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for the City of Cumberland

City of Cumberland Stormwater Management Plan

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1. INTRODUCTION

The city of Cumberland and the Beaver Dam Lake Management District are active managers of their water resources. Lakes surround the 'Island City' and cover 14% of the city's four square miles. In the interest of the health of Beaver Dam Lake and its bays (Cemetery Bay, Norwegian Bay, Rabbit Island Bay and Library Lake), Collingwood Lake, the Hay River and adjacent waterbodies, the city of Cumberland has authorized the development of this stormwater management plan.

The city of Cumberland and the Beaver Dam Lake Management District are in the initial phases of a implementing a master plan for Library Lake in downtown Cumberland. As a part of this effort, the Library Lake Management Plan was developed which provides a valuable history of the degradation of the lake and identifies each phase of the master plan. Please refer to the Library Lake Management Plan for these details.

Chapter 2 Water Resource and Landuse Summary describes the city's water resources and landscape characteristics: sensitive areas, landuse, soils and hydrology. *Chapter 3 Current Conditions of Surface Waters* is a thorough compilation of findings on the current condition of surface waters based on studies conducted for lake management work. Surface water characteristics such as water quality, aquatic vegetation and fish are summarized. Greater detail is presented in Appendix A. Based on this information, surface water resource goals and needs for this stormwater management plan were developed and are presented in *Chapter 4 Plan Goals and Identified Needs*.

Chapter 5 Watershed Modeling describes runoff and water quality modeling conducted specifically for the identification of target drainage areas for stormwater management within the city of Cumberland. Ultimately, practical stormwater management recommendations are made based on model results and findings from field visits. These recommendations are presented in *Chapter 6 Stormwater Management Recommendations*.

Chapter 7 Stormwater Best Management Practices is a general description of structural and programmatic stormwater best management practices (BMPs) identified by the city of Cumberland as appropriate tools to achieve plan goals. The following BMPs are targeted:

Structural BMPs

- Bioretention (page 39)
- Vegetated Swales and Buffers (page 40)
- Pervious Pavements (page 43)
- Infiltration (Infiltration Trench / French Drain and Underground Infiltration) (page 45)
- Stormwater Wetlands (page 48)
- Stormwater Ponds (page 49)
- Sediment Traps (page 50)
- Amended Soils (page 51)
- Urban Forestry (page 52)
- Native Landscaping (page 53)

- Reducing Impervious Surfaces (page 53)
- Open Space Design (page 54)

Programmatic BMPs:

- Rules and Ordinances (page 56)
- Rainwater Harvesting / Stormwater Reuse (page 58)
- Vacuum Sweeping of Streets and Parking Lots (page 60)
- Erosion and Sediment Control Training Programs (page 60)
- Fertilizer/Chemical Application Management (page 62)
- Stormwater Utility (page 62)
- Public and Municipal Staff Education (page 63)
- Winter Road Materials Management (page 63)
- Potential Discharge Identification and Risk Reduction (page 64)
- Hazardous Material Storage and Handling (page 65)

Chapter 8 Ordinance Gap Analysis entails a review of city ordinances for their ability to accommodate and/or facilitate development that contributes to healthy surface waters (practices that reduce impervious surfaces and enhance infiltration, water quality treatment, and volume control).

Chapter 9 Public Outreach, Information & Education Framework provides a framework for public outreach, information and education programming.

Chapter 10 Implementation Plan provides a detailed stormwater management implementation plan including action items, planning-level costs, responsible parties, and a timeline.

Chapter 11 Financing Options provides general description of options the city will consider in order to fund action items of the implementation plan:

- Stormwater utility
- Area charges (and other fees)
- Municipal bonding
- Grants and loans

References are provided in *Chapter 12 References* and appendices follow.

2. WATER RESOURCE AND LAND USE SUMMARY

The city of Cumberland in Barron County, Wisconsin, is four square miles in size, 14% of which is Beaver Dam Lake and its bays (Cemetery Bay, Norwegian Bay, Rabbit Island Bay and Library Lake) and Collingwood Lake. Beaver Dam Lake and its lakeshed extend considerably beyond city boundaries (Figure 1). Beaver Dam Lake and its bays, Collingwood Lake, and the Hay River in the city of Cumberland are recognized as Areas of Special Natural Resource Interest (ASNRI) by the Wisconsin Department of Natural Resources (DNR). Beaver Dam Lake is a destination for recreation. It has five boat landings, five swimming beaches and a fishing pier.

Sensitive Areas

The DNR is given the authority for the identification and protection of *sensitive areas* of the Wisconsin lakes. In 2007, the Wisconsin Department of Natural Resources (DNR) completed the fieldwork for the Beaver Dam Lake *critical habitat area* survey though designations are not yet available from the DNR. *Critical habitat areas* include both *sensitive areas* and *public rights features* that are important for preserving the character and qualities of the lake. *Sensitive areas* offer critical or unique fish and wildlife habitat (including seasonal or life stage requirements) or offer water quality or erosion control benefits to the area (Administrative code 107.05(3)(1)(1)). They provide important habitat for game fish, forage fish, macroinvertebrates, and wildlife, as well as important shoreline stabilization functions. *Public rights features* are areas that fulfill the right of the public for navigation, quality and quantity of water, fishing, swimming, or natural scenic beauty. Protecting these *critical habitat areas* requires the protection of both shoreline and in-lake habitat. Ultimately, the *critical habitat area* designation provides a framework for management decisions that impact the ecosystem of the lake.

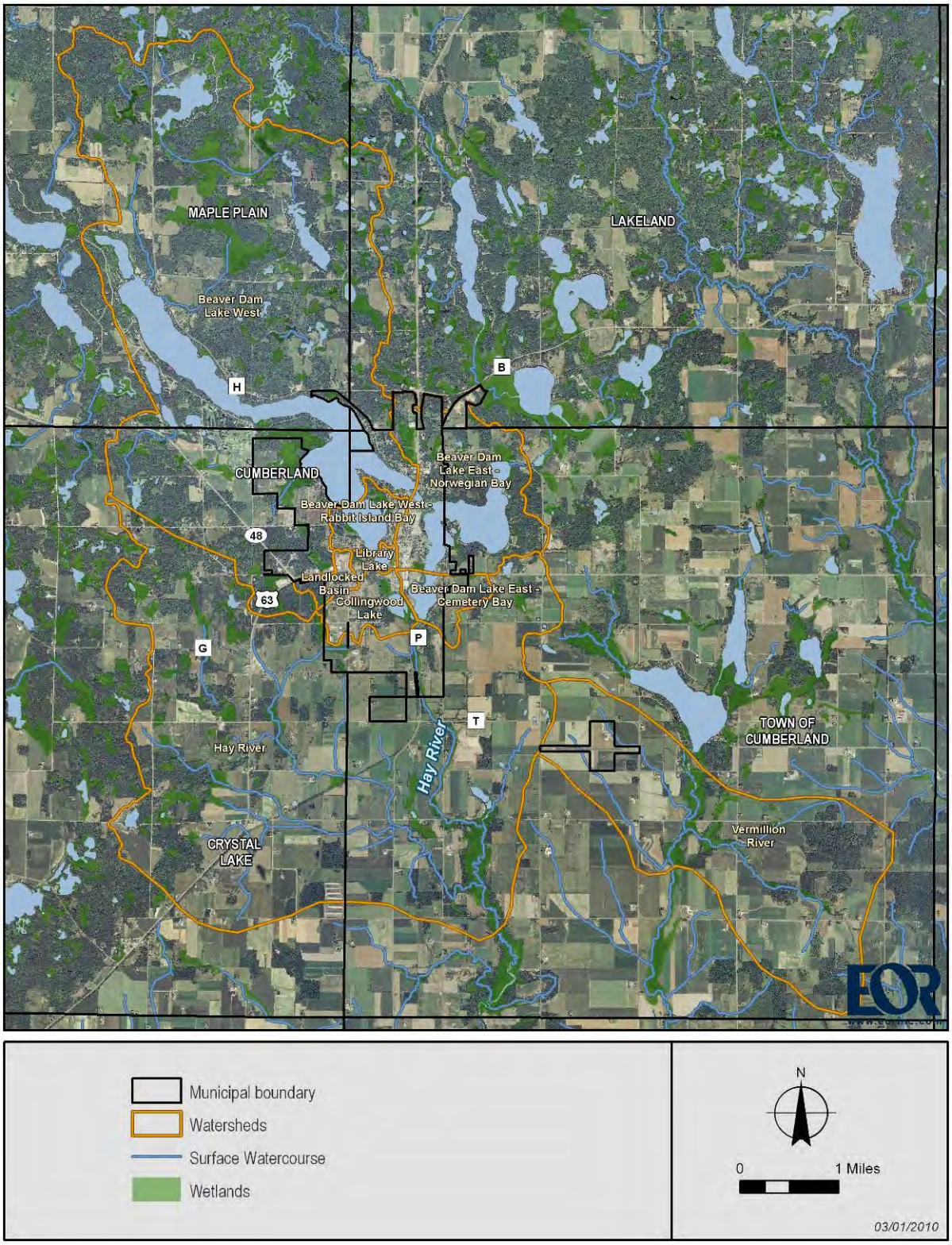

Figure 1. City of Cumberland in the context of drainage areas to Beaver Dam Lake.

Landuse

Existing (2006) and future (2026) landuse in the city are based on the City of Cumberland Comprehensive Plan (Figure 2 and Figure 3) (SEH, 2006). A portion of land within the city is considered vacant. Landcover types of vacant land include forest, primarily, and agriculture.

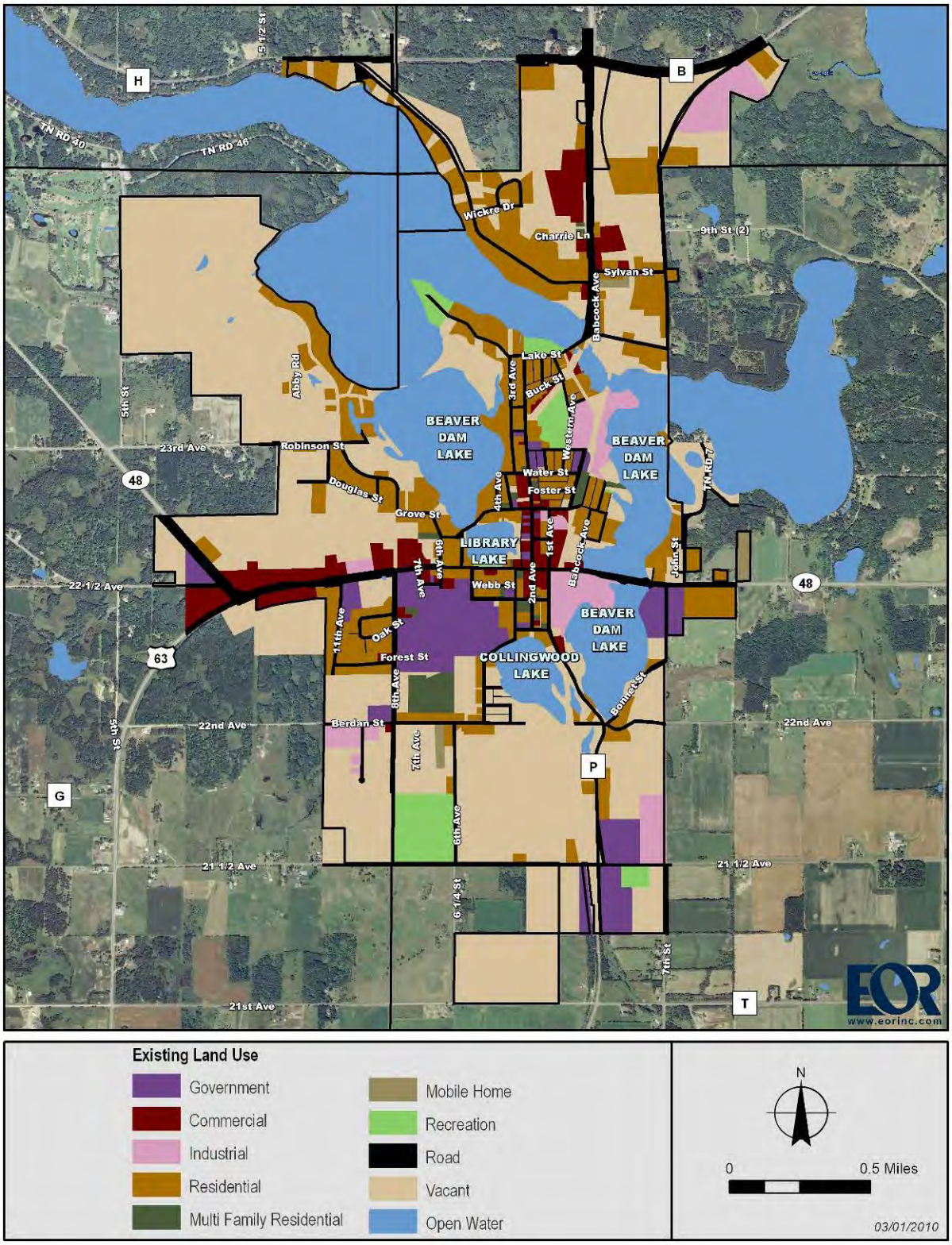

Figure 2. Existing (2006) landuse.

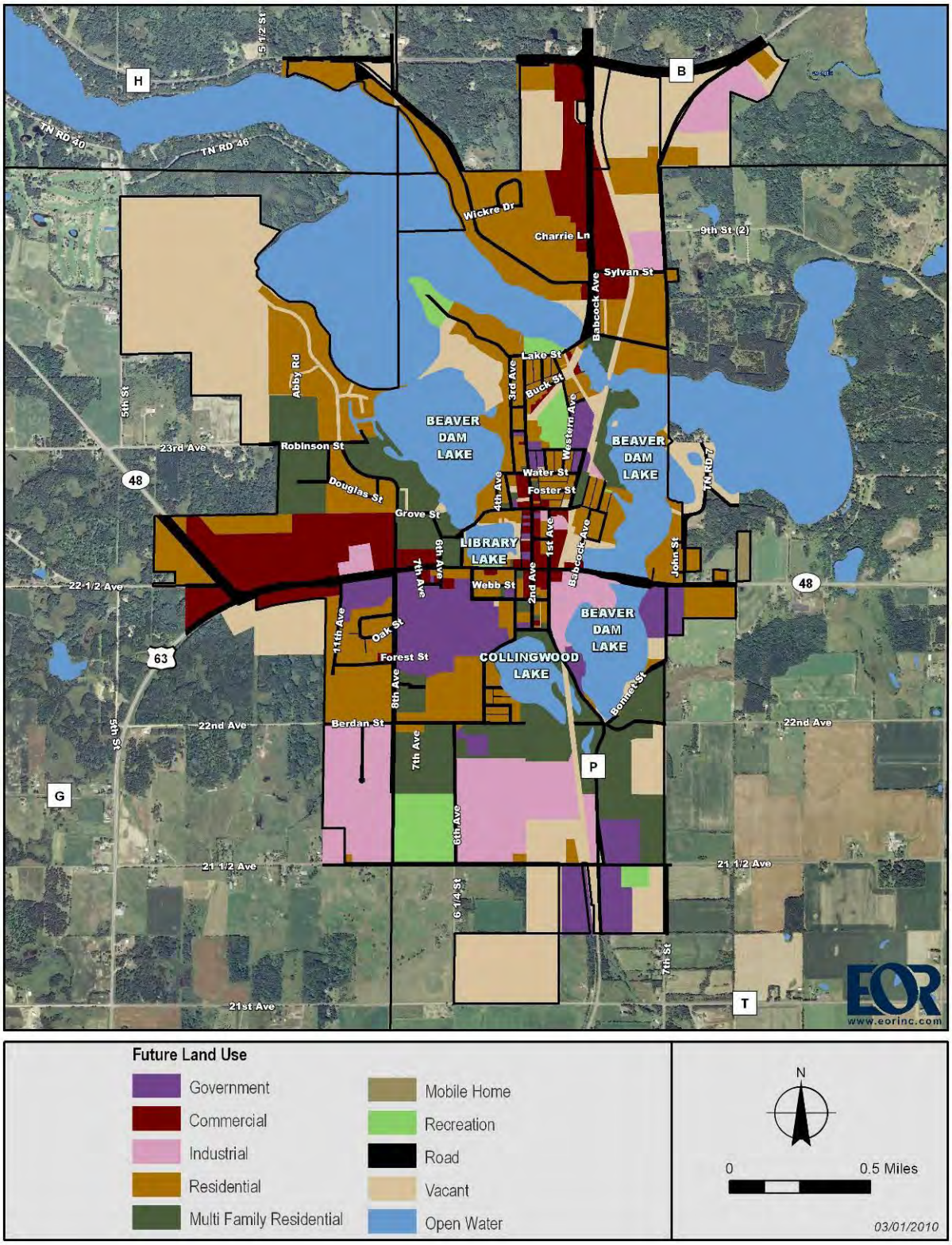

Figure 3. Future (2026) landuse.

Soils

A map identifying the soils of the city is included as Figure 4. As this map illustrates, the soils are classified into groups based upon the hydrologic characteristics of the soils. Soil hydrologic groups are used to estimate the amount of runoff generated for a given rainfall event. There are four hydrologic soil groups (HSG): A, B, C and D. The amount of runoff expected from the soil is lowest for A soils. These soils have a high sand and/or gravel content that allows water to move rapidly down into the soil instead of flowing off the soil. Runoff is highest for D soils. HSG D soils have a large clay content that prohibits the movement of water through the soil. Ultimately however, vegetation, organic/mineral or physical composition and slope all contribute to the runoff potential of a soil. Table 1 presents a description for each of the HSGs. Soils classified as, for example, A/D are A soils that behave like D soils.

Table 1. Description of hydrologic soil groups.

Hydrologic Soil Group	Description
A	Soils having high infiltration rates when thoroughly wet (low runoff potential). Deep, well drained to excessively drained sand or gravelly sand.
B	Soils having a moderate infiltration rate when thoroughly wet. Moderately deep or deep, moderately well drained or well drained with moderate to moderately coarse texture.
C	Soils having a slow infiltration rate when thoroughly wet: soils have a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture.
D	Soils having very slow rates of infiltration when thoroughly wet (high runoff potential): soils consist of clays with high shrink-swell potential; soils have a high permanent water table; soils that have a claypan or clay layer at or near the surface and soils that are shallow over nearly impervious material.

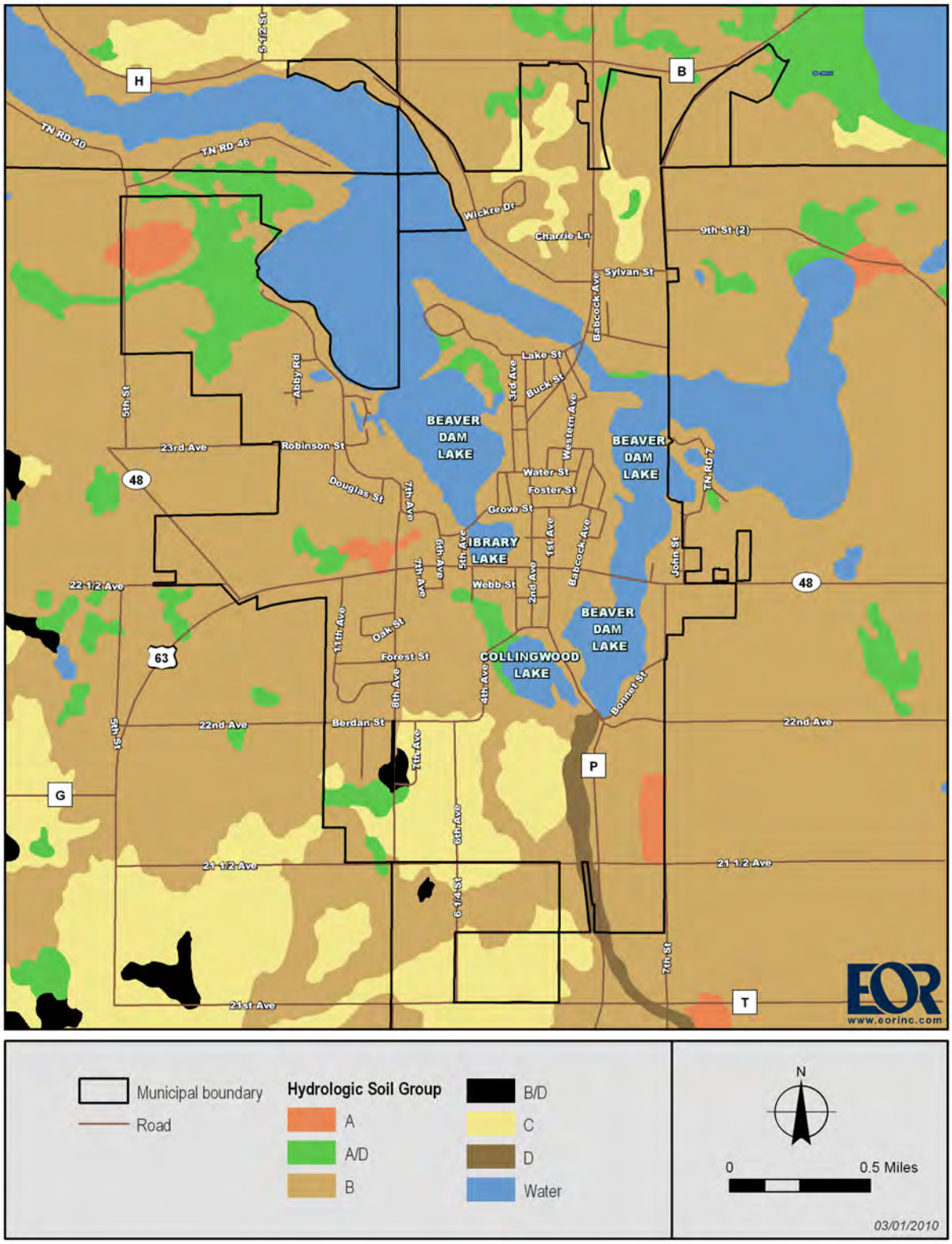

Figure 4. Hydrologic soil groups.

Hydrology

Waterbodies within the city of Cumberland receive stormwater runoff from areas outside of city boundaries. Figure 5 illustrates the full extents of land draining to city of Cumberland waterbodies. Figure 6 shows more detailed hydrology within city boundaries; drainage patterns are illustrated with black arrows. Hay River is the historic outlet of Library Lake. However, today, it is only connected to the north to Rabbit Island Bay of Beaver Dam Lake. Beaver Dam Lake flows clockwise and discharges at the southeastern tip to the Hay River. Cumberland Municipal Airport (110 acres in size) is southeast of the map extents (not shown in Figure 6) and discharges to the Vermillion River. The Hay and Vermillion Rivers ultimately discharge to the Red Cedar River.

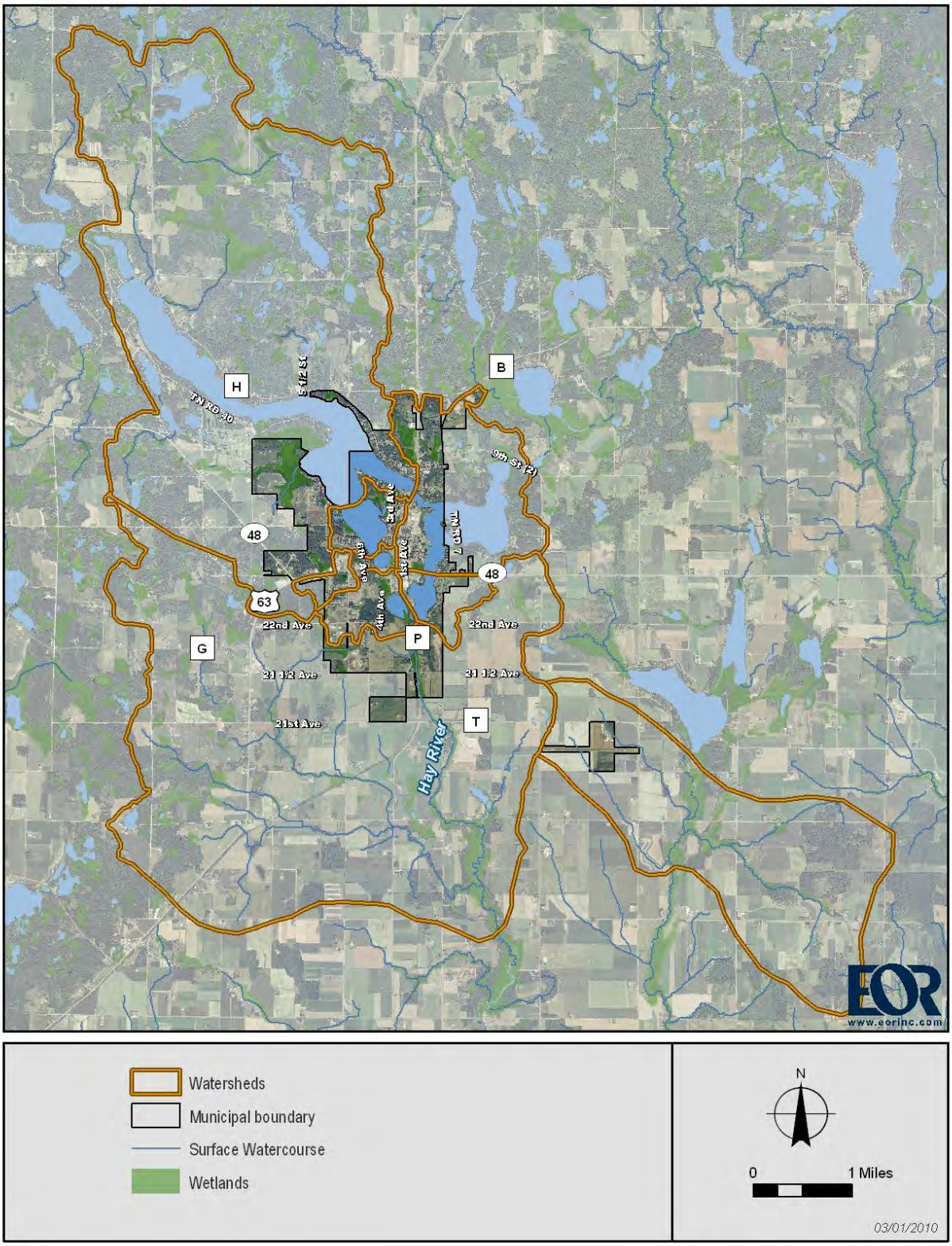

Figure 5. Full extents of drainage areas discharging to city of Cumberland waterbodies.

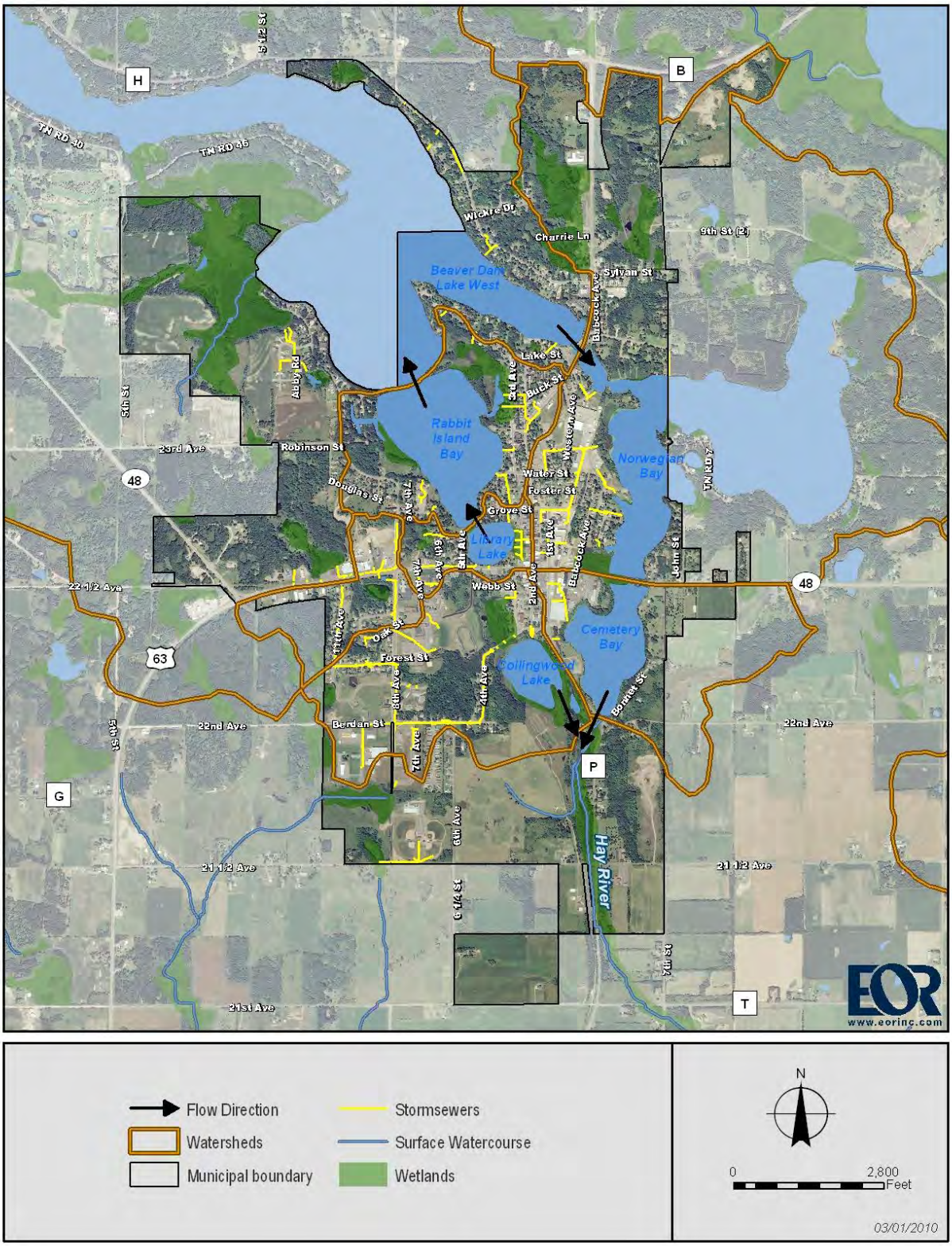

Figure 6. City of Cumberland drainage areas and waterbodies.
Not shown: Cumberland Municipal Airport (110 acres) southeast of map extents; drains to the Vermillion River.

3. CURRENT CONDITIONS OF SURFACE WATERS

Beaver Dam Lake and Bays

Surface Water Quality

Surface water quality can be defined in terms of the trophic status: hypereutrophic, eutrophic, mesotrophic and oligotrophic. Eutrophic waters have high primary productivity as a result of high nutrient content and are often identifiable by algal blooms resulting in poor water quality and poor water clarity. Hypereutrophic waters are in an extreme state of eutrophication. Oligotrophic waters have low concentrations of nutrients and algae resulting in high water clarity. Mesotrophic waters are in a state between oligotrophic and eutrophic. In order to define the trophic status, water quality measurements are taken, in particular, secchi depth (transparency), nutrients (in particular, phosphorus) and chlorophyll (an indicator of primary productivity).

The Beaver Dam Lake Management District (District) commissioned the *2007 Beaver Dam Lake Water Quality Study* that was completed in April 2008 (Barr, 2008). The report is an excellent compilation of the current water quality of Beaver Dam Lake and the overall trends in comparison to years past. Beaver Dam Lake surface water quality reported in this study are summarized in Table 2. Appendix A includes a detailed compilation of the findings from this study including monitoring locations and graphs of the data.

Table 2. Beaver Dam Lake water quality.

Waterbody	2007 Water Quality	Water Quality Trends
Beaver Dam Lake West	Excellent – varying from oligotrophic to borderline oligotrophic/mesotrophic	Overall water quality consistent since 1992; water transparency consistently mesotrophic since 1975
Beaver Dam Lake East – Cemetery Bay	Poor – varying from eutrophic to hypereutrophic	Overall water quality has deteriorated since 1994 and water transparency declined since 1994; these are attributed to increased internal phosphorus loading during dry years
Beaver Dam Lake East – Norwegian Bay	Poor – varying from oligotrophic to hypereutrophic	Overall water quality has deteriorated since 1994 and water transparency declined since 1994; these are attributed to increased internal phosphorus loading during dry years and following treatment and decay of Eurasian water milfoil
Beaver Dam Lake West – Rabbit Island Bay and Library Lake	Reasonably good – varying from mesotrophic to eutrophic	Overall water quality generally declining since 1994; water transparency consistently oligotrophic or mesotrophic since 1992.

Source: (Barr, 2008)

Aquatic Vegetation

The District commissioned the *2008 Beaver Dam Lake Report and Amended Aquatic Plant Management Plan* which was completed in February 2009 (Barr, 2009). The report provides a useful summary of aquatic plant coverage (2005-20008) and Eurasian water milfoil treatment effectiveness (2006-2008) of Beaver Dam Lake. Table 3 summarizes Beaver Dam Lake plant survey results. Appendix A includes a detailed compilation of the findings from this study including survey locations and mapping of aquatic plant coverage over time. The number of species identified increased from 2005 through 2008. Plant diversity increased from 2005 through 2007 and remained stable in 2008; a scale from 0 to 1, Beaver Dam Lake indicates consistent excellent diversity.

Table 3. Annual Beaver Dam Lake plant survey results from 2005-2008 and 2008-2009 Library Lake results.

Parameter	2005	2006	2007	2008	2008 Library Lake Only*	2009	2009 Library Lake Only*
# of Species	15	19	22	23	24	NA	37
FQI**	18.86	18.09	26.83	26.69	27.15	NA	34.29
Diversity	0.88	0.90	0.93	0.92	0.90	NA	0.92

* July survey, post-EWM treatment.
FQI = Floristic Quality Index
NA = not available
Source: (Barr, 2009)

During July 2008, an emergent and floating leaf vegetation survey of Beaver Dam Lake, including Library Lake, was conducted. Beaver Dam Lake species included soft stem bulrush, pickerelweed, arrowhead, cattail and northern blue flag. Library Lake species included northern blue flag, yellow and white waterlily, watershield, soft stem bulrush and cattail.

Aquatic Invasive Species Management

Eurasian water milfoil was accidentally introduced to Beaver Dam Lake in the 1990s and by 1999 it covered 67 percent of the lake's littoral area (Barr, 2009). Appendix A includes additional detail and mapping of invasive species management and coverage over time. Eurasian water milfoil spreads annually to new areas; this makes it hard to treat and quantify treatment effectiveness. However, treatments in Beaver Dam Lake have reduced the area of coverage and density of Eurasian water milfoil. Down from 222 acres in 2006, it covered 179 acres in 2008 consisting mainly of new areas of growth outside of the 2006 area of coverage. In all, Eurasian water milfoil is no longer present in 94 acres of area where it once was. Data from treatment effectiveness indicate that control of the zero- to five-foot depth is critical to control of Eurasian water milfoil in Beaver Dam Lake. Library Lake treatment has also seen an overall reduction in Eurasian water milfoil despite the spread to new areas.

Fish

Beaver Dam Lake has a diverse fishery. Fish include walleye, northern pike, largemouth bass, smallmouth bass, bluegill, black crappie, pumpkinseed, green sunfish, yellow perch, rock bass, common carp, white sucker, cisco, rainbow smelt and bullheads (Benike and Disrude, 2008). It is inconclusive whether Beaver Dam Lake is within the native range of walleye; however, headwater areas of the Red Cedar River (to which Beaver Dam Lake is tributary), is considered within the native range. Walleye stocking in Beaver Dam Lake has occurred sporadically since 1933 and, since 1978, on a regular basis. Rainbow smelt continues to be a management problem since their illegal introduction into Beaver Dam Lake in the late 1970s. Trout stocking occurred for several years in the early 1980s and again since 2006 as a biological control to predate on rainbow smelt. (Benike and Disrude, 2008).

In Table 4, 1993-1994 creel survey data on Beaver Dam Lake is compared to 2006-2007 survey data for major game and panfish species. In Table 5, fall electrofishing catch per effort of gamefish (fish/hour) is provided for survey years of 1970 through 2006. Angling effort for walleye in 2006-2007 was 7.9% of the total directed effort including open water and ice seasons (Table 4). The size distribution in 2006 was excellent (mean length 21.0 inches and 4% larger than 28 inches). In 1993, mean length of walleye was 18.9 inches with only 1% larger than 28 inches (Benike and Disrude, 2008). However, adult walleye abundance was similar from 1993 and 2006, and it was 50 to 75% lower than in 1979 (Benike and Disrude, 2008). In 2006, largemouth bass catch per unit effort was 22 fish/hour (Table 5). Average catch per unit effort was 7 fish/hour prior to the 2006 survey. In fact, largemouth bass relative abundance is at the highest levels in 25 years. Relative abundance of smallmouth bass has also been increasing (12 fish/hour in 2006, see Table 5), but was lower than largemouth bass and northern pike. *Beaver Dam Lake is one of a handful of lakes in Barron County that has a fishable population of smallmouth bass and that should be maintained and even possibly enhanced* (Benike and Disrude, 2008). The northern pike and panfishery have remained stable.

Table 4. 1993-1994 and 2006-2007 creel survey data by season for major game and panfish species in Beaver Dam Lake. Table credit: Benike and Disrude (2008).

Species	Season	Year	Directed Effort Percent	Catch rate (fish/hr)	Harvest rate (fish/hr)	Mean length harvested (in)
Walleye	Open Water	1993	9.6	0.0339	0.0110	18.8
		2006	9.0	0.0231	0.0111	17.2
	Ice	1994	13.1	0.0000	0.0000	N/A
		2006	1.8	0.0000	0.0000	N/A
Northern Pike	Open Water	1993	16.3	0.4054	0.0462	19.9
		2006	13.2	0.3834	0.1250	20.0
	Ice	1994	57.0	0.3002	0.1466	21.4
		2006	57.4	0.3296	0.1200	20.3
Smallmouth bass	Open Water	1993	11.9	0.2082	0.0137	15.5
		2006	25.1	0.3664	0.0074	16.4
	Ice	1994	5.8	0.0000	0.0000	N/A
		2006	0	0.0000	0.0000	N/A
Largemouth bass	Open Water	1993	21.4	0.2095	0.0051	15.6
		2006	24.2	0.5961	0.0061	15.6
	Ice	1994	3.2	0.0599	0.0599	16.4
		2006	29.4	0.0568	0.0378	15.6
Bluegill	Open Water	1993	21.3	2.8061	1.2788	6.9
		2006	20.6	3.9616	1.0932	6.8
	Ice	1994	10.8	3.5205	1.6760	6.7
		2006	3.8	1.3013	0.4042	6.5
Black crappie	Open Water	1993	18.1	0.8566	0.5088	9.2
		2006	5.5	0.6012	0.3862	9.2
	Ice	1994	8.8	0.0147	0.0147	8.8
		2006	5.6	0.0779	0.0564	9.5
Yellow perch	Open Water	1993	0.0	*	*	9.4
		2006	0.0	*	*	*
	Ice	1994	1.3	0.1523	0.0000	7.2
		2006	1.9	0.3402	0.0000	*

* not available

Table 5. Fall electrofishing catch per effort of gamefish (fish/hour) in Beaver Dam Lake. Table credit: Benike and Disrude (2008).

Date	Walleye	Northern Pike	Largemouth Bass	Smallmouth Bass
1970	54	7	9	0
1979	12	16	3	1
1984	67	26	14	4
1988	13	7	6	3
1989	12	7	6	1
1993	6	27	4	6
2006	N/A	22	22	12

Hay River

Hay River is the historic outlet of Library Lake, discharging through Collingwood Lake and south out of Cumberland ultimately discharging to the Red Cedar River just north of Menomonie, WI. Today, Library Lake and Hay River are disconnected, but Beaver Dam Lake still discharges to the south to Hay River. Hay River drains much of the high school and surrounding properties (Figure 6) in Cumberland and runs through a wetland complex that discharges to Collingwood Lake. Hay River has not undergone water quality monitoring or aquatic plant surveys.

Collingwood Lake

Collingwood Lake is 20 acres in size and discharges via Hay River at the south end of the lake. Like Hay River, it has not undergone water quality monitoring or aquatic plant surveys.

Stormwater

Sediment Samples

Three sediment samples were collected in October 2009 from a stormsewer outfall delta downstream of primarily residential and some commercial landuses at the northeast side of Rabbit Island Bay. Texture, inorganics, metals, organics and oil and grease were analyzed. The DNR has developed guidelines for sediment quality for metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and additional assorted contaminants based on effects-based (i.e. empirical) sediment quality guidelines for commonly found, in place contaminants (DNR, 2003). The consensus-based sediment quality guidelines (CBSQGs) are based on effects to benthic macroinvertebrate species. Where noncarcinogenic or nonbioaccumulative organic chemicals are involved, the guidelines should be protective of human health and wildlife concerns. Where bioaccumulative compounds (e.g. PCBs and methyl mercury) are involved, human health or wildlife-based guidelines could result in more restrictive sediment concentrations. At the threshold effect concentration (TEC), toxicity to benthic-dwelling organisms are predicted to be unlikely. At the probable effect concentration (PEC), toxicity is probable. In between is the midpoint effect concentration (MEC). Levels of concern are designated based on the respective effect concentrations (Level 1 – less than or equal to the TEC; Level 2 – greater than the TEC but less than or equal to the MEC; Level 3 – greater than the MEC but less than or equal to the PEC; Level 4 – greater than then PEC).

None of the inorganic constituents analyzed have corresponding CBSQGs. Most of the organic constituents analyzed have corresponding CBSQGs, but none of the organic constituents at any of the three sites resulted in data above the minimum detection limit of the analytical method employed. However, a few metals did appear in the sediment at levels above the TEC and, in some cases, above the MEC or PEC (see Table 6).

Table 6. Levels (above 1) of metal in sediment at northeast stormsewer outfall delta to Rabbit Island Bay based on DNR CBSQGs (DNR, 2003).

Metal	No. of Sites at Concern Level 2	No. of Sites at Concern Level 3	No. of Sites at Concern Level 4
Arsenic			1
Cadmium	3		
Copper	1		
Lead	1	1	1
Zinc	3		

Soil texture at all sites is a medium-fine sand with anywhere from 7% to 13% fines. The high sand component could be the result of sand application for winter road and parking lot maintenance. Typically, when sediment is 93 percent or more sand, sediment is unlikely to be contaminated (MPCA, 2009).

Three additional constituents (barium, selenium and cyanide) have no DNR CBSQGs. Instead, soil reference values (SRVs) from the Minnesota Pollution Control Agency (2009) were used to evaluate the significant of these constituents. Similar to CBSQGs, SRVs are soil contaminant-specific concentration levels indicating based on predicted risk to human health. Neither of these additional constituents exceeded SRVs. Copper, arsenic and PAHs are known to be good indicators of stormwater pollution. Note that no PAHs were tested in the soils analysis. Copper levels are below the lowest SRV, but arsenic at site C exceeded the Level 2 SRV.

Regarding nutrient levels in sediments, the DNR says *Elevated levels of nutrients can lead to eutrophication of water bodies and production and deposition of plant materials in sediments that deplete oxygen levels in the water body when they decompose. Addition and decomposition of natural organic matter and anthropogenic-added organic matter in sediments can lead to production of hydrogen sulfide and ammonia levels that may be detrimental to benthic organisms* (DNR, 2003). Nutrients including total phosphorus, total Kjeldahl as nitrogen and ammonia, were found in the sediment samples at measureable levels. However, the data is inconclusive regarding source, fate and transport of the nutrients.

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4. PLAN GOALS AND IDENTIFIED NEEDS

The following goals emphasize protection of Library Lake, Beaver Dam Lake, Collingwood Lake, Norwegian Bay, and Hay River while covering all land within the city boundaries.

GOAL 1 - Reduce stormwater runoff volume, peak flows and flooding

1.1	Detain (and retain as technically feasible) up to the 1-inch, 24-hour storm event to reduce erosion, sediment transport and runoff temperature and to remove the first flush of stormwater pollutants.
1.2	Utilize stormwater management practices that emulate native hydrology including stormwater retention, infiltration and peak runoff reduction.
1.3	Protect US Highway 63 from flood damage.
1.4	Enhance highway safety by avoiding flooding hazards.

GOAL 2 - Treat stormwater runoff prior to discharge to city of Cumberland waterbodies to reduce pollutant loading

2.1	Implement structural stormwater best management practices in priority watersheds.
2.2	Implement programmatic best management practices.
2.3	Restore trophic status of Beaver Dam Lake West including Rabbit Island Bay and Library Lake from eutrophic to mesotrophic.
2.4	Restore trophic status of Beaver Dam Lake East including Cemetery Bay and Norwegian Bay from hypereutrophic to mesotrophic.
2.5	Continue on-going total phosphorus, chlorophyll a and Secchi depth monitoring.
2.6	Expand monitoring to Collingwood Lake and Hay River.
2.7	Conduct sediment sampling at major storm sewer outfalls to prioritize dredging.

GOAL 3 - Protect and improve native aquatic and shoreland habitats

3.1	Protect native shoreline habitat from erosion, scouring and sediment deposition at stormsewer outfalls.
3.2	Through water quality improvements, enhance the Beaver Dam Lake fishery as it has a diverse fishery and is only one of a handful of lakes in Barron County that has a fishable population of smallmouth bass.
3.3	Continue on-going aquatic plant surveys.
3.4	Expand aquatic plant surveys to Collingwood Lake and Hay River.

5. WATERSHED MODELING

Runoff Volume Modeling

Model Development

Runoff quantity modeling was conducted for the city of Cumberland. Two different models were created using StormNET modeling software. One model is watershed based, accounting for the drainage routing to the water bodies within city limits, while the second model only includes the drainage off of land within city limits.

Results

The drainage areas within Cumberland were divided into ten subwatersheds for assessment purposes. Those subwatersheds are identified in Figure 6 on page 12 and named as follows: Beaver Dam Lake West; Beaver Dam Lake West – Rabbit Island Bay; Library Lake; Beaver Dam Lake East – Norwegian Bay; Beaver Dam Lake East – Cemetery Bay; Collingwood Lake; Hay River; Landlocked Basin; Vermillion River and Duck Lake. Table 7 summarizes the results of the runoff volume modeling for existing and future landuse conditions for the storm events identified. The results do not include the volume generated by the lake surface area. Under future conditions, no volume reducing BMPs are assumed to be implemented with development.

Norwegian Bay receives the most runoff from the half-inch runoff event of all waterbodies under existing conditions. Under future (2026) landuse conditions, Beaver Dam Lake West drainage area emerges as having the greatest volume of runoff for the same event. Beaver Dam Lake West also receives the greatest volume of runoff for the 100-year event under both existing and future landuse conditions.

Table 7. Stormwater runoff volume to Cumberland waterbodies from within city limits.

Waterbody	Drainage Area within City Limits (acres)	Lake Area (acres)	Half-Inch Runoff (0.5-in, 24-hr rain) [acre-feet]		2-year Runoff (2.7-in, 24-hr rain) [acre-feet]		100-year Runoff (5.8-in, 24-hr rain) [acre-feet]	
			Existing*	Future*	Existing*	Future*	Existing*	Future*
Vermillion River	110	N/A	1.9	1.9	12.3	12.3	37.8	37.8
Library Lake	53	13	0.8	0.9	5.5	6.5	17.4	19.0
Landlocked Basin	76	N/A	0.9	1.4	6.3	9.6	22.1	27.6
Hay River	421	N/A	1.9	5.4	15.4	34.1	83.5	122.9
Collingwood Lake	279	21	3.0	4.5	19.6	29.3	75.3	92.6
Beaver Dam Lake West – Rabbit Island Bay	153	95	1.5	1.9	9.8	12.3	39.3	44.5
Beaver Dam Lake West	601	101	2.9	5.6	24.0	36.1	123.7	151.3
Beaver Dam Lake East – Norwegian Bay	401	78	4.0	5.2	26.5	33.2	104.4	117.9
Beaver Dam Lake East – Cemetery Bay	102	50	1.4	1.7	9.2	11.8	31.3	35.7
Duck Lake**	70	100	0.5	1.9	3.7	4.5	16.6	18.2

* Existing and future scenarios are based on the city of Cumberland's existing (2006) and future (2026) landuse as identified in the City of Cumberland Comprehensive Plan (SEH, 2006).
** Duck Lake is northeast of Cumberland but a northern portion of Cumberland discharges to it.

Water Quality Modeling

Model Development

Program for Predicting Polluting Particle Passage thru Pits, Puddles & Ponds (P8) (Walker, 2007) was used to model the total phosphorus (TP) and total suspended solids (TSS) loading to waterbodies in the city of Cumberland. The P8 water quality modeling effort was undertaken for two primary reasons:

1) Develop a city-wide model for general use and anticipated future stormwater management efforts.
2) Identify priority subwatersheds where improved stormwater management would most benefit Cumberland waterbodies.

The model includes the contributing drainage area within the city limits (4 square miles) though a large portion (31 square miles) of the Beaver Dam Lake lakeshed lies outside of city limits (refer to Figure 1 on page 4). The best data available at the time were used to create the model.

Drainage areas were delineated based on topography, stormsewer data from Short Elliott Hendrickson, Inc. and field verification. The driving input parameters required in P8 are watershed (slope, curve number and percent impervious), devices (e.g. ponds and lakes), climatology (precipitation and temperature) and pollutant characteristics [based on the United States Environmental Protection Agency's Nationwide Urban Runoff Program studies and median sites (USEPA, 1986; Athayede et al., 1983)]. Both existing (2006) and future (2026) landuse conditions were modeled based on the City of Cumberland Comprehensive Plan (SEH, 2006). The use of a 50-year period of climate data ensures that the model provides an average annual loading based on the natural variability of the local climate.

Results

The pollutant loadings contributed by ten major drainage areas discharging to Cumberland waterbodies (including only the acreage within city boundaries) are summarized in Table 8 for existing and future landuse conditions. Under future conditions, no water quality treatment BMPs are assumed to be implemented with development. Average annual loading on a per acre basis can be summarized by subwatershed and grouped based on loading rates. Four tiers have been identified: Tier 1 Subwatersheds have the highest loading rates and Tier 4 Subwatersheds have the lowest loading rates. Subwatersheds have been labeled and numbered based on the major drainage area they are in. The major drainage areas are identified in Figure 6 on page 12 and named as follows with parenthetical abbreviations used in the subwatershed naming conventions: Beaver Dam Lake West (BDLW); Beaver Dam Lake West – Rabbit Island Bay (RIB); Library Lake (LL); Beaver Dam Lake East – Norwegian Bay (NB); Beaver Dam Lake East – Cemetery Bay (CB); Collingwood Lake (CL); Hay River (HR); Landlocked Basin (LLB), Vermillion River (VR), and Duck Lake (Duck Lake).

Figure 7 illustrates the total phosphorus (TP) and total suspended solids (TSS) loading for each subwatershed under existing landuse conditions for the city of Cumberland excluding Library Lake drainage; Figure 8 provides a more detailed illustration of the results for Library Lake. Table 9 summarizes the resulting tiers. The results of the analysis show that of the top 11 (22% of 49) subwatersheds that contribute the highest pollutant loads on a per acres basis to Cumberland waterbodies, all but two discharge to Library Lake.

Table 8. Total phosphorus and total suspended solids loading to Cumberland waterbodies from within city limits.

Waterbody [rank of TP + TSS loading (lb/yr/ac drainage area): 1=highest 10=lowest]	**Drainage Area within City Limits (acres)**	**Lake Area (acres)**	**Total Phosphorus Loading Rate (lbs/yr/ac drainage area)**		**Total Suspended Solids Loading Rate (lbs/yr/ac drainage area)**	
			Existing*	**Future***	**Existing***	**Future***
Vermillion River **[7]**	110	N/A	1.4	1.4	432	432
Library Lake **[1]**	53	13	25	26	7665	8077
Landlocked Basin **[4]**	76	N/A	4.3	5.9	1321	1828
Hay River **[8]**	421	N/A	0.46	1.1	142	332
Collingwood Lake **[2]**	279	21	6.5	9.0	2003	2786
Beaver Dam Lake West – Rabbit Island Bay **[5]**	153	95	4.3	4.6	1327	1425
Beaver Dam Lake West **[10]**	601	101	0.48	0.82	150	253
Beaver Dam Lake East – Norwegian Bay **[3]**	401	78	5.6	6.3	1719	1944
Beaver Dam Lake East – Cemetery Bay **[6]**	102	50	2.6	3.0	818	916
Duck Lake** **[9]**	70	100	0.70	0.88	217	272

* Existing and future scenarios are based on the city of Cumberland's existing (2006) and future (2026) landuse as identified in the City of Cumberland Comprehensive Plan (SEH, 2006).
** Duck Lake is located northeast of Cumberland but a northern portion of Cumberland discharges to it.

Table 9 Average annual total phosphorus and total suspended solids leaving city subwatersheds normalized by subwatershed area (existing landuse).

Tier 1	Tier 2	Tier 3	Tier 4
NB-6	NB-5	CL-2	HR-1
CB-3	RIB-5	CL-7	CL-3
LL-Grove-1	LLB-2	CB-2	CL-4
LL-Main-1	LLB-4	NB-3	CL-8
LL-Main-3	CL-5	NB-4	NB-2
LL-Main-4	CL-6	RIB-3	BDLW-2
LL-Main-5	LL-Sorenson-3	RIB-4	RIB-2
LL-6thSt	LL-Hwy63-1	LL-Sorenson-1	LLB-1
LL-Library-2	LL-Hwy63-2	LL-5thSt	LLB-3
LL-Sorenson-2	LL-Grove-2	LL-Library-1	LL-Main-2
LL-Sorenson-4			Duck Lake

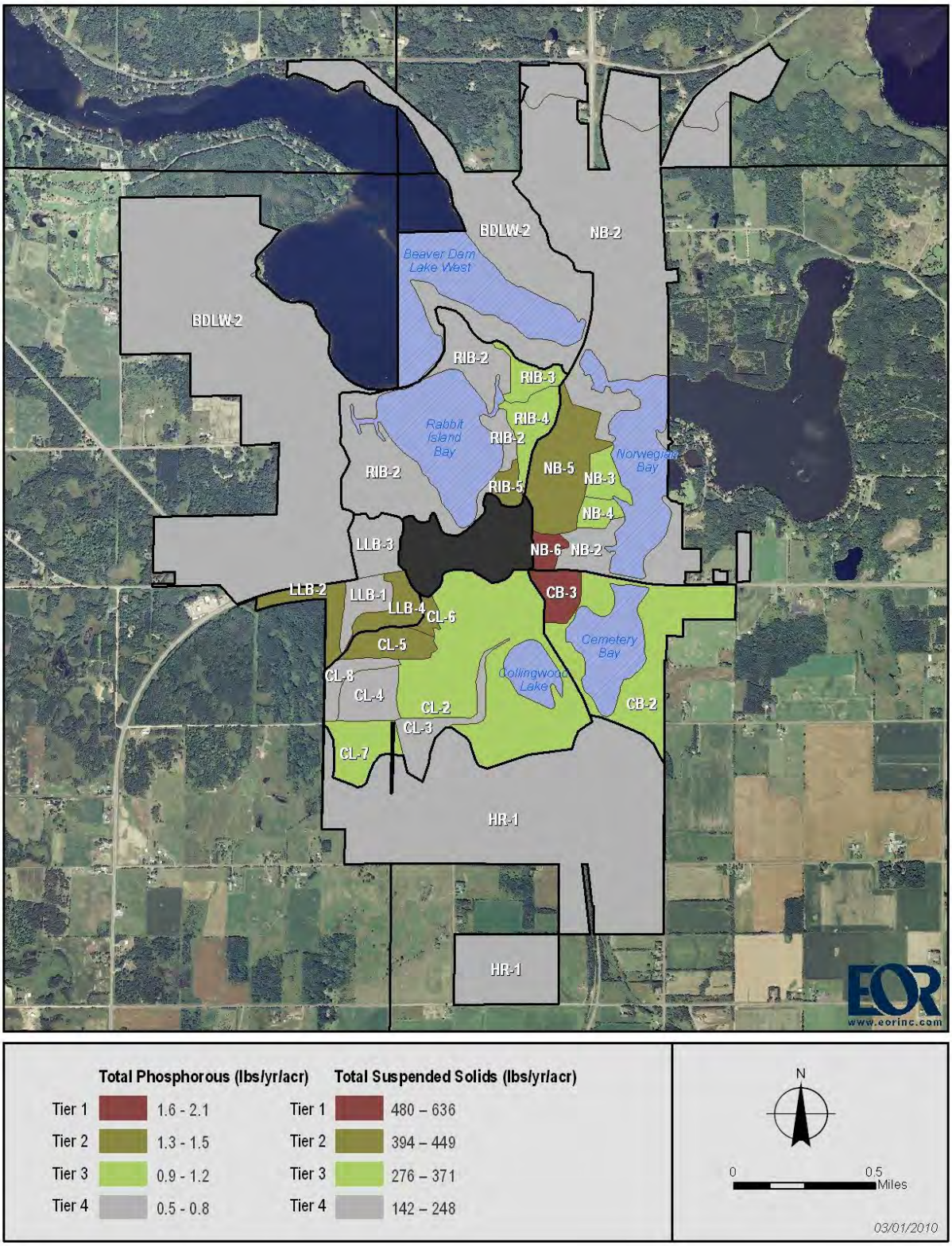


Figure 7. Average annual total phosphorus and total suspended solids leaving city subwatersheds normalized by subwatershed area (existing landuse).

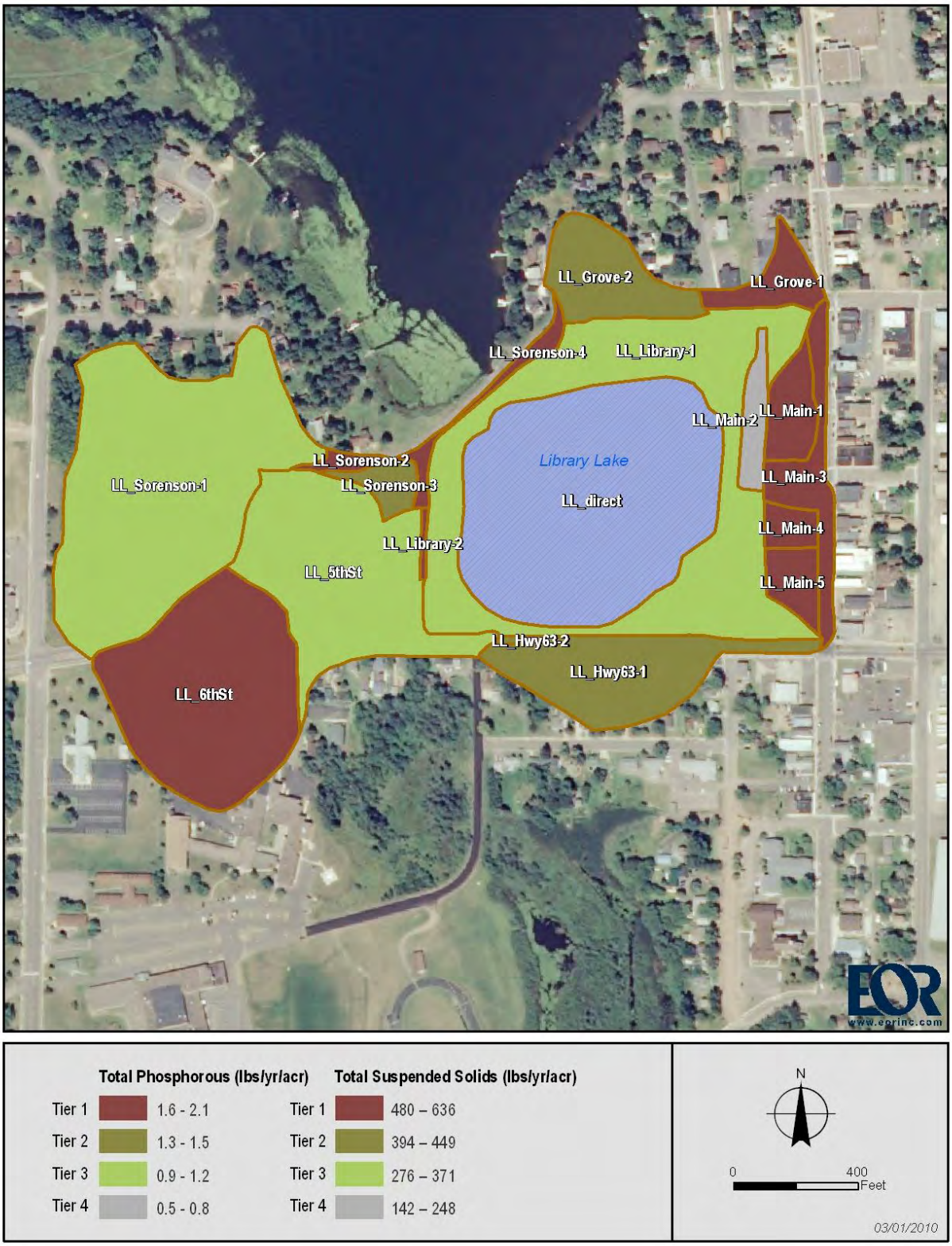


Figure 8. Average annual total phosphorus and total suspended solids leaving Library Lake subwatersheds normalized by subwatershed area (existing landuse).

6. STORMWATER MANAGEMENT RECOMMENDATIONS

Priority Subwatersheds

Those subwatersheds identified as having the highest average annual TP and TSS loading rates on a per acres basis are priority watersheds for stormwater management improvements. The second, third and fourth highest tiers of pollutant loading are to be considered in that order for ongoing stormwater management improvements except in the rare circumstance where special conditions may favor implementation out of order. Table 10 identifies the priority subwatersheds based on model results under existing landuse conditions.

Table 10. Priority subwatersheds.

Major Drainage Area	Priority Subwatershed
Beaver Dam Lake East – Norwegian Bay	c_NB-6
Beaver Dam Lake East – Cemetery Bay	c_CB-3
Library Lake	c_LL-Grove-1
	c_LL-Main-1
	c_LL-Main-3
	c_LL-Main-4
	c_LL-Main-5
	c_LL-6thSt
	c_LL-Library-2
	c_LL-Sorenson-2
	c_LL-Sorenson-4

Under future (2026) landuse conditions, c_LLB-3 (Landlocked Basin drainage) and c_LL_Sorenson-3 (Library Lake drainage) emerge in the top tier of pollutant contributing subwatersheds and will need to be given special attention during the future planning and development process.

Siting of Best Management Practices

Priority subwatersheds were compared with findings from multiple field visits to identify feasible locations for stormwater best management practices (BMPs). Figure 9 identifies the BMPs and the subwatersheds draining to them. The BMP in subwatershed c_NB-6 and the southern BMP in subwatershed c_CB-3 is recommended to take the form of a bioretention facility (see Stormwater Best Management Practices: Bioretention on page 39). The rectangular BMP in subwatershed c_CB-3 is recommended for enhanced shoreland buffer. All other BMPs are within the Library Lake Subwatershed and are discussed in greater detail in the next section, *Library Lake Restoration*.

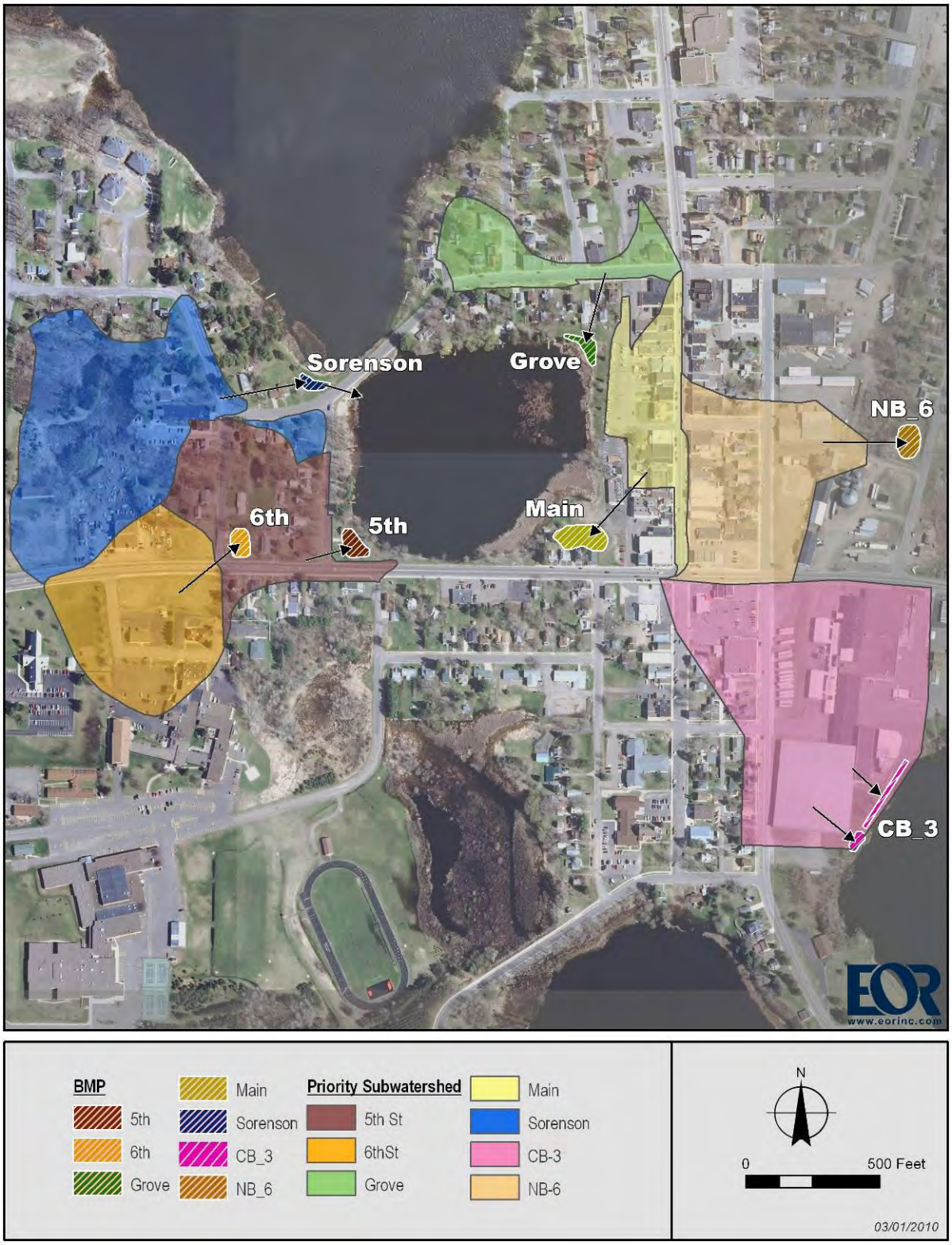


Figure 9. BMP locations for priority subwatersheds.

Library Lake Restoration

Nine of the 11 priority subwatersheds are in the Library Lake drainage. The Beaver Dam Lake Management District formed the Library Lake Committee to support the restoration of Library Lake in September 2007 long before development of this plan. The Library Lake Committee underwent substantial planning efforts and has developed project phases for lake restoration. Project plans provide stormwater treatment of runoff from the priority subwatersheds (and others) located in the Library Lake drainage area and are thereby recommended by this plan.

Table 11 identifies the phases of Library Lake restoration. Phases 1 through 3 specifically address stormwater management and include BMPs in addition to those presented in Figure 9. The Phase 1 and 2 master plan as developed for the Library Lake project is shown in Figure 10 through Figure 12 on the following pages.

Table 11. Library Lake restoration project phases.

Phase 1	**Stormwater Improvements and Park Development:** acquire land and construct stormwater practices and park.
Phase 2	**Lake and Shoreline Restoration:** remove accumulated sediments.
Phase 3	**Restore Hydrology:** restore Library Lake outlet under highway 63/48.
Phase 4	**Community Connections:** create non-motorized trail passage over highway 63/48 and in the city of Cumberland.
Phase 5	**Grove Street Bridge:** raise and widen the Grove Street Bridge to accommodate boat traffic safely.

Phase 1 - Stormwater Improvements and Park Development

Stormwater Improvements

Artificial wetlands, with forebays to allow sediment removal, are the primary method that will be employed to treat stormwater. Infiltration practices will be used where soil permeability and land area is sufficient.

Park Development

Native plantings and natural ecosystems will be integrated into the park development as much as possible to create and enhance aquatic and terrestrial habitat, as well as providing year round aesthetic interest. Because of the park's proximity to downtown, it will be a highly utilized landscape by the pedestrian, boat, bicycle, and vehicular traffic that will pass through and around. The park will display the character of the project's natural components and be an intentional, cared for public space.

A naturalistic approach to planting and design will be framed with structures and turf grass to blend into the surrounding neighborhood and create an ordered look that people most commonly associate with traditional parks. The landscaping will be functional as well as beautiful, treating stormwater as well as forming the structure of the park. Nature-based education will be an important goal of the park master plan. The park will provide a naturalistic landscape and

existing natural ecosystems for environmental education that will be supplemented with interpretive signage.

Phase 2 - Lake and Shoreline Restoration (Sediment Removal)

Sediment removal within selected areas will provide navigation channels to support boating within the lake while protecting the lake's fish spawning habitat. Three methods of dredging were researched. Suction dredging, dragline dredging, and winter excavation. Winter excavation is the selected method for sediment removal in part because less unnecessary disturbance results and more accurate finish grades are possible. The other methods of dredging pollute the water and don't provide precise bottom sensing.

The most economical and precise way to selectively dredge Library Bay is to dam the Grove Street Bridge and pump to reduce lake levels in the fall. To minimize recreational and aquatic disturbance, a maximum of two feet of drawdown below the normal water level is being proposed and will be conducted during the months of November through March. This period of operation allows sediments to compact, thus lessening the volume of excavation and associated disturbance. Furthermore, winter dredging limits the suspension of sediments and potential deposition.

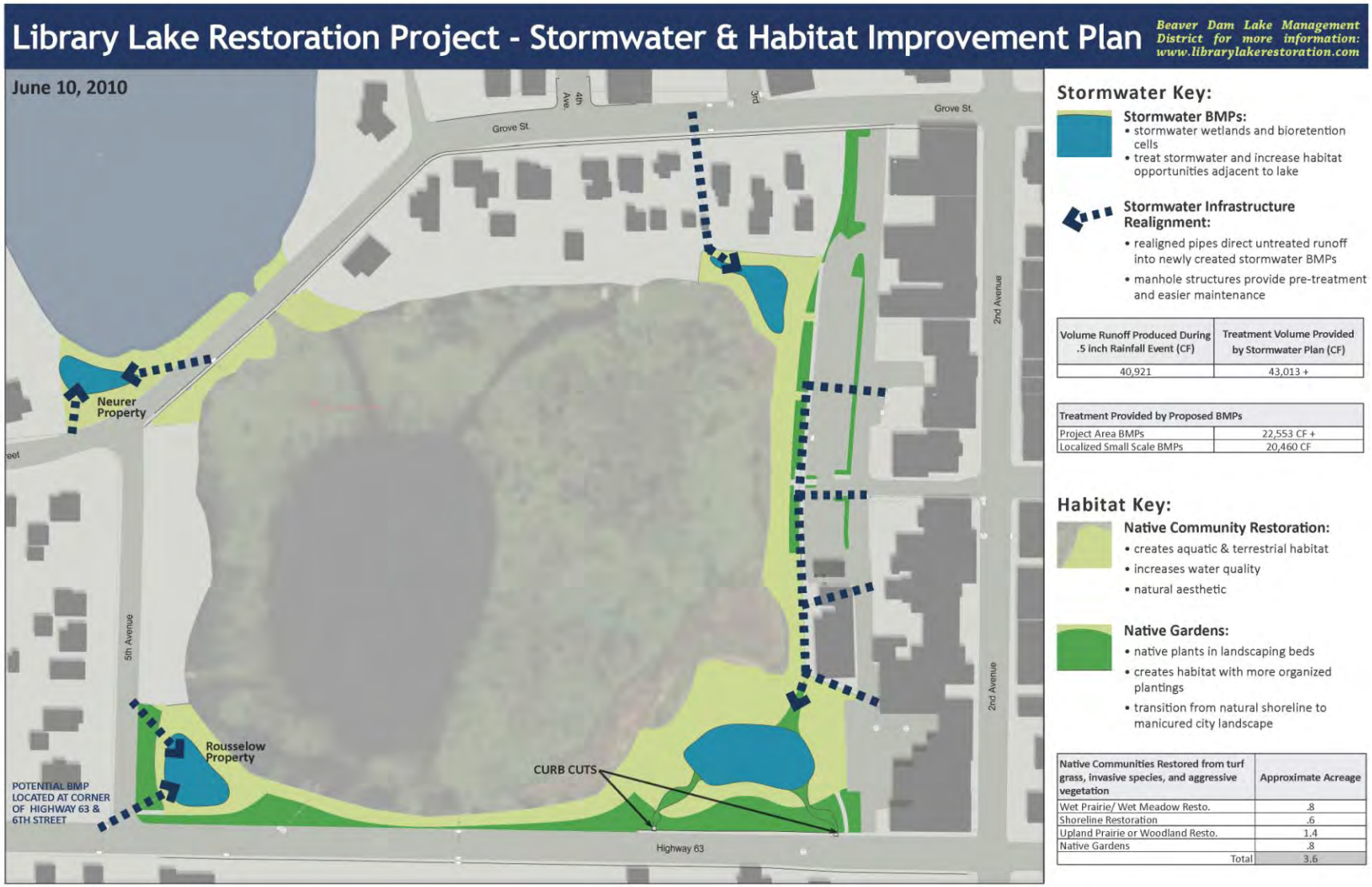
The majority of the proposed dredging is concentrated around the eleven stormwater discharge points to Library Lake. These stormwater-deposited sediments will be removed from shore via an excavator and properly disposed. The remaining dredging will also primarily be completed from shore. An aerator will be installed to ensure adequate oxygen supply to fish during the drawdown if the DNR determines that fish are present and oxygen level is insufficient.

Phase 3 - Restore Hydrology

Restoring the southwest outlet shown in the 1888 historical map would establish a second control station and increase flow through Collingwood Lake to the Hay River. Following storm events, increased water flow through Library Lake will benefit the lake by displacing high nutrient stormwater in Library Lake with lower nutrient waters from upstream portions of Beaver Dam Lake. Outlet restoration will also reduce "bounce" after storms by bringing the lake's water level to normal more quickly following storm events. Restoration of the southwest outlet and channel corridor will result in Library Lake flood improvements. The existing flood elevation (i.e., 100 year event) for Library Lake is 1,233 feet NGVD29 (vertical datum).

Phases 4 and 5 of the master plan include a park and trail system and improvements to the Grove Street Bridge.

Figure 10. Library Lake restoration project - master plan (June 14, 2010).



Volume Runoff Produced During .5 inch Rainfall Event (CF)	Treatment Volume Provided by Stormwater Plan (CF)
40,921	43,013 +

Treatment Provided by Proposed BMPs	
Project Area BMPs	22,553 CF +
Localized Small Scale BMPs	20,460 CF

Native Communities Restored from turf grass, invasive species, and aggressive vegetation	Approximate Acreage
Wet Prairie/ Wet Meadow Resto.	.8
Shoreline Restoration	.6
Upland Prairie or Woodland Resto.	1.4
Native Gardens	.8
Total	3.6

Figure 11. Library Lake restoration project - stormwater and habitat improvement plan (June 14, 2010).

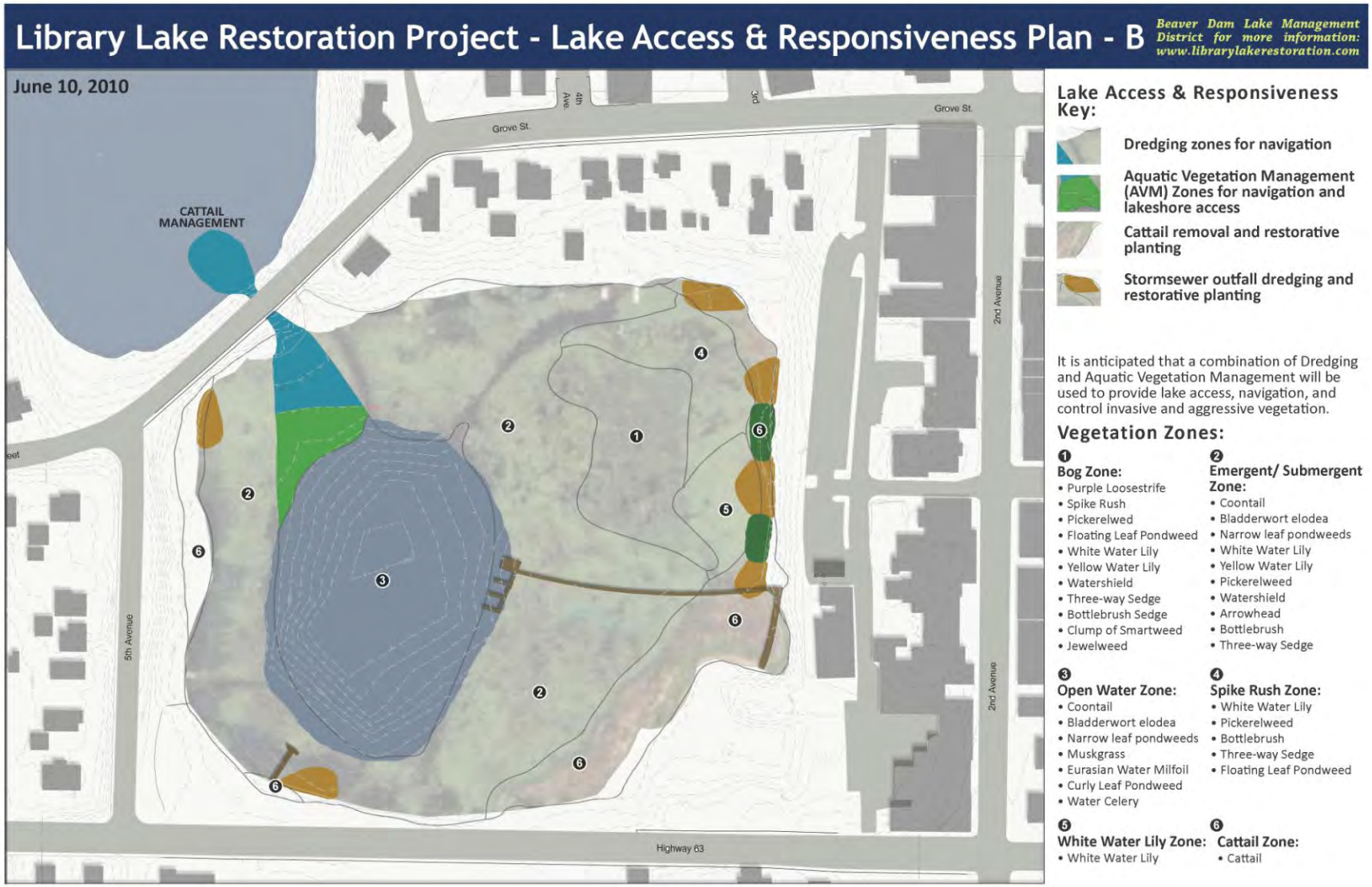


Figure 12. Library Lake restoration project - lake access & responsiveness plan A (June 14, 2010).

Additional BMP Opportunities

Field visits informed additional opportunities for stormwater improvements independent of priority subwatershed recommendations. In general, installation of sediment traps at catchbasins and dredging of major stormsewer outfalls are recommended throughout the city. Table 12 summarizes more specific BMP opportunities; site numbers correspond to locations mapped in Figure 13. Many involve maintenance or minor improvements that could be implemented efficiently and have significant benefits.

Table 12. BMP opportunities independent of priority subwatersheds.

Site No.	BMP Opportunity
1	Implement pollution prevention practices that prevent contact of stormwater with pollutants
2	Take middle catchbasin offline, redirect to swale with raised upstream inlet and/or perforated underground infiltration pipe. Provide pretreatment swale for catchbasin downstream most catch basin. Repair retaining wall.
3	Extend boulevard and/or utilize wide streets for greenspace and/or bump-out bioretention facilities. Sweep street. Add riprap to stormsewer outlet at lake to repair and prevent scour.
4	Dredge sediment delta. Provide impervious surface and berming for snow storage area in order to contain and sweep sediment in the spring. Provide linear pretreatment feature for springmelt from snow storage area. Consider downstream treatment/infiltration feature adjacent to city dock storage.
5	Prevent bypass of Inlet A and subsequent sediment buildup nearby. Prevent bypass of Inlet B and consider opportunity for retention/detention feature. Consider treatment opportunities at and near Inlets C, D and/or E. At and nearby Inlet F consider infiltration, paved parking, or greenspace. Capture school rooftop runoff (scuppers existing on south end of school) adjacent to Inlet G. Install green island or sediment trap at Inlet G. School staff person identified water in schoolyard can take a couple days to dry out; construct swale downstream and upstream of outlet H avoiding sliding gate entrance of 3M.
6	Cleanout outlet.
7	Add riprap to outlet. Implement pollution prevention practices that prevent contact of stormwater with pollutants.
8	Implement slope stabilization and riprap at storm sewer outlet.
9	Pipe maintenance.

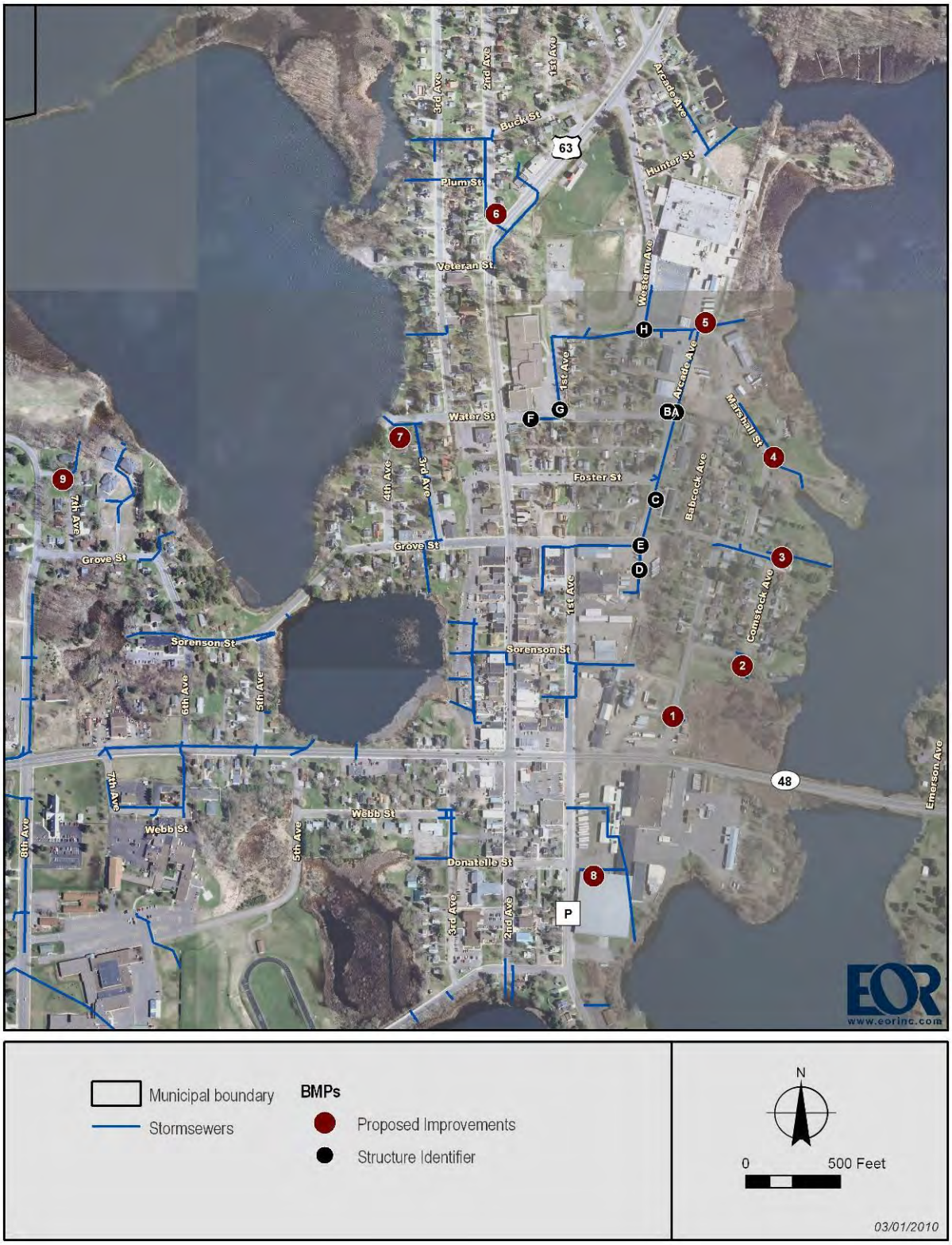


Figure 13. Locations for BMP opportunities independent of priority subwatershed recommendations.

7. STORMWATER BEST MANAGEMENT PRACTICES

The following is a set of stormwater best management practices (BMPs) identified by city of Cumberland as techniques worth considering in order to meet the city's stormwater management goals. In general, these goals entail reducing stormwater runoff, reducing flooding, providing stormwater treatment, and improving the quality and aesthetic and recreational value of the city's water resources. For specific goals, please refer to *Plan Goals and Identified Needs* on page 21. Stormwater BMPs take the form of both structural stormwater treatment and city programming.

Structural BMPs are the types of practices that could be used in proposed BMP locations. Structural practices identified herein are:

- Bioretention (page 39)
- Vegetated Swales and Buffers (page 40)
- Pervious Pavements (page 43)
- Infiltration (Infiltration Trench / French Drain and Underground Infiltration) (page 45)
- Stormwater Wetlands (page 48)
- Stormwater Ponds (page 49)
- Sediment Traps (page 50)
- Amended Soils (page 51)
- Urban Forestry (page 52)
- Native Landscaping (page 53)
- Reducing Impervious Surfaces (page 53)
- Open Space Design (page 54)

City programming can take the form of public or staff education initiatives, training programs, city practices on city land or rules and ordinances. Program activities can be implemented citywide or within priority watersheds as identified in *Recommendations* on page 29. Programmatic stormwater BMPs identified herein are:

- Rules and Ordinances (page 56)
- Rainwater Harvesting / Stormwater Reuse (page 58)
- Vacuum Sweeping of Streets and Parking Lots (page 60)
- Erosion and Sediment Control Training Programs (page 60)
- Fertilizer/Chemical Application Management (page 62)
- Stormwater Utility (page 62)
- Public and Municipal Staff Education (page 63)
- Winter Road Materials Management (page 63)
- Potential Discharge Identification and Risk Reduction (page 64)
- Hazardous Material Storage and Handling (page 65)

Structural BMPs

Stormwater management through the use of low impact development (LID) can achieve stormwater management goals for the city. The principal goal of LID is to ensure maximum protection of receiving waters by mimicking the natural hydrology of the watershed. This goal is accomplished by using design techniques for development and retrofits that minimize, store, infiltrate, evaporate, treat and retain runoff. Many of the typical BMPs associated with LID are presented in this section including bioretention, vegetated swales and buffer strips, pervious pavements, infiltration, infiltration trenches / french drains, amended soils, native landscaping, reducing impervious surfaces, and open space design. Stormwater ponds are also included among the structural BMPs herein.

All structural BMPs and in particular LID BMPs, require proper siting and sizing. BMPs are sited downslope of impervious surfaces in permeable soils. BMPs are sited in HSG A (sand/loamy sand) and B (loam/silty sand) soils wherever feasible to maximize stormwater infiltration (refer to *Soils* on page 8 and Figure 4. Hydrologic soil groups.). Soil borings are necessary in the locations of proposed BMPs in order to assess the infiltration capacity of the soil as characterized by the hydrologic soil group. Soil boring results guide the selection of BMPs and help to ensure the BMP will function properly. Onsite soil verification during construction enables siting or sizing adjustments in the case of spatial heterogeneity of HSGs. Underdrains with removable caps facilitate management of water levels during establishment of vegetation and provide operational flexibility.

Pretreatment is also an important design element for structural BMPs (and in particular LID BMPs) in order to facilitate long-term effectiveness. Grass filter strips and sediment traps are two techniques. Finally, as with all stormwater management systems, BMPs require proper operation and maintenance.

Bioretention

Bioretention is a stormwater treatment practice that utilizes the chemical, biological and physical properties of soils, microbes and plants for infiltrating and/or filtering stormwater runoff. Bioretention facilities capture stormwater runoff to be filtered through an engineered soil medium. Stormwater can infiltrate in suitable soils and/or discharge through an underdrain providing filtration (treatment). Bioretention facilities can be designed to capture the first flush of runoff and discharge through an overflow outlet connected to existing storm sewer. The versatility of the practice allows for bioretention areas to serve as effective stormwater retrofits. Figure 14 illustrates specific design recommendations. Typical applications of bioretention include:

- Parking lot islands and margins
- Commercial setbacks
- Road right-of-way or cul-de-sacs
- Homeowner raingardens
- Regional stormwater infiltration basins
- Open space

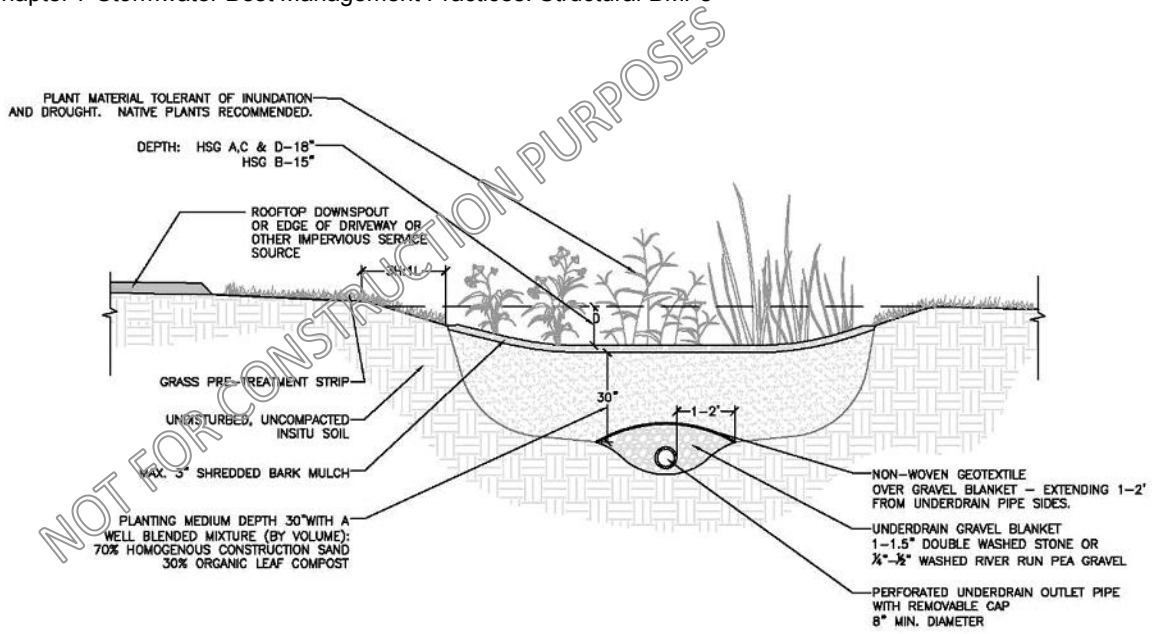


Figure 14. Design recommendations for bioretention cell.

Contamination Consideration

Whenever runoff is directed to an infiltration BMP, there is a danger of groundwater contamination by the pollutants being carried in the runoff. In short, any surface runoff source that exposes or generates toxic or highly contaminating material should not be routed to an infiltration device unless some form of pretreatment is provided to remove the contaminant.

Vegetated Swales and Buffer Strips

Swales and buffer strips are a type of stormwater treatment composed of vegetation and a porous subsoil medium. Buffer strips are vegetated areas adjacent to a waterway that prohibit stormwater runoff from flowing directly into a water body. The vegetation catches pollutants carried by stormwater, decreases the rate of flow and volume of runoff, and stabilizes the soil on the shoreline or bank, lessening erosion caused by runoff. A swale is a long, vegetated depression often used as a water conveyance system which is also designed to infiltrate water and remove sediment and pollutants from runoff. A swale, therefore, assists in recharging ground water and managing stormwater runoff quantity and quality. Maintaining a buffer or swale upstream of surface waters reduces pollutant impacts from sediment, phosphorus, nitrogen and high temperature waters.

Vegetated Swale Design

Vegetated swales are linear, channel-like surface depressions that can be utilized as conveyance to direct stormwater away from or around a structure, for treatment to remove pollutants from stormwater, to promote infiltration of runoff into the ground and as volume control for stormwater runoff. Vegetated swales can also be landscaped to provide an aesthetic appeal and provide natural habitat within an urban setting. Vegetation can range from tall plants and grasses to a short turf grass depending upon the desired application of the swale. Any vegetation used should be water tolerant. Native vegetation is preferred with its ability to uptake water and filter pollutants like phosphorus and sediment. Roots of native vegetation grow deep to stabilize the

soil and promote infiltration, and native vegetation does not require irrigation after the first year of establishment. Figure 15 and Figure 16 illustrate design recommendations for vegetated swales. Checkdams are recommended in order to provide retention and facilitate infiltration.
The following are example applications for vegetated swales:

- Natural drainage on a residential lot
- Along local roads in place of curb and gutter
- Parking lot islands and medians
- Highway medians
- First line of defense upstream of the stormwater system
- Aesthetic amenity at civic, commercial or residential sites
- Low flow conveyance in place of structural conveyance
- Pretreatment prior to discharge to open water or stormwater treatment facilities such as infiltration basins

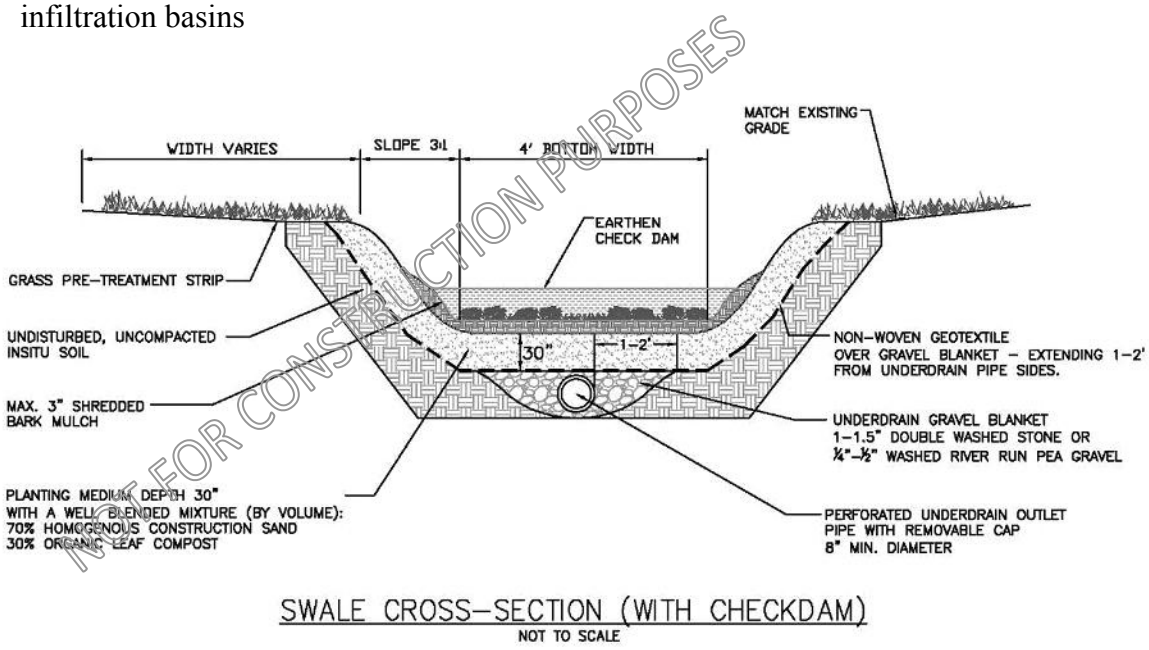


Figure 15. Design recommendations for vegetated swale (cross-section).

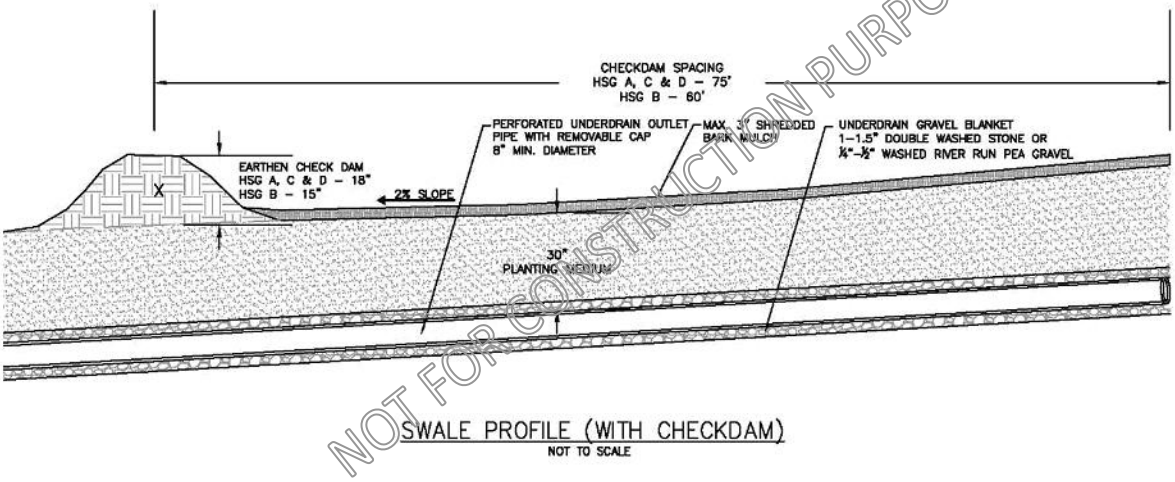


Figure 16. Design recommendation for vegetated swale (profile).

Buffer Design

Buffers can provide many different environmental and economic benefits, including:

- Protection of downstream stormwater treatment BMPs
- Protection of wetlands, streams, lakes or other waterbodies
- Reduced small drainage problems and complaints
- Reduced risk of flood damage
- Reduced stream bank erosion
- Increased adjacent property values
- Enhanced pollutant removal
- Location for greenways and trails
- Sustained integrity of stream ecosystems and habitat
- Prevention of disturbance of steep slopes
- Mitigation of stream warming
- Protection of important stream corridor habitat for wildlife

The determination of buffer widths on individual waterbodies could be based on the following minimum guidelines:

- 35 – 50 feet for reduction of human impact
- 50 – 100 feet for overall water quality protection
- 50 – 200 feet for habitat protection and species diversity

Use the high end of the range for sensitive water bodies, steep slopes and surrounding land uses that could adversely impact the water body. Add buffer width to off-set the adverse impacts of slope, poor soils, human land use pressures, or to add extra protection for sensitive aquatic organisms or wildlife. Flexibility in application of buffer width requirements can be achieved through buffer width averaging, variances and conservation easements. Overall, the U.S. Fish and Wildlife Service and the Center for Watershed Protection agree that bigger is better in terms of many factors including water quality treatment, erosion control and habitat.

A vegetative mix of trees, shrubs and groundcover are recommended to provide several layers of protection. Native prairie planting may be best for the groundcover portion of any buffer. The deep roots, hardiness, aesthetic appeal, unique habitat character and filtering ability all make prairies an ideal vegetative ecosystem for a conservation buffer. Trees and shrubs can also be used as a vegetative transition from the waterbody. Trees and shrubs can provide for enhanced infiltration and nutrient uptake while stabilizing soil and dissipating rainfall. Specific plantings will depend upon your application and area within the state. Vegetation and grading of any buffer area enables runoff to occur as sheet flow rather than forming channels and rills.

Typical Cost

The cost of installation of a vegetated swale or buffer strip varies greatly based on width, soil amendments, the use of check dams and vegetation. The cost of the installation of a vegetated swale is estimated at $0.50 per square foot, according to a 2004 study done by the Army Corps of Engineers. There will also be costs associated with labor and supplies for necessary maintenance. Financial help may be available through cost share programs and grants to offset the cost of installation.

Pervious Pavements

When rainfall hits impervious pavements such as conventional concrete and asphalt, the water runs off, collecting pollutants along the way and ends up in stormdrains and waterways. Pervious pavements allow water to pass through the surface and infiltrate into the soil below rather than running off impervious surfaces and into surface water (Figure 17). Pervious pavements have the dual benefit of serving as a parking or drive surface and a stormwater management BMP.

Figure 17. Alley with impervious pavement and poor drainage (left); alley with pervious pavement resulting in no standing water (right).
Image Source: Chicago Green Alley Handbook, CDOT.

Pervious pavements include pervious asphalt, pervious concrete, pervious interlocking concrete pavers and plastic grid systems:

- **Pervious asphalt** consists of fine and course aggregate stone bound by a bituminous-based binder. The amount of fine aggregate is reduced to allow for a larger void space of typically 15 to 20 percent.

- **Pervious concrete** is a mixture of Portland cement, fly ash, washed gravel, and water. Unlike conventional concrete, pervious concrete usually contains a void content of 15 to 25 percent which is achieved by the addition of a fine, washed gravel.
- **Pervious interlocking concrete pavers**, when installed, form patterns that create openings through which rainfall can infiltrate. These openings, generally 8 to 20 percent of the surface area, are typically filled with pea gravel aggregate.
- **Plastic grid systems**, sometimes referred to as geocells, consist of flexible plastic interlocking units that allow for infiltration through large gaps filled with gravel or topsoil planted with turf grass. Empty grids are usually at least 90 percent open space, so void space depends on the fill media.

Figure 18 illustrates design recommendations for pervious pavements, also called permeable hard surfaces.

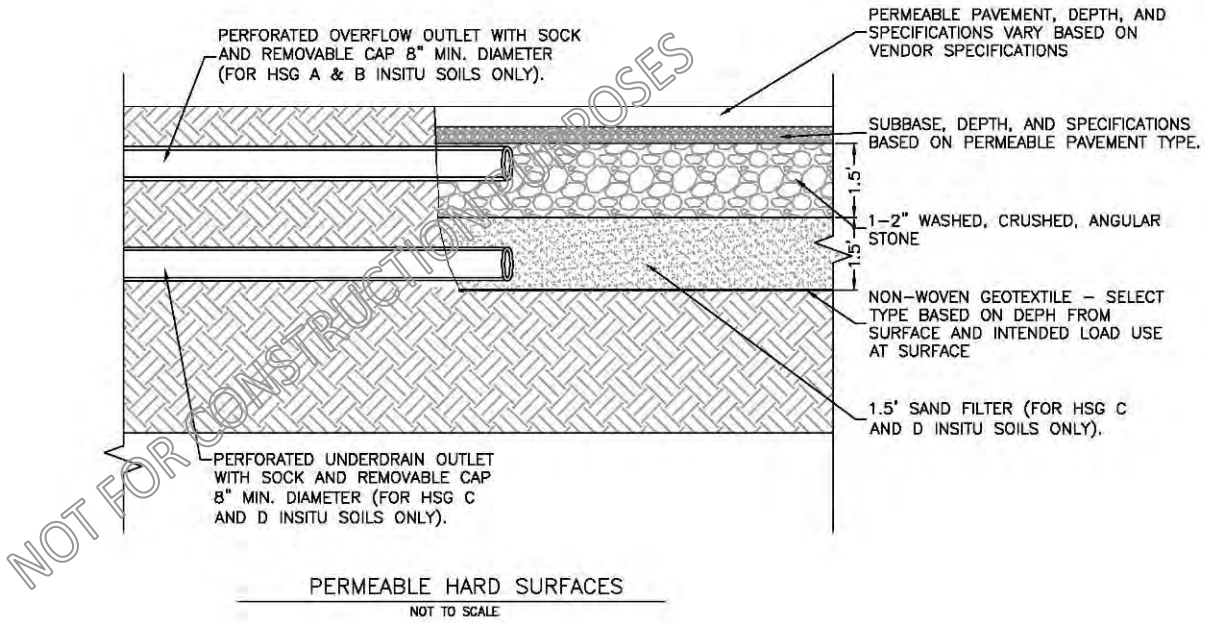


Figure 18. Design recommendations for pervious pavements.

Typical Cost

Construction costs of pervious pavements should be viewed with caution, given the wide range of site conditions and design requirements. It is recommended that each potential application be evaluated on a site-by-site basis. However, a range of cost estimates for the basic installation of pervious paver materials (including minimum base requirements) is given in the Table 13 for comparison purposes. These costs should not be compared directly to the cost of conventional pavements because pervious pavements are also stormwater management systems. An accurate price comparison would include the costs for full stormwater management and paving systems; that is, curbs, gutters, piping and storage.

Table 13. Range of cost estimates for basic installation of pervious paver materials (including minimum base requirements).

Paver System	Cost Per Square Foot Installed (2009 $)
Permeable Asphalt	$4.00 to $9.00
Permeable Concrete	$6.00 to $12.00
Pavers	$7.00 to $15.00
Plastic Grid System	$3.00 to $9.00
Amended Soils	$12.00 to $16.00

Infiltration

Stormwater infiltration practices capture and temporarily store stormwater to facilitate infiltration into the soil. Infiltration reduces stormwater pollutant discharges to receiving waterbodies, increases groundwater recharge and baseflow in streams, reduces peak flow rates volume of stormwater runoff and reduces thermal impacts of stormwater runoff. Infiltration design variants include the infiltration basin, the infiltration trench or French drain, and the underground infiltration system. Bioretention facility designs often incorporate the infiltration mechanism. For discussion regarding infiltration basins, see *Bioretention* on page 39. This section addresses infiltration trenches / French drains and underground infiltration.

Infiltration Trench / French Drain

Typically, infiltration trenches (also called French drains) are designed for small sites (e.g. five acres or less) but can be applied to larger areas if designed properly. Consideration should be given to the slopes of the contributing drainage area. Figure 19 illustrates design recommendations for infiltration trenches.

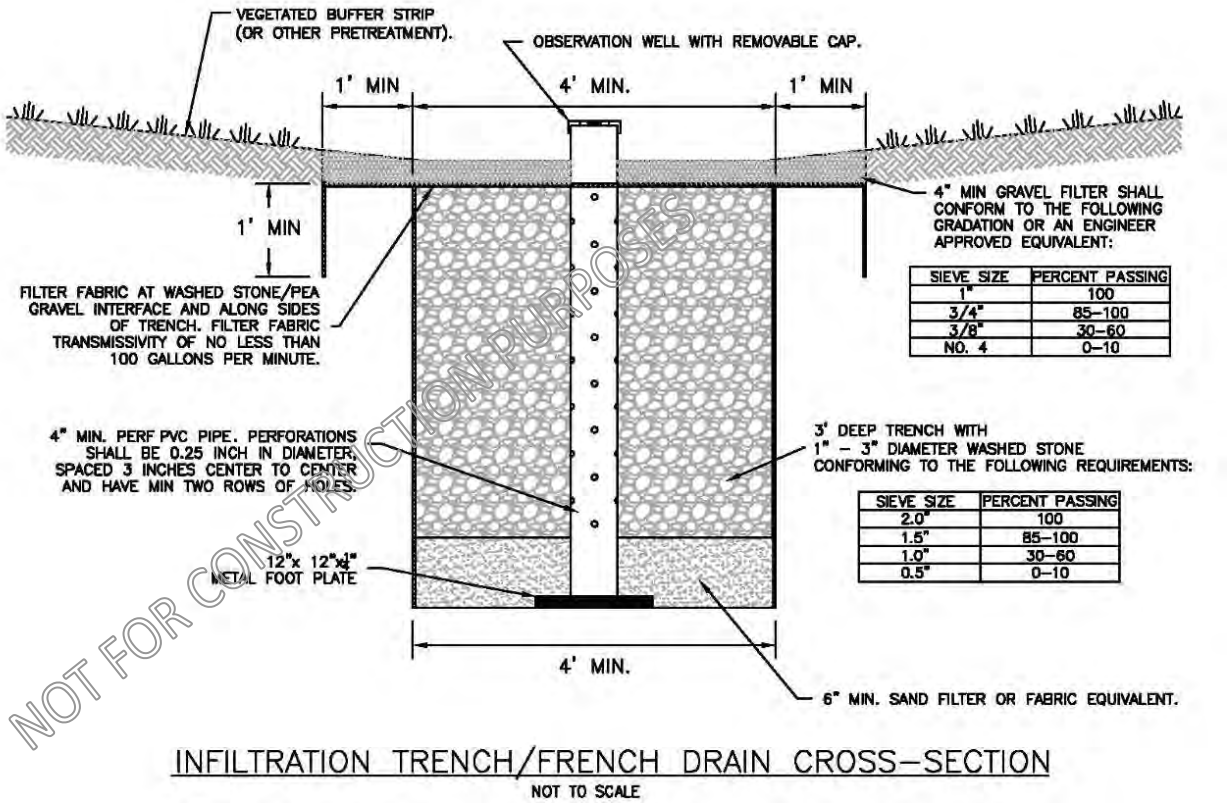


Figure 19. Design recommendations for infiltration trenches / french drains.

Underground Infiltration

Underground infiltration systems, including pre-manufactured pipes or modular structures, have been developed as alternatives to infiltration basins and trenches for space-limited sites and stormwater retrofit applications. These systems are similar to infiltration basins and trenches in that they are designed to capture, temporarily store and infiltrate the design volume of stormwater over several days. Underground infiltration systems should be installed in areas that are easily accessible to routine and non-routine maintenance. Figure 20 through Figure 22 illustrate design recommendations for underground infiltration systems; underground infiltration systems can be constructed with or without modular structures though modular structures substantially increase storage volume. Typical applications for underground infiltration systems include:

- Below parking lots or ball fields
- Retrofits in more densely developed areas

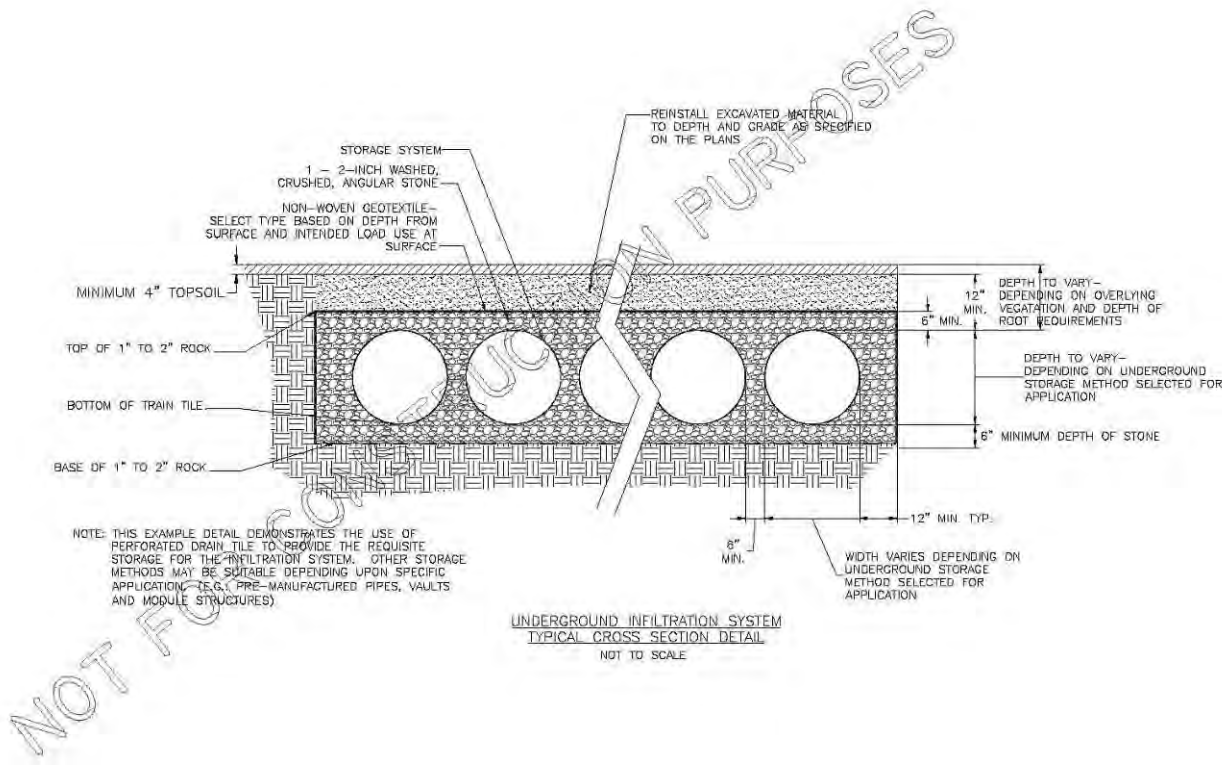


Figure 20. Design recommendations for underground infiltration systems (cross-section).

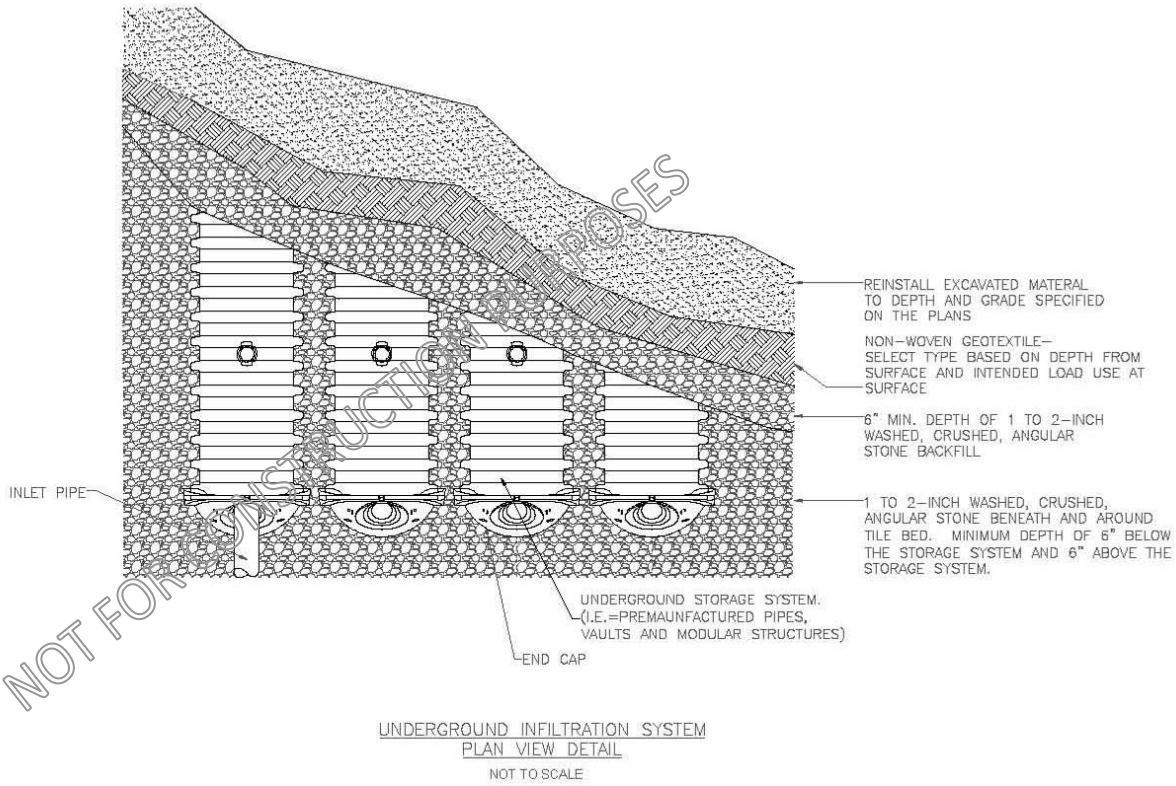


Figure 21. Design recommendations for underground infiltration (plan view).

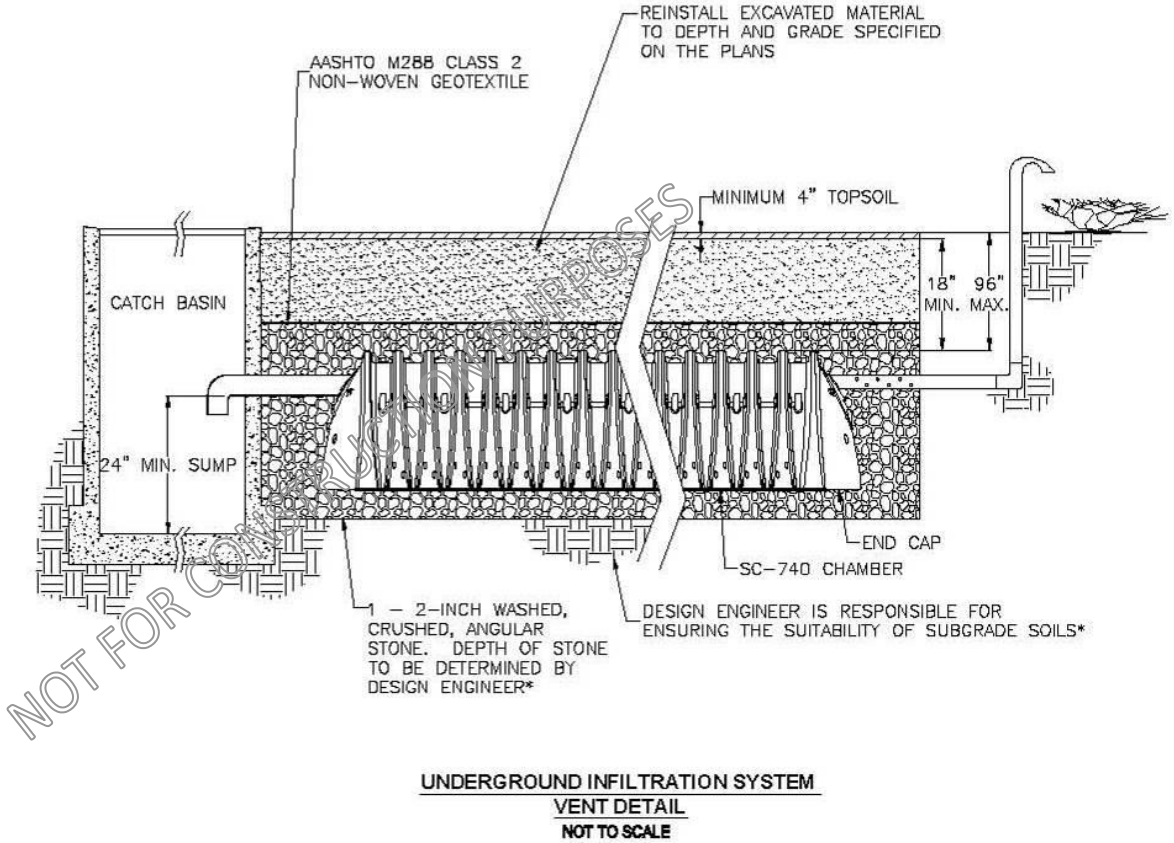


Figure 22. Design recommendations for underground infiltration (vent detail).

Stormwater Wetlands

Constructed wetland systems are implemented to store and treat runoff by emulating the function of natural wetlands. However, stormwater wetlands are not natural wetlands and natural wetland areas should not be utilized as stormwater wetlands. Stormwater wetlands are similar in design to stormwater ponds and mainly differ by their variety of water depths and associated vegetative complex. They require slightly more surface area than stormwater ponds for the same contributing drainage area. Stormwater wetlands are widely applicable stormwater treatment practices that provide both water quality treatment and water quantity control. They are typically installed at the downstream end of a stormwater treatment train. When designed and maintained properly, stormwater wetlands can be a valuable aesthetic feature of a site. Figure 23 illustrates design recommendations for a shallow stormwater wetland.

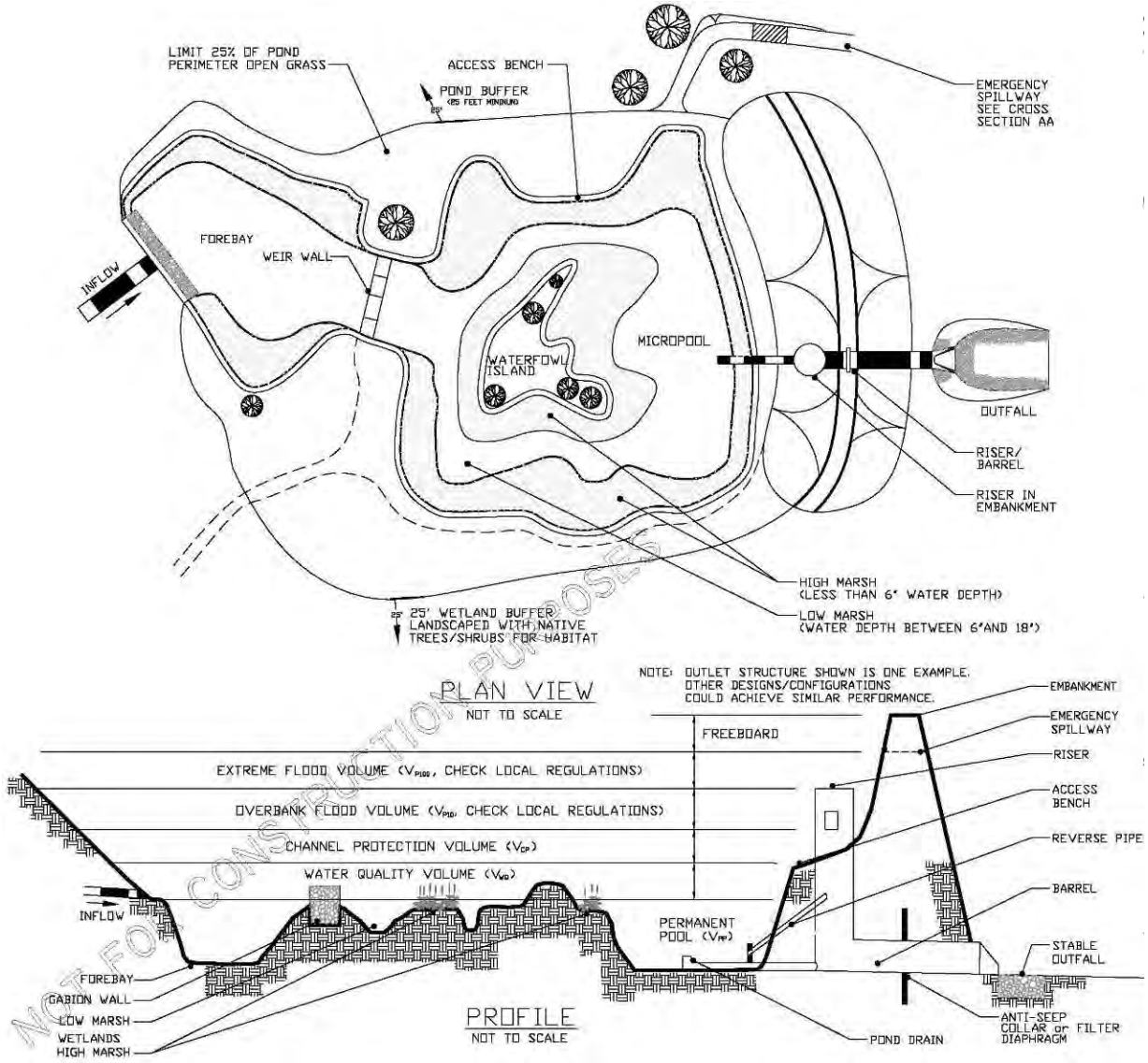


Figure 23. Design recommendations for stormwater wetlands (plan and profile).

Stormwater Ponds

Stormwater ponds are constructed basins that receive and hold stormwater runoff. The have been a tool in the stormwater management toolbox for almost 30 years. The objectives of stormwater ponds are to improve water quality through settling and biological uptake and to prevent downstream channel degradation or flood damage through outflow rate reduction and storage. During and following a storm event, runoff is stored above the permanent pool and released at a specified rate through a control structure. The actual stormwater rate control performance of stormwater ponds has been variable at best. However, stormwater ponds can be an effective stormwater management tool for its settling properties. Figure 24 illustrates design recommendations for stormwater ponds.

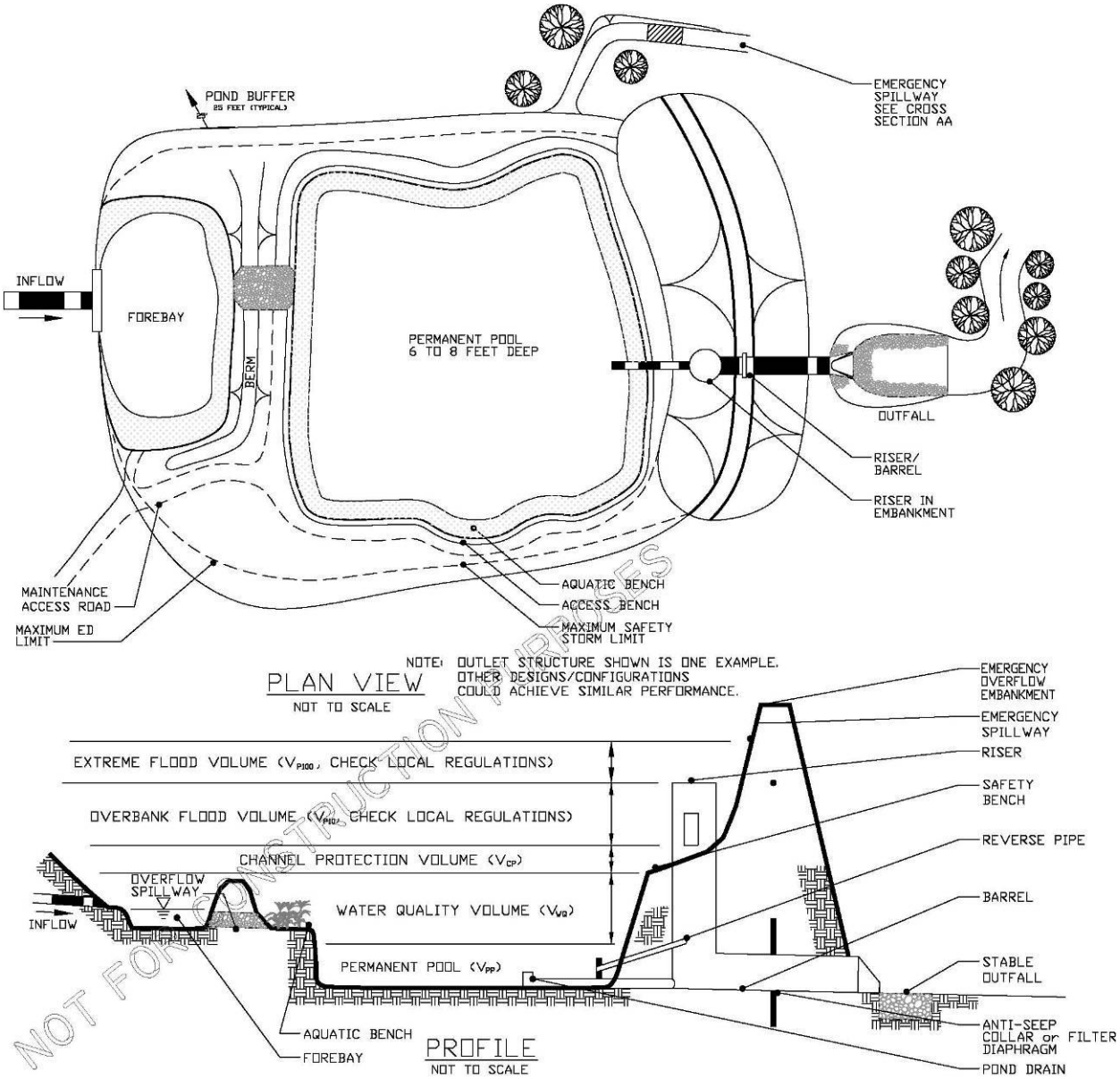


Figure 24. Design recommendations for stormwater ponds (plan and profile).

Sediment Traps

Sediment traps, also called grit chambers or water quality inlets, are designed to remove trash, debris and some amount of sediment, oil and grease from stormwater runoff prior to discharge to downstream stormwater treatment facilities and/or receiving waterbodies. Typically, these devices only capture coarse sediment and provide little to no removal of pollutants such as nutrients or metals. They do not provide volume control or flow control. There are a variety of propriety (more typically called oil/grit separators) and non proprietary devices ranging from chambered designs to manhole drop-ins. These devices include some combination of filtering, hydrodynamic sediment removal, screening or oil and grease removal. Typical applications for sediment traps include:

- Pretreatment of stormwater runoff from impervious surfaces

- Small site retrofits in absence of or in combination with stormwater treatment BMPs

Amended Soils

Land development including landscaping practices damage soil structure and function by removing or compacting topsoil. These practices decrease infiltration and increase erosion thereby impairing fish habitat and increasing the need for downstream stormwater management. These practices also create chemically dependent landscapes which are difficult and expensive to maintain and contribute to polluted runoff. Soil compaction also reduces the water retention capacity of soil which requires additional irrigation and increased public water supply demand.

Compost, an organic material, absorbs and infiltrates rainwater, reduces flooding and soil erosion and filters out pollutants typically associated with stormwater runoff. Compost also stores water and nutrients for plants to use during drought conditions, promoting healthy plants and better looking lawns that require less irrigation, pesticides and fertilizers. In addition, healthy amended soils require less irrigation and reduce municipal water demand.

The following are design recommendations for implementation of compost-amended soils applicable to new construction:

- Remove topsoil and stockpile prior to grading.
- Once rough grade is achieved and other disturbances are completed, plow or till compacted subsoil at least 2-inches deep or rototill some of the stockpiled topsoil into the subsoil.
- Reapply stockpiled soil to a minimum depth of 8 inches. If necessary to achieve 8-inch depth, import and apply a topsoil mix with 8-13% soil organic matter, which should contain 30-40% compost by volume and clean sand or sandy soil.
- Continue with the steps for *in-place soil amendment* below.

The following are design recommendations for in-place soil amendment:

- Apply a 2.5-inch deep layer of compost to the existing soil.
- Rototill compost into the soil to a depth of at least 8-inches. Note that tilling to this depth will require repeated passes with a large machine, such as a tractor-mounted or heavy reartine rototiller. Avoid plowing or tilling within the drip line of trees.
- Final soil depth should be a minimum of 8 inches.

Typical Cost

Amending with compost is often the most economical way to uncompact/loosen soils and bring them up to the desired soil organic matter content. On sites with the original, undisturbed, native soil and where space permits, stockpiling and reapplying topsoil may be less costly. Importing topsoil usually costs more than amending existing soil, although it may be easier where subsoil conditions make cultivation difficult. Reductions in the need for irrigation and fertilizer can provide payback for up front costs in the range of 2 to 7 years. Implementation of amended soils can also result in a cost savings due to reduced downstream stormwater management requirements.

Urban Forestry

Trees dissipate the energy of falling raindrops to help prevent erosion and buffer intense rainfalls. Urban tree roots have the potential to penetrate compacted soils and increase infiltration rates in open space areas, stormwater basins and subsurface stormwater storage (structured soil). Uptake of water from trees limits the volume of runoff discharged downstream, and their canopies offer interception of rainfall and shading (cooling) in an urban environment. Trees also absorb nutrients that could otherwise run off to local receiving waters. Figure 25 illustrates a typical cross-section of a tree-box filter as an urban retrofit.

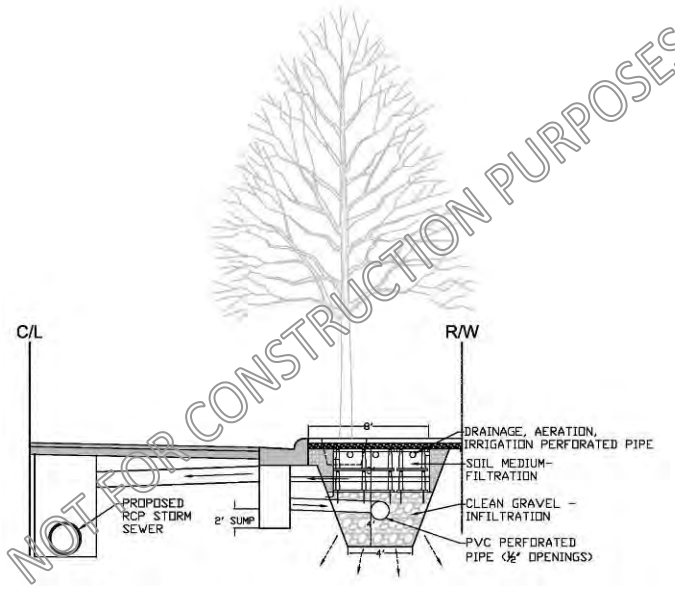


Figure 25. Typical cross-section of a tree box filter adjacent to a parking lot or roadway.

Typical Cost

The cost of preventing tree loss during development and redevelopment and the incorporation of trees into stormwater management BMPs will largely be at the expense of developers, except for staff time for ordinance and detail development. For incentivizing planting of trees in existing development, costs will vary depending on the intensity of the effort and the set maximum cost-share or rebate.

Cost savings as a result of increasing tree cover in urban areas was studied in Fayetteville, Arkansas where increasing tree canopy from 27 percent to 40 percent was estimated to reduce stormwater runoff by 31 percent. This runoff reduction was estimated to result in a savings of $43 million in capital improvement based on a $2/cubic ft. cost for stormwater management (American Forests, 2002). A similar study on Portland's declining tree canopy found that tree replacement would cost at least $5 billion, but the volume reduction and pollutant removal benefits from the trees were estimated to save the city $11 million per year in stormwater management costs. Volume and pollutant removal benefits increase with the age of the trees. Trees planted for stormwater management are planted in uncompacted soils to maximize the stormwater management benefits; this practice increases the lifetime of the tree as compared to the general practice of planting trees in compacted soil.

Native Landscaping

Traditionally, landscaping and stormwater management have been treated separately in site planning. In recent years, engineers and landscape architects have discovered that integrating stormwater into landscaping features can improve the function and quality of both. The basic concept is to adjust the planting area to accept stormwater runoff from adjacent impervious areas and utilize plant species adapted to the modified runoff regime (Table 14). Excellent guidance on how to match plant species to stormwater conditions can be found in the MPCA publication Plants for Stormwater Design: Species Selection for the Upper Midwest (Shaw and Schmidt, 2003) and in Cappiella et al. (2005).

A landscaping area may provide full or partial stormwater treatment, depending on site conditions. An excellent example of the use of landscaping for full stormwater treatment is bioretention (see *Bioretention* on page 39). In other cases, landscaping can provide supplemental treatment such as green rooftops and stormwater planters. Even small areas of impervious cover should be directed into landscaping areas since stormwater or melt water help to reduce irrigation needs.

Table 14. Environmental factors to consider when integrating stormwater and landscaping.

Factor	Problem Addressed
Duration and depth of inundation	Increased duration and depth of water changes the physical and chemical environment in ways that may favor invasive plants
Frequency of inundation	Increased frequency of inundation can carry increased levels of pollutants and toxins
Available moisture during dry weather	Soil compaction can affect plant species success at a site and also the ability of the soil to infiltrate stormwater efficiently
Sediment loading	Susceptibility to erosion and sedimentation from stormwater affects placement of stormwater management BMP as well as selection of plant material
Salt exposure	Browsers (deer and beaver) may be attracted by increased levels of salt in areas that treat roadway and parking lot runoff
Nutrient loading	Increased slopes increase ability to transport nutrients in stormwater

Typical Cost

Native landscaping as compared to non-native landscaping can be equivalent in cost depending on the supplier. Design and consideration of appropriate native plant material can add to the overall cost if staff need more time than would otherwise be used for non-native landscaping design. Native landscaping in formerly turf or bare soil areas is an added expense but, if paired with the costs of other structural BMPs (e.g. bioretention), stormwater management costs can still be ultimately lower than for conventional stormwater infrastructure.

Reducing Impervious Surfaces

Impervious areas such as road and parking pavement, building surfaces, and walkways/driveways significantly increase stormwater runoff volumes. Impervious surfaces also facilitate the wash-off and transport of pollutants like oil, grease and sediment into downstream rivers, lakes and wetlands. Reducing imperviousness reduces stormwater discharge which

thereby reduces flooding, erosion and pollutant loading. Reduced runoff can also reduce the size and cost of stormwater infrastructure. Increased greenspace can facilitate recreational and community activities that enhance the quality of life of residents/employees.

Managing the extent of impervious area of buildings, roads and parking pavements occurs through the site planning and design process. Example methods to reduce imperviousness include but are not limited to, narrower road sections, alternative road layouts, reduced application of sidewalks and on-street parking, cul-de-sac design, parking lot design, house setbacks, structure/building impervious area limits and driveway designs. Impervious area can also be effectively removed by routing runoff flow to an area that will absorb the water, such as a yard, swale or bioretention area. These methods are a component of design methodologies such as low impact development, design with nature, sustainable development and conservation design, and could become a part of standard building codes.

Typical Cost

Reducing impervious surfaces reduces maintenance and construction costs. In addition, reduced imperviousness reduces the size and cost of both the stormwater conveyance system and stormwater management practices. Additional resources may be required at the planning stages until familiarity with the design concepts and standards are established. The adoption of new ordinances requires an investment in training for the plan reviewer, the consultant, and possibly the public. Cities must also consider the cost of enforcement, including staff and equipment requirements.

Open Space Design

Open space design is a form of residential development that concentrates development in a compact area of the site to allow for greater conservation of natural areas. This form of development may also be called cluster design, conservation design, or low impact development (LID) (Figure 26). A mixed-use approach that integrates usable grassed park space with a trail system among restored native ecosystems and preserved drainageways and wetlands can be a very effective approach. Shared driveways and utilities is one example of impervious surface reduction that can facilitate the preservation of open space. Open space design overlaps with several other LID BMPs *Reducing Impervious Surfaces*, *Pervious Pavements*, *Rainwater Harvesting*, *Urban Forestry*, *Vegetated Swales and Buffers*, and *Establishing an Infiltration Standard* also presented as structural or programmatic BMPs.

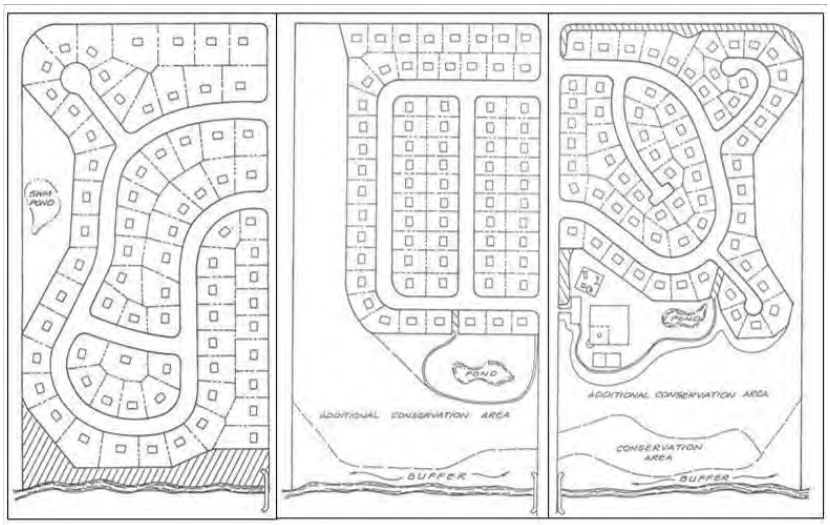


Figure 26. A conventional subdivision (left - 72 lots) with alternative layouts (center - 72 lots; right - 66 lots) implementing open space design.
Image Source: Schueler (1995)

Open space design and LID practices are not limited to new construction. Most of the techniques can be done on existing developed land. For example, raingarden networks can be incorporated into existing neighborhoods to capture street runoff, reducing the amount of runoff generated locally.

Typical Cost

Open space development, having lower built acreage and imperviousness than conventional development, results in lower costs for grading, erosion control, stormwater and site infrastructure (Mohamed, 2006). Research has shown that on average, lots in subdivisions applying open space design (conservation subdivisions) carry a premium, are less expensive to build, and sell more rapidly than lots in conventional subdivisions (Mohamed, 2006; Zielinski 2001). Mohamed (2006) quantified the average savings at $7,400 per lot based on the results of 169 subdivisions.

A cost/benefit analysis was done in 2006 in the upper midwest on three alterative site designs: low impact development (LID), a conventionally designed development, and the actual built development which contained some LID components. Though the LID design was most profitable because of lower costs for stormwater infrastructure and thirty-year maintenance, the difference in profitability was not statistically significant. Therefore, both installation and long term maintenance costs can be said to be equal between the three designs.

The Green Values® Stormwater Calculator (http://greenvalues.cnt.org/) is a cost calculator that can help cities conduct cost/benefit analyses to optimize implementation of some of the open space design techniques discussed above.

Programmatic BMPs

Municipal stormwater management programs are *front-end* methods to decrease costs, risks, and environmental concerns of water quality and flood control. In contrast to managing stormwater after it is created, programming reduces or eliminates pollutants and wastes at its source. Well-intentioned solutions sometimes remove stormwater pollutants and volume from one medium only to transfer them, and their liabilities, to another, therefore thoughtful planning and implementation is needed to ensure overall stormwater management. Programming is a multimedia approach to solve environmental problems. As residents of a community become involved in the development and implementation of municipal programs, a sense of ownership evolves and results in broader public support for the city's overall stormwater management program.

Programmatic stormwater BMPs identified herein are:

- Rules and Ordinances (page 56)
- Rainwater Harvesting / Stormwater Reuse (page 58)
- Vacuum Sweeping of Streets and Parking Lots (page 60)
- Erosion and Sediment Control Training Programs (page 60)
- Fertilizer/Chemical Application Management (page 62)
- Stormwater Utility (page 62)
- Public and Municipal Staff Education (page 63)
- Winter Road Materials Management (page 63)
- Potential Discharge Identification and Risk Reduction (page 64)
- Hazardous Material Storage and Handling (page 65)

Rules and Ordinances

Development rules are frequently in conflict with alternate design standards that limit the amount of impervious surface associated with a development. Development rules can refer to subdivision codes, zoning regulations, parking and street standards and other local ordinances that regulate development. In this section, rules and ordinances are discussed for the following topics:

- Infiltration Standard
- Open Space Design
- Buffers
- Reducing Impervious Surfaces

The EPA identifies model ordinances to protect local resources at http://www.epa.gov/owow/nps/ordinance/. Guidance includes recommendations for ordinance framework. The framework is applicable to ordinances of many kinds, but as an example it is summarized here with respect to buffer ordinances:

- **Background.** Identify the functions and benefits of buffers.
- **Intent.** Establish the intent to require the design and implementation of buffer installations.
- **Definitions.** Define key terms.
- **Applications.** Identify the activities and applications to which the ordinance applies.

- **Plan requirements.** Identify the content and submittal requirement for the buffer plan.
- **Design standards.** Define the design standards including width or area, slope and vegetative cover. Establish a minimum width that would apply to all buffers, and then customize requirements according to functions, values, and perhaps size of the water body. Determine how areas are to be calculated and identify any flexibility in the standard, such as using an average buffer width to meet the standard. This would also allow changes to be made to adjust for such factors as steep slopes, poor soils, encroaching land uses or sensitivity of the water body. Standards should also provide specifications for different vegetative mixes based on a set of site conditions (e.g. slope, soils and climatic region), require signage, and specify a minimum spacing of signage (ex. every 50 feet) to identify the buffer and prevent encroachment. Especially in early spring, the untrained eye can mistake buffers for lawn.
- **Enforcement procedures.** Identify the penalties for violations and the program responsible for detecting violations.
- **Waivers and variances.** Specify the conditions under which waivers or variances apply. Flexibility could be introduced through buffer averaging, clustering or conservation easements.
- **Conflicts with other regulations.** Identify that the more restrictive regulation applies when the ordinance conflicts with other regulations.
- **References**. Site all references used to develop the ordinance or rule.

Infiltration Standard

Infiltration is a highly effective stormwater practice that reduces runoff volume, increases ground water recharge, improves surface water quality, provides thermal benefits and helps to mimic predevelopment hydrology. While other practices may address stormwater quality and rate control, limiting increased volumes of runoff from development and redevelopment is the most effective way to reduce the cumulative impacts on downstream water resources.

The infiltration standard of the city should be based primarily on the local geology/soils, existing and planned land use, stormwater goals and stakeholder interests. Attaining a balance among these sometimes competing interests will determine what infiltration standard is feasible. Infiltration standards generally fall into two categories: flat standards and pre-to-post standards. Flat standards are typically expressed as the volume of runoff generated by a certain rainfall depth, typically 0.5- or 1.0-inch. These standards are usually applied only to impervious surfaces, either net additional impervious or total impervious. Pre-to-post standards require modeling of existing runoff volumes and hold post-development runoff volumes to existing conditions for a return frequency rainfall event, typically the 1- or 2-year storm event. In other words, pre-to-post standards restrict the volume that leaves the site after development, keeping it equal to predevelopment conditions.

Open Space Design

Development rules can be in conflict with alternate design standards that maximize the amount of open space associated with a development. Development rules can refer to subdivision codes, zoning regulations, parking and street standards and other local ordinances that regulate development. These rules will likely require review and adjustment to allow for open space design. Municipal fire, police and public works operations (ex. snow plowing) must be an

integral part of the rule/ordinance planning so that their perspective is incorporated into any changes being considered.

Many open space ordinances now require 20 percent of upland buildable area (excluding area dedicated to stormwater treatment, protected wetlands, and other non-buildable space) to be maintained as undisturbed, natural area. In addition, the code allows an increased mixture of housing types for each zoning district in order to promote and enable cluster development to facilitate open space design.

Most local codes contain front yard setback requirements that dictate driveway length. In many communities, front yard setbacks for certain residential zoning categories may extend 50 or 100 feet or even longer, which increases driveway length well beyond what is needed for adequate parking and access to the garage. Shorter setbacks reduce the length and impervious cover for individual driveways (e.g. a 20-foot setback).

City code can introduce an option for additional units in large lot residential zoning districts. Additional units could be allowed if total preserved open space represents at least 50 percent of the total buildable land area. Qualified preserved open space could include agricultural lands, natural habitat, pedestrian corridors, or neighborhood or community recreational areas. All preserved open space could be subject to a conservation easement.

Buffers

A city can adopt regulations wherein owners or developers are required to implement buffers under certain conditions. Conditions could be based on proximity to streams, lakes and wetlands, to waters of the United States, to DNR public waters or based on the functions and values of water bodies as identified by the city.

Reducing Impervious Surfaces

Municipal ordinances and initiatives that encourage the use of pervious could include:

- For all development, pervious pavements must be used for the portion of parking over the minimum required off-street parking spaces. If proposed parking exceeds the maximum required off-street parking spaces, 50 percent of all parking spaces shall be pervious pavement.
- Various types of road surfaces could be incorporated in combination to create an environmentally friendly lane. The design of the first lane could include the use of pervious pavers, plastic mats and formed concrete driving strips.
- Require 20 percent of a parking lot to be made of pervious pavement or a suitable, LID stormwater management practice.

Rainwater Harvesting / Stormwater Reuse

Rainwater harvesting programs collect runoff from rooftops, parking lots and other surfaces and reuse the water for such things as irrigation of gardens and municipal ballparks, washing patio furniture and lawn watering. Additionally, harvested rainwater when approved could be used indoors for non-potable uses such as toilet and urinal flushing. Indoor use designs are subject to

review by state plumbing code. The effect of rainwater harvesting is volume control, reduced flooding and erosion, and less demand for treated potable water.

Rain Barrels

Rainwater harvesting can be accomplished using rain barrels and/or cisterns. Rain barrels are typically small scale (25-100 gallons) and located at the downspout of a gutter system. They can also be linked to expand the overall storage volume (right). They are used to collect and store rainwater for watering landscapes and gardens or washing patio furniture. The simplest method of delivering water is by the force of gravity. However, more complex systems can be designed to deliver the water from multiple barrels connected in a series with pumps and flow control devices.

Cisterns

Cisterns have a greater storage capacity than rain barrels and may be located above or below ground. Due to their size and storage capacity, these systems (often large polyethylene drums) typically collect runoff from areas larger than residential rooftops such as commercial parking lots. Collected water is typically used to irrigate landscapes, gardens, and ballparks on a regular basis (e.g. feeding an automated irrigation system) reducing the strain on municipal water supplies during peak summer months. Again, cisterns may be used in series and water is typically delivered using a pump system. Pump systems in cisterns can be designed with a floating level that shuts off the pump and converts the water source to a municipal supply when cistern levels are too low.

Programming

Many cities have offered a $10 to $30 rebate to water customers for rain barrel purchases of over 40 gallons in volume. Cities have also provided a limited supply of rain barrels to residents at a reduced cost. Communities have also coordinated with the food industry to salvage their 55 gallon food-grade drums to recycle for use in a rain barrel program. Food-grade barrels can be retrofit into rain barrels and have been sold for $30. Innovative initiatives could include a Rain Barrel Decorating Event with optional art competition. The city could supply rain barrels at a discounted price and free painting supplies for decorating the barrels onsite.

Typical Cost

Rain barrels typically cost between $50 and $230 dollars for a 55 gallon drum depending on the manufacturer and inclusion of accessories and/or installation. Rain barrels can be easily constructed by residents using a standard food-grade plastic 55-gallon barrel which can be obtained for approximately $15 to $20. The Low Impact Design Urban Design Tools website, designed by the Low Impact Development Center, provides additional cost guidelines.

Cisterns are considerably more expensive than rain barrels ranging from $200 to $10,000 due to size, materials, and structural requirements. Very large scale stormwater reuse systems (e.g. at public buildings or commercial sites) vary in cost based on complexity of the system, the scale of the system and the existing land use prior to installation.

Vacuum Sweeping of Streets and Parking Lots

Pollutants collect on surfaces in between storm events as a result of atmospheric deposition, vehicle emissions, winter road maintenance, construction site debris, trash, road wear and tear, and litter from adjacent lawn maintenance (grass clippings). Sweeping of materials such as sand, salt, leaves and debris from city streets, parking lots and sidewalks prevents them from being washed into storm sewers and surface waters. Timing, frequency and targeting critical areas greatly influences the effectiveness of sweeping.

Table 15 identifies percent removal of total solids (TS), total phosphorus (TP) and total nitrogen (TN) from a conceptual model developed by the Center for Watershed Protection based on research findings from a variety of studies. The lower removal efficiencies represent are achieved through monthly street sweeping by a mechanical street sweeper. The highest removal efficiencies are achieved through weekly sweeping using a regenerative air or vacuum street sweeper at weekly frequencies. Note that even the highest removal efficiencies are relative low when compared to potential removal from structural BMPs or other programming. However, it is clear from Table 15 that using a mechanical street sweeper is almost complete ineffective.

Table 15. Percent removal of pollutants from street sweeping for total solids, total phosphorus and total nitrogen.

Frequency	Technology	TS	TP	TN
Monthly	Mechanical	9	3	3
	Regenerative Air/Vacuum	22	4	4
Weekly	Mechanical	13	5	6
	Regenerative Air/Vacuum	31	8	7

Source: Deriving Reliable Pollutant Removal Rates for Municipal Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin. Center for Watershed Protection.

Typical Cost

Staffing and equipment are the largest costs for street sweeping programs. Conventional street sweepers can range from $60,000 to $125,000, depending on the make, model and equipment enhancements. Prices can be as high as $180,000 for newer technologies. The average useful life is about four years, varying based on frequency of use. Cost savings can be seen by using equipment that can be converted to other uses, for example, a sweeper that converts to a sander and snowplow in the winter. Training for operators must be included in operation and maintenance budgets. Costs are small for parking restriction notifications/signage. Parking tickets are an effective reminder to obey parking restrictions and can be used as a source of revenue for the program.

Erosion and Sediment Control Training Programs

Erosion and sedimentation is the natural process in which soil and rock material is weathered and carried away by wind, water or ice. Construction activities can increase erosion by removing vegetation, disturbing soil and exposing sediment to the elements. Eroded soil quickly becomes a sedimentation problem when wind and rain carry the soil off the construction site and sediment is deposited in surface waters.

Erosion and sediment control BMPs are necessary at all construction sites to keep soil onsite and prevent unnecessary water pollution. Training individuals responsible for installing, constructing, repairing, maintaining and/or inspecting erosion and sediment control measures and post-construction stormwater management practices at construction sites will result in properly designed, installed and maintained BMPs, and protecting water quality.

There are many types of erosion and sediment controls that could be covered in a training program. The following is a condensed list of recommended BMPs to discuss in a training program.

- Site phasing
- Construction entrances
- Protecting natural vegetation and undisturbed areas
- Low impact development
- Temporary diversions
- Temporary down drains
- Sediment retention basins
- Dewatering
- Perimeter control (Figure 27)
- Stockpile protection
- Surface roughening and slope tracking
- Minimize slopes
- Stormdrain inlet protection
- Outlet protection
- Temporary and permanent stabilization
- Specific BMPs related to working near or around water

Figure 27. Installed silt fence will minimize sediment from leaving a site and entering surface waters.

Typical Cost

The development of a training program will require staff time; however, there are numerous resources and examples of training programs and certification requirements from around the state and the country. By utilizing currently established training programs as an alternative to developing a new program or to enhance a program in development, the city can save time and money.

Fertilizer/Chemical Application Management

Fertilizers, herbicides, and insecticides have various ecological effects, toxicity, and chemical fate and transport based on the product's chemical components. Depending on the chemicals' characteristics, they can have unintended harmful effects on terrestrial and aquatic plants and animals, and can end up in our soil, water, and air through conveyance by stormwater. Nitrates from fertilizers can migrate through the soil profile and contaminate ground water supplies beyond safe drinking water levels. Phosphorus from fertilizers contributes to eutrophication of surface water bodies that depletes oxygen levels and can lead to fish kills.

Programs designed to manage and minimize chemical application typically include a combination of the elements identified below. The following BMPs and chemical alternatives can provide the content for training programs and public education materials:

- Integrated Pest Management (IPM): employs mechanical, biological, cultural, and/or chemical mechanisms as determined by a thorough evaluation of the conditions rather than addressing every condition with chemicals.
- Chemical preparation and handling BMPs to select lower toxicity products, reduce spills, and provide secure containment.
- Chemical application BMPs: manages application rates, application sites (not on bare soils or near surface waters) and weather (no application when windy or when rain is forecasted).

Typical cost

A soil sample and nutrient test costs less than $25 per sample and is easily the best value for fertilizer minimization. Soybean and organic fertilizers can be up to three times the cost of standard chemical fertilizer. Reduced labor costs associated with fewer applications in larger amounts can help to offset this cost. However, alternative practices employed in place of fertilizers (identified through IPM) can easily be less expensive than chemical application. Similarly, practicing IPM can reduce herbicide and pesticide application costs.

Stormwater Utility

Stormwater utilities entail accounting for stormwater management costs in the same manner that other city services are counted, with a line item on a bill. Funds are generated through per-plot fees based on the amount of runoff leaving each plot that enters the city's stormwater conveyance system. The fee payer is given methods to reduce this fee, such as infiltrating or treating a volume of runoff from their property.

Typical Cost

This is a revenue-generating program that also has the potential to reduce the need (and cost) of downstream stormwater management facilities.

Public and Municipal Staff Education

An education program can be paired with any stormwater management BMP (structural or programmatic) to create an awareness of and appreciation for the city's water resources. Public and municipal staff can be educated on the city's goals for both stormwater management and the state of its water resources. Education can address how citizen and staff actions impact stormwater quality and quantity and, therefore, receiving waters. Developing programs that involve activities to eliminate pollution sources and/or prevent contaminants from entering waterways are a means in and of itself of public and staff education. Public and city staff education programs include, but are not limited to:

- Education on the importance of keeping lawn clippings and leaf litter off impervious surfaces, of rain barrels and rainwater harvesting, or of any other topic on water resource protection
- Public event for stenciling/marking storm drains with *No dumping. Drains to Lake.*
- Benefits of rain barrels and rainwater harvesting
- City staff workshop on how to meet city stormwater management goals through operations/management of city property and activities/practices of city staff.

Typical Cost

Costs of education programs vary based on format (e.g. flyers, email or workshop) and extent of implementation.

Winter Road Materials Management

Chloride and sand accumulate in surface and groundwaters due to stormwater runoff from road salt storage piles, areas of excessive application, or simply from years of repeated application. Chloride in road salt and road salt additives (e.g. ferrocyanide for anti-caking) can create toxic conditions for fish, insects and vegetation. Proper winter road materials storage, handling, and application reduce the risk of downstream water resources pollution and can reduce die-off of exposed vegetation, fish, and other aquatic organisms.

A municipal sand/salt management plan is a commitment to implementing BMPs while fulfilling a community's obligation to provide safe, efficient and cost-effective roads. The plan should identify BMPs (e.g. securely cover storage piles, calibrate applicator equipment) to reduce the negative environmental impacts of sand and road salt. The plan should apply to all winter maintenance personnel including staff and contractors. Training of staff and contractors should accompany all sand and salt management policies.

A snow management plan identifies the city's methods for managing the accumulation, removal and potential collection of snow so that procedures are in place for both during and after a snowfall event. This plan should not only address city operations, but also examine how commercial entities are conducting their operations. Snow storage areas should be on paved bermed surfaces if sand is used; this allows the area to be swept after snowmelt and the sand to be contained during runoff. Runoff should be pretreated prior to discharge to receiving stormwater facilities or waterbodies. If salt is used, storage should be on pervious surfaces to

prevent direct discharge to surface waters, but storage should be outside of stormwater treatment areas in order to prevent clogging from sediment and allow for runoff capacity during snowmelt.

Typical Cost

Rather than creating an additional expense, implementation of BMPs can reduced material usage by upwards of 50 percent. Materials reductions translated directly into cost savings. Increased efficiencies from operator training can similarly save a city both staff and materials costs.

Potential Discharge Identification and Risk Reduction

Illicit discharges are those wastes and wastewaters from non-stormwater sources which city's cannot legally discharge down storm drains. Sources include:

- Sanitary wastewater illegally connected to the storm drain system
- Residential laundry washwaters
- Effluent from septic tanks
- Industrial wastewaters
- Auto and household toxics such as used motor oil
- Liquid fertilizers and pesticides
- Pet waste
- Drained pool water
- Spills from roadways
- Paint waste
- Anything that isn't rain down the storm drain is a potential illicit discharge.

The result of illicit discharges entering the storm drain is untreated discharges to receiving water, contributing high levels of pollutants including heavy metals, toxics, oil and grease, solvents, nutrients, viruses, and bacteria.

A program to detect and address illicit discharges is central to the ultimate elimination of illicit discharges. The EPA recommends in their *Illicit Discharge Detection and Elimination Program Development* guidance that the program include the following four components:

- Locate problem areas
- Find the source
- Remove/correct illicit connections
- Document actions taken.

Strategies for education and incentives can include: passive education (Figure 28), active training, provision of direct city services, subsidies and discounts, home/business-owner recognition programs, stewardship group formation. Regulations might include: adoption of a local ordinance, notifications/signs/hotlines, restrictions or bans, enforcement, utility pricing.

Figure 28. Storm drain stenciling can remind homeowners of the consequences of dumping waste.

Typical Cost

The cost of detecting and reducing the risk of illicit discharges will vary depending on the intensity of the effort and the approach(es) chosen. Costs attributable to detection and correction of illicit discharges are based on the total staff involvement driven by the problem area identification methods employed and the number and extent of discharge incidences. Public education program costs are determined by the type of materials produced and the method of distribution selected. Volunteer efforts can reduce program costs, as determined by staff hours required for program implementation and leadership of volunteers. An important consideration is that prevention of illicit discharges is much less costly than detection and subsequent correction.

Hazardous Material Storage and Handling

A hazardous material is any biological, chemical, or physical material with properties that make it dangerous or potentially harmful to human health or the environment. Hazardous materials can be released to the environment in a variety of ways. A spill of only one gallon of oil can contaminate one million gallons of water. Potential hotspots for higher levels of stormwater pollutants and/or risk for spills, leaks or illicit discharges include:

- Equipment storage and maintenance yards
- Incinerators
- Landfills
- Hazardous waste handling and transfer facilities
- Public works yards
- Vehicle storage and maintenance yards

Minimizing or eliminating contact of hazardous materials with stormwater can significantly reduce pollution of downstream waters. Starting with a spill prevention plan provides a framework for city or facility operations and a training tool for personnel. Proper hazardous material handling and storage also contributes to employee health, an organized work place, and efficient operation. Proper practices include:

- Confine material storage indoors to the greatest extent feasible, and plug or disconnect floor drains that lead to the stormwater system
- Confine outdoor material storage to designated areas that are covered, away from high traffic areas, outside of drainage pathways, and on impervious surfaces
- Prevent run-on of stormwater into fueling areas using diversion dikes, berms, curbing, surface grading or other measures or use catch basin inserts to prevent discharge into storm drains
- Avoid loading/unloading materials in the rain and/or provide cover for the activity
- When conducting vehicle and equipment maintenance use drip pans, drain boards, and drying racks to direct drips back to a fluid holding tank for reuse or proper disposal

Typical Cost

Pollution prevention measures are not inherently costly and are more a matter of culture. However, providing cover over hazardous materials stored outdoors can be equivalent to the cost of a pole building ($5 to $12 per square foot) and a concrete slab ($3 to $6 per square foot). If waste reduction measures are taken, an accurate inventory is maintained, and regular waste disposal is implemented, cities can minimize the amount of materials stored onsite, decreasing costs.

8. ORDINANCE GAP ANALYSIS

Purpose

The purpose of the ordinance gap analysis is to assist the city of Cumberland in identifying how its ordinances could improve stormwater management and water quality in order to enhance and maintain the volume and flow of stormwater runoff and the quality of the city's water resources. It is apparent from the city of Cumberland 2006 Comprehensive Plan that improved development techniques are a goal of the city. Ordinances could, at least in part, address the Stormwater Management Plan goals and the following objectives and actions of the 2006 Comprehensive Plan, as they relate to stormwater management.

The 2006 Comprehensive Plan goals, as they relate to stormwater management are:

Housing

Goal: *Guide new housing development into areas that minimize impacts on sensitive natural resources so that the city continues to be an attractive place to reside.*

Objective: Encourage development in areas that will not result in property or environmental damage.

Action: Encourage "low impact" development that strives to retain natural vegetation that can help reduce storm water runoff and flooding.

Action: Encourage landscaping and natural screening between building sites.

Utilities and Communities Facilities

Goal: *Implement a Stormwater Management Plan*

Objective: The City of Cumberland will require necessary stormwater best management practices for new development and develop solutions to keep pace with evolving water quality regulations.

Agricultural, Natural, and Cultural Resources

Goal: *Conserve, protect, manage, and enhance the town's natural resources, including but not limited to, lakes, rivers/streams, wetlands, groundwater, forestlands, and other wildlife habitats in order to provide the highest quality of life for city of Cumberland's citizens and visitors.*

Objective: Enforce setback requirements for water resources by enforcing City shoreland standards when applicable.

Objective: Promote the establishment and maintenance of natural buffers along water resources.

Action: Encourage Barron County and the Wisconsin Department of Natural Resources to fund buffer strips along streams and the lakeshores.

Objective: Protect and manage local forested areas and other wildlife habitats.

Action: Encourage selective cutting in forest stands.

Action: Coordinate with WDNR to identify and protect wildlife habitats.

Action: Encourage "low impact" development that strives to retain natural vegetation.

Action: Discourage habitat fragmentation by encouraging development on the fringes of identified habitat areas.

Goal: *Provide adequate amount of parkland or greenspace to serve existing and new development.*

Objective: Require developers to dedicate a portion of the development for park and open space purposes or cash-in-lieu of land for this purpose.

Methods

The guide *Better Site Design: A Handbook for Changing Development Rules in Your Community* was developed in 1998 by the Center for Watershed Protection. The handbook outlines 22 key principles of better site design pertaining to streets, parking, open space, lot layouts, stormwater management, and natural resources. A code and ordinance worksheet is included that allows a community to answer basic questions about the standards listed in their ordinances and evaluate how well their ordinances support low-impact development or better site design based on a simple points system. Ordinances were evaluated based on the questions in the worksheet. Ordinances were identified through reference to the City Code.

Background on Better Site Design

Residential Streets and Parking Lots

One of the main goals for better site design with respect to residential streets and parking lots is to minimize the total amount of impervious surface created to allow the movement of people throughout the community. This can be accomplished through municipal ordinances that allow streets and parking areas to be as small as possible. The next goal after minimization of impervious surface is the management of the stormwater runoff from those impervious areas. The conveyance and treatment of runoff in vegetated channels is preferred over conveyance in stormsewer systems because it replenishes water in the landscape.

Lot Development

Better site design concepts when applied to lot development standards focus on the availability of open space and natural area establishment and protection options, lot sizes and setbacks, sidewalk and driveway requirements, and options for stormwater management. Standards that allow greater flexibility for protection of natural resources through a simple review process are preferred over more rigid standards.

Conservation of Natural Areas

A final key focus of better site design is the conservation of natural areas. Natural areas benefit water quality by filtering runoff and taking up nutrients, provide habitat for wildlife, and sequester carbon. Urban forests in particular can reduce cooling needs of buildings while also reducing urban runoff.

Findings

The completed code and ordinance worksheet can be found in Appendix B. The following provides a more narrative interpretation of the worksheet and the direction towards which it guides the city in potential ordinance revisions.

The primary ordinances and plans reviewed for this evaluation were:

- Chapter 8, Streets & Sidewalks
- Chapter 17, Zoning Code
- Chapter 18, Subdivision & Platting
- Chapter 19, Shoreland – Wetland Zoning
- Chapter 21, Floodplain Zoning

Current Ordinance Highlights

The current ordinances somewhat support better site design with respect to lot development. In particular, the city's standards allow flexibility for Planned Unit Developments, Open Space Design and Management as well as Buffer System Ordinances.

Findings of Analysis

Based on the Center for Watershed Protection Evaluation worksheet, the city of Cumberland appears to provide standards in its ordinances to allow for better site design in certain circumstances. However, the City has significant changes that could be made to support better site design. Findings are broken out into the three main categories used in the worksheet: Residential Streets and Parking Lots, Lot Development, and Conservation of Natural Areas.

Residential Streets and Parking Lots

In Cumberland, the required pavement width and right-of-way for residential streets is not specifically mentioned in the city ordinances. The specification of 18 feet width for Mobile Home Parks is in-line with that recommended by the Center for Watershed Protection, however the 66 foot right-of-way is much larger than the recommended 45 foot right-of-way. Cul-de-sac minimum radius is not specified in the city code and therefore could not be assessed in the worksheet. Ideally cul-de-sacs should have a minimum radius of less than 35 feet and in no case longer than 45 feet. The Cumberland ordinance states curb and gutter as a required improvement with subdivision and platting, but that rural section roads require City Council approval.

Parking standards in Cumberland require 5 spaces per 1,000 square feet of professional office or retail center. The Center for Watershed Protection recommends 3 spaces or less per 1,000 square feet of professional office and 4.5 spaces or less per 1,000 square feet of retail center. The parking requirement for single family homes in Cumberland meets the 2 spaces per home recommendation of the Center for Watershed Protection. Shared parking is promoted through Cumberland's ordinances; however compact car spaces are not encouraged. The standard parking stall size required in Cumberland is 10 feet by 18 feet, just a bit wider than the 9 feet by 18 feet recommended. Parking areas are required to be constructed of impervious (hard) surface in the Cumberland ordinances.

With respect to managing the runoff from the impervious surface created by parking lots and roadways, the City of Cumberland does not have a requirement for landscaping within parking

lots, nor are landscaped stormwater practices encouraged. Contrary to Center for Watershed Protection recommendations, the City of Cumberland does not allow driveways to be constructed of permeable materials and does not appear to allow shared driveways in residential areas.

Lot Development

The City of Cumberland allows open space or conservation development through a Planned Unit Development (PUD). PUDs can be mixed use where an area is specifically zoned as PUD, or can be of uses that fit with the underlying zoning in any other area of the City. The PUD process allows flexibility in site design criteria such as lot sizes. However, the process in Cumberland does not appear to provide additional incentives for conservation development such as increased density in other parts of the site if natural areas are preserved. As recommended by the Center for Watershed Protection, Cumberland specifically allows land trusts to manage open space and establishes standards for other associations that could manage open spaces. Allowable uses for open spaces are defined generally in different zoning districts.

The standard residential lot in Cumberland (R-1) has a front setback of 25 feet, a rear setback of 25 feet, a side setback of 8 feet and a frontage width of 80 feet. These setbacks are fairly consistent with the recommended front setback of 20 feet, rear setback of 25 feet, side setback of 8 feet and frontage width of 80 feet given by the Center for Watershed Protection, although their recommendations are for a ½ acre lot. The R-1 and R-2 zoning minimum lot area is 10,000 square feet. The City of Cumberland allows irregular shaped lots which should provide needed flexibility for conservation of natural areas.

Driveway and sidewalk dimensions are not discussed in the City of Cumberland Municipal Code. The recommended minimum width by the Center for Watershed Protection is 9 feet for single lane and 18 feet for two lanes. The Center for Watershed Protection encourages the use of pervious materials, two track design and shared driveways as well. The recommended sidewalk width is 4 feet or less on one side of residential streets with the option to substitute trails.

The Cumberland ordinances appear to allow rooftop runoff to be managed in yard areas. In addition, the ordinances appear to allow for temporary ponding of stormwater in front yards and on rooftops. These stormwater management techniques are recommended by the Center for Watershed Protection.

Conservation of Natural Areas

Cumberland requires shoreland zone buffers of 35 feet from the ordinary high water level. Presumably, these buffers would also apply to rivers and streams. The buffer areas are required to be planted with natural vegetation equally effective in retarding runoff, preventing erosion and preserving natural beauty as what originally existed. The City also has some level of protective standards that apply to floodplain districts.

The conservation standards of the City of Cumberland focus primarily on tree/shrub, wetland and steep slope preservation while other natural vegetation may not be protected under the ordinances.

Stormwater management standards are not clearly stated in the ordinances (e.g. treatment prior to discharge to a stream or lake or to storm sewer) of water quality standards. The City of Cumberland has floodplain management overlay districts that govern development activity in the floodplain.

Recommendations

Based on the findings from the Center for Watershed Protection worksheet, the City of Cumberland should consider some changes to its ordinances to better support and encourage better site design and low impact development activities that protect the water resources of the City. While reviewing ordinances, it is recommended that Cumberland fully consider:

- Whether ordinances are adequately requiring that right-of-way and paved portions of streets be as narrow as feasible.
- Consider adopting Mobile Home street, sidewalk, and right-of-way standards for all residential zone standards.
- Whether parking standards are requiring more spaces, and thus more impervious surface, than needed on a regular basis.
- Clearly identifying that low impact and better site design stormwater management practices (i.e. rural section roads, curb cuts to stormwater management practices, permeable pavements) are allowed and preferred on all sites and roadways
- Revising stormwater management standards to fully support and encourage low impact development and better site design stormwater management methods (i.e. swales, raingardens, bioretention).
- More clearly define “hard” surface as it relates to surfacing of parking areas
- Allowing porous pavement materials for driveways, sidewalks, trails and parking lots (i.e. porous pavers, porous concrete, porous asphalt, open grid systems)
- Requiring open space to be consolidated into larger or more contiguous units.
- Requiring that a portion of the open space be managed in a natural condition.
- Consider buffer standards consistent with the Center for Watershed Protection’s recommendations.
- Consider more specificity on requirement for stormwater management, with focus on water quality treatment requirements, volume and rate control.
- Develop incentive programs for developer and landowners to conserve non-regulated land.

9. PUBLIC OUTREACH, INFORMATION & EDUCATION FRAMEWORK

Purpose

Substantial water quality improvements are made with structural best management practices (BMPs), but part of the solution to water quality improvement is public education. Education programs create an awareness of and appreciation for the city's water resources and teach people how to reduce polluted runoff from their areas of influence (yards, community centers, places of work). Education programs can stand alone among city initiatives as a broadcast effort to inform the community of stormwater management and associated water quality issues, or they can be effective tools to generate public understanding (and therefore support) of city stormwater management initiatives (e.g. structural or programmatic BMPs, stormwater utility, ordinance revisions). Education can address how citizen and staff actions impact stormwater quality and quantity and, therefore, receiving waters. Developing programs that involve the public in activities to eliminate pollution sources and/or prevent contaminants from entering waterways are an additional means of education.

The purpose of this section is to develop a framework for education programs that facilitate implementation of Stormwater Management Plan goals. The city's 2006 Comprehensive Plan also identifies specific stormwater-management-related objectives and action items for public education. The goals of the Stormwater Management Plan are consistent with those of the Comprehensive Plan. Therefore, the educational programming developed for this plan also addresses the stormwater-related education goals of the Comprehensive Plan, as listed below.

- *Objective: Endorse the Wisconsin Department of Natural Resources watershed initiatives to educate shoreland and basin property owners on the appropriate safe levels, application, timing and safe types of fertilizers and pesticides applied to lawns and fields in the City.*
- *Objective: Educate the public on best management practices that will ensure the protection of natural resources.*
- *Objective: Work with Beaver Dam Lake Management District to create awareness about water quality issues in Cumberland.*
- *Action: Educate residents about the importance of natural areas and wildlife corridors.*
- *Action: Publish or obtain information that can be distributed to residents on the disposal of hazardous materials, such as paint, waste oils, computers, insecticides, etc.*
- *Action: Collaborate with state and local organizations whose charge is to enhance water quality.*
- *Action: Work and cooperate with local land trust and similar organizations on forest and wildlife habitat protection, management, and preservation.*

Target Audiences

The target audiences for achieving water quality improvement and stormwater volume reduction inform program design, content and outreach mechanisms. Target audiences are identified based on their ability to bring about change, their contribution to the problem or their geographic proximity to the problem. Table 16 identifies the target audiences within the city of Cumberland.

Table 16. Target audiences for educational programming.

Construction Professionals	Students	Occasional Users	Landowners	Private Sector	Policy Makers and Government Staff	Natural Resource Partnership Groups
Developers	Students K-12	Recreational (boaters, anglers, swimmers, etc.)	Landlords	Big Business Owners	Elected & Appointed Officials	Beaver Dam Lake Management District
Consultants (architects, engineers, etc.)	Student/ Youth Groups		Auto Owners	Facility Managers	Municipal Staff	
Home Builders	High School Environmental Learning Center		Property Owners	Small Business Owners	School Administrators	
Contractors			Tenants		Golf Course Staff	
			Lakeshore Residents			

Objectives

Information about the target audiences' interests, preferences and activities can be gathered through surveys, focus groups, discussions, and review of reports and databases. This information helps to tailor educational programming (e.g. delivery methods, communication methodologies) to the audiences. A committee of stakeholders including the UW Barron County Extension Community Resource Development Educator could join the committee to obtain the information.

Public involvement and information gathering efforts such as the Strengths, Weakensses, Opportunities and Threats (SWOT) analysis conducted during development of the 2006 Comprehensive Plan have provided the city with information regarding public opinion on the City and its resources. A detailed survey or data gathering exercise could be conducted for future educational programs or refinement of those identified here.

Based on the understood interests and preferences of the target audience and the goals of the Stormwater Management Plan, the following objectives have been identified for each.

All Audiences

These objectives pertain to all target audiences and are not repeated under each target audience.

- All audiences understand the impacts of stormwater discharge rates and volumes on water resources (e.g. flooding, soil erosion, bank failure and storm sewer sediment deltas) and the effects of impervious surface on runoff rates and volumes.
- All audiences understand what stormwater management BMPs are and why they are important.
- All audiences understand where to obtain information on stormwater management BMPs including the city's Stormwater Management Plan and other local, regional and statewide resources.
- All audiences understand where stormwater goes, the conveyance of stormwater through stormwater infrastructure (e.g. storm sewer grates and pipes) and into surface water resources.
- All audiences understand the water quality impacts of stormwater on water resources (e.g. temperature, pollutants and sediment) and the effects of impervious surface on water quality (e.g heat and pollutant build-up and washoff).
- All audiences understand who to contact in the case of stormwater pollution through illicit discharges or spills.
- All audiences understand the environmental consequences of stormwater runoff (volume, rate and quality) on aquatic habitats.

Construction Professionals

The following objectives relate specifically to those individuals who plan, implement and construct land developments, new construction and redevelopment. Construction professionals, including designers, have the ability to protect and improve the resources of Cumberland through their actions as developments and buildings are designed, constructed or re-built. The objectives

for this audience focus on increasing the understanding of the benefits of BMPs to increase implementation and to ensure communication with landowners and building managers on the function and maintenance of BMPs.

- Contractors implement measures to protect water resources during construction.
- Consultants, homebuilders and developers understand the benefits of stormwater management BMPs in terms of hydrology, water quality, financial and community aesthetics.
- Consultants, homebuilders and developers implement stormwater BMPs.
- Contractors understand the innovative nature of stormwater BMPs in order to effectively install them using potentially non-traditional approaches (e.g. construction sequencing, traffic control).

Students

The following objectives relate specifically to K-12 students. Students learn about their natural environment in school and can be active participants in the city's educational efforts. The objectives for students are focused on active participation and understanding of resources and the interaction of the built environment with the city's natural resources.

- Students participate in active community education initiatives (e.g. resource monitoring, shoreline planting, raingarden planting, storm drain stenciling).

Occasional Users

Occasional users of the city's water resources, many of whom are not residents, have a particular need to see the importance of protecting the lake in which they recreate. The objectives for occasional users of the city's lakes are focused on aquatic plants, lake recreational use, and the management of aquatic invasive species such as Eurasian Water Milfoil.

- Recreational users understand the effects of aquatic invasive species, particularly Eurasian Water Milfoil, and actively protect aquatic environments by inspecting and cleaning their boats accordingly before put-in and after take-out.
- Recreational users understand the importance of a healthy community of macrophytes.
- Recreational users recognize that a balance must be achieved between macrophyte health and recreational use.

Landowners

Homeowners, landlords, property owners, and residents need specific knowledge and skills in order to implement and maintain simple small-scale stormwater BMPs that have a big impact with high rates of implementation. The objectives for landowners and residents are focused on BMPs that can be implemented and maintained by residents and landowners: shoreland vegetation, fertilizer and leaf management, and small scale BMPs such as raingardens.

- Shoreland Residents and shoreland property owners understand the benefits of healthy native shoreland habitat on stormwater runoff and aquatic resources.

- Shoreland Residents and shoreland property owners establish and/or restore and maintain native shoreland lake buffers.
- Property owners and residents construct and maintain upland stormwater management BMPs (e.g. raingardens).
- Property owners and residents limit the use of fertilizers and ensure that leaves are managed properly in the fall.

Private Sector

Businesses and industrial facilities as well as gas stations and fleet handling facilities have the potential to discharge through stormwater runoff, pollutants such as fertilizers, pesticides, heavy metals, petroleum products and other chemicals. Small business owners typically manage their own parking lots and landscaping; whereas owners of a unit in a strip mall do not. Particular companies of interest include, but are not limited to, lawn care companies, painters, golf courses, boat storage and cleaning companies, mobile cleaning operations and any business or facility with outdoor storage. Business owners and people working in the private sector do not necessarily live in the city and, therefore, require a delivery method and message different than those who, as residents, have an inherent stake in the city and the state of its aquatic and natural resources. The objectives for business owners and those working in Cumberland are focused on increasing the understanding of site design and property management decisions.

- Business owners/operators understand stormwater rules and regulations and the importance of meeting them.
- Business owners/operators understand the positive impact of BMPs and reduced impervious on water resources and company image.
- Business owners/operators implement and maintain stormwater management BMPs.

Policy Makers and Government Staff

Elected officials and government staff have the unique ability to make policy decisions for the stormwater program. Included in this category are education administrators and municipal staff. Each of these audiences has high visibility and is able to set the bar for stormwater management and to lead by example. Policy makers and staff involved in planning, zoning, land conservation, parks and public works are of particular importance. The objectives for policy makers and municipal staff focus on consistent understanding of regulations, BMPs, and communication with the community.

- Policy makers and municipal staff understand the city's stormwater management standards and the importance of BMPs
- Policy makers and municipal staff communicate the city's stormwater management standards to landowners, developers, contractors and consultants.
- Municipal staff provide technical support for residents and construction professionals regarding stormwater management standards and BMP design.
- Municipal staff hire engineers who design stormwater BMPs and education program managers that understand water resource management.

- Policy makers and municipal staff install stormwater BMPs at their facilities, leading by example.

Natural Resource Partnership Groups

Natural resource partnership groups such as the Beaver Dam Lake Management District can be valuable partners for the city in their education efforts. As a separate avenue for conveying stormwater management information, these groups have the unique ability to reinforce the city's efforts and reach additional audiences. The objectives for natural resource partnership groups focus on information on the benefits of stormwater BMPs.

- Natural resource partnership groups convey to all audiences the environmental benefits of stormwater BMPs.

Recommended Educational Programming

Based on Stormwater Management Plan goals, 2006 Comprehensive Plan objectives, and the education and outreach objectives for each target audience, Table 17 identifies educational programming options. Education can be delivered to target audiences through guidance documents, educational flyers, hands-on activities and workshops. Programs are meant to utilize a delivery method that speaks to the target audience.

Some programming may be best achieved through partnerships with the Beaver Dam Lake Management District, the Wisconsin Department of Natural Resources, University of Wisconsin Extension, Barron County Land Conservation Department, other area Lake Districts or Associations, or other entities involved in education and outreach on water resource issues.

Table 17. Recommended educational programming based on target audiences.

Educational Program	Target Audience							
	All Audiences	Construction Prof's	Students	Occasional User	Landowners	Private Sector	Policy Makers + Staff	Nat'l Resource Grps
Involvement in stormwater utility development and abatement eligibility education		x			x	x	X	x
Storm drain stenciling (e.g., No Dumping, Drains to Lake) with introductory presentation on stormwater runoff and environmental impacts			x					x
Conservation Day for grade school students			x					x
Eurasian watermilfoil educational flyers, signage and trained volunteers at public accesses				x				x
Guidance documents on directing downspouts to pervious areas, reducing impervious areas, constructing raingardens, using rain barrels and having watershed-friendly landscape maintenance techniques including shoreland buffers, leaf litter and grass clipping management					x	x	x	x
Recognition of landowners who implement BMPs – BMP tours, newsletter/newspaper write-up or Lake Stewards award program					x	x	x	x
Raingarden workshops including identification of local resources (e.g. raingarden plant kits)					x			x
Shoreland buffer workshops including identification of local resources (e.g. shoreland plant kits)					x			x
Water conservation informational flyers sent with water bills (see Appendix C for example)					x			x
Cost-share programming for shoreland habitat restoration, raingarden and rain barrel implementation					x			x
Educational flyer regarding rules, regulations and environmental impacts of illicit discharges to storm sewers					x	x	x	x

Educational Program	Target Audience							
	All Audiences	Construction Prof's	Students	Occasional User	Landowners	Private Sector	Policy Makers + Staff	Nat'l Resource Grps
Pollution Prevention Program for city addressing property management and city staff practices; could include development of a Stormwater Pollution Prevention Plan (SWPPP)							x	
Rain barrel incentive program – (e.g. city provides rebates or sells rain barrels at reduced cost)					x			x
City staff workshop on how to meet city stormwater management goals through operations/management of city property and activities/practices of city staff							x	
Utilize the following public involvement forums as opportunities for education on the state of the city's water resources and impacts of pollution from stormwater runoff: Planning Commission Meetings City Council Meetings Multi-Jurisdictional Meetings Issues & Opportunities Meeting Strengths, Weaknesses, Opportunities & Threats (SWOT) Meeting							x	x
Share all education materials with natural resource partnership groups for distribution								x
Municipal staff representative at Beaver Dam Lake Management District meetings								x

10. IMPLEMENTATION PLAN

Introduction

The implementation section of the city's Stormwater Management Plan includes programs, projects and capital improvements. The implementation plan identifies the specific projects, studies, and other activities necessary to implement the city's goals as identified through this and previous studies as well as through the public involvement process. The initiatives contained in the implementation plan seek to protect and improve city water resources and stormwater infrastructure. Inclusion of an initiative in the implementation plan is a statement of intent by the city of Cumberland. Final decisions on implementation rest with future decisions by the city Public Works Committee and, ultimately, the City Council to budget for and authorize the initiative. In many cases, implementation requires further action and/or approval and participation of other parties. The city will regularly evaluate the water resources needs within the city and make appropriate changes in priorities during the 10-year term of the implementation plan.

Over the 10-year period of this implementation plan, as information becomes available, priorities evolve, new concerns emerge, or new technical approaches are developed, the city will likely adapt the implementation plan to reflect this new information. The listing of initiatives in the implementation plan is not intended to exclude other initiatives consistent with the goals identified in this Stormwater Management Plan. If the new activity is widely different in scope or cost from that detailed in the implementation plan, plan amendments may be warranted. If not, the city could proceed with a new initiative under the existing implementation plan.

All projects in the implementation plan (including any future additions) will only be implemented with landowner approval and a formal agreement.

Implementation Plan Structure

Activities are organized into two main categories: Programs and Projects. Programs include the ongoing initiatives of the city with respect to stormwater management. Projects include efforts that occur in a defined period of time to address a specific concern. Projects include feasibility evaluations, studies, and capital improvements or construction projects.

Information regarding the anticipated initiatives, partners, and costs involved for each of the implementation activities is presented in the implementation plan table and in narrative sections for each activity area.

Subwatershed-based initiatives are discussed using a prioritization based on pollutant loading characteristics identified through water quality modeling conducted during development of this plan. Tier 1 Subwatersheds have the highest pollutant loading of all the subwatersheds city-wide and therefore are priority subwatersheds for pollutant source analysis and BMP implementation. Subwatershed pollutant loading is lower in Tiers 2 and 3, respectively. Tier 4 Subwatersheds have the lowest pollutant loading and are therefore a low priority for study and implementation; no Tier 4 Subwatersheds are yet proposed for implementation activities with the exception of the Beaver Dam Lake West Major Drainage Area. All Library Lake subwatersheds are addressed through the Library Lake Restoration initiatives.

Table 18. Implementation plan organization: categories and activities.

PROGRAMS	Page
Site Plan Review Permitting & Enforcement	
Stormwater Infrastructure Inspection & Maintenance	
Pollution Prevention on City Properties	
Aquatic Invasive Species Management	
Monitoring and Data Assessment	
Education & Outreach	
Geographic Information System (Support for Stormwater Utility)	
PROJECTS	**Page**
Stormwater Utility Establishment	
Ordinance Development & Revisions	
Stormsewer Outfall Dredging Policy	
Stormsewer Outfall Dredging: 3rd Ave.	
Stormsewer Outfall Dredging: Marshall Street	
Riprap at Stormsewer Outlets	
Pipe Maintenance	
Stormwater Infrastructure Improvements	
Downtown Infrastructure Investigation	
Catchbasin Stormwater Treatment	
Sorensen Street Stormwater Infrastructure Re-Design	
Grove Street Boulevard Improvements	
Winter Maintenance Materials Management	
Arcade-Marshall-1st Stormsewer Infrastructure Improvements	
1st Avenue Slope Stabilization at Seneca Foods	
Library Lake Watershed Stormwater Improvements and Park Development	
Library Lake Restoration and Shoreline Restoration	
Library Lake Outlet Restoration	
Pollution Prevention Plans for Industrial Sites	
Purchase of Vacuum Street Sweeper	
Collingwood Lake Monitoring	
Collingwood Lake Stormwater Management Facility Identification and Siting	
Cemetery Bay Watershed Stormwater Management Facility Identification and Siting	
Rabbit Island Bay Watershed Stormwater Management Facility Identification and Siting	
Norwegian Bay Watershed Stormwater Management Facility Identification and Siting	
Landlocked Basin Stormwater Management Facility Identification and Siting	
Vermillion River Watershed (Cumberland Municipal Airport) Stormwater Management Facility Identification and Siting	
Beaver Dam Lake West Watershed Stormwater Management Plan for Future Development	

Implementation Plan Table

The implementation plan table includes a general timeline of how the implementation initiatives could be implemented over the 10 years of the Stormwater Management Plan. Priority initiatives are slated to occur early (years 1-3) or in the middle (years 4-5) of plan implementation. Actions that are currently of lower priority are scheduled later (years 5-10) in the 10-year period of the implementation plan.

Implementation Activity Narratives

PROGRAMS

Site Plan Review Permitting & Enforcement

Description and Purpose of Program

The City will review site plans for consistency with stormwater ordinances and will issue and enforce permits, including conducting site inspections. Many costs associated with the permitting and enforcement program can be recovered through permit fees. To support the implementation of updated stormwater management ordinances, the City will provide technical assistance and guidance to permit applicants.

The City or its engineering support will review site plans and project proposals for consistency with the City's stormwater management ordinances. The City's inspector and enforcement officer will inspect sites under construction for consistency with erosion control and stormwater ordinances and will ensure that stormwater management practices are constructed according to the plans.

The City will also provide technical assistance to permittees who are implementing better site design principles and innovative stormwater management practices. The assistance may be by city staff or in coordination with a consultant or the Beaver Dam Lake Management District. In addition, technical assistance can be supported by educational efforts or guidance materials.

Stormwater Infrastructure Inspection & Maintenance

Description and Purpose of Program

The inspection and maintenance of stormwater infrastructure is key to the long term function of the stormwater management system. The City will inspect stormwater infrastructure annually and conduct maintenance as needed as identified through the inspections. The City will also conduct recurring maintenance activities such as street sweeping.

The City or its engineering support will annually conduct a visual inspection of all stormwater management systems. More detailed inspections (e.g. sediment depth, runoff testing,etc.) will be conducted as indicated by the visual inspection. The *Stormwater Treatment: Assessment and Maintenance* [1] manual can be used as a guide and reference for the inspection process. Stormwater facilities will be maintained based on the needs identified through inspections.

The City will conduct regular maintenance such as street sweeping, catch basin cleaning, and maintenance of stormwater management facilities. Key areas for focused street sweeping are snow storage sites. Sweeping should conducted in snow storage locations in the spring as sediment from the snow piles is exposed to eliminate the transport of this material to nearby lakes.

[1] Gulliver, J.S., A.J. Erickson, and P.T. Weiss (editors). 2010. *"Stormwater Treatment: Assessment and Maintenance."* University of Minnesota, St. Anthony Falls Laboratory. Minneapolis, MN. http://stormwaterbook.safl.umn.edu/

To improve water quality benefits of street sweeping, it is recommended that the City purchase a regenerative-air or vacuum street sweeper when replacement of the current sweeper is necessary (see Purchase of Vacuum Street Sweeper Project).

Pollution Prevention for City Properties

Description and Purpose of Program

The City will plan for and conduct regular pollution prevention practices on city properties. In addition, the City will encourage pollution prevention activities on private properties and will provide technical support for implementing pollution prevention measures.

The City will prepare and implement a pollution prevention plan to address general practices of the City such as landscaping maintenance and cleanup (e.g. grass clippings management), street sweeping, winter maintenance of parking lots, sidewalks and roads (e.g. calibrated salt application equipment), stockpiling of materials (e.g., proper storage of mulch, sand and salt).

Aquatic Invasive Species Management

Description and Purpose of Program

In partnership with the Beaver Dam Lake Management District, the City will work to prevent the transport and spread of aquatic invasive species through existing programs and through education efforts.

Education and inspections will be provided at the boat launch during times with higher numbers of boats entering and exiting the lake (e.g. weekends) to demonstrate proper boat cleaning measures, check that boats are following these measures, and to discuss why these measures are needed.

Monitoring and Data Assessment

Description and Purpose of Program

The City will support the monitoring efforts of the Beaver Dam Lake Management District to annually measure key water quality parameters in its lakes. This ongoing monitoring allows the Beaver Dam Lake Management District and the City to track changes in lake quality over time in order to adjust its stormwater management strategy accordingly.

The City may also consider developing and implementing a lake inflow monitoring program or BMP monitoring program. The program could measure key water quality parameters such as suspended solids, total phosphorus, and flow in the inflow to the lake. This type of monitoring would reflect changes in the content of runoff more quickly than measurements in the lake. This monitoring could also be conducted close to constructed water quality practices before and after construction to measure the impact of the project.

Education and Outreach

Description and Purpose of Program

The City will develop and implement an education program to inform and engage the City's stakeholders including landowners, private companies, students, lake users, policy makers and government staff, and local lake districts and associations.

The City will utilize printed and/or web-based educational materials that present stormwater management and water quality improvement information in a clear and engaging manner. The materials will be targeted to specific audiences and different topics:

A. Targeted to Landowners and the Private Sector
   1. Water conservation informational flyers sent with water bills (see Appendix C for example).
   2. Educational flyer regarding ordinances, regulations and environmental impacts of illicit discharges to stormsewers.
   3. Share education materials with Beaver Dam Lake Management District for distribution to members and lakeshore owners. Materials could address topics such as directing downspouts to pervious areas, reducing impervious areas, constructing raingardens, using rain barrels and maintenance techniques including shoreland buffers, leaf litter and grass clipping management.
   4. Updates on City-led projects such as the Library Lake restoration.
   5. Informational sheet on stormwater utility (if developed).

B. Targeted to Lake Users
   1. Eurasian watermilfoil and curly leaf pondweed educational flyers and signage at lake public accesses.

The City may also implement interactive educational events and workshops to actively demonstrate stormwater management and water quality protection practices. The events will be planned to target specific audiences and different topics:

A. Targeted to Landowners
   1. Workshops on designing and establishing a shoreland buffer or building a raingarden. Perhaps partner with local garden centers who could offer shoreland buffer or raingarden plant kits to attendees.
   2. Municipal staff representative at Beaver Dam Lake Management District meetings to act as a liaison and provide outreach.
   3. Share announcements of upcoming events with Beaver Dam Lake Management District for distribution to members and lakeshore owners.

B. Targeted to All Residents and Students
   1. Storm drain stenciling (e.g., No Dumping, Drains to Lake) with introductory presentation on stormwater runoff and environmental impacts

C. Targeted to Policy Makers & Government Staff
   1. Form a coalition of all government agencies whose land drains to Beaver Dam Lake and meet regularly to discuss coordination of protection and implementation activities.

The City may consider working with the Beaver Dam Lake Management District to develop and implement incentives or cost-share programs to support the implementation of smaller distributed practices (e.g. buffers and raingardens) on private properties throughout the City. The programs could provide incentives such as technical support for raingarden or buffer design,

or could provide some level of funding (e.g. 50% of project cost) to assist in implementing projects and engaging the community in the City's efforts. The funding would likely only support projects where stormwater standards do not apply (e.g. no construction or site alteration planned other than the new practice).

GIS – Geographic Information System

Description and Purpose of Program

If a Stormwater Utility is used as a funding mechanism for stormwater management activities, GIS support will be needed to evaluate the factors influencing the utility amount charged to each property.

PROJECTS

Stormwater Utility Establishment

Description and Purpose of Project

Stormwater utilities are a mechanism to fund improvements and maintenance associated with stormwater management facilities. The utility assess residential, commercial and industrial lots for impervious surface (building footprints, private roads, driveways and parking areas) and establishes a corresponding fee. The customer pays in relation to the demands they impose on stormwater facilities and stormwater management needs.

This project will involve working with the City Council and staff to establish a stormwater utility and associated policies. The project will also involve the site-specific analysis needed to define the utility rates.

Ordinance Development & Revisions

Description and Purpose of Project

Update and/or develop ordinances to encourage and support better site design and stormwater management through specific standards and appropriate zoning. Model ordinances such as the Sustainable Development ordinances (http://www.crplanning.com/susdo.htm) could be used as a starting point for the revision process. Through an ordinance development and revision process the city will evaluate and revise current ordinances to address the concerns identified in Section 8 of this report. In addition, the city will periodically review current ordinances and modify as needed to address new concerns, areas needing clarification, and any other refinements that have been identified.

In order to support better site design and effective stormwater management, the City will evaluate and revise current ordinances to address, at a minimum, the following issues identified in Section 8 of this report:

- Whether ordinances are adequately requiring that right-of-way and paved portions of streets be as narrow as feasible.
- Adopting Mobile Home street, sidewalk, and right-of-way standards for all residential zone standards.
- Whether parking standards are requiring more spaces, and thus more impervious surface, than needed on a regular basis.
- Clearly identifying that low impact and better site design stormwater management practices (i.e. rural section roads, curb cuts to stormwater management practices, permeable pavements) are allowed and preferred on all sites and roadways
- Revising stormwater management standards to fully support and encourage low impact development and better site design stormwater management methods (i.e. swales, raingardens, bioretention).
- Allowing porous pavement materials for driveways, sidewalks, trails and parking lots (i.e. porous pavers, porous concrete, porous asphalt, open grid systems)
- Requiring open space to be consolidated into larger or more contiguous units.
- Requiring that a portion of the open space be managed in a natural condition.

- Consider buffer standards consistent with the Center for Watershed Protection's recommendations.
- Include more specificity on requirement for stormwater management, with focus on water quality treatment requirements, volume and rate control.
- Develop incentive programs for developer and landowners to conserve non-regulated land.

The city will periodically review ordinances to address areas needing clarification, updated policies and procedures, emerging issues, and other refinements that have been identified through ordinance implementation and enforcement. It is estimated that ordinance review will occur every five years on average.

Stormsewer Outfall Dredging Policy

Description and Purpose of Project

Outfall dredging is needed at a number of locations in the city. Outfalls are the location where a stormsewer system enters a lake. If stormwater management practices do not exist or are not numerous enough or large enough to capture the sediment contributed by the watershed, sediment accumulates where the stormsewer enters the lake. The DNR regulates the dredging of lakes and the disposal of excavated sediment. The city will work with the DNR to establish a policy or protocol that can be applied to all of the outfalls within the city in order to streamline the process of sediment testing for disposal.

Stormsewer Outfall Dredging: 3rd Ave.

Description and Purpose of Project

The city will conduct excavation of materials deposited in the lake bed from the outfall near the 3rd Ave. (the outfall of Site 6 as identified in Table 12).

Stormsewer Outfall Dredging: Marshall Street

Description and Purpose of Project

The city will conduct excavation of materials deposited in the lake bed from the outfall along Marshall Street (see Site 4 as identified in Table 12).

Riprap at Stormsewer Outlets

Description and Purpose of Project

The city will add riprap to stormsewer outlets at three sites to reduce erosion at these locations (see Site 3, 7 & 8 as identified in Table 12).

Pipe Maintenance

Description and Purpose of Project

The city will conduct pipe maintenance at one location (see Site 7 as identified in Table 12).

Stormwater Infrastructure Improvements

Description and Purpose of Activity

The City of Cumberland stormwater infrastructure is extensive and particularly dense in the downtown and adjacent areas. Stormwater infrastructure can degrade with age and cause water quality and flood control problems such as sediment deltas, erosion or deterioration of stormwater piping. The purpose of these initiatives is to provide for significant stormwater infrastructure improvements apart from routine maintenance and independent of subwatershed-based BMP implementation initiatives.

Downtown Infrastructure Investigation
The stormsewer system serving downtown (NB-5 subwatershed) is old and is suspected to be degrading. This project will televise the pipe to determine repair and replacement needs. Needed repairs and replacements will be conducted based on the results of the investigation.

Catchbasin Stormwater Treatment
This project will site and design sediment traps or water quality treatment inserts in catchbasins, where feasible throughout the city. Devices will reduce sediment discharge to receiving waterbodies and will reduce loading of pollutants associated with sediment. Water quality treatment inserts may also provide treatment of some dissolved constituents (pollutants not associated with sediment particles).

Sorensen Street Stormwater Infrastructure Re-Design
This project will re-design stormwater infrastructure at the south end of Comstock Avenue by taking the middle catchbasin offline, redirecting runoff to a water quality treatment swale with a raised inlet and/or a perforated underground infiltration pipe. Provide a swale for pretreatment for the downstream-most catchbasin. Repair the adjacent retaining wall. (See original recommendations under Site 2 in Table 12).

Grove Street Boulevard Improvements
This project will extend the boulevard and/or reduce street width to accommodate greenspace or bump-out bioretention facilities. (See original recommendations under Site 3 in Table 12).

Winter Maintenance Materials Management
This project will provide impervious surface and berming for snow storage area in order to contain sediment and sweep it in the spring. Provide linear pretreatment feature for springmelt from snow storage area. Consider downstream treatment/infiltration feature adjacent to city dock storage. (See original recommendations under Site 4 in Table 12).

Arcade-Marshall-1st Stormsewer Infrastructure Improvements
This project will improve the stormsewer in the Arcade-Marshall-1st Avenue region. The project will (referring to Figure 13), prevent bypass of Inlet A and subsequent sediment buildup nearby. Prevent bypass of Inlet B and consider opportunity for retention/detention feature. Consider treatment opportunities at and near Inlets C, D and/or E. At and nearby Inlet F, consider infiltration, paved parking, or greenspace. Capture school rooftop runoff adjacent to Inlet G (scuppers exist on the south end of school). Install green island or sediment trap at Inlet G. A school staff person indicated that water in the schoolyard can

take a couple days to dry out; construct swale downstream and upstream of outlet H avoiding sliding gate entrance of 3M. (See original recommendations under Site 5 in Table 12).

1st Avenue Slope Stabilization at Seneca Foods
This project will provide slope stabilization of a pervious material along 1st Avenue where impervious surface catches rooftop runoff. (See original recommendations under Site 8 in Table 12).

Library Lake Watershed Stormwater Improvements and Park Development

Description and Purpose of Activity

Library Lake is mesotrophic with minor aesthetic impacts due to algae growth. Stormwater runoff is the primary source of nonpoint source pollution to the lake. The Library Lake Management Plan was developed in order to reduce stormwater runoff volume, treat runoff to remove pollutants, improve navigation and native habitat, and provide an accessible public amenity. The purpose of this initiative is to implement Phase 1 recommendations of the Library Lake Management Plan.

The Beaver Dam Lake Management District formed the Library Lake Committee to support the restoration of Library Lake in September 2007 long before development of this plan. The Library Lake Committee underwent substantial planning efforts and has developed project phases for lake restoration that are currently in the early stages of implementation. Project plans provide stormwater treatment of runoff from the priority subwatersheds (and others) located in the Library Lake drainage area.

This phase of the Library Lake restoration project includes the construction of four stormwater management features as well as the inclusion of or modifications to trails, parking, and presentation of the Library Lake area to increase access to and engagement with Library Lake. The four stormwater features are indicated as 5th, Sorenson, Grove, and Main in Figure 9. The stormwater features as well as the other planned improvements are displayed in Figure 10 and Figure 11.

Library Lake Restoration and Shoreline Restoration

Description and Purpose of Activity

Library Lake is mesotrophic with minor aesthetic impacts due to algae growth. Sediment accumulation has changed Library Lake from a partially open water system to one nearly covered by emergent, floating and submerged aquatic plants as a result of decreased water depths. The Library Lake Management Plan was developed in order to reduce stormwater runoff volume, treat runoff to remove pollutants, improve navigation and native habitat, and provide an accessible public amenity. The purpose of this initiative is to implement the Phase 2 recommendations of the Library Lake Management Plan.

This phase of the Library Lake restoration project includes management activities within the lake itself: aquatic vegetation management, dredging for navigation, dredging to remove sediment at outfalls and restoration of the vegetation (Figure 12).

Library Lake Outlet Restoration

Description and Purpose of Activity

The Library Lake Management Plan was developed in order to reduce stormwater runoff volume, treat runoff to remove pollutants, improve navigation and native habitat, and provide an accessible public amenity. The purpose of this initiative is to implement the Phase 3 recommendations of the Library Lake Management Plan.

This project will reinstate the Library Lake outlet under Highway 63/48 (Figure 12) to restore the lake's hydrology.

Pollution Prevention Plans for Industrial Sites

Description and Purpose of Program

The City will work with landowners and property managers for the industrial properties within the city to develop pollution prevention plans. Pollution prevention plans will reduce the exposure of stormwater to pollutant sources that could be detrimental to lake quality.

Purchase of Vacuum Street Sweeper

Description and Purpose of Project

It is recommended that the City purchase a vacuum (or regenerative-air) street sweeper when replacement of the current sweeper is necessary. Conventional broom sweepers collect only a small portion of the sediment particles on the street that are most likely to cause water quality problems and may actually increase the transport of the small sized particles to downstream water bodies because these sweepers remove only the larger materials that previously shielded the small particles from the runoff [2]. Broom sweepers average about 13% collection of small particles while vacuum sweepers average about 60% collection of small particles[3]. Vacuum sweepers remove a significantly larger proportion of the smaller particles that contribute to water quality issues. Therefore, vacuum sweepers provide water quality benefits by limiting the transport of these pollutant-carrying particles to local water bodies. Typical broom sweepers are primarily a benefit to the aesthetics of the street while vacuum sweepers benefit both water quality and street aesthetics.

Collingwood Lake Monitoring

Description and Purpose of Activity

Collingwood Lake has not been included in former water quality planning and management. Water quality modeling conducted in development of this plan identified drainage areas that contribute relatively high loads of total phosphorus to Collingwood Lake. The purpose of this initiative is to identify the state of Collingwood Lake's water quality and to study its watershed to develop water quality improvement projects.

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[2] Curtis, Meosotis C., 2002. *"Street Sweeping for Pollutant Removal."* Maryland Department of Environmental Protection, Watershed Management Division. http://h2o.enr.state.nc.us/nps//documents/MDstreetsweepingreview.pdf

[3] Kuehl, Renae, Michael Marti, Joel Schilling, 2008. *"Resource for Implementing a Street Sweeping Best Practice."* Minnesota Department of Transportation Local Road Research Board. http://www.lrrb.org/pdf/2008RIC06.pdf

Water quality monitoring will entail sampling for total phosphorus, chlorophyll-a, and Secchi depth twice a month from June through September for three consecutive years. An aquatic plant survey will occur in the summer and fall of 2011. A fisheries survey will be conducted during the 2011 field season. Data will be analyzed to identify the trophic status of the lake and to identify management needs such as aquatic invasive species management.

Collingwood Lake Stormwater Management Facility Identification and Siting

Description and Purpose of Activity

Collingwood Lake has not been included in former water quality monitoring or evaluation. However, the water quality modeling for this study identified the estimated loading to Collingwood Lake from its contributing watershed. The watershed contributions are not the highest in the city, but are mid-level contributions in Tier 2 and 3. The incorporation of stormwater management facilities to these subwatersheds would be expected to benefit the water quality of Collingwood Lake. The purpose of this initiative is to study the lake and its high-contributing watersheds and identify specific water quality projects. The projects identified in this evaluation will be added to this plan for construction and implementation.

A study of the CL-5 and CL-6 Subwatersheds (Tier 2) will entail identifying sources of water quality pollution. A similar study of the CL-2 and CL-7 Subwatersheds (Tier 3) would also be beneficial. The study will ultimately yield planning-level locations and the recommended type of practice to address water quality of Collingwood Lake.

These facility identification and siting processes can be completed subwatershed-by-subwatershed based on loading contribution to the lake (Tier 3 first and Tier 3 last) or can be completed for all subwatersheds at once to more fully address the needs of Collingwood Lake.

Cemetery Bay Watershed Stormwater Management Facility Identification and Siting

Description and Purpose of Program

Cemetery Bay of Beaver Dam Lake East was found in 2007 to have poor water quality varying from eutrophic to hypereutrophic conditions according to the Beaver Dam Lake Water Quality Study (Barr, 2008). Water quality has deteriorated since 1994. In addition, water quality modeling conducted in development of this plan identified drainage areas that contribute relatively high loads of total phosphorus to Cemetery Bay. The purpose of this initiative is to study these high loading subwatersheds to identify specific water quality improvement projects for Cemetery Bay.

The CB-3 Subwatershed has one of the highest loading rates of all subwatersheds city-wide (Tier 1). A study of the CB-3 Subwatershed will entail identifying sources of water quality pollution. The study will identify planning-level locations and the recommended type of practice to address water quality improvements at each location. Potential BMPs could take the form of a bioretention facility and enhanced shoreland buffer adjacent to Cemetery Bay at the downstream end of the subwatershed. The projects identified in this evaluation will be added to this plan for construction and implementation.

The CB-2 Subwatershed is a lower contributor (Tier 3) and is therefore a lower priority than the CB-3 subwatershed improvements to the quality of Cemetery Bay. However, improvements in

the CB-2 subwatershed will still benefit Cemetery Bay. A study of the CB-2 Subwatershed will entail identifying sources of water quality pollution. The study will identify planning-level locations and the recommended type of practice to address water quality improvements at each location. The projects identified in this evaluation will be added to this plan for construction and implementation.

Rabbit Island Bay Watershed Stormwater Management Facility Identification and Siting

Description and Purpose of Activity

Rabbit Island Bay of Beaver Dam Lake West was found in 2007 to have reasonably good water quality conditions varying from mesotrophic to eutrophic according to the Beaver Dam Lake Water Quality Study, but water quality has declined since 1994 (Barr, 2008). Water quality modeling conducted in development of this plan identified drainage areas that contribute relatively high loads of total phosphorus to Rabbit Island Bay. The purpose of this initiative is to study the bay and its high-contributing watersheds and identify specific water quality improvement projects that will improve the water quality concerns for the Rabbit Island Bay Watershed. The projects identified in this evaluation will be added to this plan for construction and implementation.

The RIB-5 Subwatershed has the highest loading rate contributing to Rabbit Island Bay, it is Tier 2 Subwatershed. A study of the RIB-5 Subwatershed will entail identifying sources of water quality pollution. The study will identify planning-level locations and the recommended type of practice to address water quality improvements at each location.

The RIB-4 and RIB-3 Subwatersheds have a somewhat lower loading to Rabbit Island Bay than RIB-5; these are Tier 3 Subwatersheds. However, improvements in each of these subwatersheds will still benefit Rabbit Island Bay.

These facility identification and siting processes can be completed subwatershed-by-subwatershed based on loading contribution to the bay (Tier 1 first to Tier 3 last) or can be completed for all subwatersheds at once to more fully address the needs of Norwegian Bay.

Norwegian Bay Watershed Stormwater Management Facility Identification and Siting

Description and Purpose of Program

Norwegian Bay of Beaver Dam Lake East was found in 2007 to have poor water quality conditions according to the Beaver Dam Lake Water Quality Study (Barr, 2008). Water quality has deteriorated since 1994. In addition, water quality modeling conducted in development of this plan identified four drainage areas that contribute relatively high loads of total phosphorus to Norwegian Bay. The purpose of this initiative is to study the bay and its high-contributing watersheds and identify specific water quality improvement projects that will improve the water quality for Norwegian Bay. The projects identified in this evaluation will be added to this plan for construction and implementation.

The NB-6 Subwatershed has one of the highest loading rates of all subwatersheds city-wide; it is a Tier 1 Subwatershed. A study of the NB-6 Subwatershed will entail identifying sources of water quality pollution. The study will ultimately yield a planning-level implementation plan for

BMPs. Based on development of this plan, an initial potential BMP could take the form of a bioretention facility immediately downstream of the subwatershed outlet.

The NB-5 Subwatershed has a somewhat lower loading to Norwegian Bay than NB-6; it is a Tier 2 Subwatershed. The NB-3 and NB-4 Subwatersheds have an even lower loading to Norwegian Bay than NB-6 and NB-5; these are Tier 3 Subwatersheds. However, improvements in each of these subwatersheds will still benefit Norwegian Bay.

These facility identification and siting processes can be completed subwatershed-by-subwatershed based on loading contribution to the bay (Tier 1 first to Tier 3 last) or can be completed for all subwatersheds at once to more fully address the needs of Norwegian Bay.

Landlocked Basin Stormwater Management Facility Identification and Siting

Description and Purpose of Activity

The Landlocked Basin discharges to Library Lake infrequently (only under back-to-back 100-year 24-hour storm events). Water quality modeling conducted during development of this plan indicates relatively high phosphorus loading from some drainage areas within the Landlocked Basin. The receiving wetland is likely to be adversely affected by high phosphorus levels and high runoff rates from upstream landuses and land use changes under future development. The purpose of this initiative is to study the Landlocked Basin for flooding issues and for detrimental affects to surface water resources within the Landlocked Basin.

A study of the LLB-2 and LLB-4 Subwatersheds (Tier 2) will entail identifying sources of water quality pollution and/or flood-prone areas. The study will identify planning-level locations and the recommended type of practice to address water quality and flooding concerns. The projects identified in this evaluation will be added to this plan for construction and implementation.

Under 2020 proposed landuse conditions, the LLB-3 Subwatershed model indicates it will have one of the highest phosphorus loading rates among all subwatersheds city-wide (Tier 1 under 2020 Landuse). In anticipation of landuse changes, a study of the LLB-3 Subwatershed will identify future sources of water quality pollution and/or flood-prone areas. The study will ultimately yield landuse change guidance and stormwater management plans for future development.

Vermillion River Watershed (Cumberland Municipal Airport) Stormwater Management Facility Identification and Siting

Description and Purpose of Activity

Cumberland Municipal Airport (110 acres in size) is southeast of the contiguous boundaries of the city of Cumberland and discharges to the Vermillion River. Water quality modeling conducted during development of this plan indicates relatively high phosphorus loading. The purpose of this initiative is to reduce pollutant loading to Vermillion River.

A study of the VR-1 Subwatershed (Tier 2) will entail identifying sources of water quality pollution. The study will identify planning-level locations and the recommended type of practices to address water quality improvements at each location. The projects identified in this evaluation will be added to this plan for construction and implementation.

Beaver Dam Lake West Watershed Stormwater Management Plan for Future Development

Description and Purpose of Activity

Beaver Dam Lake West was found in 2007 to have excellent water quality conditions according to the Beaver Dam Lake Water Quality Study (Barr, 2008). Overall water quality has been consistent since 1992. Water quality modeling conducted in development of this plan found that areas draining to Beaver Dam Lake West have relatively low total phosphorus loading. The purpose of this initiative is to protect Beaver Dam Lake West through study of the lake and its watershed and, ultimately, development of water quality improvement projects.

Subwatersheds within the Beaver Dam Lake West Drainage Area were all found to have low pollutant loading; they are all Tier 4 Subwatersheds. A study of the Beaver Dam Lake West Drainage Area will enable the city to identify sources of water quality pollution based on existing conditions and in anticipation of future land-use conditions. The study will ultimately yield a planning-level implementation plan for BMPs based on expected future land use conditions.

Implementation Plan Table

10 Year Plan: annual schedule breakdown	2011	2012	2013	2014	2015	2016-2020
PROGRAMS						
Site Plan Review Permitting & Enforcement	X	X	X	X	X	X
Stormwater Infrastructure Inspection & Maintenance	X	X	X	X	X	X
Pollution Prevention on City Properties	X	X	X	X	X	X
Aquatic Invasive Species Management	X	X	X	X	X	X
Monitoring and Data Assessment	X	X	X	X	X	X
Education & Outreach	X	X	X	X	X	X
Geographic Information System (Support for Stormwater Utility)		X	X	X	X	X
PROJECTS						
Stormwater Utility Establishment	X					
Ordinance Development & Revisions	X	X				X
Stormsewer Outfall Dredging Policy	X					
Stormsewer Outfall Dredging: 3rd Ave.		X				
Stormsewer Outfall Dredging: Marshall Street		X				
Riprap at Stormsewer Outlets	X					
Pipe Maintenance	X					
Stormwater Infrastructure Improvements						
Downtown Infrastructure Investigation	X					
Catchbasin Stormwater Treatment				X		
Sorensen Street Stormwater Infrastructure Re-Design		X				
Grove Street Boulevard Improvements			X			
Winter Maintenance Materials Management	X					
Arcadi-Marshall-1st Stormsewer Infrastructure Improvements			X			
1st Avenue Slope Stabilization at Seneca Foods				X		
Library Lake Watershed Stormwater Improvements and Park Development	X	X	X	X		
Library Lake Restoration and Shoreline Restoration				X	X	

10 Year Plan: annual schedule breakdown	2011	2012	2013	2014	2015	2016-2020
Library Lake Outlet Restoration					X	
Pollution Prevention Plans for Industrial Sites		X				
Purchase of Vacuum Street Sweeper					X	
Collingwood Lake Monitoring				X		
Collingwood Lake Stormwater Management Facility Identification and Siting					X	
Cemetery Bay Watershed Stormwater Management Facility Identification and Siting					X	X
Rabbit Island Bay Watershed Stormwater Management Facility Identification and Siting						X
Norwegian Bay Watershed Stormwater Management Facility Identification and Siting						X
Landlocked Basin Stormwater Management Facility Identification and Siting						X
Vermillion River Watershed (Cumberland Municipal Airport) Stormwater Management Facility Identification and Siting						X
Beaver Dam Lake West Watershed Stormwater Management Plan for Future Development						X
TOTAL NUMBER OF PROGRAMS & PROJECTS	**14**	**13**	**10**	**12**	**12**	**14**

11. FINANCING OPTIONS

There are many mechanisms for generating funds for stormwater management operation, maintenance, new initiatives and capital expenditures. Funds may be appropriated from general revenues, bond sales, special-purpose sales taxes or other existing funding enterprises. Revenue can be generated from user fees such as charges, assessments, fines, or special fees to customers (e.g. plan review and inspection fees). Resources could include federal and state grants and loans, maintenance performed by homeowners' associations or private landowners, developer-contributed capital facilities or easement dedications. (NAFSMA, 2006). The city of Cumberland may be best suited for implementation of some combination of the following funding strategies: stormwater utility, area charges, municipal bonding, grants and loans. For all funding strategies, the key to a successful program is a clear identification of the needs for stormwater management funding and the authority, capability and vision to meet them. The stormwater management problems must be identified and publicized in order to gain public participation and support in order to gain buy-in for generating funding.

Stormwater Utility

In the 2006 Comprehensive Plan, the city of Cumberland identified the following objective as a goal for the city's stormwater management plan: *Implement a stormwater utility if necessary to help pay for improvements made for stormwater management*. Stormwater utilities can be an effective means to generate revenue for stormwater management operation, maintenance and implementation activities. Stormwater utilities assess residential, commercial and industrial lots for impervious surface (building footprints, private roads, driveways and parking areas) and establish a corresponding flat or variable fee. Metering stormwater runoff is not feasible, but the amount of impervious surface on a site is directly related to the amount of runoff coming from the site and entering the storm water system (whether through surface flow or stormwater pipes). The key to funding of this type is taking the 'user-pays' approach for establishment of the rate structure. The customer should pay in relation to the demands they impose on stormwater facilities and stormwater management needs. The cost must be deemed fair and reasonable, having a clearly established and documented rationale for linking fees to cost of providing stormwater management. Stormwater utilities are well established nationally with over 500 city and/or county stormwater utilities nationwide (NAFSMA, 2006).

Establishing a stormwater utility takes time and resources to develop and implement. The National Association of Flood and Stormwater Management Agencies (NAFSMA) estimate the cost of implementing a stormwater utility to be equivalent to about eight to twelve weeks of the revenue stream that is created. It is a function of the number of accounts and includes the cost of program and financial analyses, data assembly, modification or activation of billing and other information systems, and public education and involvement. (NAFSMA, 2006).

Stormwater utilities are highly visible charges to the customer. The stormwater utility may be called a tax, exaction, assessment, or service charge, but in either case, may still be viewed as a tax to some citizens and fall out of favor. Alternatively, high visibility can be advantageous if used as a tool to make transparent to the community that revenue will address long-standing pollution and/or flooding problems. It will also create an incentive for affected homeowners to implement stormwater improvements to lower their utility fee, thereby lowering stormwater runoff volume and pollution.

Steps to Implementation

A committee should be established to undergo the development of a stormwater utility. Initially, the committee should provide a review and recommendation of funding options in order to solicit early interest among decision makers. The stormwater utility can be developed by taking the following steps:

1) Determine the cost to create and operate the stormwater utility program and the total revenue to be generated for the resulting stormwater fund.
2) Establish criteria for setting rates. Impervious surface area is the recommended and most common criterion.
3) Determine the fee structure (flat fee versus variable rate) including exemptions and abatements.
4) Educate city staff and the public.
5) Obtain program approval following education, town meetings and addressing major issues such as tax versus fee, tax deductibility, applicability to non-profits and city property, legality.

The rate structure must be easy to implement and defensible and the stormwater utility development process must be well researched, transparent, well documented and 'sold' to decision makers.

Fee Calculation

The amount of impervious surface area on a site is the standard parameter for fee calculation among existing stormwater utilities. The city of Cumberland has access to sufficient GIS data and aerial photography to identify for each parcel the amount of impervious surface and the land use type. Typical fee calculations steps include:

1) Calculate average impervious surface area for residential parcels. This average impervious surface area is equal to one "stormwater unit."
2) Determine the total number of stormwater units on all parcels in town.
3) Divide the total revenue to be generated by the total number of stormwater units to determine the required fee per stormwater unit.
4) Adjust the number of stormwater units per parcel based on landuse (residential, commercial, industrial, governmental, non-profit, and institutional) or gross area. For example, residential land uses could have a flat fee of one stormwater unit (based on average residential parcel impervious area). Commercial and industrial land uses could have a fee based on the number of stormwater units on the parcel. Governments, cemeteries and educational institutions could be subject to a reduced number of stormwater units. Alternatively or additionally, landuse-based utility charges could reflect city policy for who is responsible for operation and maintenance of any on-site stormwater management practices (e.g. a higher charge would be administered to those landuses where the city maintains stormwater practices versus those where the landowner maintains the practices).
5) Adjust the fee to ensure that it covers abatements, non-payments and to build reserve fund.

The Town of Reading, MA, provides some additional lessons learned from program implementation (Town of Reading, 2009):

- Billing method affects administrative costs and buy-in
- If a fee is applicable to government properties, identify departments to be charged
- Prepare city staff to answer property owner questions
- Adjust fees annually based on actual revenue and stormwater fund growth/depletion

Abatements

Establish a procedure for abatements prior to implementing the stormwater utility. Abatements can be used to encourage property owners to minimize the amount of runoff from their property. By implementing eligible on-site stormwater management measures, the stormwater utility fee could be reduced and/or eliminated. Reductions realized could be based on the extent of implementation of stormwater management practices but the program must be kept simple and enforceable. Eligible stormwater management systems could include: bioretention/infiltration features, french drains, large cisterns that facilitate stormwater reuse for irrigation. It is recommended that rain barrels be ineligible due to their typically low capacity.

Area Charges (and Other Fees)

Up-front area charges (also called impact fees) could be applied to new development. Up-front area charges are intended to meet the city's one time expenses and facility maintenance costs during the critical establishment phase of stormwater practices (BMPs, ponds, regional infiltration basins). Long-term operation and maintenance for the up-keep of stormwater management facilities would be funded through a different mechanism (e.g. stormwater utility). The area charge is one-time up-front fee that could be charged on a per acre basis. In the case where runoff requirements must be addressed internally at the site level, no differentiation would need to be made between high and low density developments. Although a higher density development would produce a greater percentage of stormwater runoff or pollution, the development would provide treatment on-site, requiring greater controls to meet stormwater standards and ultimately effecting the same off-site change in runoff on a per-acre basis. This creates a 'pay as you go' system for development with the treatment needed locally commensurate with the impact created. This approach also provides incentive for the development to reduce its impact through its site design. In-lieu of construction fees are related, but these fees are usually a substitute for requiring on-site storage and treatment if, for example, storage treatment is not feasible on-site. Stormwater rules may or may not consider infeasibility of on-site construction an option. In-lieu of construction fees do not fund maintenance. Finally, capitalization recovery fees are established to recover a significant portion of prior public investment in infrastructure capacity which was installed prior to development in order to accommodate future development. The fees apply to developers who make use of the provisional capacity at the time that they develop. These fees may not be specifically authorized in legislation but could be incorporated into a stormwater utility fee rate structure on a case by case basis.

Municipal Bonding

Municipal bonding is commonly used to fund major capital expenditures and has also been used to fund stormwater utility development costs. Debt funding can also be conducted through

intergovernmental loans, warrants and other mechanisms. This funding mechanism enables more immediate action which can be especially important for flood protection projects. If not otherwise specified by the bond, debt service of bonds can be derived from, among others, general revenues, service fees such as a stormwater utility, or special assessments of properties served by the bond fund. Debt funding, however, incurs an interest expense which ultimately increases the cost of the project(s). (NAFSMA, 2006)

Revenue bonding and general obligation bonding typically differ based on the source of support and the interest expense. General obligation bonds are funded by all revenues and resources of the issuing agency. Revenue bonding is supported only by specific revenues (e.g. service fees or assessments) and often imposes higher interest rates and requires coverage to reduce the risk of non-payment. The NAFSMA indicates that the bond market recognizes stability in stormwater utility fee income and prices stormwater revenue bonds favorably (NAFSMA, 2006). There are also combination scenarios where elements of revenue and general obligation bonds are combined (called 'double-barreling' of bonds).

Grants and Loans

City of Cumberland is eligible for many grants and some loans offered through the state of Wisconsin, federal agencies and non-profits. Table 19 summarizes the available grants and identifies those that are the most likely grant sources for the city.

Table 20 summarizes available loans. Appendix D contains a more detailed description of each grant as prepared by Harmony Environmental in the context of the Library Bay Restoration Project. Grants are grouped by Restoration Project phases, which also relate to the potential work in this citywide implementation plan. Ordinance development is not explicitly identified in Appendix D but is an eligible project for many of the grants including Lake Protection Grants and Lake Management Planning Grants.

Table 19. Potential grant sources.

Grant Program	Entity	Goals/Objectives	Funding Rates and Limits
Urban Nonpoint Source Construction Grant	Wisconsin Department of Natural Resources (DNR)	Improve urban water quality by limiting or ending sources of urban nonpoint source (run-off) pollution	Up to 50% to construct BMPs, maximum of $2000,000 ($150,000 for construction activities and $50,000 for land acquisition or easements)
Targeted Runoff Management Grant	DNR	Control polluted runoff from both urban and rural sites	Up to 70% of project costs, not to exceed $150,000
Lake Protection Grants	DNR	Protect and improve the water quality of lakes and their ecosystems	Up to 70% of project costs, not to exceed $200,000
Lake Management Planning Grant	DNR	More effective watershed protection and lake management	75% of project costs (up to $3,000 for small-scale projects and $10,000 for large-scale projects, up to 2 large scale projects for each application period)
Community Development Block Grant Planning Grant Program	Wisconsin Department of Commerce (DOC)	Help communities develop clear and actionable strategies for addressing specific site, neighborhood, community or regional economic or development needs and to improve the quality of community or economic development projects by helping to fund local plans	50% matching
Community Development Block Grant for Public Facilities	DOC	Enhance the vitality of a community by undertaking public investment that contributes to its overall community and economic development. Project may involve public infrastructure, community facilities and down town revitalization	Maximum of $750,000 (average is less than $500,000 or 50% of project costs)
Recreational Boating Facilities	Wisconsin Waterways Commission	Maintain and improve opportunities for recreational boating in Wisconsin waters	Up to 50% of eligible project costs plus an additional 30% for projects that meet state and/or regional Waterways Commission requirements
North American Wetland conservation Act*	U.S. Fish & Wildlife Service (USFWS)	Long-term enhancement of wetlands for the benefit of wetlands-associated migratory birds and other wildlife	50% up to $75,000
Five-Star Restoration Program*	U.S. Environmental Protection Agency (EPA)	Provide environmental education and training through projects that restore streambanks and wetlands	$5,000 to $20,000 (average is $10,000) per project
Pulling Together Initiative*	National Fish and Wildlife Foundation	Control noxious plants through management, removal and/or public awareness efforts	50% match, $10,000 to $100,000 (average is $33,000)

Grant Program	Entity	Goals/Objectives	Funding Rates and Limits
Wildlife Forever Challenge Grants	Wildlife Forever	Conservation projects such as habitat restoration and acquisition, research and management, and educational projects	50% match, $1,000 to $10,000
Private Stewardship Grants Program	USFWS	Support voluntary conservation efforts on private land for the benefit if imperiled (federally-listed) species and state listed species	Up to 90% of project costs (average is $72,000)
Municipal Flood Control Grants	DNR	Municipal flood control management to protect life, health and property from flood damages	Up to 70% of project costs
Acquisition and Development of Local Parks (Stewardship)	DNR	Expand opportunities for nature-based outdoor recreation	50% funding of appraised value
Acquisition Development Rights (Stewardship)	DNR	Protect natural, agricultural, or forestry values that would enhance nature based outdoor recreation	50% funding of appraised value
Land and Water Conservation Fund	DNR	Create parks and open spaces, protect wilderness, wetlands, and refuges, preserve wildlife habitat, and enhance recreational opportunities	Up to 50% of project costs
Recreational Trails Program	DNR	Assist local communities and trail groups in the development, maintenance, or rehabilitation of recreational trails	50% funding
Kodak American Greenways Grants	Eastman Kodak Company, National Geographic Society, The Conservation Fund	Stimulate planning and design of green communities throughout America	$2,500 maximum (average $500 to $1,000)
Multimodal Improvement Program – Local Transportation Enhancements Grant	Wisconsin Department of Transportation (DOT)	Increase multi-modal transportation alternatives and enhance communities and the environment	Up to 80% of project costs
Multimodal Improvement Program – Surface Transportation Discretionary Program	DOT	Foster alternatives to single-occupancy vehicles such as bike and pedestrian facilities or plans, the purchase of transit vehicles for new services and other Transportation Demand Management projects	To be determined

Grant Program	Entity	Goals/Objectives	Funding Rates and Limits
Partners for Fish and Wildlife Program	USFWS	Fish management projects such as land acquisition, habitat restoration and development, aquatic education, public fishing piers and shorefishing, fish propagation and stocking, and research	Varies
Local Bridge Improvement Assistance	DOT	To help rehabilitate and replace the most seriously deficient existing local bridges on Wisconsin's local highway systems	Cost share
Community Development Block Grant Public Facilities for Economic Development	DOC	Improvements to public facilities such as water systems, sewerage systems, and streets that are owned by a unit of government, and which will principally benefit businesses; and as a result will induce businesses to create jobs and invest in the community	A maximum of $10,000 for each job created or retained (average is $5,000), $750,000 maximum
Public Works and Economic Development Program	U.S. Department of commerce Economic Development Administration	Help support the construction or rehabilitation of essential public infrastructure and facilities necessary to generate or retain private sector jobs and investments, attract private sector capital, and promote regional competitiveness, including investments that expand and upgrade infrastructure to attract new industry, support technology-led development, redevelop brownfield sites and provide eco-industrial development	Up to 50% of project costs plus an additional 30% based on relative need in the region
Transportation for Economic Assistance (TEA) Grants	DOT	Road, rail, harbor and airport projects that help attract employers to Wisconsin, or encourage business and industry to remain and expand in the state	50% up to $1,000,000
Local Highway Improvement Assistance – Surface Transportation Project, Urban	DOT	Improvements to federal-aid-eligible roads and streets in urban areas	To be determined
Local Highway Improvement Assistance – Surface Transportation Project, Rural	DOT	Improve federal aid eligible highways outside of urban areas	To be determined

* The City itself may not be eligible, but a community group could be

Table 20. Potential loan sources

Grant Program	Entity	Goals/Objectives	Funding Rates and Limits
Clean Water Fund Program	DNR	Provides loans to municipalities for wastewater treatment and urban storm water projects	Subsidized interest rate of 55%, 65%, or 70% of the Environmental Improvement Fund (EIF) market interest rate; grant or lower interest rate may be available if eligible to receive Hardship Financial Assistance (HFA)
Clean Water Fund Small Loan Program	DNR	Planning, design, and construction of wastewater treatment facilities or structural urban BMPs for storm water	Subsidized interest rate of 55%, 65%, or 70% of the EIF market interest rate; maximum total cost of $1,000,000.
State Trust Fund Loan Program	Board of commissioners of Public Lands	Support community and school projects	$2,500,000 annual borrowing limit; 3.5% to 6.25% depending on project and term

12. REFERENCES

American Forests. 2002. Urban Ecosystem Analysis Benton and Washington Counties, Arkansas: Calculating the Value of Nature. http://www.americanforests.org/resources/rea/

Barr Engineering Company. April 2008. 2007 Beaver Dam Lake Water Quality Study. Prepared for Beaver Dam Lake Management District.

Barr Engineering Company. February 2009. 2008 Beaver Dam Lake Report and Amended Aquatic Plant Management Plan. Prepared for Beaver Dam Lake Management District.

Benike, H. and Disrude, M. April 2008. Beaver Dam Lake Fisheries Survey, Barron County, Wisconsin, 2005-2007, MWBIC: (2081200). Wisconsin Department of Natural Resources, Northern Region-Barron.

Cappiella, K., T. Schueler, and T. Wright. 2005. Urban Watershed Forestry Manual Part 2: Conserving and Planting Trees at Development Sites. Prepared for: USDA Forest Service. Center for Watershed Protection. Ellicott City, MD.

Minnesota Pollution Control Agency (MPCA). Managing Dredged Materials in the State of Minnesota. June 2009. Report No. wq-gen2-01.

Mohamed, R. 2006. The Economics of Conservation Subdivisions: Price Premiums, Improvement Costs, and Absorption Rates. Urban Affairs Review, 41(3): 376-399. http://www.greenerprospects.com/EconomicsOfConservationSubdivisions-1.pdf

National Association of Flood and Stormwater Management Agencies (NAFSMA). 2006. Guidance for Municipal Stormwater Funding. Funded by the U.S. Environmental Protection Agency.

Schueler, T. 1995. Site Planning for Urban Stream Protection. Center for Watershed Protection. Ellicott City, MD. http://www.cwp.org/Resource_Library/Better_Site_Design/

Shaw, D. and R. Schmidt, 2003. Plants for Stormwater Design - Species Selection for the Upper Midwest. Edited by S. Brungardt, Designed by R. Harrison, Minnesota Pollution Control Agency, St. Paul, MN.

Short Elliott Hendrickson, Inc. (SEH). (2006). City of Cumberland Comprehensive Plan. City of Cumberland, Cumberland, WI.

Town of Reading. April 30, 2009. Structuring a Stormwater Utility. Town of Reading: Reading, MA.

U.S. Environmental Protection Agency (USEPA). Methodology for Analysis of Detention Basins for Control of Urban Runoff Quality. Nonpoint Source Branch, Washington, EPA 440/5-87-001, September 1986.

Walker, W.W. Program for Predicting Polluting Particle Passage thru Pits, Puddles and Ponds (P8), Version 3.4. Release Date: October 30, 2007. Support from: United States Environmental Protection Agency, Wisconsin Department of Natural Resources, Minnesota Pollution Control Agency.

Wisconsin Department of Natural Resources (DNR). Consensus-Based Sediment Quality Guidelines: Recommendations for Use & Application, Interim Guidance. Developed by the Contaminated Sediment Standing Team, December 2003. Report No. WT-732 2003.

Zielinski, J., 2001. The Benefits of Better Site Design in Residential Subdivisions. Watershed Protection Techniques, 3(2):633-646. Center for Watershed Protection. Ellicott City, MD. http://www.cwp.org/Resource_Library/Center_Docs/PWP/ELC_PWP46.pdf

APPENDIX A: CURRENT CONDITIONS OF SURFACE WATERS

Beaver Dam Lake and Bays

Surface Water Quality

Surface water quality can be defined in terms of the trophic status: hypereutrophic, eutrophic, mesotrophic and oligotrophic. Eutrophic waters have high primary productivity as a result of high nutrient content and are often identifiable by algal blooms resulting in poor water quality and poor water clarity. Hypereutrophic waters are in an extreme state of eutrophication. Oligotrophic waters have low concentrations of nutrients and algae resulting in high water clarity. Mesotrophic waters are in a state between oligotrophic and eutrophic. In order to define the trophic status, water quality measurements are taken, in particular, secchi depth (transparency), nutrients (in particular, phosphorus) and chlorophyll (an indicator of primary productivity).

Barr Engineering Company completed the *2007 Beaver Dam Lake Water Quality Study* for Beaver Dam Lake Management District (District) in April 2008. The report is an excellent compilation of the current water quality of Beaver Dam Lake and the overall trends in comparison to years past. Surface water quality reported herein is wholly based upon the *2007 Beaver Dam Lake Water Quality Study*. In cases where exact text and graphics are used from the study, credit is given specifically.

2007 Water Quality

A summary follows of 2007 water quality at the seven sample locations in Beaver Dam Lake prepared by Barr Engineering Company (2008). Refer to station locations in Figure 29.

C-1, C-2 and C-3 (Beaver Dam Lake West) – *Excellent water quality – Each location varied form oligotrophic (low nutrients, crystal clear) to borderline oligotrophic/mesotrophic (low nutrients, crystal clear/moderate nutrients, good water quality)*

C-4 (Beaver Dam Lake East, Cemetery Bay) – *Poor water quality – varied from eutrophic (high nutrients, poor water quality) to hypereutrophic (extremely high nutrients, extremely poor water quality)*

C-5 (Beaver Dam Lake East, Norwegian Bay) – *Poor water quality – varied from oligotrophic (low nutrients, crystal clear) to hypereutrophic (extremely high nutrients, extremely poor water quality)*

C-6 and C-7 (Beaver Dam Lake West, Rabbit Island Bay and Library Lake) – *Reasonable good water quality – varied from mesotrophic (moderate nutrients, good water quality) to eutrophic (high nutrients, poor water quality)*

The West Lake locations (C-1, C-2, C-3, and C-7) noted better water quality than East Lake locations (C-4 and C-5). Deeper locations on the West Lake (C-1, C-2, and C-3) noted better

water quality than shallower bay areas of the West Lake (C-6 and C-7). East Lake location C-4 (Cemetery Bay) noted much poorer water quality than C-5 (Norwegian Bay).
A comparison of water transparency values during the period of record indicate 2007 water transparency values were higher (better water transparency) at C-1, C-2, and C-3 approximately the same at C-6 and C-7 (no change), and were lower (poorer water transparency) at C-4 and C-5. The better water transparency at C-1, C-2, and C-3 appears to be due to the dry 2007 climatic conditions which reduced stormwater runoff to the lake. The poorer water transparency at C-4 appears due to internal loading of phosphorus released from the lake's sediments which resulted in increased algal growth. The dry 2007 climatic conditions further exacerbated the water quality impacts of internal loading since reduced water flow through the lake caused the phosphorus released from the sediment to build up and stay within the lake. The poorer water transparency at C-5 appears to result from decaying vegetation following 2007 treatment for Eurasian watermilfoil. The decaying vegetation appears to have increased the lake's phosphorus concentration and stimulated algal growth within the lake. (Barr Engineering Company, 2008).

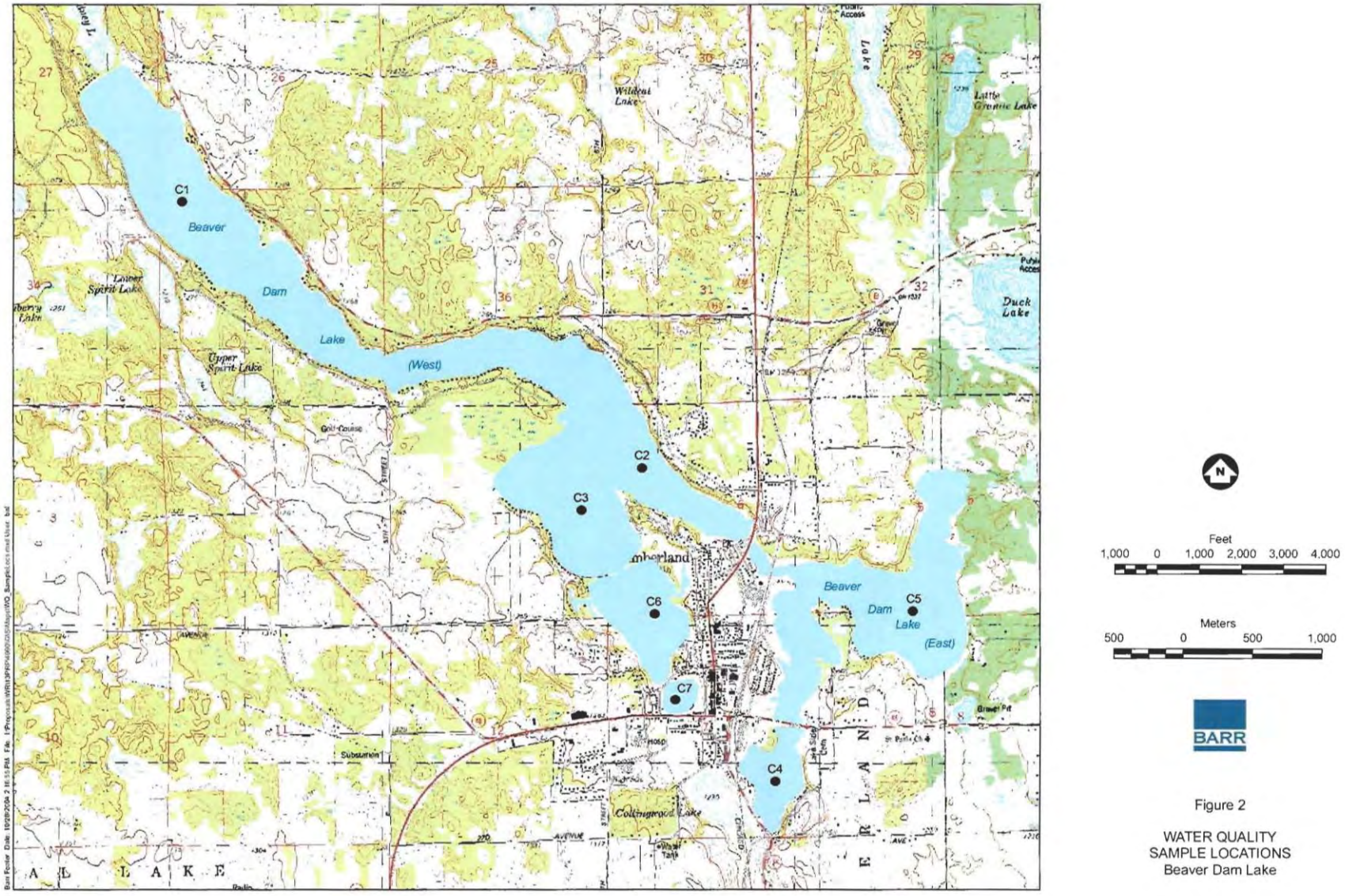

Figure 29. Beaver Dam Lake water quality sample locations. Figure credit: Barr Engineering Company (2008).

Water Quality Trends

The same stations monitored in 2007 (Figure 29) were monitored in 1992 and 1994 by the District, with assistance from Short Elliot Hendrickson, Inc. Samples were collected from approximately May through September, and subsequent water quality analyses were performed. Historically, the Wisconsin Department of Natural Resources (DNR) collected data from 1975 through 1979 and 1981 through 1987 at several stations. *However, in many years only one sample was taken from a lake station and often only during the fall, winter or spring* (Barr Engineering Company, 2008). The following data from the *2007 Beaver Dam Lake Water Quality Study* illustrate the trends based on these analyses.

Site C-1 (Beaver Dam Lake West)

The water quality at C-1 was excellent in 1992 and 1994 and the 2007 data confirm that the water quality of C-1 has remained excellent over time. The C-1 average summer total phosphorus concentration was the same in 1994 and 2007 and differed from the 1992 average summer concentration by only one part per billion (µg/L). Fluctuations in chlorophyll over time are small and are not considered significant. Average summer chlorophyll concentration at C-1 was 4.7 µg/L in 1992 and declined to 1.8 µg/L in 1994. The average summer chlorophyll concentration was essentially the same in 1994 and 2007, differing by only one tenth of a part per billion. Water transparency at C-1 has improved over time. Average summer Secchi disc water transparency increased form 3.6 meters in 1992 to 4.8 meters in 1994. Average summer Secchi disc water transparency increased to 5.8 meters in 2007 (See Figure 30*).* (Barr Engineering Company, 2008)

Water transparency values during the 1975 through 2007 period indicate the lake has generally exhibited mesotrophic (moderate nutrients, good water quality) water quality. Water transparency values during 2007 were higher than historical values. The higher values in 2007 indicated the lake's water clarity was higher in 2007 than in previous years (See Figure 31*). The improved water clarity in 2007 is apparently a result of the dry climatic conditions which reduced stormwater runoff to the lake.* (Barr Engineering Company, 2008)

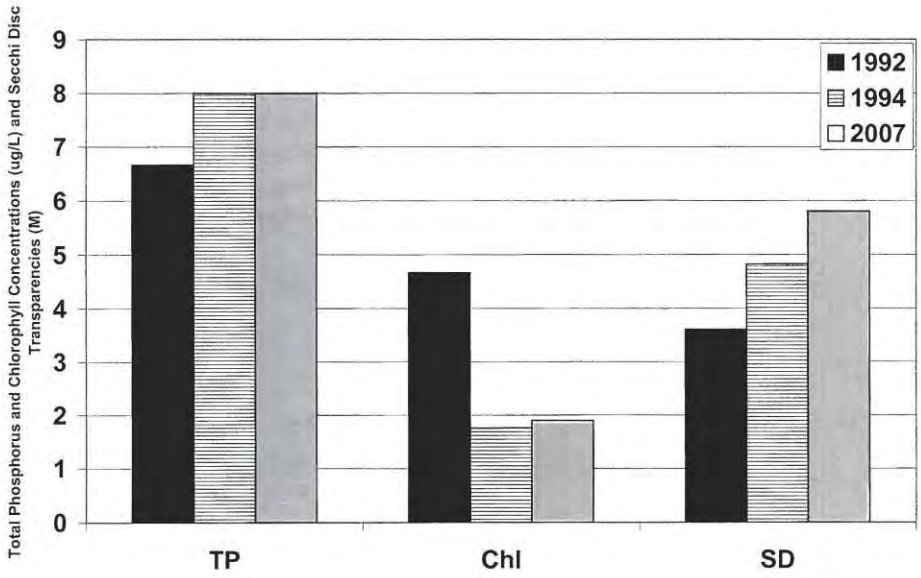

Figure 30. Site C-1 (Beaver Dam Lake West) average summer epilimnetic total phosphorus and chlorophyll concentrations and Secchi disc transparency from 1992, 1994, and 2007. Figure credit: Barr Engineering Company (2008).

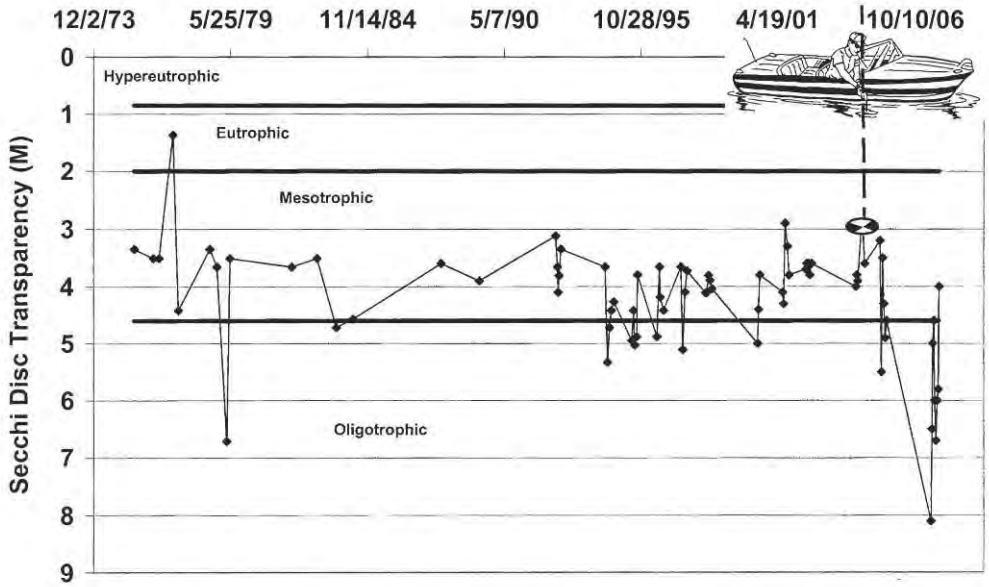

Figure 31. Site C-1 (Beaver Dam Lake West) Secchi disc transparencies from 1975-2007. Figure credit: Barr Engineering Company (2008).

Site C-2 (Beaver Dam Lake West)

The water quality at C-2 was excellent in 1992 and 1994 and the 2007 data confirm that the water quality of C-2 has remained excellent over time. The C-2 average summer total phosphorus concentrations were essentially the same in 1992, 1994, and 2007, differing by less than 1 part per billion (µg/L) between years. Average summer chlorophyll concentrations declined during the 1992 through 1994 period (from 5.1 µg/L to 2.2 µg/L) and then remained

essentially the same from 1994 through 2007 (differed by less than 1 ppb – 2.2 µg/L in 1994 and 1.7 µg/L in 2007). Average summer Secchi disc transparency increased from 3.3 meters in 1992 to 4.3 meters in 1994 to 5.9 meters in 2007 (See Figure 32*).* (Barr Engineering Company, 2008).

A comparison of water transparency values during the 1981 through 2007 period indicates the lake has generally exhibited mesotrophic (moderate nutrients) water quality. Water transparency values during 2007 were higher than historical values (See Figure 33*). The higher values in 2007 are apparently a result of the dry climatic conditions which reduced stormwater runoff to the lake.* (Barr Engineering Company, 2008).

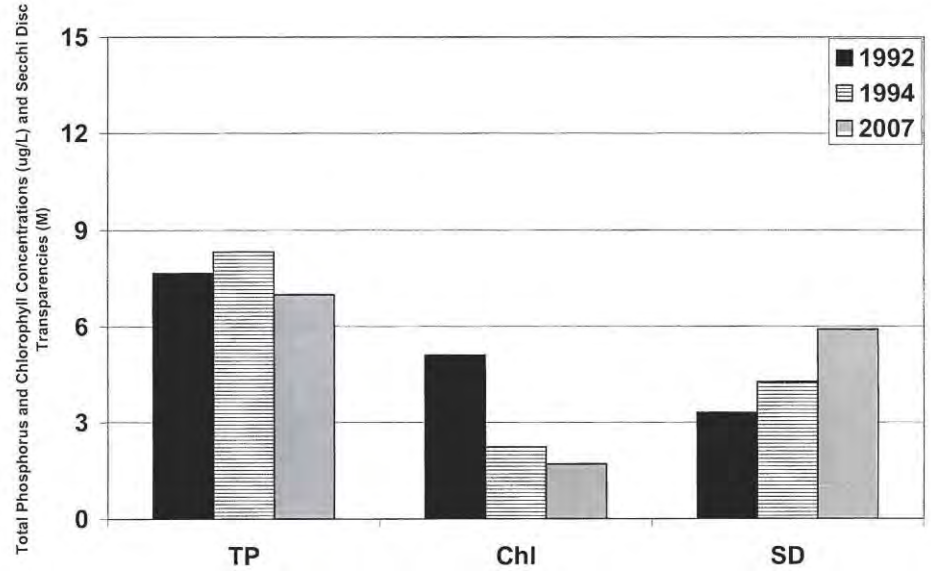

Figure 32. Site C-2 (Beaver Dam Lake West) average summer epilimnetic total phosphorus and chlorophyll concentrations and Secchi disc transparency from 1992, 1994, and 2007. Figure credit: Barr Engineering Company (2008).

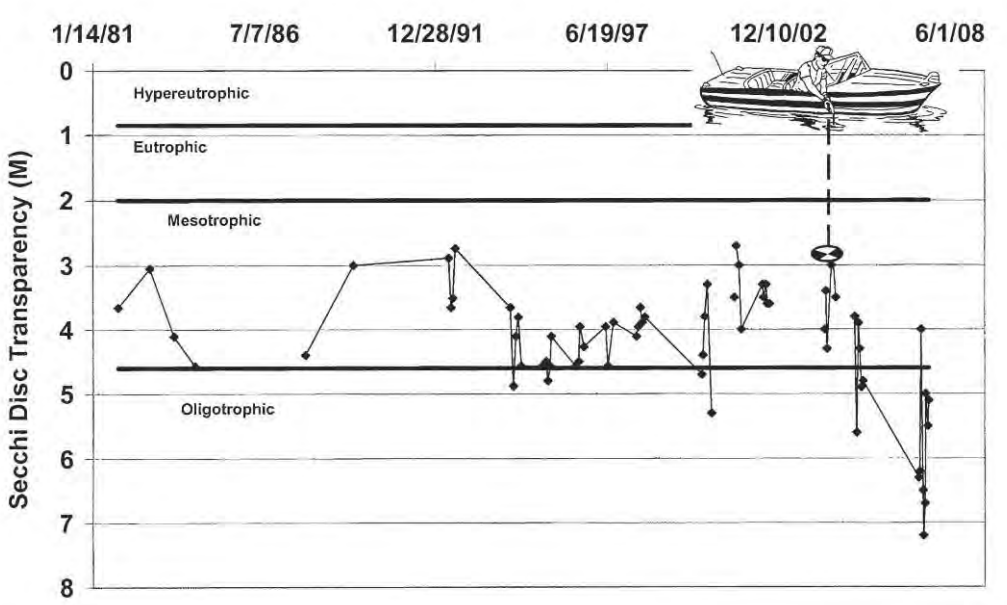

Figure 33. Site C-2 (Beaver Dam Lake West) Secchi disc transparencies from 1981-2007. Figure credit: Barr Engineering Company (2008).

Site C-3 (Beaver Dam Lake West)

The water quality at C-3 was excellent in 1994 and the 2007 data confirm that the water quality of C-3 has remained excellent over time. The C-3 average summer total phosphorus concentration was essentially the same in 1994 and 2007, differing by 0.3 parts per billion (µg/L), an insignificant change. Fluctuations in chlorophyll over time are also small and are not considered significant. Average summer chlorophyll concentration at C-3 was 2.4 µg/L in 1994 and 1.6 µg/L in 2007, differing by only 0.8 parts per billion (µg/L). Water transparency at C-3 has improved over time. Average summer Secchi disc water transparency increased from 3.5 meters in 1992 to 4.3 meters in 1994. Average summer Secchi disc water transparency increased to 5.1 meters in 2007 (See Figure 34*).* (Barr Engineering Company, 2008).

Water transparency values during the 1992 through 2007 period indicate the lake has generally exhibited mesotrophic (moderate nutrients, good water quality) water quality. Water transparency values during 2007 were higher than historical values. The higher values in 2007 indicated the lake's water clarity was higher in 2007 than in previous years (See Figure 35*). The improved water clarity in 2007 is apparently a result of the dry climatic conditions which reduced stormwater runoff to the lake.* (Barr Engineering Company, 2008).

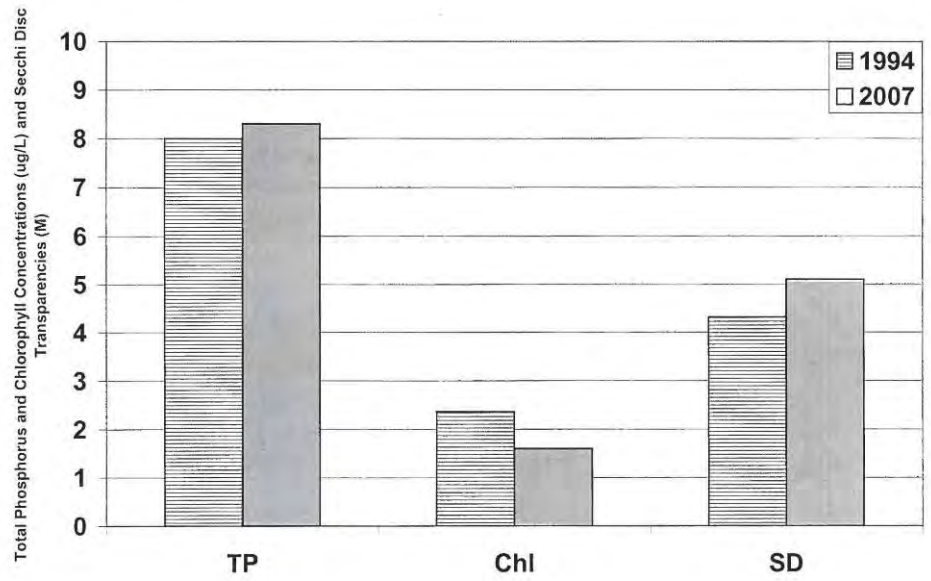

Figure 34. Site C-3 (Beaver Dam Lake West) average summer epilimnetic total phosphorus and chlorophyll concentrations and Secchi disc transparency from 1994 and 2007. Figure credit: Barr Engineering Company (2008).

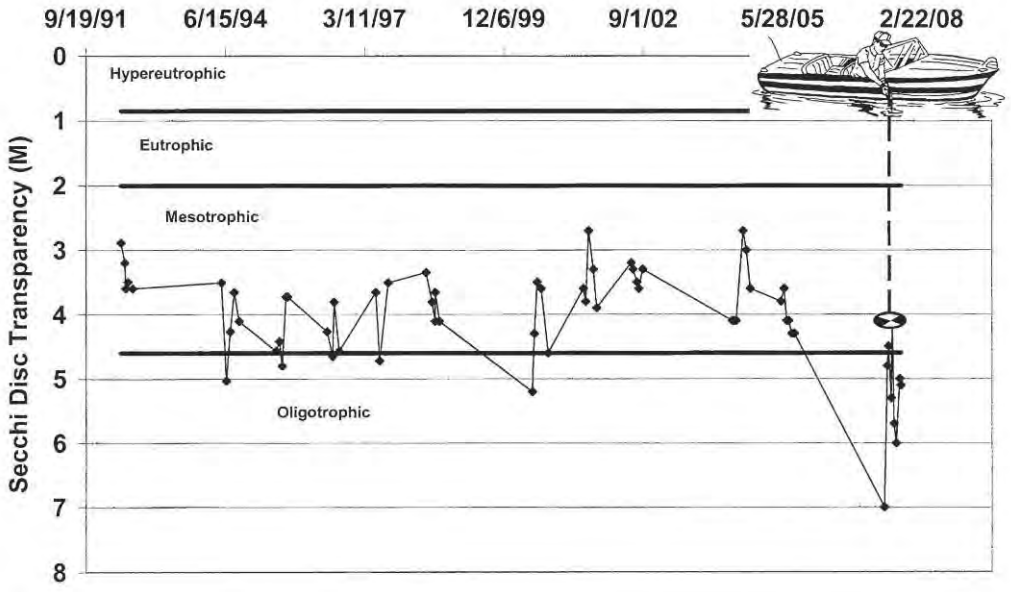

Figure 35. Site C-3 (Beaver Dam Lake West) Secchi disc transparencies from 1992-2007. Figure credit: Barr Engineering Company (2008).

Site C-4 (Beaver Dam Lake East, Cemetery Bay)

The water quality at C-4 has deteriorated substantially since 1994. As shown in Figure 36*, the summer average total phosphorus concentration nearly tripled (from 34 µg/L in 1994 to 90 µg/L in 2007) and the summer average chlorophyll concentration increased by more than six fold (from 10.2 µg/L in 1994 to 66.8 µg/L in 2007). Average summer Secchi disc water transparency was reduced by more than half, from 1.83 meters in 1994 to 0.7 meters in 2007 (See* Figure 36*).*

The decline in water quality is likely due to increased internal loading during 2007. The dry climatic year in 2007 reduced the lake's volume and flushing rate, causing the lake's internal load to have a greater impact on the lake's water quality. The data indicate the likelihood of substantial water quality improvement if the lake's internal load were reduced. (Barr Engineering Company, 2008).

A comparison of water transparency values during 1994 and 1997 indicate the lake's water transparency declined during 2007 (see Figure 37*). As discussed in the previous paragraph, the decline is attributed to increased internal phosphorus loading during 2007.* (Barr Engineering Company, 2008).

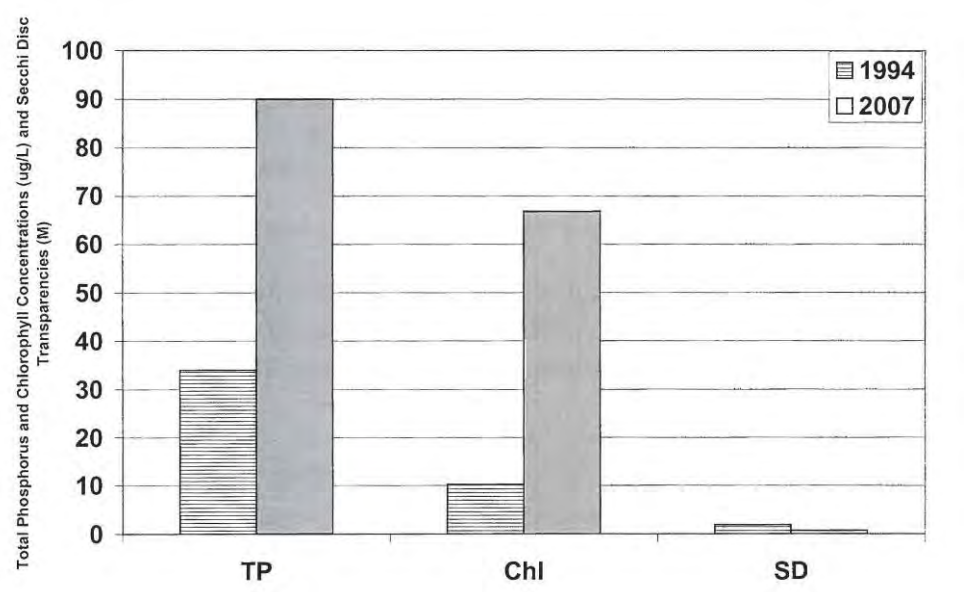

Figure 36. Site C-4 (Beaver Dam Lake East, Cemetery Bay) average summer epilimnetic total phosphorus and chlorophyll concentrations and Secchi disc transparency from 1994 and 2007. Figure credit: Barr Engineering Company (2008).

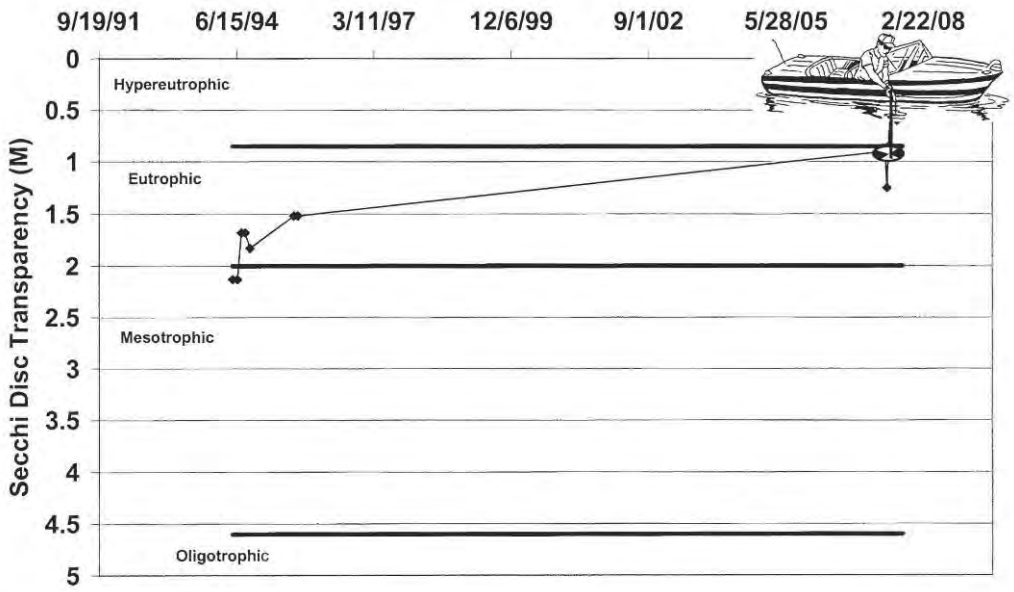

Figure 37. Site C-4 (Beaver Dam Lake East, Cemetery Bay) Secchi disc transparencies from 1994-2007. Figure credit: Barr Engineering Company (2008).

Site C-5 (Beaver Dam Lake East, Norwegian Bay)

The lake's water quality improved from 1992 through 1994, and then deteriorated in 2007. The average summer total phosphorus concentration in 2007 (39 µg/L) was more than double the average summer total phosphorus concentration in 1994 (16 µg/L). The average summer chlorophyll concentration in 2007 (10.3 µg/L) was double the average summer chlorophyll concentration in 1994 (5 µg/L). The average summer Secchi disc water transparency in 2007 (1.6 meters) was less than half the average summer water transparency in 1994 (3.8 meters) (see Figure 38*). The change in water quality may be due to the 2007 herbicide treatment of Eurasian milfoil and subsequent decay of vegetation within Norwegian Bay. It should be noted that a relatively small area within Norwegian Bay (about 17 acres) will receive herbicide treatment in 2008 due to the successful control of Eurasian watermilfoil during 2007. Additional monitoring in subsequent years will indicate the lake's current water quality and provide a more representative comparison with historical data.* (Barr Engineering Company, 2008).

A comparison of water transparency values during 1992, 1994, and 2007 indicate the lake's water transparency declined during 2007 (see Figure 39*). As discussed in the previous paragraph, the decline is attributed to increased phosphorus loading from the herbicide treatment of Eurasian watermilfoil and subsequent decay of vegetation during 2007.* (Barr Engineering Company, 2008).

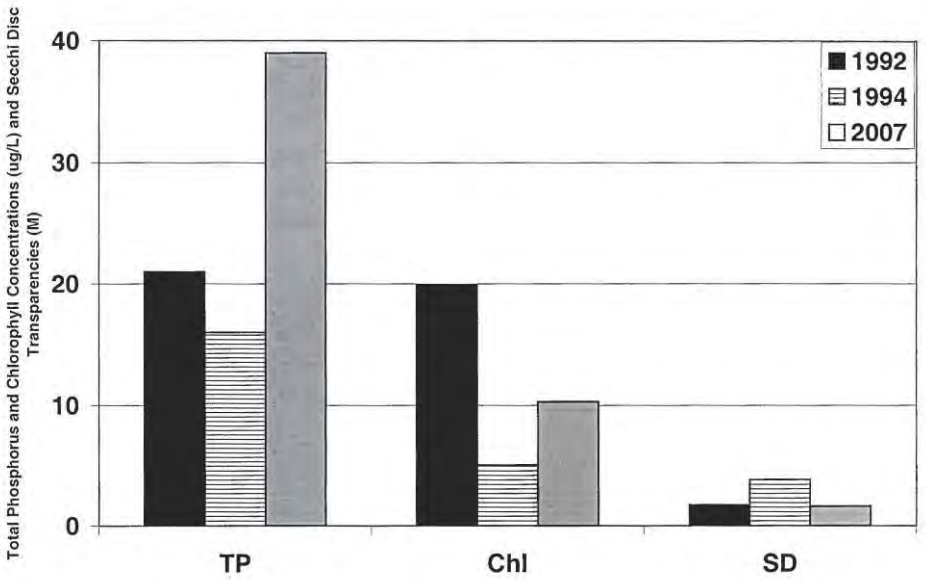

Figure 38. Site C-5 (Beaver Dam Lake East, Norwegian Bay) average summer epilimnetic total phosphorus and chlorophyll concentrations and Secchi disc transparency from 1992, 1994, and 2007. Figure credit: Barr Engineering Company (2008).

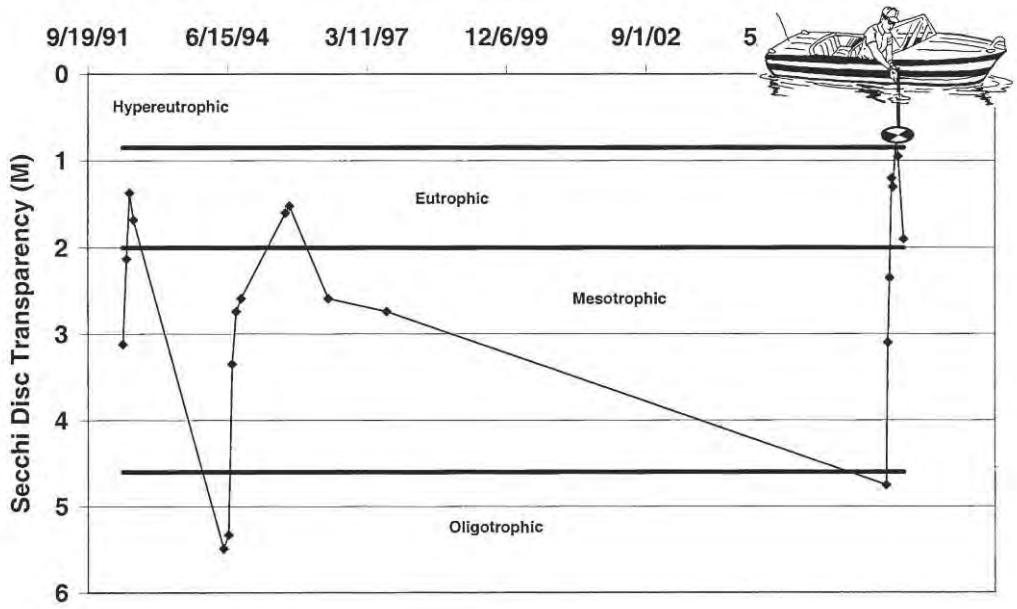

Figure 39. Site C-5 (Beaver Dam Lake East, Norwegian Bay) Secchi disc transparencies from 1992-2007. Figure credit: Barr Engineering Company (2008).

Site C-6 (Beaver Dam Lake West, Rabbit Island Bay)

The water quality at C-6 was excellent in 1994 and the 2007 data confirm that the water quality of C-6 has remained excellent over time. The C-6 average summer total phosphorous concentration in 2007 differed from the 1994 average summer concentration by only two parts per billion (µg/L). Fluctuations in chlorophyll over time are small and are not considered significant. Average summer chlorophyll concentration at C-6 was 4.3 µg/L in 1994 and declined

to 2.5 µg/L in 2007, a difference of less that two parts per billion (µg/L). Average summer water transparency at C-6 was essentially the same during 1994 and 2007, differing by only 0.05 meters (2 inches). (See Figure 40*).* (Barr Engineering Company, 2008).

Water transparency values during the 1994 through 2007 period indicate the lake has consistently exhibited oligotrophic (low nutrients, crystal clear) or mesotrophic (moderate nutrients, good water quality) water quality. Water transparency values during 2007 were similar to historical values (See Figure 41*).* (Barr Engineering Company, 2008).

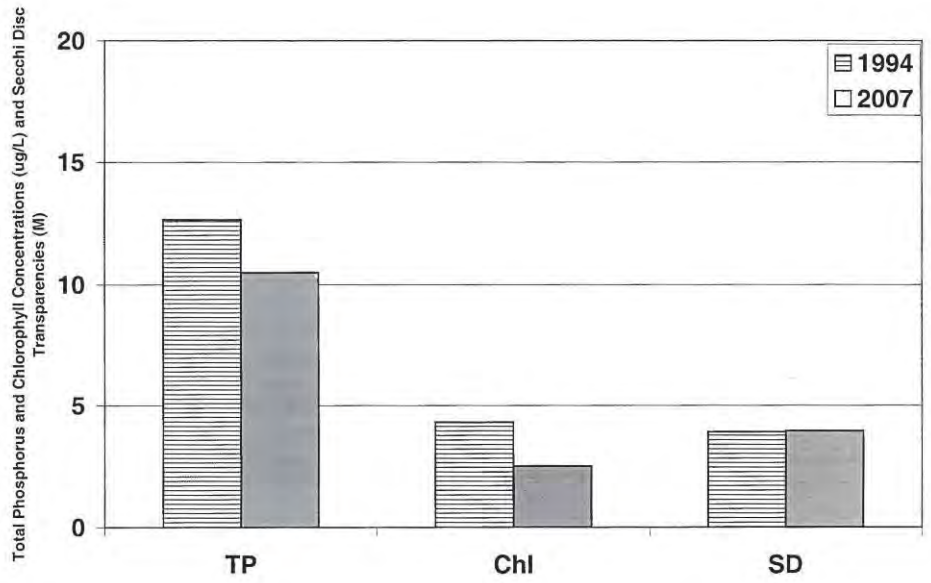

Figure 40. Site C-6 (Beaver Dam Lake West, Rabbit Island Bay) average summer epilimnetic total phosphorus and chlorophyll concentrations and Secchi disc transparency from 1994 and 2007. Figure credit: Barr Engineering Company (2008).

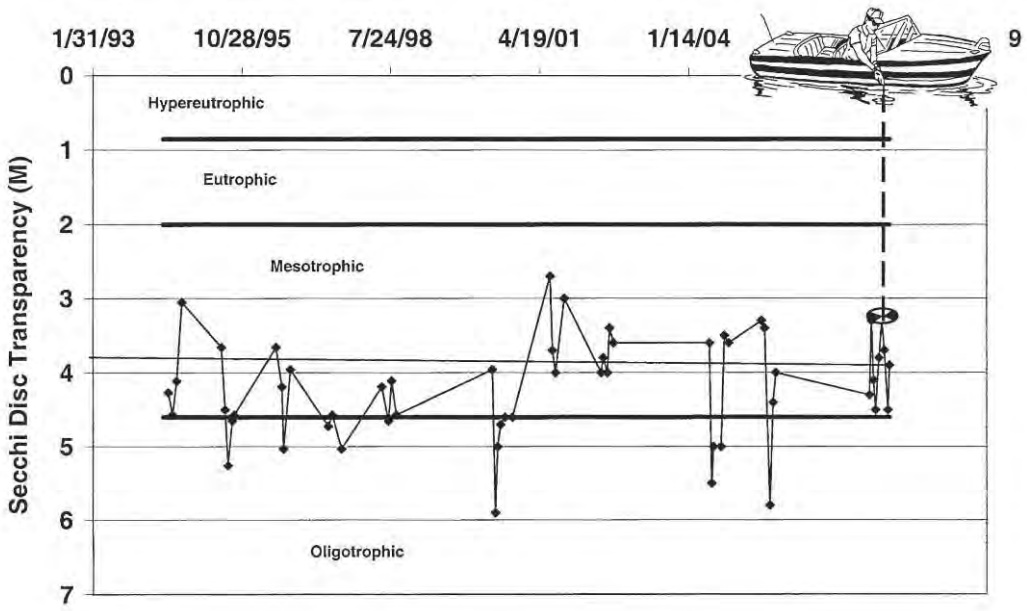

Figure 41. Site C-6 (Beaver Dam Lake West, Rabbit Island Bay) Secchi disc transparencies from 1994-2007. Figure credit: Barr Engineering Company (2008).

Site C-7 (Beaver Dam Lake West, Library Lake)

The primary difference in water quality at C-7 during 1992, 1994, and 2007 was the high phosphorus concentration during June of 2007 which caused the 2007 average summer phosphorus concentration (33 µg/L) to be much higher than 1992 (17 µg/L) and 1994 (17 µg/L) average summer phosphorus concentrations. (Barr Engineering Company, 2008).

Average summer chlorophyll concentrations declined during the 1992 through 2007 period (from 6.8 µg/L in 1992 to 5.1 µg/L in 1994 to 3.6 µg/L in 2007) (See Figure 42*). The decline may be due to increased vegetative growth within the lake. An examination of aerial photographs indicates that Library Lake's vegetative growth during the 1991 through 2005 period reduced the open water extent in the lake from 45.5 percent of the lake surface area in 1991 to 23.4 percent of the lake surface area in 2005. As discussed previously, increased vegetative growth is generally associated with increased periphytic algae growth and reduced planktonic algae growth (i.e, reduced chlorophyll concentrations).* (Barr Engineering Company, 2008).

Average summer Secchi disc transparency increased from 3.3 meters in 1992 to 3.5 meters in 1994 and then decreased to 3.1 meters in 2007. Hence, water transparency increased by about 8 inches during the 1992 to 1994 period and then decreased by 16 inches during the 1994 through 2007 period (See Figure 42*). Because chlorophyll concentrations decreased during this period of time, it appears that decreasing water transparency in 2007 was not due to increased algal growth. The more turbid waters in 2007 may be due to stormwater impacts since rainstorms occurred near the time of each 2007 sample event.* (Barr Engineering Company, 2008).

A comparison of water transparency values during the 1992 through 2007 period indicates the lake has generally exhibited mesotrophic water quality (moderate nutrients, good water quality).

*Water transparency values during 2007 were similar to historical values (*Figure 43*).* (Barr Engineering Company, 2008).

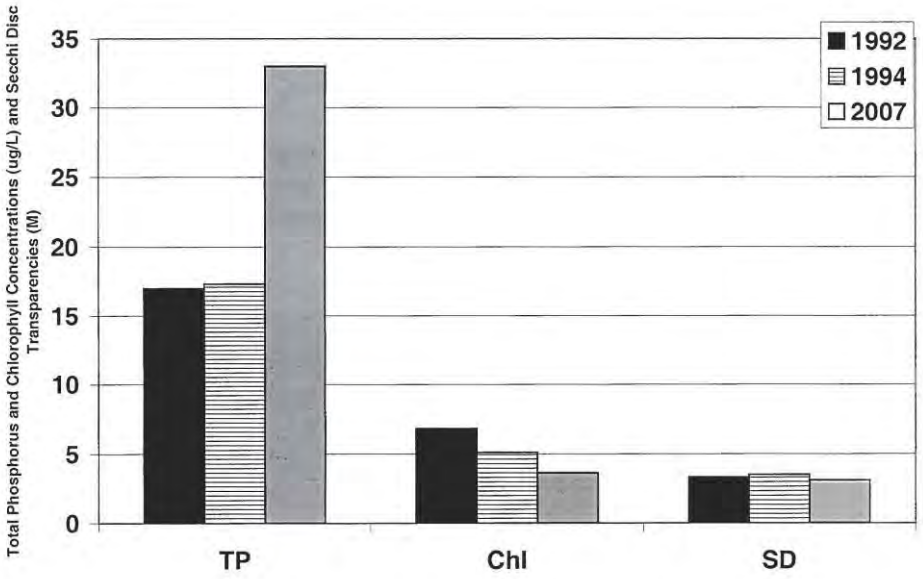

Figure 42. Site C-7 (Beaver Dam Lake West, Library Lake), average summer epilimnetic total phosphorus and chlorophyll concentrations and Secchi disc transparency from 1992, 1994, and 2007. Figure credit: Barr Engineering Company (2008).

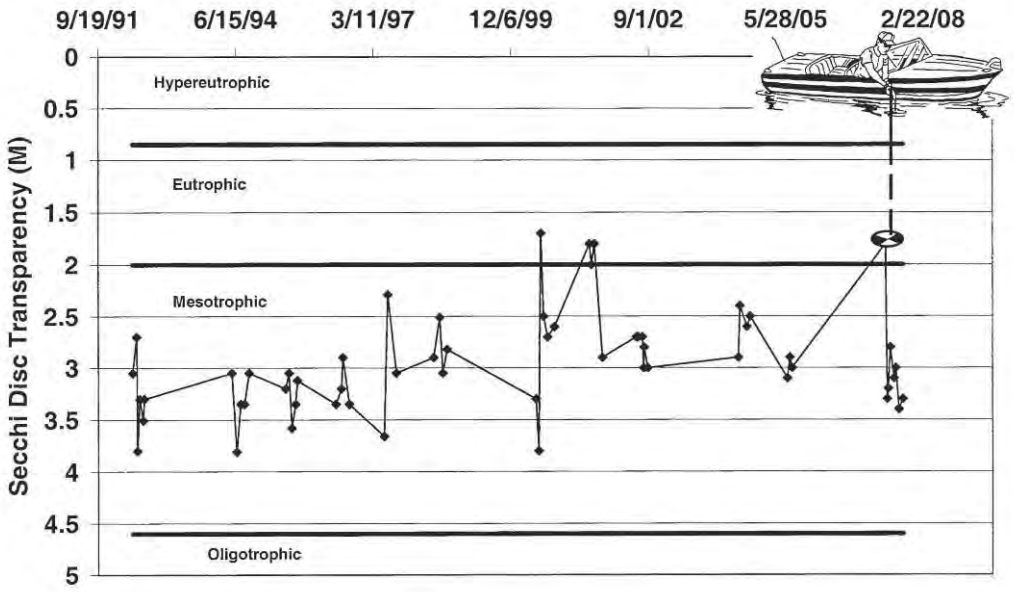

Figure 43. Site C-7 (Beaver Dam Lake West, Library Lake) Secchi disc transparencies from 1994-2007. Figure credit: Barr Engineering Company (2008).

Aquatic Plants

Barr Engineering Company completed the *2008 Beaver Dam Lake Report and Amended Aquatic Plant Management Plan* for Beaver Dam Lake Management District (District) in February 2009. The report provides a useful summary of aquatic plant coverage and Eurasian water milfoil (EWM) treatment effectiveness from 2006 to 2008 of Beaver Dam Lake. Aquatic plant coverage and EWM treatment effectiveness reported herein is wholly based upon the *2008 Beaver Dam Lake Report and Amended Aquatic Plant Management Plan*. In cases where exact text and graphics are used from the study, credit is given specifically.

2008 Aquatic Plant Coverage

Data from 41 locations monitored during summer of 2005 through 2008 were used to assess the Beaver Dam Lake aquatic plant community. These annual sample points were within EWM treatment areas in 2006. Because EWM has been removed from many areas of Beaver Dam Lake, almost half of these same sample points were not in treatment areas in 2008 (Figure 44). (Barr Engineering Company, 2009).

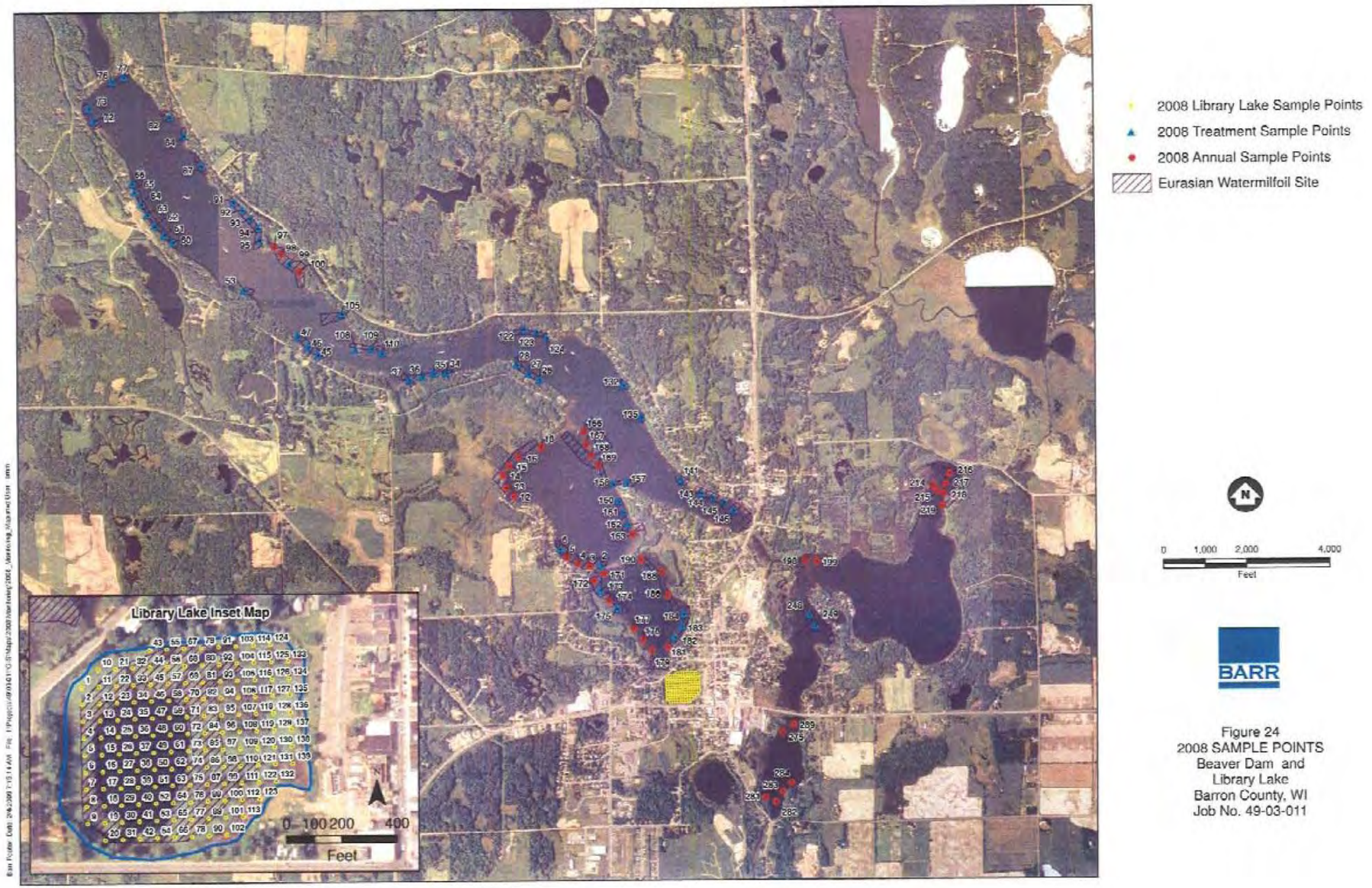

Figure 44. 2008 sample points for aquatic plant survey (annual and additional) and treatment. Figure credit: Barr Engineering Company (2009).

A comparison of the lake's summer plant community during 2006 through 2008 indicates the communities were significantly different. The changes resulted from numerous small changes in the relative frequency of a large number of species, rather than a large change in any one species. As native species colonize areas vacated by EWM, the number of species of aquatic plants has increased annually since 2005. In fact, the number of species increased form 15 in 2005 to 23 in 2008. A total of 10 native species were observed in the sample area during 2008 that were not observed in 2005. Emergent species in Beaver Dam Lake include soft stem bulrush, pickerelweed, arrowhead, cattail, and northern blue flag. (Barr Engineering Company, 2009).

The plant community within Beaver Dam Lake is diverse, and individuals of the community are distributed evenly among the different species. The average aquatic plant densities within Beaver Dam Lake have remained relatively stable during 2005 through 2008, generally ranging from low to moderate. Most species occurred in a low density, but four individual species grow very densely: Ceratophyllum demersum *(coontail),* Myriophyllum spicatum *(Eurasian water milfoil),* Potamogeton robbinsii *(Robbins' pondweed), and* Potamogeton amplifolius *(largeleaf pondweed)*. (Barr Engineering Company, 2009).

*Native species colonizing areas vacated by EWM have increased the number and quality of plant species in the lake (*Table 21*). The quality of a plant community is measured by the Floristic Quality Index (FQI) which considers the quality of the individual species found in the lake and the number of species. FQI during 2007 and 2008 (post treatment years) were substantially higher than 2005 (pre-treatment year) indicating the quality of the plant community was much higher in 2007 and 2008 than 2005. The number of species has increase annually since 2005.* (Barr Engineering Company, 2009).

Table 21. Annual Beaver Dam Lake plant survey results from 2005-2008 and 2008 Library Lake results. Table credit: Barr Engineering Company (2009).

Parameter	2005	2006	2007	2008	2008 Library Lake Only*	2009	2009 Library Lake Only*
# of Species	15	19	22	23	24	NA	37
FQI	18.86	18.09	26.83	26.69	27.15	NA	34.29
Diversity	0.88	0.90	0.93	0.92	0.90	NA	0.92

* July survey, post-EWM treatment.
NA = not available

*Plant Diversity in the sample area increased annually during 2005 through 2007 and remained relatively stable in 2008 (*Table 21*). Diversity within a plant community indicates the number of species present together with the evenness or equitability with which the individuals are distributed among the different species. Simpson's Diversity Index was used to assess diversity within Beaver Dam Lake. The index uses as scale of 0 to 1 with increasing values indicating increasing diversity. Beaver Dam lake diversity is near the top of the scale indicating the sample area has consistently noted excellent diversity.* (Barr Engineering Company, 2009).

*To more completely assess treatment effects on the lake's native plant community, 59 sample points located within treatment areas and not included in the lake's annual monitoring program were sampled in 2008. The 100 sample points (41 annual sample points and 59 sample points located within 2008 treatment areas) were assessed to determine number of species, floristic quality, diversity, frequency of occurrence, and density. The data were then compared to data from the annual monitoring program. The number of species and floristic quality were higher in the larger sample area (100 points) than the annual sample area (41 points), but diversity in the two areas was the same (*Table 22*).* (Barr Engineering Company, 2009).

Table 22. Beaver Lake Dam plant survey results: comparison between all 2008 sample points (100) and annual sample points (41). Figure credit: Barr Engineering Company (2009).

Parameter	All 2008 Sample Points (100)	Annual Sample Points (41)
# of Species	26	23
Diversity	0.92	0.92
FQI	28.80	26.69

Emergent and Floating Leaf Vegetation

During July, an emergent and floating leaf vegetation survey of Beaver Dam Lake and Library Lake were conducted. *Emergent species in Beaver Dam Lake include soft stem bulrush, pickerelweed, arrowhead, cattail, and northern blue flag* (Figure 45). *Emergent vegetation and floating leaf plants in Library Lake were observed along the North, East, and West shoreline areas* (Figure 46). *Species include Northern Blue Flag, Yellow waterlily, white waterlily, watershield, soft stem bulrush, and cattail.* (Barr Engineering Company, 2009).

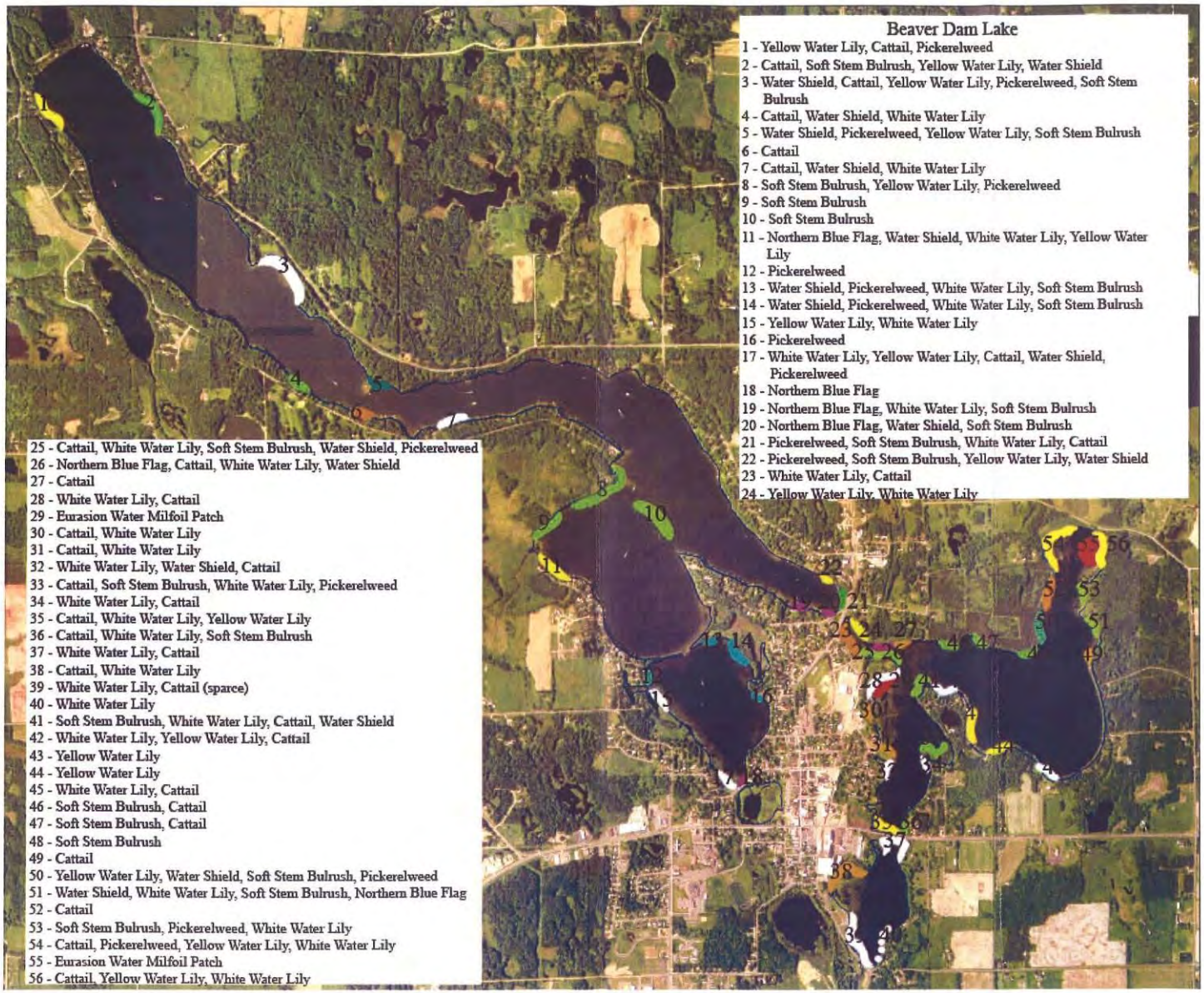

Figure 45. July Beaver Dam Lake emergent and floating leaf vegetation survey. Figure credit: Barr Engineering Company (2009).

Figure 46. July Library Lake emergent and floating leaf vegetation survey. Figure credit: Barr Engineering Company (2009).

Aquatic Invasive Species Management

After being accidentally introduced in the 1990s, [Eurasian watermilfoil (EWM)] *covered 67 percent of the lake's littoral area by 1999. With a surface area of 1,169 miles, Beaver Dam Lake has five boat landings, five swimming beaches, and one fishing pier—but the EWM was reducing the recreational usability of the lake. An aquatic plant management plan was used to manage the milfoil between 2000 and 2005. In 2006,* [Barr Engineering Company] *developed and implemented an updated plan*. (Barr Engineering Company, 2009).

Since 2006 treatments in Beaver Dam Lake have reduced the area of coverage and density of EWM in the lake, although EWM spreads annually to new areas. Figure 47 compares 2006 and 2008 ("Present") EWM coverage in Beaver Dam Lake and Library Lake. *The areas are based upon the results of aquatic plant surveys and indicate proposed treatment areas for each year. An analysis of EWM coverage in 2006 (preceding the 2006 treatment) indicates EWM covered approximately 222 acres.* [As of the 2008 survey] *EWM coverage is 179 acres, consisting mainly of new areas of EWM growth resulting from the spread of EWM beyond the 2006 area of coverage.* [In fact,] *approximately 25 percent of the 2009 proposed treatment areas have not previously observed EWM, and nearly half did not have EWM during 2008 (some areas noted EWM in 2006 or 2007). In 2008, 128 acres received herbicide treatment and treatment effectiveness was 73 percent. EWM no longer is present in 94 acres*. (Barr Engineering Company, 2009).

The data indicate treatment of the zero-to-five foot depth is necessary to control EWM in Beaver Dam Lake. Eighty percent of the EWM observed in 2008 occurred at depths up to five feet. Coverage was assessed from mid-October to early November 2008 at depths of up to 20 feet (EWM rarely occur in depths greater than 20 feet).

Figure 48 *shows EWM coverage in Library Lake before and after the 2008 treatment. The areas are based upon the results of aquatic plant surveys during the fall of 2007 and fall of 2008. Despite the spread of EWM to new areas in 2008, a reduction in EWM coverage resulted from the treatment. Library Lake observed a seventy five percent treatment effectiveness during 2008 – 3.72 acres out of the 4.96 treated acres did not observe EWM during the fall of 2008.* (Barr Engineering Company, 2009).

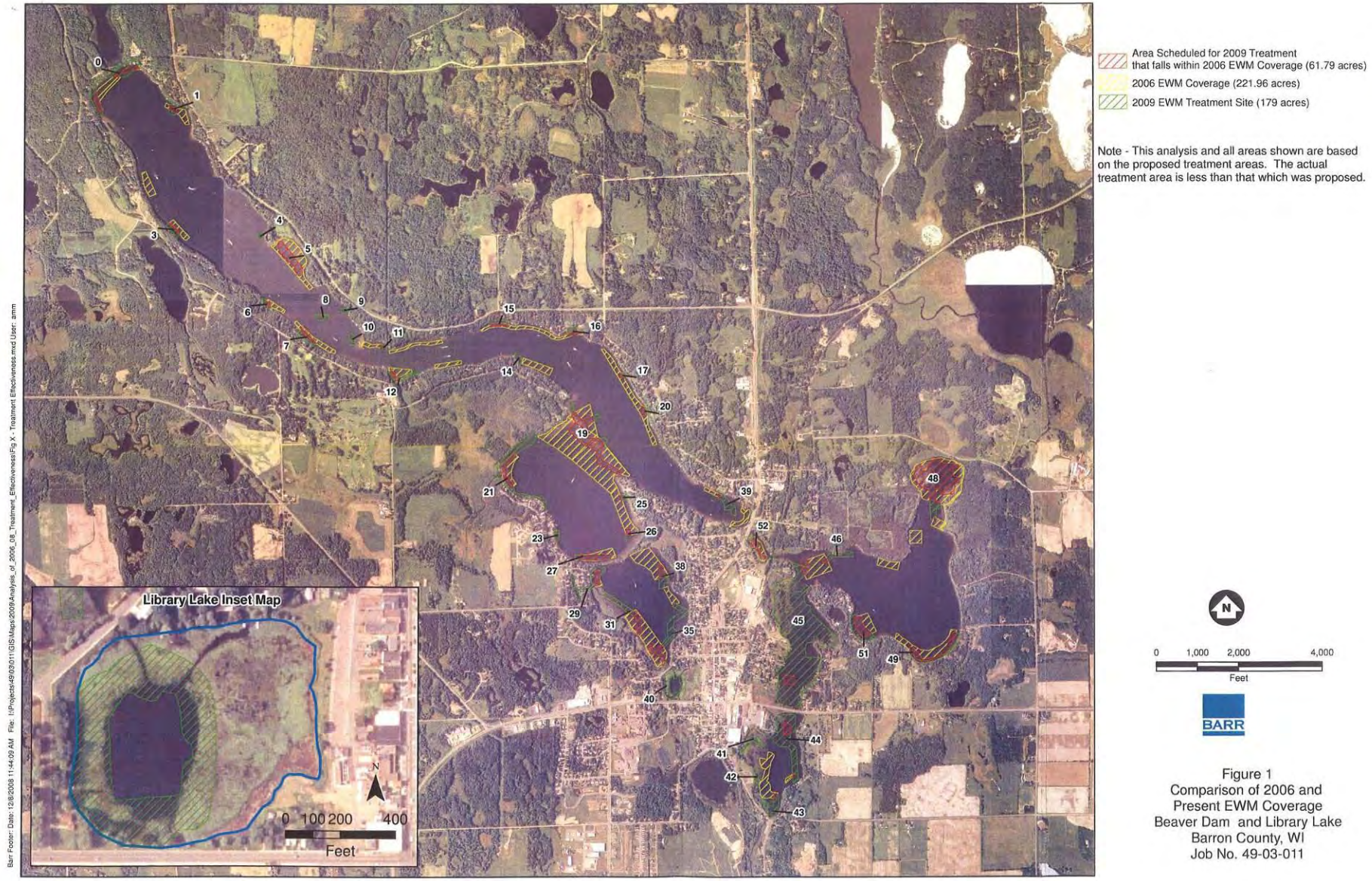

Figure 47. Comparison of 2006 and 2008 EWM coverage in Beaver Dam Lake and Library Lake. Figure credit: Barr Engineering Company (2009).

Figure 48. EWM coverage in Library Lake during 2008 and 2009. Figure credit: Barr Engineering Company (2009)

APPENDIX B: CODE AND ORDINANCE WORKSHEET

The Code and Ordinance Worksheet allows an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development occurs in your community. You are guided through a systematic comparison of your local development rules against the model development principles. Institutional frameworks, regulatory structures and incentive programs are included in this review. The worksheet consists of a series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks derived from the model development principles.

The worksheet is intended to guide you through the first two steps of a local site planning roundtable.

Step 1: Find out what the Development Rules are in your community.

Step 2: See how your rules stack up to the Model Development Principles.

The homework done in these first two steps helps to identify which development rules are potential candidates for change.

PREPARING TO COMPLETE THE CODE AND ORDINANCE WORKSHEET

Two tasks need to be performed before you begin in the worksheet. First, you must identify all the development rules that apply in your community. Second, you must identify the local, state, and federal authorities that actually administer or enforce the development rules within your community. Both tasks require a large investment of time. The development process is usually shaped by a complex labyrinth of regulations, criteria, and authorities. A team approach may be helpful. You may wish to enlist the help of a local plan reviewer, land planner, land use attorney, or civil engineer. Their real-world experience with the development process is often very useful in completing the worksheet.

Identify the Development Rules

Gather the key documents that contain the development rules in your community. A list of potential documents to look for is provided in Table 1. Keep in mind that the information you may want on a particular development rule is not always found in code or regulation, and maybe hidden in supporting design manuals, review checklists, guidance document or construction specifications. In most cases, this will require an extensive search. Few communities include all of their rules in a single document. Be prepared to contact state and federal, as well as local agencies to obtain copies of the needed documents.

Table 1: Key Local Documents that will be Needed to Complete the COW
Zoning Ordinance
Subdivision Codes
Street Standards or Road Design Manual
Parking Requirements
Building and Fire Regulations/Standards
Stormwater Management or Drainage Criteria
Buffer or Floodplain Regulations
Environmental Regulations
Tree Protection or Landscaping Ordinance
Erosion and Sediment Control Ordinances
Public Fire Defense Masterplans
Grading Ordinance

Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local agencies or authorities are actually responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable. Table 2 provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, some road design, and stormwater).

USING THE WORKSHEET: HOW DO YOUR RULES STACK UP TO THE MODEL DEVELOPMENT PRINCIPLES?

Completing the Worksheet

Once you have located the documents that outline your development rules and identified the authorities responsible for development in your community, you are ready for the next step. You can now use the worksheet to compare your development rules to the model development principles. The worksheet is presented at the end of this chapter. The worksheet presents seventy-seven site planning benchmarks. The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. You should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule. The questions require either a yes or no response or specific numeric criteria. If your development rule agrees with the site planning benchmark, you are awarded points.

Calculating Your Score

A place is provided on each page of the worksheet to keep track of your running score. In addition, the worksheet is subdivided into three categories:

- Residential Streets and Parking Lots (Principles No. 1 - 10)
- Lot Development (Principles No. 11 - 16)
- Conservation of Natural Areas (Principles No. 17 - 22).

For each category, you are asked to subtotal your score. This “Time to Assess” allows you to consider which development rules are most in line with the site planning benchmarks and what rules are potential candidates for change.

The total number of points possible for all of the site planning benchmarks is 100. Your overall score provides a general indication of your community's ability to support environmentally sensitive development. As a general rule, if your overall score is lower than 80, then it may be advisable to systematically reform your local development rules. A score sheet is provided at end of the Code and Ordinance Worksheet to assist you in determining where your community’s score places in respect to the Model Development Principles. Once you have completed the worksheet, go back and review your responses. Determine if there are specific areas that need improvement (e.g., development rules that govern road design) or if your development rules are generally pretty good. This review is key to implementation of better development: assessment of your current development rules and identification of impediments to innovative site design. This review also directly leads into the next step: a site planning roundtable process conducted at the local government level. The primary tasks of a local roundtable are to systematically review existing development rules and then determine if changes can or should be made. By providing a much-needed framework for overcoming barriers to better development, the site planning roundtable can serve as an important tool for local change.

Table 2: Local, State, and Federal Authorities Responsible for Development in Your Community			
Development Responsibility	State/Federal	County	Town
Sets road standards	Agency:		
	Contact Name:		
	Phone No.:		
Review/approves subdivision plans	Agency:		
	Contact Name:		
	Phone No.:		
Establishes zoning ordinances	Agency:		
	Contact Name:		
	Phone No.:		
Establishes subdivision ordinances	Agency:		
	Contact Name:		
	Phone No.:		
Reviews/establishes stormwater management or drainage criteria	Agency:		
	Contact Name:		
	Phone No.:		
Provides fire protection and fire protection code enforcement	Agency:		
	Contact Name:		
	Phone No.:		
Oversees buffer ordinance	Agency:		
	Contact Name:		
	Phone No.:		
Oversees wetland protection	Agency:		
	Contact Name:		
	Phone No.:		
Establishes grading requirements or oversees erosion and sediment control program	Agency:		
	Contact Name:		
	Phone No.:		
Reviews/approves septic systems	Agency:		
	Contact Name:		
	Phone No.:		
Review/approves utility plans (e.g., water and sewer) , including stormwater utility	Agency:		
	Contact Name:		
	Phone No.:		
Reviews/approves forest conservation/ tree protection plans	Agency:		
	Contact Name:		
	Phone No.:		

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Development Feature	*Your Local Criteria*

1. Street Width

a. What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)? _____ feet

If your answer is between 18-22 feet, give yourself 4 points 0

b. At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)? NO

If your answer is YES, give yourself 3 points 0

Notes on Street Width (include source documentation such as name of document, section and page #):
Section 17.35(3)(d)9.c.I – Mobile Home Parks only (18' for 2-way). What are The Urban and Rural Standards 18.07(3)(d)1.?

2. Street Length

a. Do street standards promote the most efficient street layouts that reduce overall street length? YES

If your answer is YES, give yourself 1 point 1

Notes on Street Length (include source documentation such as name of document, section and page #):
Section 18.07(3)(c)

3. Right-of-Way Width

a. What is the minimum right of way (ROW) width for a residential street? ___66____ feet

If your answer is less than 45 feet, give yourself 3 points 0

b. Does the code allow utilities to be placed under the paved section of the ROW? YES

If your answer is YES, give yourself 1 point 1

Notes on ROW Width (include source documentation such as name of document, section and page #):
Width - Section 17.35(3)(d)9.c.II – Mobile Home Parks only. Use - Section 12.14(22)(d)

4. Cul-de-Sacs

a. What is the minimum radius allowed for cul-de-sacs? _____ feet

If your answer is less than 35 feet, give yourself 3 points
If your answer is 36 feet to 45 feet, give yourself 1 point 0

b. Can a landscaped island be created within the cul-de-sac? NO

If your answer is YES, give yourself 1 point 0

c. Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments? NO

If your answer is YES, give yourself 1 point 0

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):
Cul-de-sacs only mentioned in the definitions under Street Section 1(7)c

Code and Ordinance Worksheet *Subtotal Page 5* 2

Development Feature	*Your Local Criteria*

5. Vegetated Open Channels

a. Are curb and gutters required for most residential street sections?	YES
If your answer is NO, give yourself 2 points	0
b. Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?	NO
If your answer is YES, give yourself 2 points	0

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):
Section 18.08(3) – C&G Required Improvement, rural section requires City Council approval.

6. Parking Ratios

a. What is the minimum parking ratio for a professional office building (per 1000 ft^2 of gross floor area)?	____5____ spaces
If your answer is less than 3.0 spaces, give yourself 1 point	0
b. What is the minimum required parking ratio for shopping centers (per 1,000 ft^2 gross floor area)?	____5____ spaces
If your answer is 4.5 spaces or less, give yourself 1 point	0
c. What is the minimum required parking ratio for single family homes (per home)?	____2___ spaces
If your answer is less than or equal to 2.0 spaces, give yourself 1 point	1
d. Are your parking requirements set as maximum or median (rather than minimum) requirements?	NO
If your answer is YES, give yourself 2 points	0

Notes on Parking Ratios (include source documentation such as name of document, section and page #):
Questions 6 through 10 in Sections 17.39 and 17.40

7. Parking Codes

a. Is the use of shared parking arrangements promoted?	YES
If your answer is YES, give yourself 1 point	1
b. Are model shared parking agreements provided?	YES
If your answer is YES, give yourself 1 point	1
c. Are parking ratios reduced if shared parking arrangements are in place? *With alternating time of use*	YES
If your answer is YES, give yourself 1 point	1
d. If mass transit is provided nearby, is the parking ratio reduced?	NO
If your answer is YES, give yourself 1 point	0

Notes on Parking Codes (include source documentation such as name of document, section and page #):
Questions 6 through 10 in Sections 17.39 and 17.40

Code and Ordinance Worksheet	*Subtotal Page 6*	4

Development Feature	*Your Local Criteria*

8. Parking Lots

a. What is the minimum stall width for a standard parking space? ____10____ feet

If your answer is 9 feet or less, give yourself 1 point 0

b. What is the minimum stall length for a standard parking space? ____18____ feet

If your answer is 18 feet or less, give yourself 1 point 1

c. Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars? NO

If your answer is YES, give yourself 1 point 0

d. Can pervious materials be used for spillover parking areas? Section 17.39 (8) – does 'hard surfaced' preclude pervious pavements NO

If your answer is YES, give yourself 2 points 0

Notes on Parking Lots (include source documentation such as name of document, section and page #):
Questions 6 through 10 in Sections 17.39 and 17.40

9. Structured Parking

a. Are there any incentives to developers to provide parking within garages rather than surface parking lots? NO

If your answer is YES, give yourself 1 point 0

Notes on Structured Parking (include source documentation such as name of document, section and page #):
Questions 6 through 10 in Sections 17.39 and 17.40

10. Parking Lot Runoff

a. Is a minimum percentage of a parking lot required to be landscaped? NO

If your answer is YES, give yourself 2 points 0

b. Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed? NO

If your answer is YES, give yourself 2 points 0

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):
Questions 6 through 10 in Sections 17.39 and 17.40

Code and Ordinance Worksheet *Subtotal Page 7* 1

Development Feature	*Your Local Criteria*

Time to Assess: Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of 40 points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 ___2_ + Subtotal Page 6 __4_ + Subtotal Page 7 _1_ = 7

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

In-line: Parking code

Potential Impediments: Street width/ROW, curb and gutter requirement

Potential Impediments: Parking lot runoff management

11. Open Space Design

a. Are open space or cluster development designs allowed in the community? YES
If your answer is YES, give yourself 3 points
If your answer is NO, skip to question No. 12 3

b. Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance? NO
If your answer is YES, give yourself 1 point 0

c. Are the submittal or review requirements for open space design greater than those for conventional development? YES
If your answer is NO, give yourself 1 point 0

d. Is open space or cluster design a by-right form of development? NO
If your answer is YES, give yourself 1 point 0

e. Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes) YES
If your answer is YES, give yourself 2 points 2

Notes on Open Space Design (include source documentation such as name of document, section and page #):
Section 17.02(2), Section 17.10(3), Section 17.28(1)+(4), Section 18.16(1), Section 18.07(3)(c)1+(5)(a) – These sections provide encouragement and some flexibility, but a lot of weight is put on the City Council for defining the actual flexibility for open space design. No direct encouragement (or definition) of cluster development is provided.

Code and Ordinance Worksheet *Subtotal Page 8* 5

Development Feature	Your Criteria	Local

12. Setbacks and Frontages

a. Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community? YES

If your answer is YES, give yourself 1 point 1

b. What is the minimum requirement for front setbacks for a one half (½) acre residential lot? ____25____ feet

If your answer is 20 feet or less, give yourself 1 point 0

c. What is the minimum requirement for rear setbacks for a one half (½) acre residential lot? ____25____ feet

If your answer is 25 feet or less, give yourself 1 point 1

d. What is the minimum requirement for side setbacks for a one half (½) acre residential lot? _____8___ feet

If your answer is 8 feet or less, give yourself 1 points 1

e. What is the minimum frontage distance for a one half (½) acre residential lot? ____80____ feet

If your answer is less than 80 feet, give yourself 2 points 0

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):
Question 12a. Section 17.08 lot line rear, lot width-min + Section 17.25-17.27(5)(a); Question 12b. Section 17.25-17.27(5)(b), Section 17.35(3)(d)(3)

13. Sidewalks

a. What is the minimum sidewalk width allowed in the community? _____ feet

If your answer is 4 feet or less, give yourself 2 points 0

b. Are sidewalks always required on both sides of residential streets? NO

If your answer is NO, give yourself 2 points 2

c. Are sidewalks generally sloped so they drain to the front yard rather than the street? NO

If your answer is YES, give yourself 1 point 0

d. Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)? NO

If your answer is YES, give yourself 1 point 0

Notes on Sidewalks (include source documentation such as name of document, section and page #):
Sidewalk 17.35 (Mobile home Park) width may be determined by City Council, Section 8.02 & Section 18.08(5)

14. Driveways

a. What is the minimum driveway width specified in the community? ____N/A____ feet

If your answer is 9 feet or less (one lane) or 18 feet (two lanes), give yourself 2 points 0

Code and Ordinance Worksheet *Subtotal Page 9* 5

b. Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)? NO

Development Feature	*Your Local Criteria*
If your answer is YES, give yourself 2 points	0
c. Can a "two track" design be used at single family driveways?	NO
If your answer is YES, give yourself 1 point	0
d. Are shared driveways permitted in residential developments?	NO
If your answer is YES, give yourself 1 point	0

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

a. Does the community have enforceable requirements to establish associations that can effectively manage open space?	YES
If your answer is YES, give yourself 2 points	2
b. Are open space areas required to be consolidated into larger units?	NO
If your answer is YES, give yourself 1 point	0
c. Does a minimum percentage of open space have to be managed in a natural condition?	NO
If your answer is YES, give yourself 1 point	0
d. Are allowable and unallowable uses for open space in residential developments defined?	YES
If your answer is YES, give yourself 1 point	1
e. Can open space be managed by a third party using land trusts or conservation easements?	YES
If your answer is YES, give yourself 1 point	1

Notes on Open Space Management (include source documentation such as name of document, section and page #):
Section 17.28(9)(b)

16. Rooftop Runoff

a. Can rooftop runoff be discharged to yard areas?	YES
If your answer is YES, give yourself 2 points	2
b. Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops?	YES
If your answer is YES, give yourself 2 points	2

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):
Section 17.28(10)(b)7.a

Code and Ordinance Worksheet	*Subtotal Page 10*	8

Time to Assess: Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of 36 points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 _5_ + Subtotal Page 9 __5__ + Subtotal Page 10 __8_ = 18

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

In-line: Open Space Design & Management

In-line: Open Rooftop runoff management

Potential impediment: Driveways and sidewalk regulations

17. Buffer Systems

a. Is there a stream (*shoreland*) buffer ordinance in the community? YES

If your answer is YES, give yourself 2 points 2

b. If so, what is the minimum buffer width? _____35__ feet

If your answer is 75 feet or more, give yourself 1 point 0

c. Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required? NO

If your answer is YES, give yourself 1 point 0

Notes on Buffer Systems (include source documentation such as name of document, section and page #):
Section 17.36(8)

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

a. Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation? Defined as '*natural*' not '*native*' NO

If your answer is YES, give yourself 2 points 0

b. Does the stream buffer ordinance outline allowable uses? NO

If your answer is YES, give yourself 1 point 0

Code and Ordinance Worksheet *Subtotal Page 11* 2

c. Does the ordinance specify enforcement and education mechanisms? NO

If your answer is YES, give yourself 1 point 0

Development Feature	*Your Local Criteria*

Notes on Buffer Systems (include source documentation such as name of document, section and page #):
Section 17.36(8)

19. Clearing and Grading

a. Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites? YES

If your answer is YES, give yourself 2 points 2

b. Do reserve septic field areas need to be cleared of trees at the time of development? YES

If your answer is NO, give yourself 1 point 0

Notes on Clearing and Grading (include source documentation such as name of document, section and page #):
Question 19a. Section 18.07(3)(d)2+(4)(d) provides encouragement but not requirement; Question 19b. Section 13.02(4)

20. Tree Conservation

a. If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved? NO

If your answer is YES, give yourself 2 points 0

b. Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction? YES

If your answer is YES, give yourself 1 point 1

Notes on Tree Conservation (include source documentation such as name of document, section and page #):
Section 18.07(3)(d)2+(4)(d) provides accommodation for natural areas, but firm requirements are not made.

21. Land Conservation Incentives

a. Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)? NO

If your answer is YES, give yourself 2 points 0

b. Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers? NO

If your answer is YES, give yourself 2 points 0

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):
Question 21.b: Section 17.02(2), Section 17.10(3), Section 17.28(1)+(4), Section 18.16(1), Section 18.07(3)(c)1+(5)(a) – These sections provide some flexibility in design for conservation, but conservation 'restrictions' tend not to be firm and, therefore, demand for flexibility from them is not there.

Code and Ordinance Worksheet *Subtotal Page 12* 3

22. Stormwater Outfalls

a. Is stormwater required to be treated for quality before it is discharged? NO

If your answer is YES, give yourself 2 points 0

Development Feature	*Your Local Criteria*
b. Are there effective design criteria for stormwater best management practices (BMPs)?	NO
If your answer is YES, give yourself 1 point	0
c. Can stormwater be directly discharged into a jurisdictional wetland without pretreatment?	YES
If your answer is NO, give yourself 1 point	0
d. Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist?	YES
If your answer is YES, give yourself 2 points	2

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):
Section 18.08(7), Chapter 19

Code and Ordinance Worksheet *Subtotal Page 13* 2

Time to Assess: Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 __2_ + Subtotal Page 12 __3__ + Subtotal Page 13 __2_ = 7

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

In-line: Clearing & Grading (preservation of natural vegetation)

In-line: Use of Buffer Systems

Potential impediment: Lack of buffer maintenance

Potential impediment: Lack of Land Conservation Incentives

To determine final score, add up subtotal from each Time to Assess

Principles 1 - 10 (Page 8)	7
Principles 11 - 16 (Page 11)	18
Principles 17 - 22 (Page 13)	7
TOTAL	32

There could be additional 26 points if sufficient information finds red highlighted items to be in line with the principles.

SCORING (A total of 100 points are available):	
Your Community's Score	
90- 100	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 - 89	Your local development rules are pretty good, but could use some tweaking in some areas.
79 - 70	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 - 69	Development rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
less than 60	Your development rules definitely are not environmentally friendly. Serious reform of the development rules is needed.

APPENDIX C: POTENTIAL GRANT SOURCES

The following document contains a more detailed description of each grant as prepared by Harmony Environmental in the context of the Library Bay Restoration Project. Grants are grouped by phases of that project but the phases relate to the potential work in this citywide implementation plan. Ordinance development is not explicitly identified herein but is an eligible project for many of the grants including Lake Protection Grants and Lake Management Planning Grants.

Library Bay Restoration Project
Potential Grant Projects and Sources 2010-11

Phase 1
Property acquisition for stormwater ponds
Stormwater pond design and installation
Phase 2
Dredging to remove accumulated sediments from storm sewer outfalls
Phase 3
Floodplain analysis and flood control
Phase 4
Park land acquisition, planning and facilities (trails, public facilities, handicap access)
Phase 5
Bridge design and replacement

Phase 1. First step = property acquisition

Most likely grant sources:
Urban Nonpoint Source Construction Grant
Application deadline: April 15, 2010
City is eligible applicant

Targeted Runoff Management Grant
Application deadline: April 15, 2010
Lake District can apply
May be beneficial to have pond design completed

Lake Protection Grants
Application deadline: May 1, 2010
Would be beneficial to have approved "lake management plan," pond design, and predicted TSS and P reductions from stormwater ponds

Acquisition and Development of Local Parks (Stewardship)
Application deadline: May 1, 2010
City is eligible applicant
Land donation may be used as match for the acquisition

Charitable donations of land and buildings

Phase 1

PROPERTY ACQUISITION FOR STORMWATER PONDS
STORMWATER POND DESIGN AND INSTALLATION[1]

Grant Program: Urban Nonpoint Source Construction Grant
Wisconsin Department of Natural Resources
Program Goals/Objectives: Improve urban water quality by limiting or ending sources of urban nonpoint source (run-off) pollution
Eligible Applicants: Cities, towns, villages, counties, and tribes
Eligible Project Elements: Land acquisition for stormwater ponds; stormwater pond design and installation. Dredging is not an eligible activity.
Funding Rates and Limits: up to 50% to construct Best Management Practices (BMP), maximum of $200,000 ($150,000 for construction activities and $50,000 for land acquisition or easements)
Application Deadline: April 15th of each year
Contact: Tim Parsons, WI DNR Bureau of Community Financial Assistance at 608-267-9385 or Timothy.Parsons@Wisconsin.gov, Kathleen Thompson, WI DNR Bureau of Watershed Management at 608-267-7568 or Kathleen.Thompson@Wisconsin.gov
Website: http://www.dnr.state.wi.us/Org/caer/cfa/ef/nps/urbannps.html
Comments/Concerns: Stormwater planning projects must currently be in an urban area or an area projected to be urban within 20 years to be eligible for funding under this program.
An "urban project area" must meet one of these criteria:
* Has a population density of at least 1,000 people per square mile.
* Has a commercial land use.
* Is the non-permitted portion of a privately owned industrial site.
* Is a municipally-owned industrial site (regardless of ch. NR 216 permit requirements).

Grant Program: Targeted Runoff Management Grant
Wisconsin Department of Natural Resources
Program Goals/Objectives: Control polluted runoff from both urban and rural sites
Eligible Applicants: Cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose districts such as lake, sewerage, and sanitary districts
Eligible Project Elements: Property acquisition for stormwater ponds; stormwater pond design and installation
Funding Rates and Limits: up to 70% of project costs, not to exceed $150,000
Application Deadline: generally April 15th of each year

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[1] **A note about acquisition grants**: Grant projects offer revenue to preserve conservation features or properties. They are highly competitive, and awards are generally given only where considerable work is already completed to clearly frame and commit a project. This work requires investment for initial steps such as surveys, appraisals, preliminary landowner approval, development of conservation easement requirements, and grant writing. While many of these costs are reimbursable expenses under the grant, grants are certainly not guaranteed. Allowing unrestricted public access increases grant funding possibilities.

Contact: Kathleen Thompson, WI DNR Bureau of Watershed Management at 608-267-7568 or Kathleen.Thompson@Wisconsin.gov
Website: http://dnr.wi.gov/runoff/grants/trm.htm
Comments/Concerns:
TRM grants support small-scale, 2-year projects.

Grant Program: Lake Protection Grants
Wisconsin Department of Natural Resources
Program Goals/Objectives: Protect and improve the water quality of lakes and their ecosystems
Eligible Applicants: Counties, towns, cities, villages, tribes, qualified lake associations, public inland lake districts, qualified nonprofit conservation organizations, town sanitary districts, and other local governmental units
Eligible Project Elements: Property acquisition for stormwater ponds; stormwater pond design and installation
Funding Rates and Limits: up to 70% of project costs, not to exceed $200,000
Application Deadline: May 1, 2010
Contact: Pamela Toshner, WI DNR Regional Lake Coordinator at 715-635-4073,
Jane Malischke, WI DNR Regional Environmental Grants Specialist at 715-635-4062
Website: http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/lakeprotection.html
Concerns: Stormwater pond design and installation funding requires an approved lake management plan. Dredging is not an eligible activity under the lake protection or aquatic invasive species grant programs.

Grant Program: Lake Management Planning Grant
Wisconsin Department of Natural Resources
Program Goals/Objectives: More effective watershed protection and lake management
Eligible Applicants: General-purpose units of government (county, town, city or village), not-for-profit conservation organizations, town sanitary districts, lake districts, and qualifying lake associations
Eligible Project Elements: Studying Library Bay water quality, fish and wildlife habitat, and watershed and recommend a course of action.
Funding Rates and Limits: 75% of project costs (up to $3,000 for small-scale projects and 10,000 for large-scale projects, up to 2 large scale projects for each application period)
Application Deadline: February 1st and August 1st each year
Contact: Pam Toshner, WDNR Regional Lake Coordinator at 715-635-4073,
Jane Malischke, WI DNR Regional Environmental Grants Specialist at 715-635-4062
Website: www.uwex.edu/erc/pdf/AI/LakePlanningGrants.pdf
Comments: Approved lake management plans are eligible for lake protection grant funding.

Grant Program: Community Development Block Grant Planning Grant Program
Wisconsin Department of Commerce
Program Goals/Objectives: Help communities develop clear and actionable strategies for addressing specific site, neighborhood, community or regional economic or development needs and to improve the quality of community or economic development projects by helping to fund local plans
Eligible Applicants: Non-entitlement units of local government (city, county, village, or town)
Eligible Project Elements: Planning for stormwater ponds; park facilities
Funding Rates and Limits: 50% matching
Application Deadline: Available on a continuous basis until available funds are committed
Contact: Doug Thurlow at 608-266-7942 or Douglas.Thurlow@Wisconsin.gov
Website: http://commerce.wi.gov/cd/CD-bcf-cdbg-pLNN.html
Comments/Concerns: Communities must have a population under 50,000. At least 51 percent of the persons who would benefit from implementation of the plan must be low or moderate-income persons. The plan must address a slum or blighted area in the community.

Grant Program: Community Development Block Grant for Public Facilities
Wisconsin Department of Commerce
Program Goals/Objectives: Enhance the vitality of a community by undertaking public investment that contributes to its overall community and economic development. Project may involve public infrastructure, community facilities and down town revitalization.
Eligible Applicants: Non-entitlement units of local government (city, county, village, or town)
Eligible Project Elements: Stormwater ponds; park facilities
Funding Rates and Limits: Maximum of $750,000 (average is less than $500,000 or 50% of project costs)
Application Deadline: Available on a continuous basis until available funds are committed
Contact: Sandy Herfel at 608-266-2435 or sandra.herfel@wisconsin.gov, Darlene Moss at 608-266-7998 or darlene.moss@wisconsin.gov, Jason Scott at 608-261-7714 or jason.scott@wisconsin.gov
Website: http://commerce.wi.gov/cd/cd-bcf-cdbg-pf.html
Comments: Downtown revitalization projects require participation in the Wisconsin Main Street Program or completion of a comprehensive downtown revitalization planning process.

Loan Program: Clean Water Fund Program
Wisconsin Department of Natural Resources
Program Goals/Objectives: Provide loans to municipalities for wastewater treatment and urban storm water projects
Eligible Applicants: Municipalities such as the City of Cumberland
Eligible Project Elements: Property acquisition for stormwater ponds; stormwater pond design and installation

Funding Rates and Limits: Projects qualify for a subsidized interest rate of 55%, 65%, or 70% of the Environmental Improvement Fund (EIF) market interest rate. Projects may be eligible to receive Hardship Financial Assistance, which may be in the form of a lower interest rate loan or include a grant.
Application Deadline: Intent to Apply (ITA) form due December 31st of each year
Contact: Dan Olson, Financial Assistance Specialist at 608-267-7475 or Daniel.Olson@Wisconsin.gov
Website: http://www.dnr.state.wi.us/Org/caer/cfa/EL/section/clean.html

Loan Program: Clean Water Fund Small Loan Program
Wisconsin Department of Natural Resources
Program Goals/Objectives: Planning, design, and construction of wastewater treatment facilities or structural urban BMPs for storm water
Eligible Applicants: Municipalities such as the City of Cumberland
Eligible Project Elements: Property acquisition for stormwater ponds; stormwater pond design and installation
Funding Rates and Limits: Projects with a maximum total cost of $1,000,000 qualify for a subsidized interest rate of 55%, 65%, or 70% of the Environmental Improvement Fund (EIF) market interest rate
Application Deadline: Intent to Apply (ITA) form due December 31st of each year
Contact: Dan Olson, Financial Assistance Specialist at 608-267-7475 or Daniel.Olson@Wisconsin.gov
Website: http://www.dnr.state.wi.us/Org/caer/cfa/EL/section/small.html
Comments/Concerns: This is a subprogram of the Clean Water Fund Program, and streamlines the loan process for projects under $1,000,000. It does not, however, offer the CWFP's "hardship assistance."

Phase 2

DREDGING TO REMOVE ACCUMULATED SEDIMENTS FROM STORM SEWER OUTFALLS

Grant Program: Recreational Boating Facilities
Wisconsin Waterways Commission
Program Goals/Objectives: Maintain and improve opportunities for recreational boating in Wisconsin waters
Eligible Applicants: Counties, towns, cities, villages, tribes, sanitary districts, public inland lake protection and rehabilitation districts, and qualified lake associations
Eligible Project Elements: Dredging to create navigational channels, boat landing improvements
Funding Rates and Limits: up to 50% of eligible project costs plus an additional 30% for projects that meet state and/or regional Waterways Commission requirements
Application Deadline: Established quarterly
Contact: Diane Conklin, Department of Natural Resources, 715-822-8583
Website: http://www.dnr.state.wi.us/org/caer/cfa/Grants/recboat.html

Note that remaining sources listed below involve wetland and habitat restoration. Caution: dredging is among the most expensive of wetland restoration techniques and may not be supported by these programs. Wildlife benefits and habitat improvements would need to be demonstrated for successful applications.

Grant Program: North American Wetland Conservation Act (Federal)
Program Goals/Objectives: Long-term enhancement of wetlands for the benefit of wetlands-associated migratory birds and other wildlife
Eligible Applicants: Local conservation groups
Eligible Project Elements: Wetland and habitat restoration
Funding Rates and Limits: 50% up to $75,000
Application Deadline: March 6 and July 31, 2009 (Standard Grants), October 31, 2009 (Small Grants)
Contact: Division of Bird Habitat Conservation at 703-358-1784 or dbhc@fws.gov, Tim Grunewald, WDNR Wetland Habitat Specialist at 608-264-6137 or Tim.Grunewald@dnr.state.wi.us, Barb Pardo, Joint Venture Coordinator at 612-713-5433
Website: http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm
Comments/Concerns: Since this is a federal program, state grant money could be used as match. Would need to identify benefit of the project to migratory birds.

Grant Program: Five-Star Restoration Program
US Environmental Protection Agency
Program Goals/Objectives: Provide environmental education and training through projects that restore streambanks and wetlands
Eligible Applicants: Conservation organizations, state and federal resource management agencies, among others
Eligible Project Elements: Wetland restoration
Funding Rates and Limits: $5,000 to $20,000 (avg. 10,000) per project

Application Deadline: Mid-February each year
Contact: Myra Price at 202-566-1225 or price.nyra@epa.gov
Website: http://www.epa.gov/owow/wetlands/restore/5star/
Comments: Look for diverse partnerships (5 or more)

Grant Program: Pulling Together Initiative
National Fish and Wildlife Foundation
Program Goals/Objectives: Control noxious plants through management, removal, and/or public awareness efforts
Eligible Applicants: Public/private partnership team: non-profit corporations, local and state government agencies
Eligible Project Elements: Removing invasive plants such as purple loosestrife
Funding Rates and Limits: 50% match, $10,000 to $100,000 (avg. $33,000)
Application Deadline: Preproposal: June 30, 2009, Full Proposal: Sept. 30, 2009
Contact: Ellen Gabel, Program Director, National Wildlife Refuge Programs
Ellen.Gabel@nfwf.org
Website: http://www.nfwf.org/AM/Template.cfm?Section=Charter_Programs_List&TEMPLATE=/CM/HTMLDisplay.cfm&CONTENTID=12935
Comment: Should be coordinated with the Lake District's Aquatic Plant Management Plan.

Grant Program: Wildlife Forever Challenge Grants
Program Goals/Objectives: Conservation projects such as habitat restoration and acquisition, research and management, and educational projects
Eligible Applicants: Non-profit conservation organizations and government agencies
Eligible Project Elements: Wetland and habitat restoration
Funding Rates and Limits: 50% match, $1,000 to $10,000
Application Deadline: January 1st and July 1st each year
Contact: Pat Conzemius at 763-253-0222 or
http://www.wildlifeforever.org/about/contact.aspx
Website: http://www.wildlifeforever.org/grants/overview.aspx
Comments: With challenge grants, funds must be matched on at least a one-to-one basis from a third-party donor and sent through Wildlife Forever.

Grant Program: Private Stewardship Grants Program
US Fish and Wildlife Service
Program Goals/Objectives: Support voluntary conservation efforts on private land for the benefit of imperiled (federally listed) species and state listed species
Eligible Applicants: Individuals or groups
Eligible Project Elements: Wetland and habitat restoration
Funding Rates and Limits: up to 90% of project costs (avg. $72,000)
Application Deadline: to be determined
Contact: Peter Fasbender at 612-713-5343
Website: http://www.fws.gov/endangered/grants/private_stewardship/
Comments: Land is not anticipated to be private. There are no known endangered or state special concern species present in Library Bay.

Phase 3. Restore Native Hydrology

FLOODPLAIN ANALYSIS AND FLOOD CONTROL

Grant Program: Municipal Flood Control Grants
Wisconsin Department of Natural Resources
Program Goals/Objectives: Municipal flood control management to protect life, health, and property from flood damages
Eligible Applicants: Cities, villages, towns, tribal governments, and metropolitan sewerage districts
Eligible Project Elements: Floodplain analysis and flood control
Funding Rates and Limits: up to 70% of project costs
Application Deadline: dependent on issuance of next round of grant applications
Contact: Jeffrey K. Soellner, DNR Grant Program Manager at 608-267-7152 or jeffrey.soellner@wisconsin.gov
Website: http://www.dnr.state.wi.us/org/caer/cfa/Ef/flood/grants.html
Comments/Concerns: Assistance is provided with the availability of Acquisition and Development grants to purchase property or vacant land, structure removal, construction or other development costs and with Local Assistance Grants for providing administrative support activities.

Phase 4.

PARKLAND ACQUISITION, PLANNING, AND FACILITIES (TRAILS, PUBLIC FACILITIES, HANDICAP ACCESS)

Grant Program: Acquisition and Development of Local Parks (Stewardship)
Wisconsin Department of Natural Resources
Program Goals/Objectives: Expand opportunities for nature-based outdoor recreation
Eligible Applicants: Non-profit organizations (acquisitions only), local governments (acquisition and park development)
Eligible Project Elements: Property acquisition and park development (trails, restroom facilities, handicap access)
Funding Rates and Limits: 50% funding of appraised value
Application Deadline: May 1st of each year
Contact: Pat Zatopa, Community Services Specialist at 715-365-8928 or patricia.zatopa@Wisconsin.Gov
Website: http://dnr.wi.gov/org/caer/cfa/LR/stewardship/localparks.html
Comments/Concerns:

- Park development would require partnering with a local government such as the City of Cumberland or Barron County.
- Land donation may be used as match for the acquisition.
- Federal dollars for outdoor recreation are also funneled through the Stewardship program to local government. The Land and Water Conservation Fund and Recreational Trails Act have similar goals and eligible elements.

Grant Program: Acquisition of Development Rights (Stewardship)
Wisconsin Department of Natural Resources
Program Goals/Objectives: Protect natural, agricultural, or forestry values that would enhance nature based outdoor recreation
Eligible Applicants: Local government
Eligible Project Elements: Purchase of development rights (conservation easements) for park
Funding Rates and Limits: 50% funding of appraised value
Application Deadline: May 1st of each year
Contact: Pat Zatopa, Community Services Specialist at 715-365-8928 or patricia.zatopa@Wisconsin.Gov
Website: http://dnr.wi.gov/org/caer/cfa/lr/stewardship/developrights.html

Grant Program: Land and Water Conservation Fund
Wisconsin Department of Natural Resources
Program Goals/Objectives: Create parks and open spaces, protect wilderness, wetlands, and refuges, preserve wildlife habitat, and enhance recreational opportunities
Eligible Applicants: Counties, cities, villages, towns, school districts, and Indian tribes
Eligible Project Elements: Park planning; Park facilities (trails public facilities, handicap access); Boat landing
Funding Rates and Limits: up to 50% of project costs
Application Deadline: May 1st of each year
Contact: Leslie Gauberti, Land & Water Conservation Fund Program Manager, Bureau of Community Financial Assistance at 267-0497 or leslie.gauberti@dnr.state.wi.us, Pat Zatopa, Community Services Specialist at 715-365-8928 or patricia.zatopa@Wisconsin.Gov
Website: http://dnr.wisconsin.gov/org/caer/cfa/Grants/LWCF/provisions.html

Grant Program: Recreational Trails Program
Wisconsin Department of Natural Resources
Program Goals/Objectives: Assist local communities and trails groups in the development, maintenance, or rehabilitation of recreational trails
Eligible Applicants: Incorporated organizations whose purpose includes trail promotion and development, local governments including Barron County
Eligible Project Elements: Acquisition of land or easements for trails; Trail construction; Development of trailhead and trailside facilities
Funding Rates and Limits: 50% funding
Application Deadline: May 1st of each year
Contact: Pat Zatopa, Community Services Specialist at 715-365-8928 or patricia.zatopa@Wisconsin.Gov
Website: http://www.dnr.state.wi.us/org/caer/cfa/BUREAU/staff.html#region
Comments/Concerns:

- Federal dollars for outdoor recreation are also funneled through the Stewardship program to local government. The Land and Water Conservation Fund has similar goals and eligible elements.

- Trails must be tied to a local outdoor recreation plan developed by the project sponsor.

Kodak American Greenways Grants
Program Goals/Objectives: Stimulate planning and design of green communities throughout America
Eligible Applicants: Local, regional, or statewide non-profit organizations
Eligible Project Elements: Park planning and design; Park trail construction
Funding Rates and Limits: $2,500 maximum (avg. $500 to $1,000)
Application Deadline: accepted March 1st through June 1st each year (extended to July 15th in 2009)
Contact: 703-525-6300 or kodakawards@conservationfund.org
Comments: On-line application, supporting materials mailed

Grant Program: Multimodal Improvement Program—Local Transportation Enhancements Grant
Wisconsin Department of Transportation
Program Goals/Objectives: Increase multi-modal transportation alternatives and enhance communities and the environment
Eligible Applicants: Local governments with taxing authority, state agencies and Indian tribes
Eligible Project Elements: Park trails
Funding Rates and Limits: up to 80% of project costs
Application Deadline: April of even-numbered years
Contact: John Duffe at 608-264-8723 or john.duffe@dot.state.wi.us
Website: http://www.dot.wisconsin.gov/localgov/aid/te.htm

Grant Program: Multimodal Improvement Program—Surface Transportation Discretionary Program
Wisconsin Department of Transportation
Program Goals/Objectives: Foster alternatives to single-occupancy vehicles such as bike and pedestrian facilities or plans, the purchase of transit vehicles for new services and other Transportation Demand Management projects
Eligible Applicants: Local governments with taxing authority, state agencies and Indian tribes
Eligible Project Elements: Park trails
Funding Rates and Limits: to be determined
Application Deadline: to be determined
Contact: John Duffe at 608-264-8723 or john.duffe@dot.state.wi.us
Website: http://www.dot.wisconsin.gov/localgov/aid/stp-discretionary.htm
Comments/Concerns: Funding for the STP-D program was eliminated in the 2003-05 state budget and again for the 2005-07 biennial budget.

Loan Program: State Trust Fund Loan Program
Board of Commissioners of Public Lands
Program Goals/Objectives: Support community and school projects
Eligible Applicants: Wisconsin school districts, federated library systems, counties, cities, villages, towns, technical college districts, metropolitan sewerage districts, town sanitary districts, public inland lake protection and rehabilitation districts, and drainage districts
Eligible Project Elements: Park planning; Park trails, facilities, and handicap accessibility; Boat landing; Bridge design and replacement
Funding Rates and Limits: $2,500,000 annual borrowing limit. Public purpose loans excluding those used to refinance an unfunded pension liability: 3.50% for loans up to five years in term, 4.50% for loans over five years and up to ten years in term, and 5.50% for loans over ten years, up to twenty years in term. Loans used to refinance an unfunded pension liability: 4.25% for loans up to five years in term. 5.25% for loans over five years and up to ten years in term. 6.25% for loans over ten years, up to twenty years in term.
Application Deadline: N/A
Contact: Loan Program Information: 608.266.0034, Scott Eastwood, Loan Analyst at 608.261.8001 or Scott.Eastwood@wisconsin.gov
Website: http://bcpl.wisconsin.gov/section.asp?linkid=1438&locid=145

Grant Program: Partners for Fish and Wildlife Program
U.S. Fish and Wildlife Service
Program Goals/Objectives: Fish management projects such as land acquisition, habitat restoration and development, aquatic education, public fishing piers and shorefishing, fish propagation and stocking, and research
Eligible Applicants: local units of government
Eligible Project Elements: public fishing pier
Funding Rates and Limits: varies
Application Deadline: to be determined
Contact: Pat Zatopa, Community Services Specialist at 715-365-8928 or patricia.zatopa@Wisconsin.Gov
Website: http://www.dnr.state.wi.us/org/caer/cfa/grants/sportfish.html
Comments/Concerns: The DNR may negotiate contracts and financial assistance agreements with local units of government to renovate or construct boat access sites and construct fishing piers and shorefishing opportunities. Interested local units of government that have potential projects should contact their Regional DNR Community Services Specialist.

Phase 5.

BRIDGE DESIGN AND REPLACEMENT

Grant Program: Local Bridge Improvement Assistance
Wisconsin Department of Transportation
Program Goals/Objectives: To help rehabilitate and replace the most seriously deficient existing local bridges on Wisconsin's local highway systems
Eligible Applicants: Counties, cities, villages, and towns
Eligible Project Elements: Bridge design and replacement
Funding Rates and Limits: cost share
Application Deadline: N/A
Contact: Michael Erickson at 608-266-0194 or michael.erickson@dot.wi.gov
Website: http://www.dot.wisconsin.gov/localgov/highways/bridgeprogram.htm
Comments/Concerns: Rehabilitation funding on bridges with sufficiency ratings of 80 or less, and replacement funding on bridges with sufficiency ratings less than 50

RELATED GRANTS

Job Creation

Grant Program: Community Development Block Grant Public Facilities for Economic Development

Wisconsin Department of Commerce

Program Goals/Objectives: Improvements to public facilities such as water systems, sewerage systems, and streets that are owned by a unit of government, and which will principally benefit businesses; and as a result will induce businesses to create jobs and invest in the community

Eligible Applicants: Non-entitlement units of local government (city, county, village, or town)

Eligible Project Elements: Stormwater ponds; park facilities

Funding Rates and Limits: a maximum of $10,000 for each job created or retained (average $5,000 per job or less), $750,000 maximum

Application Deadline: may be submitted at any time

Contact: Sandy Herfel at 608-266-2435 or sandra.herfel@wisconsin.gov, Darlene Moss at 608-266-7998 or darlene.moss@wisconsin.gov, Jason Scott at 608-261-7714 or jason.scott@wisconsin.gov

Website: http://commerce.wi.gov/cd/CD-bcf-cdbg-pfed.html

Comments/Concerns: Must create or retain full-time jobs. At least 51 percent of the full-time jobs created must be made available to persons of low- and moderate-income.

Grant Program: Public Works and Economic Development Program

U.S. Department of Commerce Economic Development Administration

Program Goals/Objectives: Help support the construction or rehabilitation of essential public infrastructure and facilities necessary to generate or retain private sector jobs and investments, attract private sector capital, and promote regional competitiveness, including investments that expand and upgrade infrastructure to attract new industry, support technology-led development, redevelop brownfield sites and provide eco-industrial development

Eligible Applicants: A city or other political subdivision of a state, a consortium of political subdivisions, a state, an institution of higher education, a public or private non-profit organization or association, a district organization, an Indian tribe, or a private individual or for-profit organization. The area must meet public distress criteria which include unemployment rate at least 1% above national average and average per capita income at <80% national average.

Eligible Project Elements: Land acquisition, public infrastructure

Funding Rates and Limits: up to 50% of project costs, plus an additional 30% based on relative need in the region

Application Deadline: to be determined

Contact: C. Robert Sawyer, Regional Director at 312-353-7706 or rsawyer@eda.doc.gov

Website: http://www.eda.gov/AboutEDA/Programs.xml

Comment: Primary goal is creation of new long-term private sector jobs.

Grant Program: Transportation for Economic Assistance (TEA) Grant
Wisconsin Department of Transportation
Program Goals/Objectives: Road, rail, harbor and airport projects that help attract employers to Wisconsin, or encourage business and industry to remain and expand in the state
Eligible Applicants: City, village, town, or county
Eligible Project Elements: Street, road, or highway improvement
Funding Rates and Limits: 50% up to $1,000,000
Application Deadline: first come first serve, fiscal year begins July 1
Contact: Dennis Leong, WISDOT Division of Transportation Investment Management at 608-266-9910 or dennis.leong@dot.wi.gov
Website: http://www.dot.wisconsin.gov/localgov/aid/tea.htm
Comments: Funding is based on new jobs created in the community ($5,000/job)

Improvements to major highways (HWY 63?)

Grant Program: Local Highway Improvement Assistance—Surface Transportation Project, Urban
Wisconsin Department of Transportation
Program Goals/Objectives: Improvements to federal-aid-eligible roads and streets in urban areas
Eligible Applicants: Communities
Eligible Project Elements: Bridge design and replacement
Funding Rates and Limits: to be determined
Application Deadline: N/A
Contact: Paul Wydeven at 608-266-1535 or paul.wydeven@dot.wi.gov
Website: http://www.dot.wisconsin.gov/localgov/highways/stp-urban.htm
Comments/Concerns: Funding on roads functionally classified as major collectors or higher

Grant Program: Local Highway Improvement Assistance—Surface Transportation Project, Rural
Wisconsin Department of Transportation
Program Goals/Objectives: Improve federal aid eligible highways outside of urban areas
Eligible Applicants: Communities
Eligible Project Elements: Bridge design and replacement
Funding Rates and Limits: to be determined
Application Deadline: N/A
Contact: Paul Wydeven at 608-266-1535 or paul.wydeven@dot.wi.gov
Website: http://www.dot.wisconsin.gov/localgov/highways/stp-rural.htm
Comments/Concerns: Funding on roads classified as major collectors or higher