Legislative Water Commission- 2019 Legislative Recommendations: Lakes
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DRAFT, for Discussion only, JRS

Minnesota is a water-rich state with a great deal of water stored in aquifers, lakes and streams. We are not running out of water. However, in many parts of the state we are using so much water that lake levels are declining. In addition, our human activities are negatively affecting our lakes and lake ecosystems.

Working Toward Statewide Sustainable Lakes- Top Priorities

1. **Data, Information and Analysis**: Maintain and enhance water information and monitoring program for lakes. Establish an interagency working group on lakes. Continue and accelerate studies focused on wetlands and on shallow and deep lakes .Increase emphasis on collecting information to understand groundwater and surface-water interactions in lakes. Prepare a strategy for generating and managing information needed to integrate lake- assessment results into regulatory programs on a statewide basis. Support systematic lake assessments by re-assessing data programs in order to collect the data t needed.
2. **Establish the status of lakes on a statewide basis**. Establish criteria for the state's lakes that considers criteria for lakes to be maintained, improved and protected. Establish policy to promote those goals**.**
3. **Water Budget Information**: Incorporate more robust water- budget information into water planning for lakes. Improve our understanding of the classes of lakes, water balances and water sustainability by including vigorous assessments of lakes into the one watershed/one plan program. Use existing information about groundwater recharge, streamflow, and water use to identify priorities for sustaining lake ecosystems, based on objective criteria. Use this analysis to assess priority areas for future lake- management programs.
4. ***Consider policy/legislation/incentives aimed at protecting shorelines of lakes of the state, based on a tired approach that considers lake status. This should consider housing density, wastewater management and set-back requirements to protect lake quality and habitat.***
5. ***Consider more rigorous legislation focused on stopping the progression of invasive species across lakes in the state.***
6. Consider legislation that is focused on **eliminating emerging contaminants** from wastewater across the state.
7. Provide additional agency support to understand stressors and best management practices to **preserve and to enhance deep lakes**. Assess which lakes can be preserved as deep lake habitat.
8. ***Provide program support to assess lakes across the state focused on the potential effects of climate change and management practices that can mitigate those impacts***
9. Provide additional agency support to understand stressors and best management practices to **preserve and to enhance shallow lakes**. Assess which lakes can be preserved.
10. Provide program support for studies to **assess the impact of groundwater on lakes**. Conduct a statewide assessment of isotope chemistry to understand **how lakes interact with groundwater**, the landscape and groundwater withdrawals focused on how best-management practices can be most effective.
11. ***Develop a program to assess leaking septic systems and support legislation to provide support to fix inadequate septic systems.***
12. Assess **best-management practices as they apply to lakes**. These should include practices that address invasive species, nutrients and sediment. *Provide additional agency support to* ***understand stressors*** *and best management practices to preserve and to enhance shallow lakes across the state.*
13. **Economic Analyses**: Assess the costs and benefits of ensuring/protecting and enhancing the quality of lakes across the state. Quantify the economic value of lake ecosystem services provided by lakes and wetlands.
14. ***Groundwater Recharge:*** *Protect recharge areas for lakes.*

15. **Inter-jurisdictional water planning**: Support and provide processes to manage large lakes that cross jurisdictional boundaries. Use that process to explore options for better lake management.
16. **Connections between Hydrology and Aquatic Biology**: Increase programs to understand the interrelationships between groundwater, surface water and aquatic ecology as well as the associated eco-services.
17. **Importance of our state as the land of 10,000 high-quality lakes:** Dedicate a portion of Clean Water funds for lake- sustainably efforts. Establish a Clean lake sustainability Committee within the Clean Water Council.

A lake really is just another component of Earth's surface water. Lakes occur where surface-water runoff or groundwater seepage have accumulated in a low spot, relative to the surrounding countryside. It's not that the water that forms lakes get trapped, but that the water entering a lake comes in faster than it can escape, either via outflow in a river, seepage into the ground, or by evaporation. And if humans live nearby, water levels can be affected by water withdrawals for human needs.

Lakes provide many environmental, economic, and public health benefits. Lakes are highly valued for their recreational, aesthetic, scenic, and water-supply qualities, and they are one of the most treasured of our natural resources. Lakes constitute important habitats and food resources for a diverse array of fish, aquatic life, and wildlife. However, our lake ecosystems are fragile. Lake ecosystems can undergo rapid environmental changes, often leading to significant declines in their aesthetic, recreational, and aquatic ecosystem functions. Exposed to external effects from the atmosphere, inflowing streams and groundwater, lakes are subject to change through time. Human activities can further accelerate the rates of change. If the causes of the changes are known, human intervention (lake-management practices) sometimes can control, or even reverse, detrimental changes.

Healthy lakes enhance our quality of life. They support complex and important food web interactions and provide habitat for many types of fish and wildlife. Lakes contribute to a healthy economy: they are an important draw for tourism and provide recreational opportunities for our state's residents and our visitors. We need to protect our lakes for the future. Americans.

Following are some of the most important basic factors that give unique characteristics to lake ecosystems:

- Climate: Temperature, wind, precipitation, solar radiation all critically affect the lake's hydrologic and chemical characteristics, and indirectly affect the composition of the biological community. Precipitation is the main factor affecting runoff the delivery of nutrients and sediments.
- Atmospheric inputs: Precipitation, such as acid rain, and dry particles can be major sources of certain contaminants to a lake. Each lake also receives indirect atmospheric inputs by way of the runoff from its watershed.
- Geology, soils and groundwater: Soils and geology determine the extent, nature, and quality of groundwater inflows and outflows to lakes.
- Physiography: The area, surface topography, groundwater connection, upstream lakes and wetlands, altitude, and land slope of the lake's watershed affect surface-water runoff and the amount and nature of chemicals and sediments entering the lake. Interactions with land use by people can greatly change how these factors affect runoff and the export of nutrients and sediment.
- Land use: The type, location, extent, and history of land cover/land use (such as agriculture, rural, and urban developed areas) can greatly affect the quantity of surface-water and groundwater inflows and outflows, as well as the amounts and types of sediment, nutrients and chemicals (natural or synthetic) that are transported into the lake from the watershed.
- Lake morphology: Size, shape, and depth characteristics of a lake are critical in determining currents and mixing of the lake, as well as its thermal and chemical stratification characteristics.

Common environmental problems in lakes: Lakes are subject to a variety of problems that can diminish their aesthetic beauty, recreational value, water quality, and habitat suitability. Among the most common lake problems is eutrophication, which is the process of physical, chemical, and biological changes ("aging") associated with nutrient, organic matter, and silt enrichment of a lake. Eutrophic conditions can be exhibited with the following conditions:

- Algal blooms: Extensive and rapid growth of planktonic (floating and suspended) algae, caused by an increased input of nutrients (primarily phosphorus, but sometimes nitrogen), is a common problem in lakes. Lakes normally undergo aging over centuries, but the process can be accelerated rapidly by human activities that cause increases in sedimentation and nutrient inflow to the lake. Accelerated eutrophication and excessive algal growth reduces water clarity, inhibits growth of other plants, and can lead to extensive oxygen depletion, accumulation of unsightly and decaying organic matter, unpleasant odors, and fish kills.
- Sedimentation/turbidity: Increases of sediment can harm water quality and the habitat for many aquatic species. Such events usually are caused by heavy rains that produce erosion and intense runoff.
- Oxygen depletion: Decreases in dissolved to less than 3 mg/L (milligrams per liter) in the water can be harmful or lethal to aquatic life. Oxygen can get used up due to organic decomposition. Prolonged low oxygen concentrations can lead to fish kills.
- Growth of aquatic plants: Normal plant growth generally is beneficial for the lake ecosystem; among other benefits, the plants provide refuge for fish and other organisms. However, in some lakes, the growth of aquatic plants ("weeds") can become excessive and create a serious nuisance for lake users, interfering with swimming, boating, and other recreational activities. Other causes of excessive plant growth include increased nutrients in the water, invasion of exotic species, and accumulation of organic sediment.
- Water-level change: Wide fluctuations in stage (lake level) can create major hardships for lakeside residences, marinas, and businesses. These changes most commonly are linked to weather anomalies (extended periods of abnormally high or low precipitation), but also may be associated with human activities such as withdrawals for water use.
- Species shifts: Populations of desirable animal and plant species might decline sharply or disappear, to be replaced by other less-desirable species. Species shifts can be caused by introduction of invasive species that may have little or no natural controls on their population growth.

Lakes vary greatly and understanding impairments and stressors as well as our state of our lakes can help us frame management and regulatory approaches. These indicators include the chemical, physical, recreational, and biological conditions. The chemical characteristics of lake condition, such as nutrient levels and dissolved oxygen, create environments essential for aquatic organisms to survive and grow. Chemical conditions in lakes affect the health of primary producers (algae), zooplankton, macroinvertebrates, and fish. Chlorophyll-an often is used as an indicators of trophic state (productivity). In order to address recreational and human health-related considerations, indicators such as concentrations of the algal toxin microsystem, cyanobacteria and chlorophyll-a concentrations are important for the presence of algal toxins. Mercury in lakes and in sediment is important because bio-accumulates in the food chain. Herbicides and other agricultural chemicals also are important because they have potential to affect aquatic life as well as human health.

Important physical indicators of lake condition include conditions on the water's edge (lakeshore) and in shallow water, measures of human disturbance, and drawdown (the natural or intentional lowering of lake water levels). Healthy physical habitat affects biological communities in many ways, such as providing food and shelter for aquatic wildlife and moderating the magnitude, timing, and pathways of water, sediment, and nutrient inputs into lakes.

The EPA's National Lakes Assessment (NLA) 2012 was a collaborative survey of lakes in the United States. It included an evaluation of the biological, chemical, physical, and recreational condition of lakes. During the assessment, field crews, including staff from the Minnesota Pollution Control Agency (MPCA) sampled 1,038 lakes across the country. Each field crew sampled benthic macroinvertebrates (e.g., insect larvae, snails, and clams), zooplankton (small animals in the water column), algal toxins, atrazine, and nutrients and to observe near-shore habitat so that results could be compared across the country. These measured values are important to benchmarks, and points of reference to determine the proportion of lakes that are relatively high quality (least disturbed), medium quality (moderately disturbed), and degraded (most disturbed) in condition.

The national assessment found that nutrient pollution was common in U.S. lakes; 40% of lakes had excessive levels of total phosphorus and 35% have excessive levels of total nitrogen. Nutrient pollution was found to be the most widespread stressor among those measured and contributes to algae blooms and affect public health and recreational opportunities in lakes. An algal toxin, microsystem was detected in 39% of lakes, but concentrations rarely reached

Moderate or high levels of concerns established by the World Health Organization (<1% of lakes). The herbicide atrazine was detected in 30% of lakes, but concentrations rarely reach the EPA level of concern for plants in freshwater (<1% of lakes). In addition, 31% of lakes had degraded benthic macroinvertebrate communities, while 21% of lakes had degraded zooplankton communities. Exploratory analyses found an association between nutrients and biological condition, with lakes with phosphorus pollution likely also to have a degraded biological condition. The Assessment offers a unique opportunity to frame discussions and plan strategies for the protection and restoration of lakes in Minnesota. The information can help us understand the condition of our lakes in as well as the stressors affecting them, and how stressors relate to local conditions

- **Physical Habitat Condition Indicators:** The condition of lakeshore habitats provides important information relevant to lake biological health. These include indicators such as: riparian (lakeshore) vegetation cover, littoral (shallow water) habitat, lake drawdown (lowering of lake levels), habitat disturbance (extent and intensity of human activity), and habitat complexity (a combined index of condition at the land-water interface).

- **Shallow Water Habitat:** The shallow water habitat indicator examines the quality of the shallow edge of the lake by using data on the presence of living and non-living features such as overhanging vegetation, aquatic plants, large woody snags, brush, boulders, and rock ledges. Lakes with greater and more varied shallow water habitat are typically able to more effectively support aquatic life because they have many complex ecological niches.
- **Lake Drawdown Exposure**. Lake Drawdown can occur in both natural lakes and reservoirs. It can be the result of natural processes, such as drought or the result of direct manipulation of water levels for lake management purposes. Changing or significantly lowered lake water levels can adversely affect physical habitat conditions in and around the lake and therefore can also have an impact on biological communities.
- **Lakeshore:** Disturbance. The lakeshore disturbance indicator reflects direct human alteration of the lakeshore itself. These disturbances can range from minor changes, such as the removal of trees to develop a picnic area, to major alterations, such as the construction of a large lakeshore residential complexes. The effects of lakeshore development on the quality of lakes include excess sedimentation, loss of native plants, and alteration of native plant communities, loss of vegetation structure and complexity, and modifications to substrate types. These impacts a negatively affect fish, wildlife, and other aquatic communities.
- **Lake Habitat Complexity:** The habitat complexity indicator combines lakeshore and shallow water indictors described above to estimate the amount and variety of all cover types at the water's edge (on land and in water).
- **RECREATIONAL CONDITION INDICATORS:** Lakes are used for a wide variety of recreational purposes, including swimming, waterskiing, windsurfing, fishing, and boating. Contaminants in lakes can pose a potential threat to humans, pets, and wildlife. The NLA 2012 assessed algal toxins, mercury in sediment, and atrazine as indicators of human use or recreational condition in U.S. lakes.
- **BIOLOGICAL CONDITION RESEARCH INDICATORS:** Biological indicators are commonly used in stream and river water quality assessment programs, but they are not typically used in lake monitoring programs. Aquatic organisms integrate multiple water quality factors over time, such that communities reflect their environment.

CURRENT CONDITION AND CHANGE: While many lakes are in good condition, the NLA indicates that a substantial portion of lakes in the U.S. are in a disturbed condition for nutrients; 40% of lakes contain excessive total phosphorus concentrations and 35% of lakes have excessive nitrogen concentrations. The NLA indicates that 21% of the population of lakes are hypereutrophic. For biological measures, we find that 31% and 21% of lakes are in the most disturbed condition based on benthic macroinvertebrate and zooplankton, respectively

IMPLICATIONS FOR LAKE MANAGERS: The NLA provides a number of findings that lake managers can use to protect and restore lakes. However, the NLA did not address all information needs at all scales. For example, the lakes survey did not address causal factors or sources of stress. In-depth monitoring and analysis of individual lakes necessary to establish causality and to better inform restoration. Nutrients have been longstanding stressors of water bodies in this country. Stressors include nutrients, methylmercury, and ND riparian vegetation cove. Lake managers need to continue to conduct state-wide surveys to assess site-specific information. Periodic lake surveys will help water resource managers assess broad-scale temporal differences in the data and perform trend analyses.