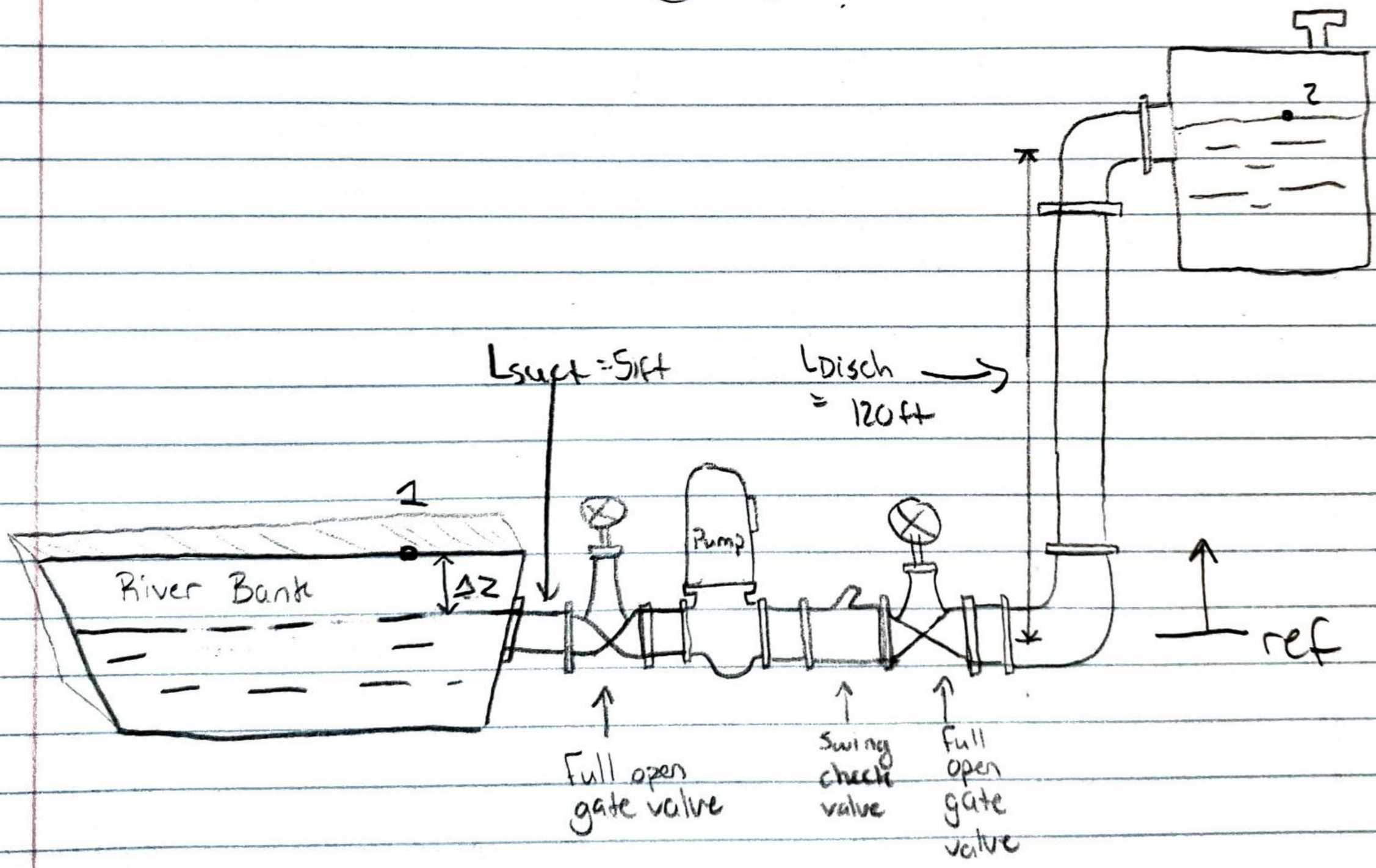
Chris Betton

Design Problem 3

- $\varepsilon_{steel} = 1.5 \times 10^{-4}$ ft
- $T_w = 80°F$, $\rho = 62.2 \frac{lb}{ft^3}$, $\nu = 9.15 \times 10^{-6} \frac{ft^2}{sec}$, $h_{vp} = 0.5069$ psia, $\mu = 1.77 \times 10^{-5} \frac{lb\text{-}s}{ft^2}$
- Volume flow rate min. = $1500 \frac{gal}{min}$
- Tank elevation = 55 ft, distance = 125ft
- Ref 1 = surface of riverbank Ref 2 = surface of fluid in tank.
- Source : Riverbank ; 0psig = P_1 in-line with pump suction
- Destination: Elevated tank @ 55ft.



Find Diameter

$V_{crit} = 3 \frac{m}{s} \approx 9.845 \frac{ft}{s}$, $Q = 1500 \frac{gal}{min} = 3.3420 \frac{ft^3}{s}$

$\therefore A = 0.3472\ ft^2 \rightarrow D = 0.66651\ ft$, 8" sch. 40 steel pipe

Compute h_A

1) $\frac{P_1}{\gamma} + z_1 + \frac{V_1^2}{2g} + h_A - h_L = \frac{P_2}{\gamma} + z_2 + \frac{V_2^2}{2g} \Rightarrow h_A = z_2 - z_1 + h_L + \frac{V_2^2}{2g}$

2) $h_L = h_{entrance} + h_{friction\ suction} + h_{friction\ discharge} + 2 \times h_{gate\ valve} + h_{check\ valve} + 2 \cdot h_{elbow} + h_{exit}$

$h_{entrance} = K \frac{V^2}{2g}$, $h_{suct} = \left(f \frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$, $h_{disch} = \left(f \frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$, $h_{gate} = \left(f_T \frac{L}{D}\right)\left(\frac{V^2}{2g}\right)2$

$h_{check} = \left(f_T \frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$, $h_{elbow} = \left(f_T \frac{L}{D}\right)\left(\frac{V^2}{2g}\right)2$, $h_{exit} = 1.0\left(\frac{V^2}{2g}\right)$

From excel: $h_L = 9.86\ ft$

1) $h_A = 55\ ft + 9.86\ ft + \left(\frac{9.619282^2}{2g}\right) = 66.296\ ft$

Select Pump

$h_A = 66.30\ ft$, $Q = 3.3420 \frac{ft^3}{sec} = 1500 GPM$

- Sulzer 60 Hz, 1775 rpm chart $\Rightarrow$ 8 × 8 × 10 cent. pump.
- Use affinity laws to select correct pump:

$\left(\frac{N_2}{N_1}\right) Q_{rpm_1} = Q_{rpm_2}$ $\therefore Q_{rpm_2} = Q_{rpm_1}(0.5956)$

$N_2 = 1775$, $N_1 = 2980$

$h_{rpm_2} = h_{rpm_1}(0.2978)$

From the above data, the 230mm pump was selected.

8 x 8 x 10 -1 OHH

SULZER

Series 2.00 / 50Hz E033

Curve No	OHH 66-1-2-01	NSS	213 (11000)	Speed 2980 rpm
Efficiency Basis	API Std. clearances	nq	48 (2470)	
Max Solid	12 mm (.47 in)	Rotation	CCW viewed from coupling