

THE SCOOP ON THE POOP IN CAMBRIDGE: CAMBRIDGE DOGS AND THE PHOSPHORUS THEY CONTRIBUTE TO STORMWATER RUNOFF

INTRODUCTION:



The Humane Society estimates there are 83 million dogs in the United States. They estimate that these dogs are producing close to 10.6 million tons of dog waste per year. The City of Cambridge in Massachusetts requires all dogs to be licensed and publishes this data on the cambridgema.gov website. Since 1974 the Environmental Protection Agency (EPA) has been working with states and cities and towns to clean up our country's waters. One of the tools the EPA uses to clean our waters is to provide a total maximum daily load (TMDL) of certain nutrients and other pollutants for rivers. Using this TMDL, local governments can manage the amount of pollutants getting into local waters, and identify and fine polluters. One source of excess nutrients is phosphorus, and one of the largest sources of phosphorus in rivers comes from people and their pets through stormwater runoff. These maps illustrate the amount of phosphorus that is contributed in stormwater runoff to local waters from the dogs that are licensed in Cambridge Massachusetts in 2017.

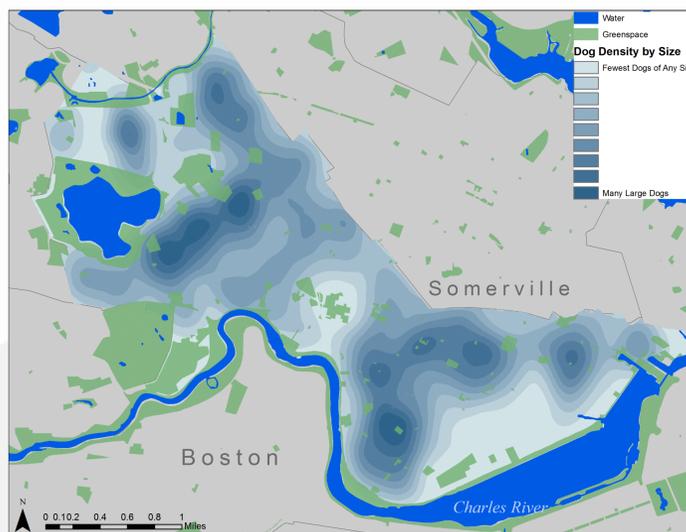
METHODOLOGY:

By law Cambridge requires all dogs to be licensed and registered. The database Cambridge keeps includes the dog breed and a slightly masked longitude and latitude for the dog owner. The American Kennel Club (AKC) maintains a size and weight database for each breed. Using these two databases the dogs were sorted into four sizes - toy, small, medium and large. Research was identified that determined the phosphorus found in a dog's waste by weight, and these four categories reasonably corresponded to the AKC standards. This phosphorus data was added to the Cambridge dog database so that the database had an estimated amount of phosphorus excreted by each dog based on its breed and size. Then the data was kerned both by dog size and phosphorus volume, resulting in a map that indicates by shade the amount of phosphorus in neighborhoods of Cambridge. Adding the catchment areas and the catchbasins throughout the city of Cambridge to the of phosphorus volume by dog created a map of the amount of phosphorus leaving each of the catchment areas. Finally the Cambridge parks that allow dogs to run off leash was added to the map that located the dogs by size in Cambridge.

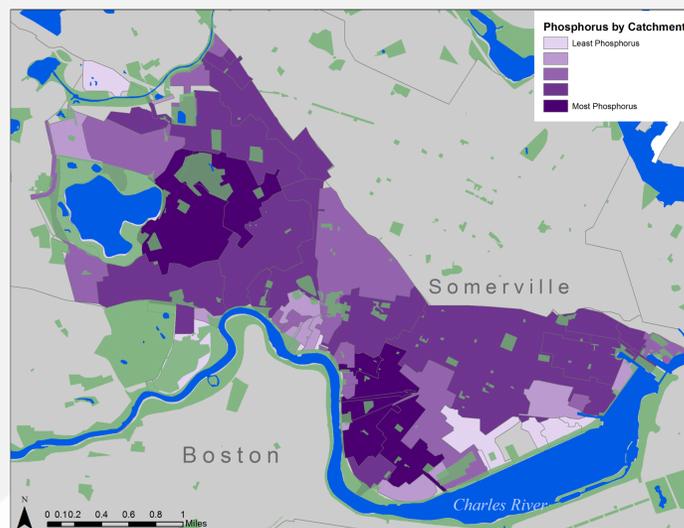
SOURCES OF DATA:
 AMERICAN KENNEL CLUB: BREED WEIGHT CHART
 CAMBRIDGE DEPARTMENT OF PUBLIC WORKS: CATCHMENT BASINS AND CATCHMENT AREAS
 CAMBRIDGE PARKS AND OPEN SPACE: LEASH-FREE DOG SPACE
 HUMANE SOCIETY: PET AND PET WASTE DATA
 MASS GIS: TOWN BOUNDARIES, WATER, GREENSPACE
 Baker, Lawrence A., Paul M. Hartzheim, Sarah E. Hobbie, Jennifer Y. King, and Kristen C. Nelson. 2007. "Effect of Consumption Choices on Fluxes of Carbon, Nitrogen and Phosphorus through Households." *Urban Ecosystems* 10 (2). *Kluwer Academic Publishers-Plenum Publishers*: 97-117.10 (2). *Kluwer Academic Publishers-Plenum Publishers*: 97-117.
 Lowe, Christopher N., Karl S. Williams, Stephen Jenkinson, and Mark Toogood. 2014. "Environmental and Social Impacts of Domestic Dog Waste in the UK: Investigating Barriers to Behavioural Change in Dog Walkers." *International Journal of Environment and Waste Management* 13 (4). *Inderscience Publishers*: 331-47.
 Hobbie, Sarah E., Jacques C. Finlay, Benjamin D. Janke, Daniel A. Nidzgorski, Dylan B. Millet, and Lawrence A. Baker. 2017. "Contrasting Nitrogen and Phosphorus Budgets in Urban Watersheds and Implications for Managing Urban Water Pollution." *Proceedings of the National Academy of Sciences of the United States of America* 114 (16): 4177-82.



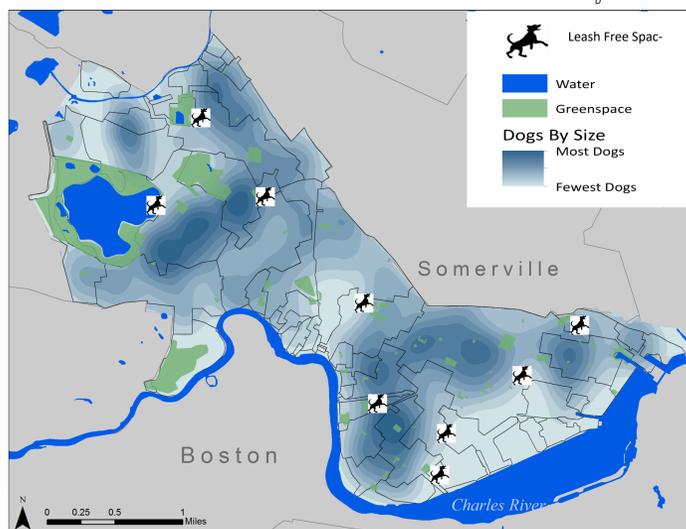
Map 1: Cambridge Dog Density



Map 2: Phosphorus Density by Catchment Area



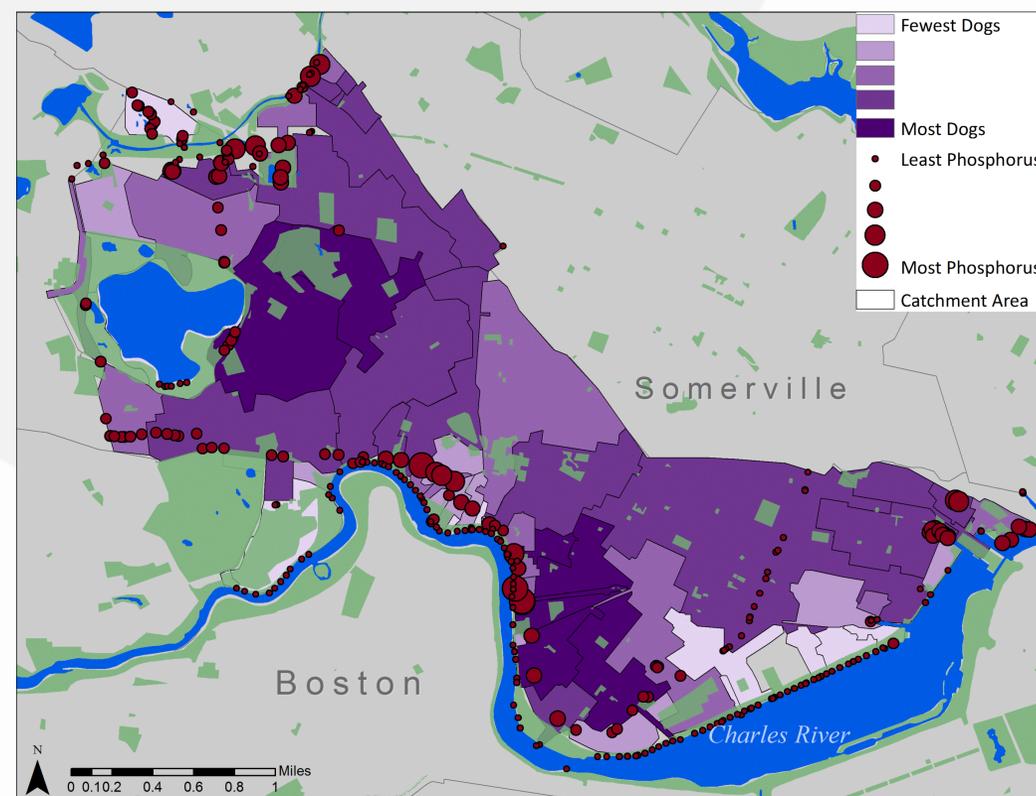
Map 3: Location of Leash-Free Dog Parks



RESULTS AND LIMITATIONS:

This analysis suggests that the dogs of Cambridge are contributing roughly nine tons of phosphorus annually. From the map below, it appears that most of this phosphorus is going directly into the Charles and the Mystic Rivers. This study evaluates one city and its database of registered dogs. There may be dogs who are not registered, and dogs may vary considerably from the American Kennel Club ranges for its breed. Boston may contribute an even larger amount of phosphorus to the Charles because of a larger dog population. This study does not take into consideration the amount of phosphorus that lands on permeable surfaces and does not go directly into the rivers. It does not include other possible sources of phosphorus that may be larger and therefore more damaging to the quality of the water in these two rivers. Finally the assumption about how much phosphorus is produced by a single dog is based on a single study of dogs from one city.

Map 4: Volume of Phosphorus at Outflow Location Overlaid by Dog Density



RECOMMENDATIONS:

It seems from this process that there may be enough phosphorus contributed to the Charles and the Mystic Rivers by dog waste to justify more research. Cambridge and Boston together could evaluate the phosphorus contribution from dogs in in the two cities. Student researchers could be deployed to test the water in front of North Point Park where a swim park is planned. Funding could be found to further investigate the relationship between the food a dog eats and the quantity of phosphorus found in dog waste. Since dog food is mostly manufactured, it is possible that a formula for pet food that contains less phosphorus can be developed and marketed to dog owners. Finally if this analysis is replicated, a reward can be provided—perhaps contributed to by several cities for the best, most creative solution to the dog waste phosphorus problem.

Katherine Florio | December 2017 | Urban and Environmental Policy and Planning | GIS 232
 Projected Coordinate System: NAD 1983 State Plane Massachusetts Mainland FIPS 2001 (feet)