Crystal Lake/Keller Lake Use Attainability Analysis

Project Synopsis

A Use Attainability Analysis (UAA) is a scientific assessment of a water body's physical, chemical, and biological conditions. It uses an outcome-based evaluation and planning process in order to obtain or maintain optimal water quality conditions and achieve beneficial uses, such as swimming, fishing, or wildlife habitat.

During 2001–2003, the Black Dog Watershed Management Organization (BDWMO) conducted a UAA for Crystal Lake/Keller Lake to address current water quality issues. The UAA includes a water quality analysis and prescription of protective measures for Crystal Lake/Keller Lake and the watershed, based on historical water quality data, the results of intensive lake water quality monitoring, and computer simulations of land use impacts on water quality.

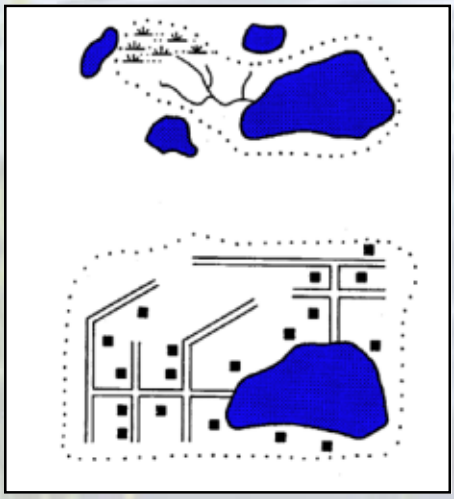
Typical Urban Lake Water Quality Problems

The primary problem in urban lakes is "cultural eutrophication," which is defined as the accelerated increase in concentrations of nutrients, primarily phosphorus and nitrogen, in a lake as a result of human activities in the watershed. Eutrophication is often indicated by increased algal growth, decreased water clarity, and loss of dissolved oxygen in the bottom waters of the lake, which leads to a shift in fish species from desirable game fish to non-game species such as carp and bullhead.

Nuisance algae in lakes results from the excess phosphorus that reaches lakes due to increased stormwater runoff.

The Usual Suspects

These problems typically occur because of watershed urbanization and nonpoint source pollution. Increased urbanization in a watershed leads to more streets, driveways, and rooftops (impervious surfaces). This increased imperviousness results in more stormwater runoff traveling quickly through storm sewers, diminishing the runoff pollutant retention capacity of watershed ponds and wetlands. The increased stormwater runoff carries excess nutrients into lakes and streams as nonpoint source pollution. Increased concentrations of phosphorus in lake waters is the leading cause of algal blooms and decreased water clarity.



Source: Monson (1992)

Before development (top image), stormwater travels slowly through a watershed. After development (bottom image), impervious surfaces are increased, resulting in more stormwater runoff and less filtration of nutrients.

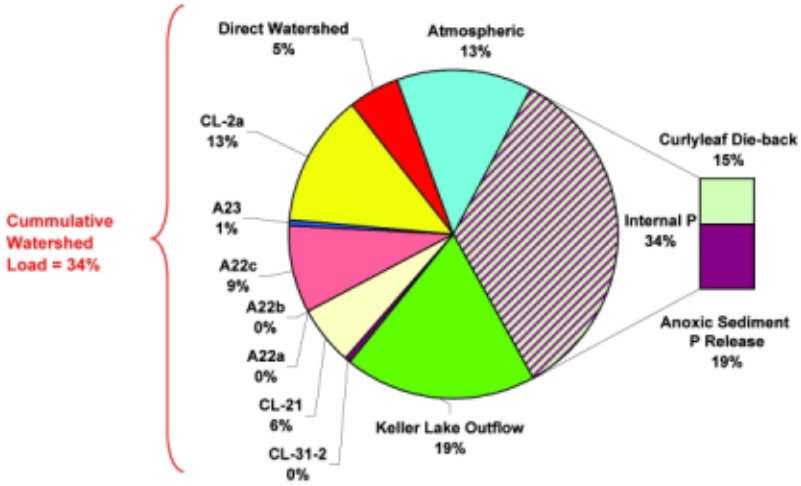
A lake's clarity (transparency) is measured by submerging a black and white patterned disc (a Secchi disc) into the lake. The depth at which the Secchi disc disappears determines the lake's transparency.

Crystal/Keller Lake Water Quality Problems and Causes

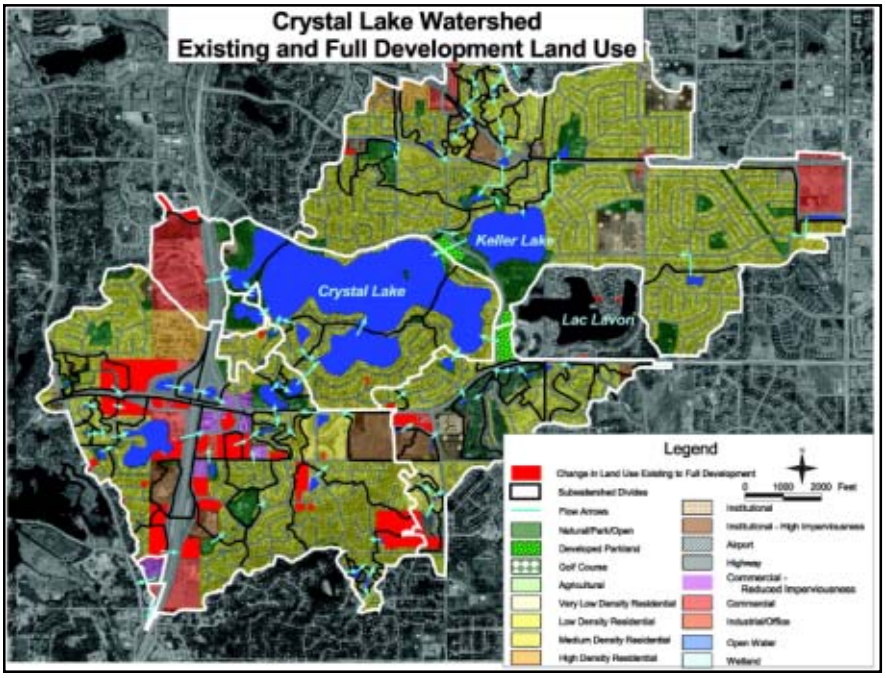
The water quality assessment portion of the UAA determined that Crystal and Keller Lakes suffer from two primary water quality problems: summer algal blooms and excess lake weeds. The algal blooms are caused by high phosphorus levels, due to poor quality urban stormwater runoff entering the lake. The problematic lake weeds are an exotic lake weed species called curlyleaf pondweed, which dies back in mid-summer each year, further increasing the lakes' phosphorus concentration and algal abundance. Nutrient-rich lake sediments also recycle phosphorus back into the lake water during summer months. The following page explains the recommended water management strategy for handling these problems.

Curlyleaf pondweed is a major problem that affects recreational use of both Crystal and Keller Lakes.

Crystal Lake Annual Phosphorus Budget (1082 lbs)
Model Calibration Year (2002) Using Existing Land Use



The UAA includes data such as this pie chart, which shows the breakdown of sources of the annual phosphorus load to Crystal Lake. See the map on page 4 to cross-reference the source/location codes. A similar pie chart for Keller Lake is included in the UAA.



Investigative Techniques Used in UAA Process

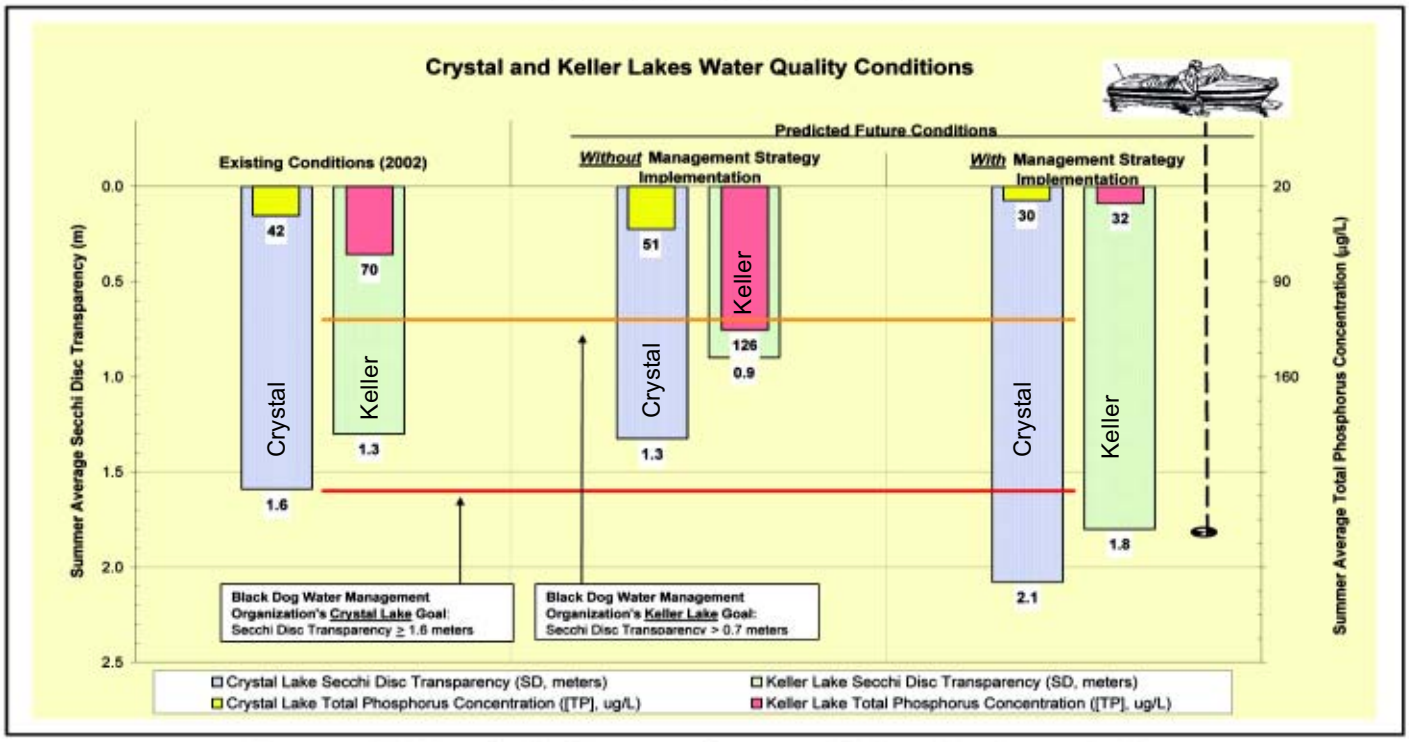
The UAA process included an intensive lakewater quality study, P8 computer simulation modeling of runoff water quality, lake hydrologic and phosphorus budget analyses, and an analysis of the likely water quality improvement benefits of several lake water management strategies. Secchi disc readings were conducted biweekly throughout the open water season as a general indicator of water quality.

The UAA found that watershed land use directly influences the lakes' annual water and phosphorus inputs.

Recommended Management Strategy for Crystal Lake and Keller Lake

The following figure and table summarize the recommended management strategy for Crystal Lake and Keller Lake. Several strategies (39 different combinations) were evaluated based on effectiveness, cost, and feasibility. Input was gathered from the BDWMO Board of Commissioners, city staff, and neighborhood residents as part of the evaluation process. The figure shows current and predicted water quality conditions, both with and without implementation of recommended water quality improvement projects. The table lists elements of the recommended strategy and its cost.

Water Quality Management Strategy



Recommended Water Quality Management Strategy and Estimated Implementation Costs

Water Quality Management Strategy Elements[†]	Capital Cost	Annual Operation & Maintenance Cost	Proposed Funding Source	Responsible Party for Implementation
Source Reduction Efforts				
1 Phosphorus Fertilizer Limitation	$0	$0	n/a	Homeowners
Infiltration of Runoff				
2 Upgrade Redwood Pond (Excavate & Enhance Infiltration)	$105,315	$843	City of Apple Valley	City of Apple Valley
3 Add Two (2) Regional Infiltration Basins	$107,825	$915		
3a Regional Infiltration Basin Located North of Valley Middle School	($48,899)	($416)	City of Apple Valley	City of Apple Valley
3b Regional Infiltration Basin Located in West Buckhill Park	($58,927)	($498)	City of Burnsville	City of Burnsville
Runoff Detention Ponding				
4 Upgrade Select Existing Ponds to NURP Design Criteria	$171,938	$1,376		
4a WVR-43a - 153rd St. Pond (Just South of Old Kmart) - Enlarge and Excavate	($52,728)	($422)	City of Apple Valley	City of Apple Valley
4b A46a - North of the Intersection of Southcross Drive and Keller Lake Drive - Excavate	($13,755)	($110)	City of Burnsville	City of Burnsville
4c A6a - Keller Lake Park Pond - Excavate	($45,850)	($367)	City of Burnsville	City of Burnsville
4d A7c - Northeast Edge of Keller Lake - Excavate	($18,340)	($147)	City of Burnsville	City of Burnsville
4e CL-21 - Bluebill Pond - Excavate	($41,285)	($330)	City of Lakeville	City of Lakeville
5 Add a Regional Water Quality Treatment Pond at the Southeast Corner of Keller Lake (Pond A7a-1)	$462,000	$3,696	City of Apple Valley	City of Apple Valley
In-Lake Chemical Treatments				
6 Resume Operation of Ferric Chloride ($FeCl_3$) Treatment System in Near-Surface Withdrawal Mode	$13,125	$36,520	Black Dog Water Management Organization	Black Dog Water Management Organization
In-Lake Mechanical Treatments				
7 Mechanical Harvesting of Curlyleaf Pondweed in Crystal Lake	$0	$54,600	Lakeshore Homeowners[‡] & City of Burnsville	City of Burnsville
8 Mechanical Harvesting of Curlyleaf Pondweed in Keller Lake	$0	$14,359	Lakeshore Homeowners[‡], City of Apple Valley, & City of Burnsville	City of Burnsville
Total	$860,203	$112,360		

[†] The attached map illustrates the approximate locations of the various water quality management strategies.

[‡] Voluntary participation in the lake weed harvesting program, for harvesting of areas within 150 feet of the shoreline, will result in a ***pro rata*** charge (area harvested basis) to each participating lakeshore property owner. Harvesting of areas beyond 150 feet from shore, up to an aggregate area less than or equal to 50 percent of the littoral zone, will be paid for by the city (cities).

Location of Recommended Management Strategy Elements

This map shows the location of the eight elements of the recommended lake water management strategy for improving the water quality of Crystal and Keller Lakes.