Frequently Asked Questions

Nutrient Inactivation Treatment to Address Internal Loads of Phosphorus in Sediment at Santuit Pond

Mashpee, MA

Q. What is in-pond nutrient inactivation?

A. In-pond nutrient inactivation is the direct addition of a binding agent to capture excess available phosphorus in the water column or sediments of a pond. This is typically applied to the pond from a treatment boat or barge. In the case of Santuit Pond, nutrient inactivation would be targeted primarily at phosphorus that has accumulated in the sediments but has not been effectively immobilized. Inactivating this sediment phosphorus will quickly and substantially reduce phosphorus concentrations in the waters of Santuit Pond. In turn, this will lead to reduced frequency, duration, and severity of cyanobacteria blooms.

Q. If stormwater and septic system inputs to Santuit Pond are addressed, won't that fix the issue with excess nutrients?

A. Reduction of these sources is an important part of the solution. However, even if all stormwater and septic system inputs were reduced to zero immediately, Santuit Pond would likely continue to have elevated phosphorus and cyanobacteria blooms for years. This is because the pond has built up a store of legacy phosphorus in the sediments. If that store is not addressed, the pond will continue to be impacted.

Q. What type of formulation is being recommended for nutrient inactivation at Santuit Pond?

A. Several different formulations are available in the marketplace. Each of these were evaluated for feasibility, reliability, and cost-effectiveness. Given environmental conditions at Santuit Pond, the selected formulation will need to be effective in the absence of oxygen. Of those that are, the most readily available and cost-effective formulation is alum. Alum also has a long track record of successful use in Massachusetts, thereby providing reasonable reliability of outcome. Therefore, alum was recommended as the preferred formulation for use at Santuit Pond.

Check out the new Santuit Pond Learning Hub

Learn all about Santuit Pond and how you can protect and enhance this natural resource.

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Frequently Asked Questions

Q. What is alum?

A. Alum is aluminum sulfate. Aluminum is the most abundant metal on Earth and is naturally found in soils and sediments worldwide. Sulfur is also commonly found almost everywhere on the Earth's surface. Alum has a large number of practical uses but the most relevant ones are related to water treatment. It is widely used to remove particulates and other undesirable pollutants as part of the drinking water treatment process.

Q. Is alum a chemical?

A. Yes, alum is a substance with a consistent elemental composition, which therefore makes it a chemical. However, the fact that it is a chemical does not inherently make it bad for water quality or the environment. For instance, water and oxygen gas are both chemicals. That said, any chemical must be used with caution and in appropriate amounts to address the issue at hand.

Q. Were non-chemical approaches to water quality improvement at Santuit Pond considered?

A. Yes, a number of alternative chemical and non-chemical approaches were considered. Stormwater and domestic wastewater management improvements are two recommended non-chemical approaches that are expected to help improve water quality. Additionally, the continued use of the existing SolarBee circulator units in Santuit Pond was also recommended.

Q. I still don't like the idea of using chemicals. Can't we use enzymes or bacteria to naturally eat the phosphorus-rich muck and solve the internal phosphorus loading problem?

A. Not at this time. Although there are a number of products on the market that claim to be natural solutions to excessive phosphorus and algae problems, there is little scientific evidence that these products work at the scale of Santuit Pond. Even if the pond's muck were fully digested by these products, the phosphorus itself would not be destroyed, removed, or permanently bound.

Q. Has alum been used elsewhere in Massachusetts to address similar problems?

A. Yes, alum has been used in dozens of water bodies over the last few decades, including a number on Cape Cod. Some examples are listed below:

1. Cliff Pond – Brewster / Orleans
2. Long Pond – Harwich
3. Hamblin Pond – Barnstable
4. Ashumet Pond – Mashpee / Falmouth
5. Great Pond – Eastham
6. Herring Pond – Eastham
7. Mystic Pond - Barnstable
8. Lovells Pond – Barnstable
9. Stillwater Pond – Chatham
10. Lovers Pond – Chatham
11. Parker Pond – Barnstable (Osterville)

Water quality in each of these ponds was improved following treatment.

Frequently Asked Questions

Q. Does alum kill algae and cyanobacteria?

A. No, not directly. Alum may incidentally trap some algae and cyanobacteria cells during treatment, carrying them down to the sediments. However, this is not the primary way in which alum controls blooms. Alum's primary mode of action is through inactivation of phosphorus, which reduces the amount of nutrients available for algae and cyanobacteria to grow and develop into blooms.

Q. Will alum completely eradicate algae from Santuit Pond?

A. No, alum treatments are only intended to prevent the excessive growth of algae. These organisms are an important part of the natural food web that fish and other aquatic life depend on. Alum will help to restore healthy levels of algae to the pond.

Q. Will alum control invasive rooted plants in Santuit Pond?

A. No, alum does not have herbicidal action on plants and does not prevent plant roots from obtaining nutrients in the sediments. Therefore, alum is not expected to reduce the growth of invasive rooted plants in Santuit Pond.

Q. How will alum be applied? Will it be dumped into the pond, broadcast, or sprayed? Does it have a chemical smell?

A. Alum comes in liquid form and treatment is a precision process that requires specialized equipment and professional training. For effective treatment, alum must be injected under the surface of the water. The injection rates are controlled so that the treatment is applied evenly and the pond is not overloaded with too much alum in one place or at one time. Alum treatments do not produce a perceptible odor.

Q. How do we know how much alum needs to be applied to Santuit Pond?

A. Sediment cores were collected from the pond in 2022 and run through a series of lab tests to determine the forms of phosphorus present and determine their concentrations. Using the results of the sediment testing in tandem with available water quality and water depth information, an appropriate dose of alum was calculated for Santuit Pond.

Q. What happens to alum when it is applied to a pond?

A. When alum is injected into pond water, it rapidly forms a whitish flocculent solid. This flocculent is aluminum hydroxide, which is very effective at attracting and binding phosphorus. Over the course of a few minutes to a few hours, this flocculent settles to the bottom of the pond. With additional time, the flocculent becomes incorporated into the sediments. As phosphorus tries to escape from the existing sediments, the aluminum hydroxide intercepts and binds it.

Q. Will the alum flocculent form a permanent blanket over the pond sediments?

A. No. At first, the flocculent will form a thin layer on top of pond sediments and aquatic plants. However, the flocculent material is dense and will become incorporated into bottom sediments over a few weeks to months.

Frequently Asked Questions

Q. Is alum harmful to life in the pond?

A. When applied appropriately by trained professionals, alum can be used without negative impacts to pond life. Alum flocculent actively binds phosphorus but it is largely inert on biology. By reducing phosphorus release from pond sediments, alum can also provide substantial benefits to water quality and, in turn, aquatic life.

Q. How will alum be applied to mitigate any harmful effects to fish or aquatic life?

A. Treatment would take place in autumn to avoid adverse impacts to the spawning of river herring and other fish species. Alum will also be appropriately buffered to minimize changes in pH during treatment. Additionally, all appropriate regulatory permits and approvals will be obtained in advance of treatment to ensure that proper protections are in place. Finally, water quality and aquatic life will be monitored over the course of treatment.

Q. Will anything else be applied with the alum? If so, why?

A. It is likely that sodium aluminate will also be applied at the same time as the alum. As with alum, sodium aluminate forms a flocculent that will bind phosphorus. Sodium aluminate is used to balance the pH of water in the pond during treatment. Typically, these are applied in a 2:1 ratio of alum to sodium aluminate (twice as much alum as sodium aluminate) which has been a reliable ratio for most treatments in Massachusetts. The treatment is monitored during application to make sure pH remains balanced within the pond. If pH rises or falls beyond the desired range, the treatment may either be paused until pH returns to the desired range or the ratio of alum to sodium aluminate may be adjusted to compensate.

Q. Will alum treatment introduce methylmercury to the pond?

A. Alum does not contain any form of mercury, so it will not directly contribute methylmercury to Santuit Pond. Methylmercury can be produced by natural, biologically mediated processes if pond sediments already contain mercury. Recent sediment sampling by the Army Corps of Engineers in 2021 found detectable concentrations of mercury in three of the ten samples tested from Santuit Pond. However, all detections were still well below the state soil and groundwater standards for mercury. Ultimately, the amount of methylmercury that can be produced by natural processes is limited by the amount of total mercury in the sediments, although the rate at which this occurs is governed by many complex and interacting factors that are still not well understood. The scientific literature to date provides little evidence that alum has a net effect one way or the other on the release of methylmercury from sediments.

Q. If iron readily binds to phosphorus, why not use iron instead of alum?

A. Iron is already present in Santuit Pond sediments at sufficient concentrations to bind phosphorus. However, iron cannot maintain this bond in the absence of oxygen. If oxygen drops to low levels, as is the case in Santuit Pond, iron-bound phosphorus will be released into the water column, making it available to fuel algae and cyanobacteria blooms. Aluminum does not require oxygen to bind phosphorus, meaning it can be more effective than iron in preventing the release of sediment phosphorus into the waters of Santuit Pond.

Frequently Asked Questions

Q. What happens to the alum after all binding sites are full?

A. As aluminum binds with phosphorus it forms aluminum phosphate. Aluminum phosphate is an unreactive solid under normal environmental conditions, meaning it will indefinitely persist in this inert form.

Q. Will alum fix water quality in the pond for good?

A. While alum is likely to provide immediate and noticeable water quality improvements, it will not address long-term issues on its own. Watershed control measures are needed to reduce pollution from external sources, such as stormwater and septic systems. Additionally, other in-pond management methods, such as circulation, may be useful for in helping to sustain the duration of water quality improvement achieved by the alum treatment. Finally, alum is not a panacea. It is very effective in capturing phosphorus and reducing the frequency and duration of blooms. However, it does not address many of the other environmental pollutants that may be entering the pond from the watershed and atmosphere.

Q. How long will the pond need to be closed if it is treated with alum?

A. To allow treatment crews to do their job safely and effectively, use of the pond will likely be restricted during periods of active treatment and possibly for a short period immediately following the treatment. However, there is no label restriction that would require closure of the pond to recreation for a particular duration.

Q. Will I be able to swim in the pond after nutrient inactivation?

A. Nutrient inactivation will not require the cessation of recreational swimming once the treatment is complete. The use of alum is intended to reduce the occurrence of algae and cyanobacteria blooms in Santuit Pond, which would improve water quality for swimming.

Q. Will an alum treatment disrupt recreation at the height of summer?

A. No. Alum is best applied during cool but not cold conditions. At Santuit Pond, a treatment would be applied in autumn.

Q. How long will nutrient inactivation be effective at Santuit Pond?

A. Alum will bind the targeted sediment phosphorus indefinitely but the duration of effective improvement on water quality varies. This is because as new phosphorus enters the pond from external sources (such as storm-water and septic) and new sediment buries the old deposits, phosphorus concentrations will begin to increase again. If nothing is done to control these external sources, Santuit Pond water quality could again degrade to its current state. However, if external sources are reduced, the benefits of nutrient inactivation will be extended. The more external sources are reduced, the longer the water quality improvements to the pond will last.

Q. Can I apply alum to treat sediments or control algae blooms along my shoreline?

A. No. Alum cannot be applied to water bodies without the proper licenses and permits. These are issued by various state and local agencies and require professional expertise to obtain.