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Effluent Irrigation, Part III: Logistics and Management

Editor's Note: This article—the last part of a series—originally appeared in the January/February issue of The Grass Roots, *the official publication of the Wisconsin GCSA. The August 2001 and April 2002 issues of* On Course *featured parts one and two of the series. Our thanks to the WGCSA for permission to reprint this discussion of a topic that is sure to come to the forefront in the near future.*

The previous two installments of the series on effluent irrigation defined effluent water and described its increasing use for golf course irrigation and agronomic issues associated with effluent water. Depending on the circumstances, several or all of the following characteristics are likely to be associated with an effluent irrigation source:

- Bacterial pathogens (human).
- Solids.
- High pH.
- Bicarbonates and carbonates.
- Salts and sodium.
- Heavy metals/toxic ions.
- Dissolved nutrients (N and P).

Special efforts may be required to deal with effluent irrigation. These include agronomic, financial, legal and sometimes simply logistical considerations.

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Agronomic Considerations

High pH can cause deficiencies of iron, manganese and zinc. Conventional soil-applied fertilizers may be unlikely to correct the deficiencies, but they can usually be overcome by using chelated and foliar applications. Addition of sulphurous or phosphoric acids, injected into the irrigation system at the pump, are useful to control moderate levels of bicarbonate (HCO_3^-) and carbonate (CO_3^{-2}). If left unchecked, these ions form lime in the soil, allowing sodium to adsorb onto the soil peds, which causes loss of soil structure. The acid reduces water pH and keeps calcium and magnesium solubilized in the soil solution by interacting with the bicarbonate and carbonate ions.

If the soil has already turned sodic and soil structure loss has occurred or is imminent, gypsum (calcium sulfate, $CaSO_4^-$) can be applied to the turf. Since gypsum can cause phytotoxicity, rates to putting greens are typically limited to 0.5 to 1.0 lb. per thousand square feet on greens, and 300-500 lb. per acre for fairways. The finer the grade (above 90 is best), the quicker the gypsum will dissolve into the turf. Generally, the process may take years. Gypsum can eventually restore soil structure because the excess calcium dislodges sodium ions from the soil peds. The sodium bonds with the sulfate from the gypsum to form water-soluble sodium sulfate ($NaSO_4$), which can be leached from the soil. Currently, the Wisconsin Department of Agriculture, Trade and Consumer Protection does not allow the sale of gypsum for use on turf in Wisconsin because there is not a problem with sodium in our soils.

Heavy metal accumulation such as chlorine can usually be minimized by removing and spreading clippings in nonaffected areas to dilute the heavy metals by applying them across a large area. Nutrients such as N and P should be monitored and fertility adjusted (reduced) to take advantage of N and P in the effluent.

Since much golf turf, especially putting greens, essentially "lives on the edge," it is important to minimize the potential negative impacts of effluent water. Effluent containing low to medium total suspended solids (TSS) can physically clog macropores over time and greatly reduce drainage. Thus, only tertiary effluent should be used; avoid secondary effluent (often illegal—primary effluent won't be available due to legal restrictions because of human pathogen concerns). Greens irrigated with effluent may require regular aeration, spiking and/or slicing to minimize crusting and algal growth.

Potential problems with effluent water can be minimized by diluting the effluent with high-quality (potable) water. This will, of course, require two water sources and two irrigation lines to "feed" the potable water into the effluent line. In Wisconsin, sufficient rainfall will usually leach excess salts below the root zone. During extended drought or in areas of the country where rainfall is minimal, the salts will need to occasionally be leached below the root zone with potable water before salts accumulate sufficiently to cause a problem (see part II in the April issue for more information). Sand-based root zones and good internal drainage (tiling) allow more rapid leaching of salts than do native soils. In certain cases, replacement of salt-affected grasses with salt-tolerant grasses may be warranted.

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Logistical Considerations

There are logistical considerations when effluent water is used for irrigation. Metal irrigation components may corrode; chlorine can affect brass and galvanized pipes and fittings, while ammonia (NH_3) can corrode copper pipe even when only 1.5 ppm N. Solids in the effluent water can clog nozzles, so large nozzles may have to be used and the water should be filtered before it reaches the nozzles.

Human health concerns dictate a special design for irrigation heads and pipes. In many states, heads from

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effluent water sources have to be spaced a minimum of 75 feet from irrigated or public areas or wells. A vegetative buffer (typically 50-100 feet) is usually required between the edge of the irrigation pattern and dwellings. These unwatered spaces in between may be subject to drought. All pipes, fittings, spigots and quick-couple connections must be belowground.

Pipes carrying effluent water must be noticeably distinguishable from lines carrying potable water. Generally, pipe carrying effluent water is colored purple. Most states that have laws regulating effluent irrigation require 10 feet horizontal and 1 foot vertical spacing between domestic and effluent pipes. Backflow prevention is required and leakage of pipes/fittings is regulated.

Supply can be one of the biggest logistical concerns. Typically, users of effluent water are required to accept a minimum amount of effluent every day, whether it is needed for irrigation or not. This forces many courses to add special holding ponds to accept the effluent until it can be used. Individual states typically have special requirements for such ponds, including an impermeable liner, specific slopes and other criteria.

In many locations, golf courses must post signs such as the following to notify staff and the public that effluent water is being used: "Warning: Course irrigated with reclaimed water." Such a sign can send a negative impact and reduce play unless the superintendent and course management properly explain the situation to players. Often, irrigation must be restricted to daylight hours and the surface must be dry before entry. The potential for disruption of play is obvious.

Financial Considerations

Dealing with the many agronomic and logistical considerations of effluent irrigation will certainly increase costs. Occasionally, these costs will be offset by the lower cost of the water (typically <80%) compared to potable water from municipal sources. Some additional costs include:

- Permits for effluent water use.
- Monitoring.
- Filters for pumps.
- Retention pond construction and maintenance.
- Corrosion to golf course vehicles.

Wisconsin's regulations for the use of effluent water are not well spelled out. Currently, there are only a handful of courses that use or have even inquired about using effluent water. The Department of Natural Resources' water quality division evaluates each request on a case-by-case basis and establishes guidelines as appropriate. As public demand for potable water increases and potable water becomes more valuable, it is likely a matter of time before the DNR is forced to outline specific requirements across the board for use of effluent irrigation.

Sampling for Water Quality

If you are concerned about water quality, whether or not you use effluent irrigation, then follow these simple steps to have your water tested:

- Collect a water sample (at least 8 oz.) in a clean, triple-rinsed plastic container with a plastic cap. Be sure not to leave ANY soap residue in the container as it will destroy the integrity of the sample and provide false results.
- Seal the container immediately after collection to prevent exposure to the air. Prolonged exposure to the air may affect the water pH, bicarbonate and carbonate levels.
- Label each bottle with a permanent marker, indicating time, date and location of where the sample was collected.
- Deliver to a state-approved water-quality-testing lab within 24 hours of collection. If situations prevent rapid delivery, refrigerate the sample (in the dark) and get it to the lab as soon as possible.

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