Maintain The Best Irrigation Water Quality On The Golf Course

Consider the use of a floating intake structure.

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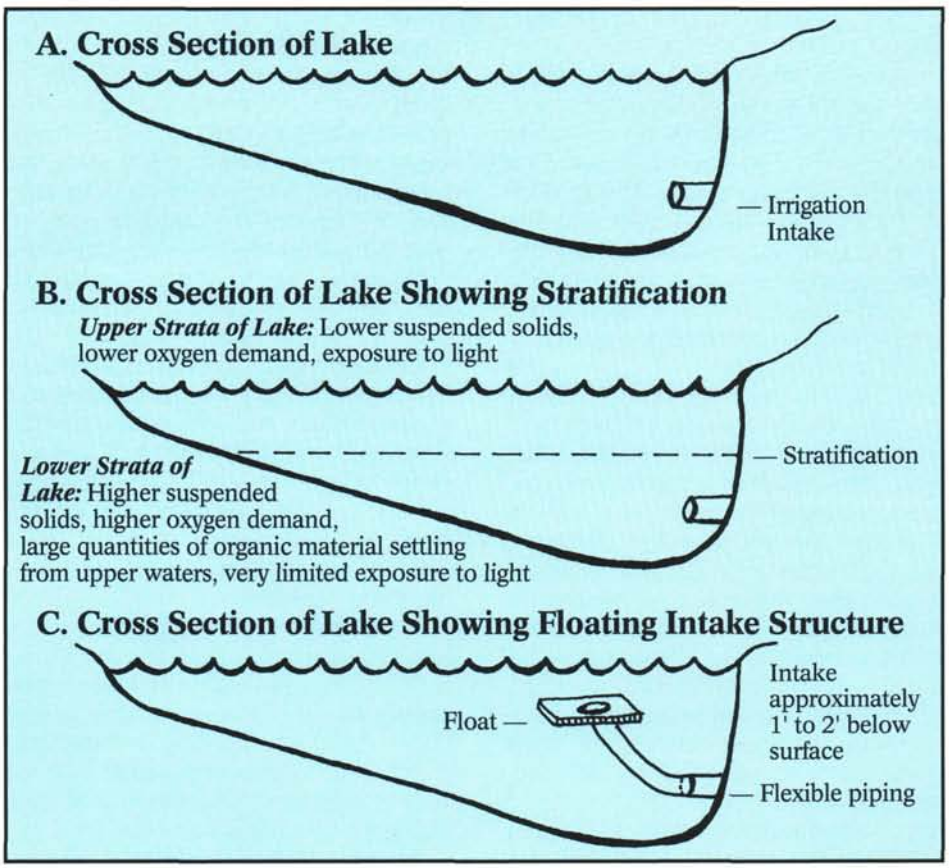

WATER MANAGEMENT is one of the significant keys to the success of golf course management. Properly managed water resources provide good quality irrigation water, aesthetically pleasing ponds and streams, appropriate stormwater treatment, and no offsite surface- or ground-water pollution problems. Properly managed water resources also provide habitat for a variety of animal and plant inhabitants.

One technique used to maintain the best possible quality irrigation water is to install a floating intake structure for the irrigation system. Why does a floating intake structure, compared to a bottom structure, make sense? Because over the course of a year, an irrigation lake may go through several physical changes that result in the poorest water quality being located in the lower strata of the lake, right where the irrigation intake structure is located. Using poor quality irrigation water may result in turf damage or, at the least, difficult conditions for turf to thrive. This may, in turn, require the use of more fertilizers, pesticides, maintenance time, and equipment use, or even more water. Using the best quality irrigation water is good for the golf course and good for nature. Additionally, the intake structure is located one to two feet under the surface and is generally not even noticed.

Audubon International, working with members of the Cooperative Sanctuary and Signature programs, has observed many cases where an intake structure located near the bottom of a lake resulted in turf and aesthetic problems on golf courses. In one example, each time the irrigation system was used, a rotten-egg smell permeated the course, the sidewalks where irrigation spray drifted turned a mottled red, tree trunks that were sprayed turned slimy and black, and the greens were dying. These situations were the result of irrigating with less than desirable quality water.

The irrigation lake can be affected by many factors that impact the quality of water. Simply because irrigation lakes (ponds, streams, etc.) are at the bottom of drainage basins, and because water runs downhill to the lake, these water bodies are influenced by meteorologic, geologic, and biologic inputs, via the terrestrial watershed or directly from the atmosphere. In addition to these outside influences, there are several internal characteristics that are important to its overall health and stability, and thus important to good irrigation water quality. Characteristics include lake regions, light, heat (thermal stratification), and nutrients. Water quality also dictates the abundance of algae, which can further influence water quality.

Light: Light is the major energy source to aquatic ecosystems, and light is the major source of heat to a lake. Absorption of light and its dissipation as heat influence the thermal structure, water stratification, and circulation patterns of lakes. Ultimately, these factors also can impact the aquatic organisms that live in the water.

Upper layers of water bodies are generally warmer than the lower layers because of heating by solar radiation. During the summer (or summer-like temperatures in the southern tier of states), temperature differences between upper and lower waters can become great enough that these waters are effectively separated. Separation is due to density differences that are caused by differences in water temperature (called thermal stratification). The upper waters are warm and mixed by

the wind to an approximately uniform temperature (called the epilimnion). Bottom waters are cool, heavier, and not affected by wind (called the hypolimnion). Separating the two regions is an intermediate zone, where temperature drops rapidly with increasing depth (called the metalimnion).

Thermal Stratification: Once a lake is thermally stratified, a number of changes take place in the lake. One of the most important is the dissolved oxygen levels. Oxygen and the levels present in an irrigation lake can have a dramatic effect on the life of a lake and its water quality. Aquatic organisms require oxygen to survive and, in its absence, organisms either move from the oxygen-poor area or die. Many studies have documented changes in biological communities with a shift in dissolved oxygen concentrations.

Dissolved oxygen in a lake comes from photosynthesis or from exchanges with the atmosphere at the water's surface. During thermal stratification, a delineation occurs between the oxygen-rich water at the top of the lake and the oxygen-poor water at the bottom. This reduction or lack of dissolved oxygen also can establish a series of chemical reactions that further reduce water quality. Examples, such as sulfate being converted to hydrogen sulfide, insoluble iron being converted to soluble forms, suspended material concentrations increasing, and decomposition of materials that settle from the surface to the bottom being slowed (algae, grass clippings, leaves), can make the bottom water an inappropriate medium for supporting aquatic life. It also makes a very poor source of irrigation water.

The irrigation intake, traditionally located in the bottom water region of the lake, generally provides your golf course with the poorest quality water. In our example from above, the rotten-egg smell is from the hydrogen sulfide, the red mottled sidewalks result from an increase in the reduced form of iron (ferrous) in the bottom water that is oxidized (ferric, red color) when the irrigation water comes in contact with the atmosphere, and the slimy black material on tree trunks is the partially decomposed organic material that was from both the drainage basin and the lake. The greens also are stressed by the partially decomposed organic matter as it competes with the turf for oxygen at the soil surface. On many of the greens, stress is so great that the turf can't survive and may have to be replaced.

An overabundance of algae also can become a hindrance to water quality and make a floating intake structure important. Water bodies have algae that occur naturally and are an important component of the aquatic food chain. However, at some point a healthy algal population may actually become an *algal bloom* that may impair the usefulness of a water body for irrigation. The cause of most algal problems is an abundance of phosphorus in the water of freshwater lakes (in marine or estuary systems, nitrogen may be more important).

Algae are particularly well adapted to take advantage of high nutrient concentrations (particularly phosphorus), warm water, and sunshine, and they reproduce exponentially. The result is an algal bloom, often distinguished by the pea-soup appearance of water that results from large quantities of algae.

Algal blooms cause many different problems, but the primary concern for irrigation water occurs when the algae die at nearly the same time. A die-off of algae occurs for many different environmental reasons (overcast skies reducing light intensities and a cold snap are among the two most common) and may also occur when chemicals are applied for algal control. A die-off is often easily observed — one day the water is green, and the next day the water is brown. The intense green of the algal bloom is from the chlorophyll in the algae. The dying and dead algae rain from the upper water to the lower water. In a stratified lake, an algal bloom followed by a die-off places a large oxygen demand on the water, increases the organic load and suspended solids load, and in general makes irrigation water unsuitable for use. Putting grass clippings in the irrigation lake also may cause symptoms similar to an abundance of algae — oxygen stress, organic loading, and increased suspended solids.

A floating intake structure is an economical way to get the best possible irrigation water for your golf course and maintain the ability to obtain water when water levels drop. A floating intake structure also reduces the possibilities of sediment problems that can occur with a bottom intake structure. A floating intake structure can be purchased or can be built and installed by a local machine shop.

There are two questions that are frequently asked by golf course superintendents concerning floating intake structures: 1) Can I use an aerator system instead of a floating intake? 2) My irrigation lake cycles every ten days (has a hydraulic retention time of ten days), so do I need to have a floating intake?

In answer to the first question, with the use of fountains, the objective is to circulate enough water to ensure mixing of the lake. Fountains generally do not have the depth or breadth of circulation to be effective as stand-alone systems for the irrigation lake. In smaller, shallower ponds they may be adequate to prevent stagnation and reduce the potential for massive algal blooms (algae reproduce rapidly in quiet waters, so stirring things up may reduce the severity of the bloom). Deep-water aerators may be useful, but this depends on the volume of the lake and the size of the aeration system. Injection of air through piping at the bottom also may be of help in reducing stratification; again, this depends on the size of the system relative to the volume of water. Injection of air rather than ozone is recommended because of the cost associated with ozone generation. Air contains enough oxygen (approximately 20.9%) to reduce stratification and aerate bottom waters. None of these aerator systems, however, effectively handle potential sedimentation problems.

An irrigation lake that cycles every ten days probably will not have significant thermal stratification, due simply to the constant mixing of the lake waters. A floating intake may make sense in these cases to reduce the potential for problems associated with sediment buildup around the intake.

Incorporating the use of a floating intake structure makes sense on many different levels. It can decrease the probabilities that your turfgrass will be negatively affected by poor water. Because the intake structure floats, it allows for continued availability of the best quality of water under many different situations and occurrences that a water source is subjected to seasonally. Using the best quality irrigation water is good for the golf course and good for nature.

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