MICROBIOLOGY, HEALTH AND THE RIVERS OF PHILADELPHIA

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NY TIMES, 4/16/1891

TYPHOID AND POLLUTED WATER.

In the first three months of this year there were in Philadelphia 910 cases of typhoid fever and 196 deaths caused by that disease. Two years ago there was a similar epidemic of typhoid in that city, but in no month of 1889 was the mortality so great as it has been in March of this year. The prevalence of the disease now has caused some unofficial investigations to be made concerning the manner in which the mortality in certain districts is related to the water supply. The greatest mortality is found in four wards that use water supplied directly from the dirty Schuylkill River by pumping, and in those wards, whose population is only 184,000, there have been in three months 317 cases of typhoid and 42 deaths. This heavy mortality is all the more noticeable in those wards because the district is an elevated one, well drained, and inhabited for the most part by well-to-do people.

VIBRIO IN THE SCHUYLKILL (1896)

THE SIGNIFICANCE OF PATHOGENIC SPIRILLA IN AMERICAN SURFACE WATERS, WITH A DESCRIPTION OF ONE ISOLATED FROM THE SCHUYLKILL RIVER AT PHILADELPHIA.

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(From the Laboratory of Hygiene, University of Pennsylvania.)

Journal of Experimental Medicine, 1(3) (1896)

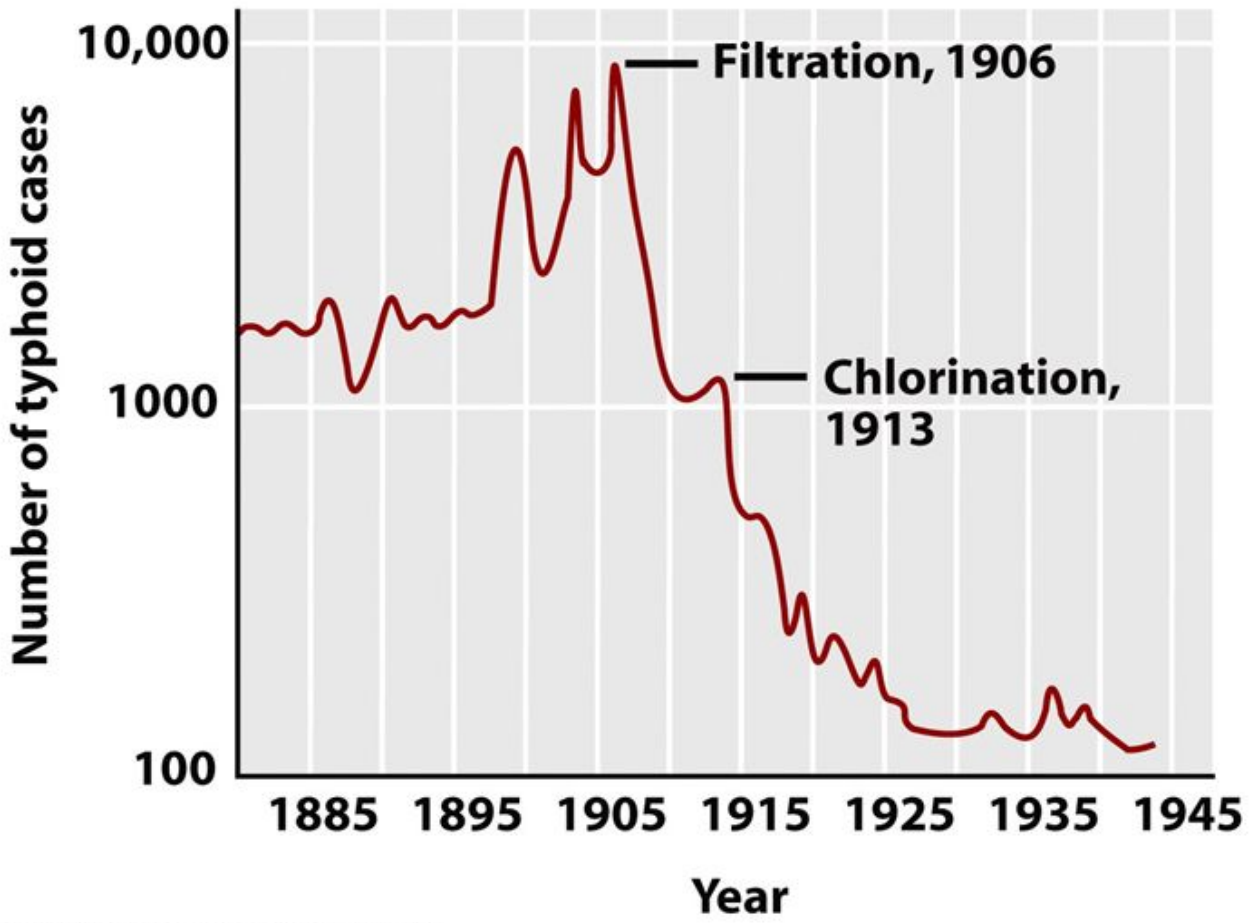
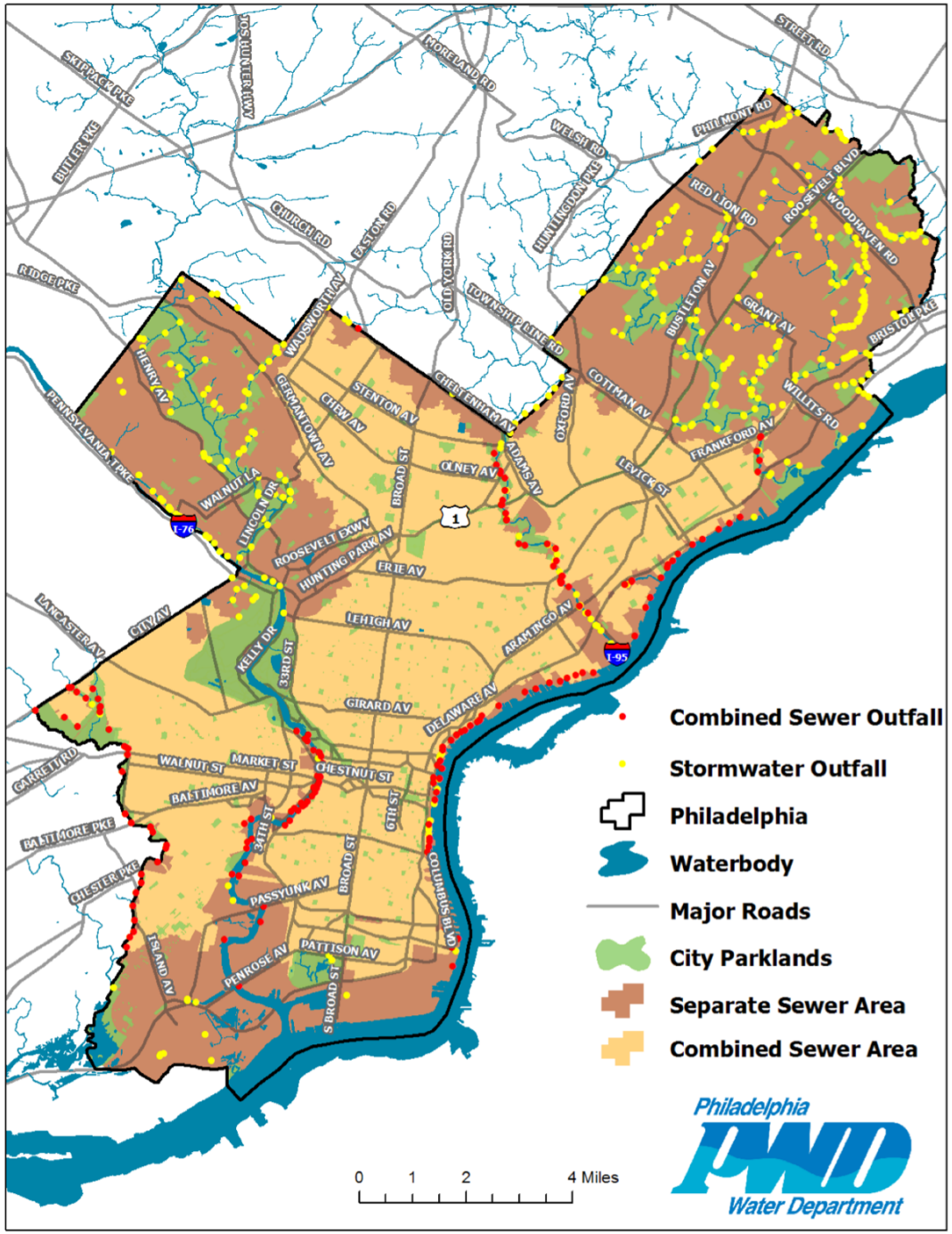


Figure 28-2 Brock Biology of Microorganisms 11/e
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Reduction of **typhoid fever** (caused by *Salmonella typhi*) in Philadelphia following introduction of filtration and chlorination to treat drinking water. Similar reductions in other waterborne diseases were seen.

EXPOSURE ROUTES NOW

- RECREATION
  - PRIMARY CONTACT: SWIMMING, KAYAKING, JET SKIING
  - SECONDARY CONTACT: FISHING, BOATING, ETC.
- DIRECT INGESTION
- WATER → HAND → MOUTH


Combined Sewer Outfall
Stormwater Outfall
Philadelphia
Waterbody
Major Roads
City Parklands
Separate Sewer Area
Combined Sewer Area
0 1 2 4 Miles
Philadelphia
PWD
Water Department

HOW TO ESTIMATE

- HOW MANY PEOPLE ENGAGE IN WHAT RECREATION
- WHERE
- WHAT IS WATER QUALITY
- WHAT IS EFFECTIVE DOSE (*)
- WHAT IS RESULTING RISK (*)

(*) – FROM LITERATURE

CAMERA LOCATIONS

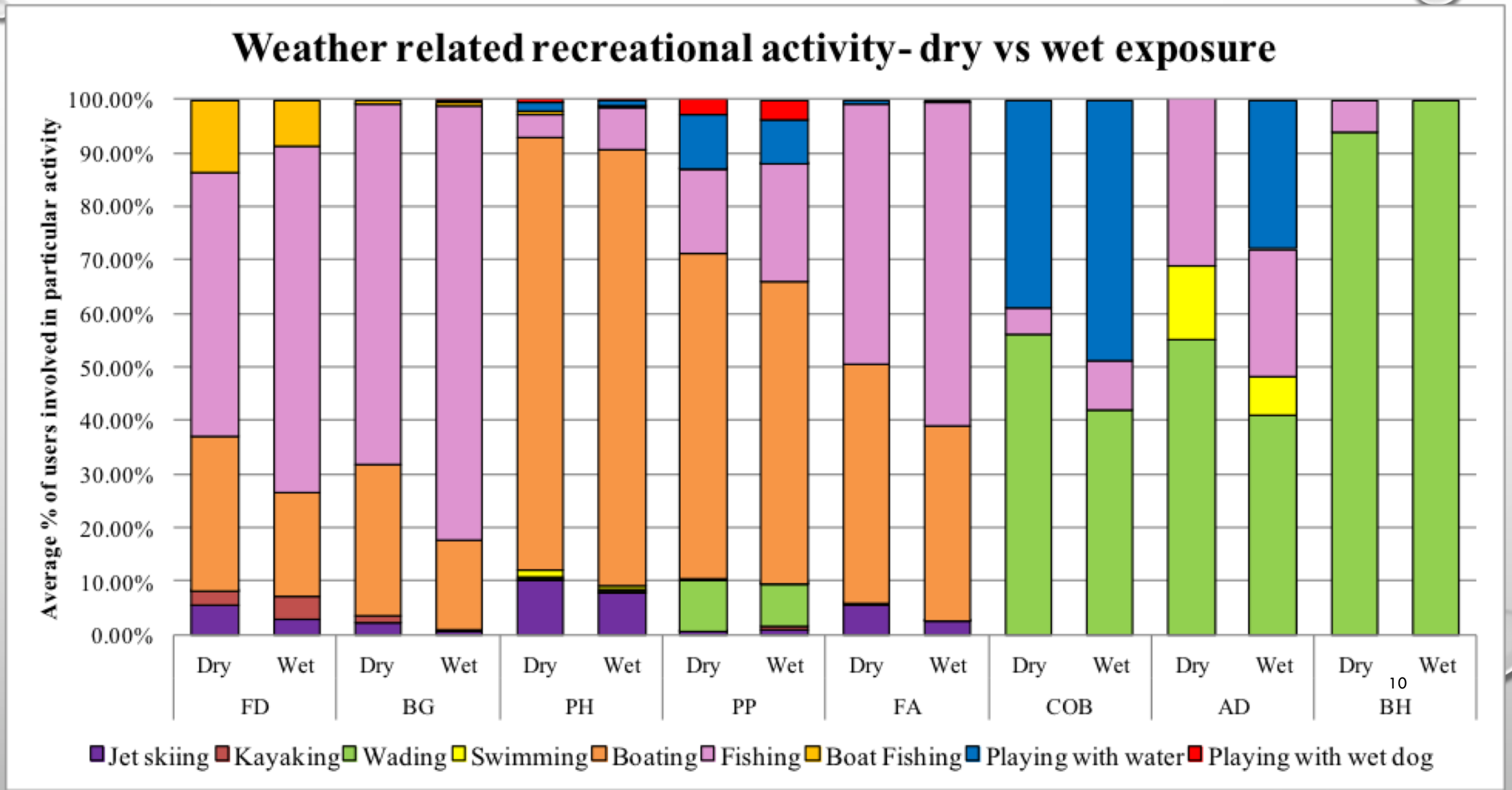


EXAMPLE IMAGES





RELATIVE PROPORTION OF USES PER SITE



GI ILLNESSES/1000 USERS

Urban Water body	Average risk of gastroenteritis illnesses/1000 users/day[a]				
	Recreational sites	Linear 1986model		Exponential Model	
		Wet[b]	Dry[c]	Wet[b]	Dry[c]
Schuylkill River	Fairmount Dam	3.51	3.77	4.74	**8.62**
	Bartram Garden	6.09	1.62	**24.93**	7.33
Delaware River	Pleasant Hill	5	0.03	6.8	1.95
	Pennypack	8.02	0.04	**17.55**	1.76
	Frankford arsenal	6.42	0.0001	**8.58**	1.72
	Penns Landing	3.85	0.0000	5.28	2.01
	Penn Treaty[d]	1.97	0.07	4.63	2.19
Tacony Creek	Adams	**11.16**	4.16	**49.77**	**11.04**
	Bingham	**8.62**	1.86	**48.29**	4.8
Cobbs Creek	Cobbs	**8.32**	3.25	**51.9**	7.8

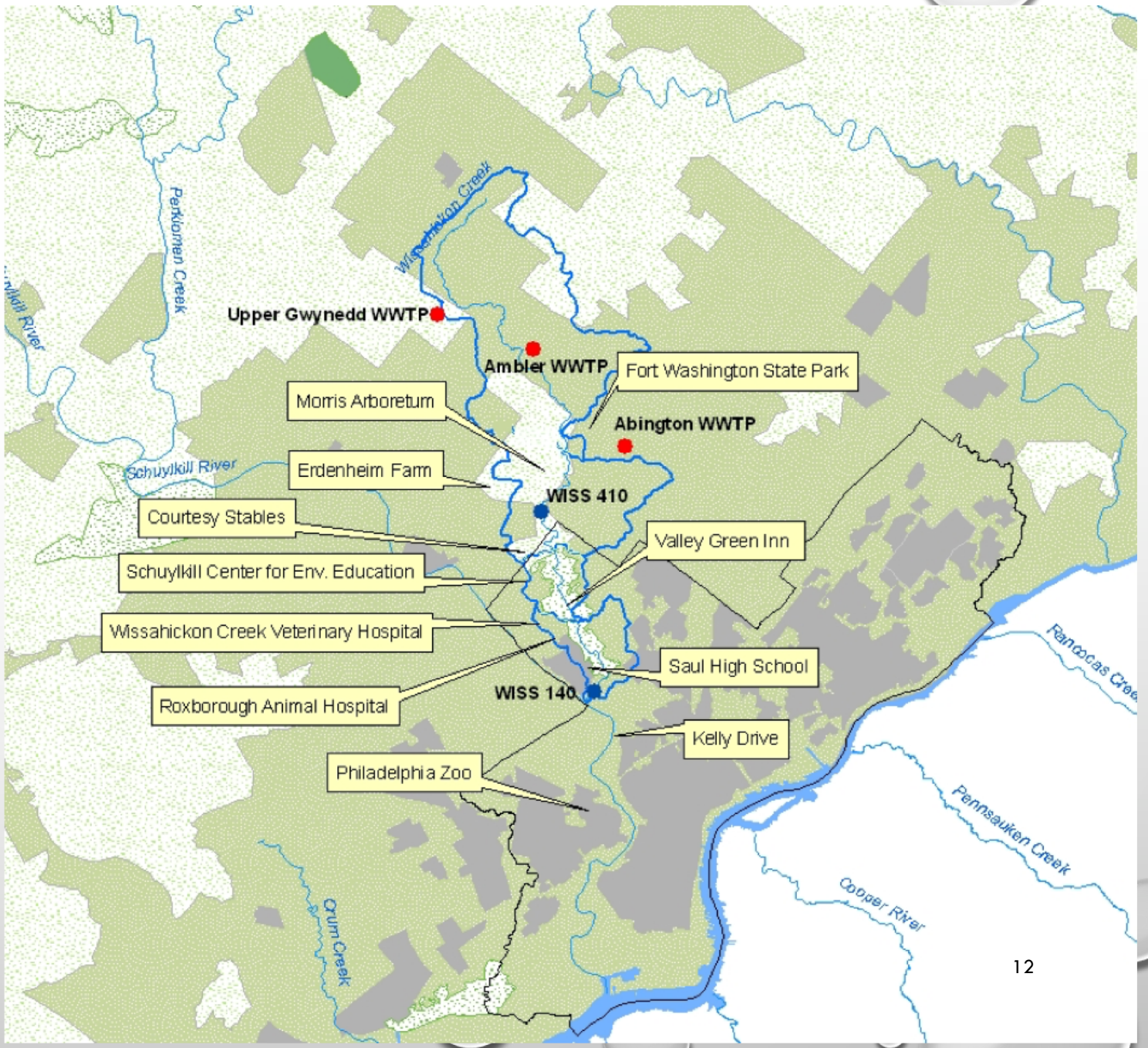
[a] Bold values indicate the sites where the risk of GI illnesses was above the EPA limit.

[b] Wet weather bacterial data for Schuylkill River, Tacony Creek and Cobbs Creek was from 2007 sampling, while for Delaware River sites it is from 2011 sampling.

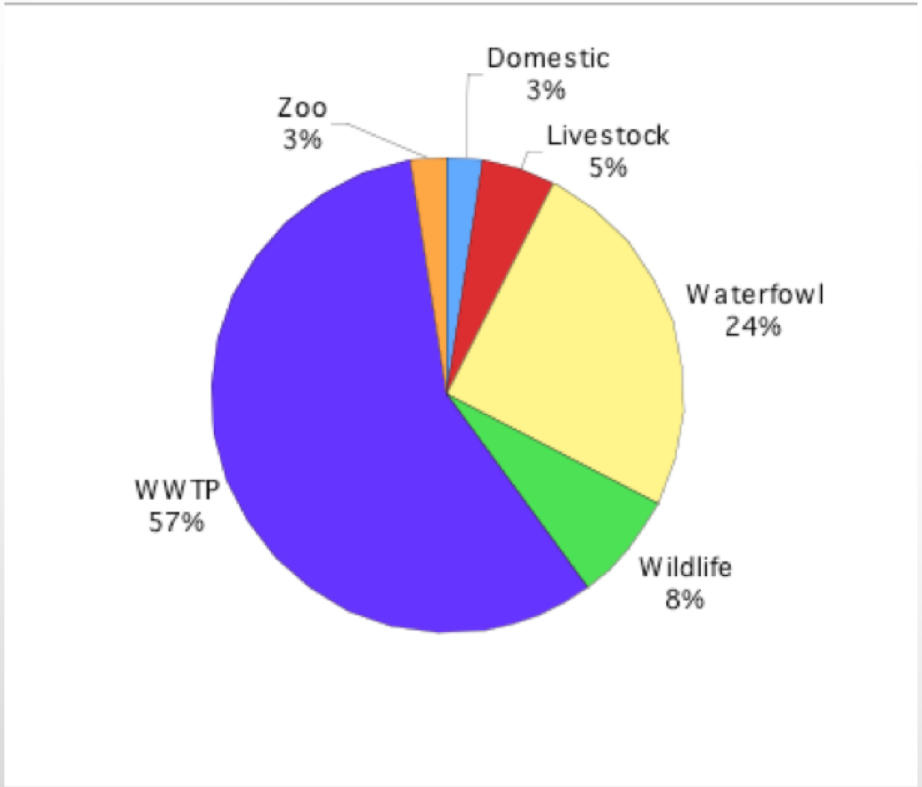
[c] Dry weather bacterial data for Schuylkill River, Tacony Creek and Cobbs Creek was from 2007 sampling, while for Delaware River sites it is from 2010 sampling.

[d] Average dose was calculated instead of a probabilistic dose distribution, due to limited data on exposure duration (only in-person surveys were conducted at this site).

ESTIMATION OF SOURCES (PHD THESIS – JOANNA POPE)

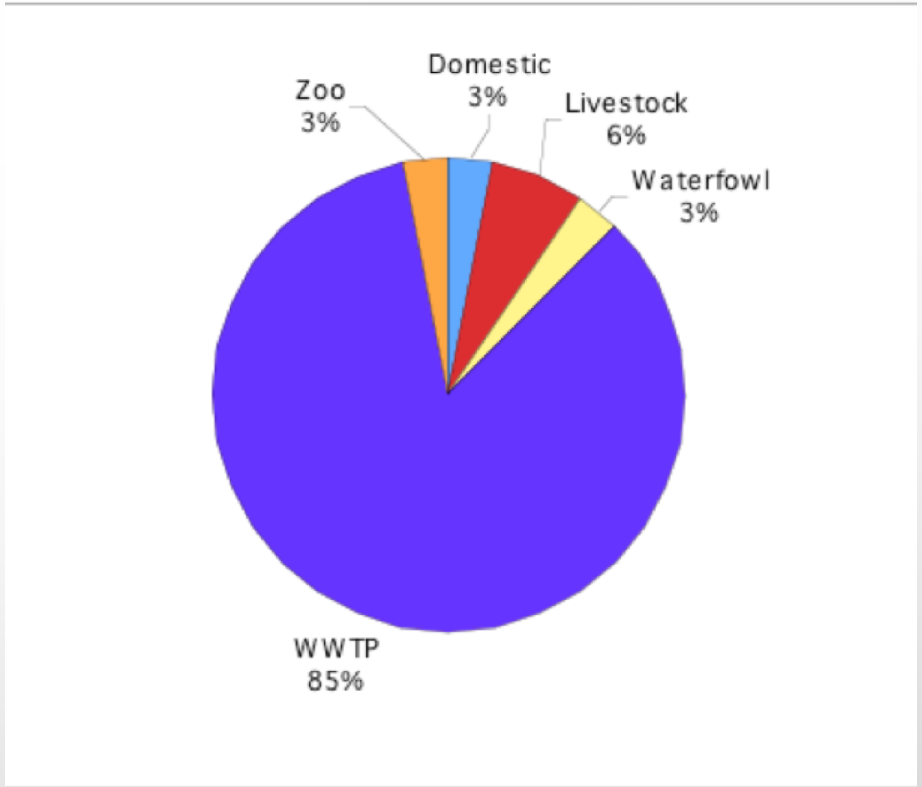


CLASSIFICATION OF UNKNOWN SOURCE ISOLATES USING BOX-PCR DATA (LIBRARY DEPENDENT)



WISS410

N = 40 enterococci



WISS140

N = 32 enterococci

CONCLUSIONS

- CURRENT WATER QUALITY PRESENTS AN UNACCEPTABLE RISK TO RECREATIONAL USERS AT A NUMBER OF LOCATIONS, ESPECIALLY DURING WET WEATHER
- THE DOMINANT SOURCES IN THE WISSAHICKON ARE WASTEWATER ASSOCIATED
  - FURTHER STUDIES ARE NEEDED TO ASCERTAIN WHETHER THIS IS TRUE IN THE MAIN SCHUYLKILL AND THE DELAWARE
- IF THIS CAN BE GENERALIZED, THE DIVERSION OF CSO'S AND SSO'S BY GREEN INFRASTRUCTURE SHOULD IMPROVE MICROBIAL WATER QUALITY AND REDUCE RISK

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- MICHAEL RYAN
- JOANNA POPE

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