Automated Analysis of Nutrients and Related Water Quality Parameters at Millsboro Pond.

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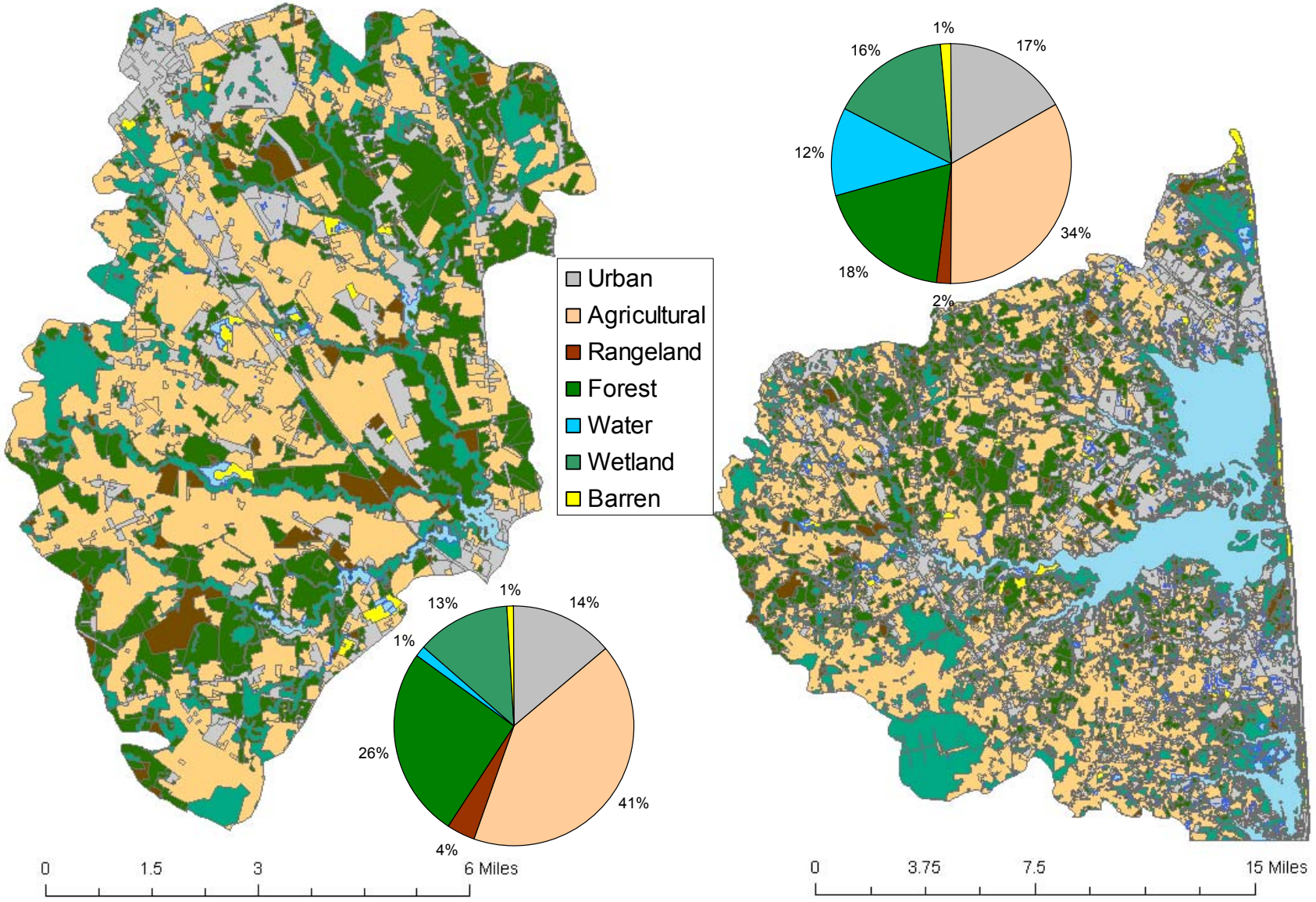
Objectives

- Frequent and rapid sampling of base- and storm-flow to more accurately estimate nutrient loads to Indian River from Millsboro Pond
- Track progress towards meeting Total Maximum Daily Load (TMDL) goals
- Develop models for estimating historical and potential future nutrient loads

Why Millsboro Pond?

- Accessible location on Route 24
- The largest sub-watershed and nonpoint source contributor
- Within the TMDL High Reduction Area making it a desirable area to track load reductions
- Land use is mixed and characteristic of the entire Inland Bays Watershed

2002 Land Use



Greenspan Aqualab®

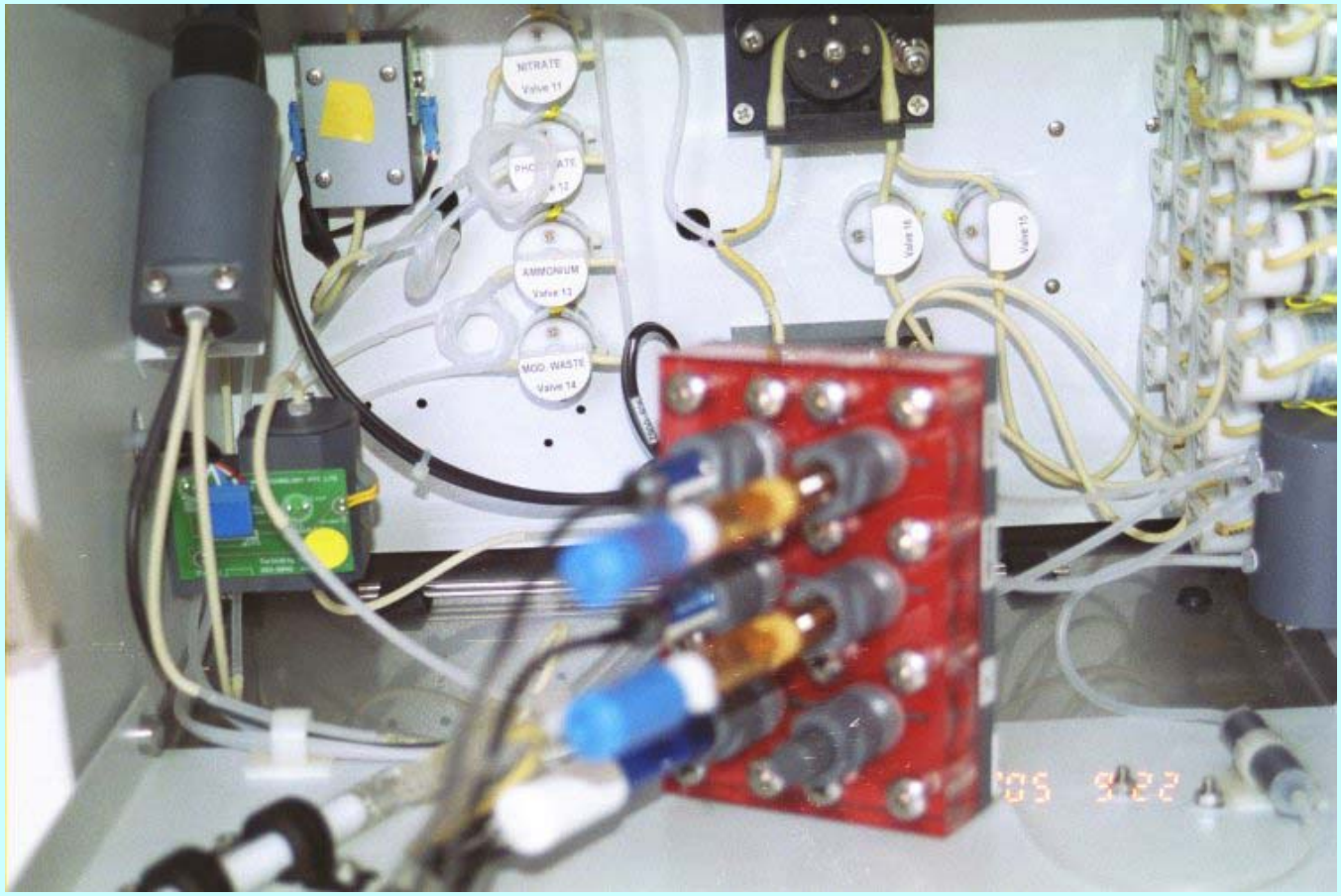
- Self-contained automated water quality analyzer
- Dissolved oxygen, pH, conductivity, temperature, turbidity, nitrate, ammonium, phosphate
- Remote control
- Interface with ISCO water sampler

Phases of Project

- Phase 1: (Completed)
  - Laboratory analytical experiments
- Phase 2:
  - Installation at Millsboro Pond
- Phase 3:
  - Calibration to grab samples, ISCO samples, and datasonde data
- Phase 4:
  - Determination of event, monthly, seasonal, and annual nutrient loads
- Phase 5:
  - Develop models for estimating historical and potential future nutrient loads

Analytical Methods

- Ion Specific Electrodes (nitrate, ammonium)
- Spectrophotometry (phophate)
- Nephelometry (turbidity)
- Electrical sensors (dissolved oxygen, pH, conductivity, temperature)
- Internal standardization (by event or daily)



Analytical Module

Reagent and Waste Storage

Aqualab®

GREENSPAN ANALYTICAL

Analytical Limitations

- Not all nitrogen species are measured by Aqualab®
  - Not measured = PON, DON, NO_2-
  - Usually minor at Millsboro Pond
- Not all phosphorus species are measured by Aqualab®
  - Not measured = DOP, all PP
- Traditional sampling is being used to estimate total loads from measured Aqualab® parameters

Phases of Project

- Phase 1:
  - Laboratory analytical experiments
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  - Develop models for estimating historical and potential future nutrient loads

Installation

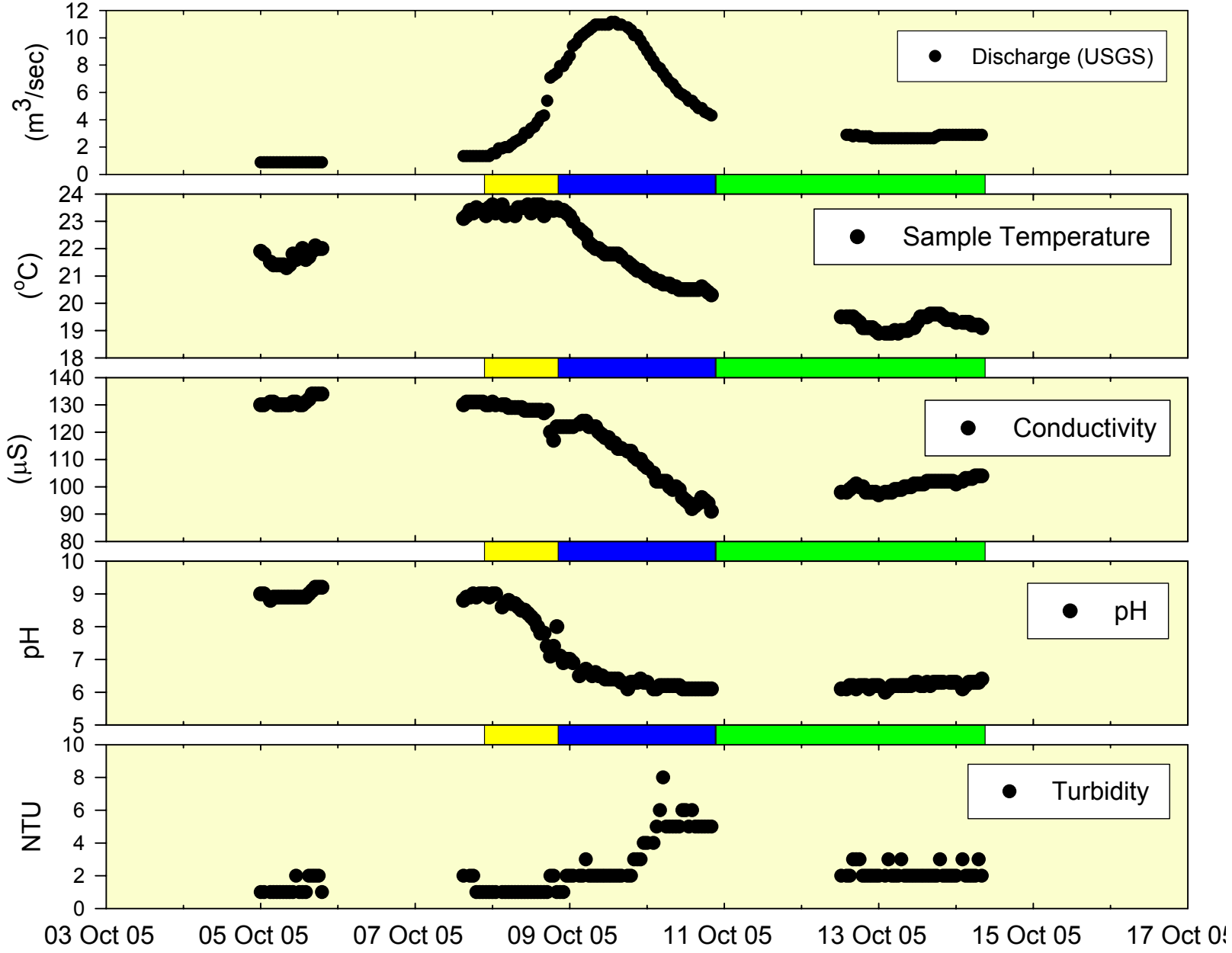
Phases of Project

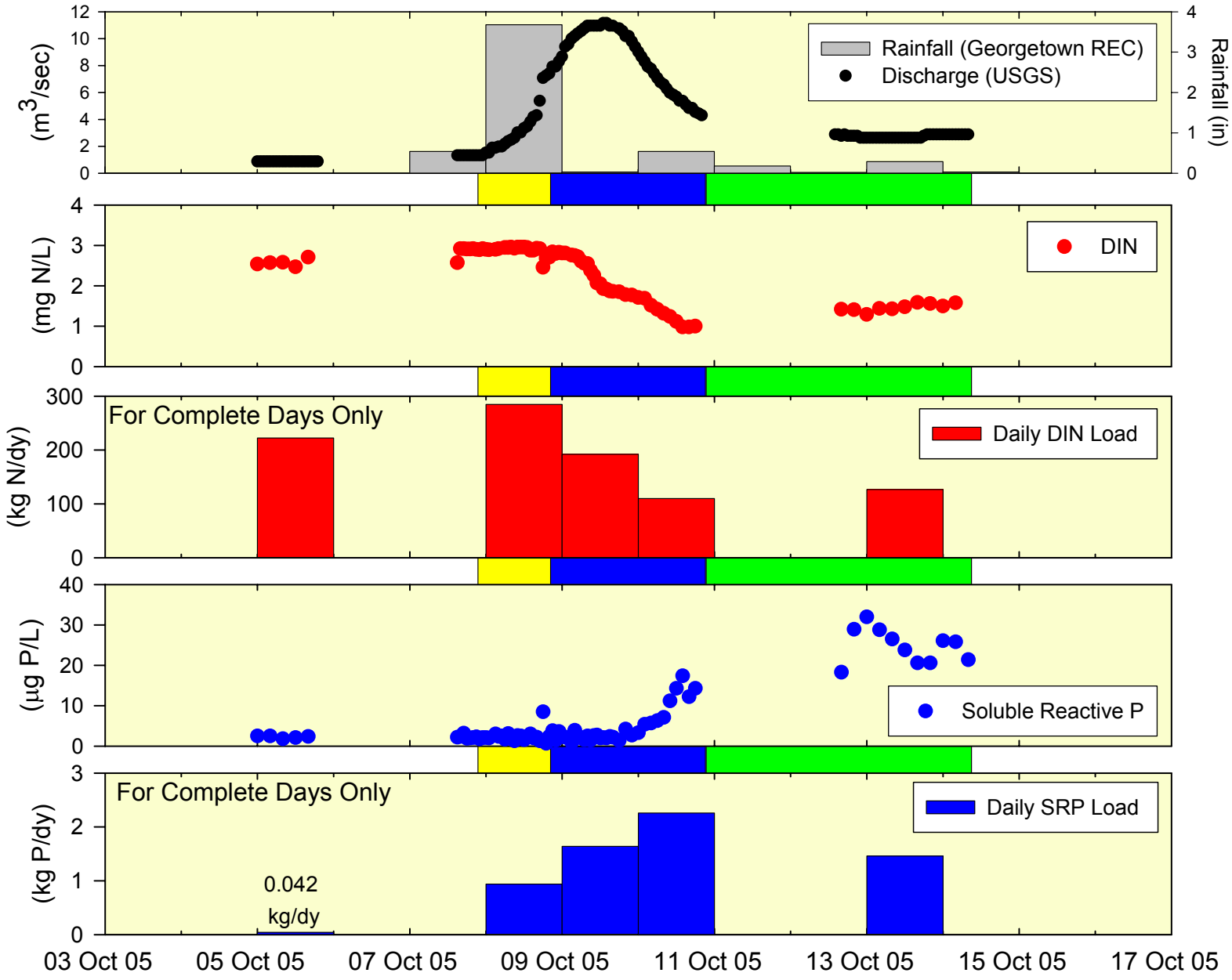
- Phase 1:
  - Laboratory analytical experiments
- Phase 2:
  - Installation at Millsboro Pond
- Phase 3: (Ongoing)
  - Calibration to grab samples, ISCO samples, and datasonde data
- Phase 4: (Ongoing)
  - Determination of event, monthly, seasonal, and annual nutrient loads
- Phase 5:
  - Develop models for estimating historical and potential future nutrient loads

Example Aqualab® Data

- Storm Data from 5 - 14 October 2005
- Discharge from USGS gauging station at Millsboro Pond
- Rainfall from UofD Research and Education Center (Georgetown and Harbeson)

October 2005	6	7	8	9	10	11	12	13	14
Georgetown	0	0.54	3.68	0.03	0.54	0.18	0.02	0.29	0.03
Harbeson	0	0.16	3.00	0.01	0.01	0.07	0.22	0.61	0.08


Discharge (USGS)
(m3/sec)
Sample Temperature
(°C)
Conductivity
(µS)
pH
pH
Turbidity
NTU
03 Oct 05
05 Oct 05
07 Oct 05
09 Oct 05
11 Oct 05
13 Oct 05
15 Oct 05
17 Oct 05

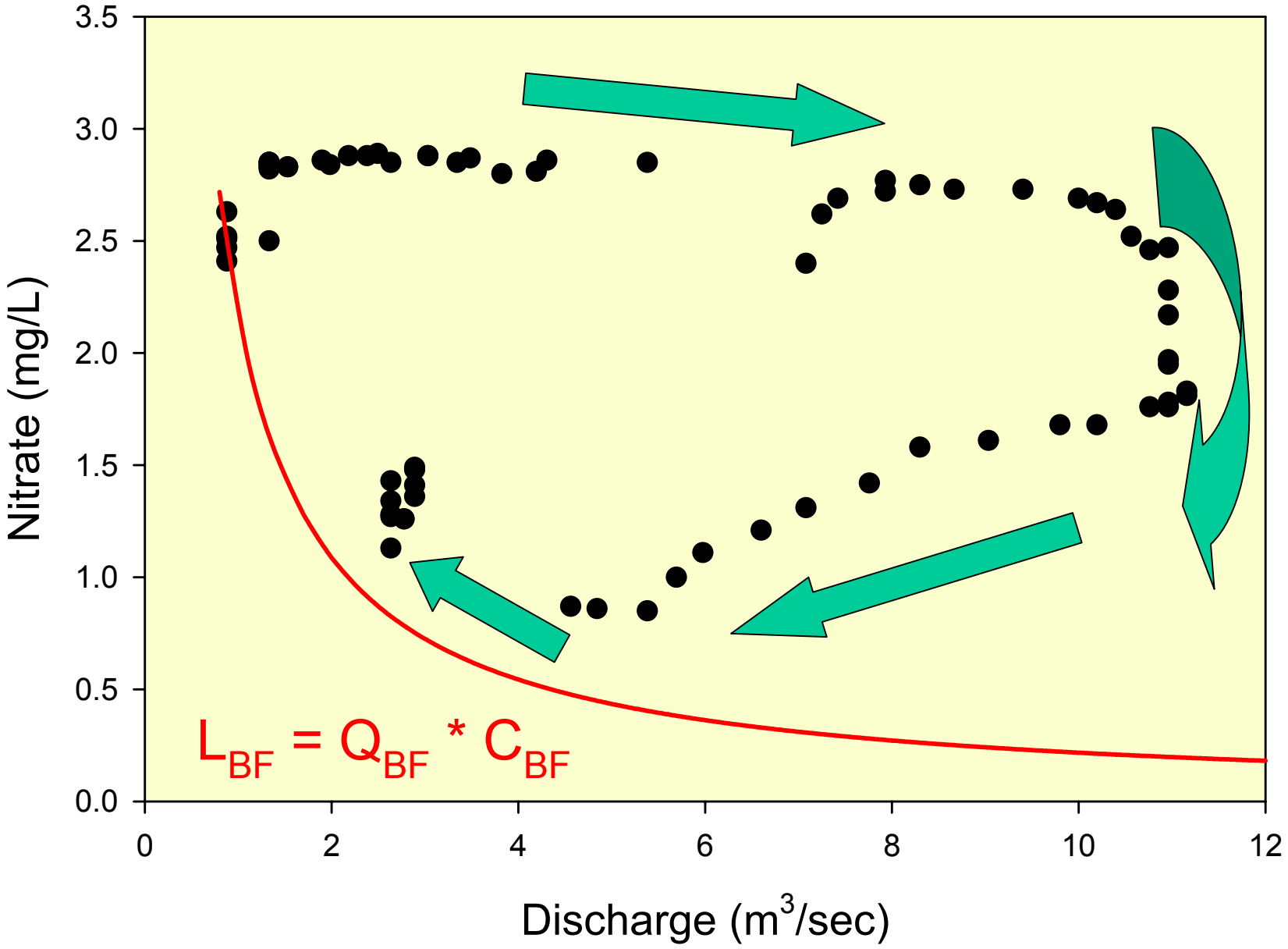

Rainfall (Georgetown REC)
Discharge (USGS)
(m3/sec)
Rainfall (in)
DIN
(mg N/L)
For Complete Days Only
Daily DIN Load
(kg N/dy)
Soluble Reactive P
(µg P/L)
For Complete Days Only
Daily SRP Load
(kg P/dy)
0.042
kg/dy
03 Oct 05
05 Oct 05
07 Oct 05
09 Oct 05
11 Oct 05
13 Oct 05
15 Oct 05
17 Oct 05

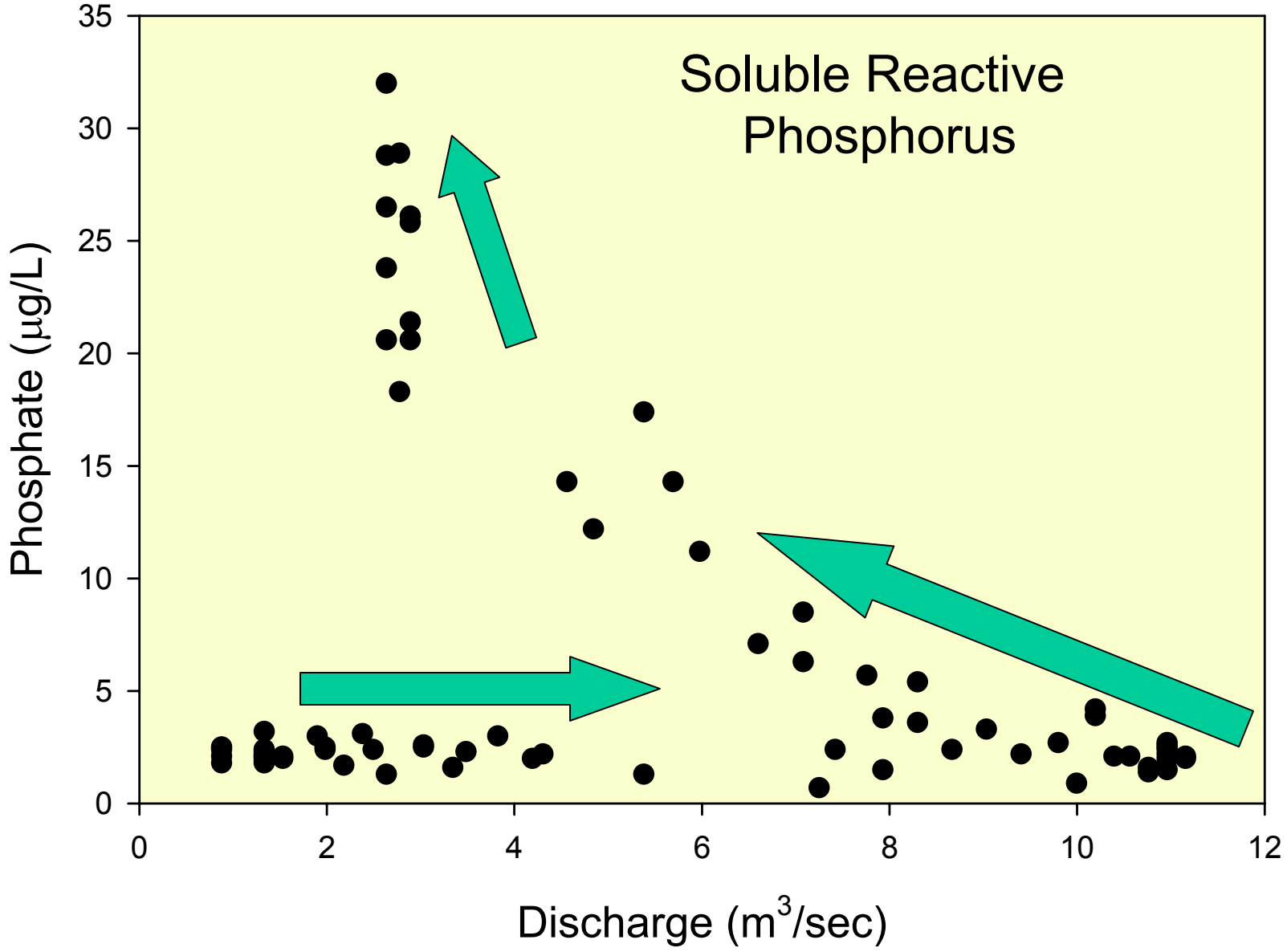
Ongoing Tasks

- Calibrate Aqualab® Nitrate, Ammonium, and Turbidity to Total Dissolved N (TDN) and/or Total N (TN)
- Calibrate Aqualab® Phosphate (unfiltered) and Turbidity to Total Dissolved Phosphorus (TDP) and Total Phosphorus (TP)
- Quality Control and Quality Assurance.
- Load Determinations (Present, Past, and Future)

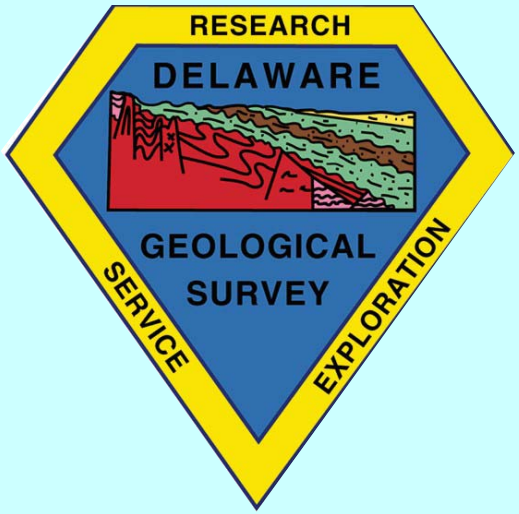
Phases of Project

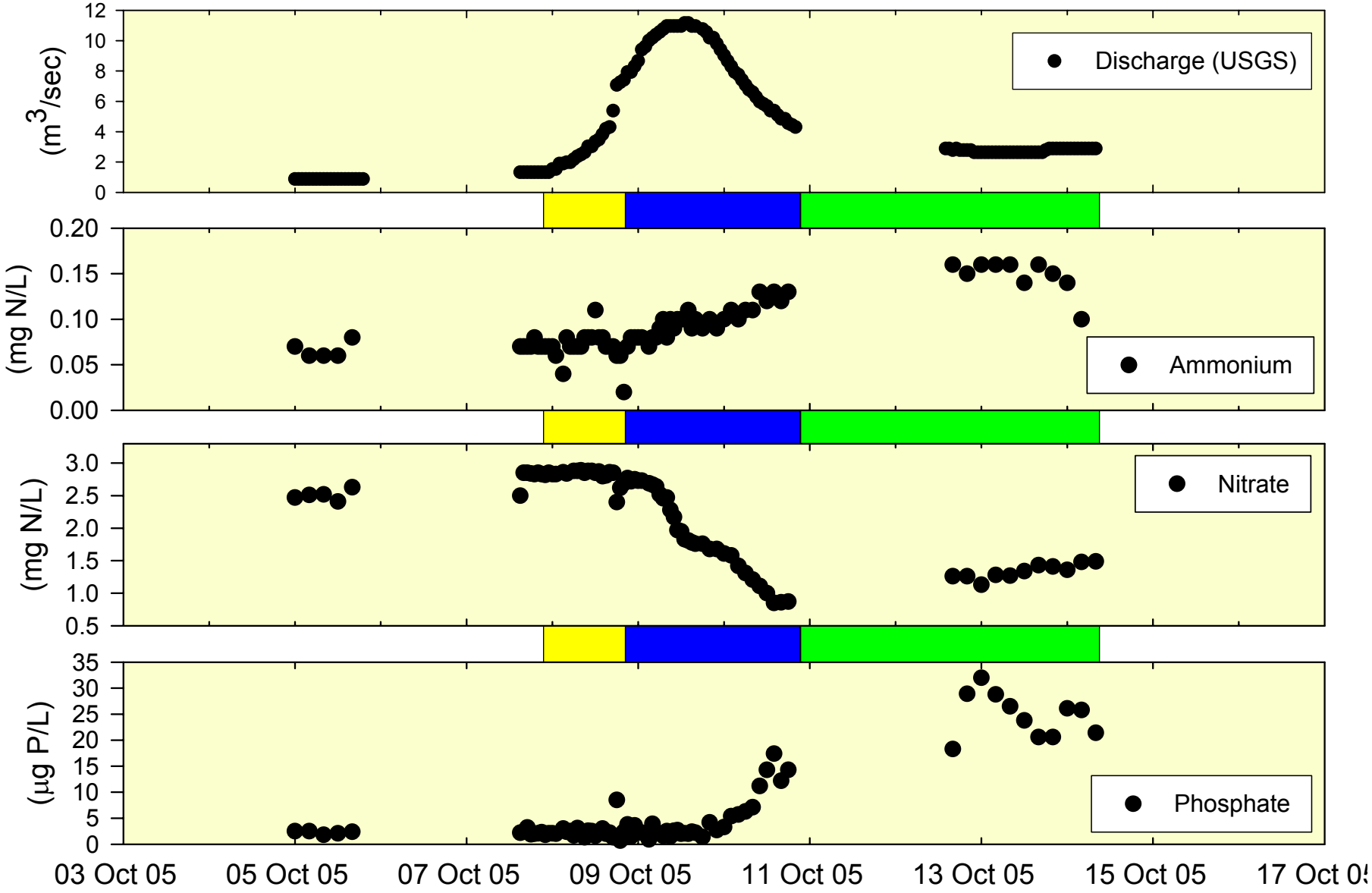
- Phase 1:
  - Laboratory analytical experiments
- Phase 2:
  - Installation at Millsboro Pond
- Phase 3:
  - Calibration to grab samples, ISCO samples, and datasonde data
- Phase 4:
  - Determination of event, monthly, seasonal, and annual nutrient loads
- Phase 5: (Future)
  - Develop models for estimating historical and potential future nutrient loads

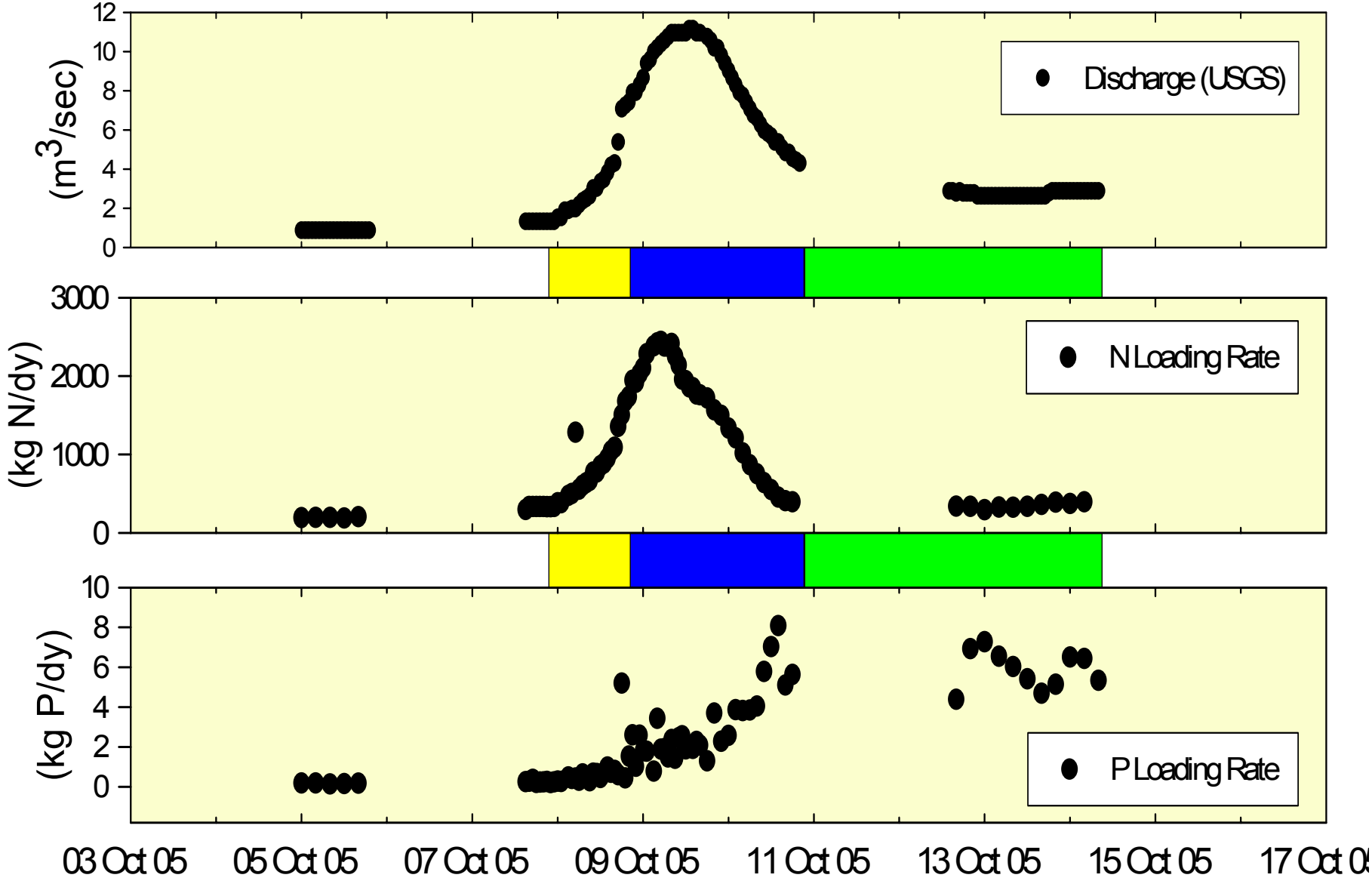

3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Nitrate (mg/L)
0
2
4
6
8
10
12
Discharge (m3/sec)
LBF = QBF * CBF


Soluble Reactive Phosphorus
Phosphate (µg/L)
Discharge (m3/sec)
0
5
10
15
20
25
30
35
0
2
4
6
8
10
12

Funding and Other Support




(m3/sec)
Discharge (USGS)
(mg N/L)
Ammonium
(mg N/L)
Nitrate
(µg P/L)
Phosphate
03 Oct 05
05 Oct 05
07 Oct 05
09 Oct 05
11 Oct 05
13 Oct 05
15 Oct 05
17 Oct 05


12
10
8
6
4
2
0
(m3/sec)
Discharge (USGS)
3000
2000
1000
0
(kg N/dy)
N Loading Rate
10
8
6
4
2
0
(kg P/dy)
P Loading Rate
03 Oct 05
05 Oct 05
07 Oct 05
09 Oct 05
11 Oct 05
13 Oct 05
15 Oct 05
17 Oct 0