Appendix D: Soil Depletion Model

The *ET Pro*^{2} and other *WeatherTRAK* control products incorporate a soil depletion model that was developed by universities and is recognized by the Irrigation Association (IA).

Definitions

MAD has been used in different ways in the irrigation industry as (1) "**management allowed depletion**", and (2) "**maximum allowed depletion**".

Management Allowed Depletion

Management allowed depletion is the fraction of total plant available water (PAW) that is to be depleted from the active root zone before irrigation is applied. This amount is "managed" by a water manager to vary the amount of water depleted from the root zone between irrigations, and thus varies the amount of stress that the plant undergoes.

Maximum Allowed Depletion

Maximum allowed depletion is the maximum amount of depletion that can occur without stress to the plant. The setting of both types of MAD is dependent on the type of plant and soil. In this document, the "maximum allowed depletion" definition is used.

Another important factor in the soil depletion model is **Plants Available Water**.

Plants Available Water

Plants Available Water is the amount of water available to the plant in its root zone. This is varies based on the soil type and plant root depth. The relationship between soil type and available water is important is maintaining optimum plant health.

Evapotranspiration

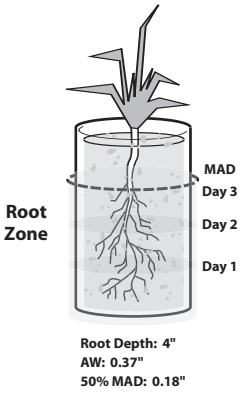
Evapotranspiration, or ET (based on local weather conditions and plant type), determines how quickly water is drawn from the Plants Available Water. In order to ensure that plant does not stress, irrigation should occur before the exceeding the MAD. This methodology has been in use for many years in agriculture for crop yields and is now being applied to "managed landscapes."

Example

Two examples below show different watering schedules based on different soil and plant types to illustrate soil water relationships. In the first example, a heavy clay soil and a plant having a deep root system 18-24" in depth will have a greater available water than sandy soil and a plant with a 3" root depth. This correlation is sometimes referred to as "soil/plant relationship".

The *WeatherTRAK* controller series usually uses 50% as the MAD in its depletion model. This simply means, before half of the available water in the root zone is depleted (either evaporated, transpired or has traveled outside of the root zone) supplemental irrigation is added to "refill" the reservoir. Allowing the depletion amount to drop down below 50% can lead to plant stress for some plant material and once a plant has reached "permanent wilting point" (PWP) no amount of water can be applied for recovery. The enclosed diagram demonstrates how cool season turf with a Crop Coefficient (Kc) of 0.75, a 4 inch root depth, and an "Available Water" (AW) of 0.37 inches is drawn down over a three day period based on a daily ET of 0.09 inches. After the second day, the soil reservoir is 38% (0.14/0.37) depleted. If we let it go to three days, the soil reservoir would be 57% (0.21/0.37) depleted which exceeds MAD.

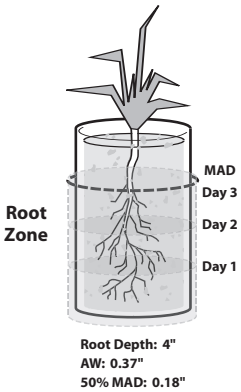
Plant Factor for medium water use shrub: 0.75 or 75% of ETo



Day	ETo	Kc	ETc ETo x Kc	Depletion	Status
1	0.09"	0.75	0.0675	19%	Don't Irrigate
2	0.09"	0.75	0.0675	38%	Irrigate
3	0.09"	0.75	0.0675	57%	Would have exceeded MAD

In this example, a medium water use shrub is shown having a root depth of 4 inches. "Allowable Water" (AW) of 0.37 inches and a Crop Coefficient (Kc) of 0.50. Again the daily ET is 0.09" and after five days time, the water reservoir has been depleted by 50% requiring supplemental irrigation.

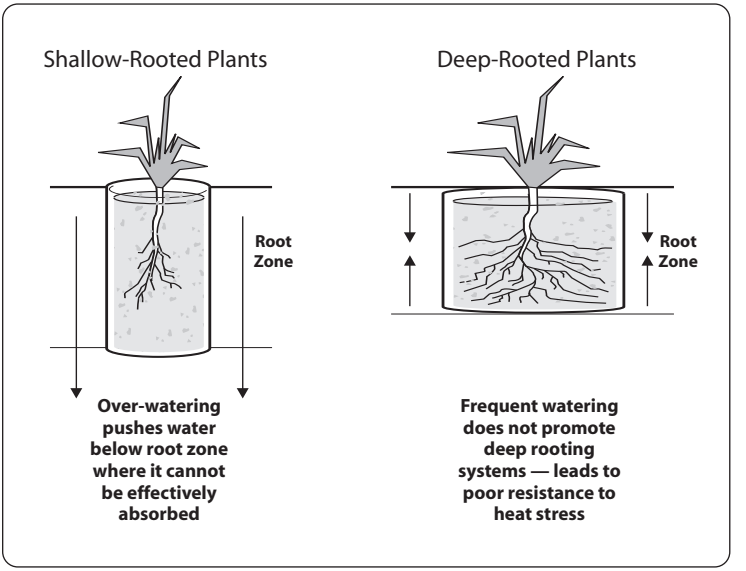
Plant Factor for medium water use shrub: 0.50 or 50% of ETo



Day	ETo	Kc	ETc ETo x Kc	Depletion	Status
1	0.09"	0.5	0.045	12%	Don't Irrigate
2	0.09"	0.5	0.045	24%	Don't Irrigate
3	0.09"	0.5	0.045	36%	Don't Irrigate
4	0.09"	0.5	0.045	49%	Irrigate

Different soil types with higher Allowable Water and varying ET will determine when supplemental irrigation is required. Applying water before it's required, can promote shallow root systems and water

wastage because frequent watering will push available water down below the root zone where it cannot effectively be absorbed by a plant. The two following diagrams show the adverse affects of over-watering.



The following charts show how different soil types, varying root depths, plant material with different crop coefficients (Kc's) with the same ET require different run times and different day patterns.

TURF IN LOAM NO SLOPE

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STA 1   12.1 MIN   1X   AUTO
-ST-TS   sh        Soak 15
```

RECAP OF CALCULATION PARAMETERS STATION #1

Adjusted ET for last 7 days = 1.4 inches
Month of Year = July
Sprinkler Type = Fixed Spray
Precipitation Rate = 1.7 inches/hour
Sprinkler Efficiency = 65%
Plant Type = Cool Season Turf
Plant Factor = 0.94
Plant Root Depth = 4 inches
Micro-Climate Factor = 1.1
Soil Moisture Allowable Depletion = 50%
Soil Type = Loam
Available Water in Soil = 1.8 inches/foo
Soil Infiltration Rate = 0.5 inches/hour
Slope Type = None / Slight -0 to 5% Grade
Slope Cycle Multiplier = 1.0
Soak Time = 15 minutes
Water Days per Schedule = 7
Sprinkler Location Adjust = 1.0

SHRUBS IN CLAY NO SLOPE

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STA 2  0.6 MIN  6X  AUTO
-M---F-  pcr      Soak 30
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RECAP OF CALCULATION PARAMETERS STATION #2

Adjusted ET for last 7 days = 1.4 inches
Month of Year = July
Sprinkler Type = Part Circle Rotor
Precipitation Rate = 1.0 inches/hour
Sprinkler Efficiency = 75%
Plant Type = Shrub - medium water use
Plant Factor = 0.5
Plant Root Depth = 12 inches
Microclimate Factor = 1.1
Soil Moisture Allowable Depletion = 50%
Soil Type = Clay
Available Water in Soil = 2.2 inches/foo
Soil Infiltration Rate = 0.12 inches/hour
Slope Type = greater than 20%
Slope Cycle Multiplier = 0.25
Soak Time = 30 minutes
Water Days per Schedule = 7

When irrigating with conventional irrigation control products, applying water on a specific day pattern when it's not required wastes water, promotes shallow root depths and increases a plant's susceptibility to all types of stress unnecessarily. This is a portion of the science that continually proves *WeatherTRAK* as the Smart choice for irrigation.