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## The Environmental Condition of Tan Brook and Campus Pond, A Community and University Concern

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# The Environmental Condition of Tan Brook and Campus Pond: A Community and University Concern

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## Introduction:

- This study is part of a larger overall student focused outreach effort to understand the potential for conservation and restoration of the Tan Brook
- Tan Brook is a headwater of the Mill River watershed and originates below Wildwood cemetery at Strong Pond.
- 69.6% of the stream runs underground
- Streams and rivers are highly impacted by land developed for human use(1)
- Urbanization can result in elevated nutrient concentrations, altered channel morphology, reduced biotic richness, and increased dominance of tolerant species(1, 2)

- Major chemical impacts to the stream include non-point sources (e.g., run off from urban roadways) and periodic point source inputs.
- We measured a suite of chemical and biological characteristics along the Tan Brook to assess water quality within the Tan Brook

## Objectives:

- To understand how water chemistry, metal concentrations, change over the length of the brook.
- To visually compare data from sampling ~10 years ago, and qualitatively observe any increase or decrease in water chemistry and metal concentrations.

## Predictions:

- Metals and nutrients will increase longitudinally, due to the urbanization and decrease in pollutant-abating characteristics of a healthy stream.
- Metals and nutrients will have increased temporally due to recent construction and changes in timing of sampling

- Additional grab samples were taken to analyze total phosphorus (TP), and Chlorophyll (Chl-a) at the WRRC.

## Methods:

### Sample locations

- Five sites along the Tan Brook were sampled in 2014.
- Sampling sites were chosen to correspond with daylighted areas and pond environments.
- Data for 2003 was provided by the Water Resources Research Center (WRRC) and was collected at three of the sites included in this study using different methodology.
- (Figure 1) illustrates sampling at Lincoln Apartments

### Analytes (2014)

- We analyzed temperature (C) dissolved oxygen (DO), pH, and conductivity using a Sonde with YSI 650 handheld probe (Figure 3).
- We took one grab sample from each location to be analyzed for metals: Pb, Cd, Cu, Cr, and Zn and nitrate-nitrogen (NO3-N) at the UMass soils lab.



- Chlorophyll Analysis (2014)
  - Chlorophyll samples were filtered, dried, and frozen to preserve them after sampling
  - Samples were ground, rehydrated with 10 ml of acetone, and fun in a centrifuge for ten minute cycles twice (total of 20 minutes)
  - Samples were analyzed for color content with a Shimadzu model UV-1601 spectrophotometer with optically matched 5 cm path length cells.
- We determine the concentration based on calculations using values detected at absorbance's of 750, 665, and 664nm.

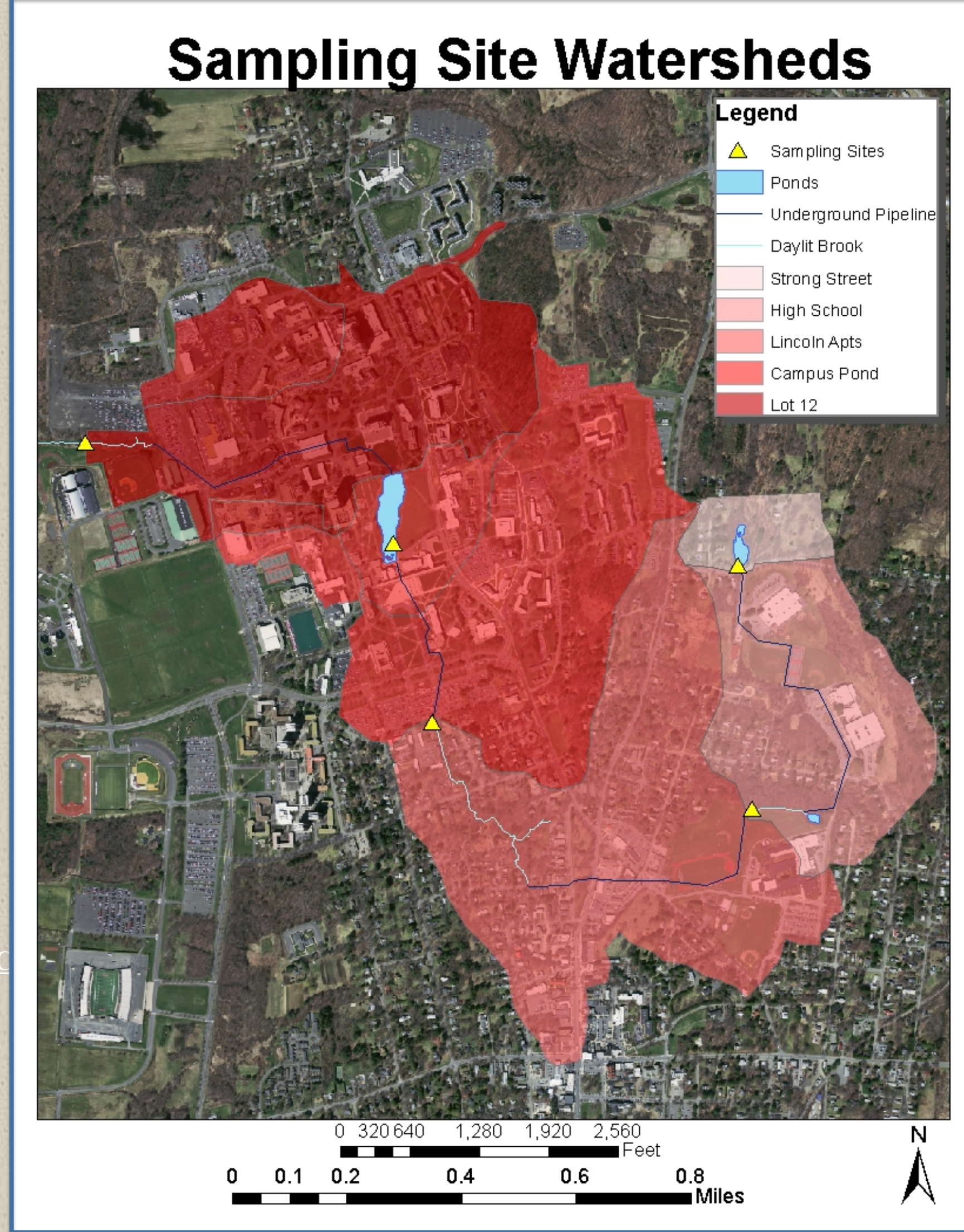
### TP Analysis (2014)

- Grab samples for TP were frozen to preserve them after collection:
- Process includes digestion, addition of chemical reagents and finally evaluation of color content with a Shimadzu model UV-1601 spectrophotometer with optically matched 5 cm path length cells.

### Watershed analysis (2014)

- ArcMap 10.1 was used to delineate nested watersheds for each sampling location
- Percent impervious surfaces and watershed size were calculated for each watershed Examined longitudinal changes in watershed characteristics along the Tan Brook

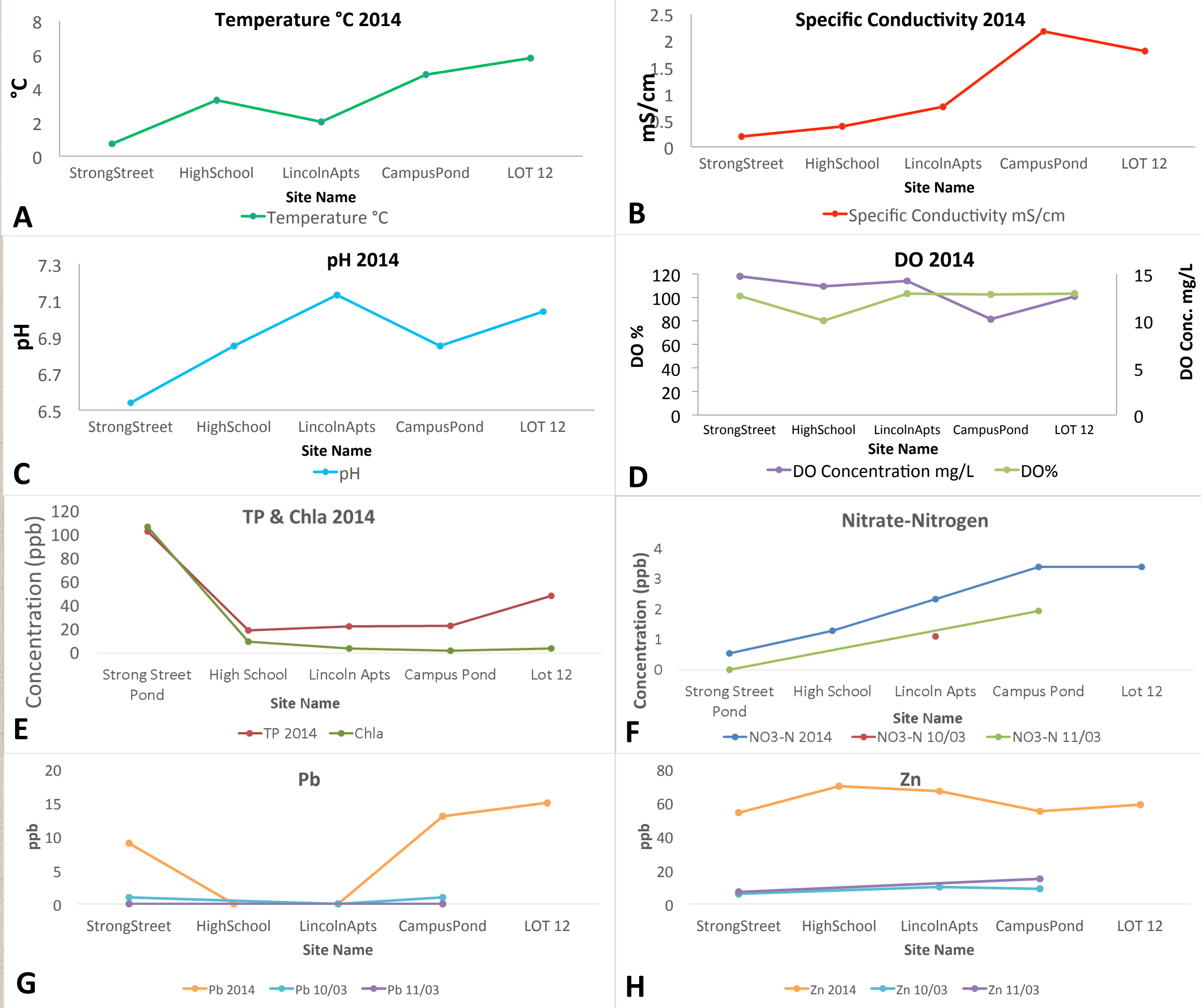
## Results:



**Figure 2:** (above) Map of sampling site watersheds from upstream sites-downstream (Strong Street-Lot12)

Sample Watershed	% Impervious
Strong Street	15.06%
High School	25.52%
Lincoln Apartments	34.34%
Campus Pond	42.06%
Lot 12	47.37%
Entire Watershed	47.15%

**Table 1:** (above) Calculated % impervious of each sampling watershed, the % impervious increases for each nested watershed. The %impervious for the point in lot 12 is slightly higher than that of he entire watershed



**Figure 3:** A-D: YSI Sonde data. A: temperature increases slightly downstream. B: specific conductivity increases downstream. C: pH increases (more basic) downstream. D: DO mg/L decreases below the pond. E: Nitrogen increases longitudinally. F: Total P and ChlA decrease. G: Lead starts high, decreases, then rises. H: Zinc appears higher than the previous sampling.

## Conclusion:

The effects of urbanization within the Tan Brook are apparent. Nutrients such as nitrogen increase along the length of the stream, this is an indication of poor nutrient absorption, a symptom of an urbanized stream(2).The health of the brook is directly related to the town of Amherst and the University of Massachusetts, as these urban centers grow and develop the University should take into consideration these important watersheds and the effects that impermeable surfaces have on the stream quality. Without a comprehensive study we cannot make any solid inferences as to the state of the Brook but we can understand and see that the stream is impacted and that a more comprehensive study would be beneficial to understanding the causes of impairment.



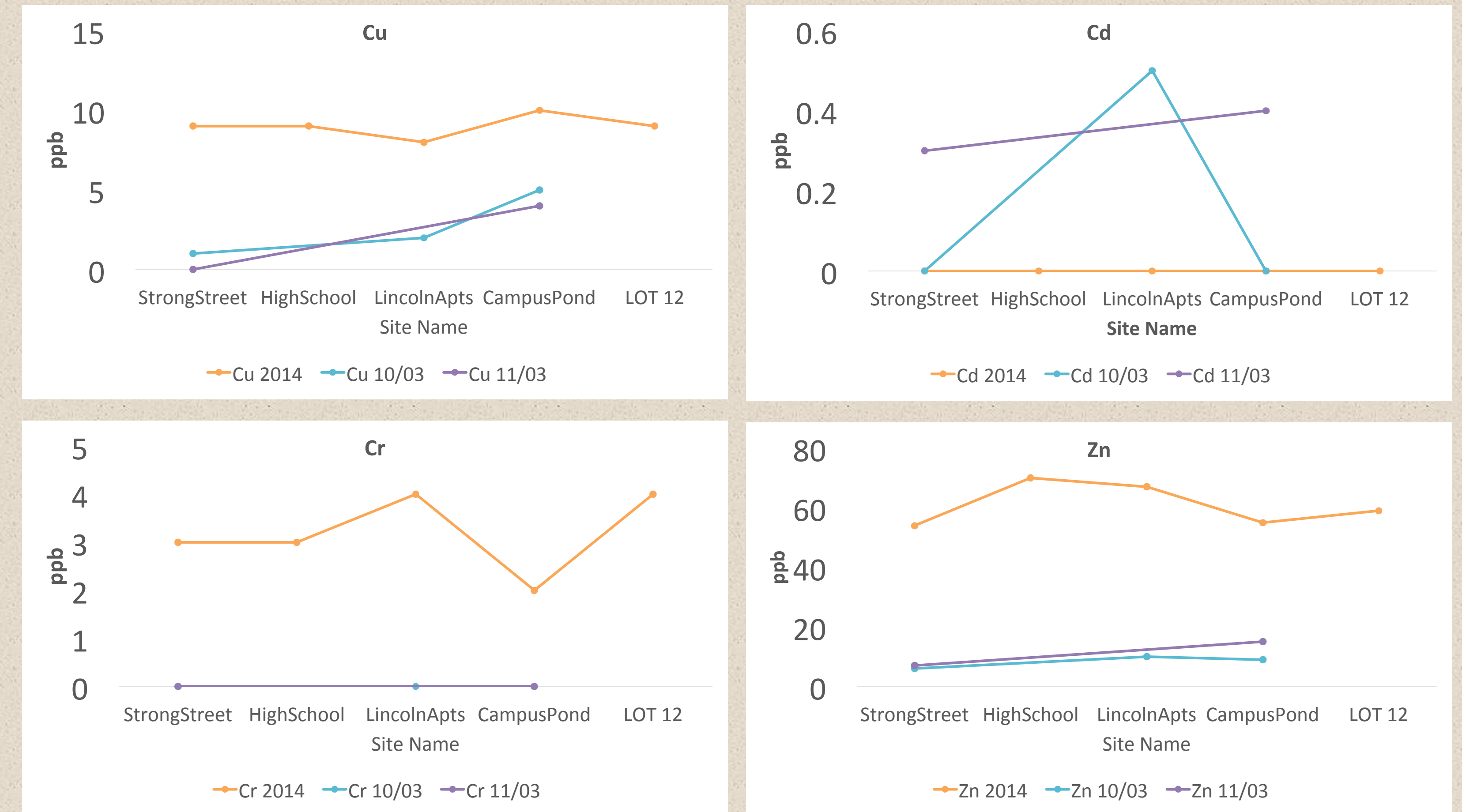
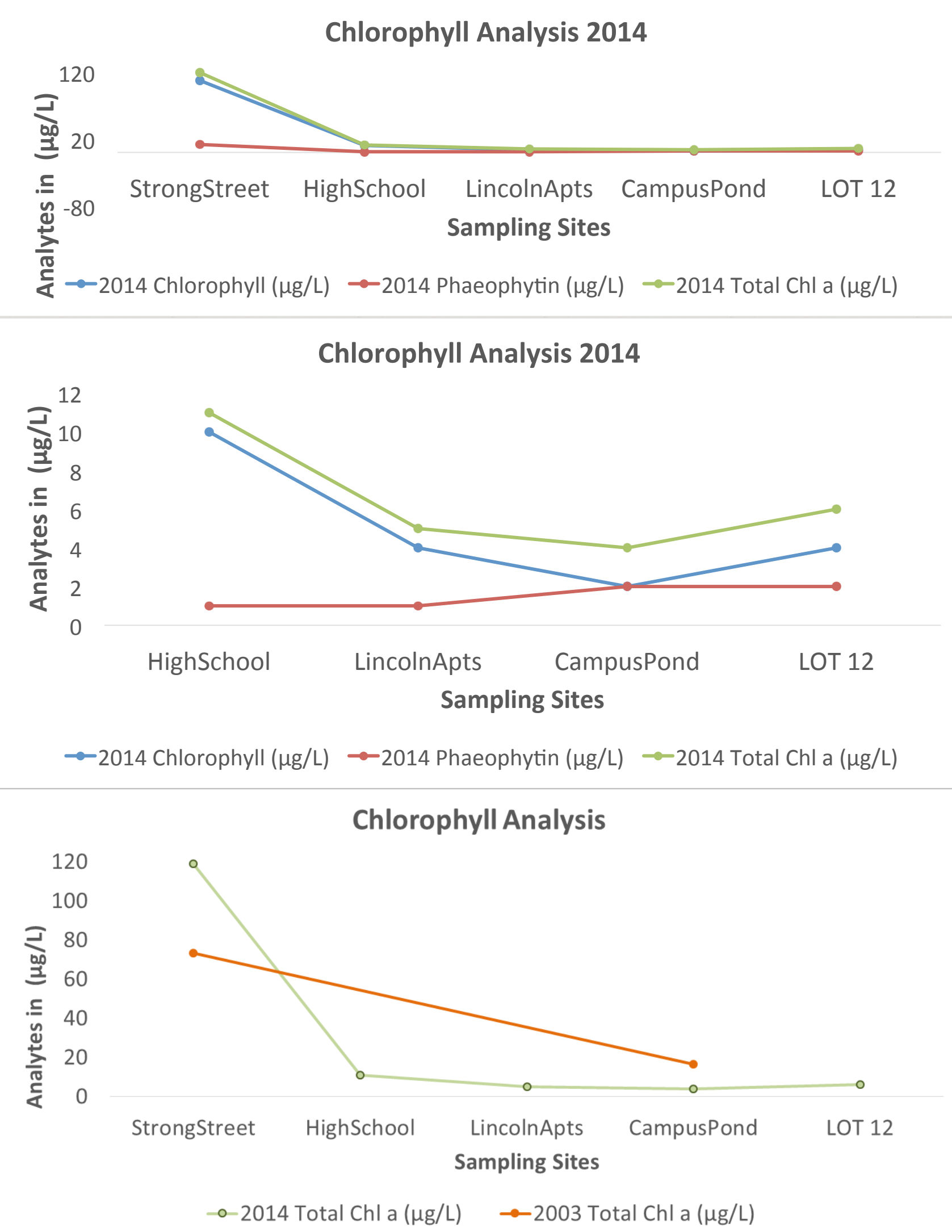
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## Abstract:

Small streams have the unfortunate ability to be greatly impacted by human intervention. Civilizations for centuries have attempted to alter the natural state of their environment, and Amherst's own Tan Brook is a local example of the consequences of human alterations on a stream. The brook flows over and under what many local citizens call home, and where many UMass students go to learn. A healthier Tan Brook would be expected to provide for improvement of ecosystem services such as flood control and nutrient processing, resulting in a cleaner campus pond and a better connection between the stream and the local community. The purpose of this study is to examine and compare previously recorded biochemical characteristics with current conditions in the Tan Brook and campus pond to determine if the health of this system has changed. Additional parameters related to the geomorphology and biology of the Tan Brook will also be characterized. Community concern in concurrence with the fact that the majority of the stream is piped underground through culverts indicates that the Tan Brook is currently impacted. The data collected can provide clues about levels of ecological impairment in Tan Brook and the source of these impairments. With interpretation, the information gathered could eventually lead to the development of infrastructure to remediate the sources of impairment, consequently leading to a cleaner Tan Brook. This is an optimistic transformation that would aid both the town of Amherst and the University.



**Figure 6:** Metals Cu, and Cr, are higher than recorded previously, Cd was not detected, and Zn was higher than the prior sampling

## Acknowledgements

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## References:

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- (2)Walsh, Christopher Roy, Allison Feminella, Jack Cottingham, Peter Groffman, Peter Morgan, Raymond. (2005). The urban stream syndrome: Current knowledge and the search for a cure. *Journal of the North American Benthological Society*, 24(3), 706-723. doi: 10.1899/0887-3593(2005)024\{0706:TUSSCK\}2.0.CO;2

**Figure 4:** A: Chlorophyll analysis 2014. B: Chlorophyll analysis 2014 without skewed Strong Street Site. C: 2003-2014 comparison

**Figure 5:** Pictures from sampling