

Slow the Flow Colorado

Sprinkler Irrigation Audits

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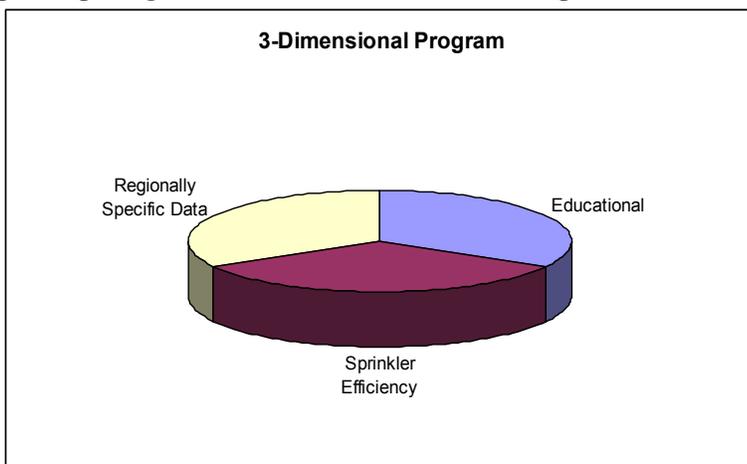
Abstract

After Colorado's severe drought in 2002, water conservation techniques and programs had reached the pinnacle demand generating Slow the Flow Colorado irrigation audit program. This program provides three dimensional services free to residential and commercial sites. It offers educational information to property owners, examines irrigation systems condition and efficiency, and provides water consumption data to the State of Colorado and cities within Boulder County. It was implemented in the city of Boulder during the summer of 2003 and the following summer extended to the county. Data collected includes precipitation rates that range from 0.22"/hr to 3.32"/hr for fixed spray heads and 0.09"/hr to 1.42"/hr for rotary sprinkler heads. Distribution uniformities data ranged from 14% to 92% for fixed spray heads and 16% to 92% for rotary sprinkler heads. These statistics coincide with other irrigation audit programs performed throughout the nation. Water records will be analyzed for water savings from audit in future.

Introduction:

The Slow the Flow Colorado program was implemented in Boulder Colorado during the summer of 2003 as an internship fulfilling the requirements for the Utah State University Water Efficient Landscaping Masters program. The irrigation audit program was patterned after the Slow the Flow, Save H₂O, Utah's Water Check Program and the Irrigation Association's water auditing procedures.

The Slow the Flow Colorado program as stated in the abstract provides three dimensional services free to residential and commercial sites. It offers educational irrigation information to property owners from trained Colorado University interns, examines irrigation systems condition and efficiency by performing several tests, and provides water consumption data to the State of Colorado and participating cities. The three services were performed and documented for data collection.



FIRST DIMENSION

I. EDUCATIONAL:

The sprinkler irrigation audit provides a free one-hour consultation regarding the property owner's irrigation system. Residential owners and large commercial and industrial maintenance employees are involved in hands-on sprinkler education.

They learn the systems operating procedures, its current performance and if any, system malfunctions. They are given their own report card that allows them to evaluate how well their sprinkler system is performing and how to improve its operating capabilities.

These actions and so called report card are important to reduce the deterioration of irrigation systems and reduce the usage of wasted water in the landscape. The sprinkler system operator and his/her behaviors are keystones in the amount of water used which also affect the water demand curve during the growing season.

IRRIGATION AUDIT INFORMATION

- 1. Recommendations**
- 2. Precipitation Rate**
- 3. Distribution Uniformity**
- 4. Sprinkler Head Pressure**
- 5. Irrigation Schedule**

II. BOULDER COUNTY IRRIGATION AUDIT RESULTS:

In the summer of 2003, the city of Boulder targeted sites that had dedicated water meters for the landscape. The following summer of 2004, landscapes included any type of meter from several cities within Boulder County. Data collected from these audits includes pressure taken at the sprinkler heads, precipitation rates that range from 0.22”/hr to 3.32”/hr for fixed spray heads and 0.09”/hr to 1.42”/hr for rotary sprinkler heads, distribution uniformity data ranged from 14% to 92% for fixed spray heads and 16% to 92% for rotary sprinkler heads. These statistics coincide with Slow the Flow Colorado’s sister program Slow the Flow, Save H₂O (*Jackson*) and also with nationwide irrigation audit programs.

Boulder County Pressure Rate Results

Table 1 demonstrates that 65% of the fixed spray zones exceeded 30 PSI and 9% of the rotary zones exceeded 70 PSI. Spray heads optimal operating pressure range from 20- 30 PSI and 50-70PSI (*Rainbird and Hunter*) for rotary type heads pending on manufacture design. Pressure that exceeds the manufacture details and specifications cause the distributed water droplets to decrease in size and drift away into the atmosphere or to other areas on the landscape that do not require water. During the summer of 2002, a catch cup test was performed on a Boulder residents spray zone that operated at 65 PSI. The distribution uniformity was a low 53%. The pressure was lowered to 30 PSI and a second catch cup test was performed identical to the first test. The distribution uniformity increased to an 85%. This outcome leads us to believe that pressure is an important element in water usage efficiency in the irrigation system.

Table 1. PRESSURE AT THE SPRINKLER HEAD	
Fixed Heads	65% over 30 PSI
Rotary Heads	9% over 70 PSI

The rotary type sprinkler head pressure varies on the manufacture, the model type, and the area the sprinkler head is designed to cover. Most of the industrial irrigation audit sites such as parks or soccer fields require 70 PSI or more. Residential sites that have rotary heads installed usually cover a smaller area in the landscape which requires a lower PSI, around 40-50. Table 1 suggests that rotary heads do not have high pressure problems as does the spray type heads.

Boulder County Precipitation Rate Results

Table 2 illustrates the precipitation rates among five different Boulder County cities. The Precipitation rate range from 0.22”/hr to 3.32”/hr for fixed spray heads and 0.09”/hr to 1.42”/hr for rotary sprinkler heads.

Precipitation rates have a dynamic range of results within the fixed spray type sprinkler head category but also with the rotary type. The average fixed sprinkler head applied 1.3”/hr which is a rate that most

		Fixed Sprays		Rotor	
	Audit #	Avg. PR (in/hr)	Range (in/hr)	Avg. PR (in/hr)	Range (in/hr)
Residential	416	1.3	0.22-3.0	0.64	0.1-1.5
		Fixed Sprays		Rotor	
Commercial	87	1.3	0.5-3.32	0.53	0.09-1.42

clay soils in Boulder County cannot absorb quickly enough. For this reason, clay soils irrigation schedules should be divided into intervals that will apply 0.5”/hr or less. Rotary sprinkler heads average application rate is 0.64”/hr which is half the amount of fixed sprinkler heads. With lower

precipitation rates, rotary sprinkler heads application time should run longer than a fixed spray head to receive the mutual .5”/hr. Soil type and precipitation rate are two very valuable elements when calculating an irrigation schedule that does not over water or waste water.

Catch Cup Tests and Efficiency Background

The distribution uniformity (DU) standards vary amongst irrigation, state, and city agencies allowing as low as 55% for fixed spray heads and 65% for rotary heads as acceptable operating conditions. Slow the Flow Colorado was patterned after the Slow the Flow, Save H₂O, Utah’s Water Check Program and the Irrigation Association certified water auditor training. Table 3

illustrates three different sprinkler head categories and what percentages are achievable, expected, and poor. Poor is the low DU category that advises not

SPRINKLER TYPE	EXCELLENT (achievable)	GOOD (Expected)	POOR (If lower than this, consider not scheduling)
Multiple Stream Rotors	85%	75%	60%
Single Stream Rotors	80%	70%	55%
Fixed Spray Heads	75%	65%	50%

(Irrigation Association Auditor Training Manual, 1996, p. ix)

to recommend a water schedule due to the possibility of promoting water waste. Irrigation systems that operate at a 50% DU will apply two gallons of water to achieve the designed one gallon. Slow the Flow Colorado’s minimum DU standards for their program are 70% for both the fixed spray type heads and the rotary type heads. The program also requires four catch cup tests per commercial site and two catch cup tests on residential sites.

Boulder County Distribution Uniformity Results

Table 4 illustrates the distribution uniformities among five different Boulder County Cities. The distribution uniformities range from 14% to 92% for fixed spray heads and 16% to 92% for rotary sprinkler heads.

Neither the rotary or fixed sprinkler heads are meeting the Slow the flow Colorado DU standard. There is clearly a dynamic range of poor and excellent performing irrigation systems. These inefficient sprinkler systems that are operating at 25% DU will use 4 gallons of water to receive 1 gallon on the landscape. Results like this are not only being compiled in Boulder County, but are being gathered in states such as Utah, Florida, and California. (Mecham, NCWCD). As a

		Fixed Sprays		Rotor	
	Audit #	Avg. DU %	Range %	Avg. DU %	Range %
Residential	416	51	14-92	52	16-92
		Fixed Sprays		Rotor	
Commercial	87	55	21-81	54	19-78

nation, our water industry needs to promote water efficient techniques and education to increase the efficiency and usage of our water resource. Statistics such as these are not acceptable performance in other natural resource industries and should not be accepted in the water industry.

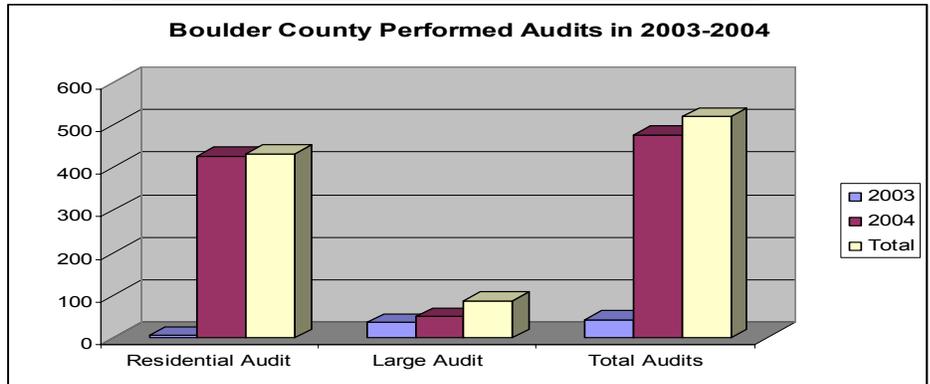
III. WATER CONSUMPTION DATA:

Slow the Flow Colorado performed 520 irrigation audits in Boulder County during the summers of 2003 and 2004. Out of the 520 audits, there are 433 residential sites, 32 home owners' association sites, 30 parks, and 25 commercial sites. A waiting list of 236 properties requesting an irrigation audit was compiled at the end of the 2004 season for the following season of 2005.

The 520 irrigation audits provide statistics from a variety of different landscape sites. In 2003, water records were requested from the water providers to reveal water usage on the landscape. One audited commercial property site from the summer of 2003 discovered that in the year 2001, 1,790,000 gallons or 144 inches were applied on 19,930 square feet. The actual water demand for

Table 5. BOULDER COUNTY IRRIGATION AUDITS 2003-2004

	2003	2004	Total
Residential Audit	6	427	433
Large Audit	37	50	87
Total Audits	43	477	520



236 Properties that are on a Waiting List for 2005

this turf site was 335,482 gallons or 27 inches. This converts into 433% water over use (*View Point*). The same year, a residential audited site of 2,755 square feet of landscape applied 192,800 gallons or 85 inches of water. The actual water turf need was 46,376 gallons or 27” (*Spotswood*). This converts to 316% over watering. Slow the Flow Colorado has the potential to decrease their water usage through the irrigation audit program. Slow the Flow save H₂O Utah residential irrigation audit properties have reduced their water usage by 10-15% and commercial irrigation audit properties reduced to 15-20% (*Jackson and Mohadjer, P, Saving Utah Water in the Fifth Year of Drought*). Boulder County’s water savings has not yet been calculated.

STATE, CITY AND WATER PROVIDER DATA

- **Water Consumption Behavior**
- **Water Use Overages**
 - % Over Evapotranspiration
 - In inches
 - In Gallons
- **Potential Water Savings**

These above mentioned record generates the average water consumption in inches which help indicate trends of water usage behavior pending on rainfall. Table 6 provides data from the city of Boulder and illustrates the use of more than 27” (the average historical water use) of water was applied on the

Table 6. The Average Property Water Use in Inches for Boulder County							
	1997	1998	1999	2000	2001	2002	2003
# of Samples	76	138	145	189	250	263	261
Average "	40	39	33	43	43	30	33
Turf Requirement	27	27	27	27	27	27	27
Inches Over watered	13	12	6	16	16	3	6
Rainfall " (NCWCD B. Mecham)	13.37	7.92	14.93	5.96	8.92	5.91	9.05

landscape between the years of 1997 - 2003. 1998, 2000, and 2001 were low rainfall years which reveals water usage increase above turf water requirement. In the growing season of 2002, the city of Boulder enforced water restrictions. The water restrictions and severe drought explain the small 3 inches of water used over the turf water requirement. The year 2003, water consumers remember the water restrictions and drought from the previous year, but are not enforced to conserve by city regulations. There is a 100% increase in water usage from 2002, but have not increased their usage to reach the level as in the years between 1997-2001. This water usage increase can be decreased or ceased by instigating continual water techniques and education programs that provide knowledge on how to properly irrigate vegetation as indicated in several different irrigation audit programs.

IV. CONCLUSION:

The future for urban water consumption in Boulder and neighboring counties is unknown and can be dynamic pending on the behavior of humans and the weather. These issues force state, city, and water

entities to obtain regionally specific data and numbers from water conservation programs. More irrigation audit programs will be implemented or enforced as water supplies begin to diminish or cities begin to grow. Pressure, precipitation rate, and distribution uniformity statistics have provided knowledge for improvement in the irrigation systems design, installation, components, and water use that have also helped refine the education process and the technical process of irrigation audit programs. The Slow the Flow Colorado program will have more catch cup results and water usage behavior data for future audited years and follow up data comparing the years to each other.

Appendix

Slow the Flow Colorado Participants and Procedures 2003-2004

Funding: The city of Boulder funded the irrigation audit program in 2003 and the Center for ReSource Conservation housed the irrigation audit program for the summer of 2004. The center received a grant from the Colorado Water Conservation Board and matching funds from each participating municipality. The city of Boulder Water Conservation Office provided the technical support and program procedures for both years.



Water Audit Methods

Water audit methods determine the precipitation rate, distribution uniformity, water pressure, and the overall quality of the irrigation system which follow the Irrigation Association (*IA Handbook, 1996*).

#1. Visual inspection

- Observing each zone's sprinkler heads and pipes that may be performing in good or poor condition. Providing recommendations to improve the efficiency of the irrigation system.

#2. Catch cup test

- Precipitation Rate- Sprinkler systems amount of water that it applies in a given hour. Different for each sprinkler system due to variable of material, hydraulics, and maintenance.
- Distribution Uniformity- A percentage that reflects how evenly the water is being distributed in the designed turf area.

#3. Soil Sample

- A soil probe will sample the length of the turf roots for drought resistance and soil type for water infiltration rate and scheduling.

#4. Result Sheet

- A sheet for homeowners and a report for large irrigated sites will be given with the test results and recommendation for the sprinkler irrigation site.

#5. Landscape Measurement

- The measurement is calculated for water usage on the landscape per site.

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