SOUTHERN CALIFORNIA GOLF & WATER SUMMIT

August 18, 2022

Golf's Use of Water in the Southwest

Results from the GCSAA Golf Course Environmental Profile III - Water

Dr. J. Bryan Unruh
Extension Turfgrass Specialist
University of Florida/IFAS

Benchmark *noun*

bench·mark | ˈbench-ˌmärk

: a point of reference from which measurements may be made

https://www.merriam-webster.com/dictionary/benchmark

Golf Course Environmental Profile

- The Golf Course Environmental Profile (GCEP) survey series was first launched in 2006 to establish baseline data on issues ranging from land use to regulations and practices governing water use, nutrients, and pest control.
- A subsequent set of surveys (GCEP-2) were conducted starting in 2014 and provided scientifically valid measurements of industry change as it related to the five surveys:
  - Energy Use, Land Use Characteristics and Environmental Stewardship Programs, Pest Management Practices, Nutrient Use and Management, and Water Use and Conservation Practices.

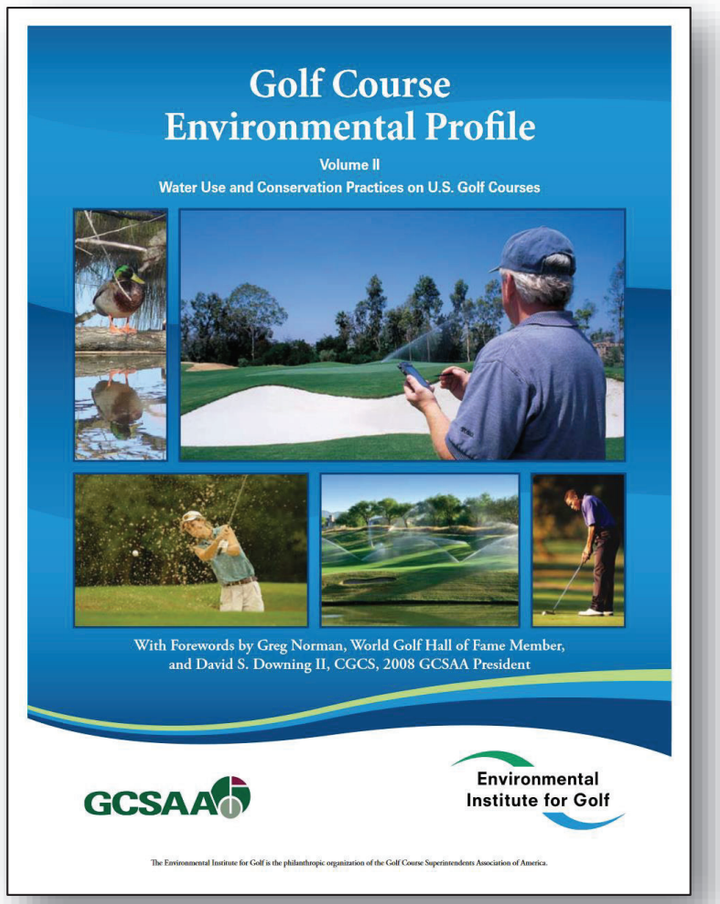
GCEP – Phase 3 Surveys

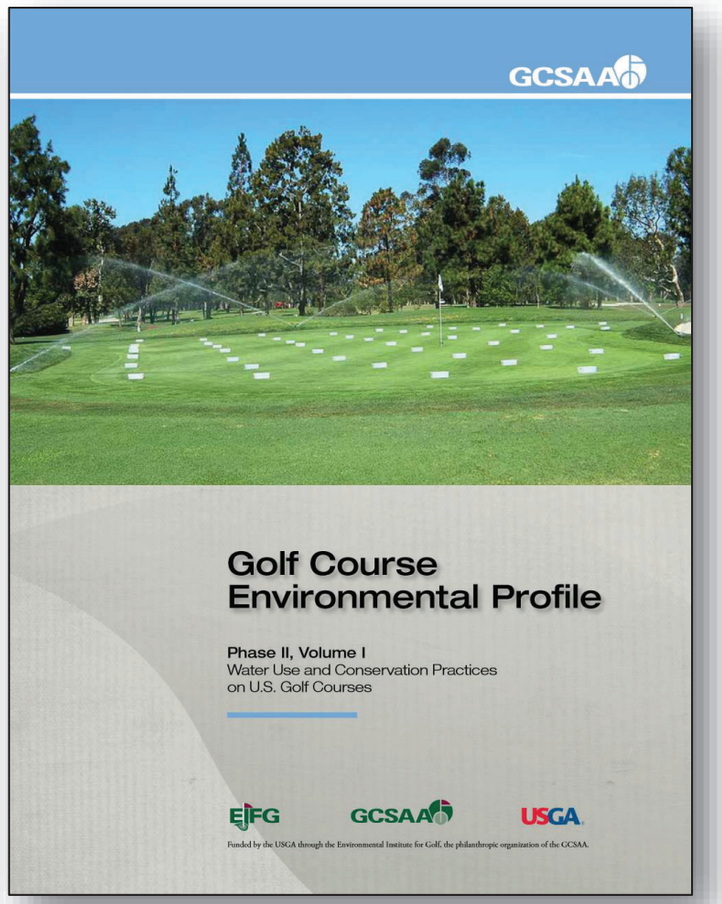
GCSAA staff worked closely with the scientists and NGF to bring the project to completion.

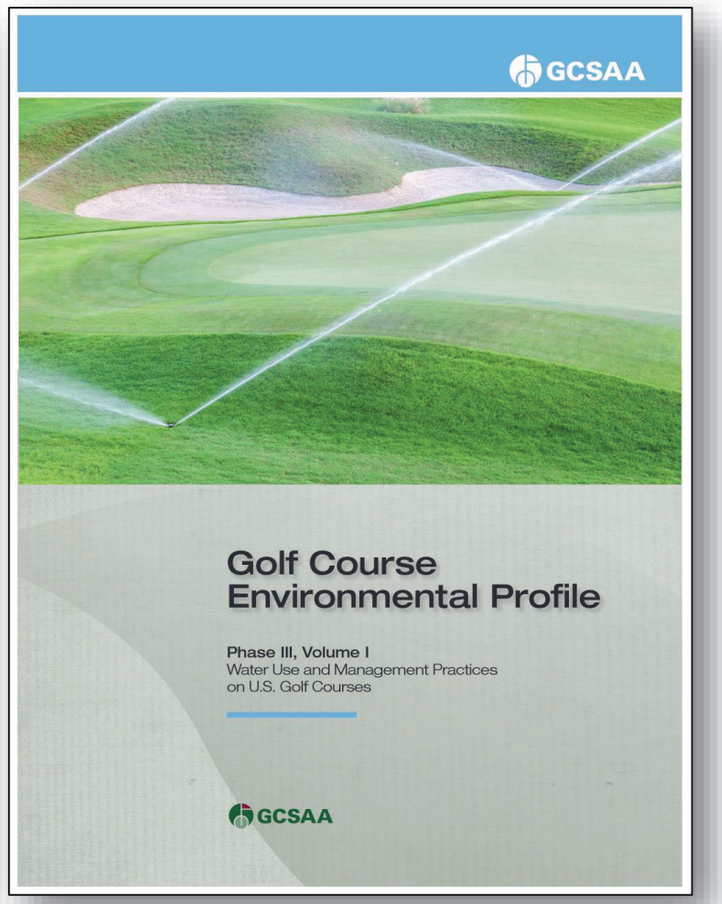
Provided oversight of the survey instrument programming, recruited and administered the survey, collated the data, and computed the projected water use data

Dr. Travis Shaddox, Bluegrass Art and Science, LLC
Dr. J. Bryan Unruh, University of Florida

Focused on the scientific aspects of the project including data analysis and interpretation and writing the peer-reviewed scientific journal article and the GCSAA publications.


Golf Course
Environmental Profile
Volume II
Water Use and Conservation Practices on U.S. Golf Courses
With Forewords by Greg Norman, World Golf Hall of Fame Member,
and David S. Downing II, CGCS, 2008 GCSAA President
GCSAA
Environmental
Institute for Golf
The Environmental Institute for Golf is the philanthropic organization of the Golf Course Superintendents Association of America.

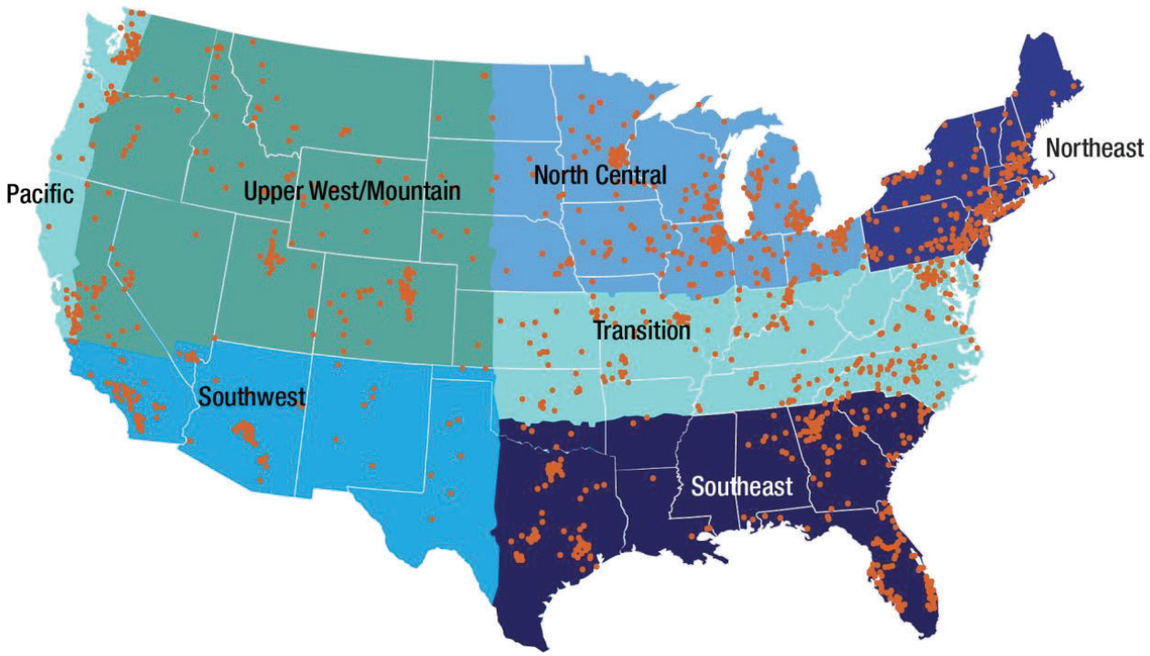

GCSAA
Golf Course
Environmental Profile
Phase II, Volume I
Water Use and Conservation Practices
on U.S. Golf Courses
EIFG
GCSAA
USGA
Funded by the USGA through the Environmental Institute for Golf, the philanthropic organization of the GCSAA.


GCSAA
Golf Course
Environmental Profile
Phase III, Volume I
Water Use and Management Practices
on U.S. Golf Courses
GCSAA

Survey Distribution and Response

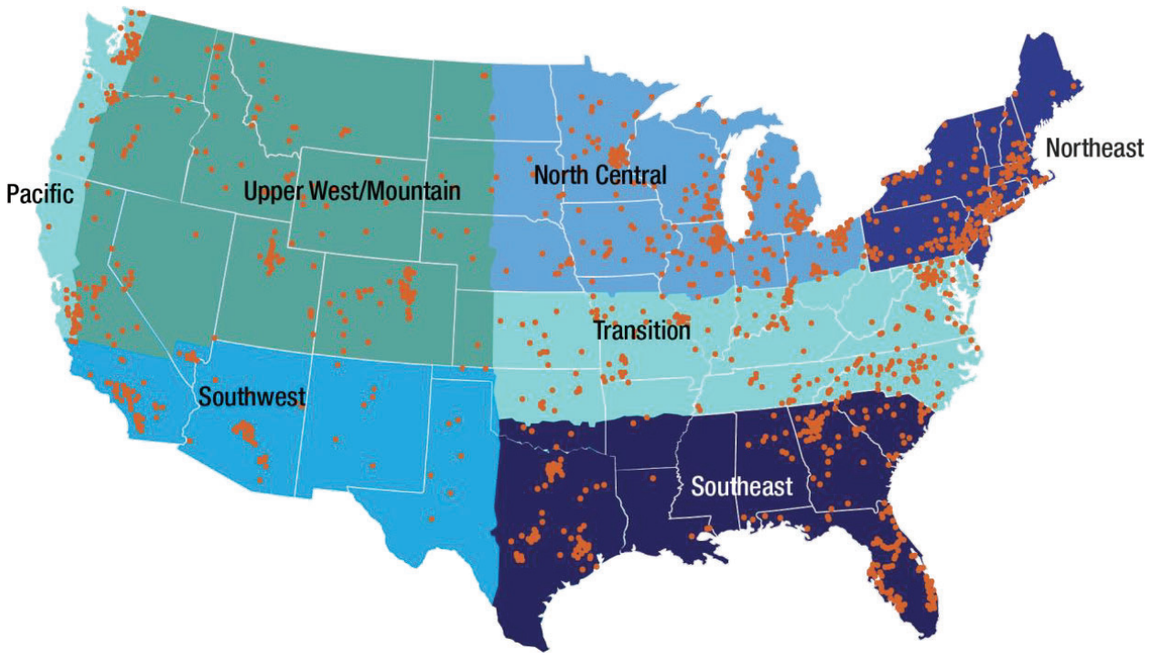
- Online survey was distributed by e-mail to the mailing lists of the NGF and the GCSAA – sent to 14,145 golf facilities.
  - A facility is defined as a business location where golf can be played on one or more golf courses.
- Each phase of the GCEP surveys target the same population, however, the respondents from 2006, 2014, and 2021 are not identical.
- Respondent names were omitted from the data file and each respondent received a unique identifying number, which provided anonymity within the data file and only one response was allowed per golf course.

Survey Distribution and Response



- For ease of comparison and to maintain consistency between surveys, respondents were classified by:
  - Agronomic regions
  - Facility type
    - daily fee, municipal, or private
  - Number of holes
    - 9, 18, or 27+
  - Greens fees
    - < $40, $40 - $70, > $70/round

Survey Distribution and Response



- Survey responses were received from 1,575 facilities representing 11.1% of the U.S. total.
  - By comparison, the response rates for the 2014 and 2006 survey were 12.7% and 15.2% respectively.
- There are 1,139 golf courses in the SW U.S. (8.1 % of U.S. facilities).
  - 127 surveys received (8.1% of surveys received).

Data Analysis

- Data were weighted to provide a valid representation of U.S. golf courses and were analyzed using appropriate statistical procedures.
- Projected water use and irrigated acres were determined by calculating the sum product of the regional water use means with the respective number of golf facilities in each region.
  - As a result, statistical separation of projected water use and irrigated acres was not conducted.

Applied Water Units – What do they mean?

- **Projected applied water** (national and regional) is the sum product of the average amount of water applied to a 9-, 18-, or 27+- hole facility using the known number of facilities within each region.
  - It is an estimate of the total volume of applied water.
- **Median applied water** is the median water applied to a golf facility regardless of the facility's irrigated acres.
  - It is the amount of water where half of golf facilities apply more, and half apply less.
- **Median applied water per acre** is the median water applied to a golf facility divided by the facility's irrigated acres.
  - It is an estimate of the efficient use of water and allows for a commensurable comparison of applied water across facilities, regions, etc.

Mean vs. Median

- Mean = sum of all values divided by the number of values.
- Median = midpoint of a frequency distribution

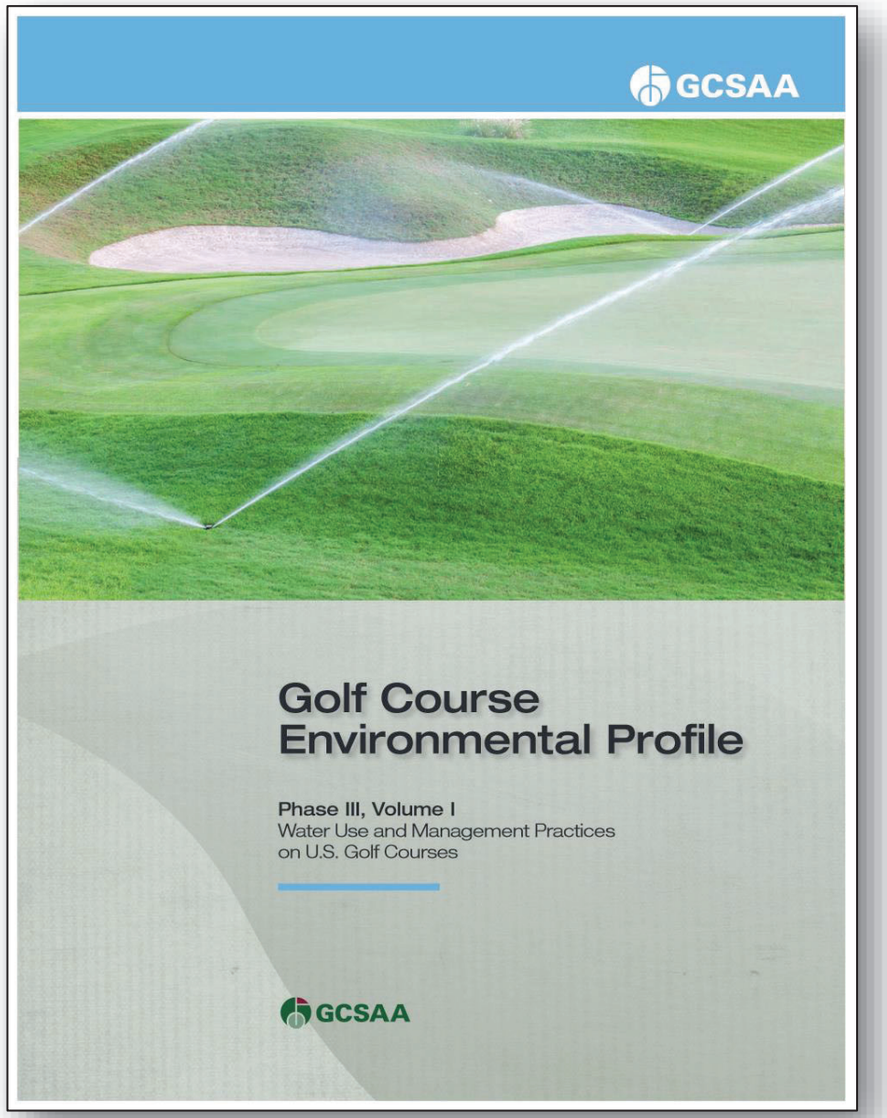
- The mean is more influenced by extremely high or low outliers than the median.
- The median is less influenced by extremely high or low outliers and is regularly used in survey sciences.

- The use of the median in this survey provides a greater probability of reporting the true value than using the mean.

Results

WHAT versus WHY

The survey tells us “what” but not “why”.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GCSAA

Projected Water Use on U.S. Golf Facilities

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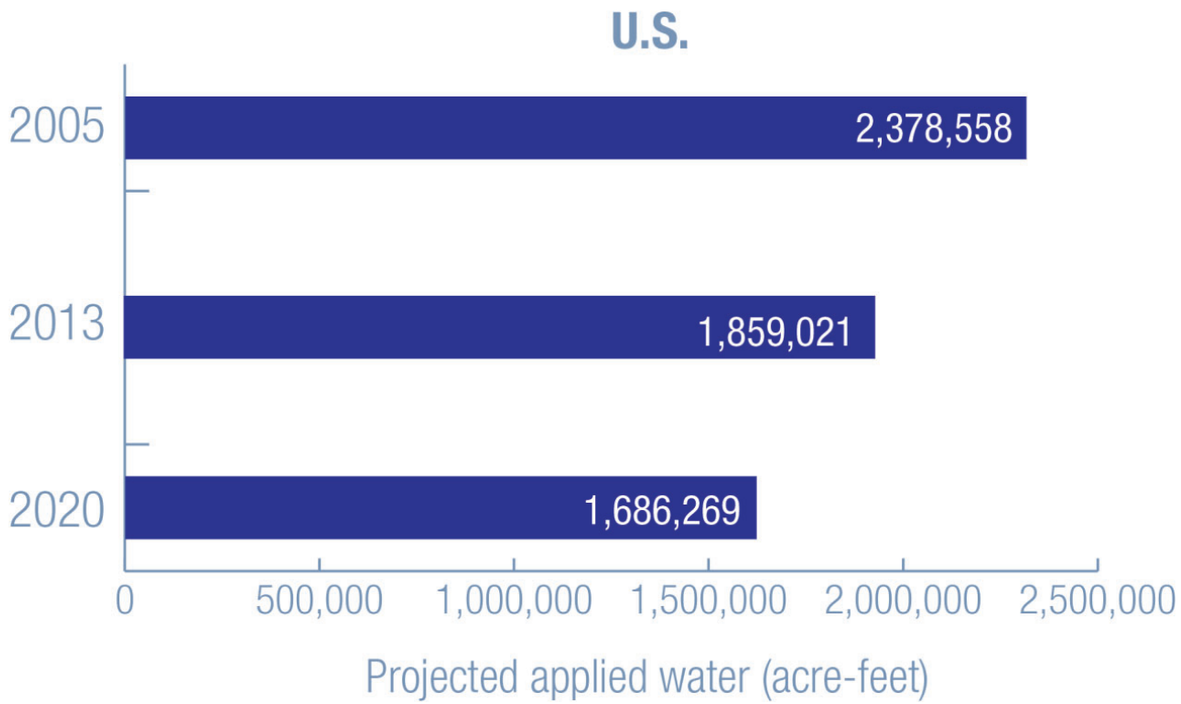
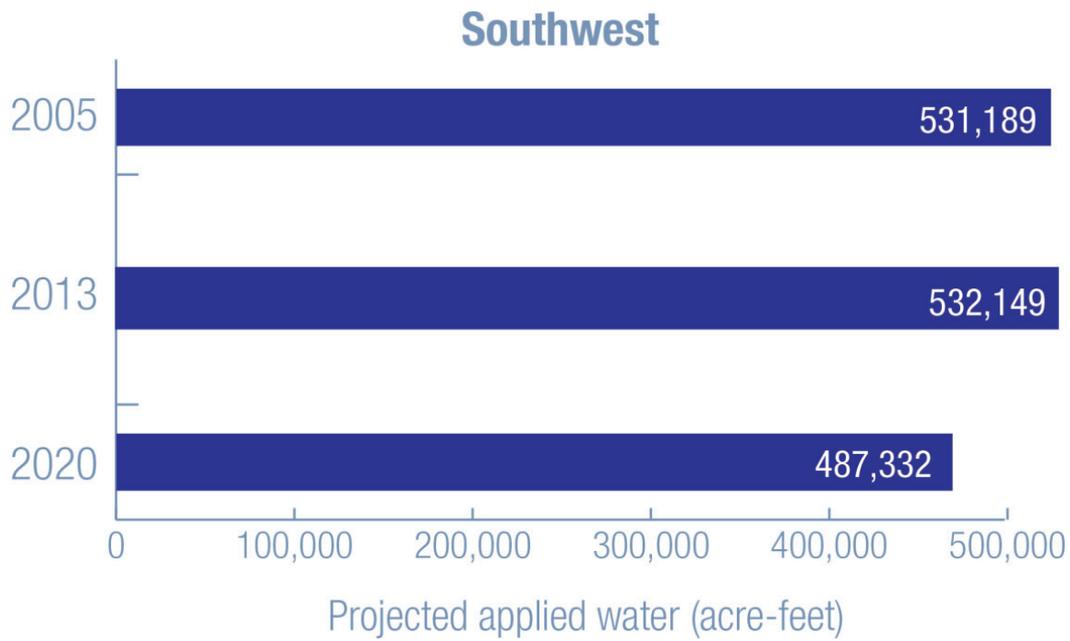


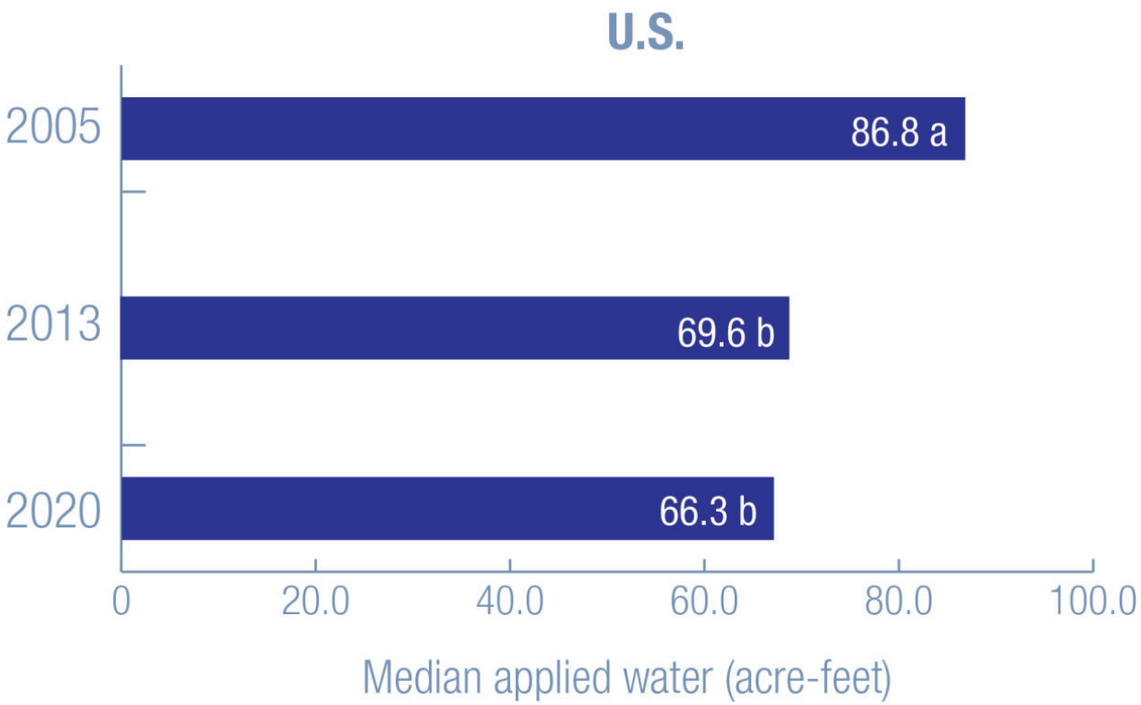
- A projected 1.68 million acre-feet of water was applied to U.S. golf facilities in 2020.
  - 9.3% reduction of applied water since 2013
  - 29.1% reduction since 2005

Projected Water Use on U.S. Golf Facilities in the Southwest



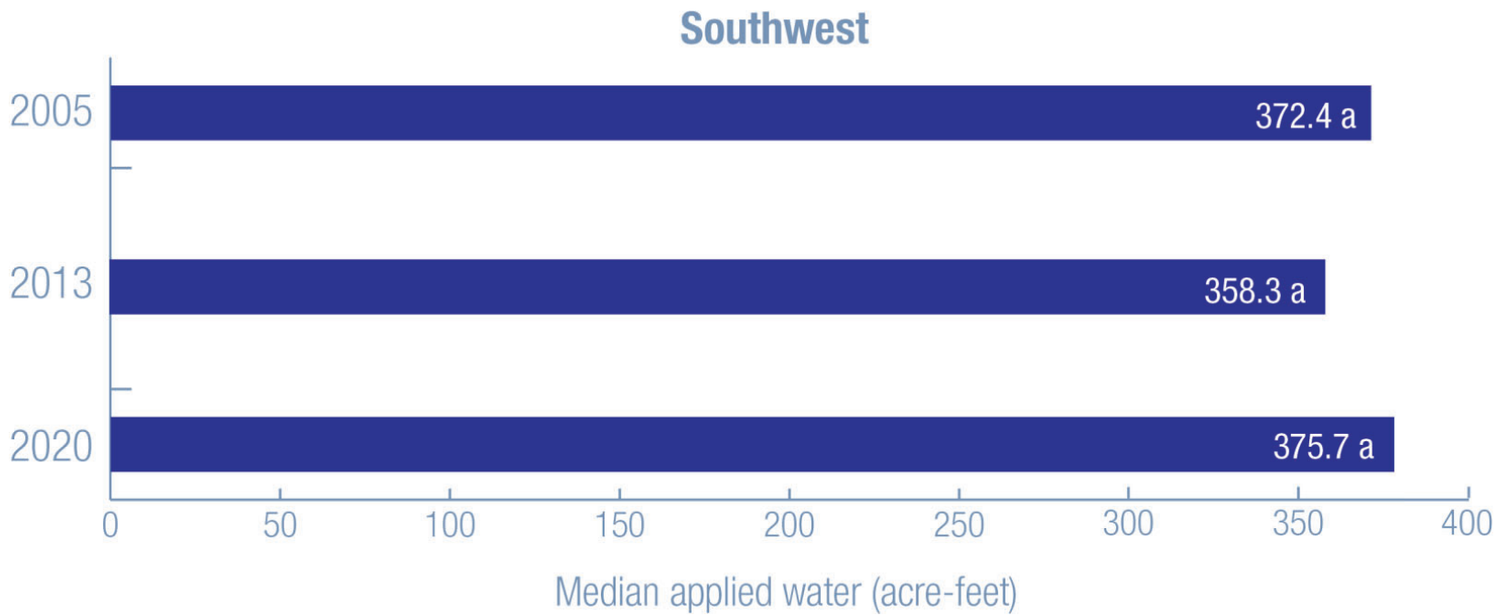
- Projected applied water was 8% less in 2020 than in 2005, resulting in a water savings of 43,857 acre-feet.

Median Applied Water on U.S. Golf Facilities



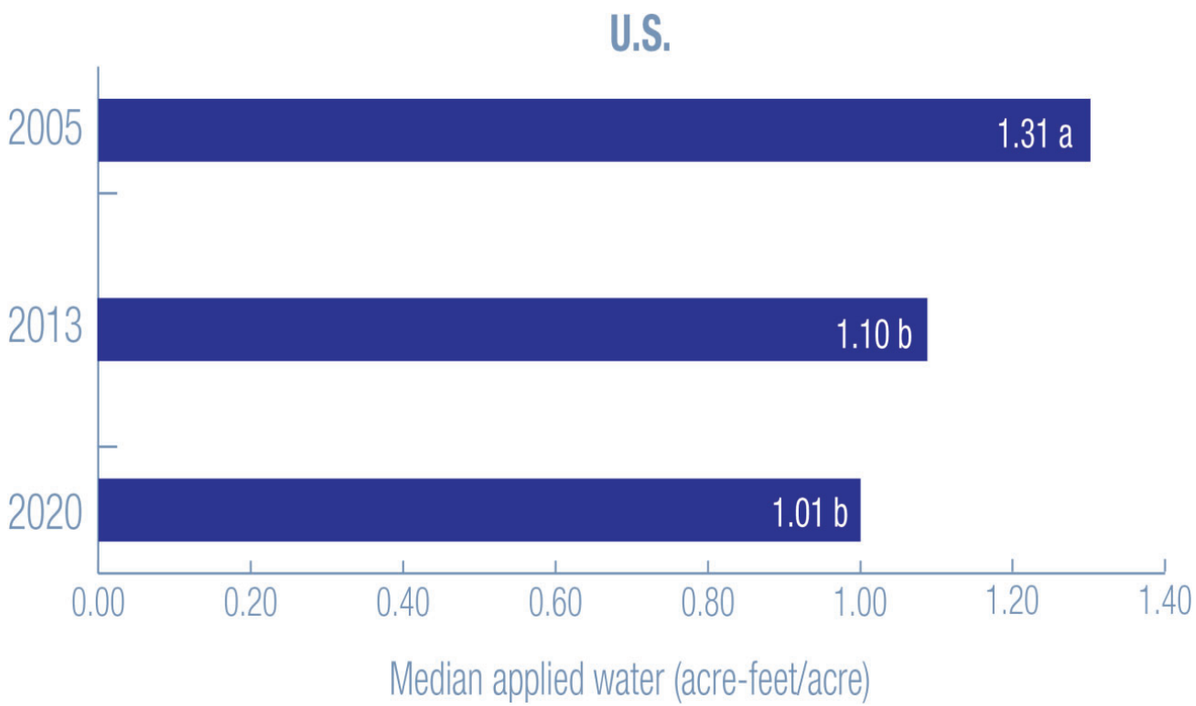
- Median applied water per U.S. golf facility in 2020 was 66.3 acre-feet, which was 23.6% less than that reported in 2005 and equivalent to 2013

Median Applied Water on U.S. Golf Facilities in the Southwest



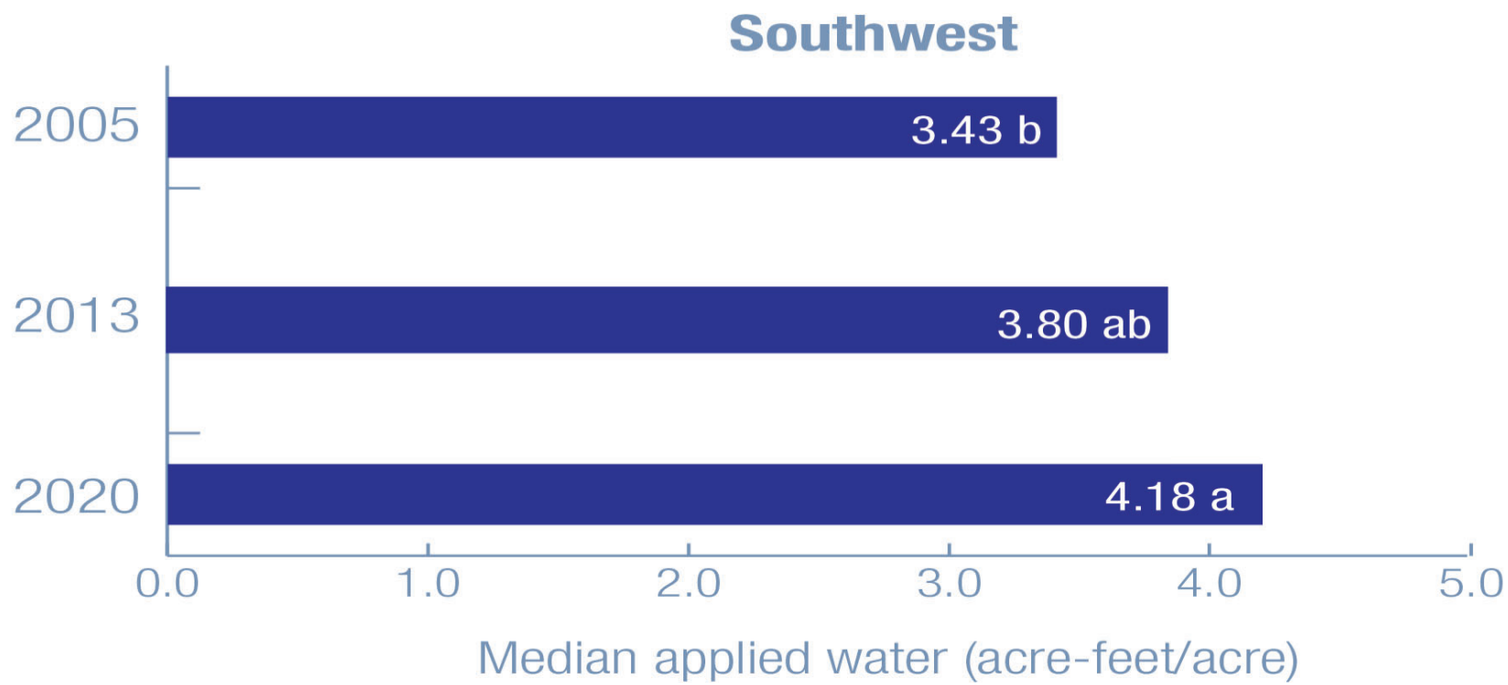
- Median applied water per facility was 375.7 acre-feet in 2020 and was equivalent to 2005.

Median acre-feet/acre Water Use on U.S. Golf Facilities



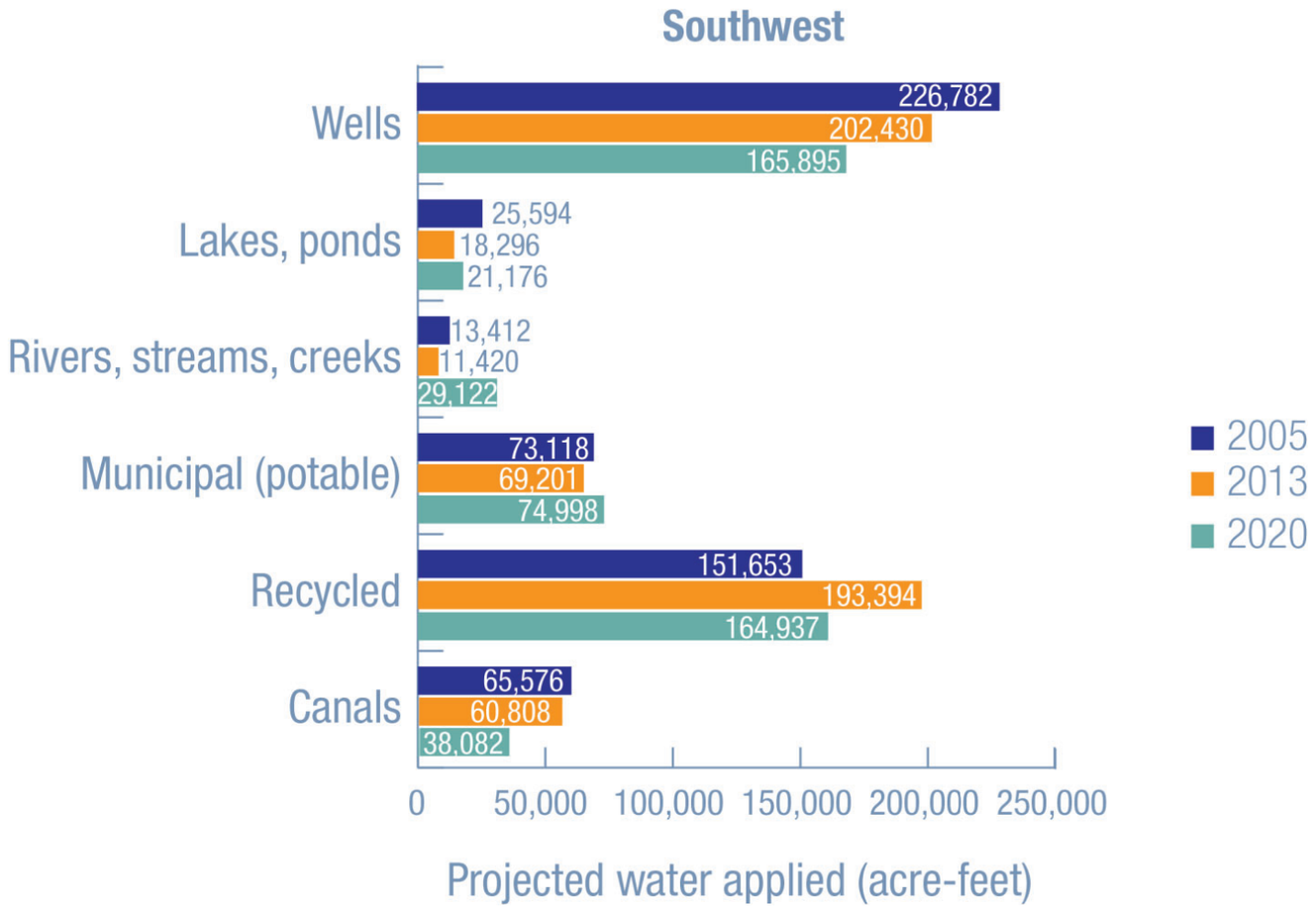
- Median acre-feet per acre of applied water per U.S. golf facility in 2020 was 1.01, which was 22.9% less than that reported in 2005.
- Similar to acre-feet, the acre-feet per acre was also similar to that reported in 2013.

Median acre-feet/acre Water Use on U.S. Golf Facilities



- Median applied water per acre increased from 3.43 in 2005 to 4.18 in 2020, a 22% increase.

Golf Course Irrigation Water Sources in the Southwest U.S.



- In 2020, 34% of projected applied water was sourced from wells and 15% was sourced from municipal water.
- In 2020, 33% of projected applied water was sourced from recycled water.

Recycled Water Use on Golf Facilities – U.S. vs. Southwest

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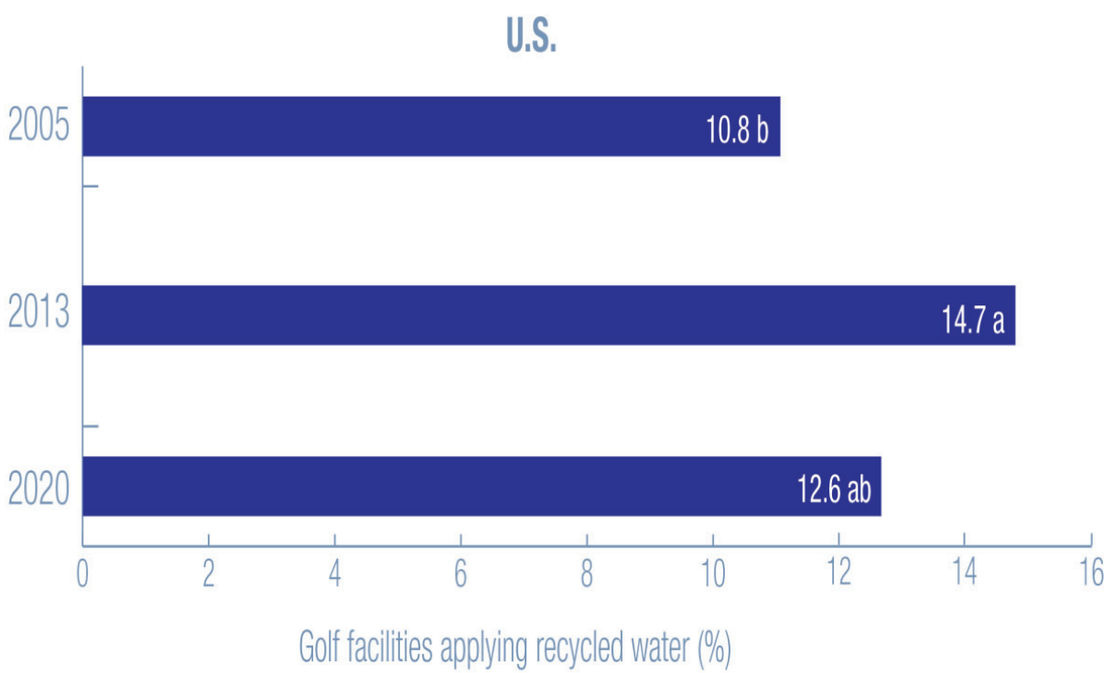

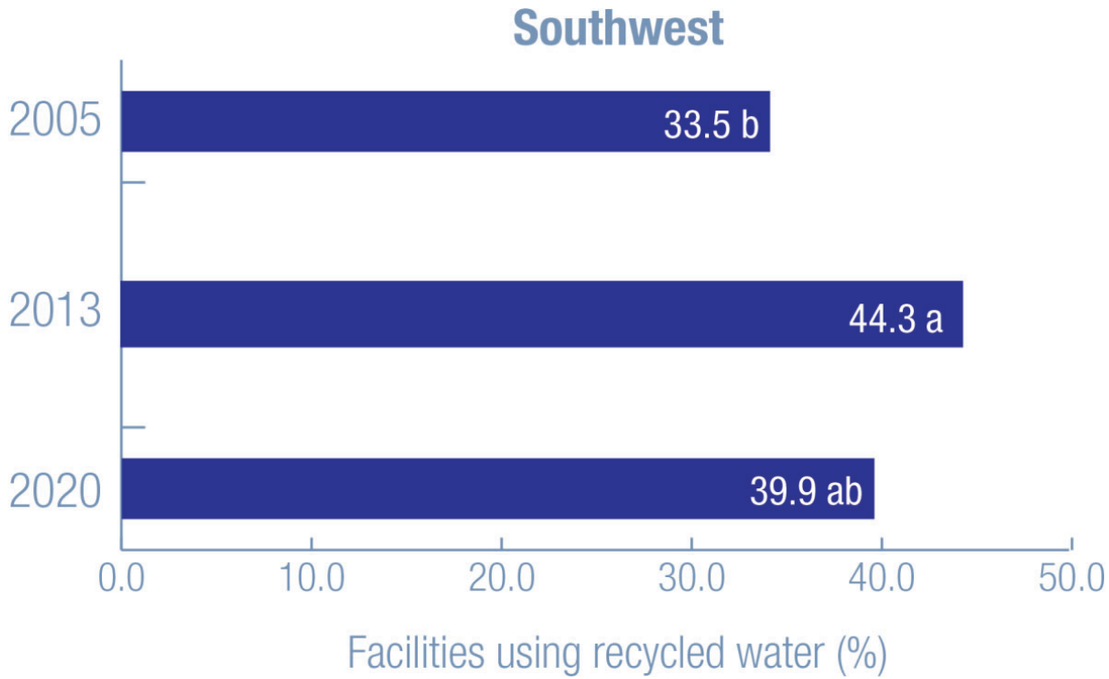

Recycled Water Use on U.S. Golf Facilities

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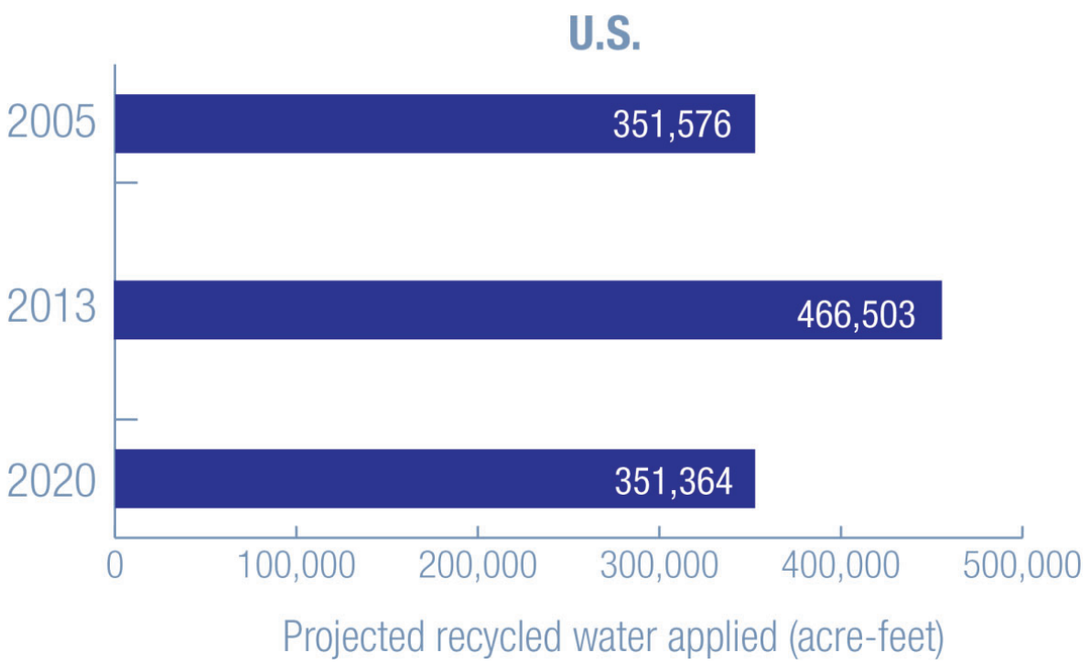
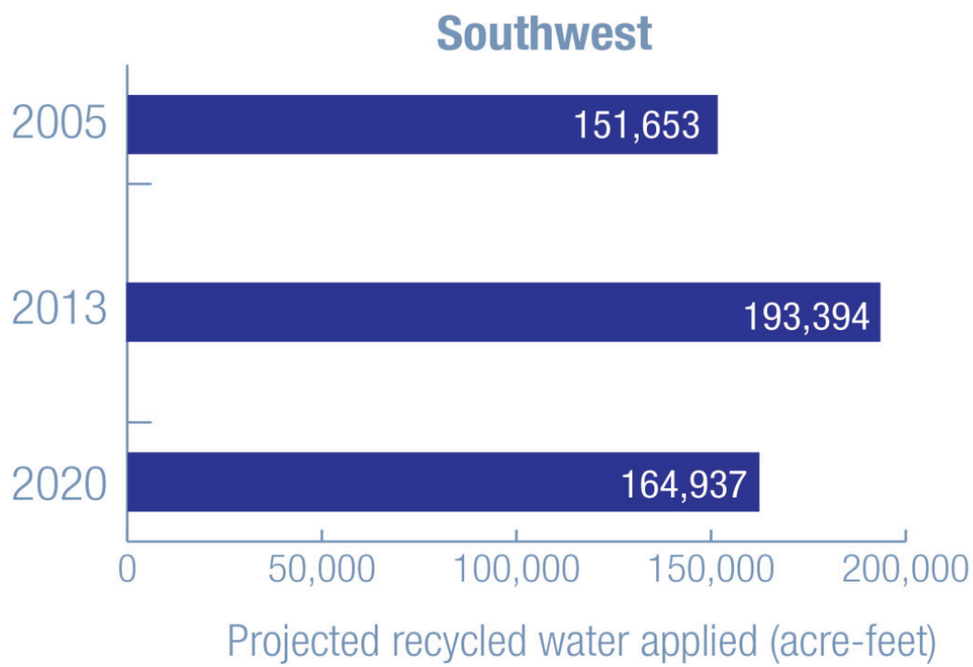
GOLF & WATER SUMMIT





Recycled Water Use on U.S. Golf Facilities

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	No Source	No Infrastructure	Cost	Poor Quality	Unnecessary	Other
	%					
U.S.	50.8	13.9	1.4	0.9	30.8	2.2
North Central	53.9	7.6	1.5	0.4	36.0	0.5
Northeast	57.9	13.7	0.5	0.2	26.6	1.0
Pacific	41.1	8.2	0.7	0.0	36.4	13.6
Southeast	48.5	12.6	5.0	4.7	27.0	2.2
Southwest	42.2	21.5	0.0	0.8	31.8	3.6
Transition	51.3	10.8	0.0	0.0	37.1	0.8
Upper West/Mountain	46.0	34.0	1.1	0.4	17.0	1.6

Table 6. Factors influencing the lack of effluent water use at U.S. golf facilities that did not use effluent water in 2020.

Projected Irrigated Acres of U.S. Golf Facilities in the Southwest

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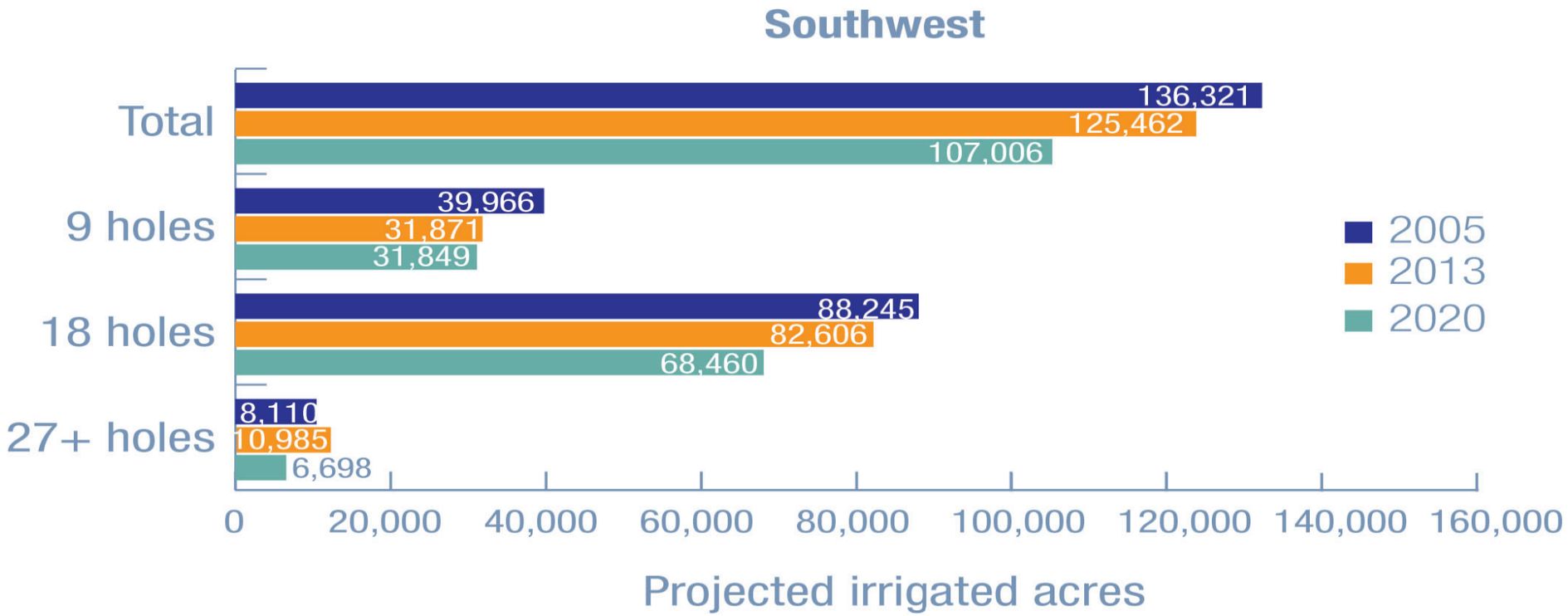

- Projected irrigated acres declined by 22% from 136,321 acres in 2005 to 107,006 acres in 2020.

Median Irrigated Acres on Golf Facilities – U.S. vs. Southwest

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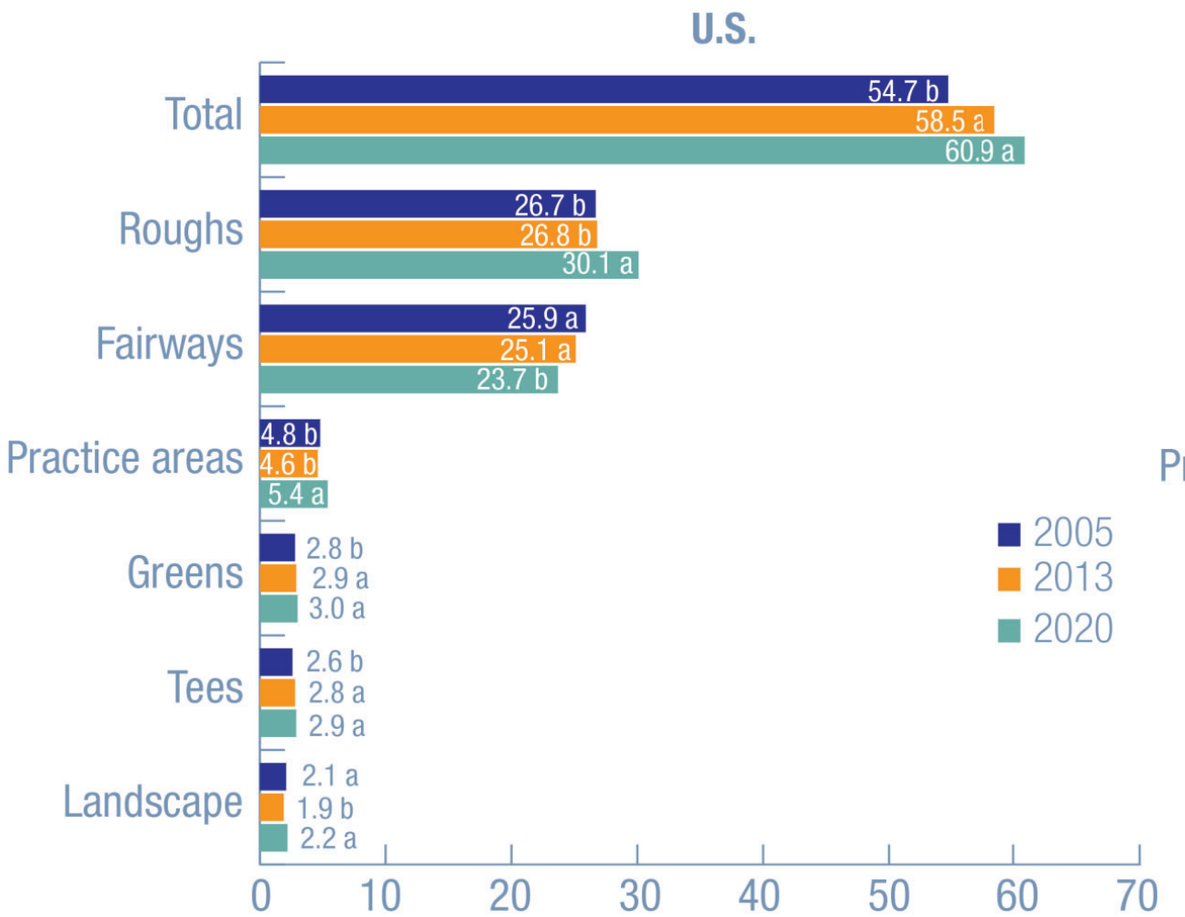

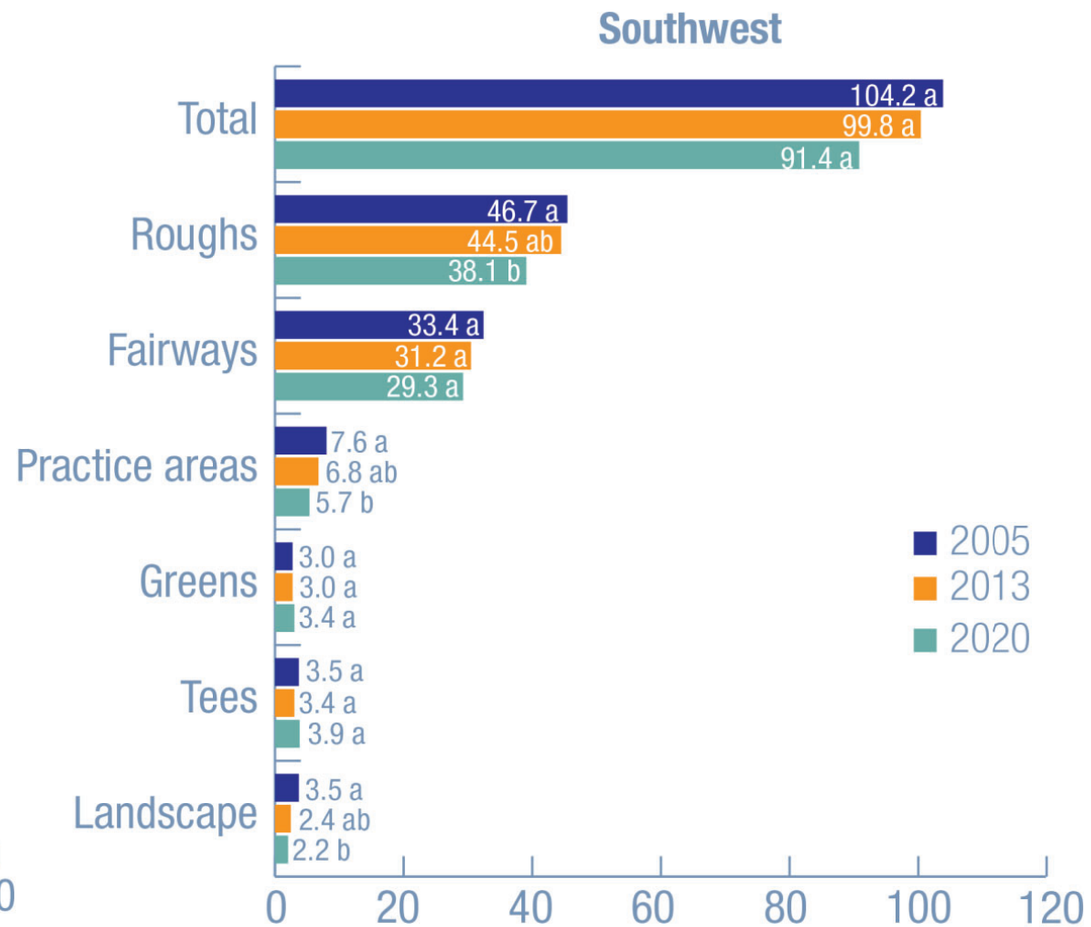

Median irrigated acres

Factors Motivating the Decision to Reduced Irrigated Acres at U.S. Golf Facilities

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	Water Cost	Regulations	Water Conservation	Water Availability	Drought	Environmental Stewardship
	%					
U.S.	20.7	5.6	61.3	19.8	22.4	10.9
North Central	21.7	0.6	51.9	15.8	8.9	16.0
Northeast	13.8	2.7	59.6	12.8	13.6	5.6
Pacific	34.2	7.7	66.3	21.4	42.4	17.8
Southeast	20.7	14.0	57.7	23.8	24.2	17.0
Southwest	35.4	15.7	58.7	15.0	36.7	4.0
Transition	20.3	1.0	61.1	7.6	11.4	10.1
Upper West/Mountain	9.3	1.8	80.4	42.8	37.1	6.0

Table 17. Factors motivating the decision to reduce irrigated acres at U.S. golf facilities in 2020.

Water Use Changes Due to Change in Golf Facilities

Region	2005	2013	2020	Δ2005-2020	Area	Applied Water	Δ2005-2020	
	U.S. golf facilities				acres	acre-feet	acres	acre-feet
North Central	4,127	3,925	3,592	-535	62.8	47.9	-33,616	-25,611
Northeast	2,746	2,677	2,482	-264	51.9	33.1	-13,711	-8,734
Pacific	655	638	571	-84	70.4	112.2	-5,914	-9,421
Southeast	3,250	3,046	2,766	-484	102.2	180.2	-49,488	-87,217
Southwest	1,224	1,201	1,139	-85	105.0	482.4	-8,921	-41,003
Transition	2,961	2,795	2,528	-433	73.6	59.7	-31,860	-25,869
Upper West/Mountain	1,089	1,104	1,067	-22	86.6	186.8	-1,904	-4,110
U.S.	16,052	15,386	14,145	-1,907	76.6	122.8	-146,113	-234,269

Table 9. U.S. golf facilities, acres and applied water as influenced by change in golf facilities from 2005 to 2020. The change in acres and acre-feet from 2005 to 2020 was determined by multiplying the change in facility number by the mean acres or acre-feet, respectively.

11.9% reduction

~ 33% reduction of applied water

Management Practices on U.S. Golf Courses in the Southwest

- The Southwest is the only region showing an increase in adoption of new irrigation controller technology.
- The Southwest has the greatest use of hand-held moisture sensors and the region with the most significant adoption of this technology.
- In the Southwest, 51% of Golf Course Superintendents indicated that they reduced irrigated acres.
- The Southwest is second only to the Pacific Region in the use of hand-watering.

Threat of Scarcity or Increasing Water Costs

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	Water Scarcity					Water Cost				
	No Concern ⟷ Major Concern					No Concern ⟷ Major Concern				
	%									
U.S.	48.9	17.4	17.4	8.7	7.5	58.2	14.1	15.3	7.1	5.3
North Central	64.4	18.7	12.1	3.5	1.4	67.8	16.7	10.8	3.9	0.8
Northeast	53.0	20.1	17.9	3.8	5.2	67.6	14.9	9.3	6.0	2.2
Pacific	50.7	6.1	21.5	6.0	15.8	37.7	7.2	40.2	7.0	7.9
Southeast	51.0	18.8	16.4	11.5	2.3	62.1	13.1	14.5	7.1	3.2
Southwest	17.4	16.2	26.3	17.4	22.7	20.9	7.7	22.7	24.0	24.6
Transition	55.7	21.3	19.0	3.4	0.6	69.4	12.5	12.1	4.2	1.9
Upper West/ Mountain	18.9	12.0	18.2	25.0	26.0	40.1	19.7	16.9	9.6	13.6

Note. Respondents rated threat on a 1-5 scale, where 1 = Nothing we really need to worry about at this time, and 5 = It is a major issue for our course.

Table 7. Threat of water scarcity or increasing water costs on U.S. golf facilities in 2020.

Water Applied (Acre-feet/Acre) by Course Size and Type

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	Golf course size			Golf course type	
	9 holes	18 holes	27+ holes	Public	Private
	acre-feet/acre				
2005	1.09 a	1.37 a	1.47 a	1.32 a	1.28 a
2013	0.83 b	1.15 b	1.40 a	1.11 b	1.08 b
2020	0.73 b	1.07 b	1.23 a	1.02 b	1.00 b

Within columns, medians followed by a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level
Table 10. Acre-feet of water applied per acre on 9-hole, 18-hole, 27+-hole, public and private golf facilities in 2005, 2013 and 2020.

- Both public and private facilities reported a reduction in applied water per acre since 2005 but applied equivalent water per acre since 2013.

Frequency of Water Use Restrictions

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	Not Receptive ⟷ Very Receptive				
	%				
U.S.	4.1	9.6	27.5	25.2	33.7
North Central	2.8	10.9	27.4	24.5	34.5
Northeast	4.7	10.4	28.8	15.8	40.3
Pacific	4.9	6.0	34.1	29.2	25.7
Southeast	2.6	7.5	29.0	26.7	34.3
Southwest	9.1	4.5	30.3	29.2	26.8
Transition	2.4	6.7	21.8	32.9	36.2
Upper West/Mountain	7.0	17.9	26.4	20.3	28.4

Note. Respondents rated golfer receptiveness on a 1-5 scale, where 1 = not receptive at all, and 5 = very receptive.

Table 18. Golfer receptiveness resulting from reduced water use and any perceived change in course appearance and playability among U.S. golf facilities that reported a reduction in water use in 2020.

Water Use Treatments on U.S. Golf Facilities

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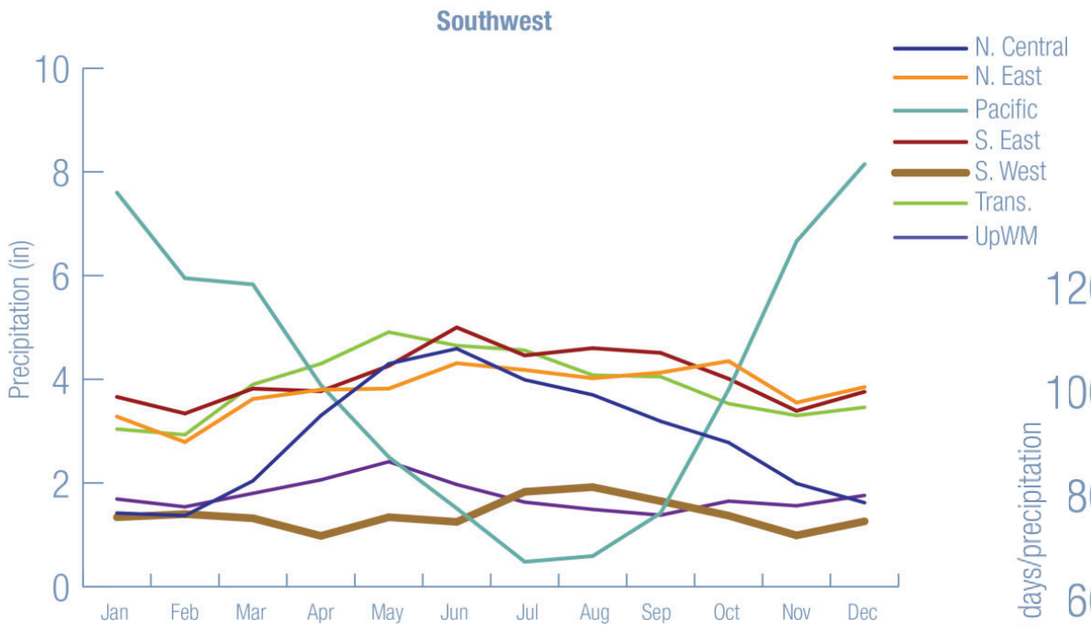
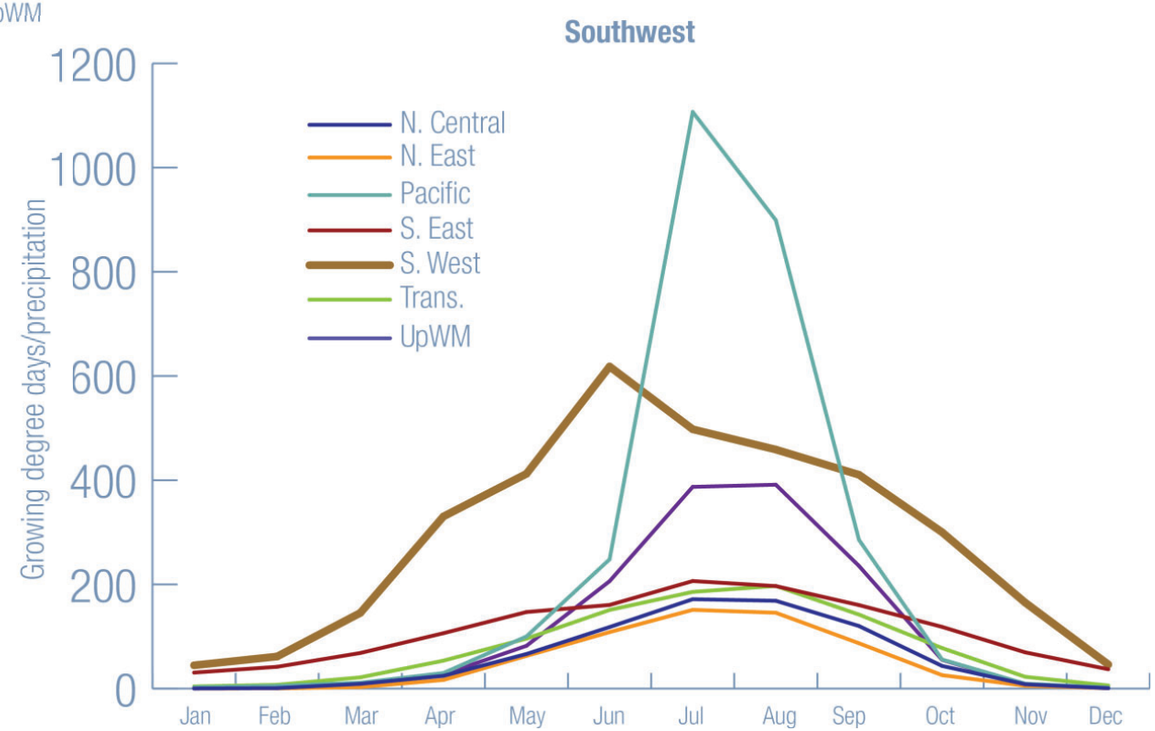
	Wetting Agent	Acid	Fertigation	BioControl	Sulfur	Gypsum
	%					
US	34.1	7.2	12.1	3.6	0.7	0.7
North Central	34.5	5.2	1.3	0.3	0.2	0.0
Northeast	33.1	8.4	8.3	4.4	0.0	0.0
Pacific	25.8	3.9	6.0	1.4	1.0	2.8
Southeast	38.1	10.0	25.4	3.2	0.3	0.2
Southwest	55.9	19.9	36.5	4.4	4.2	1.9
Transition	21.9	2.4	5.6	0.4	0.7	0.0
Upper Mountain/West	39.7	7.4	15.6	14.5	1.2	2.6

Table 20. Frequency of water treatment used with irrigational systems at U.S. golf facilities in 2020.

Meteorological Factors





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@jbunruh

J. Bryan Unruh, Ph.D.
West Florida Research and Education Center
University of Florida/IFAS
jbu@ufl.edu