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USGA® Green Section RECORD

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1 A Quality Control Checklist for Successful Greens Reconstruction

by James Francis Moore

6 Tee Construction: Use of the Laser Grader

by Patrick M. O'Brien

9 Using Effluent Water on Your Golf Course

by Dr. David Kopec, Dr. Charles Mancino,
and Douglas Nelson

13 The Bird Community Found on British Columbia Golf Courses

by Ian E. Moul and John E. Elliott

16 Biting the Bullet: Greens Complex Reconstruction at the Country Club of Virginia

by Alan D. Hess

19 On Course With Nature Restoration of Potash Pond

by Scott Bertrand

21 All Things Considered Hit The Ball!

by David A. Oatis

Back Cover Turf Twisters



Cover Photo:

Careful attention to detail and quality control helps ensure success in green construction. Photograph by Alan D. Hess.

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Installation of the "smile" interceptor trench and drain at the low end of a green.

ALAN D. HESS

A Quality Control Checklist for Successful Greens Reconstruction

by **JAMES FRANCIS MOORE**
Director, Mid-Continent Region, USGA Green Section

QUALITY CONTROL. Think about those words for a minute. They describe an effort to control or ensure quality. Now consider the construction of a golf green. Greens construction requires a precise combination of artistic talent, a sound scientific base, and the best in workmanship. The reconstruction of greens

is one of the most challenging projects in the life of any course. Reconstruction represents a tremendous opportunity for improvement of the facility. This is the chance to correct agronomic problems such as poor drainage, inconsistency in playing quality, weed and pest infestations, and inadequate cupping area. It is a chance to convert to superior

turfgrasses, make the course more attractive, and make it more fun to play for all classes of players.

Unfortunately, there also exist many opportunities to make mistakes. Attempting to cut corners during critical aspects of reconstruction invariably leads to problems with the new greens that soon have every-

one questioning the worth of the project. Building good greens is not as easy as some think. There are many pitfalls that must be avoided.

Since most of us would expect the new green to last at least 20 years and possibly much longer, quality control in the construction of that green is critical. Who should be in charge of ensuring quality control? Ideally, all participants in the project will strive to do the best work possible and will constantly review their own efforts. The architect, contractor, materials supplier, and blender all should have quality control guidelines and procedures of their own. Certainly, it is in their best interest to construct greens that perform properly.

Those who are paying for the new greens also have a responsibility as consumers to be knowledgeable about what they are buying. It is foolish to assume that the quality control efforts of the seller (regardless of what is being sold) are sufficient to completely protect the interests of the buyer. The buyers need someone on the project representing only their interest. That person needs to have a working knowledge of all aspects of the construction of greens. They should know the area well, be in tune with the desires of those who play the course, and have a vested interest in the success of the project. No one fits this description better than the golf course superintendent.

In most cases the golf course superintendent will serve as the "owners' representative" during the reconstruction of greens. On a project of this magnitude there is a wide variety of tasks and procedures that must be accomplished. In most cases, there are numerous ways to accomplish the same goal. It therefore is quite possible for differences of opinion to arise concerning which method is best. For the superintendent to be effective in such circumstances, the owners must give him/her the authority to halt the project if necessary until a consensus of opinion can be reached.

Obviously, there is a great deal to monitor during a project of this size. Very likely it will prove impossible for the superintendent alone to provide such close scrutiny throughout the project, particularly on courses that remain open during construction. It therefore is a very good idea to appoint a member of the maintenance crew as a "clerk-of-the-works" for the duration of the project. This individual should have no responsibilities other than providing a second set of eyes and ears for the superintendent. Using the guidelines provided below as a beginning, the superintendent should prepare a daily "punch-list" for the clerk-of-the-works, detailing specific aspects of the project to be monitored.



ALAN D. HESS

Plywood protects the subgrade surface so that the small skid loader can bring in the gravel and choker layer materials.

What follows is a checklist to help the golf course superintendent make certain that good quality control is maintained throughout every critical phase of a greens construction or reconstruction project. It is important to note that not every step in the checklist will be appropriate for every job. It is equally important to keep in mind that this list is an example only. Every job is different, and consequently every quality control effort must be individually tailored

to the specifics of site, individuals involved, materials, etc. For example, on many jobs a great deal of additional testing of materials may be necessary to meet contractual agreements. This is particularly true in areas where the physical properties of materials are inconsistent.

Once prepared, a quality control checklist such as this one will help the superintendent avoid many of the mistakes commonly made during greens construction. Space

does not permit detailed discussion of each guideline. Refer to the March/April 1993 issue of the *Green Section Record* and call your local Green Section office for additional details.

I. Identification Phase

The first step to take before the reconstruction of greens that have a history of poor performance is to ensure all the factors responsible for that poor performance have been identified. Greens fail for many reasons. While an improved root zone mix can correct drainage problems, it cannot provide light, air movement, or additional surface area. Unfortunately, all too often a new green is built without correcting many of the most limiting factors that caused the old green to fail. The first step should be to make certain that poor construction was the principal reason for the existing green's

poor performance. The following questions should be asked:

1. Is surface drainage good?
2. Do the greens drain well internally?
3. Have root zone samples been submitted to a physical soil testing lab for analysis?
4. Are there layers in the profile that inhibit drainage?
5. Has deep-tine aerification been tried?
6. Is the existing root zone high in silt and clay?
7. Is the existing root zone of consistent depth?
8. Have the terminal points of the drainage tile been found and checked for blockage?
9. Has the drain tile system been flushed?
10. Does sufficient light reach the turf surface at all times of the year?
11. Is there sufficient air movement across the putting surface?
12. Is the green large enough to take the traffic?

13. Are there adequate entry and exit points to the green to distribute the traffic?
14. Have nutritional requirements been met?
15. Has there been a check for nematodes?
16. Have irrigation coverage and application needs been met?
17. Could water quality problems (either physical or chemical) be the basis for the problems?
18. Have walk-behind mowers been tried instead of triplex equipment?
19. Are the greens being cut too low and kept too fast?
20. Is the type of grass on the greens appropriate for the demands of your climate?
21. If part of the reason for rebuilding is to eliminate *Poa annua* in the greens, has *Poa* been controlled on the rest of the course?
22. Is the membership happy with the architectural characteristics? Remember, the desire of the players for a better design is as much a justification for reconstruction as poor drainage.

A piece of rebar, marked at a four-inch depth, is used to probe the area to check for consistent depth in the layers.

ALAN D. HESS



23. Has your regional Green Section agronomist been asked to examine the greens and help identify and document the problems causing their failure?

II. Selecting Construction Materials

A. Is climate an issue? These questions must be answered prior to selecting construction materials.

1. Will the greens be maintained in a climate of extreme dryness and high evapotranspiration rates?

2. Will the greens be maintained in a climate of frequent and prolonged wet weather, high humidity, and heat?

3. Will the root zone be irrigated with water high in sodium, salts, or both?

B. Selecting materials

1. Have you personally visited local suppliers to collect samples for submitting to a lab?

2. Have you discussed with the supplier the construction of greens so they understand the need for preciseness during the project?

3. What is the source of the material?

4. Is the source consistent?

5. How much notice is needed to guarantee that the required quantity and quality will be available?

6. Can they stockpile the materials at their site throughout the project, or must the stockpile be kept at the golf course site?

7. Is their stockpile area free of weeds and soil?

8. Can they mix organic matter and sand, or will a custom blender be hired?

9. Will they mix the components and then wait until an outside lab tests the mixture?

10. Can they incorporate nutrients?

11. Do they keep "in-house" quality control records?

12. Do they use their own trucks for delivery?

13. How much are shipping costs over FOB?

14. To what other golf courses have they supplied material?

15. Has a physical soil testing lab been located, and have their fees and testing standards been determined?

16. Does the lab test according to the procedures published by the USGA?

17. Have all of the materials (sands, organic matter, and gravel) been submitted to the lab to verify their suitability for the construction of greens according to the USGA Green Section recommendations?

18. Has a sample been prepared according to the lab's mixing ratio to serve as a visual "standard" throughout the project?

19. If because of cost or lack of availability the proper materials cannot be acquired, have you discussed with your Green

Section agronomist the possible repercussions of whatever compromises must be made?

20. It is likely that more than one sand and organic matter mixture will fall within the guidelines. Have you discussed the various mixtures available with your Green Section agronomist to help you select the material best suited to your needs?

21. Once a root zone mixture is determined, has a chemical soil test been run to identify which nutrients should be added prior to planting?

ALAN D. HESS



An insulated copper wire, wrapped around the main line, can be used in the future to locate the drainage lines.

III. Monitoring Quality During Mixing

This is one of the most critical phases of a greens construction project, and therefore good quality control efforts are mandatory. What follows is a sample quality control program that will suffice for many projects. However, note that this aspect of your quality control program must be tailored to fit the specifics of your situation. It may prove necessary to include much more testing throughout the project, depending on the

consistency of the materials and to meet contractual agreements.

1. Test the first load mixed to verify that the mixing procedure is valid. The project will have to be put on hold for 24 to 48 hours while the lab verifies that the field mixing duplicates the recommendations offered by the lab.

2. Remove samples daily or anytime the mixing operation is interrupted and compare them to the standard.

3. Be prepared to mix as much of the material at one time as possible and stockpile it.

4. Each delivery truck should be inspected as the load is dumped and the mix compared against the standard.

5. Collect a one-gallon composite sample from every green, and label and store it.

6. Submit to the lab a composite sample from every third green built.

7. When moving root zone mix from stockpile into trucks, closely monitor the loader operator to ensure that the bucket is not collecting the underlying soil or asphalt and that cleated tires or tracks are not "tilling" other material into the mix.

IV. Construction

A. Location of the Green

1. Will there be plenty of air movement across the green?

2. Will sunlight be a problem in summer or winter?

3. Will tree roots compete with turf?

4. Will there be good access to the green?

5. Is there room for triplex greensmowers to turn?

6. Is a perimeter irrigation system needed?

7. Is the green site prone to flooding?

8. Is enough surface area provided to withstand anticipated traffic?

9. Are there enough hole locations?

10. If not all the greens are to be rebuilt, does the design of the new greens complement the old greens?

B. Subgrade Checks

1. Are there prior construction problems such as still-functional drain lines from the previous greens?

2. Have the new drainage outlet point(s) been identified?

3. Is the material to be used for the surrounding base of good quality?

4. Is the material free of large organic matter clumps and stone?

5. Is the subgrade smooth and compacted?

6. Are there any water-collecting hollows?

7. Has the architect approved the grades?

8. Has the superintendent approved the grades?

9. Has the club's representative approved the grades?

10. Have the grade stakes been installed and checked?
11. Are the side walls of the cavity stable?
12. Has the plastic barrier been installed along the side walls of the cavity?
13. Has the green perimeter location wire been installed?
14. Have pictures been taken of the sub-grade?

C. Tile Line Installation

1. Are trenches at least 8" deep, after cleaning?
2. Are bottoms of ditches smooth and clean?
3. Is enough fall provided?
4. Are the lateral lines within 15 feet of each other?
5. Have "smile" drains been installed at each surface runoff location?
6. Has the subgrade been cleaned of soil displaced during trenching?
7. Has gravel been laid and firmed on the bottom of the trench?
8. Are connections taped or glued?
9. Are all lines completely free of buckles or bridges?
10. Have lines been "shot" to ensure proper grade?
11. Has the tile location wire been installed?
12. Have flush points been installed, capped, and marked with metal for future location?
13. Have the perimeter and tile location wires been brought to the main flush point?
14. Has the inspection drain in front of the green been installed?
15. Have pictures been taken of the finished drain tile system?

D. Gravel Layer

1. Is the gravel clean and properly sized?
2. Has care been taken not to crush drain lines?
3. Have joints been checked to ensure they are intact after gravel has been spread?
4. Is the surface of the gravel smooth?
5. Are grade stakes still intact?
6. Has the finished grade of the gravel layer been checked to ensure it "mirrors" the desired finished grade of the putting surface?
7. Have pictures been taken after gravel installation?

E. Intermediate Layer

1. Has the gravel contour been preserved?
2. Has the sand been kept moist during installation to help prevent occlusion?
3. Have grades been rechecked?
4. Have pictures been taken?

F. Root Zone Mix

1. Is the depth of the root zone mix uniform throughout the green?



To insure that there are no pockets and that the green has positive surface drainage, a level and transit should be used in conjunction with a mechanical bunker rake.

2. Was the mixture kept moist during installation to help prevent occlusion?
3. Has the mix been firmed?
4. Have all grades been checked?
5. Have amendments been added?
6. Have samples of the mix been collected?
7. Does the finished grade mate well with surrounding soil?

G. Irrigation System

1. Has single-head control been provided?
2. Has coverage been checked?
3. Have quick couplers been installed?
4. Is a perimeter system needed?
5. Have isolation valves been installed?
6. Have all ditches been firmed and leveled?

H. Final Checks Prior to Planting

1. Have all drains been checked?
2. Have all terminal points of drains been protected?
3. Have nutrients been added?
4. Has the root zone mix been compacted?
5. Is the irrigation system completely functional?

6. Have all parties approved of final construction?

7. Is certified seed or sod being used?
8. Has enough root zone mix been stock-piled for the first year's topdressing?
9. Has all heavy equipment damage been repaired?

10. Have the surrounds been sodded to prevent erosion during grow-in?

11. Has fumigation been accomplished in areas prone to nematode, nutsedge, or warm-season grass contamination problems?

* * *

A properly built USGA green can provide many years of dependable, relatively low-cost service. Where problems have occurred with USGA greens, often it was because shortcuts were taken or mistakes were made without someone being aware of what was happening. Developing and following a good quality control program is a small price to pay for ensuring success in the construction of the most important features of the golf course.



New technological methods have made leveling a tee surface faster and more reliable. Reconstructing tees by a laser-guided grader produces an accurate final product.

Tee Construction: Use of the Laser Grader

by **PATRICK M. O'BRIEN**

Director, Southeastern Region, USGA Green Section

SURFACE SMOOTHNESS of golf tees is a desirable characteristic that aids the golfer in addressing and driving the ball. A smooth surface ensures a level and balanced stance during the execution of the tee shot, necessary for delivery of the golf club along the desired path to hit a long and straight shot. Unfortunately, unlevel tees are all too common on golf courses.

Given the amount of golfer traffic today, and the resulting divots and surface compaction, it isn't any wonder why tees become

uneven. The purpose of this article is to discuss a quick and reliable method of reconstructing unlevel tees.

Historically, tees often have been built by simply using the native soil from the golf course property to form these features. Internal drainage lines and modified root zone materials have been used only occasionally. This construction system works fairly well as long as the tees have adequate size and receive adequate sunlight and routine maintenance. Nevertheless, depres-

sions or undulations generally occur over a period of time, requiring rebuilding to correct.

Traditional methods of rebuilding using I-beams, grader boxes on small tractors, concrete forms, and transits are time-consuming, and depending on staff size and demand for the playing surface, a tee may be closed for months. A faster, more reliable method is available and is more popular with both golf course superintendents and golfers alike.

In the South, golf course superintendents have significantly reduced the time required for tee reconstruction by abandoning old technology for new technology. The golf course staff does practically all of the preparation and most of the finishing work, except the final surface leveling. A skilled contractor does the most difficult step, which is leveling the tee surface, using new laser leveling equipment. A skilled laser operator can level an average-size tee in 45 to 75 minutes. Traditional grading methods can take as long as eight to 16 hours. The degree of accuracy achieved with the laser-guided boxblade is equal or superior to any other method. Preparation of nine tees prior to final leveling by the laser contractor requires three to four days. The following steps typically are required:

Establish a Temporary Tee

Find a level site (approximately 200 square feet) in front of or next to the existing tee. Mow down the area to tee height and topdress. Establish this site in advance of expected construction work to minimize mower scalping. Fortunately, one advantage of this method is that golfers will be forced to play from the temporary tee only for a short time.

Realign the Tee Edges

A psychological correlation seems to exist between alignment of the teebox to the target area and how the golfer tends to line himself up with the edges of the tee. Obviously, proper tee marker positioning facilitates the proper alignment to the target area, but many golfers use the edge of the tees for this alignment. Before reconstruction work begins, readjust the mowing pattern on the edge of the tee to align it with the fairway. Next, install stakes on the actual corners of the tee for alignment purposes. Attach string to the stakes parallel to the direction of play. Stand on the tee again and adjust the mowing pattern and strings to achieve the desired tee alignment. Prior to leaving, shift the stakes onto the bank of the tee at each corner, approximately 15 feet from the site of the new edge. The stakes and string later will serve as guides for the laser grader operator.

Strip the Sod

Strip off the sod accurately from the tee surface with a sod-cutter set approximately 1 to 1.25 inches deep. An extra pass over the tee surface with the sod-cutter sometimes may be necessary on older tees with more thatch. Remove the sod on the tee surface, working perpendicular to the direction of

play if you wish to reuse the sod; otherwise, any direction is fine. Next, remove the sod from around the edge of the tee, approximately 4 to 5 feet down the tee slope. If sod will be reused, roll and store it in a shaded area by the tee. Another option is to lay the sod flat on plastic or plywood and syringe frequently.

Tilling Considerations

Clay or compacted soils may require shallow tilling to produce the friable material necessary for final grading. Adjust a tractor-mounted tiller to a 3- to 4-inch tilling depth and thoroughly loosen the soil. Tilling to greater depths is a common error that in-

creases your chances of surface settling at a later time.

After tilling, rake the area to remove soil clods, thatch, tree roots, or rocks. Haul this debris away. In compacted soils, a Verti-Drain treatment, either before or after tilling, will help to relieve deep subsurface compaction. The Verti-Drain will penetrate approximately 10 inches into most compacted bases. Incorporating sand topdressing into the aeration holes will help facilitate drainage as the water reaches the base of the tee.

On sandy soils, tilling may not be necessary. Nonetheless, spot-tilling isolated compacted areas may be required, and having a hand tiller available is helpful.

Using washed sod or a sod grown on a similar soil reduces the likelihood of problem-causing layering within the soil profile.



Add Root Zone Material

On most well-drained soils, simply dump 2 to 3 cubic yards of root-zone-quality sand or a sand/organic mix over an average-size tee (approximately 1½ to 2 inches deep). This sand or mix will provide a good surface on which to establish the sod. On poorly drained soils, adding new root zone material (up to 6 inches) would be beneficial. Refer to the chart (Figure 1) to estimate the amount of material needed based on the root zone depth and tee size. During reconstruction, it may be desirable to elevate the tee surface to improve playability. This can be accomplished by adding fill to the base or by adding root zone mix. Before adding 2 inches or more of root zone mix, it is essential to grade and compact the sub-base to prevent settling. A laser grader is the fastest and most accurate machine for this step. Usually, new root zone material with an infiltration rate of between 2 and 6 inches per hour would be considered adequate for tees.

How to Obtain a Level Surface

Many golf course superintendents in the South are familiar with laser grading technology, and several local contractors now

have this equipment. It is important to investigate the type of equipment used, since certain equipment may be more accurate, and to examine the degree of experience of the operator. These factors will affect the quality of the finished product and how the tee blends into the surrounding landscape. The cost is approximately 10 to 15 cents per square foot. It is possible to level even very small tees with this equipment.

Laser grading enhances the playability of the tee in two ways. As a general guideline, tee surfaces follow the contour of the fairway. For example, elevated fairways dictate an upward pitch sloping upward from back to front. Secondly, a laser grader also can establish fall from side to side. On dogleg holes, a draw or fade will be encouraged with a slight pitch to either the left or right. The laser contractor should work with the golf course superintendent or golf course architect to decide the pitch and side fall for each tee.

As mentioned previously, water infiltration through the root zone mixture is important, but surface drainage is essential. Surface drainage will prevent water from accumulating on the tee surface. Usually, a .33% to 1% fall is satisfactory for an average tee, but the surrounding landscape should

be considered. Establishing such a small slope for good surface drainage is easily done with a laser grader. The tee surface will appear flat at a pitch of 1% or less. A consistent pitch from tee to tee isn't necessary since these small percentages are undetectable to the eye. Surface water always should be directed away from heavy traffic areas, cart paths, and any high banks at the rear of tees.

New Tee Additions

It is very easy to add teeing ground to existing tees during the project. Begin by installing extra fill according to availability. However, care must be taken so that the "add-on" blends with the existing tee both in terms of grade and soil. A laser grader easily blends the new tee surface into the existing tee surface, a difficult task with other methods. Normally, the size of most tees increases by 5% to 10% since the outer edge of the tee generally will be 1 to 1½ feet wider after grading is complete. Establish new edges after grading by lightly hand raking and feathering the root zone into the existing contours. For additional width, add more root zone mix to the edges.

Resodding

The tee surface and slopes are ready for turf establishment after laser grading. Unlike other methods, no touch-up work is required prior to grassing because the base created by the laser is perfectly finished. If time permits, water the graded surface for several days to promote settling. Next, sod, sprig, or seed the tee surface and sod the tee banks. If you choose to sod, avoid using a sod grown on a different or incompatible soil. This is especially true with cool-season turfgrasses. Drainage and rooting may be seriously impaired otherwise. Using washed sod or sod grown on a similar soil will reduce the likelihood of having to deal with a sod layer. Surface irregularities will occur due to the variability of the sod pieces, but the faster establishment is a tremendous advantage compared to seed establishment. Topdressing after sodding will smooth any irregularities. If sod grown on a clay soil is used, plan on establishing a coring program to break up this soil layer.

Conclusion

A level tee increases the ease, comfort, and relaxation of the golfer during the tee shot, and the golfer looks forward to teeing up on a surface that enhances his game. Laser grading technology allows for a superior surface in minimum time. Any way you look at it, the course comes out on top with level tees.

Laser grading results in a well-defined tee edge.



Using Effluent Water On Your Golf Course

by DR. DAVID KOPEC, DR. CHARLES MANCINO, and DOUGLAS NELSON
University of Arizona, Tucson, Arizona

YOU MIGHT CALL IT a recycler's nightmare. Every day, 365 days a year, hundreds of millions of gallons of useable treated water is dumped needlessly into the ground, rivers, and oceans of the world. Is this truly necessary, or is there an alternative method of disposal to allow the recapture of some of this water and put it through a natural filter? Actually, there is! Parks, golf courses, sports fields, and certain agricultural crops all can use effluent water for irrigation.

In addition to preventing needless dumping, a useable effluent water supply has several other advantages. These include (1) guaranteed availability, even during periods of drought, (2) a nutrient content that potentially can lessen dependence on manufactured fertilizers, (3) the freeing of limited supplies of potable water for other, more essential uses, and (4) income, from the sale of effluent water to agricultural users, to pay for the construction of public sewage treatment plants.

Before running to the faucet and turning on an effluent water supply, however, there are several points that should be considered. To begin with, a thorough understanding of effluent water and how it is produced is essential.

What is Effluent?

The source of most effluent water supplies comes from municipal sewage that is approximately 99.9% water (effluent) and

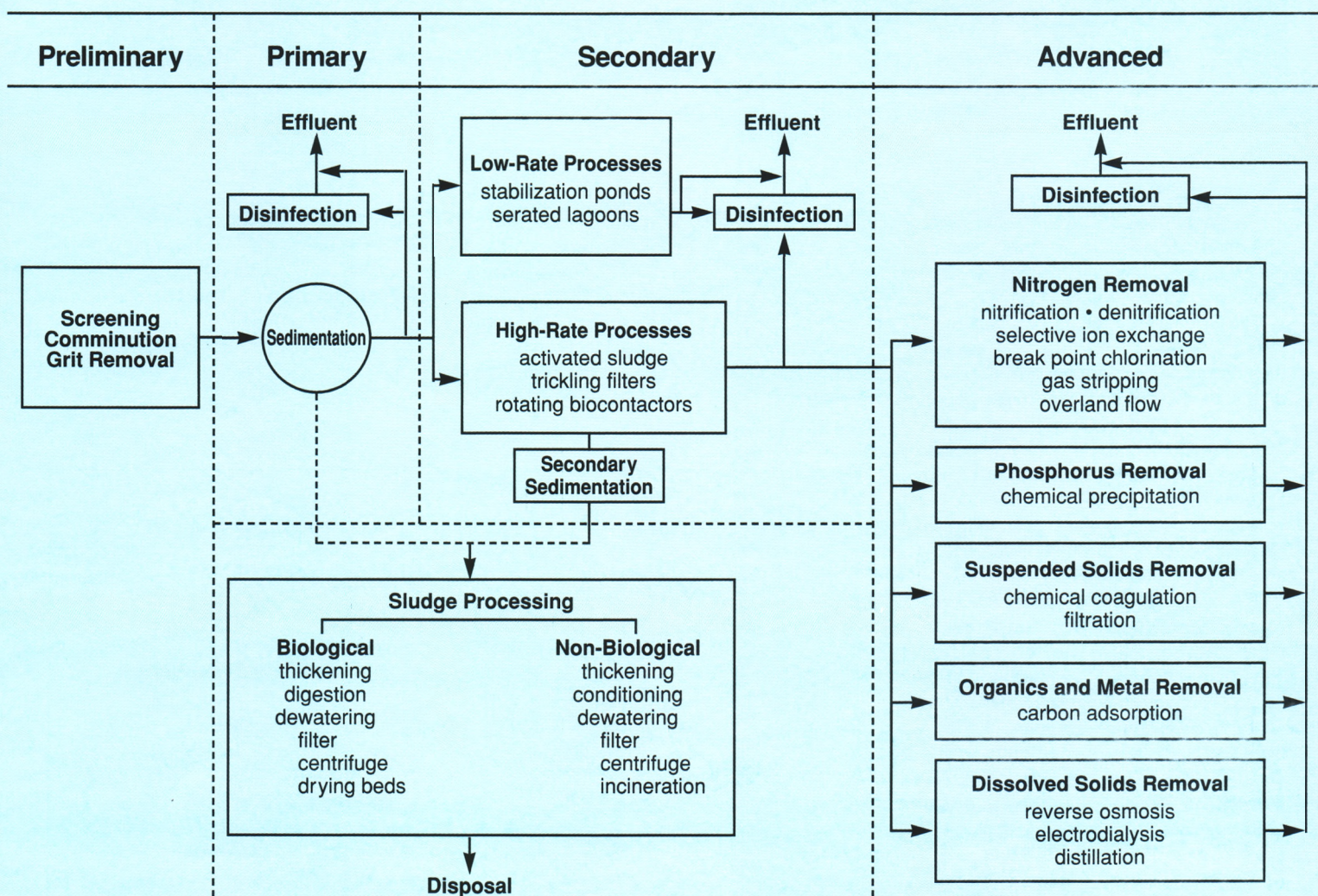


Figure 1 — Generalized Flow Sheet for Wastewater Treatment

Source: Asano, T., R. G. Smith, and G. Tschobanoglous, 1984



To produce usable effluent for golf course irrigation, the water is screened and treated.

.06% solids (sludge). To produce useable effluent for golf course irrigation, treatment plants process the raw sewage in several successive stages (Figure 1).

The first stage of the process is known as primary treatment. This involves screening the raw sewage for large debris and placing it in settlement ponds. The solid particles either sink or float and are removed. Primary effluent contains no more than 50% solids. Following primary treatment, the resulting effluent usually has a very foul odor and contains numerous harmful pathogens. Effluent water at this stage is not yet suitable for irrigation.

The next stage of the process is known as secondary treatment. This stage involves removing more than 90% of the original solids via microbial digestion by pumping the effluent through large cylindrical vats containing bacterial colonies. Following solid removal, the effluent usually is chlorinated, so that the coliform bacterial count is less than 23 per 100 milliliters of water (Table 1). Because secondary treated effluent has been chlorinated to reduce human health risk and is virtually solid-free, it commonly is used for irrigation of turf and several non-edible crops.

Even though secondary effluent can be used for irrigation, many treatment plants

continue the process with a final stage known as tertiary treatment. Tertiary treatment involves the removal of non-biodegradable organic pollutants and a significant percentage of nutrients, such as nitrogen and phosphorus. Tertiary effluent can be described as having no foul odor and a coliform

bacterial count of less than 2.2 per milliliter, and can be used safely for most purposes.

Understanding what effluent water is and what it is not allows us to address concerns of the golfing public and to develop maintenance practices to compensate for its use on the golf course.

Table 1
Water Treatment and Quality Criteria for Irrigation in California

Treatment Level	Coliform Limits Per 100 Milliliters	Type of Use
Primary		Surface irrigation of orchards and vineyards Fodder, fiber, and seed crops
Oxidation and disinfection	≤ 23	Pasture for milking animals Landscape impoundments Landscape irrigation (golf courses, cemeteries, etc.)
	≤ 2.2	Surface irrigation of food crops (no contact between water and edible portion of crop)
Oxidation, coagulation, clarification, filtration, and disinfection	≤ 2.2	Spray irrigation of food crops Landscape irrigation (parks, playgrounds, etc.)

Source: California Department of Health Services, 1978

Table 2
Constituents of Concern in Wastewater Treatment and Irrigation with Effluent Water

Constituent	Measured Parameters	Reason for Concern
Suspended solids	Suspended solids, including volatile and fixed solids	Suspended solids can lead to the development of sludge deposits and anaerobic conditions when untreated wastewater is discharged in the aquatic environment. Excessive amounts of suspended solids cause plugging in irrigation systems.
Biodegradable organics	Biochemical oxygen demand, chemical oxygen demand	Composed principally of proteins, carbohydrates, and fats. If discharged to the environment, their biological decomposition can lead to the depletion of dissolved oxygen in receiving waters and to the development of septic conditions.
Pathogens	Indicator organisms, total and fecal coliform bacteria	Communicable diseases can be transmitted by the pathogens in wastewater: bacteria, viruses, parasites.
Nutrients	Nitrogen Phosphorus Potassium	Nitrogen, phosphorus, and potassium are essential nutrients for plant growth, and their presence normally enhances the value of the water for irrigation. When discharged to the aquatic environment, nitrogen and phosphorus can lead to the growth of undesirable aquatic life. When discharged in excessive amounts on land, nitrogen can also lead to the pollution of groundwater.
Stable (refractory organics)	Specific compounds (e.g., phenols, pesticides, chlorinated hydrocarbons)	These organics tend to resist conventional methods of wastewater treatment. Some organic compounds are toxic in the environment, and their presence may limit the suitability of the wastewater for irrigation.
Hydrogen ion activity	pH	The pH of wastewater affects metal solubility as well as alkalinity of soils. Normal range in municipal wastewater is pH = 6.5-8.5, but industrial waste can alter pH significantly.
Heavy metals	Specific elements (e.g., Cd, Zn, Ni, Hg)	Some heavy metals accumulate in the environment and are toxic to plants and animals. Their presence may limit the suitability of the wastewater for irrigation.
Dissolved inorganics	Total dissolved solids, electrical conductivity, specific elements (e.g., Na, Ca, Mg, Cl, B)	Excessive salinity may damage some crops. Specific ions such as chloride, sodium, boron are toxic to some crops. Sodium may pose soil permeability problems.
Residual chlorine	Free and combined	Excessive amount of free available chlorine (0.05 mg/l) may cause leaf-tip burn and damage some sensitive crops. However, most chlorine in reclaimed wastewater is in a combined form, which does not cause crop damage. Some concerns are expressed as to the toxic effects of chlorinated organics in regard to groundwater contamination.

Source: Asano, T., R. G. Smith, and G. Tschobanoglous, 1984

Human Considerations

The most common question raised by the golfing public concerns that of human health (Table 2). Although effluent water is derived from municipal sewage, people should generally feel safe if exposed to effluent because it has been chlorinated. In fact, many public health officials concede that some tertiary effluent supplies could be used for swimming, although at this point in time adequate supplies of potable water are still available.

Despite the low human health risk involved with using effluent water, legislation nonetheless has been written to reduce exposure to an absolute minimum. This legislation consists primarily of restricting the

use of the irrigation system to non-daylight hours, when golfers are absent from the course, and posting the course with signs, such as "*Warning: Course Irrigated With Reclaimed Water.*" In some cases, to comply with this legislation requires the installation of an automatic irrigation system that can deliver the volume of effluent water necessary to irrigate the course within a nightly eight-hour irrigation cycle.

In the environmental '90s, some concern also is being raised by the general public as to possible adverse side effects on wildlife. Again, due to chlorination, irrigation with effluent water poses little risk to wildlife. Furthermore, the use of effluent water on golf courses prevents its dumping in pristine

public waterways, where the nutrient content would promote damaging algae growth.

Chemical Interactions

The first step in developing maintenance practices to accommodate effluent water usage is to have a sample analyzed to determine the following parameters:

- Salt concentration.
- Sodium hazard.
- Bicarbonate concentration.
- Toxic ion concentration.
- pH.

Salt Concentration — Effluent water generally contains a significant amount of several salts that are combinations of sodium

(Na), chlorine (Cl), magnesium (Mg), calcium (Ca), sulfate (SO₄), and bicarbonates (HCO₃). After irrigation with effluent, these salts accumulate in the soil and attract pure water molecules, preventing some of the water from being absorbed by the turfgrass plants. As a result, less "free" water is available for turfgrass uptake and symptoms of drought stress begin to occur.

Sodium Hazard — Sodium hazard indicates the relative amount of sodium (Na) in relation to calcium (Ca) and magnesium (Mg). A high amount of sodium in effluent water is undesirable from a water and soil standpoint. In addition to being a component of salt stress, sodium (Na) accumulation eventually will result in displacement of calcium (Ca) and magnesium (Mg) on the exchange sites of soil particles. This in turn inhibits the ability of the soil to aggregate and form peds necessary to maintain good soil structure.

Bicarbonate Concentration — Bicarbonate (HCO₃) concentration is important because of its ability to form precipitates of calcium carbonate (CaCO₃) and magnesium carbonate (MgCO₃). These precipitates "steal" calcium and magnesium from the soil particle exchange sites, and in turn can be replaced by sodium. Of lesser importance is that excess bicarbonate can lead to an increase in soil pH.

Toxic Ion Concentration — High concentrations of specific ions, such as chlorine and boron, can cause damage as they accumulate in plant tissue. Fortunately, turfgrasses are relatively tolerant of several toxic ions. These ions tend to accumulate in the leaf tip and are removed during mowing. Many ornamental trees and shrubs are not as fortunate, however, and can experience disfiguring leaf burns. The type and amount of toxic ions found in effluent is a function of where the raw sewage emanates from. Generally speaking, most municipal effluent does not contain high toxic ion concentrations, whereas industrial and mining effluent does.

pH — The pH (negative logarithm of the hydrogen ion concentration) of effluent water serves as an indication that there may be some type of ion imbalance in the water. In general, it is held that the pH of the water itself is not a problem, as most soils have a great resistance to pH alteration.

What Next?

With an understanding of the chemical characteristics of effluent water, developing maintenance practices that compensate for any negative attributes is a relatively simple matter. To begin with, the highest management priority is determining the water's total salt concentration. As mentioned previously, dissolved salts can quickly accumulate in the soil and inhibit "free" moisture/nutrient uptake.

To avoid such an occurrence, periodic heavy irrigation cycles must be programmed to saturate the soil and leach the salts below the root zone. To accommodate salt leaching, the importance of good subsurface drainage cannot be overstated. This point is especially important in regard to putting greens, where excessively wet conditions would make the soil more susceptible to excessive compaction from concentrated foot traffic.

Another high priority is the sodium hazard, or the relative amount of sodium in comparison to calcium and magnesium. If the sodium hazard is high, the sodium ions will accumulate on the soil exchange sites and cause degradation of the soil structure. As a counterbalance, additional calcium should be added to the soil. In a majority of cases, this can be done by applying calcium sulfate (gypsum) in either a granular or liquid formulation.

In cases where the soil has a high pH and excess free calcium carbonate, however, sulfur should be applied. As the sulfur breaks down, it dissolves the natural calcium deposits and increases the availability of minor nutrients by lowering the pH.

As a potential benefit, many effluent water supplies contain substantial amounts of nitrogen, phosphorus, and potassium (Table 3). However, due to daily and seasonal nutrient fluctuations, it is not possible to calculate the exact amount of these nutrients that will be deposited on the turf so that it can be subtracted from the annual fertilization program. Therefore, monitoring of both turf performance and soil test data should be done to make the necessary adjustments.

Although nutrient content is a potential benefit, toxic ions are another matter. If present, some toxic ions can lead to the deterioration of the turf and the surrounding landscape. Since the removal of toxic ions from an effluent supply would not be economically feasible in most cases, and they cannot be effectively leached through the soil, blending of the effluent with other water sources is likely to be the only real solution. For example, the concentration of boron could be reduced to a nontoxic level by blending an effluent water supply with a well water supply.

Though not directly toxic to plants, high bicarbonate levels in effluent water can contribute to sodium buildup in the soil by reacting with calcium and magnesium. To prevent this reaction, acid injection (the addition of acid to the effluent water) sometimes is used to lower the pH and nullify the bicarbonate ion. To determine the potential benefits of acid injection, water samples can be submitted for special testing.

Conclusion

As an alternative to potable water use, effluent water can in fact be a logical, safe, and economical choice for golf course and sports turf irrigation. Furthermore, it offers an environmentally responsible choice to the wholesale dumping of treated water into existing waterways. Turning on the faucet simply requires understanding both what effluent water is and what it is not!

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Table 3
Potential Fertilizer Value of Irvine Ranch
Water District Reclaimed Water (Per Acre-Foot)

Nutrients	Concentration mg/l	Pounds/ac.-ft.	Commercial* Value \$/ac.-ft.
Nitrogen (N)	23.0	62.6	\$11.27
Phosphorus (P)	2.2	6.0	2.82
Potassium (K)	13.9	38.1	6.10
Total Potential Fertilizer Value			\$20.19

*Commercial value based on average fertilizer prices for the summer of 1980: N = 18¢/lb., P = 47¢/lb., K = 16¢/lb.
Source: Asano, T., 1981



Suburban expansion and the demand for more golf courses is impacting the rural landscape.

The Bird Community Found on British Columbia Golf Courses

by IAN E. MOUL and
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Canadian Wildlife Service,
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IN BRITISH COLUMBIA, like most regions in North America, the popularity of golf has resulted in many proposals for new courses. New golf course developments are often at the interface between expanding population centers and diminishing rural lands. If urbanization trends continue as expected, golf courses will provide important green spaces. In an effort to foster the inclusion of wildlife habitat within new golf courses, we undertook a project to survey the birds found on existing courses, and

to compare bird numbers and species richness with the habitats offered.

Study Area and Methods

Birds were counted on eight golf courses located in the Fraser Valley region of British Columbia. The courses were chosen to reflect a range of potential wildlife habitat from very open sites with minimal tree cover to sites with large areas of trees and hedgerow. On four of the courses, we

mapped the major vegetation and classified habitats as:

1. Turf — all areas of intensive turf maintenance, including the greens, tees, fairways, and areas of rough not associated with trees, shrubs, or brush.
2. Water — all lakes, ponds, streams, and ditches.
3. Hedgerow — all areas of trees, shrubs, or brush where understory vegetation was minimally maintained and allowed to grow naturally.

Table 1.
The Golf Course Bird Community and the Habitats Where They Are Found

Bird Species	Habitat			
	Water	Grass	Hedgerow	Tree
Great Blue Heron	■			
Canada Goose	■	■		
Mallard	■	■		
Bufflehead	■			
Hooded Merganser	■			
Bald Eagle			■	■
Red-Tailed Hawk			■	■
Killdeer		■		
Glaucous-Winged Gull	■	■		
Belted Kingfisher	■			
Downy Woodpecker			■	■
Northern Flicker		■	■	■
Violet-Green Swallow	■	■	■	■
Barn Swallow	■	■	■	■
Northwestern Crow		■	■	■
Black-Capped Chickadee			■	■
Bushtit			■	■
Winter Wren			■	■
Golden-Crowned Kinglet			■	■
Ruby-Crowned Kinglet			■	■
American Robin		■	■	■
Cedar Waxwing			■	■
European Starling		■	■	■
Orange-Crowned Warbler			■	■
Yellow Warbler			■	■
Rufous-Sided Towhee			■	■
Song Sparrow			■	■
Dark-Eyed Junco			■	■
Red-Winged Blackbird	■		■	
Brewer's Blackbird		■	■	■
Brown-Headed Cowbird			■	■
House Finch			■	■
Pine Siskin			■	■
American Goldfinch			■	■
Evening Grosbeak			■	■
House Sparrow			■	■

Table 2
Species Counts and Total Number of Birds Counted in Four Types of Habitat Found on Four Golf Courses During 30 Counts at Each Course from November 1990 to July 1991

Habitat	Number of Bird Species	Total Number of Birds	Land Area Surveyed (Acres)	Average Number of Birds/Acre
Turf	19	6,355	127.0	1.6
Water	22	4,871	7.2	22.6
Hedgerow	40	1,210	12.8	3.2
Trees	37	1,348	25.2	1.8
Total	73	13,784*	172.2	2.6

*This total excludes 1,519 birds observed flying

4. Trees — individual or groups of trees or shrubs of any species where the understory vegetation has been removed.

Between July 1990 and July 1991, during 152 bird counts, the species and the numbers of all birds seen or heard (on all eight courses) were recorded, along with the habitat in which they were found (four courses).

Results and Discussion

A total of 19,443 birds representing 103 species were observed during this study. Twenty of these species were seen only once, on one golf course, and were considered accidental. We considered 36 species (Table 1), observed on over half the courses surveyed, to form the community of birds likely to be found on golf courses. Within this community, some species were very abundant, while others were present in lower numbers. Eight species, the European starling, American robin, mallard, Northwestern crow, Canada goose, barn swallow, dark-eyed junco, and black-capped chickadee, were among the 10 species most commonly sighted and also the 10 most numerous species. Collectively, these birds represented 69.8% of all the birds counted; they have minimal habitat requirements and could also be found in parks and neighborhoods throughout the study area. Bird species observed in low numbers were often associated with a specific habitat. Great blue herons and hooded mergansers were found associated with water bodies of sufficient quality to support the fish consumed by those birds. Woodpeckers, kinglets, and wrens were found in hedgerows and treed areas.

Wildlife habitats offered by golf courses may be judged by how effectively they meet the most basic requirements of birds: food and shelter. We noticed a considerable difference among the habitats found on the golf courses surveyed. During the initial surveys in July and August 1990, the species count on eight courses ranged from 14 to 46. While we did not measure the habitats at the time, it was clear that those courses with minimal foliage or small, recently planted trees had less habitat to offer birds, and the species diversity was accordingly low (14 to 16 species). This is not to say that those courses were without some suitable habitat. On one course we frequently observed a green-backed heron foraging or roosting in vegetation along the edges of one pond. The presence of this uncommon species indicates the value of the habitat offered.

In terms of overall numbers of birds counted, just under half were seen on turf (Table 2). If we consider bird numbers per land area of each habitat, though, turf accounted for only 1/4 that of water, 1/2 that

of hedgerow, and was the lowest in species richness. Of the birds using turf, the American robin and the European starling together accounted for over 80% of the birds counted. Large numbers of American wigeon were observed feeding on turf during the winter at one course. As golfers approached, the wigeon would flush to nearby ponds, returning to the turf as the golfers passed. Of the species using turf, only Canada geese, mallards, and glaucous-winged gulls used turf surfaces for resting.

Water, while it only accounted for 4% of the land area surveyed, contained the greatest density of birds. The American wigeon was the most numerous species, accounting for 47.5% of the birds seen on water. Aside from the mallard at 39.4% and the Canada goose at 8.9%, all other species had a relative abundance of less than 1%. It was interesting to observe large numbers of American wigeon and mallards on the water at one golf course despite the fact that they did not use the habitat for foraging. At least during the winter, they used the ponds exclusively as a safe place to rest.

The differences between hedgerow and tree habitats, as we defined them, were due to the clearing of underbrush at tree bases. From the golfer's perspective, minimal vegetation makes it easier to locate stray golf balls. The removal of ground vegetation, from the perspective of a ground-feeding bird, means the elimination of a place to retreat from predators or from perceived threats, such as passing golfers. On the courses we visited, hedgerows often were located along course boundaries, screening a service road, or at a junction between a green, tee, and an adjacent fairway. Hedgerows often were not large, but formed a valuable habitat island within the open turf expanse.

Hedgerows had the greatest species richness of all the habitats observed. With the more common bird species, there was little difference in numbers between hedgerows and trees. For species observed less frequently, more birds per acre were located in hedgerows. Of the two species of woodpecker, both the downy woodpeckers and the northern flickers were seen twice as often in hedgerows as in trees. Of the birds typically found on the ground or in lower-story vegetation, the dark-eyed junco, rufous-sided towhee, and song sparrow were, respectively, 4, 9, and 25 times more abundant in hedgerows versus trees.

Conclusions and Recommendations

On the courses we visited, those with both the highest numbers of bird species and also the greatest numbers of birds (excluding those found on water) had extensive areas



(Top) The vegetation of this pond provides habitat for mallards and a green-backed heron.

(Above) This beaver pond on a Vancouver Island golf course is ideal habitat for nesting waterfowl and red-winged blackbirds.

of natural vegetation. Most of the courses we visited contained areas where additional wildlife habitat could be created. Small changes in management practices in locations away from immediate areas of play could increase the quality of habitat offered to wildlife without a great inconvenience to the golfer. A deep rough consisting of long grasses typical of abandoned fields would provide for species such as the ring-necked pheasant, common yellowthroat, and western meadowlark. Allowing bulrushes to grow in a pond or marshy area would supply the habitat needs of green-backed herons, red-winged blackbirds, American bitterns, and various species of waterfowl. We encourage

golf courses to join programs like the Audubon Cooperative Sanctuary Program, designed to acknowledge and enhance the wildlife component of golf courses. While golf courses never can be truly "natural" habitat, they can serve as urban green spaces and support a wildlife community.

The information presented here was part of larger study, titled "A Survey of Pesticide Use and Bird Activity on Selected Golf Courses in British Columbia," Technical Report Series Number 163. Copies may be obtained from the Canadian Wildlife Service, Box 340, Delta, British Columbia, Canada, V4K 3Y3, (604) 946-8546.

Biting the Bullet: Greens Complex Reconstruction at the Country Club of Virginia

by ALAN D. HESS, C.G.C.S.

Director of Golf, Country Club of Virginia, Richmond, Virginia

WHAT IMAGE comes to mind when you think of a golf course constructed 65 years ago? To the golfer it might be thoughts of a mature, traditional layout weaving through wooded, gently rolling hills. A golf course superintendent might describe a golf course with small, slow-draining greens complete with compacted soils and a mix of bentgrass and *Poa annua*. This latter scenario described the conditions at the James River Course at the Country Club of Virginia before the reconstruction began.

The James River Course at the Country Club of Virginia in Richmond was opened for play on June 30, 1928. It was designed by William Flynn and constructed by Frederick Findlay. Mr. Findlay, who built much of the original character of the golf course, eventually became the golf course superintendent and an accomplished architect in his own right.

Since the late '60s and early '70s, the old course began showing signs and problems associated with age. All were classic problems, including:

- Small greens.
- Original green design had been lost over the years, and most had become more oval in shape.
- Poor internal drainage within the greens.
- Enlarged and encroaching bunkers.

There were other problems, too. For instance, golf equipment and golfer skill had evolved to such an extent since the 1920s that the course was now playing much shorter. This, in turn, created a fairway visibility problem because golfers were clearing areas which were unapproachable before. Furthermore, the "postage stamp" size tees of the early years were not capable of handling the increasing amount of play. Ultimately, though, the emphasis of the golf course renovation project came down to the greens.

The restoration work had been in the long-range plans for a number of years. Essentially, the work was needed because of the inconsistency in the health of the turf on the greens. Several other factors contributed to the need for renovation of the course. First, there was the encroachment and infestation of common bermudagrass from the edges of the greens. The encroachment was partially responsible for the greens losing their original size and shape.

The second consequence of time was the condition of the old German bentgrasses with which the greens were originally planted. Examples of different strains of bentgrass with varying colors, leaf textures, disease susceptibilities, etc., could be found on every green. Fred Findlay even developed two of his own bentgrass varieties, James River I and James River II, from the patches in the greens.

Increasing traffic, lower mowing heights, and even changing climatic conditions had made it difficult for these grasses to perform to today's standards. The newer bentgrass varieties have enhanced heat tolerance, better rooting, and better disease resistance compared to some of the old strains. Also, they have a more upright and consistent growth habit and can provide the good quality playing conditions desired by today's golfers. Moreover, the newer bentgrasses provide a more consistent appearance, at least for many years, and should tolerate the lower heights demanded today for faster greens.

Perhaps the most critical factor in rebuilding the greens was to improve both the internal and surface drainage problems. Typically, the old greens had only one exit point for surface drainage, and this usually was to the front of the green. Also, pockets near the center of the greens were prone to turf loss due to water accumulation and traffic problems. These were not good cir-

cumstances in which to grow reliable turfgrass in Virginia, right in the heart of the Transition Zone.

To correct these problems, we established a team of experts to develop a workable master plan, create a budget, sell the idea to the membership, and, finally, complete the reconstruction project. The key components of this team were the architect, an overseer, the general contractor, the golf committee chairman, a select group of members, and the staff all working together. The club went through a detailed process of selecting the golf course architect, eventually selecting Rees Jones.

The other members of the team were the agronomists of the USGA Green Section Mid-Atlantic Region. Stanley Zontek, Director of the Mid-Atlantic Region, was an important contributor, along with Bob Brame. Mr. Zontek, by coincidence, had worked cooperatively on a renovation project with Rees Jones just a few years earlier. The continuity between the team players was critical to the success of our project. Not only were we getting a team that had worked together before, but we had a well-recognized group. As a matter of fact, once the team was secure and the project approved, the membership's attitude changed from apprehensive to one of excitement and anticipation. Landscapes Unlimited, Inc., of Lincoln, Nebraska, was selected as the general contractor. Of particular interest to us was their experience in building greens to USGA recommendations. Once under contract, they were on-site and began working within two weeks. All work began April 1, 1992. More than one comment was made about starting the project on April Fool's Day!

By the time Landscapes Unlimited had finished planting the greens and had left the property, it was early October. Within that period of five months, we had rebuilt



ALAN D. HESS



(Above) Taking the blade to a problem green.

(Left) At the rear portion of the seventh green, an elbow section was installed as the basis for a flush-out drain for the main line. The orifice for this flush-out will be protected by a valve box.

19 green complexes and all or part of 13 fairways, constructed 58 sand bunkers, enlarged tees, created two large lakes, and installed a double row, computerized irrigation system.

Before the reconstruction process started, all the construction materials were analyzed and selected. By working with an experienced soil testing laboratory and our advisors, and with an expense of almost \$7,000 for tests, we were able to find quality construction materials. Eventually, a mixture of 80% sand and 20% Canadian sphagnum peat was selected for the root zone mix. This topmix met all the USGA recommendations and tested at 16.2 inches per hour percolation rate. All materials were to be mixed off-site, and a balanced blend of fertilizer and lime were included during the blending process.

The sand was an especially good material, not just for its particle size, but also for its uniformity, particle shape, and absence of fines. Eighty-five percent of the material tested in the coarse- and medium-sized sand fractions. The use of soil in the green con-



Methyl bromide fumigation was a key step prior to the seed bed preparation. We were convinced this was necessary due to the amount of bermudagrass established during construction on the green cavity wall.

ALAN D. HESS

struction mix was never a consideration due to our desire to maintain an accelerated rate of percolation.

When the actual construction began, it was very methodical and deliberate, with attention to quality. Our assistant superintendents were positioned at each green site throughout the entire process. Rees Jones approved each green shell cavity before subsurface drainage work began. It was his desire to have the shape of the subgrade conform as closely as possible to the final shape of the green. The personal attention to each step by Mr. Jones and his architectural assistant, Steven Weisser, deserves special recognition.

The drainage system was installed from the back of the green to the front, using a herringbone design with laterals installed on 15-foot centers. In the process of working back to front, the trenches, gravel, rigid drainage pipe installation, and intermediate layer were done almost simultaneously. To protect the subgrade and materials, $\frac{3}{4}$ -inch plywood was used as a buffer below the skip loader. Every step of the way, the gravel and intermediate layer were constantly gauged to ensure the correct depths.

In addition, at the low end of each green, a "smile" perimeter drain was installed to intercept any additional drainage water that might collect at the interface of the subgrade and native soil collar. Flush-out boxes

were installed at the top of each green and at the head of the main drain line. The final touch was the addition of a 14-gauge copper wire to designate the main drain lines, as well as the perimeter of the green. This will help in the future for determining the original green configuration and locating drain lines.

The hard part was finally over! Now it became a simple matter of filling the green cavity with the topmix. Each green averaged about 6,200 square feet, and about 7,000 tons of topmix was needed. After the greens mix was in place, irrigation was installed, followed by the completion of the bunkers and the sodding of the entire putting green complex. The greens were left to settle and firm up until the time was right for planting in late August.

When the optimal planting temperatures had finally arrived, the greens were fumigated with methyl bromide and prepared for seeding. Once this was done, Mr. Jones designated and approved the final putting green contours. To help the establishment process, an organic turkey manure by-product fertilizer was applied at the rate of 1.5 pounds of actual nitrogen per 1,000 square feet. The greens were seeded to Pennlinks creeping bentgrass, applied in three different directions using a drop spreader at a rate of 1.5 pounds per 1,000 square feet. The seed was worked into the soil, using leaf rakes, and then rolled.

Within two weeks, we had uniform germination and a solid stand of new grass! By mid-October, all the greens were being mowed every other day using walk-behind mowers set at a height of $\frac{1}{4}$ ". This was a remarkable accomplishment. It is still too early to be definite, but an opening date in mid to late summer of 1993 is tentatively planned.

Large-scale renovations such as this one are rare. When envisioning the restoration of a historic, championship-quality golf course, seldom is it thought of on such a large scale. Furthermore, the tendency is to underestimate the amount of work involved. A key to the successful outcome comes back to "the team." They helped formulate a workable, common-sense, and agronomically sound plan to develop a better golf course for the future. Moreover, everyone on the team assisted in ensuring the integrity of the process and the final construction effort. Eventually, when the course is reopened for play, people will be enjoying a better golfing experience that will serve them long into the future.

It was a big project, but we can all look back with pride at what has been accomplished. Our membership "bit the bullet," did the job right, and we now have a better golf course for it. Perhaps our success will serve as a pattern for other golf courses that have similar problems and need similar solutions.

ON COURSE WITH NATURE

Restoration of Potash Pond

by SCOTT BERTRAND

Superintendent, The Bridgehampton Golf Club, Bridgehampton, New York

“HEY, SCOTTY, the course looks great, but what’s the story with the pond on the first hole? Boy, what an eyesore.” As superintendent at The Bridgehampton Club for 10 years, I began, for the uncountable time, to tell the gentleman before me the story about Potash Pond.

The eyesore the member referred to was a drainage area located in a highly visible area near the clubhouse and the first tee. Time and excess drainage from surrounding roadways and agricultural fields resulted in silt deposits to the pond, rendering it unusable and aesthetically unpleasing. To add to the problem, during periods of excessive rainfall the pond overflowed and flooded several fairways.

While everyone wanted to see something done, there was a problem. Potash Pond was listed as a wetland on the New York Department of Environmental Conservation (DEC) wetland map and, as in many states, was heavily protected and regulated. A DEC permit was required for any changes. The man groaned, wished me luck, and proceeded off to the first tee. At that point, I knew it was time to tackle this problem.

My hopes for finding a creative solution were renewed when shortly thereafter I met my new green chairman, Wallace Quimby. I was delighted to learn that as president of the local historical society, Mr. Quimby had knowledge about the pond’s history. Potash Pond is listed on the earliest known maps of the area, and Bridgehampton’s oldest members remember it as a wonderful skating pond. With dedicated determination, Mr. Quimby was instrumental in gaining the membership’s support for restoring the pond.

The Initial DEC Meeting

Having heard many nightmarish tales about the DEC, I had last-minute reservations when the DEC car pulled into the parking lot for the site visit. I really didn’t know what to expect from this all-important first meeting, and, I must admit, I half expected them to appear with horns and pointed red tails! I was pleasantly surprised to meet



Local schoolchildren were some of the most enthusiastic workers that we could have hoped for.



Before: The drainage area near the first tee was an eyesore that the members were ready to get rid of.

After: Restoration of Potash Pond left a natural area that everyone can be proud of.



two extremely knowledgeable and helpful individuals.

The DEC's major concern was that the end result of the restoration project be just as valuable as the existing wetland. I told the DEC representatives about our commitment to the environment and about other environmental projects such as IPM and the development of naturalized areas on the golf course. This set a good tone for the meeting. Also, all the pertinent information was available, and it helped to have a club official present at the meeting to provide input. We were honest and up-front in our dealings with them, and we asked them outright what they thought could be done to make the area more attractive to wildlife and more aesthetically pleasing.

The Maze of Paperwork

Shortly after the site inspection, the ½"-thick permit application arrived. At first it was overwhelming, but the DEC contacts were extremely helpful in completing the application, and it helped to establish a good working relationship. Additional information was required from us, which was promptly sent, and I made periodic calls to the DEC to check on the application status. Patience was needed as the review process extended over six months.

The approved permit included the following DEC construction recommendations:

1. Remove the upper four inches of topsoil from the project site and stockpile nearby.
2. Excavate the fill and use in low areas near the site. Soil is not to be removed from club property.
3. Slope the pond shoulder not to exceed 1:10.
4. Spread stockpiled topsoil four inches deep over the sloped shoulder.
5. Two years after the project, hand-pull all phragmites.

Construction and Grow-In

When the final permit approval arrived in October 1991, there was not much time before winter to get the project completed. The DEC required a 24-hour posting notification, and we began the construction exactly 24 hours after the final approval. I don't believe anyone was ready for the huge piles of earth that seemed to be everywhere.

If you are planning a project like this, here are a few suggestions for the planning stages that can help the construction go much more smoothly:

1. Before moving the first shovel of soil, review the information sent with the approved permit. Many guidelines need to be followed.

2. Communicate with the membership about the realistic start and completion dates of the project. Focus on the positive aspects.

3. Develop a good working relationship with the contractor. I brought ours coffee each morning and we talked about the day's work.

One problem was encountered during construction when trying to spread the stockpiled topsoil. The topsoil, which looked more like muck, is the original wetland soil and is a valuable seed source of wetland plants. The material was difficult to work with, and I had to borrow a farmer's disc harrow to move it. It took seven weeks to complete the contouring and finish grading.

To establish a natural buffer, we seeded the area around the pond perimeter with a ryegrass and fescue mix to control erosion and to slow runoff. The buffer zone provides food and cover for wildlife and also shades the shallow water along the edge, helping

to moderate the water temperature. Switchgrass, marsh hibiscus, Joe-pye weed, wild iris, and broomsedge were planted the following spring. More native plants, including buttonbush and shadbush, are planned for subsequent plantings.

Project Costs

The entire restoration project cost approximately \$12,000, and several factors helped keep the costs down. The permit application was only \$50 since the area disturbed was less than an acre. The DEC did not require the standard engineering drawings, but allowed my sketches. I did a portion of the work with my crew and utilized local resources to accomplish many of the tasks. A local nursery provided invaluable advice on wetland plant materials.

The most cost-effective labor for seeding of the pond edges was provided by the local

elementary school. The kindergarten and second-grade classmates of my two sons, armed with cups of switchgrass seed, were the most enjoyable and enthusiastic workers. We plan to include these future environmentalists in more projects.

The Bridgehampton Golf Club is registered in the Audubon Cooperative Sanctuary Program for Golf Courses, and I am delighted with the program's suggested projects and advice. This program has provided information for making Potash Pond even better for wildlife, along with other projects that we can incorporate on the golf course.

While I started out trying to improve an undesirable situation on my course, I have found a new avenue to enhance the golf course, improve the area for the wildlife, and educate a future generation about the environment. The restoration of Potash Pond has been a rewarding experience.

ALL THINGS CONSIDERED HIT THE BALL!

by DAVID A. OATIS

Director, Northeastern Region, USGA Green Section

A COUPLE of years ago, I visited a golf course and was shocked to find that the club had played "preferred lies" for many years because of having poor-quality fairway turf during a portion of each summer. At the time of my visit, the fairways were nearly flawless, yet the club continued to "roll the ball" because a few thin areas of turf existed (1% or 2% of the total fairway acreage), and thus it was possible to have a less-than-perfect lie in the fairway. In essence, this membership was saying that a ball landing in a fairway should be guaranteed a perfect lie and to have less simply would not be fair!

I was so shocked by the attitude of the club that I related the story to the golfers at another course the following week. To my dismay, the story was met with blank looks and embarrassed stares from the committee members, as they admitted having played preferred lies for years as well!

The account typifies what has happened to American golfers and American golf courses. Perfection is demanded, and if it can't be attained, we cheat! Golf isn't sup-

posed to be fair. Golf is supposed to be a test of nerves, physical skill, and mental acuity. It should be a challenge and a lesson in overcoming adversity, not a cakewalk and *definitely not a guarantee!*

The major objective in golf turf management always has been to improve playing conditions, the theory being that by doing so we would increase the skill factor and reduce the luck factor. Playing conditions have been improved unbelievably over the years, but the demands of golfers have increased along with the quality of the playing conditions. A well-struck tee shot landing in the fairway should not be intentionally penalized; that would make no sense at all. By the same token, neither should the golfer be guaranteed a perfect lie. Removing the luck factor entirely also eliminates the need for the skill required to negotiate a tricky lie.

I contend that luck is an integral part of golf and that it adds great interest to the game. Can you imagine how boring it would be to be able to predict exactly what type of lie you would face on your second

shot immediately after striking your tee shot? Do not misunderstand me; I am not advocating that we should trick up our golf courses, only that they need not, and cannot, be perfect. Above all else, we need to play the ball as we find it, not as we think we should find it, or would like to find it.

It is time we put things in perspective. There should be no guarantees in golf. If a shot landing in a fairway comes to rest in a divot, invent a shot to get it out of the divot. If a ball plugs in a bunker, don't change the sand or raking techniques or complain to the course manager. Figure out a way to get the ball unplugged. If the greens are hard and do not hold shots as well as you would like, try landing the ball short. If the condition of the golf course doesn't suit your particular game, adjust your game. It is not the responsibility of the golf course superintendent to tailor course conditioning to a particular golfer's desires. We do not need to trick up our courses, but neither do we need to perfect their condition. In short, play the course as you find it. Just hit the ball!

TURF TWISTERS

PROTECT AGAINST

Question: I would like to reduce pesticide use on my golf course. Japanese beetle grub populations in the fairways often are high enough to warrant an insecticide treatment. Would placing the commercial Japanese beetle traps in the roughs protect the fairways from damage? (Michigan)

Answer: The Japanese beetle traps will attract adult beetles from a considerable distance, but should only be considered a monitoring tool. True, many beetles are captured, but many more are attracted to the area. This may increase the potential for foliar feeding injury of ornamental plantings and turf injury from grubs later in the season. A few well-placed traps near the course will help monitor the overall population in the area and provide useful information regarding when to sample fairways for grubs.

SLIMY SNAILS

Question: During the summer, we have problems with small aquatic snails plugging the screens in our sprinklers. We use reclaimed water and suspect the snails are feeding on the algae that is typically found in our irrigation pond. We tried granular copper sulfate to eliminate the algae, but we still have a problem with the snails. Any other suggestions? (California)

Answer: The installation of a self-flushing filtration system for your pump station would help keep the snails from plugging the sprinklers. A screen size of 50-100 microns would be most effective. In addition to granular copper sulfate applications, you may also want to inject chlorine into your irrigation pond. Check the water before adding the chlorine to be sure you do not exceed a total of 10 ppm, which could adversely affect the turf.

AND PRODUCT OVERUSE

Question: I've used Nematicur on my greens the last three seasons to suppress nematodes and it worked fine. However, this year's treatment didn't work! What happened? (Mississippi)

Answer: True resistance to nematicides has not been documented, but there is evidence of enhanced microbial degradation of certain nematicides. One possibility is that some microbes may be using the Nematicur as a food source. After years of repeated use, the microbe population may have increased to levels that cause the material to degrade before it kills the nematodes. To avoid resistance problems, rotate the nematicide products used. If possible, adjust management practices to promote turfs that are less susceptible to these pests.