Ballston Lake Water Quality

Status, trends, needs

Report to Town of Ballston

In support of the WSOD baseline assessment

April 2010

Key findings

- Nitrogen nutrients show wide fluctuation, but are statistically stable for last 20 years.
- Phosphorus has increased significantly in the last 10 years
- Measures that correlate with increased phosphorus have also increased (chlorophyll, total coliform).
- Phosphorus is the limiting nutrient for biological activity in Ballston lake, increased nitrogen would not dramatically affect water quality.
- High lake levels and watershed inflow are the primary suspects in increased Phosphorus

- More measurements are needed to fully assess the source of increasing phosphorus

History of water quality testing

- CSLAP (Citizens Statewide Lake Assessment Program - DEC)
  - Nutrients (Phosphorus, Nitrogen)
  - Clarity (Secchi, color)
  - Solution chemistry (ph, conductivity, calcium)
  - Subjective assessments (clarity, plants, recreation)
  - BLIA member since 1991: annual fee from voluntary dues.
- DEC, ELS (Eastern Lakes survey). Limited testing – 1975-1985. Phosphorus, Nitrate, ph, Secchi

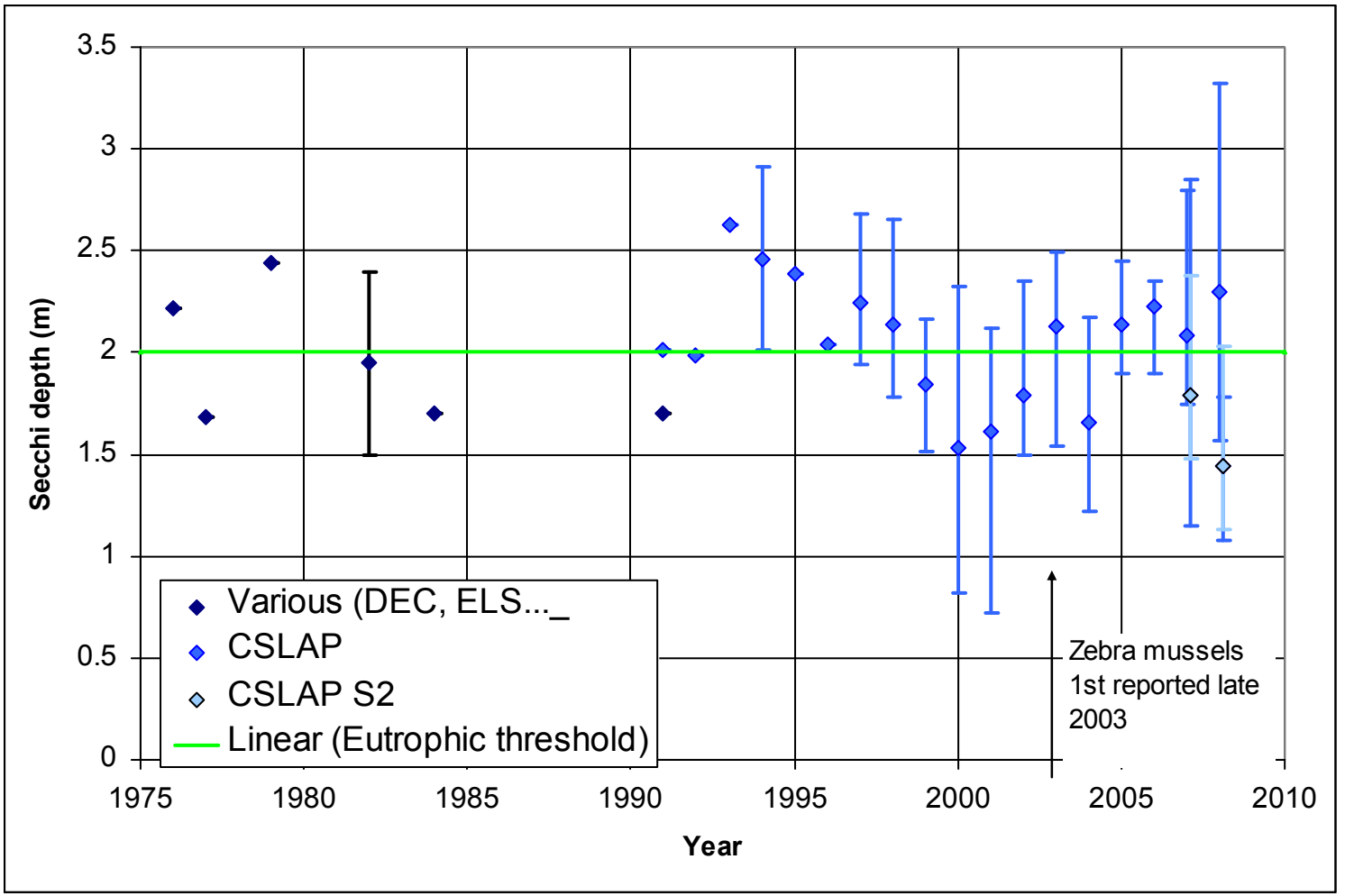
- BLIA
  - Bacteria, coliform, e-coli. Starting in 2000 – town funded ~$800/year
  - Water level – starting in 2009 (manual)
  - Limited stream testing, starting in 2009 – 2 streams, P and Nitrate

Typical data

Secchi disk visibility

CSLAP data point:

- 7 or 8 samples June - Sept
- Single lake location

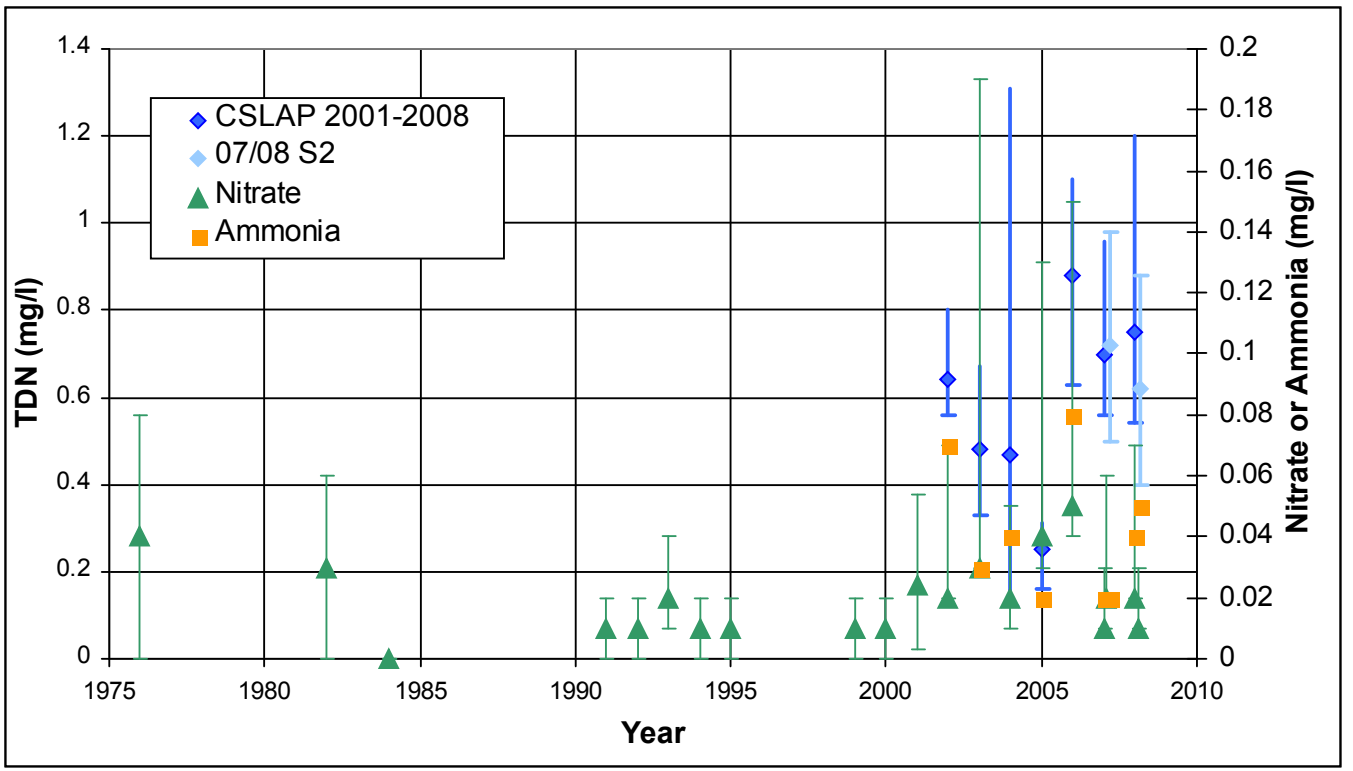


Stable water quality measures

- Secchi disk (2 m) (may be masked by Zebra mussels)
- Ammonia (0.04 mg/l)
  - deep water ammonia very high ~80-200 mg/l
  - drinking water standard < 2 mg/l
  - Possible source of nitrate in surface waters
- Calcium (300 microOhm-cm)
- Water quality perception (~ 3 +/- 0.5; Scale of 1 to 5)

Minimally correlated water quality parameters
($R^2 < 0.33$)

- Total dissolved nitrogen; $R^2 = 0.2$, increasing, large scatter.
- Nitrate (NO3); $R^2 = 0.2$, increasing.
- Color; $R^2 = 0.25$, increasing.



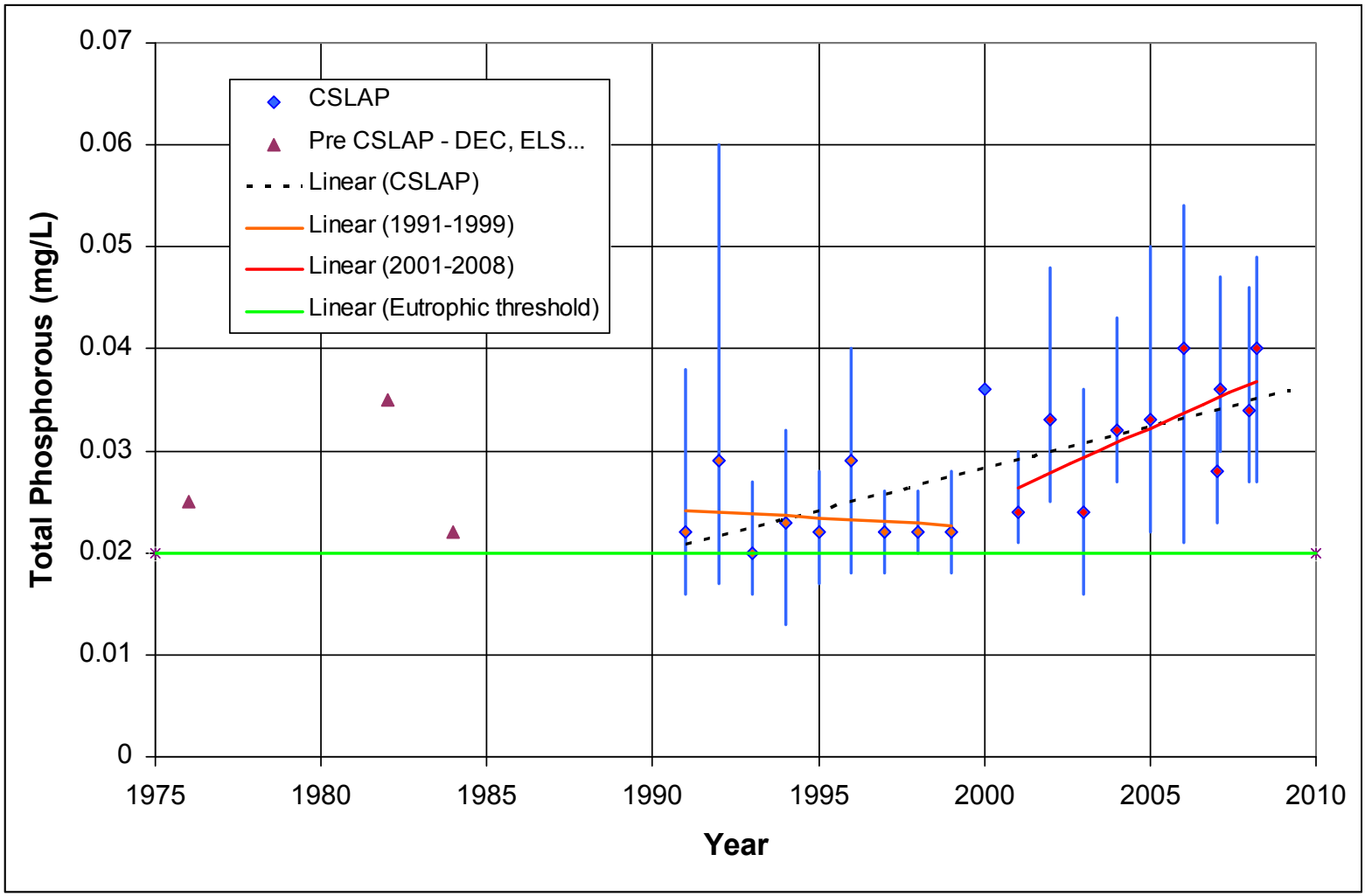
Moderately or strongly correlated water parameters
$R^2 > 0.33$, or $R^2 > 0.5$

- Chlorophyll
  - $R^2 = 0.34$
  - Doubling from a mean of 10 in 1990 to 20 in 2008
- pH
  - $R^2 = 0.6$
  - Dropping from a mean of 8.3 in 1990 to 7.5 in 2008
  - Extrapolates to neutral pH in about 10 years
  - Reasons for drop not understood
- Total phosphorus
  - $R^2 = 0.53$
  - Increasing from 0.025 to 0.035 (mg/l) in 20 years.

Moderately or strongly correlated water parameters - discussion

- Ballston Lake plant activity is phosphorus limited
  - Total N/ total P ratio exceeds 25: 40 to 60 in recent years
  - Nitrogen levels have increased only slightly
  - Phosphorus level trends are significant by both statistical measures used in CSLAPL; a) linear regression, b) Kendall tau
  - Phosphorus levels are high and trend slope is high.
- Chlorophyll is a measure of algae growth
  - measures correlate well with P in NYS lake systems.
  - Chlorophyll trends are increasing with moderate statistical measures
- pH is decreasing (more acidic) in a strongly correlated manner with a strong trend slope.

Phosphorus

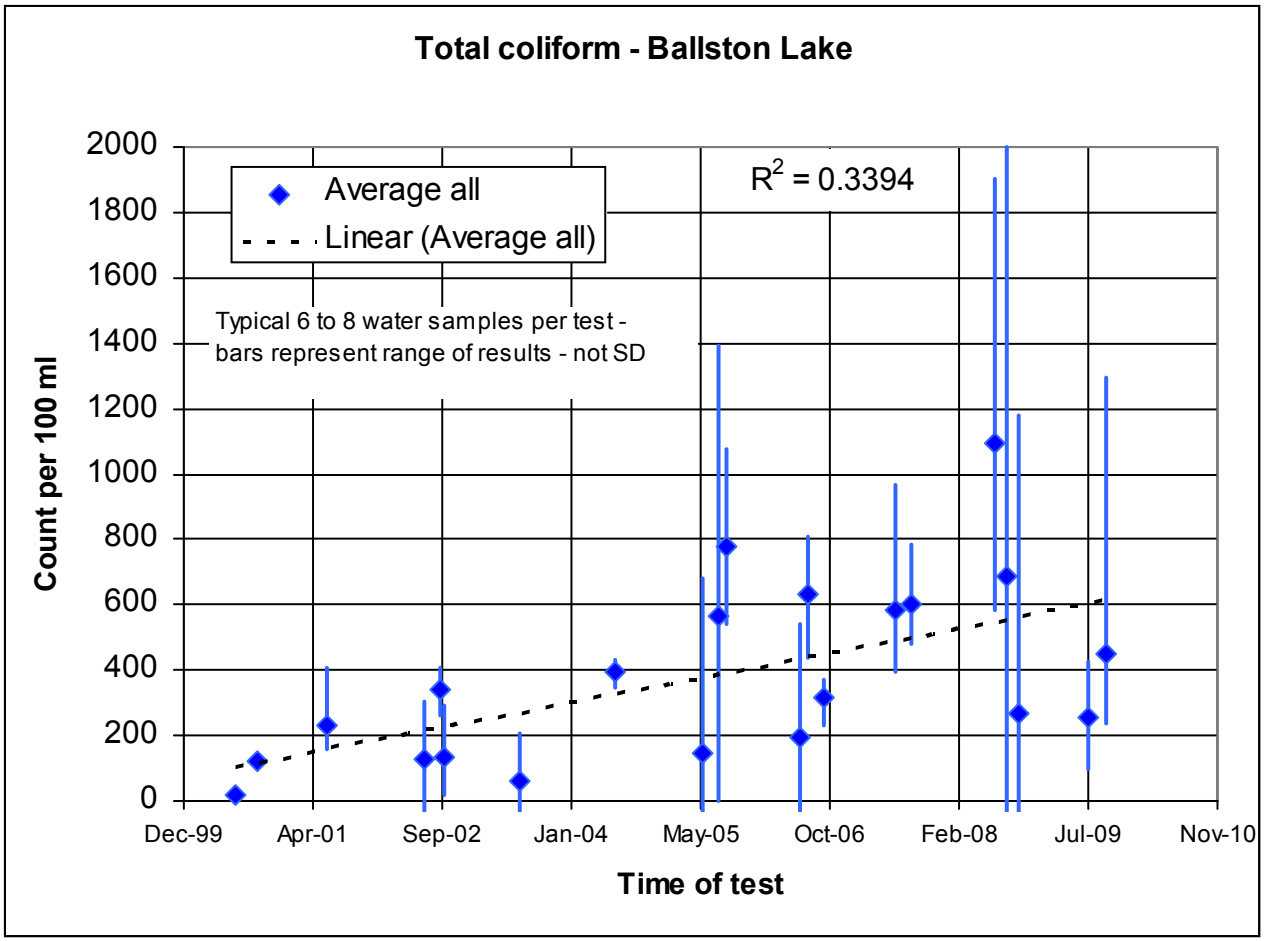

CSLAP
Pre CSLAP - DEC, ELS...
Linear (CSLAP)
Linear (1991-1999)
Linear (2001-2008)
Linear (Eutrophic threshold)
Total Phosphorous (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1975
1980
1985
1990
1995
2000
2005
2010
Year

Bacteria testing

- Surface water samples, collected in 7-8 locations on Lake since 1999 - subsidized by Town of Ballston.
- E-coli (since 2004)
  - A better measure of pathogens than fecal coliform
  - No values above 11 per 100 ml (compare to 77 for beach closure in VT.) Zero tolerance for drinking.
  - No trend apparent
- Total coliform
  - A measure of biological activity
  - Values > 2400 per 100 ml – recommend beach closing (a few samples in recent years exceed this number)
  - Trend is strongly up (R^2 =0.33, median in 2009 4 times median in 1999)
- Fecal coliform (until 2004)

Bacteria testing

Total coliform correlates with other measures of nutrient loads – Chlorophyll, and Phosphorus



Conclusion:
Phosphorus is decreasing water quality

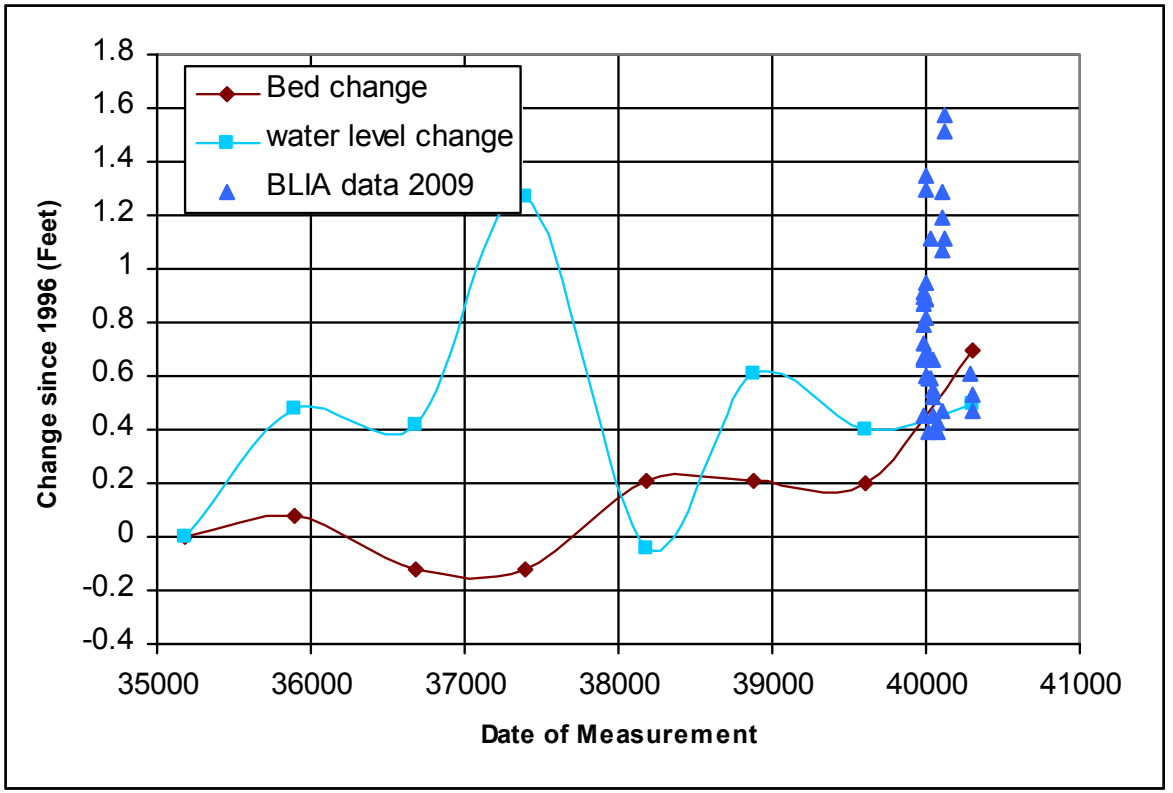
- Statistically significant increases in P in the last 10 years
- Significant increase in P in the last 20 years 0.02 to almost 0.04 mg/l
- P increases driving increases in algae, coliform.

- Possible Sources
  - Lake shore erosion (high lake levels, reduced shore vegetation)
  - Lake residents/septic (aggravated by high lake levels)
  - Inflow from watershed
  - Disturbance of hypolimnetic boundary

Lake level

Trend is up:

- Anecdotal data: dock immersion, shoreline loss
  - 2-3 feet over 30 years
- DOT outlet data: ½ foot over last 14 years
  - larger data sample needed
  - BLIA sample illustrates level variability
- Outlet beaver dams: 21” cumulative water depth, 33” dam height



BLIA activities and proposals

- Beaver management
  - Trapping for shoreline vegetation protection (funded through special appeal)
  - Outlet dam management (breeching, flow control devices) to reduce lake levels
- Augment water quality measurements:
  - Rainfall
    - for assessing watershed hydrologic response changes over time
    - understanding water quality measurement variability
  - Lake level
    - for assessing watershed hydrologic response changes over time
    - Reliable correlation of nutrients with lake level
  - Stream inlet water quality
    - identify watershed sources of phosphorus
    - baseline for assessing effects of future watershed development
  - Dissolved oxygen (monitor hypolimnetic boundary)

Problems and needs

Looking for partners, cost share for long term solutions

- Beaver dam flow control devices are expensive $6 – 15k
  - Several times BLIA annual volunteer contributions
  - ½ of lake residents contribute to BLIA, all would benefit (as would Outlet Road).
  - BLIA does not carry (nor can it afford) liability insurance to allow volunteer installation or maintenance
- Water quality testing beyond CSLAP and bacteria
  - Automatic rainfall gauge ($300)
  - Continuous lake level recording: $1300 (pressure compensated)
  - Water quality measurements on inlet streams:
    - $30-90/ sample (~ 30 each for P, Nitrate, coliform)
    - 5 streams, 7 samples for a complete assessment
    - Minimum: 2 streams, 7 samples, P and Nitrate: $800/ year