DEPARTMENT OF NATURAL RESOURCES

# Considering a Nanobubble Aeration Pilot Project?

If you are considering nanobubble to address water quality concerns it is important to ask the right questions early to evaluate whether a pilot project is appropriate for your waterbody.

**Who is this for?**

This document is intended for lake associations, municipalities, watershed districts, consultants, or other potential applicants who are considering whether nanobubble technology could help improve a lake's water quality. Approval of a nanobubble pilot project allows the activity for the period authorized and does not guarantee that the activity will be approved again in future years.

The information below is provided to help you understand what to consider early in this decision, before committing financial resources or submitting a permit application.

1. **Defining the Purpose, Concern and Scale.** Before pursuing nanobubble aeration, applicants should clearly identify what problem they are trying to solve and whether nanobubble aeration is the best way to address the problem:

    a. **What problem are you trying to solve?**
        - Low dissolved oxygen
        - Internal phosphorus loading
        - Harmful algal blooms
        - Organic sediment accumulation
        - Odors or aesthetic concerns

    b. **At what scale is the problem you are trying to solve?**
        - Localized area (near dock)
        - Part of a lake (*e.g.,* bay)
        - Whole lake

2. **Understanding Expectations and Claims.** At this time, limited independent, peer-reviewed data exists on the use of nanobubble technology in natural lake systems. Applicants are encouraged to carefully evaluate expectations associated with nanobubble technology, particularly when information is provided by vendors. Due to current data limitations and safety considerations, nanobubble pilot projects will be strongly discouraged for winter aeration.

    a. **Key questions to consider when deciding if nanobubble aeration is a viable option include:**
        - Has there been a diagnostic study done specifically for your lake to demonstrate that nanobubbles are logical and practical?
        - What data exist demonstrating the identified problem could be addressed at the proposed scale?
        - What outcomes are being promised and are there any numeric measures for success?
        - How long are the proposed benefits expected to last? Only while the system is running? Throughout the season? Or into subsequent years?
        - Has the technology worked in a similarly sized, natural lake system, and is there documentation?

3. **Cost and Long-Term Commitments.** Running a nanobubble system at a whole-lake scale can be expensive. Cost alone does not determine permit eligibility, but economic feasibility and sustainability are important considerations when deciding if nanobubble technology is right for you.

   a. **What are the upfront and ongoing costs? These may include:**
      - Capital costs for equipment and installation.
      - Energy requirements and operational expenses.
      - Monitoring and reporting costs.
      - Maintenance, repair, and replacement.
      - Decommissioning or removal if the project is discontinued.

   b. **You also may want to consider:**
      - Is funding available for a multi-year commitment?
      - What happens if/when the system is removed or turned off?
      - How long will it take to produce measurable results?
      - What are the consequences if the process fails to produce results in a reasonable time?

4. **What work has already been done and have you considered alternatives before nanobubbles?** Most lake water quality problems originate from the loading of nutrients and other pollutants from the lake's watershed. It's important to first understand and address these pollutant sources before working within the lake. There are other more established in-lake water quality management options as well. For lake associations, much of this work has likely been considered by your local unit of government and early coordination is encouraged.

   **Consider the following questions:**
      - What watershed-based nutrient reduction projects or other relevant best management practices (BMPs) have been done?
      - Has any coordinated effort been taken to determine if other ongoing monitoring programs or implementation plans may be influencing water quality conditions?
      - Have other internal nutrient load management strategies been considered (e.g. alum, shoreline restoration, carp control, conventional aeration)?

5. **What is a Pilot Project?** A nanobubble pilot project is intended to:
      - Generate measurable, lake-specific environmental data.
      - Reduce uncertainty of potential ecological impacts.
      - Define monitoring methods and future regulatory framework.
      - Contribute to the scientific evaluation of nanobubble technology in public waters.

   **A pilot project is not**:
      - A guaranteed pathway to long-term system approval for your lake,
      - Endorsing the technology over other clean water practices,
      - A substitute for other regulatory compliance with water quality parameters (*i.e. MPCA)*.

6. **Using the Permit Questionnaire as a Self-Screening Tool**.

   DNR has prepared a Nanobubble Permit Aeration Application to help applicants determine:
      - Whether their proposal is developed to the best of its ability,
      - Whether baseline data exists and where you may find it,
      - Whether monitoring and reporting can be reasonably conducted,
      - Whether the proposed use aligns with public water protection standards.

Applicants who are unable to address key questionnaire elements may want to gather additional information or reach out to Denise Elston, Aeration Program Coordinator, with questions before submitting a formal application. The DNR encourages early coordination and realistic expectations. Protecting Minnesota's public waters remains the priority, and innovation must proceed in a manner that is measurable and protective of aquatic resources.