Long Lake Oxygenation Feasibility and Engineering Pre-Design Study - Recommended Scope of Study

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July 13, 2005

Introduction

The following is a rough outline and cost estimate for a feasibility/engineering pre-design study for aeration and/or oxygenation of Long Lake. Aeration/oxygenation is a common lake management strategy in which dissolved oxygen is added to oxygen-deficient lake waters, usually bottom (hypolimnetic) waters during periods of thermal stratification in summer and fall, and less commonly, under stratification associated with winter ice cover. These systems use either air (aeration) or pure oxygen gas (oxygenation), and will be generically referred to here as oxygenation systems. Generally, oxygenation systems are most frequently employed to directly reduce internal nutrient loading, particularly of phosphorus, and indirectly to control excess algae productivity, particularly that of blue-green forms.

Internal source reduction complements external source controls, and can provide other significant water quality benefits. Impacted water bodies may contain stored oxygen demand and nutrients in aquatic sediments, and external controls efforts often do not provide sufficient overall nutrient and oxygen demand reduction to overcome this "legacy", at least within reasonably short timeframes. Oxygen addition can overcome this problem. Other benefits of oxygenation include increased or restored habitat for fish and aquatic invertebrates, and reduction of ammonia and certain toxic metals, such as mercury.

The study outlined here would provide important and practical information concerning potential benefits and costs associated with the oxygenation system for Long Lake, thereby allowing for better evaluation of how oxygenation technologies might compliment or enhance phosphorus and nutrient control efforts on the Spokane River corridor, as well as improve oxygen and habitat downstream of the Long Lake dam.

The study should contain four major elements:

1. Current data assessment
2. Goals of oxygenation- benefits/limitations impacts
3. Technology options
4. Facility requirements and costs

Recommended Scope of Study

1. Data Assessment

Substantial historical data on the Spokane River/Long Lake corridor exist, and understanding spatial and temporal patterns of dissolved oxygen (DO) relative to water quality criteria are essential to define potential oxygenation needs. The data assessment element should focus on, but not be limited to, documenting the following for as may years as data permit: DO levels and flow rates of discharge from the lake, rate of DO uptake in hypolimnetic waters, changes in hypolimnetic volume and sediment surface area, locations of "hot spots" or isolated regions that may exhibit depressed DO.

Since patterns of DO in the lake are a major determinant in the type, location, and size of any aeration/oxygenation system, it is critical that the assessment is developed and presented in a straight forward and transparent manner so that it can be evaluated by all interested stakeholders.

2.Goals of Oxygenations- benefits/negative impacts

To date, various TMDL Workgroup participants have verbalized the following goals for oxygenation:

1. Meet regulatory criteria for minimum DO (8 mg/L)
2. Meet regulatory criteria for DO reduction (no less than 0.2 mg/L below "natural" conditions)
3. Improve reservoir water quality by suppressing internal phosphorus loading that may exacerbate algae and blue-green algal blooms, by reducing ambient ammonia levels, and by reducing sediment releases of toxic metals, such as mercury and others
4. Improve habitat in Long Lake for fish and other aquatic organisms
5. Improve DO in tail-waters discharged from the Long Lake dam and improve downstream water quality and aquatic habitat to meet Spokane Indian Reservation water quality standards

Task associated with this element would include articulation of objectives for achieving these goals, and others identified by the TMDL Workgroup. The task should include identification of both benefits and limitations of associated with the goals and objectives.

3. Technology options

Various technologies exist to enhance DO in surface and hypolimnetic waters of rivers, lakes, and reservoirs (e.g, , turbine venting, aeration weirs, destratification/mixing, lift-tube aeration, layer aeration, line diffuser oxygenation, submerged chamber oxygenation). This task would include listing of the suite of potentially appropriate technologies to be employed to meet goals of Task 2, and investigation of their potential application to Long Lake/Spokane River system.

The principal output of the feasibility study will be a decision making matrix of appropriate technologies with cost, benefits, etc. for addressing goals associated in the Spokane River, in Long Lake, and downstream of the Long Lake dam. Since the best technology or mix of technologies will be affected by the goal or goals, the early involvement of all potential parties in the process is highly desireable.

4. Facility Requirements and Costs

This task would include a description of the actual facilities associated with appropriate technologies identified in Task 3. The magnitude and potential locations for facilities should be identified. For example, a key component of oxygenation facilities is provision for power and maintenance access, and this task would provide a detailed account of similar issues. Depending on the quantity and quality of data provided from Task 1, a statistical approach to sizing aeration/oxygenation systems could be used. Such an approach would avoid "over engineering" a system based on "worst-case" conditions, and instead size a system to meet the objective some percentage (e.g., 90%) of the time. We anticipate that such an approach could result in significant cost savings.

This task would also include a rough, preliminary estimate of both capital and operating costs. Subsequent detailed engineering analysis would be required to implement any selected options, but this study would be designed to provide sufficient information to guide decision making.

Cost and Timing of Study

Based on previous experience as an engineering consultant (Beutel), it is estimated that cost associated with Tasks 2 through 4 would be on the order of $100,000 to $150,000 and take four to six months to complete.