Heterogeneity in Urban River Ecosystems:

Understanding the contribution of natural and anthropogenic factors on dissolved oxygen in ponded areas of the Ipswich River Watershed

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1. Background

The Issue: Many reaches within the Ipswich River Watershed are characterized by low dissolved oxygen content, which threatens fish populations, aquatic organisms, and the health of the entire ecosystem.

•Anthropogenic factors, including nutrient loading, road crossings, etc. and natural beaver dams found in this suburban watershed influence metabolism .

•Little is known about the influence of fluvial wetlands on the dissolved oxygen, metabolism, and nutrient dynamics of a river network (O Brien et al. 2012).

Project Summary: This study will focus on understanding the interaction of geomorphology, dissolved oxygen, metabolism, transient storage and nutrients in a suburban river network.

Figure 1: Boxford Wetland Site. Blue circles represent DO logger locations.

2. Research Question and Hypotheses:

Q1:What Is causing the extremely low dissolved oxygen content and high metabolic rates observed in streams of the Ipswich river watershed?

Hypotheses:

•Fluvial wetlands are extremely heterotrophic, driving down oxygen, while re-aeration in channels is low, keeping depressed oxygen levels over long reaches.

•Humans are exacerbating this issue through road crossings, etc., while increased beaver activity also contributes to the problem

4. Approach:

Overarching Approach: Dissolved oxygen, metabolism, and biogeochemical patterns are measured continuously for weeklong periods at each fluvial wetland during base flow conditions. Transient storage is also assessed through rhodamine additions (Figure 2).

Sites:

- Chestnut Wetland – Wilmington MA
- Boxford Wetland – Boxford MA (Figure 1)
- Boston Hill Wetland – North Andover MA
- Cart Creek beaver pond network – Newbury/ Byfield MA

Instrument Suite and Logger locations:

- *Instruments:* Onset U 26 Dissolved Oxygen, Onset U 24 Conductivity, Onset U 22 water level, Odyssey PAR sensors, turner C3 fluorometer
- Experimental Design:
  - Within each site, there are 4 logger (dissolved Oxygen and light) locations (sub sites)
    - one channel uninfluenced by fluvial wetland, one fluvial wetland (side pool), one at outflow of wetland, and one downstream of wetland
  - During Rhodamine addition – Fluorometer is located at wetland outflow
  - Water level water level and conductivity loggers are located at outflow

Nutrients:

•Grab samples will be taken 3 times per week to and tested for multiple constituents, including ammonium, anions (including NO3, SO4, and Cl), phosphate, dissolved organic carbon (DOC), and total dissolved nitrogen (TDN).

•This allows us to understand interactions between GPP, R, and nutrients.

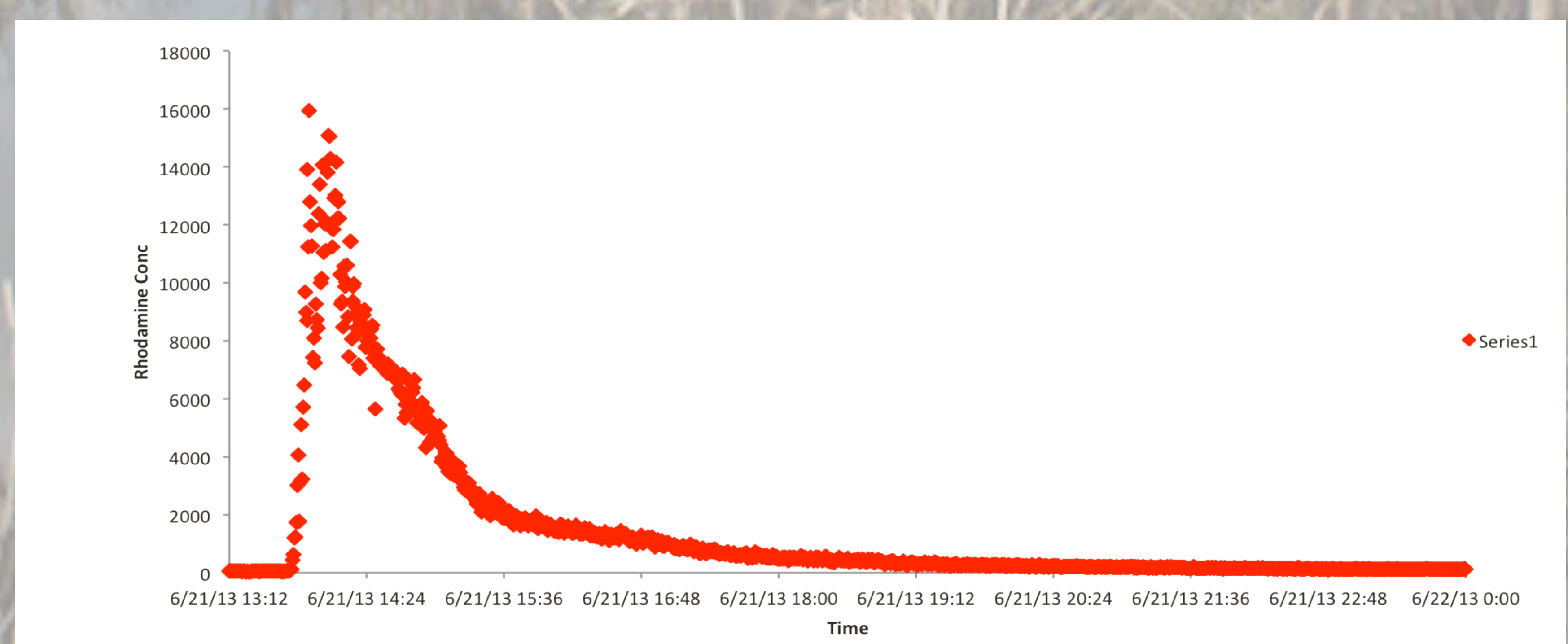

Figure 2: Break through curve created from the addition of a slug of rhodamine to the Boxford Wetland site.

5. Preliminary Results (Boxford Site)

• Mean dissolved oxygen saturation steadily decreases along the transect from above the wetland to the outflow (Figure 3, A).

•The diurnal swing is much more pronounced in the sidepool location and the outflow of the wetland when compared to the input.

•The sidepool experiences the greatest change in DO % saturation from day to night.

•There is a lag in the time that peak DO saturation is reached from input DO to sidepool DO to Outflow DO (Figure 3, B).

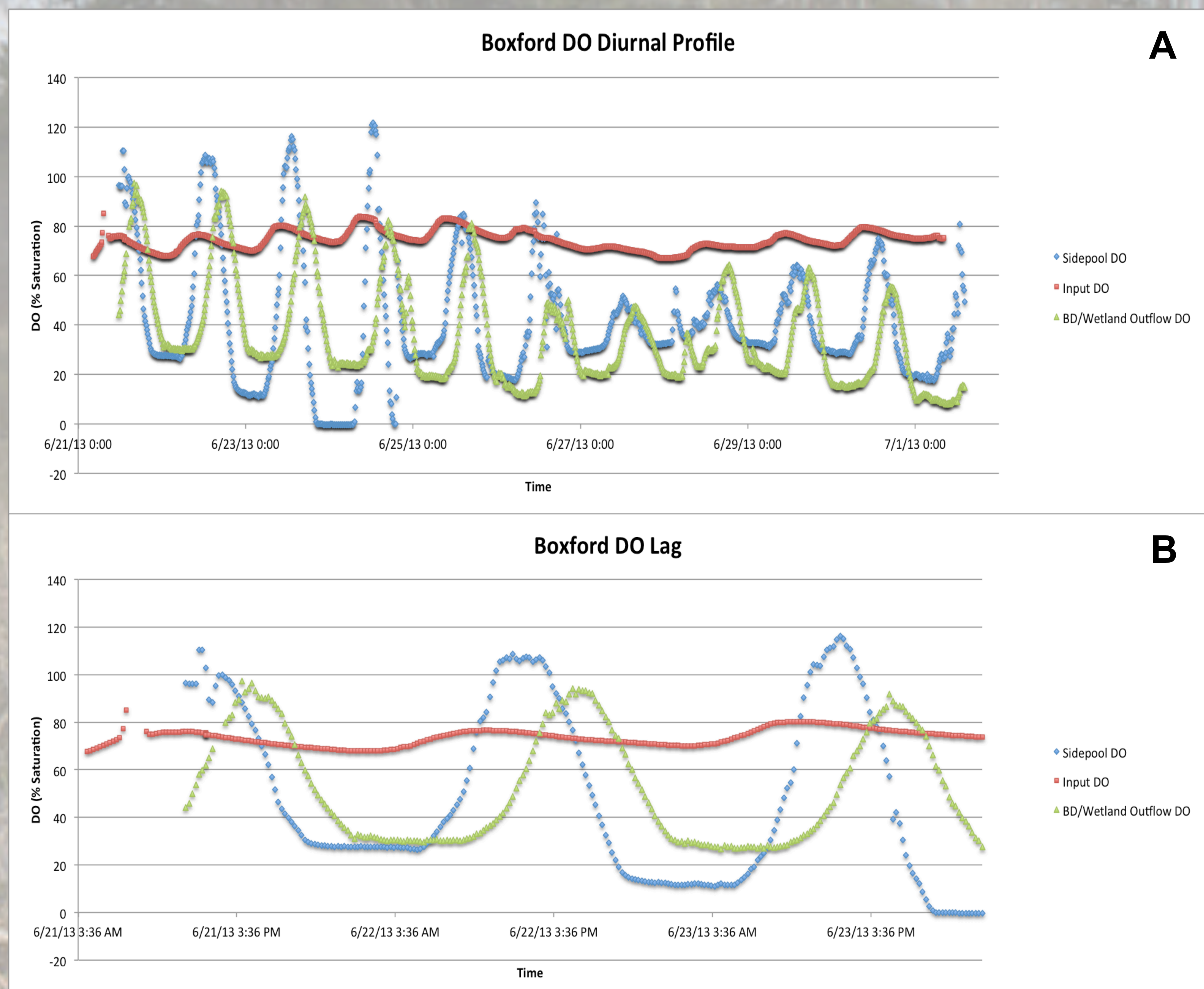

Figure 3: Diurnal dissolved oxygen patterns at the Boxford Site during June. A = the entire time series, B= zoomed in version to highlight the lag.

6. Next Steps:

•Model transient storage and the lag in dissolved oxygen at all sites.

•Investigate the causes of the observed lag.

•Compare peak DO saturation times to temperature and light conditions across sites.

•Figure out what other data is needed to support my current findings and incorporate it into the sampling for this upcoming field season.

References:

1.O' Brien, J. M., Hamilton, S. K., Kinsman-Costello, L. E., Lennon, J. T., & Ostrom, N. E. (2012). Nitrogen transformations in a through-flow wetland revealed using whole-ecosystem pulsed 15 N additions, *57*(1), 221–234. doi:10.4319/lo.2012.57.1.0221

2.Young, R. G., & Huryn, A. D. (1999). EFFECTS OF LAND USE ON STREAM METABOLISM AND ORGANIC MATTER TURNOVER. *Ecological Applications*, *9*(4), 1359–1376

3.http://www.ourworldfoundation.org.uk/turbine.jpg - - background photo