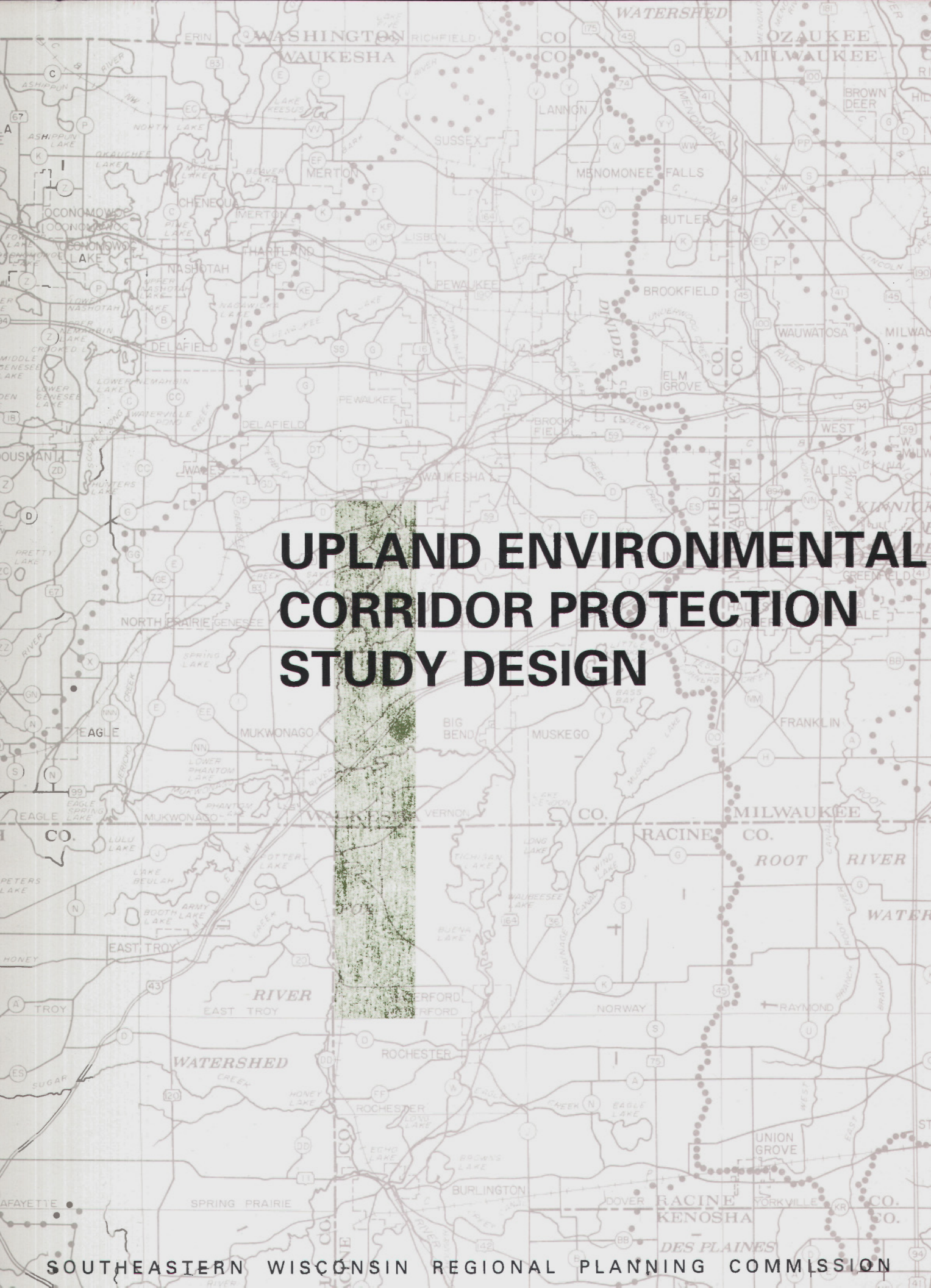

UPLAND ENVIRONMENTAL CORRIDOR PROTECTION STUDY DESIGN

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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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Special acknowledgement is due Christopher N. Jakubiak, SEWRPC Principal Planner, for his contribution to the preparation of this report.

UPLAND ENVIRONMENTAL CORRIDOR PROTECTION STUDY DESIGN

Prepared by the

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September 1995

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Chapter I

INTRODUCTION

BACKGROUND

At an interagency staff meeting of the Wisconsin Department of Natural Resources and the Southeastern Wisconsin Regional Planning Commission held in February 1992, it was determined that the Commission water quality management planning work program should be amended to include the preparation of a prospectus for an upland primary environmental corridor protection study. The determination to prepare a prospectus represented formal recognition of many years of interagency discussion centering on the issue of upland environmental corridor preservation. The prospectus was prepared, evaluated by both Commission and Department staff, and served as the basis for this preliminary study design. The following brief description of the Commission water quality management planning work program will provide background information on why the determination was made that an upland environmental corridor study was needed.

On July 12, 1979, the Commission formally adopted an areawide water quality management plan for Southeastern Wisconsin. The Department acted to adopt the plan on September 2, 1979. The principal aim of the plan was to maintain and improve surface water quality in the Region. The plan has five basic elements: a point source water pollution abatement element; a nonpoint source water pollution abatement element; a sludge management element; a water quality monitoring element; and, most importantly, a land use element. The land use element contains recommendations for the preservation of the primary environmental corridors of the Southeastern Wisconsin Region.

Wisconsin law and implementing administrative rules mandate that certain actions taken by the Department be in conformance with the adopted water quality management plan, and therefore with the environmental corridor preservation recommendations contained in that plan. Such Department actions include: approval of waste discharge permits; approval of State and Federal grants for the construction of wastewater treatment and conveyance facilities; and approval of locally proposed sanitary sewer extensions.

The Commission has since assisted the Department in implementing the water quality management plan through a continuing water quality management planning program. This assistance has included the preparation of sanitary sewer service area plans, and the provision of assistance to the Wisconsin Department of Natural Resources and to the Wisconsin Department of Industry, Labor and Human Relations in the review of proposed public sanitary sewer extensions, proposed private main and building sewer construction, and proposed large onsite sewage disposal systems and holding tanks.

While the current cooperative Department-Commission program, especially as it relates to sewer service area planning and sewer extension review, has been effective in protecting the lowland portions of environmental corridors—that is, the floodplain and wetland portions of the corridors—because it is rooted narrowly in water quality protection, the program has not been as effective in preserving the upland areas of the corridors and, therefore, the corridors as a whole. Commission studies have found that a majority of the corridor losses to development have occurred in the upland resource areas. This development threatens the integrity of the environmental corridors and the coincident natural resource base of the Region.

Thus, the need for this study is based on both the recognition that upland environmental corridors have a role in the maintenance of water quality and that public policy concerning the protection of such areas and of water quality should be continually informed by scientific methods and information. This study, through its primary focus on the effects of upland development on biological diversity, will provide additional scientific information upon which may be based public policy intrinsically related to the maintenance of water quality throughout the Southeastern Wisconsin Region.

THE ENVIRONMENTAL CORRIDOR CONCEPT

The Southeastern Wisconsin Regional Planning Commission has prepared and adopted three regional land use plans, beginning with adoption of the first such plan in 1966.[1] Among the most important concepts underlying these plans has been the protection and preservation of the environmental corridors of the Region in essentially natural, open uses.

Environmental corridors are defined by the Commission as linear areas in the landscape containing concentrations of natural resource and natural resource-related amenities. Most of the remaining high-value wetlands, woodlands, prairies, critical species habitat, wildlife habitat areas, major bodies of surface water, floodplains, and shorelands of the Region are contained in these corridors. In addition, significant groundwater recharge and discharge areas, important recreational and scenic areas, and the best remaining potential parklands are located within the environmental corridors. These corridors, first formally identified in the first-generation regional land use plan completed in 1966, are thus essentially a composite of the most significant individual elements of the natural resource base remaining in Southeastern Wisconsin.

Primary environmental corridors are the most important of these linear concentrations of resource elements, and, by Commission definition, are at least two miles long and 200 feet wide and cover an area of at least 400 acres. Primary environmental corridors have immeasurable environmental and recreational value, and their preservation in essentially natural, open uses provides such benefits as:

- Recharge of groundwater.
- Maintenance of surface water and groundwater quality.
- Attenuation of flood flows and stages.
- Maintenance of base flows of streams and watercourses.
- Reduction of soil erosion.
- Abatement of air pollution.
- Abatement of noise pollution.
- Favorable modification of climate.
- Facilitation of the movement of wildlife and provision of game and nongame wildlife habitat.
- Facilitation of the dispersal of plant seeds.
- Protection of plant and animal diversity.
- Protection of rare, threatened, and endangered species.
- Enhancement of outdoor recreational opportunities.
- Maintenance of scenic vistas and landscape beauty.

The functions of primary environmental corridors, and the resource elements contained therein, make the intrusion of urban development into the corridors environmentally inappropriate. The incompatibility of urban development and corridor lands may also cause serious and costly problems, such as failing foundations of pavements and structures, wet basements, excessive operation of sump pumps, excessive clear-water infiltration into sanitary sewer systems, and poor drainage. In addition, the destruction of ground cover in the corridors may result in soil erosion; stream siltation; more rapid, higher volumes of storm-

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[1] *See SEWRPC Planning Report No. 7, Land Use-Transportation Study, Volume 1, Inventory Findings: 1963, May 1965; Volume 2, Forecasts and Alternative Plans: 1990, June 1966; and Volume 3, Recommended Regional Land Use and Transportation Plans: 1990, November 1966; SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin—2000, Volume 1, Inventory Findings, April 1975; and Volume 2, Alternative and Recommended Plans, May 1978; and SEWRPC Planning Report No. 40, A Regional Land Use Plan for Southeastern Wisconsin—2010, January 1992.*

water runoff and increased flooding; as well as the destruction of wildlife habitat; loss of scenic beauty; and loss of rare, threatened, and endangered species habitat.

In 1985, primary environmental corridors encompassed about 468 square miles, or about 17 percent, of the total area of the Region.[2] Surface water comprised about 71 square miles, or about 15 percent of the total primary environmental corridor area; wetlands comprised about 210 square miles, or about 45 percent; woodlands comprised about 118 square miles, or about 25 percent; and other open lands comprised about 56 square miles, or about 12 percent. About 13 square miles, or about 3 percent of the total primary environmental corridor area, consisted of small enclaves of urban land within the overall corridor configuration. The adopted regional land use plan recommends the unqualified preservation and protection of primary environmental corridors from urban development.

IMPLEMENTATION RECOMMENDATIONS

Toward the goal of preserving primary environmental corridors, the Commission has recommended the following implementation mechanisms: public land acquisition, land use zoning, plan refinement at the local and county level, and utility extension regulation. As of 1985, 350 square miles, or about 75 percent of primary environmental corridor area, had been substantially protected through public land use regulation or public ownership (see Table 1 and Map 1).

The most effective means available for protecting the primary environmental corridors is public acquisition. Public acquisition may involve the purchase or dedication in fee simple or the purchase or dedication of preservation easements.

As shown in Table 1, county and local governments have acquired 76 square miles of primary environmental corridor land for parks and open space, constituting about 16 percent of total primary environmental corridor area within the Region. This area purchased is exclusive of 71 square miles of surface water contained within the corridors.

Public land use regulation has accounted for the remaining 274 square miles of protected corridor areas, including the surface water areas noted above. These 274 square miles constitute 78 percent of the total protected corridor areas. Recognizing that different types of resources are contained in environmental corridors, the Commission recommends that counties and local governments adopt two types of zoning districts: lowland conservancy and upland conservancy.

Lowland conservancy districts are intended to be applied to those portions of environmental corridors that contain lakes, rivers and streams, wetlands, undeveloped floodlands, and lowland wildlife habitat areas. The recommended district regulations seek to maintain these lowland areas in essentially natural, open uses. All urban development and all filling activities are recommended to be excluded from lowland conservancy districts.

The upland conservancy districts are intended to be applied to those portions of the corridors that contain upland woodlands, prairies, critical species habitat, steep slopes, and upland wildlife habitat areas. While the recommended district regulations seek to preserve these upland areas in essentially natural, open uses, the plan recommendations permit residential development in the upland areas at a density not to exceed one housing unit per five acres of corridor land.

The plan refinement process, most notably in the form of sanitary sewer service area plans, is a third means of achieving protection of the environmental corridors. Sanitary sewer service area plans identify the outer boundaries of planned sewer service areas, and within those boundaries the location of the environmental corridors. If development in the environmental corridors may be expected to adversely affect water quality, then extension of sewer service into the corridor areas is to be prohibited.

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[2] *The planned primary environmental corridor area contained in the design year 2010 regional land use plan totals about 474 square miles. The additional six square miles would come about over time by the natural reversion to wetlands of currently farmed floodlands at the margins of existing corridor lands.*

Table 1

PROTECTION OF PRIMARY ENVIRONMENTAL CORRIDORS IN THE REGION BY COUNTY: 1985

County	Primary Environmental Corridors Protected										Primary Environmental Corridors Not Protected		Total Primary Environmental Corridors	
	Public Park and Open Space Land		Additional Areas Protected through Land Use Regulation[a]						Subtotal					
			Surface Water		Wetlands Protected by Floodplain Zoning, Shoreland-Wetland Zoning, and Federal Wetland Regulations		Upland Areas Protected by State Administrative Rules Governing Sewer Extensions[b]							
	Square Miles	Percent	Square Miles	Percent	Square Miles	Percent	Square Miles	Percent	Square Miles	Percent	Square Miles	Percent	Square Miles	Percent
Kenosha	9.8	21.9	7.1	15.9	15.6	34.9	1.7	3.8	34.2	76.5	10.5	23.5	44.7	100.0
Milwaukee	9.0	58.8	1.6	10.5	0.8	5.2	1.5	9.8	12.9	84.3	2.4	15.7	15.3	100.0
Ozaukee	3.1	10.0	2.5	8.1	15.2	49.0	2.0	6.5	22.8	73.6	8.2	26.4	31.0	100.0
Racine	5.5	14.9	7.2	19.5	11.2	30.4	2.0	5.4	25.9	70.2	11.0	29.8	36.9	100.0
Walworth	12.5	12.3	21.3	20.9	27.7	27.2	5.8	5.7	67.3	66.1	34.6	33.9	101.9	100.0
Washington	12.5	13.3	6.2	6.6	46.5	49.4	2.4	2.5	67.6	71.8	26.6	28.2	94.2	100.0
Waukesha	23.6	16.4	25.4	17.6	59.5	41.3	10.3	7.1	118.8	82.4	25.3	17.6	144.1	100.0
Region	76.0	16.2	71.3	15.2	176.5	37.7	25.7	5.5	349.5	74.6	118.6	25.4	468.1	100.0

[a]*Excludes lands within public park and open space sites.*

[b]*The protection of upland corridors within planned sewer service areas is limited, as the statutory basis for State objection to urban encroachment into these corridors relates only to potential adverse water quality impacts.*

Source: SEWRPC.

Protection of the environmental corridors is also recommended to be promoted through the regulation of onsite sewage disposal systems. The land use plan recommends that local governments adopt ordinances to ensure that onsite sewage disposal systems are not located in areas poorly suited for the proper application of such systems. Recent State oversight of private sewage disposal systems, however, has worked against this recommendation. This issue is addressed in the following section.

The objective of protecting and preserving primary environmental corridors can be pursued in other ways as well. Through project-area planning efforts undertaken by the Department of Natural Resources, environmentally significant lands associated with major park and forestry projects can be identified for possible public acquisition. Through the use of exactions, local governments can receive dedication of corridor lands when development occurs. Such dedications often significantly enhance the quality and value of proposed land use developments. Finally, the acquisition of corridor lands by private conservation organizations can serve to protect and preserve the corridors.

IMPLEMENTATION STATUS

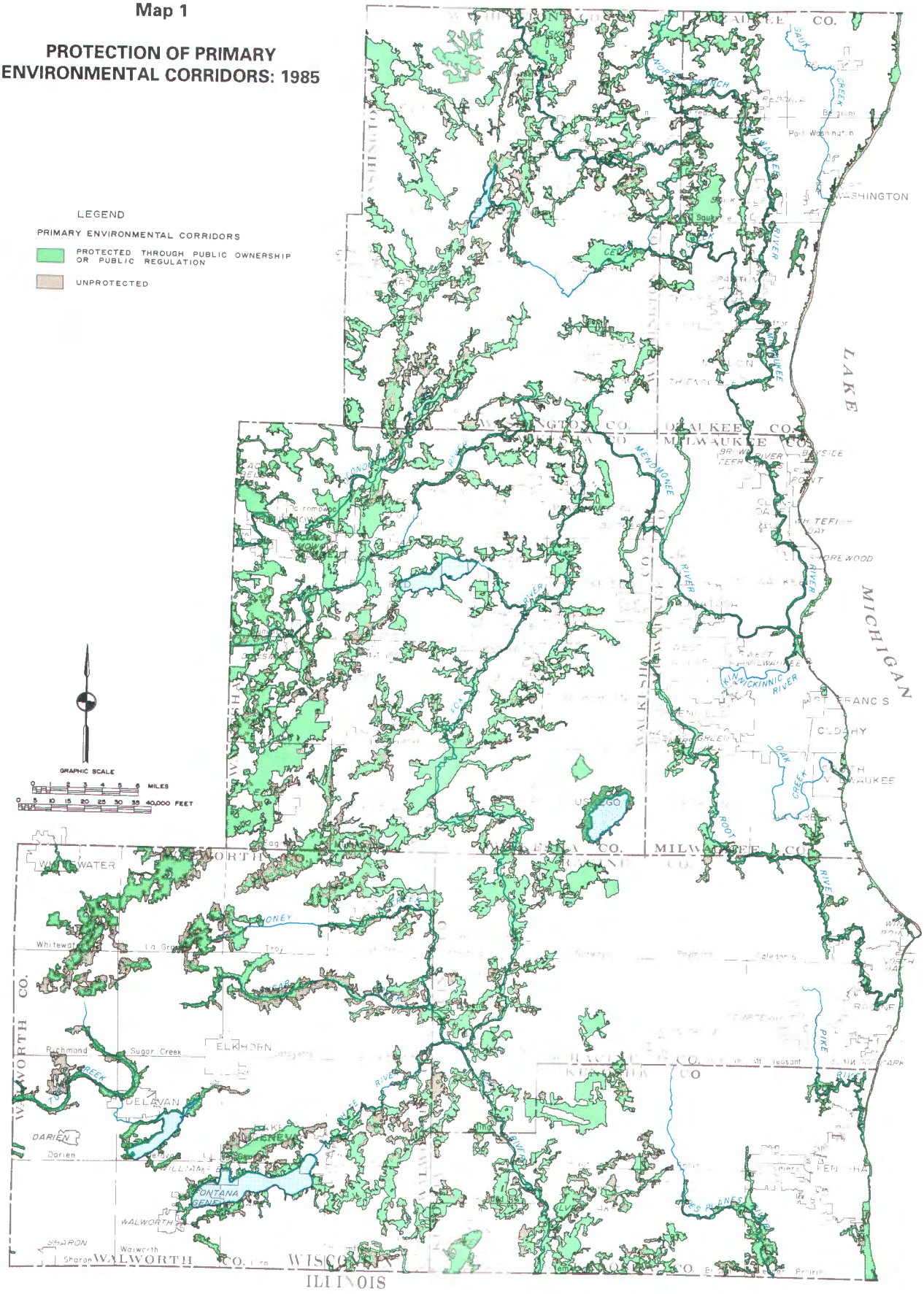
Although the preservation of primary environmental corridors has long been a central objective of the regional land use plan, full implementation has not been achieved. The combined effects of inappropriate local zoning, State and Federal regulations that protect only certain portions of corridor lands, and inadequate State regulation of onsite sewage disposal facilities threaten the integrity of the primary environmental corridors.

While State and Federal regulations have been generally effective in preserving lowland corridors, upland corridor areas generally remain open to urban development. The State and Federal regulations protecting lowland areas include: Chapter NR 121 of the Wisconsin Administrative Code, which protects wetlands, floodplains, surface waters and areas of steep slopes adjacent to wetlands, and surface waters within planned sanitary sewer service areas; Chapters NR 115 and 117, which protect most wetlands within shoreland areas; Chapter NR 103, which recognizes the need to protect the water quality-related functions of wetlands in State-level decision making; and the U. S. Army Corps of Engineers' Section 10 and Section 404 permit programs, which provide for the protection of a variety of wetland and surface water resources.

Protection of upland areas of primary environmental corridors has proven less comprehensive, as well as less effective, than protection of lowland areas. Protective measures for upland corridor areas are embodied in sanitary sewer service area plans and in the sewer extension permit process, but the effectiveness of these measures is limited.

Map 1

PROTECTION OF PRIMARY ENVIRONMENTAL CORRIDORS: 1985



Many important actions have been taken by the concerned agencies and units of government in accordance with the adopted regional land use plan to ensure the preservation of the primary environmental corridors in the Region. By 1985, about 350 square miles, or about 75 percent of all primary environmental corridor lands in the Region, were fully or partially protected through public ownership, State/local shoreland-wetland zoning and floodplain zoning, Federal wetland regulations, and State utility extension policies.

Source: SEWRPC.

Table 2

PRIMARY ENVIRONMENTAL CORRIDORS IN THE REGION BY COUNTY: 1963, 1970, AND 1985

County	Primary Environmental Corridors											
	1963		1970[a]		1985		Change 1963-1970		Change 1970-1985		Change 1963-1985	
	Acres	Percent of Region	Acres	Percent of Region	Acres	Percent of Region	Acres	Percent	Acres	Percent	Acres	Percent
Kenosha	30,050	9.8	29,617	9.7	28,597	9.5	-433	-1.4	-1,020	-3.4	-1,453	-4.8
Milwaukee	9,805	3.2	9,752	3.2	9,780	3.3	-53	-0.5	28	0.3	-25	-0.3
Ozaukee	19,940	6.5	19,817	6.5	19,859	6.6	-123	-0.6	42	0.2	-81	-0.4
Racine	24,739	8.1	24,174	8.0	23,588	7.9	-565	-2.3	-586	-2.4	-1,151	-4.7
Walworth	67,693	22.2	67,260	22.1	65,228	21.8	-433	-0.6	-2,032	-3.0	-2,465	-3.6
Washington	59,945	19.6	59,985	19.7	60,284	20.1	40	0.1	299	0.5	339	0.6
Waukesha	93,655	30.6	93,809	30.8	92,223	30.8	154	0.2	-1,586	-1.7	-1,432	-1.5
Region	305,827	100.0	304,414	100.0	299,559	100.0	-1,413	-0.5	-4,855	-1.6	-6,268	-2.0

[a]*Estimated.*

Source: SEWRPC.

Only those upland areas located within sewer service boundaries, the development of which would have significant negative impacts on water quality, are protected from destruction through the intrusion of urban development.

Additionally, State policies regulating onsite sewage disposal systems have not served to protect upland corridors. Rather than protecting upland corridors, these policies in recent years have encouraged urban development within the corridors. Two State actions have fostered this situation: the development of the mound system for onsite sewage disposal;[3] and the requirement that county and local regulation of onsite sewage disposal systems not be more restrictive than the State regulations. These two developments have worked to ensure that onsite waste disposal regulation does not constrain urban sprawl into rural lands, including environmental corridor lands.

According to preliminary estimates, upland areas of primary environmental corridors, declining as a percentage of total corridor land, are being lost within the Southeastern Wisconsin Region at a rate of about 1.1 square miles per year. Of this yearly loss in upland areas, 0.9 square mile is due to subdivision development using onsite sewage disposal. Indeed, 12 percent of all development in the Region is occurring in upland areas of the environmental corridors, about twice the rate as elsewhere. The general conversion of rural land to urban use is occurring at a rate of 10 square miles per year, and because at least 25 percent of primary environmental corridors currently remain unprotected, additional upland losses are likely. Table 2 documents the change in the amount of primary environmental corridor lands in the Region since corridor delineations were first recorded in 1963.

PURPOSE OF STUDY DESIGN

The purpose of this document is to establish a preliminary design for a study that will assess the potential impacts resulting from the conversion of upland environmental corridor areas to urban land uses. To this end, the study design will:

1. Assess and document the need for a study that analyzes the potential environmental impacts of the development for urban use of upland areas of the primary environmental corridors, secondary environmental corridors, and isolated natural resource areas in Southeastern Wisconsin.

2. Specify the scope and content of the required study.

3. Recommend a time schedule for the study.

4. Recommend a cost-effective means for organizing and accomplishing the study.

5. Provide sufficient cost data to permit the development of an initial budget and to suggest possible sources of funding for the study.

[3]*An alternative onsite sewage disposal system that involves the construction of an engineered soil absorption waste disposal system on the surface of the ground. The system was developed by the State of Wisconsin through the University of Wisconsin.*

Chapter II

NEED FOR AND PURPOSE OF THE STUDY

Twelve percent of all development in the Region is occurring in upland areas of primary environmental corridors. Preliminary estimates suggest that upland corridor areas are being lost at a rate of about 1.1 square miles per year. Upland area, as a percentage of total corridor land, is declining, increasingly threatening the balance between the individual resource elements that comprise environmental corridors. The study described in this document is needed, first and foremost, to document the quantitative extent and geographic location of this loss and to determine the effect of this loss on the remaining corridor lands and on the functions which these corridors perform.

The loss of upland areas of primary environmental corridors will continue if current levels of protection persist. Protective zoning and public and private acquisition activities are not adequate, and State regulatory oversight is insufficient to protect upland corridor areas. Thus, woodlands, wildlife habitat, prairies, critical species habitat, groundwater recharge areas, and other open lands will continue to be converted to urban development and to agricultural uses. The greatest losses throughout the Region will continue to occur in those upland areas with the greatest development potential. Therefore, the proposed study is also needed to forecast and determine the future geographic location of these losses so that potential environmental impacts can be evaluated.

Current information concerning the impacts of the loss of upland areas is based primarily on sound principles regarding the role that such lands play in ensuring environmental health. These principles are widely accepted by the scientific community, and are illustrated in isolated cases when detailed, site-specific impact investigations are required. To date, however, the regional environmental impacts of the loss of upland corridor areas have not been estimated. The study is needed to demonstrate the potential adverse environmental impacts associated with the continued loss of upland corridor areas, and to estimate the impacts on the biological diversity, water resources, and potential park sites of the Region.

Primary environmental corridors are essentially linear compositions of interdependent ecosystems, and because primary environmental corridors contain most of the Region's ecologically significant woodlands, wetlands, prairies, critical species habitat, and surface waters, they support a biological diversity unique to Southeastern Wisconsin. The intrusion of urban development into the upland areas of corridors destroys natural pathways and habitat areas essential to the migratory, reproductive, and territorial needs of diverse wildlife and plant communities. For economic, scientific, aesthetic, and ethical reasons, the study is needed to estimate the impacts of development of the upland areas on the biological diversity of the Region.

Primary environmental corridors contain significant groundwater recharge and discharge areas, and are important to the maintenance of surface-water and groundwater quality and quantity. Upland woodlands, in particular, may contribute significantly to groundwater recharge, and thus to the maintenance of water tables and streamflows and lake levels. Upland woodlands are also vital to the reduction of soil erosion and stream sedimentation, and thus to the maintenance of abundant aquatic life in the streams and lakes of Southeastern Wisconsin. The study is needed to estimate the impacts of development of the upland corridor areas on areawide surface-water and groundwater quality and quantity.

Secondary environmental corridors are also essentially linear compositions of interdependent ecosystems. They are similar to the primary environmental corridors in terms of the resource features contained within them, but are not as significant with respect to their overall resource values due largely to their smaller size. Secondary corridors, however, often provide economical drainageways, as well as needed "green" space, particularly in the urbanizing areas of the Region.

Isolated natural resource areas generally consist of those natural resource base elements that have "inherent natural" value, such as wetlands, wood-

lands, wildlife habitat areas, and surface-water areas, but that are separated physically from the primary and secondary environmental corridors by intensive urban or agricultural land uses. An isolated natural resource area must be at least five acres in size.

Because the environmental impacts of developing upland corridors on an areawide basis have not been estimated, the potential significance of these impacts to the Region is unknown. Such impacts may affect future public investment decisions, the public health, or the enjoyment of public park and recreational lands. Such impacts may also contribute to the potential extinction of plant and animal species, and may make conformance with Federal and State environmental standards costly and difficult, if not impossible, to maintain. The loss of upland corridor areas, if left unchecked, may result in irreparable damage to the ability of corridor lands to sustain and support certain types of animal and plant life, and to enhance the lives of the residents of the Region. The study is needed, therefore, to assess the significance to the Region of the development of upland areas.

Accordingly, the upland environmental corridor study has been designed to:

1. Document the loss of upland primary and secondary environmental corridor areas, as well as of isolated natural resource areas, since 1963.

2. Estimate the probable future loss of upland primary and secondary environmental corridor and isolated natural resource areas, assuming current levels of protection and preservation persist.

3. Estimate the impacts of the loss of upland primary and secondary environmental corridor and isolated natural resource areas on biological diversity.

4. Assess the significance to the Region of the impacts associated with the loss of upland primary and secondary environmental corridor and isolated natural resource areas.

In 1992, the Wisconsin Department of Natural Resources formed an internal staff committee to review the potential impacts of the loss of primary environmental corridor lands. The study should generate information that will assist this committee in determining the potential impacts of, and in recommending means to prevent, future losses of upland areas.

The adopted regional land use plan calls on governmental units and agencies to apply appropriate means to protect and preserve the primary environmental corridors in essentially natural, open uses. The application of such means has not been fully realized and has not been fully effective in protecting the upland areas. The study should essentially be directed at providing information necessary to encourage the governmental units and agencies concerned to formulate and employ effective means of protecting and preserving the upland areas of primary environmental corridors in particular.

Chapter III

MAJOR ELEMENTS OF THE STUDY

INTRODUCTION

The needed upland environmental corridor protection study should consist of: a detailed study design; an assembly of pertinent data; the forecasting and analyses necessary to demonstrate the potential environmental impacts of the loss of upland environmental corridor areas; and the formulation of recommendations to abate the future potential losses of the upland portions of the environmental corridors and isolated natural resource areas. The collection and analysis of data should be confined to the upland portions of primary and secondary environmental corridors and isolated natural resource areas and, as may be necessary, to lands and waters immediately adjacent to these areas. All data shall be disaggregated to the county level in order to relate findings to jurisdictional systems, and to major watersheds in order to relate findings to water resource management plans.

STUDY DESIGN

The work required to complete the needed study should be carried out in accordance with this preliminary study design, and a subsequently prepared detailed study design. The detailed study design is intended to ensure that sound planning techniques are employed and resources are used in the most efficient manner. The work description set forth herein is detailed sufficiently to permit the development of initial cost estimates for budgetary purposes; to establish a practical time sequence and work schedule; and to develop an organizational structure for the completion of the study.

It is recommended that the detailed study design take the form of memoranda setting forth the methods and procedures proposed to be followed in accomplishing the data inventories, forecasting, and analyses. The memoranda should specify the steps involved in collecting and analyzing appropriate data; the manner in which the data are to be compiled, displayed, and analyzed; and forecast requirements and techniques. In addition, the staff memoranda should set forth the criteria to be used in determining the environmental impacts of the development of upland environmental corridor areas.

The memoranda should also specify the resources and time needed for the completion of each operation, and should detail the end products of each task. As each memorandum is completed and approved, it should serve as a working guide for directing and assessing program progress.

DEFINITIONS

The definitions below should be used in order to maintain consistency between this work effort and previous work efforts.

1. Archaeological Sites
   Archaeological sites are herein defined as those tracts of land, streambeds, or lake bottoms that include objects or other evidence of archaeological interest at least 100 years of age, aboriginal mounds and earthworks, ancient burial grounds and human skeletal remains, and prehistoric and historic ruins.[1,2]

2. Critical Species
   Critical species are herein defined as those animals and plants considered by the Federal or State governments to be rare, threatened, or endangered, or to have significantly declining or unstable populations.

3. Critical Species Habitats
   Critical species habitats are herein defined as those tracts of land or water which support Federally or State-designated rare, threatened, and/or endangered plant or animal species. These habitats contain all of the

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[1] *National Historic Preservation Act of 1966, as amended, 16 U. S. C., Section 470bb.*

[2] *Wisconsin Statutes, Section 44.47(1)(b).*

abiotic and biotic factors necessary for the long-term support of the critical species population.

4. Ecosystem
An ecosystem is herein defined as the sum total of all organisms of a locality and their interactions with both the abiotic and biotic elements of the environment.

5. Extirpated Species
An extirpated species is herein defined as any species that has disappeared from the State as a breeding species, although it may still be present in other States. Animals and plants designated as extirpated have been lost to Wisconsin's breeding population since 1800.

6. Federally Designated Endangered Species
A Federally designated endangered species is herein defined as any species or subspecies designated by the U. S. Congress which is likely within the foreseeable future to become endangered throughout all or a significant portion of its range.

7. Gene Pool
A gene pool is herein defined as the total of all the genetic material of all the organisms within a designated population.

8. Geological Sites
Geological sites are herein defined as those tracts of land that include specific glacial features such as eskers and kames, fossil beds, and rock outcrop and exposed bedrock sites of scientific and educational value. Such sites may also support specific plant communities, such as dry prairie remnants or oak openings at eskers and kames.

9. Isolated Natural Resource Areas
Isolated natural resource areas are herein defined as pockets of natural resource base elements that have been separated from environmental corridors by urban development or agricultural use. These areas must be at least five acres in size and contain natural elements that total at least 10 cumulative points and meet other criteria as set forth in the environmental corridor delineation refinement process.[3]

10. Natural Areas
Natural areas are herein defined as those tracts of land or water so little modified by human activity, or which have sufficiently recovered from the effects of such activity, that they contain intact native plant and animal communities believed to be representative of the pre-European-settlement landscape. Natural area sites may be ranked according to several factors, including diversity of plant and animal species and community types present; the structure and integrity of the native plant or animal community; the extent of disturbance from human activity, such as logging, grazing, water level changes, and pollution; the commonness of the plant and animal communities present; the size of the area; any unique natural features within the area; and the educational and scientific value of the area.

11. Plant Community
A plant community is herein defined as repeating plant groups in which a particular association of plants occurs, usually described by referring to the most characteristic species or moisture conditions. Examples include "beech-maple forest," "sedge meadow," and "dry-mesic prairie."

12. Prairies
Prairies are herein defined as open, generally treeless areas which are dominated by native grasses. There are three general types of prairies within the Southeastern Wisconsin Region—wet prairies, mesic prairies, and dry prairies. The types correspond to soil moisture conditions. In addition, it is important to note that oak openings, which are savannas—that is, parklike areas dominated by dry prairie grasses and forbs but having between one and 17 oak trees, usually bur oaks, per acre—are included in prairie inventories. Upland corridor areas which

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[3]*Bruce P. Rubin and Gerald H. Emmerich, Jr., "Refining the Delineation of Environmental Corridors in Southeastern Wisconsin," SEWRPC Technical Record*, Vol. 4, No. 2, March 1981, pp. 1-21.

contain prairies include the mesic and dry prairies and oak openings. Wet prairies are a wetland type and as such are included in lowland corridor areas.

13. Pre-Settlement Vegetation
Pre-settlement vegetation is herein defined as the characteristic vegetation of a region of the New World prior to settlement by Europeans.

14. Primary Environmental Corridors
Environmental corridors are herein defined as linear areas in the landscape containing concentrations of the most important individual elements of the natural resource base of Southeastern Wisconsin. Almost all of the remaining high-value wetlands, woodlands, prairies, critical species habitat areas, wildlife habitat areas, major bodies of surface water, and delineated floodlands and shorelands are contained within these corridors. Of these elements, woodlands, prairies, critical species habitat areas, wildlife habitat areas, and steep slopes comprise the upland areas of the corridors. Primary environmental corridors must be at least two miles long, 200 feet wide, and cover an area of at least 400 acres. The natural elements within primary environmental corridors must total at least 10 cumulative points and meet other criteria as set forth in the corridor delineation refinement process.[4]

15. Protective Zoning
As defined herein, protective zoning is deemed to cover an upland area of an environmental corridor or an isolated natural resource area that is zoned in a conservancy district; zoned at a residential density of one dwelling unit per five acres or more of land; or zoned as a park and recreation district.

16. Rare Species
Rare species are herein defined as those native animal or plant species which infrequently occur as individuals or in specific communities on the natural landscape.

17. Secondary Environmental Corridors
Secondary environmental corridors are herein defined as corridors which contain a variety of natural resource elements, often being remnants of primary environmental corridors. Secondary environmental corridors must be at least one mile in length and 100 acres in area. The natural elements within these corridors must total at least 10 cumulative points and meet other criteria as set forth in the corridor delineation refinement process.[5]

18. State-Designated Endangered Species
State-designated endangered species are herein defined to include any species native to the State of Wisconsin whose continued existence as a viable component of the State's wild animals or wild plants is determined by the Wisconsin Department of Natural Resources to be in jeopardy on the basis of scientific evidence.[6]

19. State-Designated Threatened Species
State-designated threatened species are herein defined to include any species of wild animals or wild plants native to the State of Wisconsin which appear likely, within the foreseeable future and on the basis of scientific evidence, to become endangered.[7]

20. Steep Slopes
Steep slopes are herein defined as slopes of 12 percent or greater. Such slopes are generally unsuitable for all types of urban development as well as for most types of agricultural uses, and development of such slopes can have adverse water quality impacts.

21. Watch Species
A watch species is herein defined as any native species within the State of Wisconsin about which some problem of abundance or distribution is suspected, but not yet proved. This designation is an informational,

[4] *Ibid.*

[5] *Ibid.*

[6] *Wisconsin Statutes, Section 29.415(2)(a).*

[7] *Wisconsin Statutes, Section 29.415(2)(b).*

nonlegal category designed to focus attention on certain species before they become endangered or threatened.

22. Wildlife Habitat Areas
Wildlife habitat areas are herein defined as areas which are devoted to natural open uses and which have a vegetative cover and structure, as well as a size, sufficient to render them capable of supporting a high and balanced diversity of wildlife. Such areas generally have vegetative cover and structure which support nesting and denning opportunities, and which provide travel routes, food sources, concealment, and weather impact modification for a variety of wildlife species.

Wildlife habitat areas are rated as being Class I, II, or III. Class I habitat areas are of a high quality and contain a wide diversity of wildlife; are adequate in size and structure to meet all of the habitat requirements of the species concerned, including territorial and vegetative composition and structure requirements; and are generally located in proximity to other wildlife habitat areas. Class II habitat areas generally lack one of the three aforementioned criteria for a Class I wildlife habitat area; however, Class II habitat areas do support good plant and animal diversity. Class III habitat areas are remnant in nature in that they generally lack two or more of the aforementioned criteria for Class I wildlife habitat areas, but may nevertheless be important if they are located close to Class I or II wildlife habitat areas, if they provide corridors linking higher-value wildlife habitat areas, or if they provide the only available range in the area.

23. Woodlands
Woodlands are herein defined as those upland areas one acre or more in size having 17 or more deciduous trees per acre, each measuring at least four inches in diameter at breast height, and having at least a 50 percent canopy cover. Coniferous tree plantations and reforestation project areas are also defined as woodlands.

INVENTORY

Inventory is the first operational step of the upland environmental corridor protection study. It includes both the collating of existing information and the gathering of new information by direct measurement. Much of the necessary inventory data are available in the Southeastern Wisconsin Regional Planning Commission data bank. Those data that are not available in the Commission files will have to be collated from other sources, or otherwise collected. Where possible, inventories requiring graphic presentation should be compiled using a geographic information system. Converting graphic data inventories to a computer-compatible format will increase the options available when analyzing and presenting material.

The following inventory elements are to be incorporated into the study:

1. Maps
Essential to understanding the actual or potential impacts of the loss of environmental corridor lands is a knowledge of topographic and cultural features of the Region. Such knowledge can best be derived from topographic and cadastral maps of the required scale and accuracy. Definitive information will be required on such natural features as relief; watershed boundaries; and the location of streams, lakes, and wetlands; and on such built features as real-property lines, highways, railways, and principal buildings.

   a. General Base Maps
   General base maps of the Region are required to provide a medium for recording and presenting in graphic form the results of the study. Regional base maps have been prepared by the Commission and are available for use in the study. These maps can be used to portray the Region, and subareas thereof, at three scales: 1:24000, 1:48000, and 1:96000. These maps can be expanded or reduced in scale for use in various phases of the study, and show, among other information, all major lakes, streams, and watercourse lines; all railways, streets, and highways; all U. S. Public Land Survey township, range, and section lines; all civil division lines; and relief by contours having a 10-foot vertical interval. The maps have been compiled to National Map Accuracy Standards utilizing the Wisconsin State Plane Coordinate grid, South Zone, as the map projection.

b. Large-Scale Topographic Maps
Large-scale, one-inch-equals-200-feet, topographic maps, based upon a monumented system of horizontal and vertical control which combines the U. S. Public Land Survey and State Plane Coordinate Systems and permits the accurate correlation of topographic data, are available for about 54 percent of the Region. These maps, prepared by the Regional Planning Commission or by constituent counties and municipalities to Commission-recommended specifications, show relief by contours having a vertical interval of two feet. These maps are available for use in the study.

c. Aerial Photographs
Current and historical aerial photographs at appropriate scales will be required to provide detailed planimetric data. Aerial photography of the entire Region was obtained by the Commission in April 1963 and 1967, and at five-year intervals from 1970 through 1990. These photographs will be available for use in the study at one-inch-equals-400-feet and one-inch-equals-2,000-feet ratioed and rectified scales.

2. Land Use Data
The loss of upland areas of environmental corridors and isolated natural resource areas results from land use changes. Accordingly, an inventory which identifies the historical changes in land use is required for the study. Such an inventory must reveal the historical and existing amounts, types, intensities, and spatial distributions of land use. The Commission has, since 1963, prepared data on land use within the Region. Data are available in mapped and tabular form for the years 1963 and 1967, and at five-year intervals from 1970 through 1990. These data are available for use in the study.

3. Population and Economic Activity Data
It will be necessary to inventory the socio-economic factors which contribute to the conversion of environmental corridors and isolated natural resource areas to urban development. Such an inventory must identify trends in population and in economic activity levels, and seek correlations of these trends with land use changes. Demographic and economic activity studies of the Region have been completed by the Commission, and are available for use in the study.

4. Climatic Data
Climate, especially extreme variations in three principal elements of climate—temperature, precipitation, and snow cover—directly affects the Region's biota. Rainfall and temperature affect the active growing season for native plants, which, in turn, affects the distribution, type, and quality of habitat for the Region's wildlife. Snow cover, in terms of both depth and duration, also affects the overwintering success of much of the Region's wildlife. The temperature and precipitation characteristics of the Region, particularly as they relate to short-term and long-term trends, should be evaluated with respect to the growing season of the Region's flora. In addition, snow cover, depth and duration, should be evaluated, summarized, and correlated to those wildlife species and their populations that are affected by cover conditions in terms of predation, modification of weather impacts, and exposure to winter food sources. All of the climatic data should be viewed in terms of their impact on data analysis relative to species composition and population trends within the major habitat categories selected for study.

5. Environmental Corridor- and Isolated Natural Resource Area-Associated Data
Data on the primary and secondary environmental corridors and isolated natural resource areas in the Region and their resource features are required. The location and extent of the environmental corridors within the Region has been determined by the Commission in the base years 1963, 1967, 1970, 1975, 1980, 1985, and 1990. The data, including calculation of the changes in the extent of corridor land, are available for use in the study.

Also required for the study are the delineations, on aerial photographs at a one-inch-equals-400-feet scale, of the natural resource base and natural resource base-related elements. The cumulative point values for these elements, as calculated in the Commission corridor refinement process, are also required. Table 3 lists the elements and

the point values that correspond to each element. A knowledge of the process used by the Commission in refining the environmental corridors is required for the execution of elements of the study. The Commission's wetland delineations are consistent with the Wisconsin Department of Natural Resources wetland inventory maps.

Also required for the study are the design year 2010 regional land use plan and related plan maps which incorporate the delineations of primary and secondary environmental corridors and isolated natural resource areas and the delineations within these lands of wetlands and upland resource areas. This information is available in computer-compatible format, can be mapped at appropriate scales, and is available from the Commission for use in the study.

6. Upland Habitat Areas Data
   A separate set of data on wildlife habitats and critical species habitats of the upland corridor areas is required. This data set should include: delineations of each class of wildlife habitat; delineations of the three major upland habitat categories—woodlands, shrub communities, and grasslands; and delineations of upland habitat subcategories—the major habitat only, the major habitat directly associated with riverine and/or lake habitats, and the major habitat directly associated with multiple upland and lowland habitats. The Commission and the Wisconsin Department of Natural Resources have jointly prepared these delineations on one-inch-equals-400-feet-scale aerial photographs. These delineations include the identification of individual plant communities, and are available for use in the study.

7. Sanitary Sewer Service Area Plans Data
   An inventory of existing and planned sanitary sewer service areas is required to determine the portions of environmental corridors that are located within sewer service areas. This inventory should identify the parts of the planned sewer service areas which have locally adopted sewer service plans including recommendations for environmental corridor preservation. This information is available in the Commission files, in mapped form, for use in the study.

8. Surface Water Quality Data
   An inventory of existing surface water use objectives and pollutant loadings by watershed is necessary to consider potential water quality impacts related to upland corridor development. The appropriate data can be collated from previous work programs completed by the Commission and the Wisconsin Department of Natural Resources.

9. Potential Parks Inventory Data
   Data on the location and extent of existing, planned, and potential park sites are required. Such data are available from the Commission files for use in the study.

10. Data on Ownership of Upland Environmental Corridor and Isolated Natural Resource Areas
    The ownership of upland environmental corridor and isolated natural resource areas may determine the likelihood of corridor conversion to urban development, and thus should itself be determined. The amount of upland primary and secondary environmental corridor and isolated natural resource area land held both publicly and privately should be quantified by county and by watershed area, and graphically displayed for further analysis.

11. Data on Zoning of Upland Environmental Corridor and Isolated Natural Resource Areas
    The zoning classification of upland corridor areas may determine the likelihood of their conversion to urban development. Accordingly, the amount of upland environmental corridor and isolated natural resource area land in each zoning district should be quantified and graphically displayed for each county and for each watershed. These data are available from the Commission files.

FORECASTS AND ANALYSES

Inventories are required to provide factual information about historical and present conditions regarding upland areas. Forecasts and analyses are necessary to provide estimates of probable future losses of these areas and estimates of the likely impacts of those losses. The major forecast and analysis steps described below build upon each other, beginning with an identification

Table 3

NATURAL RESOURCE BASE AND NATURAL RESOURCE BASE-RELATED ELEMENTS AND THEIR POINT VALUES

Natural Resource Base or Related Element	Point Value
Natural Resource Base	
Lake	
Major (50 acres or more)	20
Minor (five to 49 acres)	20
River or Stream (perennial)	10
Shoreland	
Perennial (lake, river, or stream)	10
Intermittent Stream	5
100-Year Floodland	3
Wetland	10
Wet, Poorly Drained, and Organic Soils	-- [a]
Woodland	10
Wildlife Habitat	
Class I	10
Class II	7
Class III	5
Steep Slope	
20 Percent or More	7
12 Percent to 19 Percent	5
Prairie	10
Natural Resource Base-Related	
Existing Park or Other Open Space Site	
Rural Open Space Site	5
Other Park or Recreation Site	2
Potential Park Site	
High-Value	3
Medium-Value	2
Low-Value	1
Historic Site	
Structure	1
Other Cultural	1
Archaeological	2
Scenic Viewpoint (combined with area of steep slope)	5
Natural or Scientific Area	
State Scientific Area	15
Natural Area of Statewide or Greater Significance	15
Natural Area of Countywide or Regional Significance	10
Natural Area of Local Significance	5

[a] *Point values for wet, poorly drained, and organic soils were not assigned in the environmental corridor-refining process. The consideration of wet, poorly drained, and organic soils in the determination of environmental corridors is discussed in "Refining the Delineation of Environmental Corridors in Southeastern Wisconsin," SEWRPC Technical Record, Vol. 4, No. 2, March 1981.*

Source: SEWRPC.

of upland areas that have conditions favoring development, and ending with an assessment of the significance of major environmental impacts associated with such development.

At-Risk Upland Areas

The following steps constitute the recommended procedure for identifying those upland areas that are at risk of being lost to development:

1. The delineations of the corridors and natural areas, including the delineations of the upland resource areas within them, should be overlaid with zoning district maps to determine the zoning of the concerned uplands. The objective of this analytical step is to identify those uplands that are zoned for a protective use.

2. The delineations of the corridors and natural areas, including the delineations of the upland resource areas within them, should be overlaid with the public land ownership data to identify those uplands that are publicly owned.

3. The delineations of the corridors and natural areas, including the delineations of the upland resource areas within them, should be compared with the sanitary sewer service area plans to identify those uplands that are within sewer service area boundaries.

4. The delineations of the corridors and natural areas, including the delineations of the upland resource areas within them, should be overlaid with existing land use data to determine the land uses adjacent to the concerned uplands.

The four overlay analysis steps described above serve to identify those upland areas that are protected by zoning, protected by public ownership, contained within sewer service areas, and adjacent to existing urban development. These factors comprise the criteria for identifying upland areas at risk of being converted to urban development. Upland areas that are known to be private conservancy lands should be identified and excluded from the list of at-risk upland areas.

The following guidelines should be used to identify upland areas that are at risk of being lost to development, and the degree of such risk:

1. If the upland area is privately owned, and is not zoned for a protective use, it should be considered "at risk."

2. If the upland area is privately owned, is not zoned for a protective use, and is adjacent to existing urban development, it should be considered "at high risk."

3. If the upland area is privately owned, is not zoned for a protective use, and is within an adopted sewer service area boundary, it should be considered "at extreme high risk." This determination should be made only if it is clear that the development of the upland area will not cause direct and adverse water quality impacts.

As part of the detailed study design, criteria for identifying upland areas whose development would be likely to cause direct and significant negative water quality impacts should be established. State oversight protects such upland corridor areas if they are located within adopted public sewer service area boundaries. Consequently, those upland areas whose development would be likely to cause adverse water quality impacts and which are located within planned sanitary sewer service areas should be identified and excluded from the universe of at-risk upland areas, consistent with the third guideline listed above. The upland areas whose development would be likely to cause adverse water quality impacts and which are located outside of public sewer service area boundaries should also be identified. These areas, especially those determined to be at risk under either the first or second guidelines listed above, will be important in estimating site-specific impacts of urban development on water quality. The water quality criteria to be established should focus on slope, distance from surface-water systems, and type of connection to surface waters.

Finally, all information should be digitized, compiled, and presented in mapped and tabular form. A composite map should identify at-risk upland primary and secondary environmental corridors and isolated natural resource areas and their resource compositions, as well as upland areas whose development would be likely to cause adverse water quality impacts.

Threatened Environmental Corridors and Isolated Natural Resource Areas

The following guidelines should be used to identify those environmental corridors and isolated natural resource areas that are threatened due to the potential development of their "at-risk," "at-high-risk," or "at-extreme-high-risk" upland areas. In the guidelines below, the term "at-risk upland area" includes any upland area falling within any of the three risk categories described above.

An environmental corridor or isolated natural resource area should be identified as threatened:

1. If the potential loss of an at-risk upland area within the corridor or area would result in reducing the cumulative point value of the corridor or isolated natural resource area below the value of 10; or

2. If the potential loss of an at-risk upland area within the corridor or area would result in reducing the acreage of a primary environmental corridor to less than 400 acres, the length of the corridor to less than two miles, or the width of the corridor to less than 200 feet; the acreage of a secondary environmental corridor to less than 100 acres or the length of the corridor to less than one mile; or the acreage of an isolated natural resource area to less than five acres; or

3. If the potential loss of an at-risk upland area of a primary or secondary environmental corridor would result in a break in the continuity of the corridor resulting in two sections, each smaller than the area required to warrant continued classification as a primary or secondary environmental corridor as described in the foregoing paragraph.

The Loss of Upland Areas: Numerical Forecasting

The potential loss of upland areas should be forecast for each county and for each watershed area to an appropriate target year not to be more than 20 years into the future. The first step in forecasting the loss of the upland areas is to develop reasonable rates of expected loss within sewer service areas and outside of sewer service areas. It is recommended that these rates be based upon historical loss data, the documentation of which is required.

The documentation of historical loss requires overlaying two sets of mapped data in order to distinguish upland areas from lowland areas. The first set of mapped data contains delineations of all wetlands and other lowlands in the Region. This set of mapped data should be overlaid with the second set, which contains the delineations of all primary and secondary environmental corridor and isolated natural resource area land lost between 1963 and the latest inventory year for which data are available. Both sets of mapped data are available from the Commission for use in the study.

The study should assume that those lost areas not identified as wetlands or floodlands through this overlay procedure are lost upland areas. Measurements of the upland areas should be made, and an average annual rate of loss should be calculated over the period of record. It may be desirable to calculate the rate of loss by county and watershed. Using this rate or rates, losses should be forecast for the Region to the target year, with consideration being given to the amount of upland primary and secondary environmental corridor area and isolated natural resource area remaining. Consideration should also be given in the study to longer-term, potentially ultimate, losses in the amount of upland areas.

The Loss of Upland Areas: Forecasting Spatial Distribution

The losses of upland areas should also be forecasted spatially on positional-distribution overlay maps. These maps should display the U. S. Public Land Survey quarter sections that are located in areas with high historical rates of upland loss, and indicate upland areas identified as at-risk areas. A quarter-section data file designed to aid in the production of the positional-distribution overlay maps should be developed. To complete the data file, the total acreage of upland areas lost within each quarter section should be determined. This information can be derived from the overlay procedure described in the foregoing section. The acreage lost in each quarter section should be determined, and a historical rate of loss for each quarter section should be calculated.

Those quarter sections determined to have high rates of loss, and which contain at-risk upland areas, should be identified and mapped as potential loss areas. Those quarter sections

determined to have low rates of loss, regardless of whether they contain at-risk upland areas, should not be identified as potential loss areas. This analysis step identifies the location of the at-risk upland areas most likely to be developed, and is based on the assumption that quarter sections with a history of losing upland areas to development will lose the remaining upland areas meeting the criteria for being at risk. Two positional-distribution overlay maps should be prepared, the first displaying the historical loss, and the second displaying the forecast loss. Criteria for defining high and low rates of loss should be established as part of the detailed study design.

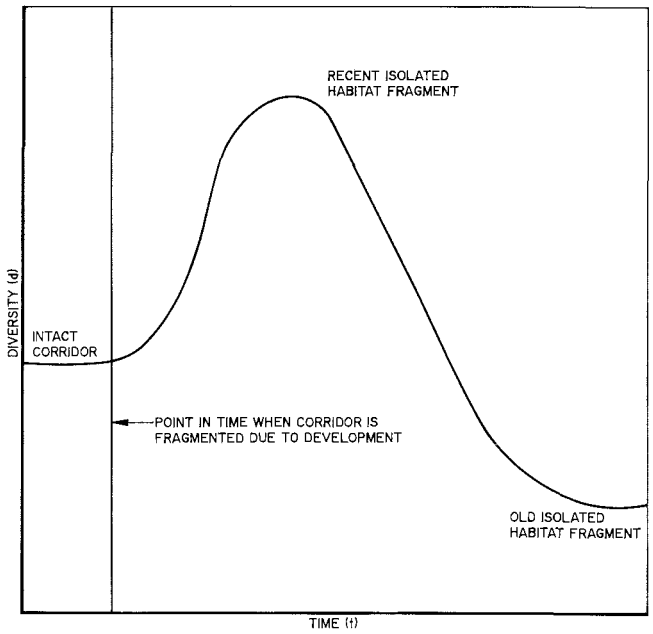
The Loss of Upland Areas:
Estimating the Impacts on Biological Diversity

Introduction: The purpose of this evaluation is to estimate the potential impacts on biological diversity that may result from the development of at-risk upland areas. In the context of the Region, biological diversity may be viewed at three levels: the variety of ecosystems, the most significant of which are generally located in the primary environmental corridors; the variety of species living within these ecosystems; and the number of individuals within each species.

The impacts of upland corridor and natural area development on the interrelationship among ecosystems should be determined in order to provide a measure of potential changes in biological diversity. Using ecological and related natural resource base theories, available site-specific case studies, and existing habitat inventory data, the ecological links between upland and lowland resource areas should be defined. Potential changes in the successional rate of individual ecosystems that result from upland corridor and natural area development should also be estimated. Mature ecosystems are balanced in the absorption and loss of energy, have long and complex food chains, and a variety of resident native organisms. Immature, or pioneer, ecosystems have high ratios of absorbed energy to lost energy, short food chains, short-term resident native organisms, and more open nutrient cycles. In general, the more diverse an ecosystem is, the more stable it is; thus, the greater its ability to preserve species diversity.

Figure 1

CONCEPTUAL CHANGES IN BIOLOGICAL DIVERSITY OVER TIME IN UPLAND AREAS FRAGMENTED BY URBAN DEVELOPMENT



Source: Reed F. Noss, 1983; Denis A. Saunders, Richard J. Hobbs, and Chris R. Margules, 1991; and SEWRPC.

Study Alternatives: Four alternative evaluation methods for estimating the impacts on biological diversity are outlined below. Each alternative essentially focuses on the ability of upland areas to sustain biological diversity over time subsequent to urban development. Figure 1 conceptually demonstrates the theory that the alternatives are designed to apply. The figure shows three stages in time along a curve representing the biological diversity of a given upland area before, during, and after habitat fragmentation. Immediately following urban development and the resulting fragmentation of an upland corridor, diversity in the remaining natural areas increases. This increase is the result of the attendant destruction of habitat and the migration of animals and plants, particularly forest-edge-related species, into the remaining habitat areas. Over time, because of such factors as competition, starvation, and other stresses, biological diversity in such areas is ultimately diminished.

Background Concepts: The alternative methods of estimating impacts on biological diversity, especially those methods requiring the collection

of additional field data, involve several variations in procedure. The procedural variations are discussed below.

Upland Habitat Categories: Upland areas in the Region consist of three major habitat categories: woodlands, shrub communities, and grasslands. Each major habitat category is divided into three habitat subcategories: the major habitat area only; the major habitat area directly associated with riverine and/or lake habitats; and the major habitat area directly associated with multiple upland and lowland habitats. Therefore, the planned conduct of fieldwork in each of the three major habitat categories implies that a woodland habitat, a shrub community habitat, and a grassland habitat would be examined. The planned conduct of fieldwork in all woodland habitat subcategories implies that a woodland habitat, woodlands with riverine and/or lake habitats, and woodlands with multiple upland and lowland habitats would be examined.

Upland Stages: The objective of each of the four alternative evaluation methods is to estimate the impacts on biological diversity that may result from urban use of the upland portions of environmental corridors and isolated natural resource areas in the Region. Because of the problems inherent in tracking the ecological conditions of upland areas over time, prior and subsequent to development, the alternatives are designed to estimate conditions in upland areas that represent three sequential stages:

Stage 1: The upland area is undeveloped and is a part of a primary or secondary environmental corridor;

Stage 2: The upland area is undeveloped, but has recently been isolated from a primary or secondary environmental corridor by urban development; and

Stage 3: The upland area is undeveloped, but has been isolated from a primary or secondary environmental corridor by urban development for some period of time.

Selection of Upland Sites: Sites should be selected that are compatible in size and in adjacent land uses, because the biological diversity within habitat areas can be influenced by these factors. To further ensure that selected sites are compatible, data on historical land uses in the prospective sites should be assembled, the succession of natural landscape covers over identified periods of time should be determined, and the occurrence of natural and human-induced changes to the landscape of the sites should be documented.

Estimates of Biological Diversity: For the purpose of the alternatives contained herein, estimates of biological diversity include the number of animal and plant species identified within an upland site, as well as the number of individuals identified within each species.

Upland Fieldwork: Fieldwork to estimate biological diversity should consist of three visits per selected site. The first site visits should include an identification of the prevalence of food sources, nesting areas, breeding grounds, and other relevant habitat support features. Subsequent site visits should determine the population sizes of specified species through the execution of the following data-collection activities: breeding and migratory bird surveys; capture, tagging, and recapture procedures for selected animal species, such as amphibian, reptile, and mammal species; and breeding-pond censuses, fish surveys, selected invertebrate surveys, and vegetation surveys. A collation and analysis of existing wildlife and plant data should precede the initial fieldwork activities.

Alternative 1: Alternative 1 would entail a review of all relevant literature, including literature on the theories of ecology, resource management, conservation biology, island biogeography, and biological diversity, as well as a review of existing wildlife and plant inventory data for the Region. The theoretical work should be matched with existing data, collected from the Region, to estimate the changes in biological diversity that may result from the potential urban development of upland areas. Specialists in the fields of ecology and resource management should also be consulted for their insights.

Alternative 2: Alternative 2 would consist of fieldwork in each of the three major habitat categories—woodland habitat, shrub community habitat, and grassland habitat—to estimate the biological diversity within these areas. The field-

Figure 2

MATRIX FOR ESTIMATING THE IMPACTS ON BIOLOGICAL DIVERSITY: ALTERNATIVE 2

Upland Habitat Type	Estimates of Biological Diversity		
	Corridor (acres)	Recently Isolated (acres)	Isolated for Significant Period (acres)
Woodland Only			
Shrub Community Only			
Grassland Only			

Source: SEWRPC.

work sites selected would be approximately equal in size, and representative of the three upland area development stages described above. Alternative 2 would require fieldwork at nine sites. For the purpose of costing this alternative, a total of 27 field surveillance exercises was assumed, requiring one growing season to complete. Figure 2 presents a matrix setting forth the methodology of Alternative 2. This alternative requires the participation and close collaboration of biologists and ecologists employed by relevant public and private institutions and agencies within the Region. Alternative 2, like Alternative 1, would also entail a review of all relevant literature, including literature on the theories of ecology, resource management, conservation biology, island biogeography, and biological diversity, as well as a review of existing wildlife and plant inventory data for the Region. The theoretical work should be matched with data collected at the nine fieldwork sites.

Alternative 3: Alternative 3 would also consist of fieldwork in each of the three major habitat categories—woodland habitat, shrub community habitat, and grassland habitat—to estimate the biological diversity within these areas. Unlike Alternative 2, however, fieldwork sites would be selected in two size classifications, such as sites 20 acres or larger in area and sites smaller than 20 acres. These sites should be representative of the three upland area development stages described above. Alternative 3 requires fieldwork at 18 sites. For the purpose of costing this alternative, a total of 54 field surveillance exercises was assumed, requiring one growing season to complete. Figure 3 presents a matrix setting forth the methodology of Alternative 3. This alternative would also require the participation and close collaboration of biologists and ecologists employed by relevant public and private institutions and agencies operating within the Region. Alternative 3, like Alternatives 1 and 2, would also entail a review of all relevant literature, including literature on the theories of ecology, resource management, conservation biology, island biogeography, and biological diversity, as well as a review of existing wildlife and plant inventory data for the Region. The theoretical work should be matched with data collected from the 18 fieldwork sites.

Alternative 4: Alternative 4 would consist of fieldwork in all woodland habitat, shrub community habitat, and grassland habitat categories and their subcategories to estimate the biological diversity within these areas. As in Alternative 3, fieldwork sites would be selected in two size classifications, such as sites 20 acres or larger in area and sites smaller than 20 acres. These sites should be representative of the three upland area development stages described above. Alternative 4 would require fieldwork at 54 sites. For the purpose of costing this alternative, a total of 162 field surveillance exercises was assumed, requiring three growing seasons to complete. Figure 4 presents a matrix setting forth the methodology of Alternative 4. This alternative would also require the participation and close collaboration of biologists and ecologists employed by relevant public and private institutions and agencies operating within the Region. Alternative 4, like

Figure 3

MATRIX FOR ESTIMATING THE IMPACTS ON BIOLOGICAL DIVERSITY: ALTERNATIVE 3

Upland Habitat Type	Estimates of Biological Diversity					
	Corridor (acres)		Recently Isolated (acres)		Isolated for Significant Period (acres)	
	Less than 20	20 or More	Less than 20	20 or More	Less than 20	20 or More
Woodland Only						
Shrub Community Only						
Grassland Only						

Source: SEWRPC.

Figure 4

MATRIX FOR ESTIMATING THE IMPACTS ON BIOLOGICAL DIVERSITY: ALTERNATIVE 4

Upland Habitat Type	Estimates of Biological Diversity					
	Corridor (acres)		Recently Isolated (acres)		Isolated for Significant Period (acres)	
	Less than 20	20 or More	Less than 20	20 or More	Less than 20	20 or More
Woodland Only						
Woodland with Riverine and Lake Habitats						
Woodland with Multiple Upland and Lowland Habitats						
Shrub Community Only						
Shrub Community with Riverine and Lake Habitats						
Shrub Community with Multiple Upland and Lowland Habitats						
Grassland Only						
Grassland with Riverine and Lake Habitats						
Grassland with Multiple Upland and Lowland Habitats						

Source: SEWRPC.

Alternatives 1, 2, and 3, would also entail a review of all relevant literature, including literature on the theories of ecology, resource management, conservation biology, island biogeography, and biological diversity, as well as a review of existing wildlife and plant inventory data for the Region. The theoretical work should be matched with data collected from the 54 fieldwork sites.

Recommended Alternative: After consideration of the scope of each alternative and of the time and costs attendant to each alternative, the Commission recommends that Alternative 3 be incorporated into the study as the procedure for estimating the potential impacts on biological diversity. Alternative 3, unlike Alternatives 1 and 2, involves the collection and analysis of data in habitat areas of different sizes. In so doing, Alternative 3 incorporates an accepted principle of biological diversity theory—that habitat size is a major factor accounting for the number of animal and plant species. A procedure that factors in the size of habitat areas, in addition to a variety of habitat types, is more likely to yield information representative of the impacts of urban development on biological diversity than a procedure that does not. The recommended alternative also includes a thorough review of relevant literature.

The fieldwork required under Alternative 3, unlike that under Alternative 4, can be completed in one growing season. The benefits of this difference in favor of Alternative 3 are twofold in that, first, necessary fieldwork can proceed and end concurrently with the other analysis steps described in this study design; and, second, study findings and recommendations concerning biological diversity can more promptly reach appropriate policy makers. If current development trends continue, it is probable that the Region will lose 3.3 square miles of upland primary environmental corridor during the next three years.

The Commission also considered the estimated cost of each alternative in determining which alternative to recommend. Table 4 sets forth a comparison of the estimated costs. The total estimated costs of each alternative are essentially a summation of the estimated costs associated with preliminary research and analysis; fieldwork activities; and the analysis and presentation of data collected through fieldwork. The estimated cost of Alternative 3 is $7,100 more than the estimated cost of Alternative 2 owing to the fact that Alternative 3 requires fieldwork exercises in two size classifications. The estimated cost of Alternative 3 is $28,500 less than that of Alternative 4 owing to the fact that Alternative 3 is more narrowly focused on the three major upland habitat categories.

Scholarly thinking and research regarding biological diversity indicate that biological diversity is influenced by the size of habitat areas, the vegetative cover of habitat areas, and the degree to which habitat areas are isolated from other natural areas. Each of these factors is incorporated in Alternative 3, as described in this study design. During the formulation of the detailed study design, specialists in relevant fields should detail all required work and determine appropriate site sizes, site locations, fieldwork techniques, and time schedules to be used.

The Loss of Upland Areas:
Estimating the Impacts on Surface-Water and Groundwater Quality and Quantity

The potential impacts associated with the development of upland areas on surface-water and groundwater quality and quantity should be estimated. The potential impacts should be estimated on a watershed basis and on a site-specific basis. The site-specific evaluations should focus on at-risk areas that have been identified in the study as areas whose development would be likely to cause direct and adverse water quality impacts, and which are located outside of a public sanitary sewer service area boundary.

Nonpoint source pollutant loadings related to probable amounts of urban runoff and construction-site erosion should be the main determinant in estimating surface water quality impacts. Appropriate pollutant-loading models should be used to estimate pollutant loadings for suspended solids, total phosphorus, and metals. The anticipated pollutant loadings should be compared to previously prepared data on existing and expected loadings. For purposes of this evaluation, it should be assumed that at-risk areas will be developed in uses and densities similar to those of adjacent lands, or as current zoning permits.

Groundwater quality and quantity should be estimated by evaluating the effects of the probable losses of groundwater recharge areas. The

Table 4

ESTIMATED COSTS OF ALTERNATIVE PROCEDURES
FOR ESTIMATING IMPACTS ON BIOLOGICAL DIVERSITY

Alternatives	Required Fieldwork Exercises	Fieldwork Costs	Preliminary Research Costs	Analysis of Findings Costs	Total Estimated Costs	Cost Index
Alternative 1	--	--	$10,500	--	$10,500	0.3
Alternative 2	27	$ 7,100	10,500	$10,500	28,100	0.8
Alternative 3	54	14,200	10,500	10,500	35,200	1.0
Alternative 4	162	42,700	10,500	10,500	63,700	1.8

Source: SEWRPC.

principal source of groundwater recharge for the shallow aquifers in the Region is local precipitation on undeveloped open lands with permeable soils, open water, and wetland areas. Some of the best recharge areas are contained in the primary environmental corridors. The principal source of recharge for the deep aquifer underlying the Region is the precipitation that percolates downward through glacial deposits in the western portions of the Region. The primary environmental corridors in this part of the Region are vital to maintaining both the quality and quantity of the recharge to this deep aquifer. Potential losses of groundwater recharge areas should be documented where it is evident that such losses could affect the base flows in headwaters or other surface waters dependent on groundwater discharges.

The Loss of Upland Areas:
Estimating the Impacts
on Park and Recreational Land

The potential development of at-risk upland areas is likely to affect lands that have been identified as potential park sites. Some potential park sites may be lost while others may be devalued. To determine the impact on potential park sites, the location of the potential sites should be compared to the location of the at-risk upland areas. Potential park sites whose location corresponds with the location of at-risk upland areas should be considered threatened. Impacts on planned and existing park and recreational areas should also be estimated.

The Loss of Upland Areas:
Assessing the Impacts

To interpret the significance of the environmental impacts resulting from the conversion of upland areas to urban development, the following determinations should be made in the context of the Region:

1. The degree to which predicted impacts could affect public health and safety;

2. The degree to which predicted impacts could potentially affect unique cultural, historical, and natural characteristics;

3. The degree to which predicted impacts could affect future land use decisions, including public land regulation and acquisition practices, and private land development patterns;

4. The degree to which predicted impacts could potentially alter the use and enjoyment of public investments, such as parks and recreational areas;

5. The degree to which predicted impacts are related to other environmental factors, and the degree to which the resulting cumulative impacts could affect the natural and built environments;

6. The degree to which predicted impacts could potentially affect rare, threatened, and endangered species and their critical habitat areas; and

7. The degree to which predicted impacts could potentially violate Federal, State, and local standards for environmental quality.

SUMMARY OF FORECASTS AND ANALYSES

Each step of the required work has been designed to build on the findings generated from the

previous step. The list below summarizes the major recommended operational steps of the study.

- The inventory phase should establish the foundation for the subsequent analytical work by collating and constructing basic data.

- The inventoried data should be used to identify the upland areas that have conditions which favor urban development, and which are therefore "at risk" of being lost to urban development.

- The primary and secondary environmental corridors and isolated natural resource areas which are threatened by the potential urban development of the at-risk upland areas contained within them should be identified. This determination should be made by applying the Commission's definitions of primary environmental corridors, secondary environmental corridors, and isolated natural resource areas, as outlined in the Commission's environmental-corridor-refining process.

- The average annual rates of loss of upland areas should be calculated and used, in combination with the location of at-risk upland areas, to numerically and spatially forecast the probable losses of upland areas.

- Environmental impacts should be estimated, based on the forecasted loss of upland areas. The potential impacts on biological diversity, water resources, and potential park sites within the Region should be estimated and, where possible, quantified.

- A series of qualitative determinations should be made to assess the significance to the Region of the potential environmental impacts as estimated in the analyses.

FINAL REPORT OF THE STUDY

A final report of the study should be prepared, presenting the following: results of all inventory, forecast, analysis, and fieldwork operations; methodologies employed in all work elements; and interpretations of all study findings.

Also, the report should contain recommendations concerning the scope and direction of future policies related to upland primary environmental corridor, secondary environmental corridor, and isolated natural resource area protection. Recommendations should be based on study results, and should be addressed to local and county governments within the Region and to State agencies, including the Department of Natural Resources and the Department of Industry, Labor and Human Relations. It is essential that the final report address the relationships between public policy related to environmental corridor and isolated natural area protection and environmental quality within the Region.

Chapter IV

ORGANIZATION, TIMING, AND ESTIMATED COSTS OF THE STUDY

STUDY ORGANIZATION

Owing to institutional experience and staff expertise, the Southeastern Wisconsin Regional Planning Commission is the logical agency to lead in the conduct of the upland environmental corridor protection study. As the lead agency, the Commission would be responsible for assembling all needed inventory data, for conducting all needed analyses, and for organizing and coordinating fieldwork to be provided by other participating agencies. The role of the Wisconsin Department of Natural Resources in estimating the impacts of upland corridor loss on biological diversity would be particularly important in this respect.

It is recommended that a technical coordinating and advisory committee composed of environmental scientists having experience in both theoretical and applied research be created to oversee the conduct of the study. One of the basic purposes of the committee would be to involve the concerned units and agencies of government and private interests in the Southeastern Wisconsin Region in the active review of the study methodologies, findings, and recommendations. As its first action, the committee would review this preliminary study design and prepare a detailed working study design. The advisory committee should have an active role in reviewing the preliminary drafts of the report and the final recommendations of the study. It is also recommended that the committee assist in familiarizing the general public with the study, its purpose, and its findings.

TIME SCHEDULE

From the date of formal approval and provision of necessary funding, the upland environmental corridor protection study is estimated to take 18 months to complete. The inventory work and the bulk of the forecasts and analyses will take six months to complete. Together, the elements of the study that call for estimating the environmental impacts of corridor loss will take eight months to complete. Once the inventory and forecasting foundation is established, these elements, including necessary fieldwork, can be accomplished simultaneously. The final element of the study—assessing the impacts of potential corridor loss—will entail thoughtful reflection and review of the study findings. This vital and interpretive work element, serving as a point of departure for the development of final recommendations, will take an additional four months to complete. The scheduling in the detailed study design of the work elements described in this preliminary study design should reflect the progressive order in which the elements are arranged.

COST ESTIMATES AND REVENUE SOURCES

The upland environmental corridor protection study is estimated to cost $129,500. This cost estimate is based on the scope of the work, the time schedule, and the study organization described in this study design. In considering this estimate, it must be recognized that precise cost estimation is impossible in the absence of a detailed study design. Consequently, the cost estimates presented in Table 5 must be considered tentative with respect to the allocation of total dollars among individual work elements. Changes in this allocation should be expected upon completion of the detailed study design. The total cost of the study, however, should not deviate from that estimated. It is recommended that the necessary funding for the study be provided by the Wisconsin Department of Natural Resources over a two-year period.

Table 5

COST ESTIMATES FOR THE UPLAND ENVIRONMENTAL CORRIDOR PROTECTION STUDY

Work Program Element	Estimated Cost
Study Organization and Preparation of Detailed Study Design	$ 2,400
Inventory	
Mapping	
General Base Maps	$ 1,000
Large-Scale Topographic Maps	700
Aerial Photographs	1,000
Land Use Data	600
Population and Economic Activity Data	600
Climatic Data	3,000
Environmental Corridor Data	1,200
Upland Habitat Areas Data	1,200
Sanitary Sewer Service Area Plans Data	600
Surface Water Quality Data	2,400
Potential Parks Inventory Data	600
Data on Ownership of Upland Environmental Corridors and Isolated Natural Resource Areas	3,000
Data on Zoning of Upland Environmental Corridors and Isolated Natural Resource Areas	3,000
Subtotal	$ 18,900
Forecasts and Analyses	
At-Risk Upland Areas	$14,500
Threatened Environmental Corridors and Isolated Natural Resource Areas	4,800
Numerically Forecasting Upland Area Loss	4,800
Spatially Forecasting Upland Area Loss	6,000
Estimating Impacts on Biological Diversity	35,200
Estimating Impacts on Water Resources	14,500
Estimating Impacts on Park and Recreational Sites	2,400
Assessing the Impacts	6,000
Subtotal	$ 88,200
Publication of Report	$ 10,000
Travel, Equipment Rental, and Data Processing	$ 10,000
Total	$129,500

Source: SEWRPC.

Chapter V

SUMMARY AND CONCLUDING RECOMMENDATIONS

In 1979, both the Southeastern Wisconsin Regional Planning Commission and the Wisconsin Department of Natural Resources adopted an areawide water quality management plan for the Southeastern Wisconsin Region. One of the major elements of the plan contained recommendations for the preservation of the primary environmental corridors in the Region. The Department and the Commission have worked cooperatively to implement the plan since its adoption, and in February 1992 determined that the water quality management work program should be amended to include the preparation of a prospectus for an upland primary environmental corridor protection study. The prospectus was prepared and reviewed by Commission and Department staff and served as the basis for this preliminary study design, which recommends the conduct of a study to assess the potential impacts resulting from the conversion of upland areas of primary and secondary environmental corridors and isolated natural resource areas to urban land uses.

Environmental corridors are defined by the Commission as linear concentrations of natural resource and natural resource-related amenities. Most of the Region's remaining high-value lowland resource land areas, which include wetlands, floodplains, and shorelands, and upland resource areas, which include woodlands and prairies, are contained in these corridors. In addition, significant critical species and wildlife habitat areas, major bodies of surface water, groundwater recharge and discharge areas, important recreational and scenic areas, and the best remaining potential parklands are located within the environmental corridors. The protection of primary environmental corridors has long been a central goal of the regional land use plan prepared by the Commission.

While actions taken by the Department in compliance with the water quality management plan have largely been effective in preserving lowland corridor areas, the upland areas generally remain open to urban development. Regulation of upland areas, at all levels of government, has been less comprehensive and effective than regulation of lowland areas. According to preliminary estimates, upland areas of primary environmental corridors are being lost within the Southeastern Wisconsin Region at a rate of 1.1 square miles per year. Urban development in the upland sections of the corridors threatens the integrity of the corridors, which function to provide many benefits, including the preservation of wildlife and plant species diversity, the maintenance of groundwater and surface-water quality, and the maintenance of outdoor recreational opportunities.

To date, the regional environmental impacts of the loss of upland environmental corridor lands and isolated natural resource areas have not been estimated and assessed. The upland environmental corridor study proposed in this preliminary study design is needed to formally and quantitatively determine the potential impacts of the continued loss of these environmentally significant areas. Such a study should forecast the probable loss of upland areas; estimate the impacts of this loss on the biological diversity, water resources, and potential park sites of the Region; and assess the significance to the Region of such environmental impacts.

The work elements of the needed study, as outlined in this preliminary study design, are progressively ordered. The information and findings generated in each study operation will enable the completion of subsequent study operations. It is recommended that the work elements of the study proceed as herein described. The research, analysis, and fieldwork techniques and methodologies to be elaborated upon in the detailed study design phase should be in keeping with this recommendation. The committee formed to oversee the study, as its first action, should review this preliminary study design and the preparation of a more detailed study design as described herein. The Commission further advises that the upland environmental

corridor study begin at the earliest possible date, and that the committee structure, time sequence, and study cost be as recommended in this preliminary study design.

Local, national, and international experience in the conduct of a regional study as herein outlined is limited. Indeed, most analytical work in the field of biological diversity has focused on species-area relationships within limited urban areas. Consequently, the Commission recommends that the final report of the study thoroughly document all study procedures, findings, and recommendations. In addition, the Commission recommends that a separate compendium of the study report be prepared for the general public that outlines the purposes of the study; the study findings and recommendations; and the relationships between public policies regarding environmental corridors and isolated natural resource areas and urban development, and their effects upon the environmental quality of the Region.

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