



LONG ISLAND SOUND STUDY

A Partnership to Restore and Protect The Sound

ALTERNATIVE STRATEGIES FOR HYPOXIA MANAGEMENT: Creative Ideas to Complement Advanced Treatment

The Long Island Sound Comprehensive Conservation and Management Plan (CCMP) identifies low dissolved oxygen, or hypoxia, as the most serious water quality impairment in the Sound. The annual summertime occurrence of hypoxia in the deeper waters of western Long Island Sound reduces the amount of healthy habitat necessary to support fish and shellfish. The CCMP identifies excessive discharges of nitrogen, a nutrient, as the primary cause of hypoxia, and sewage treatment plants as the primary source of this excess nitrogen. To address this problem, the Long Island Sound Study (LISS) is implementing a phased approach to reducing nitrogen loads to the Sound from sewage treatment plants, industrial dischargers, and nonpoint sources.

These phased nitrogen reductions, however, may not raise dissolved oxygen to levels necessary to support all life stages of marine life in Long Island Sound. Additional measures will likely be required to achieve the states' water quality standards for dissolved oxygen. These measures may include advanced treatment at sewage treatment plants upstream of the Connecticut border, reductions in atmospheric nitrogen loadings, and several "non-treatment" techniques, which are the subject of this fact sheet.

Solving a large, complex environmental problem like hypoxia in Long Island Sound requires creative solutions. New ideas are being considered as part of a dynamic process that takes advantage of changes in technology and different ways of thinking. This fact sheet highlights some of the methods other than advanced treatment that have been considered to improve dissolved oxygen levels in the Sound. Some

are more feasible than others, and some may never be implemented. The alternatives are listed in order, from those most likely to be put in place to the least likely.

In assessing the alternatives, the LISS considered the requirements outlined in the federal water pollution control regulations. The requirements call for the use of treatment over nontreatment techniques (e.g., increasing the flow of receiving waters to enhance dilution or using in-stream mechanical aerators to increase oxygen levels).

However, non-treatment techniques may be considered as a method of achieving water quality standards on a case-by-case basis when treatment technologies are not sufficient to achieve the standards.



CREATION OF ARTIFICIAL WETLANDS

Creating artificial wetlands can provide treatment for storm water runoff entering Long Island Sound. Artificial wetlands, if well-designed and managed properly, may be able to remove nitrogen from runoff. However, it is, at best, a partial solution that can be incorporated into the overall nitrogen control strategy, complementing natural wetland protection and restoration efforts.

Advantages:

- Provides nitrogen removal;
- May help reduce loadings of toxic contaminants, sediment, pathogens, and floatable debris by filtering them out before they reach the Sound; and
- May provide valuable shoreline habitat for birds and marine life.

Disadvantages:

- Limits public access to the shoreline;
- Presents potential conflicts with developers; and
- Requires large areas of wetlands to have a measurable benefit.

AERATION OF BOTTOM WATERS

Locating mechanical aerators in hypoxia “hot spots” would introduce oxygen to oxygen-depleted waters. Aerators also would help break up vertical density stratification in the water column, allowing mixing of oxygen-rich surface waters with oxygen-depleted bottom waters. Although impractical for large areas, this alternative may be considered after planned nitrogen reductions have reduced the areal extent of hot spots.

Advantages:

- Serves as a direct solution to the low dissolved oxygen problem;
- Easy to operate;
- Has flexibility and can be used in a variety of locations;

- Has relatively low capital costs;
- Has proven successful in small scale operations; and
- Can be switched on and off.

Disadvantages:

- May cause resuspension of sediments and associated chemical contaminants;
- May disrupt marine organism movement and migration;
- May eject bacteria and viruses into the atmosphere;
- Creates froth on the water’s surface from the bubbles;
- Requires long-term maintenance of mechanical equipment; and
- Intense energy requirements could inflate the costs.

SEAWEED FARMS

Raising benthic macro algae (seaweeds) may help alleviate the hypoxia problem by removing nitrogen from the water column through biological uptake. As with creation of artificial wetlands, seaweed farms are at best a partial solution that can be incorporated into an overall nitrogen management plan.



Advantages:

- Has existing market for seaweed and its byproducts;
- Removes nutrients from the water column;
- Generates dissolved oxygen through photosynthesis; and
- Seaweed farms in other countries have proven to be successful.

Disadvantages:

- Has limited effectiveness as a single solution to the hypoxia problem;
- Uncertainty of whether there is species of

seaweed that would be feasible for aquaculture in Long Island Sound; and

- Floating structures may interfere with navigation.

RELOCATION OF SEWAGE TREATMENT PLANT OUTFALLS

This alternative involves redirecting New York City sewage treatment plant outfalls from the East River to New York Harbor, and relocating Westchester County outfalls toward central Long Island. It had been determined that relocation of the Westchester County outfalls is not cost-effective. Relocation of the East River outfalls needs further evaluation.

Advantages:

- Improves dissolved oxygen in western Long Island Sound and the East River;
- Reduces toxic contaminant loading in the East River;
- Is cost-effective; and
- May reduce combined sewer overflow impacts (i.e., nitrogen, toxic contaminants, pathogens, and floatable debris).

Disadvantages:

- Causes adverse water quality impacts at new discharge locations;
- Introduces new pollutant loads to the Hudson River circulation pattern;
- Increases nutrients to the New York Bight and Raritan Bay;
- May cause changes in flora, fauna and fish migration patterns in the Sound;
- Increases salinity and temperature alterations in the western Sound;
- May cause adverse effects at Atlantic Ocean beaches; and
- Disturbs habitat near the diffuser field at the discharge.

TIDE GATES

Installing tide gates could prevent tidal currents in the East River from entering Long Island Sound. Preliminary estimates by two engineering firms placed construction costs at \$500 million to \$1 billion. Some of the cost could be defrayed if the tide gate served a dual purpose, such as providing a structure for a railroad crossing. Operational costs are anticipated to be relatively low. This alternative is not likely to be pursued, however, because it has the potential to change the whole ecosystem in the western Sound, resulting in unintended consequences that are difficult to predict and may prove to be irreversible.

Advantages:

- May increase the overall circulation in the Sound and adjacent water bodies;
- Prevents nitrogen and other pollutants from entering the Sound from the west end;
- Causes reduction in coliform bacteria concentrations; and
- May flush Long Island Sound and New York Harbor with cleaner Atlantic Ocean water.

Disadvantages:

- Affects tidal heights and currents;
- May cause potential changes in flora, fauna and fish migration patterns in the Sound;
- May alter salinity and temperature regimes in the western Sound;
- Increases pollutant loading to New York Harbor and the New York Bight; and
- Impedes vessel navigation in the western Sound.



ALTERING THE BASIN **MORPHOLOGY OF THE SOUND**

Dredging the Mattituck Sill, East River, and Hempstead Sill may increase water circulation in the Sound. Like tide gates, this option has the potential to alter the ecosystem of the Sound, resulting in consequences that are difficult to predict and may be impossible to reverse.

Advantages:

- Increases bottom water renewal from the Atlantic Ocean;
- Can be implemented in phases, allowing for evaluation of effects;
- May be a potential source of sand for activities such as beach nourishment; and
- Is technologically simple.

Disadvantages:

- Presents disposal problems for any contaminated dredged material;
- May cause changes in salinity in the Sound and associated ecological effects;
- Is expensive;
- May have adverse effects on coastal erosion; and
- Causes changes in characteristics of surface sediments and benthic communities in dredged areas.

All of these alternatives are currently being subjected to varying degrees of evaluation by LISS Management Conference participants. New York City in particular is very interested in exploring the feasibility of an East River tide gate and the relocation of sewage treatment plant outfalls. The development of a "systemwide" computer model, which includes Long Island Sound, New York/New Jersey Harbor, and the New York Bight, will help assess the broader, regional impacts of some of these alternatives.



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