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Resource Management

Stream and Shoreland Management

Lake Management

Groundwater Management

STREAM AND SHORELAND MANAGEMENT

Environmental and Open Space Corridors

The open space corridors illustrated on the *Regional Development Plan* map (Map 1-1) provide the basic planning framework and foundation for resource protection, including stream and shoreland protection and management. The open space corridors are continuous open space systems based on natural resources and environmentally important lands. The corridors are based primarily on streams, lakes, shorelands, floodplains, and wetlands. Steep slopes, woodlands, parks and publicly-owned open space lands may also be included. Protection of open space corridors from disturbance and development is important because these lands are critical to a variety of community concerns and environmentally important functions, including the following:

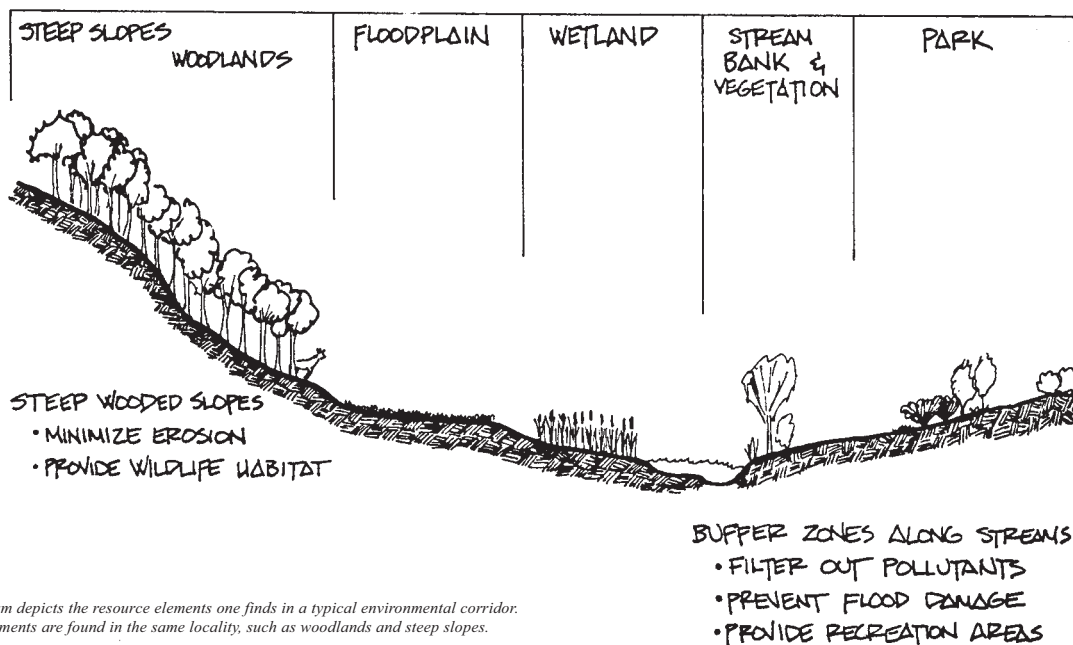
- protection of water resources, drainage, and hydrologic functions;
- pollution control;
- protection of public health, safety, and property;
- provision of outdoor recreation and education opportunities;
- protection of wildlife habitat; and
- enhancement of scenic beauty and shaping of urban form.

The delineation and protection of a continuous areawide open space corridor system is based on the recognition of the interrelatedness of adjacent landscape types and the importance of protecting valuable ecological units and linkages. The corridor system, therefore, is primarily associated with stream valleys and water features, emphasizes the importance of continuity of environmental systems and protection of the land/water edge.

The open space corridor system shown on the *Regional Development Plan* map includes **two distinct components: (1) urban environmental corridors** within urban service areas; and **(2) rural resource protection areas** outside of urban service areas. While both of these components represent continuous corridor systems, and they are connected with each other, there are some differences and distinctions between the two components.

Urban environmental corridors face greater pressure from the adverse impacts of development or modification, higher densities of surrounding development and land use, and greater need and use of corridors for public open space and recreation. As a result, the urban environmental corridors have a higher proportion of land in public ownership, are more extensively used for recreation, and have a greater emphasis on protecting intermittent streams and drainageways which are threatened by development and landscape alteration. The urban environmental corridors often require more stringent protection measures or acquisition to adequately protect critical or scarce resources and environmental functions.

The urban environmental corridor system represents a substantial framework for the basic open space and environmental network in a community. As an example, the environmental corridor system in the Central Urban Service Area (the largest urban service area in Dane County) includes approximately 15,500 acres of land, or about 20 percent of the total land area. About 11,400 acres (75 percent) of this land is in public ownership. Most of the remaining 4,100 acres is subject to environmental regulations of some sort (such as shoreland, wetland, or floodplain zoning), and some of this land will be acquired in the future through purchase or dedication.



This schematic diagram depicts the resource elements one finds in a typical environmental corridor. Often one or more elements are found in the same locality, such as woodlands and steep slopes.

Rural resource protection areas are based mainly on floodplains, wetlands, and shorelands delineated in town plans and protected through zoning or other regulations, together with existing and proposed publicly-owned or controlled lands needed for resource protection, continuity, or public recreation. There is less pressure for alteration or development of these lands, and less land is needed for public open space and recreational use. As a result, most of the lands in rural resource protection areas will remain in private ownership, and there is less need for acquisition or stringent regulation of such resources as intermittent streams and drainageways, woodlands or steep slopes.

The countywide open space corridor system illustrated on the *Regional Development Plan Map* has evolved from a general planning concept to a specific and detailed tool used for guiding land use and environmental management decisions. Urban environmental corridors have been mapped and adopted for all of the urban service areas in Dane County. The environmental corridor delineations have been incorporated into local land use and comprehensive plans, and provide the basis for decisions on acquisition, regulation, and protection of open space in urbanizing areas. The primary protection mechanisms for environmental corridor lands and resources at the local level include land use regulations (such as floodplain, wetland, shoreland, and conservancy zoning, subdivision regulations, official mapping), and acquisition (through purchase or dedication). These protective mechanisms are reinforced by using the environmental corridors as the basis for federal (404 permits) and state (Chapter 30 and 31 permits) actions and decisions. In addition, the requirement that sanitary sewer extension approvals be based on a delineation of sewer service areas which include the identification of lands (environmental corridors) which are to be excluded from sewered development provides an additional powerful tool in protecting corridors from urban development. A fact sheet explaining environmental corridors and the mapping process is included in Appendix 1. (See the *Environmental Corridors Report, 1996*, for a more detailed treatment of the subject).

The open space corridor system shown on the *Regional Development Plan Map* represents the basic skeleton of an areawide open space network. It is expected that this basic system will be expanded by adding buffer areas, areas for protecting scenic views and community separation, and areas desired for active recreation or public use (such as trail systems). Adjacent or contiguous upland areas important for wildlife habitat, groundwater recharge, or protection of unique or valuable resources (unique vegetation, geologic features, archeological sites, etc.) should also be considered for addition to the corridors.

The most important current issues and priority needs concerning to open space and environmental corridor protection are as follows: (1) using the adopted open space/environmental corridor system as a consideration in all local land use and siting decisions and planning; (2) continuing to emphasize the use of the open space corridor network as basic guidance and priorities for open space acquisition and protection programs; and (3) providing emergency acquisition funds to ensure protection of important corridor lands and critical environmental resources which are endangered or threatened by development which cannot be adequately protected through other means.

Floodplain, Wetland, and Shoreland Protection Programs

Within the overall context of open space and environmental corridors protection there are several specific programs directed at protection of streams and shorelands from adverse impacts which would detract from the environmental functions of these resources. These programs are directed at regulating activities in floodplains, shorelands, and wetlands. Programs include the federal Section 404 permit program, administered by the U.S. Army Corps of Engineers, regulating the discharge of dredge or fill materials into all waters of the United States (generally all lakes, streams and adjacent wetlands which are part of a surface tributary system to and including navigable waters). State Chapter 30 and 31 permits, administered by the Department of Natural Resources, regulate a variety of activities in, or directly affecting the navigable waters of the state. DNR also administers NR 103, Wetland Water Quality Standards, which provides criteria for activities affecting wetlands. State law requires counties to adopt and enforce restrictive zoning of shorelands along navigable streams or lakes in unincorporated areas. Shorelands are defined as areas lying within 1,000 feet of lakes, ponds or flowages, and within 300 feet of rivers or streams, or to the landward side of the floodplain, whichever distance is greater. Minimum standards and criteria for regulation of land use in the shoreland areas are included in chapter NR 115 of the Wisconsin Administrative Code. State shoreland protection rules also require counties (in unincorporated areas) villages, and cities to adopt shoreland-wetland zoning ordinances which provide substantial additional protection measures for wetlands (5 or more acres)

Function	Resource Features							
	Lakes, Ponds & Streams	Wetlands	Floodplains	Shoreland Buffer Strips	Steep Slopes	Woodlands	Parks	Unique Vegetation or Geology
Protect Water Resources, Drainage & Hydrologic Functions	▲	▲	▲	▲	△			△
Provide Pollution Control		▲	△	▲	▲	△	△	
Protect Public Health, Safety, and Property	▲	△	▲	▲				▲
Provide Outdoor Recreation and Education Opportunities	▲	△	△	△		△	▲	△
Provide Wildlife Habitat	▲	▲	△	△		▲	△	△
Enhance Scenic Beauty and Shape Urban Form	▲	△	▲	▲	▲	▲	▲	

▲ Primary Function △ Secondary or Supplemental Function

located within shoreland areas. NR 115 and NR 117 are the administrative rules providing standards and criteria for these zoning programs. State law also requires counties, cities, and villages to adopt floodplain zoning ordinances under criteria and standards established in NR 116 of the Administrative Code.

Dane County has adopted the required general shoreland, wetland, and floodplain zoning for the unincorporated areas of the county. Nearly all of the villages and cities in Dane County with areas subject to flooding have adopted floodplain zoning ordinances. Most villages and cities also have adopted shoreland-wetland ordinances.

The most important issues regarding floodplain, wetland, and shoreland protection programs are limitations in the degree of protection provided, and the incomplete scope or coverage required of the zoning programs. Since the basic intent of floodplain zoning is to limit flooding damages, these ordinances do not restrict development or other activities in the floodplain which adversely affect other environmental functions. Similarly, general shoreland zoning addresses certain basic criteria and standards for development and activities within the shoreland area, but many potential activities and impacts are not addressed. Shoreland-wetland zoning provides a greater degree of protection for wetlands than floodplain or general shoreland zoning, but shoreland-wetlands smaller than five acres, and wetlands outside the shoreland area are not covered by these ordinances. The protection of critical environmental resources afforded by these programs would be substantially improved if local units of governments adopted and enforced ordinances beyond the minimum state requirements. Vegetative buffers (75 to 300 feet) have proven to be especially effective in protective in protecting streams, wetlands and shorelands, and have been used to augment greenbelts and recreational area with great success in many parts of the country. In 1994, Dane County recently expanded the scope of wetland zoning in unincorporated areas to include all wetlands over 2 acres.

Wisconsin's shoreland zoning standards were originally developed in the late 1960s based on the best professional judgement at that time. Since then, there have been significant advances in the understanding of natural aquatic systems, and the public's knowledge and perceptions and the political landscape has changed as well. Current and future development trends pose major challenges to the shoreland program. Options for improving the shoreland zoning program are being considered at the state and local levels tied to regional classification systems specifically tailored to local circumstances and priorities. It is now recognized that one size doesn't fit all, and that different standards can be used for different situations. A classification system may also be used to guide program resources and promote cost-sharing opportunities and partnerships among various agencies and groups, directing their efforts where they will do the most good and have the largest beneficial effect.

In 2004, Dane County was awarded a DNR Lake Classification grant to develop a water body classification system that would include all navigable waters. The Phase I study will provide the technical basis and support for a subsequent Phase II management program developed in cooperation with local units of government, private citizen groups, and landowners, and incorporated into the County's Comprehensive Plan. The water body classification study is the first step toward developing a consistent set of countywide standards, policies, and strategies among cities, villages, and towns to help protect and restore the waters of the county. This would be based on the water body type, the quality of the resource, and its potential with the current level of development.

Streambank and Shoreline Protection and Improvement

The management and improvement of streambanks and shorelines is another important aspect of resource management. These programs include such management activities as acquisition of shorelands; easements and buffer strips; vegetation management; stream bed and bank stabilization measures and structures, such as riprap or sheetpiling, dredging, and grading; fencing and streambank crossings for livestock exclusion; improvements to upgrade recreational use and access; and improvements to enhance habitat for fish and wildlife. The basic purpose of these management programs and activities is to protect or enhance the basic environmental and open space functions of the resource, including maintenance of flow capacity, erosion control, improving recreational use and access, improving fish and wildlife habitat, and providing adequate protective buffers between land uses and environmental resources.

Other Stream Management Issues

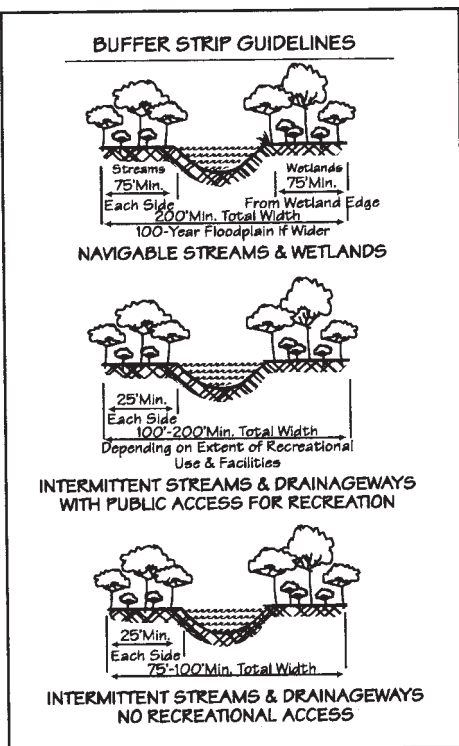
Other stream management issues include monitoring, fishery management and habitat improvement, maintaining and improving navigation and flood handling capacity, and providing access and facilities for in-stream recreation. In Dane County, there is a limited amount of up-to-date information on stream water quality conditions, and it is difficult to determine whether water quality in any particular stream is adequate or suitable for supporting the intended uses in that stream. It is, therefore, important to support a continuing program of monitoring streams to provide information on flow, chemical characteristics, and biological characteristics to determine whether the conditions are supporting the stream's potential for use, or whether the stream's use is being limited or impaired by pollution or other impacts.

In-stream construction, or dredging and grading activities designed to maintain or improve navigation and flood-carrying capacity, or to provide recreational facilities or access, can have adverse effects on water quality if not undertaken with care and in concert with an overall stream and shoreland management program.



From the standpoint of in-stream fishery or shoreland wildlife management programs, the Department of Natural Resources is the principal agency having both the technical expertise and the institutional responsibility. The role of local units of government is primarily to participate in and support those state management programs.

There is no clear-cut overall responsibility for stream management for major streams which involve more than one local jurisdiction. The Wisconsin Department of Natural Resources, designated the trustee of all waters of the state (including groundwaters), exercises fairly complete regulatory control over the navigable waters of the state, but its role in streambank and shoreline protection and improvement programs has generally been limited to specific projects and locations where the state has an active role in fish, game, and resource management. Local programs for streambank stabilization and shoreline protection and improvement projects have been pursued by individual local units of government for specific areas in their jurisdiction. These programs and projects have included streambank and channel stabilization projects and structures using public funds, equipment, and personnel; sponsoring or providing funding to private conservation groups for streambank and shoreline improvement projects; and sponsoring and supporting volunteer shoreline cleanup and vegetation management programs.



Dane County can play a much greater role in stream, streambank, and shoreline management under state legislation enacted in 1990 that grants the County Lakes and Watershed Commission additional authority and financing tools.

The importance and role of streambank and shoreline buffer strips and easements in protecting and managing streams is being increasingly recognized, and more attention and effort will need to be directed to acquisition programs, including dedication and easement approaches. Stream and shoreline buffer strip acquisition and protection is, of course, consistent with and supportive of the overall approach to open space and environmental corridors.

STREAM AND SHORELAND MANAGEMENT RECOMMENDATIONS

- S-1: The environmental and open space corridors illustrated on the Regional Development Plan Map should be adopted and incorporated into the plans, land use controls, and resource protection programs of all units of government in Dane County. The corridor system should be adopted as the basic skeleton or framework to promote community-wide and countywide open space and resource protection networks, and should be expanded to include additional needed lands and resources.
- S-2: Wetlands, steep slopes, buffer strips, and wooded areas in or near water bodies should be protected from development or adverse impacts through regulation or acquisition. Restore these areas where possible.
- S-3: Management agencies should endeavor to increase or maintain functional values of wetlands regardless of size, especially in urban settings where they have multiple functions. Restore farmed or prior-converted wetlands where possible.
- S-4: Park and open space land acquisition policies in Dane County should continue to place priority on acquisition of water-oriented parks, water-related resource protection areas, and public access.
- S-5: Enhance and promote the role of woodlands and hillsides in protecting water quality and hydrologic functions, such as groundwater recharge, through woodland management and protection plans, and financial incentives.
- S-6: Adequate vegetative cover and buffer strips to protect and stabilize the shoreline and stream corridor functions should be included in land use and development plans, controls or regulations.
- S-7: Support the efforts of watershed and conservation groups to protect and improve water resources.
- S-8: Work with lake, watershed, and conservation organizations to promote and install conservation buffers along intermittent and perennial streams, wetlands, ponds, and lakes through easements, land acquisitions, and voluntary cooperation from land owners.
- S-9: Municipalities should take advantage of federal, state, and private funding opportunities to implement streambank and in-stream habitat restoration, as well as increase public access along surface water areas.
- S-10: An ongoing program of monitoring stream water quality conditions, use suitability and limitations, and corridor evaluation should be supported and conducted by the Wisconsin Department of Natural Resources, Dane County, and local management agencies.
- S-11: Maintain and enhance the designation of all current Outstanding Resource Waters, Exceptional Resource Waters, Class I and Class II trout streams, and promote the improvement of impaired water bodies so they can be removed from the 303(d) list.
- S-12: Participate and support the development of a water body classification System for Dane County waters.
- S-13: Municipalities in which sewer service area boundary expansions are requested should review and revise existing floodplain zone maps to accommodate potential hydrologic modifications.
- S-14: Management agencies should endeavor to prevent development that would increase the potential for flood-related problems. Promote implementation of the Dane County Flood Mitigation Plan.
- S-15: Cities and villages should consider regulating their shoreland through conformance with county or model ordinances for shoreland protection – whichever are more protective – even though they are not required to regulate shorelands other than wetlands under NR 117.
- S-16: All units of government should be proactive in the preservation and conservation of aquatic natural resources while promoting environmentally sound development.

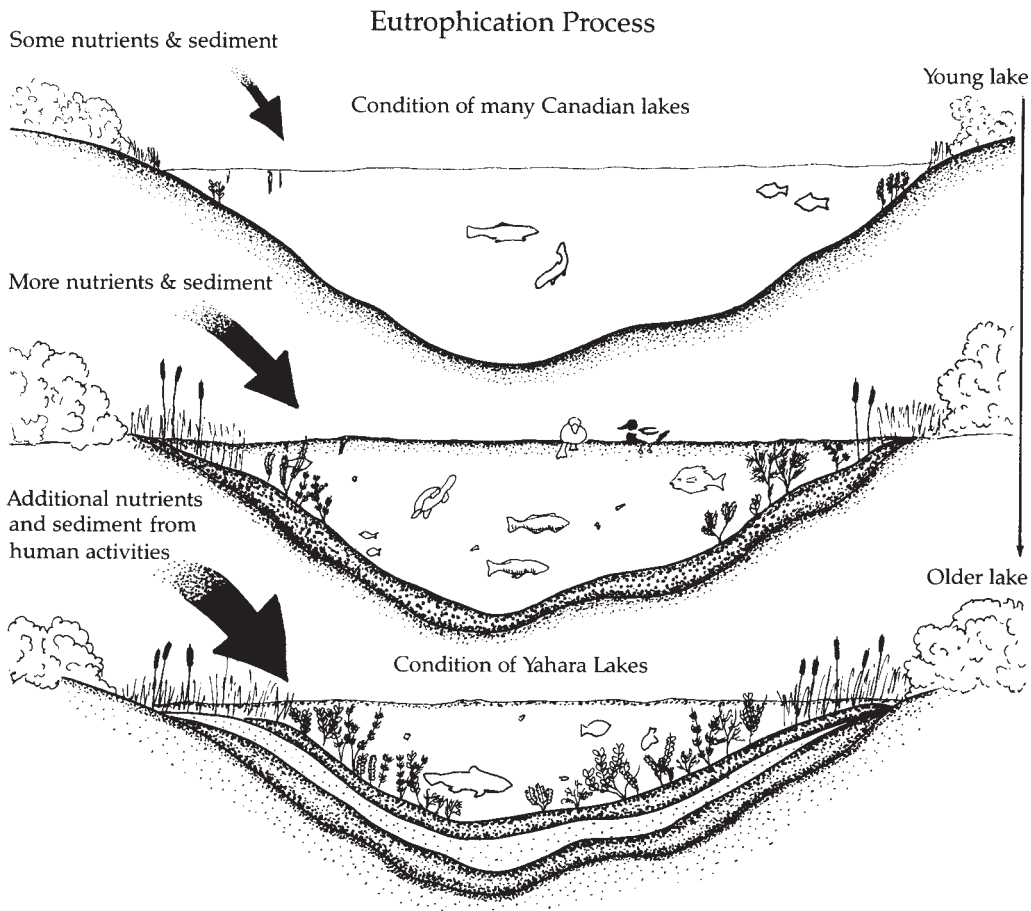
LAKE MANAGEMENT

Lake Conditions and Management Problems

Lake management issues in Dane County are dominated by the Yahara River chain of lakes, since these are the largest, the most prominent, and the most heavily used lakes. There are other, smaller lakes throughout Dane County including seepage lakes such as Fish Lake and Crystal Lake, as well as small stream impoundments and millponds like the Marshall and Rockdale millponds, Lake Belle View, and the Yahara River dams below Lake Kegonsa. The most important water quality problems and management concerns for most of these smaller lakes are the same as those for the Yahara River lakes—excessive fertility and eutrophication resulting from high nutrient and sediment loading. Specific and detailed management plans for each of these smaller lakes and impoundments need to be developed before management practices and programs can be undertaken, in order to reflect the particular problems, circumstances and pollution sources affecting each lake.

The Yahara lakes, Lake Wingra and most of the other lakes and impoundments in Dane County are classified as eutrophic lakes. Eutrophic lakes are nutrient-rich and usually have an abundant crop of aquatic weeds and algae. Natural eutrophication is a slow process in which sediment and nutrients enter the lake from runoff from the lake's watershed, causing increased plant growth and a

gradual filling of the lake. The time required for this filling or “aging” depends greatly on the surrounding landscape and on the nature of the lake itself. The rate of aging or eutrophication can be sped up by human inputs of sewage and polluted runoff from farms and cities. Through this process of “cultural” or accelerated eutrophication, the lake can quickly become more fertile and support nuisance levels of aquatic plants and algae. The Yahara lakes are examples of cultural eutrophication. Problems with algae growth were first reported in the 1880s, possibly caused by sewage discharging into Lake Monona from an expanding urban population. Although Lake Mendota never received large quantities of sewage, Lakes Monona, Waubesa and Kegonsa were all heavily affected by the discharge of treated sewage from the Madison area. Most sewage was diverted from Lake Monona in 1936 and from Lakes Waubesa and Kegonsa in 1958. Following these diversions, the lower three lakes improved greatly. In 1971, remaining treatment plant discharges from small communities upstream from Lake Mendota were diverted around the lakes; and in the 1980s, all remaining wastewater discharges tributary to the Yahara lakes were diverted, so that none of the lakes now receives point sources of pollution. However, the lakes continue to receive sediment, nutrients, and other types of pollutants in runoff from the surrounding farmlands and municipalities.



The public and lake users have long identified poor water quality and shoreline conditions caused by excessive aquatic weeds and algae as the main problems and obstacles to enjoying the lakes. Aquatic weeds and algae are natural and important elements in the lake ecosystem, but excessive growth of these plants causes nuisance conditions. Some species of blue-green algae produce toxins that, in large enough concentrations, can be toxic to humans and animals. Aquatic plant growth is fueled by the availability of nutrients, especially phosphorus, washed into the lakes from the watershed. Phosphorus in the water stimulates algae growth, while rooted aquatic plants obtain phosphorus from the sediment. Since this is the cause of the water quality problem, **the most important aspect of lake protection and management is reducing the input of sediment and nutrients to the lakes**, while also controlling and harvesting aquatic plants so they don't interfere with recreational and aesthetic enjoyment of the lakes. Reducing nutrients available to algae and weeds in the lakes can reduce the problem if the reductions are substantial enough.

It is difficult, however, to achieve dramatic or visible changes in the water quality of the Yahara lakes in the short term, because nutrients have accumulated in the sediment of the lakes and can be recycled and used by plants. Nevertheless, **an aggressive watershed pollution control and management program is absolutely essential and the most important ingredient in the long-term management strategy of the lakes** for the following reasons: (1) such programs, if aggressively pursued and well funded, can result in long-term improvement in lake water quality conditions; (2) aggressive watershed management programs are necessary to ensure that watershed nutrient loadings do not increase and worsen algae and weed problems to the point that they become unmanageable; and (3) most watershed nutrient and sediment control programs provide important benefits in addition to reducing nutrient loadings to the lakes--reduction of loss of topsoil and productivity on agricultural land, improved urban stormwater management and pollutant removal, and reduction of drainage and flooding problems. Thus, the most important element in the long-term strategy to protect and manage the lakes is the reduction in nutrient and sediment inputs from tributary watersheds, applying the urban and agricultural nonpoint source pollution control practices and programs described in Chapter 3.

Direct Lake Management Programs

In addition to reducing pollution inputs to the lakes, there are a variety of direct or in-lake management practices and programs which are designed to avoid or manage nuisance conditions or problems, enhance use and enjoyment of the lakes, and ensure that the lakes are safe and healthy environments for recreational use and support of fish and aquatic life.

Nuisance algae blooms, and subsequent die-off and decay, create obnoxious and odorous conditions which seriously impair or interfere with scenic enjoyment and recreational use of the lakes. The only safe and proven long-term strategy to preventing nuisance algae blooms is to reduce the nutrients which fuel these blooms. Algae can be controlled and killed by applying chemical algicides to the lakes, and algicides such as copper sulphate have been heavily used in the past for algae control on the Yahara River lakes. Chemical control of algae, while cheap and effective in treating short-term algae bloom problems, does not resolve the need for nutrient reduction, or avoid problems caused by the organic decay of dead algae. In addition, algicides accumulate in bottom sediment of the lakes to levels that can become of environmental concern. In summary, chemical control of algae, while an economical approach, is primarily of short-term and cosmetic benefit. Lasting effects are potentially deleterious, so that the use of chemicals for algae control is presently limited to small areas, and is not a significant lake management technique. A biological approach to algae control which has promise is the manipulation of the food chain and fish species composition in the lake to favor zooplankton which feed on algae. Experiments have been carried out in Lake Mendota. Further experimentation and evaluation is needed to determine whether or not this approach, combined with nutrient reduction, can be effective in reducing algae populations.

In addition to algae, excessive sediment and nutrient inputs can fuel growth of large aquatic plants and weeds to nuisance levels which interfere with aesthetic and recreational enjoyment and use of the lakes. Rooted aquatic plants are important and necessary elements in the lake ecosystem, and provide important fish habitat and cover as well as food.

In the 1960s, however, the Yahara lakes were invaded and dominated by a species of an exotic aquatic weed (Eurasian water milfoil) that was less desirable in many respects than previously dominant native plant communities. This change in species dominance increased the nuisance factor and management problems. The lake management problems caused by dense growths of aquatic rooted plants in shallow areas include serious interference with recreational boating and navigability; interference with swimming and other shallow area recreational activities; and acceleration of sediment deposition and filling of shallow areas (which also expands the area suitable for growth of weeds). Subsequent die-off and decay of excessive aquatic plants also contributes to the odors and oxygen depletion.

The primary management practices used for control of excessive weed growth include physical control (such as mechanical harvesting), and chemical control. Dane County presently maintains an aggressive program of mechanical cutting and harvesting of aquatic weeds in the Yahara lakes and other lagoons and lakes in the County. The basic purpose and objective of the mechanical harvesting program is to maintain adequate recreational navigability and access, and to enhance the overall recreational or aesthetic value of the lakes. Other physical weed management techniques which have promise and have been used in some circumstances include lake drawdowns to expose and kill or remove aquatic weeds in shallow shoreline areas, and the use of bottom screens or barriers to prevent or limit aquatic plant growth in small selected areas. Another promising approach is introducing the milfoil weevil which feeds on the invasive weed.

Application of chemical herbicides is an economical approach to killing aquatic weeds, and has been extensively used in the Yahara lakes in the past. The same concerns and effects are associated with the use of chemical herbicides such as sodium arsenite to control weeds as those described for the use of chemical algicides—the approach provides only short-term and cosmetic benefits, does not avoid the problems of nutrient availability and organic matter decay, and represents potential long-term environmental risks. At the present time, chemical herbicides are used for control of aquatic weeds only in small areas of the Yahara lakes, generally along private shorelines, and are restricted to approved herbicides applied under the DNR supervision.

A promising biological approach to managing aquatic plant problems is direct management of aquatic plant communities to create conditions which favor more desirable plant species and plant community compositions than those presently existing. This approach is receiving increasing attention and experimental efforts are being considered for the Yahara lakes.

The extent of rooted aquatic plant beds in the Yahara lakes is generally limited to shallow areas where sunlight is able to penetrate a sufficient depth to support plant growth. The expansion of shallow areas through sedimentation can increase the area suitable for rooted aquatic plant growth. Paradoxically, the improvement of water clarity from reduced algae populations can also expand the area suitable for aquatic plant growth. In other words, as the water becomes clearer and algae problems become less serious, the extent and growth of nuisance rooted aquatic plants can increase. Conversely, in lakes where algae problems are serious enough to create very poor water clarity, growth of aquatic weeds can be limited.

Another lake water quality concern is the deposition of potentially toxic or hazardous materials in lake sediment as a result of pollution sources or previous applications of chemicals for algae and aquatic weed control. Substances of concern which have been found in lake sediment include mercury, arsenic, copper and PCBs. Although levels of these materials in lake sediment do not appear to be a serious concern in terms of direct exposure, some of these materials can be concentrated or accumulated in the food chain. Because of this, DNR has issued general “safe-eating guidelines” for all waters of the state, generally focused on pregnant women and their fetuses. Current sources of these pollutants can be reduced through nonpoint source pollution control programs. The effects of dredging or disturbance of previously deposited in-place pollutants is of concern and requires careful evaluation.

Other Lake Management Issues

There are other important lake management issues related to lake use which are interrelated with water quality management concerns and programs. These include programs to enhance recreational use and scenic enjoyment of the lakes and lake shorelines, management of lake levels and lake outflows, lake shoreline cleanup and maintenance activities, dredging, and management of the fisheries of the lakes.

The Yahara River Lakes Water Recreation Study (RPC, 1987, 1995) examines lake recreational uses, problems and issues, many of which are related to lake water quality conditions and management programs. The study addresses management programs, in addition to water quality improvement and lake management, directed at providing sufficient access and support facilities for swimming and boating, developing and enforcing boating and water safety programs and regulations, and monitoring and evaluating the growth and patterns of recreational use of the lakes in order to anticipate and avoid future use conflicts and problems.

The Yahara lakes support a diverse fishery, and fishing is one of the most popular uses of the lakes. DNR is the principal agency having both the technical expertise and institutional responsibility for managing the fisheries in Dane County lakes. Fishery management includes a variety of approaches, including fishing regulations, stocking, habitat improvement, and rough fish removal. Fishery management is also interrelated with aquatic weed and algae control.

Dane County manages lake levels and lake outflows under criteria and guidelines established by DNR. It would be useful to develop improved, more sophisticated and more precise operating rules for lake levels and outflows, treating the Yahara River lakes as a series of multipurpose reservoirs. These operating rules would need to address all of the competing, and sometimes conflicting, concerns related to lake levels and outflows. Improved lake level and flow management could result in improved flood control benefits and reduced flooding problems, better satisfaction of recreational access and use concerns related to lake levels, maintenance of lake levels most conducive to fish spawning conditions, use of lake level manipulation to better control and manage shallow shoreline aquatic weed growth and conditions, reduced shoreline ice and erosion damage, and better baseflow control to offset the effects of groundwater pumping and diversion.

As part of the Dane County Regional Hydrologic Study, the U.S. Geological Survey developed a Yahara Lakes reservoir routing model. The model provides the basis for an ongoing comprehensive management program focused on the hydraulics and hydrology of the entire Yahara lakes system. Evaluations of alternatives are expected to be conducted over the long-term, providing options for addressing problems associated with fluctuating lakes levels and flow that are either higher or lower than DNR regulatory limits, establishing realistic and achievable regulatory lake levels that address multiple use concerns, and evaluating potential management or structural measures that could be employed to reduce future problems.

The Yahara River watershed is one of the most rapidly urbanizing areas in the state and the water resource problems are accelerating along with the increased development. The urban areas are all experiencing dramatic increases in the amount of impervious area, resulting in increasing stormwater runoff to the lakes and decreasing infiltration to the groundwater system. This development is creating a potential for more frequent and more severe flooding during wet periods and is also creating a water demand that results in more frequent and more severe drought conditions during periods of low flow. In order to address these issues, a watershed runoff model is currently being developed by Dane County, in cooperation with Madison Gas & Electric, as well as state and local units of government.

Finally, the Yahara lakes, particularly Lake Mendota, and Lake Wingra and the UW Arboretum, represent important field laboratories for technical and scientific analyses and the study of limnology and lake ecosystems. A substantial body of scientific and technical information has been gathered for these lakes over several decades. This body of knowledge is important in lake studies and limnological research and has benefits beyond the boundaries of Dane County. It is important to continue to monitor water quality as well as physical and biological conditions of the major lakes in Dane County (particularly the Yahara lakes, Lake Wingra, and Fish Lake). This will provide valuable information for managing the Yahara River lakes, and it will expand the scientific data base and increase our knowledge of limnology, lake ecosystem, and lake management. In addition, these lakes can serve as field laboratories for promising lake management programs and approaches, and research.

Public information and education about the lakes and lake management is critical in maintaining public support for lake protection and management programs, and for increasing public understanding of the lakes' complex ecosystems, the problems and their causes, and developing a realistic vision of what the lakes can become.

LAKE MANAGEMENT RECOMMENDATIONS

- L-1: Dane County should continue to provide sufficient funds and personnel for mechanical weed harvesting and other environmentally sound aquatic plant management programs. Harvested weeds should continue to be recycled to land as mulch, fertilizer and soil conditioner rather than disposed in landfills.
- L-2: The use of chemicals for control of aquatic plants should continue to be limited to shallow water areas where other suitable management alternatives do not exist, and should be supervised by the Wisconsin Department of Natural Resources. Chemical treatment should be prohibited in sensitive lake areas identified by the DNR.
- L-3: Dane County should research and evaluate flow and lake level management strategies for the Yahara River lakes as a series of multipurpose reservoirs, and develop optimal operating and outflow/lake level control rules for the entire Yahara River system.
- L-4: Dane County should work with other units of government to finance and develop a Yahara River Watershed rainfall/runoff model to help mitigate the impact of flooding and drought conditions.
- L-5: Dane County should conduct a countywide study of dredging needs and associated problems of recreational navigability.
- L-6: Dane County should continue to develop and maintain active shoreline cleanup, improvement and maintenance programs aimed at reducing shoreline erosion and loss of riparian lands, and improving the aesthetics and stability of shorelines. Dane County should continue to coordinate an annual volunteer lakeshore cleanup event on all the Yahara River lakes and other county lakes where interest exists.
- L-7: Dane County should continue the long-term program of monitoring indicators of lake conditions on the major lakes in Dane County.
- L-8: Management agencies responsible for lakeshore parks and beaches should continue to conduct frequent monitoring at beaches throughout the swimming season to ensure conditions are safe for water-contact recreation.
- L-9: Continue to explore, evaluate, and promote promising in-lake management techniques such as biomanipulation of the food chain, improved fisheries and lake level management, phosphorus inactivation, hypolimnetic pumping, re-establishment and management of more desirable and diversified aquatic plant communities, lake drawdown, dredging, etc.
- L-10: Conduct information and education about lake management and water quality issues along with other water quality information and education programs aimed at landowners, residents, citizens, and lake users.
- L-11: Educate and inform water users in Dane County about the threats by invasive and exotic aquatic species.
- L-12: Participate with other public agencies and private environmental and conservation groups to implement the recommendations contained in the Yahara Lakes Advisory Group (YLAG) Report.

GROUNDWATER MANAGEMENT

Introduction

Since groundwater represents the source of all water supplies in Dane County, protection and management of the groundwater resource is a high priority. The discussion of groundwater quality conditions and problems in Chapter 2 indicates that groundwater in Dane County is of generally good quality, but that there have been localized instances of contamination from nearby pollution sources, particularly in the upper or shallow aquifer, affecting most individual private water supply wells. Areawide water supply concerns relate primarily to potential increases in nitrates, dissolved salts, and volatile organic compounds, which could affect the deep aquifers, from which most municipal water supplies are drawn.

Groundwater hydrology and the impacts of groundwater pumping and diversion described in Chapter 2 have been addressed through the Dane County Regional Hydrologic Study, and ongoing modeling and management programs.

The basic approach to groundwater protection and management is founded on two major considerations:

- (1) Siting and land use decisions:
 - Locating potential pollution sources in areas that minimize the risk of contaminating groundwater supplies.
 - Locating groundwater supply sources in areas where they will be protected from pollution sources.
- (2) Employing management practices and programs that are designed to reduce the risk of groundwater contamination from *potential pollution* sources.

Siting and Land Use Decisions

Siting and land use decisions which are based on an evaluation of potential groundwater impacts are the most effective defense against groundwater contamination problems which are irreversible or very costly to correct. It is important to evaluate, as part of the process of making land use decisions, whether the location of a potentially polluting activity poses a high risk of contaminating the groundwater, or whether the location of a well in relation to pollution sources results in a high risk of well contamination. Examples of these land use and siting decisions include locating landfills, waste disposal and land application sites, zoning changes, subdivision reviews, and conditional use permits related to a variety of potentially polluting activities, such as large on-site wastewater disposal systems or clusters of on-site wastewater disposal systems (as in rural residential subdivisions), junkyards and salvage yards, and pesticide or hazardous waste storage and handling facilities.

As part of the Dane County Hydrologic Study, Groundwater Contamination Risk maps have been developed. Map 4-1 indicates the risk of groundwater contamination from *surface* pollution sources. The map represents a combined overlay of the attenuating effects of soil properties, depth to bedrock, depth to groundwater,

and groundwater flow patterns. By removing the soil layer, a groundwater contamination risk map from *subsurface* sources has also been created (Map 4-2). Note that removing the natural ability of the soil to treat and remove pollutants results in an increased risk of contamination in some areas. The surface map indicates the relative contamination risk from activities conducted on the surface of the land, such as pesticide, fertilizer, sludge (biosolids) and septage application. The subsurface map indicates the relative contamination risk to groundwater from subsurface activities such as landfills, underground storage tanks and other pollution sources which are located below the soil zone. The groundwater contamination risk maps have been developed as tools to assist in the initial screening and evaluation of the potential for groundwater pollution from pollution sources or land uses. Suggested guidelines and criteria for using the contamination risk maps and for siting decisions have also been developed. Potential groundwater pollution sources are listed and have been mapped for Dane County in the *Dane County Groundwater Protection Plan*.

Since the contamination risk maps are based on generalized areawide information, they cannot be used to indicate the potential for localized problems or contamination of shallow, private wells from nearby pollution sources. To determine potential problems for these cases, and to assess situations for which the initial evaluation indicates a potential risk, more detailed site-specific information needs to be developed.

The maps also indicate areas (well protection zones) where pollutants have a greater likelihood of reaching municipal water supplies. More refined water supply, or Zones of Contribution (ZOC) maps, have been prepared by the Wisconsin Geological and Natural History Survey in cooperation with the DCRPC and local water utilities (Map 4-3). The ZOC maps provide the basis for developing local wellhead protection plans and ordinances. They are based on 5-, 50-, and 100-year travel times, or the time it takes for water to reach a well under an assumed rate of withdrawal. The ZOCs delineated on Map 4-3 are based on projected 2030 withdrawals for each community distributed evenly among existing and planned wells. ZOCs will vary based on different configuration of wells and withdrawal rates in a community, as well as interference from wells in adjacent communities. The Well Protection Zones on the Contamination Risk maps are based on the length of the 100-year, "maximum sustained" (one-half capacity) well withdrawal as the radius for each protection zone. DNR requires wellhead protection plans for all new wells constructed after 1992 (Adm. Code NR 811), but requires only a 5-year ZOC. For most Dane County wells, the 5-year ZOC — typically less than 1,000 feet across — is probably too small to offer much protection. The ZOC maps provide the technical bases for communities to develop well protection plans based on local priorities which may extend beyond state requirements.

In April 2004, the Legislature passed Wisconsin Act 310 which sets new standards and conditions for DNR approval of high capacity wells (>100,000 gallons per day), as well as other requirements for the management and use of groundwater. One of the most significant changes in the new groundwater law is that it directs DNR to review the environmental consequences of proposed high capacity wells within 1,200 feet of “Outstanding Resource Waters,” Exceptional Resource Waters,” trout streams, or certain springs. In addition, DNR has nearly completed and delivered Source Water Assessments to each community public water supplier. The 1996 Amendments to the Safe Drinking Water Act (SDWA) require states to develop and implement a Source Water Assessment Program. An assessment is a document produced by DNR staff that provides basic information to public water suppliers regarding: where their drinking water comes from, and the degree to which it may be impacted by potential sources of contamination. It also provides recommendations for source water protection. In addition, public water suppliers are required to provide Consumer Confidence Reports to their customers about the condition of the water in their systems.

As communities continue to grow and groundwater withdrawals increase, protection of groundwater will become even more important. Intergovernmental coordination and cooperation will be especially critical in addressing future impacts to our ground water and surface water resources, which do not recognize jurisdictional boundaries.

Pollution Control Practices

The application of management practices to reduce the risk of groundwater contamination from pollution sources was noted in Chapter 3 (Pollution Control) for major sources of groundwater contamination. Many of the program recommendations in Chapter 3, therefore, are specifically directed to groundwater protection and management. Pollution control practices not specifically covered in the recommendations in Chapter 3 include registration, monitoring, and testing of underground and above-ground storage tanks for gasoline products and chemicals, and emergency response programs designed to control and manage spills of contaminants or hazardous materials during storage, handling, and transportation. Programs have been developed by various state and federal agencies to address these areas of groundwater protection, and they need to be further expanded and coordinated with appropriate municipal personnel.

Water Supply Protection

Another aspect of groundwater protection and management involves programs and practices for locating wells where they are not near pollution sources. These practices utilize the most protected groundwater sources (the lower sandstone aquifer) for water supply, and employ construction standards to ensure that water supply wells are protected from direct and inadvertent contamination. In addition, proper procedures for sealing and abandoning wells, and restrictions on the use of wells for disposal of waste are also important management tools.

Although the emphasis of this water quality plan is on preventing or avoiding groundwater contamination, there still may be instances of contaminated water supplies. Information and assistance is available to individuals and governmental units for developing contingency plans, alternative sources of water, and treatment options.

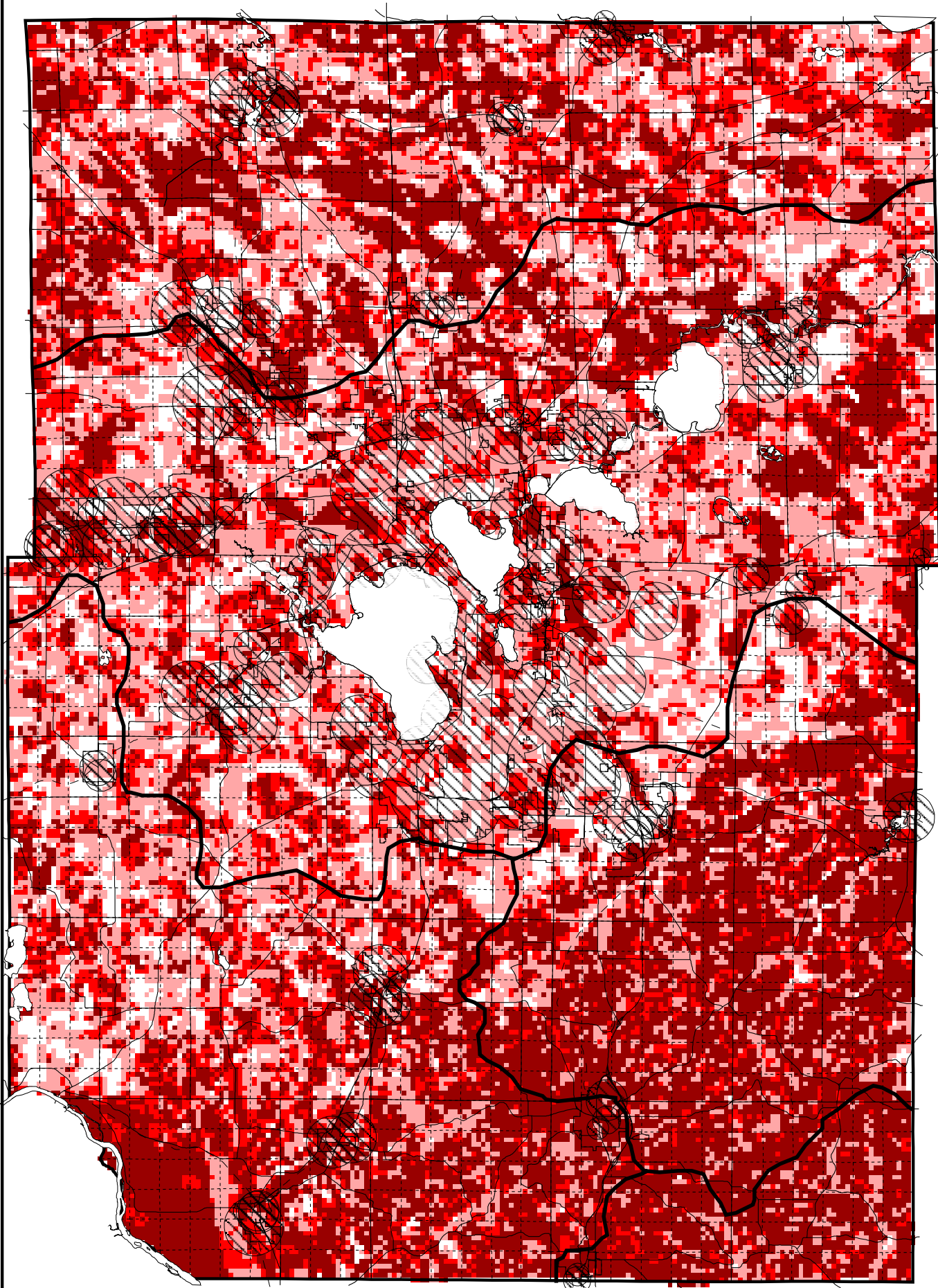
Information and Education Needs

In some cases, there is a lack of information on potential groundwater contamination problems, and additional monitoring is needed to determine the extent and seriousness of these problems. Problem areas which should receive priority for additional attention include monitoring of existing and abandoned landfills in municipal well protection zones; monitoring of agricultural pesticides in groundwater, particularly in areas most susceptible to contamination; and monitoring to determine the effects of clusters of on-site wastewater systems on local shallow groundwater nitrate levels.

An expanded public information and education program on groundwater is also needed. It should be directed at those households most vulnerable to potential groundwater contamination—rural households depending on shallow, private water supply wells. The information and education program should include guidance on proper siting, construction, and (especially) maintenance and servicing of on-site wastewater disposal systems; proper siting, construction, and testing needs for wells and water supplies; and information and recommendations on proper use, storage, and disposal of potentially hazardous or toxic materials such as pesticides, cleaning agents, and other potentially hazardous household products. Education efforts should emphasize the vulnerability of groundwater to contamination – that once it is contaminated it is very difficult, if not impossible, to restore to its original quality.

Groundwater Contamination Risk Maps Guidelines and Criteria

Pollution Source	Contamination Risk Map to Use	Guidelines and Criteria
1. Sanitary Landfill	Subsurface	Proposed landfills should be located outside of municipal well protection zones and areas of high or extreme contamination risk. High priority for monitoring active and abandoned landfills should be for those landfills in areas of high or extreme risk in municipal well protection zones.
2. On-Site Wastewater Systems	Subsurface	Proposed large on-site systems, or clusters of more than 20 on-site systems, which would result in an overall loading of more than 150 gal/acre/day (which roughly corresponds to a 1.0 to 1.5-acre lot size) should be carefully evaluated to ensure that groundwater standards will not be violated.
3. Wastewater Lagoons and Infiltration Ponds	Subsurface	Proposed wastewater lagoons and infiltration areas should be located outside of municipal well protection zones and areas of extreme contamination risk. Existing lagoons and ponds in municipal well protection zones should be monitored.
4. Wastewater Irrigation and Landspreading Sites	Surface	Proposed wastewater irrigation and landspreading sites should not be located in areas of extreme contamination risk. Existing and future sites in municipal well protection zones should be monitored and subject to stringent design and operating requirements.
5. Underground Storage Tanks	Subsurface	Stringent design and periodic testing for corrosion protection and leak containment should be required of all existing and proposed underground tanks storing hazardous or flammable materials within municipal well protection zones and in areas of extreme contamination risk outside of well protection zones. Existing tanks in these areas not providing adequate corrosion protection or leak containment should be immediately replaced or properly abandoned.
6. Above-ground Storage Tanks	Surface	Strict design criteria should be required for spill or leak containment for all above-ground tanks storing hazardous or flammable materials within municipal well protection zones and in areas of greatest pollution hazard outside of well protection zones. Existing tanks in these areas without adequate spill or leak containment should be replaced or properly abandoned.
7. Land Application of Sludge (Biosolids) and Septage	Surface	Application sites should not be located in areas of greatest pollution hazard. Sites in areas of high or moderate risk should receive highest priority in enforcement of existing siting guidelines, and should receive increased surveillance to ensure applications adhere to state guidelines and criteria.
8. Large Manure Storage Lagoons and Feedlots	Subsurface	Proposed large feedlots and manure storage lagoons should not be located in areas of high or extreme contamination risk. Strict design criteria and monitoring or storage lagoons should be required for all large lagoons in areas of moderate contamination risk.



Groundwater Contamination Risk from Surface Activities

Dane County, Wisconsin

Risk

Low	Moderate	High	Extreme
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Well Protection Zone

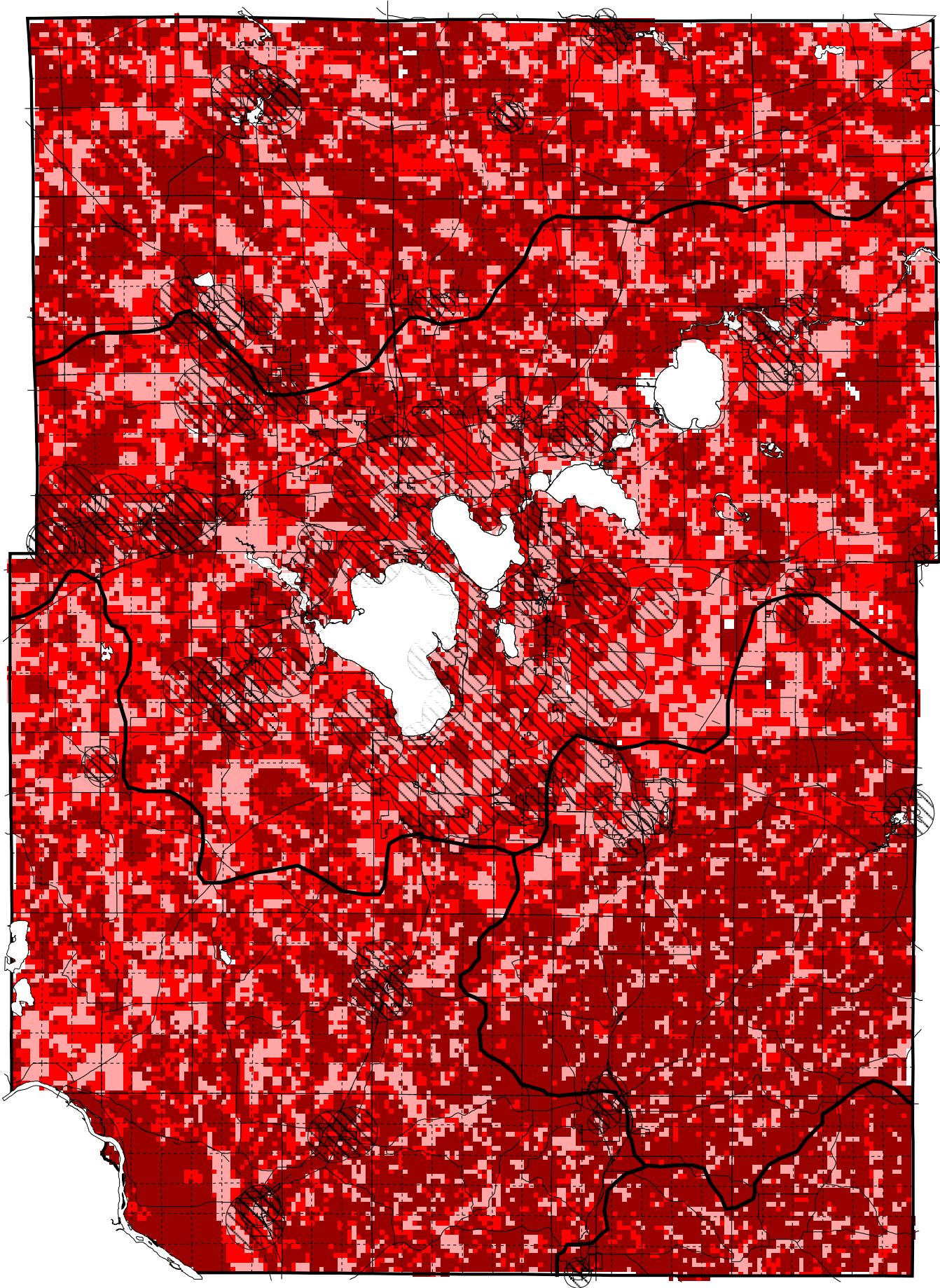
Major Groundwater Divide

Map 4-1

Prepared by: The Dane County Regional Planning Commission
 Projection: Lambert Conformal Conic
 Dane County Coordinates - NAD 83(91)



Source: Fritz, 1996, developed as part of the Dane County Regional Hydrologic Study



Groundwater Contamination Risk from Subsurface Activities Dane County, Wisconsin

Map 4-2

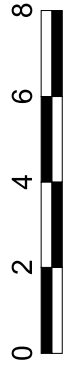
Risk

- Low
- Moderate
- High
- Extreme

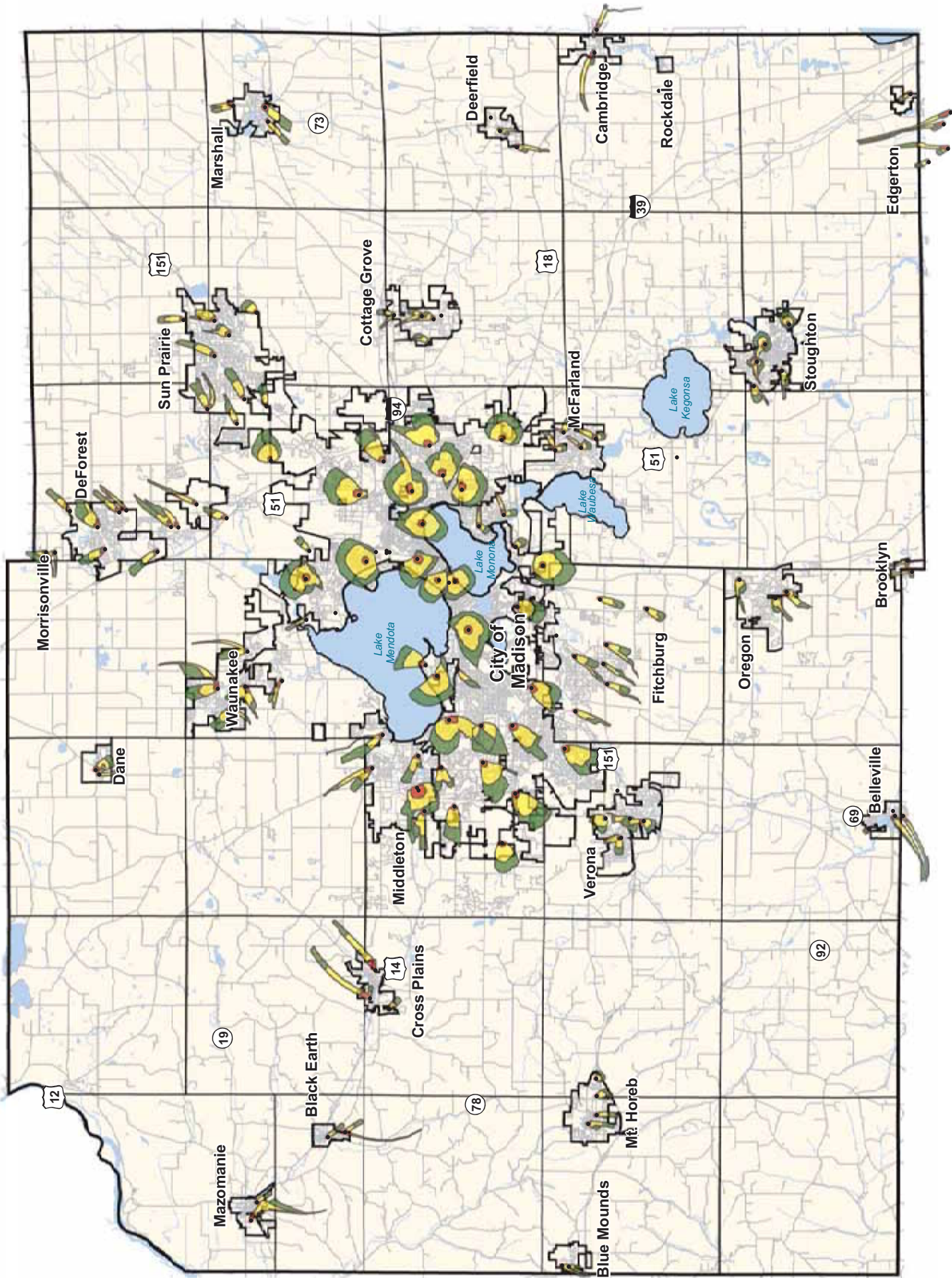
- Well Protection Zone
- Major Groundwater Divide

Prepared by: The Dane County
Regional Planning Commission

Projection:
Lambert Conformal Conic
Dane County Coordinates - (MAD 83191)



Source: Fritz, 1996, developed as part of the Dane County Regional Hydrologic Study



Zones of Contribution for Municipal Wells (projected 2030 Pumping Rates) Dane County, Wisconsin

Well

Zones of Contribution

- 5 - Year
- 50 - Year
- 100 - Year

Map 4-3

Projection: Cyclic
Dane County Coordinates - NAD 83(91)
Prepared by: The Dane County
Regional Planning Commission

0 0.5 1 2 3 4 5
Miles

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GROUNDWATER MANAGEMENT RECOMMENDATIONS

- G-1: All land use and siting decisions in Dane County should include evaluation of potential groundwater and hydrologic impacts. Incorporate and use the information, tools, criteria, and guidelines identified in the Dane County Groundwater Protection Plan, and coordinate with local agencies. Applicants for land use or siting approvals, such as zoning or subdivision approvals, site or development plan approvals, urban service area additions, or state, federal, or local land disturbance or discharge permit approvals, should provide sufficient information to allow the regulatory agency to evaluate the potential groundwater and hydrologic impacts of the proposed activity or development. Evidence of significant unaddressed or unmitigated groundwater or hydrologic impacts should provide the basis for withholding approval for the requested activity or development, or for requiring additional information to be submitted by the applicant before approval is granted. Compliance with state surface water and groundwater standards should be included in the evaluation along with hydrologic impacts. The guidelines and criteria listed in the table on page 62 should be used in conjunction with the groundwater contamination risk maps for preliminary screening and evaluating the potential impacts.
- G-2: State and local agencies should work cooperatively to develop wellhead protection programs to protect municipal water supplies, including adopting more stringent siting and land use regulations for potentially polluting activities in wellhead protection zones. The guidelines and criteria for using the groundwater contamination risk maps in the table on page 62 can provide a basis for these more stringent land use and siting criteria in well protection zones.
- G-3: Conduct additional groundwater quality monitoring related to the impacts of closed landfills, barnyard and livestock waste storage, agricultural fertilizer and pesticide use, unsewered subdivisions, and land application of septage.
- G-4: Underground and above-ground storage tank monitoring and testing programs, and emergency spill response and cleanup programs should continue to be developed.
- G-5: Dane County should conduct an aggressive public information and education program to inform rural homeowners of proper use and maintenance of on-site waste disposal systems, along with information on well protection and disposal of household hazardous wastes.
- G-6: Inform and educate farmers, homeowners, and commercial businesses on safe handling of chemicals, including the vulnerability of groundwater to contamination and the tremendous difficulty and expense of restoring it to its original condition. Proper on-farm storage of fuel, pesticides, and fertilizers should receive greater emphasis.
- G-7: Provide rural homeowners information, guidelines, and contacts for testing their wells and drinking water supplies.
- G-8: Develop a strategy for the proper abandonment of unused wells.
- G-9: Measures should be taken to protect groundwater recharge areas and springs. Especially in urban areas, the adverse impacts of development on groundwater, including diversion through pumpage and sewerage, as well as loss of recharge due to expanded impervious area, are significant and should be mitigated to the maximum extent practicable.
- G-10: State and local agencies should work together to develop a comprehensive groundwater information and education program.