The Role of the Maumee River as a Source of Phosphorus Supporting Algal Growth in the Western Basin of Lake Erie

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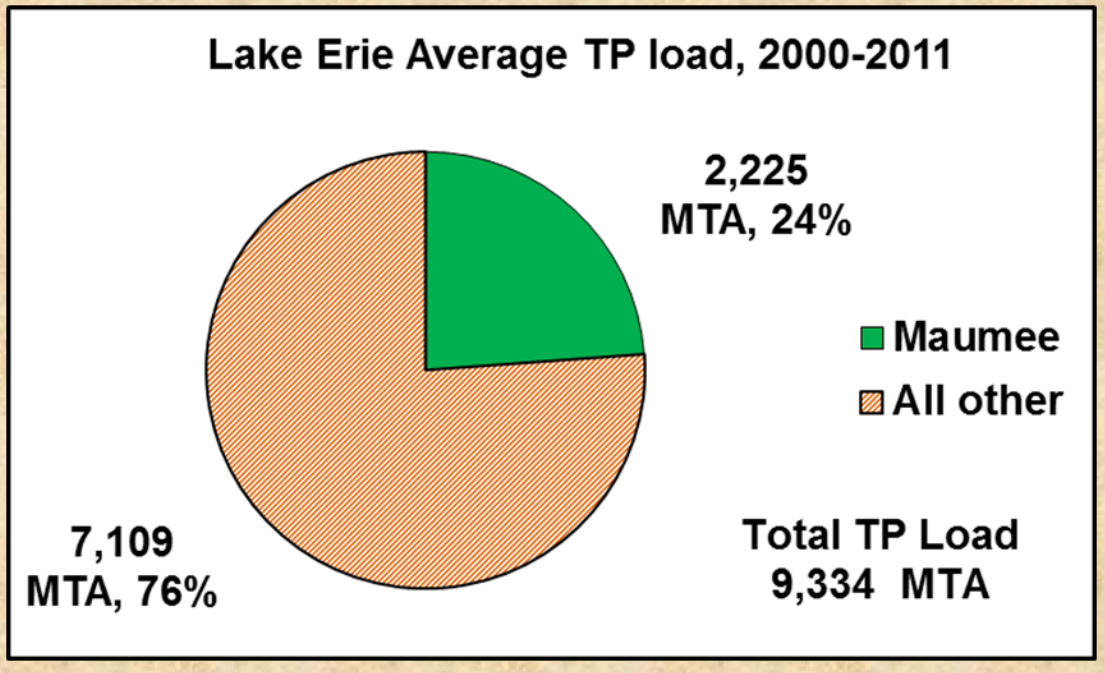
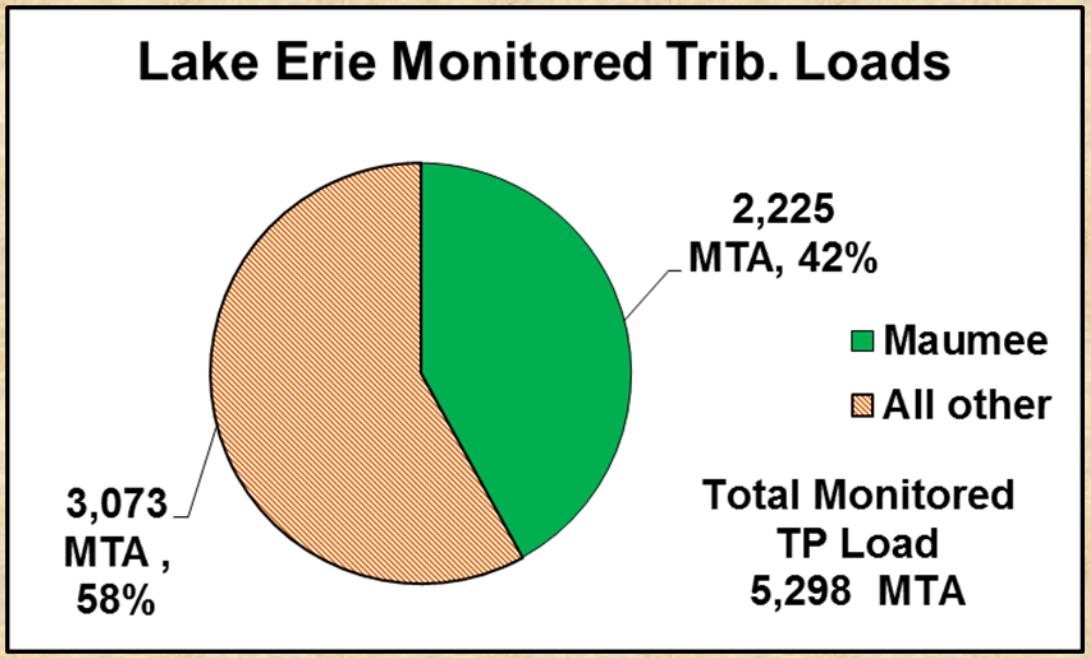
Maumee Waterville TP loads in relation to total Lake Erie TP loads, 2000 -2011



Maumee Waterville TP loads in relation to total Lake Erie <u>monitored tributary</u> TP loads, 2000 -2011



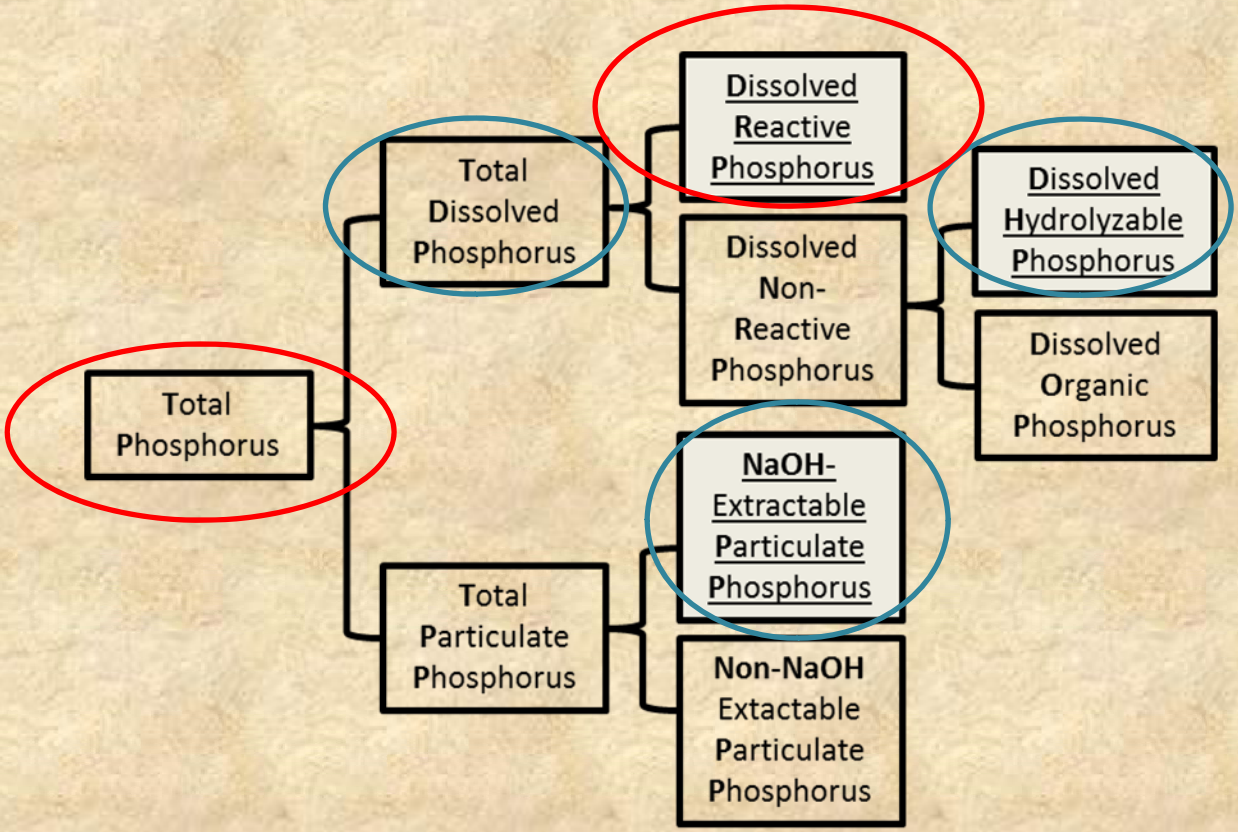
In this presentation we will address two questions --

1. **What proportion of the total phosphorus load at Waterville is bioavailable?**

2. **What proportion of the bioavailable phosphorus is delivered to the Western Basin in a position for algal uptake? (positional bioavailability)**

1. What proportion of the total phosphorus load at Waterville is bioavailable?

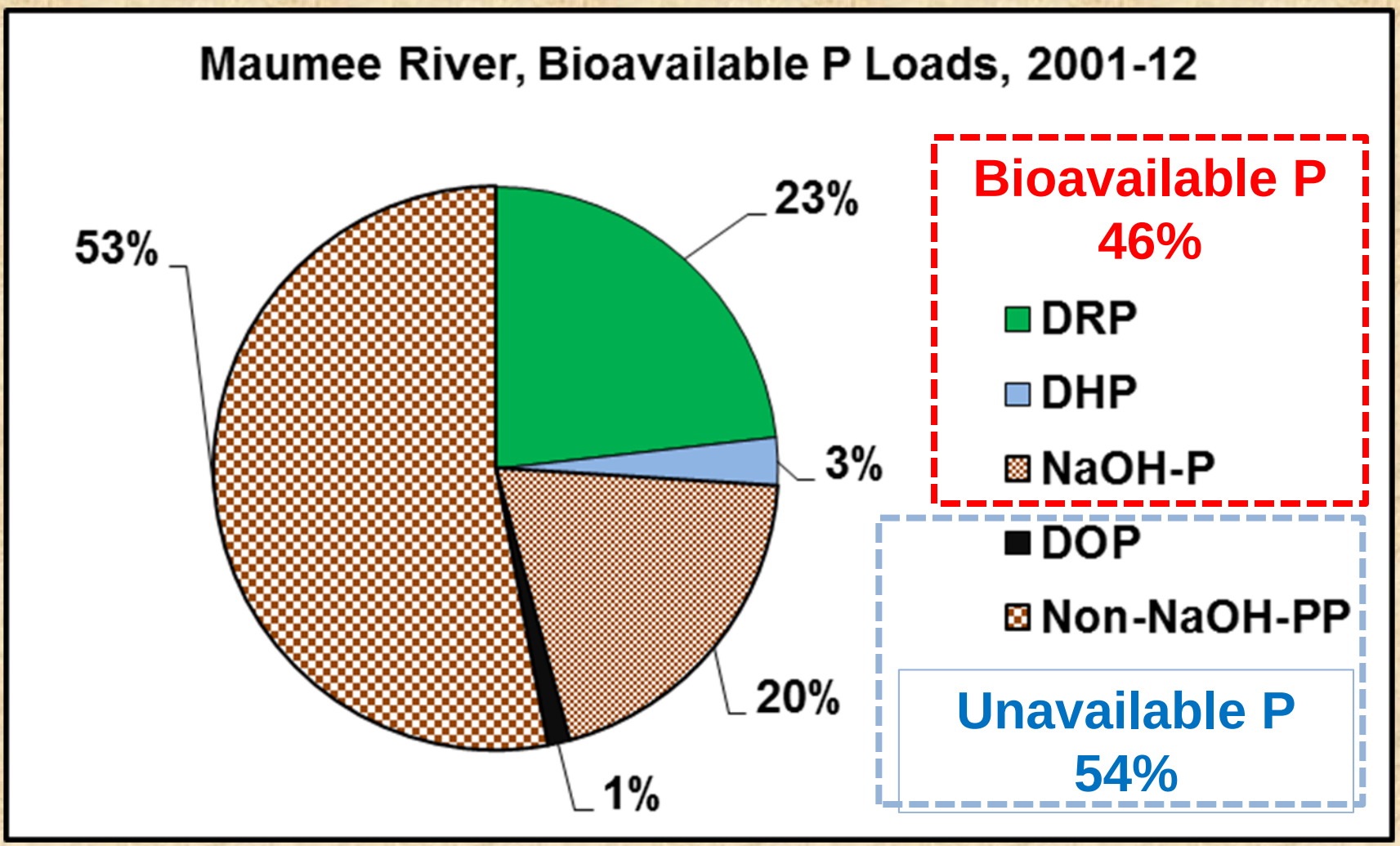
Studies of bioavailable phosphorus loading from northern Ohio tributaries to Lake Erie



Total Bioavailable Phosphorus = Dissolved Reactive Phosphorus + Dissolved Hydrolyzable Phosphorus + NaOH-Extractable Particulate Phosphorus

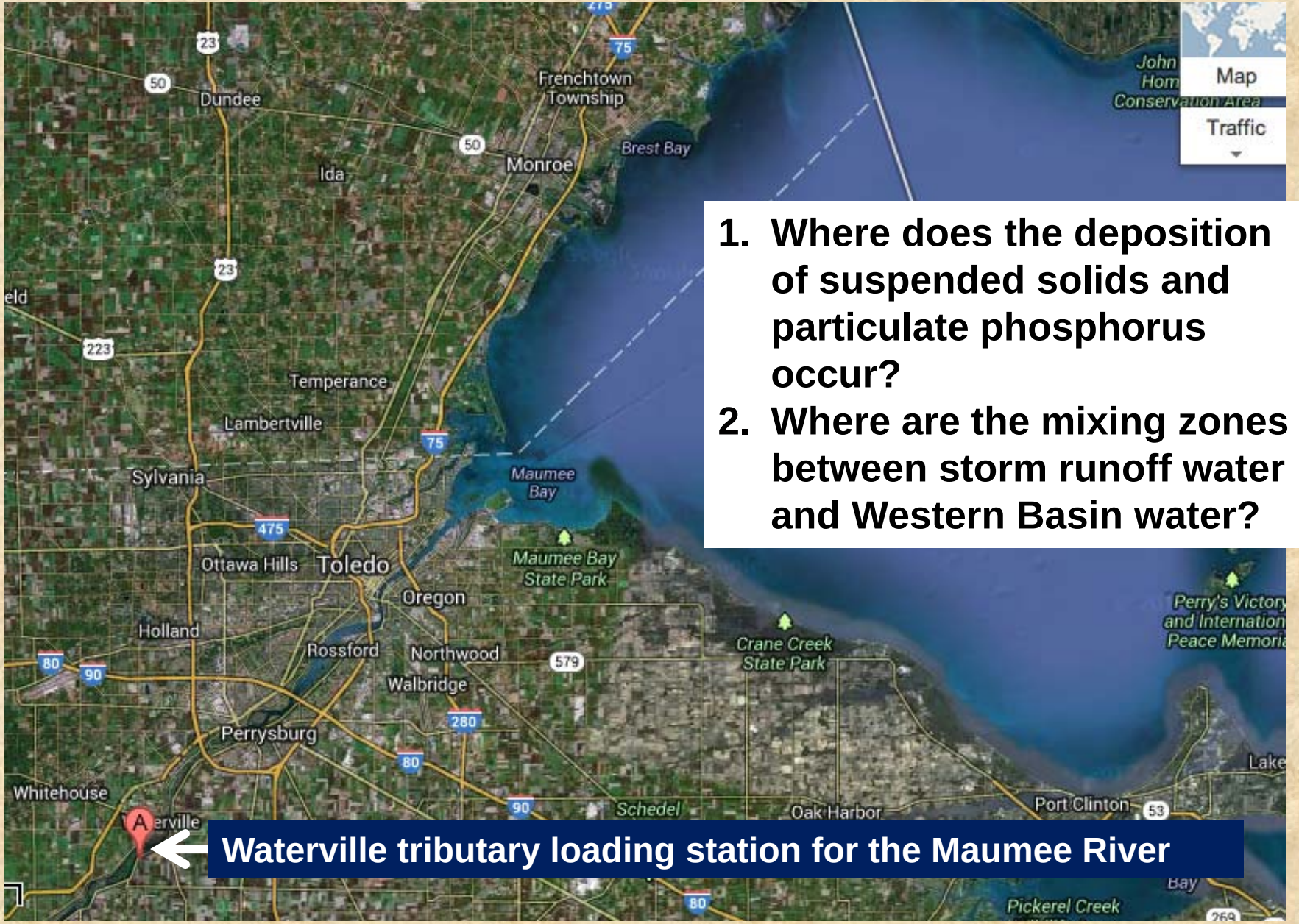
All samples

Bioavailability samples



Only 27% of the particulate phosphorus is bioavailable (NaOH-extractable).

On the issue of positional bioavailability --



Study Methods --

1. Lagrangian analysis of an April 2010 storm event for the Maumee River.

2. Data mining for an August 2007 storm event for the Maumee River.

   a. Bob Vincent – Bowling Green State University
   b. Tom Bridgeman – University of Toledo
   c. Heidelberg - Waterville data

Lagrangian Analysis Pilot Study

12 Stations

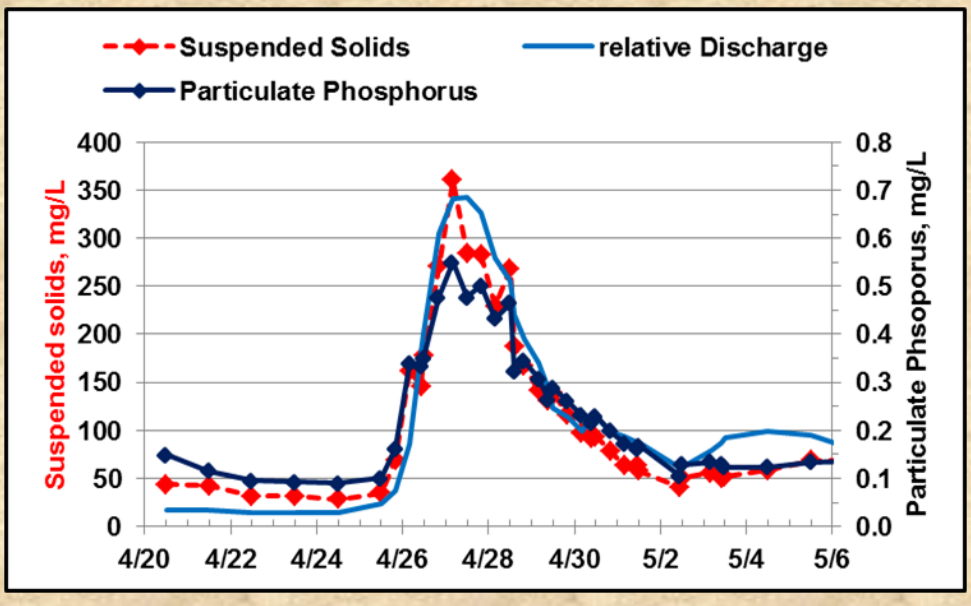
Sampling depth
- **1 meter below surface**
- **1 meter above bottom**

Collection Dates:

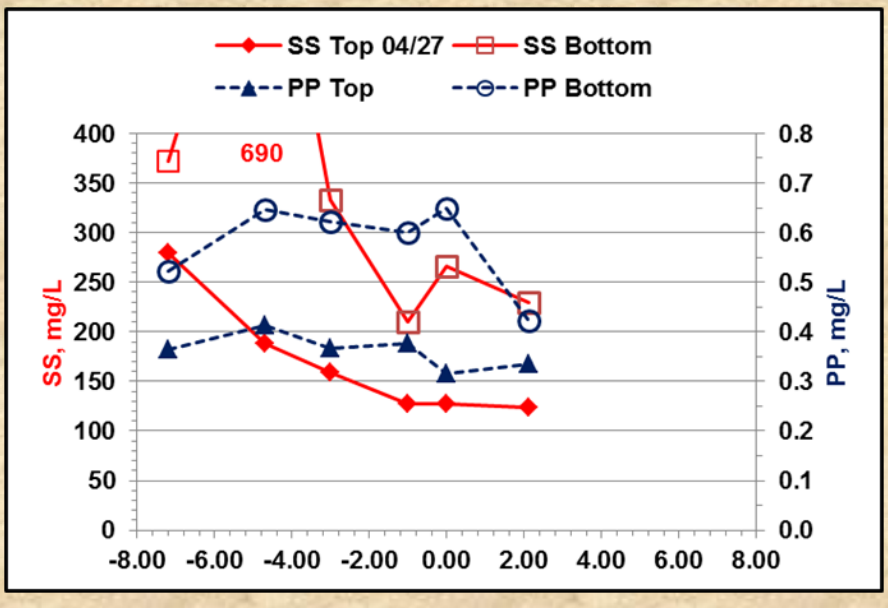
4/21/2010	← Algal Sampling
4/27/2010	
4/28/2010	← Algal Sampling
4/29/2010	
4/30/2010	
5/1/2010	
5/3/2010	
5/5/2010	← Algal Sampling
5/12/2010	← Algal Sampling
5/19/2010	← Algal Sampling

- A grid of stations
- Frequent sampling
- Recognize water masses by storm water markers
- Analyze changes in successive parcels of water

April 2010 storm hydrograph and chemographs for suspended solids and particulate phosphorus at Waterville



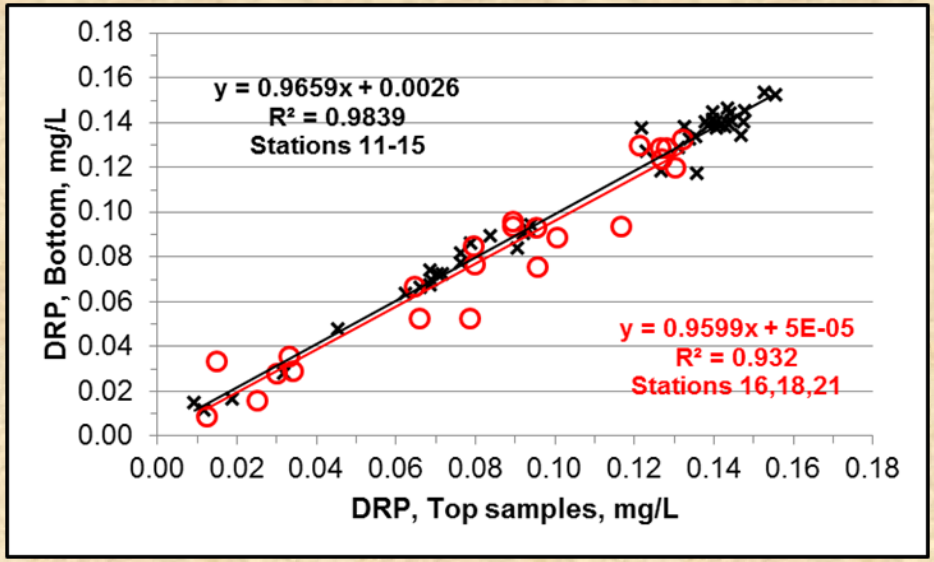
Lagrangian April 27 transect data for suspended solids and particulate phosphorus for top and bottom samples



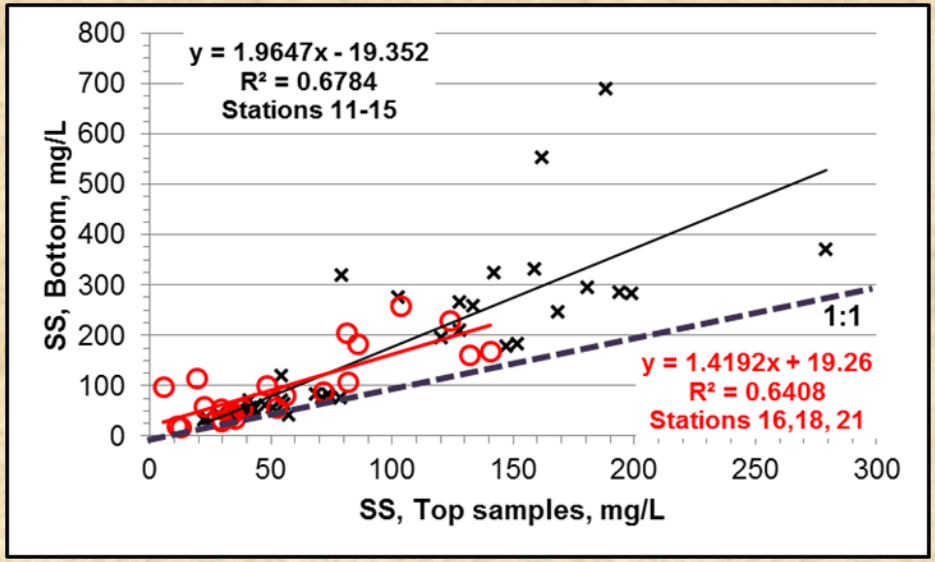
Although the suspended solids export at Waterville is dominated by clay-sized particles, the clay does appear to be settling out of the water column in the lower river and bay.

A comparison of top and bottom samples for a dissolved substance (DRP) and a particulate substance (SS) for riverine stations (x) and lake/bay stations (○) in the Lagrangian sampling program.

Dissolved Reactive Phosphorus



Suspended Solids

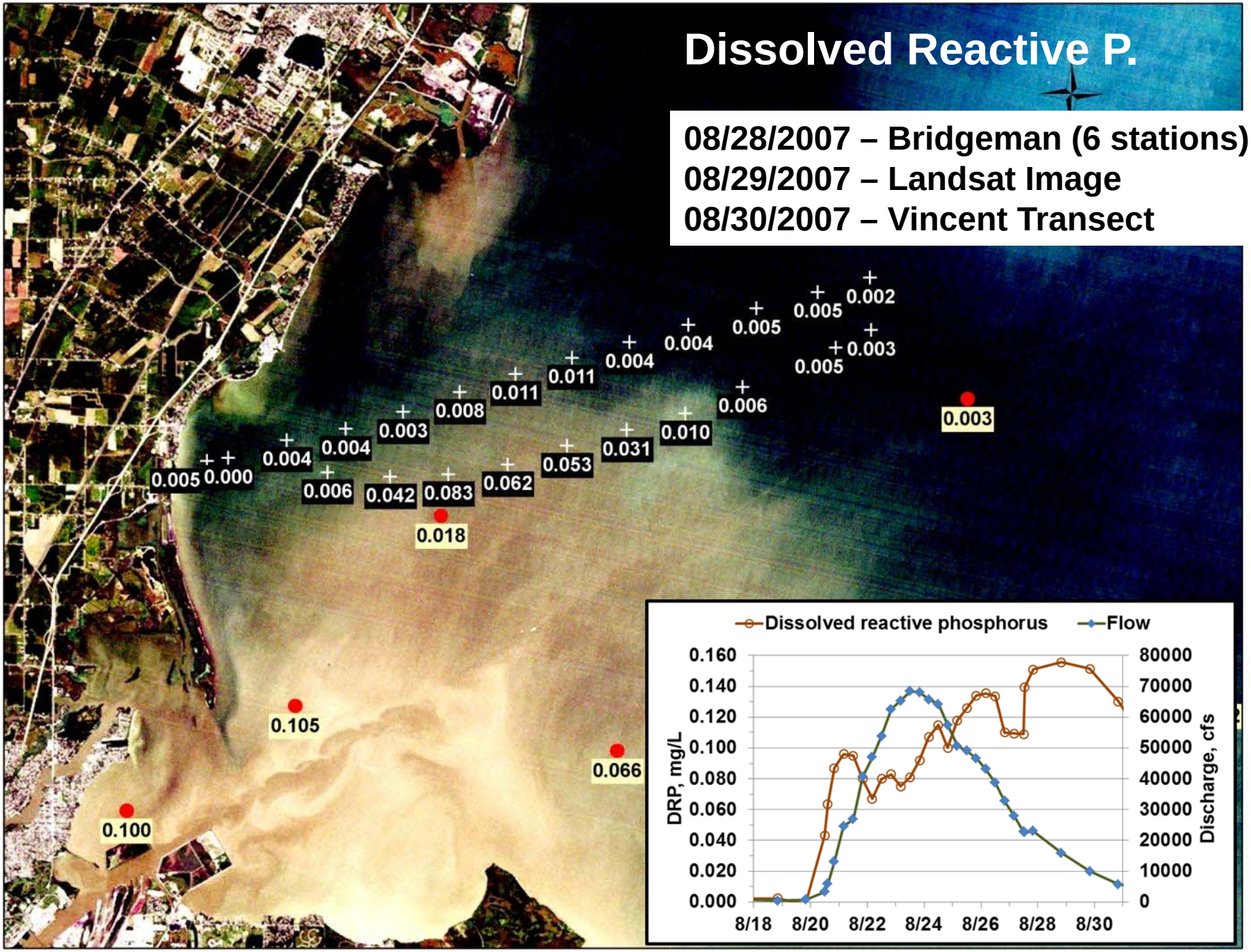


Dissolved substances – similar concentrations in top and bottom samples.

Particulate substances – higher concentrations in bottom samples than in top samples.

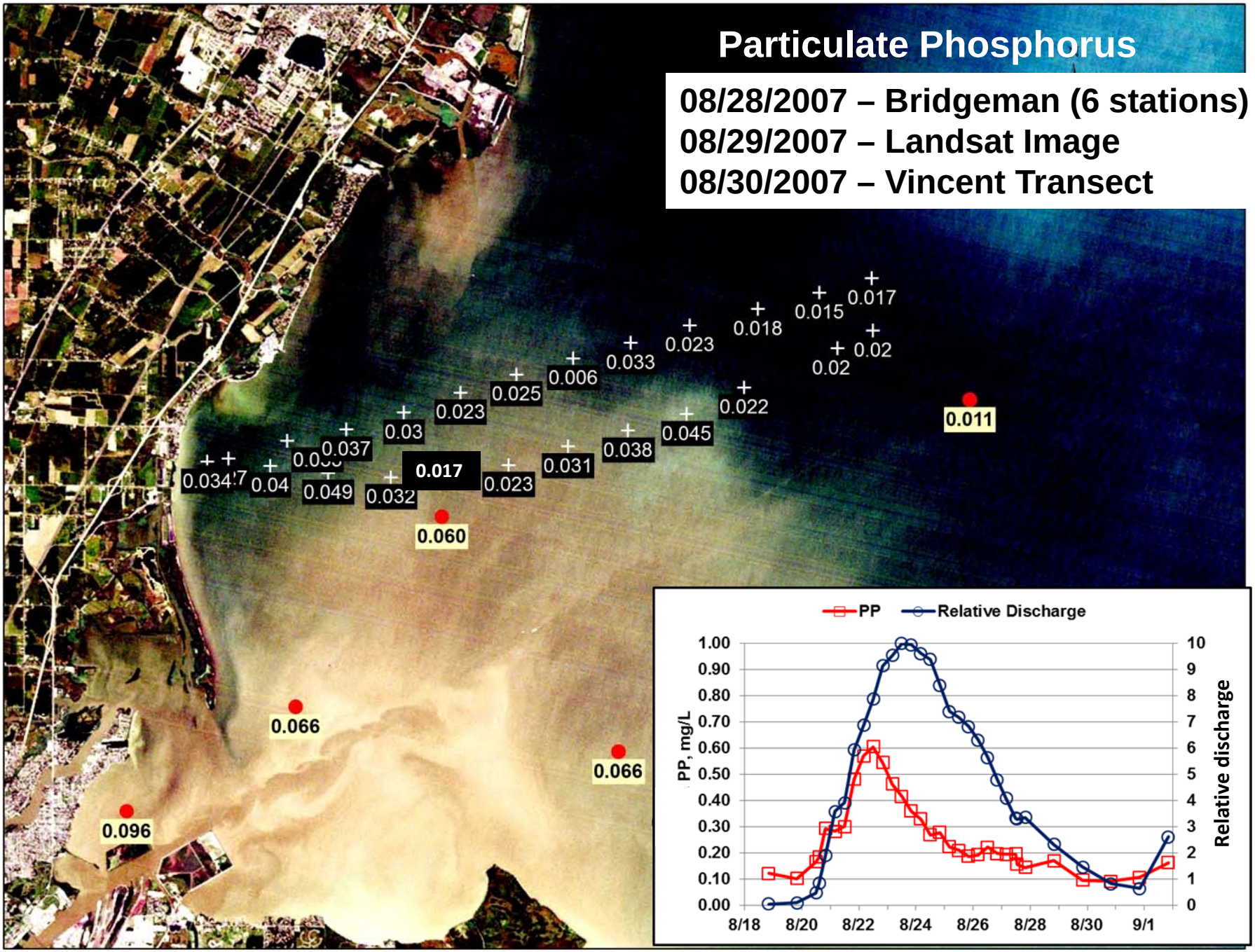
Dissolved Reactive P.

08/28/2007 – Bridgeman (6 stations)
08/29/2007 – Landsat Image
08/30/2007 – Vincent Transect

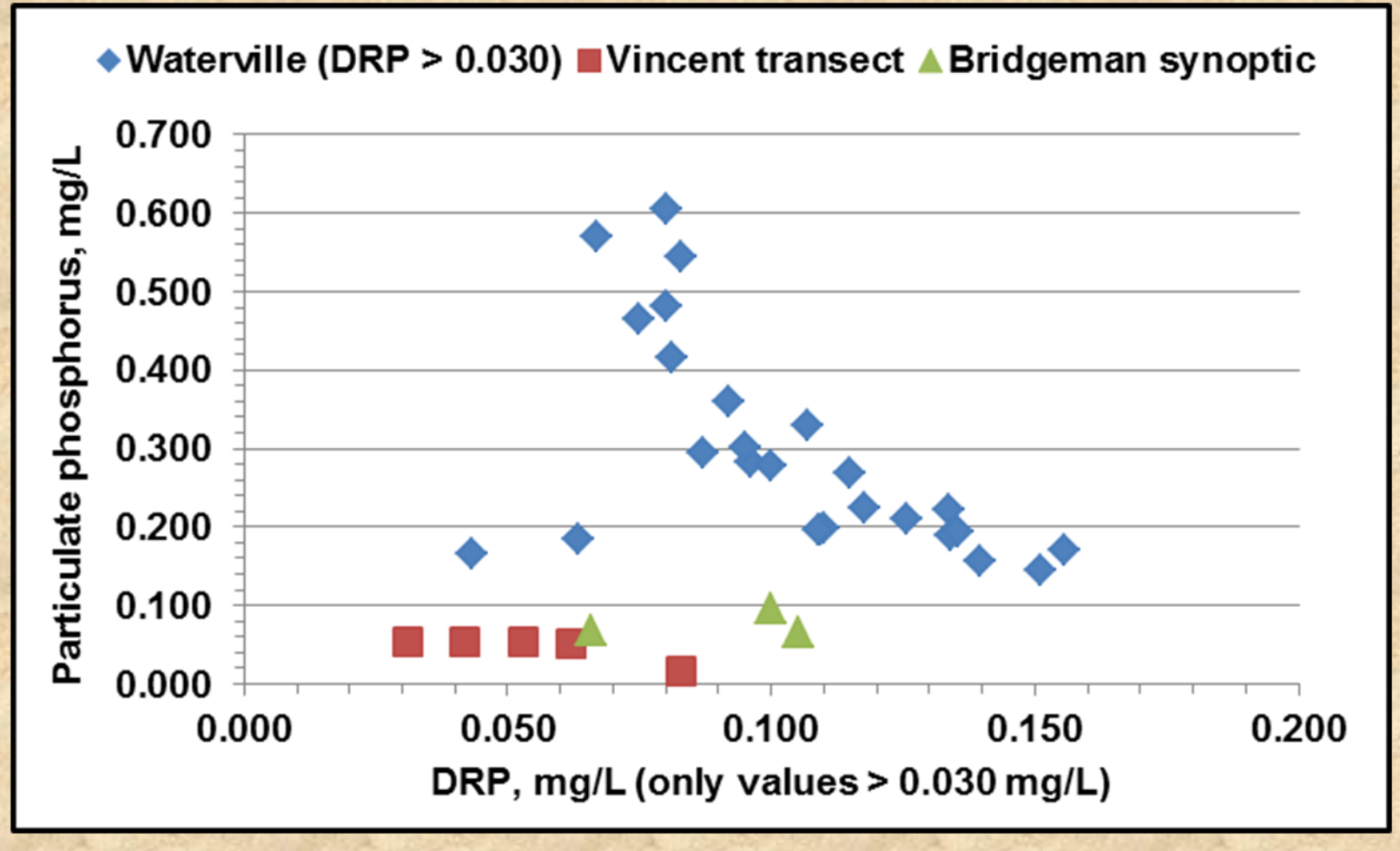


Particulate Phosphorus

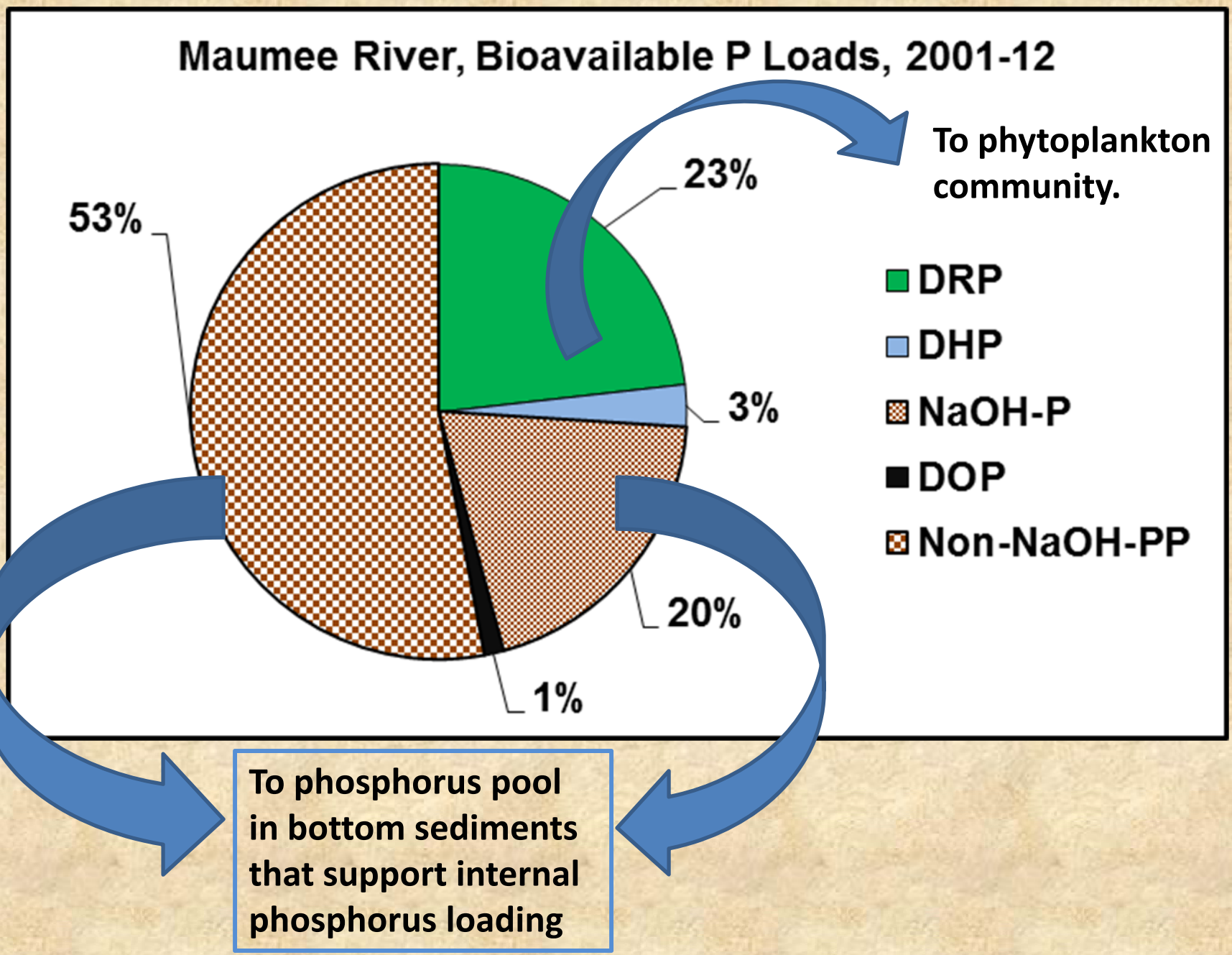
08/28/2007 – Bridgeman (6 stations)
08/29/2007 – Landsat Image
08/30/2007 – Vincent Transect

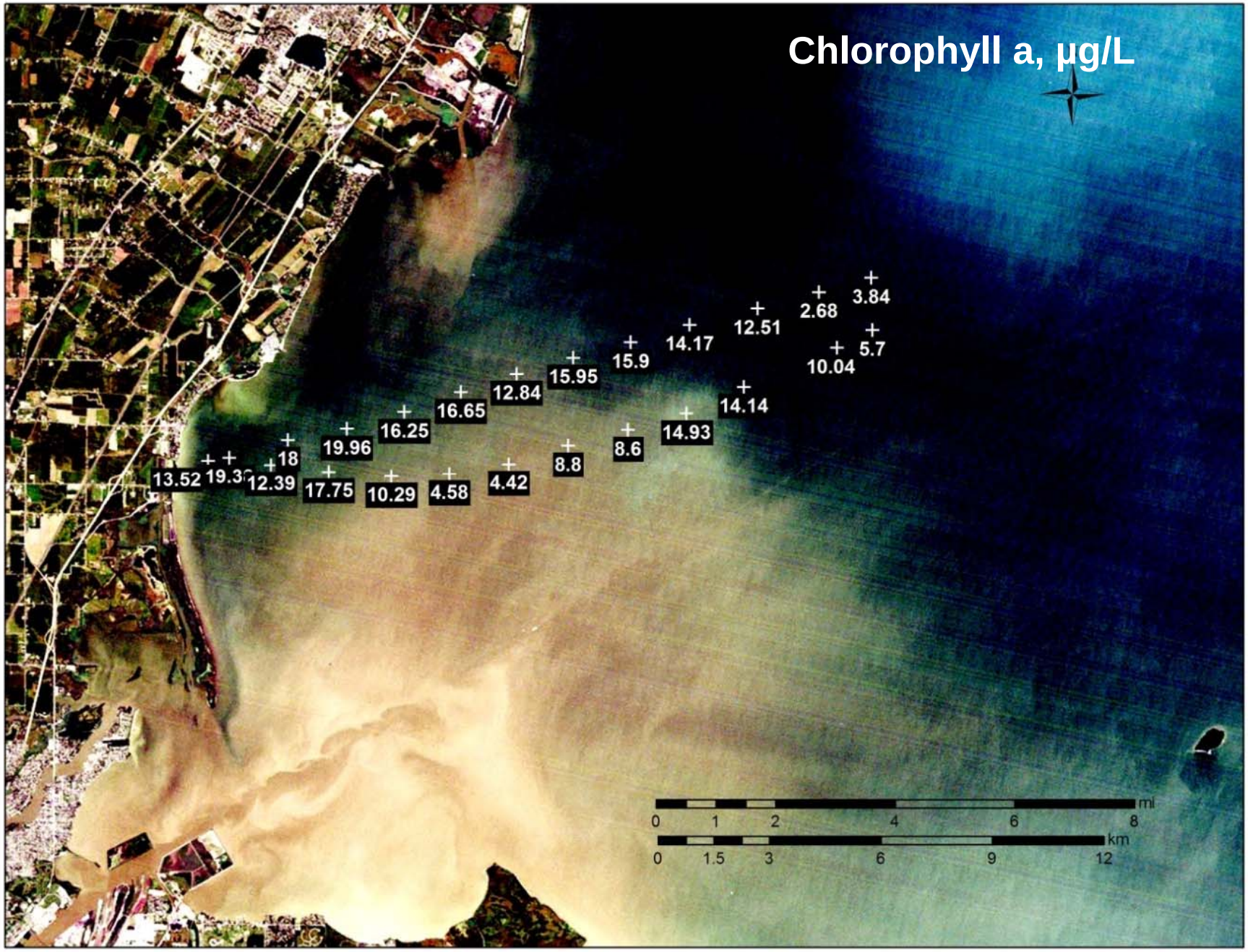


The relationships between particulate phosphorus and dissolved reactive phosphorus for river samples (Waterville) and for Lake/Bay samples (Vincent & Bridgeman)



No surprise - even clay sized sediments settle out of the water column.


Maumee River, Bioavailable P Loads, 2001-12
To phytoplankton community.
23%
3%
20%
1%
53%
DRP
DHP
NaOH-P
DOP
Non-NaOH-PP
To phosphorus pool in bottom sediments that support internal phosphorus loading


Chlorophyll a, µg/L
13.52
19.3
12.39
18
19.96
17.75
16.25
10.29
16.65
4.58
12.84
4.42
15.95
8.8
15.9
8.6
14.17
14.93
12.51
14.14
2.68
10.04
3.84
5.7
mi
0 1 2 4 6 8
km
0 1.5 3 6 9 12

Summary

1. Only about 46% percent of the total phosphorus loads at Waterville are bioavailable.
2. Only about 27% percent of the particulate phosphorus is bioavailable.
3. Most of the particulate phosphorus appears to settle out of the water column in the lower river and/or Maumee Bay.
4. Since the particulate phosphorus attached suspended solids is likely in equilibrium with surrounding high ambient DRP concentrations, little DRP is likely to be released during the settling process. Instead, bioavailable particulate phosphorus contributes to the phosphorus pools that support internal phosphorus loading.
5. Large volumes of storm water with high concentrations of DRP (and other dissolved nutrients) move into the lower river, bay and adjacent waters of the Western Basin during storm events on the Maumee River. The areal extent varies with storm volume.
6. Trends in algal biomass in the Western Basin should track trends in DRP loading.

Acknowledgements

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1. **EPA/GLNPO,**
2. **Lake Erie Protection Fund**
3. **The Great Lakes Protection Fund**

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Charter Boat Operators

Colleagues at the Heidelberg NCWQR

Questions

The role of the Maumee River in total phosphorus loading to Lake Erie --