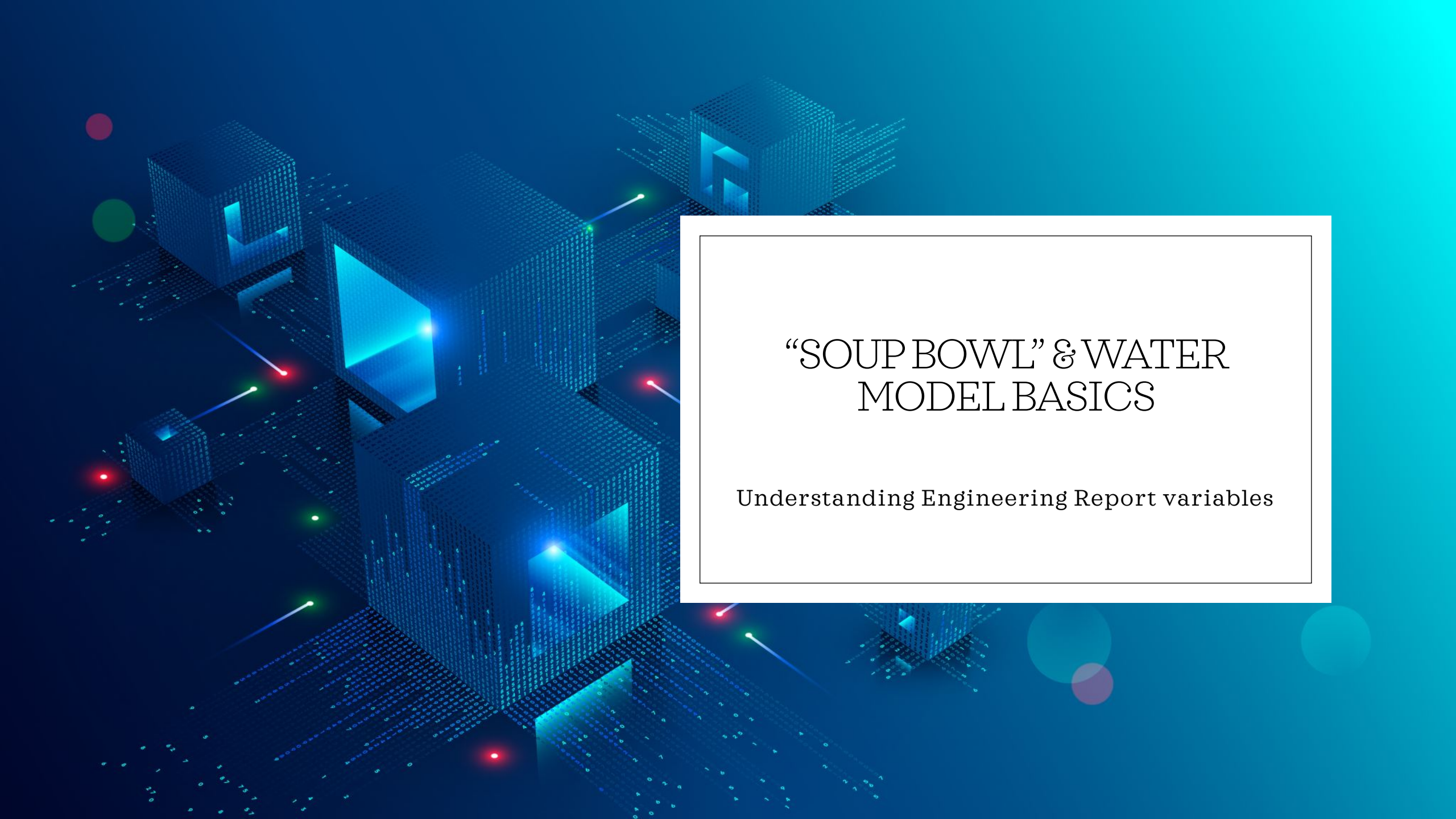


“SOUP BOWL” & WATER MODEL BASICS

Understanding Engineering Report variables

Why the Rush level is a function of flow rate(Q)

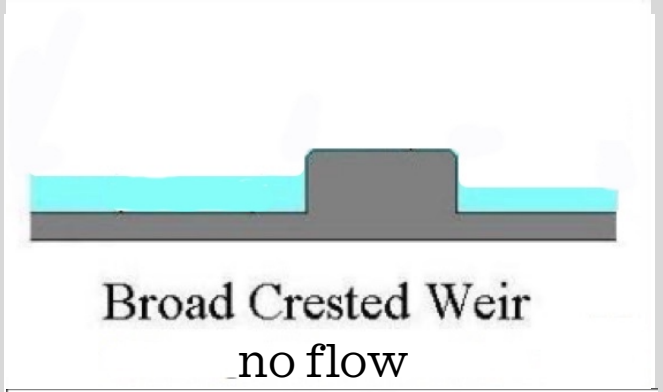
Dry Mode
With no flow the water level is static until water starts over the weir. Q=0

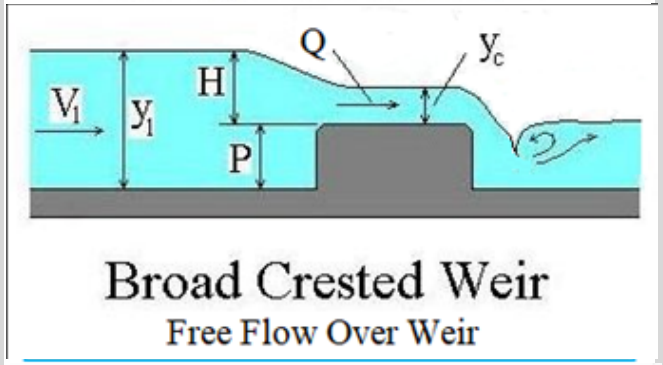
Free Flow calculation: (Lilly creek H > 8 inches when flowing)
L = length, Y1 = lake depth, P= weir height, C= .29 (coeff)

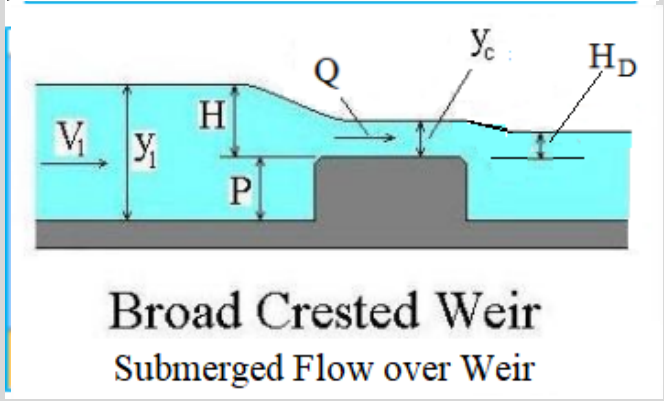
Equations for this Calculation: $Q = CLH^{1.5}$ and $H = y_1 - P$

Drowned Flow
As the downstream side becomes fuller the flow rate slows. H remains about the same. No longer indicating flow.

$$Q = C_d C_v (2/3)^{1.5} \sqrt{g}\, b\, h_1 [(h_1 - h_2) / (1 - m)]^{0.5}$$







Flow calculation example

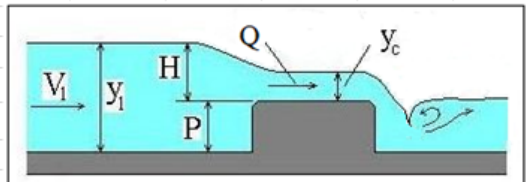
Calculation of Flow Rate Over a Broad-Crested Weir - U.S. Units

Instructions: *Enter values in blue boxes. Spreadsheet calculates values in yellow boxes*

1. Calculation of Flow Rate for Free Flow

Inputs

Weir Length, **L** =	13.1	ft
Upstream Depth of Flow, y_1 =	14.8	ft
Weir Coeff., **C** =	0.29	
Weir Height, **P** =	6.56	ft



Broad Crested Weir
Free Flow Over Weir
HHB

Calculations

For Free Flow over the weir and flow at critical velocity over the weir:

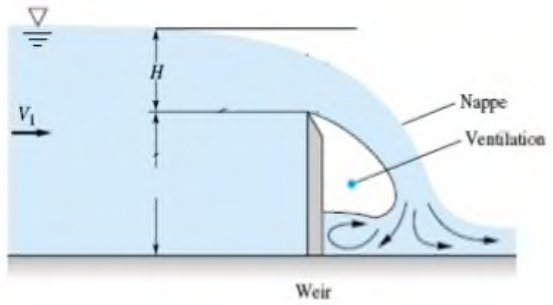
Q = 89.9 cfs

Equations for this Calculation: $Q = CLH^{1.5}$ and $H = y_1 - P$

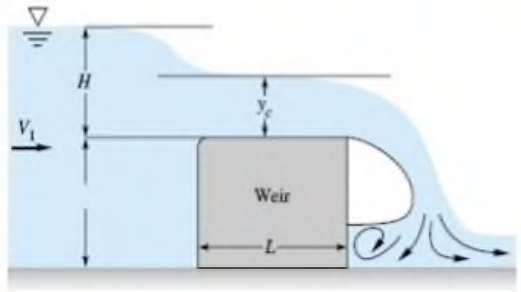
Water level increases with the flow rate. This makes lake levels effectively a flow meter.

Broad Crested Weir

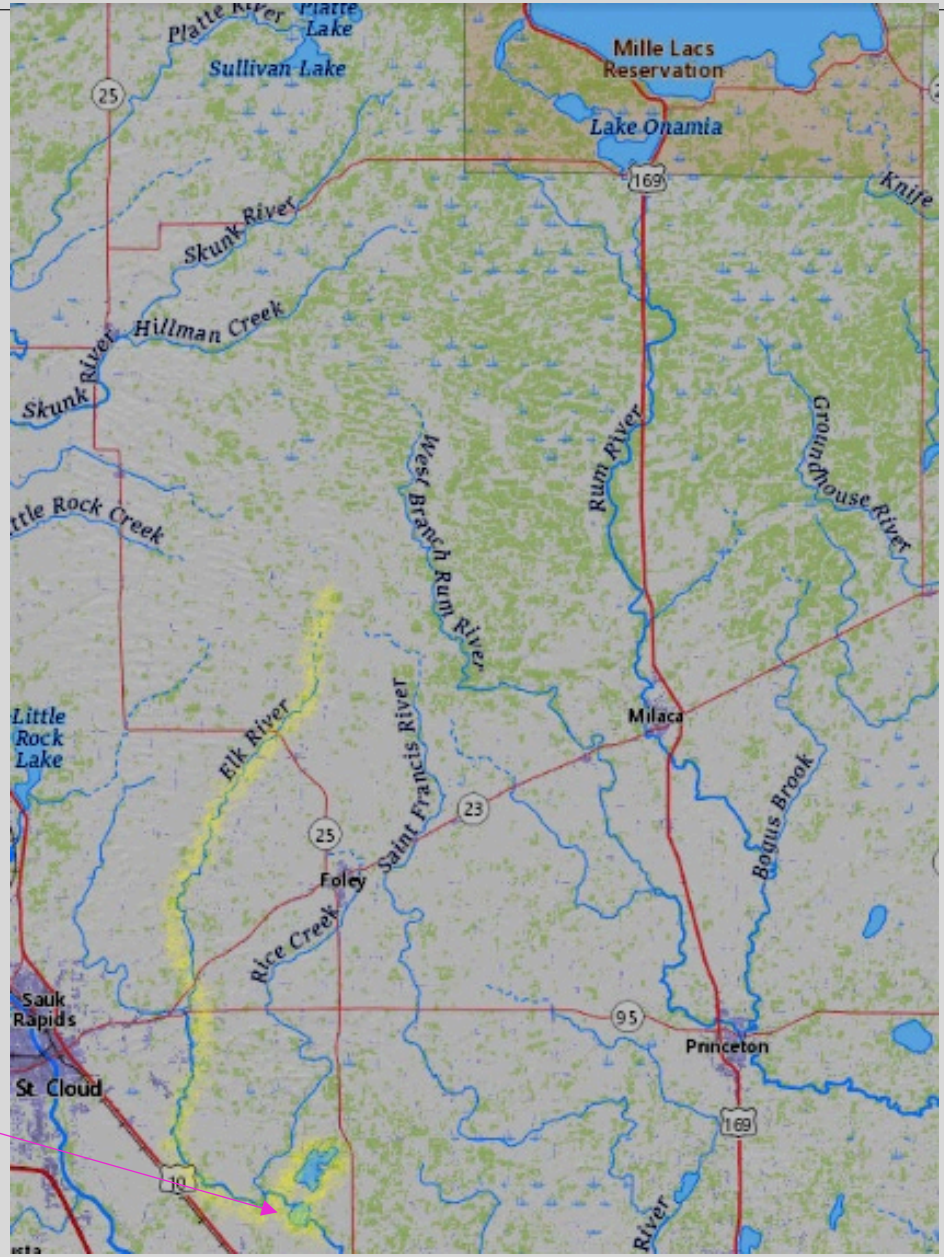
- A *weir,* of which the ordinary dam is an example, is a channel obstruction over which the flow must deflect.
- For simple geometries the channel discharge Q correlates with gravity and with the blockage height H to which the upstream flow is backed up above the weir elevation.
- Thus a weir is a simple but effective open-channel flow-meter.



- Figure shows two common weirs, sharp-crested and broad-crested, assumed. In both cases the flow upstream is subcritical, accelerates to critical near the top of the weir, and spills over into a supercritical *nappe*. For both weirs the discharge q per unit width is proportional to $g^{1/2}H^{3/2}$ but with somewhat different coefficients C_d.



Elk river watershed From Mille lacs wetlands to Elk Lake: (Highlighted in yellow)

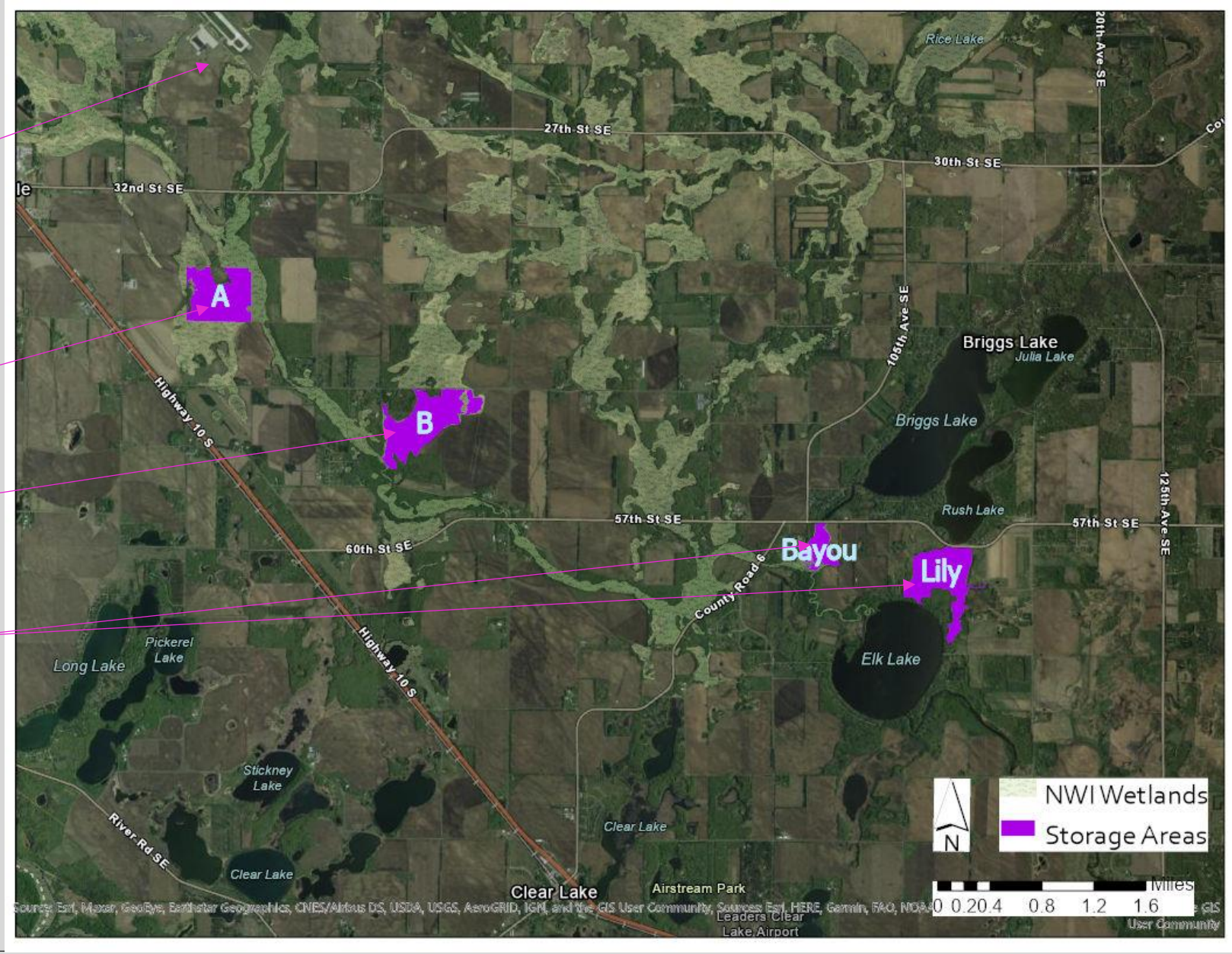


Storage changes:
2000- 2002:
Airport and golf course constructed reducing water storage of river.

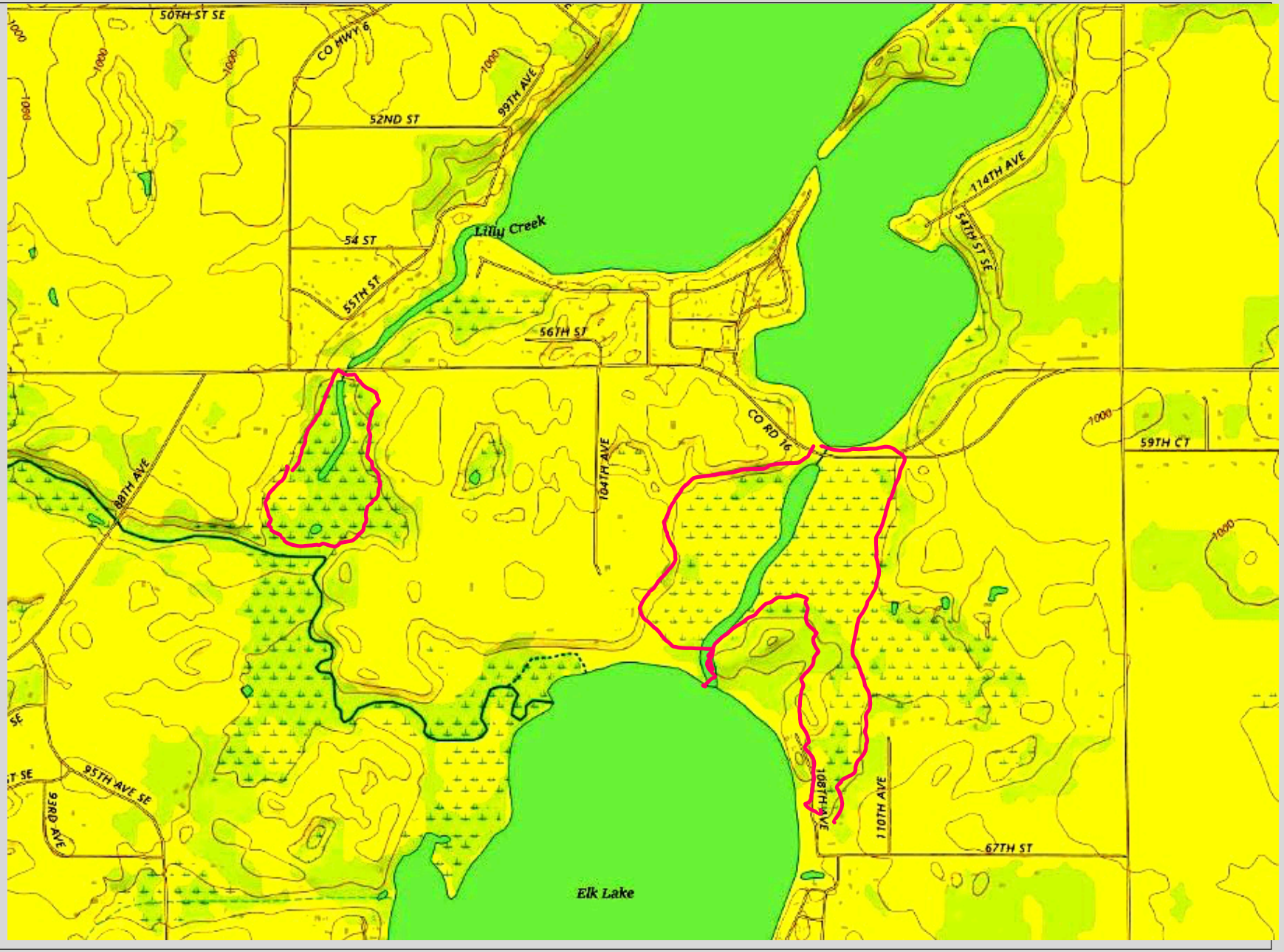
Site A

Site B

Suggested Bayou weir



Sheet Pile Weir shows storage area in red. Storage should be much greater. A weir at bayou bridge would not just raise water levels for the area in red as indicated in the report!



It is more likely that the area of water that backs up behind a county 16 weir would cover the FEMA flood zone area shown in pink and store more than double the estimate from WENK. Also standing wave would put the rise in that area and not in the upper lakes.