HOUSTON HEALTH DEPARTMENT

HOUSTONHEALTH.ORG

Tracking SARS-CoV-2 in the city of Houston's wastewater system

Presented by:
Loren Hopkins, PhD
Chief Environmental Science Officer
Bureau Chief Community and Children's Environmental Health
Houston Health Department
Tuesday, Sep 2nd, 2020

HOUSTON HEALTH DEPARTMENT

Today's Agenda

HOUSTON HEALTH DEPARTMENT

- **Team**
- Introduction
- Methodology
- Analysis of results
- Comparison between wastewater and clinical-based positivity rates
- Conclusions

Collaborative Team

Houston Health Department: Loren Hopkins, PhD, Lilian Mojica, MS, Braulio Garcia, Daniel Bahrt, Courtney Hundley, MPH, Jeremy Rangel, Ruochen Liu, MS

Houston Water – Wastewater Operations: Carol LaBreche, PE, Walid Samarneh, PE, Paul Zappi, PE, Rae Mills, PE

Rice University: Lauren Stadler, PhD, Kathy Ensor, PhD, Phil Bedient, PhD, Roberto Bertolusso, PhD, Prashant Kalvapalle, Zach LaTurner

TAILOR Molecular Virology and Microbiology, Baylor College of Medicine: Anthony Maresso, PhD, Tony Piedra, MD, Viasanthi Avadhanula, PhD, Austen Terwilliger, PhD, Justin Clark, PhD, Haroldo de Santos Hernandez

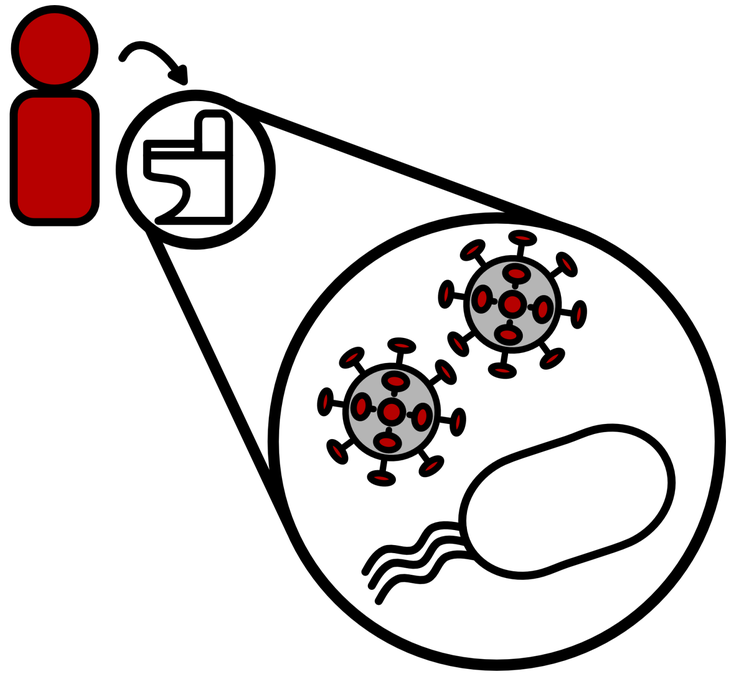
Today's Agenda

- Team
- **Introduction**
- Methodology
- Analysis of results
- Comparison between wastewater and clinical-based positivity rates
- Conclusions

What is wastewater surveillance?

HOUSTON HEALTH DEPARTMENT

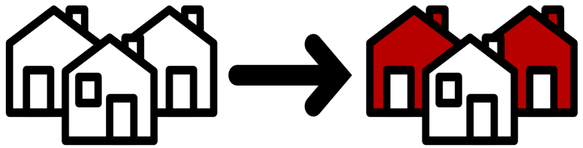
- Infected persons (asymptomatic and symptomatic) shed the virus in feces
- Feces enters the sewage network
- Wastewater collected at the treatment plant is an aggregate or pooled sample
- Results
  - Qualitative (positive or negative)
  - Quantitative (viral genomes/L wastewater)



Advantages of Wastewater Monitoring

HOUSTON HEALTH DEPARTMENT

- Can serve as an early warning system for outbreaks
- Detects resurgence in communities
- Less expensive mass surveys
- Coverage in areas with little clinical testing information
- Can be used to identify geographic areas of concern



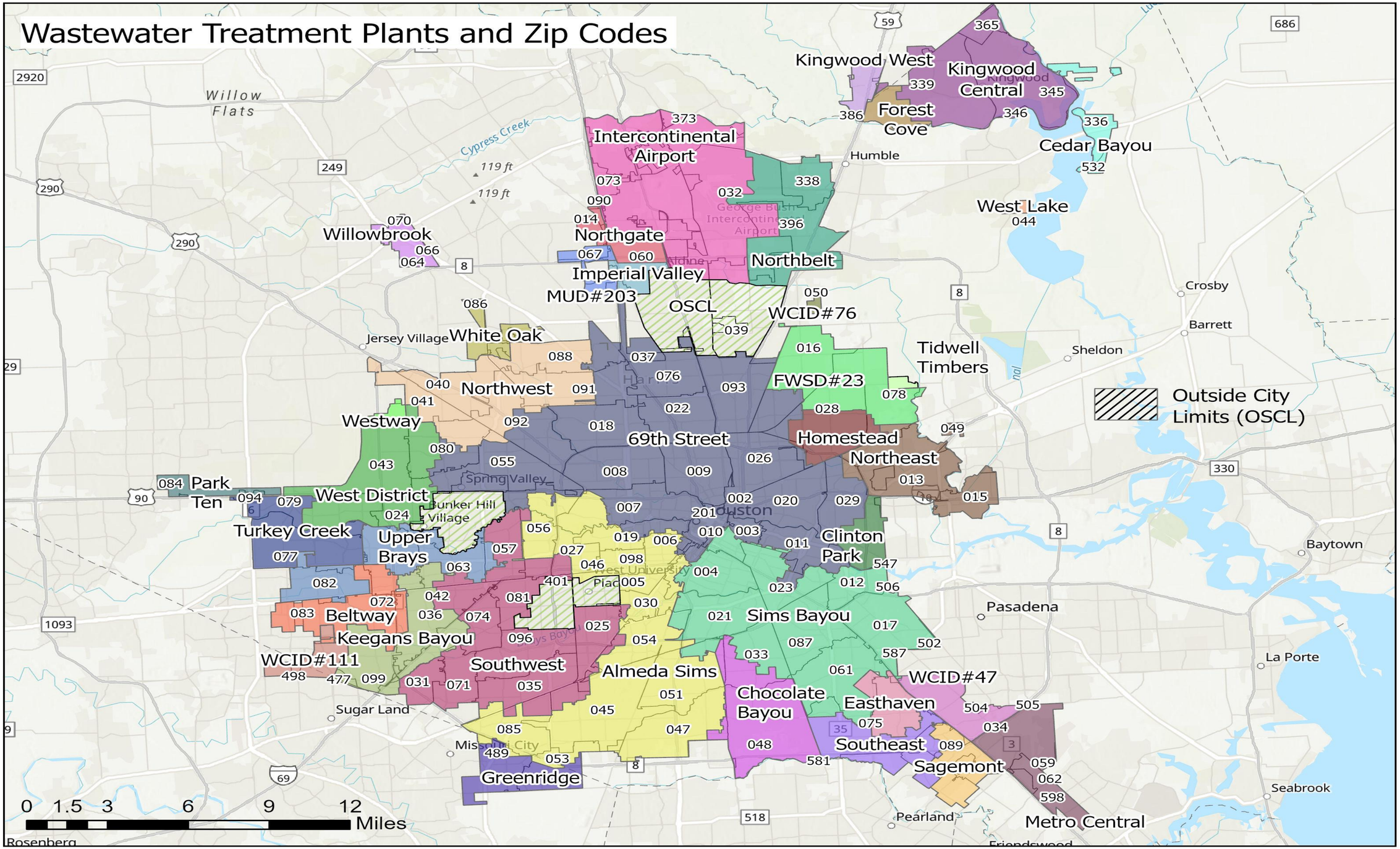
Today's Agenda

- Team
- Introduction
- **Methodology**
- Analysis of results
- Comparison between wastewater and clinical-based positivity rates
- Conclusions

Monitoring 39 Sewersheds Across Houston

HOUSTON HEALTH DEPARTMENT

- 39 wastewater treatment plants
  - 2.1 million people
  - 670 square miles
- Once per week
- 24-hour composite samples of influent


Wastewater Treatment Plants and Zip Codes
Kingwood West
Kingwood Central
Forest Cove
Cedar Bayou
Intercontinental Airport
Northgate
Willowbrook
Northbelt
Imperial Valley
MUD#203
OSCL
WCID#76
White Oak
Jersey Village
Northwest
Westway
69th Street
FWSD#23
Tidwell Timbers
Homestead
Northeast
Park Ten
West District
Spring Valley
Bunker Hill Village
Houston
Turkey Creek
Upper Brays
Clinton Park
Beltway
Keegans Bayou
Sims Bayou
Pasadena
WCID#111
Southwest
Almeda Sims
Chocolate Bayou
Easthaven
WCID#47
Southeast
Sagemont
Greenridge
Metro Central
West Lake
Crosby
Barrett
Sheldon
Baytown
La Porte
Seabrook
Pearland
Sugar Land
Humble
Outside City Limits (OSCL)
0 1.5 3 6 9 12
Miles

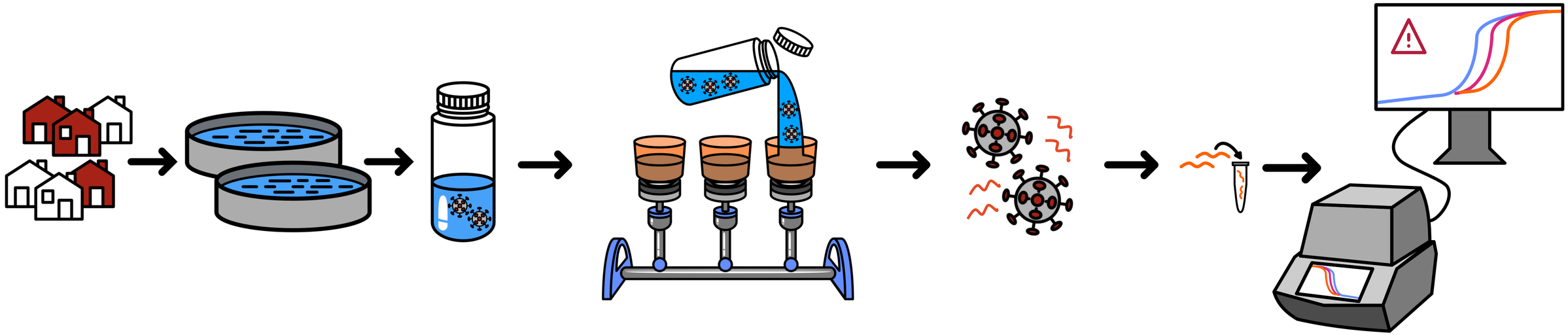
Monitoring Manholes and Lift Stations

HOUSTON HEALTH DEPARTMENT

- Sensitive locations:
  - Congregant living centers
- New locations will be monitored in October:
  - Long-term care facilities
  - Segmenting large areas

Quantification Methods

HOUSTON HEALTH DEPARTMENT



24 hr. composite samples of influent from wastewater treatment plants/manholes/lift stations

Concentration of virus using adsorption to filters

Extraction and purification of viral genomes

Quantification of viral genomes

Today's Agenda

- Team
- Introduction
- Methodology
- **Analysis of results**
- Comparison between wastewater and clinical-based positivity rates
- Conclusions

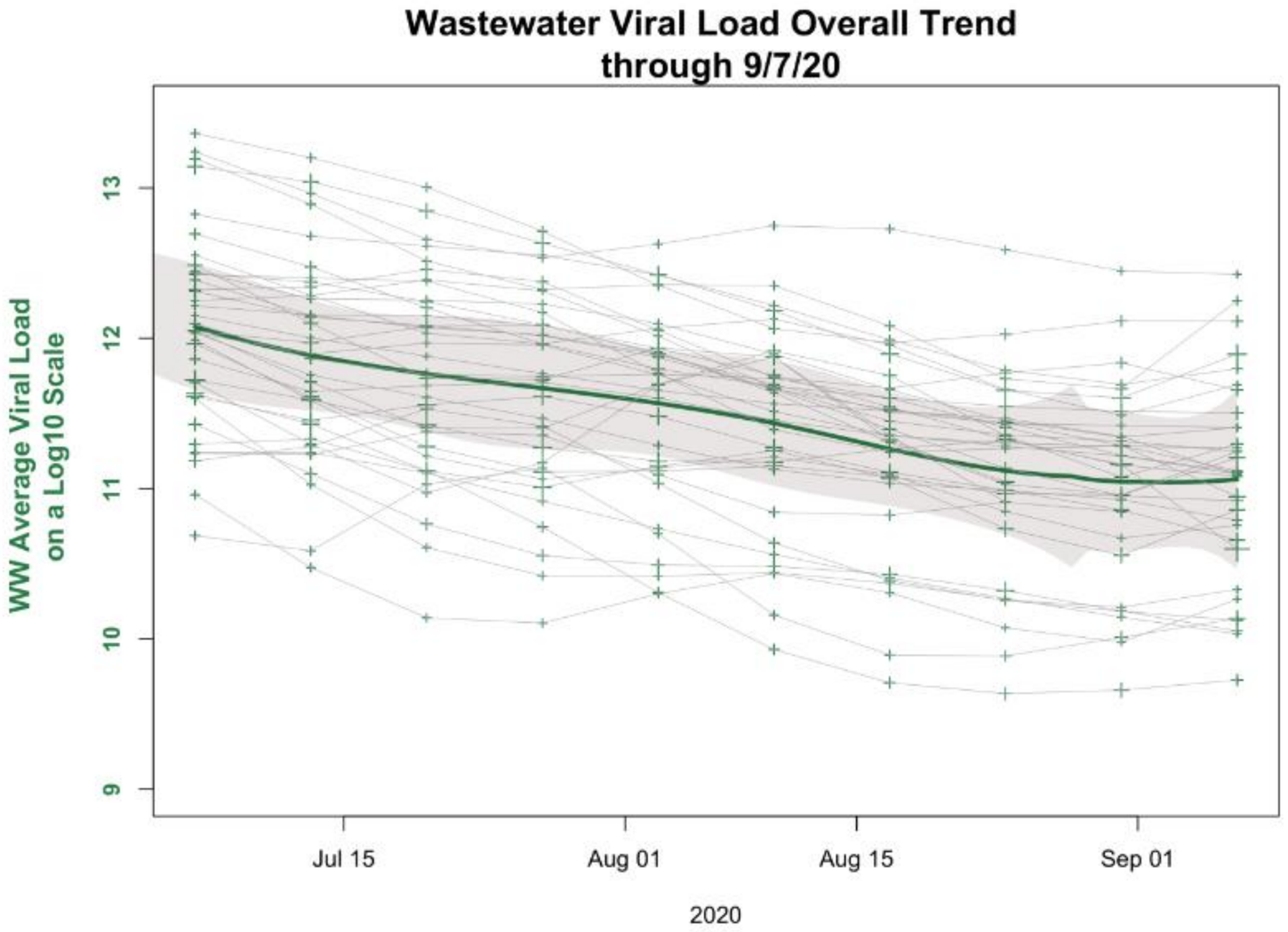
Statistical analysis

Data collected every week:

- Two laboratories (Rice and BCM)
- Results from triplicate samples
- Two different primers N1 and N2 (12 readings total)
- Exact flow rates from each WWTP
- Population (manholes)

Overall Trend

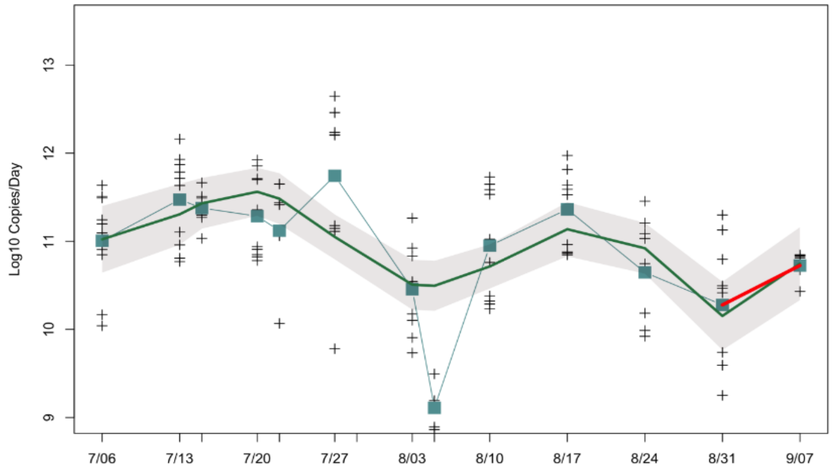
HOUSTON HEALTH DEPARTMENT



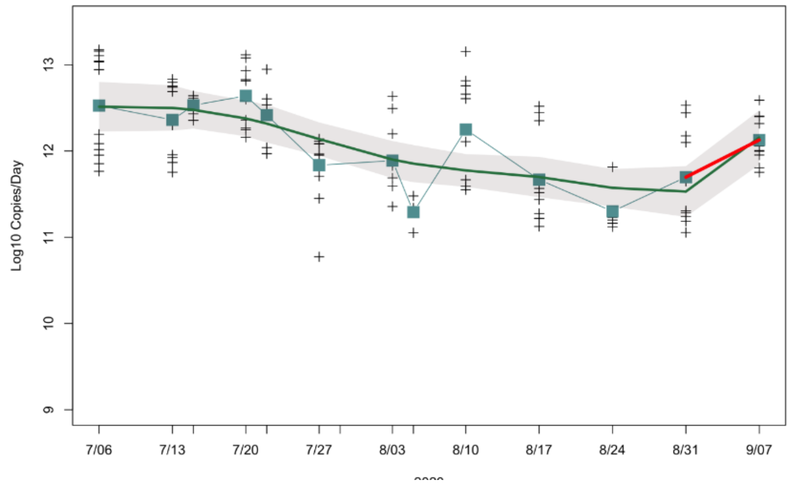
Individual WWTP Trend

HOUSTON HEALTH DEPARTMENT

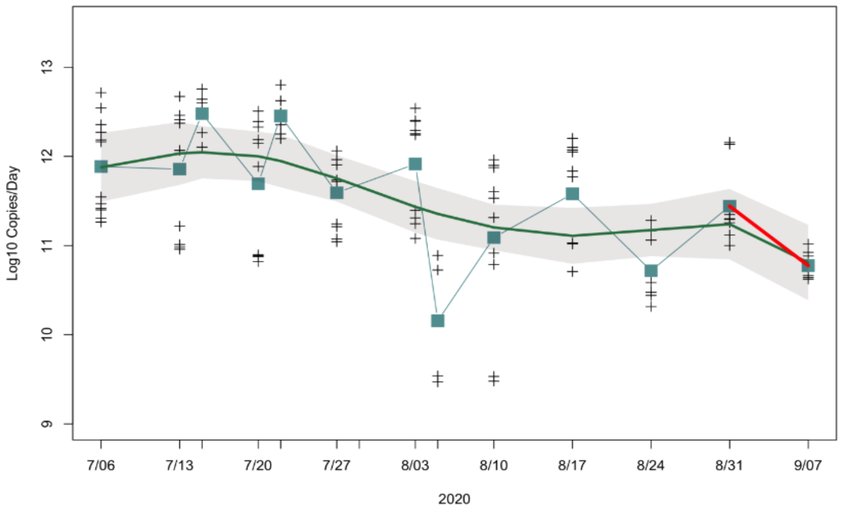
HOMESTEAD



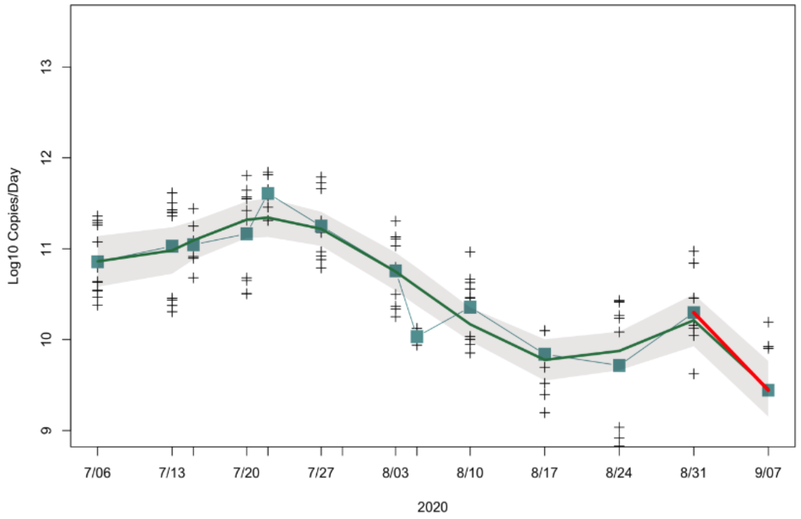
NORTHWEST



GREENRIDGE

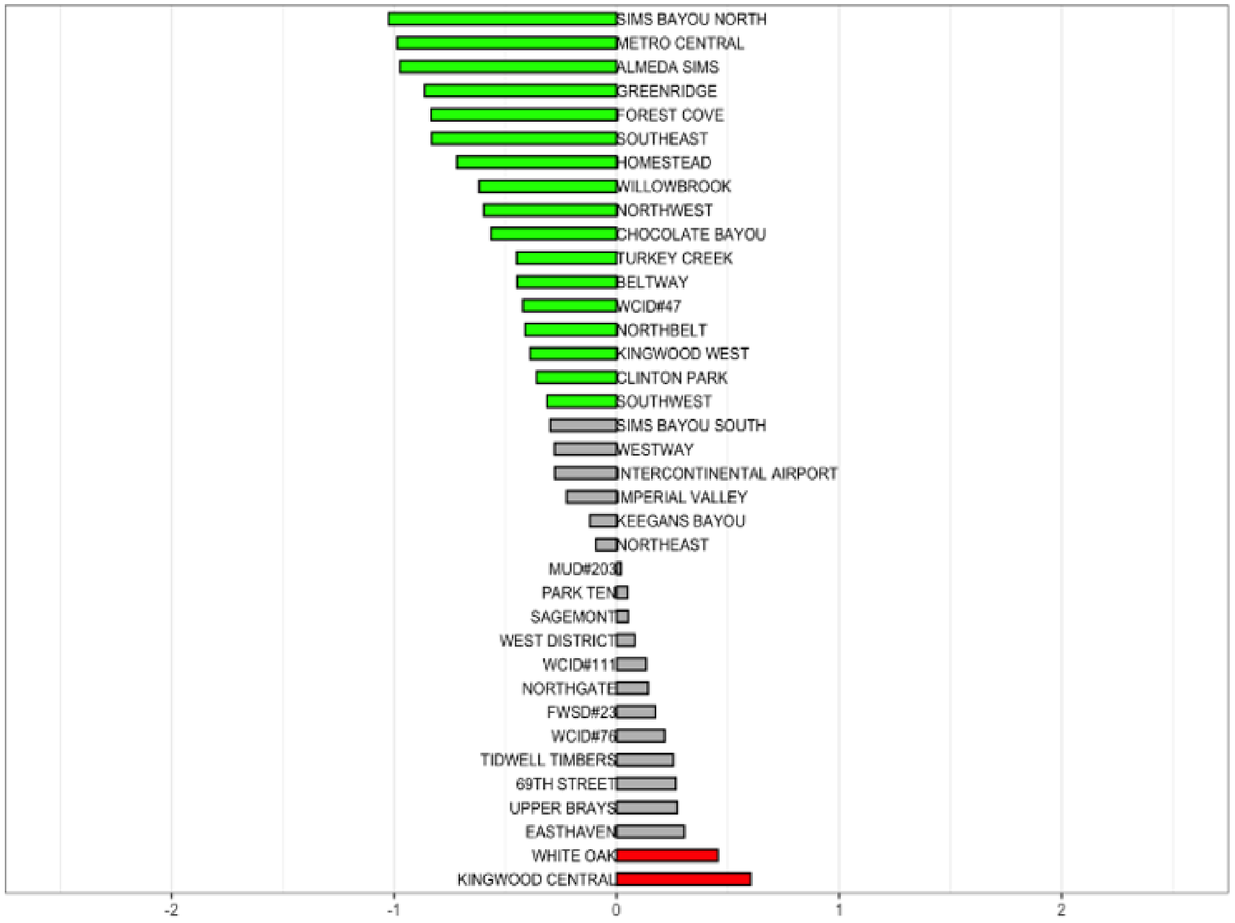


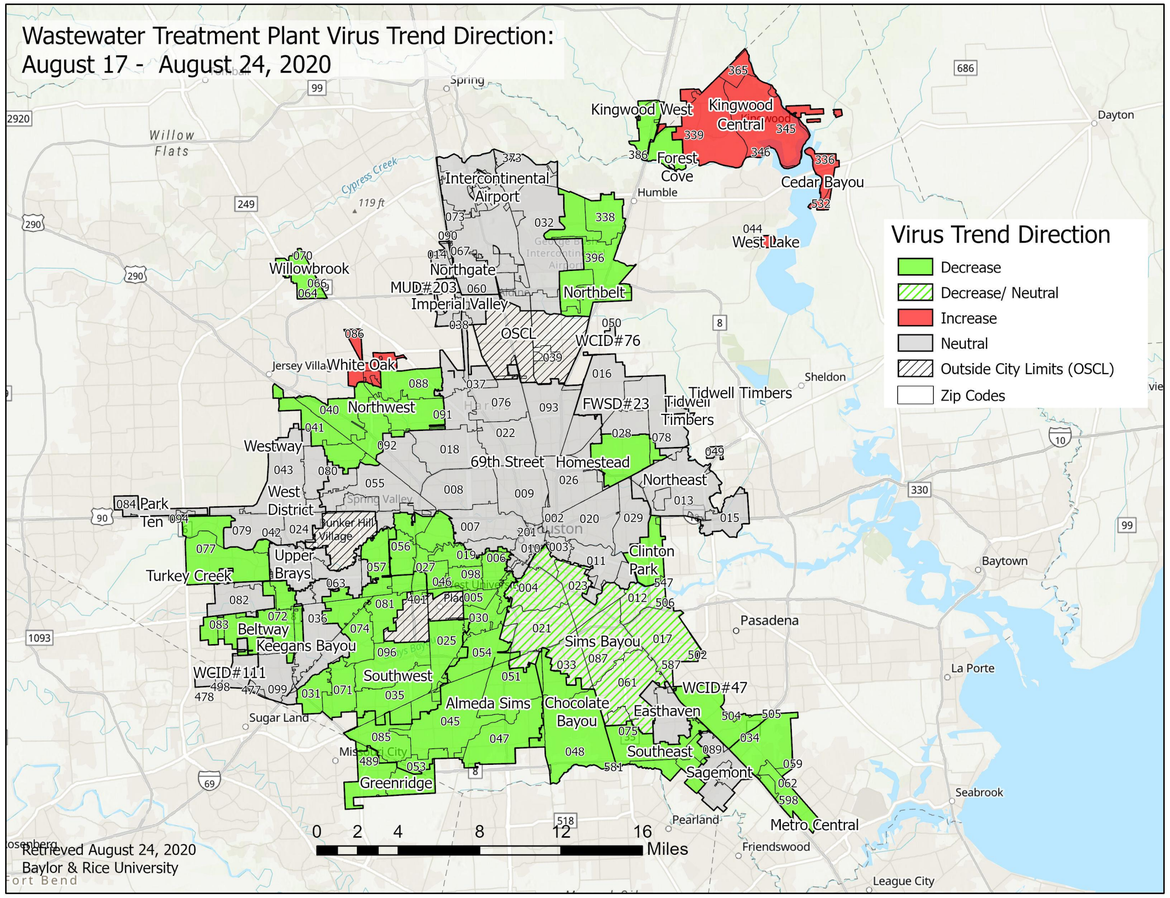
WCID#76



Virus load trend direction: 8/17 to 8/24

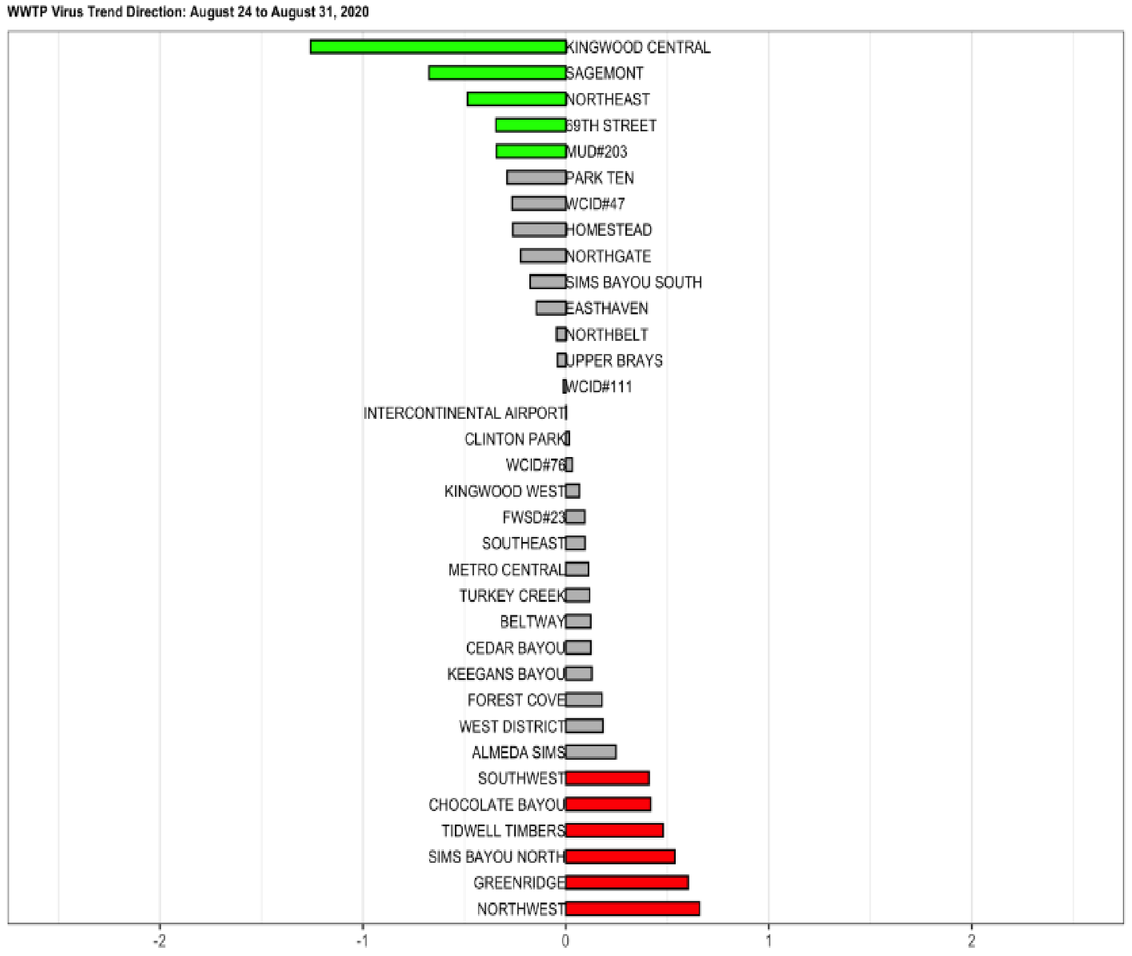
HOUSTON HEALTH DEPARTMENT

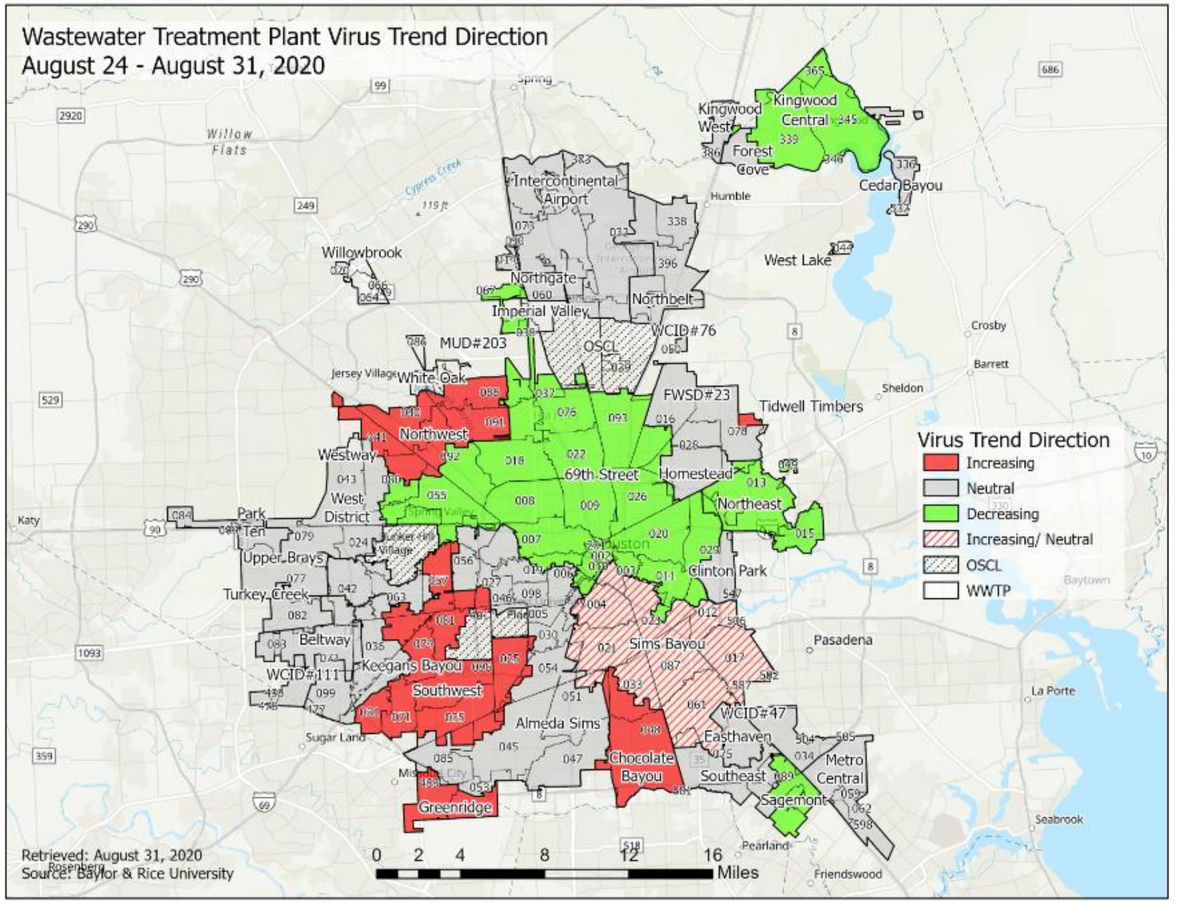




Virus load trend direction: 8/24 to 8/31

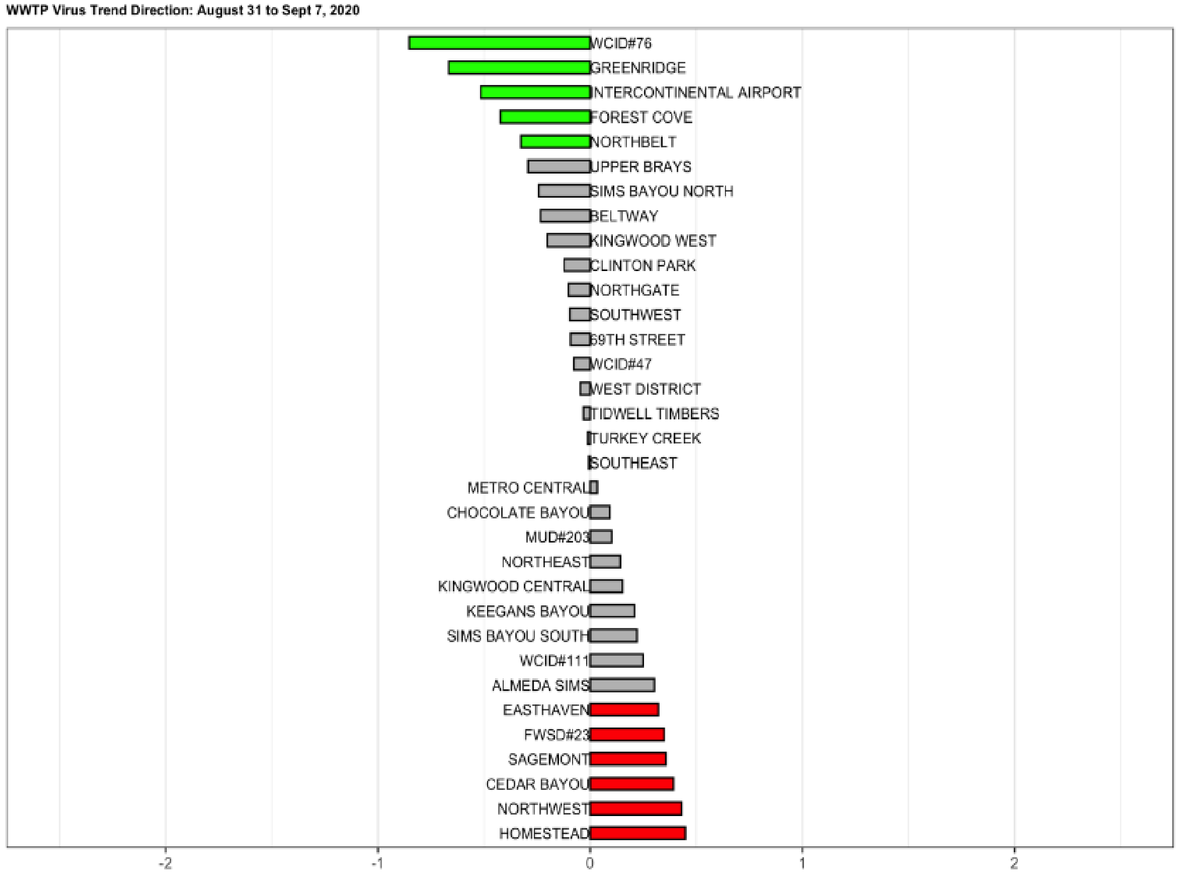
HOUSTON HEALTH DEPARTMENT

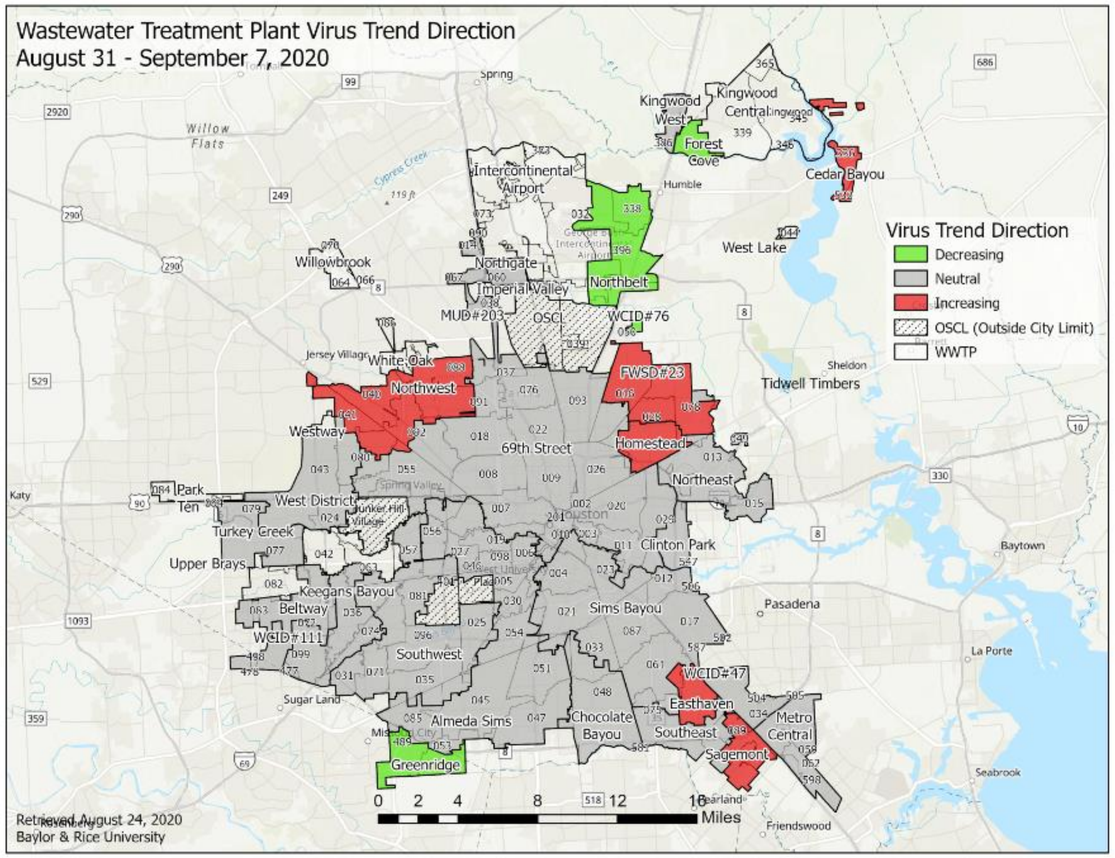




Virus load trend direction: 8/31 to 9/07

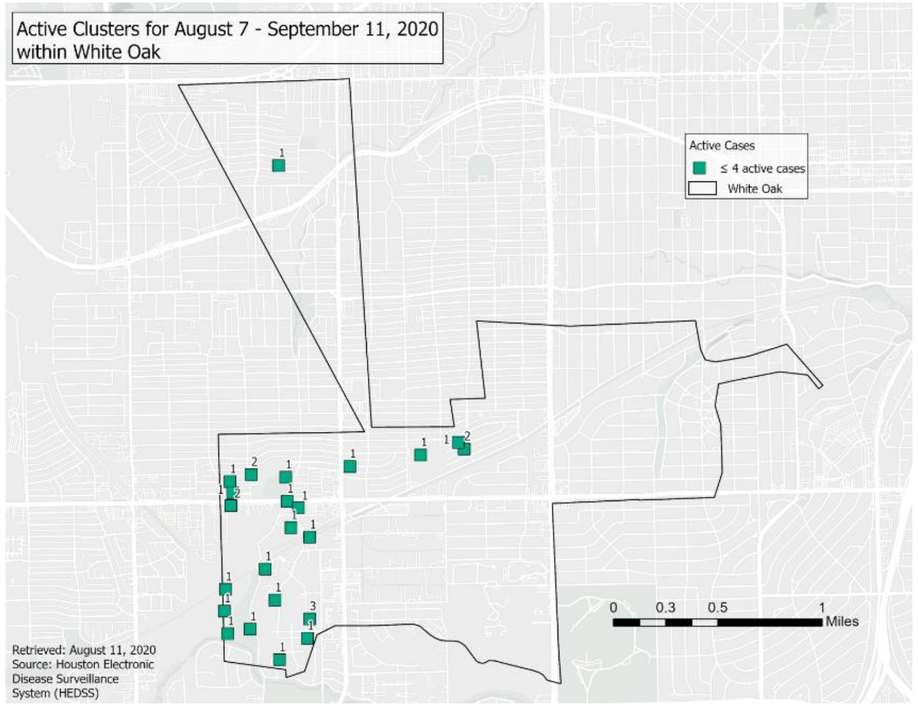
HOUSTON HEALTH DEPARTMENT

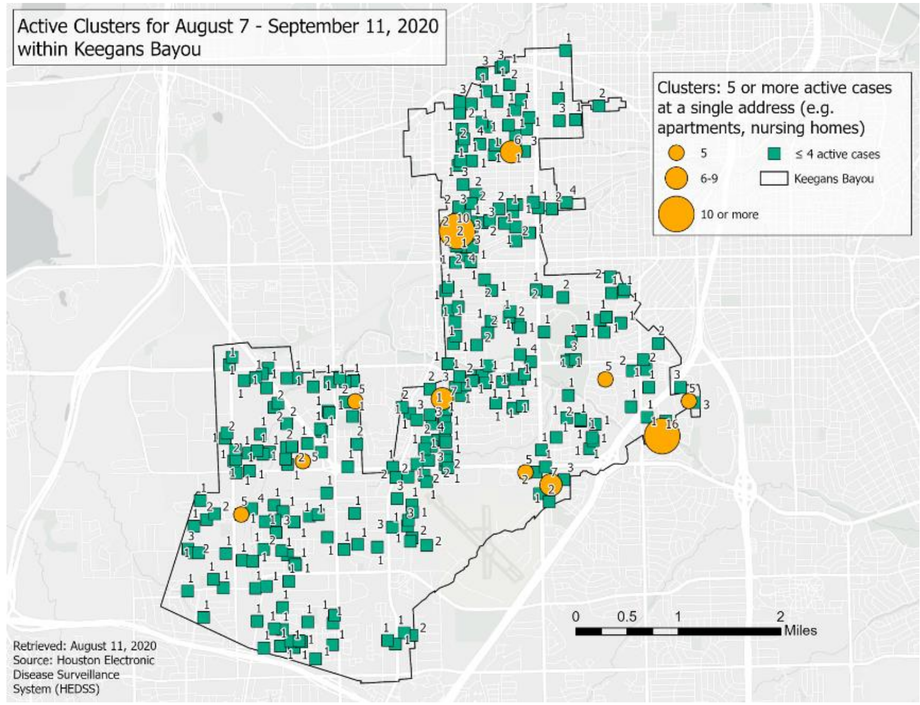




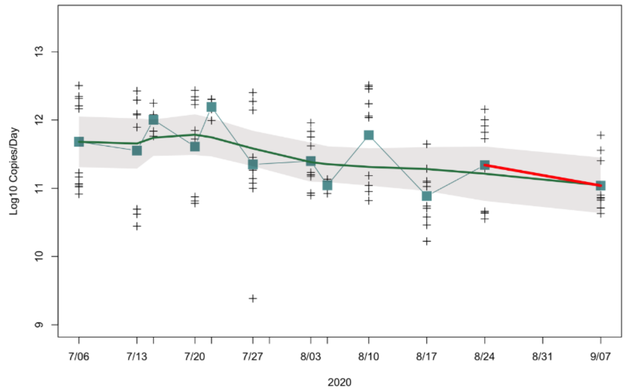
Examples of use of WWTP trend at zip code cluster

HOUSTON HEALTH DEPARTMENT

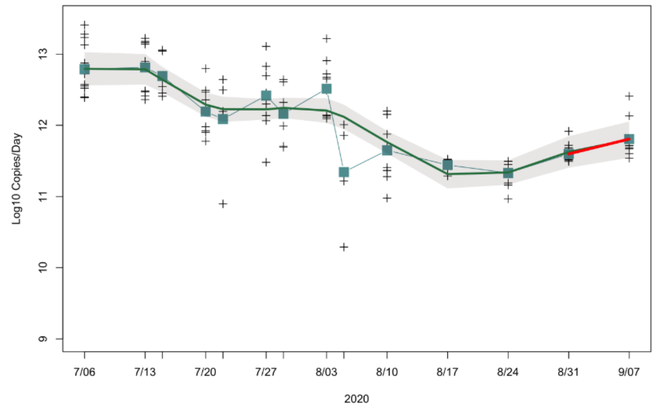




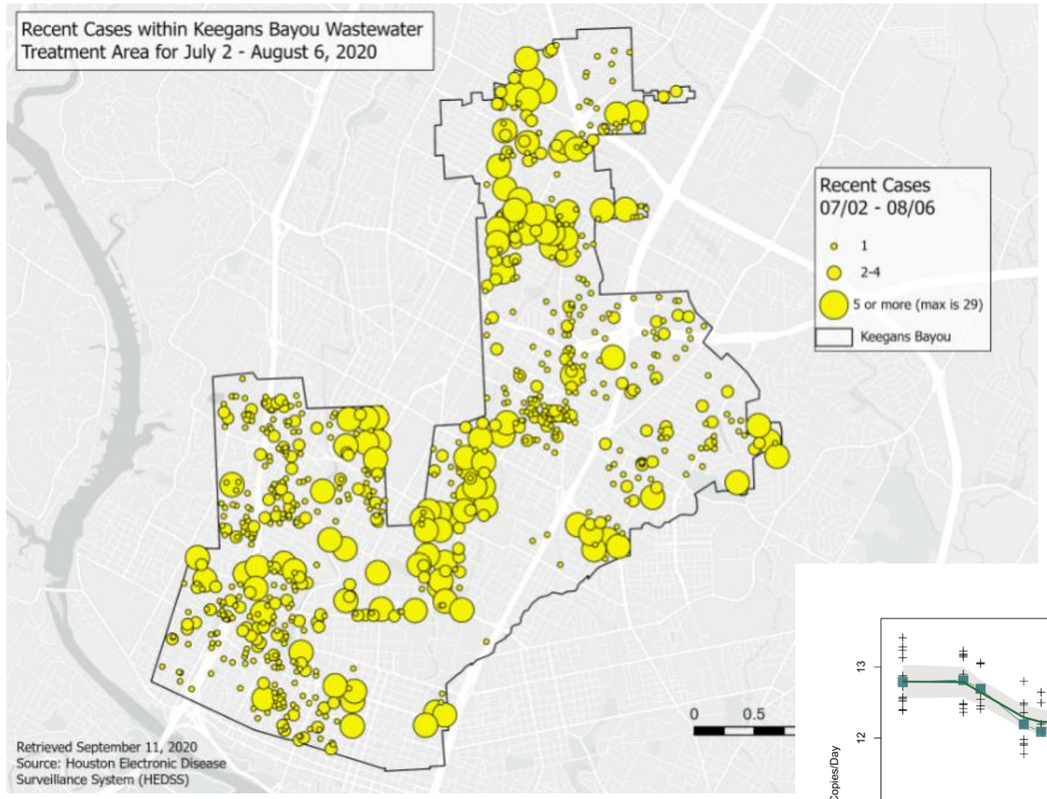
WHITE OAK



KEEGANS BAYOU

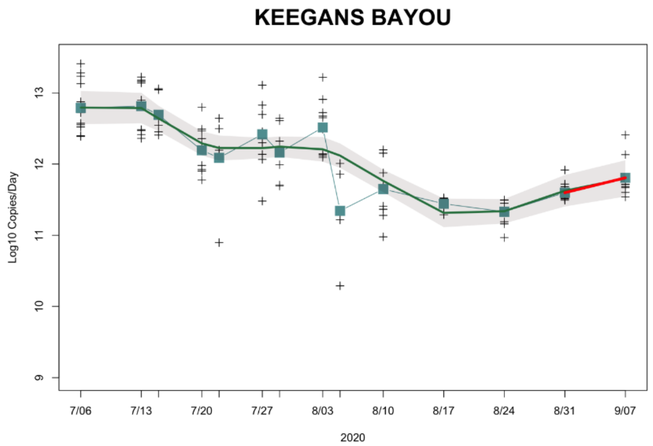


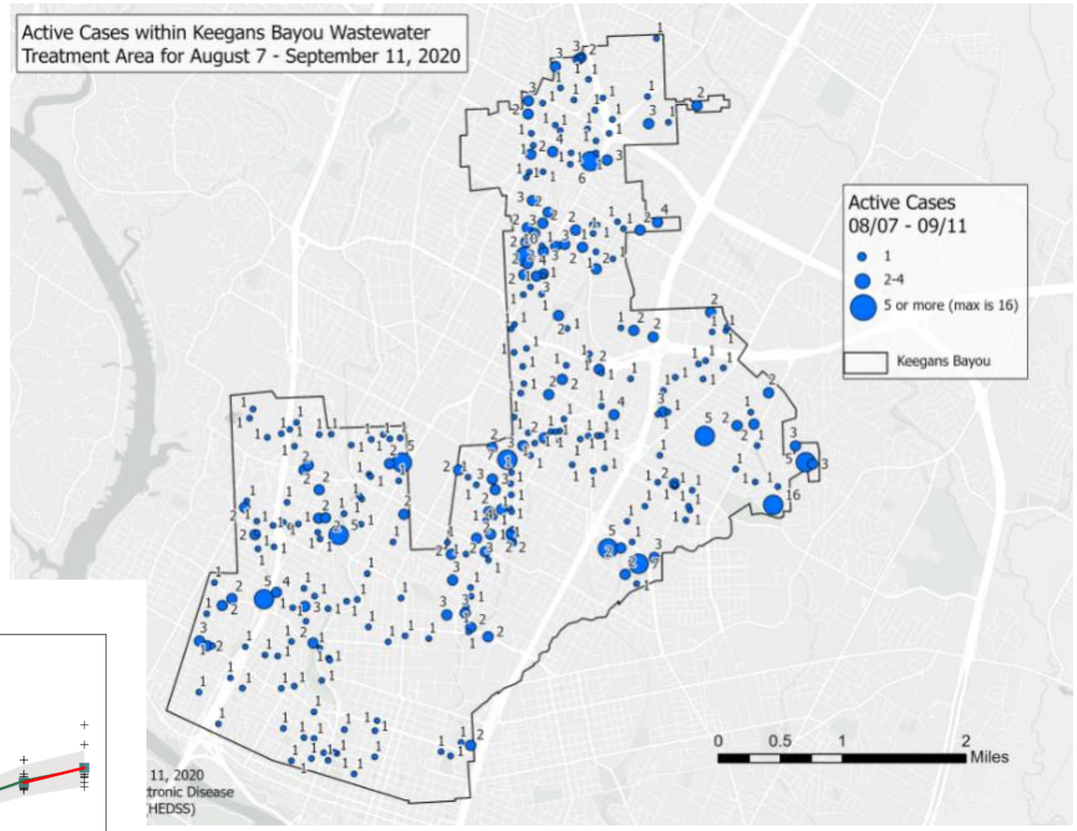
Examples of use of WWTP trend at zip code cluster



Recent: 1,800

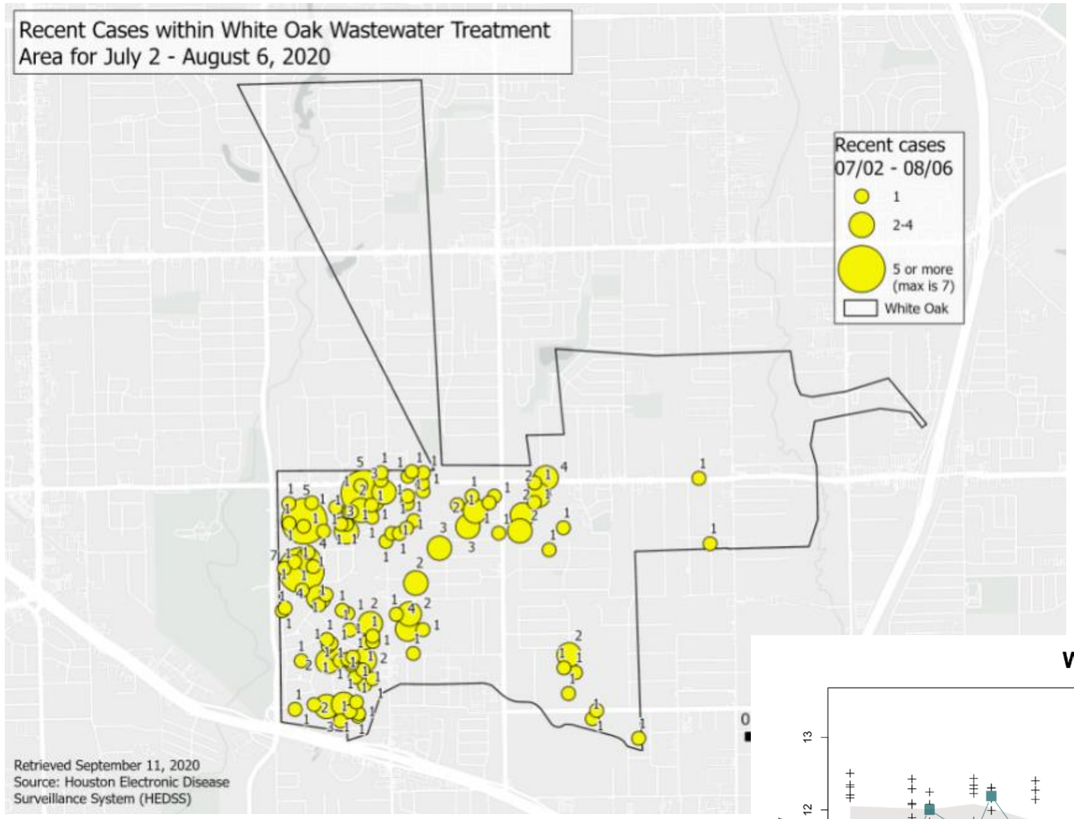
Active: 473

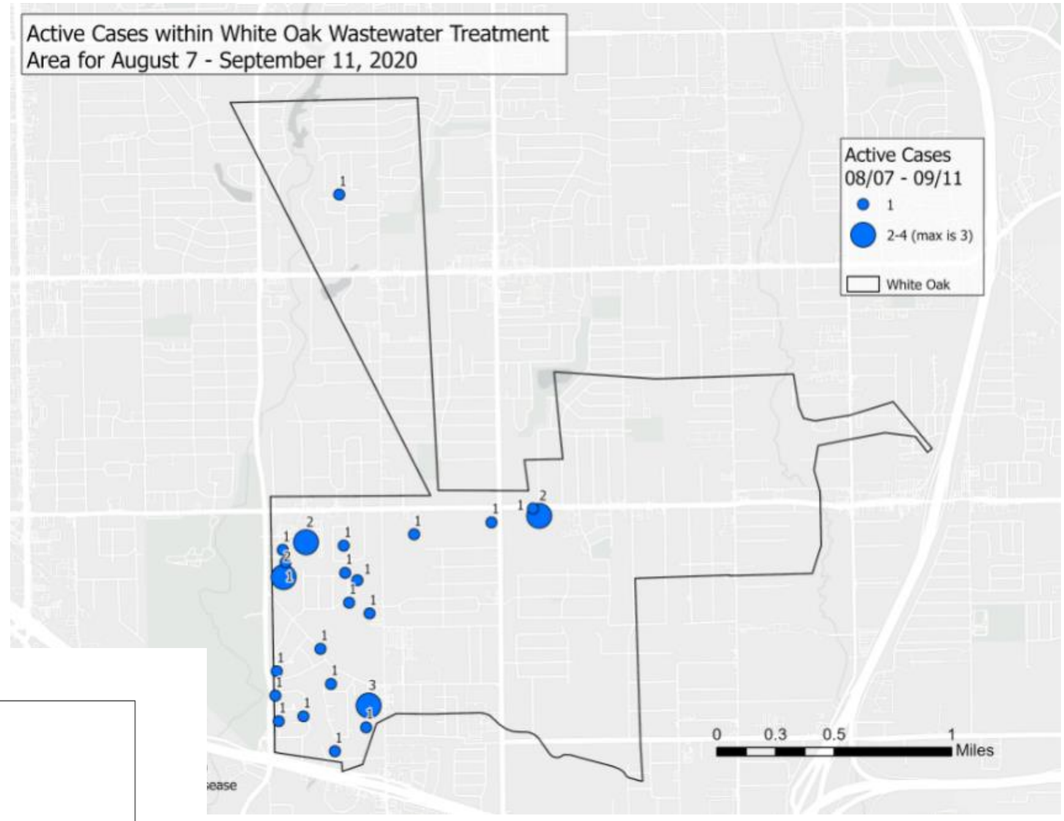


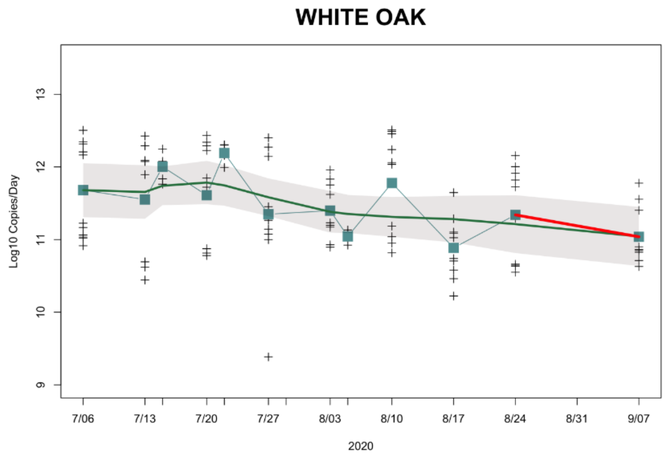


Locations jittered to de-identify

Examples of use of WWTP trend at zip code cluster





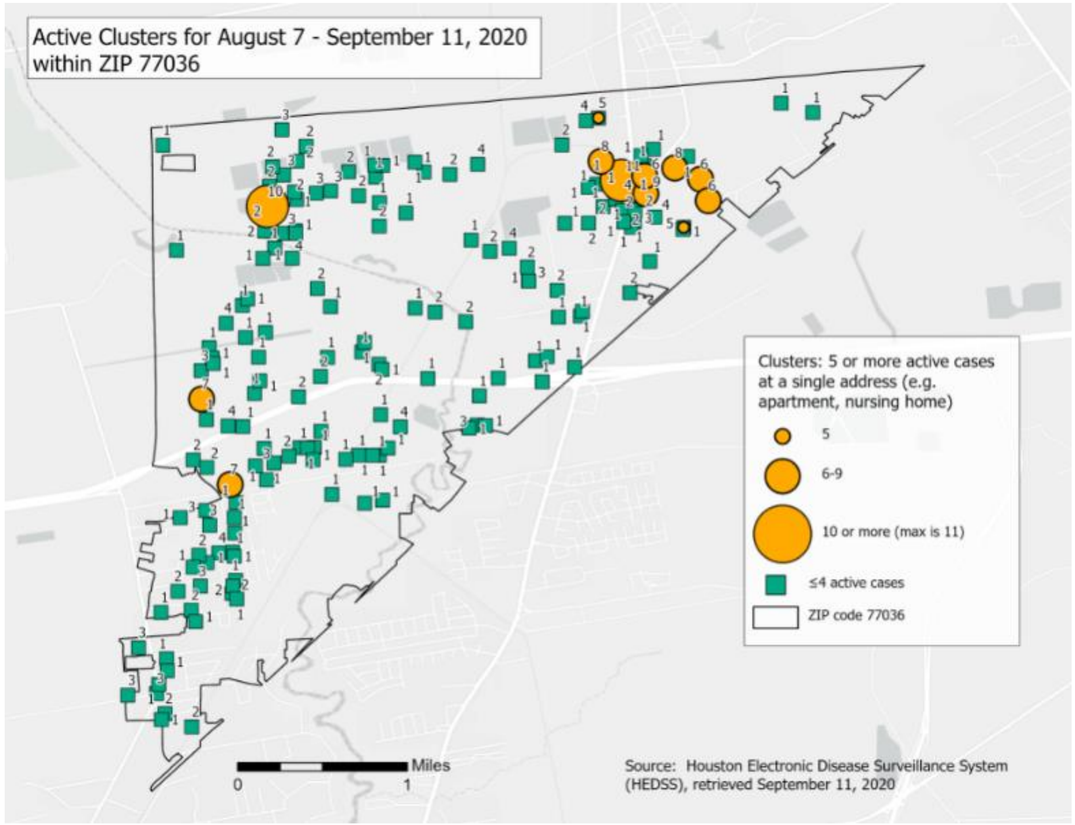


Recent: 156

Active: 28

Locations jittered to de-identify

ZIP code 77036



Locations jittered to de-identify

Segmenting large areas:

Soon HHD will be sub-sampling three lift stations within the same zip code.

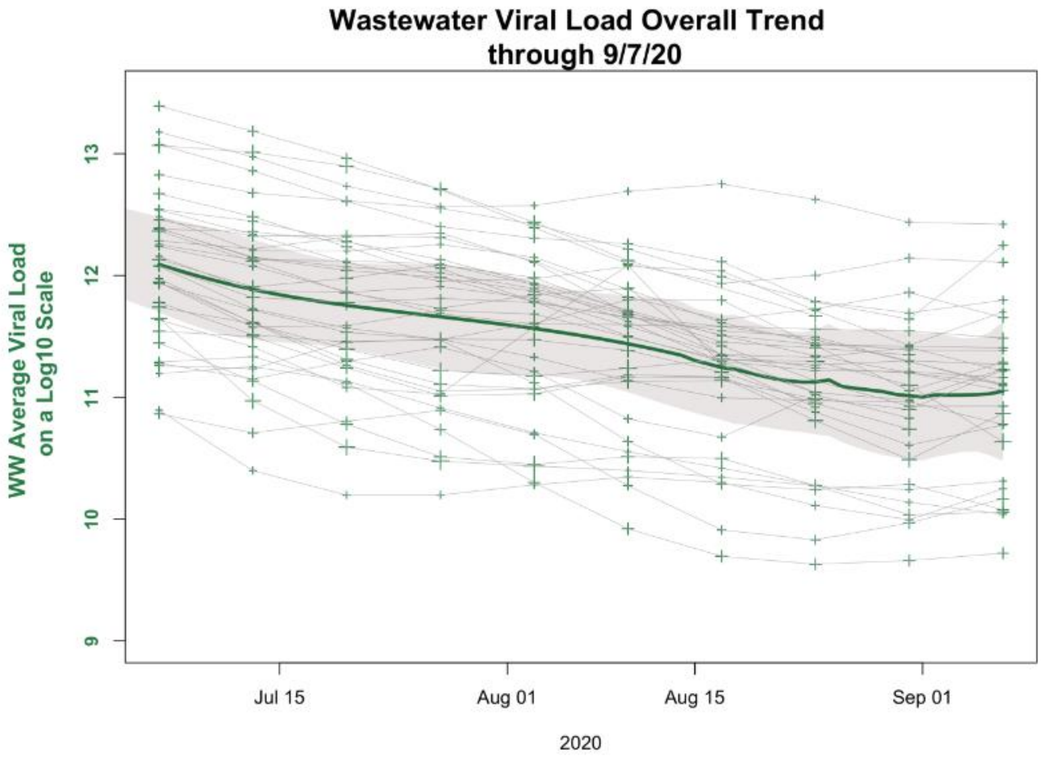
Today's Agenda

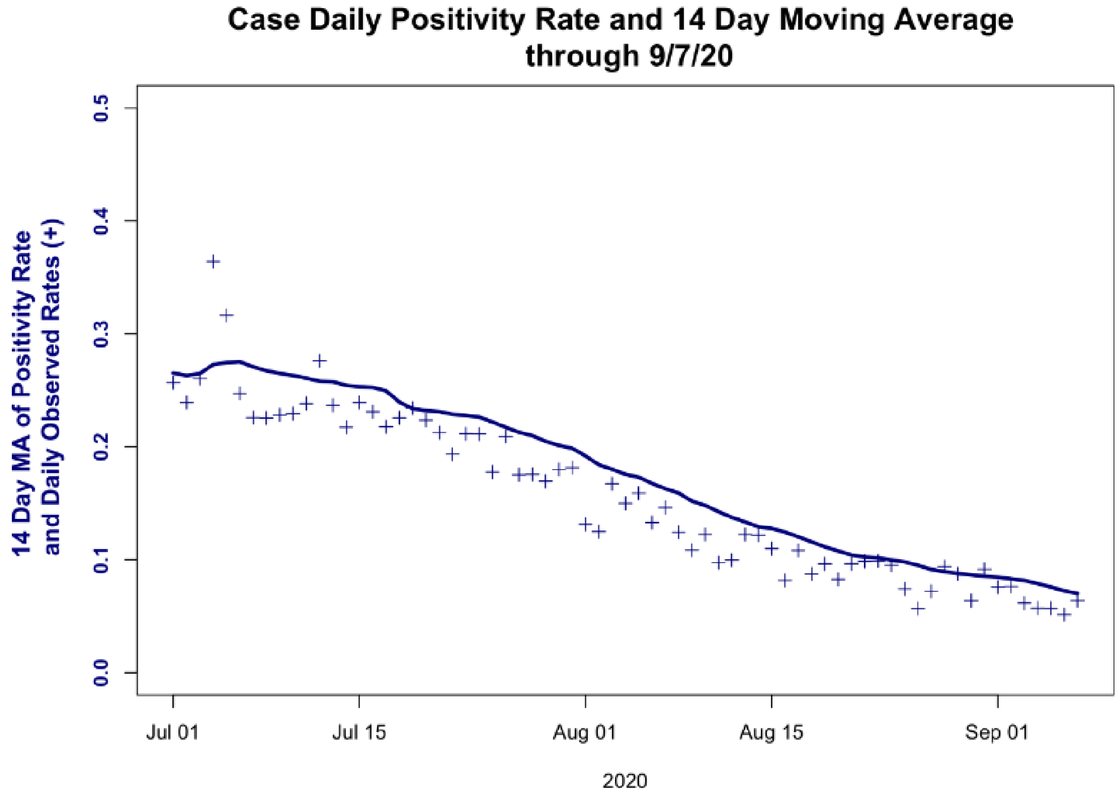
HOUSTON HEALTH DEPARTMENT

- Team
- Introduction
- Methodology
- Analysis of results
- **Comparison between wastewater and clinical-based positivity rates**
- Conclusions

WWTP comparison to clinical positivity rates

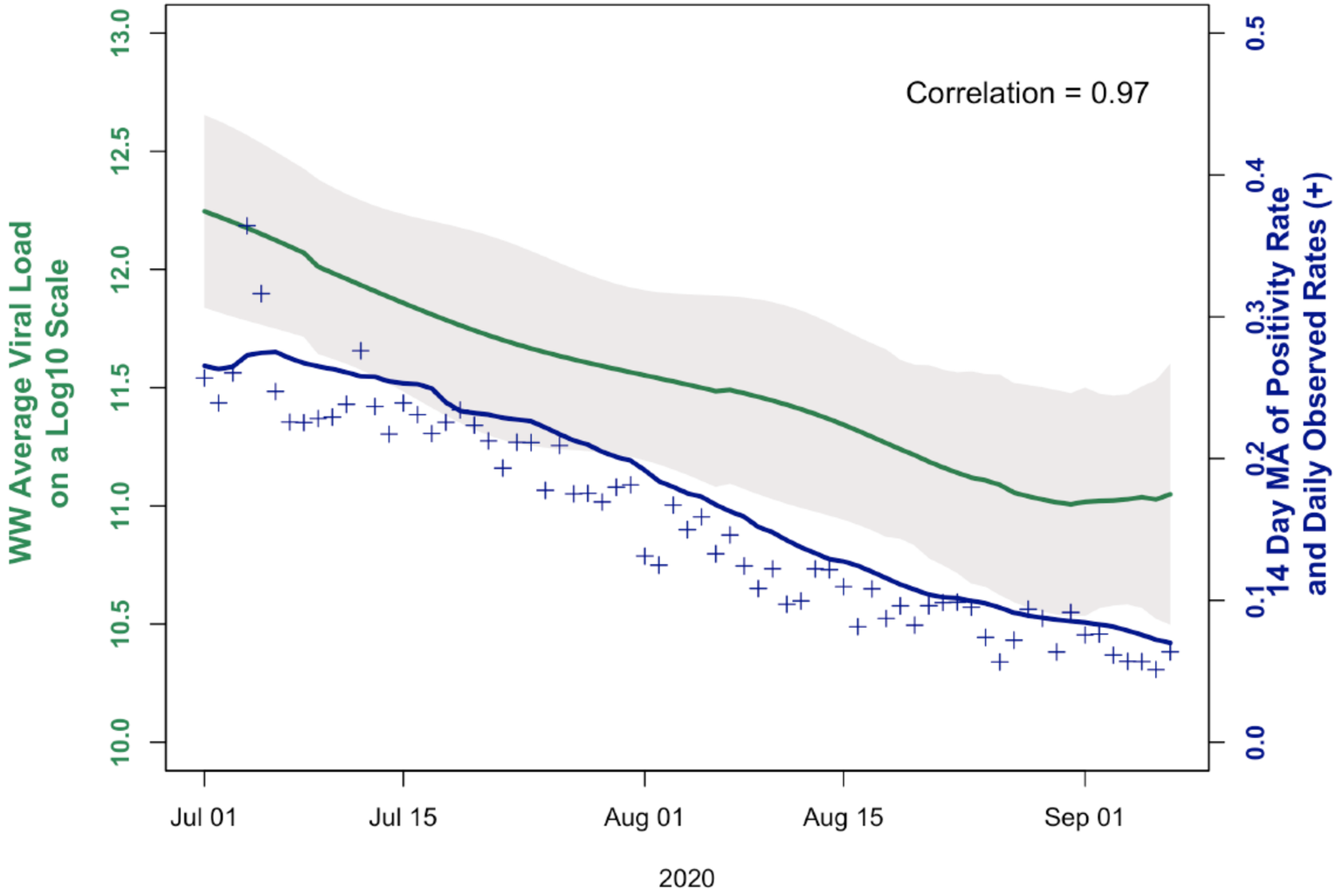
HOUSTON HEALTH DEPARTMENT

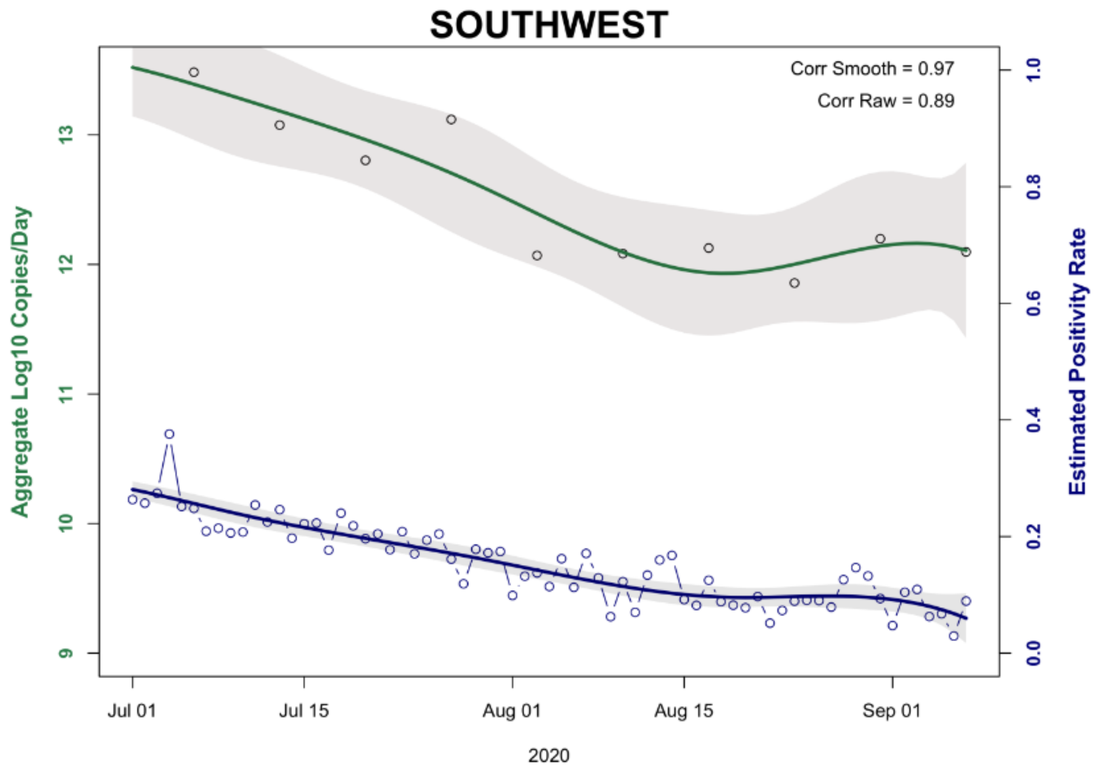


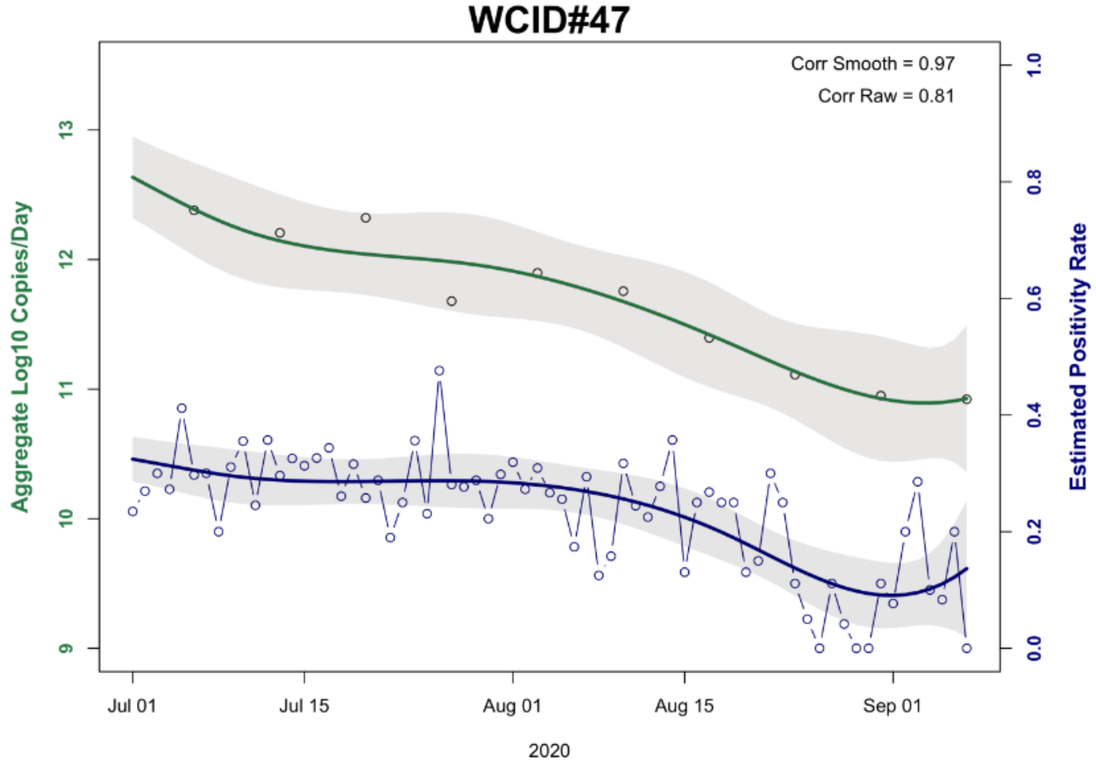


HOUSTON HEALTH DEPARTMENT

Wastewater Viral Load Trend and Clinical Positivity Rate through 9/7/20



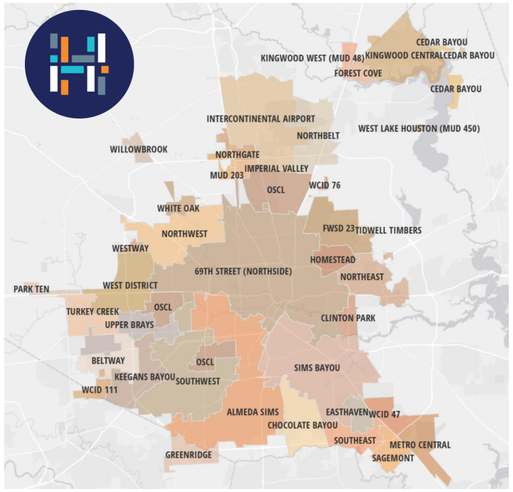

SOUTHWEST
Corr Smooth = 0.97
Corr Raw = 0.89
Aggregate Log10 Copies/Day
Estimated Positivity Rate
9
10
11
12
13
0.0
0.2
0.4
0.6
0.8
1.0
Jul 01
Jul 15
Aug 01
Aug 15
Sep 01
2020


WCID#47
Corr Smooth = 0.97
Corr Raw = 0.81
Aggregate Log10 Copies/Day
Estimated Positivity Rate
9
10
11
12
13
0.0
0.2
0.4
0.6
0.8
1.0
Jul 01
Jul 15
Aug 01
Aug 15
Sep 01
2020

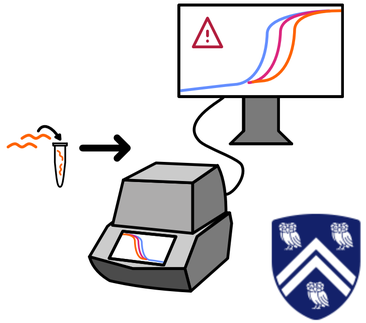
Today's Agenda

- Team
- Introduction
- Methodology
- Analysis of results
- Comparison between wastewater and clinical-based positivity rates
- **Conclusions**

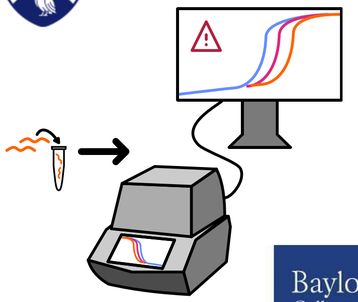
24-hour composite influent samples are collected from 39 wastewater treatment plants each week



Samples are transported to a central laboratory facility and aliquoted into bottles.

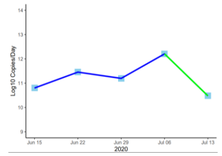


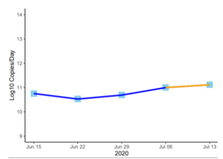
SARS-CoV-2 in quantified in replicate samples in two independent laboratories.

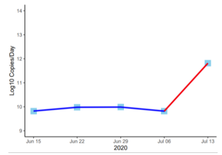


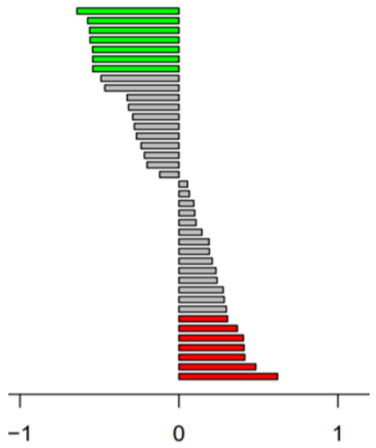
Baylor College of Medicine

Raw data is input into statistical models that identify geographic areas of concern with significant increases in wastewater virus concentration.









Health Department uses wastewater data to inform interventions, including additional testing

Conclusions

- Complements positivity rate to monitor COVID-19 in our communities
- Serves to better target and direct interventions
- Future uses: estimation of prevalence, granular monitoring at schools

Questions?

HOUSTON HEALTH DEPARTMENT