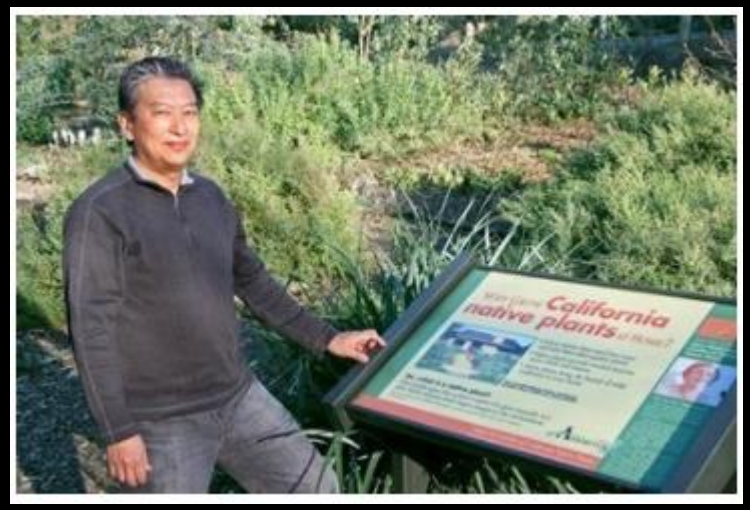
Irrigation Scheduling in a Severe Drought
Scheduling for Survival
Turf Irrigation Performance and Scheduling
Webinar Session 5

Presented by
Jim Borneman - Ewing Irrigation and Landscape Supply
(retired) jborneman@ewingirrigation.com

EWING
Irrigation & Landscape Supply

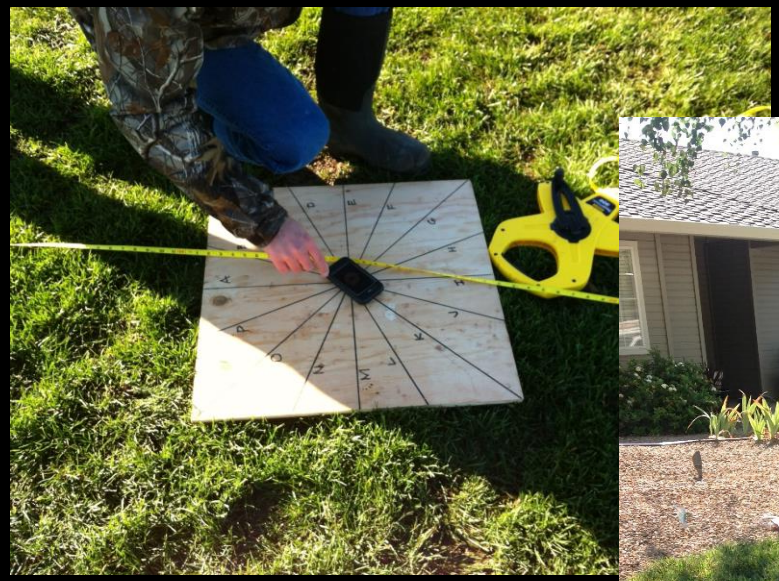


Dave Fujino - Ph. D. – Director
California Center for Urban Horticulture at U.C. Davis

UCDAVIS
California Center for
Urban Horticulture

Let’s do a quick review of how to calculate an application rate for drip before we get started!

Start by measuring the irrigated area with Ewing's 16-point measurement method to determine how many square feet the zone valve is irrigating.



	FEET	INCHES
A	5	6
B	7	
C	8	7
D	10	4
E	11	11
F	12	1
G	10	4
H	9	2
I	9	4
J	7	
K	8	5
L	7	1
M	13	1
N	12	
O	13	10
P	8	5
	154	**1**

Locate the sum of the sixteen perimeter measurements and you'll find the square footage. Accurate to within about 2%

Area (square feet)	Sum of 16 perimeter measurements	Area (square feet)	Sum of 16 perimeter measurements	Area (square feet)	Sum of 16 perimeter measurements	Area (square feet)	Sum of 16 perimeter measurements	Area (square feet)	Sum of 16 perimeter measurements
295	**155**								
314	160	1,142	305	2,485	450	4,345	595	6,811	745
334	165	1,179	310	2,541	455	4,418	600	6,903	750
355	170	1,218	315	2,597	460	4,492	605	6,995	755
376	175	1,257	320	2,653	465	4,566	610	7,088	760
398	180	1,296	325	2,711	470	4,642	615	7,182	765
420	185	1,336	330	2,769	475	4,717	620	7,276	770
443	190	1,377	335	2,827	480	4,794	625	7,371	775
467	195	1,419	340	2,887	485	4,871	630	7,466	780
491	200	1,461	345	2,946	490	4,948	635	7,562	785
516	205	1,503	350	3,007	495	5,027	640	7,659	790
541	210	1,547	355	3,068	500	5,105	645	7,756	795
567	215	1,590	360	3,130	505	5,185	650	7,854	800
594	220	1,635	365	3,192	510	5,265	655	7,952	805

Residential Meters 5/8" - 3/4" - 1"				(METER FLOW CONVERSION CHART)						
CFM	GPM	GPH		CFM	GPM	GPH		CFM	GPM	GPH
0.03	0.25	15		0.74	5.50	330		1.40	10.50	630
0.07	0.50	30		0.70	5.25	315		1.44	10.75	645
0.10	0.75	45		0.74	5.50	330		1.47	11.00	660
0.13	1.00	60		0.77	5.75	345		1.50	11.25	675
0.17	1.25	75		0.80	6.00	360		1.54	11.50	690
0.20	1.50	90		0.84	6.25	375		1.57	11.75	705
0.23	1.75	105		0.87	6.50	390		1.60	12.00	720
0.27	2.00	120		0.90	6.75	405		1.64	12.25	735
0.30	2.25	135		0.94	7.00	420		1.67	12.50	750
0.33	2.50	150		0.97	7.25	435		1.70	12.75	765
0.37	2.75	165		1.00	7.50	450		1.74	13.00	780
0.40	3.00	180		1.04	7.75	465		1.77	13.25	795
0.43	3.25	195		1.07	8.00	480		1.80	13.50	810
0.47	3.50	210		1.10	8.25	495		1.84	13.75	825
0.50	3.75	225		1.14	8.50	510		1.87	14.00	840
0.53	4.00	240		1.17	8.75	525		1.91	14.25	855
0.57	4.25	255		1.20	9.00	540		1.94	14.50	870
0.60	4.50	270		1.24	9.25	555		1.97	14.75	885
0.64	4.75	285		1.34	10.00	600		2.01	15.00	900
0.67	5.00	300		1.37	10.25	615		2.04	15.25	915

Next, measure the flow at the water meter. Time the flow for 1 minute after the air has flushed form the system. Each revolution of the needle on a residential meter 5/8” – 1” is 1 cubic foot or 7.5 gallons or for drip 450 gph.

Utilize the tables to determine the rates of precipitation. Recall that when dealing with drip, it is often referred toas the rate of application.

Precipitation Rate Tables - Low Volume/Drip-Micro Irrigation

Point Source Emiiters or Micro Spray

(METER FLOW)

AREA IN SQUARE FEET(CANOPY AREA)

CFM	GPM	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800
0.03	**0.25**	##	0.32	0.24	0.19	0.16	0.14	0.12	0.11	0.10	0.09	0.08																				
0.07	**0.50**	##	0.64	0.48	0.39	0.32	0.28	0.24	0.21	0.19	0.18	0.16	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.08									
0.10	**0.75**	##	0.96	0.72	0.58	0.48	0.41	0.36	0.32	0.29	0.26	0.24	0.22	0.21	0.19	0.18	0.17	0.16	0.15	0.14	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.10	0.10	0.10	0.09	0.09
0.13	**1.00**	##	1.28	0.96	0.77	0.64	0.55	0.48	0.43	0.39	0.35	0.32	0.30	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.18	0.18	0.17	0.16	0.15	0.15	0.14	0.14	0.13	0.13	0.12	0.12
0.17	**1.25**	##	1.61	1.20	0.96	0.80	0.69	0.60	0.54	0.48	0.44	0.40	0.37	0.34	0.32	0.30	0.28	0.27	0.25	0.24	0.23	0.22	0.21	0.20	0.19	0.19	0.18	0.17	0.17	0.16	0.16	0.15
0.20	**1.50**	##	1.93	1.44	1.16	0.96	0.83	0.72	0.64	0.58	0.53	0.48	0.44	0.41	0.39	0.36	0.34	0.32	0.30	0.29	0.28	0.26	0.25	0.24	0.23	0.22	0.21	0.21	0.20	0.19	0.19	0.18
0.23	**1.75**	##	2.25	1.69	1.35	1.12	0.96	0.84	0.75	0.67	0.61	0.56	0.52	0.48	0.45	0.42	0.40	0.37	0.35	0.34	0.32	0.31	0.29	0.28	0.27	0.26	0.25	0.24	0.23	0.22	0.22	0.21
0.27	**2.00**	##	2.57	1.93	1.54	1.28	1.10	0.96	0.86	0.77	0.70	0.64	0.59	0.55	0.51	0.48	0.45	0.43	0.41	0.39	0.37	0.35	0.33	0.32	0.31	0.30	0.29	0.28	0.27	0.26	0.25	0.24
0.30	**2.25**	##	2.89	2.17	1.73	1.44	1.24	1.08	0.96	0.87	0.79	0.72	0.67	0.62	0.58	0.54	0.51	0.48	0.46	0.43	0.41	0.39	0.38	0.36	0.35	0.33	0.32	0.31	0.30	0.29	0.28	0.27
0.33	**2.50**	##	3.21	2.41	1.93	1.61	1.38	1.20	1.07	0.96	0.88	0.80	0.74	0.69	0.64	0.60	0.57	0.54	0.51	0.48	0.46	0.44	0.42	0.40	0.39	0.37	0.36	0.34	0.33	0.32	0.31	0.30
0.37	**2.75**	##	3.53	2.65	2.12	1.77	1.51	1.32	1.18	1.06	0.96	0.88	0.81	0.76	0.71	0.66	0.62	0.59	0.56	0.53	0.50	0.48	0.46	0.44	0.42	0.41	0.39	0.38	0.37	0.35	0.34	0.33
0.40	**3.00**	##	3.85	2.89	2.31	1.93	1.65	1.44	1.28	1.16	1.05	0.96	0.89	0.83	0.77	0.72	0.68	0.64	0.61	0.58	0.55	0.53	0.50	0.48	0.46	0.44	0.43	0.41	0.40	0.39	0.37	0.36
0.43	**3.25**	##	4.17	3.13	2.50	2.09	1.79	1.56	1.39	1.25	1.14	1.04	0.96	0.89	0.83	0.78	0.74	0.70	0.66	0.63	0.60	0.57	0.54	0.52	0.50	0.48	0.46	0.45	0.43	0.42	0.40	0.39
0.47	**3.50**	##	4.49	3.37	2.70	2.25	1.93	1.69	1.50	1.35	1.23	1.12	1.04	0.96	0.90	0.84	0.79	0.75	0.71	0.67	0.64	0.61	0.59	0.56	0.54	0.52	0.50	0.48	0.46	0.45	0.43	0.42
0.50	**3.75**	##	4.82	3.61	2.89	2.41	2.06	1.81	1.61	1.44	1.31	1.20	1.11	1.03	0.96	0.90	0.85	0.80	0.76	0.72	0.69	0.66	0.63	0.60	0.58	0.56	0.54	0.52	0.50	0.48	0.47	0.45
0.53	**4.00**	##	5.14	3.85	3.08	2.57	2.20	1.93	1.71	1.54	1.40	1.28	1.19	1.10	1.03	0.96	0.91	0.86	0.81	0.77	0.73	0.70	0.67	0.64	0.62	0.59	0.57	0.55	0.53	0.51	0.50	0.48
0.57	**4.25**	##	5.46	4.09	3.27	2.73	2.34	2.05	1.82	1.64	1.49	1.36	1.26	1.17	1.09	1.02	0.96	0.91	0.86	0.82	0.78	0.74	0.71	0.68	0.65	0.63	0.61	0.58	0.56	0.55	0.53	0.51
0.60	**4.50**	##	5.78	4.33	3.47	2.89	2.48	2.17	1.93	1.73	1.58	1.44	1.33	1.24	1.16	1.08	1.02	0.96	0.91	0.87	0.83	0.79	0.75	0.72	0.69	0.67	0.64	0.62	0.60	0.58	0.56	0.54
0.64	**4.75**	##	6.10	4.57	3.66	3.05	2.61	2.29	2.03	1.83	1.66	1.52	1.41	1.31	1.22	1.14	1.08	1.02	0.96	0.91	0.87	0.83	0.80	0.76	0.73	0.70	0.68	0.65	0.63	0.61	0.59	0.57
0.67	**5.00**	##	6.42	4.82	3.85	3.21	2.75	2.41	2.14	1.93	1.75	1.61	1.48	1.38	1.28	1.20	1.13	1.07	1.01	0.96	0.92	0.88	0.84	0.80	0.77	0.74	0.71	0.69	0.66	0.64	0.62	0.60

The following tables indicate the water use in gallons per square foot per week for each month of the year. Locate the chart for the water use category (very low, low, or moderate) and then the canopy area. The first table indicates water use for cool season turfgrass

These charts serve as a “benchmark” to evaluate water use.

Water Use Requirement (Weekly) in gallons – Cool Season Turfgrass

Water Use Reqt. for Cool Season Turfgrass at 0.70 K_p - WEEKLY

DEMAND IN GALLONS PER WEEK

FROM CIMIS STA. 157- 18 YEAR AVERAGE & WUCOLS - REGION 1

MO	Gallons/ Sq Foot / WK	SQUARE FEET OF TURF AREA																								
		100	150	200	250	300	350	400	450	500	550	600	700	750	800	850	900	950	1,000	1,050	1,100	1,150	1,200	1,250	1,300	1,350	1,400
Jan	0.1372	13.7	20.6	27.4	34.3	41.2	48	54.9	61.7	68.6	75.5	82.3	96	103	110	117	123	130	137.2	144.1	150.9	157.8	164.6	171.5	178.4	185.2	192.1
Feb	0.2191	21.9	32.9	43.8	54.8	65.7	76.7	87.6	98.6	110	120	131	153	164	175	186	197	208	219.1	230	241	251.9	262.9	273.8	284.8	295.8	306.7
Mar	0.3152	31.5	47.3	63	78.8	94.6	110	126	142	158	173	189	221	236	252	268	284	299	315.2	331	346.7	362.5	378.3	394	409.8	425.6	441.3
Apr	0.4597	46	69	91.9	115	138	161	184	207	230	253	276	322	345	368	391	414	437	459.7	482.7	505.7	528.7	551.7	574.6	597.6	620.6	643.6
May	0.5429	54.3	81.4	109	136	163	190	217	244	271	299	326	380	407	434	461	489	516	542.9	570.1	597.2	624.4	651.5	678.7	705.8	732.9	760.1
Jun	0.6312	63.1	94.7	126	158	189	221	252	284	316	347	379	442	473	505	536	568	600	631.2	662.7	694.3	725.9	757.4	789	820.5	852.1	883.6
July	0.6171	61.7	92.6	123	154	185	216	247	278	309	339	370	432	463	494	525	555	586	617.1	648	678.8	709.7	740.5	771.4	802.2	833.1	863.9
Aug	0.5448	54.5	81.7	109	136	163	191	218	245	272	300	327	381	409	436	463	490	518	544.8	572	599.3	626.5	653.7	681	708.2	735.5	762.7
Sep	0.4561	45.6	68.4	91.2	114	137	160	182	205	228	251	274	319	342	365	388	410	433	456.1	478.9	501.7	524.5	547.3	570.1	592.9	615.7	638.5
Oct	0.3215	32.1	48.2	64.3	80.4	96.4	113	129	145	161	177	193	225	241	257	273	289	305	321.5	337.5	353.6	369.7	385.8	401.8	417.9	434	450
Nov	0.1839	18.4	27.6	36.8	46	55.2	64.4	73.6	82.8	91.9	101	110	129	138	147	156	166	175	183.9	193.1	202.3	211.5	220.7	229.9	239.1	248.3	257.5
Dec	0.1263	12.6	18.9	25.3	31.6	37.9	44.2	50.5	56.8	63.2	69.5	75.8	88.4	94.7	101	107	114	120	126.3	132.6	139	145.3	151.6	157.9	164.2	170.5	176.8

WUCOLS – Very low water use category

Water Use Requirement for Very Low Water Use Ornamental Trees, Shrubs, and Groundcovers - WEEKLY
DEMAND IN GALLONS PER WEEK
FROM CIMIS - PT. SAN PEDRO - 18 YEAR AVERAGE & WUCOLS - REGION 1

		DIAMETER OF CANOPY																												
MO	Gallons/ Sq Foot / WK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		SQUARE FEET OF CANOPY																													
		0.79	3.14	7.07	12.6	19.6	28.3	38.5	50.2	63.6	78.5	95	113	133	154	177	201	227	254	283	314	346	380	415	452	491	531	572	615	660	707
Jan	0.0196	0.02	0.06	0.14	0.25	0.38	0.55	0.75	0.98	1.25	1.54	1.86	2.22	2.6	3.02	3.46	3.94	4.45	4.99	5.55	6.15	6.79	7.45	8.14	8.86	9.62	10.4	11.2	12.1	12.9	13.8
Feb	0.0313	0.02	0.1	0.22	0.39	0.61	0.88	1.2	1.57	1.99	2.46	2.97	3.54	4.15	4.82	5.53	6.29	7.1	7.96	8.87	9.83	10.8	11.9	13	14.2	15.4	16.6	17.9	19.3	20.7	22.1
Mar	0.0450	0.04	0.14	0.32	0.57	0.88	1.27	1.73	2.26	2.86	3.54	4.28	5.09	5.97	6.93	7.95	9.05	10.2	11.5	12.8	14.1	15.6	17.1	18.7	20.4	22.1	23.9	25.8	27.7	29.7	31.8
Apr	0.0657	0.05	0.21	0.46	0.82	1.29	1.86	2.53	3.3	4.18	5.16	6.24	7.42	8.71	10.1	11.6	13.2	14.9	16.7	18.6	20.6	22.7	25	27.3	29.7	32.2	34.9	37.6	40.4	43.4	46.4
May	0.0776	0.06	0.24	0.55	0.97	1.52	2.19	2.98	3.9	4.93	6.09	7.37	8.77	10.3	11.9	13.7	15.6	17.6	19.7	22	24.4	26.9	29.5	32.2	35.1	38.1	41.2	44.4	47.7	51.2	54.8
Jun	0.0902	0.07	0.28	0.64	1.13	1.77	2.55	3.47	4.53	5.73	7.08	8.56	10.2	12	13.9	15.9	18.1	20.5	22.9	25.6	28.3	31.2	34.3	37.4	40.8	44.2	47.8	51.6	55.5	59.5	63.7
July	0.0882	0.07	0.28	0.62	1.11	1.73	2.49	3.39	4.43	5.61	6.92	8.37	9.97	11.7	13.6	15.6	17.7	20	22.4	25	27.7	30.5	33.5	36.6	39.9	43.3	46.8	50.4	54.3	58.2	62.3
Aug	0.0778	0.06	0.24	0.55	0.98	1.53	2.2	2.99	3.91	4.95	6.11	7.39	8.8	10.3	12	13.7	15.6	17.7	19.8	22.1	24.4	26.9	29.6	32.3	35.2	38.2	41.3	44.5	47.9	51.4	55
Sep	0.0652	0.05	0.2	0.46	0.82	1.28	1.84	2.51	3.27	4.14	5.11	6.19	7.37	8.64	10	11.5	13.1	14.8	16.6	18.5	20.5	22.6	24.8	27.1	29.5	32	34.6	37.3	40.1	43	46
Oct	0.0459	0.04	0.14	0.32	0.58	0.9	1.3	1.77	2.31	2.92	3.6	4.36	5.19	6.09	7.07	8.11	9.23	10.4	11.7	13	14.4	15.9	17.4	19.1	20.8	22.5	24.4	26.3	28.3	30.3	32.4
Nov	0.0263	0.02	0.08	0.19	0.33	0.52	0.74	1.01	1.32	1.67	2.06	2.5	2.97	3.49	4.04	4.64	5.28	5.96	6.68	7.44	8.25	9.09	9.98	10.9	11.9	12.9	13.9	15	16.2	17.3	18.6
Dec	0.0180	0.01	0.06	0.13	0.23	0.35	0.51	0.69	0.91	1.15	1.42	1.71	2.04	2.39	2.78	3.19	3.63	4.09	4.59	5.11	5.67	6.25	6.86	7.49	8.16	8.85	9.58	10.3	11.1	11.9	12.7

WUCOLS – Low water use category

Water Use Requirement for Low Water Use Ornamental Trees, Shrubs, and Groundcovers - WEEKLY
DEMAND IN GALLONS PER WEEK
FROM CIMIS STA. 157- 18 YEAR AVERAGE & WUCOLS - REGION 1

		DIAMETER OF CANOPY																											
MO	Gallons/ Sq Foot / WK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
		SQUARE FEET OF CANOPY																												
		0.79	3.14	7.07	12.6	19.6	28.3	38.5	50.2	63.6	78.5	95	113	133	154	177	201	227	254	283	314	346	380	415	452	491	531	572	615	660
Jan	0.0392	0.03	0.12	0.28	0.49	0.77	1.11	1.51	1.97	2.49	3.08	3.72	4.43	5.2	6.03	6.92	7.88	8.89	9.97	11.1	12.3	13.6	14.9	16.3	17.7	19.2	20.8	22.4	24.1	25.9
Feb	0.0626	0.05	0.2	0.44	0.79	1.23	1.77	2.41	3.14	3.98	4.91	5.95	7.08	8.3	9.63	11.1	12.6	14.2	15.9	17.7	19.7	21.7	23.8	26	28.3	30.7	33.2	35.8	38.5	41.3
Mar	0.0901	0.07	0.28	0.64	1.13	1.77	2.55	3.46	4.52	5.73	7.07	8.55	10.2	11.9	13.9	15.9	18.1	20.4	22.9	25.5	28.3	31.2	34.2	37.4	40.7	44.2	47.8	51.5	55.4	59.5
Apr	0.1313	0.1	0.41	0.93	1.65	2.58	3.71	5.05	6.6	8.35	10.3	12.5	14.8	17.4	20.2	23.2	26.4	29.8	33.4	37.2	41.2	45.5	49.9	54.5	59.4	64.4	69.7	75.2	80.8	86.7
May	0.1551	0.12	0.49	1.1	1.95	3.04	4.38	5.97	7.79	9.86	12.2	14.7	17.5	20.6	23.9	27.4	31.2	35.2	39.5	44	48.7	53.7	58.9	64.4	70.1	76.1	82.3	88.8	95.5	102
Jun	0.1803	0.14	0.57	1.27	2.27	3.54	5.1	6.94	9.06	11.5	14.2	17.1	20.4	23.9	27.7	31.9	36.2	40.9	45.9	51.1	56.6	62.4	68.5	74.9	81.5	88.5	95.7	103	111	119
July	0.1763	0.14	0.55	1.25	2.21	3.46	4.98	6.78	8.86	11.2	13.8	16.7	19.9	23.4	27.1	31.1	35.4	40	44.8	50	55.4	61	67	73.2	79.7	86.5	93.6	101	109	116
Aug	0.1557	0.12	0.49	1.1	1.95	3.05	4.4	5.99	7.82	9.9	12.2	14.8	17.6	20.6	23.9	27.5	31.3	35.3	39.6	44.1	48.9	53.9	59.1	64.6	70.4	76.4	82.6	89.1	95.8	103
Sep	0.1303	0.1	0.41	0.92	1.64	2.56	3.68	5.01	6.55	8.29	10.2	12.4	14.7	17.3	20	23	26.2	29.6	33.1	36.9	40.9	45.1	49.5	54.1	58.9	63.9	69.2	74.6	80.2	86
Oct	0.0918	0.07	0.29	0.65	1.15	1.8	2.6	3.53	4.61	5.84	7.21	8.72	10.4	12.2	14.1	16.2	18.5	20.8	23.4	26	28.8	31.8	34.9	38.1	41.5	45.1	48.7	52.6	56.5	60.6
Nov	0.0525	0.04	0.16	0.37	0.66	1.03	1.48	2.02	2.64	3.34	4.12	4.99	5.94	6.97	8.08	9.28	10.6	11.9	13.4	14.9	16.5	18.2	20	21.8	23.8	25.8	27.9	30.1	32.3	34.7
Dec	0.0361	0.03	0.11	0.25	0.45	0.71	1.02	1.39	1.81	2.29	2.83	3.43	4.08	4.79	5.55	6.37	7.25	8.19	9.18	10.2	11.3	12.5	13.7	15	16.3	17.7	19.2	20.7	22.2	23.8

WUCOLS – Moderate water use category

Water Use Reqt. for Moderate Water Use Ornamental Trees, Shrubs, and Groundcovers - WEEKLY DEMAND IN GALLONS PER WEEK FROM CIMIS STA. 157- 18 YEAR AVERAGE & WUCOLS - REGION 1

		DIAMETER OF CANOPY																												
MO	Gallons/ Sq Foot / WK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		SQUARE FEET OF CANOPY																													
		0.79	3.14	7.07	12.6	19.6	28.3	38.5	50.2	63.6	78.5	95	113	133	154	177	201	227	254	283	314	346	380	415	452	491	531	572	615	660	707
Jan	0.0784	0.06	0.25	0.55	0.98	1.54	2.22	3.02	3.94	4.99	6.15	7.45	8.86	10.4	12.1	13.8	15.8	17.8	19.9	22.2	24.6	27.1	29.8	32.6	35.5	38.5	41.6	44.9	48.3	51.8	55.4
Feb	0.1252	0.1	0.39	0.88	1.57	2.46	3.54	4.82	6.29	7.96	9.83	11.9	14.2	16.6	19.3	22.1	25.2	28.4	31.8	35.5	39.3	43.3	47.6	52	56.6	61.4	66.4	71.6	77	82.6	88.4
Mar	0.1801	0.14	0.57	1.27	2.26	3.54	5.09	6.93	9.05	11.5	14.1	17.1	20.4	23.9	27.7	31.8	36.2	40.9	45.8	51	56.6	62.4	68.4	74.8	81.4	88.4	95.6	103	111	119	127
Apr	0.2627	0.21	0.82	1.86	3.3	5.16	7.42	10.1	13.2	16.7	20.6	25	29.7	34.9	40.4	46.4	52.8	59.6	66.8	74.4	82.5	90.9	99.8	109	119	129	139	150	162	173	186
May	0.3102	0.24	0.97	2.19	3.9	6.09	8.77	11.9	15.6	19.7	24.4	29.5	35.1	41.2	47.7	54.8	62.3	70.4	78.9	87.9	97.4	107	118	129	140	152	165	178	191	205	219
Jun	0.3607	0.28	1.13	2.55	4.53	7.08	10.2	13.9	18.1	22.9	28.3	34.3	40.8	47.8	55.5	63.7	72.5	81.8	91.7	102	113	125	137	150	163	177	191	206	222	238	255
July	0.3526	0.28	1.11	2.49	4.43	6.92	9.97	13.6	17.7	22.4	27.7	33.5	39.9	46.8	54.3	62.3	70.9	80	89.7	99.9	111	122	134	146	159	173	187	202	217	233	249
Aug	0.3113	0.24	0.98	2.2	3.91	6.11	8.8	12	15.6	19.8	24.4	29.6	35.2	41.3	47.9	55	62.6	70.6	79.2	88.2	97.7	108	118	129	141	153	165	178	192	206	220
Sep	0.2606	0.2	0.82	1.84	3.27	5.11	7.37	10	13.1	16.6	20.5	24.8	29.5	34.6	40.1	46	52.4	59.1	66.3	73.9	81.8	90.2	99	108	118	128	138	149	160	172	184
Oct	0.1837	0.14	0.58	1.3	2.31	3.6	5.19	7.07	9.23	11.7	14.4	17.4	20.8	24.4	28.3	32.4	36.9	41.7	46.7	52.1	57.7	63.6	69.8	76.3	83.1	90.1	97.5	105	113	121	130
Nov	0.1051	0.08	0.33	0.74	1.32	2.06	2.97	4.04	5.28	6.68	8.25	9.98	11.9	13.9	16.2	18.6	21.1	23.8	26.7	29.8	33	36.4	39.9	43.6	47.5	51.6	55.8	60.1	64.7	69.4	74.2
Dec	0.0722	0.06	0.23	0.51	0.91	1.42	2.04	2.78	3.63	4.59	5.67	6.86	8.16	9.58	11.1	12.7	14.5	16.4	18.4	20.5	22.7	25	27.4	30	32.6	35.4	38.3	41.3	44.4	47.7	51

The Situation – The intent of the workshops was to address some of the more serious irrigation challenges you now face with restrictive watering guidelines and to offer solutions. The reality is that with the solutions we have offered, you will have irrigation problems you have not previously encountered!

Designated Watering Day by City for Overhead Irrigation

Monday	Tuesday	Wednesday	Thursday	Friday
• Ross • Tiburon • Belvedere • San Geronimo • Forest Knolls • Lagunitas	• San Rafael • All other unincorporated areas in Marin County	• San Quentin • Sausalito • Corte Madera • San Anselmo	• Mill Valley	• Woodacre • Larkspur • Fairfax • Greenbrae • Kentfield

No overhead irrigation is allowed on Saturdays and Sundays and no watering between the hours of 9:00 a.m. and 7:00 p.m.!

The One Thing -

The irrigation systems you managed and those you have installed were never intended to water within such a narrow watering window.

There will be hydraulic limitations that prevent you from Implementing the scheduling we have proposed. Also, the continuous cycling to avoid runoff will introduce new problems.

Three learning Objectives Today!

Learning Objective 1

At the completion of this objective, the participant will understand how to spot problems with low sprinkler head drainage, how to measure the potential loss and renovation techniques to resolve the problem.

Learning Objective 2

At the completion of this learning objective, the participants will understand how to determine the maximum water that may be delivered and balance that to the square footage of the irrigated landscape.

Learning Objective 3

At the conclusion of this webinar the participant will learn how to create a temporary drip system for turf areas which will significantly improve the Irrigation efficiency and allow twice weekly watering.

Let’s get started!

Learning Objective 1

At the completion of this objective, the participant will understand how to spot problems with low sprinkler head drainage, how to measure the potential loss and renovation techniques to resolve the problem.

The recommendation for multiple cycling of overhead sprinklers to avoid runoff will create problems with drainage out of low sprinkler heads!

What does runoff look like?


STOP

Irrigation runoff can occur on what seems to be “flat” surfaces!

So we know what runoff is, then how is it traditionally controlled.

By shutting irrigation water off when the intake rate of the soil has been exceeded and letting a “soak” occur, then watering multiple repeat cycles.

Infiltration Rates by Soil Texture Class

Soil Texture	Available water in/in	Infiltration in/hr
Fine		
Sandy clay	0.12	0.08 - 0.20
Silty clay	0.15	0.05 - 0.15
Clay	0.14	0.05 - 0.10

Soils with a high clay content have a low intake rate. Turf growing in clay textured soil that is flat can take in water at a rate between 0.05 and 0.10 inches / hr

How soon during an irrigation cycle does runoff occur on clay soil (flat surface)?

Answer – It depends on the sprinklers!!!

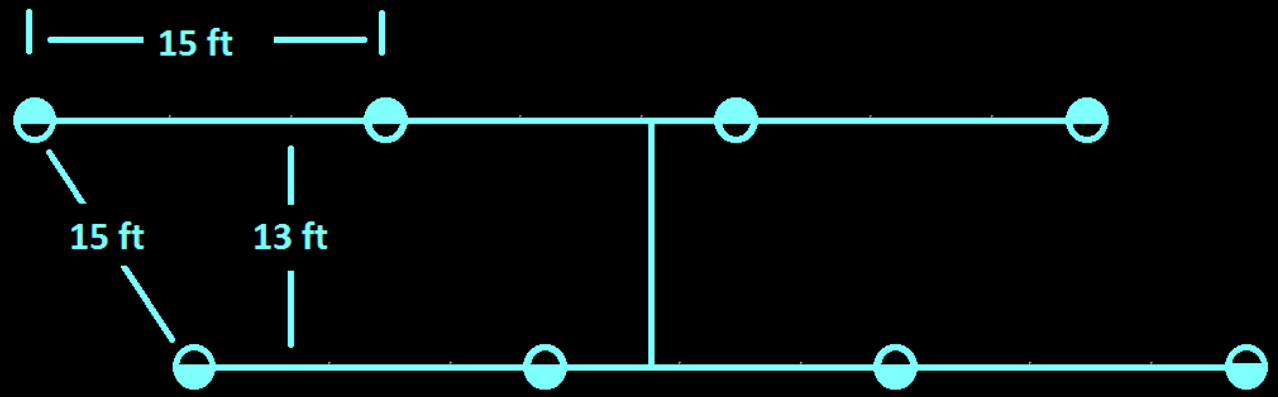
We must know the precipitation rate of the sprinklers

15 Series MPR

30° Trajectory ■ ▲

Nozzle	Pressure psi	Radius ft.	Flow GPM	Precip In/h ■	Precip In/h ▲
15F	15	11	2.60	2.07	2.39
	20	12	3.00	2.01	2.32
	25	14	3.30	1.62	1.87
	30	15	3.70	1.58	1.83
15H	15	11	1.30	2.07	2.39
	20	12	1.50	2.01	2.32
	25	14	1.65	1.62	1.87
	30	15	1.85	1.58	1.83

At 30 psi and triangular spacing the 15 ft spray has a 1.83” / hr precip. Rate.



We can calculate the maximum run time on clay in minutes as follows…

$$\frac{\text{IR (infiltration rate)}}{\text{PR (precip rate)}} \times 60 \text{ (constant)} = \text{max minutes run time}$$

$$\frac{0.10}{1.83} = 0.055 \text{ hrs} \quad \times 60 = 3.28 \text{ min or } 4 \text{ min}$$

4 minutes

We must know the precipitation rate of the sprinklers

15 Series MPR

30° Trajectory ■ ▲

Nozzle	Pressure psi	Radius ft.	Flow GPM	Precip In/h ■	Precip In/h ▲
15F	15	11	2.60	2.07	2.39
	20	12	3.00	2.01	2.32
	25	14	3.30	1.62	1.87
	30	15	3.70	1.58	1.83
15H	15	11	1.30	2.07	2.39
	20	12	1.50	2.01	2.32
	25	14	1.65	1.62	1.87
	30	15	1.85	1.58	1.83

At 30 psi and square spacing the 15 ft spray has a 1.58” / hr precip. rate

We can calculate the maximum run time on clay in minutes as follows…

$$\frac{\text{IR (infiltration rate)}}{\text{PR (precip rate)}} \times 60 \text{ (constant)} = \text{max minutes run time}$$

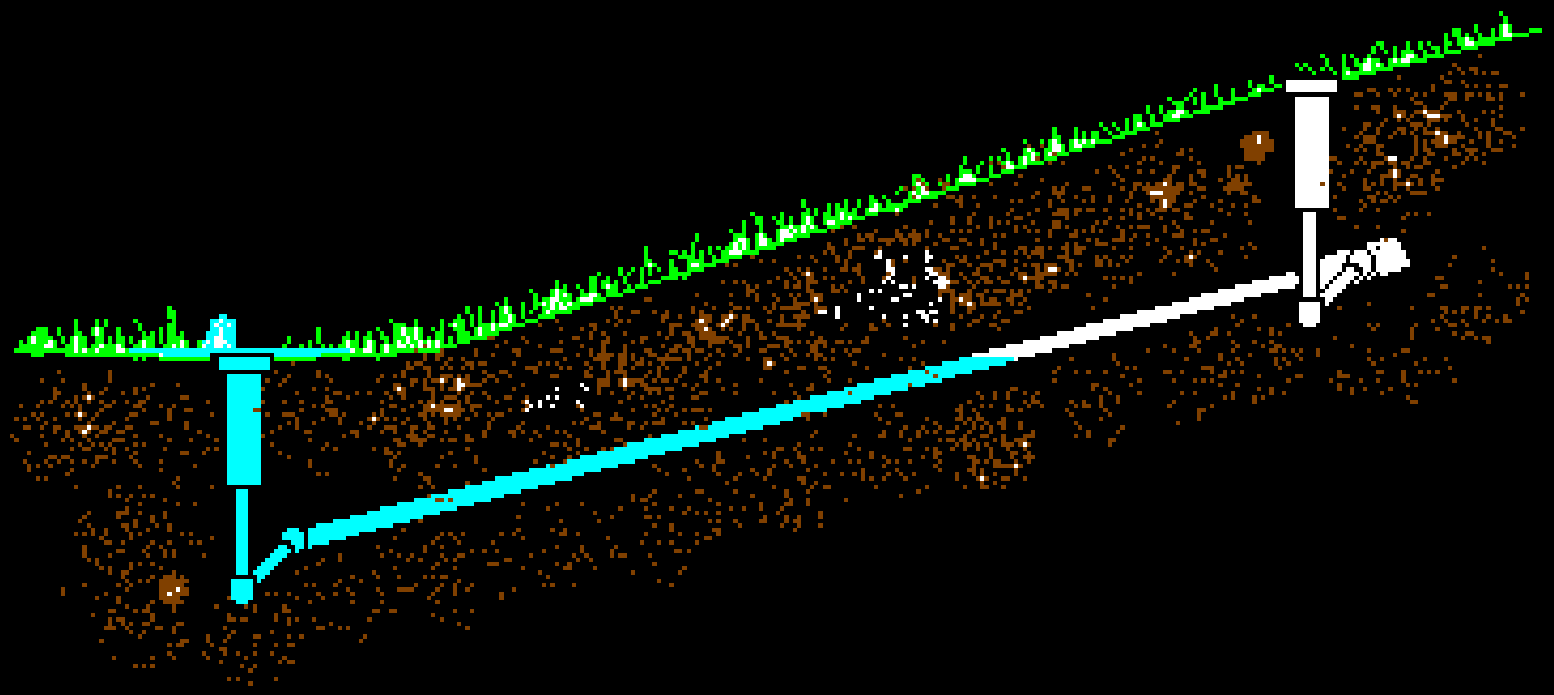
$$\frac{0.10}{1.58} = 0.063 \text{ hrs} \quad \times 60 = 3.79 \text{ min or } 4 \text{ min}$$

4 minutes

The problem in Marin is that in the peak months , eight, four-minute cycle may not be enough water with lower precip. rate sprays or the controller may not offer enough repeats so we may have to push to five minutes on clay soils.

In months of lower irrigation demand, drop maximum cycle length to 4 minutes on clay soils when using sprays!

Multiple cycling to avoid runoff causes water waste when water drains out the sprinkler heads after each automatic cycle



The elevation difference in the laterals can create water pressure that causes drainage out the lowest heads

This water that is running off the landscape could also be polluted with chemicals applied to the landscape

There is a slight rise in pressure, due to the elevation difference which approximately 1 – 2 psi in this case.

And aside from the hazard to our waterways, significant damage can be caused to the hardscape

And there is a way to calculate the volume of water that is being lost

The morning after the irrigation cycle, proceed to the water meter and take a reading or a picture with your phone.

Proceed to the valve box controlling the area and bleed the valve manually. Let it run until all the air bleed out, then shut if off immediately.

A fair amount of air will escape from the sprinkler nozzles,. As soon as the circuit comes to pressure, shut the valve off. Return and read the meter.

after

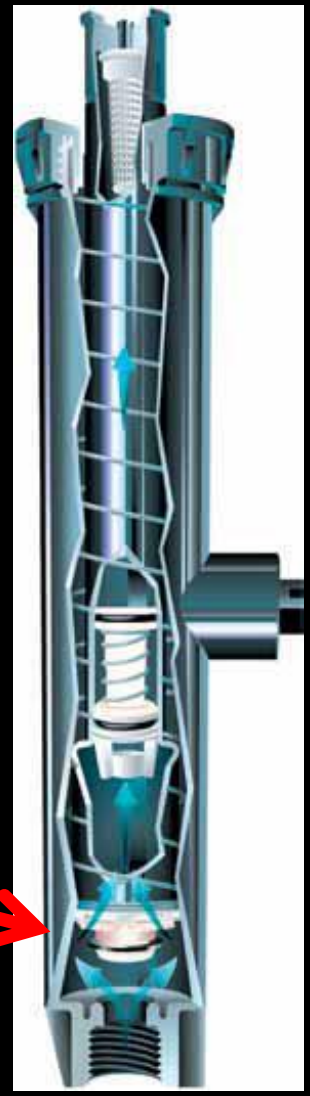
before

The loss here is 7.4 cubic feet or 55 gallons (7.48 x 7.4). Each night with five cycles 275 gallons is lost. In 5 years the loss on this valve would be 137,000 gallons!!!

The solution…

Low head drainage solution…
(check valves in the base of all sprinklers)

check valve to prevent low head drainage *(use for retrofits & mandatory for new projects)*



But remember, multiple cycling to avoid runoff disables the seasonal adjust feature
Here’s what you can do about it!

The ideal number of cycle starts in August in the Marin area to avoid runoff on clay with spray heads is 8 starts which would typically require the use of two programs.

DAYS/WEEK TO WATER	M	T	W	T	F	S	S
SPECIAL INTERVAL TO WATER							

PROGRAM START TIMES			
	1		pm
	2		pm
	3		am
	4		

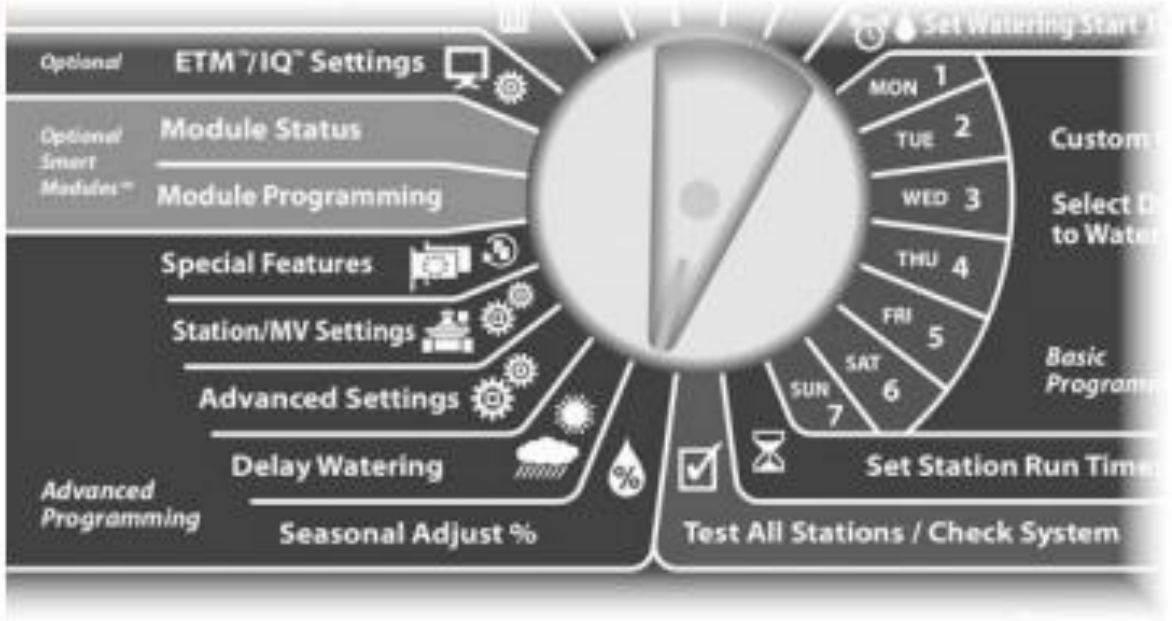
PROGRAM A

STA.		SQ. FT	GPM	PR	RUN TIME	CYCLES	TOTAL RUN GAL.
1							
2							

Controller limitation!!! – The % or Water budget key becomes a meaningless feature with sprays when the run time is reduced to 4 minutes!

Adjust Individual Program

Turn the controller dial to Seasonal Adjust %.



1. The Seasonal Adjust screen appears with Individual PGM selected; press Next.
2. Press the + and – buttons to set the seasonal adjustment percentage (from 0 - 300%).

It’s a math problem most controllers can’t resolve

Most controllers water in even 1 minute increments. Let’s assume a valve has a 4 minute run time so a reduction of one minute (from 4 to 3 minutes) is a 25% change in water applied

A -10% water budget adjustment on a 4 minute spray head run time does not change water time! Punch the buttons all you want, nothing happens!!!

The best way to change total run time is to reduce total watering by eliminating a start time.

WATERING SCHEDULE FORM EXAMPLE

		PROGRAM A							PROGRAM B							PROGRAM C						
DAY OF THE WEEK		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
ODD/ EVEN or INTERVAL																						
PROGRAM START TIMES	1	Start 1 – 12:30 am							Start 1 – 6:00 am													
	2	Start 2 – 2:00 am							Start 2 – 9:00 pm													
	3	Start 3– 3:30 am							Start 3 – 10:00 pm													
	4	Start 4 – 5:00 am							Start 4 – 11:00 pm													
STATION	LOCATION	STATION RUN TIME							STATION RUN TIME							STATION RUN TIME						
1		4 min							4 min													
2		4 cycle x 4 min = 16 min							4 cycle x 3 min = 16 min													

The best way to change total run time is to reduce total watering by eliminating a start time.

WATERING SCHEDULE FORM EXAMPLE

		PROGRAM A							PROGRAM B							PROGRAM C						
DAY OF THE WEEK		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
ODD/ EVEN or INTERVAL																						
PROGRAM START TIMES	1	Start 1 – 12:30 am							Start 1 – 6:00 am													
	2	Start 2 – 2:00 am							Start 2 – 9:00 pm													
	3	Start 3– 3:30 am							Start 3 – 10:00 pm													
	4	Start 4 – 5:00 am																				
STATION	LOCATION	STATION RUN TIME							STATION RUN TIME							STATION RUN TIME						
1		4 min							4 min													
2		4 cycle x 4 min = 16 min							3 cycle x 4 min =							12 min						

By reducing start times from 8 to 7 cycles, the overall total run time on Tuesday is reduced from 32 minutes to 28 which is a 10% reduction!

So, with sprays (4 min max. run)
the % key is disabled

Instead adjust total run times by reducing start times.

The final problem is not created by cycling but in water conserving scheduling is often overlooked

Runoff that occurs with drip/low volume irrigation

Runoff after 5 minutes on clay soils with “line source” drip

Run off from point source drip in Chandler, AZ

Dying plant material and damaged hardscape due to drip runoff – University of Nevada

Once again, match clay soil intake rates of 0.10” / hr to the precipitation rate of the drip

Maximum run times for various sprinkler types on flat clay surfaces with vegetation. We are stretching to 5 min. due to irrigation controller flexibility issues.

Another issue is the tendency to complete watering sooner by activating multiple valves which drops pressure.

Learning Objective 2

At the completion of this learning objective, the participants will understand how to determine the maximum water that may be delivered and balance that to the square footage of the irrigated landscape.

Water meters have a maximum capacity for flow, which, when exceeded, can damage the meter and cause excessive pressure loss which hurts sprinkler performance.


LP
Cubic Feet

Want more information on how to read a meter

Visit “you tube” as there are many videos to be found

The following charts allow a quick conversion of cubic feet to gallons per minute or gallons per hour.

This chart converts cubic feet for residential meters (5/8”, ¾”, and 1” where each full revolution of the meter needle is 1 cubic foot (7.48 gallons)

Residential Meters 5/8" - 3/4" - 1"				(METER FLOW CONVERSION CHART)					
CFM	GPM	GPH	CFM	GPM	GPH	CFM	GPM	GPH
0.03	0.25	15	0.74	5.50	330	1.40	10.50	630
0.07	0.50	30	0.70	5.25	315	1.44	10.75	645
0.10	0.75	45	0.74	5.50	330	1.47	11.00	660
0.13	1.00	60	0.77	5.75	345	1.50	11.25	675
0.17	1.25	75	0.80	6.00	360	1.54	11.50	690
0.20	1.50	90	0.84	6.25	375	1.57	11.75	705
0.23	1.75	105	0.87	6.50	390	1.60	12.00	720
0.27	2.00	120	0.90	6.75	405	1.64	12.25	735
0.30	2.25	135	0.94	7.00	420	1.67	12.50	750
0.33	2.50	150	0.97	7.25	435	1.70	12.75	765
0.37	2.75	165	1.00	7.50	450	1.74	13.00	780
0.40	3.00	180	1.04	7.75	465	1.77	13.25	795
0.43	3.25	195	1.07	8.00	480	1.80	13.50	810
0.47	3.50	210	1.10	8.25	495	1.84	13.75	825
0.50	3.75	225	1.14	8.50	510	1.87	14.00	840
0.53	4.00	240	1.17	8.75	525	1.91	14.25	855
0.57	4.25	255	1.20	9.00	540	1.94	14.50	870
0.60	4.50	270	1.24	9.25	555	1.97	14.75	885
0.64	4.75	285	1.34	10.00	600	2.01	15.00	900
0.67	5.00	300	1.37	10.25	615	2.04	15.25	915

This chart converts cubic feet for commercial meters (1 ½” and larger) where each full revolution of the meter needle is 10 cubic feett (74.8 gallons)

Commercial Meters - 1 1/2" - 2"				(METER FLOW CONVERSION CHART)		
CFM	GPM	GPH		CFM	GPM	GPH
0.010	0.75	45		0.210	15.72	943
0.020	1.50	90		0.220	16.47	988
0.030	2.25	135		0.230	17.22	1033
0.040	2.99	180		0.240	17.96	1078
0.050	3.74	225		0.250	18.71	1123
0.060	4.49	269		0.260	19.46	1168
0.070	5.24	314		0.270	20.21	1213
0.080	5.99	359		0.280	20.96	1257
0.090	6.74	404		0.290	21.71	1302
0.100	7.49	449		0.300	22.46	1347
0.110	8.23	494		0.310	23.20	1392
0.120	8.98	539		0.320	23.95	1437
0.130	9.73	584		0.330	24.70	1482
0.140	10.48	629		0.340	25.45	1527
0.150	11.23	674		0.350	26.20	1572
0.160	11.98	719		0.360	26.95	1617
0.170	12.72	763		0.370	27.69	1662
0.180	13.47	808		0.380	28.44	1707
0.190	14.22	853		0.390	29.19	1751
0.200	14.97	898		0.400	29.94	1796

Water meters are also rated for a maximum flow by the AWWA

Size	Maximum Flow
5/8"	15
3/4"	22
1"	37
1 1/2"	75
2"	120
3"	225

These flows are the maximum safe flows regardless of the level of water pressure

Remember that just as the irrigation controller can have limitations so too with the water meter!

When most irrigation systems were designed it was thought they would water 3 to 5 days per week!

There is a physical limitation to the water that can be delivered to the landscape in a 1 day per week watering restriction!

- Watering one day per week at 12 hrs per day would equal 720 minutes of water time! (60 x 12 = 720)

The gallons of water that can safely be delivered to the site in 720 minutes / week

Meter Size	Max Flow	Deliverable Water 12 hrs
5/8"	15	10,800
3/4"	22	15,840
1"	37	26,640
1 1/2"	75	54,000
2"	120	86,400

This maximum amount of water that may be delivered in a week can be compared to a turf water requirement for a week in the month of August

Meter Size	Max Flow	Deliverable Water 12 hrs	Maximum Turf area at 75% capacity - sq. ft.
5/8"	15	10,800	14,944
3/4"	22	15,840	21,918
1"	37	26,640	36,863
1 1/2"	75	54,000	74,722
2"	120	86,400	119,555

Resist the temptation to activate multiple valves, you'll have enough water in 12 hrs.

The problem is the depletion of soils moisture in 6 days, so if you want to water more often, you'll have to convert turf to drip.

Learning Objective 3

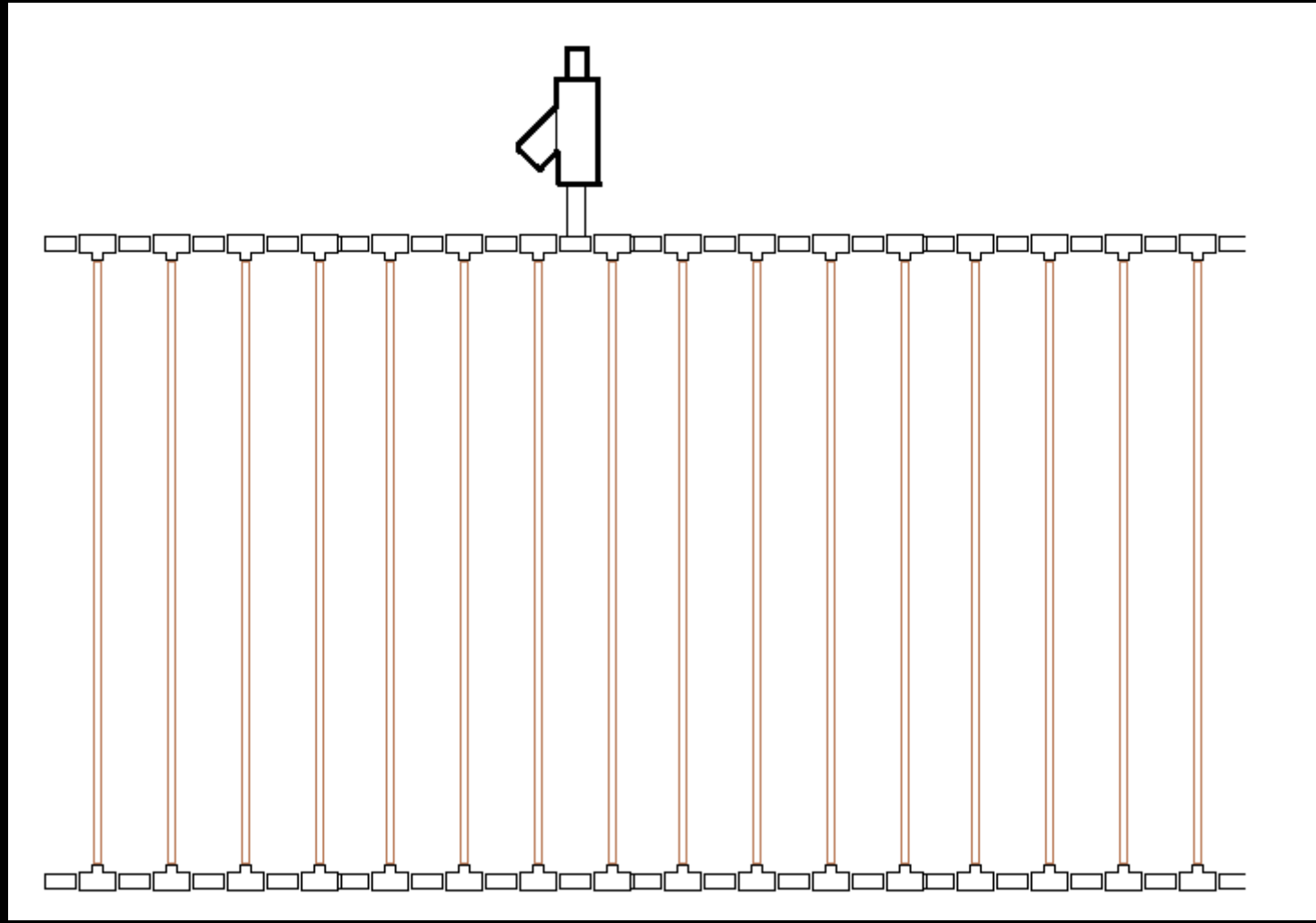
At the conclusion of this webinar the participant will learn how to create a temporary drip system for turf areas which will significantly improve the Irrigation efficiency and allow twice weekly watering.

Linear drip can be used to irrigate turf but scheduling is critical!
You must know the application rate.

TECHLINE CV	TURF												
	CLAY SOIL			LOAM SOIL			SANDY SOIL			COARSE SOIL			
EMITTER FLOW	0.26 GPH			0.4 GPH			0.6 GPH			0.9 GPH			
EMITTER SPACING	18"			12"			12"			12"			
LATERAL (ROW) SPACING	18"	20"	22"	12"	14"	18"	12"	14"	18"	12"	14"	16"	
BURIAL DEPTH	Bury evenly throughout the zone from 4" to 6"												
APPLICATION RATE (INCHES/HOUR)	0.19	0.17	0.15	0.64	0.55	0.43	0.98	0.84	0.65	1.48	1.27	1.11	
TIME TO APPLY ¼" OF WATER (MINUTES)	80	89	97	23	27	35	15	18	23	10	12	13	
Following these maximum spacing guidelines, emitter flow selection can be increas 0.9 GPH flow rate available for areas requiring higher infiltration rates, such													

Note: 0.4, 0.6 and 0.9 GPH are nominal flow rates. Actual flow rates used in the calculations are 0.4

Temporary, surface installed linear drip on turf . Hose Fed – 10 gpm max. .
Utilize 0.4 gph tubing on a 12” x 12” grid. Application rate is 0.642.
Maximum areais 1,500 sq. ft



Irrigate for 90 minutes per week in August!

Let’s review and get to questions!

Learning Objective 1

At the completion of this objective, the participant will understand how to spot problems with low sprinkler head drainage, how to measure the potential loss and renovation techniques to resolve the problem.

Learning Objective 2

At the completion of this learning objective, the participants will understand how to determine the maximum water that may be delivered and balance that to the square footage of the irrigated landscape.

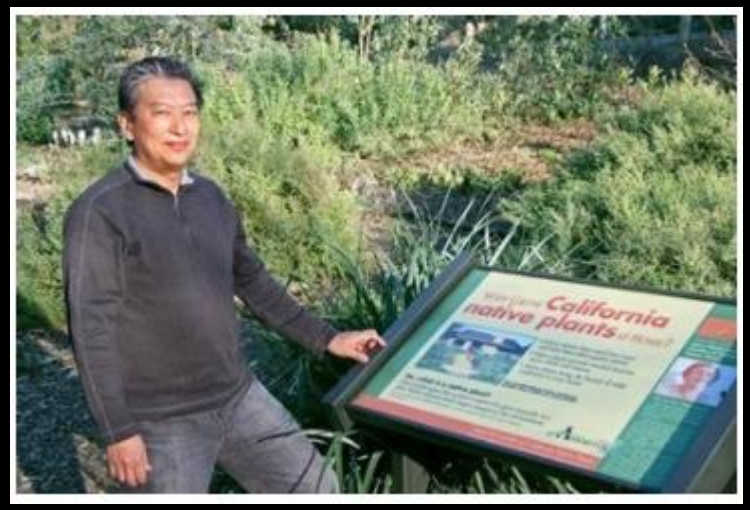
Learning Objective 3

At the conclusion of this webinar the participant will learn how to create a temporary drip system for turf areas which will significantly improve the Irrigation efficiency and allow twice weekly watering.

The One Thing -

The irrigation systems you managed and those you have installed were never intended to water within such a narrow watering window.

There will be hydraulic limitations that prevent you from Implementing the scheduling we have proposed. Also, the continuous cycling to avoid runoff will introduce new problems.



Dave Fujino - Ph. D. – Director
California Center for Urban Horticulture at U.C. Davis

UCDAVIS
California Center for
Urban Horticulture

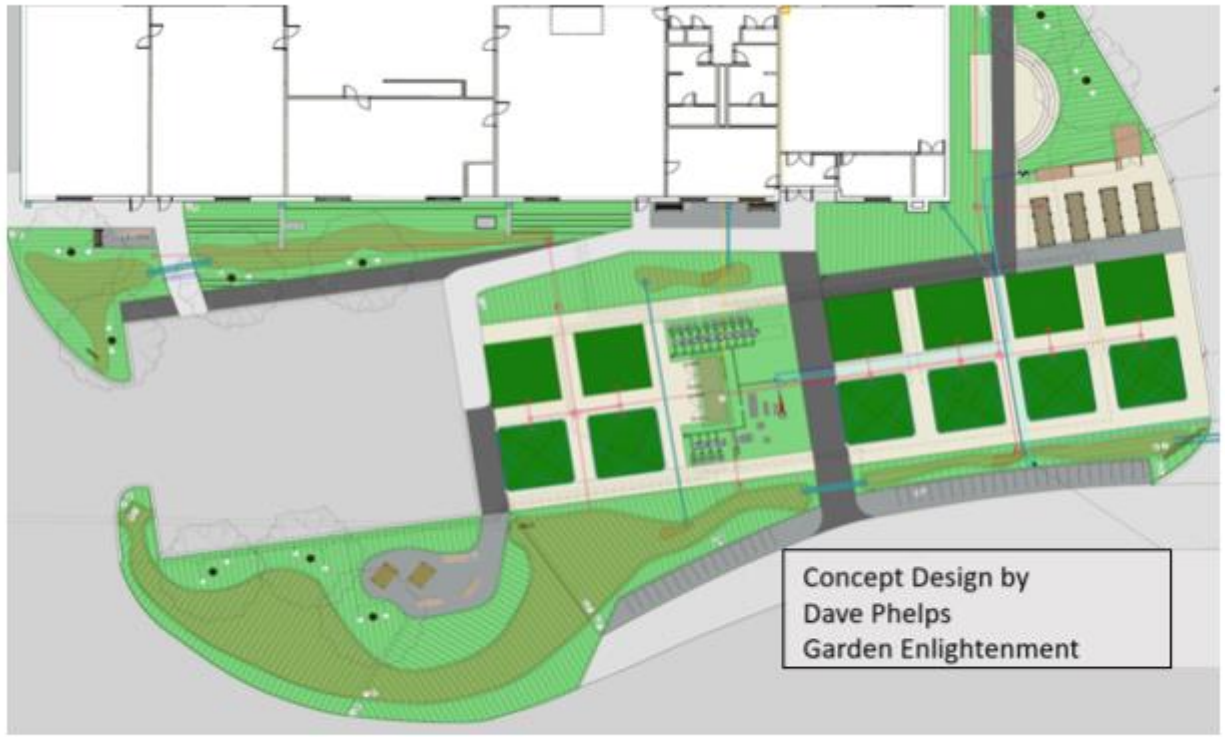
ccuh.ucdavis.edu

Apps | www.mail@ewing1.... | Huesitos Landscapi... | New Tab | Spears® Super Sou... | 2017-10 - HDPE Tra... | Email | 2017 - Ocotillo Golf... | Army Depot Park M... | Reading li

UCDAVIS California Center for Urban Horticulture

California Center for Urban Horticulture

BEFORE: SmartLandscape site at WCAE



Conceptual Design: July 2019

Industry Partners

Individual Partners

Individual Partners

•Elizabeth Traynham Estate

Marin Municipal Water District

Presented by
Jim Borneman - Ewing Irrigation and Landscape Supply
(retired) jborneman@ewingirrigation.com

Ewing Irrigation & Landscape Supply