A CARBON BUDGET FOR AN URBAN MAN-MADE LAKE

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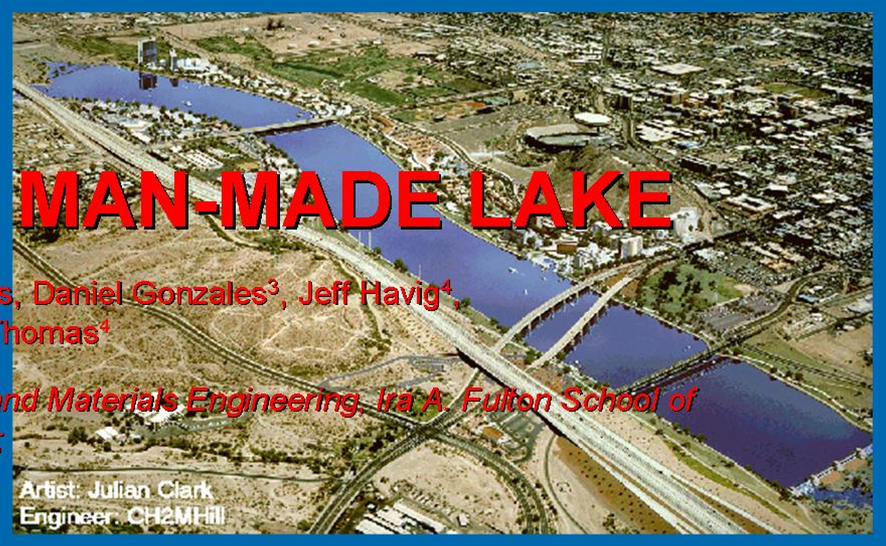
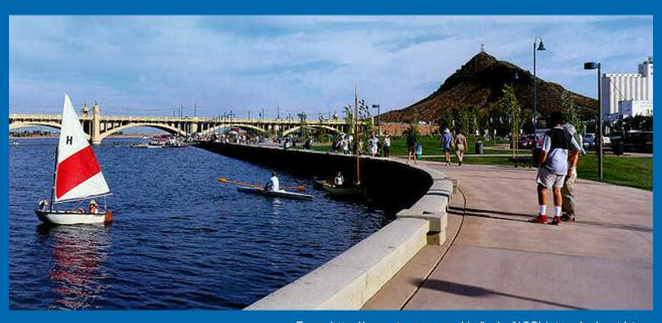


Introduction:

Tempe Town Lake (Figure 1) is an artificially created lake within the urban matrix of metropolitan Phoenix, Arizona. The lake was created in July 1999 by placing dams in the Salt River, applying an impermeable clay layer to most of the utilized river bed, and filling with canal water. The lake today covers an area of 0.89 km^2 and serves as a recreational focal point for residents in the southeast portion of the Phoenix metro area.

Tempe Town Lake has a limited number of interactions with surrounding environment (Figure 2). This simplification of ecosystem interactions, and the fact that the lake was only recently created, present a unique opportunity to formulate a nutrient budget for an urban, man-made lake. We sought to determine if the waters of the lake are acting as a "sink" or a "source" for organic carbon, i.e. has there been a total accumulation or loss over the life of the lake (4.3 years).



From http://www.tempe.gov/rio/Lake%20history/askqst.htm

Methods:

Five teams investigated the relevant carbon budget components of the lake ecosystem. Each team was charged with determining a total accumulation or loss for its component. All sampling at the lake was performed in November 2003.

Primary Production and Respiration:

As a surrogate for CO_2 fluxes between the lake and atmosphere, net primary production and respiration were measured at 2 lake depths using the dark/light bottle method. The two were then added together to obtain an estimate of gross primary production in the lake.

Hydrological Interactions:

Groundwater pump samples were collected and data from multiple sources, including the US Geological Survey, Flood Control District of Maricopa County, CAP LTER and the City of Tempe were used to determine approximate concentration and volumes for hydrological inputs.

Atmospheric Interactions:

Atmospheric deposition of organic carbon was estimated using complex mathematical modeling of organic carbon aerosol concentrations and ambient weather conditions gleaned from the AZMET and IMPROVE databases. Emissions of organic carbon *from* the lake were assumed to be negligible.

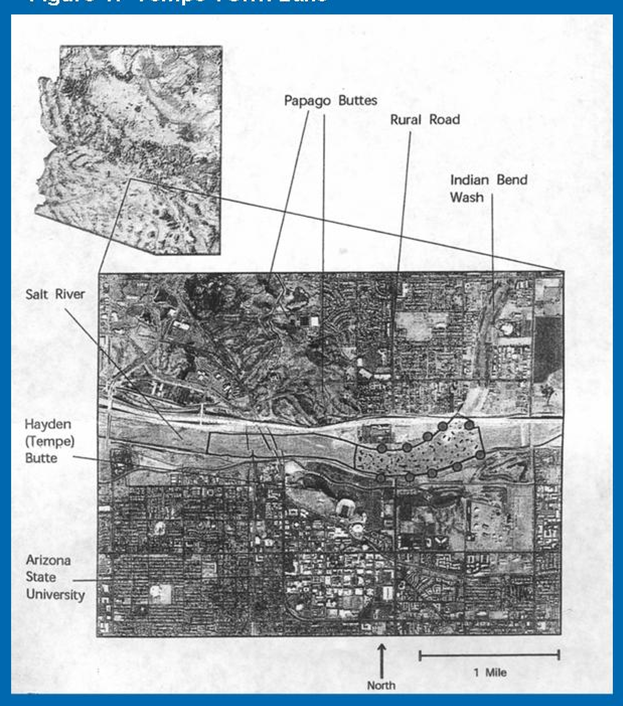
Sediment Accretion:

Lake bed cores were taken from 3 lake locations and later analyzed for organic carbon content. Concentrations were then used to infer sedimentation rates.

Lake Chemistry:

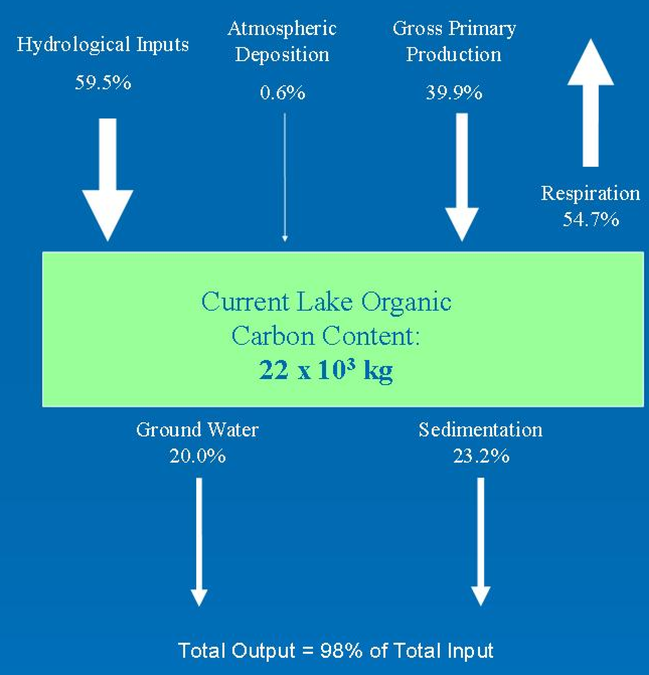
Water samples were collected from 3 depths at 3 locations on the lake and measured for dissolved organic carbon. Concentrations were then used to calculate the current carbon content of the lake.

Figure 1: Tempe Town Lake



From Fergason, K. C. (2001). Investigation of Changes in Water Table Elevation Associated with Tempe Town Lake. Tempe, Arizona State University.

Figure 2: Ecosystem Model for Tempe Town Lake with Lifetime Inputs and Outputs as a Percentage of Total Input



Results:

By subtracting carbon outputs from inputs (Table 1, Figure 2), we determined that there has been a net accumulation of 13 x 10^3 kg of organic carbon over the life of the lake.

Table 1: Inputs and Outputs by Source July 1999 – November 2003.

	10^3 kg	
Inputs		
Primary production	259	
Hydrological inputs	386	
Atmospheric deposition	4	
Total Inputs		649
Outputs		
Respiration	355	
Sedimentation	151	
Groundwater seepage	130	
Total Outputs		636
Net accumulation		13
Estimated original loading	36	
Calculated current content		49
Measured current content	22	
Difference		27

Sediment and Water Chemistry Teams collecting samples

Findings and highlights:

- The lake is a heterotrophic system (respiration > primary production)
- The lake is a net importer of organic carbon
- Since net import is greater than net respiration the lake acts as a **sink** or accumulation site for carbon

The accuracy of our estimates is limited by the fact that our sampling took place in November 2003 and may not reflect the actual average climatic and lake conditions over the life of the lake. Additionally, in constructing our models for atmospheric and hydrological inputs, we relied heavily on surrogate monitoring data from nearby sites other than the lake and/or from time periods before the lake was formed.

However, the difference between the current carbon content of the lake as measured by the water chemistry team and that calculated by summing each budget item represents only 4.2% of total inputs, indicating that our calculations may be representative for the ecosystem.

Acknowledgments:

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