NO SHORTCUTS

An irrigation audit reveals which areas of your course are covered... and which aren't. by Mike Vogt

THINKSTOCK

There remains no simple way or shortcut to arrive at a method to manage irrigation water, especially given the inherent inefficiencies of a water application with a circular pattern with designed overlaps along with single-head coverage.

However, the increase use of handheld moisture meters and in-ground moisture sensors have brought about many changes in water management and hand-water applications particularly on greens surfaces. The superintendent must quantify the use of the current irrigation system by adjustments individual heads on a constant basis, which remains our best practice today. Without the baseline numbers from an audit, it remains a guessing game on what areas of the course are receiving quality coverage. Out of all information attained from irrigation audits, the most important number to attain remains Distribution Uniformity (DU); that percentage is the broad report card of the irrigation systems ability to apply water evenly over a given area.

When a superintendent designs a schedule for water distribution, that schedule must be modified to accommodate changes in weather or evapotranspiration (ET) which can change the turfs need for water. An audit provides the tools necessary to meet these requirements.

Our modern irrigation systems become less efficient with time and even the most advanced systems were never designed or intended to be a "set-it-and-forget-it" water distribution tool. The recommended schedule resulting from an audit is based on the field results; inspections, distribution uniformity, precipitation rate, soil intake amounts, turf water use, root zone depth and soil water holding capacity. Further adjustments to scheduling must be made to accommodate the limits of the control system used to operate the system.

An added benefit to an irrigation audit, or multiple audits, is to identify trends in irrigation system maintenance or other system needs. Typical irrigation maintenance activities that may be identified by an audit include:

- Adjusting and leveling sprinkler heads
- Adjusting arcs for proper pattern coverage
- Ensuring there is nozzle and sprinkler uniformity
- Clearing clogged nozzles;
- Replacing drive mechanisms or irregular rotating heads.

Also, an audit may alert superintendents to more significant problems, such as:

- Moving heads to more appropriate spacing
- Adjusting pressures at pumping source
- Adding pressure regulating devises
- Component upgrades – sprinklers, valves, pressure regulating valves, screens, filters).

Audit Worksheets

These worksheets use data accumulated from a proper and complete Irrigation Audit to quantify cost savings and operational efficiencies. *Editor's Note: These worksheets are based on information from Irrigation Association, Certified Golf Irrigation Auditor Manual, July, 2004.*

Power Savings Worksheet

	Data Required	Value	Unit	Source
#	**Part 1: Calculate Irrigation Requirements**			
1	Total Irrigated Area	110	Acres	Site Maps
2	Yearly Plant Water Requirements	32.20	Inches Per Year	ET0 3 Avg. K_c 3 Avg. K_{mc}
3	Yearly Irrigation Requirements	19.20	Inches per Year	#2 2 Effective Rain
4	Adjusted Yearly Irrigation Requirement (gross)	23.42	Inches per Year	#3 3 Run Time Multiplier
5	Total Gallons Recommended per Year	69,954,135	Gallons per Year	#4 3 27,154 3 Acreage
	Part 2: Calculate Power Cost			
6	Historic Yearly Power Cost	$8,379	$	Power Bills
7	Historic Gallons Pumped	76,973,885	Gallon per Year	Pump Station / Records
8	Historic Average Power Cost per Gallon	$.000109	$ per Gallon	#6 4#7
	Part 3: Estimate Power Savings			
9	Cost of Recommended Gallons	$7,625	$	#5 3 #8
10	Potential Yearly Power Savings	$754	$	#6 2 #9
11	Reduced Pump Maintenance Costs	$1,000	$	Estimate Impact of #5 on Frequency of Maintenance
12	Cost of Audit and/or Equipment Upgrades	$7,000	$	Calculate
13	Estimated Life of Pump Remaining	9	Years	Calculate
14	Return on Investment	$2.26	Ratio	#13 3 (#10 + #11) / #12

MONEY SAVINGS. A properly maintained and scheduled system will save money. An irrigation audit provides superintendents with the correct data to calculate accurate savings.

Once field data is gathered an illustration of saving can become clear and a return on investment can be communicated to club or course leaders.

WATER SAVINGS. Water will always have a cost, whether its cost is just pumping or you must actually purchase water. In the example above Distribution Uniformity (DQLQ) was collected for a golf course on the East Coast that purchased water by the unit (1,000 gallons) which costs $1.40. Simple math tells us that saving 10 percent in DQLQ will yield a savings of 4,236,024 gallons per year. The equation would look work out to be 4,236,024 divided by 1,000 to equal 4,236. Then multiply 4,236 by $1.40 to get a savings of $5,930.40.

POWER SAVINGS. Pump station pumps 1,000 gallons per minute, we save 4,236,024 gallons per year or 4,236 minutes of pumping time or 70.6 hours. If your course irrigation power bill was $21,000 per year based on 55,910,086 gallons at 60 percent DULQ that number would be 0.000376 (55,910,086 / $21,000 = 0.000376) per gallon in electricity or electricity savings of $1,592.00. In addition, saving 70.6 hours over the life of the pump system, that would equate to at least one free year added to the life of the pump station. Combined savings of $5,930.40 water plus $1,592.00 electricity would equal a total yearly savings of $7,522.40. **GCI**

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Sample Audit

Plant Water Requirements	Uniformity DU_{LQ}	Irrigation Water Requirement	Gallons per Acre Inch	Irrigated Acres	Total Gallons per Year
15.6 Inches per Year	60%	20.59 Inches per Year	27,154	100 Acres	55,910,086
15.6 Inches per Year	70%	19.03 Inches per Year	27,154	100 Acres	51,674,062
				Difference	4,236,024

Pump Operation Savings Worksheet

	Data Required	Value	Unit	Source
#	**Part 1: Calculate Irrigation Requirements**			
1	Total Irrigated Area	110	Acres	Site Maps
2	Yearly Plant Water Requirements	32.20	Inches Per Year	ET_0 3 Avg. K_c 3 Avg. K_{mc}
3	Yearly Irrigation Requirements	19.20	Inches per Year	#2 2 Effective Rain
4	Adjusted Yearly Irrigation Requirement (gross)	23.42	Inches per Year	#3 3 Run Time Multiplier
5	Total Gallons Recommended per Year	69,954,135	Gallons per Year	#4 3 27,154 3 Acreage
	Part 2: Calculate Pump Operation Hours			
6	Recommended Hours of Pump Station Operation	1214	Hours Per Year	#5 4Avg. Pump GPM 60 Minutes
7	Historic Hours of Pump Operation	1,336	Hours Per Year	Yearly Gallons Used4Avg. Pump GPM 60 Minutes
8	Potential Operational Reduction	122	Hours Per Year	#7 2#6
	Part 3: Estimate Pump Operational Savings			
9	Potential Operational Savings	$765	$ per Year	#8 3 (Yearly Power Cost 4#7)
10	Potential Yearly Power Savings	$754	$	#6 2 #9
11	Reduced Pump Maintenance Costs	$1,000	$ per Year	Estimate Impact of #8 on Frequency of Maintenance
12	Cost of Audit and/or Equipment Upgrades	$7,000	$	Calculate
13	Estimated Life of Pump Remaining	9	Years	Calculate
14	Return on Investment	$2.27	Ratio	#12 3 (#9 + #10) #11

Water Cost Savings Worksheet

	Data Required	Value	Unit	Source
#	**Part 1: Calculate Irrigation Requirements**			
1	Total Irrigated Area	110	Acres	Site Maps
2	Yearly Plant Water Requirements	32.20	Inches Per Year	ET_0 3 Avg. K_c 3 Avg. K_{mc} [1]
3	Yearly Irrigation Requirements	19.20	Inches per Year	#2 2 Effective Rain
4	Adjusted Yearly Irrigation Requirement (gross)	23.42	Inches per Year	#3 3 Run Time Multiplier
5	Total Gallons Recommended per Year	69,954,135	Gallons per Year	#4 3 27,154 3 Acreage
	Part 2: Calculate Water Cost			
6	Cost per Billing Unit	$1.40	$ per Unit	Water Bills
7	Convert Recommended gallons to Billing Units	93,522 ccf[2]	Units per Year	$5 4748 (for ccf units) -OR- #5 41,000 (for 1,000 gallon units)
	Part 3: Estimate Water Savings			
8	Historic Yearly Water Cost	$135,485	$ per Year	Water Bills
9	Cost of Recommended Gallons	$130,931	$ per Year	#6 3#7
10	Potential Yearly Water Cost Savings	$4,554	$ per Year	#8 2 #9
11	Cost of Audit and/or Equipment Upgrades	$7,000	$	Calculate
12	Estimated Life of Pump Remaining	9	Years	Calculate
13	Return on Investment	$5.86	Ratio	(#103#13)4#12

(Footnotes) 1. ETO refers to Evapotranspiration, specifically in turf; Kc refers to Crop Coefficient - type of turf and height of cut. Kmc refers to Microclimate factor for different exposures, such as south facing slopes, shade, high wind areas. 2. ccf refers to 100 cubic feet