### Length
- 1 yard = 3 feet
- 1 yard = 0.9144 meters
- 1 foot = 12 inches
- 1 foot = 0.3048 meters
- 1 inch = 2.54 centimeters
- 1 inch = 0.0254 meters

### Area
- 1 “section” = 1 sq. mile
- 1”section” = 640 acres
- 1“quarter section” = 160 acres
- 1 acre = 43,560 sq-ft
- 1 acre = 0.4047 hectares
- 1 hectare = 2.471 acres
- 1 hectare = 10,000 sq-m

### Volume
- 1 cu-meter = 1,000 liters
- 1 cu-ft = 7.48 gallons
- 1 cu-ft = 6.24 lbs. water
- 1 gallon = 3.79 liters
- 1 gallon = 8.34 lbs. water
- 1 acre-ft = 12 acre-inch
- 1 cu-cm = 1 gram water

### Depth
- 1 inch = 1 ac-in/acre
- 1 inch = 27,152 gal/acre
- 1 mm = 10,000 L/hectare
- 1 mm = 10 cu-ft/acre
- 1 mm = 27,152 gal/acre

### Application Rate
- 1 in/day = 18.85 gpm/acre
- 1 in/day = 0.042 cfs/acre
- 1 mm/day = 0.417 cu-m/hr/ha
- 1 mm/day = 0.116 Lps/ha

### Soil Moisture
- 1 in/ft = 8.33% by volume
- 1 mm/m = 0.1% by vol.

### Power
- 1 hp = 1 horse power
- 1 kW = 1 kiloWatt
- 1 hp = 0.746 kW

### Basic Geometry
\[
\text{Triangle: } A = \frac{\text{base} \times \text{height}}{2}
\]
\[
\text{Circle: } A = \pi \times r^2
\]
\[
\text{Trapezoid: } A = \frac{(\text{base}_1 + \text{base}_2) \times \text{height}}{2}
\]
General: \( V = \text{depth} \times \text{area} \)

### Rates, Flow Rates, Application Rates
General:
\[
\text{rate} = \frac{\text{amount}}{\text{time}} \quad \text{in. flow rate (gpm)} = \frac{\text{flow rate (gpm) \times 96.3}}{\text{area (sq ft)}}
\]
\[
\text{flow rate (cfs)} = \frac{\text{volume (ac-in.)}}{\text{time (hrs)}}
\]

### Soil Moisture
\[
\text{AWHC} = \text{FC} - \text{PWP}
\]
\[
\text{AWHC} = \text{available water holding capacity}
\]
\[
\text{FC} = \text{field capacity}
\]
\[
\text{PWP} = \text{permanent wilting point}
\]
% by mass = \( \frac{\text{wet soil weight} - \text{ooven dry weight}}{\text{ooven dry weight}} \times 100 \)
% by volume = \( \frac{\text{volume of water in soil (cm)}^3}{\text{bulk soil volume (cm)}^3} \times 100 \)

### Depths: Available Water, Penetration into soil, of Irrigation Needed to Refill the Root Zone
General:
\[
\text{depth} = \frac{\text{volume}}{\text{area}}
\]
available water (in.) = depth of soil (in.) \( \times \frac{\% \text{ moisture by volume}}{100} \)

penetration (ft) = \( \frac{\text{water (in.)}}{\text{soil moisture depletion (in./ft)}} \)
\[
\text{AD} = \frac{\text{depth to refill root zone (in.)}}{\text{AW (in.)}} \times \frac{\text{MAD} \%}{100}
\]
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Irrigation Efficiency & Uniformity

\[
\text{efficiency (E) (\%) } = \frac{\text{NET output}}{\text{GROSS input}} \times 100 = \frac{\text{irrigation water beneficially used}}{\text{irrigation water applied}} \times 100
\]

With perfect timing, (good management)

\[
E (\%) = DU_{\text{liq}} \times 100 \times \left(1 - \frac{\% \text{ losses before infiltration}}{100}\right)
\]

Average depth infiltrated = Gross average depth applied \times [1 - % losses before infiltration/100]

Irrigation Scheduling

\[
\text{irrigation interval (days)} = \frac{\text{PAW (in.)} \times \frac{\text{MAD\%}}{100}}{\text{ETc (in./day)}}
\]

\[
\text{AD (in.)} = \text{PAW (in.)} \times \frac{\text{MAD (\%)}}{100}
\]

\[
\text{NET} = \text{ET}_{\text{crop}} + \text{other beneficial uses} - \text{effective rain} - \text{high water table contribution}
\]

with perfect timing, no salts

\[
\text{GROSS Applied} = \text{NET} \times \left(1 - \frac{\text{losses}}{100}\right)
\]

For Perfect Timing (of an irrigation) => minimum depth applied = NET = smd = AD

\[
\text{Kc} = \text{Kcb} \times (\text{soil surface evaporation adjustment factor}) \times (\text{moisture stress adjustment factor})
\]

\[
\text{ETc} = \text{Kc} \times \text{ETO} \quad \text{[for climate based ET estimates]}
\]

Given: Net irrigation required

\[
\text{Average Depth Infiltrated} = \frac{\text{Net (smd or min)}}{\text{DU}}
\]

\[
\text{Gross} = \frac{\text{Average Depth Infiltrated}}{(1-\text{losses})}
\]

\[
\text{Hours} = \text{Gross (in.)} \times \text{Area (ac)} \times 43,560 \div \text{GPM} \times 96.3
\]

Given: Hours, GPM, Area

\[
\text{Gross (in.)} = \text{GPM} \times 96.3 \times \text{Hrs} \div \text{Area (sq ft)}
\]

\[
\text{Net (smd or min or AD)} = \text{Average Depth Infiltrated} \times \text{DU}
\]

Average Depth Infiltrated = Gross \times (1-\text{losses/100})

Salinity

\[
\text{LR} = \frac{\text{EC}_{\text{w}}}{5 \times \text{EC}_{\text{e}}} - \text{EC}_{\text{w}}
\]

\[
\text{LR} = \text{leaching requirement (fraction)}
\]

\[
\text{EC}_{\text{w}} = \text{EC of irrigation water, dS/m}
\]

\[
\text{EC}_{\text{e}} = \text{threshold EC for crop}
\]

\[
\text{Gross} = \frac{\text{Net}}{\text{DU} \times (1-\text{losses}) \times (1-\text{LR})}
\]

\[
\text{Gross} = \frac{\text{Net}}{\text{good management IE / 100} \times (1-\text{LR})}
\]

\[
\text{flow rate (gpm)} \times 96.3 \div \text{area (sq ft)}
\]