APPENDIX B

Ecological Basis for Design Criteria

This appendix provides information pertaining to the ecological basis for developing the Design Criteria for each of the natural features. The specific ecological purpose for each of the natural features has been researched, analyzed, and reviewed by the Environmental Advisory Committee. Based on this process, the following ecological basis for each natural feature has been concluded.

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Section 1 Lakes and Streams

1. **Ecological and Character Factors to Consider**. Land use planning should consider the following ecological and character factors in establishing lake and stream regulations:

    a. The amount of impervious surface within a watershed is a strong indicator of the degree of risk to water quality. A watershed with more than 10% impervious surface is likely see impacts to water quality, and with impervious surface coverage greater than 25% is likely to degrade water quality (Schueler, 1994, 2003). Shoreland areas are particularly critical to protecting water quality, and impervious surface limitations of 10-15% are generally recommended (Cappiella and Schueler, 2001). Managing stormwater on-site using infiltration techniques on appropriate soils and retaining critical open space areas can greatly (but not completely) mitigate the impacts of impervious surfaces on water quality (Assessment and Rationale for the Alternative Shoreland standards, DNR, 2006).

    b. Retaining vegetative cover is critical to maintaining surface water quality and protecting stream and lake banks (and nearby slopes) from erosion. Land erodes 2,000 times faster when vegetative cover is removed because vegetation lessens the impact of falling rains and slows runoff so that water can be absorbed gradually into the soil (*Preserving Natural Resources Through Local Environmental Laws: A Guidebook for Local Governments*. Land Use Law Center, Pace University School of Law. White Plains, NY. 2001. www.pace.edu/lawschool/landuse/).

    c. Non-point source pollution from stormwater is as great or greater contributor to pollution and nutrient loading in Minnesota lakes than septic systems. Historic assumptions behind different setback and lot width standards for sewered and unsewered shoreland development are no longer justified (Assessment and Rationale for the Alternative Shoreland Management Standards, Minnesota DNR, 2005, p. 23)

    d. Natural vegetation in shoreland areas provides visual and physical definition that defines Shakopee's visual and ecological character. Building placement and design within shoreland areas can change the character of adjacent neighborhoods and natural areas (*Mississippi National River and Recreation Area Comprehensive Plan*, National Park Service, U.S. Dept. of the Interior, 1995, *Mississippi River Critical Area Task Force Report: A Summary For Public Discussion,* Department Of Planning & Economic Development, City Of Saint Paul, 2006).

2. **Minimum Primary Shoreland Buffers Required**. Establishing a minimum buffer distance from the ordinary high water level (OHWL) and buffer vegetative characteristics, provides critical water quality protection. Buffer less than 50 feet in width provide little benefit, and buffers as large as 100 feet are frequently necessary to remove most of the phosphorus and other nutrients in stormwater (DNR, 2006). Buffers must include a variety of indigenous shoreland vegetation to slow and cool stormwater, and remove sediment and nutrients (DNR, 2006).

3. **Minimum Secondary Shoreland Buffers Required**. Secondary buffers are the area between the primary buffer and the building or other impervious surface. A minimum of 25 feet between the primary buffer and buildings is necessary to retain the appropriate functioning of the primary buffer (DNR, 2006).

4. **Management and Protection of Vegetation**. No clearing should be allowed within the primary buffer (shore impact zone), with exceptions for approved vegetative management plans. Additional design criteria for clearing on slopes between 6 and 15% should be considered in order to mitigate risk, based on the best management practices described in *Protecting Water Quality in Urban Areas,* Minnesota Pollution Control Agency, 2000, or most recent version.

5. **Scenic and Character Protection**. Prominent natural features, including shoreland areas as seen across the water or from shoreland bluffs and steep slopes, contribute to Shakopee's character. Shoreland areas should have a combination of setbacks and screening requirements including protection of native vegetation within the buffer area, and architectural design preferences to address the impact of development on the character of communities and natural areas (National Park Service, 1995; City of St. Paul, 2006).

6. **Protecting Open Space Areas.** Development design criteria cannot fully mitigate for the impacts of impervious surfaces on water quality, habitat, and community character. Open space needs to be included in shoreland subdivisions, permanently retained as either public or private space that fulfills natural systems functions (Booth, et al., 2004)

7. **Preference for Conservation Design and Low-Impact Development Techniques.** Conservation design in new subdivisions, and low-impact development in building and infrastructure design, capture many of the elements described above (2 through 6). Conservation design and low-impact development concepts should be applied in new subdivisions in shoreland areas.

Section 2 Wetlands

1. **Ecological factors to consider**. Land use planning should consider the following ecological factors in establishing wetland regulations *(Benefits of Wetland Buffers: A Study of Functions, Values and Size, 2001)*:

    a. Wetlands serve a variety of functions within the eco-system, including water quality protection, hydrologic event modification, habitat protection, and provision of open space. All wetlands serve at least one of these functions, and many will serve multiple functions.

    b. Buffering wetland areas from development is the primary method of protecting wetland functions from development or impacts associated with many land uses. Pretreatment of runoff is needed so that the natural wetland functions are not overwhelmed by sediments, heat, and water volume from urban runoff. Buffer areas play a non-structural role in pre-treatment simply by serving as a place for runoff to filter, soak in, contact soil and be taken up by vegetation.

    c. Wetland buffers may be inadequate to protect wetland functions influenced by the broader watershed and surrounding landscape, particularly in developed watersheds. In order to minimize the storm water-related impacts on wetlands, drainage areas beyond the buffer may need to meet design criteria that minimize impervious surfaces, retain woodlands, cluster development or impervious surfaces, restore drained wetlands, or construct infiltration systems where feasible (*Azous et al., 1997).*

2. **Minimum Buffer**. Establishing a minimum buffer around all wetlands, regardless of function, recognizes that wetlands need not be high quality to serve critical functions. Buffers of less than 50 feet are only marginally effective in protecting wetland functions (*Benefits of Wetland Buffers, 2001*). Buffers less than 50 feet should be used only for wetlands with a lower MnRAM rating, wetlands that serve primarily a floodwater function, and wetlands with little or no local priority value.

3. **Watershed Functionality**. Many wetlands in Shakopee and in watersheds that extend through Shakopee have been drained ~~as indicated in Figure 2.2~~. As the function of these wetlands has been lost, greater pressure is placed on remaining wetlands. Restoration of drained wetlands or mitigation that enhances wetland function within impacted watersheds will improve the viability of Shakopee's remaining wetlands.

4. **Maintaining Green Infrastructure**. Protecting the wetland function requires that buffer and wetland areas are maintained consistent with the functions that need to be protected. Wetlands are part of the City's infrastructure, and require ongoing maintenance and investment, just as other infrastructure must be maintained.

Section 3 Woodlands

1. **Ecological Factors to Consider**. Land use planning should consider the following ecological factors in establishing woodland regulations (Environmental Law Institute 2003):
    a. The types of species in your community's woodland habitats. Different species of trees and animals require different size areas (patches) to thrive. Large patches provide better sustainability of wildlife populations and ecosystem functions over time than small patches.
    b. The core area of the patch size. Core area is defined by the ratio of the perimeter of the patch edge to the interior area of the patch. A low ratio of edge to interior indicates more interior habitat available (core area). Certain plant and animal species require larger core areas to survive.
    c. The extent of connectedness or fragmentation of woodland patches. Certain animal species require a level of connectedness between woodland patches to thrive. The more connected woodland patches are to other habitats and woodlands, the better the chance at maintaining viable habitat. A series of small or medium sized patches may capture a greater diversity of habitat types and biological diversity than the preservation of one large fragment.
2. **Minimum Patch Size Recommended**. Establishing a minimum patch size for protection addresses the factors listed above. An estimated five (5) acres is needed to sustain a representative tree community type and at least twenty-five (25) acres is needed to conserve an old growth forest if surrounded by secondary forest, or two hundred fifty (250) acres if surrounded by cleared land. (Environmental Law Institute 2003)
3. **Ability to Achieve Recommended Minimum Patch Size**. Of the original woodland area of Shakopee, there are now only 189 patches left ranging from 0.3 acres to 194 acres in size. The 189 patches encompass about 2000 acres or 10% of the entire City area and very few patches have a core area suitable to protect interior woodland species. Only 31 of these patches are greater than 15 acres.

Section 4 Upland Vegetation

1. **Ecological Factors to Consider**. Land use planning should consider the following ecological factors in establishing regulations for areas with high quality native vegetation, and those non-developed areas connecting stands of high quality vegetation.

    a. Much of the region's original grassland flora is now considered rare. This pervasive rarity among grassland plants is due to the extensive loss of the original grassland sod and the conservative nature of many grassland plants, which are rarely found outside of native vegetation remnants Tall grass prairies and related oak savannas are now the most decimated and threatened plan communities in the Midwest (*Wisconsin's Biodiversity as a Management Issue – Chapter 8 Grassland Communities*. Richard Henderson. Wisconsin Department of Natural Resources. May 1995. http://dnr.wi.gov/org/land/er/biodiversity/report.htm#report).

    b. Major vegetation changes within savannas took decades, if not centuries, to occur. Today oak savanna now shares equal billing with tall grass prairie as the most threatened plant community in the Midwest and among the most threatened in the world (*Wisconsin's Biodiversity as a Management Issue – Chapter 6 Oak Savanna Communities*. Richard Henderson. Wisconsin Department of Natural Resources. May 1995).

    c. The retreat of agriculture in the face of urban expansion has lead to an abandonment of light to moderate grazing pattern in wooded pastures and a subsequent acceleration of succession of oak woodlots toward heavy shade producing trees and shrubs. The remaining remnants of savanna flora and fauna are in need of restoration, including tree thinning, brushing, and burning. In the absence of fire or grazing, savanna and brush-prairie communities rapidly succeed to woodland , which does not sustain the same habitat as the savanna and prairie (Henderson, Grassland Communities, 1995).

    d. Many the savanna mammals, birds, reptiles, and amphibians have adapted to the changed landscape or they have managed to hang on and survive in suboptimal habitat. The ability of the vertebrate animals to adapt has been due to the major elements of savanna structure that are still well represented today in various "edge" habitats, including pastures, lawns, and woodlots (Henderson, Oak Savanna Communities, 1995). Maintenance of the system of "edge" habitats is critical to the habitat function of the City's oak savanna remnants.

2. **Buffer Required for Small Stands or Remnants**. Establishing a minimum buffer prevents buildings from encroaching into the high quality vegetation areas, while allowing some 'edge' habitat to help sustain many of the savanna and prairie remnants.

3. **Prohibition on Intensive Vegetative Clearing and Grading**. Clearing or grading of high quality upland vegetation areas should be prohibited in the Natural Resources Corridor, and limited in other areas, except for approved restoration efforts.

4. **Encourage or Require Restoration Measures**. Development on or adjacent to Shakopee's high quality native vegetation areas presents an opportunity for restoration of the prairie or oak savanna habitat, and is encouraged to be part of the subdivision or development process. These sites cannot be sustained merely by

preventing high quality vegetation sites from being developed. These areas will require management (i.e., fire management, invasive species reduction, seeding) in order to sustain the habitat.

5. **Maintaining Corridors and Habitat Connectivity**. Many of the high quality vegetation areas in Shakopee are within or adjacent to the Natural Resources Corridor identified in the Comprehensive Plan. High quality upland vegetation areas, and lower priority vegetated areas connecting them, are priorities for maintaining or creating connectivity within the Natural Resources Corridor.

Section 5 Wildlife Habitat

1. **Ecological Factors to Consider**. Land use planning should consider the following ecological factors in establishing regulations for wildlife corridors connecting high quality habitat patches.

    a. Habitat fragmentation significantly reduces wildlife populations and diversity. When wildlife is contained to small, isolated patches of habitat, resources required for survival such as food, water, cover and mating opportunities become scarce. Depending on the extent of fragmentation, populations can become unstable and entire species can disappear from a region. (Bond, Monica. 2003. *Principles of Wildlife Corridor Design***.** Center for Biological Diversity).

    b. Wildlife corridor can negate the effects of fragmentation by restoring connectivity to fragmented patches of habitat. Wildlife corridors are linear landscape features composed of native vegetation that connect two or more habitat patches to allow for the movement of animals, birds and other species. (*Conservation Thresholds for Land Use Planners***.** 2003. The Environmental Law Institute. Washington D.C. ISBN# 1-58576-085-7).

    c. Corridors are particularly imperative for wildlife when they connect widely spaced habitat patches and when they provide a travel route through highly developed, low-quality habitat. In these cases, a wildlife corridor may be the only means for a species to move between habitat patches. (*Conservation Thresholds for Land Use Planners***.** 2003. The Environmental Law Institute. Washington D.C. ISBN# 1-58576-085-7).

2. **Corridor Width**. Wildlife abundance and diversity within corridors is positively correlated with the width of corridors. Wider corridors provide more interior habitat and greater protection from human disturbances and predators. (Lindenmayer, B. and J. Franklin. 2002. *Conserving Forest Biodiversity: A Comprehensive Multiscaled Approach***.** Island Press, Washington DC.)

3. **Corridor Configuration**. Interconnected networks of corridors allow the fullest range of wildlife movement. Ideally, corridors should extend across a topographical gradient, i.e. from river bottom to ridge top, to connect the widest variety of local microhabitats. This configuration is especially important for wildlife that migrates between different types of habitat throughout their lifecycles.

4. **Encourage or Require Restoration Measures**. Maintaining native vegetation within corridors provides concealing cover and food sources for wildlife. Within the Natural Resources Corridor selected restoration of habitat will sustain Shakopee's natural heritage into the future as the city grows.

5. **Minimize Barriers to Movement within Corridors**. Fences and roads are barriers to wildlife movement. Corridors should not be directed across roads, and new roads should not cross corridors or should accommodate wildlife movement. Night lights can also represent a barrier to wildlife movement. Night time yard and street lights shall be directed away from corridors.

6. **Require or Encourage a Buffer Zone around Corridors**. Providing a buffer zone of somewhat natural habitat around the corridor increases the effectiveness of the corridor. Development within the Natural Resources Corridor shall incorporate edge habitat design criteria along wildlife corridors.

Section 6 Endangered and Threatened Species

Conserve the ecosystem upon which species classified as endangered, threatened, or of special concern depend for survival to ensure ecological diversity.

1. **High Quality of Life**. Protecting the environment to ensure a diversity of flora and fauna species is a strategy included in the visioning initiative to achieve the goal of a high quality of life for the City.
2. **Compliance with Federal and State Law**. The federal Endangered Species Act of 1973, as amended, and the Minnesota Endangered Species Statute, as amended.
3. **Recognizing Eco-system Design Criteria**. The Minnesota Endangered Species Statute does not require protection or maintenance of habitat that supports species that are endangered, threatened, or of special concern. Ensuring that endangered and threatened species habitat is maintained within Shakopee's Natural Resources Corridor will help sustain the City's natural heritage as the City continues to grow.

Section 7 Steep Slopes and Bluffs

1. **Ecological and Character Factors to Consider.** Land use planning should consider the following ecological and character factors in establishing steep slope and bluff regulations:

    a. Steep slopes and bluffs provide visual and physical definition to the landscape that defines both the visual and ecological character of the community. Building placement and design on or near prominent natural features can affect the ecological function of the feature and change the character of adjacent neighborhoods and natural areas (*Mississippi National River and Recreation Area Comprehensive Plan*, National Park Service, U.S. Dept. of the Interior, 1995, *Mississippi River Critical Area Task Force Report: A Summary For Public Discussion,* Department Of Planning & Economic Development, City Of Saint Paul, 2006).

    b. The slope of the land on either side of a water body is very significant in determining effectiveness of the buffer in trapping sediment and retaining nutrients. The steeper the slope, the higher the velocity of overland flow and the less time it takes nutrients and other contaminants to pass through the buffer. Slope is a variable in virtually all models of buffer effectiveness and should definitely be included in a formula for buffer width (*A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation*. Seth Wenger. Institute of Ecology, University of Georgia. Revised March 1999).

    c. Retaining vegetative cover on slopes is critical to maintaining surface water quality and protecting slopes from erosion. Land erodes 2,000 times faster when vegetative cover is removed because vegetation lessens the impact of falling rains and slows runoff so that water can be absorbed gradually into the soil (*Preserving Natural Resources Through Local Environmental Laws: A Guidebook for Local Governments*. Land Use Law Center, Pace University School of Law. White Plains, NY. 2001. www.pace.edu/lawschool/landuse/).

    d. Soil types, in association with the gradient of slope and slope length, greatly affect the ability of the slope to accommodate development or clearing. The erosion potential of water flow increases with slope and length; the greater the slope length, the greater the erosion hazard. Highly erodible lands, such as silt sands, will increase erosion potential. (*Protecting Water Quality in Urban Areas – Best Management Practices for Dealing with Storm Water Runoff from Urban, Suburban and Developing Areas of Minnesota*. Minnesota Pollution Control Agency. 2000).

2. **Minimum Buffer Recommended.** Establishing a minimum buffer at the top of all steep slopes and bluffs provides visual protection for topographic features and a minimum threshold of protection from the effects of impervious surface on stormwater velocity. Buffers at the top of the slope should be a minimum of two feet per 1% increase in slope, starting at a 12% threshold (Wenger, 1999; MPCA, 2000; National Park Service, 1995; City of St. Paul, 2006).

3. **Prohibition on Vegetative Clearing.** No clearing should be allowed on slopes in excess of 12%, in the presence of erodible lands, with exceptions for approved vegetative management plans. Additional design criteria for clearing on slopes between 6 and 15% should be considered in order to mitigate risk, based on the best management practices described in *Protecting Water Quality in Urban Areas,* Minnesota Pollution Control Agency, 2000, or most recent version.

4. **Scenic and Character Protection.** Prominent natural features, including bluffs and steep slopes, define the character of adjacent natural areas and neighborhoods. Steep slopes and bluffs are frequently prominent components of the public viewshed. Bluffs and steep slopes abutting and upland of public lands or waters should have a combination of setbacks, screening requirements including protection of native vegetation within the buffer area, and architectural design preferences to address the impact of development on the character of communities and natural areas (*Regulating Development on Steep Slopes, Hillsides, and Ridgelines.* Lakes Region Planning Commission. 2005. Meredith, NH, www.lakesrpc.org; National Park Service, 1995; City of St. Paul, 2006)

5. **Protecting Erodible Lands.** Erodible lands increase the risks associated with development in areas with slopes. Stable soils on a 15% slope may allow for development with minimal risk of erosion if general best management practices are used, while erodible lands on a 6% slope might create a high level of risk for development or infrastructure that requires additional BMP's (MPCA, 2000).

Section 8 Recreation Opportunities

Create an active and healthy community. Protecting the environment enhances the physical, mental, and spiritual health of the City.

1. Views of nature have positive, physiological impacts on individuals whether or not they are consciously aware of them. These effects include lower blood pressure, reduced muscle tension, and lower skin conductance *(Human Issues in Horticulture: HortTechnology, April/June 1992 2(2))*.
2. Scenes with plants are highly preferred over those without, and plants play a significant role in neighborhood satisfaction. The proper maintenance of plants is also a factor in positive perception of plants. By working together in tree plantings, community gardens, and beautification projects, people get to know each other, thus creating a true community with inhabitants who have a sense of allegiance to and responsibility for their surroundings *(Human Issues in Horticulture: HortTechnology, April/June 1992 2(2))*.
3. Plants are extremely important in mediating environmental factors, such as temperature, noise, and pollution *(Human Issues in Horticulture: HortTechnology, April/June 1992 2(2))*.

Section 9 Accessibility/Infrastructure

Protecting the environment to ensure a diversity of flora and fauna species is a strategy included in the visioning initiative to achieve the goal of a high quality of life for the City.

Section 10 Connectivity

Create an active and healthy community. Protecting the environment and enhancing the physical, mental, and spiritual health of the City.

1. Views of nature have positive, physiological impacts on individuals whether or not they are consciously aware of them. These effects include lower blood pressure, reduced muscle tension, and lower skin conductance *(Human Issues in Horticulture: HortTechnology, April/June 1992 2(2))*.
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