(Groundwater continued)

As states previously, slow-release nitrogen sources have a lower solubility than inorganic nitrogen sources. Slow-release nitrogen sources are recommended for use on sandy soils. Research has shown that nitrate leachihng is less when applied as a natural organic form (Milorganite) or a synthetic organic form (ureaform).

If soluble nitrogen sources are preferred, rates should be adjusted to prevent movement through the soil profile into the groundwater. For example, nitrogen applications with urea on high sand content golf greens should be at a rate of .1 to .25 lb. N/1000 sq. ft. per application. Anything greater may leach below the root zone. Once this occurs, the nitrogen is no longer available for plant use. However, if slow-release nitrogen sources with a high water insoluble nitrogen ratio are used, N rates can be as high as 2 lb. N/1000 sq. ft. per application on Kentucky bluegrass.

Certain types of weather will favor nitrogen leaching. For instance, cool rainy weather favors the movement of nitrogen beyond the root zone into the groundwater. Increased leaching potential occurs because cool temperatures decrease denitrification, volatilization, microbial activity and plant nutrient uptake. Thus, application of high rates of nitrogen on sandy sites during the late fall, winter or early spring can lead to nitrate movement into the groundwater.

Irrigation practices that result in water movement below the root system will increase potential nitrogen and pesticide leaching. Irrigation on a daily basis during cool months will increase leaching losses. On the other hand, infrequent deep irrigation to well below the root system will more than likely move nutrients with the water. Irrigation should only be provided to replace what water has been removed by plant uptake and evaporation.

Source: NYSTA Spring 1990 Bulletin 138

Golf Course Drainage

A Hands-On Report by Geoffrey Corlett of Turf Drain Inc.

It is now common knowledge that good drainage is an important ingredient for the success of a golf course. Lesser known are the causes for poor drainage, and further, how to rectify the situation. Outlined in the following paragraphs are four typical drainage problems on a golf course with options that may be applied to permanently improve drainage.

High water table, low lying area

For a golf course built with a river as the predominant feature, there is a strong possibility that at least one site on the course will exhibit the following characteristics: Commonly found in a natural low point of the water shed, a basin is formed with slopes on at least three sides where surface and ground water collects. The soils exhibits the following characteristics of anaerobic conditions: A foul odour and very dark in colour. Standing water remains long after a rain and the turf is spongy throughout the season. The scale of this problem area can range from isolated pocket of less than one acre to a situation where most of the golf course is built within the basin.

Extensive drainage is required to remove the volumes of water that collect in the basin and maintain the water table at a depth conducive to growing turf. Spacing and depth of the tile is based on the grade available for fall in the drainage line and the soil characteristics. Native soil backfill is sufficient as the objective is to lower the water table, not to cut off flowing ground water. Once the depth of the soil is controlled, water holding capacity of the soil is greatly increased, allowing for the infiltration of surface water soon after a rain.

Sidehill seepage

Sidehill seepage exists anytime there are two distinct elevations separated by a well defined slope. This scenario is particularly evident where a sidehill has been excavated to accommodate a fairway. Distinctive features are soft soil along the lower run of the slope, water boiling from the ground on the lower elevation and in more severe conditions, slumping soil along the base of the slope. Sidehill seepage is the result of a head created by the ground water in the upper elevation causing an unusually high water content in the soil directly along the base of the slope.

The objective here is to intercept the ground water as it flows down the slope before reaching the lower elevation. A series of drainage lines should be installed, with granular backfill, allowing for the site characteristics for grade and outlet.

Subsoil layering

Subsoil layering is a problem not easily identified. Although water problems do occur naturally as a result of subsoil layering, they are most pronounced when the native subsoil has been disturbed through excavating and forming the architecture of a golf course. The natural ground water flow is altered by a new and non-uniform arrangement of materials in the subsoil, such as a pocket with high permeability isolated by a impervious layer of clay. Share variances in the texture of the subsoili are difficult to detect without removing a three

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or four foot core sample. Poor drainage under these conditions will appear in several forms. A spring boiling from an otherwise well draining fairway with moderate grade and spongy pockets randomly located in an area which appears to be well graded. (See fig. 1)

Once identified, drainage lines should be installed continous with the clay outcrop to a suitable outlet. If the wet area is localized, three to fifteen meters in diameter, one or two lines into the problem area are sufficient to remove the trapped ground water.

Surface grading

It is a well known fact that high quality surface grading is critical to the success of every golf course. Unfortunately, in practice, surface grading rarely, is well executed in both design and construction. The result area areas that suffer extensive erosion while on the same project there will exist an area with pockets of standing water scattered throughout.

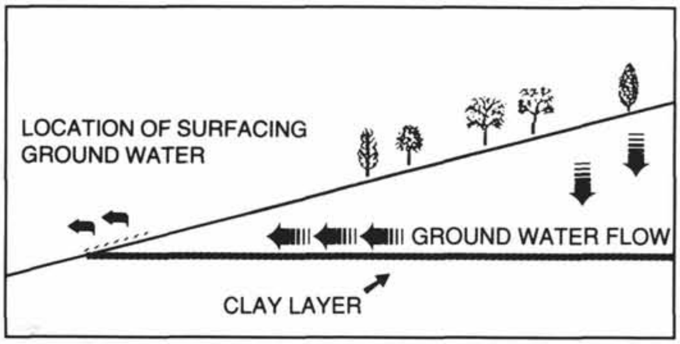

Fig. 1. Ground water movement restricted by impermeable layer of clay. Result is an underground ponding area.

Depressions in the surface grade are the most visible and inconvenient water problem for the membership. The condition is mostly pronounced on fairways with topsoil having more than 30% clay content, as the surface water is very slow to infiltrate after a rain or an irrigation application. For fairways with minimal grade, it is critical that depressions are eliminated during construction.

Due to numbers and random locations of depressions, the best approach is the installation of a main line initiating at an open outlet or tied into an existing line. From the main, several short lines are installed passing through each depression.

Erosion as a result of excess water flow through a restricted area is evidence of misformed or improperly designed surface grading. Soil type will determine the extent of soil movement. Sandy and gravelly soils are most subjected to erosions.

Total acreage that is supplying surface water to the area must be determined in order to calculate volumes of flow during peak periods of the year. To demonstrate this point, a hypothetical situation is outlined:

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A neighbouring field, presently in agricultural crops, slopes to a swail, which feeds onto the golf course, crossing two fairways before reaching the creek which winds through the course. It was hoped that the swail would provide a natural hazard, however, several times this season serious erosion has occurred to a point where the swail is now two meters deep & seven meters across. A topographic map of the area is used to determine that 60m across from the neighbouring field surface drains into the swail. It is evident from the material washed out of the swail that the soil is sandy in texture. An erosion control structure must be built which includes a beam to contain the surface runoff and a surface inlet. In addition to the conduit, an emergency overflow must be constructed to allow for occasional flash floods, a more common occurrence of late. Capacity of the holding area and sizing of the conduit pipe are dependent on several site variables and should be referred to a qualifieid consultant for their design.

Materials

Corrogurated plastic tubing is the most common drainage material and is available in 36, 75, 200, 150, 250, and 300 mm diameters. When chosing between pipe diameters, a good rule to remember is with a decrease in diameter of 50%, the capacity of the tubing is reduced four times. (See fig. 3). Additionally, for small diameter tubing less than 100 mm, there is very little tolerance for error in grade when installing such materials. All diameters of tubing should be installed using laser assisted equipment. Laser installation is compulsory for tubing less than 100 mm in diameter. (See fig. 2). Use tubing that meets C.G.S.P. 41-29M and the provincial recommendations for tubing used in land drainage applications.

Fig. 2. Laser Transmitter with grade control for use on equipment with automatic laser control.

Envelopes are designed to restrict the entry of granular soils that may cause sedimentation within the tubing. Materials with individual grain size of 0.025-0.25 mm will precipitate out of solution under low flow conditions resulting in a sedimentation layer to form in the tubing. Once initiated, this condition rapidly worsens unless large volumes of water are flushed

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(Drainage continued)

through the tubing on a regular basis. There are two types of a woven nylon polyester stocking and a non-woven geotextile fabric. The non-woven geotextile fabric is relatively recent in the drainage industry, and has proven to be less susceptible to clogging with fines. Ideally, the results of soil a test should be matched with the individual characteristics of the envelope.

Figure 3.
SAMPLE CALCULATION
<u>FOR TUBING CAPACITY:</u>

<u>In a 100 mm Tube:</u>
area = 3.14 x (0.05m x 0.05m)
= 0.00785 sq.m.
volume = area x length
therefore : for a 1.0 m. length,
volume = 0.00785 cu.m.
<u>Whereas In a 200 mm Tube</u>
area = 3.14 x (0.10m x 0.10m)
= 0.0314 sq.m.
therefore : for a 1.0 m. length,
volume = 0.0314 cu. m.

The outlet for a drainage line is the single most important factor in any drainage system. In addition to ensuring that the outlet provides sufficient fall for the drainage line to be self cleaning, steel outlets with gates are necessary to restrict the entry and colonization of rodents in your new drainage system.

For a long term solution to drainage problems, establish a drainage program covering five successive years. This program is based on a drainage blueprint for the complete property and is broken into manageable yearly projects thus allowing the superintendent to budget accurately for each annual project, in addition to getting the long term program on the agenda for the budget meeting with the board of directors. The net result is a golf course integrated with a drainage network that provides complete coverage against water problems, giving the superintendent greater control over the individual hydraulic cycle of the golf course.

Credit: Greenmaster, 11-12/89

REMEMBER TO WEAR YOUR NAME BADGES AT OUR MEETINGS.