 2.3 Dedication and Reservation of Lands (Addition)

Whenever Floodlands and Shorelands are contained in a tract of land proposed to be divided into lots, building sites, or parcels of less than five (5) acres in area, all such floodlands and those shorelands designated for park, recreation, environmental corridor, or other open-space land use in a comprehensive plan or a component of such a comprehensive plan prepared by state, regional, county, or municipal agencies and duly adopted or acknowledged by the County Board of Supervisors and lying within the below specified distances from the high-water elevation shall be dedicated to the public by the subdivider. In lieu of such dedication, all such designated floodlands and shorelands shall be reserved by the subdivider for a period not to exceed two (2) years, unless extended by mutual agreement, for acquisition by the state, county, or local unit of government at undeveloped land costs or shall be reserved for the recreational use of the future residents of the land to be divided, with stream or lake bank maintenance easements given to the unit of government which has jurisdiction.

The following distances from the high-water elevation shall apply to the provisions of this section:

Lake Michigan	400 feet
Lakes 50 acres or more in area	300 feet
Lakes less than 50 acres in area	200 feet
Navigable streams	100 feet
All other streams	50 feet

SECTION 2.6 Land Suitability (Addition)

Floodlands shall not be divided into building sites. The elevation of all lands proposed for division shall be at least two (2) feet above the elevation of the one hundred (100)-year recurrence interval flood or, where such data is not available, five (5) feet above the elevation of the maximum flood of record.

Shorelands shall not be divided into building sites which are to be served by deep soil absorption waste disposal systems.

Lands Made, Altered, or Filled with non-earth materials within the last ten (10) years shall not be divided into building sites which are to be served by soil absorption waste disposal systems.

Existing Residential Land Abutting a Pond, lake, stream, or wetland shall not hereafter be divided so as to give water access to more than one family and their occasional guests for each one hundred and fifty (150) feet of shoreline.

Lands Having a Slope of twelve (12) percent or more in shoreland areas shall not be divided into building sites. No lot shall have more than fifty (50) percent of its minimum required area with slopes of ten (10) percent or greater.

Lands Having Bedrock within eight (8) feet of the natural undisturbed surface shall not be divided into building sites to be served by soil absorption sewage disposal systems.

Lands Having Ground Water within eight (8) feet of the natural undisturbed surface shall not be divided into building sites to be served by soil absorption sewage disposal systems.

Soils Having a Percolation Rate slower than 60 minutes per inch or faster than 10 minutes per inch shall not be divided into building sites to be served by soil absorption sewage disposal systems.

Following Soil Types having very severe limitations shall not be divided into building sites:

2	5	10	217	451	455	458
3	7	11	218	452	456	459
4	9	13	302	453	457	460

Appendix J (continued)

Lands Drained by farm drainage tile or farm ditch systems shall not be divided into building sites to be served by soil absorption sewage disposal systems.

SECTION 2.7 Violations (Addition)

Every Structure, Fill, or Development placed or maintained on floodlands in violation of this Ordinance is a public nuisance and the creation thereof may be enjoined and maintenance thereof may be abated by action at suit of the state, the County, or any citizen thereof.

SECTION 2.8 Penalties (Addition)

Floodland structures, fills, and development shall have penalties as specified in Section 87.30(2) of the Wisconsin Statutes.

SECTION 3.0 PROCEDURE

SECTION 3.2 Preliminary Plat Review

Whenever Shorelands are contained within a tract of land proposed to be divided, the County Planning Agency shall request a review of such plat from the State Department of Natural Resources and await their recommendations before approving such plat but not to exceed twenty (20) days.

SECTION 4.0 PRELIMINARY PLAT

SECTION 4.2 Plat Data (Addition)

Soil Type, slope, and boundaries, as shown on the operational soil survey maps prepared by the U.S. Department of Agriculture, Soil Conservation Service, for the Southeastern Wisconsin Regional Planning Commission.

High-Water Elevation of all ponds, streams, lakes, flowages, and wetlands based on Mean Sea Level Datum.

Contours to National Map Accuracy Standards based upon Mean Sea Level Datum at vertical intervals of not more than two (2) feet. At least two (2) permanent bench marks shall be located in the immediate vicinity of the plat; the location of the bench marks shall be indicated on the plat, together with their elevations referenced to Mean Sea Level Datum, and the monumentation of the bench marks clearly and completely described. If a local datum is used, the equation between it and Mean Sea Level Datum shall be given.

Floodland and Shoreland Boundaries and the contour line lying a vertical distance of two (2) feet above the elevation of the one hundred (100)-year recurrence interval flood or, where such data is not available, five (5) feet above the elevation of the maximum flood of record.

Location, Depth, Area, and Type of all soil absorption waste disposal facilities.

Location and Results of Soil Boring Tests made to a depth of eight (8) feet or five (5) feet below the bottom of a proposed deep absorption system, whichever is greater. The number of such tests shall be adequate to portray the character of the soil and the depths of bedrock and ground water from the natural undisturbed surface but no less than two (2) tests per acre.

Location and Results of Percolation Tests conducted in accordance with Section H65.06 of the Wisconsin Administrative Code, taken at the location and depth in which the soil absorption waste disposal area is to be installed. The number of such tests shall not be less than three (3) tests per disposal system area.

Any Additional Information required by the County Engineer or the County Planning Agency.

SECTION 5.0 FINAL PLAT

SECTION 5.2 Additional Information (Addition)

Location, Area, Depth, and Type of the soil absorption waste disposal system for each building site.

Additional Yards required by the County Planning Agency.

Floodland and Shoreland Boundaries and the contour line lying a vertical distance of two (2) feet above the elevation of the one hundred (100)-year recurrence interval flood or, where such data is not available, a verti-

cal distance of five (5) feet above the elevation of the maximum flood of record.

Special Restrictions required by the County Planning Agency relating to shorelands and floodlands.

Any Additional Information required by the County Engineer or the County Planning Agency.

SECTION 6.0 CERTIFIED SURVEY MAP

SECTION 6.1 General (Replacement)

A Certified Survey Map prepared by a land surveyor registered in Wisconsin shall be required for all minor subdivisions. It shall comply in all respects with the requirements of Section 236.34 of the Wisconsin Statutes.

A Preliminary Map shall be submitted to the County Planning Agency for all tracts of land proposed to be divided that contain floodlands or shorelands and shall show all the data required by Section 4.2 of this Ordinance for preliminary plats.

SECTION 6.2 Additional Information (Addition)

Location, Area, Depth, and Type of the soil absorption waste disposal system for each building site.

Additional Yards required by the County Planning Agency.

All Lands Reserved for future public acquisition.

Names of Adjoining Streets, highways, parks, cemeteries, subdivisions, ponds, streams, lakes, flowages, and wetlands.

Floodland and Shoreland Boundaries and the contour line lying at a vertical distance of two (2) feet above the elevation of the one hundred (100)-year recurrence interval flood or, where such data is not available, at a vertical distance of five (5) feet above the elevation of the maximum flood of record.

Any Additional Information required by the County Planning Agency.

SECTION 7.0 DESIGN STANDARDS

SECTION 7.1 Street Arrangement (Addition)

Street, Block, and Lot Layouts shall be so designed as to: be within the capability of the land and water resources; least disturb the existing terrain, flora, fauna and water regimen; and meet all the use, site, sanitary, floodland, and shoreland regulations contained in the County Zoning, Sanitary, and Building Ordinances.

Shorelands. Due consideration shall be given to the reservation of a suitable area along ponds, streams, lakes, flowages, and wetlands for the purpose of providing public access to such waters and creating a buffer between private shoreland owners and public water users.

SECTION 7.3 Street Design Standards (Addition)

Elevations of roadways passing through floodland areas shall be at least two (2) feet above the fifty (50)-year recurrence interval flood elevation for arterial streets and at least two (2) feet above the ten (10)-year recurrence interval flood elevation for minor streets.

Waterway Openings of all new bridges and culverts carrying arterial streets over perennial streams shall be adequate to accommodate the fifty (50)-year recurrence interval flood flow, with the upstream high-water elevation not to exceed a level of two (2) feet below the roadway elevation and the hydraulic head loss through the structure not to exceed 0.5 foot. Waterway openings of all new bridges and culverts carrying minor streets over perennial streams shall be adequate to accommodate the ten (10)-year recurrence interval flood flow, with the upstream headwater elevation not to exceed a level of two (2) feet below the roadway elevation and the hydraulic head loss through the structure not to exceed 0.5 feet. However, the combination of the waterway opening and the approach road elevations on the floodlands shall not increase the flood stages more than 0.5 foot upon the occurrence of the one hundred (100)-year recurrence interval flood. Such bridges and culverts shall be so designed and constructed as to facilitate the passage of ice floes and other debris.

Appendix J (continued)

SECTION 7.5 Blocks (Replacement)

Pedestrian Ways of not less than ten (10) feet in width may be required between rear lot lines where deemed necessary by the *County Planning Agency* to provide safe and convenient pedestrian circulation between the individual lots, streams, lakeshores, park lands, or other public areas.

SECTION 7.6 Lots (Replacement)

Area and Dimensions of all lots shall conform to the requirements of the *County Zoning Ordinance*, and those building sites not served by a public sanitary sewer system or other approved system shall be sufficient to permit the use of an on-site soil absorption sewage disposal system designed in accordance with the *County Sanitary Ordinance* but in no case shall be less than one hundred and fifty (150) feet in width and forty thousand (40,000) square feet in area.

Lands Lying Between the Meander Line and the water's edge and any otherwise unplattable lands which lie between a proposed subdivision and the water's edge shall be included as part of lots, outlots, or public dedications in any plat abutting a stream or lake. All lands under option to the subdivider or to which he holds any interest that abut the proposed subdivision and a stream, lake, flowage, or wetland shall also be included.

SECTION 7.7 Building Setback Lines (Addition)

Shoreland Setback in addition to those required by the *County Zoning Ordinance* may be required by the *County Zoning Agency*.

SECTION 7.8 Easements (Replacement)

Drainage Easements. Where a subdivision is traversed by a drainageway or stream, an adequate easement shall be provided as may be required by the *County Planning Agency*. The location, width, alignment, and improvement of such drainageway or easement shall be subject to the approval of the *County Engineer*; and parallel streets or parkways may be required in connection therewith. Where necessary, storm water drainage shall be maintained by landscaped open channels of adequate size and grade to hydraulically accommodate maximum potential volumes of flow, subject to review and approval by the *County Engineer*.

SECTION 8.0 REQUIRED IMPROVEMENTS

SECTION 8.7 Sewage Disposal Facilities (Replacement)

The subdivider shall construct sanitary sewers in such a manner as to make adequate sanitary sewerage service available to each lot within the subdivision. If public sewer facilities are not available, the subdivider shall make provision for adequate private sewage disposal systems to meet the Wisconsin Administrative Code and the *County Sanitary Ordinance*.

SECTION 8.8 Storm Water Drainage Facilities (Replacement)

The subdivider shall construct storm water drainage facilities, which may include curbs and gutters, catch basins and inlets, storm sewers, road ditches, and open channels, as required by the *County Engineer*. All such facilities shall be of adequate size and grade to hydraulically accommodate maximum potential volumes of flow, the type of facility required, the design criteria, and the sizes and grades to be determined by the *County Engineer*. Storm drainage facilities shall be so designed as to present no hazard to life or property; and the size, type, and installation of all storm water drains and sewers proposed to be constructed shall be in accordance with the plans and standard specifications approved by the *County Engineer*.

Shoreland drainage facilities shall include water retention structures and settling basins so as to prevent erosion and sedimentation where such facilities discharge into streams or lakes.

SECTION 8.14 Shoreland Planting (Addition)

The subdivider shall plant those grasses, trees, and vines, a species and size specified by the *County Engi-*

neer or *County Planning Agency*, necessary to prevent soil erosion, protect stream and lake banks, and effectively screen all development within five (5) years from surface water users.

In Addition, the *County Planning Agency* may require the subdivider to provide or install certain stream and lake protection and rehabilitation measures, such as fencing, sloping, seeding, rip-rap, revetments, jetties, clearing, dredging, snagging, drop structures, and grade stabilization structures.

SECTION 9.0 CONSTRUCTION

SECTION 9.1 Commencement (Replacement)

No construction or installation of improvements shall commence in a proposed subdivision until the preliminary plat or map has been approved and the *County Engineer* has given written authorization.

SECTION 9.2 Permits (Replacement)

No building, zoning, or sanitary permits shall be issued for erection of a structure on any lot not of record until all the requirements of this Ordinance have been met.

Access. The *County Engineer* shall have access to premises and structures during reasonable hours to make those inspections as deemed necessary by him to ensure compliance with this Ordinance. If, however, he is refused entry after presentation of his identification, he shall procure a special inspection warrant in accordance with Section 963.10 of the Wisconsin Statutes, except in cases of emergency.

SECTION 9.5 Erosion Control (Addition)

The subdivider shall cause all grading, excavations, open cuts, side slopes, and other land surface disturbances to be so mulched, seeded, sodded, or otherwise protected that erosion, siltation, sedimentation, and washing are prevented in accordance with plans and specifications approved by the *County Engineer*.

Sod Shall Be Laid in strips at those intervals necessary to prevent erosion and at right angles to the direction of drainage.

SECTION 9.6 Existing Flora (Addition)

The subdivider shall make every effort to protect all existing trees, shrubbery, and grasses not actually lying in public roadways, drainageways, building foundation sites, private driveways, soil absorption waste disposal areas, paths, and trails.

Such Trees are to be protected during construction in accordance with those practices recommended by the U.S. Department of Agriculture in Agricultural Information Bulletin No. 285, Protecting Trees Against Damage from Construction Work, U.S. Government Printing Office, 1964. Such trees are to be preserved by well islands or retaining walls whenever abutting grades are altered.

SECTION 11.0 DEFINITIONS (Addition)

Deep Absorption System

A soil absorption sewage system for disposal of effluent through the bottom and sides of a hole or trench at a depth of more than three (3) feet below the natural undisturbed surface.

Environmental Corridor

Those lands containing concentrations of scenic, recreational, and other natural resources as identified and delineated in the comprehensive planning program of the Southeastern Wisconsin Region by the Southeastern Wisconsin Regional Planning Commission. These natural resource and resource-related elements include the following: 1) lakes, rivers, and streams, together with their natural floodplains; 2) wetlands; 3) forests and woodlands; 4) wildlife habitat areas; 5) rough topography; 6) significant geological formations; 7) wet or poorly drained soils; 8) existing outdoor recreation sites; 9) potential outdoor recreation and related open-space sites; 10) historic sites and structures; and 11) significant scenic areas or vistas.

Appendix J (continued)

Floodlands

Those lands, including the floodplains, floodways, and channels, subject to inundation by the one hundred (100)-year recurrence interval flood or, where such data is not available, the maximum flood of record.

High-Water Elevation

The average annual high-water level of a pond, stream, lake, flowage, or wetland referred to an established datum plane or, where such elevation is not available, the elevation of the line up to which the presence of the water is so frequent as to leave a distinct mark by erosion, change in, or destruction of, vegetation or other easily recognized topographic, geologic, or vegetative characteristic.

Mean Sea Level Datum

Mean Sea Level Datum, 1929 Adjustment, as established by the U.S. Coast and Geodetic Survey.

National Map Accuracy Standards

Standards governing the horizontal and vertical accuracy of topographic maps and specifying the means for testing and determining such accuracy, endorsed by all federal agencies having surveying and mapping functions and responsibilities. These standards have been fully reproduced in Appendix D of SEWRPC Technical Report No. 7, Horizontal and Vertical Survey Control in Southeastern Wisconsin.

Shorelands

Those lands lying within the following distances: one thousand (1,000) feet from the high-water elevation of navigable lakes, ponds, and flowages or three hundred (300) feet from the high-water elevation of navigable streams or to the landward side of the floodplain, whichever is greater.

Wetlands

Those lands which are partially or wholly covered by marshland flora and generally covered with shallow standing water or lands which are wet and spongy due to a high-water table.

Appendix K Model Sanitary Ordinance

This model ordinance has been designed for adoption by counties pursuant to Section 59.07(51) of the Wisconsin Statutes and contains regulations applicable to private water supply and waste disposal systems. Other health and sanitation regulations concerning the operation of public bathing beaches, swimming pools, restaurants, tourist camps, schools, and hotels were not included because they were beyond the scope of this Guide.

A county may elect to create a County Board of Health, pursuant to Section 140.09, which then would have the power to adopt and enforce regulations similar to the model ordinance, as well as other health and sanitation regulations.

The regulations contained in this Ordinance are equal to or exceed those minimum standards required or recommended by the State Division of Health, the State Department of Natural Resources, the Federal Housing Administration, the U.S. Department of Agriculture, and the U.S. Public Health Service that are applicable to soil absorption sewage disposal facilities and private well water supply systems (see Table 6).

SECTION 1.0 INTRODUCTION

SECTION 1.1 Authority

This Ordinance is adopted under the authority granted by Sections 59.07 (51) and 144.26 of the Wisconsin Statutes and amendments thereto. The *County Board of Supervisors* of the County of _____ do ordain as follows:

SECTION 1.2 Purpose

The purpose of this Ordinance is to promote the health, safety, prosperity, aesthetics, and general welfare of the people and communities within the *County*.

SECTION 1.3 Intent

The general intent of this Ordinance is to regulate the location, construction, installation, alteration, design, and use of all private water supply and waste disposal systems so as to protect the health of residents and transients and to:

Secure Safety from disease, pestilence, and other health hazards.

Further the Maintenance of safe and healthful conditions for the enjoyment of aquatic recreation.

Prevent and Control further pollution of surface and subsurface waters.

Require a Septic Tank Permit before any retailer may sell a septic tank for installation.

Further the Appropriate Use and conservation of the land and water resources of the *County*.

Provide for More Stringent regulations of, and dispersion of, waste disposal systems in shoreland areas so as to assure proper operation of such systems near navigable waters.

Implement those municipal, county, watershed, and regional comprehensive plans and their components adopted by the county.

Provide for the Administration and enforcement of this Ordinance and to provide penalties for its violation.

SECTION 1.4 Abrogation and Greater Restrictions

It is not intended by this Ordinance to repeal, abrogate, annul, impair, or interfere with any existing easements, covenants, deed restrictions, agreements, ordinances, rules, regulations, or permits previously adopted or issued pursuant to law. However, wherever this Ordinance imposes greater restrictions, the provisions of this Ordinance shall govern.

SECTION 1.5 Interpretation

In their interpretation and application, the provisions of this Ordinance shall be held to be minimum require-

ments and shall be liberally construed in favor of the *County* and shall not be deemed a limitation or repeal of any other power granted by the Wisconsin Statutes.

SECTION 1.6 Severability and Non-Liability

If any section, provision, or portion of this Ordinance is adjudged unconstitutional or invalid by a court of competent jurisdiction, the remainder of this Ordinance shall not be affected thereby. The *County* does not guarantee, warrant, or represent the safe and proper operation of water supply and waste disposal systems located, constructed, and maintained in accordance with this Ordinance and hereby asserts that there is no liability on the part of the *Board of Supervisors*, its agencies, or employees for any health hazards or damages that may occur as a result of reliance upon, and compliance with, this Ordinance.

SECTION 1.7 Repeal

All other ordinances or parts of ordinances of the *County* inconsistent or conflicting with this Ordinance, to the extent of the inconsistency only, are hereby repealed.

SECTION 1.8 Title

This Ordinance shall be known as, referred to, or cited as the SANITARY ORDINANCE, _____ COUNTY, WISCONSIN.

SECTION 1.9 Effective Date

This Ordinance shall be effective after adoption by the *County Board of Supervisors* and publication or posting as provided by law.

SECTION 2.0 GENERAL PROVISIONS

SECTION 2.1 Jurisdiction

The provisions of this Ordinance shall apply to all lands and waters within the *County* except within the corporate limits of those cities and villages which have adopted ordinances expressly concerning the same subject matter.

SECTION 2.2 Compliance

No private water supply or waste disposal systems or parts thereof shall hereafter be located, installed, or moved without a *Sanitary Permit* and without full compliance with the provisions of this Ordinance and all other applicable local, county, and state regulations.

Emergency Repairs or the removal of stoppages may be performed without a *Sanitary Permit*, provided such work is reported to the *Sanitary Inspector* as soon as possible for a determination by him as to whether a *Sanitary Permit* is required.

SECTION 2.3 Sanitary Permit

Applications for a *Sanitary Permit* shall be made by the property owner in duplicate to the *Sanitary Inspector* on forms furnished by him prior to issuance of a building or zoning permit and prior to purchase or installation of any septic tank and shall include the following, where pertinent and necessary, for proper review by the *Sanitary Inspector*.

Names and Addresses of the applicant; owner of the site; either the surveyor, architect, licensed master plumber, or professional engineer; and the installer and any state license held by him.

Description of the Subject Site by lot, block, and recorded subdivision or by metes and bounds referenced to the U.S. Public Land Survey System; address of the subject site; type of proposed installation; septic tank specifications; existing and proposed operation or use of the structure or site; maximum number of users of proposed installation, including employees, customers, or pupils; and any special or unusual wastes anticipated.

Plat of Survey prepared by a land surveyor registered in Wisconsin, showing the location, property boundaries, dimensions, type, elevations, and size of the following:

Appendix K (continued)

subject site, soil mapping unit, soil boring and percolation test holes, shallow or deep absorption system sites, high-water elevation, floodlands, and shorelands. In addition, the plat of survey shall show the location and elevation of all existing or proposed buildings, cisterns, springs, wells, other sources of domestic water supply, watercourses, drainage ditches, farm drainage tile systems, slopes exceeding twelve (12) percent, and bodies of water within the subject site and within one hundred (100) feet of the disposal system site.

Results of Soil Boring Tests made to a depth of eight (8) feet. The number of such tests shall be adequate to portray the character of the soil and the depths of bedrock and ground water from the natural undisturbed surface but shall not be less than two (2) tests per disposal system site.

Results of Percolation Tests conducted in accordance with Section H 65.06 (4) of the Wisconsin Administrative Code, taken at the location and depth at which the soil absorption waste disposal system is to be installed. The number of such tests shall not be less than six (6) per disposal site.

Evidence of Review and Approval by the Plumbing Division of the State Division of Health of all industrial and public building waste treatment and disposal systems.

Fee Receipt from the County Treasurer in the amount specified in Section 8.0 of this Ordinance.

Copy of Each Application for septic tank installation, together with a fee of One Dollar (\$1), shall be forwarded to the State Division of Health by the Sanitary Inspector so as to reach said Division within ten (10) days after the application is filed.

SECTION 2.4 Water Supply

All water closets, urinals, dishwashers, clothes washers, lavatories, slop sinks, food waste grinders, and other plumbing fixtures shall be served by a public water system where available. Where such public water supply system is not available and will not be available in a reasonable time, a private water supply system may be used.

SECTION 2.5 Waste Disposal

In addition to the prohibitions of Sections 29.288, 29.29(3), and 144.045 of the Wisconsin Statutes and Section RD 12.13 of the Wisconsin Administrative Code, all domestic, commercial, agricultural, medical, and industrial wastes of such nature, quantity, noxiousness, toxicity, or temperature that could contaminate, pollute, or harm the surface or subsurface waters shall be so located, stored, or discharged in a way that they will not run off, seep, percolate, or wash into such waters and will not cause the emission of dangerous or offensive elements that might injure or damage persons or property.

SECTION 2.6 Sewage Disposal

All waste disposal facilities, including water closets, urinals, dishwashers, clothes washers, lavatories, slop sinks, food waste grinders, and other waste fixtures shall be connected to a public sanitary sewer system where available. Where such public sewer system is not available and will not be available in a reasonable time, a private sewage disposal system may be used.

When a Public System becomes available, the private system shall be discontinued and connection made to the public system within one (1) year in accordance with Section 144.06 of the Wisconsin Statutes and Section H 62.20(5) of the Wisconsin Administrative Code.

Outdoor Toilets and Privies are prohibited except as provided in Section 6.0.

Width and Area of all lots hereafter created, not served by a public sanitary sewer system or other approved system, shall be sufficient to permit the use of an on-site soil absorption sewage disposal system designed in accordance with this Ordinance but in no case shall be less than one hundred and fifty (150) feet in width and forty thousand (40,000) square feet in area.

SECTION 2.7 Land Suitability

The County Health Agency may prohibit the installation or operation of any waste disposal facilities where such facilities would harm, impair, or reduce surface or subsurface water quality.

Floodlands shall not be used for any type of waste disposal or well water supply systems.

Shorelands shall not be used for any type of waste disposal except domestic waste burial sites and shallow soil absorption sewage disposal systems serving individual single-family dwellings. Deep absorption systems shall not be used unless the applicant can show the natural or induced hydraulic gradient is away from the stream, pond, flowage, or lake.

Lands Having a Slope of twelve (12) percent or more shall not be used for soil absorption disposal systems.

Lands Having Bedrock within eight (8) feet of the natural undisturbed surface shall not be used for soil absorption disposal systems.

Lands Having Ground Water within eight (8) feet of the natural undisturbed surface during any season of the year shall not be used for soil absorption disposal systems.

Lands Drained by farm drainage tile or farm ditch systems shall not be used for soil absorption disposal systems.

SECTION 2.8 Violations

It shall be unlawful to construct any private water supply or waste disposal system or use any system, land, or water in violation of any of the provisions of this Ordinance. In addition, it shall be unlawful to resist, obstruct, or interfere with the Sanitary Inspector in the discharge of his duties or to neglect, refuse, or fail to obey the Sanitary Inspector's orders pertaining to his duties.

In Case of Any Violation, the County Board of Supervisors, the County Health Agency, the Sanitary Inspector, the local Boards of Health, or any property owner who would be specifically damaged by such violation may institute appropriate legal action or proceeding to enjoin a violation of this Ordinance.

Every Waste Disposal System placed or maintained on floodlands in violation of this Ordinance is a public nuisance; and the creation thereof may be enjoined and the maintenance thereof may be abated by action at suit of the state, the County, or any citizen thereof.

All Violations of this Ordinance shall be reported by the Sanitary Inspector to the Office of the County Corporation Counsel, who shall then prosecute such violations on behalf of the County.

SECTION 2.9 Penalties

Any person, firm, or corporation that fails to comply with the provisions of this Ordinance or permits the use of any private water supply or sewage disposal system in violation of this Ordinance shall, upon conviction thereof, forfeit not less than Ten Dollars (\$10) nor more than Two Hundred Dollars (\$200) and costs of prosecution for each violation and, in default of payment of such forfeiture and costs, shall be imprisoned in the County Jail until payment thereof but not exceeding thirty (30) days. Each day a violation exists or continues shall constitute a separate offense.

Any Person, Firm, or Corporation that places or maintains any waste disposal system on any floodland in violation of this Ordinance may be fined not more than Fifty Dollars (\$50) for each offense. Each day a violation exists or continues shall constitute a separate offense.

Discharge of Untreated Sewage into surface waters or drainage ditches has penalties as specified in Section 146.13(2) of the Wisconsin Statutes.

Nuisances caused by improper sewage disposal systems have penalties as specified in Section 146.14 of the Wisconsin Statutes.

Cost of Abatement of nuisances may be recovered in accordance with Sections 146.13(1) and 146.14 of the Wisconsin Statutes.

Appendix K (continued)

SECTION 3.0 PRIVATE WATER SUPPLY SYSTEMS

SECTION 3.1 Location
Wells shall be located as specified in Section RD 12.04 of the Wisconsin Administrative Code, except they shall not be located closer than ten (10) feet to any property line or any building sewer constructed of cast iron pipe with leaded joints, shall not be closer than fifty (50) feet to any septic tank or other building sewer or building drain, and shall not be closer than one hundred (100) feet to any soil absorption sewage effluent disposal system.

SECTION 3.2 Construction and Materials
Well and pump construction and materials shall be as specified in Sections RD 12.05, 12.06, 12.07, 12.09, 12.11, and 12.15 of the Wisconsin Administrative Code.

SECTION 3.3 Samples and Reports
Well water samples shall be submitted to the State Laboratory of Hygiene; and well construction reports shall be submitted to the State Department of Natural Resources and the well owner, as specified in Section RD 12.08 of the Wisconsin Administrative Code.

SECTION 3.4 High-Capacity Wells
Wells which have a capacity of withdrawal in excess of 100,000 gallons per day shall be constructed, located, and operated as approved by the State Department of Natural Resources in accordance with Sections 144.03 (7) and (8) of the Wisconsin Statutes.

SECTION 3.5 Abandonment
Wells shall only be abandoned in the manner specified in Section RD 12.13 of the Wisconsin Administrative Code.

SECTION 4.0 SEPTIC TANKS

SECTION 4.1 General
All private sewage disposal systems shall be the septic tank system or some other alternate system approved by the State Department of Natural Resources and the State Division of Health provided such system does not create a nuisance or health hazard.
Holding Tanks shall only be used as a corrective measure for existing systems, in accordance with the State Division of Health requirement, and shall not be used for initial installations.

SECTION 4.2 Location
Septic tanks shall not be located closer than ten (10) feet to any property line; shall not be closer than fifty (50) feet to any cistern, spring, well, or other source of domestic water supply; shall not be closer than ten (10) feet to any building; and shall not be closer than one hundred (100) feet to any watercourse or body of water.

SECTION 4.3 Capacity
Septic tank size shall be based on the number of persons using the building, the facility to be served, or upon the nature and type of waste. The minimum liquid capacity of a septic tank measured below the outlet shall be 1,000 gallons for any installation.
No Liquid other than sewage shall be permitted to drain into a septic tank. Liquid depth shall be not less than three (3) feet nor more than six (6) feet. The total depth of the tank shall be at least eight (8) inches greater than the liquid depth.
For Each Additional Person over six (6) to be accommodated in the proposed buildings, the liquid capacity shall be increased as specified in Section H 62.20(1) (e)1 of the Wisconsin Administrative Code.

SECTION 4.4 Construction
Septic tanks shall be designed and constructed of those materials as specified in Section H 62.20(1)(d) and (3) of the Wisconsin Administrative Code, except a clean-out riser not less than twenty (20) inches in diameter shall extend to not less than one (1) foot of the finished surface grade.

SECTION 4.5 Maintenance
Septic tanks shall be cleaned whenever the sludge and scum occupies one-third (1/3) of the tank volume.

SECTION 5.0 SEWAGE EFFLUENT DISPOSAL

SECTION 5.1 General
The effluent from septic tanks shall be disposed of by shallow systems or by some other system approved by the State Division of Health, provided such alternate system does not create a nuisance or health hazard.
Deep Absorption Systems shall not be used where shallow systems can be provided, where porous subsurface materials do not exist in their natural undisturbed condition, and where any well is less than fifty (50) feet deep within five hundred (500) feet of the system.
Such Systems shall be located, sized, constructed, used, and maintained so as to assure that effluent from the septic tank will not reach surface or subsurface waters in a condition which will contribute to health hazards, taste, odor, turbidity, fertility, or impair the aesthetic character of any navigable water.

SECTION 5.2 Soil Survey
Certain soil types lying in the County, as shown on the operational soil survey maps prepared by the U.S. Department of Agriculture, Soil Conservation Service, for the Southeastern Wisconsin Regional Planning Commission, which are on file with the *Sanitary Inspector* and are to be published as Soil Survey, _____ County, U.S. Department of Agriculture, Soil Conservation Service, U.S. Government Printing Office, Washington D.C., 1969, and on Table 8, Soils of Southeastern Wisconsin, SEWRPC Planning Report No. 8, 1966, have severe or very severe limitations for soil absorption sewage disposal systems because of one or more of the following reasons: high or fluctuating water table, flooding, ground water contamination, silting, slow permeability, steep slopes, or proximity to bedrock.

SECTION 5.3 Soils with Very Severe Limitations
Soil types described in the aforementioned publications and designated by the following numbers shall not be used for soil absorption sewage disposal facilities:

4	27	37Z	51	66	80Z	126Y	181Z
5	28	38	52	73	81	172R	182
5W	28Z	38Z	53	76	87	174	188

SECTION 5.4 Soils with Severe Limitations
Soil types described in the aforementioned publications and designated by the following numbers and any soils whose slopes exceed twelve (12) percent shall not be used for soil absorption sewage effluent disposal facilities unless the *County Health Agency* finds that such severe limitations have been overcome by elimination or avoidance of bedrock, provision of larger absorption areas, protection from runoff, terracing and reduction of steep slopes, or other corrective measures in accordance with Section 9.5 of this Ordinance.

16	22	32	40	70Z	82	170Z	297	325
21	24	33Z	44	72V	84Z	172Z	297S	331
21Y	31	39	70Y	72Z	110Y	295	324Z	336

SECTION 5.5 Percolation Test
The type and size of soil absorption waste disposal systems to be used for effluent disposal on soils not having severe and very severe limitations, enumerated in Sections 5.3 and 5.4 of this Ordinance, shall be determined through percolation tests conducted by a person approved in writing by the *Sanitary Inspector*. The percolation tests shall be conducted in accordance with Section H 65.06 (4) of the Wisconsin Administrative Code, except
Tests shall be taken at the location and depth in which the absorption disposal system is to be installed and shall not be less than six (6) uniformly spaced separate test holes per disposal site.

SECTION 5.6 Vertical Location
Soil absorption sewage effluent disposal systems shall be placed within undisturbed soils that have not been

Appendix K (continued)

made, altered, or filled with non-earth material within the last ten (10) years.

Bedrock, Creviced, or Fractured Rock shall be no closer than four (4) feet to the bottom or sides of any such system.

Ground Water shall be no closer than four (4) feet to the bottom of any such system.

Surface Elevation of all lands used for such systems shall be at an elevation of at least two (2) feet above the elevation of the one hundred (100)-year recurrence interval flood level or, where such data is not available, five (5) feet above the maximum flood of record.

SECTION 5.7 Horizontal Location

Soil absorption sewage effluent disposal systems shall be located at a point lower than the grade of any well or spring lying within one hundred (100) feet; shall not be located closer than twenty-five (25) feet to any dwelling or cistern; shall not be closer than one hundred (100) feet to any well or spring; shall not be closer than twenty (20) feet to any property line; shall not be closer than one hundred (100) feet to any stream, lake, pond, flowage, or wetland; shall not be closer than ten (10) feet to any tree; and shall not be closer than fifty (50) feet to the edge of steep slopes falling away toward ponds, streams, lakes, flowages, or wetlands.

SECTION 5.8 Size

The minimum soil absorption area required to dispose of the sewage effluent shall be computed as specified in Section H 62.20(2)(c)1 of the Wisconsin Administrative Code by use of percolation test rates; however:

Deep Absorption Systems shall not be installed in areas having percolation rates slower than thirty (30) minutes per inch of fall nor where shallow wells are in use.

Shallow Absorption Systems shall not be installed in areas having percolation rates slower than sixty (60) minutes per inch of fall.

Deep Absorption Systems shall not be installed in areas having percolation rates faster than ten (10) minutes per inch of fall.

No Liquids other than sewage effluent shall be permitted to drain, wash, or discharge onto or into a soil absorption area.

SECTION 5.9 Construction

Soil absorption disposal systems shall be constructed in accordance with Section H 62.20(2)(b) and (c) of the Wisconsin Administrative Code.

Soils above the absorption area shall not be surfaced with impervious materials; shall not be planted with deep-rooted plants, which will disrupt the system; and shall not be planted with root vegetables which may be used for human consumption.

SECTION 6.0 OUTDOOR TOILETS

SECTION 6.1 General

Construction or installation of permanent outdoor toilets or privies are prohibited, and those existing shall be replaced with water-flush toilets within one (1) year after a public sewer system becomes available.

SECTION 6.2 Portable Toilets

Portable toilets may be used temporarily at construction and agricultural work sites, provided they meet the horizontal location requirement of Section 5.7 of this Ordinance.

SECTION 6.3 Sanitary Privies

Sanitary privies may be permitted in public or private parks by the *County Health Agency* or as a remedial action in accordance with Section 9.4 of this Ordinance, provided no public sanitary sewer system is available.

Such Privies shall be constructed as a watertight vault-type privy in accordance with Section Ind. 52.63 of the Wisconsin Administrative Code.

SECTION 7.0 WASTE DISPOSAL

SECTION 7.1 Sewage Systems

No effluent, untreated sewage, nor any pumpage from any type of sewage disposal system shall be discharged into any pond, stream, lake, flowage, wetland, storm sewer, drain tile, or drainage ditch nor placed where it would be likely to wash into such ponds, streams, lakes, flowages, or wetlands. Septic tanks, seepage pits, grease traps, holding tanks, privies, watercraft sewage systems, and other sewage disposal systems shall be serviced in accordance with Section 146.20 of the Wisconsin Statutes and Chapter RD 13 of the Wisconsin Administrative Code.

SECTION 7.2 Sludge Disposal

Sludge and scum from septic tanks and any other material removed from sewage disposal units, all hereafter referred to as sludge, shall be disposed of in such manner so as not to create a nuisance or health hazard and shall be disposed of as follows:

Discharge into a Public Sewerage System when practical, with the point and method of discharge subject to the requirements of the municipality or utility operating such system, or at a disposal site or facility designated by the *County Health Agency* for such purpose; or

In the Absence of a public sewerage system or designated disposal site, by burial under eighteen (18) inches of earth on the premises on which produced at a distance of at least one hundred (100) feet from a well; or if on other premises at a distance of at least five hundred (500) feet from a place of habitation, provided that there is also at least eighteen (18) inches of soil between the buried sludge and the ground water level or limestone rock; or by spreading on land not used for pasturing livestock or for growing vegetables, at a distance of one thousand (1,000) feet from a place of habitation.

The Sludge Shall Not Be Disposed of by discharge into a lake, drainage ditch, or dry run or be deposited on floodlands or shorelands.

SECTION 7.3 Industrial and Agricultural Wastes

Industrial and agricultural waste treatment and disposal systems, such as lagoons or ridge and furrow irrigation systems, shall meet the provisions of Section RD 8.03(1) of the Wisconsin Administrative Code and shall be designed to meet the individual applicant's needs and be of a type that will adequately dilute, purify, filter, cool, and trap the specific waste. Industries producing wastes of a toxic, putrescible, or otherwise objectionable character should consult and comply with the recommendations of the State Division of Health and the State Department of Natural Resources in reference to their waste disposal problems.

Any Industry which intends to increase waste discharge or discharge new waste into any navigable waters of the state shall notify the State Department of Natural Resources in accordance with Section 144.555 of the Wisconsin Statutes.

SECTION 7.4 Disposal Standards

All solid waste disposal sites and facilities shall be licensed and shall meet the minimum standards relative to location, design, construction, sanitation, operation, and maintenance standards to be prepared and adopted by the State Department of Natural Resources pursuant to Sections 144.43 and 144.44 of the Wisconsin Statutes.

SECTION 8.0 LICENSES AND FEES

SECTION 8.1 Licenses

All persons, firms, or corporations performing any work on any private water supply or private sewage disposal systems shall obtain the required license from the State Division of Health prior to commencing such work, except:

Any Person may service his private sewage disposal system on real estate owned or leased by him; however, he must comply with all other provisions of this Ordinance.

Appendix K (continued)

SECTION 8.2 Fee Schedule

All persons, firms, or corporations performing any work on any private water supply or private sewage disposal systems shall pay a fee according to the following schedule:

Well Construction	\$10.00 ea.
Pump Installation	5.00 ea.
Septic Tank Installation or Addition	10.00 ea.
Effluent Disposal Installation	15.00 ea.
Sanitary Privies	5.00 ea.
Waste Disposal	10.00 per annum

SECTION 8.3 Total Fee

The total fee for any work on any one site during any one period of *ninety (90)* days not requiring more than a total of *three (3)* inspections by the *Sanitary Inspector* shall not exceed *Twenty Dollars (\$20)*.

SECTION 8.4 Double Fee

A double fee may be charged by the *Sanitary Inspector* if work is started before permit is applied for and issued, except for emergency repairs authorized in Section 2.2 of this Ordinance. The double fee does not relieve the applicant of full compliance with this Ordinance nor from prosecution for violating this Ordinance.

SECTION 8.5 Subsequent Inspections

Each inspection after the first that is necessary to enforce ordered corrections shall cost the permit-holder *Five Dollars (\$5)* each.

SECTION 9.0 ADMINISTRATION

SECTION 9.1 Sanitary Inspector

There is hereby created the position of *Sanitary Inspector* for the *County*, who shall have the following duties and powers:

SECTION 9.2 Duties

It shall be the duty of the *Sanitary Inspector* to enforce the provisions of this Ordinance and to:

Record all permits issued, inspections made, work approved, and other official actions.

Inspect all existing and new private water supply and waste disposal systems periodically, and all new work shall be given a final inspection before it is closed.

Test all new private water supply and private sewage disposal systems upon completion of the work in accordance with standard testing methods.

Investigate all complaints made relative to private water supply and waste disposal systems.

SECTION 9.3 Powers

The *Sanitary Inspector* shall have all the powers necessary to enforce the provisions of this Ordinance, including the following:

Access to premises and structures during reasonable hours to make those inspections deemed necessary by him to ensure compliance with this Ordinance. If, however, he is refused entry after presentation of his identification, he shall procure a special inspection warrant in accordance with Section 963.10 of the Wisconsin Statutes, except in cases of emergency.

Prohibit the use of any new private water supply or private waste disposal facilities until he has inspected, tested, and approved such facilities.

Order any person, firm, or corporation owning, using, operating, or installing a private water supply or private waste disposal system to modify, repair, or place it in a safe or sanitary condition if he finds such system to be in a defective, unsafe, or unsanitary condition.

Recommend to the *County Health Agency* any additional sanitary measures as he shall deem necessary.

Request Assistance and cooperation from personnel of the State Division of Health, the State Department of Natural Resources, and other local and county health and police officials.

Condemn and prohibit the use of any private water supply or private waste disposal systems which he finds so constructed, operated, or maintained as to be a menace to the health of the users, neighbors, or community.

Cooperate with local, county, and state personnel in county and state health and water resource programs and in the enforcement of local, county, and state health and water resource regulations.

SECTION 9.4 Remedial Action

Whenever an order of the *Sanitary Inspector* has not been complied with within *thirty (30)* days after written notice has been mailed to the owner, resident agent, or occupant of the premises, the *County Board of Supervisors*, *County Health Agency*, or the *Sanitary Inspector* may institute appropriate legal action or proceeding to prohibit the owner, resident agent, or occupant of the premises from the use of such private water supply or private waste disposal system until such order is complied with.

Closed Holding Tank Systems, sanitary privies, or public sanitary sewer systems may be required by the *County Health Agency* wherever existing sewage disposal systems are inoperative, causing or contributing to a reduction in, or impairment to, surface water quality or creating public health hazards.

Nuisances may be abated as provided in Sections 146.13 and 146.14 of the Wisconsin Statutes.

SECTION 9.5 Appeals

Any person, firm, or corporation or any office, department, or board of the *County* aggrieved by an order, requirement, interpretation, or determination made by the *Sanitary Inspector* may appeal such decision to the *County Health Agency*.

An Applicant desiring to install soil absorption sewage disposal facilities on the soils having very severe limitations, listed in Section 5.3 of this Ordinance, shall have an opportunity to present evidence contesting such classification and analyses if he so desires.

The *County Health Agency* shall fix a reasonable time and place for a public hearing, give a Class 1 notice thereof at least ten (10) days prior thereto, and give notice by mail to the parties-in-interest.

Upon a Finding-of-Fact after the hearing, the *County Health Agency* may affirm, modify, or reverse the decision appealed from.

The Distances Required in Sections 3.1, 4.2, and 5.7 of this Ordinance may be modified by the *County Health Agency* on any legal lot or parcel of record in the *County Register of Deeds* office existing before the adopted date of this Ordinance, providing such modification is not below the minimum distance required by the Wisconsin Administrative Code.

An Applicant desiring to install soil absorption sewage disposal facilities on the soils having severe limitations, listed in Section 5.4 of this Ordinance, shall have additional on-site investigations made, including soil boring and percolation tests; shall obtain the certification of a soils scientist that specific areas lying within these soils are suitable for the proposed soil absorption sewage disposal system; and shall meet the State Division of Health and the State Department of Natural Resources regulations. Thereafter, the *County Health Agency* must find that the proposed corrective measures have overcome the severe soil limitations and may attach any conditions it deems necessary to fulfill the purpose and intent of this Ordinance.

The *County Health Agency* may request the *County Soil and Water Conservation District* to provide expert assistance from regional, state, or federal agencies which are assisting such District under a "Memorandum of Understanding."

Appendix K (continued)

SECTION 10.0

DEFINITIONS

Words used in the present tense include the future; the singular number includes the plural; the plural number includes the singular number; and the word 'shall' is mandatory and not directory. Definitions provided in Sections RD 12.03, H 62.02, H 65.02, and RD 13.02 of the Wisconsin Administrative Code are hereby adopted by reference. In addition, the following definitions shall also be used:

Deep Absorption System

A soil absorption sewage effluent disposal system for disposal of effluent through the bottom and sides of a hole or trench at a depth of more than three (3) feet below the natural undisturbed surface.

Effluent

Liquid flowing from any sewage treatment device, such as a septic tank.

Floodlands

Those lands, including the floodplains, floodways, and channels, subject to inundation by the one hundred (100)-year recurrence interval flood or, where such data is not available, the maximum flood of record.

High-Water Elevation

The average annual high-water level of a pond, stream, lake, flowage, or wetland referred to an established datum plane or, where such elevation is not available, the elevation of the line up to which the presence of the water is so frequent as to leave a distinct mark by erosion, change in, or destruction of vegetation or other easily recognized topographic, geologic, or vegetative characteristic.

Nuisance

Any source of filth or cause of sickness.

Parties-In-Interest

All abutting property owners and all property owners within two hundred (200) feet of the subject site.

Privy

An outhouse or structure used for deposition of human excrement.

Retailer

For the purposes of this Ordinance, the septic tank retailer shall be deemed to be the installer.

Sanitary Inspector

A person recommended by the County Health Agency and appointed by the County Board of Supervisors to administer and enforce this Ordinance. References to the Sanitary Inspector shall be construed to include duly appointed deputy inspectors.

Septic Tank

A watertight, covered receptacle, which receives crude untreated sewage, and by bacterial action and sedimentation effects a process of clarification and decomposition of the solid sewage and discharges an effluent.

Shallow Absorption System

A soil absorption sewage effluent disposal system for disposal of effluent through open-jointed or perforated pipe at a depth not to exceed three (3) feet below the natural undisturbed surface.

Shorelands

Those lands lying within the following distances: one thousand (1,000) feet from the high-water elevation of navigable lakes, ponds, and flowages and three hundred (300) feet from the high-water elevation of navigable streams or to the landward side of the floodplain, whichever is greater.

Soil Mapping Unit

Soil types, slopes, and erosion factors delineated on operational soil survey maps prepared for the County by the U.S. Department of Agriculture, Soil Conservation Service, in cooperation with the Southeastern Wisconsin Regional Planning Commission.

Wastes

Any materials, such as explosives, fuel, litter, paper, garbage, sewage, gas, inflammables, oil, refuse, rubbish, tar, wood ashes, or other solid or liquid materials, that may cause or contribute to health hazards or a reduction in surface or subsurface water quality.

Wetlands

Those lands which are partially covered by marshland flora and generally covered with shallow standing water, or lands which are wet and spongy due to a high-water table.

Wisconsin Administrative Code

The rules of administrative agencies having rule-making authority in Wisconsin, published in a loose-leaf, continual-revision system as directed by Section 35.93 and Chapter 227 of the Wisconsin Statutes, including subsequent amendments to those rules.

Appendix L
Special Floodland Regulations to be Incorporated into Building Ordinances

The following sections and subsections have been designed to replace or be added to those regulations found in properly prepared local building ordinances so as to effectively and efficiently reduce or prevent damages and minimize expenditures for flood relief programs and flood control projects and to prevent and control erosion.

SECTION 1.0 INTRODUCTION

SECTION 1.1 Authority (Replacement)

Pursuant to the authority granted by Sections 59.07(51), 87.30(2), 144.26, and 280.21 of the Wisconsin Statutes and amendments thereto, the *County Board of Supervisors* of the County of _____ do ordain as follows:

SECTION 1.3 Intent (Addition)

Secure Safety from flooding, water pollution, disease, and other hazards.

Prevent Flood Damage to persons and properties and minimize expenditures for flood relief programs and flood control projects.

Prevent and Control Erosion, sedimentation, and other pollution of surface and subsurface waters.

Preserve Shore Growth and Cover and promote the natural beauty of the County.

Require Floodproofing of those structures that exist in, or must of necessity be constructed on, floodlands.

Provide for Razing and Removal of those structures on floodlands which are unsafe, unsanitary, or dangerous to persons or property.

Require Bridge and Road Design and Construction that is able to pass floodwaters and withstand flood-flow velocities.

Provide for the Least Disturbance of existing terrain, flora, fauna, and water regimen.

SECTION 1.8 Non-Liability (Addition)

The County does not guarantee, warrant, or represent that those structures and other improvements designed and constructed in accordance with this Ordinance will not be subject to flood damage and hereby asserts that there is no liability on the part of the *Board of Supervisors*, its agencies, or employees for any flood damage that may occur as a result of reliance upon, and compliance with, this Ordinance.

SECTION 2.0 GENERAL PROVISIONS

SECTION 2.1 Jurisdiction (Replacement)

The provisions of this Ordinance shall apply to all lands and waters within the County except within the corporate limits of those cities and villages which have adopted ordinances expressly concerning the same subject matter.

SECTION 2.2 Compliance (Replacement)

No structure shall be erected, constructed, altered, repaired, relocated, reconstructed, extended, converted, enlarged, demolished, occupied, or maintained without a building permit and without full compliance with the provisions of this Ordinance; the Wisconsin Statutes; the National Board of Fire Underwriters standards; and all other applicable local, county, and state regulations.

The Building Inspector, with the aid of the Sheriff and the Corporation Counsel, shall accept all applications, issue or deny all building permits, investigate all complaints, give notice of violations, and enforce the provisions of this Ordinance. The Building Inspector shall have access to premises and structures during reasonable hours to make those inspections as deemed necessary by him to ensure compliance with this Ordinance. If, however, he is refused entry after presentation of his identification, he shall procure a special inspection warrant in accordance with Section 963.10 of the Wisconsin Statutes, except in cases of emergency.

SECTION 2.3 Building Permit (Addition)

Plat of Survey prepared by a land surveyor registered in Wisconsin, showing the floodland boundaries and the vertical contour line lying two (2) feet above the one hundred (100)-year recurrence interval flood boundaries or, where such data is not available, five (5) feet above the maximum flood of record.

Any Additional Information required by the Building Inspector, County Building Agency, or County Engineer.

SECTION 2.4 Floodland Regulations (Addition)

In addition to any other applicable use, site, or sanitary regulations, the following restrictions and regulations shall apply to floodlands:

Within the Floodplains, Dumping, filling, on-site sewage disposal facilities, residential uses, basements, and permanent public assembly structures are prohibited. The applicant shall show that the erection of any other proposed structure will not impede drainage and will not substantially reduce the floodwater storage capacity of the floodplain or significantly raise floodwater elevations, based on the assumption that there will be an equal degree of encroachment extending for a significant reach on both sides of the stream.

Within the Floodways, In addition to the above prohibition, all structures are prohibited except navigational structures, public water-measuring and control facilities, bridges, and utilities. The applicant shall show that these permitted structures will not obstruct the floodway, increase flood-flow velocities, increase the flood stage, or retard the movement of floodwaters.

Within the Channels, the erection of all structures shall require a permit from the State Agency having jurisdiction pursuant to Section 30.12(2) of the Wisconsin Statutes; and any bulkheads, wharves, or piers shall comply with bulkhead or pierhead lines established by any municipality, pursuant to Sections 30.11 or 30.13 of the Wisconsin Statutes.

All Structures and Improvements shall be floodproofed in accordance with Section 8.0 of this Ordinance and shall not be used nor inhabited until a Certificate of Occupancy is issued by the Building Inspector.

SECTION 2.8 Violations (Addition)

Every Structure erected or maintained on floodlands in violation of this Ordinance is a public nuisance; and the creation thereof may be enjoined and maintenance thereof may be abated by action at suit of the state, the County, or any citizen thereof.

SECTION 2.9 Penalties (Addition)

Any Person, Firm, or Corporation that erects or maintains any structure on any floodland in violation of this Ordinance may be fined not more than Fifty Dollars (\$50) for each offense. Each day a violation exists or continues shall constitute a separate offense.

SECTION 3.0 SITE IMPROVEMENT

SECTION 3.1 General (Addition)

Building Sites shall be so designed, developed, and improved as to result in the minimum disruption of the natural terrain, flora, fauna, and water regimen; excavation, grading, cutting, and filling shall be directly related to the construction of public rights-of-way, private driveways, and building foundations; and natural drainage patterns shall not be altered so as to divert water onto adjoining properties.

SECTION 3.2 Erosion Control (Addition)

All grading, excavations, open cuts, and other land surface and subsurface disturbances shall be so mulched, seeded, sodded, or otherwise protected that erosion, siltation, sedimentation, and washing are prevented during and after site development.

Appendix L (continued)

- SECTION 3.3 Existing Flora (Addition)
Every effort shall be made to protect all existing trees, shrubbery, and grasses not actually lying in public roadways, drainageways, building foundation sites, private driveways, soil absorption waste disposal areas, pathways, and trails.
Such Trees are to be protected during construction in accordance with those practices recommended by the U.S. Department of Agriculture, Agricultural Information Bulletin No. 285, Protecting Trees Against Damage During Construction Work, United States Government Printing Office, 1964, and such trees are to be preserved by well islands or retaining walls whenever abutting grades are altered.
- SECTION 3.4 Drainage (Addition)
All Excavations or changes in the natural terrain shall be provided with adequate drainage so as to prevent ponding.
- SECTION 4.0 FOUNDATIONS
- SECTION 4.2 Disturbed Soils (Addition)
Lands filled with non-earth materials over five (5) feet in depth within the last ten (10) years shall not have structures erected thereon unless designed, constructed, and supervised in accordance with plans and specifications approved by a professional engineer registered in Wisconsin, who is experienced in foundation engineering; and such engineer shall certify that such structures are designed and constructed in accordance with such plans and specifications.
- SECTION 4.3 Floodplain (Addition)
The ground level surrounding any building erected on the floodplain shall be raised to an elevation of no less than one (1) foot above the level of the one hundred (100)-year recurrence interval flood for a horizontal distance of at least fifteen (15) feet from the outer face of the building walls.
- SECTION 8.0 FLOODPROOFING
- SECTION 8.1 General (Addition)
All structures and improvements erected or placed on floodlands shall be designed, constructed, and flood-proofed in accordance with the following.
- SECTION 8.2 Streets (Addition)
The elevation of all roadways passing through floodland areas shall be at least two (2) feet above the fifty (50)-year recurrence interval flood elevation for arterial streets and at least two (2) feet above the ten (10)-year recurrence interval flood elevation for minor streets.
- SECTION 8.3 Structures (Addition)
All structures shall be so designed, constructed, and maintained as to facilitate the passage of ice floes and other debris and to resist the horizontal forces produced by the one hundred (100)-year recurrence interval flood or, if such data is not available, by the maximum flood of record.
Design and Supervision of construction shall be performed by a professional engineer registered in Wisconsin.
Girders or Beams bearing on masonry walls or piers shall be connected to such walls or piers to a depth of at least six (6) inches by at least one-half (1/2)-inch diameter bolts.
Joist-Bearing Sills shall be anchored to the foundation walls at intervals not to exceed six (6) feet by anchor bolts not less than one-half (1/2)-inch in diameter with proper washers embedded at least six (6) inches into such walls.
- SECTION 8.4 Bridges and Culverts (Addition)
All new bridges and culverts carrying arterial streets over perennial streams shall be adequate to accommodate the fifty (50)-year recurrence interval flood-flow, with the upstream high-water elevation not to exceed a level of two (2) feet below the roadway elevation and the hydraulic head loss through the structure not to exceed 0.5 foot.
Minor Streets. All new bridges and culverts carrying minor streets over perennial streams shall be adequate to accommodate the ten (10)-year recurrence interval flood-flow, with the upstream headwater elevation not to exceed a level of two (2) feet below the roadway elevation and the hydraulic head loss through the structure not to exceed 0.5 foot.
The Combination of these Waterway Openings and the approach road elevations on the floodlands shall not increase the flood stages more than 0.5 foot upon the occurrence of the one hundred (100)-year recurrence interval flood.
All Private Bridges over navigable waters that are thirty-five (35) feet in width or more shall only be constructed in accordance with a permit issued by the State Department of Natural Resources, pursuant to Section 31.23 of the Wisconsin Statutes.
- SECTION 8.5 Buildings (Addition)
All non-residential and nonpublic assembly buildings that must of necessity be erected on floodlands shall have their lowest floor placed at an elevation at least two (2) feet above the elevation of the one hundred (100)-year recurrence interval flood or, if such data is unknown, five (5) feet above the elevation of the maximum flood of record and shall be floodproofed as follows:
Footings, Foundation Walls, and ground floors shall be reinforced, underpinned, anchored, or so treated as to withstand the hydrostatic and hydrodynamic pressures which may be caused by the one hundred (100)-year recurrence interval floodwaters.
Existing Exterior Openings shall be sealed by use of masonry construction or the erection of watertight bulkheads, shutters, and doors.
Basement Walls shall be sealed on the outside by not less than one application of approved watertight paint, one-half (1/2) inch pargeetting coat of Portland cement mortar, or equivalent waterproofing treatment.
Storage Tanks shall be permanently anchored; and the elevation of the overflow and vent pipe openings shall be at least two (2) feet above the elevation of the one hundred (100)-year recurrence interval flood or, if this data is not available, at least five (5) feet above the elevation of the maximum flood of record.
Installation of watertight utilities; automatic sump pumps; horizontal swing-check valves in soil, sewage, and other drain lines; wire-reinforced glass; and seal-tight windows and doors.
Any Additional Treatment required by the County Engineer, Building Inspector, or *Building Agency*.
- SECTION 8.6 Utilities
All heating, electrical, and other essential utilities shall be installed at an elevation of at least two (2) feet above the elevation of the one hundred (100)-year recurrence interval flood or, if such data is unknown, five (5) feet above the elevation of the maximum flood of record.
Existing Electrical Equipment shall have adequate fuse protection and be waterproofed, disconnected, elevated, or removed.
- SECTION 9.0 RAZING AND REMOVAL
- SECTION 9.1 Authority (Replacement)
Any building which has been declared so old, dilapidated, or out of repair as to be dangerous, unsafe, unsanitary, or otherwise unfit for human habitation or has been determined to be unreasonable to repair under Section 66.05(1) of the Wisconsin Statutes may be proceeded against under Chapter 280 of the Wisconsin Statutes by the County upon obtaining leave from the court.

Appendix L (continued)

SECTION 10.0

DEFINITIONS

Words used in the present tense include the future; the singular number, the plural; the plural number, the singular; and the word 'shall' is mandatory and not directory.

Arterial Streets

Streets used or intended to be used primarily for fast or heavy through traffic. Arterial streets shall include freeways and expressways, as well as standard arterial streets, highways, and parkways.

Basement

A story wherein, on every side of the building, the average floor line is below the grade and the average ceiling height in every elevation is not more than five (5) feet above such grade.

Bulkhead Line

A boundary line established along any section of the shore of any navigable waters by a municipal ordinance approved by the State Department of Natural Resources, pursuant to Section 30.11 of the Wisconsin Statutes. Filling and development is only permitted to the landward side of such bulkhead line.

Building

Any structure having a roof supported by columns or walls which is designed, used, or intended to be used for the permanent, year-round sheltering of persons or animals or for the enclosure or storage of equipment, machinery, or other materials.

Building Inspector

A person recommended by the County Building Agency and appointed by the County Board of Supervisors to administer and enforce this Ordinance. References to the Building Inspector shall be construed to include duly appointed deputy inspectors.

Channels

Those floodlands normally occupied by a stream of water under average annual high-water flow conditions while confined within generally well-established banks.

Encroachment Lines

Lines generally drawn parallel to, and along both sides of, a stream to establish the limits to which fill or structures obstructing flood flows or reducing floodwater storage will be permitted. In the establishment of such encroachment lines, it is assumed that the area to the landward side of the lines (outside the lines) will be ultimately filled and developed in such a way as to be unavailable for the conveyance of flood flows or the storage of floodwaters. It is further assumed that the stream channel and the adjoining floodplains between these lines will be maintained in open use as a floodway and will be available and adequate to pass the one hundred (100)-year recurrence interval flood flow without significantly increasing upstream or downstream flood stages.

Equal Degree of Encroachment

An assumption made in the establishment of encroachment lines that, for each encroachment permitted in a floodplain, a similar encroachment will eventually have to be allowed on both sides of a stream valley for a significant reach both upstream and downstream. The concept of an equal degree of encroachment is an extremely important one since the effect of an individual encroachment on

flood stage cannot be determined in any meaningful way. Only when the cumulative effect of similar encroachments along a stream reach is considered can a meaningful hydraulic analysis of the effect of encroachments in a given channel reach be determined.

Flood

A temporary rise in streamflow or stage in lake level that results in water overtopping the banks and inundating areas adjacent to the stream channel or lake bed.

Floodplain

Those floodlands, excluding the floodway, subject to inundation by the one hundred (100)-year recurrence interval flood or, where such data is not available, the maximum flood of record.

Flood Profile

A graph showing the relationship of the floodwater surface elevation for a flood event of a specified recurrence interval to the stream bed and other significant natural and man-made features along a stream.

Floodway

Those floodlands, including the channel, required to carry and discharge the one hundred (100)-year recurrence interval flood. If development and fill are to be prohibited in the floodplain, the floodway may be delineated as that area subject to inundation by the ten (10)-year recurrence interval flood.

Flood Stage

The elevation of the floodwater surface above an officially established datum plane. In southeastern Wisconsin it is recommended that the datum plane used be Mean Sea Level, 1929 Adjustment.

Foundation

A substructure, including masonry walls, piers, footings, piles, grillage, and similar construction, which is designed to transmit the load of any superimposed structure to natural soil or bedrock.

Minor Streets

Streets used or intended to be used primarily for access to abutting properties.

Pierhead Line

A boundary line established along any section of the shore of any navigable waters by a municipal ordinance approved by the State Department of Natural Resources, pursuant to Section 30.13 of the Wisconsin Statutes. Piers and wharves are only permitted to the landward side of such pierhead line unless a permit has been obtained pursuant to Section 30.12(2) of the Wisconsin Statutes.

Reach

A longitudinal segment of a stream generally including those floodlands wherein flood stages are primarily and commonly controlled by the same man-made or natural obstructions to flow.

Storage Capacity

The volume of space available above a given cross section of a floodplain for the temporary storage of floodwater. The storage capacity will vary with stage.

Structure

Any erection or construction, such as booms, bridges, buildings, bulkheads, carpports, cribs, decorations, machinery, masts, piers, poles, posts, signs, towers, and walls.

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Appendix M
Model Aquatic Recreation Ordinance

This model ordinance has been designed for adoption by counties, pursuant to Section 30.77(3)(a) of the Wisconsin Statutes, and contains regulations applicable to recreational uses of streams and lakes. The authority for this Ordinance is granted to counties only on those lakes and adjoining waters where the county operates a marina. However, this authority is granted to cities, villages, and towns on inland lakes if all municipalities having jurisdiction adopt an identical ordinance.

SECTION 1.0 INTRODUCTION

SECTION 1.1 Authority
Pursuant to the authority granted by Sections 30.77(3)(a) and 144.26 of the Wisconsin Statutes and amendments thereto, the *County Board of Supervisors* of the *County of _____* do ordain as follows:

SECTION 1.2 Purpose
The purpose of this Ordinance is to promote the health, safety, prosperity, aesthetics, and general welfare of the people and communities within the *County*.

SECTION 1.3 Intent
The general intent of this Ordinance is to regulate the use of certain waters in the *County* so as to:
Secure Safe and Healthful conditions for the enjoyment of aquatic recreation.
Minimize the Conflict between private shoreland owners and public water users.
Meet Conflicting Demands for boating, swimming, diving, skiing, fishing, and other water uses within the capability of water resources.
Prevent and Control water pollution and promote the natural beauty of the *County*.
Protect Fish and Animal Life, including their spawning, nesting, nursing, resting, and feeding areas.
Provide for the administration and enforcement of this Ordinance and penalties for its violation.

SECTION 1.4 Abrogation and Greater Restrictions
It is not intended by this Ordinance to repeal, abrogate, annul, impair, or interfere with any existing easements, covenants, deed restrictions, agreements, ordinances, rules, regulations, or permits previously adopted or issued pursuant to law. However, wherever this Ordinance imposes greater restrictions, the provisions of this Ordinance shall govern.

SECTION 1.5 Interpretation
In their interpretation and application, the provisions of this Ordinance shall be held to be minimum requirements and shall be liberally construed in favor of the *County* and shall not be deemed a limitation or repeal of any other power granted by the Wisconsin Statutes.

SECTION 1.6 Severability and Non-Liability
If any section, provision, or portion of this Ordinance is adjudged unconstitutional or invalid by a court of competent jurisdiction, the remainder of this Ordinance shall not be affected thereby. The *County* does not guarantee, warrant, or represent the safety of persons operating watercraft and icecraft in accordance with this Ordinance and hereby asserts that there is no liability on the part of the *Board of Supervisors*, its agencies, or employees for any health hazards or damages that may occur as a result of reliance upon, and compliance with, this Ordinance.

SECTION 1.7 Repeal
All other ordinances or parts of ordinances of the *County* inconsistent or conflicting with this Ordinance, to the extent of the inconsistency only, are hereby repealed.

SECTION 1.8 Title
This Ordinance shall be known as, referred to, or cited as the AQUATIC RECREATION ORDINANCE, _____ COUNTY, WISCONSIN.

SECTION 1.9 Effective Date
This Ordinance shall be effective after adoption by the *County Board of Supervisors*, publication, posting, and filing as provided by law.

SECTION 2.0 GENERAL PROVISIONS

SECTION 2.1 Jurisdiction
The jurisdiction of this Ordinance shall apply to all the land, air, and water on, above, and below the surface of the following streams, lakes, ponds, flowages, wetlands, and their shorelands:

SECTION 2.2 Compliance
No person, firm, or corporation shall hereafter operate any watercraft, participate in other aquatic recreation, or use the waters under the jurisdiction of this Ordinance in any way that does not conform to the provisions of this Ordinance and all other applicable local, county, and state regulations.

The Duty of Water Patrol, with the aid of the *Sheriff* and *Corporation Counsel*, shall be to patrol the above waters and their shorelands, investigate complaints, give notice of violations, and enforce the provisions of this Ordinance. Water Patrol officers may stop and board any boat for the purpose of enforcing this Ordinance whenever they have reasonable cause to believe a violation exists.

SECTION 2.3 State Boating Laws
Sections 30.50 through 30.71 of the Wisconsin Statutes, and amendments thereto, relating to watercraft and their capacity plates, numbering, ownership, abandonment, destruction, classification, equipment, traffic rules, distress flags, accidents, operation, water skiing, skin diving, and toilets are hereby adopted by reference.

SECTION 2.4 Waste Disposal
No wastes shall be discharged, deposited, thrown, or so located that they may blow, fall, or wash into the waters under the jurisdiction of this Ordinance.

All Watercraft equipped with toilet facilities shall not be operated in the water unless such facilities are plugged from the outside of the hull so that the plug cannot be removed from the inside.

All Watercraft Wastes shall be retained for discharge at disposal sites or facilities designated by the *County Health Agency*.

SECTION 2.5 Violations
It shall be unlawful to operate any watercraft, participate in other aquatic recreation, or use the waters under the jurisdiction of this Ordinance in any way in violation of the provisions of this Ordinance. In addition, it shall be unlawful to resist, obstruct, or interfere with the Water Patrol in the discharge of its duties or to neglect, refuse, or fail to obey the Water Patrol orders pertaining to its duties.

Failure to Remove Cut Weeds shall be deemed a nuisance as provided in Section 30.125 of the Wisconsin Statutes.

In Case of Any Violation the *County Board of Supervisors*, the Water Patrol, or any property owner who would be specifically damaged by such violation may institute appropriate legal action or proceeding to enjoin a violation of this Ordinance.

All Violations of this Ordinance shall be reported by the Water Patrol to the Office of the *Corporation Counsel* or *District Attorney*, who shall then prosecute such violations on behalf of the *County* or the state, as appropriate.

SECTION 2.6 Penalties
Any person, firm, or corporation that fails to comply with the provisions of this Ordinance or permits the use of any watercraft in violation of this Ordinance shall, upon conviction thereof, forfeit not less than Ten Dol-

Appendix M (continued)

lars (\$10) nor more than Fifty Dollars (\$50) and costs of prosecution for each violation and, in default of payment of such forfeiture and costs, shall be imprisoned in the County Jail until payment thereof but not exceeding thirty (30) days. Each day a violation exists or continues shall constitute a separate offense.

Violations of State Boating Laws shall have penalties as specified in Section 30.80 of the Wisconsin Statutes.

Failure To Remove Cut Weeds shall have penalties as specified in Section 30.125(3) of the Wisconsin Statutes.

SECTION 2.7 Money Deposits

Water Patrolmen who are unable to bring arrested alleged violators before the County Court without unnecessary delay shall permit such violator to make a money deposit in accordance with Section 30.76 of the Wisconsin Statutes.

SECTION 3.0 WATERCRAFT OPERATION

SECTION 3.1 General

No watercraft shall be operated or used in a careless, negligent, or reckless manner so as to endanger the life, property, or person of another; or operated, directed, or handled in such manner as to unreasonably annoy, frighten, or endanger its occupants or those of another watercraft; or operated by anyone under the influence of an intoxicant, narcotic, or any other dangerous drug.

No Person in Charge or Control of any watercraft shall authorize or permit such craft to be operated by any person who, by reason of physical or mental disability, is incapable of operating such craft under the prevailing circumstances or permit any person who is so intoxicated as to be unable to provide for his own safety or the safety of others to ride as a passenger in such craft.

SECTION 3.2 Minors

No person under twelve (12) years of age shall operate or be permitted to operate any motorized watercraft unless there is present in such craft a person sixteen (16) years of age or older. The owner of such motorized craft shall be held to have violated this Ordinance if he knowingly permits or suffers any such operation.

SECTION 3.3 Wake or Wash

No watercraft shall be operated so as to approach or pass another watercraft in such a manner as to create a hazardous wake or wash. An operator of such craft is liable for any damage caused to the person or property of another by the wake or wash from such craft, unless the negligence of such other person was the primary cause of damage.

SECTION 3.4 Restricted Areas

No watercraft shall be operated within a water area which has been clearly marked by buoys or some other distinguishing device as a bathing or swimming area, or anchored in the traveled portion of any navigable water or in any traffic lane established and legally marked so as to prevent, impede, or interfere with the safe passage of any other watercraft.

No Motorized Watercraft shall be operated repeatedly in a circular course around any other watercraft or around any person who is swimming or diving if such circular course is within two hundred (200) feet of such boat, swimmer, or diver or in the shore zone, except the shortest distance to and from its mooring.

SECTION 3.5 Overuse

No watercraft shall be loaded with passengers or cargo beyond its safe carrying capacity, taking into consideration weather and other existing operating conditions.

No Person in Charge or Control shall loan, rent, or permit any watercraft to be so loaded or equipped with any motor or other propulsion machinery beyond its safe power capacity, taking into consideration the type and construction of such craft and other existing operating conditions.

SECTION 3.6 Specific Prohibition

No motorized watercraft shall be permitted on the following lakes under fifty (50) acres in surface area and on the following ponds, streams, flowages, and wetlands:

SECTION 3.7 Horns, Whistles, and Sirens

No horn, whistle, or other sound-producing device on any watercraft, while at anchor or underway, shall be unnecessarily sounded. The use of siren on any watercraft is prohibited except duly authorized patrol craft on patrol or rescue duty.

SECTION 3.8 Navigational Aids

No unauthorized person shall move, remove, molest, tamper with, destroy or attempt to destroy, or moor or fasten a watercraft, except to mooring buoys, to any navigation aids or regulatory markers, signs, or other devices established and maintained to aid water users.

SECTION 3.9 Accidents

Operators of watercraft involved in accidents shall stop their watercraft and render such assistance as practicable and necessary to save life and minimize dangers caused by such accident.

SECTION 4.0 WATERCRAFT SPEED

SECTION 4.1 Reasonable

No watercraft shall be operated at a speed greater than is reasonable and prudent under existing conditions and having regard for potential hazards. The speed and navigation of any motorized watercraft shall be so controlled as to avoid colliding with any object in or on the water or with any person or watercraft in or on the water.

SECTION 4.2 Night

No watercraft shall be operated at a speed in excess of ten (10) miles per hour between the hours of one-half (1/2) hour after sunset and one-half (1/2) hour before sunrise, except on lakes of one thousand (1,000) acres in area or larger, where the speed shall not be in excess of twenty-five (25) miles per hour.

SECTION 4.3 Shore Zone

No motorized watercraft shall be operated so as to show a wake within two hundred (200) feet of any shoreline, swimmer, marked public swimming area, diving flag, canoe, rowboat, sailboat, non-operating motorized watercraft bridge, landing, pier, or anchorage.

SECTION 4.4 Crowded Conditions

No person shall operate any boat at a speed in excess of five (5) miles per hour on the following streams, ponds, lakes:

nor on the following lakes between fifty (50) and two hundred (200) acres in surface area where the Water Patrol estimates that over one (1) boat per ten (10) acres of lake surface area has been launched:

SECTION 5.0 SWIMMING, DIVING, AND SKIING

SECTION 5.1 Swimming

No person shall swim outside the Shore Zone unless accompanied by a competent person in a boat, swim from any unmanned watercraft unless such craft is anchored, or swim more than two hundred (200) feet from the shoreline between sunset and sunrise, except:

Experienced Swimmers towing not more than fifteen (15) feet behind them a tight-weight flotation device distinctly marked by a flag designed so as to have one horizontal red stripe on a yellow background and be of a size

Appendix M (continued)

and height above the water so as to be clearly apparent at a distance of at least one hundred (100) yards under normal conditions.

SECTION 5.2 Diving

Underwater diving or swimming with the use of self-contained underwater breathing apparatus shall not be engaged in unless the approximate location of such diving or swimming operation is distinctly marked by a flag designed so as to have one diagonal white stripe on a red background and be of a size and height above the water so as to be clearly apparent at a distance of at least one hundred (100) yards under normal conditions.

No One Engaged in such diving or swimming shall rise near or to the surface of the water in less than a radius of fifty (50) feet from such flag, except in the case of an emergency. Such diving or swimming operation shall not be engaged in between sunset and sunrise and shall not interfere with the operations of anyone fishing in the immediate area.

SECTION 5.3 Skiing

Motorized watercraft towing a person on water skis, aquaplane, or similar device shall not be operated between 6:00 p.m. and 10:00 a.m., except during tournaments, exhibits, or trials authorized in writing by the Water Patrol and where adequate lighting is provided.

Motorized Watercraft having in tow water skis, aquaplanes, or similar devices shall be operated in a careful and prudent manner and at a reasonable distance from persons and property so as not to endanger life or property.

Such Craft shall not be operated for the purpose of towing a person on water skis, aquaplane, or similar device unless there are two or more competent persons twelve (12) years of age or over in such craft.

Shore Zone. Water skiing shall not be engaged in within two hundred (200) feet of shoreline-designated swimming areas, other watercraft swimmers not in a designated swimming area, diving flags, or public boat landings or on lakes under two hundred (200) acres or upon the following streams or lakes because of their use, size, width, shape, or depth:

Water Skiers shall wear a life belt or preserver approved by the U.S. Coast Guard. Water skier tow ropes shall not exceed seventy-five (75) feet from the watercraft.

SECTION 6.0 HOUSEBOATS

SECTION 6.1 General

Anchoring, drifting, or mooring of houseboats is prohibited from 12:00 midnight to sunrise; however, unoccupied houseboats may be anchored in designated anchorages or moored to shore during this period with written permission of the property owner. An exception may be granted by the Water Patrol for a period not to exceed twenty-four (24) hours, provided such houseboat is moored to shore with written permission of the property owner and where suitable shore sanitary facilities are available for use.

SECTION 6.2 Specific Prohibition

Houseboats are prohibited on the following streams and lakes because of their use, size, width, shape, or depth:

SECTION 7.0 ANCHORAGES

SECTION 7.1 General

Anchoring or mooring of watercraft for more than twenty-four (24) hours is prohibited except in the shore zone.

SECTION 7.2 Shore Zone

The shore zone is hereby designated as an anchorage or moorage, except in swimming zones and heavy traffic zones

when so designated or marked by the Water Patrol. No raft, ski jump, stationary platform, or any other obstacle to navigation outside the shore zone shall be erected or maintained unless a permit is obtained from the Water Patrol.

SECTION 8.0 ICECRAFT OPERATION

SECTION 8.1 General

No icecraft shall be operated or used in a careless, negligent, or reckless manner so as to endanger the life, property, or person of another; or operated, directed, or handled in such manner as to unreasonably annoy, frighten, or endanger its occupants or those of another icecraft; or operated under the influence of an intoxicant, narcotic, or any other dangerous drug.

No Person in Charge or Control of any icecraft shall authorize or permit such craft to be operated by any person who, by reason of physical or mental disability, is incapable of operating such craft under the prevailing circumstances, or permit any person who is so intoxicated as to be unable to provide for his own safety or the safety of others to ride as a passenger in such craft.

SECTION 8.2 Minors

No person under twelve (12) years of age shall operate or be permitted to operate any motorized icecraft unless there is present in such craft a person sixteen (16) years of age or older. The owner of such motorized craft shall be held to have violated this Ordinance if he knowingly permits or suffers any such operation.

SECTION 8.3 Overuse

No icecraft shall be loaded with passengers or cargo beyond its safe carrying capacity, taking into consideration weather and other existing operating conditions.

SECTION 8.4 Specific Prohibition

No propeller driven icecraft shall be operated anywhere within the jurisdiction of this Ordinance; and no motorized icecraft shall be permitted on the following lakes under fifty (50) acres in surface area or on the following ponds, streams, flowages, and wetlands:

SECTION 8.5 Speed

No icecraft shall be operated at a speed greater than is reasonable and prudent under existing conditions and having regard for potential hazards, and

Motorized Icecraft shall not be operated at a speed greater than ten (10) miles per hour and shall be so controlled as to avoid colliding with any person, icecraft, or other object.

SECTION 8.6 Hours

No motorized icecraft shall be operated on the ice between the hours of one-half (1/2) hour after sunset and one-half (1/2) hour before sunrise.

SECTION 8.7 Tow

No motorized icecraft shall be used to tow or push any person, craft, or other object except for emergency vehicles authorized by the Water Patrol.

SECTION 9.0 DEFINITIONS

Words used in the present tense, include the future; the singular number includes the plural; the plural number includes the singular; and the word 'shall' is mandatory and not directory.

Anchorage

An area where continuous anchoring or mooring of boats for more than twenty-four (24) hours is permitted.

Houseboat

A boat on which a toilet or food preparation facilities exist or which is used or designed for living, sleeping, cooking or camping.

Icecraft

Any object, device, or material capable of sliding and transporting a person or goods on ice or snow, such as automobiles, sleds, skis, toboggans, and ice boats.

Appendix M (continued)

Operate

To navigate, steer, sail, row, or otherwise move or exert control over the movement of any watercraft.

Shore Zone

The water area within *two hundred (200)* feet of the average annual high-water elevation.

Shorelands

Those lands lying within the following distances: one thousand (1,000) feet from the average annual high-water elevation of navigable lakes, ponds, and flowages and three hundred (300) feet from the average annual high-water elevation of navigable streams or to the landward side of the floodplain, whichever is greater.

Shoreline

The intersection of the land surfaces abutting streams, ponds, lakes, flowages, and wetlands with the average annual high-water elevation.

Wake

Wave moving out from a watercraft in an ever-widening "V."

Wastes

Any materials, such as explosives, fuel, litter, paper, cut weeds, garbage, gas, inflammables, oil, refuse, rubbish, tar, wood ashes, or other solid or liquid materials, that may cause or contribute to health hazards or a reduction in surface or subsurface water quality.

Watercraft

Any object, device, or material capable of floating and transporting a person or goods on water, except sea-planes.

Water Patrol

Those *County* agents granted the power to, and assigned the duty of, enforcing this Ordinance pursuant to Section 30.79 of the Wisconsin Statutes.

Wetlands

Those lands which are partially or wholly covered by marshland flora and generally covered with shallow standing water or lands which are wet and spongy due to a high-water table.

Appendix N Story of Cedar Creek

The second annual clean-up of Cedar Creek on May 20, saw 378 volunteers cleaning 16 truckloads of debris from the creek in an effort to keep the local waters clear and sparkling. The following article by Mrs. Joicey Acker Hurth of Cedarburg, a member of the Port Washington DAR, re-printed from the DAR Magazine, tells the story of Cedar Creek and its clean-up program from the beginning.

The true spirit of neighborliness and cooperation has been demonstrated in the small city of Cedarburg, where 350 or more citizens have volunteered to help in the special project, "Operation Clean-Up," with amazing results. The war on water pollution has begun and the long range objective is to eliminate pollution and to restore Cedar Creek to its natural health and beauty.

A picturesque city of many churches, historical buildings and oak-lined streets, Cedarburg is laid out on the banks of Cedar Creek, a winding stream which eventually widens and joins the Milwaukee River.

Not too long ago the little creek was crystal clear, sustaining within its waters oxygen and food for fish. Certain areas were used for swimming. Little boys collected rocks, fished for crabs, and waded for the sheer delight of it. It provided power for industry, water for farming operations and recreational facilities. Cedar Creek was pure.

PEOPLE WERE CARELESS

As the city grew and the population increased, the very people who sought the shady park areas along the creek banks on hot summer days were careless in their treatment of the water and surrounding property. Industries sprang up and all types of chemicals, dyes, waste products, and refuse from mills were dumped into the creek. City maintenance could not keep abreast of the need. As a result the little creek became polluted. Green algae formed along its banks; muck and slime lined its bottom. Debris carelessly thrown into the water caused contamination. Fish died for lack of oxygen. The water looked muddy, smelled foul, and became stagnant in places of obstruction. Wastes from homes, farms, factories, and sewage treatment plants left the water in an unhealthy and unusable condition.

Today, thanks to the City Park Board and the Cedar Creek Restoration Council, Inc., and the leadership of local men, the story changes.

On Saturday, September 17, 1966, over 350 volunteer workers donned old clothes, hip boots, and gloves; carried rakes, hoes, and shovels; and went to work. The Mayor of the city issued a proclamation designating this day as "Cedar Creek Clean-Up Day." Governor Warren P. Knowles of Wisconsin joined the attack to further the state program on conservation. He was on hand to see the work in progress. The operation started at 8:00 and was concluded at noon the same day.

What actual progress took place in that length of time?

COUNCIL WAS ORGANIZED

To get the complete picture, we have to go back in time 18 months to the occasion of one man's indignation at the unhealthy condition of this 30-mile stream. Heading a group of Explorer Scouts, he started a tedious, bitter, and often thankless crusade. This group, under the leadership of Mr. Delbert Cook of Cedarburg, organized the Cedar Creek Restoration Council, Inc.

The first step was a complete survey of the stream to determine contributing factors that caused its pollution. Actual testing of lakes and streams in the Cedar Creek watershed was done to ascertain the degree of the water's purity or pollution. The group sought advice from state agencies and recruited adult help and supervision. They uncovered the source of many problems, such as domestic and industrial waste, illegal fencing of cattle, broken down dams, extensive stretches of badly silted banks, water-soaked log stoppages, private dumps, piles of litter, and oil-soaked shores.

To correct these conditions, the citizens group took it upon themselves to express their grievance and to seek the guidance of such groups as the State Board of Health, the Public Service Commission, the Water Pollution Control Committee, County Conservation Wardens, local Health Officers, South Eastern Planning Commission, local city councils, town boards, and any other agencies that had some part in pollution control and conservation. The cooperation was excellent.

Survey results and facts were carried to women's and men's civic organizations. Many groups joined the effort.

Financial assistance came from \$1.00 a year dues for voting members of the Restoration Council, some 2,000 active or associate members; \$5.00 per year for youth groups; \$10.00 for adult groups; individual con-

tributions. No money was asked for or received from state or federal sources.

Work and planning continued another year. Through progress reports and press coverage, public awareness and enthusiasm grew.

Then came the organization of "Operation Clean-Up." Plans for stream work were provided by the Wisconsin Conservation Department.

CLEAN-UP BEGINS IN EARNEST

There were chairmen and co-chairmen, a volunteer coordinator, group representatives, area supervisors, team captains, and workers. Communications were handled by public address system, by short-wave radio, telephone, and by messengers. Refreshments were served by women's organizations at a community house. Headquarters was established in the park area. Public service groups which gave time and supplied essential equipment were Fire Department, Auxiliary and Regular Police, Rescue Squad, Tree-cutting, Transportation, and Trash-removal services, and others. Equipment donated for use by individuals or firms were boats, canoes, chain-saw, bushel baskets or cartons, motorized weed cutter, and hand tools.

On the designated day, teen-agers donned in "grub" clothes, outnumbered the adults. Assigned to a particular crew and given a map of a designated area, the groups received briefing instructions and started to work. Undaunted by the discomfort of wading into cold, slimy water, these enthusiastic young people accomplished tasks difficult for adults. They hauled and dragged unbelievable objects from the creek--a 1936 automobile frame, a kayak, a water-logged maple, stove pipes, and baby buggies. Forming lines from shore to shore like the old "bucket brigade," they passed rocks, wood, weeds, and debris. They rebuilt the creek banks with rocks dug out with bare hands, deepened channels, straightened shorelines, loosed obstructions, even tearing down an island of sand, rocks, and weeds. More than one worker lost his footing and came up soaked, but he was quickly taken to headquarters for a cup of hot chocolate, rushed home for a change of clothes, and returned to his job. Personal injury and liability insurance protection was provided for each worker, though no serious accidents were reported. Twenty dump trucks carried off the huge piles of junk.

A ramp was constructed by city workers using mechanized equipment to launch a motorized weed cutter, which cut out a large section of weeds and cattails and raked them to shore. Following this operation the stagnant water began to move with the current, and for a time the entire surface was green with floating algae. By noon the signal to discontinue work was sounded. Tired but thoroughly satisfied, the volunteers enjoyed a hot lunch. Each worker was awarded a personal citation for his effort.

A SPARKLING CASCADE

Water cascades merrily downstream; and Cedar Creek sparkles in the sunshine, so clear that the sandy bottom can be seen for the first time in years.

The story does not end here. Written reports on the project and recommendations were sent to state, regional, and local agencies. A permanent "creek patrol" was established to ensure that the clean condition be maintained. Regular planning meetings and inspection tours will continue. Future plans call for two more years of work on major stream improvement, such as renovating of dam gates and races, cleaning of silt and junk from dam ponds, deepening channels, building retaining walls, improvement of the use of sewer systems and sewage treatment, and correction of any other unforeseen problems. The creek will be restocked with game fish.

What is the over-all effect of this clean-up project?

To the area residents, the results are measured in terms of civic improvement to provide a healthful atmosphere for better living conditions, for park and recreation facilities, and for beauty. It is a matter of pride for one generation to pass to another an unpolluted waterway abounding in its natural resources.

It is an incentive to other communities to safe-guard the health of their residents by attempting to clean up polluted streams and rivers. Cedarburg is the only city other than one in Pennsylvania to have approached a job of such magnitude with perseverance, and to have been successful in the effort. On state and national levels, it is an example of conservation at its highest potential.

Source: *The Citizen*, June 1, 1967. Reprinted from the DAR Magazine.

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Appendix O
Selected Standards Related to Shoreland Protection¹

1. Four acres of regional park and recreational lands for each 1,000 persons.
2. Ten acres of local park and recreational lands for each 1,000 persons.
3. A minimum of 25 percent of the shoreland frontages of lakes 50 acres or more and of both banks of all perennial streams should be maintained in a natural state.
4. A minimum of 10 percent of the shore line of each inland lake over 50 acres should be maintained for public uses.
5. Not more than 50 percent of the shore lines of inland lakes over 50 acres and of perennial streams should be allocated to urban development except park and recreational uses.
6. It is desirable that 25 percent of shore line of each inland lake less than 50 acres be maintained in a natural state or some low-density public use, such as park lands.
7. All wetland areas adjacent to streams or lakes should not be allocated to any urban development and should not be drained or filled.
8. A minimum of 10 percent of the land area of each watershed should be devoted to woodlands.

¹Standards related to shorelands selected from the regional standards adopted by the Southeastern Wisconsin Regional Planning Commission and published in SEWRPC Planning Report No. 7, Forecasts and Alternative Plans-- 1990 Volume 2, 1966.

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Appendix P
Soils Subject to Flooding and Ponding Hazards¹

It is recommended that the detailed operational soil survey and the following table be used to determine lands subject to flooding only in conjunction with U.S. Geological Survey 7 1/2 minute topographic quadrangle maps and historic flood inundation records and that such determination be performed by someone skilled in the use of such data. It is further recommended that floodlands so delineated be revised when additional hydrologic and hydraulic engineering data becomes available as part of the comprehensive watershed planning programs of the Commission.

<u>No.</u>	<u>Soil Type</u> <u>Name</u>	<u>Limitation</u>	<u>Hazard</u>
2	Stinson Silt Loam	SEVERE	Frequent flooding
4	Marsh		Perennially wet
5	Lawson Silt Loam	SEVERE	Frequent flooding
5W	Sawmill Silt Loam	SEVERE	Frequent flooding
7	Dorchester Silt Loam	SEVERE	Frequent flooding
7W	Lawson Silt Loam	SEVERE	Frequent flooding
10	Alluvial Land	SEVERE	Frequent flooding
10W	Alluvial Land, Wet	SEVERE	
11	Alluvial Land	SEVERE	Frequent flooding
11W	Alluvial Land, Wet	SEVERE	
15	Hillside Seepage	MODERATE	Ponding and occasional flooding
16	Rome Silt Loam	MODERATE	Occasional flooding
23	Lawson Silt Loam	SEVERE	Frequent flooding
26	Wauconda Fine Sandy Loam	MODERATE	Subject to occasional flooding
27	Wauconda Silt Loam	MODERATE	Subject to occasional flooding
27Z	Aztalan Loam	MODERATE	Occasional flooding
28	Colwood Fine Sandy Loam	MODERATE	Ponding
28Z	Navan Loam	MODERATE	Ponding; occasional flooding
29	Colwood Silt Loam	MODERATE	Ponding; occasional flooding
29V	Colwood Silt Loam	MODERATE	Ponding; occasional flooding
29X	Sebewa Silt Loam	MODERATE	Ponding
29Z	Navan Loam	MODERATE	Ponding; occasional flooding
30	Colwood Silt Loam	MODERATE	Ponding; occasional flooding
35	Yahara Very Fine Sandy Loam	MODERATE	Occasional flooding
35Z	Mosel Silt Loam	MODERATE	Occasional flooding
36	Yahara Very Fine Sandy Loam	MODERATE	Occasional flooding
37	Kibbie Fine Sandy Loam	MODERATE	Occasional flooding
37Z	Mosel Silt Loam	MODERATE	Occasional flooding
38	Kibbie Silt Loam	MODERATE	Occasional flooding
38R	Knowles Silt Loam, Wet Variant	MODERATE	Occasional flooding
38Z	Mosel Silt Loam	MODERATE	Occasional flooding
41	Tichigan Silt Loam	MODERATE	Occasional flooding
42	Tichigan Silt Loam	MODERATE	Occasional flooding
42R	Knowles Silt Loam, Wet Variant	MODERATE	Occasional flooding
42V	Kibbie Silt Loam	MODERATE	Occasional flooding
42X	Sleeth Silt Loam	MODERATE	Occasional flooding
42Y	Lamartine Silt Loam	MODERATE	Occasional flooding
45	Yahara Very Fine Sandy Loam	MODERATE	Occasional flooding
45Z	Mosel Silt Loam	MODERATE	Occasional flooding
46	Yahara Very Fine Sandy Loam	MODERATE	Occasional flooding
47	Yahara Very Fine Sandy Loam	MODERATE	Occasional flooding
47Z	Mosel Silt Loam	MODERATE	Occasional flooding
48	Keowns Silt Loam	MODERATE	Ponding; occasional flooding
48Z	Navan Loam	MODERATE	Ponding; occasional flooding
49	Keowns Fine Sandy Loam	MODERATE	On 2-6 percent slopes
49Y	Keowns Fine Sandy Loam	MODERATE	On 2-6 percent slopes
51	Aztalan Loam	MODERATE	Occasional flooding
52	Aztalan Sandy Loam	MODERATE	Occasional flooding
53	Aztalan Silt Loam	MODERATE	Occasional flooding
54	Lawson Silt Loam	SEVERE	Frequent flooding
59Z	Aztalan Sandy Loam	MODERATE	Occasional flooding
60Z	Aztalan Loam	MODERATE	Occasional flooding
63	Brookston Silt Loam	MODERATE	Ponding; occasional flooding
64	Brookston Silt Loam	MODERATE	Ponding; occasional flooding
66	Granby Fine Sandy Loam	MODERATE	Ponding; occasional flooding

Appendix P (continued)

<u>No.</u>	<u>Soil Type</u>	<u>Name</u>	<u>Limitation</u>	<u>Hazard</u>
67		Granby Fine Sandy Loam	MODERATE	Ponding; occasional flooding
76		Sebewa Silt Loam	MODERATE	Ponding
76R		Ehler Silt Loam, Rock Substratum	MODERATE	Ponding
76V		Colwood Silt Loam	MODERATE	Ponding; occasional flooding
76Y		Brookston Silt Loam	MODERATE	Ponding; occasional flooding
76Z		Navan Loam	MODERATE	Ponding; occasional flooding
77Z		Mosel Silt Loam	MODERATE	Occasional flooding
78		Dousman Loam	MODERATE	Occasional flooding
78V		Kibbie Silt Loam	MODERATE	Occasional flooding
78Y		Crosby Silt Loam	MODERATE	Occasional flooding
79		Waukechon Loam	MODERATE	
80		Sebewa Loam	MODERATE	Ponding; occasional flooding
80V		Colwood Silt Loam	MODERATE	Ponding; occasional flooding
80Y		Brookston Silt Loam	MODERATE	Ponding; occasional flooding
80Z		Navan Loam	MODERATE	Ponding; occasional flooding
81		Sebewa Sandy Loam	MODERATE	Ponding
82		Juneau Silt Loam	MODERATE	Occasional flooding
87		Sleeth Silt Loam	MODERATE	Occasional flooding
87Z		Mosel Silt Loam	MODERATE	Occasional flooding
109		Fabius Loam	MODERATE	Occasional flooding
109V		Kibbie Silt Loam	MODERATE	Occasional flooding
109Y		Mosel Silt Loam	MODERATE	Occasional flooding
109Z		Mosel Silt Loam	MODERATE	Occasional flooding
110Z		Rome Silt Loam	MODERATE	Occasional flooding
113		Clyman Silt Loam	MODERATE	Occasional flooding
118		Crosby Silt Loam	MODERATE	Occasional flooding
119Z		Rome Silt Loam	MODERATE	Occasional flooding
124		Crane Silt Loam	MODERATE	Occasional flooding
126		Westland Silt Loam	MODERATE	Ponding; occasional flooding
126Y		Ehler Silt Loam	MODERATE	Ponding; occasional flooding
126Z		Sisson Silt Loam	MODERATE	Ponding; occasional flooding
126V		Colwood Silt Loam	MODERATE	Ponding; occasional flooding
142		Manawa Silt Loam	MODERATE	Occasional flooding
144		Mosel Silt Loam	MODERATE	Occasional flooding
165		Poygan Silt Loam	MODERATE	Ponding; occasional flooding
171		Poygan Silt Loam	MODERATE	Ponding; occasional flooding
174		Fabius Loam	MODERATE	Occasional flooding
175		Fabius Sandy Loam	MODERATE	Occasional flooding
175Z		Mosel Silt Loam	MODERATE	Occasional flooding
176		Mussey Loam	MODERATE	Ponding; occasional flooding
176Z		Navan Loam	MODERATE	Ponding; occasional flooding
176V		Mussey Loam	MODERATE	Ponding; occasional flooding
178		Crosby Silt Loam	MODERATE	Occasional flooding
179		Brookston Silt Loam	MODERATE	Ponding; occasional flooding
180		Mussey Sandy Loam	MODERATE	Ponding
181		Mussey Silt Loam	MODERATE	Ponding; occasional flooding
181V		Colwood Silt Loam	MODERATE	Ponding; occasional flooding
181Y		Brookston Silt Loam	MODERATE	Ponding; occasional flooding
181Z		Navan Loam	MODERATE	Ponding; occasional flooding
182		Fabius Silt Loam	MODERATE	Occasional flooding
182V		Kibbie Silt Loam	MODERATE	Occasional flooding
182Y		Crosby Silt Loam	MODERATE	Occasional flooding
182Z		Mosel Silt Loam	MODERATE	Occasional flooding
188		Crosby Silt Loam	MODERATE	Occasional flooding
189		Bristol Silt Loam	MODERATE	Occasional flooding
203		Matherton Loam	MODERATE	Occasional flooding
203V		Kibbie Silt Loam	MODERATE	Occasional flooding
203Y		Crosby Silt Loam	MODERATE	Occasional flooding
203Z		Mosel Silt Loam	MODERATE	Occasional flooding
212		Ehler Silt Loam	MODERATE	Ponding; occasional flooding
212X		Westland Silt Loam	MODERATE	Ponding; occasional flooding
212Y		Ehler Silt Loam	MODERATE	Ponding; occasional flooding
212R		Ehler Silt Loam, Rock Substratum	MODERATE	Ponding
213		Ehler Silt Loam	MODERATE	Ponding; occasional flooding
213V		Colwood Silt Loam	MODERATE	Ponding; occasional flooding

Appendix P (continued)

<u>No.</u>	<u>Soil Type</u> <u>Name</u>	<u>Limitation</u>	<u>Hazard</u>
213R	Ehler Silt Loam, Rock Substratum	MODERATE	Ponding
214	Ehler Silt Loam	MODERATE	Ponding; occasional flooding
215	Ehler Silt Loam	MODERATE	Ponding; occasional flooding
216	Ehler Silt Loam	MODERATE	Ponding; occasional flooding
217	Bono Silty Clay Loam	MODERATE	Ponding
218	Bono Silty Clay Loam	MODERATE	Ponding
218V	Ehler Silt Loam	MODERATE	Ponding; occasional flooding
218Y	Ehler Silt Loam	MODERATE	Ponding; occasional flooding
228	Rollin Muck, Shallow	MODERATE	Ponding; occasional flooding
231	Brookston Silt Loam	MODERATE	Ponding; occasional flooding
231Z	Ashkum Silty Clay Loam	MODERATE	Ponding; occasional flooding
233	Matherton Silt Loam	MODERATE	Occasional flooding
233V	Kibbie Silt Loam	MODERATE	Occasional flooding
233Y	Crosby Silt Loam	MODERATE	Occasional flooding
233Z	Mosel Silt Loam	MODERATE	Occasional flooding
234	Matherton Sandy Loam	MODERATE	Occasional flooding
234V	Kibbie Fine Sandy Loam	MODERATE	Occasional flooding
234Y	Crosby Silt Loam	MODERATE	Occasional flooding
250	Tedrow Sandy Loam	MODERATE	Occasional flooding
250Z	Mosel Silt Loam	MODERATE	Occasional flooding
250V	Tedrow Sandy	MODERATE	Occasional flooding
250Y	Tedrow Sandy Loam	MODERATE	Occasional flooding
251	Tedrow Loamy Sand	MODERATE	Occasional flooding
251Y	Tedrow Loamy Sand	MODERATE	Occasional flooding
251Z	Aztalan Sandy Loam	MODERATE	Occasional flooding
254	Tustin Sandy Loam	MODERATE	Occasional flooding
261	Hackett Sandy Loam, Wet Variant	MODERATE	Occasional flooding
262	Hackett Loamy Sand, Wet Variant	MODERATE	Occasional flooding
276Z	Tustin Sandy Loam	MODERATE	Occasional flooding
277Z	Tustin Sandy Loam	MODERATE	Occasional flooding
278	Clyman Silt Loam	MODERATE	Occasional flooding
283	Mosel Silt Loam	MODERATE	Occasional flooding
284	Mosel Silt Loam	MODERATE	Occasional flooding
285	Mussey Loam	MODERATE	Ponding; occasional flooding
286	Mussey Silt Loam	MODERATE	Ponding; occasional flooding
287	Mussey Loam	MODERATE	Ponding; occasional flooding
289Z	Tustin Sandy Loam	MODERATE	Occasional flooding
295	Morley-Beecher Silt Loam	MODERATE	Occasional flooding (Beecher)
298	Ashkum Silty Clay Loam	MODERATE	Ponding; occasional flooding
299	Blount Silt Loam	MODERATE	Occasional flooding
300	Ashkum-Beecher Silt Loams	MODERATE	Ponding; occasional flooding
302	Rollin Muck, Shallow	MODERATE	Ponding; occasional flooding
303	Alluvial Land, Rock Substratum	SEVERE	
306	Knowles Silt Loam, Wet Variant	MODERATE	Occasional flooding
307	Knowles Silt Loam, Wet Variant	MODERATE	Occasional flooding
311	Manawa Loam	MODERATE	Occasional flooding
326	Abington Silt Loam	MODERATE	Ponding; occasional flooding
326Z	Ehler Silt Loam	MODERATE	Ponding; occasional flooding
327	Wallkill Silt Loam	MODERATE	Ponding; occasional flooding
328	Pistakee Silt Loam	MODERATE	Occasional flooding
328Y	Pistakee Silt Loam	MODERATE	Occasional flooding
330	Navan Loam	MODERATE	Ponding; occasional flooding
331	Markham-Elliott Silt Loams	MODERATE	Occasional flooding (Elliott)
332	Kane Silt Loam	MODERATE	Occasional flooding
332V	Wauconda Silt Loam	MODERATE	Occasional flooding
332Y	Crosby Silt Loam	MODERATE	Occasional flooding
332Z	Aztalan Silt Loam	MODERATE	Occasional flooding
333Z	Rome Silt Loam	MODERATE	Occasional flooding
338	Ashkum Silty Clay Loam	MODERATE	Ponding; occasional flooding
339	Abington Silty Clay Loam	MODERATE	Ponding
340	Navan Silt Loam	MODERATE	Ponding; occasional flooding
345	Nenno Silt Loam	MODERATE	Occasional flooding
346	Kane Loam	MODERATE	Occasional flooding
346Y	Crosby Silt Loam	MODERATE	Occasional flooding
363R	Knowles Silt Loam, Wet Variant	MODERATE	Occasional flooding

Appendix P (continued)

<u>No.</u>	<u>Soil Type</u>	<u>Name</u>	<u>Limitation</u>	<u>Hazard</u>
364		Lamartine Silt Loam	MODERATE	Occasional flooding
364V		Kibbie Silt Loam	MODERATE	Occasional flooding
364X		Matherton Silt Loam	MODERATE	Occasional flooding
364Z		Mosel Silt Loam	MODERATE	Occasional flooding
369		Mosel Silt Loam	MODERATE	Occasional flooding
370		Mosel Silt Loam	MODERATE	Occasional flooding
371		Mosel Loam	MODERATE	Occasional flooding
386		Granby Fine Sandy Loam	MODERATE	Ponding; occasional flooding
386Y		Granby Fine Sandy Loam	MODERATE	Ponding; occasional flooding
386Z		Navan Loam	MODERATE	Ponding; occasional flooding
387		Granby Loamy Sand	MODERATE	Ponding; occasional flooding
387V		Wauconda Fine Sandy Loam	MODERATE	Ponding; occasional flooding
398		Ashkum Silty Clay Loam	MODERATE	Ponding; occasional flooding
399		Mequon Silt Loam	MODERATE	Occasional flooding
413Z		Tustin Sandy Loam	MODERATE	Occasional flooding
419		Beach Sand	SLIGHT	Governed by lake level
449		Houghton Mucky Peat	MODERATE	Ponding; occasional flooding
450		Houghton Mucky Peat	MODERATE	Ponding; occasional flooding
451		Houghton Mucky Peat	MODERATE	Ponding; occasional flooding
452		Adrian Muck	MODERATE	Ponding; occasional flooding
452Z		Palms Muck	MODERATE	Ponding; occasional flooding
453		Adrian Muck	MODERATE	Ponding; occasional flooding
454		Palms Muck	MODERATE	Ponding; occasional flooding
455		Palms Muck	MODERATE	Ponding; occasional flooding
456		Ogden Muck	MODERATE	Ponding; occasional flooding
457		Ogden Mucky Peat	MODERATE	Ponding; occasional flooding
458		Rollin Muck, Shallow	MODERATE	Ponding; occasional flooding
459		Rollin Muck	MODERATE	Ponding; occasional flooding
460		Rollin Muck	MODERATE	Ponding; occasional flooding
461		Ogden Muck	MODERATE	Ponding; occasional flooding
462		Houghton Peat, Acid Variant	MODERATE	Ponding
505		Flagg Silt Loam, Wet Variant	MODERATE	Occasional flooding
511		Flagg Silt Loam, Wet Variant	MODERATE	Occasional flooding
550		Ehler Silt Loam, Rock Substratum	MODERATE	Ponding
3251		Elliott Silt Loam	MODERATE	Occasional flooding
3251V		Elliott Silt Loam	MODERATE	Occasional flooding
3361		Beecher Silt Loam	MODERATE	Occasional flooding

¹Excerpt from Table 5, SEWRPC Planning Report No. 8, Soils of Southeastern Wisconsin.

Source: SEWRPC.

Appendix Q

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