Helping Your Greens Make the Grade

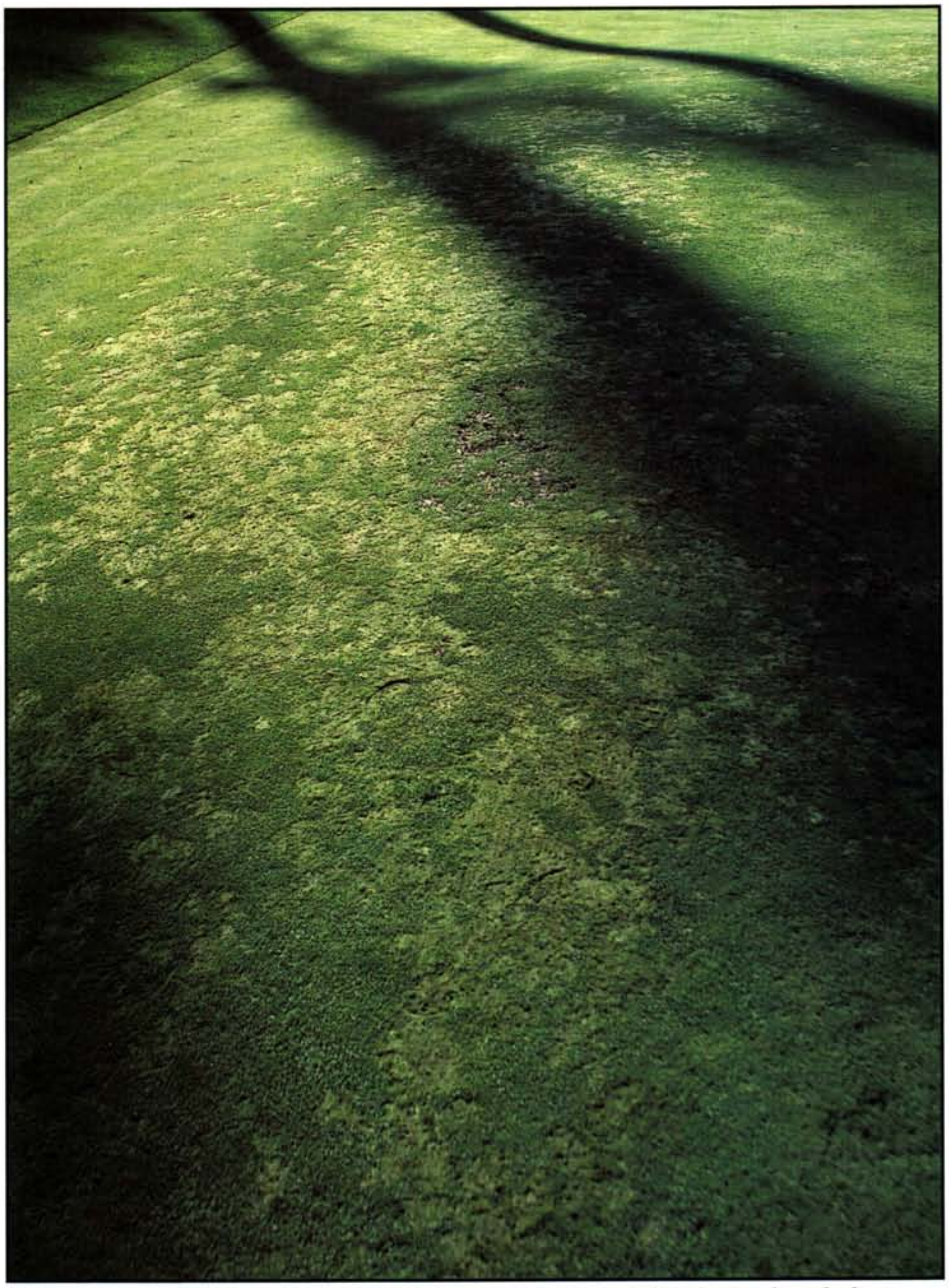
Here's a guide to help you evaluate the many factors that determine how your greens perform.

by JAMES FRANCIS MOORE

GOLFERS and their greens have had a long and often tumultuous relationship. In fact, no area of the course has a stronger influence on the golfer's game, since between the approach shot and putting, the greens come into play on approximately 75% of the shots of a typical round of golf. Most golfers realize this and are quick to point their putters in disgust whenever the green does not act as they believe it should, and they brag to their neighbor when their club's greens are in top form.

Golf course superintendents and their greens have an even greater love/hate relationship. There is an old saying in the superintendent's world — "Your greens are your resume." True enough, since players overlook a great deal on the course when the greens are in good shape, but will call for the superintendent's head when the putting surfaces are less than perfect (regardless of how good the remainder of the course is). The golfer's perception of the role of the superintendent in providing perfect greens is reflected in the tendency of the weekend hacker to refer to the *superintendent* as the *greenkeeper* — a term poorly suited to describe the varied and often complex duties of today's professional golf course superintendent.

Since golfers and superintendents alike have such close relationships with their greens, it is beneficial for all concerned to have a better understanding of why greens perform the way they do. Truth be known, few golfers have any idea of the various factors that determine the overall performance of the green. They hear stories of mysterious turf diseases and bugs, and most know they should generally fear terms like *Poa annua*, goosegrass, and brown patch. But for the average golfer the *pest* most feared is the aerifier. And while superintendents spend many hours studying the agronomics of maintaining greens, they are occasionally guilty of putting the needs of the turf over those of the golfer. The best superintendents recognize the need to seek a middle ground — to establish a level of maintenance that results in a healthy stand of turf but still provides good putting quality. Obviously, the establishment of this *middle ground* should be the golfer's goal as well, since this is their best hope of playing greens that perform well day after day. Finding the middle ground is the purpose of this article.



Reduced sunlight results in decreased photosynthesis and therefore reduced plant vigor. Problems are compounded by low-cut greens that have very small leaf area available to gather light. Moss invasion on a green is an indication that the proper environmental conditions aren't present to grow good turf.

Greens usually do not perform well or poorly because of a single factor. Instead, like most things, overall performance is the result of many influences. To identify these factors, it is suggested a *Report Card* be developed for each green. This Report Card will graphically illustrate where improvement is needed.

Quite simply, the Report Card is a *tool* to help golfer and superintendent alike evaluate the many factors that influence the overall performance of each green on their course. After the factors are identified and quantified, steps should be taken to improve each factor as much as possible. It probably will not be possible to bring each factor (or perhaps even any factor) up to a grade of "A." For example, on old or poorly built greens the factor for internal drainage may be graded as a "D." Through an aggressive aerification program the grade may be raised to "C," but only complete reconstruction would achieve the "A" rating. However, it may be possible to raise the grades for other factors as well. Perhaps entrance and exit points can be improved by rerouting a cart path or making greater use of ropes and signs. Air movement may be improved by removing brush or trees that block the wind. The relocation of misplaced sprinklers could improve the accuracy of irrigation. The overall impact of raising three or four factors will be a significant reduction in the influence of a factor that cannot be altered. In other words, the overall performance of the green can be expressed as a simple formula: The Average of Factors $A + B + C + D + E \ldots$ = *Overall Green Performance.*

Think of each green as a decathlon competitor. An athlete whose height may limit his or her ability to high jump will have to make up points on the 200-meter dash to remain competitive. There is another formula you should keep in mind regarding the changes that are made to improve the greens. This is a case where $1 + 1 + 1 + 1 + 1$ can actually add up to 6. In other words, by implementing multiple changes (each reducing the stress on the green), a synergism is likely to occur, reducing overall stress by more than the sum of the individual steps. This is due to the fact that so many of the stress factors are closely related. Improving one factor frequently results in improvement in one or more of the others.

To be the most useful and effective, the Report Card must be developed with the combined input of the golf course superintendent, course professional, and members of the course leadership (often the Green Committee). This group is referred to below as the *Rating Team*. There are three steps to completing this evaluation process.

Step 1

Assign an overall performance grade to each green. Before heading out to the course, the Report Card rating team should first gather in a comfortable and private area to discuss what lies ahead. This is also the time to complete the first phase of the Report Card — assigning a letter grade to each green's overall performance. Just like in school, a grade of "A" reflects superior performance, and "F" indicates failure. This overall grade is much like a college student's final GPA or grade point average over four years of education. Be sure not to base the overall grade on a single good or bad season. Base the grade on four or five years' worth of performance.

Layers in the green profile severely restrict internal drainage and can even block it altogether. Conventional aerification may not be deep enough to fully penetrate a buried layer. Deep-tine aerification is the next step in solving the problem.

Step 2

Visit each green to complete the Report Card and identify where changes should be made. This is where the evaluation process gets more detailed. Listed on the accompanying rating sheet are many factors, each of which should be assigned a letter grade. Notice that the sheet has room to add additional factors. It also is possible that some of the factors listed are not applicable to your particular course. Since the grades are obviously subjective, it is important that the entire rating team participate in the evaluation process from start to finish. It is also advisable to complete the process in a single day. Based on personal experience with this rating concept, 18 greens should take approximately three hours to rate fairly.

Step 3

Implement the changes. The Report Card is useless unless changes are made to improve the overall growing conditions on the greens. Implement as many positive changes as possible, keeping in mind that no single change will have the impact of multiple changes.

Factors Influencing a Green's Performance

Listed below are the factors that have the greatest impact on the overall performance of a green. (Note that they are not listed in any particular order.) Also included are some criteria for determining a grade for each factor. It should be viewed as a starting point and not an inflexible guide that must be followed to the letter. Your rating team probably will find it helpful to modify the criteria to better fit your course.

Light

A basic agronomic fact that is overlooked far too often is that turfgrass requires light (lots of it) to flourish. As you rate each green for light, keep in mind what you probably learned back in the fourth grade. Light is necessary for photosynthesis. Photosynthesis is the process of turning the energy of light into energy the plant can use for growth. Growth is necessary for a plant to withstand and recover from wear and tear. Therefore, it stands to reason that when less light is available, the turfgrass is less able to withstand traffic.

The steps to improve the grade for light are obvious. Tree pruning, and in some cases complete removal, will be necessary to provide better growing conditions. It is easy to forget that trees grow larger every year and as a result block more light each season. Keep this physiological fact in mind when someone observes, "We never used to have problems with that green."

• "A" — given to greens that receive 8 hours or more of direct sunlight.

• "B" — given to greens that receive 6 to 8 hours of direct sunlight.

• "C" — given to greens that receive 4 to 6 hours of direct sunlight.

• "D" — given to greens that receive 2 to 4 hours of direct sunlight.

• "F" — given to greens receiving less than 2 hours of direct sunlight.

Air Movement

Air movement across the putting surface has a very strong influence on the overall health of the turf — particularly in terms of disease susceptibility and cooling of the plant. The pathogens responsible for the most devastating turfgrass diseases are far less active (and therefore less destructive) when air moves immediately over the turf. The air movement helps keep the turf and the surface of the soil dry. Wet, stagnant air provides excellent conditions for pathogens to proliferate. From a cooling standpoint, a good comparison can be made to our built-in air-conditioning system — perspiration. On a hot day, our skin is cooled as we perspire. The plant's perspiration system is called evapotranspiration (a combination of evaporation and the transpiration of water through the stomata or *pores* of the leaf). Air movement must be given high priority for all greens — particularly on golf courses located in climates that include high heat and humidity.

Steps to improve air movement include pruning and possibly removing trees and brush on the upwind and downwind sides of the green. When tree removal is considered to be impossible because of architectural or sentimental reasons, institute an effective pruning program. Even high mounding around a green can block air movement, so regrading the mounds can produce a significant improvement. In severe cases, fans are used to provide an artificial source of air movement.

• "A" — given to greens that receive unrestricted air movement across the turf surface.

• "B" — given to greens that are blocked from the predominant winds but open on other sides.

• "C" — given to greens that would receive very limited air movement without the use of fans.

• "D" — given to greens "open" on only one side.

• "F" — given to greens located in low areas that receive extremely limited air movement from any side.

Entrance and Exit Points

Codes for buildings call for a specific number of entrances and exits based on the capacity of the building. Perhaps greens should be given the same consideration. When the architecture of a greensite is such that entrance and exit points are severely limited, even a small annual number of rounds can be quite destructive to the turf. Greenside mounding, bunkering, trees, and other features can be as restrictive as cattle chutes. Predictably, such restrictions are far more important on heavily played courses than on the extremely private facility.

Steps for improvement include rerouting cart paths to encourage players to enter and exit from different sides of the green. Ropes and signs often are necessary evils (but be sure to move them frequently and keep them in good condition). In severe cases, bunkers may have to be removed or redesigned to provide greater access to the green. Mounding may have to be softened, since players instinctively avoid walking over hills to get to the green. Inconsiderate players might ignore all these efforts to spread traffic out over a large area. However, the majority of golfers realize they benefit the most from a course in good condition and will cooperate with properly placed and maintained traffic control devices.

• "A" — given to a green that has at least four readily usable entrance and exit points.

• "B" — given to a green that has three readily usable entrance and exit points.

• "C" — given to a green that has only two readily usable entrance and exit points. Other access points exist but will require extensive roping and/or signage to force players to use them.

• "D" — given to a green with only one readily usable entrance and exit point. Other access points may exist but require extensive roping and/or signage to force players to use them.

• "F" — given to a green with only one readily usable entrance and exit point and no other real options, regardless of roping, etc.

Size of Green

Golf has enjoyed tremendous growth over the past couple of decades. As a result, the greens on many courses must endure countless additional rounds. In many instances, the original architectural design that was appropriate in the early days of the course simply cannot support the twofold or even threefold increase in annual rounds that is not uncommon today. Just as many families start out driving a two-seater, these families often find themselves driving station wagons ten years later.

Steps for improvement are limited. Since greens sometimes grow smaller over time (as the workers on the mowers try to avoid scalping the edges), it is possible that the original boundaries of the green can be reestablished, providing additional square footage. A probe should be used to find the original edge of the rootzone

Often, something as simple as eliminating triplex mowing in favor of walk-behind can be enough to help a green through the rough times.

cavity. It should be noted that even if the green has grown it, enlarging the surface may take a lot of effort. For example, in areas of the country where bermudagrass fairways and banks surround bentgrass greens, simply enlarging the mowing pattern would likely introduce bermudagrass into the bentgrass green. In this situation, fumigation of the bermudagrass in the area to be recovered as green should be accomplished first.

• "A" — given to a green in excess of 7,000 square feet.

• "B" — given to a green 6,000 to 7,000 square feet in size.

Triplex mowers on sharp turns can result in severely worn turf. Simply changing to walk-behind mowers may be enough to return the turf to good health.

• "C" — given to a green 5,000 to 6,000 square feet in size.

• "D" — given to a green 4,000 to 5,000 square feet in size.

• "F" — given to a green less than 4,000 square feet in size.

Cupping Area

Another factor that has been strongly impacted by the increase in the popularity of the game (and therefore increased traffic on the greens) is cupping area, or the number of areas in which the hole can be *fairly* located. As a general rule, the hole should be located approximately five paces from the edge of the green, and the putting surface within three feet of the hole should be on the same plane.

Estimating the percentage of the green that is usable for hole locations takes a little practice. To develop a feel for this estimating process, try the following procedure on the first couple of greens rated. Using tees, roughly outline the portions of the green in which the hole can be reasonably placed. Next, estimate the square footage of each marked area. Add the square footage together and divide the sum by the total square footage of the green. For example, suppose there are three areas of the green that can be used for hole locations. The total square footage of these three areas is approximately 1,500 square feet. The entire green measures 6,000 square feet. 1,500 ÷ 6,000 = .25 or 25%.

Steps to increase cupping area include the restoring of original green boundaries (as discussed above in the "Size of Green" section) and selecting a speed for the greens that is appropriate to their contouring. For example, a green mowed at ⅛ of an inch and rolling 9 feet on the Stimpmeter may yield a rating of "D." Raising the cut to 5/32 inch might yield a speed of 8 feet and increase the percentage of usable cupping area to a "C" or even "B" rating.

Assuming greens are moderately sized to begin with, use the following grades to rate cupping area:

• "A" — given to greens with cupping areas in excess of 50%.

• "B" — given to greens with cupping areas between 40% and 50%.

• "C" — given to greens with cupping areas between 30% and 40%.

• "D" — given to greens with cupping areas between 20% and 40%.

• "F" — given to greens with less than 20% cupping area.

Surface Drainage

Surface drainage is extremely important to every green, including those with good internal drainage. Even the best-constructed rootzone will gradually drain more slowly. This is due to the production of organic matter by the plant and the introduction of soil *fines* (notably clay, silt, and very fine sand) into the rootzone over the years. These fines are introduced through topdressing, wind, and even during irrigation when the water supply contains suspended solids. It is even possible for some types of sand to be chemically weathered, causing a reduction in size.

Without good surface drainage, water collects in the low areas of the green, resulting in extremely poor growing conditions for the turf. The rootzone becomes saturated and can remain that way for extended periods of time. This results in anaerobic (without oxygen) conditions, which can lead to the death of the plant. Disease incidence also increases, as does the occurrence of algae and soured soil (often referred to as *black layer*).

Surface drainage occasionally can be improved by lifting the sod, adding additional rootzone mix to eliminate the water-collecting hollow, and replacing the sod. Obviously, this step is practical only in small areas and near the edges of the green. Sometimes surface drainage is blocked by the development of thick thatch in the turf immediately adjacent to the green. Removal of the sod and thatch, followed by replacement with a thatch-free sod, may be all that is necessary to allow water to once again flow off the green.

• "A" — given to greens with no water collecting hollows and surface drainage in at least three directions.

• "B" — given to greens with no water collecting hollows and surface drainage in two directions.

• "C" — given to greens with no water collecting hollows and surface drainage in one direction.

• "D" — given to greens with surface drainage to the center of the green and one surface exit point.

• "F" — given to greens with water collecting hollows.

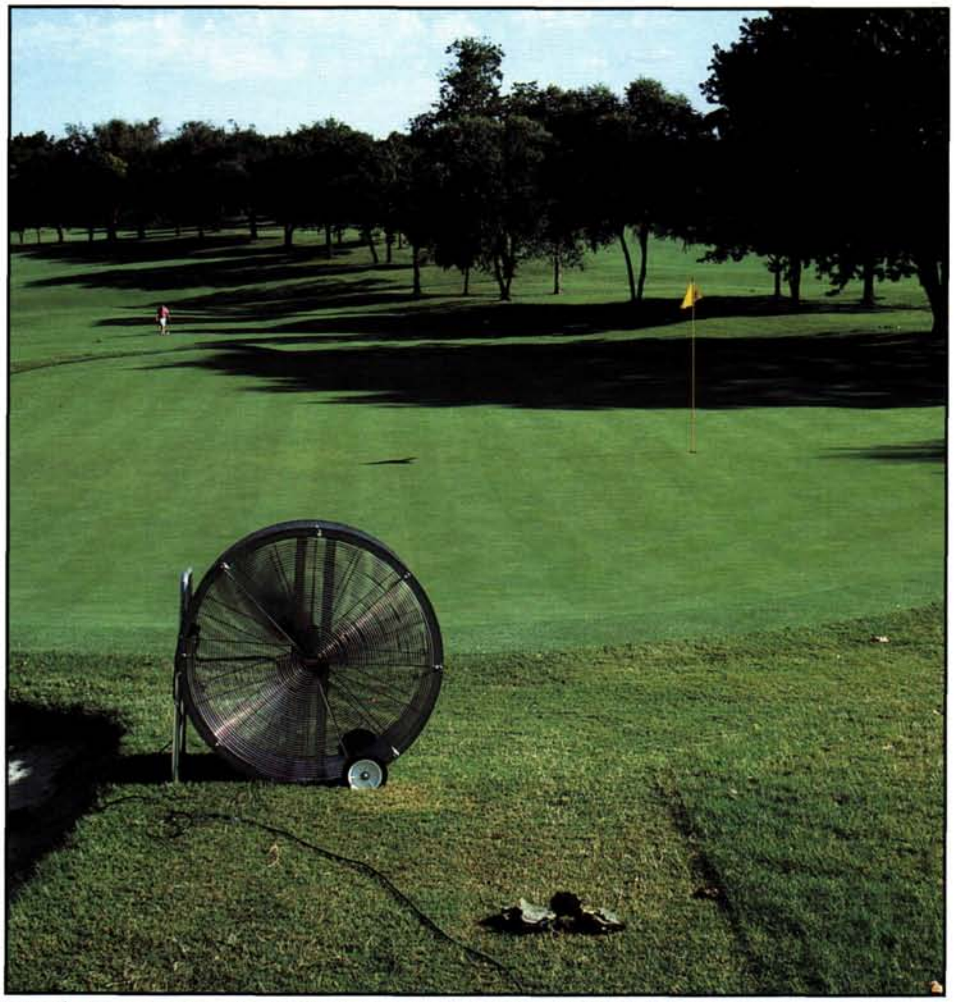
Internal Drainage and Rootzone Porosity

Internal drainage and rootzone porosity are often the only factors considered when determining the need for the complete reconstruction of golf greens. The USGA provides specific guidelines regarding these factors (see the *USGA's Guidelines for a Method of Green Construction*). However, all too often greens will be rebuilt to meet these guidelines without consideration of the many other factors that contributed to the poor performance of the original green. Not surprisingly, in many instances the new green does not perform as well as expected. Internal drainage and porosity are extremely important, but they cannot compensate for the lack of light, poor air movement, poor traffic control, etc.

Good internal drainage is without question very influential to the overall performance of the green — particularly in adverse climates and in areas where water quality is less than ideal. The degree of internal drainage is measured as *saturated hydraulic conductivity.* Rootzone porosity represents the sum of two types of porosity — *capillary* and *non-capillary.* Capillary porosity is a measure of the percentage of pores in a rootzone mixture that are filled with water at field capacity, while non-capillary porosity refers to the percentage of pores filled with air. To determine these factors accurately, samples should be removed from the green and submitted to an accredited physical soil testing laboratory.

Short of complete reconstruction, the most effective means of improving internal drainage and porosity is to increase aerification. Often, a combination of deep-tine and conventional core aerification is necessary. Many courses now include water-ject aerification as a supplement to the mechanical aerification practices.

- "A" — given to greens built in accordance with USGA guidelines.
- "B" — given to non-USGA greens with hydraulic conductivity rates over 3 inches per hour and a functional subsurface drainage system.
- "C" — given to greens with hydraulic conductivity rates over 3 inches per hour but no subsurface drainage system.
- "D" — given to greens with hydraulic conductivity rates of 1 to 3 inches per hour.
- "F" — given to greens with hydraulic conductivity rates of less than 1 inch per hour.

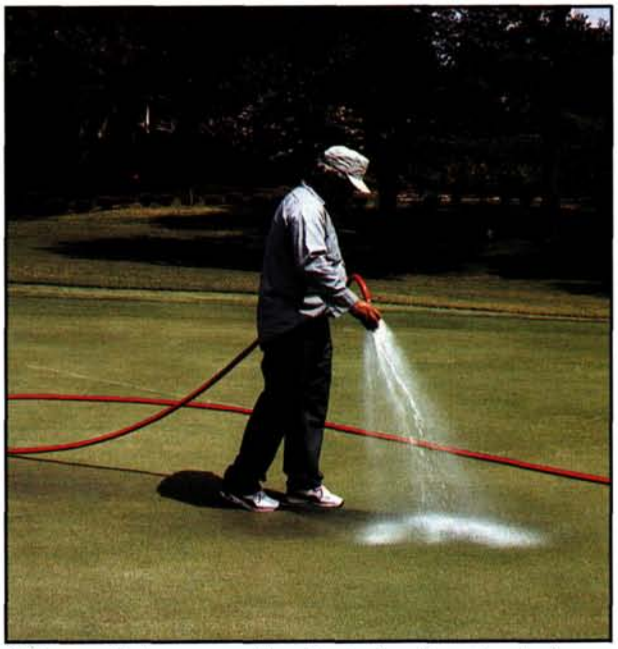

Good air movement across the putting surface is vital for disease suppression and plant cooling. If tree pruning or removal is not possible, fans are the next best option.

Irrigation Control and Coverage

This is another area that frequently is overlooked when evaluating the overall performance of greens. Although proper irrigation has always been important, the lowering of cutting heights and the use of different grass species in the vicinity of the greens has enhanced the need for as much control and accuracy as possible. Common sense should make us wonder how full-circle, overhead sprinklers that cover the green, surrounds, and fairway approach areas, can possibly meet the specific needs of the turf in each area. For example, a bentgrass or bermudagrass green maintained at $\frac{3}{16}$ inch or less does not conveniently have the same water requirements as the bermudagrass fairway cut at $\frac{1}{2}$ inch or the bluegrass rough mowed at 2 inches. Different cutting heights and different turfgrasses demand different irrigation frequencies and volumes. As a result, even a well-designed and properly installed and operated system often must be supplemented with hand watering. And, obviously, a system with poor spacing, improper nozzles, or improper pressure adjustments will cause nothing but problems.

Steps for improvement include upgrading the irrigation system to provide single head control, installing a perimeter system to water the surrounding turf separately from the greens, relocating heads to provide even coverage, and altering nozzle sizes to achieve better coverage and proper pressure regulation. Hand watering can also be increased to help compensate for a substandard irrigation system.

- "A" — given to greens irrigated with a combination of full-circle and adjustable part-circle heads facing outward. Such a system is often referred to as a *perimeter* system. Each of the heads should be able to be controlled independently through the automatic irrigation system.
- "B" — given to greens without a perimeter irrigation system but with single head control of sprinklers that are correctly spaced.
- "C" — given to greens without a perimeter irrigation system and without single head control.
- "D" — given to greens with no perimeter system, no single head control, and the satellite that controls the greens is located on the same irrigation cycle as other areas of the course.



Good employee tenure usually results in a better-trained crew. Knowing the difference between cooling the turf and spot watering, and when each technique is needed, can result in better-managed turf during stress periods.

• "F" — given to greens with a manual irrigation system.

Purity of Turf Stand

Older greens are often composed of more than one species of turfgrass and even various biotypes of the same grass. For example, older bentgrass greens often have large percentages of *Poa annua* intermixed with the bent. Biotypes of both bentgrass and bermudagrass in greens begin to segregate over time, resulting in many patches of distinctly different grasses in the same green. Each of these different grasses and biotypes has a particular set of vulnerabilities to insects, disease, climatic stresses, and, particularly, cutting heights. As a result, the more varied the makeup of the putting surface, the more difficult it is to manage.

With the exception of very minor outbreaks of *Poa annua* and/or off-type grasses, there is little that can be done to restore the purity of the stand of grass other than completely replant. Until then, raising cutting heights to suit the type of grass in the green that is least able to tolerate low cutting heights will help provide uniformity in terms of putting quality.

• "A" — given to greens composed of a pure stand of turf.

• "B" — given to greens with less than 20% "off" types.

• "C" — given to greens with less than 30% "off" types.

• "D" — given to greens with less than 40% "off" types.

• "F" — given to greens with less than 50% "off" types.

Amount of Play

No agronomic mysteries here — the less you use your greens, the healthier the turf will be. When golfers make their inevitable comparisons from one course to the next, the amount of traffic the greens must endure often is the most overlooked factor.

To deal effectively with traffic, it is vital the greens be established to the best turf for the climate in which the course is maintained. What is agronomically possible does not mean it is agronomically sensible. Bentgrass greens maintained in hot and humid climates cannot tolerate the same amount of play as bermudagrass greens in the same climate. The superintendent also should be sure that adequately high cutting heights are maintained to *cushion* the turf from heavy traffic loads. Topdressing, fertilizing, and grooming practices must be adjusted to maintain a pad or thin layer of organic matter between the crown of the plant and the underlying (usually abrasive) rootzone mixture. Potassium levels should be kept at recommended levels to provide a stronger plant that is better able to withstand stress. Spikeless shoes should be encouraged to reduce injury to the turf.

• "A" — given to greens that receive fewer than 20,000 rounds per year.

• "B" — given to greens that receive fewer than 30,000 rounds per year.

• "C" — given to greens that receive fewer than 40,000 rounds per year.

• "D" — given to greens that receive fewer than 50,000 rounds per year.

• "F" — given to greens that receive more than 50,000 rounds per year.

Water Quality

The water used to irrigate the greens can make the difference between success and failure of the turf. Greens maintained with water high in salts or bicarbonates are predisposed to a wide variety of problems. Establishing a grade system for water quality is impossible, since so many factors interact. If you have questionable water quality, it is best to solicit the input of a qualified agronomist to determine the impact of the water on the turf, as well as steps for improvement. The ratings listed below are therefore highly generalized.

• "A" — excellent water quality.

• "B" — good water quality.

• "C" — marginally acceptable water quality.

• "D" — poor water quality.

• "F" — very poor water quality.

Other Rating Factors

There are many other factors that may need to be considered by the rating team. These could include the following:

• Nematode levels.

• Experience and skill of maintenance crew.

• Availability of proper maintenance equipment.

• Tenure and skill of the superintendent.

• Tree root competition.

• Cutting height.

Rating the skill of the superintendent is perhaps the most subjective process of all. Without question, a skilled superintendent who has been given time to learn the nuances of a particular set of greens can have a very positive impact on the overall performance of those greens. However, no superintendent, regardless of skill, can completely overcome stresses resulting from the many factors discussed earlier. The superintendent cannot independently provide light, air movement, adequate size, drainage, or good water quality. Assuming your course has a superintendent of at least average ability, the team would be wise first to correct the many other factors that are holding back the greens. It is amazing how often a superintendent considered by the golfers to be without talent suddenly develops a green thumb when given the opportunity to manage properly constructed greens. By the way, there are steps to take to help the superintendent improve as well. The leadership of the course should support the superintendent's efforts to learn by providing the opportunity to attend educational sessions on national, state, and local levels. The science and art of greens management changes rapidly with the introduction of new technologies and the ever-increasing stresses today's greens must endure.

Conclusion

Developing the Report Card can identify where work is needed to improve the greens. It can also help determine whether or not reconstruction is necessary. Finally, completing the Report Card before building or rebuilding greens can help ensure that, when the construction is finished, the greens will be both agronomically sound and capable of providing top-quality putting conditions.

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Table 1

Report Card for ______________________________ Date Completed ________________

FACTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Light																		
Air movement																		
Entrance and exit points																		
Size of green																		
Cupping area																		
Surface drainage																		
Internal drainage																		
Irrigation control/coverage																		
Purity of turf stand																		
Amount of play																		
Water quality																		
Historical Performance																		