

Surface Irrigation System Formulas

Area of Square or Rectangle (ft²) = length x width

Area of Circle (ft²) = 3.14 x radius² = π x radius² = πr^2

Volume of Rectangular Tank (ft³) = length x width x depth

Volume of Cylindrical Tank (ft³) = area x height = πr^2 x h

Volume of Tank (gal) = volume of tank (ft³) x 7.48 gal/ft³

Detention Time (unit of time) =
$$\frac{\text{volume (gallons or ft}^3\text{)}}{\text{flow (volume/unit of time)}}$$

Pounds per day (lbs/day) = concentration (mg/L) x flow (MGD) x 8.34 lb/gal

Pounds per year (lbs/year) = mg/L x MGY (annual effluent application) X 8.34 lb/gal

Concentration (mg/L) =
$$\frac{\text{lbs}}{\text{flow (MGD) x 8.34 lb/gal}}$$

Flow Rate (volume/unit time) = area (ft²) x velocity (feet per minute)

Horsepower =
$$\frac{\text{flow (gpm) x total dynamic head (TDH)}}{3960 \text{ x pump efficiency x motor efficiency}}$$

Pump Delivery Rate =
$$\frac{\text{volume pumped (gal)}}{\text{pump run time}}$$

Pump Delivery Rate Efficiency (%) =
$$\frac{\text{Measured pump delivery rate (gpd)}}{\text{design pump delivery rate (gpd)}} \times 100$$

Hydraulic Loading Rate (gpd/ft²) =
$$\frac{\text{flow (gpd)}}{\text{area (ft}^2\text{)}}$$

Hydraulic Soils Loading Rate (in/day) =
$$\frac{\text{flow (gpd)}}{27,152 \text{ gal/acre-inch x area (acres)}}$$

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Plant Available Nitrogen (PAN)

$$\text{Surface application} = [\text{MR} \times (\text{TKN} - \text{NH}_4)] + (0.5 \times \text{NH}_4) + \text{NO}_3 + \text{NO}_2$$

where: MR = Mineralization Rate

TKN = Total Kjeldhal Nitrogen

$$\text{Sodium Adsorption Ratio (SAR)} = \frac{\text{Na (meq)}}{\sqrt{0.5 \times (\text{Ca (meq)} + \text{Mg (meq)})}}$$

$$\text{Milliequivalent (meq)} = \frac{\text{Concentration}}{\text{Equivalent weight}}$$

$$\text{Exchangeable Sodium Percentage (ESP)} = \frac{\text{Na (meq/100 cm}^3\text{)}}{\text{CEC (meq/100 cm}^3\text{)}} \times 100$$

$$\text{Precipitation rate for stationary sprinklers (in/hr)} = \frac{96.3 \times \text{discharge rate (gpm)}}{\text{sprinkler spacing (ft)} \times \text{lateral spacing (ft)}}$$

$$\text{Time of operation (hours)} = \frac{\text{target application depth (in)}}{\text{precipitation rate (in/hr)}}$$

$$\text{Application depth for traveling gun sprinkler (in)} = \frac{19.3 \times \text{sprinkler discharge rate (gpm)}}{\text{lane spacing (ft)} \times \text{travel speed (in/min)}}$$

$$\text{Travel speed for traveling gun sprinkler (in/min)} = \frac{19.3 \times \text{sprinkler discharge rate (gpm)}}{\text{lane spacing (ft)} \times \text{application depth (in)}}$$

1 acre = 43560 square feet