Water Quality and Drainage

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OUR CLUB IS located 20 miles southeast of Denver, Colorado. Original construction of the golf course began in 1956. Like most of the golf courses built in this area at that time, drainage was not considered to be a problem since the average rainfall here is less than 15 inches per year.

Prior to 1965, water availability problems were encountered in our shallow wells. These four wells, 50 feet deep, normally produce sufficient water of acceptable quality to irrigate 145 acres of turf. In June of 1965, the entire back nine holes were flooded, and silt one to three inches deep was deposited over all turf areas, including greens. In subsequent cleanup, we removed as much of the silt as we could. It was impossible to remove all of it, however, and silt layering continued to cause problems for a long time. The flood did solve the water availability problems for us, however, and our wells produced at a peak capacity of 2,250 gallons per minute for the next nine years.

In May of 1973 the second "100-year flood" in eight years again struck the Valley Country Club. After cleaning the flood damage, we regretfully noted a rapid deterioration in the quality of our irrigation water.

The spring of 1974 was the beginning of a prolonged drought period. The decrease in the static water table was accompanied by a severe increase in the total dissolved solids (TDS) in the water. In November of 1976 the total soluble salts reading was 960 parts per million (ppm) with an adjusted sodium absorption ratio (SAR) of 10.3. Soil scientists say that 650 to 700 ppm is reaching the high side of turf tolerance. To compound the poor water quality problem, we encountered a hardpan layering effect at a depth of two and a half to four inches under all of the greens. This hardpan layer ranged from three quarters of an inch to an inch and a half in thickness. Subsequent tests indicated less than half an inch per hour water infiltration rate on 50 percent of the greens with the best greens infiltrating only an inch and a quarter per hour. Soil testing indicated up to 1,800 ppm sodium accumulations on the poorer greens which are extremely high readings. Our inability to leach the accumulated salts from the rootzone was the cause of the problem. Our solution may be of interest to anyone having poor drainage or poor water quality problems. The following methods immediately increased the infiltration rate to three and a half inches per hour and dropped the sodium content of the greens to 250 ppm in 18 months.

Green 12 — This green was chosen first because it was the least damaged of the three worst greens we planned to recondition. On Monday, November 8th, we began to install drainage under this green. After consulting with Carl Schwartzkopf, our USGA Green Section Regional Director, we decided to install one center main line trench and lateral lines on 8-inch centers using a trencher. Our trencher's effective digging width is six to seven inches. After installing our drain pipe and gravel, the trenches were filled with plaster-quality bunker sand and resodded. Results were satisfactory. However, some problems were encountered and modifications were planned when the second green was to be done.

Green 13 — June 3, 1977. Work proceeded on this green. In the attempt to improve on our work with No. 12 green, we decided that in addition to the main line and laterals, we would add smaller (2½-inch wide) trenches between laterals to provide drainage on 4-foot centers. We also changed from plaster sand to topdressing quality sand with particle sizes ranging from 25 to 50 mm. These results were superior to results achieved on No. 12 green and led to this final method which we recommend highly. It has given us excellent results.

THE FOLLOWING step by step procedure was used to do our final green — No. 15 green. We used a staggered 10-man crew, six men worked from 6:00 A.M. until 2:30 P.M. and four men worked from 11:00 A.M. until 7:00 P.M.

Monday, June 13, 1977 — We established the center line for this green. We cut and preserved the sod on the sand in a greenside bunker, then began digging the main drainage line trench, followed by soil cleanup. We dug the main line trench to a depth of 15-inch minimum and 36-inch maximum and continued to a point approximately 70 feet into the rough where we installed a gravel-filled sump, providing a five-foot fall from main and laterals. We smoothed and graded the bottom of the main line trench and installed gravel. The gravel was packed two inches under the drain line, and we then installed a 3-inch perforated flex drain line and gravel was packed two inches over the drain. Next we measured and installed the lateral lines on 4-foot centers. We cut and laid the sod in the bunker sand and started lateral line trenching and soil cleanup. The lateral trench depth varied from a minimum of 12 inches to a maximum depth of 18 inches. All lateral lines were dug with a 2½-inch wide trencher.

Tuesday, June 14th — We completed the lateral line trenching and cleanup. We graded and gravel-packed the lateral trenches, then installed 1½-inch drains which we made by punching holes in the regular irrigation line polythylene pipe. Gravel was packed over the lateral lines. We then filled all trenches with 25-50 millimeters topdressing-quality sand which was hand-tamped and water-packed in the trenches.

We also stripped additional weak turf areas in preparation for resodding.

Wednesday, June 15th — We continued tamping and water-packing trenches, then relaid the original sod over trenches and the bad spots. Some extra sod from the nursery was needed to replace unusable sod. We then hand-tamped and hand-watered all sod.

Thursday, June 16th — We continued our work of replacing sod, hand-tamping, topdressing by hand and hand-watering.

Friday, June 17th — 11:00 A.M. Completed construction and cleanup. Elapsed time four and a half days — 270 man-hours.

Green was opened for play at 1:00 P.M. on June 17 through June 19.

Monday, June 20th — 6:00 A.M. We closed the green for aerifying and topdressing the green and collar. We removed plugs and then applied 700 pounds granulated gypsum. We spread 5,000 pounds of topdressing sand and then dragged and brushed the sand and gypsum into the aerification holes and turf. We then watered, fertilized and hand mowed the next morning and reopened the green for good at 7:30 A.M., Tuesday, June 21.

Fall aerification and all subsequent aerifications have included gypsum, magnesium sulphate and elemental sulfur applications as needed along with 5,000 pounds of high quality topdressing sand per application to continue to build away from our troublesome soil problems.

(Left) Sod is stripped where main drain is to be installed.

(Below) Preserving the stripped sod by placing it on sand in greenside bunker.

(Left) Trenching for the main line.

(Above) Measuring and marking for lateral drains.

(Top, left) Lateral drain trenching and clean-up.

(Top, right) Installing main drain — perforated continuous plastic pipe (tubing).

(Above) Placing gravel in trenches.

(Right) Placing sand over gravel.

A LISTING OF the equipment and tools used follows: one sod cutter; one 4-inch trencher (effective width six to seven inches; effective depth up to 36″; one 2½-inch trencher (effective width two-and-a-half inches; effective depth up to 18 inches); one cart or dolly to remove sod; a utility truck or trailer to remove soil. Hand tools include trench levelers — scoops for placing gravel and sand; survey instruments for shooting grades; square point shovels for clean up; hand sod tools for stripping and replacing sod and sod tampers to firm up replaced sod.

Materials used for a 6,500 square feet green —

Approximately 10 tons of ⅛-inch gravel.

Approximately 25 tons of 25-50 mm sand for filling trenches and topdressing. 150 feet of 3-inch perforated flexible drain line.

1,200 feet of 1½-inch slotted polyethylene tubing.

700 pounds granulated gypsum.

5,000 pounds topdressing sand (after aerification).

Fertilizer and additional nutrients as needed.

Summary Notes:

Total surface area 6,500 square feet — 1977 cost including labor and material, $1,500.00.

During the period of construction we cut a temporary green and placed an 8-inch hole in this area for play.

Although this work may be done during a dormant period, superior results will be obtained during the active growing season because of the faster recovery of the playing surface.

It is important to clean up all loose material each day so that normal watering of the green area during construction can continue.

We are continuing an overseeding program of three quarters of a pound per 1,000 square feet of seaside bentgrass on all greens after aerification and topdressing. We selected seaside bentgrass because of its better tolerance to salt.

The Valley Country Club, after consultations with the USGA staff agronomist, golf course architects and soil and water engineers had to select from three proposed solutions.

First Alternative — Locate a source of more acceptable quality water. This was economically unfeasible.

Second Alternative — Completely rebuild the greens and provide adequate internal drainage to leach poor quality water through the soil profile. Rejected also because of cost.

Third Alternative — Attempt to install an internal drainage system on present greens that would flush accumulated toxic salts out of the zone of the turfgrass plants. This program has proven to be extremely successful, and it has provided results exceeding our expectations. We feel this may prove to be a viable alternative to major reconstruction of some poorly-drained greens.

(Far left) Hand tamping of the sand.

(Left) Water-packing to further compact the sand.

(Below, left) Replacing sod.

(Below) View of green 14 days after completion.