
Large Ponds and Aeration

If you are contemplating a large pond (say ¼ acre and larger) then you need lots of aeration. Such ponds are too large to use biofilters and UV lights to control algae and clean healthy water. You will also want to think of using bioaugmentation but this is only effective under well aerated conditions/ Bioaugmentation is the process of adding specific bacteria to absorb nutrient build up.

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Please take notice of the vendors selling guarantees and delivery conditions. You will I am sure find these excellent and to your liking.

Inside this report you will find a catalog type layout to make comparison easy and meaningful ... far easier than web site clicking. ... you MUST be connected to the internet before clicking this link

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This report is a concise summary of an excellent detailed report produced by The Otterbine Corporation. I strongly recommend all interested readers get this report.

If you do not want to read the whole report be content with this summary ... BUT there is one over-riding message for any big pond owner you MUST add oxygen in large quantities to your pond to stand any chance of "natural" behaviour. This means installing large fountains or aerators. That is the simple over-riding message.



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Managing Large Ponds For Clean and Healthy Water ... such as seen in golf courses, turf, commercial or residential property. Poorly managed water will have a negative impact on the quality of the environment and the aesthetic value of the property.

Consider the negative effects of polluted water and air. It is no different when we talk about the aquatic ecosystem typical of larger ponds. A large pond is not just a larger version of a big garden koi or fish pond. Biofilters and UV lights do not work and are not economically feasible. So if you are thinking of installing a large pond (anything of surface area more than say 1/4 acre) then this article should be understood well.

Water is one of our most important and least understood natural resources. Many of our ponds, lakes, irrigation basins, and water features are not well managed. It sometimes seems easier to treat the visible symptoms of poor water quality such as, algae blooms, aquatic vegetation growth, odors, clogged valves and pumps rather than prevent them.

Our understanding has been superficial, leading to temporary and ineffective solutions that address acute problems and even appear to solve them temporarily but leave the underlying

causes unsolved to resurface time and time again. A better understanding of the causes of these larger pond problems leads to long term, environmentally friendly solutions - we do our best to emulate the natural process which mother nature has been successful at for ever such a long time.

Experts in lake management are called limnologists ... from now on we call large ponds lakes.

Leading limnologists are located at The University of Florida and The University of Minnesota. These universities provide testing and research in the field of aeration systems oxygen transfer and circulation.

This article is designed to give you a better understanding of the causes of poor water quality thereby allowing you to make rational decisions and understand what is important. Do not try to re-invent the wheel.

Every Lake is a Unique Ecosystem and Different. There is no single solution to every lake problem but the general approach is constant. Greater understanding is the secret.

In order to design and put into practice preventative water quality management programs it is essential to have a firm understanding of the causes of water quality problems.

Man made lakes tend to become Eutrophic lakes in a very short time ... such lakes are characterized by high nutrient levels, turbid water, and large algae and small plant life populations. Phosphorus levels can be in the range of 1mg/l.

One gram of phosphorus will produce 100 grams of algal biomass, and so eutrophic lakes contain high algae populations. This Eutrophic impact results from human inputs which include erosion, chemicals, fertilizers, waste runoff, leaky septic systems etc. The situation is worsened in shallow lakes, and where edges of lakes are badly designed runoff accelerates the eutrophication process.

Special attention is needed for a lake to be aesthetically pleasing.

Were you able to identify which categories your lakes are in?

Both the shape of the basin, morphometry and the shoreline characteristics, morphology, have significant importance to the lake manager. Inside these lake regions there are zones which have tremendous influence over water quality. Morphometry and morphology have significant influence over mixing in the basin. Both vertical and horizontal circulation are important in creating and maintaining a balanced ecosystem. Morphometry, or lake shape, has tremendous influence over horizontal mixing. Long narrow channels or canals often experience water quality management problems. Isolated peninsulas can create physical barriers to mixing and, water quality issues can more easily occur. Morphology, or the shoreline characteristics of a lake, has significant impact over vertical mixing and plant populations reference Otterbine web site.

Specific shoreline characteristics

The littoral zone is where the pond slopes from the shore out to the area of open water. It is the interface between the water entry point and the open water it is where run-off rich in nutrients takes place. Here sunlight will penetrate to the bottom of the lake. Sunlight, waves and the lake bottom influence this zone. It is the most challenging region of the lake to manage. This is where you normally see a ring of plants around the shore. The type of plants are dependent upon depth and a large part of the plant life will be algae, including filamentous types. Algae are often attached to emergent marginal aquatic plants such as rushes and reeds. This creates an excellent habitat for micro flora and zooplankton which are the cleaners of the lake. Zooplankton are microscopic animals like protozoan, micro crustaceans, rotifers and larger invertebrates such as: aquatic worms, crayfish, insect larvae, and fish.

The limnetic zone is the open water zone. It begins at the intersection of the littoral zone and extends out into open areas of the pond. This lake region is less influenced by what happens at the bottom of the lake. Planktonic algae, water lilies, submerged pondweed, zooplankton, invertebrates and fish are commonly found in the open water zone. The limnetic zone is easier to manage.

The epilimnion zone is the upper well lighted (by sunlight) area where photosynthesis takes place ... the region becomes populated by algae that thrive in sunlight and warmer water.

The benthic zone is the area at the bottom of the lake where solids settle to create sediment ... much of this is organic in nature and creates what is called the high BOD (biological oxygen demand)

Oxygen is added to the lake from wave and wind action, and by the daytime activity of plants and the photosynthesis process. Rain also adds dissolved oxygen to lake water. When there is not enough dissolved oxygen sets a series of undesirable chemical reactions that reduce water quality take place: sulfur products are converted to hydrogen sulfide, and insoluble iron is converted to soluble forms. In addition suspended solids increase and a large decrease in the decomposition of waste materials on the pond bottom will occur and the lake will become shallower over time.

Shallow lakes create many problems. If less than 6ft/2m in depth they tend to be warm which means the whole lake has a high population of weed and algae growth. These types of lakes need extra care at the design stage.

Warm water holds much less oxygen than cold water (for example at 50 degrees F water holds about 11ppm of oxygen but at 70 degrees F only 9ppm). This is a very significant change and is the reason certain fish cannot live in warm water ... eg trout. Carp on the other hand like warm water and tolerate much lower oxygen levels.

Nutrients in the lake

There is a direct correlation in the level of available nutrients and the populations of algae and aquatic weeds. Like you and me these plants need food and the more food there is the more they propagate (biomass increases). It is important to understand the sources of nutrients, how the nutrients are absorbed and broken down, and the impact nutrients can have on water chemistry.

The main nutrients are chemicals based upon Nitrogen, Phosphorous and Carbon or organic nutrients which have to be digested by the lake to provide food to plants. Phosphorus has been identified as the single greatest contributor to aquatic plant growth (one gram of phosphorus will produce 100 grams of algal biomass). As the nutrient level in the water increases so does aquatic plant and weed growth. In turn this creates significant problems both environmental and aesthetic.

Sources of nutrient

The three most common sources are bottom silt and dead vegetation in the lake (from dying algae and other plant life and organic life), runoff water from surrounding turf areas, and the sources of incoming water which contains nitrogen and phosphorous. Organic life cycles in the lake and sediment at the lake bottom are the primary sources of nutrient. This becomes a compost pile bottom of the lake. The layer of dead plant material acts as nutrient for future algae and aquatic weed blooms, a phenomena called nutrient cycling. Nutrient cycling creates additional demands on the available oxygen. Studies at the University of Florida indicate that sediment or sludge build up can accumulate at a rate of 1 to 5 inches or 2.5 to 12cm per year in temperate climates. While in tropical climates the rate increases to 3 to 8 inches, or 6 to 16 cm per year all depending on the level of nutrient loading. At a mid point accumulation rate of 3 inches or 7cm per year, a one surface acre or a 4000 square meter lake will lose 80,000 gallons or 300 cubic meters of water storage capacity in a single year reference Otterbine report. Just think what happens over a 10 year or 20 year period ... and now you know how swamps are created.

The second most common source of nutrients is runoff from surrounding garden, lawn or turf areas as well as paving etc. It is reckoned that 4% of the fertilizer you apply to the surrounding area will find its way into the pond water. Leaves and garden waste (grass clippings for example) also find a way into the pond. A case study presented by the North American Lake Management Society (NALMS) suggests that the algae can absorb over 1mg/L of phosphorus and over 2.5mg/L of nitrogen from the incoming water flow before it gets to the middle of the lake. If there were no nutrients there would be no plant or algae growth.

Oxygen is the secret in large ponds and lakes

The third critically important essential factor in any lake is the role oxygen plays. Oxygen is important to all forms of life in the lake. Oxygen supports the food chain in a lake or pond, a healthy ecosystem in a lake contains a wide variety of plants and animals including a natural mechanism to biodegrade organic nutrients. They all need oxygen. The bottom of the food chain consists of microscopic algae which are consumed by slightly larger zooplankton. Each level of consumer transfers a small fraction of the energy the lake receives up the food chain to the next

level of consumer. This means that a few sport fish depend on a much larger supply of smaller fish, and in turn the smaller fish depend on a large base of plants and algae. This large mass of plants and algae require an even larger amount of nutrient to grow, a healthy food chain can pull a tremendous amount of nutrient out of the water. Natural decomposition processes in the aquatic ecosystem are oxygen dependent. Aerobic digestion is a fast and efficient way of breaking down nutrients. Moreover, an abundant supply of dissolved oxygen supports the oxidation and other chemical processes that help keep the lake in ecological balance.

How is a lake supplied with oxygen?

From several sources but primarily through photosynthesis, wave and wind action. Aquatic plants and algae produce large amounts of oxygen through the light process of photosynthesis. This is an important source of oxygen in most lakes especially older, eutrophic lakes. At night plants become oxygen consumers in the dark process of photosynthesis and produce carbon dioxide.

The other significant oxygen producer is the oxygen transfer created by wave and wind action. The surface area of the lake is increased by surface waves or ripples caused by wind or other means, this wave action created by the wind creates additional circulation and partially breaks down thermal stratification. Surface waters that have direct contact with the air will be oxygenated through diffusion. As rain passes through the atmosphere it picks up free oxygen and deposits it in a dissolved state when it strikes the surface waters of the lake.

Oxygen depletion or stress situations occur for different reasons. Whenever oxygen levels fall below 3 to 4 PPM or mg/L an oxygen stress will occur. Typical situations when this will happen are:

Late at night and just before dawn

Cloudy and still days

Hot and humid days

When the lakes nutrient content is high

After a chemical application

The most immediate reactions to oxygen depletion would be fish kills or odors. Long term issues include nutrient build up, sludge accumulation, and a chemical imbalance in the lake. Nature has provided a clean up process that will metabolize or decompose excess nutrients. Two types of naturally occurring bacteria are present in all lakes and ponds, aerobic and anaerobic. The bacteria in the water will work to break down the nutrient load by feeding on the organic nutrients and digesting it into non-organic compounds that algae and aquatic plants cannot readily use for food.

The most effective of these bacteria are aerobic bacteria. Aerobic bacteria only live in the presence of oxygen and they metabolize or break down nutrients respiring or consuming oxygen in the process. They are very efficient, breaking down organic nutrients, carbon dioxide and other materials and are roughly seven times faster in organic digestion than anaerobic bacteria.

Anaerobic bacteria also break down organic nutrient and exists in pond water and soils that are oxygen deficient. They are not as effective as aerobic bacteria in the digestion of organic wastes and allow soluble organic nutrients to re-cycle into the water column. Noxious by-products such as methane, ammonia and hydrogen sulfide are created by anaerobic decomposition. In general, any foul smelling waters can be assumed to be anoxic or oxygen deficient.

Many people view algae as the lake management problem but the true problem is poor water quality, Algae and weed growth are the first signs of poor water quality. Benthic or filamentous algae is a very difficult type of algae to control. These plants grow from the bottom of the lake or benthic zone, break loose and float to the surface. They will only grow in conditions where the depth and turbidity of the water allow sunlight to reach the lake bottom. These algae are often called moss or cotton algae, some species have small air bladders that float the algae to the surface. Once at the surface, this algae becomes an ideal habitat for mosquitoes and other insects.

Probably the most difficult type of weed to eradicate are bottom rooted vascular plants. These plants often have small air sacks or bladders attached permitting them to float and to keep them in suspension. Bottom rooted, vascular weeds will only grow where the sunlight penetrates to the pond bottom. All of these weeds and algae have one common benefit...

they help reduce the available nutrients in the lake.

What are the impacts that algae and aquatic weeds create for the lake or property manager?

Increased nutrient/biomass levels in water causing sludge build-up Oxygen depletion issues such as odors and fish kills For the property manager the negative effects and costs of poor water quality are very real and can impact the property both in aesthetic and functional ways.

Sludge build up (eutrophication) as stated earlier impacts the manager in different ways. With the reduction in the basin's capability to store water, it has severe impact if the lake is an irrigation storage basin or a storm water retention pond. In either instance, the lake has been designed to hold a given capacity of water which have now been diminished.

Oxygen depletion can lead to fish kills and odors. Warm water fish require roughly 4 PPM (parts per million) of dissolved oxygen and cold-water fish require 5 PPM of dissolved oxygen. When oxygen levels in a pond drop one of the first indicators is a fish kill. When fish go into an oxygen stress you will typically see them at the surface where a minimal oxygen transfer occurs through oxygen diffusion. By increasing oxygen levels and circulating oxygen rich water throughout the pond, anaerobic conditions can be minimized while odorous gases can be stripped out of the water.

Preventing problems

In order to identify the proper preventative practice it is important to review the design process. How does the design overcome any potential problem relating to the three factors that have the

most impact on water quality management: sun light and temperature, nutrients and oxygen? With the growing awareness of the importance of water quality and its impact on the environment, preventative practices revolve around these issues and offer the most acceptable solutions as these solutions are directed at the causes.

Many lake management issues are related to light and the heat generated by the sun. Shallow lakes with a severe benthic or filamentous algae problem would be in this category. To attack the causes of excess solar radiation we need to look at the basin configuration and the use of lake dyes to block U.V. penetration. Proper lake design or configuration is the first step towards sound water quality and will minimize many of the inevitable management issues that arise as the lake ages.

Unfortunately there are many times lakes are designed too shallow, creating unnecessary problems that could have easily been avoided in the initial stages of development. Proper lake design is the first step towards sound water quality and will minimize many of the inevitable management issues that arise as the lake ages. In regards to the shape of the lake (morphometry) long isolated peninsulas or fingers of land that interfere with circulation should be avoided.

The shoreline of the lake (morphology) should allow for a littoral shelf where nutrients can be buffered or absorbed by plants before reaching the limnetic zone. A minimum of 9ft/3m is suggested for the depth of the basin. This depth will allow for sunlight and provide an area that should not experience bottom rooted plants and have cooler waters to mix with surface waters. By allowing for reasonable depths it will help minimize the impact of solar radiation and the related heat on the lake.

The lakebed should be well prepared before the liner is laid down making sure that it is smooth and well manicured to insure an easy and successful installation. Lake-liners can be a tremendous asset to the property manager.

Surface spray type aerators provide the best vertical circulation in lakes less than 15ft or 5m deep. They lift bottom water up to the top and spread it out over the surface waters to aerate it and create convection currents. While they provide an attractive display, independent research indicates that these systems add 2mg per liter of dissolved oxygen at 10ft/ 3m in depth. The wave action caused by the spray pattern is excellent at breaking up algae mats and discouraging mosquito breeding.

For Surface Spray units you will want to use 2 horsepower per surface acre or 4,000 square meters of water. Add more horsepower if the lake is less than 6ft/2m in depth, if there is evidence of high nutrient levels or if it is an older lake with a heavy organic sludge layer.

Another form of biological control is the introduction of additional bacteria into the pond, otherwise known as bio-augmentation. This is effective when used in conjunction with aeration. Algae should either be harvested or chemically treated before the addition of bacteria, if chemicals are used wait at least 48 hours before using bio-augmentation. Initial doses are required with lighter maintenance doses following periodically. If bio-augmentation is to work it must be accompanied by aeration.

By removing all of the aquatic plant growth in the pond a major source of oxygen is removed and odor and water quality problems can result.

Much of this article was written based upon what I have learned from studying expert articles ... a leading source of information is Otterbine.

Large Pond Aerators and Fountains For Oxygen and Life

Maximum aeration of water in large ponds is required to prevent algae and smell problems.

This is best achieved using large aerators or fountains. Installing a biofilter is not really feasible or effective.

There will be three positive effects

For waste in ponds to break down large amounts of oxygen are needed and this process adds significantly to wind effects that also add oxygen to water through wave action.

Water is circulated even in large ponds

A very pleasant appearance and sound is created that adds value to the investment ... lighting can add dramatic effects also

Product Image



Skyward Fountain
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Product Description

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