1. $\frac{dy}{dx} = \frac{S_0 - S}{1 - F^2}$ $\quad A = y(b + zy)$ $\quad R = \frac{A}{b + 2y\sqrt{1 + z^2}}$

$n = 0.013$

$B = 1.6$

$S_0 = 0.0005$ $\quad Q = 1.7m$

y = varies from 0.85 - 1.0m

$$Q = \frac{1}{n} AR^{2/3} S_0^{1/2} = \frac{1}{n}(By_0)\left[\frac{By_0}{B + 2y_0}\right]^{2/3} S_0^{1/2}$$

$$\frac{1}{7} = \left(\frac{1}{0.013}\right)\left(1.6y_0\right)\left[1.6 + 2y_0\right]^{2/3}\left[0.0005\right]^{1/2}$$

$y_0 = 1.047m$

NB: manning's equation assuming normal depth is

$$Q = \frac{1.49}{n} AR^{2/3} S_0^{1/2}$$

$$R \rightarrow \frac{A}{P_w}$$

Additional iterations should be run to be 95% sure that ~~you~~ the estimate of the depth is accurate within ±5 units.
According to the Latin Hypercube sampling method - sample means are much close together for the same number of iterations

Scanned with CamScanner

2. $F = 0.03$

$Q = V/t$ for voluming gives

$V = Qt$

$$V = \left(\frac{5.00\,L}{1\,min}\right)(75y)\left(\frac{1m^3}{10^3 L}\right)\left(5.26\times10^5 \frac{min}{y}\right)$$

$2.0\times10^5\,m^3$ - iteration 1

$$\bar{V}_1 = \frac{(0.500\,L/s)(10^{-3}\,m^3/L)}{\pi(9.00\times10^{-3}\,m)^2} = 1.96\,m/s \text{ - iteration 2}$$

$$\frac{0.03\,cm^2}{~~0~~1.96} = 0.025\,m \text{ - iteration 3}$$

Additional iterations are not needed since the estimate of the depth gets closer with each iteration

3 a) $V = \frac{Q}{A}$

where Q = flow rate through pipe

A = pipe cross sectional area

$$A = \frac{\pi D^2}{4} = \frac{\pi \times 0.8^2}{4} = 0.5 m^2$$

$$V = \frac{25000}{3600} \times \frac{1}{0.5} = 1.39 m/sec$$

b) $$K = \frac{0.0165 \times 250}{0.8} = 5.16$$

$$K = 5.16 + 9.95 = 15.11$$

$$HD = \frac{15.11 \times (1.39)^2}{2 \times 9.81} = 1.49 m/sec$$

c) Pump 1 is better as it can provide a minimum flow of 1.39 m/sec

4. a) $V = \frac{1.49(0.957)^{2/3}(0.005)^{1/2}}{0.05} = 2.05$ ft/sec

$$T_i = \frac{3000}{(3600)(2.05)} = 0.406 \text{ hr}$$

$$V = \frac{0.59(3)^{2/3}(0.015)^{1/2}}{0.015} = 10 \text{ ft/sec}$$

$$T_i = \frac{2000}{(3600)(10)} = 0.056 \text{ hr}$$

$$T_c = 0.256 + 0.240 + 0.406 + 0.056 = 0.958 h = 57.5 \text{ min}$$

b) $Re = \frac{VD}{\nu} = \frac{(0.251 m/s)(0.3 m)}{(1 \times 10^{-6} m^2/s)} = 4.9 \times 10^4$

c) $P(F) = 1 - 100$

where 1 is the total probability of the event occurring.

$P = 0.99$

d) i) Drainage areas are smaller than 300 acres
ii) Peak flow occurs when the entire catchment is contributing
(iii) Rainfall intensity is uniform over a duration of time.
iv) Rational coefficients are independent of the intensity of the rainfall.
v) The rational method does not account for storage in drainage area