

Report for 2002AZ6B: Evaluating the Irrigation Efficiencies and Turf/Landscape Maintenance Practices on the Campus of Northern Arizona University

- Conference Proceedings:
 - Roanhorse, Abigail S.; Slack, Donald; and Waller, Peter. September 2002, Summary of Northern Arizona Universitys Reclaimed Water Feasibility Study in Arizona Hydrological Societys Annual Symposium, Flagstaff, Arizona
 - Roanhorse, Abigail S.; Slack, Donald; and Waller, Peter September 2001, Northern Arizona Universitys Reclaimed Water Feasibility Study in Arizona Hydrological Societys Annual Symposium, Tucson, Arizona
- Dissertations:
 - Roanhorse, Abigail S. July 2002, NAU Reclaimed Water Feasibility Study Final Report, Master of Engineering Project, Department of Agricultural and Biosystems Engineering, University of Arizona, Tucson, AZ, 83 pages.

Report Follows:

A. Problem and Research Objectives:

Water shortages are developing in many northern Arizona cities and towns as water demand resulting from population growth and expanded tourism approaches and/or exceeds the area's finite supplies of water. An issue of critical concern in the region is the growing volume of water consumed in turf and landscape irrigation as the number of residences, businesses, parks and golf resorts increase. Northern Arizona University (NAU) is Flagstaff's largest consumer of potable water. With the exception of one athletic field, the University is dependent on potable ground water for irrigation. The project completed an irrigation system efficiency evaluation of NAU's, identified system deficiencies (i.e., poor design vs. system management), and recommended possible solutions. The study concluded the optimization of NAU's existing irrigation system would conserve an estimated 35.4 million gallons of potable water per year or \$93,102 per year.

There has been a growing demand for sound, science-based information on turf and landscape irrigation from county and city governments, water suppliers, landscape managers and concerned citizens. While there has been considerable emphasis placed on developing information pertaining to proper turf and landscape irrigation management in the desert areas of Arizona, considerably less attention has been paid to these same issues in northern Arizona. Much of the existing landscape irrigation information available for higher elevation arid and semiarid regions has not been summarized for use in Arizona. The project worked closely with the NAU grounds personnel to share information and increase awareness of more efficient water use practices. The project provided landscape maintenance/grounds personnel with environmental evaluations (i.e., soil and plant characteristics) and recommendations for optimizing irrigation maintenance practices and scheduling. Finally, this effort encouraged natural resource sustainability and water conservation from the City of Flagstaff's major water consumer, increasing water research opportunities in northern Arizona.

B. Methodology: The irrigation system evaluations included irrigation audits and double ring infiltrometer tests. Together these tests quantified the amount of water applied versus the amount of water infiltrated into the soil. The UA's Pima County Cooperative Extension Low 4 Program provided the project irrigation audit kits to evaluate the irrigation uniformity and efficiency of the existing system. Irrigation audits, also known as catch can tests, were performed to determine the irrigation or distribution uniformity, efficiency, irrigation depth, and system condition. The information recorded included:

- Number of sprinklers per station
- Irrigation times/duration
- Irrigation frequency (i.e., how many times per week)
- Sprinkler types
- Observed problems

The irrigation audits reported numerous design and system maintenance deficiencies (i.e., valve malfunctions, low pressure, high pressure, tilted sprinkler heads, spray deflections, sunken sprinklers, plugged equipment, arch misalignment, low sprinkler drainage, leaky

seal or fittings, lateral or drip line leaks, missing or broken heads, slow drainage or ponding, soil compaction, thatch, runoff). A summary of the system deficiencies per field is provided below (Table 1). The irrigation audits reported clay and clay loam soils. These type of soils have an infiltration rate of 0.20 in/hour¹ with irrigation times ranging from 10-21 minutes. The precipitation rates ranged from 0.57-0.82 in/hour, resulting in runoff and poor rooting depths (2"-3"). To reduce runoff the project recommends reducing runtimes and implementing "cycle and soak" irrigation practices. This will increase infiltration depths, rooting depths, and reduce runoff.

Table 1
Summary of NAU System Deficiencies

System Info/Problems	Hilltop	Lmbrjack	Quad	Gabalton	Observ.	Nadat.	South
Rooting depth (in.)	3	3	3	3	3	3	3
Soil Type	clay	clay-loam	clay	clay-loam	clay-loam	clay-loam	clay-loam
No. of catch cans	45	56	56	56	45	91	76
Run times (minutes)	21 ^a	Varied	17-18	10	10 ^a	15	15
Pressure (psi)	45-60	45-50	20-40	40-55	35-60	45-70	35-55
Pressure Varies = 20%							
Times/week	6	6	6	6	6	6	6
DU	0.56	0.48	0.20	0.52	0.40	0.32	0.38
Precipitation rate (in/hr)	0.68	0.57	0.92	0.82	0.84	0.70	0.82
Infiltration rate (in/hr) ^b	0.22	0.80	0.20	0.53	0.41	0.34	0.25
Sprinkler type	I-40	I-40	Mixed	Mixed	Mixed	Mixed	Mixed
Valve malfunctions	-	-	-	-	-	Station 10	
Pressure (Lo/Hi)	Low	-	Both	Low	Low	Low	Low
Tilted sprinklers	4	1	3	1	1	3	2
Spray deflection	1	-	2	-	3	4	4
Sunken sprinklers	-	-	1	-	-	-	1
Plugged equip.	-	1	-	-	-	-	8
Arc misalignment	3	8	3	2	5	4	-
Low drainage	1	-	-	-	1	-	-
Leaking seals/fittings	-	-	2	1	1	-	-
Line leaks	-	-	-	-	-	Yes	-
Missing/broken heads	-	1	22	1	-	3	-
Ponding	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Compaction	Yes	-	Yes	-	-	-	-
Thatch	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Runoff	-	-	Yes	-	-	-	-
Sticking heads	-	1	Yes	-	-	4	5
Broken lines	-	-	Sta 11	-	-	-	-
A – Irrigation times and frequencies have been adjusted to 10 minutes, twice a week.							
B – Calculated from double ring infiltrometer tests.							

C. Principal Findings and Significance:

The summer of 2002 was the second-driest summer in 108 years. The City of Flagstaff is primarily dependent on groundwater to meet the water demands of its residents. NAU is

¹ Shepersky, Keith. *Landscape Irrigation Design Manual*, Rainbird Sprinkler Corporation, 1994

the City's largest consumer of potable water. The Study estimated the Mountain Campus consumes 154 million gallons of potable water per year for irrigation purposes. This demand corresponds to the City's increased water demand during the summer months (April – October). The Study estimated the amount of water wasted at NAU due to poor system performance was 35 million gallons per year.

The ultimate benefit of this Study was that it increased awareness of turf and landscape water consumption and sustainability. This will assist in water conservation efforts throughout the drought stricken regions of northern Arizona. The Study has received statewide recognition, with 8 articles published in *Arizona Water Resource Newsletter*, *The Arizona Daily Sun*, and *The Lumberjack*. The Study's legacy will continue through the recently state-funded "Improved Turf and Landscape Irrigation Management for Northern Arizona." This 3-year project (July 2003-June 2006) will continue to provide education and outreach in turf and landscape irrigation by establishing a landscape irrigation demonstration project on the NAU campus. In addition, the project will hold annual landscape irrigation workshops in Flagstaff, Prescott and Payson. These workshops will train attendees in the areas of irrigation design and management, irrigation scheduling, evapotranspiration, soil and plant water relationships, reclaimed/gray water use, pesticide use and water quality, and xeriscaping.