Section 8

IRRIGATION SCHEDULING

LEARNING OBJECTIVES

1. Understand the concept of irrigation scheduling
2. Know how to determine irrigation run time
3. Know how to develop on irrigation schedule
4. Tools to assist with monitoring and adjustment

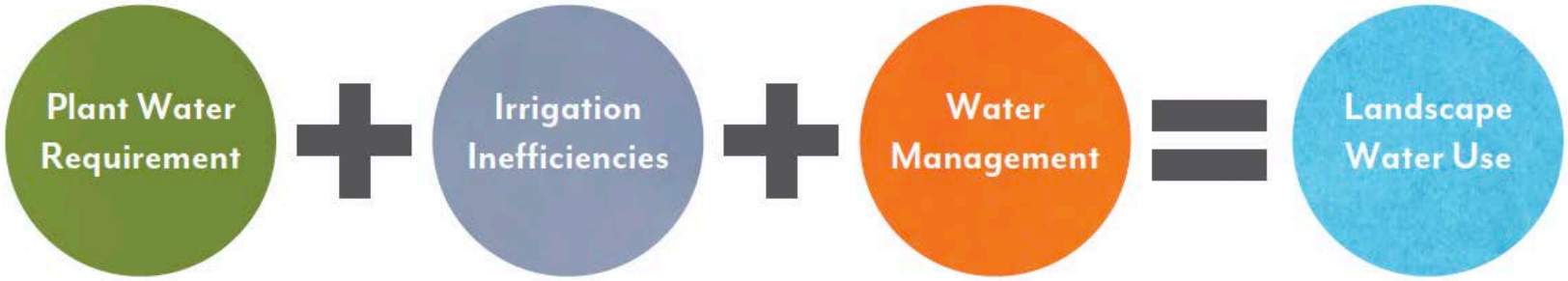
1. IRRIGATION SCHEDULING CONCEPT

- Understand the concept of irrigation scheduling

1.1-1.3 IRRIGATION SCHEDULING CONCEPT

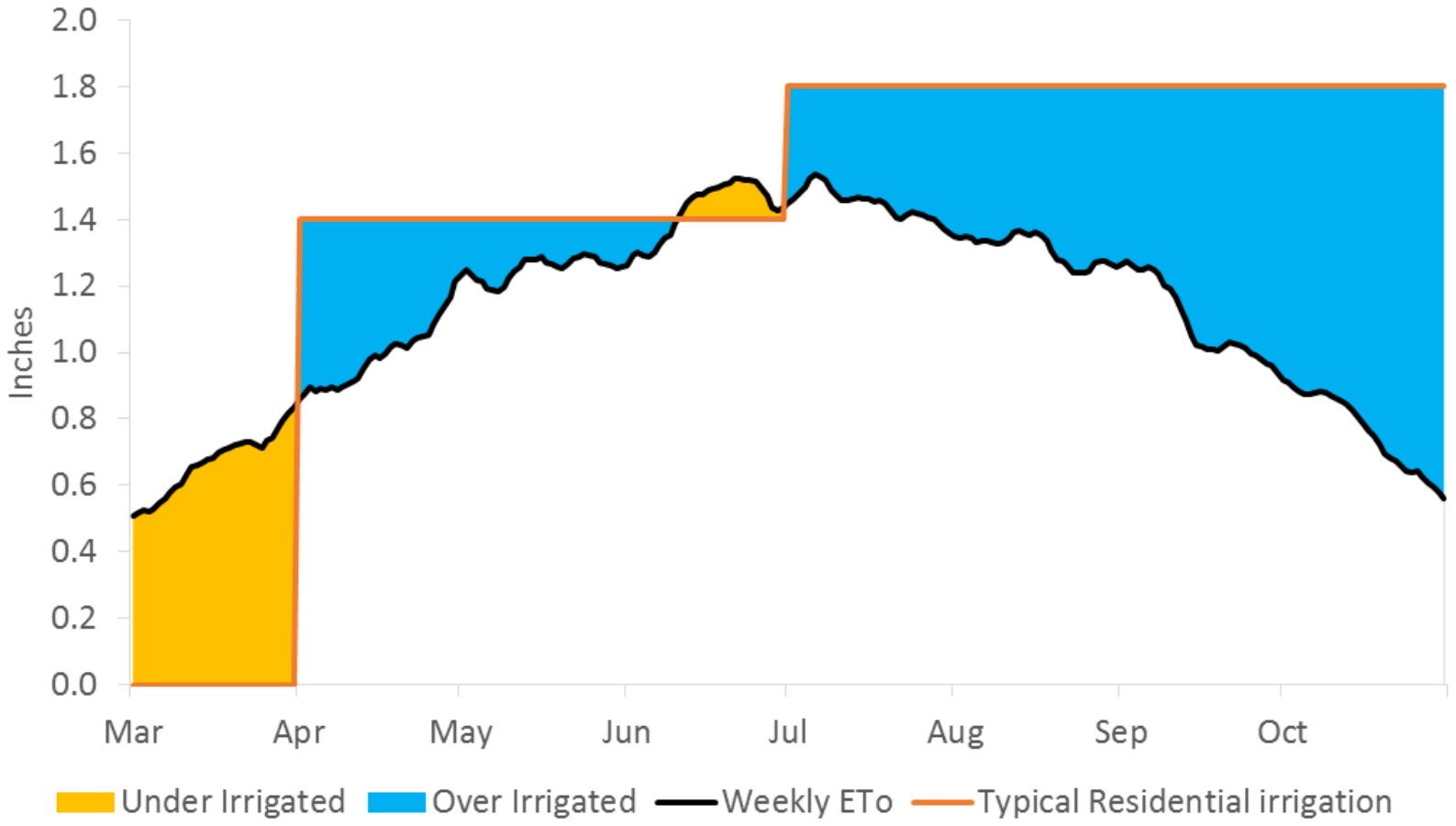
- Irrigation scheduling involves developing a plan for the operation of the irrigation system
- Important for conventional and weather based irrigation controllers
- Not an exact science
- Involves management decisions

1.4 WATER MANAGEMENT



- Three elements to saving water in the landscape
- Water management – optimize the beneficial use of water in the landscape
- Need for someone to actively oversee landscape irrigation and plant health to fully realize water savings

1.4 WATER MANAGEMENT



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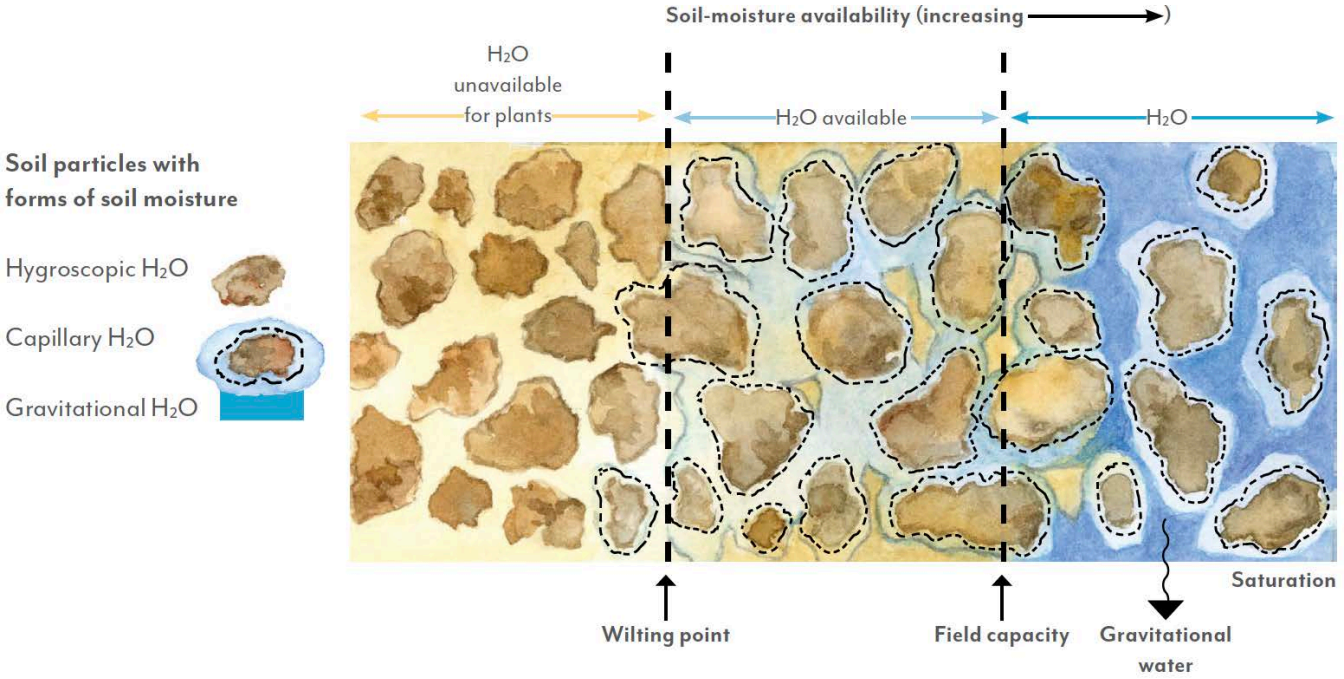
1.5 SOIL MOISTURE RESERVOIR

- Maintain soil moisture between field capacity and wilting point
- Management allowable depletion (MAD) = threshold to trigger irrigation
- Root depth determines depth of soil moisture reservoir
- Soil type determines application rate and frequency



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2. IRRIGATION RUN TIME

- Know how to determine irrigation run time

2.1 PLANT WATER REQUIREMENT (PWR)

- Determine how much water the plants in the landscape need
- Use weekly ETo to generate a weekly schedule

PWR = Weather x Plant Type

PWR = ETo x PF

2.2 RUN TIME MULTIPLIER (RTM)

- The Run Time Multiplier (RTM) is used to adjust the irrigation water requirement for irrigation system inefficiencies

$$RTM = 1 \div [0.4 + (0.6 \times DU_{LQ})]$$

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2.3 IRRIGATION WATER REQUIREMENT (IWR)

- Multiply the PWR by the RTM to calculate the Irrigation Water Requirement (IWR)

IWR = PWR x RTM

2.4-2.5 LOWER & UPPER BOUNDARY

- PWR and IWR provide lower and upper boundaries for the amount of water to apply
- Divide by precipitation rate (PR)
- Multiply by 60 to convert to minutes

Lower Boundary = (PWR ÷ PR) x 60

Upper Boundary = (IWR ÷ PR) x 60

2.6 EXAMPLE: WEEKLY RUN TIME

Plant Type			Low Water Use Plants	Moderate Plants	Cool Season Turf	Cool Season Turf
Irrigation Type			Inline Drip	Inline Drip	Rotating Sprinklers	Fixed Spray Sprinklers
Plant Factor, Distribution Uniformity & Precipitation Rate			PF 0.3, DU 0.9, PR 0.5 in / hr	PF 0.5, DU 0.9, PR 0.5 in / hr	PF 0.8, DU 0.7, PR 0.5 in / hr	PF 0.8, DU 0.6, PR 1.5 in / hr
Month	Monthly ETo (inches)	Weekly ETo (inches)	Weekly Run Time Lower / Upper Boundary (minutes)			
Apr	4.20	0.98	35 / 38	59 / 63	94 / 115	31 / 41
May	5.58	1.26	45 / 48	76 / 80	121 / 148	40 / 53
Jun	6.30	1.47	53 / 56	88 / 94	141 / 172	47 / 62
Jul	6.51	1.47	53 / 56	88 / 94	141 / 172	47 / 62
Aug	5.89	1.33	48 / 51	80 / 85	128 / 156	43 / 56
Sep	4.50	1.05	38 / 40	63 / 67	101 / 123	34 / 44
Oct	3.10	0.7	25 / 27	42 / 45	67 / 82	22 / 29

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3. IRRIGATION SCHEDULING

- Know how to develop on irrigation schedule

3.1-3.2 MANAGEMENT DECISIONS

- Determine:
  - How many days to water
  - How long to water each day
  - How many start times to use
  - At what time of day to irrigate
- Understand controller limitations and the requirements of the landscape plants
  - Time to runoff
  - Number of start times and programs available
  - Cycle and soak
  - Root depth
  - Soil infiltration rate
  - Wind and heat

3.3 NUMBER OF DAYS TO IRRIGATE

	Example Root Depth	Cool (ETo < 0.5-inch)	Warm (ETo 0.6-1.0-inch)	Hot (ETo > 1-inch)
Turf	6-inches	1 – 2 days	2 – 3 days	3 – 7 days
Annuals	8-inches	2 – 3 days	3 – 5 days	4 – 7 days
Shrubs	12-inches	Every 2 weeks	Every week	2 – 4 days
Trees	24-inches	None	Every 2 months	Every month

3.4 EXAMPLE: DAYS TO IRRIGATE

Plant Type			Low Water Use Plants	Moderate Plants	Cool Season Turf	Cool Season Turf
Irrigation Type			Inline Drip	Inline Drip	Rotating Sprinklers	Fixed Spray Sprinklers
Plant Factor, Distribution Uniformity & Precipitation Rate			PF 0.3, DU 0.9, PR 0.5 in / hr	PF 0.5, DU 0.9, PR 0.5 in / hr	PF 0.8, DU 0.7, PR 0.5 in / hr	PF 0.8, DU 0.6, PR 1.5 in / hr
Month	Monthly ETo (inches)	Weekly ETo (inches)	Weekly Run Time Lower / Upper Boundary (minutes)			
Apr	4.20	0.98	1	1	2	3
May	5.58	1.26	1	2	3	3
Jun	6.30	1.47	1	2	4	4
Jul	6.51	1.47	1	2	4	4
Aug	5.89	1.33	1	2	3	3
Sep	4.50	1.05	1	2	2	3
Oct	3.10	0.7	1	1	2	2

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3.5 DAILY RUN TIME

- Divide the weekly irrigation run time by the number of days to irrigate to determine the daily run time

Daily Run Time = Weekly Run Time ÷ Number of Days to Irrigate

3.6 EXAMPLE: DAILY RUN TIME

Plant Type			Low Water Use Plants	Moderate Plants	Cool Season Turf	Cool Season Turf
Irrigation Type			Inline Drip	Inline Drip	Rotating Sprinklers	Fixed Spray Sprinklers
Plant Factor, Distribution Uniformity & Precipitation Rate			PF 0.3, DU 0.9, PR 0.5 in / hr	PF 0.5, DU 0.9, PR 0.5 in / hr	PF 0.8, DU 0.7, PR 0.5 in / hr	PF 0.8, DU 0.6, PR 1.5 in / hr
Month	Monthly ETo (inches)	Weekly ETo (inches)	Weekly Run Time Lower / Upper Boundary (minutes)			
Apr	4.20	0.98	35 / 38	59 / 63	47 / 58	11 / 14
May	5.58	1.26	45 / 48	38 / 40	41 / 50	14 / 18
Jun	6.30	1.47	53 / 56	44 / 47	36 / 43	12 / 16
Jul	6.51	1.47	53 / 56	44 / 47	36 / 43	12 / 16
Aug	5.89	1.33	48 / 51	40 / 43	43 / 52	15 / 19
Sep	4.50	1.05	38 / 40	32 / 34	51 / 62	12 / 15
Oct	3.10	0.7	25 / 27	42 / 45	34 / 41	11 / 15

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3.7 CYCLES PER DAY

- Divide the daily run time by the time to runoff, to determine the number of irrigation cycles required each day
  - Round up to the next whole number

Cycles per Day = Daily Run Time ÷ Time to Runoff

3.8 EXAMPLE: CYCLES PER DAY

Plant Type			Low Water Use Plants	Moderate Plants	Cool Season Turf	Cool Season Turf
Irrigation Type			Inline Drip	Inline Drip	Rotating Sprinklers	Fixed Spray Sprinklers
Plant Factor, Distribution Uniformity & Precipitation Rate			PF 0.3, DU 0.9, PR 0.5 in / hr	PF 0.5, DU 0.9, PR 0.5 in / hr	PF 0.8, DU 0.7, PR 0.5 in / hr	PF 0.8, DU 0.6, PR 1.5 in / hr
Month	Monthly ETo (inches)	Weekly ETo (inches)	Weekly Run Time Lower / Upper Boundary (minutes)			
Apr	4.20	0.98	2 / 2	2 / 3	2 / 2	3 / 3
May	5.58	1.26	2 / 2	2 / 2	2 / 2	3 / 4
Jun	6.30	1.47	2 / 2	2 / 2	2 / 2	3 / 4
Jul	6.51	1.47	2 / 2	2 / 2	2 / 2	3 / 4
Aug	5.89	1.33	2 / 2	2 / 2	2 / 2	3 / 4
Sep	4.50	1.05	2 / 2	2 / 2	2 / 3	3 / 3
Oct	3.10	0.7	1 / 1	2 / 2	2 / 2	3 / 3

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3.9 RUN TIME PER CYCLE

- Divide the daily run time by the number of cycles per day to determine the run time per cycle
  - Round up to the next whole minute

Run Time Per Cycle = Daily Run Time ÷ Cycles per Day

3.10 EXAMPLE: RUN TIME PER CYCLE

Plant Type			Low Water Use Plants	Moderate Plants	Cool Season Turf	Cool Season Turf
Irrigation Type			Inline Drip	Inline Drip	Rotating Sprinklers	Fixed Spray Sprinklers
Plant Factor, Distribution Uniformity & Precipitation Rate			PF 0.3, DU 0.9, PR 0.5 in / hr	PF 0.5, DU 0.9, PR 0.5 in / hr	PF 0.8, DU 0.7, PR 0.5 in / hr	PF 0.8, DU 0.6, PR 1.5 in / hr
Month	Monthly ETo (inches)	Weekly ETo (inches)	Weekly Run Time Lower / Upper Boundary (minutes)			
Apr	4.20	0.98	18 / 19	30 / 21	24 / 29	4 / 5
May	5.58	1.26	23 / 24	19 / 20	21 / 25	5 / 5
Jun	6.30	1.47	27 / 28	22 / 24	18 / 22	4 / 4
Jul	6.51	1.47	27 / 28	22 / 24	18 / 22	4 / 4
Aug	5.89	1.33	24 / 26	20 / 22	22 / 26	5 / 5
Sep	4.50	1.05	19 / 20	16 / 17	26 / 21	4 / 5
Oct	3.10	0.7	25 / 27	21 / 23	17 / 21	4 / 5

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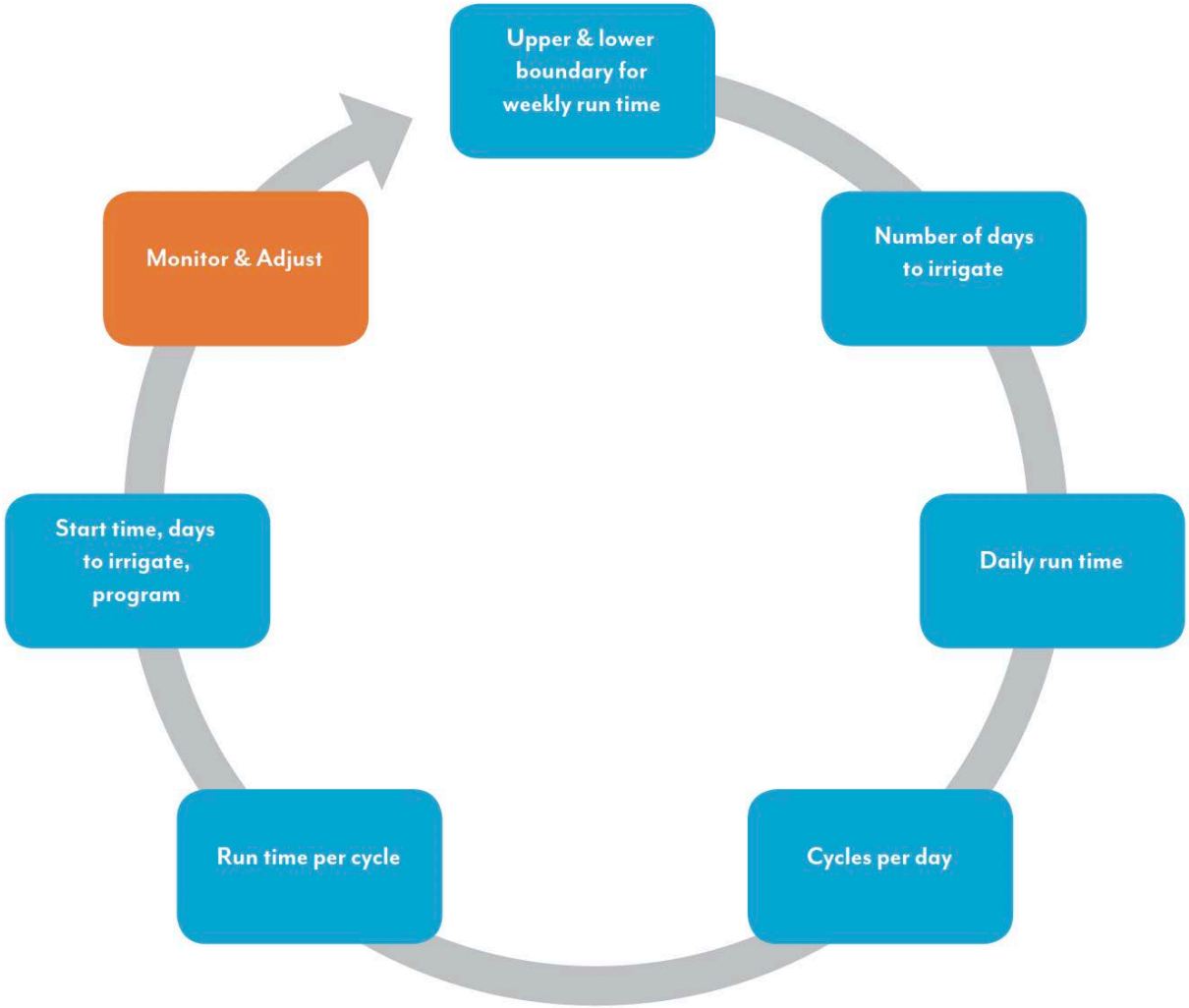
3.11 MANAGEMENT DECISIONS

- Select the appropriate start times, days to irrigate, and program for each hydrozone
- Hydrozones with the same number of days to irrigate and number of irrigation cycles per day, can go on the same program
  - In the example used throughout this section, four programs could be used using multiple start times for each hydrozone
  - Three programs could be used by putting the two turf zones on one program and using cycle and soak as an alternative to multiple start times
- Start time and days to irrigate should be selected by the water manager in agreement with the owner or user of the landscape
  - Overhead spray is typically best to operate just before or around sunrise when winds tend to be lower and the atmosphere and soil surface are cooler to minimize water loss to evaporation
  - Care should be taken not to operate overhead spray when it is excessively windy

3.12 MONITOR & ADJUST



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4. TOOLS TO ASSIST

- Tools to assist with monitoring and adjustment

4.1-4.4 TOOLS TO ASSIST

- No substitute for expertise and observation
- Soil probe
  - Soil moisture
  - Depth of soil moisture
  - Root Depth
- Weather based irrigation controllers (WBIC)
- Sensors for irrigation controllers
  - Section 9 Irrigation Controllers

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5. IRRIGATION SCHEDULING REVIEW QUESTIONS

- Tools to assist with monitoring and adjustment

5. IRRIGATION SCHEDULING REVIEW QUESTIONS

1. What are some of the decisions that the water manager needs to make when developing an irrigation schedule for a conventional controller.
2. What are the three methods of saving water in the landscape?
3. Using the concept of the soil moisture reservoir, explain what the water manager is trying to achieve when managing water in the landscape.
4. What is the relationship between root depth and developing an irrigation schedule?
5. How are the plant water requirements calculated using ETo and the plant factor?
6. What does the run time multiplier do?
7. What is the difference between the plant water requirement (lower boundary) and the irrigation water requirement (upper boundary)?
8. What is the daily run time if the weekly run time is 30 minutes and irrigation will occur 2 days per week?

5. IRRIGATION SCHEDULING REVIEW QUESTIONS

9. How many cycles per day are required if the daily run time is 15 minutes and the time to runoff is 5 minutes?
10. What is the run time per cycle if the daily run time is 15 minutes and the number of cycles per day is 3?
11. Name a few important considerations regarding the time of day to operate overhead irrigation.
12. What is the most important aspect of irrigation scheduling? Hint: continually monitor and adjust.
13. What tools are available to the water manager to assist with monitoring and adjustment of the irrigation schedule.