

## 2015 Goals and Objectives for the Green Lake Watershed

An Addendum to "A Lake Management Plan for Green Lake," (January 2013)

Activity	Cost	Funding Sources <sup>A</sup>	Measurable Deliverable	Activity Status
<b>1. Green Lake County Best Management Practices</b>				
<i>The Green Lake County Land Conservation Department partners with farms in Green Lake County to install conservation practices (i.e. grass waterways, retention ponds) or to implement management techniques (i.e. tillage practices, crop rotation, cover crops, soil health) to keep nutrients upstream and out of the lake.</i>				
	\$452,000	NRCS (National Water Quality Initiative Grant), DNR (Large-Scale Lake Protection Grant), Green Lake County LCD, GLSD	1,065+ lbs phosphorus removed	Over 30 projects planned for 2015
<b>2. Twin Lakes Restoration</b>				
<i>This initiative includes a series of restoration efforts on Twin Lakes aimed to improve water quality for Hill Creek, a Green Lake tributary with degraded water quality that is currently identified as an impaired waterway.</i>				
	TBD	DNR	TBD	DNR Special Project
<b>3. Targeted Chemical Treatment on Silver Creek Estuary</b>				
<i>Chemical treatment on Silver Creek will reduce nuisance populations of invasive plants, particularly Eurasian watermilfoil and curly leaf pondweed.</i>				
	\$25,000	DNR (AIS Control Grant), GLSD	180 acres of chemically-treated estuary	2013: Chemical treatment in Silver Creek Estuary complete 2014: Chemical treatment in Beyers Cove and Green Lake Millpond complete 2015: Ongoing
<b>4. Big Green Lake Shoreline Inventory</b>				
<i>The entire perimeter of Green Lake will be inventoried for current shoreline condition, including vegetation buffer width, development and signs of erosion. Results will be used to target and prioritize future restoration efforts.</i>				
	\$32,800	DNR (Lake Protection Grant), Green Lake County LCD	27 miles of inventoried shoreline	DNR Grant Pending

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<b>5. Dissolved Oxygen Monitoring and Modeling Study for Big Green Lake</b> <i>Big Green Lake experiences dramatic spikes in low dissolved oxygen levels during certain times of the year and at certain depths of the lake. To date, the exact cause of this problem is unknown. The Dissolved Oxygen Monitoring and Modeling Study seeks to identify the mechanism(s) causing this phenomenon, to develop a nutrient budget to achieve water quality goals, and to recommend management strategies to achieve water quality goals for dissolved oxygen.</i>				
	~\$110,000 for 2 years	DNR, GLSD, GLA	1 developed lake model with a proposed nutrient budget and management strategies	Proposals being reviewed; Start-date will be 2015 or 2016, pending funding opportunities
<b>6. Green Lake Shoreline Restoration Project</b> <i>The Green Lake Shoreline Restoration Project seeks to restore areas of degraded shoreline habitat at Hammers Trail and Norwegian Bay through installation of Fish Sticks and other erosion control structures.</i>				
	\$25,000	DNR (Healthy Lakes Grant), GLSD, GLA	12 to 15 Fish Stick tree bundles	DNR Grant Pending
<b>7. Stream Bank Inventory of Silver Creek &amp; Green Lake Tributaries</b> <i>Conduct an extensive stream bank inventory along the length of Silver Creek that will identify areas of extensive stream bank erosion, degraded habitat, reduced buffer width and other metrics. Data will be used to create a GIS-based map and to target future restoration/management efforts.</i>				
	\$10,000	Fond du Lac County LCD, Green Lake County LCD, GLA, GLSD	Over 15 miles of assessed stream bank GIS maps documenting future management efforts	Planned for summer of 2015
<b>8. Biological Oxygen Demand Assessment of Green Lake Tributaries</b> <i>Partner with Ripon College to conduct an assessment of biological oxygen demand (BOD) along the length of select Green Lake tributaries. Use results to identify areas of intensive development/agricultural pressure and to implement future protection/restoration activities.</i>				
	\$5,000	GLSD, Ripon College, GLA	TBD	Planned for summer of 2015

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<b>9. Agricultural Outreach Coordinator</b>				
<i>Employ an Agricultural Outreach Coordinator in the Green Lake watershed in Fond du Lac County based on results of a Watershed Model for Green Lake (completed in 2015). Use results to identify and secure Best Management Projects.</i>				
	\$10,000/year for 2 years	GLSD	1 Agricultural Outreach Coordinator	Planned for 2015-2016
<b>10. Restoration of CTH K Estuary Restoration</b>				
<i>Restore the CTH K Estuary through an extensive planting of submergent propagules. Maintain native species with herbicide spraying for EWM/CLP, as needed. Monitor the extents of native plant re-establishment. The DNR will monitor the success of the CTH K Estuary restoration as part of a DNR Special Project.</i>				
	\$30,000-\$50,000	GLSD, DNR	225 acres of restored wetland Over \$30,000 of installed submergent plants	Planned for 2015-2016
<b>11. City of Green Lake Stormwater Management Impact Study and Management Plan</b>				
This initiative seeks to reduce the City of Green Lake's nutrient loading to Big Green Lake and its outlet, the Puchyan River. The Impact Study & Management Plan will quantify current nutrient loading to Green Lake, prioritize contributing areas based on nutrient loading, and identifying potential areas for new or enhanced management practices.				
	\$50,000 for 2 years	DNR (Urban Nonpoint Source & Storm Water Grant), City of Green Lake, GLSD, GLA	Developed Impact Study and Management Plan	DNR Grant Pending
<b>12. Near-Shore Fish Appraisal</b>				
Conduct a Near-Shore Fish Appraisal in CTH K Estuary to create a baseline appraisal and a pre-/post-evaluation strategy for the CTH K Estuary Restoration Project.				
	\$6,000	DNR (Small-Scale Lake Planning Grant), GLSD	5 miles of near-shore appraised	DNR Grant Pending Planned for 2015

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<b>13. Cisco Monitoring</b>				
The Green Lake Coldwater Advisory Committee intends to partner with the DNR to monitor native cisco density and population trends in Green Lake for 3 years through a combination of sonar monitoring and vertical gill-net surveys.				
	\$4,000/year	DNR, Green Lake Coldwater Advisory Committee		Planned for 2015-2017, Pending DNR Project
<b>14. Revitalization of Shoreline Restoration Project (RSVP)</b>				
Sponsorship of multiple shoreline restoration project homeowner grants to be installed along the perimeter of Big Green Lake and its tributaries.				
	\$10,000	GLSD	\$10,000	Ongoing
<b>15. Management of Conservancy Properties</b>				
Spraying of invasive species, shoreline restoration work,				
	TBD	US Fish & Wildlife (\$20,000 awarded), GLSD, GLC	TBD	Ongoing

<sup>A</sup> Department of Natural Resources (DNR), Green Lake Association (GLA), Green Lake Conservancy (GLC), Green Lake Sanitary District (GLSD), Land Conservation Department (LCD), Natural Resources Conservation Service (NRCS).

## Big Green Lake Impairment

The Wisconsin Department of Natural Resources (WI DNR) applies specific water quality criteria to all Wisconsin lakes, Big Green Lake included, to determine if the water body in question should be classified as “impaired”. These criteria are used to measure the relative health of our water resources in the state, and subsequently, used to guide management actions. The water quality criteria for Big Green Lake are provided below:

Phosphorus	Dissolved Oxygen	Chlorophyll
<15ug/L	>5mg/L	<20ug/L during 95% of the time

The above parameters have been monitored for several years on Green Lake through a partnership with the WI DNR, United States Geological Survey (USGS) and the Green Lake Sanitary District (GLSD). Below are the results of that monitoring over the past 5 years, allowing us to determine if Green Lake meets the criteria applied to our lake by the WI DNR:

Phosphorus	Dissolved Oxygen	Chlorophyll
17.2ug/L	<5 mg/L*	4ug/L

\*measured below 5mg/L at mid-depth and in deepest areas of the lake  
Note: 1ug/L = 1 parts/billion and 1 mg/L = 1 parts/million

By comparing the criteria against the monitoring results, there is divergence. More specifically, the divergence involves the dissolved oxygen (DO) and phosphorus (P) for Big Green Lake. The Chlorophyll complies with the recommended criteria. When the criteria are exceeded, the lake can be designated as impaired (as it pertains to the criteria for that specific parameter). In short, **Big Green Lake has been listed as “impaired” for low dissolved oxygen levels as of 2014.**

### The Dissolved Oxygen Issue

Our lake does meet the threshold for listing Big Green as “Impaired for Low DO”. There can be a low DO deficiency in a narrow band at the lake’s thermocline. This deficit is of concern because aquatic organisms, especially fish, require sufficient DO to stay alive. Although the low DO remains within a narrow band of 10 feet or so during late summer, there is concern with respect to its cause and potential for expansion.

Consequently, lakes designated as “impaired” in Wisconsin typically have greater funding opportunities from government agencies to help understand and alleviate the identified problem. Furthermore, having the State identify Big Green Lake as impaired further enables all parties to identify specific strategies and solutions for returning our water body to acceptable water quality.

Although our LMP Team is aware of our low DO impairment (we know what’s happening), we do not believe we have a solid understanding of why it’s happening with certainty at this point in time. Therefore, we are in the process of working with experts to determine which data/information and hydrodynamic tools would be best suited for helping us to clarify the reasons behind our low DO situation.

## The Phosphorus Issue

Big Green Lake is not presently listed as “impaired” for phosphorus (P). Although the 17.2ug/L concentration is above the 15ug/L impairment criteria, confidence limits caused by the variability in P concentrations actually fall slightly below the 15ug/L so our lake does not meet the impairment criteria as it pertains to P. Despite the “non-impairment” determination for P, the primary concern for our lake continues to be *too much phosphorus* and it is possible the lake could be listed as impaired for P in the future. P has been and remains the problem nutrient for Big Green Lake. Too much P in a lake causes unwanted and excessive plant and algal growth. We also believe P is directly tied to our current impairment of low DO near the thermocline. The vast majority of our Lake Management Plan (LMP) is aimed directly at reducing P. We have been aggressively targeting reductions in P entering the lake. We believe there is good science supporting our “domino effect”. By aggressively trying to reduce P input to the lake, the other lake water quality indicators (DO, water clarity, chlorophyll) should also improve.

### Current Status of Big Green Lake Water Quality

*The U.S. Geological Survey (USGS), in cooperation with the GLSD, continues to monitor the water quality of Big Green Lake using very consistent, reliable and rigorous sampling protocols that enable the water quality of the lake to be regularly evaluated. Overall, the water quality of Big Green Lake in 2014 was relatively similar over the past few years, with a few subtle changes.*

*Over the past 5 years, Big Green Lake had a summer average secchi depth of 17 feet, phosphorus concentration of 17.2ug/L, and chlorophyll a concentration of 4ug/L. Based on these values, Big Green Lake would be classified as a Mesotrophic lake (moderately productive) with respect to phosphorus and chlorophyll a concentrations, and oligotrophic (very low productivity) based on water clarity. Although the average phosphorus concentration in 2014 and over the past 5 to 10 years was slightly above 15ug/L (the criteria threshold for a lake with trout), the lake is not considered by WI DNR at this time to be impaired for phosphorous, because of annual variability in P concentration.*

Note: The information in the 2 paragraphs above was provided independently by the USGS. Moving forward, the LMP Team will continue to utilize the USGS for our lake’s water quality monitoring. We believe it is helpful to have an independent arm doing this monitoring work to provide consistent and reliable data. This establishes a baseline record for the lake which is critical as we continuously measure the effectiveness of our Lake Management Plan (LMP).