

Jordan River DO Linkage Symposium Effects of Algal Consumption of DO

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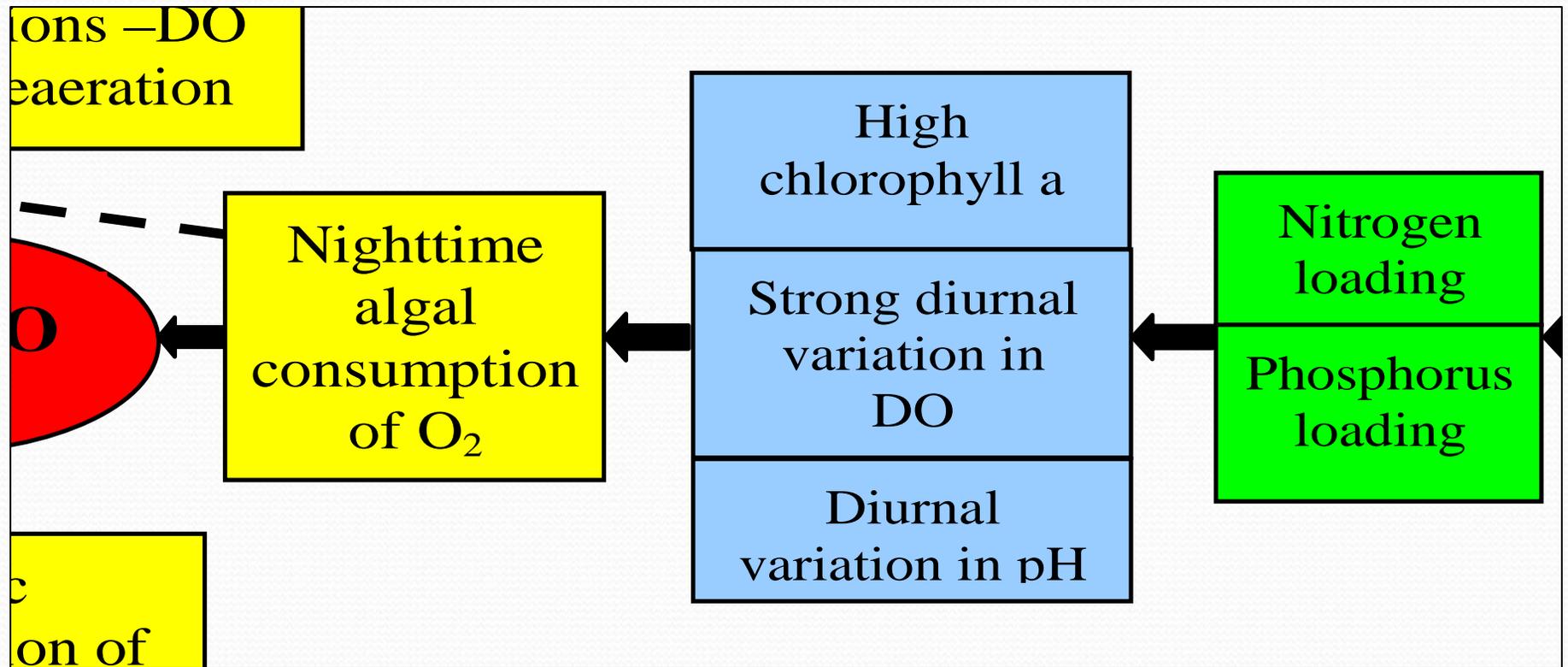


In our last episodes...

- Physical processes not account for low DO – reaeration should be increasing DO, but it's decreasing downstream...
- Direct and indirect evidence for organic matter in water column demanding DO for decomposition
- Direct and indirect evidence for organic matter and inorganic processes in sediments demanding DO for decomposition and nitrification processes

What role does algae play?

Nighttime Algal Net Consumption of DO



- Suspended and benthic algae and macrophytes
- Net production of DO during daytime photosynthesis
- Net consumption of DO for respiration at night
- (Eventual senescence of algae contributes to BOD and SOD)

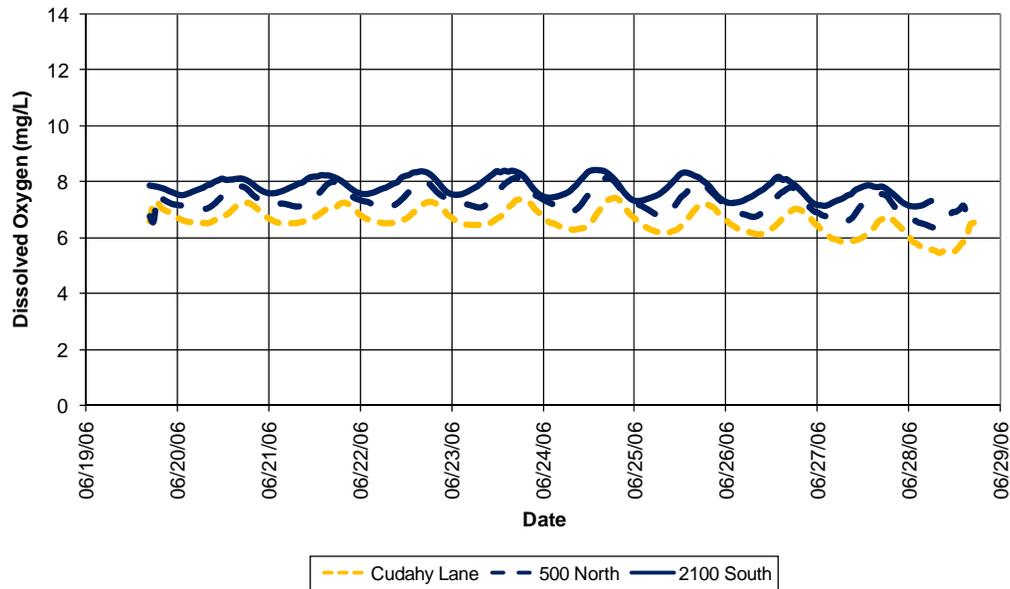
Algal Effects on DO

- Daytime – photosynthesis increases DO
- Nighttime – photosynthesis stops; plants still respiring; net demand on DO
- Result: Diurnal swings in DO
 - Peaks in late afternoon
 - Sags in early morning before dawn
 - Larger swings with longer days
 - Ultimately limited by nutrients

Diurnal Measurements in Lower Jordan River

- Troll 9000 probe; hourly measurements
 - DO, pH, temperature
- Probes left in place for days
 - June 2006
 - August 2006
 - October 2006
 - February 2007
- Wet (grab) samples also taken for cBOD, SCBOD, TSS, VSS, alkalinity, NO₂, NO₃, orthophosphate, NH₄-N, Total KN, Total P

**Jordan River Diurnal DO
(June 20-28, 2006)**



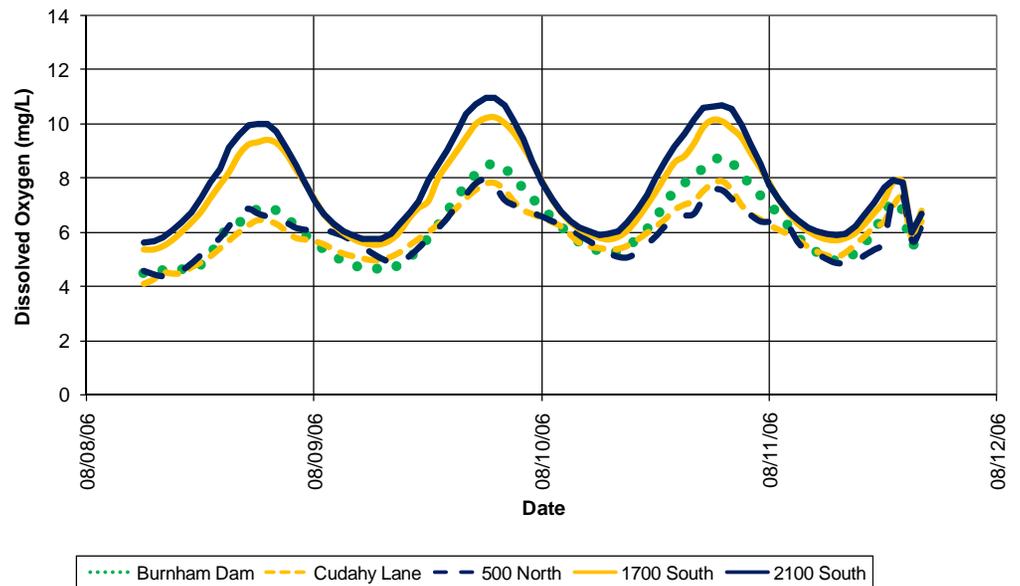
June:

- Regular but low amplitude diurnal pattern
- DO decreasing downstream

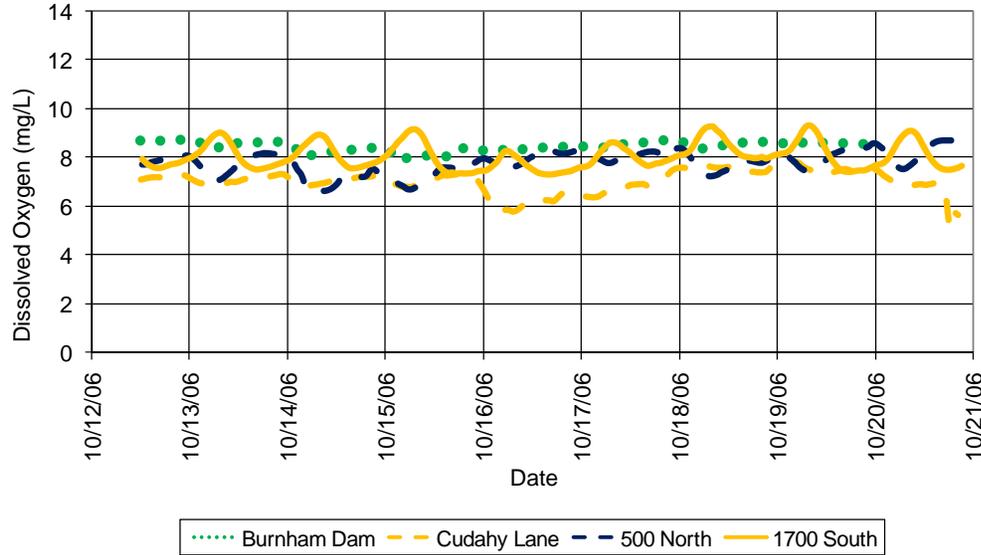
August:

- Higher amplitude ~5 mg/L
- Amplitude and means decreasing downstream

**Jordan River Diurnal DO
(August 8-11, 2006)**



**Jordan River Diurnal DO
(October 12-20, 2006)**



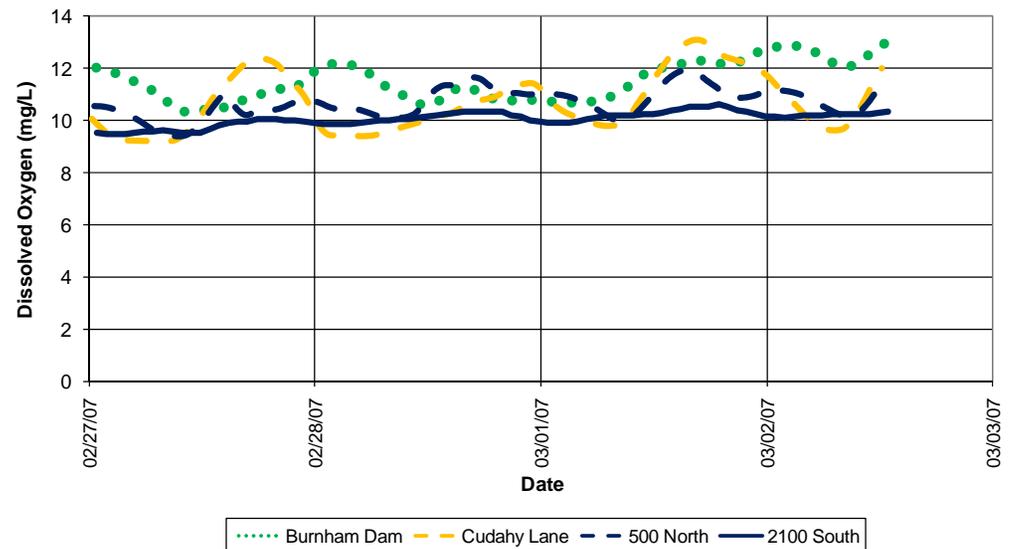
October:

- Low amplitude
- Irregular pattern downstream

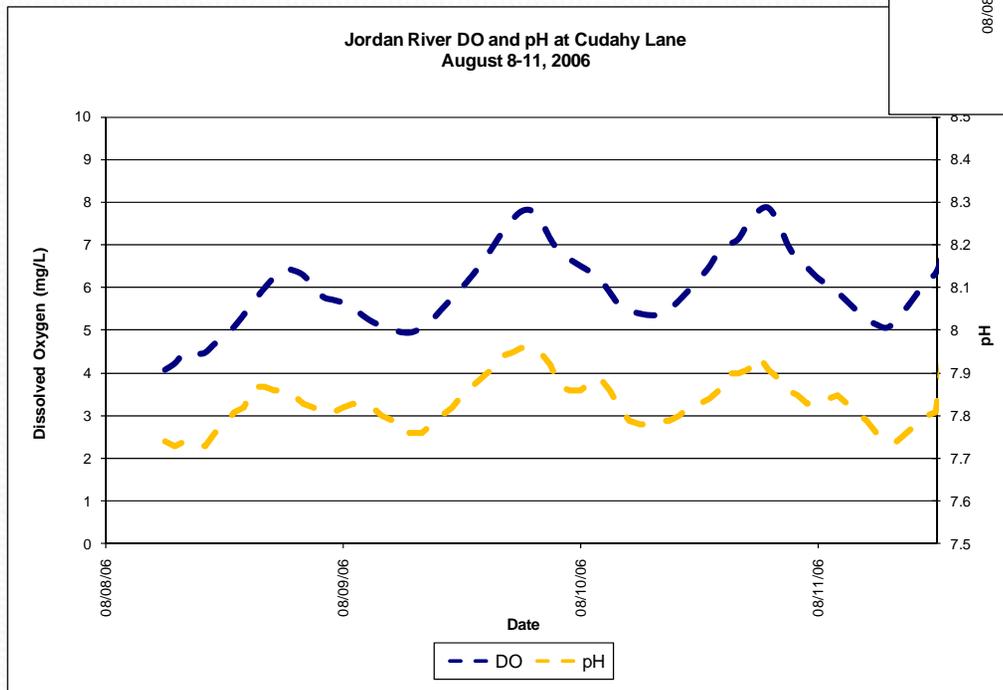
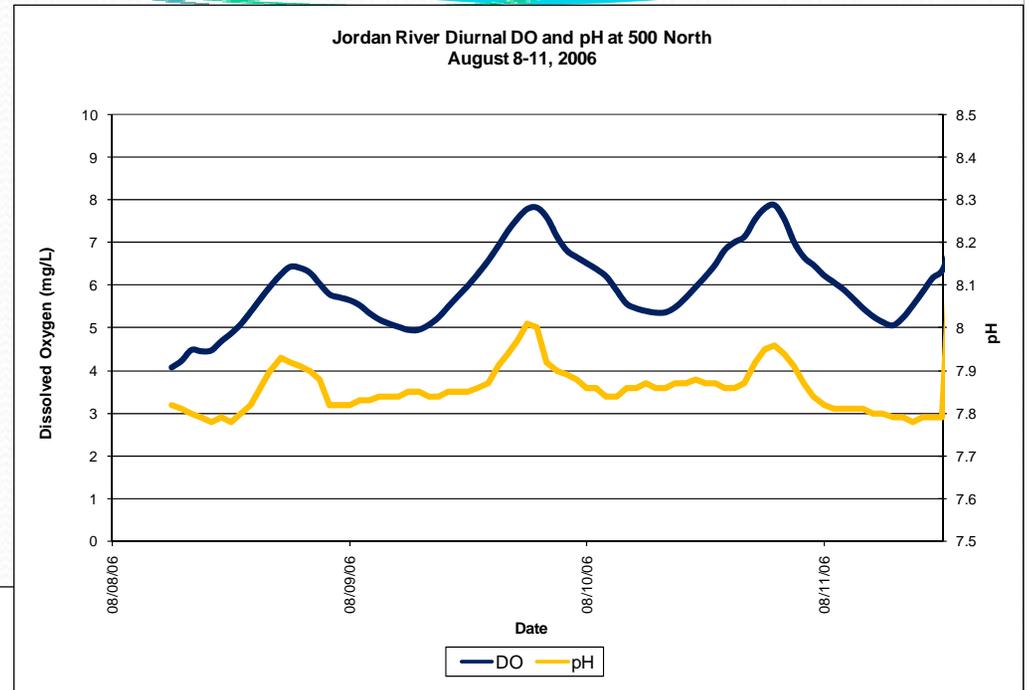
February:

- Irregular pattern
- DO increases slightly and stronger pattern downstream

**Jordan River Diurnal DO
February 27 - March 2, 2007**



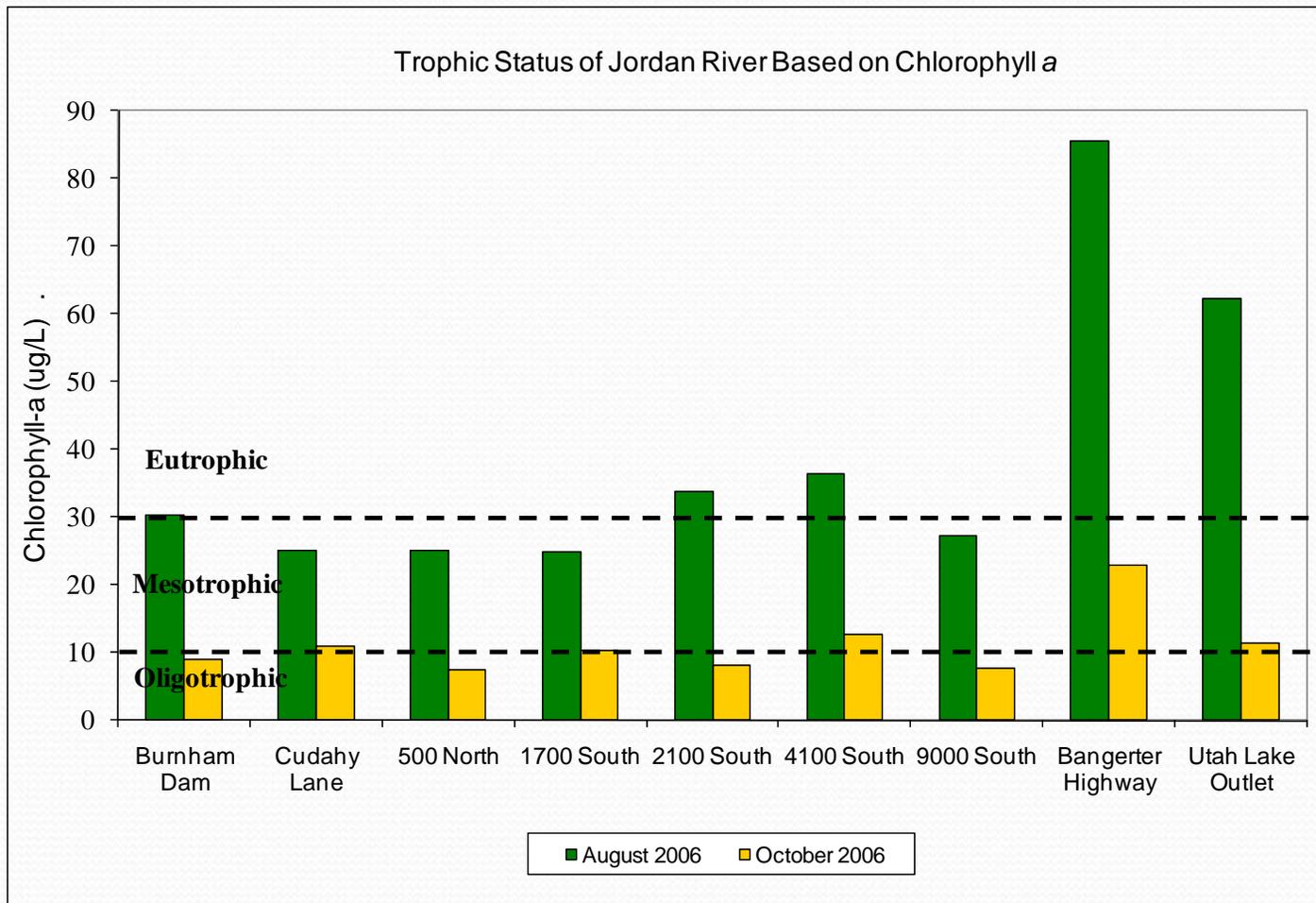
pH Indicators of Algae



pH swings at 500 North and Cudahy Lane:

- Regular pattern synchronized with DO
- Within acceptable range of 6.5 – 9.0

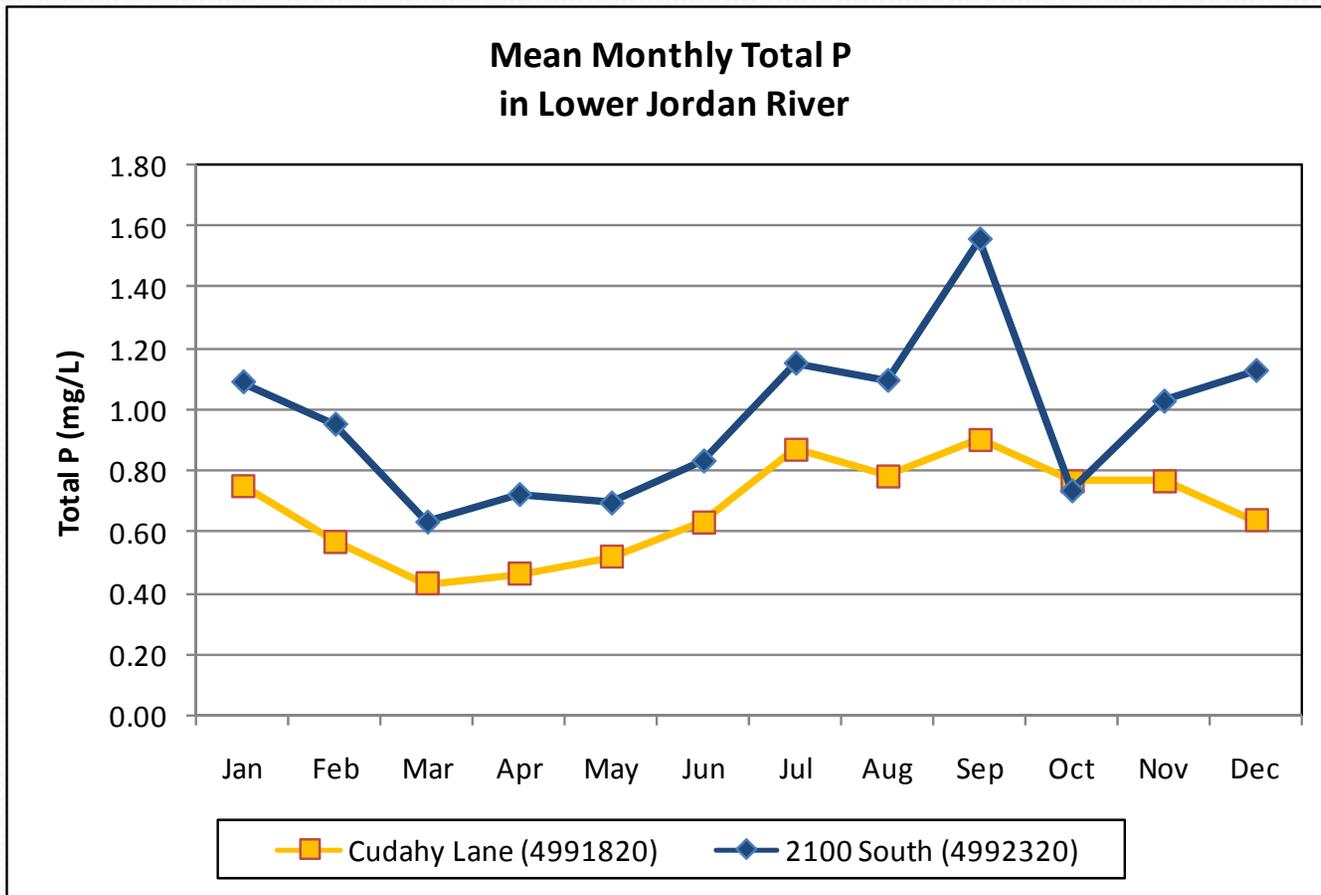
Algae Source



- Chlorophyll-a indicator of algal mass

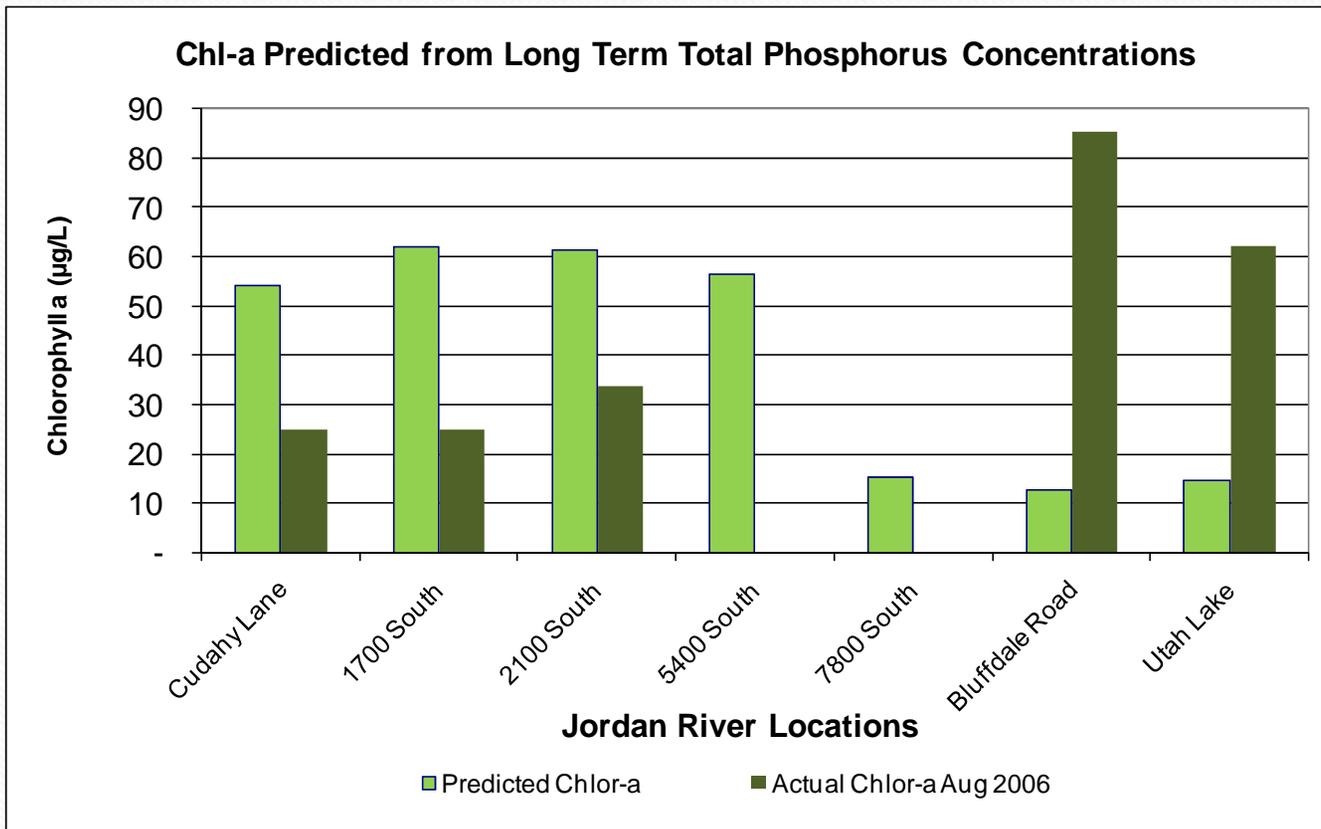
- Increasing from Utah Lake Peak at Bangerter Highway

Total P (Indicator) Uptake in Lower Jordan River



Total P above 0.05 mg/L criterion but decreases from 2100 South to Cudahy Lane

Limited by Nutrients?



EPA calculation based on Total P predicts Chlorophyll-a increasing downstream, **contrary** to data

...Why?

N:P Ratios

- Algae ultimately limited by nutrients
- Chapra (1997) N:P ratio less than 7.2:1 suggests N would be limiting factor
- Few Total N measurements available, but...suggests that P uptake and therefore algal growth below 2100 South may be limited by N

Table 4.9. Average N:P ratios measured from locations on the lower (1978–2005).

Station	Total N (n TKN, n N-N)	Total P (n)	TN/TP Ratio
Cudahy Lane	2.73 (139, 188)	0.92 (257)	6.22
North Temple	2.39 (22, 8)	1.32 (29)	5.40
2100 South	2.41 (21, 41)	1.19 (65)	4.90

Conclusions

- Few measurements, but algae indicated by
 - Strong diurnal DO pattern in August
 - Weak pattern in winter
 - Peak in late afternoon
 - Sag in DO at night
- Source: Utah Lake (senescent algae already settled in lake)
- Algal growth below Utah Lake to 9000 South
- Possible N-limited below 2100 South
- Senescing algae possible source of BOD – VSS in TSS?