Design and Manage Irrigation according to plant needs

- **Design Smart**
- **Design for Efficiency**
- **Monitor and Maintain**
- **Replace ?**

Kris Loomis, Wyatt Irrigation Co.
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Design Smart- Identify Hydro zones

- Choose compatible plants according to water needs (Ks)
- Choose compatible plants for the microclimate (Kmc)
- Group plants with similar density (Kd)
- Identify hydro zone soil type
- Consider Slopes when choosing zones and application rates

$K_{landscape} = K_{species} \times K_{density} \times K_{microclimate}$

Graphic 5-1
Adjustment Factors

	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5
$K_{species}$	Low Water Use Plants			Moderate Water Use Plants			High Water Use Plants								
$K_{density}$					Low density plantings					Average	High density plantings				
$K_{microclimate}$					Cool, shaded, no wind, northern exposure, etc.					Average	Windy, reflective heat, parking lots, etc.				

Courtesy of
Hunter Industries

Soil Texture and Infiltration Rate

SOIL TEXTURE	MAXIMUM PRECIPITATION RATES: INCHES PER HOUR (MILLIMETERS PER HOUR)							
	0 to 5% slope		5 to 8% slope		8 to 12% slope		12%+ slope	
	cover	bare	cover	bare	cover	bare	cover	bare
Course sandy soils	2.00 (51)	2.00 (51)	2.00 (51)	1.50 (38)	1.50 (38)	1.00 (25)	1.00 (25)	0.50 (13)
Course sandy soils over compact subsoils	1.75 (44)	1.50 (38)	1.25 (32)	1.00 (25)	1.00 (25)	0.75 (19)	0.75 (19)	0.40 (10)
Light sandy loams uniform	1.75 (44)	1.00 (25)	1.25 (32)	0.80 (20)	1.00 (25)	0.60 (15)	0.75 (19)	0.40 (10)
Light sandy loams over compact subsoils	1.25 (32)	0.75 (19)	1.00 (25)	0.50 (13)	0.75 (19)	0.40 (10)	0.50 (13)	0.30 (8)
Uniform silt loams	1.00 (25)	0.50 (13)	0.80 (20)	0.40 (10)	0.60 (15)	0.30 (8)	0.40 (10)	0.20 (5)
Silt loams over compact subsoil	0.60 (15)	0.30 (8)	0.50 (13)	0.25 (6)	0.40 (10)	0.15 (4)	0.30 (8)	0.10 (3)
Heavy clay or clay loam	0.20 (5)	0.15 (4)	0.15 (4)	0.10 (3)	0.12 (3)	0.08 (2)	0.10 (3)	0.06 (2)

Figure 15: Maximum precipitation rates for slopes

RAIN BIRD Landscape Irrigation Design Manual 21

Courtesy of

Rain Bird

SOIL TYPE	SOIL TEXTURE	SOIL COMPONENTS	INTAKE RATE	WATER RETENTION	DRAINAGE EROSION
Sandy soil	Coarse texture	Sand	Very high	Very low	Low erosion Good drainage
		Loamy sand	High	Low	
Loamy soil	Moderately coarse	Sandy loam	Moderately high	Moderately low	Low erosion Good drainage
		Fine loam	Moderately high	Moderately low	
	Medium texture	Very fine loam Loam Silty loam Silt	Medium Medium Medium Medium	Moderately high Moderately high Moderately high Moderately high	Moderate drainage Moderate drainage Moderate drainage Moderate drainage
	Moderately fine	Clay loam Sandy clay loam Silty clay loam	Moderately low Moderately low Moderately low	High High High	
Clay soil	Fine texture	Sandy clay Silty clay Clay	Low Low	High High	Drainage Severe erosion

Know the Species watering needs

Species Evaluation List–1999

TYPE	BOTANICAL NAME	COMMON NAME	REGIONAL EVALUATIONS 1	2	3	4	5	6	INVASIVE
S	Abelia chinensis	Chinese abelia	M	?	?	?	/	/	
S	Abelia floribunda	Mexican abelia	M	?	M	M	/	/	
S Gc	Abelia X grandiflora	glossy abelia	M	M	M	M	/	/	
S	Abelia 'Sherwoodii'	Sherwood dwarf abelia	M	M	M	M	/	/	
T	Abies spp.	fir	M	/	M	M	/	/	
T	Abies pinsapo	Spanish fir	L	/	L	/	/	/	
S	Abutilon X hybridum	flowering maple	M	H	H	H	/	/	
S	Abutilon palmeri	indian mallow	?	?	L	?	?	?	
S T	Acacia abyssinica	Abyssinian acacia	/	?	/	?	/	L	
T	Acacia aneura	mulga	/	?	?	?	/	L	
T	Acacia baileyana	Bailey acacia	L	L	L	L	/	/	Ⓢ
T S	Acacia berlandieri	guajillo	?	?	?	M	/	L	
T	Acacia boormanii	Snowy River wattle	?	?	L	?	?	?	
T	Acacia cognata (A. subporosa)	bower wattle	L	L	M	M	/	/	
T S	Acacia constricta	whitethorn acacia	?	L	L	L	L	L	
T S	Acacia craspedocarpa	leatherleaf acacia	?	?	?	?	L	L	
T	Acacia cultriformis	knife acacia	L	L	L	L	/	/	
T	Acacia dealbata	silver wattle	VL	L	L	L	/	/	Ⓢ
T	Acacia decurrens	green wattle	VL	L	L	L	/	/	Ⓢ
T	Acacia farnesiana	sweet acacia	?	?	L	L	/	L	
S	Acacia glaucoptera	clay wattle	L	/	L	L	/	/	
T S	Acacia greggii	catclaw acacia	L	L	L	L	L	L	
T S	Acacia longifolia	Sydney golden wattle	L	L	L	L	/	/	Ⓢ
T	Acacia melanoxylon	blackwood acacia	VL	L	L	L	/	/	Ⓢ
T	Acacia pendula	weeping acacia	L	L	M	M	/	L	
T	Acacia pennatula	pennatula acacia	?	?	VL	?	L	L	
T S	Acacia podalyriifolia	pearl acacia	VL	VL	L	M	/	/	
S Gc	Acacia redolens	prostrate acacia	VL	VL	L	L	L	L	
S	Acacia rigens	needleleaf acacia	/	/	?	?	?	?	
T	Acacia rigidula	rigidula acacia	/	/	?	?	?	?	
T	Acacia salicina	willow acacia	L	L	L	M	/	M	
T S	Acacia saligna	blue leaf wattle	L	L	L	L	/	M	
T	Acacia schaffneri	twisted acacia	/	/	?	?	/	L	
T	Acacia smallii	desert sweet acacia	/	/	VL	L	/	L	
T	Acacia stenophylla	eumong/shoestring acacia	VL	L	L	L	/	L	
T S	Acacia subporosa	subporosa acacia	L	/	L	?	?	?	
S	Acacia vestita	hairy wattle	?	?	L	L	?	?	
T	Acacia willardiana	palo blanco	/	/	?	L	/	L	
P	Acanthus mollis	bear's breech	M	M	M	M	/	M	
T S	Acca sellowiana (Feijoa sellowiana)	pineapple guava	L	L	L	M	/	M	
T	Acer buergerianum	trident maple	M	M	M	/	/	/	

Key to Symbols

CATEGORIES OF WATER NEEDS

- H High
- M Moderate
- L Low
- VL Very Low
- / Inappropriate
- ? Unknown

PLANT TYPES

- T Tree
- S Shrub
- V Vine
- Gc Groundcover
- P Perennial (includes ferns, grasses and bulbs)
- Bi Biennial

WUCOLS REGIONS

- 1 North Central Coastal
- 2 Central Valley
- 3 South Coastal
- 4 South Inland Valley
- 5 High and Intermediate Desert
- 6 Low Desert

INVASIVE SPECIES

- Greater Statewide Concern
- Lesser Statewide Concern

Courtesy of

WUCOLS

Water Use Classification of Landscape Species. A Guide to the Water Needs of Landscape Plants.

Courtesy of CIMIS

Reference ET by Zone

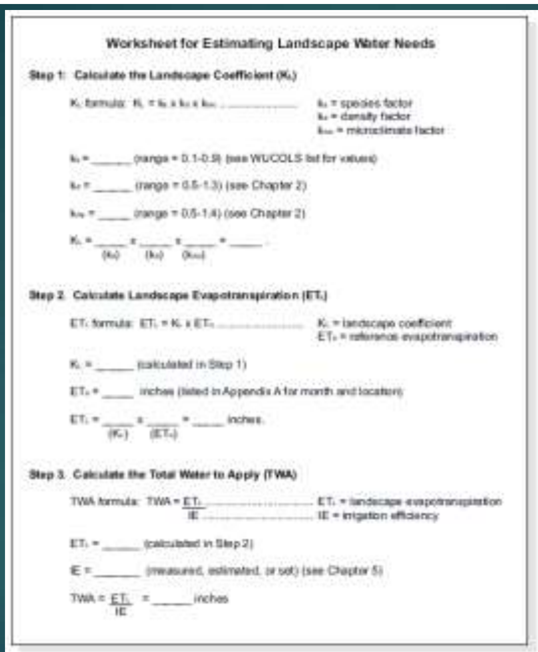
Monthly Average Reference Evapotranspiration by ETo Zone (inches/month)

Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48	1.20	0.62	32.9
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79	1.80	1.24	39.0
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
4	1.86	2.24	3.41	4.50	5.27	5.70	5.89	5.58	4.50	3.41	2.40	1.86	46.6
5	0.93	1.68	2.79	4.20	5.58	6.30	6.51	5.89	4.50	3.10	1.50	0.93	43.9
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72	2.40	1.86	49.7
7	0.62	1.40	2.48	3.90	5.27	6.30	7.44	6.51	4.80	2.79	1.20	0.62	43.3
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41	1.80	0.93	49.4
9	2.17	2.80	4.03	5.10	5.89	6.60	7.44	6.82	5.70	4.03	2.70	1.86	55.1
10	0.93	1.68	3.10	4.50	5.89	7.20	8.06	7.13	5.10	3.10	1.50	0.93	49.1
11	1.55	2.24	3.10	4.50	5.89	7.20	8.06	7.44	5.70	3.72	2.10	1.55	53.1
12	1.24	1.96	3.41	5.10	6.82	7.80	8.06	7.13	5.40	3.72	1.80	0.93	53.4
13	1.24	1.96	3.10	4.80	6.51	7.80	8.99	7.75	5.70	3.72	1.80	0.93	54.3
14	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	57.0
15	1.24	2.24	3.72	5.70	7.44	8.10	8.68	7.75	5.70	4.03	2.10	1.24	57.9
16	1.55	2.52	4.03	5.70	7.75	8.70	9.30	8.37	6.30	4.34	2.40	1.55	62.5
17	1.86	2.80	4.65	6.00	8.06	9.00	9.92	8.68	6.60	4.34	2.70	1.86	66.5
18	2.48	3.36	5.27	6.90	8.68	9.60	9.61	8.68	6.90	4.96	3.00	2.17	71.6

34.85 inches April - October Zone 4
40.36 inches April - October Zone 8

Courtesy of CIMIS

How Much Water To Apply



Worksheet for Estimating Landscape Water Needs

Step 1: Calculate the Landscape Coefficient (K_L)

K_L formula: $K_L = k_s \times k_d \times k_{mc}$ .... k_s = species factor; k_d = density factor; k_{mc} = microclimate factor

k_s = ______ (range = 0.1-0.9) (see WUCOLS list for values)

k_d = ______ (range = 0.5-1.3) (see Chapter 2)

k_{mc} = ______ (range = 0.5-1.4) (see Chapter 2)

K_L = ______ (k_s) x ______ (k_d) x ______ (k_{mc}) = ______

Step 2. Calculate Landscape Evapotranspiration (ET_L)

ET_L formula: $ET_L = K_L \times ET_o$ .... K_L = landscape coefficient; ET_o = reference evapotranspiration

K_L = ______ (calculated in Step 1)

ET_o = ______ inches (listed in Appendix A for month and location)

ET_L = ______ (K_L) x ______ (ET_o) = ______ inches.

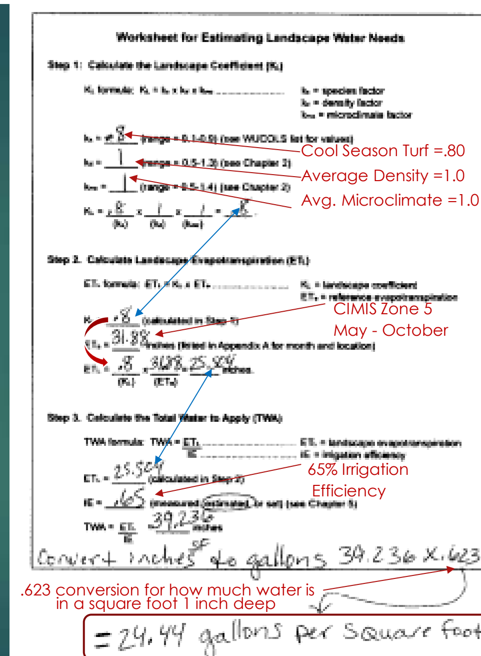
Step 3. Calculate the Total Water to Apply (TWA)

TWA formula: $TWA = \frac{ET_L}{IE}$ .... ET_L = landscape evapotranspiration; IE = irrigation efficiency

ET_L = ______ (calculated in Step 2)

IE = ______ (measured, estimated, or set) (see Chapter 5)

$TWA = \frac{ET_L}{IE}$ = ______ inches



Worksheet for Estimating Landscape Water Needs

Step 1: Calculate the Landscape Coefficient (K_L)

K_L formula: $K_L = k_s \times k_d \times k_{mc}$ .... k_s = species factor; k_d = density factor; k_{mc} = microclimate factor

k_s = .8 (range = 0.1-0.9) (see WUCOLS list for values) — Cool Season Turf =.80

k_d = 1 (range = 0.5-1.3) (see Chapter 2) — Average Density =1.0

k_{mc} = 1 (range = 0.5-1.4) (see Chapter 2) — Avg. Microclimate =1.0

K_L = .8 (k_s) x 1 (k_d) x 1 (k_{mc}) = .8

Step 2. Calculate Landscape Evapotranspiration (ET_L)

ET_L formula: $ET_L = K_L \times ET_o$ .... K_L = landscape coefficient; ET_o = reference evapotranspiration

K_L = .8 (calculated in Step 1)

ET_o = 31.88 inches (listed in Appendix A for month and location) — CIMIS Zone 5 May - October

ET_L = .8 (K_L) x 31.88 (ET_o) = 25.504 inches.

Step 3. Calculate the Total Water to Apply (TWA)

TWA formula: $TWA = \frac{ET_L}{IE}$ .... ET_L = landscape evapotranspiration; IE = irrigation efficiency

ET_L = 25.504 (calculated in Step 2)

IE = .65 (measured, estimated, or set) (see Chapter 5) — 65% Irrigation Efficiency

$TWA = \frac{ET_L}{IE}$ = 39.236 inches

Convert inches SF to gallons 39.236 x .623

.623 conversion for how much water is in a square foot 1 inch deep

= 24.44 gallons per Square foot

Courtesy of

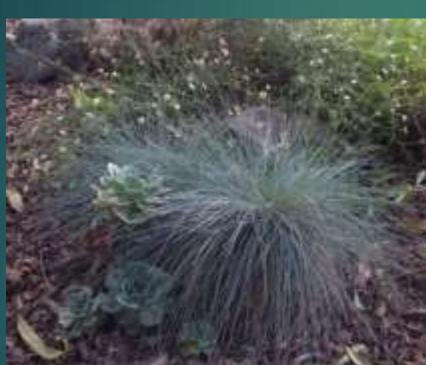
WUCOLS

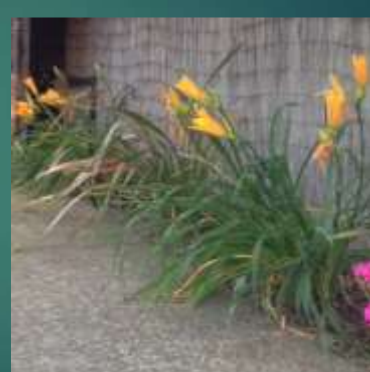
Water Use Classification of Landscape Species. A Guide to the Water Needs of Landscape Plants.

Water requirements of Turf

2 ½+/- gallons per season for Very Low water use plants

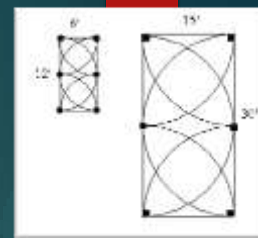
3 to 14 gallons per season for Low to medium water use plants

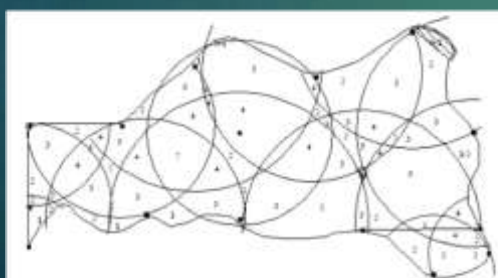


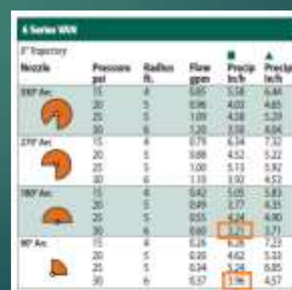


Design for Efficiency

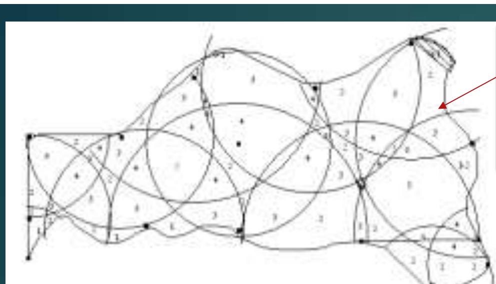
- When using spray heads, avoid areas with irregular shapes
- Avoid spraying areas with any side smaller than 8 feet
- Avoid over-spraying and runoff
- Choose Irrigation components that
  - Fit the application
  - Have compatible application rates vs soil infiltration rates
  - Are highly efficient





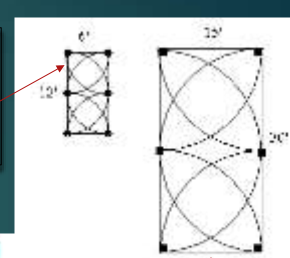


Courtesy of Rain Bird

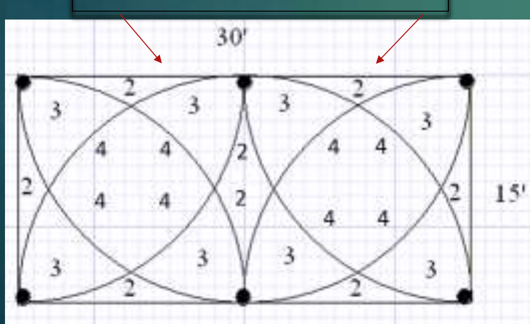


Irregular shaped areas are less efficient and generally have more overspray which is a cause of runoff

Short radius nozzles generally have High precipitation rates which soil infiltration rates can't match



"Head –to-head" coverage Doesn't mean 100% efficient



Courtesy of Rain Bird

Revisit
Soil Texture and Infiltration Rate

SOIL TEXTURE	MAXIMUM PRECIPITATION RATES: INCHES PER HOUR (MILLIMETERS PER HOUR)							
	0 to 5% slope		5 to 8% slope		8 to 12% slope		12%+ slope	
	cover	bare	cover	bare	cover	bare	cover	bare
Course sandy soils	2.00 (51)	2.00 (51)	2.00 (51)	1.50 (38)	1.50 (38)	1.00 (25)	1.00 (25)	0.50 (13)
Course sandy soils over compact subsoils	1.75 (44)	1.50 (38)	1.25 (32)	1.00 (25)	1.00 (25)	0.75 (19)	0.75 (19)	0.40 (10)
Light sandy loams uniform	1.75 (44)	1.00 (25)	1.25 (32)	0.80 (20)	1.00 (25)	0.60 (15)	0.75 (19)	0.40 (10)
Light sandy loams over compact subsoils	1.25 (32)	0.75 (19)	1.00 (25)	0.50 (13)	0.75 (19)	0.40 (10)	0.50 (13)	0.30 (8)
Uniform silt loams	1.00 (25)	0.50 (13)	0.80 (20)	0.40 (10)	0.60 (15)	0.30 (8)	0.40 (10)	0.20 (5)
Silt loams over compact subsoil	0.60 (15)	0.30 (8)	0.50 (13)	0.25 (6)	0.40 (10)	0.15 (4)	0.30 (8)	0.10 (3)
Heavy clay or clay loam	0.20 (5)	0.15 (4)	0.15 (4)	0.10 (3)	0.12 (3)	0.08 (2)	0.10 (3)	0.06 (2)

Figure 15: Maximum precipitation rates for slopes

RAIN BIRD Landscape Irrigation Design Manual 21

Courtesy of
Rain Bird

Low Precipitation Rate Rotary Nozzles

SOIL TEXTURE	SOIL INTAKE RATES (inches per hour)							
	0 to 5% slope		5 to 8% slope		8 to 12% slope		12%+ slope	
	Cover	Bare	Cover	Bare	Cover	Bare	Cover	Bare
Coarse sandy soils	2.00	2.00	2.00	1.50	1.50	1.00	1.00	0.50
Coarse sandy soils over compact subsoils	1.75	1.50	1.25	1.00	1.00	0.75	0.75	0.40
Uniform light sandy loams	1.75	1.00	1.25	0.80	1.00	0.60	0.75	0.40
Light sandy loams over compact subsoils	1.25	0.75	1.00	0.50	0.75	0.40	0.50	0.30
Uniform silt loams	1.00	0.50	0.80	0.40	0.60	0.30	0.40	0.20
Silt loams over compact subsoil	0.60	0.30	0.50	0.25	0.40	0.15	0.30	0.10
Heavy clay or clay loam	0.20	0.15	0.15	0.10	0.12	0.08	0.10	0.06

Soil Intake Rates for Various Soil Textures

MP1000
Radius: 8' to 15'
Adjustable Arc and Full Circle
Color Code: Maroon, Lt. Blue, or Olive

Arc	Pressure PSI	Color	Radius ft.	Flow GPM	Flow GPH	Precip in/hr ■	Precip in/hr ▲
90°	25	Maroon = 90° to 210°	–	–	–	–	–
	30		12'	0.16	9.6	0.43	0.50
	35		13'	0.18	10.8	0.40	0.46
	40		**14'**	**0.19**	**11.4**	**0.39**	**0.45**
	45		14'	0.20	12	0.39	0.45
	50		14'	0.21	12.6	0.38	0.43
	55		15'	0.22	13.2	0.37	0.43
180°	25		–	–	–	–	–
	30		12'	0.32	19.2	0.43	0.50
	35		13'	0.35	21	0.40	0.46
	40		**14'**	**0.37**	**22.2**	**0.39**	**0.45**
	45		14'	0.40	24	0.39	0.45
	50		15'	0.41	24.6	0.38	0.43
	55		15'	0.43	25.8	0.37	0.43
210°	25		–	–	–	–	–
	30		12'	0.37	22.2	0.43	0.50
	35		13'	0.41	24.6	0.40	0.46
	40		**14'**	**0.43**	**25.8**	**0.39**	**0.45**
	45		14'	0.46	27.6	0.39	0.45
	50		15'	0.48	28.8	0.38	0.43
	55		15'	0.50	30	0.37	0.43
270°	25	Lt. Blue = 210° to 270°	–	–	–	–	–
	30		12'	0.48	29	0.43	0.50
	35		13'	0.54	32	0.40	0.46
	40		**14'**	**0.57**	**34**	**0.39**	**0.45**
	45		14'	0.60	36	0.39	0.45
	50		15'	0.63	38	0.38	0.43
	55		15'	0.66	40	0.37	0.43
360°	25	Olive = 360°	–	–	–	–	–
	30		12'	0.65	39	0.43	0.50
	35		13'	0.71	42.6	0.40	0.47
	40		**14'**	**0.75**	**45**	**0.39**	**0.46**
	45		14'	0.80	48	0.39	0.45
	50		15'	0.84	50.4	0.38	0.44
	55		15'	0.87	52.2	0.37	0.43

Rainfall equivalent .39" per hour

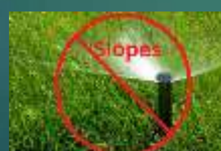
Application rate matches more closely to intake rate

Courtesy of
Hunter Industries

Application Rates and run off

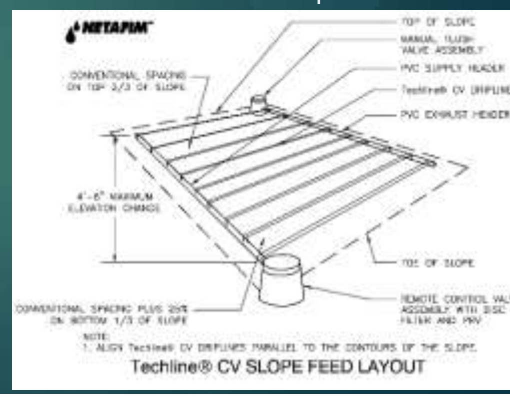
Rainfall equivalent 1 ½" or more per hour

High PR sprinklers and slopes don't mix. Consider Low PR sprinklers with cycle and soak programming or low volume Drip Irrigation to greatly improve efficiency.



Courtesy of WUCOLS

Water Use Classification of Landscape Species. A Guide to the Water Needs of Landscape Plants.



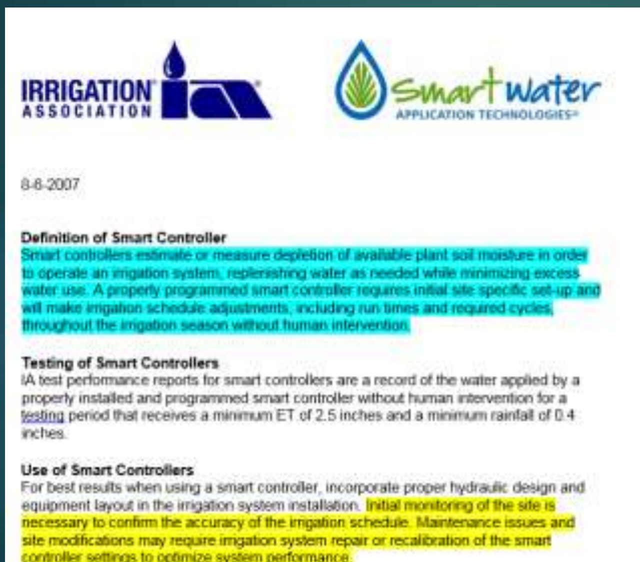
Efficiency Inefficient vs Efficient

Lack of adequate system pressure causes poor performance resulting in efficiency loss due to inadequate coverage and poor DU

Excessive system pressure causes decreased droplet size resulting in efficiency losses due to inadequate coverage, wind and poor DU

Larger droplet size help to fight wind drift, Resulting in better DU

Smart Controller Definition



IRRIGATION ASSOCIATION

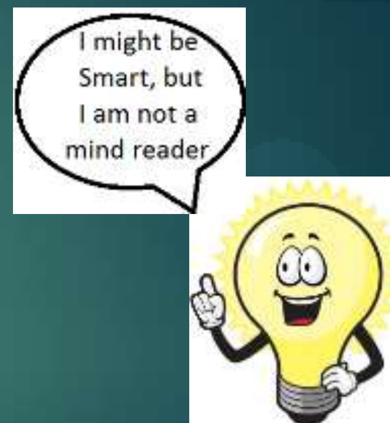
Smart water APPLICATION TECHNOLOGIES

8-6-2007

Definition of Smart Controller
Smart controllers estimate or measure depletion of available plant soil moisture in order to operate an irrigation system, replenishing water as needed while minimizing excess water use. A properly programmed smart controller requires initial site specific set-up and will make irrigation schedule adjustments, including run times and required cycles, throughout the irrigation season without human intervention.

Testing of Smart Controllers
IA test performance reports for smart controllers are a record of the water applied by a properly installed and programmed smart controller without human intervention for a testing period that receives a minimum ET of 2.5 inches and a minimum rainfall of 0.4 inches.

Use of Smart Controllers
For best results when using a smart controller, incorporate proper hydraulic design and equipment layout in the irrigation system installation. Initial monitoring of the site is necessary to confirm the accuracy of the irrigation schedule. Maintenance issues and site modifications may require irrigation system repair or recalibration of the smart controller settings to optimize system performance.



Courtesy of
the Irrigation Association

Limited Programming options (discontinued)

Commercial Quality Controller with various programming options

Commercial Quality Controller with Smart options added

Courtesy of
Irritrol

Commercial Quality Controller with various programming options

Commercial Quality Controller with Smart options added

Courtesy of Hunter Industries

Realtime plus ET Based controller

Commercial Quality Controller with various programming options and smart features

Realtime data collected onsite
Cloud Based
Cellular service required

Courtesy of Hydropoint

Monitor and Maintain

Add value and responsibility to maintenance accounts by

- Monitoring and adjusting controllers

❖ Smart Controllers need support until established
❖ Traditional controllers, modify program min once per month
❖ Use cycle and soak if there is visual runoff
❖ Check external sensors for issues (leaves, debris inhibiting function, etc)

- Adjust irrigation equipment

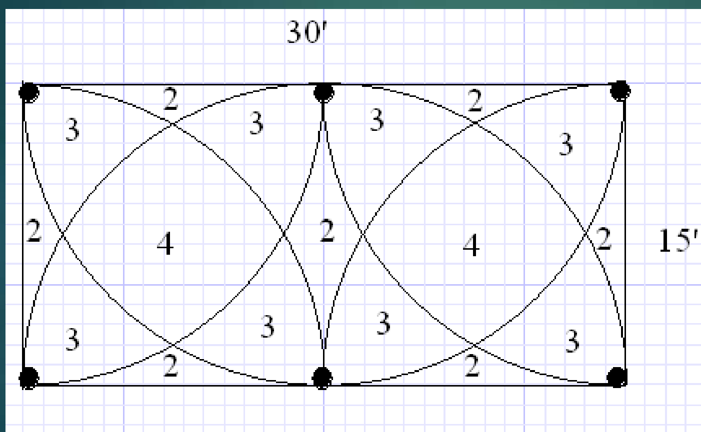
❖ Fix broken, leaking, tilted or sunken sprinkler heads
❖ Perform audits to insure efficient distribution uniformity
❖ Make corrections and replace worn equipment

Replace ?

WYATT Irrigation Co.

DRIP IRRIGATION
IS IT TIME TO MAKE THE SWITCH?

Turf water use

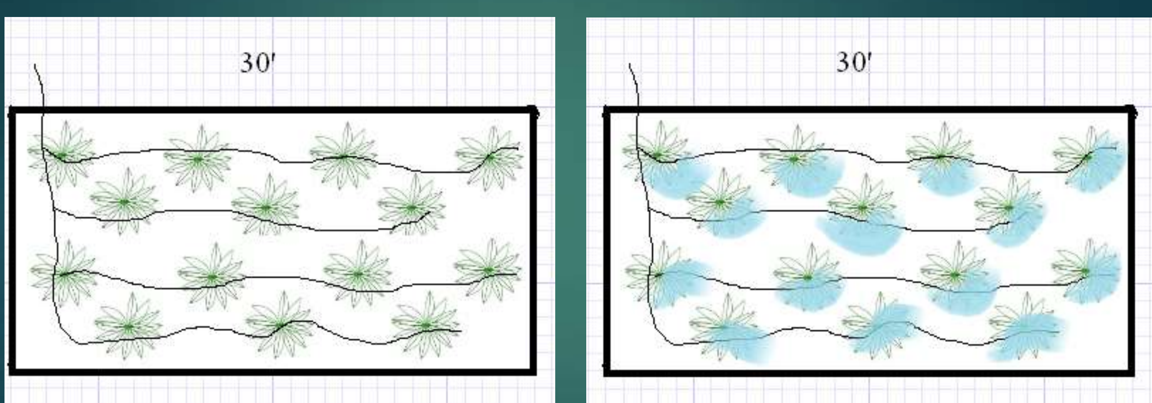


Annual water use approximately 11,250 Gallons *

*@ 25 Gallons per Sq. Ft

- *Estimate

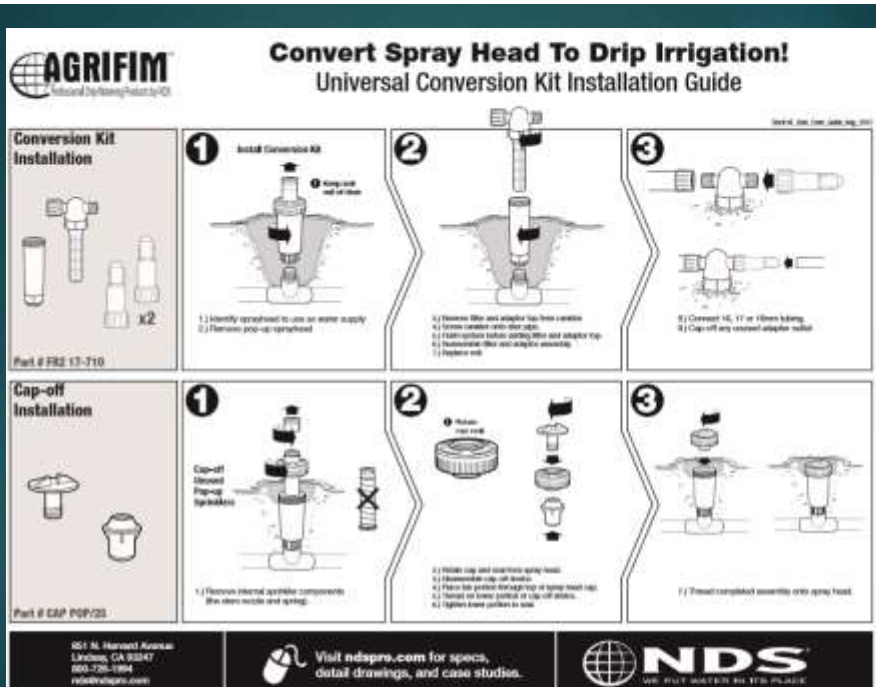
Switching from turf to Low-Water Use plants with drip



Annual water use approximately 3,822 Gallons
66% water savings compared to turf

Ways To Connect

AGRIFIM
Quality Products by NDS



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Questions?

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