Amanda Wilson, 1 May 2014

PCB Hazards in Upstate South Carolina Drinking Water

South Carolina, USA

Problem Overview

In August 2013 dangerously high levels of the toxic chemical polychlorinated biphenyl, or PCB, were found in several water treatment plants in upstate South Carolina. PCB is a known endocrine disruptor and neurotoxin, which is associated with immune system, developmental impairment and cancer. These levels were only discovered after contaminated sludge from these facilities was processed into biosolid fertilizer and spread onto agricultural fields in the region, which in turn recirculated these chemicals into the drinking water. PCB levels have been an issue in this region since the 1970s, after the Sangamo Weston capacitor manufacturing plant in Pickens, SC closed and it was revealed that the plant had dumped over 400,000 lbs of PCB directly into Lake Hartwell, a large reservoir

Figure 1 EPA Employee Testing Water for PCB in Twelve Mile Creek, SC (Courtesy EPA)

that provides drinking water to many communities in South Carolina and Georgia. Because PCB is persistent and bioaccumulative, it doesn't biodegrade or breakdown in natural conditions and remains a hazard for years after it's introduced. In 1990 the EPA declared the 1000 acre area around the plant a toxic superfund site and placed it on the National Priorities List. EPA water monitoring stations around Lake Hartwell still test positive for PCB and even after being processed, PCB is still measurable in the drinking water provided from the lake. Because of the Sangamo Weston superfund site, as well as the contamination found in sewer treatment plants and biosolid sludge, upstate South Carolina citizens are at a potential risk for PCB exposure. This project seeks to show which cities and areas are at the greatest risk from PCB.

Data Collection

This project required a large amount of data collection from many sources. First political data showing the locations of cities and counties for the entire state of South Carolina had to be gathered. Then environmental data showing lakes, rivers, and watersheds had to be added to the dataset. The the

location of EPA water monitoring stations had to be gathered, as well as the locations of all contaminated sewage treatment plants. The treatment plants were difficult, as the facility names were released to the press when contamination was found, but not the locations of the plants themselves were given. Occasionally a city or road was listed, but the coordinates of all five plants had to be found manually using google maps. The general area was taken from press releases and satellite view in google maps was used to find the characteristic appearance of a sewer treatment facility. A point was then made at the area and the coordinates recorded in a Microsoft excel table. These points will be revisited in
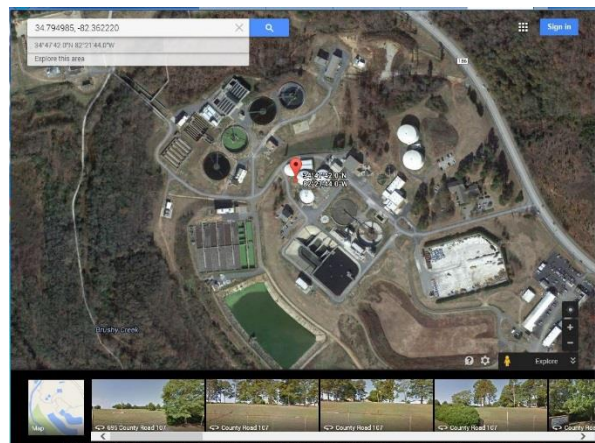

Figure 2 Google Maps Location of the Mauldin Road Sewage Treatment Plant

the data preprocessing section. This same method had to be used to find the coordinates of the Sangamo Weston superfund site because the EPA lists an address of the contamination site but does not have a downloadable superfund site dataset or listed coordinates.   The final piece of information needed for the map were the locations of known agriculture applications of the contaminated sewer sludge. Because sludge cannot be applied to land without a permit, the locations of all permitted applications are recorded with the State of South Carolina. I began searching the internet for records of these applications filed with the state or released to the press. After an hour of searching I found a google maps file of all permitted sludge applications made with contaminated biosolid. I was able to download this file in a CSV table for future processing.

Data Preprocessing

Figure 3 Display XY Data Screen

The water treatment plant locations, Sangamo Weston plant location, and the contaminated sludge applications were not in an ArcGIS readable format and had to be converted. Luckily, as they were all saved in CSV format tables, the same procedure was used to convert all three datasets. Because I compiled the Sangamo Weston location and water treatment plant location in excel tables, the tables were saved as CSV tables. I then used the Table to Table Conversion tool in ArcToolbox to convert the CSV tables and add them to my table of contents in ArcMap. In the table of contents, I then had to right-click on the imported table and select "Display XY Data." On the input screen that then appears, I had to change the coordinate system for the points to NAD 1983 so that the points would be projected in the same coordinate system as the rest of my map. After selecting the new coordinate system and selecting "OK," the points were displayed on my map.
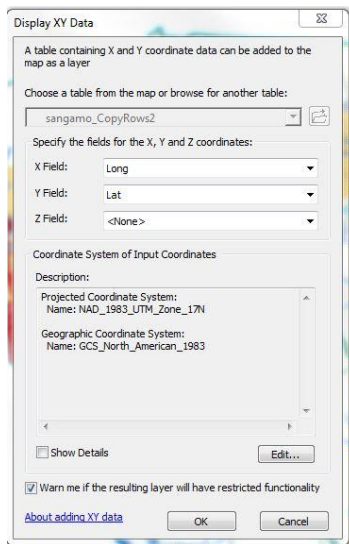
ArcGIS Processing

Once all relevant data was imported into ArcMap, I clipped all of the data to only show the Upstate area. After all data was sufficiently clipped, I had to create a series of buffers around my datasets in order to demonstrate potential hazard zones. To do this, I had to create five different buffers. I first buffered my four sets of points: the Sangamo Weston site, EPA Water Monitoring Stations with PCB, Contaminated Treatment Plants, and Contaminated Sludge Applications. The water treatment plants, EPA stations, and Lake Hartwell were all buffered to show a ten mile zone and the sludge applications and were buffered to show a five mile surrounding zone. The sludge applications were only buffered to five miles

Figure 4 All Datasets Clipped to Map Area

because many of the radii surrounding the points overlap, creating a large continuous zone, so a ten
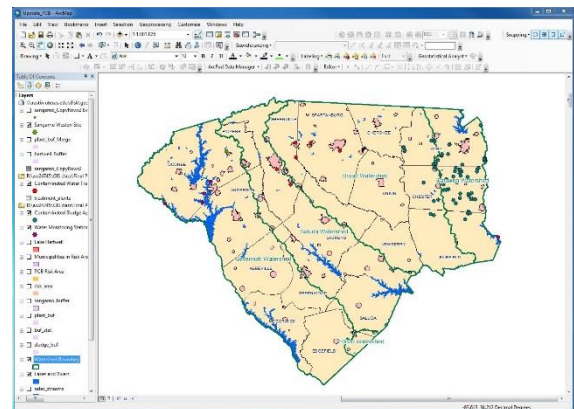
mile radius on many of the points would not be discernable on a map or make a difference in the potential hazard area. Also, the sludge application sites only show potential for the chemical to be introduced to drinking water sources not that any PCB was actually present in drinking water, which puts them at less risk than at the monitoring stations, treatment plants, and lake where PCB is confirmed and known to be in the water supply.
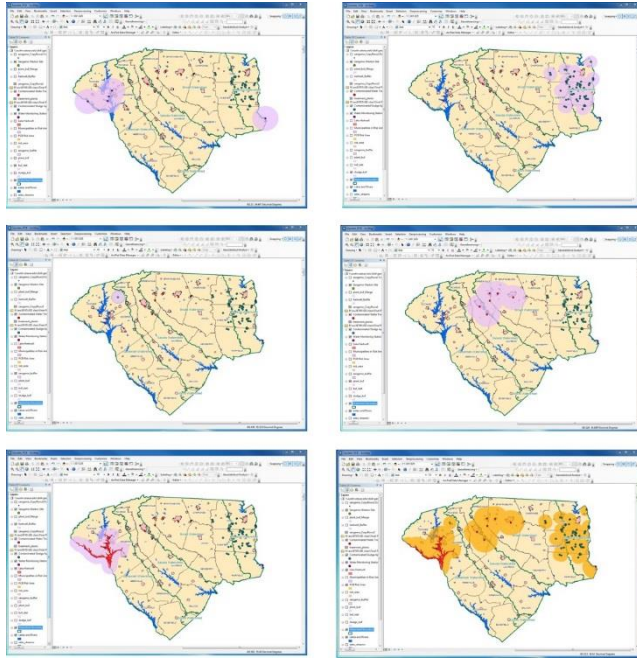

Figure 5 Individual Buffers and Final Combined Buffer Area

For this same reason the Sangamo Weston site was only buffered to a five mile radius as it only shows potential for introduction to the water supply, not confirmed presence like the lake, treatment plants, and EPA monitoring stations do. Finally, these five buffers were combined using the Merge tool in the Data Management toolbox. This created one dataset of all buffer zones, which displays the total risk area for PCB exposure. The last step in the mapping process was displaying the cities and towns in the PCB risk area. I used the "select by location" option in the selection drop-down menu and created an SQL query for municipalities that inside the PCB risk area map layer. Once selected, I exported the selected data from the "Municipalities" layer and added it back to the map as the

"Municipalities in Risk Area" layer and labeled the cities and towns. Finally, I cleaned up the map, added labels to watersheds and counties, a neat line, title, scale, north arrow, legend, and also created an image to show where the counties are located with respect to the rest of the state.

PCB Hazards in Upstate South Carolina Drinking Water, South Carolina, USA

SPARTANBURG

GREENVILLE

INMAN

COWPENS   CHEROKEE

PICKENS

WELLFORD
GREER   LYMAN   SPARTANBURG
DUNCAN

HICKORY GROVE   YORK
SHARON   YORK

FORT MILL

ROCK HILL

OCONEE

SIX MILE
LIBERTY
NORRIS
CENTRAL
SENECA CLEMSON
PENDLETON

CITY VIEW
GREENVILLE

PACOLET MILLS
PACOLET

MCCONNELLS

Broad Watershed

Catawba Watershed

WESTMINSTER

MAULDIN
SIMPSONVILLE
FOUNTAIN INN

LOWRYS

CHESTER
CHESTER   FORT LAWN

ANDERSON

UNION

ANDERSON

BLACKSTOCK

GREAT FALLS

Saluda Watershed
LAURENS

NEWBERRY

Savannah Watershed

FAIRFIELD

ABBEVILLE

GREENWOOD

Edisto Watershed

McCORMICK

SALUDA

EDGEFIELD

Legend

- 🟢 Sangamo Weston Site
- 🔴 Contaminated Water Treatment Plants
- 🔵 Contaminated Sludge Applications
- 🟣 Water Monitoring Stations Testing Positive for PCB
- 🟥 Lake Hartwell
- 🟪 Municipalities in Risk Area
- 🟧 PCB Risk Area
- ▭ Watershed Boundary
- 🟦 Lakes and Rivers
- ▭ Counties

N

0   5   10   20   30   40
Miles