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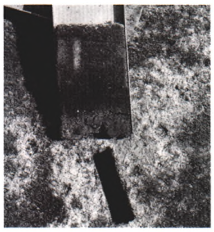

Cover Photo: Time to rebuild?

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Sometimes Successful Agronomy Means Starting Over

by **PAUL VERMEULEN**
Agronomist, Western Region, USGA Green Section

WHY DO some putting greens endure the stresses of summer successfully while others slowly melt away despite the superintendent's best efforts? Perhaps it is related to how greens are constructed, or how they have been managed. There is no doubt, though, that the problems with a certain percentage of these greens would best be solved by total reconstruction.

Most superintendents and club officials react to their problem greens by looking for a relatively quick, simple, inexpensive cure. They often start by trying the most recent miracle fertilizer, plant extract, or soil conditioner. When that fails, and a new superintendent is on the job, he tries the next stage of cures, including conventional aerification, deep-tine aerification, and tree removal and the like. If these worthwhile but sometimes insufficient programs fail, the next superintendent has to rebuild the greens from scratch.

How to decide which cure to apply to the problem greens can be a real challenge. After all, many greens can be salvaged by proper cultural management programs. Rebuilding the greens according to good specifications would certainly resolve most problems, but rebuilding is expensive, and it takes the greens out of play for several months at least.

Several factors to consider in preparing to attack problem greens:

Soil Variability — Topmix components used for putting green construction vary tremendously throughout the country. If someone were to sample newly built greens from different sections of the country he would surely see everything from 100 percent washed plaster sand suitable for highway construction, to red clay suitable for professional pottery. Interestingly, both materials have their advantages. For instance, pure sand resists compaction and promotes rapid drainage, while pure clay has excellent water and nutrient retention. In order to build a successful putting green, though, the best characteristics from both materials are required. At first glance, the perfect balance might seem to be a 50:50 mix between sand and clay, but it turns out that such a soil would be equally bad, and perhaps worse, for putting green construction than the pure form of either material.

Consider the problems at two courses, each of which built greens with economy

These contours would probably be too much for 120,000 rounds of golf.

in mind. One course built greens according to the ever-popular "modified" USGA Putting Green Specifications, and the other followed the equally popular "almost built" to USGA Putting Green Specifications.

The "modified" USGA greens received a topmix consisting of an 80:20 sand/soil mix. (It is a widely held misconception that a USGA topmix is always 80:20, regardless of the quality of the components. This is an incorrect and sometimes fatal notion.) The mixture was not tested by a soils laboratory, and the soil component turned out to contain a significant amount of silt and clay.

The "almost" USGA greens were constructed using an untested 80:20 mix as well, but this time the sand was much too fine. Also, to save some money, the club dispensed with the tile drains and skimped on the depth of the topmix.

Despite being built in an era when scientific, time-tested construction methods are available, the greens at both courses caused the same endless nightmare. Turf is lost on a regular schedule, and the blame for these failures is attributed to poorly devised cultural programs and neglect. In truth, all the miracle cures and deep aerification in the world cannot compensate for a poorly drained soil. Without reconstruction, the future of these two courses rests in the hands of nature. During favorable weather, these putting greens are satisfactory, but during periods of heat and heavy precipitation they can deteriorate quickly.

If the original construction materials have physical properties that cannot be overcome through conventional means, then reconstruction may be the only solution. Where, then, can we find a soil suitable for putting green construction?

One proved method is to mix and match several different combinations of sand and organic matter according to USGA specifications. Not just any sand and any organic matter can be used, only those that conform to proved specifications. Developing a topmix with desirable bulk density, porosity, water infiltration, and resistance to compaction requires physical soil testing by a reputable laboratory. Remember the old saying, "Exercise caution, and never look for bargains when considering brain surgery." The same is true for putting green construction.

Although it is an important consideration, the wide range of soil textures used in the greens' original construction probably doesn't account for half the variability in soil profiles on established golf courses. What really separates one course from another and makes each of them unique is their management history. Depending on the ages of the courses, and how many different topdressing materials have been used, soil profiles are as individual as human fingerprints.

Consider too the variability in subsurface drainage, and you can quickly appreciate why each putting green requires individual consideration. An old putting green, for instance, built from a well-drained native soil and topdressed for years with a good-quality sandy material may have very good drainage characteristics and require no special cultural practices.

Now consider an old putting green built from a poorly drained, easily compacted soil and topdressed with the same quality sandy material. Because the underlying soil has such poor characteristics, the green might be a good candidate for deep-tine aeration. If this process does not dramatically improve the drainage, however, oxygen can become a limiting factor during heavy irrigation or rainfall, and the potential for serious turf loss is a constant threat. The final chapter in this story should then be reconstruction.

Water Variability — Water quality has been given close attention in recent years, and for some very good reasons. In considering water quality, two important aspects deserve discussion.

First, for the irrigation system to operate properly, suspended matter, such as organic debris, should be eliminated. This problem might easily be solved by the installation of a filtering system or settling pond.

Second, water pH and the presence of dissolved salts and other compounds should be considered in relation to soil chemistry.

The solutions to some of these problems might well be difficult, and they may even include putting green reconstruction.

To determine scientifically if water quality is a problem, a case history using soil and water test reports should be put together. Keep in mind that even potable water with low levels of soluble salts can cause significant turf loss if internal drainage is inadequate.

If the irrigation source is tainted with soluble salts, adequate drainage is of critical importance. It is essential, though, to define soil drainage properly as it applies to putting greens. There are greens constructed with well-drained soils, and then there are greens constructed with poor-quality soils but drained artificially to remove puddles.

Water does not stand on either type of green, but only the well-drained soil allows leaching of soluble salts. The putting green constructed with artificial drainage could suffer from toxic salt accumulations in the soil between the drain lines.

Should the club consider irrigating with salty water, reconstruction with a well-drained root zone mix and artificial subsurface drainage should be a foregone conclusion.

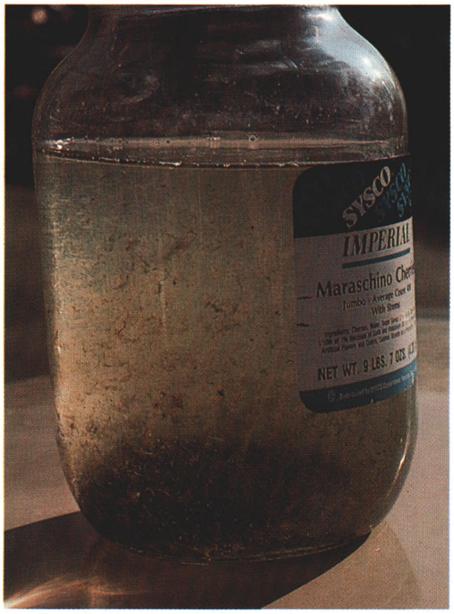
When irrigation water contains other compounds, such as bicarbonates, or has an unusually high pH, programs should be instituted to neutralize their effects on the soil. Sulfur-containing materials applied directly to the soil in most cases are used most often to lower pH.

Looking to the future, new technology that employs reverse osmosis and other techniques may help relieve some of the deficiencies of today's irrigation sources. Until this technology can deliver quality water at an affordable price, however, we must continue to rebuild putting greens to provide the necessary drainage.

Surrounding Vegetation — When evaluating problem putting greens for possible reconstruction, don't underestimate the impact of nearby large trees. Courses that have resisted the temptation to over-plant with an abundance of trees invariably enjoy greater success with their greens than those where too many trees have been planted. The reason is that large trees planted too close to important turf areas often restrict air circulation, inhibit sunlight penetration, and invade under the turf surface to compete with the grass for water and nutrients.

The failure of greens surrounded by tall trees is too often attributed to an outbreak of disease or some other problem. In truth, the disease may have dealt the final blow, but the trees were probably responsible for predisposing the turf to disease activity. The moral is, never decide to rebuild a green without first considering the effects trees might have. Rebuilding the problem green without dealing with the trees will probably not solve the problem, and even well-built new greens will likely be difficult to maintain.

To evaluate greens for tree-related problems, compare the problem green located next to large trees with another green located in an open area. If the two



(Top) These trees beget disease.

(Left) Good-quality topdressing on a well-drained soil deserves praise, not reconstruction.

(Above) Poor-quality irrigation water can force reconstruction in some cases.

greens are built with the same soil and have been managed similarly in the past, most often the putting green located among the trees will show problems.

If trees cause a green to be difficult to maintain, root prune the trees by digging a trench two-and-a-half feet deep around the perimeter of the greens. Trenching between the green and the surrounding trees will sever the invasive tree roots, and allow the turf to absorb water and nutrients without competition. After reviewing the irrigation system layout, the trench should be established as close to the greens as possible. Then thin out and prune the surrounding trees to improve air circulation and sunlight penetration. As a guideline, continue to prune and remove trees until the problem green receives the same amount of sunlight as greens located in open areas.

After these important steps have been taken, it's time to wait. If the trees were indeed the primary problem source, some improvement should be noted during the next several weeks or months. If the green does not show signs of recovery, then other problems need to be addressed, and reconstruction may have to be considered.

Putting Green Contours — In the race to achieve faster putting green speeds, the slopes on many older greens are becoming unplayable. Not only do severe slopes frustrate the average player, but they also limit the number of good hole locations available on each green. Concentrating the hole locations in the same areas over an extended period of time inevitably leads to a thin turf canopy and soil compaction.

The alternatives for dealing with severely sloped greens are very much limited. One choice would be to reduce the speed of the greens to allow for more hole locations. The other would be to restrict the number of rounds so the few available hole locations would not suffer excessive compaction and wear injury. If these solutions are impossible or unacceptable to the golfers, then it is probably time to approach a golf course architect and construct a larger green with a less severe slope.

Membership Demographics — There is no doubt that the passion for golf is growing throughout the country. The result is that some golf courses designed for 15,000 to 20,000 rounds annually are now entertaining from 70,000 to 120,000 rounds. Despite great advances in equipment technology and significantly greater understanding of the principles of turfgrass science, discrepancies such as this are more than can be dealt with. In such instances, rebuilding greens may be the best solution.

If all your detective work reveals that reconstruction is necessary, it would be wise to employ a golf course architect. He can be given the task of preserving the architectural theme of the original design, and he can be held responsible for the finished product. Furthermore, the architect can provide accurate blueprints to work from during construction, and he can help ensure a successful renovation program.

The USGA Specifications for Putting Green Construction are certainly not the only construction specifications available, but they do have a successful record in all geographic locations. These specifications are the result of years of scientific investigation and field experience, and are highly recommended. Simply mixing sand and soil together based on intuitive feel often leads to disastrous results.

In summary, deciding whether or not to rebuild problem greens can be a very complex business. Each case must be considered individually, and all the potential causes of failure must be given due consideration. This includes studying what makes each course unique by looking at soil and water test reports, surrounding vegetation, putting green contours, and membership demographics. After this information has been carefully evaluated, it might well be the right time to approach the Board of Directors with a greens reconstruction proposal. Sometimes successful agronomy means starting over.

Putting Green Construction: Interpreting Physical Soil Test Data

by JAMES M. LATHAM
Director, Great Lakes Region, USGA Green Section

THE LABORATORY procedures followed for establishing the physical characteristics of mixtures used in putting green construction haven't changed much since the USGA Green Section Specifications were introduced some 30 years ago. The specific recommendations based on the results, however, have evolved through the years to correspond to continuing research and experiences in the field. The agronomic success of greens built with mixtures of sand and peat, with little or no soil, has led not only to a critical evaluation of all the types of components, but also to the laboratory data the mixtures are based on.

In earlier days, when soil was considered to be a mandatory part of topmixes, concrete-grade sand was used to create resistance to compaction and to furnish large, non-capillary pores for drainage. Greens built with concrete sand during the late 1950s and early 1960s, however, were hard, because of the gravel content, and they required more time to mature than many people thought necessary. To compensate for the hardness, many superintendents used softer topdressing materials, which often turned out to be incompatible with the gravely topmix.

The evolution of component specifications began in the early 1970s, and favored greater sand uniformity and a trend to medium-sized, round particles. Articles published by Madison[1] and Spomer[2] furthered the movement to near soil-less greens and topdressing. Some researchers promoted the use of fine and very fine sands in topmixes, but experiences in the field have not supported this.

The upshot of these evolutionary advances is the present set of specifications

Determining sand particle size range is one part of a complete soil analysis.

(Table 1), which should be with us for some time. The changes since the last publication appear to be small, but their application in future construction will result in better playing conditions and a prolonged life expectancy for the greens. Shortcuts in construction or failure to follow laboratory recommendations will significantly increase the potential for failure.

Data produced by a laboratory physical analysis of test mixtures tell a great deal about the construction components and their future performance. Laboratory reports include sieve test results on the sands, showing the percentages of different size particles and how well they fit the basic recommendations.

Organic components are also tested to expose the amount of mineral matter present, since some apparently good peats can contain surprisingly high percentages of silt, clay, and very fine sand, which can be detrimental to a green's long-term performance. These very small particles can migrate downward with the flow of drainage water, and eventually accumulate at some point in the profile to the degree that drainage will be restricted or blocked.

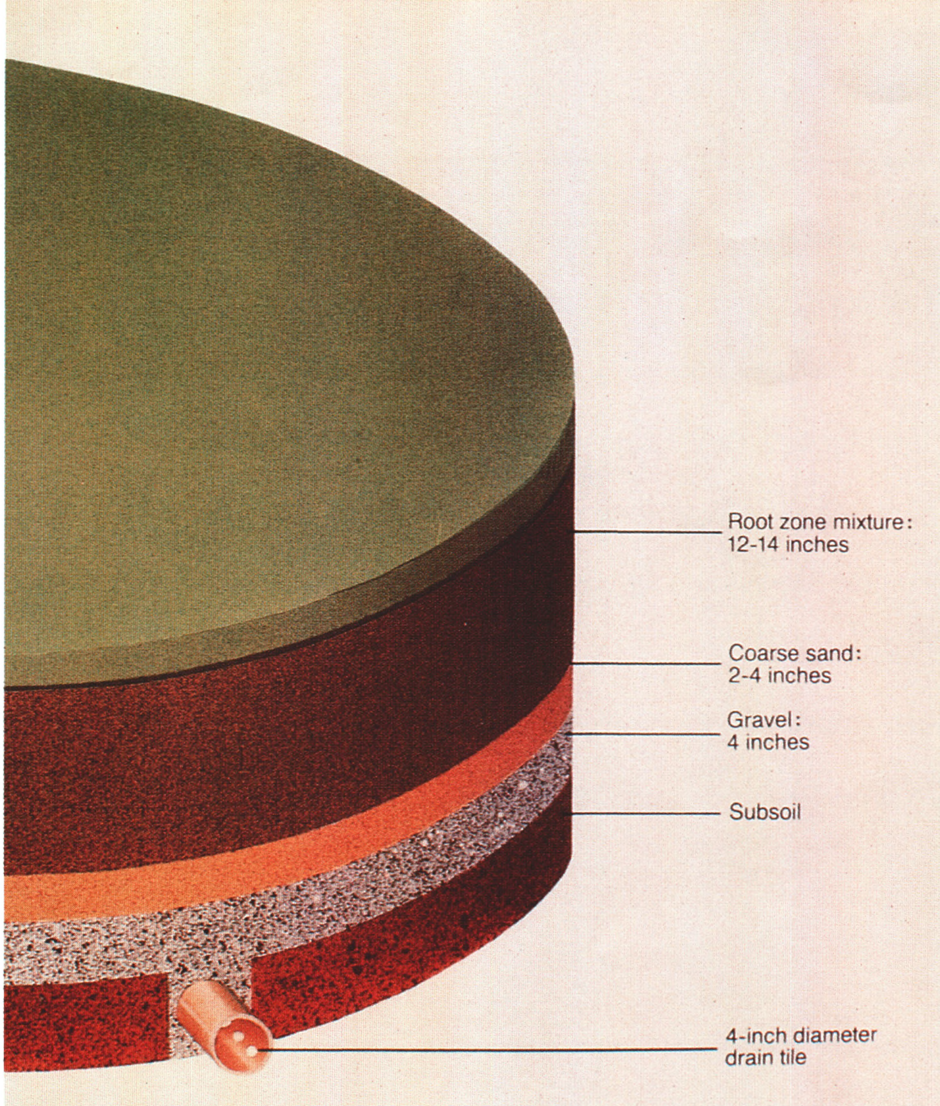
Physical performance data are developed from specific tests on trial mixtures of components that are submitted to the laboratory.

The data collected correspond to several factors considered to be essential to the performance of putting green turf. Among these factors is **porosity** (pore space), the volume of empty space in a dry sample. The recommended total pore space now ranges from 35% to 50%, up from the 33% in earlier publications. The amount of that space that retains water against the pull of gravity is called **capillary pore space**, and the water that drains freely is called **non-capillary pore space**. These numbers vary with the quantity and the quality of the various components.

The current specifications call for 12% to 18% capillary pores (down from 15% to 21%) and a minimum of 15% non-capillary pores, compared to the earlier 12% to 18%. These changes may seem minor, but they can greatly influence the drainage capability of the profile and the oxygen supply for the turfgrass roots in the years to come. They reflect a concern for the status of the root systems of turfgrasses subjected to extreme traffic and environmental stresses.

Table 2 compares a recommended mixture composed of concrete sand, a sandy loam soil, and a peat (7-2-1), circa 1958, with a recent mixture consisting of medium sand and peat (85-0-15). Note that the bulk densities and porosities are not very far apart.

The difference in non-capillary pore space is only 4%, but there is a tenfold difference in permeability. It is interesting to note that the low permeability of the 1958 sample was acceptable at the time, since the rates were set relative to the permeability of good-quality soil greens of that era.



Profile of a green built to USGA Specifications.

TABLE 1
Summary of Acceptable Physical Analysis Data for Root Zone Mixtures in "USGA Greens"

Characteristic	*Range*
Porosity (Pore Space)	
Total	35% to 50% (by volume)
Capillary	15% to 25%
Non-Capillary	15% to 25%
Water Retention	12% to 18% (by weight)
Bulk Density	1.25 to 1.45 g/cc (ideal)
Permeability (H_2O infiltration)	A lab decision
Sand Particle Size Ranges	
> 2mm	None
0.25mm to 0.75mm	Maximum 100% (optimal)
0.10mm to 0.25mm	Minimum
< 0.10mm*	Maximum 10%
Silt	Maximum 5%
Clay	Maximum 3%

*In some cases, particles < 0.25mm should be limited to 10%

The influence of peat selection is illustrated in Table 3.

The reed-sedge peat produces more capillary pores and greater water retention than the sphagnum peat when mixed with the same sand. Sphagnum, on the other hand, produces more non-capillary pores and a much higher permeability. (The data apply only to these particular samples, and do not necessarily reflect test results using other sources of peat or sand.)

The only factor in the current recommendations for which an accepted value range is not set is **permeability**. Experience has shown that this factor may have exerted undue influence on recommendations in the past, because the water infiltration data generated in the laboratory is usually much higher than that of mature greens in play. In addition, permeability needs can vary from location to location. For example, the use of saline irrigation water requires better drainage capability for leaching purposes than where higher quality water is available. Greater permeability is also desirable in high-rainfall areas and/or where heat stress is a major concern. Greens located in milder or drier climates may not need such high infiltration rates. An experienced laboratory may well set its own parameters, based on the grass species to be used and specific knowledge of the region involved.

Water retention is the percentage by weight of water in the compacted test sample at field capacity (held against gravity) compared to an oven-dried sample. (Porosity, on the other hand, is a measure of volume.) This value is considered to be a measure of the amount of water available for plant use after drainage by gravity and before wilt becomes permanent. It should be between 12% and 18%.

Laboratory analysis also includes a report on **bulk density**. It is the weight of a specific volume of the mixtures, reported in grams per cubic centimeter. The acceptable range is from 1.20 to 1.60 grams per cubic centimeter, which is broader than before.

To summarize, the parameters used to evaluate mixtures for putting green construction have changed as our understanding of the performance of topmixes has grown. In turn, better *playing* and *staying* quality has been achieved in greens constructed by those who have followed USGA Specifications to the letter.

When testing components for putting green construction, it is very important

TABLE 2

The Relationship of Components to Topmix Permeability

	Sample 1 (1958)	**Sample 2 (1988)**
% Sand-Soil-Peat	70-20-10	85-0-15
Bulk Density	1.49 g/cc	1.41 g/cc
Total Pore Space	39%	44%
Capillary	18%	19%
Non-Capillary	21%	25%
Permeability	1.4 in./hr.	14 in./hr.

TABLE 3

Differences in Physical Characteristics Between Mixtures Using Different Peat Sources with the Same Sand*

Characteristics	**Sphagnum**	**Reed-Sedge**
Bulk Density	1.39 g/cc	1.40 g/cc
Total Porosity	42%	41%
Capillary	23%	28%
Non-Capillary	19%	13%
Water Retention	17%	20%
Permeability	17 in./hr.	5 in./hr.
Compression Factor (shrinkage)	9%	18%

*Data courtesy Agri-Systems of Texas

to provide the laboratory with as much up-front information as possible. The decision by the laboratory to recommend a particular mixture over another may hinge upon such factors as anticipated play, unusual local conditions, quirky weather, irrigation water sources, and other concerns. The physical ayalysis of a mixture to be used in green construction should not be just a sterile compilation of numbers. Rather, it should be part of a dialogue with the laboratory director that results in a clear understanding of all of the factors that influence the outcome of such a major undertaking. And don't forget, there is no such thing as a dumb question when it comes to building greens the right way.

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[1]Madison, John H., J. L. Paul and W. B. Davis. 1974. Consider — A New Management Program for Greens. USGA Green Section Record. 12(3): 16-18.

[2]Spomer, L. Art. 1977. Principles of Soil Preparation for Drained Golf Greens. USGA Green Section Record. 15(4): 9-12.

Editor's Note: A copy of the recently published (1989) version of the USGA's Specifications for a Method of Putting Green Construction can be purchased through the United States Golf Association, P.O. Box 708, Far Hills, NJ 07931-0708.

New Zealand . . . The Grass Capital

by DR. JEFFREY V. KRANS
Mississippi State University

DURING a six-month period in 1989 I had the opportunity to study turfgrass science and tissue culture technology in New Zealand. I was granted a sabbatical leave from my present position at Mississippi State University, and I worked at the Division of Scientific and Industrial Research (DSIR), Grasslands, in Palmerston North, New Zealand. The trip was supported in part by the USGA, and included laboratory research as well as on-site visits to golf courses, sports fields, and general-use turf areas. In my study and research I collaborated with Peter Evans, an agronomist, and Derek White, a molecular geneticist.

Research work dealt with the development of protocol for the *in vitro* manipulation of colonial bentgrass (brown top) *Agrostis tenuis*. The on-site visits to turf areas were arranged by David Howard, an agronomist with the New Zealand Turf Culture Institute, who also accompanied me on many of these visits.

New Zealand consists of two islands located in the South Pacific Ocean approximately 1,200 miles southeast of Australia. Its land mass is comparable to that of Montana, and it has a climate similar to coastal Washington and Oregon. If you went to Cairo, Illinois, and dug a deep enough hole, it would eventually come out in the center of New Zealand. Because it is in the southern hemisphere, its seasons are the opposite of ours.

With a population of about three million people, New Zealand has a low population density, which makes the country pleasing and unspoiled. Visitors are overpowered by another statistic that adds to New Zealand's flavor and appeal — it is home to over 65 million sheep. As this figure implies, the country's economy is based heavily on agriculture. In addition to its sheep and low population density, New Zealand possesses some of the most beautiful landscapes and scenic countryside in the world.

Of special interest to me was New Zealand's ability to grow grass. This alone was one of the most impressive parts of my six-month study. For example, at the turfgrass research plots in Palmerston North, perennial ryegrass (a cool-season species) and bermudagrass (a warm-season species) were maintained side by side as perennial stands. The bermudagrass did not winter kill, and the perennial ryegrass did not succumb to high temperatures. Not only does this illustrate the desirability of New Zealand's climate, but it also provided me with some insight into the factors that allow these grasses to survive environmental extremes. In the case of bermudagrass, nighttime air temperatures dropped below freezing, but soil temperatures (the critical factor in low-temperature kill) remained above freezing because of high daytime temperatures and heat accumulation by the soil. The summer heat tolerance of perennial ryegrass was accompanied by temperatures of over 90 degrees, but low relative humidity and a constant breeze provided for optimal transpirational cooling.

All of New Zealand's turfgrasses have been naturalized. Originally islands covered by dense forest, New Zealand was changed from trees to grasslands. Today, the principal turfgrass species found on their 400-plus golf courses are colonial (brown top) and highland (dryland) bentgrass, fine-leaf fescues, and perennial ryegrass. Colonial bentgrass is the most dominant; it could be found throughout the golf course, from greens (the preferred putting green surface) to roughs.

Other turfgrasses familiar to us in the United States, including creeping bentgrass, tall fescue, Kentucky bluegrass, St. Augustinegrass, centipedegrass, and bermudagrass, were noticeably missing, but these grasses could be found in localized areas or under special situations.

And of course *Poa annua*, the grass that is found almost everywhere, was there in New Zealand. Of the turfgrasses used, perennial ryegrass required the highest maintenance, compared to the widely used and low-maintenance colonial bentgrass. Fine-leaf fescues were also used as low-maintenance turfs, but they did not predominate to the extent of colonial bentgrass.

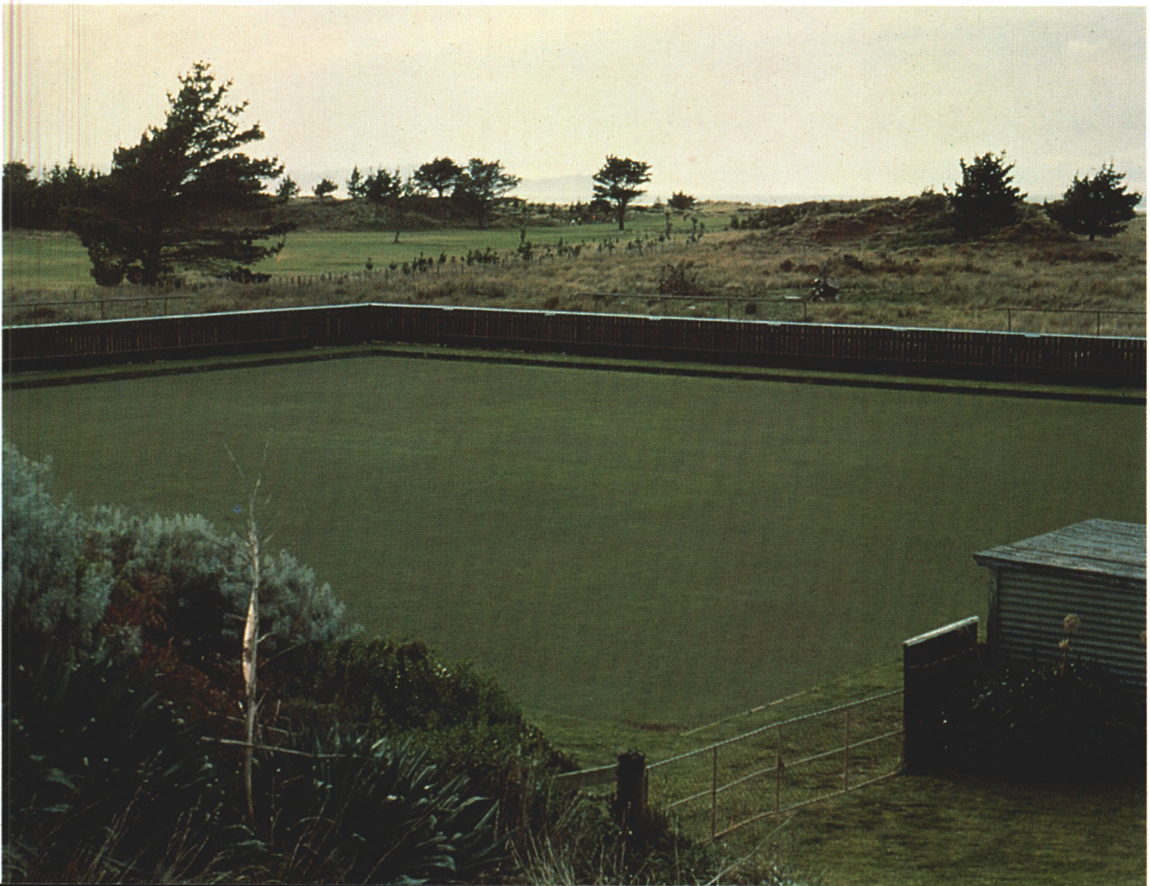
Maintenance of turf was unusual and perhaps refreshing compared to our standards. Most courses used the natural terrain, and manicured turf across the entire course was not a prerequisite for their golfers. In some instances, rural golf courses relied on members to mow greens on a rotational basis, and fairways and roughs were clipped by the original mowing machines — the sheep. No weather was too nasty for a game of golf, and riding in a golf cart was unthinkable.

Few golf course superintendents (often called greenkeepers) had formal education past high school level. Knowledge was passed on through work experience and by participating in educational meetings provided by the New Zealand Turf Culture Institute. The Institute is the primary source of turf culture information. It consists of a group of regional agronomists who conduct activities similar to those of the USGA Green Section. Unlike USGA Green Section support, though, *all* golf and lawn bowling facilities in New Zealand are obligated to pay a standard fee for support of this organization.

Now that I have returned, several impressions of turfgrass management stay with me. First of all, the diversity of our climatic conditions in the United States and the large land mass of the North American continent make our region of the world a challenging place to grow consistently good-quality turfgrass. We may be a leader in several technological fronts, but in many regions of the United States we don't have desirable climate for golf course turf. The ability of colonial bentgrass to flourish under low maintenance and the natural conditions of golf course management in New Zealand have given me a new perspective on this species. In retrospect, it was a unique pleasure and delight to meet the people and see the turf of New Zealand.

The presence of New Zealand's 65 million sheep is never missed, as one can always count on seeing sheep and grass.

A country golf course setting, with the putting green protected from the sheep by a wire fence, and local farmers engaged in mowing the putting surfaces. The four-legged fairway cutting units are always operating in order to keep the fairway surface neat and tidy.



(Above) The New Zealand countryside with its rolling grassland, sheep, and unique appeal and beauty.

(Left) The lawn bowling green in the foreground is used for summer recreation, and a golf course situated in the background is used for winter sport. Both facilities are commonly found together in a country club setting.

Gassing and Regrassing

by TOM WALKER
Golf Course Superintendent, Inverness Club, Toledo, Ohio

EXCEPT FOR a few holes, the current golf course of Inverness Club, in Toledo, Ohio, was designed by Donald Ross in 1919. It has enjoyed a long and illustrious reputation, but its putting green quality became increasingly difficult to maintain during the 1980s.

Clearly the club had reached a crossroad. Fortunately, a positive solution was eventually reached, and this is the story of the problems and their solutions.

Surprisingly enough, Inverness Club has had only three superintendents, and consequently the greens soil profile has remained free of the layering problems that often accompany frequent changes in topdressing materials.

The greens were originally seeded with South German mixed bentgrass, and over the years the various varieties became segregated and produced a turf with a patchy appearance. These different grasses, of course, reacted differently to different weather conditions and pesticide applications, and this further contributed to their patchy appearance.

Poa annua contamination also became a problem, causing the greens to be inconsistent day to day and green to green. More importantly, their *Poa annua* content made them increasingly unreliable.

For all of these reasons the club began to consider extensive changes.

Inverness has always been a strong supporter of the USGA and its Green Section, and after lengthy consultations with USGA agronomists and several university personnel, the club considered various options.

After discussing the problem, the club decided to regrass the existing greens rather than rebuild them from

Covers in place following seeding in August, 1988.

scratch. This idea was well received by the club membership, which was extremely concerned about preserving what is left of the original Ross design. Regrassing was a particularly viable alternative, since the old soil greens had always drained well. In addition, the undulations on the greens, for which the club has long been noted, provided excellent surface drainage.

Cost was also a consideration, since the estimates for reconstruction were in excess of $400,000, while the regrassing estimates were only $40,000. Obviously, the changes being considered were monumental, and the club wanted to be absolutely sure the best option was chosen so that the fundamental problems would be solved while the integrity of the original design was preserved.

In order to gain firsthand information about the merits of regrassing versus reconstruction, as well as to evaluate the various choices for grass selection, a delegation of club officials visited a number of coures in Indiana, New Jersey, and Delaware. I went along.

As noted earlier, the regrassing program was selected in lieu of total reconstruction. Pennlinks was our choice for putting green turf because of its aggressive, deep-rooting nature as well as its upright growth and fine texture.

Deciding how to proceed with the project was our next step. Proposals included (a) regrassing all 18 greens immediately, (b) doing nine greens one year and nine the next, and (c) regrassing just two greens on a trial basis.

Even though we felt very confident about regrassing all 18 greens at one time, the knowledge that the project would thoroughly disrupt the golf season and that the trial program would allow us to fine-tune our program led us to choose that method.

August 27, 1988, was our target seeding date for the two trial greens, but rain forced a four-day delay, and the greens were not seeded until September 1st. Because of this delay and because we did not verticut thoroughly enough in preparing the seedbed, germination percentages were not as high as we would have liked. Nonetheless, the finished product turned out extremely well, and the trial was an undeniable success.

The two trial greens were opened on May 31st, 1988, just nine months after the regrassing project had begun. At that time they rolled 8 feet 6 inches on the Stimpmeter.

Armed with this excellent experience, planning began for regrassing the other eighteen greens. The timetable and the scope of the work for the remaining

The finished product eight months later.

greens had been set in October of 1987. It was decided to change the contour of the sixth green and to make minor changes in the fifth green, two holes added by George and Tom Fazio for the 1979 U.S. Open, but no other changes were to be made. August 15, 1988, was our target seeding date, giving us more time for fall grow-in.

Precise planning was essential, since the operation involved several consultants and contractors. Arrangements were made to have extra equipment and parts on hand in the event of breakdowns. Our efforts and planning paid off handsomely, as everything went exactly according to the plan.

Regrading work began on the sixth green on August 1 and was completed by August 7, so that it could be fumigated and seeded along with the rest of the greens. Work began on the remaining greens with an aerification program on August 8.

In order to protect the green contours, we had originally planned to aerify once with the Verti-Drain deeptine aerifier and twice with Ryan Greensaires before we removed the sod. This turned out to be impractical, however, because the sod broke into small pieces and was difficult to remove. To speed the process, the sod was removed after using the Verti-Drain but before aerifying with the Ryans.

Following core removal, a contractor then moved in and performed methyl bromide fumigation on August 10 and 11. After 48 hours, the plastic tarps were removed, and the greens were allowed to breathe for an additional 24 hours. Seedbed preparation began by verticutting to a depth of ⅜ inch in four directions. Finally, the greens were carefully raked to preserve their original contours.

After a light irrigation, the soil surface was raked again, and ½ lb. N/1,000 sq. ft. was applied using a 10-18-22 predominantly soluble fertilizer. This material was incorporated with another light raking.

Pennlinks creeping bentgrass seed was applied with drop spreaders in two directions, each at ⅝ lb./1,000 sq. ft. Granular metalaxyl (Subdue) was applied to control *Pythium*, and the seed and fungicide were incorporated with a final raking. Great care was taken to erase all footprints to produce a perfectly smooth putting surface.

Geotextile covers were placed over the greens to prevent erosion during the germination and establishment phase. They were not easy to install without disturbing the seedbed, and 15 people were required to float them over the green, much as you would a parachute. To illustrate the value of the covers, 1.75 inches of rain fell the night we seeded the greens, and even though some minor erosion occurred, it was far less than would have occurred had the covers not been used.

Soil thermometers proved to be invaluable, since soil temperatures can be as much as 20 degrees warmer under a cover in the sun than in the shade. Temperatures were monitored closely, and when they rose to 90 degrees or higher, one-minute syringe cycles cooled them.

The covers were removed after five days, and were replaced only when rain threatened. There was no danger of erosion after three weeks, and the covers were not used again until winter.

The first mowing occurred at 14 days, and by 21 days the greens were being mowed three to five times a week at a height of ¼ inch. Two weeks after seeding, soluble 10-18-24 fertilizer was used at a rate of ¼ lb. N/1,000 sq. ft. on a four-day cycle. Eventually, the fertilization program evolved such that weekly applications were made at a rate of ⅓ to ½ lb. N/1,000 sq. ft. By late October, 4 lbs. N/1,000 sq. ft. had been applied, and growth and development were excellent.

Fungicides were applied as needed on a 14- to 21-day cycle, and three light topdressings were made in the fall. The geotextile covers were replaced in late November and were kept in place until March.

As of April 12, 1989, just eight months after seeding, cutting heights have been lowered to less than ¼ inch, and the putting green surfaces are quite smooth. Root growth has been exceptional, with roots commonly found at depths of 8 to 10 inches. Opening day is planned for sometime in May, which translates to a total downtime of just nine months.

At this point I could not be happier with our renovation project. It has proceeded beautifully from start to finish. The total regrassing project, including the reconstruction of the sixth green, cost less than $40,000, one-tenth of the cost of the original estimated reconstruction cost of $400,000. Regrassing certainly is not a viable alternative in every situation, but it has worked wonderfully at Inverness, and at a much lower cost.

Vigorous root system of Pennlinks creeping bent after eight months.

News Notes for Summer 1989

Gloriosa Daisy

Jim Skorulski

Jim Skorulski Joins Green Section Staff as Northeastern Region Agronomist

The Green Section is pleased to announce the appointment of James E. Skorulski to its staff. A native of New Hartford, New York, Jim earned a bachelor of science degree from Syracuse University's College of Environmental Science and Forestry, specializing in pest management. Following graduation he joined the staff at the Yahnandasis Country Club, near Utica, New York, where he worked as supervising arborist. He instituted a major tree planting program, carrying out tree and turf pest management programs, and other duties.

Jim left Yahnandasis in 1987 to pursue graduate studies in turfgrass management at Cornell University, where he recently earned a master of professional studies degree. His thesis work concerned the development of integrated pest management (IPM) strategies for golf courses.

Jim joined the Green Section staff in April, and will assist Jim Snow, Northeastern Region Director, and Jim Connolly with visits to Turf Advisory Service clubs in New Jersey, New York, and New England.

Give a Gift of the Green Section Record

Do you know someone who would like to know more about what is going on in turf and golf course management? Give him a gift subscription to the GREEN SECTION RECORD. For just $9 per year ($11 outside the United States), your friend, associate, or know-it-all golf partner will receive six bimonthly issues full of the latest in golf course management techniques and turfgrass research. The recipient will be notified of your gift by way of an acknowledgement card sent from Golf House. Send your request and a check for the appropriate amount to the USGA, P.O. Box 708, Far Hills, NJ 07931, Attn: Order Department.

ALL THINGS CONSIDERED

Aerial Hazards

by **PATRICK M. O'BRIEN**
Director, Southeastern Region, Green Section

TREES ARE important features on many golf courses. The tree-lined fairways that follow the natural terrain of these courses provide beauty, challenge, and tranquility for the golfer. In general, golfers prefer a course with lots of trees, but most of them do not realize the deleterious effects trees have on nearby turf areas. More serious consideration toward tree placement and dealing with existing trees is essential.

The greatest error in tree placement is planting too many trees around greens and tees. Trees are desirable for framing a putting green or for producing the chute effect at a tee, but they shouldn't be allowed to cause major turf problems. Adequate sunlight and air circulation are necessary for proper turf growth, and when these conditions are not available, the turf can become thin and weak. Both bermudagrass and bentgrass greens are more susceptible to disease and more expensive to maintain in these tree-pocketed sites.

In addition, tree branches, debris, and roots can significantly affect the golfer's game and add to the cost of maintaining a golf course. It is frustrating to discover your golf ball in an unplayable situation under tree branches just a few feet from the edge of a fairway. Shrubs used as yardage markers can cause the same problem. Trees that produce litter and surface roots are best planted well away from the playing areas of the course.

Club officials are often reluctant to remove a tree that interferes with maintenance of an important turf area. The golfer who complains about the poor quality turf on a green is often the same one who will put his body between the chain saw and the tree. A choice must be made, and in all but the most unusual circumstances it should be made in favor of the turf.

Trees are great, but let's use some common sense about them on the golf course. Trees that interfere with the health and vigor of the turf in important playing areas should be thinned, pruned, moved, or removed. When new trees are planted, give careful consideration to how they will affect nearby turf in the decades ahead.

TURF TWISTERS

MOTHER GOOSE

Question: Four of our bermudagrass greens have consistently developed very severe goosegrass infestations by midsummer. Efforts to control the goosegrass with post-emergent herbicide treatments have produced limited success. Is there an alternative approach to maintaining an acceptable level of goosegrass control on the greens? (Florida)

Answer: First, determine why these particular greens have more of a severe weed problem. Do surrounding factors such as shade, poor air circulation, tree root competition, concentrated traffic patterns, or soil profile problems limit turf growth? Next, consider using a pre-emergent herbicide to prevent the weed seeds from germinating. Although most pre-emergent herbicides are not labeled for use on putting greens, a combination material is available, consisting of bensulide and oxadiazon, that controls severe goosegrass infestations on both bermuda and bentgrass greens. Your local manufacturer's representative should be contacted to discuss application rates. Of course, there is always the old standby of hosting a goosegrass party for the crew, and simply using knives to cut the goosegrass crowns out of the putting surfaces.

LEASES EQUIPMENT

Question: It seems our golf course is always maintained with older equipment. We are a small club that doesn't have the means to purchase new equipment regularly. Do you have any suggestions for an alternative means of equipment procurement? (Idaho)

Answer: Unfortunately, unlike gravity, equipment prices do not go down. Many golf courses report success with equipment leasing programs with a purchase buy-out at the end of the lease. While this may or may not be more expensive than actual equipment purchase, you can usually begin using the piece of equipment for less money down, lower payments, and bring about immediate improvement in turf playing quality.

FOR MAKING NURSERY RHYMES

Question: How critical is it to have a putting green nursery? Should it be built to USGA specifications? How big should it be? (Nebraska)

Answer: Think of a nursery as a spare tire. If the tires on your vehicle are well made and new, the spare will likely go unused for quite some time. However, every wise driver keeps a spare ready for emergencies, regardless of the condition of his tires. Likewise, every course should have a nursery. Although it is certainly ideal to build the nursery to specs, the most critical factor is that the root zone mixture is compatible with the soil on the existing greens. As for size, a general rule of thumb is to build a nursery to the size of one average green. However, for courses where the greens are frequently under stress from weather, heavy play, etc., the bigger the nursery the better.