By John Kelly and Steve Ami

If you have ever wrestled with a drainage problem—or two or three—on your course, you know there are no cut and dry solutions. Like failing turf, drainage issues can have any number of causes, and diagnosing them properly is half—if not all—the battle. Your best first line of defence is to accept that not all drainage problems are created equal. There is no magic cure-all. Each golf course drainage issue is a special case that requires individual attention, such as surveying the topography and testing the subsoil conditions of each specific problem area. Then and only then do you have a shot at devising a drainage system solution that will work. The following article examines four drainage problems common to golf courses.

Drainage problem #1: impermeable soils
Impermeable soils are one of the most common culprits in golf course drainage problems. You know them well. They are characterized by a silty, clay-like soil texture with flat topography and poor infiltration rates. They are also very susceptible to compaction from golf carts and maintenance machinery. A vicious cycle starts with more compaction leading to increasingly lower infiltration rates. This in turn leads to even greater compaction and eventually sealing at the surface.

To be certain the root cause of your drainage issue is, in fact, impermeable soil conditions, you will want to verify soil texture and infiltration rates. The best way to do this is to dig an auger hole near a group of pondings that is 50 to 75 mm (2 to 3 in.) in diameter, taking care to keep the surface water from entering the auger hole. Wait several hours for the water table to stabilize in the hole; then measure the depth of the water table and compare that to the level of the water in the pondings. If the water table is more than 45 cm (18 in.) below the level of the water in the pondings, you are most certainly dealing with an impermeable soil condition.

Drainage solution for impermeable soils: slit drainage
Your first thought might be to install a conventional drain in the dry subsoil and then backfill it with native soils (or with stone and then capped with soil and sod), but this will not remedy this type of drainage problem.
To maintain a high infiltration rate into the slit trench, it is also important that you allow the adjacent turf to root in the coarse aggregate without the addition of finer topsoil. This can slow the water’s progress through the top layer of the soil profile.

Installing slit drains is made easy with the use of a special wheel trencher. This piece of equipment is capable of digging a trench on a grade, controlled automatically by laser-grade control. It can then excavate the soil directly into a trailer, installing the slit drain pipe and back-filling with a coarse aggregate—all in one fell swoop. Another appealing feature is cleanup is fast, easy and always done as you go.

You can drain entire fairways in just two to six days, depending on the intensity of drainage required. Better still, golf play can generally continue with the use of temporary tee placements or temporary greens.

Although slitting trenching is a relatively expensive drainage technique, it provides excellent results with dramatic improvements for large, flat areas.

Drainage problem #2: depressional areas
Depressional areas are the low wet spots where water ponds after a rainfall. You can be certain you are dealing with a depressional area when you have water pondings that are greater than 3 m (10 ft.) in diameter or more than 10 cm (4 in.) deep. The problem is there is no deep percolation available for the excess water.

Drainage solution for depressional areas: surface inlets
Although conventional subsurface drains are often installed through these depressional areas, they generally do not work adequately because it is very difficult to get large amounts of water to infiltrate fast enough into a drain pipe through the turf, soil and back-fill material. A better tactic is to install surface inlets in the lowest part of the depressional area where water naturally ponds. The inlets allow large quantities of water to rapidly enter a collector pipe that must be properly sized to allow for water flow.

Surface inlets come in many shapes and sizes. You will want to be sure the inlet you select is sturdy and well constructed with a metal or plastic grate at the surface that has large enough openings to allow unrestricted water entry. It is also recommended that you include a 300- to 450-mm (12- to 18-in.) deep sediment trap to prevent sediment or debris from entering into the drainage system.
Drainage problem #3: high water table

High water table conditions occur when soils have reasonable infiltration rates but no natural outlet through deep percolation—usually due to the presence of a clay or stone barrier.

One of the telltale signs of a high water table is the presence of waterweeds, either in shallow adjacent ditches or in the low-lying areas of the fairway. More obvious, however, is that water in these areas comes to the surface very rapidly after a rainstorm, creating numerous small ponds.

Ponding is also characteristic of impermeable soils, so diagnosing this type of drainage problem takes careful analysis. The treatment for a high water table condition, after all, would be quite ineffective for an impermeable soil condition.

The difference between the two problems can be determined only after digging test holes, analyzing the soils, and studying the water table depths over time. In general, you know a high water table is at work when the level of free water in your test hole (i.e., auger hole) stays within 30 to 40 cm (12 to 16 in.) of the ground surface.

Is this high water table or an impermeable soil condition? You cannot tell the difference without subsurface investigations.

Drainage solution for high water table: parallel subsurface drains

To remedy high water table conditions, you must find a way to remove the excess water that has entered into the soil profile. The best way to do this is to install a system of parallel subsurface drains.

An effective water table control drainage system should include 100-mm (4-in.) diameter drain pipes installed 75 to 120 cm (30 to 48 in.) deep. They can then be backfilled with the native soils that we know the water can adequately enter.

The drain spacing should be based on the native soil's saturated hydraulic conductivity and the desired "drawdown" on the water table. Also, be sure you have a sufficiently deep outlet to allow free flow from the drainage collector pipe.

Drainage problem #4: side hill seepage

Side hill seepage can occur in a couple of different situations. First, there is the scenario where a relatively permeable soil—a sandy soil—overlies a relatively impermeable soil—silt/clay—on a slope. Excess water infiltrates into the sand at higher elevations, but because it cannot continue downwards into the clay, it is forced to move horizontally and "seep" out where the sand layer ends. This generally happens along the toe of a slope or partially up the slope.

Side hill seepage can also occur where clay soils have been reworked into mounds or hills by machinery. There will be large voids left in the disturbed clay since it is virtually impossible to re-compact this type of soil into its original state. These large voids will allow the water to move freely into the disturbed profile or mound. The native soils under the new mound will not permit the water to continue downward. The result is the same as in the first scenario: Water moves horizontally and seeps out along the base of the new mound or hill.

You can identify this problem by digging a series of test auger holes 60 to 90 cm (24 to 36 in.) deep at the toe of—and also partially up—the wet slope, taking care to stay in the wet zone. Observe the soils during the digging for texture changes and observe the holes afterward for water level changes as you go up the hill. This type of drainage problem can keep a wide, flat fairway adjacent to the slope very wet.

Drainage solution for side hill seepage: interceptor drains

Though it might seem logical to solve this drainage problem by installing conventional drains in your wet fairway, chances are you would be sorely disappointed by the outcome. Wet spots due to side hill seepage are best drained by installing 100-mm (4-in.) diameter interceptor drains—also known as curtain drains—75 to 120 cm (30 to 48 in.) deep, and then backfilling them with a highly permeable drainage sand. The bottom of the trench should be placed just into the less permeable subsoil.

Be forewarned. This is a tricky operation. If the interceptor drains are not placed in exactly the right position, your efforts will be for naught. The drains should be placed just above the wet spot—or just above the highest seepage point—along the contour.

The curtain of sand, which allows the water to flow freely downward into the pipe drain and then over to the outlet, will intercept the seepage water. The wet seepage area will not dry if the interceptor drains are installed either too far below or too far above the seepage zone on the hill. It usually takes more than one interceptor drain to solve the problem.

The selection of the sand is also critical to the success of this drainage system. The back-fill must have permeability at least 10 times greater than the native soils. Another option is to use clear stone.

It's all in the planning

One thing is for certain: you cannot underestimate the importance of drainage planning—and taking the time to properly investigate and custom-tailor drainage systems for each problem area on your course. Clubs such as the Victoria Golf Club and the Magna Golf Club have recently completed a master plan for drainage improvements on their golf courses. We uncovered some of these four types of drainage problems at both these golf clubs. The master plan specifies exactly how we plan to resolve every one of the problem areas.

The advantage of looking at the whole course at once is simple—to avoid situations where clubs have to duplicate their efforts. For instance, different holes could be drained together if you investigate all the holes. Perhaps larger or deeper collectors will be needed than what was suggested if only one hole was examined. Also, when the requirements for the entire course are known, your long-range planning and budgeting will benefit.

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