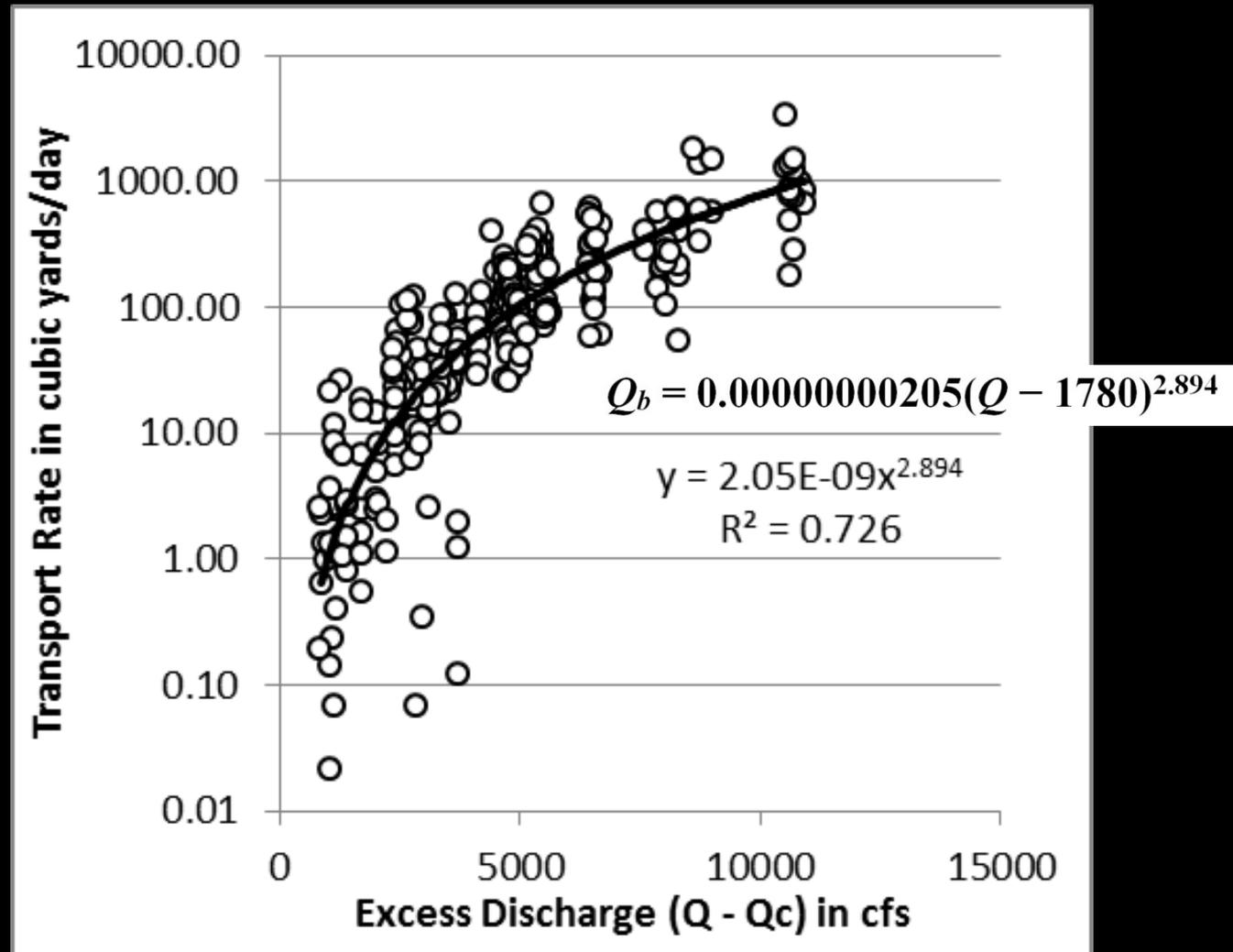


# Proposed 2016 Gravel Augmentation

TAMWG & TMC Meetings  
April 5 & 6, 2016

# Estimate Hydrograph Transport Capacity with DC Rating Curve



# Scale Initial Estimate to Water Year Targets

Define  $Z_{WY\ type}$  by  $Z_{dry} = 1$ ,  $Z_{normal} = 2$ ,  $Z_{wet} = 3$ ,  $Z_{extremely\ wet} = 4$

Empirical fit to transport capacities of ROD hydrographs:

$$A_i = 69.61 e^{1.19 Z_{WY\ type}}$$

$(r^2 = 0.996)$

Inverting that relation and replacing  $A_i$  with  $A_H$  and  $Z_{WY\ type}$  with  $Z_H$  yields:

$$Z_H = \ln(A_H/69.61)/1.19$$

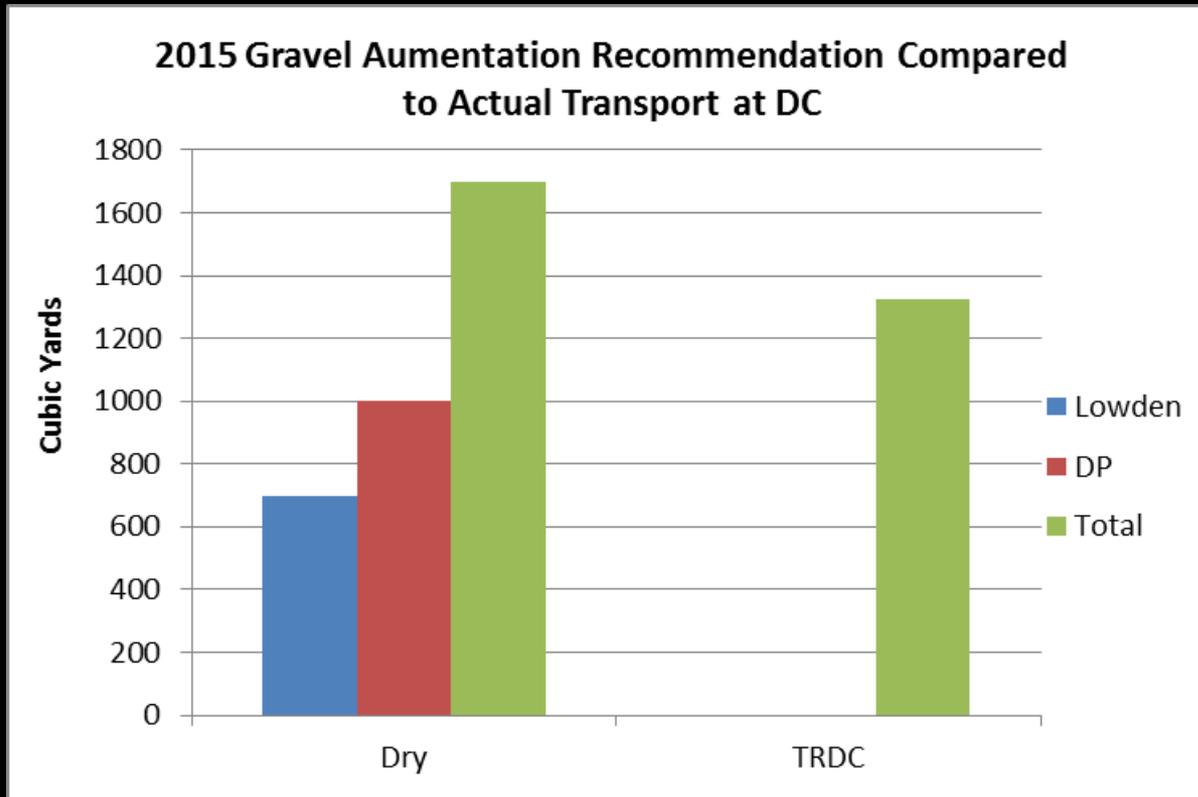
Hydrograph-specific augmentation targets ( $G_H$ ) are then estimated as:

$$G_H = (Z_H - 1) (G_3 - G_2) + G_2; \quad \text{if } Z_H < 2$$

$$G_H = (Z_H - 2) (G_4 - G_3) + G_3; \quad \text{if } 2 < Z_H < 3$$

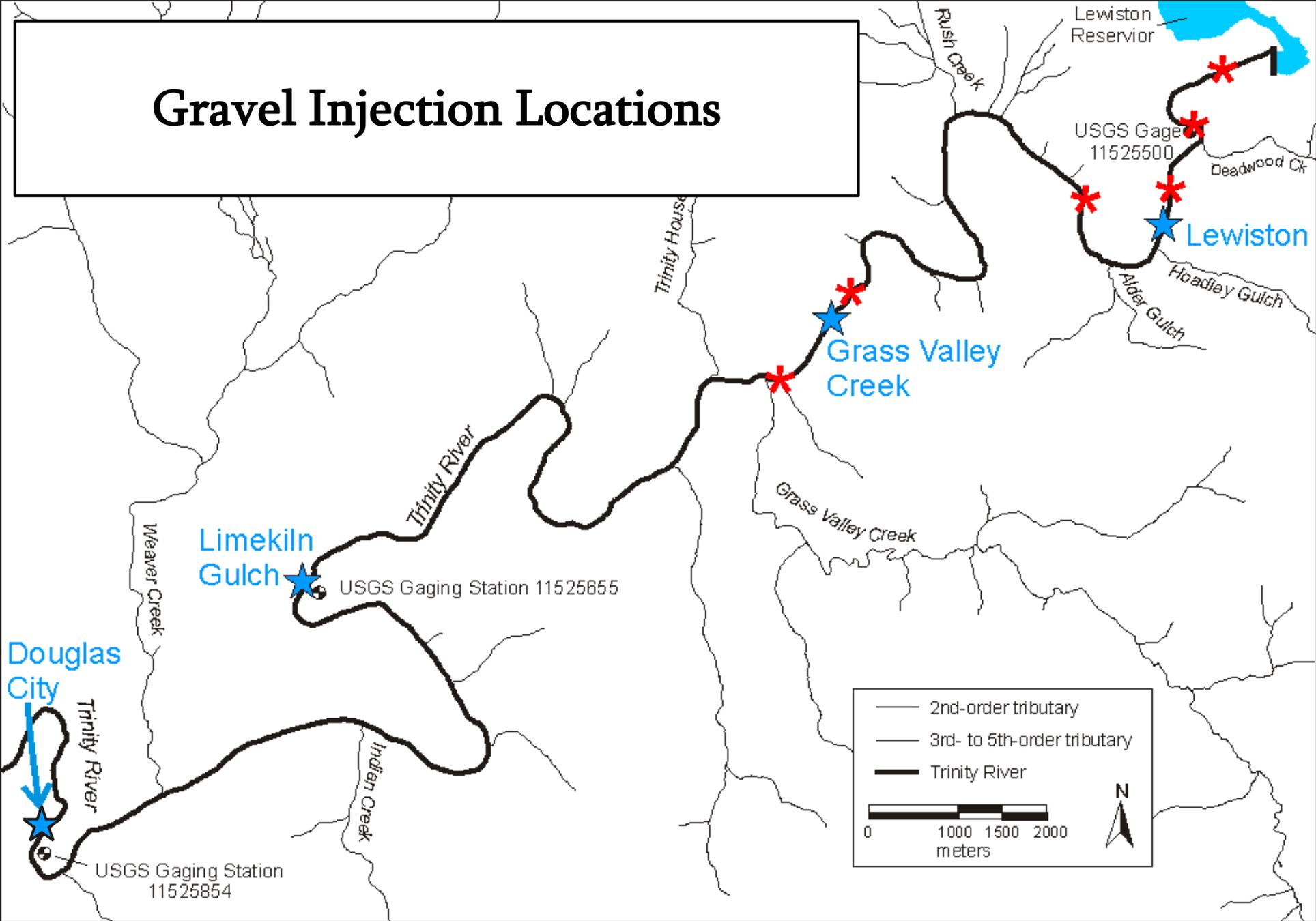
$$G_H = (Z_H - 3) (G_5 - G_4) + G_4; \quad \text{if } 3 < Z_H$$

# Last Year (2015)

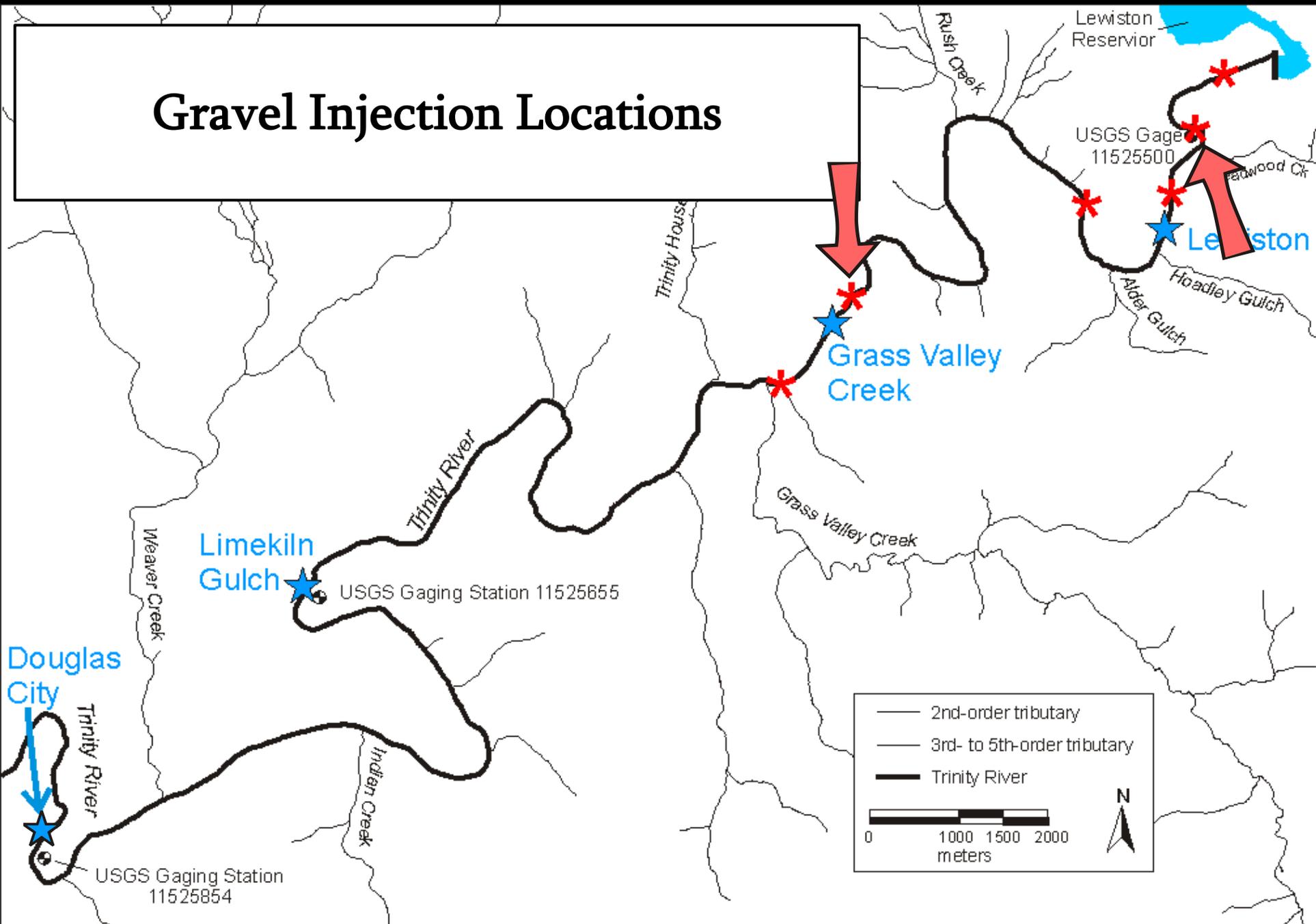


**Total Augmentation = 1700 yards**  
**Total Export Past Douglas City = 1325 yards**  
**Difference = 28%**

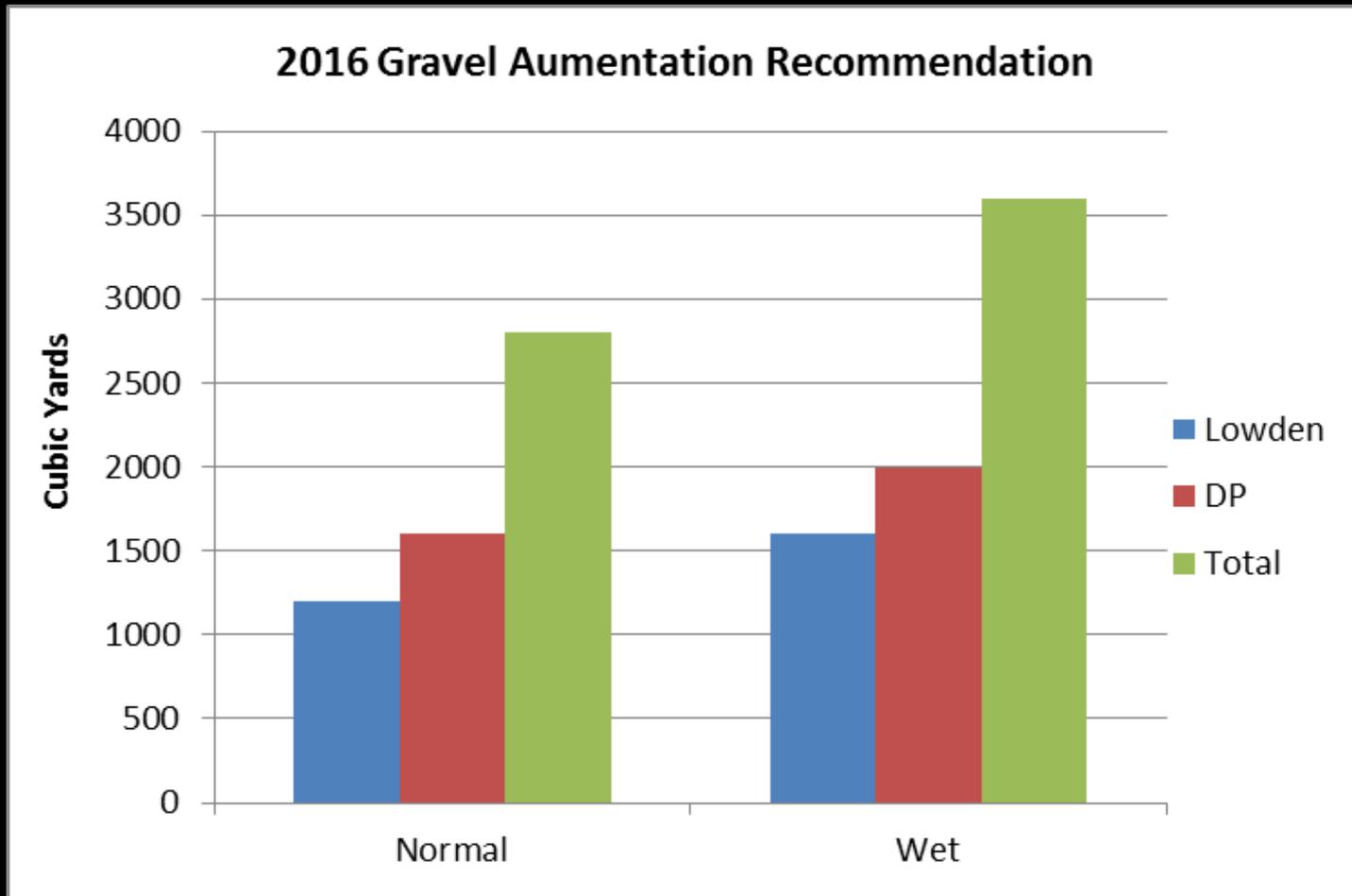
# Gravel Injection Locations



# Gravel Injection Locations



# 2016 High Flow Gravel Injection



Water Year Type	Upper Lowden Site	Diversion Pool Site	Total 2016 Injection
Normal	1200 yards	1600 yards	2800 yards
Wet	1600 yards	2000 yards	3600 yards

# Hypotheses and Monitoring

The rising limbs of each of the two peaks is more effective for accomplishing geomorphic work than a sustained peak

Sediment monitoring; repeat multibeam sonar

The first rise and peak is more effective for accomplishing geomorphic work than the second

Sediment monitoring; repeat multibeam sonar

Gravel injected at moderate flows on the rising limb will move farther downstream than sediment injected at the peak

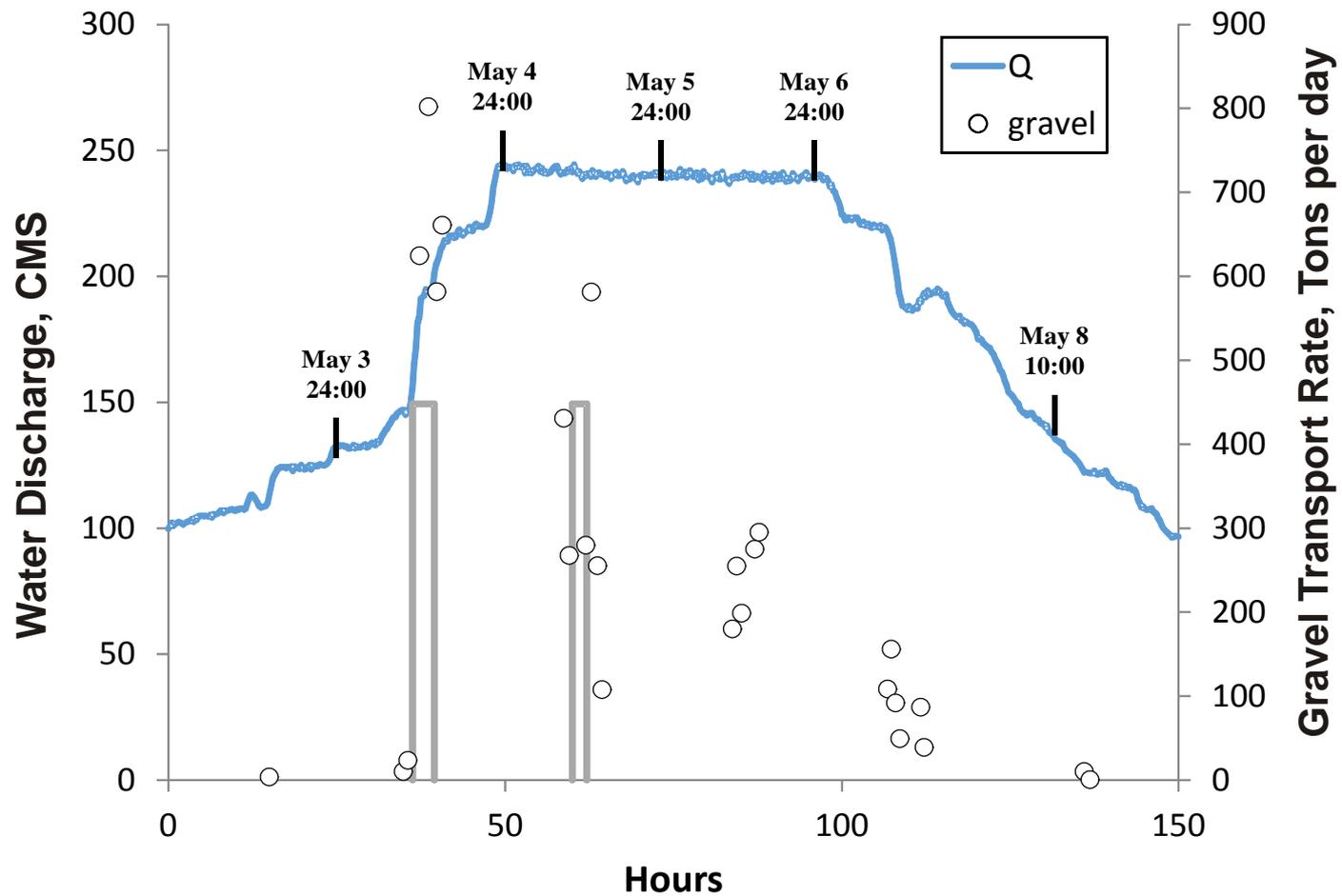
RFID tracers; repeat multibeam sonar

Gravel injected on the second rise/peak will move farther downstream than sediment injected on the first

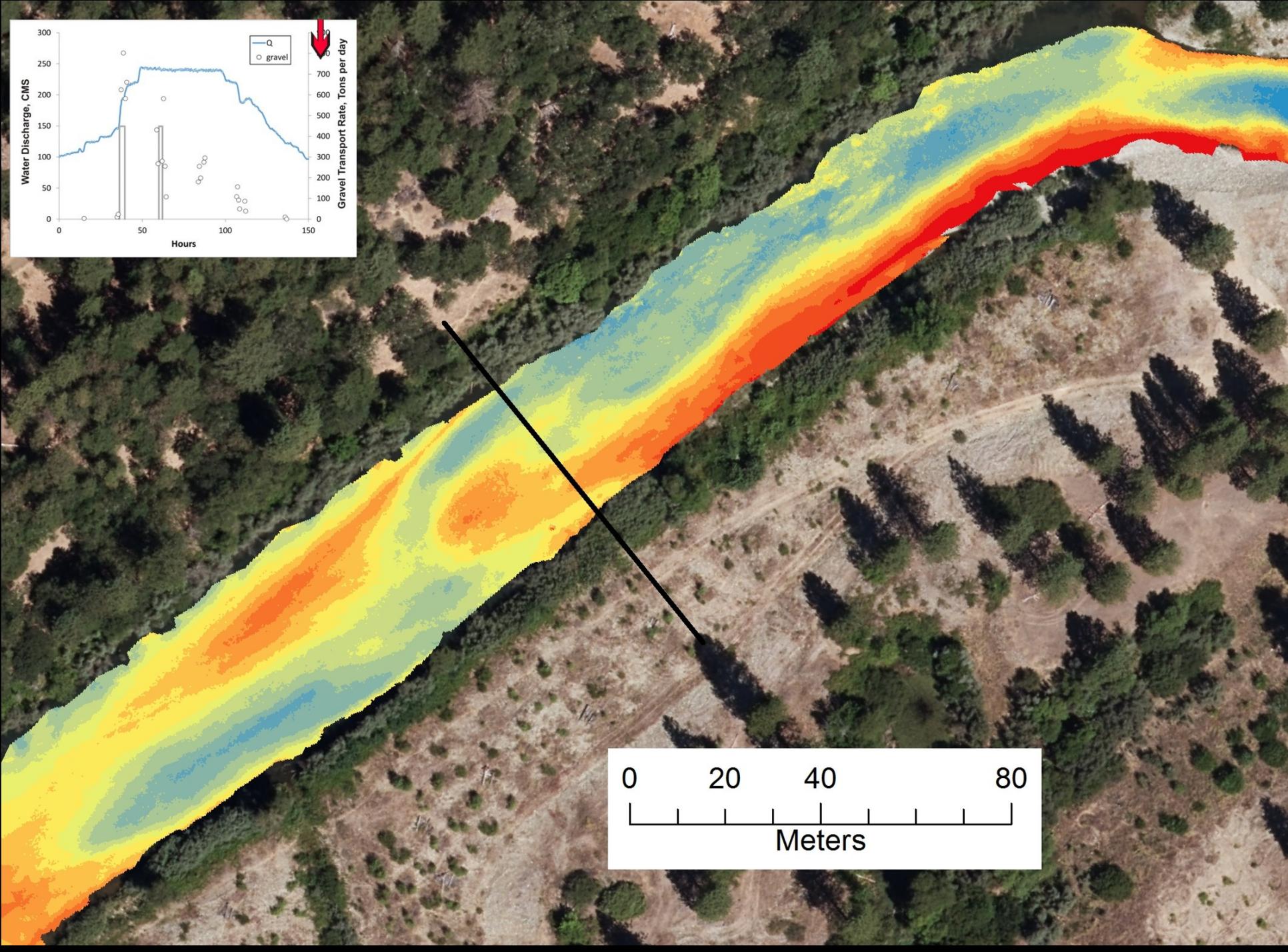
RFID tracers; repeat multibeam sonar

Site	May 8	May 9	May 10	May 11	May 12	May 13
Lowden	400 yds, begin after 2 p.m.	400 yds, begin after 2 p.m.	none	none	400 yds, finish by 3 p.m.	400 yds, begin after 2 p.m.
Diversion Pool	500 yds, begin after 1 p.m.	500 yds, begin after 1 p.m.	none	none	500 yds, finish by 3 p.m.	500 yds, begin after 1 p.m.

# Decreasing Transport on Peak Bench



Lowden Ranch, 2015



# Gravel Management Objectives

## Range of Scales

