Gwinnett
Water Resources

Modeling Sanitary Sewer Overflows

Multiple Linear Regression Analysis of the Beaver Ruin Sewer Basin

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Penn State MGIS Program

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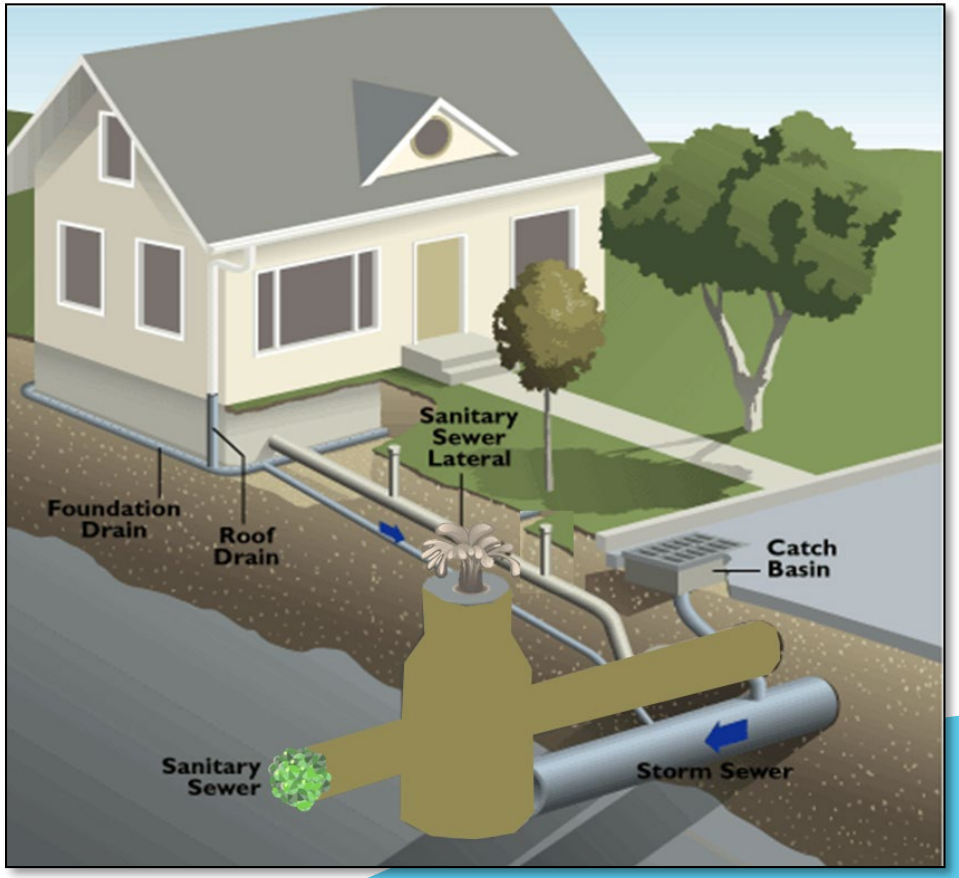
Geog 596A, Fall 2019

Overview

- Introduction
- Purpose
- Previous Research
- Background
- Methodology
- Expected Results
- Timeline
- References

Introduction

What is a Sanitary Sewer Overflow (SSO)?



Gwinnett County, Georgia

427 square miles

Second most populous county in the state

- 920,000 residents
- 1750,000 sewer accounts

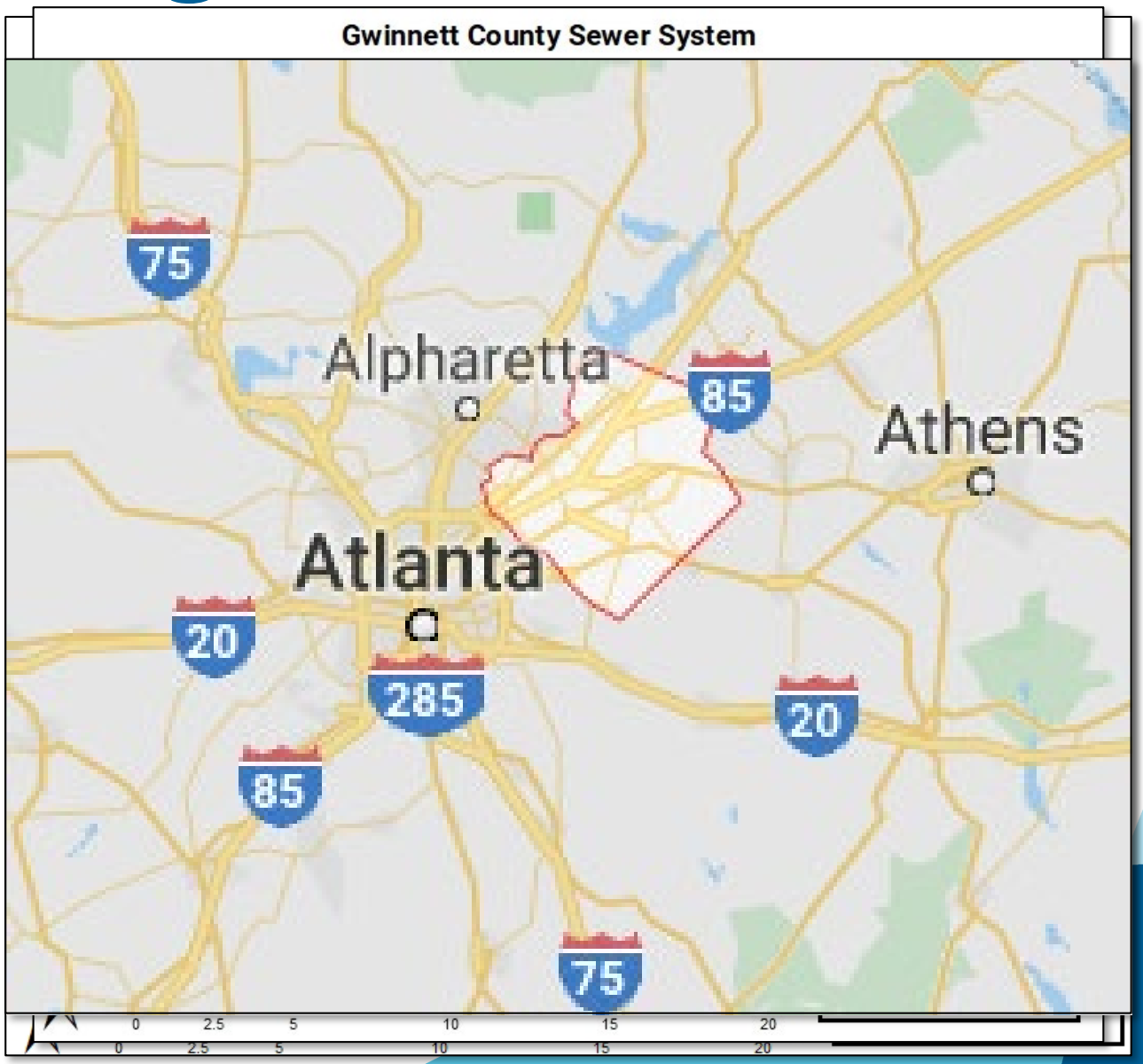
3,102 miles of sewer pipe

81,545 structures

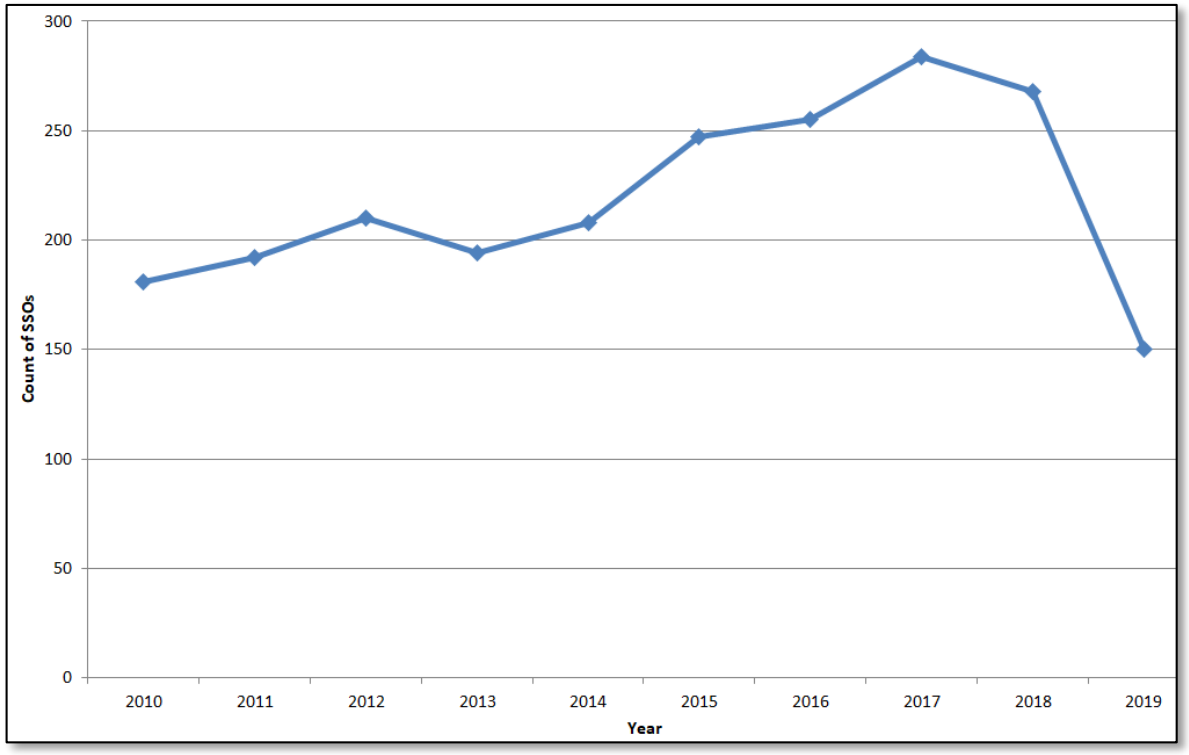
219 Pump Stations

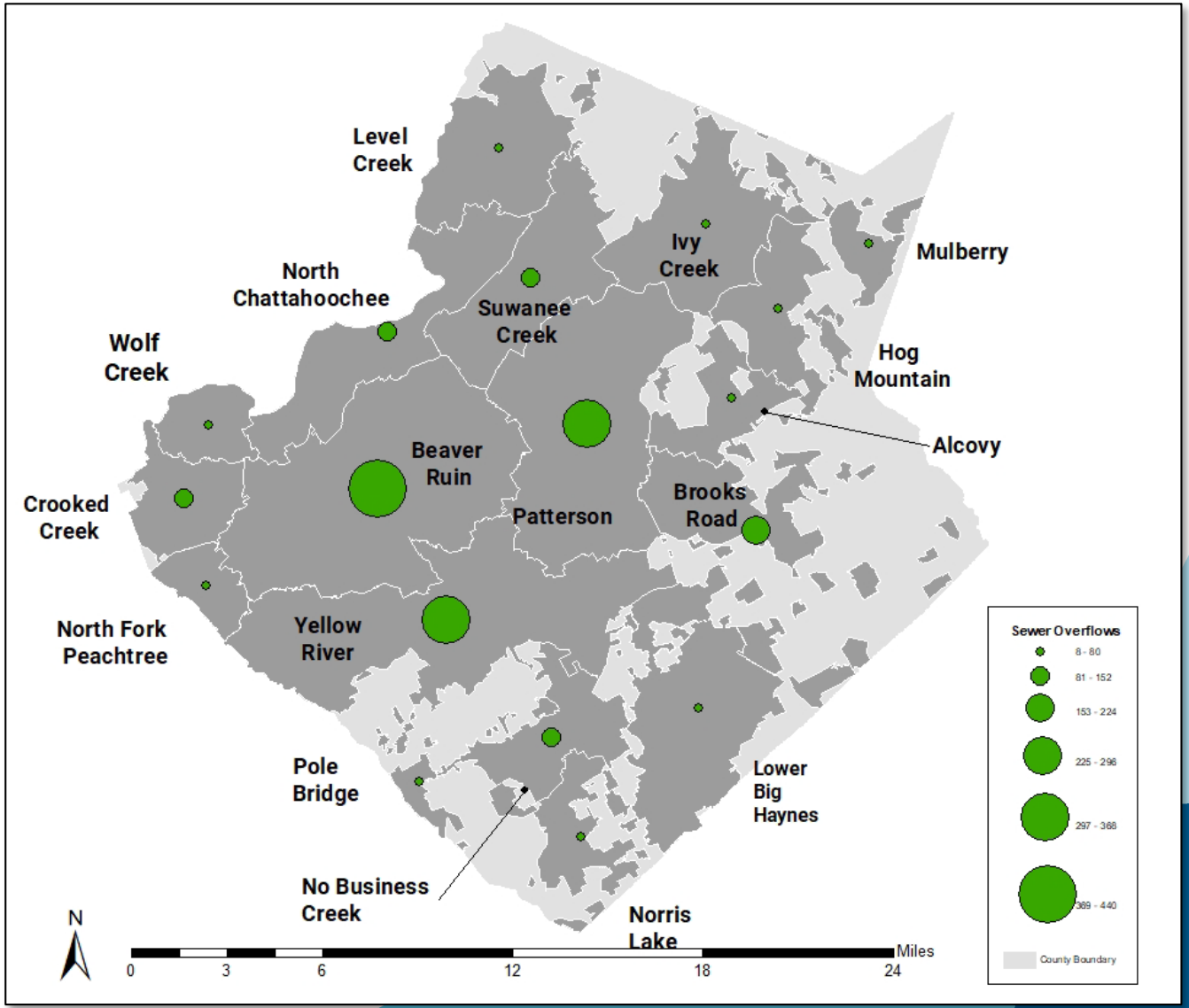
3 Water Reclamation facilities

Treat an average of 58 million gallons of wastewater per day



Background: SSO History





Gwinnett County Sewer Maintenance

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- CCTV Inspections
- Sewer Cleaning
- Sewer Repair
- Sewer Rehabilitation
- Sewer Replacement

Maintenance Strategies

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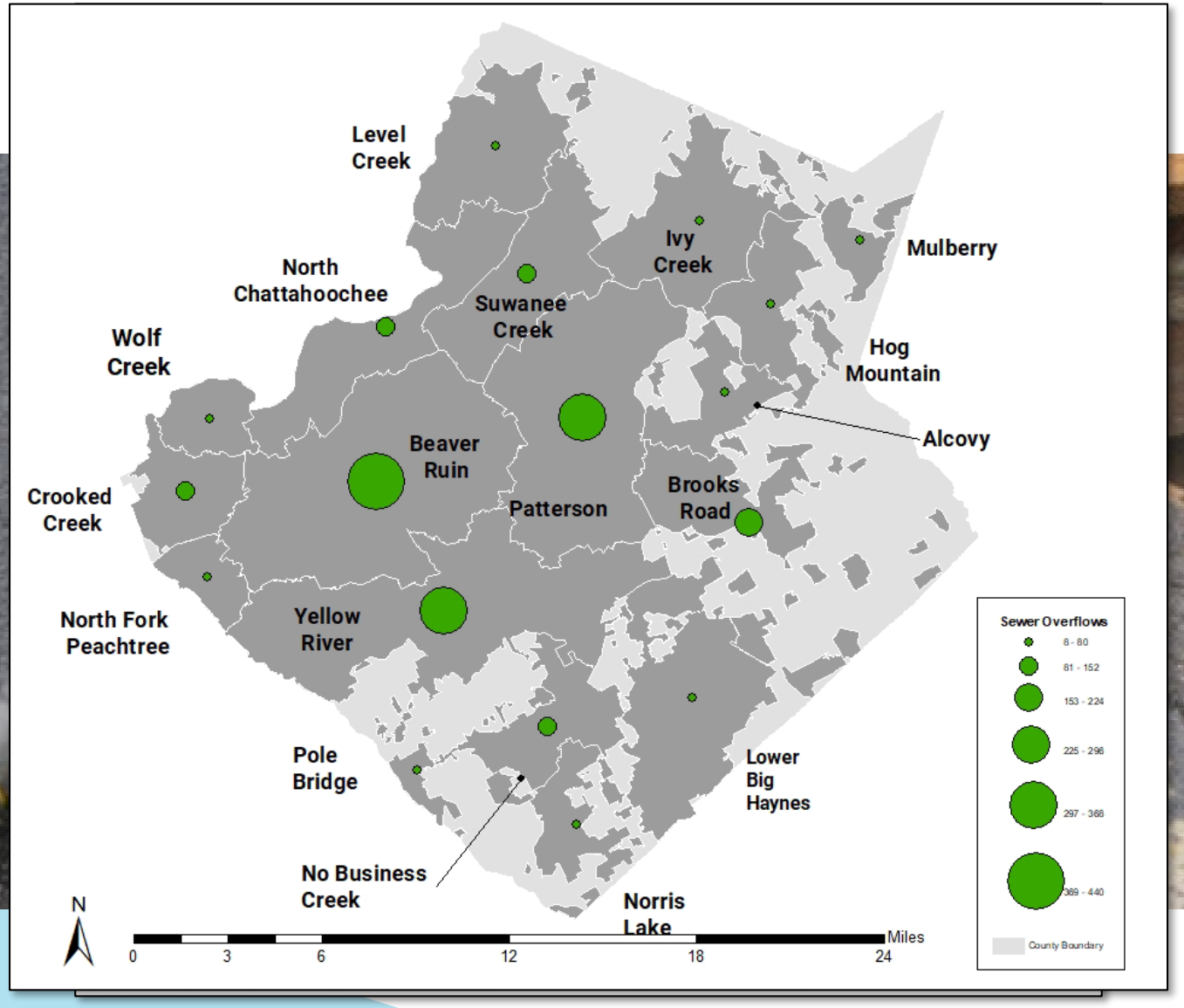
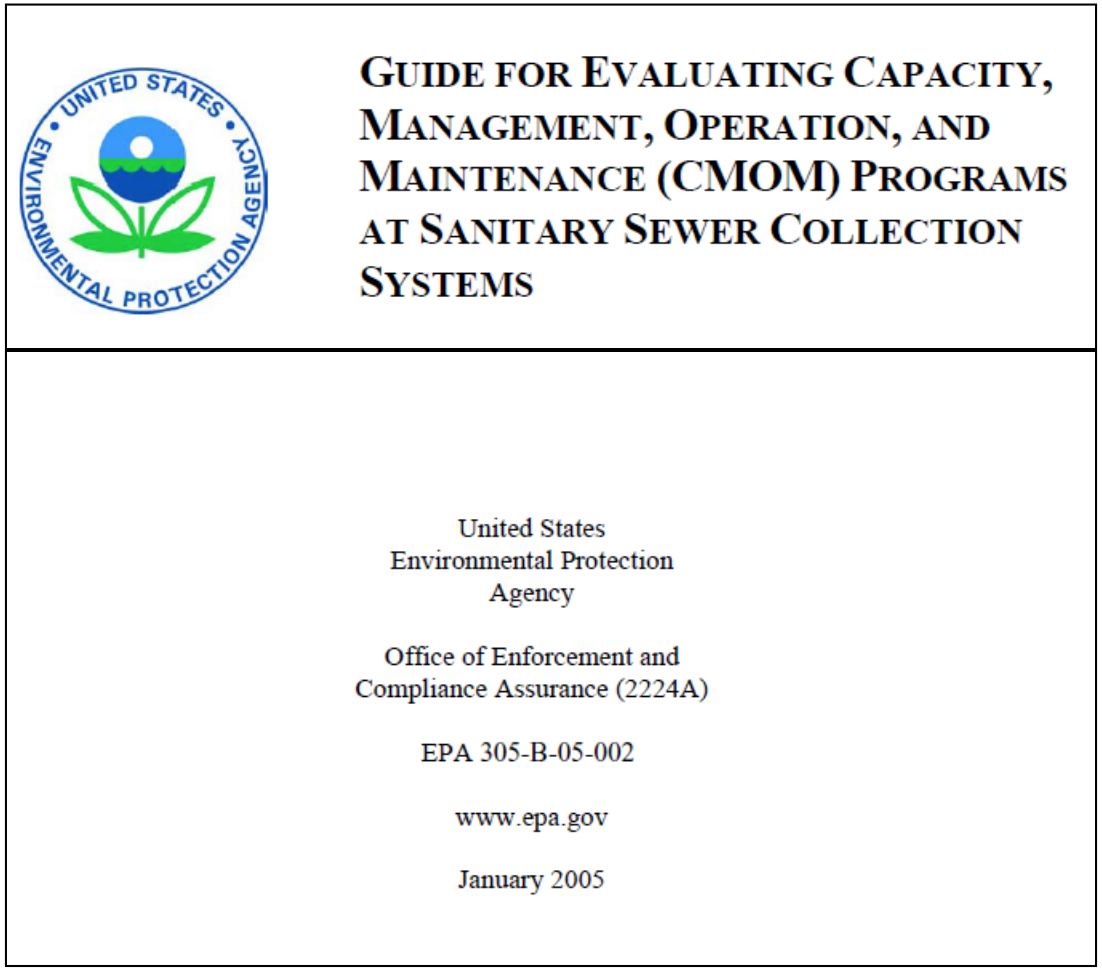
- Which pipes are most likely to cause an overflow?
- Which maintenance activities are best at preventing overflows?
- Which pipes should we focus on?



Purpose

- Regression analysis will determine the relationship between the occurrence of SSO and a number of independent factors.
- Which independent variable(s) contribute to SSOs.
- Identify locations where maintenance best practices are most effective to reduce the occurrence of future overflows.

Previous Research



GUIDE FOR EVALUATING CAPACITY, MANAGEMENT, OPERATION, AND MAINTENANCE (CMOM) PROGRAMS AT SANITARY SEWER COLLECTION SYSTEMS

United States
Environmental Protection
Agency

Office of Enforcement and
Compliance Assurance (2224A)

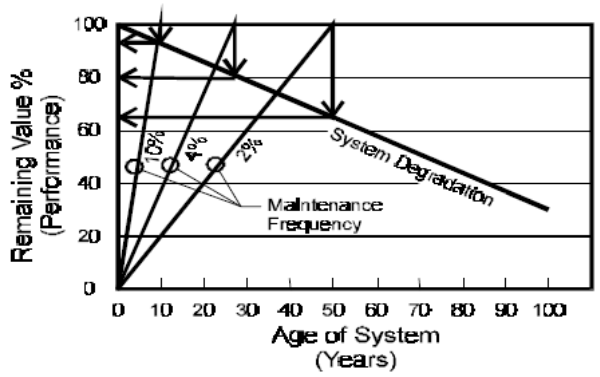
EPA 305-B-05-002

www.epa.gov

January 2005

Previous Research

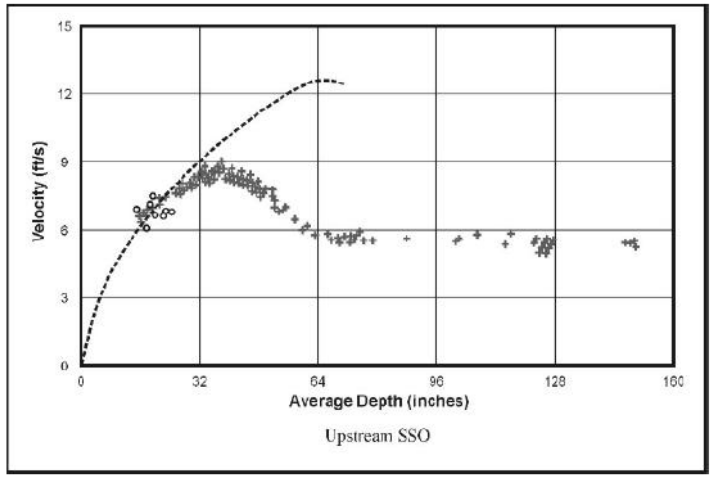
OPTIMIZATION OF COLLECTION SYSTEM MAINTENANCE FREQUENCIES AND SYSTEM PERFORMANCE



American Society of Civil Engineers
EPA Cooperative Agreement #CX 824902-01-0

February 1999

PROTOCOLS FOR IDENTIFYING SANITARY SEWER OVERFLOWS



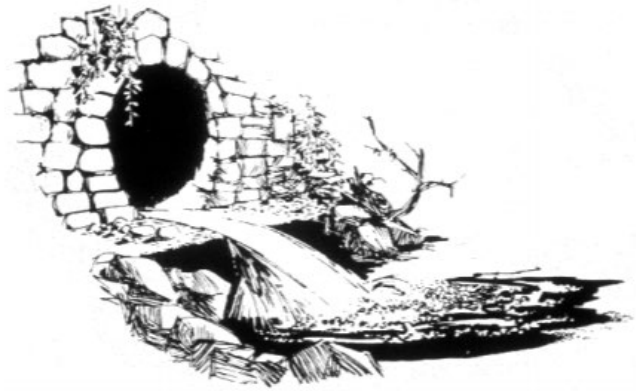
American Society of Civil Engineers
EPA Cooperative Agreement #CX 826097-01-0

June 2000

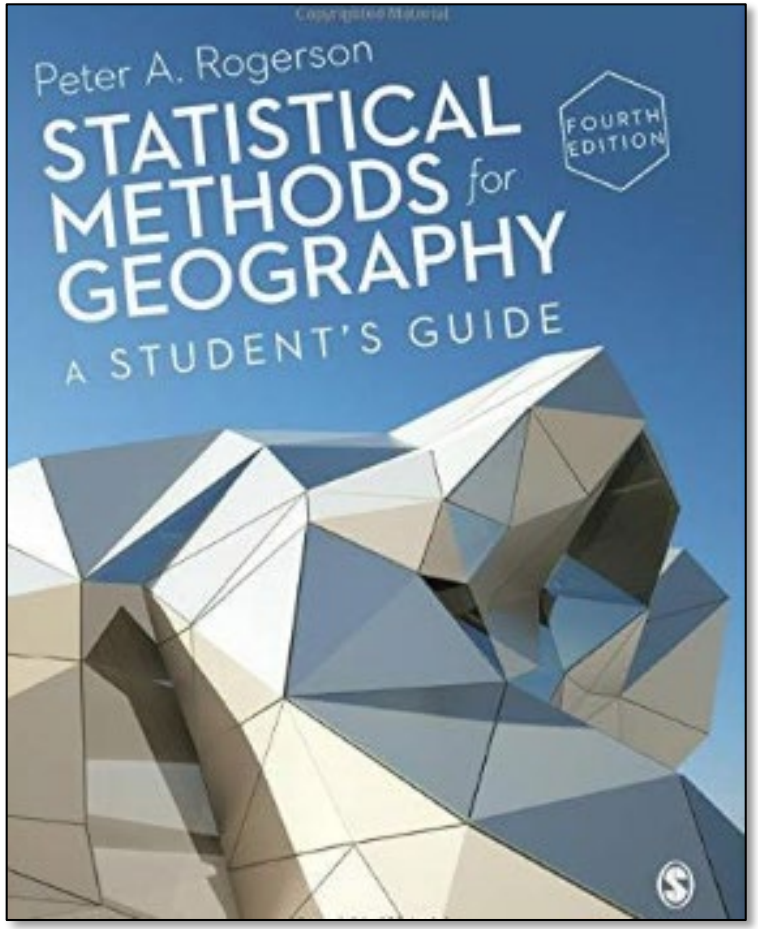
United States Environmental Protection Agency | Office of Research and Development Washington, DC 20460 | EPA/600/R-08/010 January 2008

EPA

Review of Sewer Design Criteria and RDII Prediction Methods



Previous Research: Regression Analysis



Regression Analysis of the Variation in Rainfall Derived Inflow and Infiltration

Li Zhang, Fang Cheng, Gregory Barden, Hunter Kelly, Timothy Fallara and Edward Burgess

Modelling Sewer Systems Costs with Multiple Linear Regression

Valentina Marchionni · Nuno Lopes · Luis Mamouros · Dídia Covas

Prediction of Sewer Pipe Main Condition Using the Linear Regression Approach

Ali Gedam[1], Suraj Mangulkar[1], Bal Gandhi[2]

[1]Ladhane Consultant Engineering, Roorkee, India
[2]Civil Engineering Department, University of Roorkee, Roorkee, India

More Pipes Mean More Overflows?

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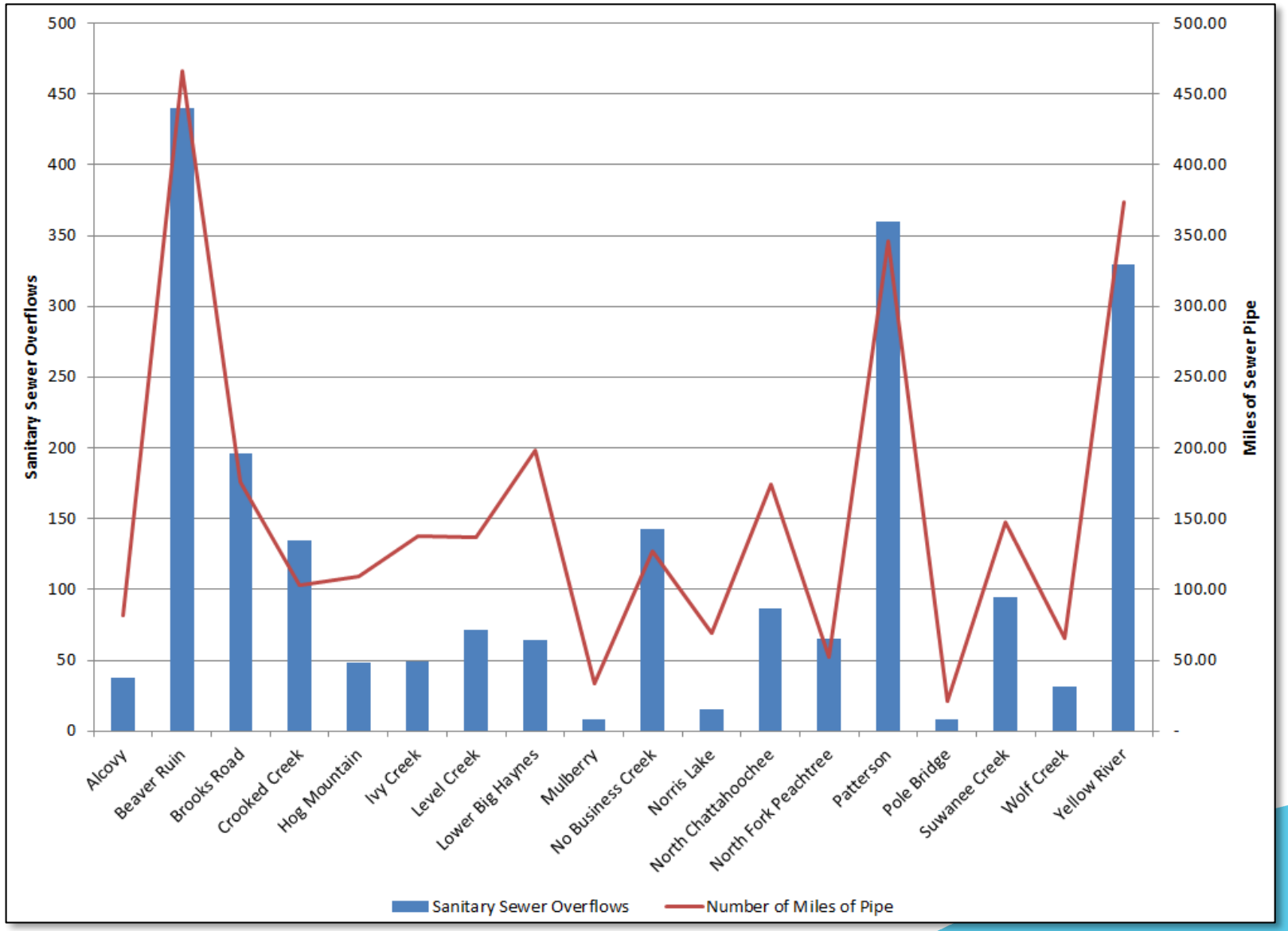
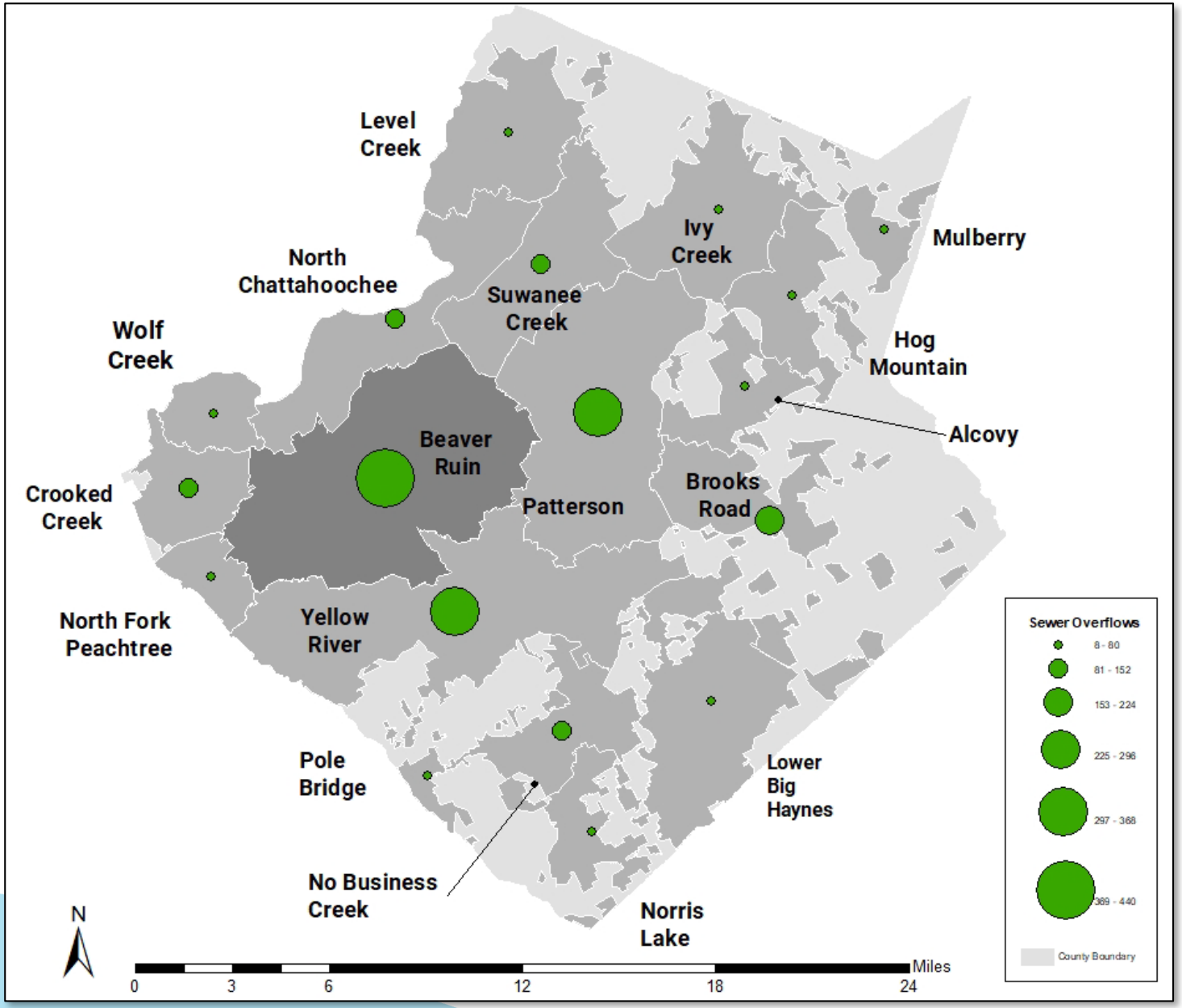


Methodology

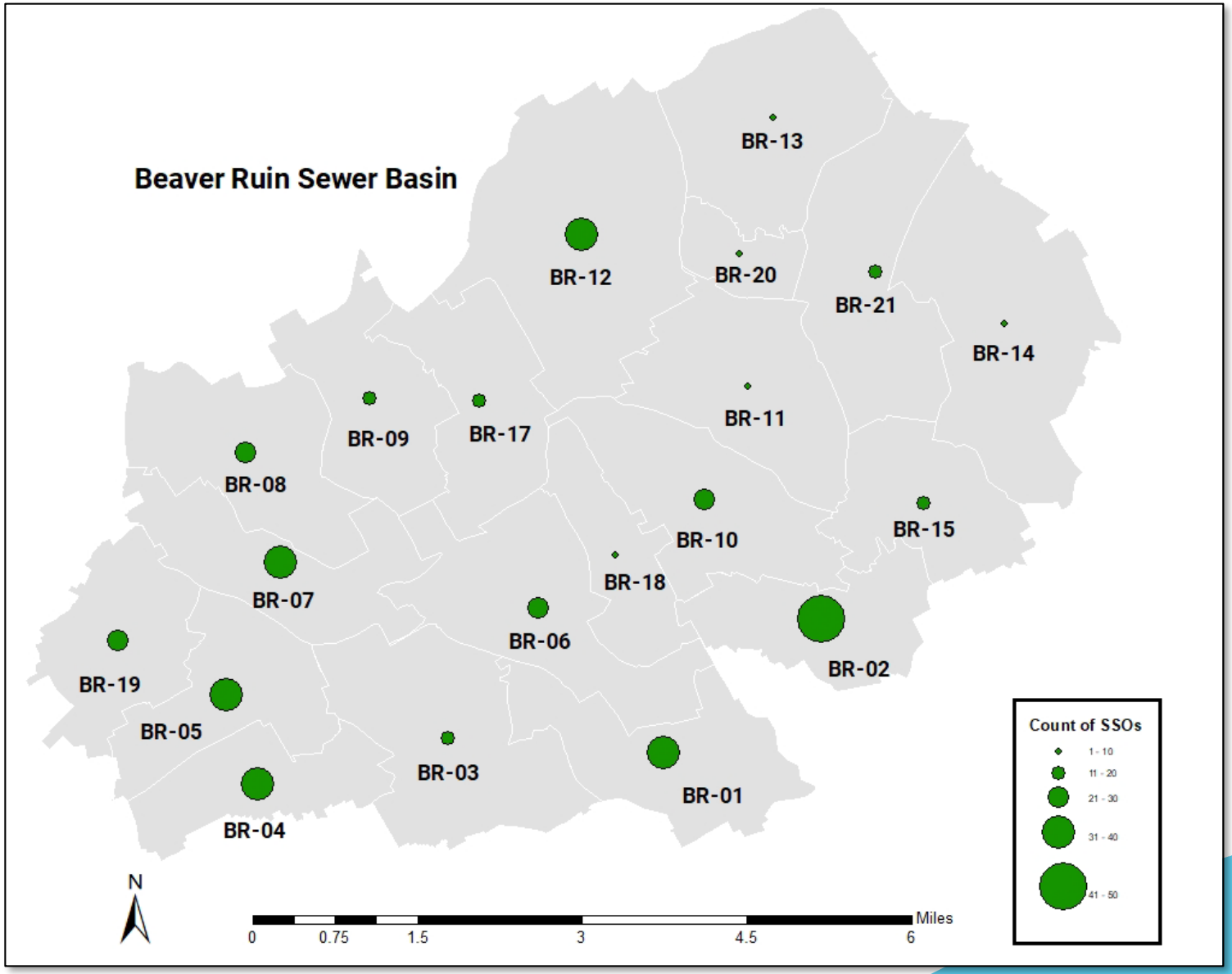
Identify study area:

Beaver Ruin Basin

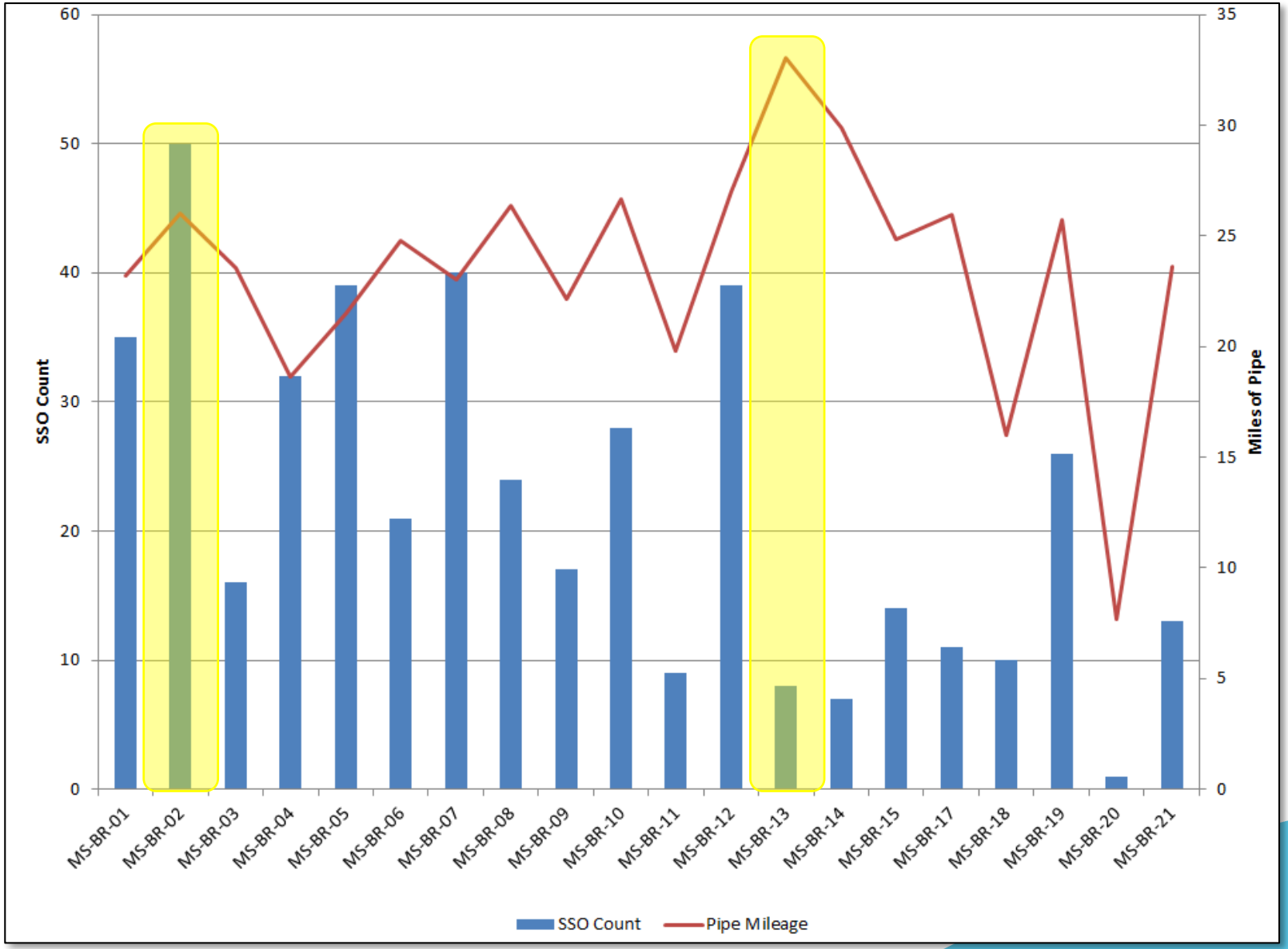
- Most SSOs
- Largest by area
- Most number of pipes
- Twenty-one small sewer basins



Beaver Ruin Overflows



More Pipes Don't Mean More Overflows



Define Independent Variables

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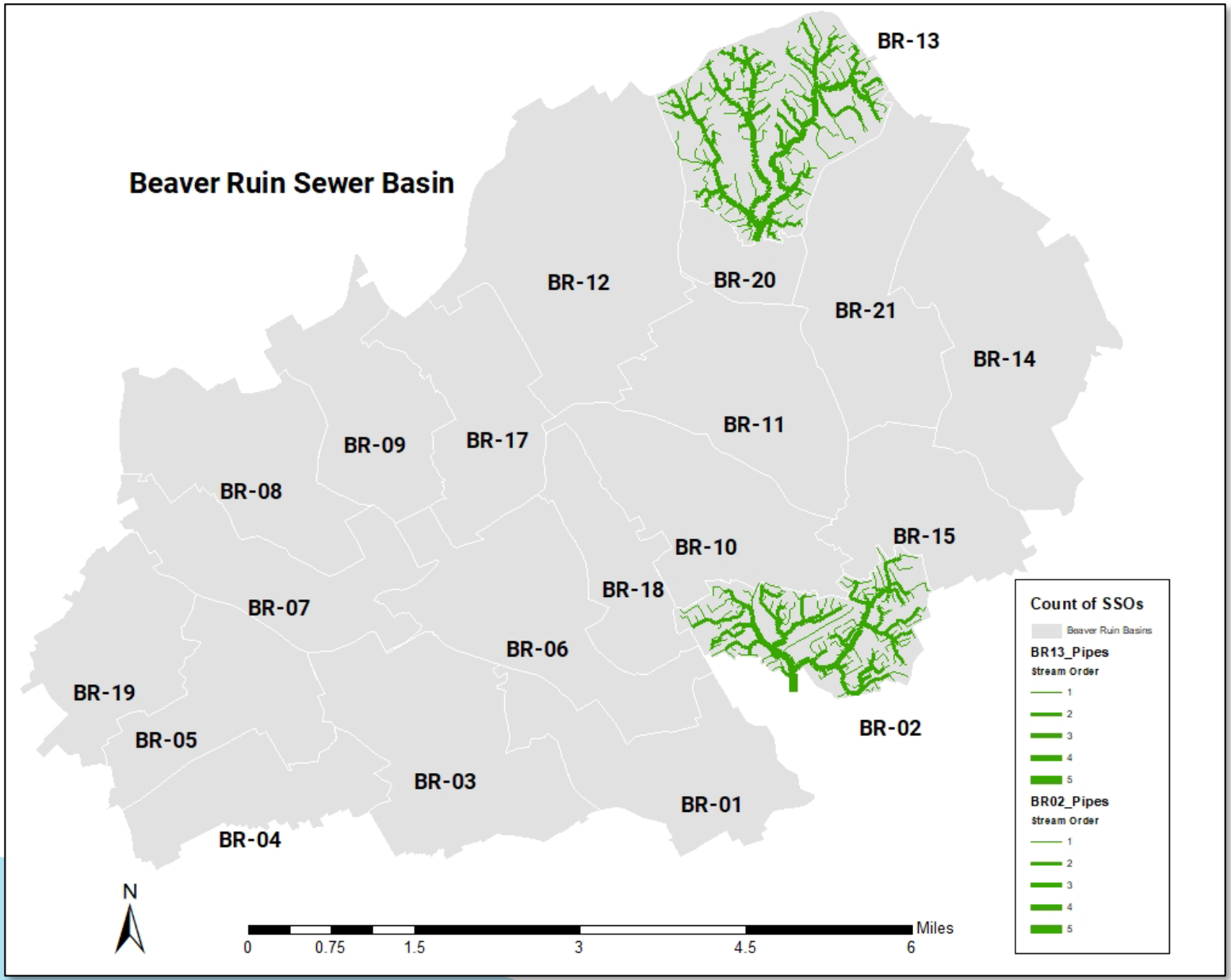
- Diameter
- Material
- Age
- Stream Order
- Capacity
- Slope
- Average Velocity
- Development Type
- WO History



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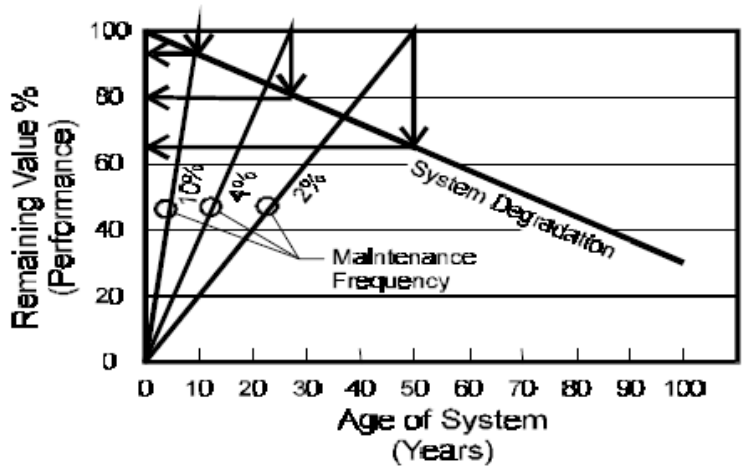
Run Analysis using SPSS

Intended Results

- Determine significant variables
- Recommend preventive maintenance activities in specific locations
- Reduce SSOs over time

OPTIMIZATION OF COLLECTION SYSTEM MAINTENANCE FREQUENCIES AND SYSTEM PERFORMANCE



American Society of Civil Engineers
EPA Cooperative Agreement #CX 824902-01-0

February 1999

Timeline

Run analysis on two minor basins:

- BR-02
- BR-13

Refine Results

Run analysis entire Beaver Ruin Basin

Present results at WEFTEC October 2020

Graduate December 2020!

References

Barden, H., Burgess, E., Cheng, F., Fallara, T., Kelly, H. Zhang, L. (2011). "Regression Analysis of the Variation in Rainfall Derived Inflow and Infiltration." *Journal of Water Management Modeling, January, 223-236.*

Black & Veatch. (1999). Optimization of Collection System Maintenance Frequencies and System Performance, ASCE, EPA Cooperative Agreement #CX 824902-01-0.

Black & Veatch. (200). Protocols for Identifying Sanitary Sewer Overflows (SSOs), ASCE, EPA Cooperative Agreement #CX 826097-01-0.

Gedam, A., Mangulkar, S. and Gandhi, B. (2016) Prediction of Sewer Pipe Main Condition Using the Linear Regression Approach. *Journal of Geoscience and Environment Protection*, 4, 100-105. http://dx.doi.org/10.4236/gep.2016.45010

Lai, F.-h. (2008). Review of Sewer Design Criteria and RDII Prediction Methods, Report No. EPA/600/R-08/010, EPA Washington, D.C.

U.S. Environmental Protection Agency (USEPA). (2005). Guide For Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems, Report No. EPA 305-B-05-002, EPA Washington, D.C.

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Questions?

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