Important Synder's Synthetic Unit Hydrograph Formulas PDF

Formulas
Examples
with Units

List of 34
Important Synder's Synthetic Unit Hydrograph Formulas

1) Basin Lag given Modified Basin Lag Formula

Evaluate Formula

Formula

$$t_p = \frac{t'_p - \left(\frac{t_R}{4}\right)}{\frac{21}{22}}$$

Example with Units

$$5.9924\,\text{h} = \frac{6.22\,\text{h} - \left(\frac{2\,\text{h}}{4}\right)}{\frac{21}{22}}$$

2) Basin Lag given Modified Basin Lag for Effective Duration Formula

Evaluate Formula

Formula

$$t_p = \frac{4 \cdot t'_p + t_r - t_R}{4}$$

Example with Units

$$6.22\,\text{h} = \frac{4 \cdot 6.22\,\text{h} + 2\,\text{h} - 2\,\text{h}}{4}$$

3) Basin Lag given Peak Discharge Formula

Evaluate Formula

Formula

$$t_p = 2.78 \cdot C_p \cdot \frac{A}{Q_p}$$

Example with Units

$$5.6162\,\text{h} = 2.78 \cdot 0.6 \cdot \frac{3.00\,\text{km}^2}{0.891\,\text{m}^3/\text{s}}$$

4) Basin Lag given Standard Duration of Effective Rainfall Formula

Evaluate Formula

Formula

$$t_p = 5.5 \cdot t_r$$

Example with Units

$$11\,\text{h} = 5.5 \cdot 2\,\text{h}$$

5) Basin Length Measured along Water Course given Basin Lag Formula

Evaluate Formula

Formula

$$L_{basin} = \frac{\left(\frac{t_p}{C_r}\right)^1}{0.3} \cdot \left(\frac{1}{L_{ca}}\right)$$

Example with Units

$$1.1416\,\text{km} = \frac{\left(\frac{6\,\text{h}}{1.46}\right)^1}{0.3} \cdot \left(\frac{1}{12.0\,\text{km}}\right)$$

6) Basin Length Measured along Water Course given Modified Equation for Basin Lag Formula

Evaluate Formula

Formula

$$L_{basin} = \left(\frac{t_p}{C_{rL}}\right)^{\frac{1}{n_B}} \cdot \left(\frac{\sqrt{S_B}}{L_{ca}}\right)$$

Example with Units

$$9.0261\,\text{km} = \left(\frac{6\,\text{h}}{1.03}\right)^{\frac{1}{0.38}} \cdot \left(\frac{\sqrt{1.1}}{12.0\,\text{km}}\right)$$

7) Basin Slope given Basin Lag Formula

Evaluate Formula

Formula

$$S_B = \left(\frac{L_{basin} \cdot L_{ca}}{\left(\frac{t_p}{C_{rL}}\right)^{\frac{1}{n_B}}}\right)^2$$

Example with Units

$$1.193 = \left(\frac{9.4\,\text{km} \cdot 12.0\,\text{km}}{\left(\frac{6\,\text{h}}{1.03}\right)^{\frac{1}{0.38}}}\right)^2$$

8) Catchment Area given Peak Discharge for Nonstandard Effective Rainfall Formula

Evaluate Formula

Formula

$$A = Q_p \cdot \frac{t'_p}{2.78 \cdot C_r}$$

Example with Units

$$1.3654\,\text{km}^2 = 0.891\,\text{m}^3/\text{s} \cdot \frac{6.22\,\text{h}}{2.78 \cdot 1.46}$$

9) Catchment Area given Peak Discharge of Unit Hydrograph Formula

Evaluate Formula

Formula

$$A = Q_p \cdot \frac{t_p}{2.78 \cdot C_p}$$

Example with Units

$$3.205\,\text{km}^2 = 0.891\,\text{m}^3/\text{s} \cdot \frac{6\,\text{h}}{2.78 \cdot 0.6}$$

10) Distance along Main Water Course from Gauging Station given Basin Lag Formula

Evaluate Formula

Formula

$$L_{ca} = \left(\left(\frac{t_p}{C_r}\right)^{\frac{1}{0.3}} \cdot \left(\frac{1}{L_{basin}}\right)\right)$$

Example with Units

$$11.8268\,\text{km} = \left(\left(\frac{6\,\text{h}}{1.46}\right)^{\frac{1}{0.3}} \cdot \left(\frac{1}{9.4\,\text{km}}\right)\right)$$

11) Distance along Main Water Course from Gauging Station to Watershed Formula

Evaluate Formula

Formula

$$L_{ca} = \frac{\left(\frac{t_p}{C_{rL}} \Big/ \left(\frac{L_b}{\sqrt{S_B}}\right)^{n_B}\right)^1}{n_B}$$

Example with Units

$$15.4309\,\text{km} = \frac{\left(\frac{6\,\text{h}}{1.03} \Big/ \left(\frac{30\,\text{m}}{\sqrt{1.1}}\right)^{0.38}\right)^1}{0.38}$$

12) Equation for Catchment Parameter Formula

Evaluate Formula

Formula

$$C = L_b \cdot \frac{L}{\sqrt{S_B}}$$

Example with Units

$$1430.1939 = 30\,\text{m} \cdot \frac{50\,\text{m}}{\sqrt{1.1}}$$

13) Modified Basin Lag for Effective Duration Formula

Evaluate Formula

Formula

$$t'_p = \left(21 \cdot \frac{t_p}{22}\right) + \left(\frac{t_R}{4}\right)$$

Example with Units

$$6.2273\,\text{h} = \left(21 \cdot \frac{6\,\text{h}}{22}\right) + \left(\frac{2\,\text{h}}{4}\right)$$

14) Modified Basin Lag given Peak Discharge for Nonstandard Effective Rainfall Formula

Evaluate Formula

Formula

$$t'_p = 2.78 \cdot C_r \cdot \frac{A}{Q_p}$$

Example with Units

$$0.0038\,\text{h} = 2.78 \cdot 1.46 \cdot \frac{3.00\,\text{km}^2}{0.891\,\text{m}^3/\text{s}}$$

15) Modified Basin Lag given Time Base Formula

Evaluate Formula

Formula

$$t'_p = \frac{t_b - 72}{3}$$

Example with Units

$$6\,\text{h} = \frac{90\,\text{h} - 72}{3}$$

16) Modified Equation for Basin Lag Formula

Evaluate Formula

Formula

$$t_p = C_{rL} \cdot \left(L_b \cdot \frac{L_{ca}}{\sqrt{S_B}}\right)^{n_B}$$

Example with Units

$$0.0363\,\text{h} = 1.03 \cdot \left(30\,\text{m} \cdot \frac{12.0\,\text{km}}{\sqrt{1.1}}\right)^{0.38}$$

17) Modified Equation for Basin Lag for Effective Duration Formula

Evaluate Formula

Formula

$$t'_p = t_p + \frac{t_R - t_r}{4}$$

Example with Units

$$6\,\text{h} = 6\,\text{h} + \frac{2\,\text{h} - 2\,\text{h}}{4}$$

18) Non-Standard Rainfall Duration given Modified Basin Lag Formula

Evaluate Formula

Formula

$$t_R = \left(t'_p - \left(\frac{21}{22}\right) \cdot t_p\right) \cdot 4$$

Example with Units

$$1.9709\,\text{h} = \left(6.22\,\text{h} - \left(\frac{21}{22}\right) \cdot 6\,\text{h}\right) \cdot 4$$

19) Peak Discharge for Nonstandard Effective Rainfall Formula

Evaluate Formula

Formula

$$Q_p = 2.78 \cdot C_p \cdot \frac{A}{t'_p}$$

Example with Units

$$0.8045\,\text{m}^3/\text{s} = 2.78 \cdot 0.6 \cdot \frac{3.00\,\text{km}^2}{6.22\,\text{h}}$$

20) Peak Discharge per Unit Catchment Area Formula

Evaluate Formula

Formula

$$Q = \frac{Q_p}{A_{catchment}}$$

Example with Units

$$0.4455\,\text{m}^3/\text{s} = \frac{0.891\,\text{m}^3/\text{s}}{2.0\,\text{m}^2}$$

21) Peak discharge per unit Catchment Area given Unit Hydrograph Width at 50 percent Peak Discharge Formula

Evaluate Formula

Formula

$$Q = \left(\frac{5.87}{W_{50}}\right)^{\frac{1}{1.08}}$$

Example with Units

$$2.9877\,\text{m}^3/\text{s} = \left(\frac{5.87}{1.8\,\text{mm}}\right)^{\frac{1}{1.08}}$$

22) Regional Constant given Peak Discharge Formula

Evaluate Formula

Formula

$$C_r = Q_p \cdot \frac{t_p}{2.78} \cdot A_{catchment}$$

Example with Units

$$3.846 = 0.891\,\text{m}^3/\text{s} \cdot \frac{6\,\text{h}}{2.78} \cdot 2.0\,\text{m}^2$$

23) Regional Constant given Peak Discharge for Nonstandard Effective Rainfall Formula

Evaluate Formula

Formula

$$C_p = Q_p \cdot \frac{t'_p}{2.78 \cdot A}$$

Example with Units

$$0.6645 = 0.891\,\text{m}^3/\text{s} \cdot \frac{6.22\,\text{h}}{2.78 \cdot 3.00\,\text{km}^2}$$

24) Regional Constant representing Watershed Slope and Storage Effects Formula

Evaluate Formula

Formula

$$C_r = \frac{t_p}{\left(L_b \cdot L_{ca}\right)^{0.3}}$$

Example with Units

$$0.1292 = \frac{6\,\text{h}}{\left(30\,\text{m} \cdot 12.0\,\text{km}\right)^{0.3}}$$

25) Snyder's Equation Formula

Evaluate Formula

Formula

$$t_p = C_r \cdot \left(L_b \cdot L_{ca}\right)^{0.3}$$

Example with Units

$$1.0746\,\text{h} = 1.46 \cdot \left(30\,\text{m} \cdot 12.0\,\text{km}\right)^{0.3}$$

26) Snyder's Equation for Peak Discharge Formula

Evaluate Formula

Formula

$$Q_p = 2.78 \cdot C_p \cdot \frac{A}{t_p}$$

Example with Units

$$0.834\,\text{m}^3/\text{s} = 2.78 \cdot 0.6 \cdot \frac{3.00\,\text{km}^2}{6\,\text{h}}$$

27) Snyder's Equation for Standard Duration of Effective Rainfall Formula

Evaluate Formula

Formula

$$t_r = \frac{t_p}{5.5}$$

Example with Units

$$1.0909\,\text{h} = \frac{6\,\text{h}}{5.5}$$

28) Snyder's Equation for Time Base Formula

Evaluate Formula

Formula

$$t_b = \left(72 + 3 \cdot t'_p\right)$$

Example with Units

$$90.66\,\text{h} = \left(72 + 3 \cdot 6.22\,\text{h}\right)$$

29) Standard Duration of Effective Rainfall given Modified Basin Lag Formula

Evaluate Formula

Formula

$$t_r = t_R - 4 \cdot \left(t'_p - t_p\right)$$

Example with Units

$$1.12\,\text{h} = 2\,\text{h} - 4 \cdot \left(6.22\,\text{h} - 6\,\text{h}\right)$$

30) Standard Effective Duration given Modified Basin Lag Formula

Evaluate Formula

Formula

$$t_r = -\left(4 \cdot \left(t'_p - t_p\right) - t_R\right)$$

Example with Units

$$1.12\,\text{h} = -\left(4 \cdot \left(6.22\,\text{h} - 6\,\text{h}\right) - 2\,\text{h}\right)$$

31) Taylor and Schwartz Equation for Time Base Formula

Evaluate Formula

Formula

$$t_b = 5 \cdot \left(t'_p + \frac{t_R}{2}\right)$$

Example with Units

$$36.1\,\text{h} = 5 \cdot \left(6.22\,\text{h} + \frac{2\,\text{h}}{2}\right)$$

32) Width of Unit Hydrograph at 50 percent Peak Discharge Formula

Evaluate Formula

Formula

$$W_{50} = \frac{5.87}{Q^{1.08}}$$

Example with Units

$$1.792\,\text{mm} = \frac{5.87}{3.0\,\text{m}^3/\text{s}^{1.08}}$$

33) Width of Unit Hydrograph at 50 percent Peak Discharge given 75 percent Discharge Formula

Evaluate Formula

Formula

$$W_{50} = W_{75} \cdot 1.75$$

Example with Units

$$1.785\,\text{mm} = 1.02\,\text{mm} \cdot 1.75$$

34) Width of Unit Hydrograph at 75 percent Peak Discharge Formula

Evaluate Formula

Formula

$$W_{75} = \frac{W_{50}}{1.75}$$

Example with Units

$$1.0286\,\text{mm} = \frac{1.8\,\text{mm}}{1.75}$$

Variables used in list of Synder's Synthetic Unit Hydrograph Formulas above

- **A** Area of Catchment *(Square Kilometer)*
- $A_{catchment}$ Catchment Area *(Square Meter)*
- **C** Catchment Parameter
- C_p Regional Constant (Snyder)
- C_r Regional Constant
- C_{rL} Basin Constant
- **L** Watershed Length *(Meter)*
- L_b Length of Basin *(Meter)*
- L_{basin} Basin Length *(Kilometer)*
- L_{ca} Distance along Main Water Course *(Kilometer)*
- n_B Basin Constant 'n'
- **Q** Discharge *(Cubic Meter per Second)*
- Q_p Peak Discharge *(Cubic Meter per Second)*
- S_B Basin Slope
- t_b Time Base *(Hour)*
- t_p Basin Lag *(Hour)*
- t'_p Modified Basin Lag *(Hour)*
- t_r Standard Duration of Effective Rainfall *(Hour)*
- t_R Non-standard rainfall duration *(Hour)*
- W_{50} Width of Unit Hydrograph at 50% Peak Discharge *(Millimeter)*
- W_{75} Width of Unit Hydrograph at 75% Peak Discharge *(Millimeter)*

Constants, Functions, Measurements used in list of Synder's Synthetic Unit Hydrograph Formulas above

- Functions: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Kilometer (km), Meter (m), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Time** in Hour (h)
  Time Unit Conversion
- Measurement: **Area** in Square Kilometer (km²), Square Meter (m²)
  Area Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion

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