Irrigation Water Management Practice Calculations

1. You have 5/32" nozzles on a wheel line that operate at 50 psi. This results in a flow rate of 5 gpm. The wheel line is 70% efficient. The sprinklers are 40 ft. apart, and the distance between risers is 60 ft. The alfalfa field you are irrigating consumes 0.28 inches of water on a hot day in July.

Additional information from web soil survey:

Soil management (rooting) depth = 18 inches
Soil available water capacity (AWC) = 0.12 in/in

a. What is the sprinkler application rate?

$$\frac{96.3\ x\ 5\ gpm}{(40\ ft.\ \ x\ 60\ ft.)} = 0.2\ in/hour$$

b. What is the maximum irrigation return interval?

First we calculate the available water content:

$$18\ in.\ x\ 0.12\frac{in}{in}. = 2.16\ in.\ available\ water$$

The maximum allowable depletion (MAD) is 50%, so the amount of water available to plants is:

$$2.16\ in.\ x\ 0.5 = 1.08\ in.\ available\ water$$

From Agrimet, we know that the ET rate is 0.3 in/day. So the number of days to reach MAD are:

$$1.08\ in.\ x\frac{day}{0.28\ in.} = 3.9\ days$$

c. What is the required net irrigation application?

$$2.16\ in. - 1.08\ in. = 1.08\ in.$$

d. Since the system is only 70% efficient, what will the gross application rate need to be to meet this irrigation requirement?

$$\frac{1.08\ in.}{0.7} = 1.5\ inches$$

e. **What would be an appropriate set time for this field?**

$$set\ time = \frac{gross\ application}{sprinkler\ rate} = \frac{1.5\ in}{0.2\ in/hr} = 7.5\ hrs$$

2. If you wanted to replace your wheel line with a pivot, and the area of the field is 150 acres, what (approximate) flow rate might you expect to use for the pivot?

   (Hint: to convert from in/day to gpm/acre, use a conversion factor of 10/0.53)

First we calculate the gpm/acre required to meet an ET rate of 0.28 in/day:

$$0.28\ in/day\ x\ \frac{10}{0.53} = 5.28\ gpm/acre$$

We can assume a new pivot would be 85% efficient, so the required application rate would be:

$$\frac{5.28\ \frac{gpm}{acre}}{0.85} = 6.2\ gpm/acre$$

Then we convert that to a flow rate, gpm:

$$6.2\ gpm/acre\ \ x\ 150\ acres = 930\ gpm$$