



*Reservoirs of adequate water-holding capacity are best developed during construction stage of course development.*

# Maximum Use of Land Sites- EMPHASIS WATER MANAGEMENT

by REES L. JONES

**I**N DISCUSSING water in the context of golf course design, it seems that we either have too little or too much. When we have too little water to support good turf properly, we must look for supplemental sources or methods of supply. When we have too much water, the drainage systems must be designed to dispose of it rapidly from the entire playing area. Whenever possible, drainage systems should be designed so that runoff will be channelled into a reservoir or series of reservoirs to serve the dual purpose of water conservation and drainage.

When a site is being considered for a golf course, the major physical properties to take into account are topography, drainage, vegetation, soil and water. Perhaps the most critical element, however, is water. It would not be wise to build a

golf course if sufficient water is not available for irrigation to insure playable turf.

Golfers in the United States have been spoiled. They expect lush conditions even during droughts. In order to maintain a golf course in such a manner during dry periods, it is necessary to water the greens three quarters of an inch to two inches a week and the fairways from one inch to an inch and a half a week. The type of irrigation system chosen, as well as the total area of irrigation coverage contemplated, is also used to determine the quantity of water required. Golf course architects calculate these needs and design irrigation systems based on these factors.

While irrigation systems are installed for supplemental water, except in deserts or tropical areas, they are designed to yield the total water supply during periods of drought. The water source must be capable of yielding the maximum amount needed for all seasons.

A golf course architect is most concerned about an adequate water supply during the post-

---

REES L. JONES is President of the American Society of Golf Course Architects.

construction maintenance period, when the turf is becoming established. At this time it is imperative to have an adequate supply. If, because of the lack of sufficient water, a good stand of turf cannot be established during the optimum growing period, the ground probably will erode, and it will have to be replanted at substantial additional cost. Also, the revenue lost by not being able to open on schedule will have a detrimental effect on the golf course, especially if the course is part of a resort or real estate development. To minimize this possibility, golf course construction should begin early enough so that it will be completed at the beginning of the optimum growing period. Golf course architects often face the problem of beginning construction late because of economic reasons, and, consequently, not completing it at the proper time. Obviously, it is ideal to build the course during the dry season and grow the grass during the wet season. In many parts of the world, especially tropical areas where the growing season is 12 months, the acquisition of rainfall data is essential to schedule the construction of a golf course. If the supplemental water supply is not abundant, proper scheduling of the construction is imperative.

Golf course irrigation water comes from wells, streams or rivers, lakes and drainage canals; or by using effluent or by outright purchase from a local source.

Well drilling is a common way of finding an adequate water source. In most cases the well water is discharged into a pond or irrigation reservoir and then pumped into the irrigation system. Using this method, the yield of the well can be substantially lower than the amount required by the irrigation system. If the well is discharged into a reservoir, the daily gallonage requirement can be recharged over a 24-hour period, whereas if the well pumps directly into the system, the gallons per minute must be substantially higher to supply the daily requirement of the golf course.

Whenever possible, it is most efficient to locate the well and reservoir centrally. If the yield from one well is not sufficient, it is still best and in many cases more reasonable to pipe the water from all wells to a central reservoir. A central water source keeps the irrigation pipe sizes down, and thus the cost is cheaper for the irrigation system. This method of supplying water is better than pumping directly into the system from two or more wells, because pumping from several wells increases the possibility of dirty water. If sediment is passed into the system instead of settling to the bottom of the reservoir, irrigation problems and equipment malfunctions will occur more frequently.

A stream is another very common source for golf course irrigation water. Since many newer golf courses are being located in low areas or floodplains, these tributaries are often incorporated into the strategic design of the golf course. Before choosing a stream as a water source, the watershed area should be analyzed and tests should be made to determine the rate of flow during the driest times. If the test results indicate an adequate

supply of water, a pond should be excavated adjacent to the stream. Ideally, this pond should not be directly connected to the stream, but it should be filled by installing a feeder pipeline from the pond to the upstream point with the same elevation as the desired water level. A small dam must be built at this point to create enough "head" at the intake to fill the pond regardless of the rate of flow. This type of "bypass" pond can also be kept recharged by pumping into it from the stream. In some cases, because of existing topography, it is necessary to connect the stream into the excavated reservoir. However, this should be avoided if possible since silt, sediment and debris will soon fill the pond and cause constant cleaning. It should be noted that environmental groups in some areas now require us to feed our streams directly into the ponds for erosion control. Before one determines which method to use, all local or state regulations should be studied.

Water from rivers, because of their depth and constant rate of flow, can be pumped directly into the irrigation system. However, due to the probability of frequent dirty water, it is recommended that water from rivers be pumped into irrigation reservoirs.

Man-made or natural large lakes filled by runoff from large watershed areas are also good sources of irrigation water. The elevation difference between the mean water level of the lake and the high point on the golf course is the prime determining factor in deciding whether to pump directly from the lake into the irrigation system or from the lake to an irrigation reservoir and then into the system.

Many courses built on low, relatively flat ground, often in coastal areas, obtain their water from the drainage canals which have been previously excavated. The water level of the canals generally represents the water table of the area. In most cases, ponds can be excavated and used for irrigation supply with similar results as using the canals. However, the flow and supply of water in the canals is generally more reliable since they are recharged by large areas of runoff as well as the ground water supply.

In Myrtle Beach, South Carolina, several courses use the water from the Intracoastal Waterway for their irrigation. Some of the courses pump directly from the canal into their irrigation systems while others pump into reservoirs and then into their systems. The latter method is best since the water from the Intracoastal contains a small degree of salt. The reservoir at Skyway Golf Club is also the receptacle for large quantities of runoff water harnessed through a complex ditch system. Thus the degree of salinity is substantially decreased by mixing the water from the two supplies. The parts per million of soluble salts found in the water is of critical importance. The U.S. Department of Agriculture feels that water containing 1,200 parts per million is acceptable for growing crops. For golf courses, water with more than 2,000 parts per million is not considered desirable for growing good turf.

With the general public's increasing concern for the environment and because of recently enacted laws concerning the treatment of our waste products, sewage effluent will be used increasingly for golf course irrigation. Each state has different regulations regarding the use of this water. The requirements of the state should be thoroughly checked before the water source is decided upon and irrigation systems are designed. The decision to use effluent as the water source poses two problems for the golf course architect. First of all, sewage effluent is generally not available at the time when the golf course is built. Because of this, an auxiliary water supply must be available when golf course construction is completed. Thus, money must be spent on a water source which won't be needed in years to come. The second major problem is that the effluent must be disposed of whether or not the golf course needs additional water. To partially alleviate this problem, large holding ponds should be constructed to retain the effluent water until it is needed.

Purchasing water is the least desirable way to irrigate a golf course; avoid it if at all possible. Even if obtaining water by one of the previously discussed methods seems to be prohibitively expensive, the long-run costs should be considerably lower and availability more certain if one of them is employed. However, purchasing water may be the best temporary solution if early use of effluent is a certainty.

In several cases a combination of two or more sources is needed to provide the necessary quantity of water. In any event, a thorough chemical analysis of the available water should be made before the source is decided. Results of the analysis should be studied by an agronomist to be sure that the water is suitable to grow the specified turf.

Immediately after determining the source, the required three-phase power should be ordered for the pump station and/or well pump. The pump station itself should be ordered early. Too often there are long delays in acquiring the necessary power and/or the pump station. Often installation and delivery cannot be made before construction is completed. This leads to the costly use of generators and/or diesel pumps. Use of a diesel pump without a pressure-regulating valve can be harmful to the irrigation system. As a result, the efficiency and life of the system is potentially decreased.

Golf course architects often joke that the three most important items of construction are drainage, drainage and drainage. Without good drainage a new golf course can become an economic disaster because of soil erosion, turf loss and the loss of revenue caused by many days of unplayable conditions.

Whenever possible, it is cheaper and easier to handle small drainage areas by surface grading swales or by regrading existing ones. Ditches are also an effective way to handle excessive runoff, but unlike swales, their use should be avoided on the turfed areas of the golf course. In cases of

moderate to large amounts of runoff, a great deal of erosion can occur. It is very difficult to maintain turf on ditch slopes, and they are unfair golf hazards because they are generally blind. It is advisable to use ditches only in non-play areas, to intercept large quantities of water where they will require little maintenance and will not affect play.

Concrete or asphalt-coated corrugated metal pipe with headwalls or drop inlets should be installed across a golf course to drain adjacent watershed areas. The initial installation of properly sized pipe will pay definite dividends immediately by erosion control before and during the grass-growing period and later by accommodating all future runoff.

Creeks and streams should generally be left in their natural state to be used as drainage courses and, whenever possible, as effective hazards. Swales and pipes should discharge into them since they are usually formed by natural positive drainage and are, therefore, the most effective means to pass excess water off a site and into an irrigation reservoir. It is best not to redirect them unless the playability of a hole will be vastly improved or if it is decided that they are too meandering to accommodate present or future runoff. Whenever possible, the drainage system should be designed so that much of the excess water can be captured in reservoirs to be used later as supplemental water for the turf. This is the cheapest method of obtaining irrigation water.

Drainage is the key consideration in building the golf course features — the greens, tees and bunkers. The greens are built with PVC drain pipe, a sub-surface gravel layer and a seedbed mixture consisting predominantly of sand. This method of construction, along with properly designed surface contouring, provides the drainage necessary to play a golf course soon after a severe rainfall. Tees are designed to be built with surface drainage without water-holding pockets. They are pitched slightly to shed excess water. Bunkers are no longer holes in the ground. They are generally built from imported fill, and their floors are shaped to be above the existing grade. Drainage pipe is installed to remove excess water caused by rainfall or from the use of the irrigation system.

In summation, if the golf course architect is allowed to and has done the proper job in his research and design, an abundance of water will be available to a golf course that drains well. The water supply will have been calculated, whenever possible, to furnish all the necessary water during a drought, and the drainage system will have been designed to eliminate excess water quickly from a course after periods of heavy rainfall. However, if the drainage system is effective, one should not be deluded into the belief that the course often needs the maximum amount of water per day. Each day the water should be re-evaluated so that the turf gets only the amount of water it requires. If the budget and the client allow, the golf course architect leaves the golf course well provided to manage water, the most important item in golf course management.