Increasing Water-Use Efficiency Using Block-Zone Design on Tees

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Abstract

A case-study including a performance audit survey was conducted at Heritage Palms Golf and Country Club in Fort Myers, Florida during the summer of 2017 to determine if there might be significant increases in water-use efficiency after redesign and retro fitting from larger rotors to smaller rotors. The number 10 tee complex was evaluated, both prior to and after the retrofit, with subsequent averages calculated for Distribution Uniformity values.

Average values for D.U. were observed to have increased from .60 to .76 ("Before/After") as a result of the installation and upgrade to the new design using smaller heads. Ensuing worksheets recommended a comparative scheduling decrease in Adjusted Run Time of 25% (from 93 minutes per week to 70 minutes per week) based on the increase in the Distribution Uniformity values. This represents a reduction in irrigation gallons of approximately 65 percent for this particular tee complex or a savings of water equal to approximately 162,000 gallons per year based on comparative usage. Theoretically, if all 18 tee complexes were upgraded a water savings of nearly 3,000,000 gallons per year could be experienced.

Keywords

Performance Audit, Distribution Uniformity, Water-Use Efficiency, Irrigation Design, Block-Zone, Precipitation Rate, Irrigation Scheduling, Turf Quality, Tee Complex, Head Spacing, Adjusted Run-Time

Introduction

Golf course irrigation systems typically include the application of large rotary sprinkler heads in their design. This approach is relatively appropriate for the majority of the golf course, however many constricted areas such as tee complexes require alternative irrigation design to achieve acceptable levels of water-use efficiency. The application of over-sized sprinkler heads installed on narrow sites result in much of the water being cast over the targeted area and effectively wasted. Moderate investments in retro-fitting such areas can go a long way toward conserving irrigation water and drastically improving turf conditions. Adding supplemental block zones that utilize smaller sprinkler heads in areas that are narrow, abruptly evaluated or severely sloped can significantly improve water-use efficiency and turf drought resistance. Performance audits can document, explain and measure this process.

An audit provides critical components of the water management plan including benchmarking how well the current system is performing compared to how well it could actually perform (Stetson and Mecham, 2011). From this starting point future improvements can be strategically made as a means of increasing the efficiency of the system to achieve the same result with less water, consequently providing costs savings on water, power, pump station operation and maintenance. Improving irrigation uniformity and efficiency also equates to fewer dry and/or wet spots, healthier turf, reduced runoff and leaching. (Barrett, Vinchesi, Dobson, Roche and Zoldoske, 2003.)

The Case-Study

The case-study subject area is the number 10 tee complex on the Sable golf course at Heritage Palms Golf and Country Club located in Fort Myers, Florida. This particular tee complex has two separate teeing areas which are referred to as the "East" and "West" tees respectively. The corridor of turf that comprises the overall tee complex is relatively narrow and long, approximately 50 feet in width and 250 feet in length. The number 10 tee complex is very typical and representative of many other tee complexes in place on the two 18-hole golf courses at Heritage Palms.

Audits were first conducted on both East and West tees where existing sprinkler heads were of the large rotary type. The heads serving the area were full-circle in adjustment and located just off the tee surface with in-line or "single-row" spacing ranging from 65 to 80 feet apart. Nozzle configurations for all sprinkler heads yielded discharge rates of approximately 56 gallons per minute for each head at working pressure (80+ psi). Two sprinkler heads provided irrigation to each tee surface (East and West) respectively. Audit scores revealed relatively low values in the .58 to .61 range. Consequently, turf quality, vigor and density on these sites was also comparatively poor.

Figure 1. Aerial image of site with new design overlay

A new “block-zone” irrigation design was created for the same tee complex. Each of the two teeing surfaces were looped with 1.5 inch PVC pipe that tapped into the existing 2.5 inch PVC lateral pipe. The looped configuration supports more consistent pressure throughout the zone and permits the location of the new smaller rotors to be on both sides of the tee complex (opposed to previous “single-row”) which significantly increases coverage and uniformity. The original larger rotors were replaced by 16 small rotors with spacing ranging from 25 to 28 feet apart. The smaller rotor sprinklers utilized a nozzle configuration that operated each head at a discharge rate of approximately 6.5 gallons per minute at a working pressure of 80 psi. Zone valves provided control for the new sprinklers and utilized the existing station wires that had previously controlled the larger original rotors with electric solenoid valve-in-head configuration.

Figure2. Installation of new block-zone design, note the narrow width of the irrigated site

A new performance audit was conducted for the same two teeing surfaces upon completion of the redesign and installation of the block zones. The “After” distribution uniformity scores reflected notable increases relative to the “Before” values observed in the original system design with the larger rotors. The average distribution uniformity increased from .60 to .76 or approximately 27 percent.

Irrigation Scheduling Worksheets and Total Irrigation Gallons

Actual records indicated that prior run-times for this particular tee complex over twelve months preceding the case-study were averaging around 90 minutes per week. The ensuing irrigation schedule worksheets (based on the performance audit data) for both “Before” and “After” yielded average recommended run-times of 93 and 70 minutes per week respectively. This reduction in recommended run-time is equal to a decrease of approximately 25 percent.

Based on the respective recommended run-times and the corresponding sprinkler-nozzle configurations utilized, the total volumes were calculated on both East and West tees for scenarios representing both before and after the retrofit. Total irrigated gallons per week for the tee complex were calculated at 20,720 gallons per week for the “Before” scenario as compared to only 7,228 gallons per week (13,492 gallons per week less) for the “After” scenario that is now in place. This represents a reduction in irrigation gallons of approximately 65 percent or a savings of water equal to approximately 162,000 gallons per year based on comparative usage. Theoretically, if all 18 tee complexes were upgraded a water savings of nearly 3,000,000 gallons per year could be experienced.

Table 1. Summary of audit data and corresponding totals "Before"

BEFORE	D.U.	HEADS	DISCHARGE (gal/min)	RUN TIME (min/wk)	TOT/WK (gal/wk)
EAST	.58	2	56	102	11,424
WEST	.61	2	56	83	9,296
AVERAGE	**.60**			**93**	
TOTAL					**20,720**

Table 2. Summary of audit data and corresponding totals "After"

AFTER	D.U.	HEADS	DISCHARGE (gal/min	RUN TIME (min/wk)	TOT/WK (gal/wk)
EAST	.72	8	6.5	66	3,432
WEST	.79	8	6.5	73	3,796
AVERAGE	**.76**			**70**	**7,228**
TOTAL					**7,228**

Impact on Turf Quality and Environment

While the main focus of the case-study has concentrated on water-use efficiency, emphasis certainly should be noted concerning the relative increased quality of turf at the subject site. Many turf managers have come to realize the benefit of saving water as a byproduct result of the effort to correct turf quality issues very similar to the actual situation described within this particular case-study. Areas of turf that suffer from inadequate hydration will persist to struggle and require additional inputs including extra fertilizer, hand-watering and pesticides. Typically, when the irrigation is adjusted or corrected the problematic issues cease and the turf performance increases.

Many natural areas that are adjacent to irrigated turf can be negatively impacted by the irrigation water. Wetlands, streams, ponds and other sites with sensitive vegetation or wildlife should not have irrigation introduced into their environment. This is especially the case if the irrigation water contains materials that are injected into the irrigation system such as fertilizer or other chemicals potentially containing caustic substances. Effluent or reclaimed irrigation water sources typically contain significant levels of chlorine as a byproduct of the treatment process that can certainly harm flora and fauna if constantly wetted with such tainted water. More precision in the control and placement of irrigation water through the use of smaller rotors will undoubtedly reduce these potential problems and issues related to unintentional irrigation impact.

Conclusion

Adding supplemental block-zones with smaller heads in irrigated areas that are narrow, abruptly evaluated or severely sloped (such as tee complexes) will significantly improve water-use efficiency, turf health and drought resistance. This concept was clearly observed upon completion of the “Before” and “After” case-study at Heritage Palms number 10 tee complex where redesign and retrofit efforts resulted in water savings of 65% for the subject site.

Performance auditing provided the critical information necessary to thoroughly document and illustrate the significance of this process. More work and research is needed to further understand and emphasize the importance of the technique of utilizing smaller heads in block-zone irrigation design for constricted areas on golf courses such as tee complexes.

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