A Geospatial Approach to Estimate *E. Coli* Loadings into Waterways

Houston-Galveston Area Council

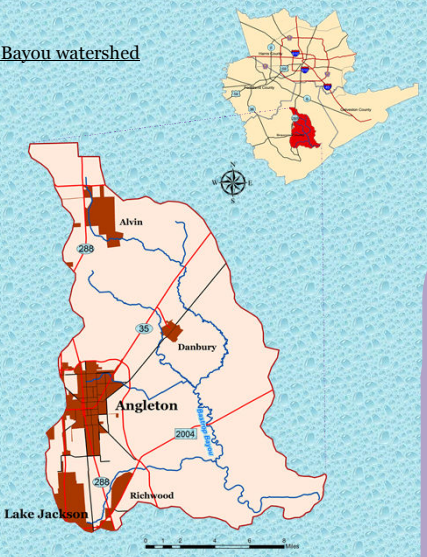
Introduction

More than half of water bodies in Houston-Galveston region are contaminated by harmful levels of bacterial pathogens (E. coli)and prevented from the uses of contact recreation activities (such as Swimming, Wading, Diving, etc) due to possible health risks to people who use them.

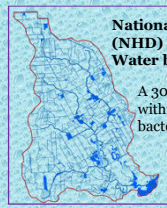
The Houston-Galveston Area Council develops Watershed Protection Plans which aim to improve water quality up to the standard for contact recreational use. For this purpose, it is important to identify the bacteria sources and analyze the spatial patterns in the distribution of bacteria. We integrate geospatial analytical techniques with pathogen load estimation methods and model the spatial distribution of E. coli.

This presentation includes one such analysis conducted by H-GAC for the Bastrop Bayou watershed.

The Bastrop Bayou watershed



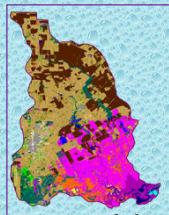
Methods and Results



National Hydrography Dataset (NHD) Stream Network and Water body

A 300ft buffer was applied: Sources within this distance directly deposit bacteria into streams without dying

- Population and Household Census (US Census 2010)
- Animal Census (USDA Census 2012)



NOAA Coastal Change Analysis Program (C-CAP) 22 Class Land Use Land Cover dataset 2011

Excretions from Wild Animals

Two Sources:

- *Feral Hogs* $= \#\ of\ Hogs * 4.45 * 10^9\ cfu\ day^{-1}\ head^{-1}$

  Applied to all land type, except Developed, Barren and Open Water

- *Deer* $= \#\ of\ Deer * 1.75 * 10^8\ cfu\ day^{-1}\ head^{-1}$

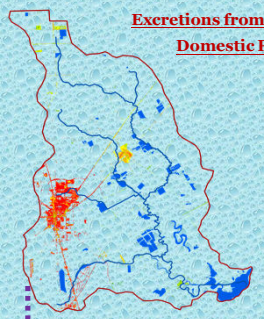
  In all Forest types, Shrubs and Grasslands

Excretions from Livestock

Three Sources:

- *Cattle* $= \#\ of\ Cattle * 2.7 * 10^9\ cfu\ day^{-1}\ head^{-1}$
- *Horses* $= \#\ of\ Horses * 2.1 * 10^8\ cfu\ day^{-1}\ head^{-1}$
- *Sheep & Goat* $= \#\ of\ Sheep\ \&\ Goat * 9.0 * 10^9\ cfu\ day^{-1}\ head^{-1}$

Applied to Hay/Pasture and Grasslands



Excretions from Domestic Pets

- *Dogs* $= \#\ of\ HH * 0.8 \frac{dogs}{HH} * 5 * 10^9\ cfu\ day^{-1}\ head^{-1}$

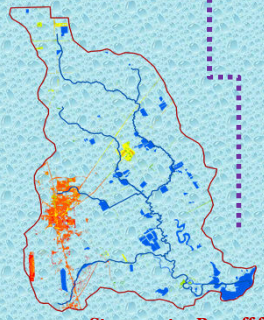
Applied to All Developed land classes

Discharges from Wastewater treatment plants

A system daily discharges,

$= Self\ Reported\ Flow\ (MGD) * \left(\frac{126\ cfu}{100\ mL}\right) * \frac{10^6\ gal}{MGD} * \frac{3758.2\ mL}{gal}$

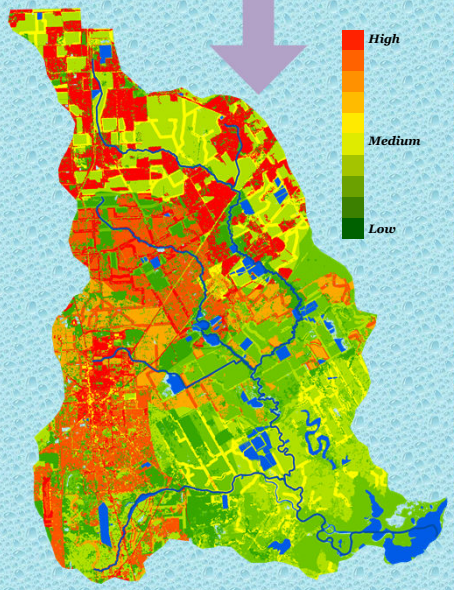
- *Applied to High and Medium Developed land classes*

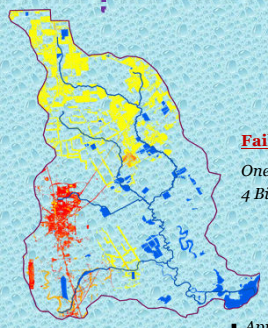


Strom water Runoff from Urban surfaces

This counts all other forms of domestic and industrial pathogen loadings

- *Applied to all lands with Impervious surfaces*





Failing Septic systems

One failed system discharge

4 Billion colony units of bacteria

$= \#\ of\ failing\ systems * average\ \#\ of\ person\ per\ HH * \frac{5 * 10^5\ cfu}{100\ mL} * \frac{2.65 * 10^6\ mL}{person/day}$

- *Applied to all Developed land classes*

Conclusions

- This methodology provides detailed information on bacteria sources and spatial distribution that helps to regulatory agencies to apply the Best Management Practices (BMP) to control the source loadings.
- In this study:
  - Developed land areas show the highest bacteria loading (62%)
  - Hay/Pasture and Grasslands (Livestock sources) are the second highest (26%)
- Failing Septic systems are the highest contributor (35%), followed by Livestock (32%), Dogs (12%), Urban Runoff (12%) and Wildlife (8%) respectively.

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