Article 134

Technical Note #20 from Watershed Protection Techniques. 1(2): 73-75

Minimizing the Impact of Golf Courses on Streams

Over 13,000 golf courses now exist in the U.S. and many more will be constructed to meet the growing popularity of the sport. The construction of a new golf course has the potential to create adverse impacts on the aquatic environment. To begin with, a typical 18-hole golf course can convert as much as 100 acres of rural land into a highly "terra-formed" environment of fairways, greens, tees, sand traps, and water hazards. As such, golf courses are often an attractive part of the urban landscape. Haphazardly designed golf courses, however, can disrupt and degrade the wetlands, floodplains, riparian zones, and forests that contribute to stream quality.

A second recurring concern about golf courses are the large inputs of fertilizer, pesticides, fungicides, and other chemicals that are required to maintain vigorous and attractive greens. In many cases, chemical application rates can rival and even exceed those used in intensive agriculture. Table 1 shows a side by side comparison of chemical application rates for a coastal plain golf course and cropfield in Maryland, as reported by Klein (1990).

The actual rate of fertilizer and pesticide application rates at a particular golf course can vary considerably, depending on the soil, climate, and management program. As an example, fungicides and nematicides are only lightly used in regions with cold winters, but constitute a major fraction of total pesticide applications in warmer climates. Given such intensive use of chemicals, golf courses clearly have the potential to deliver pollutants to ground and surface waters. Actual monitoring data on pollutant loads from golf courses, however, are quite scarce.

Golf courses are also intensive water consumers, particularly in drier regions of the country. This need for irrigable water can place strong demands on local groundwater and/or surface water supplies, which in turn, can cause baseflow depletion. In addition, the construction of the ubiquitous golf course water hazards can lead to downstream warming in sensitive trout streams.

In the late 1980s, Baltimore County, Maryland was confronted with a wave of golf course development proposals and strong concerns about the possible risk they might have on their Piedmont streams. The Department of Environmental Protection and Resource Management drafted and revised a series of environmental guidelines for new golf course construction. The guidelines stress the importance of integrating the layout of the course with the natural features of the site.

For example, the guidelines require a detailed evaluation of wetlands, perennial and intermittent streams, floodplains, slopes, forest stands and habitat features at the proposed course. The course must be configured to avoid or minimize disturbance to these resource areas. In this respect, long broad fairways are a prime culprit, as they frequently cross or encroach into streams and other buffer areas.

Consequently, the guidelines devote a great deal of attention to the issue of fairway crossings (see Figure 1). For example, no more than two fairway crossings are allowed for each 1,000 feet of stream length. These crossing must be perpendicular to the stream. If forests or wetlands are present at the crossing, this zone must be managed as unplayable rough and remain undis-

Table 1: Comparative Chemical Application Rates for a Maryland Golf Course and Corn/Soybean Rotation Reported in Pounds/Acre/Year (Klein, 1990)

Chemical	Cropland	Fairway	Greens	Tees
Nitrogen	184	150	213	153
Phosphorus	80	88	44	93
Herbicides	5.8	10.4	10.2	11.4
Insectcide	1.0	2.0	2.0	2.0
Fungicide	0.0	26.9	34.9	26.9
Total Pesticides	5.8	37.3	45.1	38.3

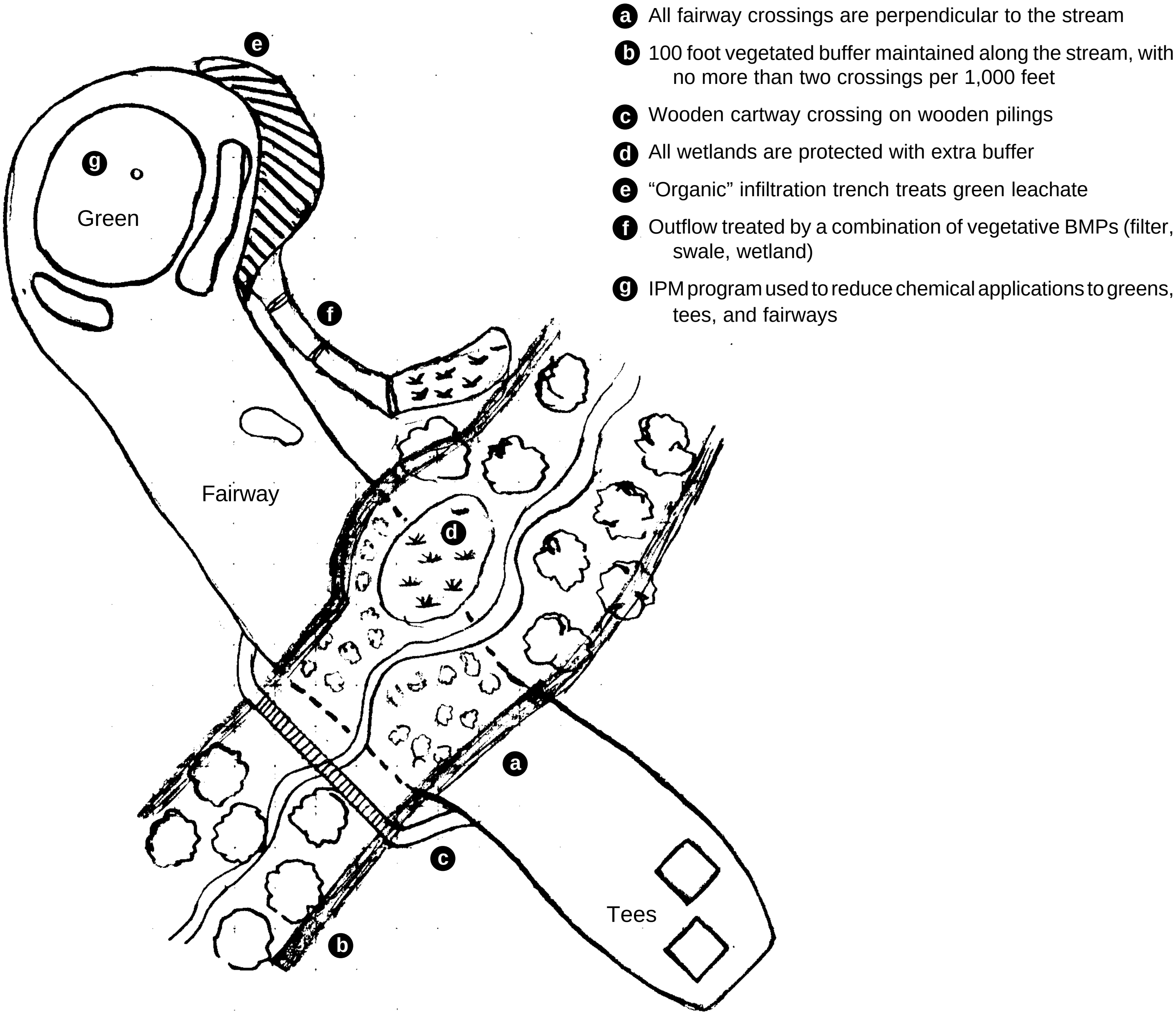

Figure 1: Stormwater Practices for a Golf Course and Stream Crossing (Powell and Jolley, 1992)

turbed as early successional forest or wetland. Cartways and footpaths that cross the stream corridor must be narrow and constructed of timber on wooden pilings. The County guidelines also limit the extent of forest that can be cleared during construction. No more than 25% of the pre-existing forest cover may be removed during course construction.

Constructed ponds are not permitted in trout streams unless they are "zero discharge" facilities constructed in upland areas (see article 82). Best management practices emphasize treatment of greens and tees where nutrient and pesticide applications are greatest. The use of a series of vegetative filtering mechanisms such as swales, forest buffers, sand filters, and infiltration trenches are recommended.

A common practice for greens is illustrated in Figure 2. To start with, a four-foot thick mantle of soil is required below the green's underdrain system to prevent leachate from entering groundwater. The leachate is collected in perforated pipes and routed into small depression. This depression is usually filled with layers of organic matter, sand and stone, and then landscaped. The depression acts as both a biofilter and an infiltration facility.

Excess runoff from fairways is also treated by a series of best redundant best management practices (e.g., a grass swale leading to a pocket wetland or

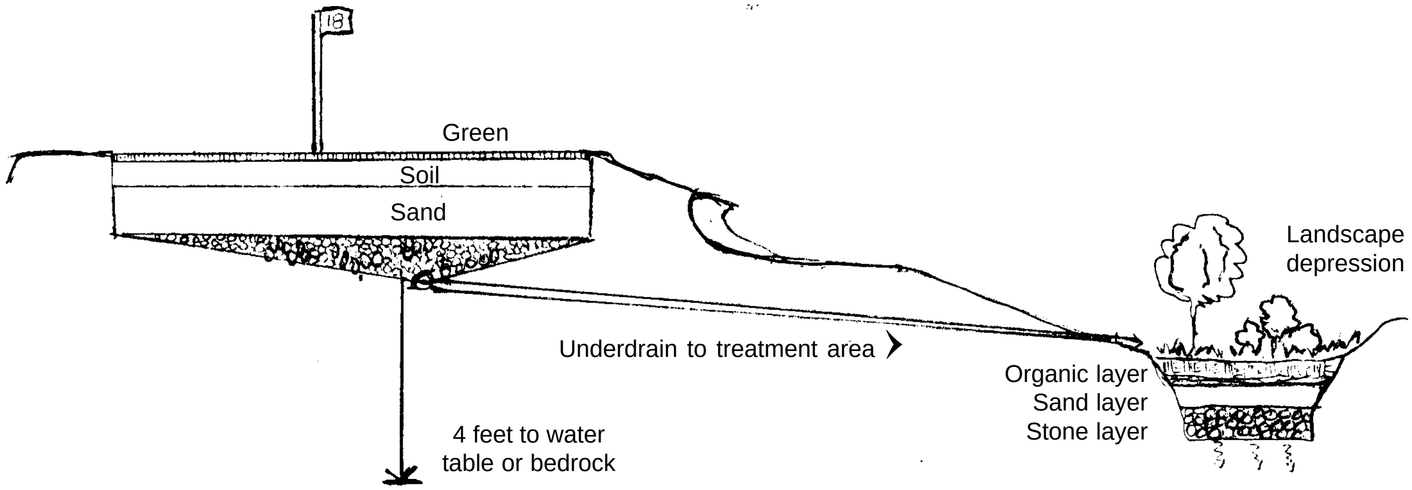

Figure 2: Schematic of a Water Quality Treatment System to Remove Pollutants From a Golf Course Green

irrigation pond that in turn overflows into a forest buffer strip).

Since golf courses are largely pervious in nature, it is not always appropriate to size stormwater practices systems for water quality treatment based on conventional water quality sizing rules (i.e., based on the amount of impervious area created at the site). Rather, it is more important to ensure proper control of each green, tee, and fairway, and to maximize the use of swales, forest buffers, and wetlands to achieve high rates of treatment.

The Baltimore County guidelines require the installation of permanent sampling wells in addition to periodic monitoring of storm runoff, groundwater, and the biological community present in golf course streams. The guidelines also recognize the importance of integrated pest management (IPM).

The golf course operator must submit an IPM plan that emphasizes the selection of drought and disease resistant turf that requires less maintenance, utilizes biological controls rather than chemicals, and carefully regulates the selection and application of pesticides. The use of slow-release fertilizers is also encouraged to minimize the leaching of nitrates into groundwater.

To date, the guidelines have been applied to seven new golf course development proposals in Baltimore County with the active cooperation from the golf design community. Preliminary storm and groundwater monitoring data from several golf courses designed under the new guidelines indicate that they appear to have little impact on water quality, with the possible exception of nitrate leaching. Additional storm monitoring data is expected at both public and private courses over the next two years to attempt to confirm this observation.

—TRS

References

Powell, R.O. and J.B. Jollie. 1993. *Environmental Guidelines for the Design and Maintenance of Golf Courses.* Baltimore County Dept. of Environmental Protection and Resource Management.

Klein, Richard D. 1990. *Protecting the Aquatic Environment From the Effects of Golf Courses.* Community & Environmental Defense Assoc. Maryland Line, MD.