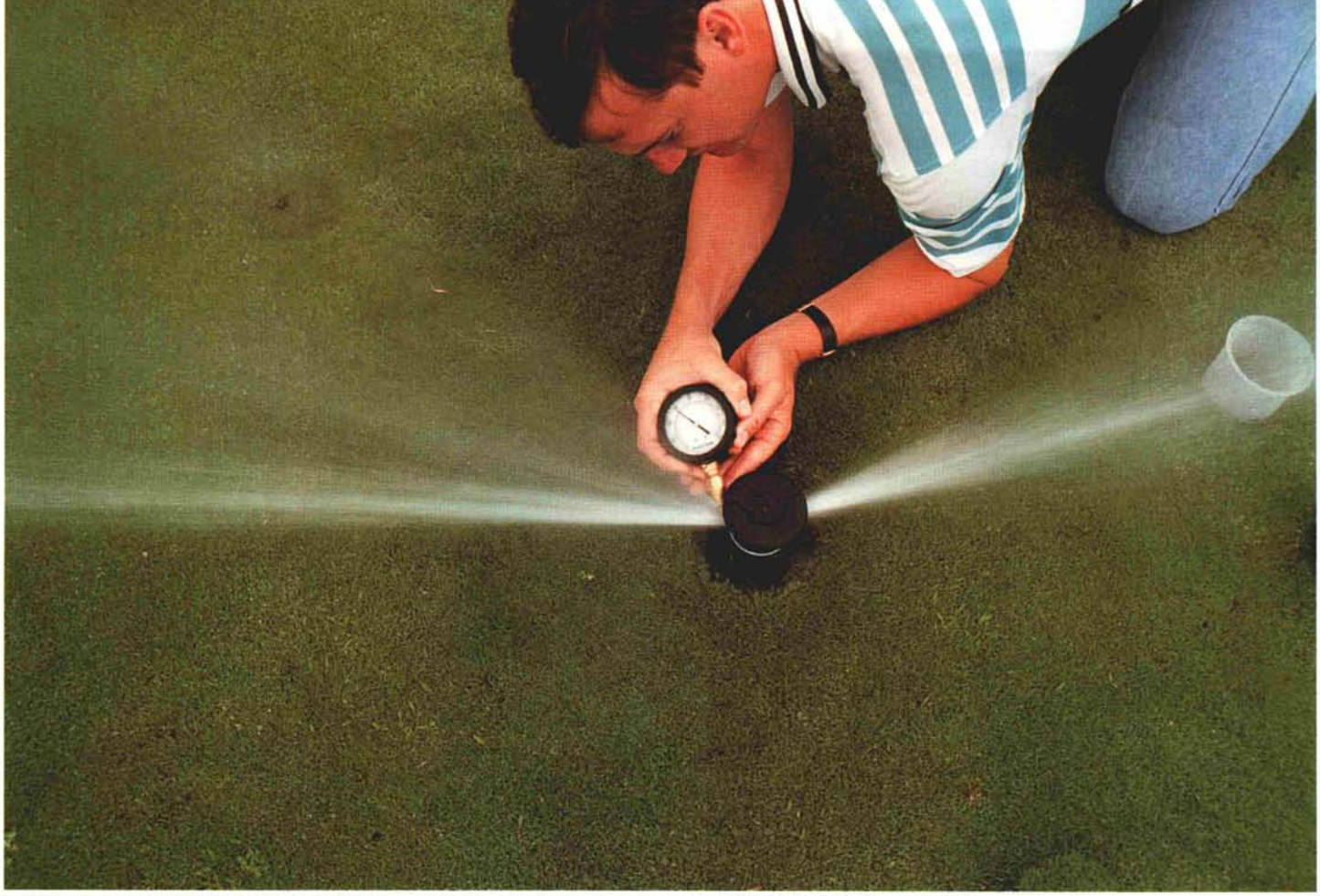

One clear sign of an irrigation system with undersized main lines and laterals is the loss of operating pressure at sprinkler heads located furthermost from the pump station.

RAIN MAKING

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IN JOHN STEINBECK'S *The Grapes of Wrath*, an entire generation of Americans was forced out of the mid-continent region by severe drought. While Steinbeck's novel itself is fictional, such catastrophic events have actually happened and have had a major impact on people's lives. Thankfully, however, mankind's increasing technology and subsequent ability to deal with Mother Nature are making a difference in the way people now live.

One shining example of how technology has made a significant difference is the mere presence of millions of residents in the arid region of Southern California. As impossible as it sounds, this astonishing miracle is the result of transporting water through aqueducts across mile after mile of uninhabited desert.

On a smaller scale, golf course irrigation systems also can produce miraculous results if, and only if, they are specifically designed to do so. Although some people suggest that an irrigation system should be designed only to supplement Mother Nature, not replace Her, good irrigation systems are designed to meet the true peak demand of the course. Perhaps this point should be self-evident, as indeed the only time an irrigation system should be turned on is when Mother Nature has failed to provide adequate rainfall.

To help make rain at your course, key features of a well-designed irrigation system need to be identified. The following information is intended to help familiarize both those who are planning to install a new irrigation system in the future and those who are searching for criteria to evaluate whether their existing irrigation system is state of the art or simply out of date.

Whether installing a new irrigation system or evaluating an existing one, the most important point to keep in mind is performance. Simply stated, good irrigation systems are those that are capable of economically applying water precisely when and where it is needed to sustain good-quality turf under drought conditions. The exact opposite is true for bad irrigation systems — they apply too much water in one location and not enough in another, and do so at great expense and inconvenience.

Pumps and Pipes

For discussion, the key features of a good irrigation system can be grouped into three categories. The first category, pumping and

piping, is the heart and arteries of an irrigation system.

As the old adage tends to suggest, when it comes to pumping stations, the bigger the heart, the better. But exactly how big is big enough for new systems, and how small is too small for existing ones?

As previously mentioned, good irrigation systems are those that are capable of meeting the peak demand of the course. Peak demand, in theory as well as in practice, is the amount of water needed during a 24-hour period to sustain healthy growth during prolonged drought conditions. Given the dramatic regional differences in climate, soil classification, and turfgrass species, an accurate figure for peak demand should be obtained from a nearby university or other regional authority.

The other bit of information needed to determine proper pump station size is the time interval within which the course must be irrigated. In the past, the standard time interval, or *watering window,* as it is sometimes referred to, was simply the shortest seasonal interval between the last foursome walking off the 18th green and the first foursome teeing off on the first tee the next morning.

Today, however, many power companies are offering reduced pricing schedules that make it financially attractive to complete nightly watering of a course in as little as six hours. Also, in cases where reclaimed water is being used, special regulations may state even greater limitations.

Now back to answering the question about how big is big enough for new systems, and how small is too small for existing ones. As an example, take a course in the western United States with a peak demand of 1,000,000 gallons per day during drought conditions and a financially attractive six-hour watering window. Since there are 360 minutes in a six-hour period, the pump station must have an output of approximately 2,800 gallons per minute to meet the 1,000,000-gallon peak demand.

Having determined the proper size of the pump station, the next key feature of a good irrigation system is its mainlines and laterals. For those installing a new irrigation system, pipe sizing must be left to the design engineer.

Don't be bashful, though. Insist that the mainline system be adequately looped (i.e., interconnected), where necessary, both to minimize pressure losses and allow segments of the course to be shut off with isolation valves in case of emergency. Remember, the opportunity to upgrade at a later date will never present itself without unearthing the entire system. Such an unfortunate necessity would be far more expensive than installing it right the first time.

For those evaluating an existing irrigation system, the signs of undersized mainlines and/or laterals include frequent pipe breakage and excessive loss of operating pressure for sprinkler heads located furthest from the pump station. It should be noted that pipe breakage can also be the result of installation of underrated pipe.

The Control System

The second category, the control system, brings the discussion to a fundamental principle of golf course maintenance — that

In order to use reclaimed water for irrigation, many courses will need to install new irrigation systems capable of completing nightly watering in as little as six hours to avoid public contact.

greens, tees, fairways, and roughs all have their own unique watering requirements. For example, consider a creeping bentgrass putting green constructed with a sand-modified root zone positioned next to a hybrid bermudagrass fairway established on a clay soil. To accommodate the individual watering requirements of each area, the irrigation system must be designed with opposite-facing 180-degree sprinkler heads.

Good irrigation systems also compensate for variables such as slope, soil texture, shade, and other factors by operating small groups of sprinkler heads from the central controller. Under most circumstances, no more than two or three sprinkler heads should be grouped together. Under extreme circumstances, however, irrigation systems are now being designed with individual head control not only on greens, but also on tees, fairways, and roughs as well.

Good control of an irrigation system should not sound extravagant. Have you ever heard someone complain about having too much control of an irrigation system? Too little, maybe, but never too much.

In addition to the installation of 180-degree sprinkler heads around greens and small groupings within an irrigation zone, good irrigation systems have quick-coupling valves at every green and tee, and at 200- to 300-foot intervals along the fairways. These manual valves allow small areas of turf and newly planted trees to be conveniently watered when necessary.

For those evaluating an existing irrigation system, the extent of control over water application between and within irrigation zones boils down to an issue of quality. Ask yourself the following questions. Is it acceptable to have under-watered rough areas around greens because one group of sprinkler heads covers both areas of the course? Can small areas or trouble spots be watered without having to haul water in a spray tank? Are areas of the fairways too wet because four or five sprinkler heads are wired together on each satellite controller station? Depending on the answers to these and other similar questions, it may be time to abandon the existing irrigation system.

A few words about the brains of the control system, or more specifically, the central controller. Today, most, if not all, good irrigation systems use a computer and on-site weather station to help schedule nightly irrigation cycles. The advantage of having a computer is that it can be used to program the shortest possible irrigation cycle that places a consistent demand on the pumping station and minimizes pressure surges in the main lines.

Existing irrigation systems that may need replacement have electro-mechanical control systems that start and stop groups of sprinkler heads in an unpredictable or erratic fashion. In many instances, both the demand on the pump station and operating pressure continuously fluctuate. As a result, nightly irrigation cycles take longer than necessary, increasing electrical costs and placing undue wear on the entire system.

Sprinkler Heads

The last category, sprinkler heads, is one that has received little attention in most articles discussing irrigation system performance. Sprinkler heads have one simple function, and that is to distribute water evenly over the surface of the course when properly spaced. Perfection should not be taken for granted, however, because of two basic reasons.

First, some sprinkler heads are poorly engineered. Believe it or not, all sprinkler

When installing a new irrigation system, selection of a particular sprinkler head model should be based solely on performance. Evaluation requires measuring the amount of water distributed at regular intervals away from the sprinkler head and then analyzing the data with special computer software.

heads have what some might call an individual fingerprint. This unique print can easily be determined using data (the amount of water) collected from rain gauges placed at 12-inch intervals along a line extending outward from the sprinkler head itself.

Using the data, a denso-gram can be generated with a computer program called S.P.A.C.E. (Sprinkler Profile And Coverage Evaluation). This graphic reveals the exact water distribution pattern for each sprinkler head model when operated at any given spacing with identical complimentary sprinkler heads.

The computer program also generates an irrigation scheduling coefficient to help interpret the significance of the denso-gram. This value indicates the amount of extra watering time required during nightly irrigation cycles to provide enough moisture to the critical dry area of the denso-gram pattern. Final selection of a particular sprinkler head model should be based on the lowest scheduling coefficient at the manufacturer's recommended spacing.

Knowing that all sprinkler heads are mechanically different and that they have unique requirements in terms of spacing, operating pressure, etc., it stands to reason that the first decision when installing a new irrigation system should be on what model of sprinkler head to install. This establishes the primary criterion to enable the design engineer to draw up plans that will produce optimum long-term performance in terms of even water distribution. Computer evaluation also can be used on existing irrigation systems to evaluate the amount of water and electricity wasted by poor water distribution from the sprinkler heads. By collecting data from the field and imputing the sprinkler head spacing and orientation, the scheduling coefficient of an existing irrigation system can be determined.

Second, some well-engineered sprinkler heads can perform poorly in the field because they are not spaced properly. Based on years of trial and error, the most practical sprinkler head spacing has proven to be 60 to 65 feet in a uniform equilateral triangular or square pattern. This fact has also been reaffirmed by computer analysis with S.P.A.C.E.

In conclusion, becoming familiar with the key components of a good irrigation system can help you *make rain* the next time Mother Nature turns her back on your course.