Table A
Savings Measured and Reported in the Literature

Toilet Savings:

Source	gcd	Savings	Penetration	Remarks	References
A&N Studies for MWD	11.4		73%	large sample, statistical model	1,2,3
AWWARF Study (early results)	8.0	44.1%		large sample (130,000 toilet flushes)	6
Tampa-micro metering	6.1	45.9%	100%	small sample, drought period	5
EBMUD-micro metering	5.3	41.0%	100%	small sample, drought period	4
Heatherwood	2.6	17.2%	50%	small sample	7
Avg	6.7				
Use	8.0				

Clothes Washing Machines (high efficiency/tumbler type):

Source	gcd	Savings	Penetration	Remarks	References
Heatherwood	10.9	61%	100%	very small sample	7
Thelma		20%		lab tests, avg of 6 models	9
Seattle Demonstration		58%		per load	8
Manufacturer's Literature		40%		Maytag's "Neptune," Frigidaire's "Gallery"	12
Avg		45%			
Use		30%			

Shower Savings:

Source	gcd	Savings	Penetration	Remarks	References
HUD	7.2			relatively small sample	10
Tampa-micro metering	3.6	34%	100%	small sample	5
EBMUD-micro metering	1.7	28%	100%	small sample	4
AWWARF End Use (early results)	2.4	18%		large sample (22,000 showers)	6
Seattle Study	4.2			statistical model	11
Avg	3.8	27%			
Use	2.4	18%			

*Savings reported in Ref. 6 has been adjusted to include "zero" shower days.

Faucet Savings:

Source	gcd	Savings	Penetration	Remarks	References
Heatherwood	2.6		82%	small sample	7
AWWA	0.5			apriori judgment	13
Nelson	0.3			apriori judgment	14
Avg	1.1				
Use	0.3				

Leak Repair:

Source	gcd	% savings	Penetration	Remarks	References

Heatherwood	5.5	77%		small sample	7
Avg Use		77%			

All Fully Retrofitted Home (all of the above measures installed):

Source	gcd Savings		Penetration	Remarks	References
Heatherwood	22.2	33%		small sample	7

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Table B
References Noted in Table A

1. A&N Technical Services Inc., The Conserving Effect of Ultra Low Flush Toilet Rebate Programs, Metropolitan Water Dist. of Southern CA, June 1992
2. A&N Technical Services Inc., Continuous-Time Error Components Models of Residential Water Demand, MWD of Southern CA, June 1992
3. A&N Technical Services Inc., Ultra Low Flush Toilet Programs: Evaluation of Program Outcomes and Water Savings, MWD of Southern CA, Nov 1994
4. Stevens Institute of Technology, East Bay Municipal Utility District Water Conservation Study, Oct 1991
5. Stevens Institute of Technology, The Impact of Water Conserving Plumbing Fixtures on Residential Water Use Characteristics: A Case Study in Tampa, FL, Feb 1993
6. DeOreo, Nelson, Mayer and Opitz; North American End-Use Study: Progress Report, June 1997, Conference Proceedings of AWWA
7. DeOreo, Lander and Mayer, Evaluating Conservation Retrofit Savings with Precise End Use Data, Heatherwood, CO, June 1996, AWWA Conf. Proceedings
8. Dietemann, Alan and Hill, Susan, Water and Energy Efficiency Clothes Washers, 1994 AWWA Conf. Proceedings
9. Hill, Pope, Winch, Thelma: Assessing the Market Transformation Potential for Efficient Clothes Washers in the Residential Sector, Conserv96
10. Brown and Caldwell, Residential Water Conservation Projects, Summary Report, U.S. Dept of Housing & Urban Development, Water Resources Bulletin, June
11. Whitcomb, John, Water Use Reduction from Retrofitting Indoor Water Fixtures, Dec 1990
12. Specifications and literature obtained from Maytag and Frigidaire, June 1997
13. Maddaus, AWWA Water Conservation Report, 1987
14. John Olaf Nelson's estimate

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Table C
Basis for "V," the Applied Water Requirement for Cool Season Grass

		Irrigation Requirement for Alfalfa National Assess. (1)		Irrig. Requirement (AWR) for Cool Season *
State	Sector or Drainage (major city)	acre feet per acre	inches	inches
Alabama	Prairie (Montgomery)	1.2	14.4	15.6
	Gulf (Mobile)	0.8	9.6	10.4
Arizona	Northeast (Flagstaff)	2.4	28.8	31.2
	South Central (Phoenix)	5.9	70.8	76.7
	Southeast (Tuscon)	5.5	66.0	71.5
Arkansas	Central (Little Rock)	1.5	18.0	19.5
California	North Coast Drainage (Eureka)	2.1	25.2	27.3
	Sacramento Drainage (Sacramento)	3.0	36.0	39.0
	Central Coast Drainage (San Francisco)	2.1	25.2	27.3
	South Coast Drainage (Los Angeles)	4.8	57.6	62.4
Colorado	Platte Drainage Basin (Denver)	2.2	26.4	28.6
Connecticut	Central Coastal (hartford)	1.3	15.6	16.9
Delaware	Northern (Wilmington)	1.6	19.2	20.8
Florida	North (Jacksonville)	2.8	33.6	36.4
	South Central (Tampa)	2.8	33.6	36.4
	Lower East Coast (Ft. Lauderdale)	2.6	31.2	33.8
Georgia	(Entire State)	2.3	27.6	29.9
Idaho	Southwestern Valleys (Boise)	2.7	32.4	35.1
Illinois	Northeast (Chicago)	1.5	18.0	19.5
	West Southwest (Springfield)	1.7	20.4	22.1
Indiana	Central (Indianapolis)	1.6	19.2	20.8
Iowa	Central (Des Moines)	1.6	19.2	20.8
Kansas	Northeast (Kansas City)	1.8	21.6	23.4
	South Central (Wichita)	1.4	16.8	18.2
Kentucky	Central (Louisville)	1.8	21.6	23.4
Louisiana	Southeast (New Orleans)	1.6	19.2	20.8
Maine	Coastal (Portland)	0.9	10.8	11.7

Maryland	Northern Central (Baltimore)	1.6	19.2	20.8
Massachusetts	Coastal (Boston)	1.3	15.6	16.9
Michigan	Southeast Lower (Detroit)	1.1	13.2	14.3
Minnesota	East Central (Minneapolis)	0.8	9.6	10.4
Mississippi	Coastal (Biloxi)	1.6	19.2	20.8
	Southwest (Vicksburg)	1.9	22.8	24.7
Missouri	Northeast Prairie (St. Louis)	1.8	21.6	23.4
	Northwest Prairie (Kansas City)	1.5	18.0	19.5
Montana	Western (Missoula)	1.6	19.2	20.8
Nebraska	East Central (Omaha)	2.0	24.0	26.0
Nevada	Northwestern (Reno)	2.8	33.6	36.4
	Extreme Southern (Las Vegas)	4.3	51.6	55.9
New Hampshire	Southern (Concord)	1.1	13.2	14.3
New Jersey	Northern (Newark)	1.0	12.0	13.0
New Mexico	Northern Mountains (Santa Fe)	2.4	28.8	31.2
	Central Valley (Albuquerque)	3.0	36.0	39.0
New York	Coastal (New York)	1.1	13.2	14.3
	Great Lakes (Buffalo)	1.0	12.0	13.0
North Carolina	Southern Mountains (Asheville)	1.1	13.2	14.3
	Central Piedmont (Raleigh)	1.9	22.8	24.7
North Dakota	South Central (Bismark)	1.5	18.0	19.5
Ohio	Northeast (Celeveland)	1.4	16.8	18.2
	Southwest (Dayton)	1.6	19.2	20.8
Oklahoma	Central (Oklahoma City)	2.0	24.0	26.0
Oregon	Willamette Valley (Portland)	1.9	22.8	24.7
Pennsylvania	Southeastern Piedmont (Philadelphia)	1.0	12.0	13.0
Rhode Island	(Entire State)	1.1	13.2	14.3
South Carolina	Southern (Charleston)	1.9	22.8	24.7
South Dakota	Southeast (Sioux Falls)	1.9	22.8	24.7
Tennessee	Western (Memphis)	1.7	20.4	22.1
Texas	North Central (Dallas)	2.9	34.8	37.7
	South Central (San Antonio)	3.8	45.6	49.4
	Upper Coast (Houston)	2.2	26.4	28.6

Utah	North Central (Salt Lake City)	2.4	28.8	31.2
Vermont	Northeast (Montpelier)	1.1	13.2	14.3
Virginia	Eastern Piedmont (Richmond)	1.0	12.0	13.0
Washington	Puget Sound Lowland (Seattle)	1.5	18.0	19.5
West Virginia	Southwestern (Charleston)	1.0	12.0	13.0
Wisconsin	Southeast (Milwaukee)	0.9	10.8	11.7
Wyoming	Platte Drainage (Cheyenne)	1.8	21.6	23.4

* Irrigation Requirement for cool season grasses = AF x Irrigation requirement for Alfalfa

Equations:

- AF = Adjustment Factor = R2/R1 = 1.08
- R1 = Evapotranspiration requirement for rapidly growing alfalfa/evapotranspiration requirement for rapidly growing cool season grasses = 1.20 (2)
- R2 = Ratio of alfalfa/cool irrigation efficiencies = 1.30
  - Irrigation efficiency alfalfa (farm) = 0.65 (1)
  - Irrigation efficiency cool season grasses (residential site) = 0.50 (3)

Equation Notes:

1. Crop consumption Irrigation Requirements and Irrigation Efficiency Coefficients for the U.S., June 1976, U.S. Dept. of Agriculture Soil Conservation Service, Special Projects Division.
2. ASCE Manual #70, Evapotranspiration and Irrigation Water Requirements, 1989 (pp 127, 128).
3. Experience of author and recommendation of Gary Kah of Gary Kah and Associates.

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Table D
Showing How Factor "S" Was Derived

	Kc	IE (4)	Kc x IE	S (6)
Cool season grasses (Kentucky bluegrass, rye, tall fescue, etc.)	0.80 (1)	0.50 (4)	1.60	1.00
Warm season grasses (Bermuda, Zoysia)	0.58 (2)	0.50 (4)	1.17	0.73
Groundcovers	0.60 (3)	0.81 (5)	0.74	0.46
Shrubs and trees	0.30 (3)	0.90 (3)	0.33	0.21

Table D Notes:

1. California DWR, Office of Water Conservation, Art Carvajal.
2. Univ. of California Cooperative Extension Service, Leaflet 21499:

	Daily ET, inches	Ratio	Annual Kc
Cool season	0.390	1.00	0.80 (1)
Warm season	0.285	0.73	0.58 calc'd

3. AWWA, Water Efficient Landscape Guidelines, Richard E. Bennett and Michael S. Hazinski, 1993
4. Experience of author and recommendation of Gary Kah of Gary Kah and Associates
5. Value from Ref. (3) increased by 25% to reflect efficiency added by extensive rooting systems
6. This column sets value for cool season grasses to 1.00 and references all other values in proportion thereto.

Definitions:

Kc = crop coefficient
IE = overall irrigation efficiency
S = factor to be used in the "rule of thumb" equation

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