WATER -WISE DEMONSTRATION LANDSCAPE: A CASE STUDY IN WATER CONSERVATION

Gary L. Wade

AUTHOR: Professor and Extension Program Coordinator, Department of Horticulture, University of Georgia, Athens, GA 30602.
REFERENCE: Proceedings of the 2005 Georgia Water Resources Conference, held April 25-26, 2005, at the University of Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, University of Georgia, Athens, Georgia.

Abstract. A water wise demonstration landscape, established at the Bamboo Farm and Coastal Gardens in Savannah in 1999, showcases the seven principles of Xeriscape™ and various water-saving devices available to consumers. The landscape is divided into three water-use zones: low, moderate, and high. Approximately one-third of the garden is irrigated. A self-guided tour brochure, including a plant list, is available at the entrance.

Rainfall and irrigation data were recorded monthly from July 2000 through December 2004. A model was developed, based on Xeriscape™ principles, to forecast how much water the garden should receive each month of the year. Estimates were contrasted with the actual rainfall recorded.

The data show that through careful plant selection and design according to Xeriscape™ principles, little supplemental irrigation is needed on landscapes in the coastal region of Georgia. Similar models can be used by water purveyors to estimate how much water a landscaped property should require, based on its size and historical rainfall data.

INTRODUCTION

Georgia's coastal counties, like many areas of Georgia, are faced with water supply problems as population growth places an ever-increasing strain on municipal water supplies. In some areas, salt water intrusion into underground aquifers also is becoming a problem as water tables drop. When demand for water exceeds available supply, restrictions or bans on outdoor water use become necessary, and elected officials and water purveyors are not held in high esteem. However, through a concerted effort of public education on water-wise landscape techniques, combined with economic incentives for water conservation, significant quantities of water can be saved, and restrictions on outdoor water use can be avoided.

A Water Wise Demonstration Landscape at the Bamboo Farm and Coastal Gardens was established in 1999 with grants from the Chatham County Metropolitan Planning Commission Water Conservation Program, Chatham County Department of Public Works, and the Georgia Water Wise Council.The purpose of this public education landscape is to demonstrate the seven principles of Xeriscape ™ and how they can reduce outdoor water use (Wade et. al., 1993). The landscape also showcases a number of water-saving devices and products available to consumers. The conceptual plan for the garden was done by a student in the School of Environmental Design at The University of Georgia.

The garden was officially dedicated in March 2000. A self-guided tour map, showing the garden design and plant list, is available at the garden entrance. Signage throughout the garden explains Xeriscape™ and discusses various water-saving techniques and devices exhibited throughout the garden.

The landscape occupies 6,080 square feet (approx. 0.14 acres). This includes 415 square feet of turfgrass, 4,479 square feet of tree/shrub bed, 166 square feet of flower beds, and 1,020 square feet of paved walkways. Of the total landscaped areas, 2,820 square feet are irrigated, while 2,240 sq. ft. are not irrigated.

The irrigation system has three zones, and the amount of water applied to each zone is monitored with gauges. Sprinkler irrigation is used on the turf area, while drip irrigation is used on the shrub and tree areas. The drip irrigation system has seventy-six drip emitters, each with an application rate of 1 gallon per hour.

Once the garden was planted, it was watered routinely during the 3-month establishment period. Then, from July 2000 to December 2004, rainfall and irrigation data were recorded.

RESULTS AND DISCUSSION

Table 1 shows monthly rainfall from July 2000 through December 2004. During 2001, the first full year of data, over 36 inches of rainfall were recorded. During 2002, 59.03 inches of rain fell, while 44.81 inches of rain were recorded in 2003, and 52.90 inches in 2004. Table 2 shows the rainfall amount, in gallons, that fell on the irrigated area of the garden each month. The reason this amount is based only on the irrigated area and not the total landscaped area is so comparisons can be made of projected water needs, rainfall amount, and actual irrigation applied.

Table 1. Rainfall data (inches) by month[z] from July, 2000 to December, 2004

Year	Jan	Feb	Mar	Apr	May	June	July[y]	Aug	Sept	Oct	Nov	Dec	Year Totals
2000							2.00	2.80	7.00	2.60	2.30	0.10	16.80
2001	1.66	1.00	6.70	0.80	1.30	11.35	3.90	2.55	6.20	0.05	0.06	0.65	36.22
2002	2.35	1.45	6.85	0.60	1.85	17.35	6.95	4.46	4.11	5.33	3.31	4.42	59.03
2003	0.41	3.65	7.95	5.95	3.44	4.29	10.03	2.55	1.87	2.32	0.92	1.43	44.81
2004	1.80	4.80	0.80	2.80	2.95	12.85	4.45	5.10	8.55	4.25	1.55	3.00	52.90

[z] Data obtained from the Georgia Automated Environmental Monitoring Netwok. A weather station is located on the property.
[y] Garden established in Jan., 2000. Plants were watered routinely during establishment. Data collection began on July 1, 2000

Table 2. Rainfall (gallons) by month on irrigated area (2,820 sq. ft.) [z] of the water-wise landscape

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Year Totals
2000							3,553	4,975	12,436	4,619	4,086	178	29,847
2001	2,94 9	1,777	11,903	1,421	2,310	20,164	6,929	4,530	11,015	89	107	1,155	64,349
2002	4,175	2,576	12,170	1,066	3,286	30,824	12,347	7,924	7,302	9,469	5,811	7,853	104,873
2003	728	6,485	14,124	10,570	6,122	7,622	17,819	4,530	3,322	4,122	1,635	2,541	79,610
2004	3,198	8,528	1,421	4,974	5,241	22,829	7,906	9,061	15,190	7,511	2,754	5,330	93,983

[z] The turf area (415 sq. ft.) + flower beds (166 sq. ft.) + ½ of the tree/shrub area (2,239 sq. ft.) are irrigated.;
415 + 166 + 2,239 = 2,820 sq. ft. 1-in of rain = 630 gal/1,000 sq. ft

The only areas of the landscape considered high water-use zones (watered routinely) are the annual flower beds. The turf area (415 sq. ft.) and half of the tree/shrub area (2240 sq. ft.) are considered moderate water-use zones (watered on-demand when plants showed symptoms of moisture stress). The remaining half of the tree/shrub area was treated as a low water-use zone (provided no supplemental irrigation).

Assumptions and Estimates of Water Requirements

Figure 1 shows assumptions and calculations of water requirements of the irrigated areas of the landscape. The calcu-lations were based on an application rate of 1 inch of water (630 gallons/1000 sq. ft.). This 1-inch volumetric assumption comes from published Extension literature which states that turfgrasses generally require 1-inch of water per week during the growing season (March - October) for optimum growth (Landry, 2000). We further assumed that moderate water-use zone would be watered at 1/2 the rate of the high water-use zone (2 times per month instead of 4 times) during the growing season. Furthermore, we assumed that the water requirements of the high water-use zones would be reduced by half (1-inch, 2 times/ month) during the winter months (November to February). The moderate water-use zones would receive no supplemental irrigation during the winter months.

Using these assumptions, the irrigated areas of the landscape are estimated to require 30,932 gallons of water (rainfall or irrigation) during a 12-month period (Jan. - Dec.). This is equivalent to 10,969 gallons per 1,000 sq. ft. per year.

Table 3 shows the monthly surplus or deficit of rainfall on the irrigated portion of the landscape, based on our estimate of the water needs of the irrigated areas. In 2001, the landscape received more water via rainfall than it was projected to need during 8 months. In 2002, there was a surplus of rainfall during 10 months. Similarly, in both 2003 and 2004, the landscape received more rain than it was estimated to need during 11 months. Summer rains are frequent in the coastal area. The rains reduce the need for supplemental irrigation during what is typically the hottest time of year. However, as one might expect, rainfall was not equally distributed throughout the year, and supplemental irrigation was occasionally needed.

Figure 1. Estimating water requirement of the irrigated areas.

166 sq. ft. = High Water Use (flower beds)
2,654 sq. ft. = Moderate Water Use (turf areas + ½ of the tree and shrub area)
2,240 sq. ft. = Low Water Use (approx. ½ of the tree and shrub area)

Assumptions : **High Water Use Zone** = 1 inch of water (630 gal/1,000 sq. ft.) 4 times/mo from March to October, then 2 times/month from November to February
March to October: 630 gal./1,000 sq. ft. x 4 times/month = **2,520 gal./1,000 sq. ft./month**
November to February: 630 gal./1,000 sq. ft. x 2 times/month = **1,260 gal./1,000 sq. ft./month**

Moderate Water Use = 1 inch of water (600 gal/1,000 sq. ft.) 2 times/ mo. from March to Oct + No Irrigation from Nov. to Feb.= 1,200 gal/1,000 sq. ft./mo.

Low Water Use = No Supplemental Irrigation

Calculations: **High Water-use Zones:**

$\frac{2{,}520 \text{ gal}}{1{,}000 \text{ sq. ft.}} = \frac{X}{166 \text{ sq. ft}}$ X = **418 gal./mo**. (March to October)

$\frac{1{,}260 \text{ gal.}}{1{,}000 \text{ sq. ft.}} = \frac{X}{166 \text{ sq. ft.}}$ X = **209 gal./mo.** (November to February)

Moderate Water-use Zones:

$\frac{1{,}260 \text{ gal.}}{1{,}000 \text{ sq. ft.}} = \frac{X}{2{,}654 \text{ sq. ft.}}$ X = **3,344 gal./mo**. (March to October)

Projected Requirement on the Irrigated area:
March to October: = 418 gal + 3,344 gal = **3,762 gal/mo**. x 8 mos. = **30,096 gal.**
November to February = **209 gal/mo**. x 4 mos. = **836 gal**.

Total Projected Requirement: 30.096 + 836 = **30,932 gal./yr.**

Annual Water Requirement/ 1000 sq. ft. of irrigated area/yr:
$\frac{30{,}932 \text{ gal.}}{2{,}820 \text{ sq. ft.}} = \frac{X}{1{,}000 \text{ sq. ft.}}$ X = **10,969 gal./1,000 sq. ft./yr.**

Table 3. Rainfall vs. projected water needs (gallons) on irrigated area (2,820 sq. ft.) [z]

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2000							-209	+1213	+8674	+857	+3877	-31
2001	+2740	+1568	+8141	-2341	-1452	+16402	+3167	+741	+7253	-3673	-102	+946
2002	+3966	+2367	+8408	-2696	-476	+27062	+8585	+4162	+3540	+5707	+5881	+7664
2003	+519	+6276	+10362	+6808	+2350	+3860	+14057	+768	-440	+360	+1462	2332
2004	+2989	+8319	-2341	+1212	+1479	+19067	+4144	+5297	+11428	+3789	+2545	+5121

[z] Calculated water requirement: Mar. - Oct. = 3,762 gal/month; Nov. - Feb = 209 gal./month (Fig. 1).
[y] + = surplus, - = deficit
Example calculation: July, 2000 (Table 1): 3,553 gal. (actual rainfall) - 3,762 gal.(estimated requirement, Fig. 1) = 209 gal. deficit

Table 4 shows the actual amount of irrigation water applied to the garden each month. No supplemental irrigation was applied during 5 months in 2001, during 10 months in 2002, and during 7 months of both 2003 and 2004.

Table 4. Supplemental irrigation (gallons) applied to the irrigated areas of the landscape by month from July, 2000 to December, 2004

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
2000							0	161	24	0	304	138	793
2001	0	0	249	1,038	380	0	401	152	0	608	0	380	3,208
2002	0	0	0	1,748	462	0	0	0	0	0	0	0	2,210
2003	0	0	0	0	462	840	1,594	0	1,047	2,002	0	0	5,945
2004	0	0	3,311	1,074	1,356	261	1,827	0	0	0	0	0	7,829

CONCLUSIONS

It is not our intent to deprive the garden of water just to see how little water we can use, but rather to use water efficiently and effectively. Our goal is to maintain an attractive landscape having year-round seasonal interest and a low requirement for supplemental irrigation. Visitors to the garden say we have accomplished this goal.

We paid special attention to the selection of regionally adapted plants and plants having exceptional tolerance to hot, dry conditions sometimes experienced in the area. We also grouped plants in the landscape according to their water requirements so we could make most efficient use of supplemental irrigation, and we made subtle changes in topography which influence water availability, such as putting canna lilies and iris (two plants that like moisture) in low spots to take advantage of the natural drainage of the site.

As you can see from Table 4, we provided only a fraction of the annual water needs of the irrigated area through supplemental irrigation. The rest was provided by Mother Nature. It is not uncommon for a traditional landscape of equivalent size to receive 10 to 15 times more irrigation than we applied to this landscape.

This study proves that significant amounts of water can be saved by designing a landscape according to Xeriscape™ principles, by understanding the water needs of plants, by grouping plants according to their water need, and modifying the irrigation schedule with changes in rainfall patterns.

IMPLICATIONS

Water purveyors could use a model similar to that presented in this paper to forecast water requirements of landscapes and to allocate water according to property size and histo-rical rainfall data. Then, economic incentives could be im-posed to encourage water conservation. Surcharges, al-though viewed by some as negative incentives, would encourage customers to adopt Xeriscape™ principles. Revenue generated from surcharges could be used for public education. Water allocation forecasting, combined with economic incentives and disincentives, done in concert with public education, are crucial and equally important solutions to the water conservation equation.

ACKNOWLEDGEMENT

Appreciation is expressed to Kathy Deloe, Horticulturist at the Bamboo Farm and Coastal Gardens, for her assistance in data collection and maintenance of the demonstration garden.

LITERATURE CITED

Landry, G. Lawns in Georgia. 2000. Georgia Cooperative Extension Service Bulletin 733. http://pubs.caes.uga.edu/caespubs/pubcd/b773-w.html#Maintenance

Wade, G. L., J. T. Midcap, K. D. Coder, G. Landry, A. W. Tyson, and E. N. Weatherly 1993. Xeriscape: A Guide to Developing a Water-wise Landscape. Georgia Cooperative Extension Service Bulletin 1073. http://pubs.caes.uga.edu/caespubs/pubcd/B1073.htm