Shoreland Water Quality Improvement Technical Memorandum

City of Oconomowoc
August 4, 2008

INTRODUCTION

The City of Oconomowoc's shoreland properties are a diverse mix of residential, retail, business and entertainment land uses on the shores of Fowler Lake, Lac La Belle, the Oconomowoc River, Rosenow Creek and several other waterways. As the transformation of these shoreland properties intensifies, the City began a review of their current development regulations, including the examination of shoreland setbacks. The current ordinance (Section 17.505 – Lakeshore Overlay District) does not provide setback regulations, but instead places "use" restrictions within 75 feet of the waterways, and 45 feet along the isthmus on North Lake Road. These restrictions limit the opportunities for redevelopment, and ultimately deter economic development within the downtown area. To address this, City Staff and the City Plan Commission recently proposed to eliminate the current ordinance and replace it with shoreland setbacks of 75 feet throughout most of the City, 45 feet on the downtown isthmus and 45 feet within Tax Incremental Financing (TIF) District #4.

The City of Oconomowoc understands the benefits, both financially and environmentally, of clean waterways. This technical memorandum examines the effect the proposed changes to the shoreland setbacks would have on the water quality within the riparian waterways. Although this document briefly discusses the water quantity impacts of the proposed changes (both in peak flow rates and volumes), the focus of the document remains centered on the water quality impacts of the proposed shoreland setback reductions. For the purposes of this memorandum, the shoreland area was divided into the following three distinct groups, which are also shown on the map at the end of this document.

Area 1: The first area consists of the shoreland within the central business district of TIF District #4. This area is bound by St Paul Street on the east and the City Beach near Worthington Street on the west. The area is fully developed in heavy urban use, with large areas of impervious area such as parking lots and rooftops. Redevelopment within the central business district would likely result in a net reduction of impervious surfaces, and a corresponding decrease in the quantity (peak rate and volume) of storm water runoff.

Area 2: The second area consists of the remainder of the shoreland within the TIF District #4, but outside of the central business district. The area is fully developed, but contains a mixture of residential, retail, business and entertainment land uses.

Area 3: The third area consists of all other shoreland properties within the City, but outside the TIF District #4. These areas are generally residential land use, but also contain some business and institutional land uses.

WATER QUALITY STANDARDS

In November of 2006, the Wisconsin Department of Natural Resources (WDNR) issued the City of Oconomowoc a Wisconsin Pollutant Discharge Elimination System (WPDES) permit to regulate the discharge of municipal storm water runoff. As part of the compliance program, the City will develop and implement numerous programs aimed at improving the quality of storm water runoff throughout the City, including updating their Erosion Control and Storm Water Management Ordinance to comply with State and Federal standards by November of 2008. This new ordinance will include a 40 percent reduction in total suspended solids from all redevelopment projects which add more than 0.5 acres of impervious surface, or which disturb more than 1 acre of land. The new ordinance will likely encompass most, if not all, of the central business district redevelopment (area 1), some of the redevelopment within area 2 and very few redevelopment projects within area 3.

If the storm water best management practices (BMPs) needed to meet the above water quality standards are constructed as redevelopment within the central business district (area 1) progresses, the practices will be paid for by developers, but will likely result in a piecemeal installation that may not benefit the overall downtown revitalization effort. Alternatively, the City may prefer to install regional storm water treatment facilities within the central business district prior to the redevelopment. This option would allow the facilities to be constructed in accordance with the City's lakeshore vision, would result in some immediate water quality benefits to the City's waterways, and would make the facilities an asset to the overall revitalization of the area. Capacity in the treatment systems could then be sold back to the individual developers as redevelopment progresses.

The lack of coordinated redevelopment efforts in areas 2 and 3 may make regional facilities difficult to plan and construct in these areas. In all areas, it is recommended that a technical review be completed on each redevelopment project to assure compliance with both these requirements and the City's overall development vision.

The City will also update their storm water ordinance by November of 2008 with regard to "protective areas" around waterways. WDNR defines a protective area as an area bordering a waterway where impervious surfaces are to be kept out to the maximum extent practicable. The distance of the protective area varies based upon the waterway, but for typical lakes and streams extends out 50 feet from the edge of the water. In the DNR regulations, these protective areas do not apply to redevelopment sites. In the City's to-be-updated (by November, 2008) storm water management and erosion control ordinance (which mirrors Waukesha County's new storm water ordinance), redevelopment sites should not be subject to the protective areas, thereby mirroring the DNR regulations and not creating a conflict with the proposed shoreland setback reduction.

POLLUTANTS OF CONCERN

The shoreland areas within the City of Oconomowoc may be expected to generate pollutants typically found in storm water runoff from mixed-use areas. These pollutants, along with their common sources, are summarized below:

- **Sediment** is the most common pollutant in storm water runoff by volume and weight. Sediments readily wash off paved surfaces and exposed earth during storms. Excess sediment can turn water cloudy, thereby making it less suitable for recreation, fish life, and plant growth; and clog storm drains, leading to increased private and public maintenance costs and flooding problems. It also poses a health risk since when sediments enter water, they usually carry other pollutants including oils, metals, bacteria, and nutrients with them. Common sources include erosion from construction sites, deicing sand, dirt from equipment and vehicles, fallout from pressure washing or sandblasting, and dirt and grit from parking lots and streets.
- **Heavy metals** such as lead, copper, zinc and cadmium are commonly found in urban runoff. Metals can contaminate surface and ground waters and concentrate in bottom sediments, presenting health problems for fish and animals that eat from the bottom. Reproductive cycles of bottom-dwelling species can be severely reduced, and fish inhabiting such metal-contaminated locations often exhibit lesions and tumors. Metals can also contaminate drinking water supplies. Common sources include industrial areas, scrap yards, paints, pesticides, and fallout from automobile emissions.
- **Oils and greases** are a common component of stormwater runoff pollutants, primarily because there are so many common sources. Oils and greases concentrate on the surface of waterways, presenting problems for the entire water ecosystem. Common sources include streets, parking lots, food waste storage areas, heavy equipment and machinery storage areas, and areas where pesticides have been applied.
- **Chlorides** are increasingly becoming a significant storm water pollutant as municipalities switch from sand to salt for roadway and parking lot winter deicing. Chlorides kill vegetation along waterways, and severely stress the fish and other aquatic life within the water body.
- **Temperature** increases are a common urban storm water concern. As runoff flows over impervious surfaces or is stored in ponds, the temperature increases. Elevated temperatures impact a water body's ability to support certain fish and aquatic organisms.
- **Nutrients** such as phosphorus and nitrogen are needed by plants to grow, but high levels can be harmful to water quality. Excess nutrient levels can over-stimulate the growth of algae and other aquatic plants, resulting in unpleasant odors, unsightly surface scums, and lowered dissolved oxygen levels from plant decay. Sources include pet, bird and other animal

wastes, fertilizers, detergents, road deicing salts, automobile emissions, and organic matter such as lawn clippings and leaves.

- **Toxic Organic Compounds** such as pesticides and PCBs are particularly dangerous in the aquatic environment. Excessive application of insecticides, herbicides, fungicides, and rodenticides, or application of any of these shortly before a storm, can result in toxic pesticide chemicals being carried from agricultural lands, construction sites, parks, golf courses, and residential lawns to receiving waters. Common sources include wood preservatives, antifreeze, brake fluid, gasoline, paint thinners, pesticides, fertilizers, furniture strippers, dry cleaning chemicals, cleansers, solvents and a variety of other chemical products.
- **Oxygen-Demanding Substances** such as plant debris, food waste, and some chemical wastes use dissolved oxygen in water when they decay or chemically react. If dissolved oxygen levels in water become too low, aquatic animals can become stressed or die. Common sources include animal wastes, food wastes, leaves, twigs and other miscellaneous organic matter.
- **Bacteria** in storm water runoff affect recreational uses and aquatic life, while posing significant health risks to humans. Common sources include pet or other animal waste, garbage and leaking sanitary or septic systems.
- **Litter** improperly disposed of, including bottles and cans, paper and plastic bags, fast-food wrappers, cigarette butts and more pose a danger to water quality.

The Department of Natural Resources has written most of their pollutant reduction regulations using sediment as an indicator pollutant. As many other pollutants attach to and are carried by sediment, the Department reasons that if sediment is controlled in storm water runoff, so too will many of the other pollutants. For this reason, the recommendations discussed within this technical memorandum were primarily selected on their ability to control sediment, while also providing corresponding reductions in the concentrations of the other pollutants listed above. These recommendations may be implemented in combination with other future City programs aimed to reduce chlorides, nutrients, organic compounds, oxygen demanding substances, bacteria and litter.

BEST MANAGEMENT PRACTICES TO CONTROL STORM WATER RUNOFF

There are many types of best management practices (BMPs) to manage storm water runoff. As previously stated, this technical memorandum is primarily focused on water quality impacts. Although this analysis is not focused on changes in the quantity of storm water runoff resulting from any proposed redevelopment, the following water quantity control practices may be applicable on redevelopment sites to comply with the necessary peak flow reduction requirements of specific projects. The following is a sampling of typical practices used to reduce peak flow rates or volumes from storm water runoff: dry ponds, pervious pavement, infiltration ponds, green roofs, and additional green space.

Alternatively, this analysis places an emphasis on water quality impacts from reduced shoreland setbacks. The following is a sampling of typical best management practices used to remove pollutants from storm water runoff, and a discussion on the feasibility of these BMPs within the City of Oconomowoc.

- **Wet ponds** are designed to capture and detain storm water runoff in a relatively deep standing pool of water, allowing sediment and other pollutants to settle to the bottom of the facility. Although wet ponds are extremely effective in treating storm water runoff, they require a significant amount of space to construct, making them difficult to implement for the fully developed central business district, but potentially applicable in other areas of the City.

- **Infiltration facilities** are designed to capture and treat storm water runoff by directing the water into the native soils. Infiltration facilities are often used in combination with a pretreatment BMP such as a wet pond to remove most of the pollutants prior to the infiltration of relatively clean water into the ground water aquifer. Although infiltration facilities are effective at treating storm water runoff, they are dependant on in-situ soils and groundwater levels, and require a significant amount of land to construct. Based on the anticipated high groundwater levels throughout the shoreland areas, they were not considered further.

- **Bioretention facilities** use plants, engineered soil and other landscaping features for the removal of storm water pollutants. Bioretention facilities are commonly located in parking lot islands, along roadways, or within small pockets of developed land uses. Surface runoff is directed into shallow, landscaped depressions designed to incorporate many of the pollutant removal mechanisms that operate in natural ecosystems. During storms, storm water runoff is collected and then percolates through the plant, mulch, and engineered soil layers of these systems. Typically, the filtered runoff is collected in a perforated underdrain and returned to the conventional drainage system. Bioretention facilities enhance storm water quality through adsorption, filtration, microbial soil processes, evapotranspiration, nutrient uptake in plants, and decomposition prior to exfiltration into the surrounding soil mass. The facilities are designed for relatively small drainage basins, can function with limited change in elevation and should be considered as a viable option for all shoreland redevelopment areas.

- **Filter strips** are relatively flat areas of grass or native vegetation adjacent to or downstream from an impervious surface. They remove pollutants from storm water runoff via filtration from healthy stands of grass vegetation that allow pollutants to settle out at low velocities. Filter strips provide a partial reduction in most types of pollutants, although they are not as effective as wet ponds, wetlands, infiltration basins or bioretention facilities. The facilities are designed for relatively small drainage basins, can function with limited change in elevation and are a viable option for all shoreland redevelopment areas.

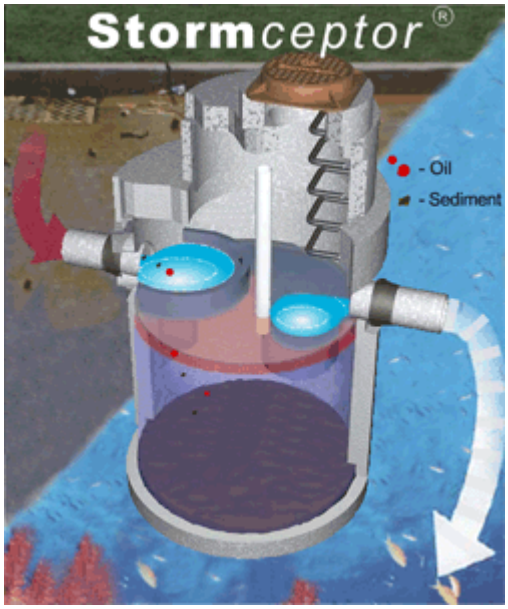
- **Storm water wetlands** are designed to mimic the treatment of storm water runoff found in natural wetlands using physical, chemical and biological processes. Similar to wet ponds, storm water wetlands are effective at the treatment of storm water, but require considerable space requirements for construction.

- **Catch basins** are storm water inlets with one or two foot deep sumps. They capture storm water runoff, allow the larger particles to settle out into the sump and discharge runoff to the conventional storm sewer system. Although catch basins provide some limited water quality treatment, they are best used in combination with the other practices listed above.

- **Street sweeping** involves mechanical or vacuum sweeping of the parking lots and roadways within the central business district. Where curbs are present, street sweeping captures some storm water pollutants before they enter the conventional storm water management system. In roadways without standard curbs or in parking lots, street sweeping is significantly less effective. For these reasons, street sweeping is best used in curbed areas and in combination with the other practices previously discussed.

- **Deicing management** involves analyzing the current ice and snow removal practices within the City and identifying any potential areas of improvement. Changes may include a reduction in the amount of salt or sand applied, or changing to alternative deicing techniques, such as beet juice, which are less harmful to the City's waterways.

- **Proprietary best management practices** are storm water devices designed to remove pollutants via a variety of filtration and sedimentation methods. They are installed at strategic points along the storm sewer system and are typically housed in underground concrete manholes or junction chambers. Based on the unproven pollutant removal of these devices, they are not recommended where more proven best management practices are available. However, in some areas within the downtown area, proprietary devices may be appropriate.



ROOFTOP RUNOFF

The Wisconsin Department of Natural Resources and historical water quality studies have indicated that rooftop runoff may generally be considered relatively free of pollutants. Although the rooftop runoff may show traces of heavy metals and hydrocarbons from the roofing material, it is significantly cleaner than runoff falling directly on streets or parking lots. Rooftop runoff should be treated to the maximum extent practicable. If treatment of rooftop runoff is not feasible, it may be disconnected from the storm water collection and conveyance system (catch basins, storm sewers, etc), thereby significantly avoiding pollutants.

CASE STUDY – FOWLER LAKE PROMENADE AREA

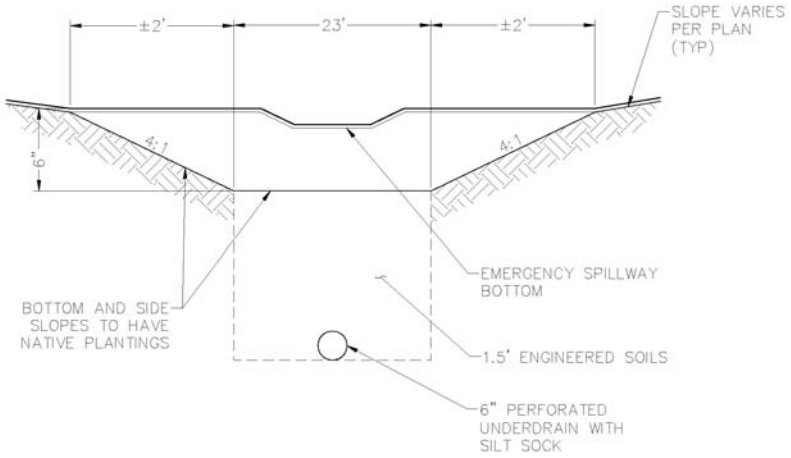
One of the most important questions that must be examined in this technical memorandum is the effect of reduced shoreland setbacks on the quality of water within the City's lakes and streams. In particular, an analysis was needed to approximate the water quality effects of any proposed redevelopment, and determine whether redevelopment could comply with the Federal, State and local water quality requirements with reduced setbacks. To complete this analysis, a case study was completed on the promenade area within the central business district.

For the purposes of this case study, the promenade area was bound by Fowler Lake on the north, Main Street / N. Lake Road on the west, Wisconsin Avenue on the south and St. Paul Street on the east. The Source Loading and Management Model (SLAMM) computer model was used to calculate pollutant loadings within the area under existing conditions, under redeveloped conditions with no storm water controls and under redevelopment conditions with storm water controls. SLAMM was developed in the 1970s with heavy input from the University of Wisconsin-Madison and the Wisconsin Department of Natural Resources as a pollutant estimating tool. The DNR currently recognizes SLAMM as the model of choice for calculating pollutant runoff from urban areas. Storm water controls included bioretention facilities and filter strips which were sized for an approximate 50 percent sediment removal based upon the redeveloped land use. For all redevelopment conditions, the rooftops were assumed to be disconnected from the conventional drainage system and discharging directly to the lake. For the purposes of this analysis, it was also assumed that the ultimate redevelopment of the area would result in the same amount of green space, while increasing the rooftop area by 10 percent and decreasing the parking area by the same amount. While actual redevelopment conditions may result in increased green space or greater than 10 percent conversion of parking area to rooftop (both of which would reduce pollutant loadings under redeveloped conditions), the conditions described above were selected to provide conservative results.

The SLAMM results for the promenade area are summarized below:

Land Use Condition	Annual Pounds of Sediment Generated
Existing Land Use	2381 pounds
Redevelopment – Rooftops Disconnected, No Other Controls	1986 pounds (17% reduction)
Redevelopment – Rooftops Disconnected With 27 Foot Wide Biofiltration	992 pounds (58% reduction)
Redevelopment – Rooftops Disconnected With 27 Foot Wide Filter Strip	1118 pounds (53% reduction)

Based on these results, the conversion of parking lot into rooftop and the disconnection of the roof drainage system result in a 17 percent sediment reduction based on existing conditions. The biofiltration facility was sized to provide a 50 percent reduction in total sediment based on the redeveloped land use and rooftop drainage disconnection, or a 58 percent reduction when compared to the existing land use. The required biofiltration facility would be approximately 27 feet in width and may be configured as shown below.



BIORETENTION AREA CROSS SECTION NO SCALE

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The filter strip was designed to be identical in size to the biofiltration facility to provide an accurate comparison. A 27-foot wide filter strip provides a 44 percent reduction in total sediment based on the redeveloped land use and rooftop drainage disconnection, or a 53 percent reduction when compared to the existing land use. The required filter strip would be configured in the same layout as the biofiltration facilities shown above.

Conclusion

This case study demonstrated that significant water quality improvements may be achieved even with reduced shoreland setbacks. Additionally, bioretention facilities proved to be slightly more effective at reducing sediment than filter strips, based on the higher pollutant reduction in a similar sized facility.

RECOMMENDATIONS AND IMPLEMENTATION

The promenade case study illustrates that significant water quality improvements above and beyond those required by Federal, State and forthcoming local regulations can be achieved even with reduced shoreland setbacks. If properly planned, designed and constructed, the water quality treatment practices can also be an amenity for the region, and contribute towards the City's development vision.

- Areas 1 and 2 (within TIF #4): It is recommended that a 50 percent reduction in sediment be required for any redevelopment effort with reduced shoreland setbacks (less than 75 feet) within TIF District #4 (areas 1 and 2). Most of the redevelopment projects in areas 1 and 2 will likely be subject to the proposed erosion control and storm water management ordinance which will require a 40 percent sediment reduction. The recommended 50 percent sediment reduction requirement for shoreland properties with reduced setbacks is higher than the required 40 percent reduction based on State and soon-to-be-adopted local regulations, but is warranted to offset the reduction in buffer length from the edge of the waterway. It is anticipated that regional facilities will generally be applicable in area 1, while a mix of regional and site-specific facilities will be used in area 2.

- Area 3 (outside TIF #4): It is recommended that a 40 percent reduction in sediment be required for any redevelopment effort with reduced shoreland setbacks (less than 75 feet) outside TIF District #4 (area 3). Very few, in any, of the redevelopment projects in area 3 will likely be subject to the proposed erosion control and storm water management ordinance. Therefore, the recommended sediment reduction requirement for shoreland properties with reduced setbacks within area 3 is equal to (if the storm water ordinance applies) or higher (if the ordinance does not apply) than the required reduction based on State and soon-to-be-adopted local regulations, but is warranted to offset the reduction in buffer length from the edge of the waterway. All new developments within area 3 shall remain subject to the erosion control and storm water management ordinance (if the developments meet the applicability requirements). It is anticipated that regional facilities will be difficult to achieve in area 3, primarily due to a lack of coordinated redeveloped efforts. Instead, site-specific practices will generally be used to facilitate the diverse timing and needs of the different properties.

- All development and redevelopment projects that meet the appropriate applicability criteria shall remain subject to the peak flow reduction requirements of the City's erosion control and storm water management ordinance.

- The highly variable site conditions of the City (soil types, groundwater levels, etc) do not lend themselves to the application of a one-type-fits-all storm water treatment practice. A best management practice that works in one part of the City may not function properly in another part of the City. Based on this variability, all projects with proposed setbacks less than 75 feet shall have a technical review completed by City staff on a case-by-case basis to verify compliance with these requirements.

- If the recommended storm water best management practices are constructed as redevelopment progresses, they will be paid for by developers, but may result in a piecemeal installation that may not benefit the overall City revitalization effort. Alternatively, it is recommended that the City install the practices as regional storm water treatment facilities where the timing of the redevelopment allows. Primarily, these regional facilities will likely be most applicable within the central business district (area 1). This option would allow the facilities to be constructed and maintained in accordance with the City's lakeshore vision, making them an asset to the revitalization of the area. Capacity in the treatment systems could then be sold back to individual developers as redevelopment progresses. In effect the City would be creating a "bank" of storm water treatment credit for future central business district redevelopment efforts. Individual redevelopment projects would then be reviewed by City staff for conformance with the overall lakeshore redevelopment plan. In addition, the immediate placement of the improvements would benefit the public waterways immediately.

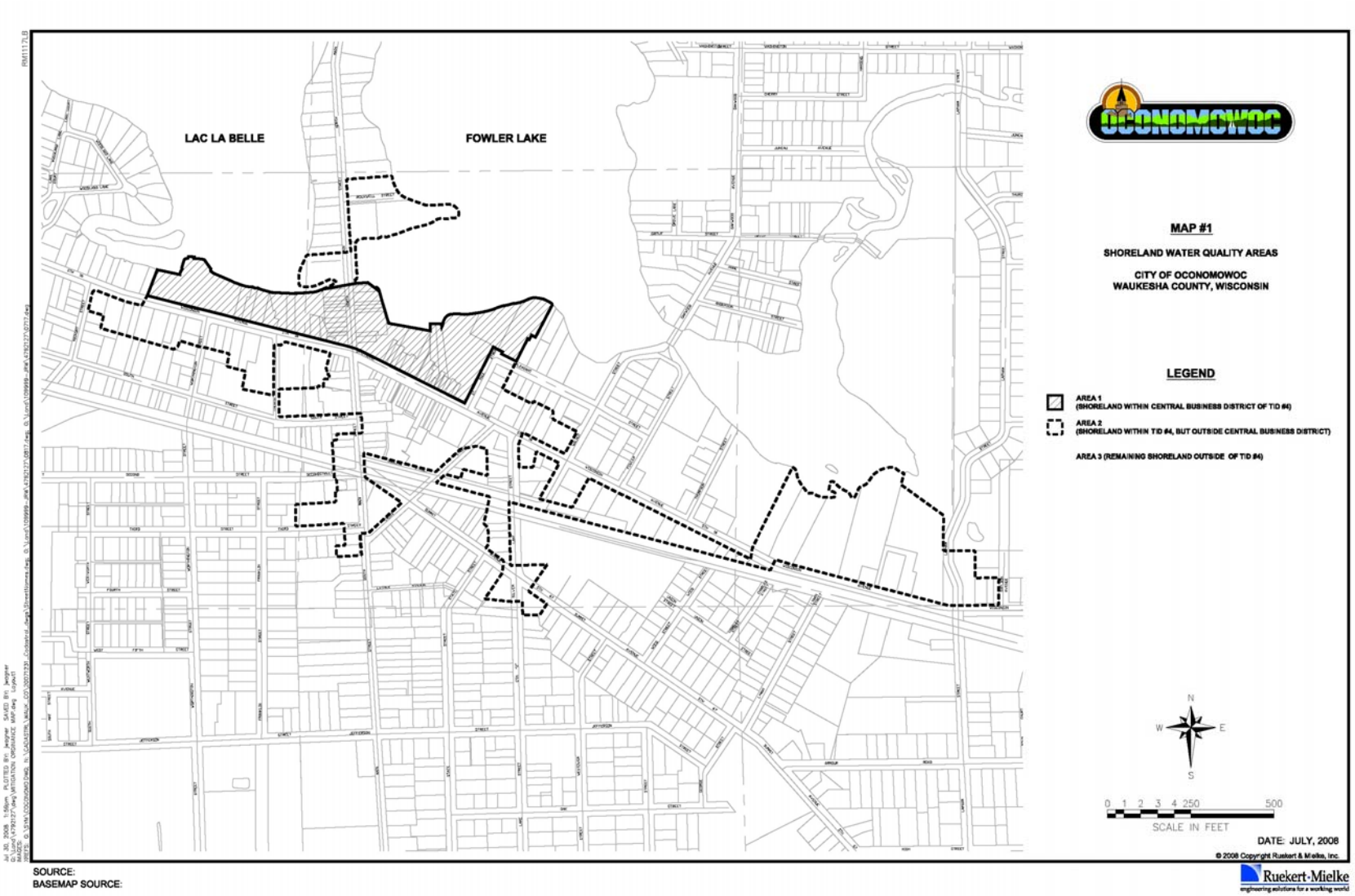
- Although many types of storm water best management practices may be used to achieve the recommended pollutant reductions, the limited space and anticipated high groundwater constraints of the central business district (area 1) lend itself to the use of both biofiltration facilities and filter strips as preferred storm water runoff treatment practices. The case study demonstrated that both biofiltration facilities and filter strips could meet the required 50 percent sediment reduction. Based on their greater efficiency and historically higher pollutant reduction results, it is recommended that biofiltration facilities be used as the primary treatment device in area 1, in conjunction with filter strips as pretreatment devices. Soil borings, groundwater analysis and site topography must be analyzed prior to design to confirm the applicability of biofiltration and filter strips within area 1, and also to review the applicability of any other potential BMPs.

- The City's draft storm water management and erosion control ordinance must be adopted prior to November 2008 and must allow the reduced shoreland setbacks. In particular, it is recommended that Section 19.11 (d)(4) mirror the State of Wisconsin requirements such that protective areas do not apply to redevelopment sites.

- Finally, it is recommended that the City's deicing management program be reviewed to ensure that limited sand and salt are being used, and alternative deicing techniques (such as beet juice) are examined. Additionally, street sweeping and catch basin cleaning should be continued and/or expanded where applicable and in conformance with the City's municipal WPDES storm water permit.

These recommendations are summarized below.

- With a proposed shoreland water quality ordinance, the proposed shoreland setback ordinance may be adopted and yield improved water quality. Therefore, adopt the proposed shoreland setback ordinance.
- Adopt the proposed shoreland water quality ordinance.
- Adopt the draft storm water management and erosion control ordinance to be consistent with the shoreland water quality ordinance by November 1, 2008.
- As redevelopment is proposed, complete the study, design and construction of regional storm water treatment devices (where applicable). If desired, sell capacity in the City's "bank" of regional storm water best management practices to neighboring developers.
- Complete the technical review of individual redevelopment projects to ensure compliance with the City's overall vision and the appropriate water quality ordinances.


LAC LA BELLE
FOWLER LAKE
OCONOMOWOC
MAP #1
SHORELAND WATER QUALITY AREAS
CITY OF OCONOMOWOC
WAUKESHA COUNTY, WISCONSIN
LEGEND
AREA 1
(SHORELAND WITHIN CENTRAL BUSINESS DISTRICT OF TID #4)
AREA 2
(SHORELAND WITHIN TID #4, BUT OUTSIDE CENTRAL BUSINESS DISTRICT)
AREA 3 (REMAINING SHORELAND OUTSIDE OF TID #4)
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SCALE IN FEET
DATE: JULY, 2008
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