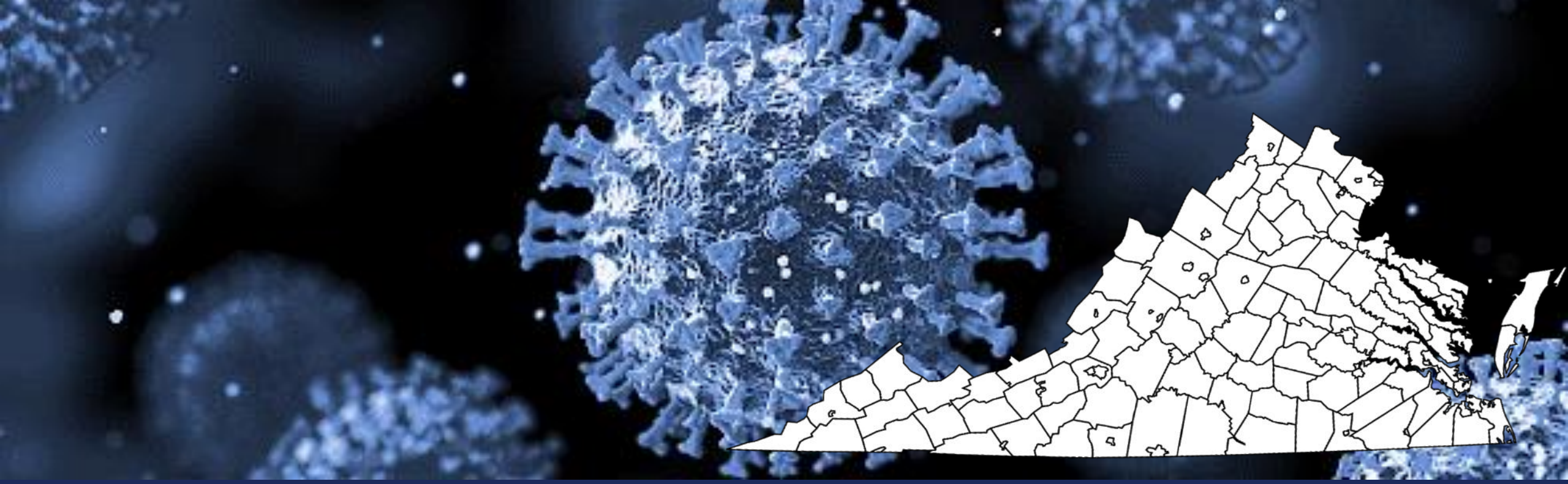

Wastewater Surveillance for COVID-19: Here to Stay?

Marcia Degen, Ph.D., P.E.
Wastewater Surveillance Program
VDH-Office of Environmental Health Services
October 31, 2022

VDH VIRGINIA DEPARTMENT OF HEALTH

Agenda

Onsite Wastewater
Promoting Health & Protecting Our Resources
2022 MEGA-CONFERENCE

NOWRA NAWT SORA Missouri Smallflows Organization

- What is Wastewater Surveillance?
- How does it work?
- National Wastewater Surveillance System (NWSS)
- Review Virginia program & challenges
- Future of Wastewater Surveillance – Here to Stay?

The materials being presented represent the opinions of the presenter and do NOT reflect the opinions of NOWRA.

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Protecting You and Your Environment

HEALTH CARE

CDC wants to monitor poop: States aren't all on board

PUBLIC HEALTH

Colorado is moving toward statewide coverage of wastewater surveillance

April 6, 2022 · 5:11 AM ET
Heard on Morning Edition

NEWS | 10 May 2021

The myriad ways sewage surveillance is helping fight COVID around the world

Wastewater tracking was used before the pandemic to monitor for polio and illicit drug use, but interest in the field and its applications has now ballooned.

U.S. Sewer Data Warns of a New Bump in Covid Cases After Lull

Data from wastewater can spot a rise in infections before it shows up through positive tests

Wastewater Surveillance

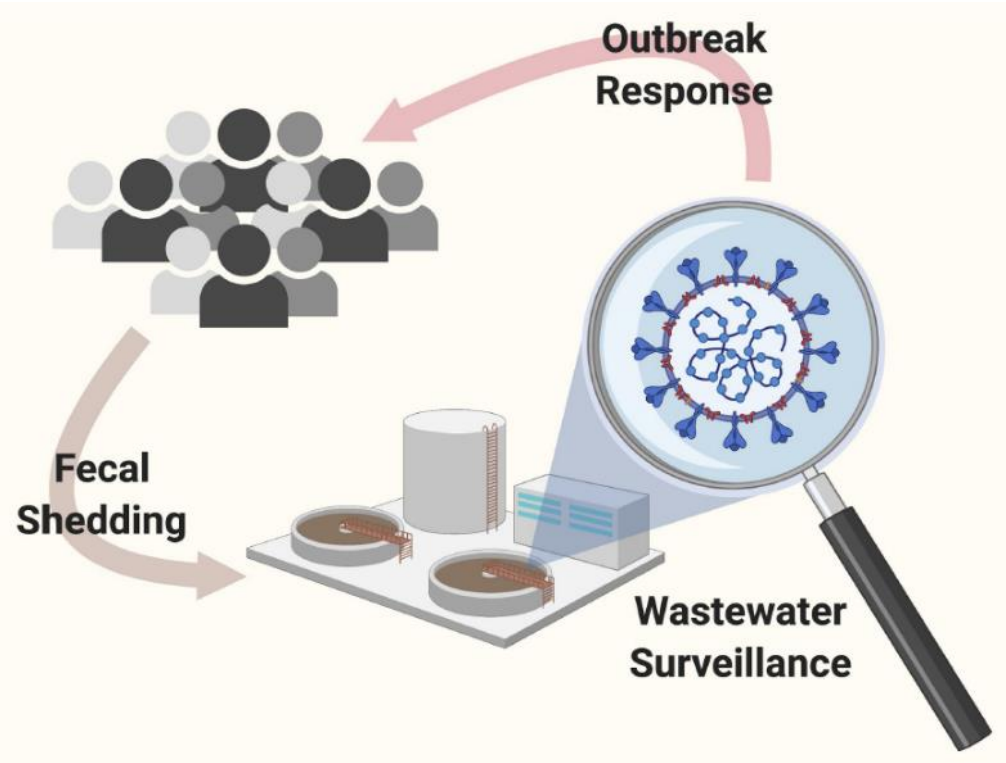
Wastewater Based Epidemiology (WBE)

Molecular Source Tracking

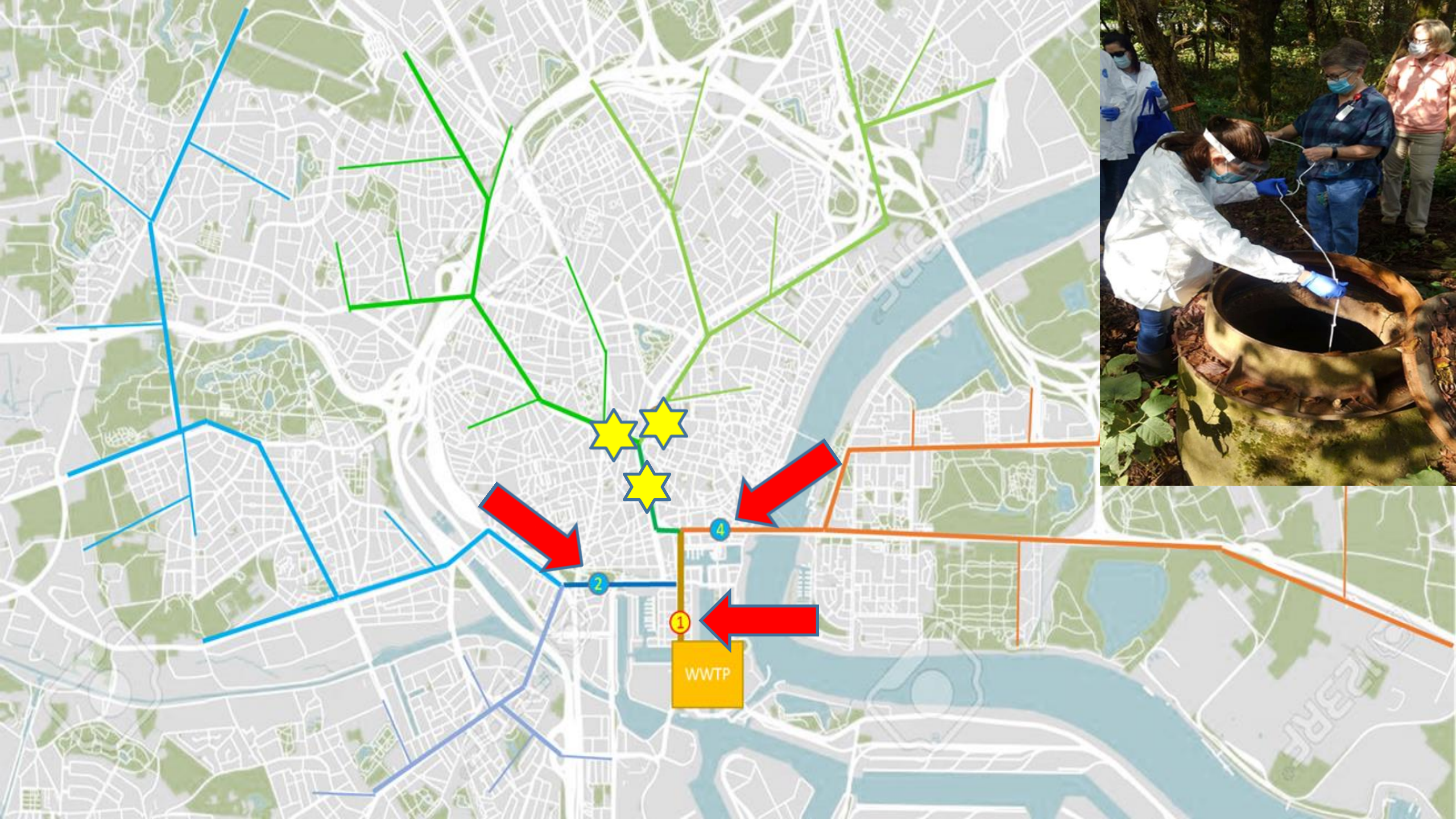
Wastewater epidemiology uses ***markers*** *in raw wastewater to gather data on the population within a wastewater catchment.*

Wastewater Surveillance for SARS-CoV-2

- Infected people shed SARS-CoV-2 genetic material in their feces
  - not infectious in sewage
  - measured in wastewater samples
  - analytical technique called polymerase chain reaction (PCR)
- Can assist with population prevalence
  - sewershed, including neighborhood/institutions



Aaron Bivins et al. Wastewater-Based Epidemiology: Global Collaborative to Maximize Contributions in the Fight Against COVID-19 *Environmental Science & Technology* 2020 *54* (13), 7754-7757

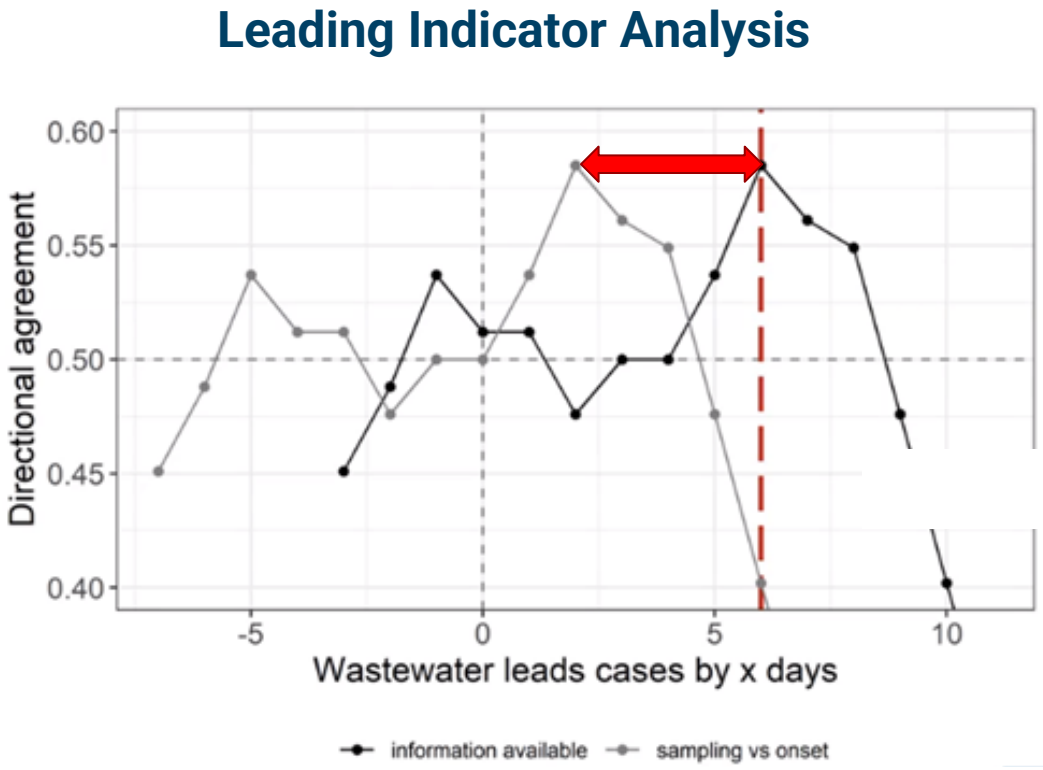

4
2
1
WWTP

Advantages of Wastewater Surveillance

Pooled populations
Captures subclinical infections
Lead time indicator (~1-2 weeks)
Independent of healthcare-seeking behaviors!

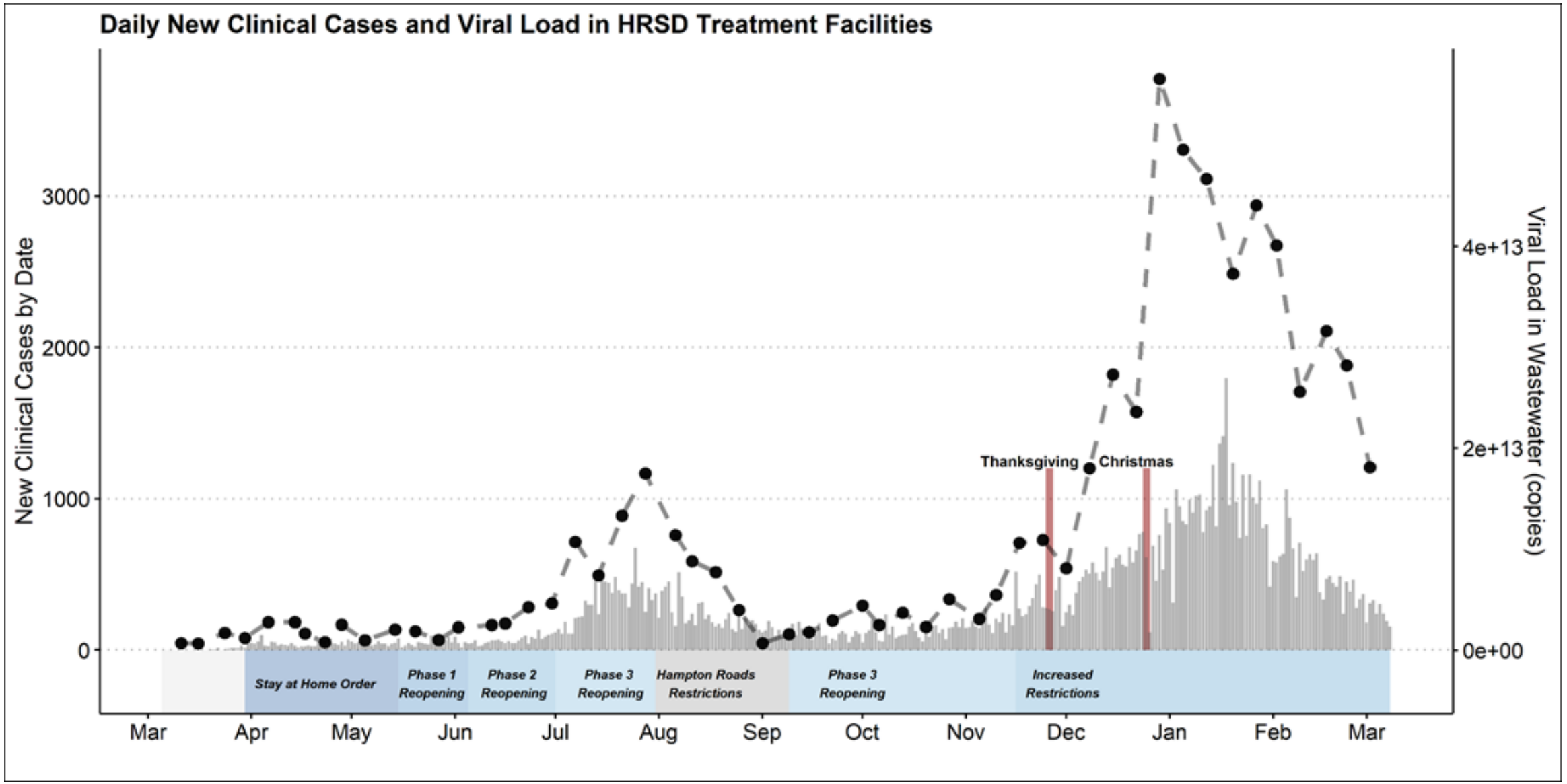
Can Assist in:

Measuring scope of outbreak
Decision support
Anticipating healthcare needs
Early warning



Source: Centers for Disease Control and Prevention

HRSD SARS-CoV-2 Surveillance Data 2020

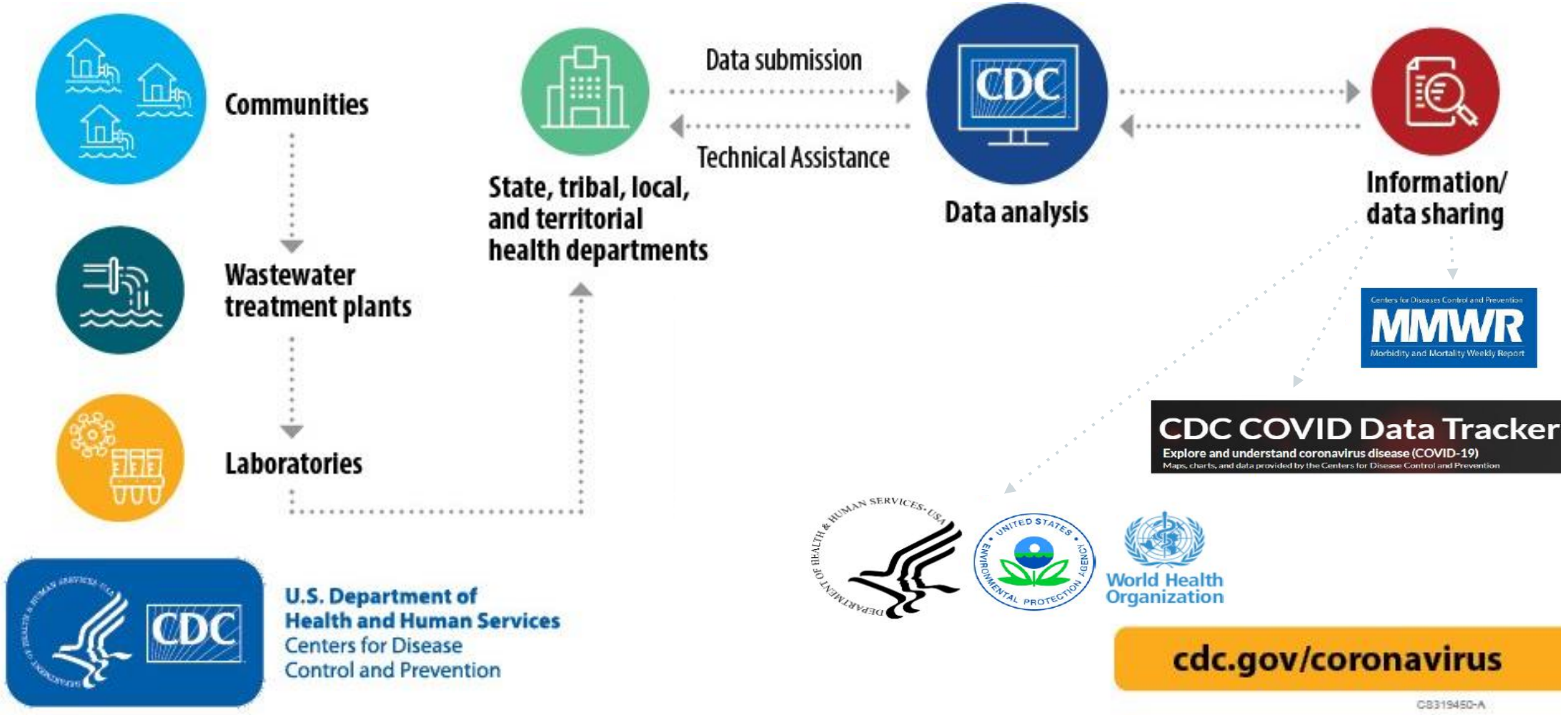


used with permission from Hampton Roads Sanitation District

Uses of Wastewater Surveillance

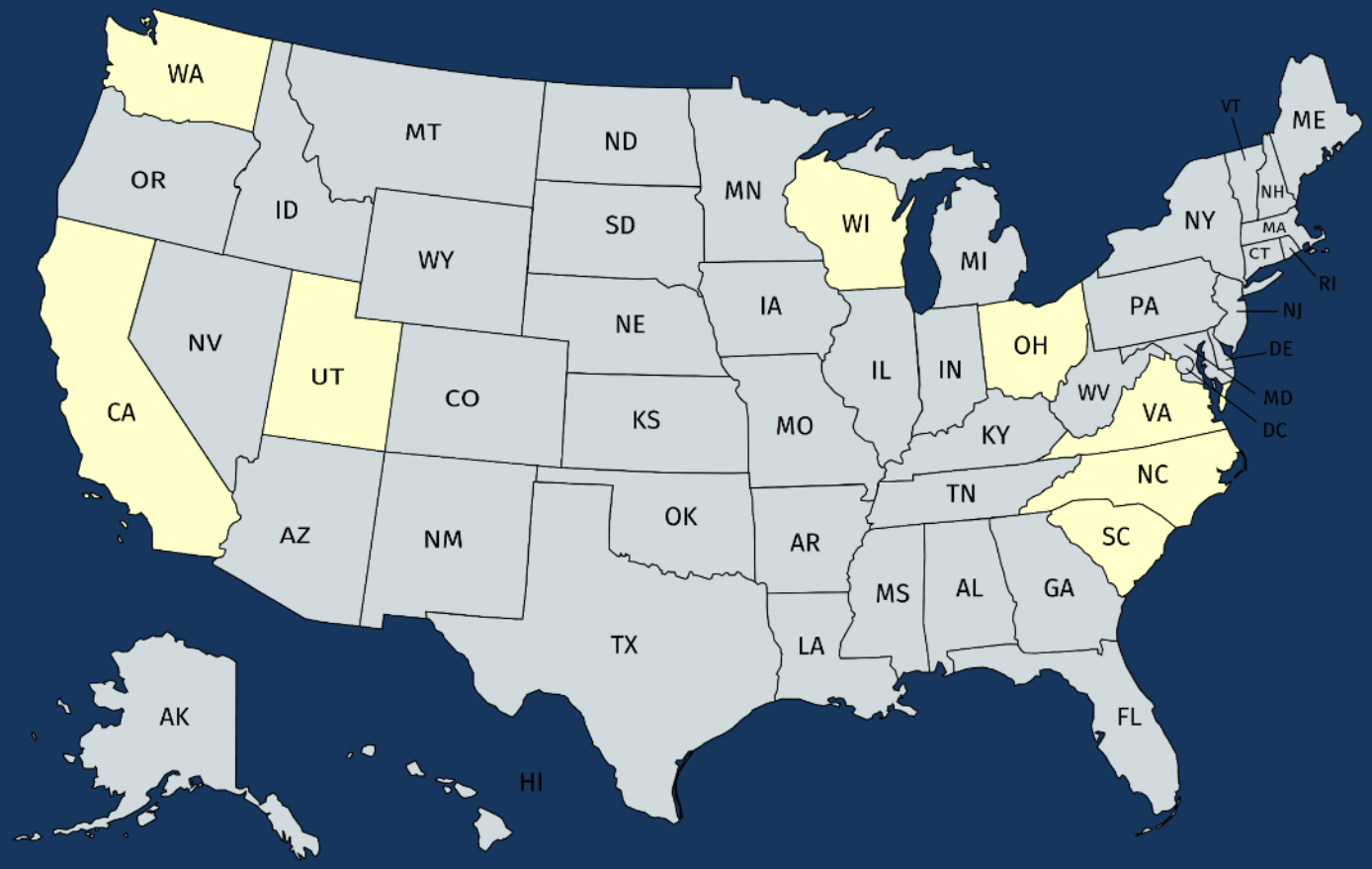
Sentinel	**Local**	**Building Level**
• Screening • Trends • Variants • Broad responses - vaccinations, education	• Subsewershed • Targeted testing & vaccinations • Targeted education • Hotspot tracking	• Initiate testing • Isolate positives • Rapid response

National Wastewater Surveillance System (NWSS)



Early Adopters – Special COVID-19 Project Funded by CDC

- $2.5 Million Awarded to 8 Early Adopter States
  - Washington
  - California
  - Utah
  - Wisconsin
  - Ohio
  - North Carolina
  - South Carolina
  - Virginia $300,000



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CDC Project has Three Goals

Data Collection

- High-Quality
- Standardized
- Centralized via NWSS platform

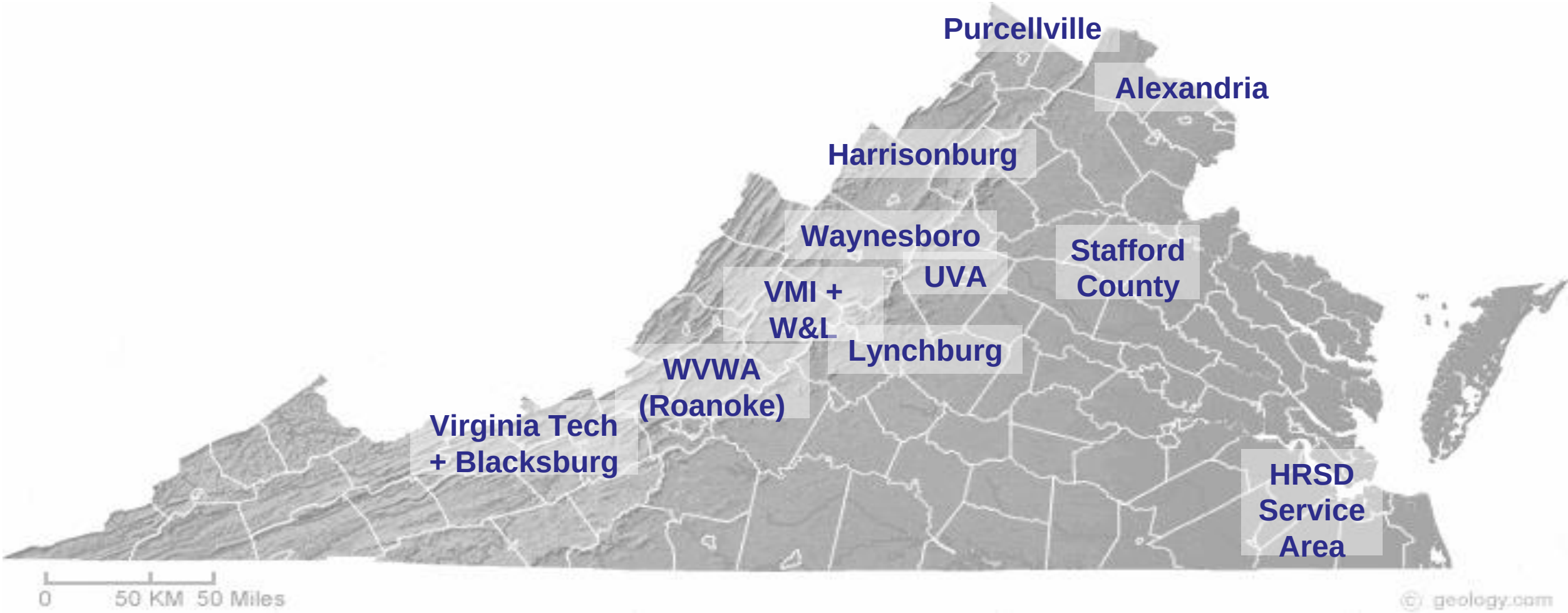
Data Analysis and Visualizations

- Convert raw data into a form that is useful to epidemiologic and programmatic decision makers

Community of Practice

- Facilitate
- Collaborate
- Exchange Information
- Best practices
- Lessons learned
- Troubleshooting
- New research

Wastewater Surveillance in Virginia



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Protecting You and Your Environment

Year 1: Accomplishments

- Hired staff
- Outreach to utilities
- Established partnerships
- Uploaded data to NWSS
- Supported a local project

Year 1: Challenges

- ❑ No funding for testing
- ❑ Upload of data from multiple utilities and labs
  - The data requirements of CDC are extensive (80 variables)
  - Going back to get required parameters did not work
  - Variability between testing methods makes it difficult to compare
- ❑ Timeliness of data
- ❑ Lack of general understanding of how to use data results

Conclusion: One lab is desired to facilitate timeliness of data, data upload, and comparability of data

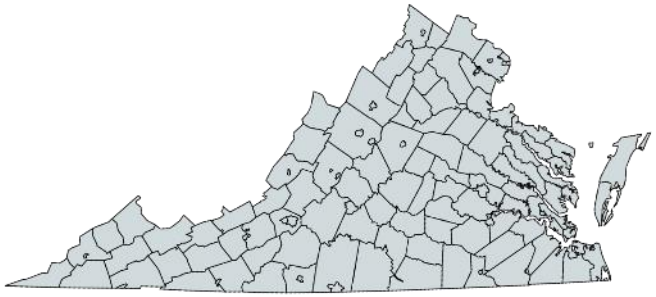
CDC Funding to Virginia

October 2020: $300,000

August 1, 2021: $1.28 M

- ✓ set up state lab
- ✓ initiate sampling program

Year 2:Virginia Wastewater Surveillance Program



SARS-CoV-2 Wastewater Surveillance

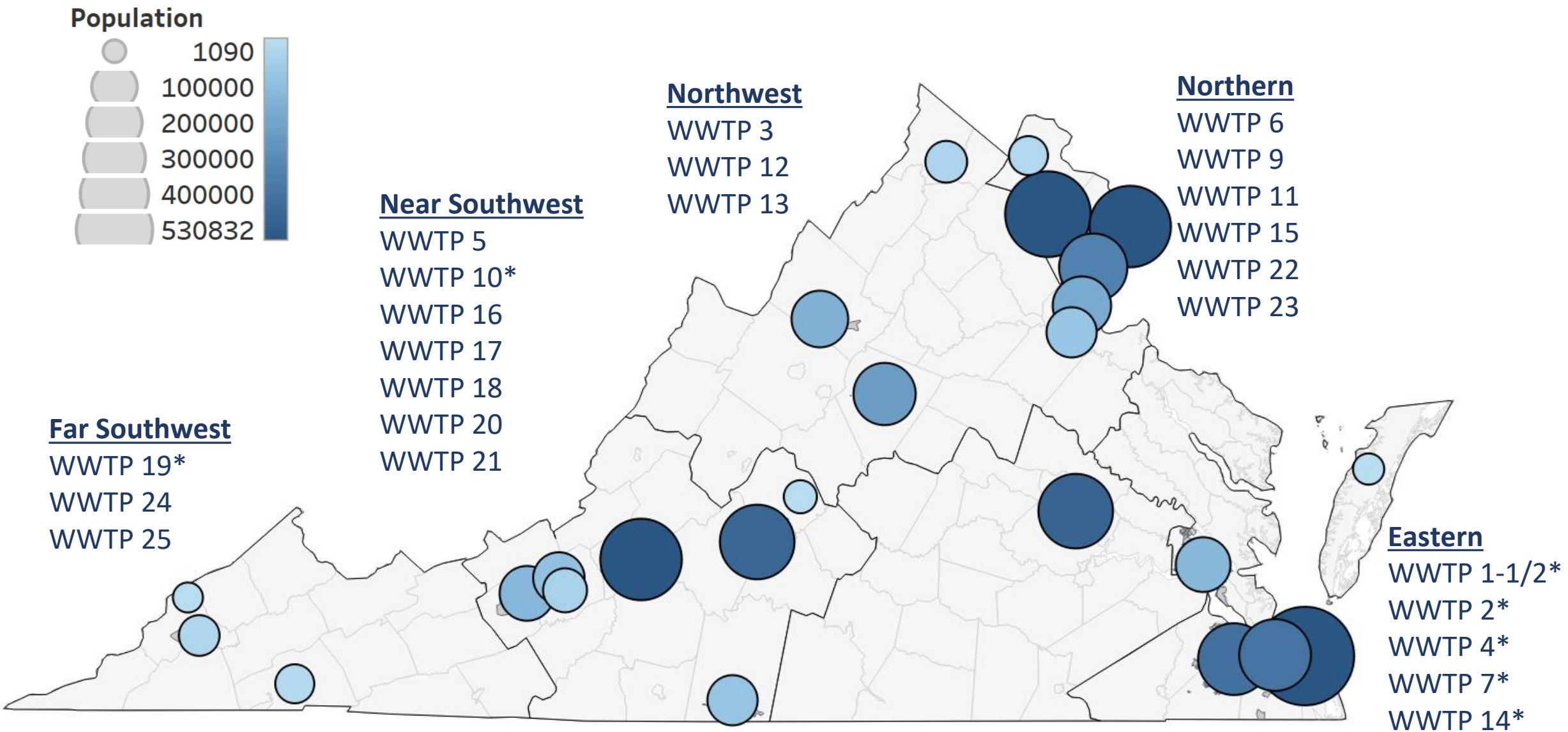
- Initiated Sentinel Monitoring Program
- Funded 4 local projects
- State Laboratory developed capacity
  - for SARS-CoV-2 analysis
  - genomic sequencing

Year 2:Virginia Sentinel Monitoring Program

SARS-CoV-2 Wastewater Surveillance

- Influent to wastewater treatment plants
- Selected **25** sampling sites
- Sampling start date: September 13, 2021
- Year 2 sampling end date: July 31, 2022
- Sampling Frequency: Once/week

Sentinel Monitoring Facilities



Northwest
WWTP 3
WWTP 12
WWTP 13

Northern
WWTP 6
WWTP 9
WWTP 11
WWTP 15
WWTP 22
WWTP 23

Near Southwest
WWTP 5
WWTP 10*
WWTP 16
WWTP 17
WWTP 18
WWTP 20
WWTP 21

Far Southwest
WWTP 19*
WWTP 24
WWTP 25

Eastern
WWTP 1-1/2*
WWTP 2*
WWTP 4*
WWTP 7*
WWTP 14*

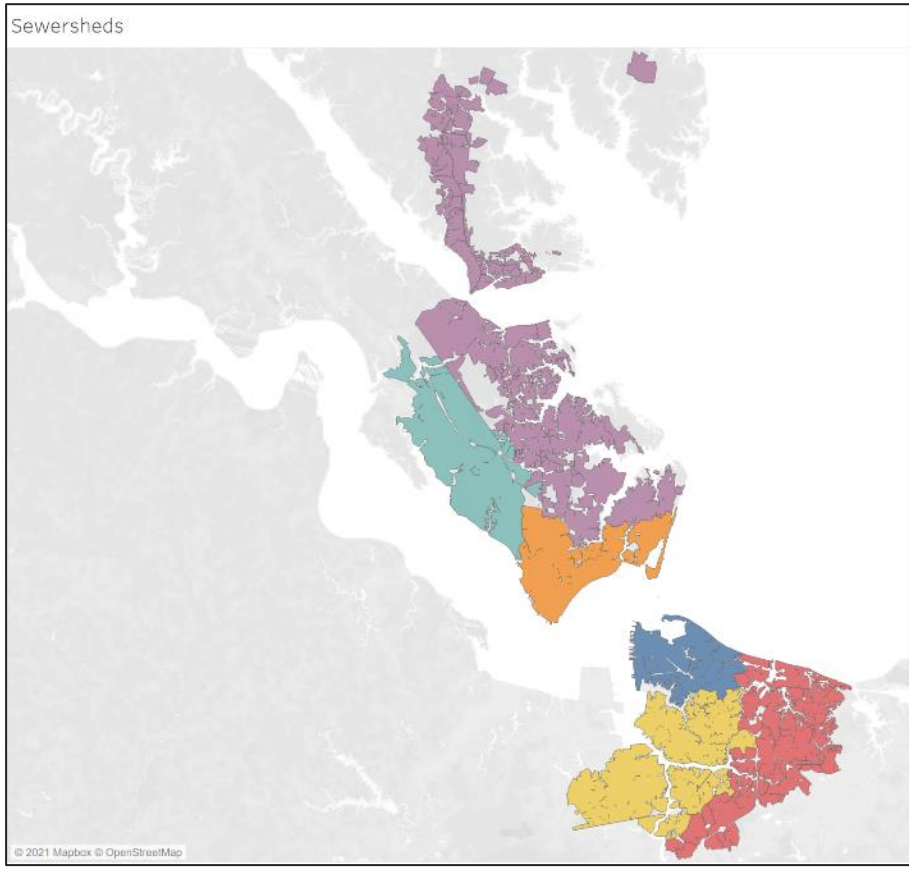
*sample type: grab

Data Collection Components

- **Wastewater Surveillance Data**
  - Viral concentration & load
  - Genomic sequencing

- **Sewershed Maps:** geographical extent of the sewershed

- **Spatially-joined Patient Cases:** geolocated positive COVID-19 cases to the sewershed



Workflow

Lab sends sample bottles and shipping supplies to utilities

Facility collects sample, records metadata, Ships to lab

Lab Shares data with utility

Lab analyzes sample, merges metadata, formats data

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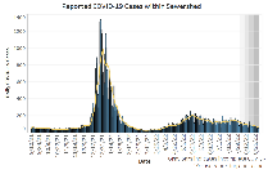
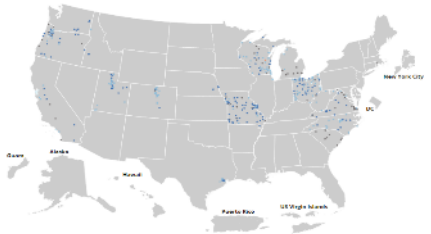
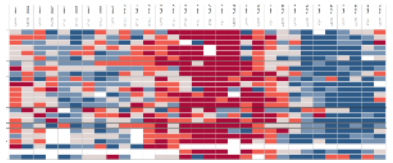
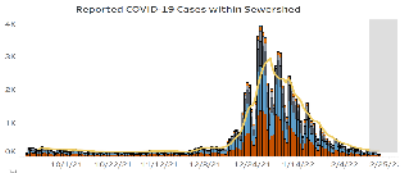
Patient case data



Boundary shapefiles







VDH cleans & uploads data to CDC,
Prepares interpretations,
Converts to dashboard

VDH Shares Weekly Reports with each utility

Year 2 Accomplishments:

- 46 weeks of sentinel monitoring data
- Initiated genomic sequencing
- Completed 4 local projects
- Created database
- Created internal dashboard
- Hosted routine Community of Practice meetings

Year 2 Challenges:

- Data Interpretation and integration into VDH
- Contracting out of state for lab services
- Public Facing Dashboard

CDC Funding to Virginia

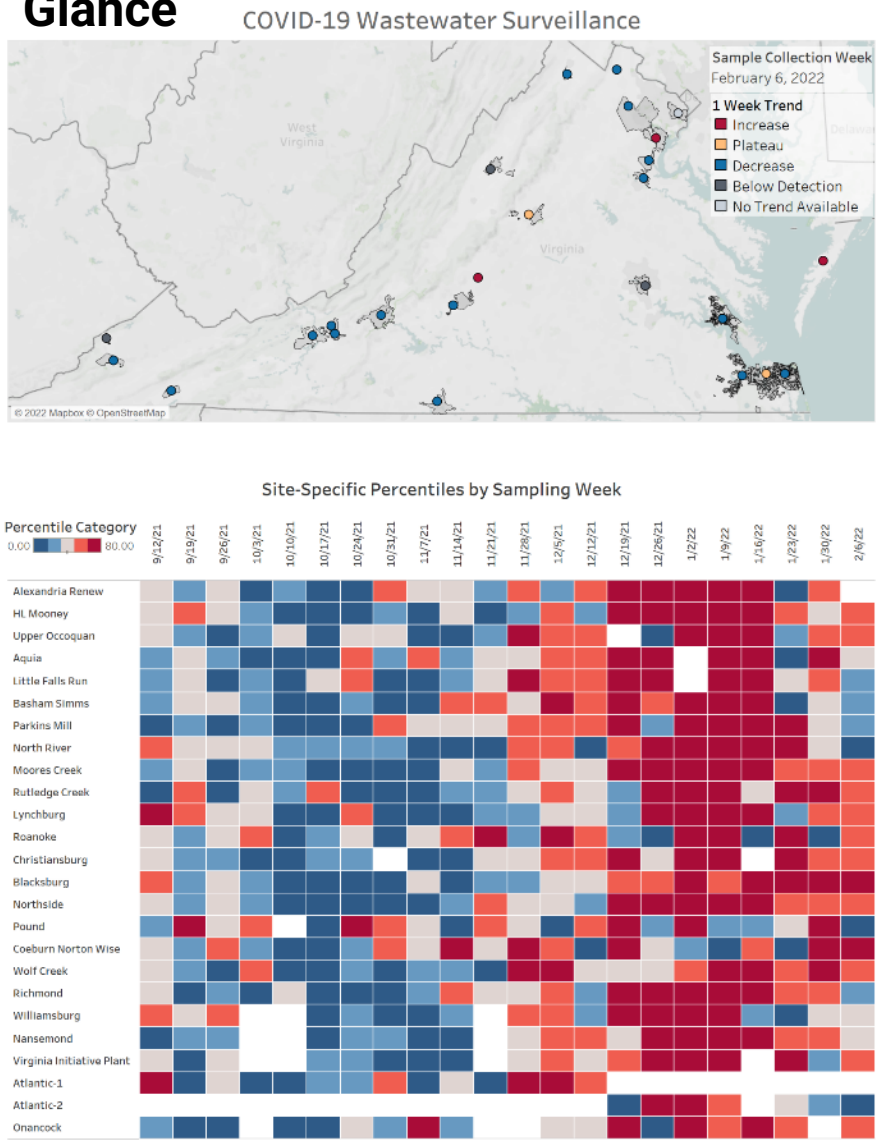
October 2020:	$300,000 – Programmatic funding only
August 1, 2021:	$1.28 M – set up state lab; initiate sampling
August 1, 2022:	**$2.1 M - continue and expand**

Year 3: Wastewater Surveillance in Virginia

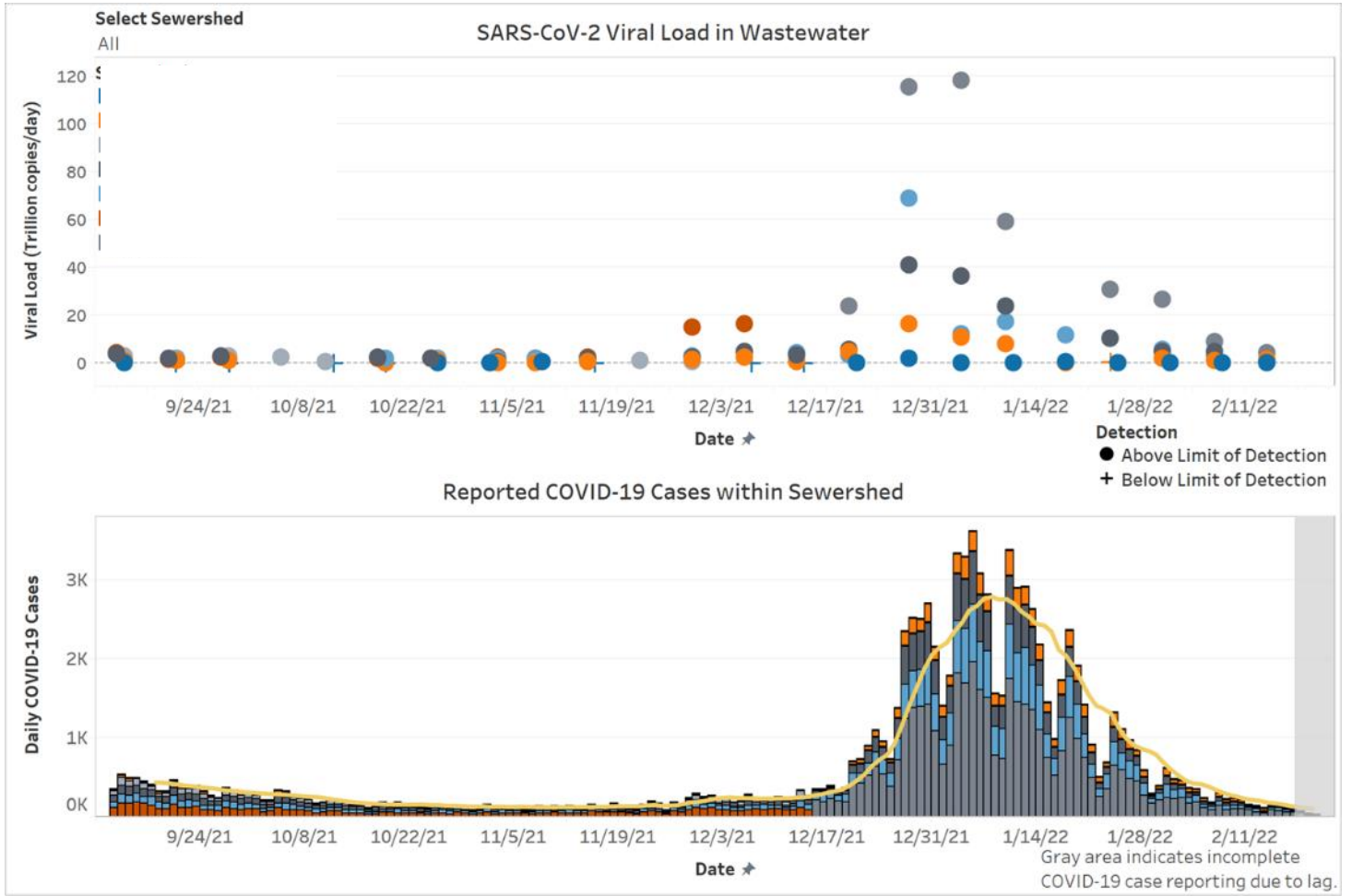
- Expand weekly sampling to up to **40 sites**
- Convert up to **20 sites** to **twice weekly** sampling
- Continue **genomic sequencing** of 20 samples weekly
- Run **pilot projects** to test efficacy of other targets
- Improve **interpretation** of data
- Continue **Community of Practice** meetings

Dashboard Layout

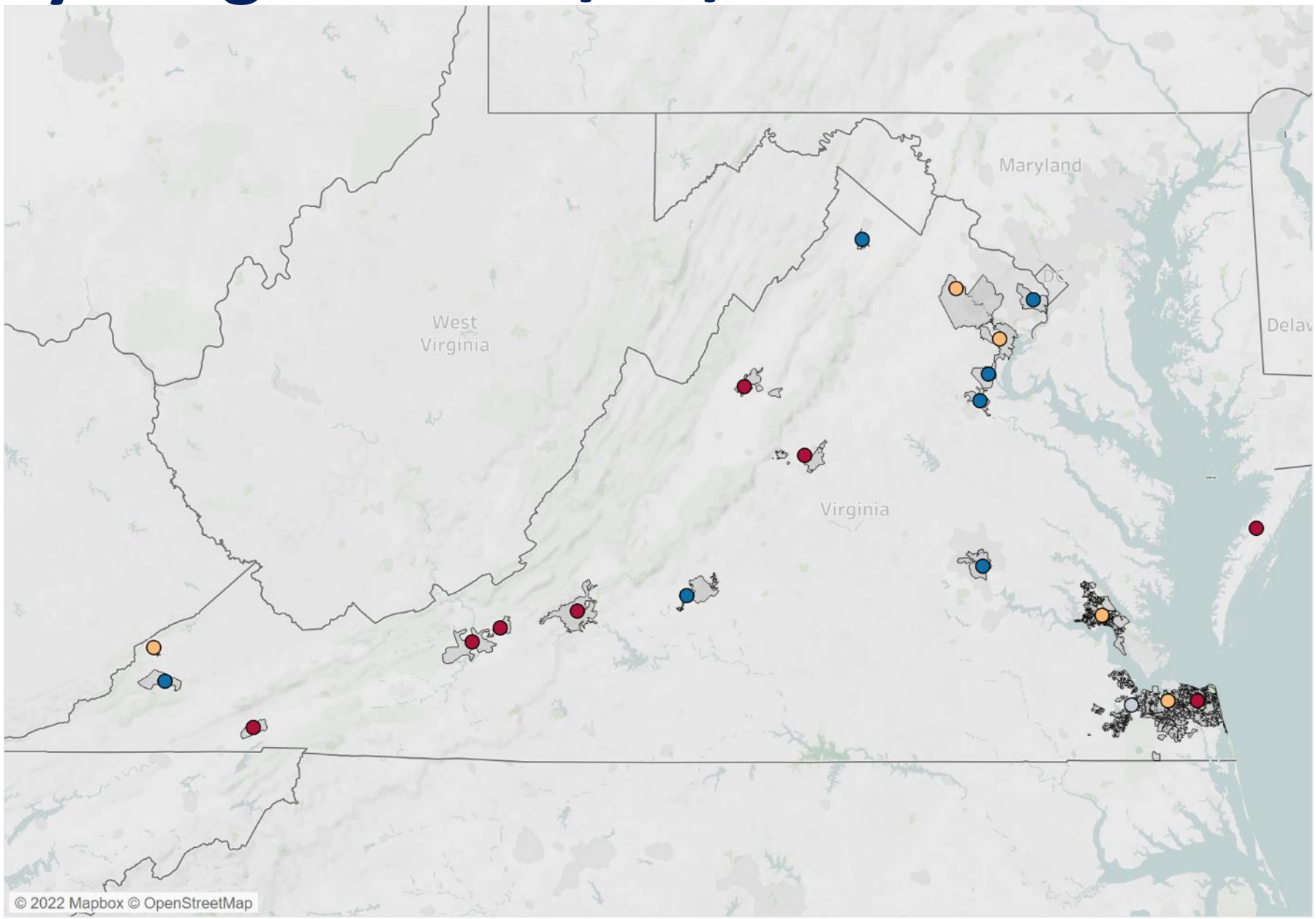
Wastewater Surveillance At-a-Glance



Site-Specific Viral Loads and Cases by Region



Weekly Progression 8/14/22



INCREASE	PLATEAU	DECREASE	BELOW DETECTION	NO TREND AVAILABLE
8	5	7	0	1

Eastern VA
Thru 8/22/22

Select Region
Eastern Virginia

Select Sewershed
All

Figure 1a. SARS-CoV-2 Viral Load in Wastewater

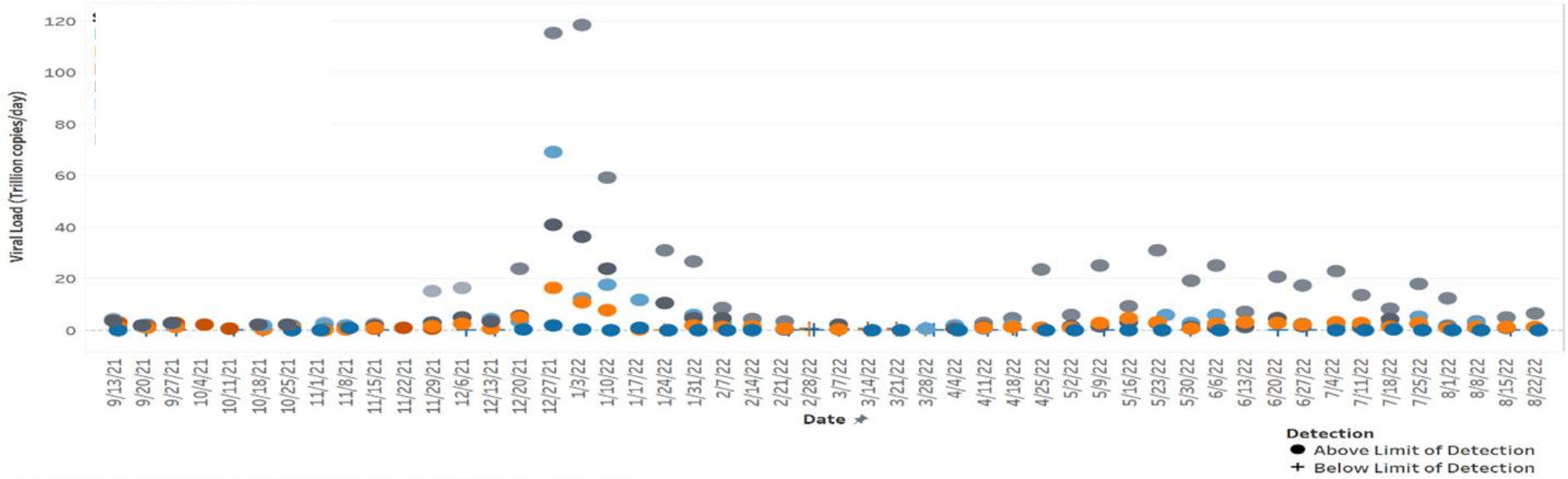
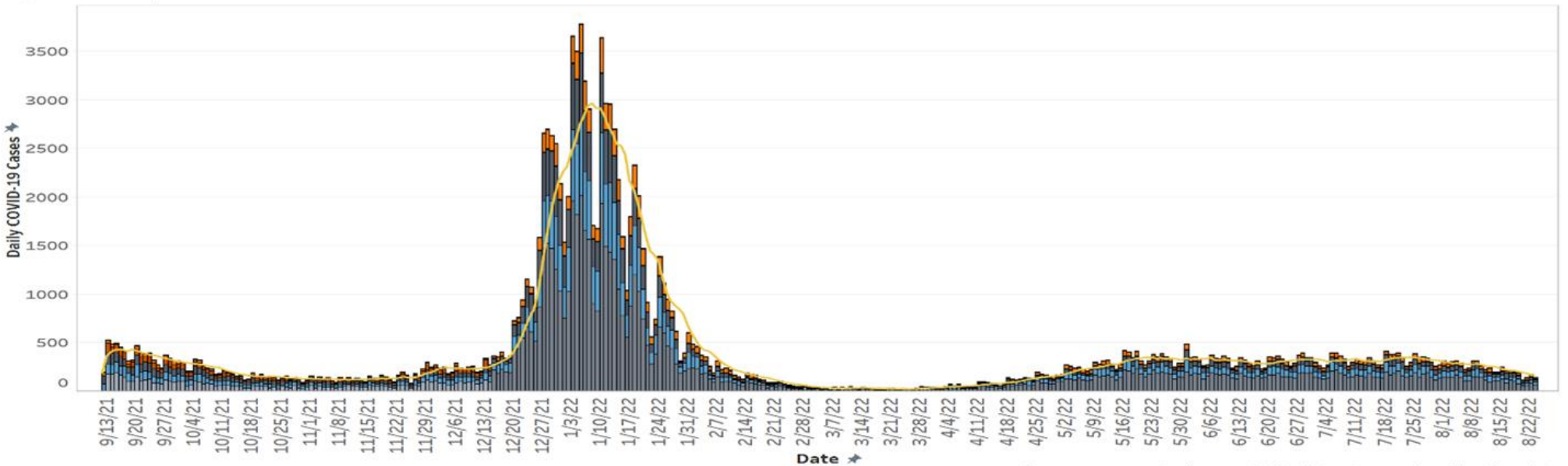


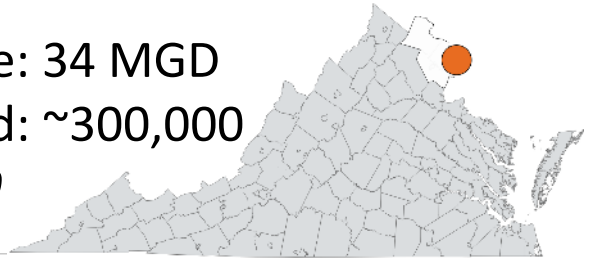
Figure 1b. Reported COVID-19 Cases within Sewershed

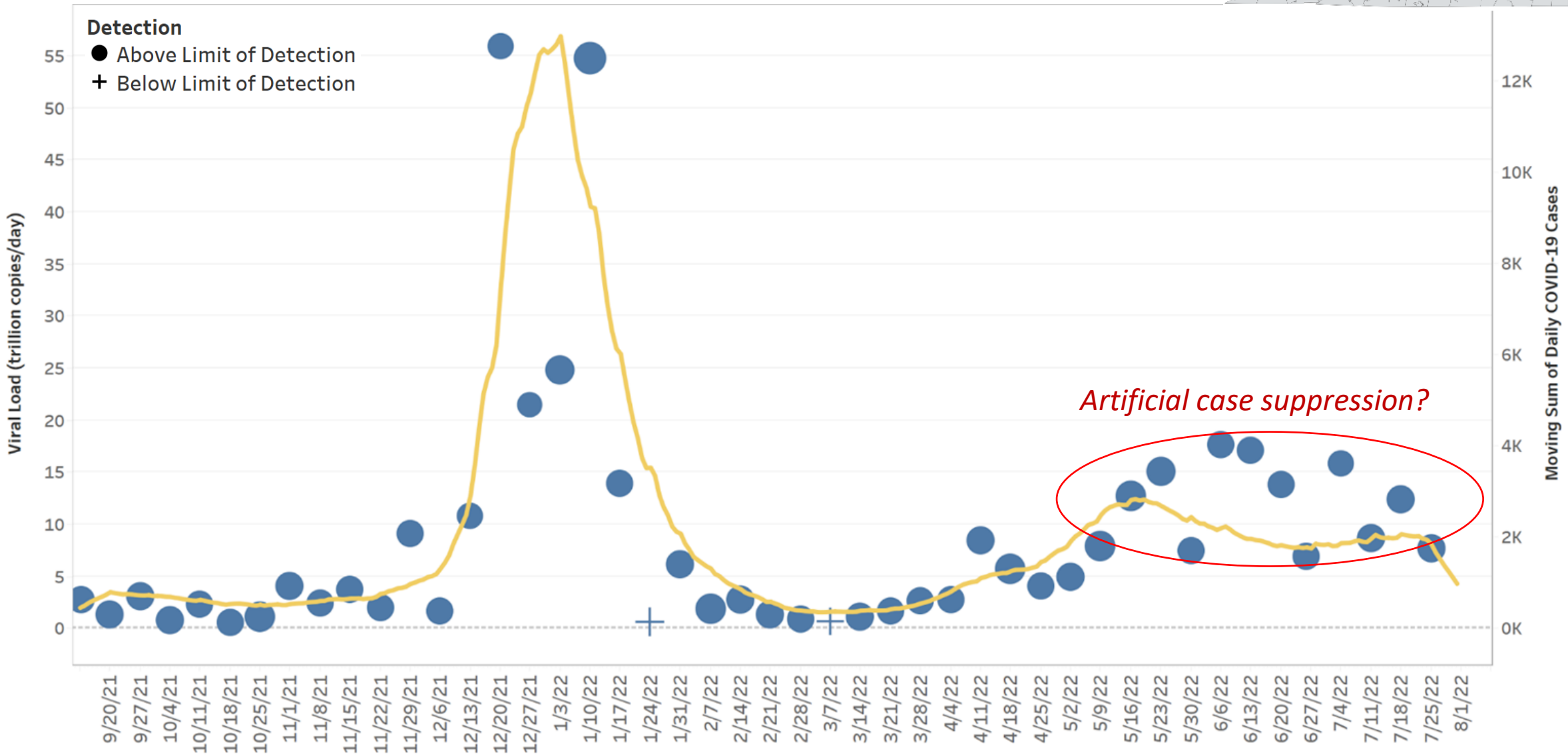


Cases are reported up until the latest sample collection date.

Viral Load + Case suppression?

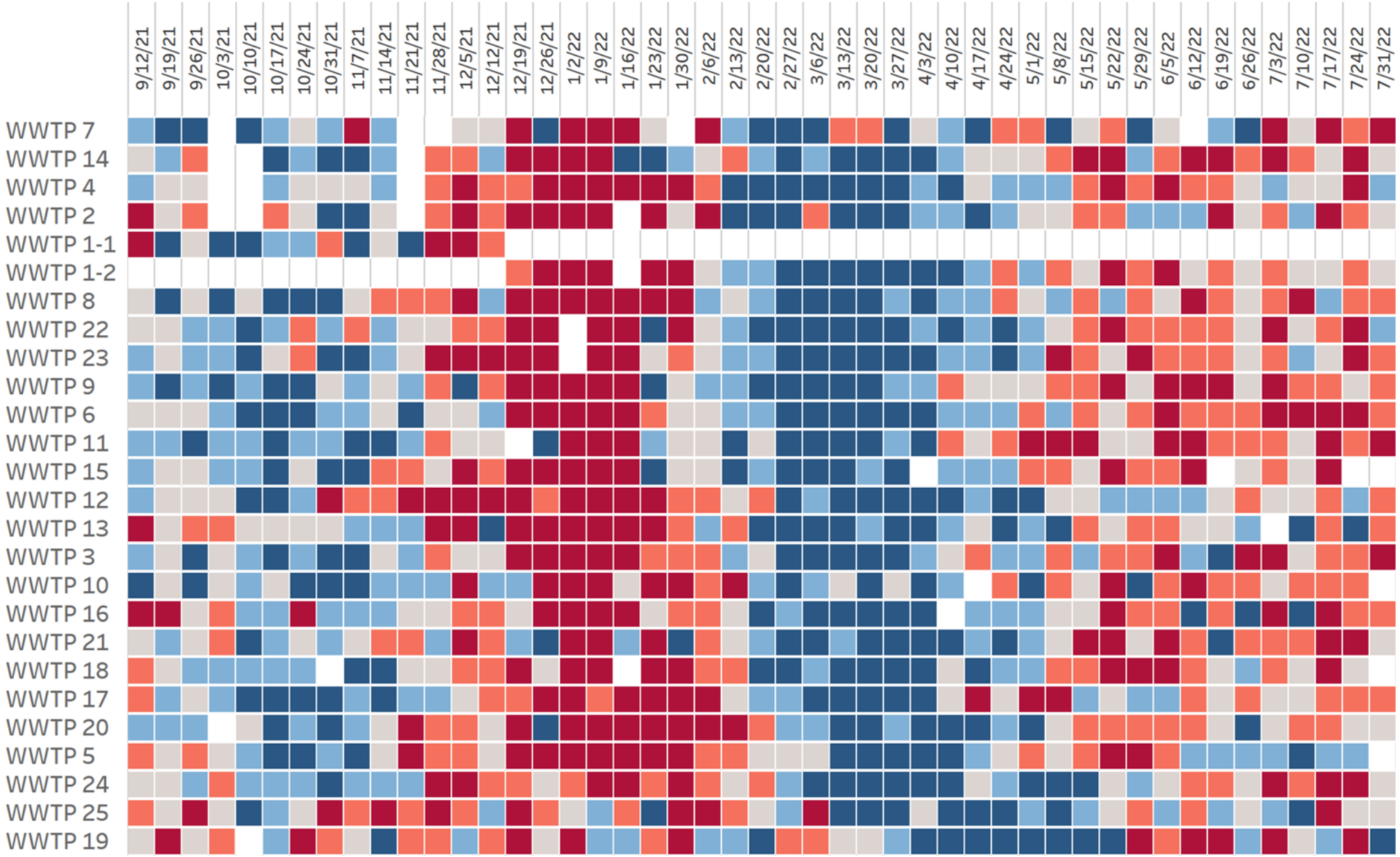
Median Flow Rate: 34 MGD
Population served: ~300,000
WWTP 9



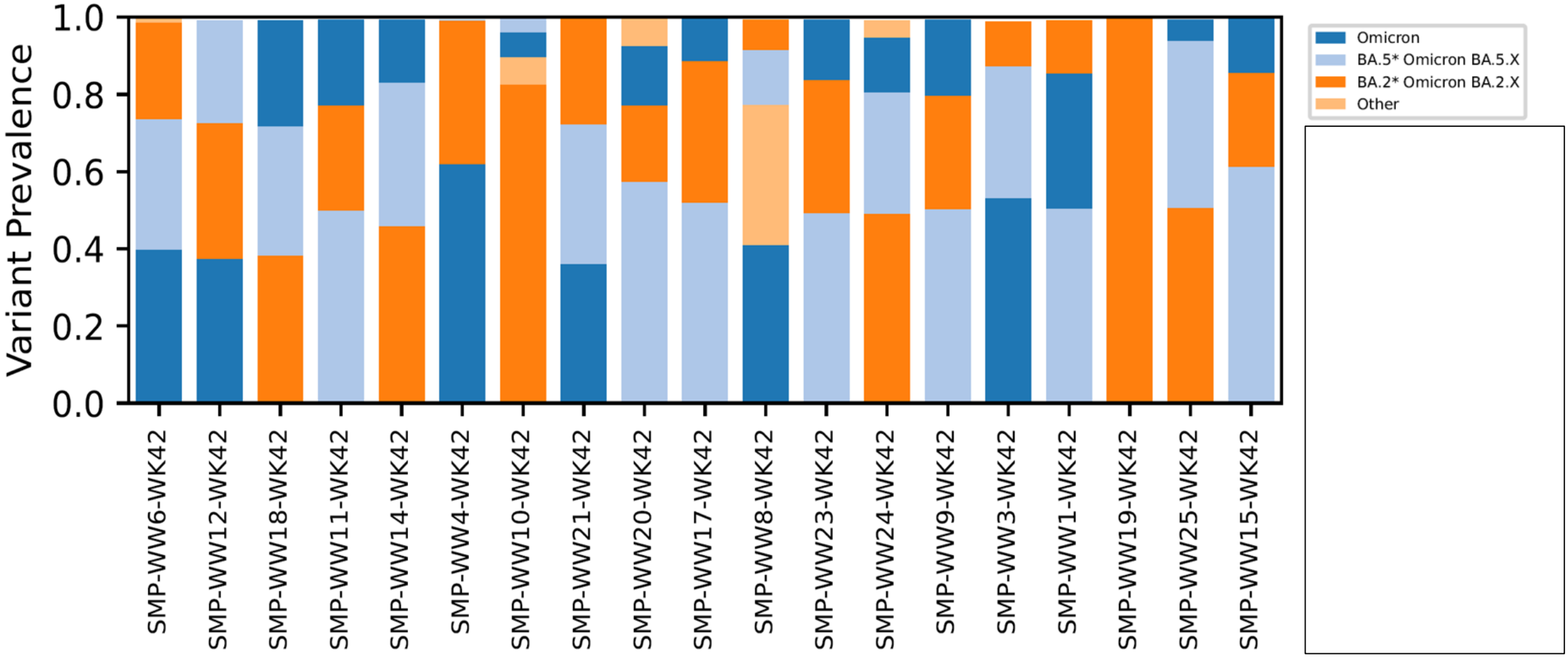


Size: flow rate

Site-Specific Percentiles



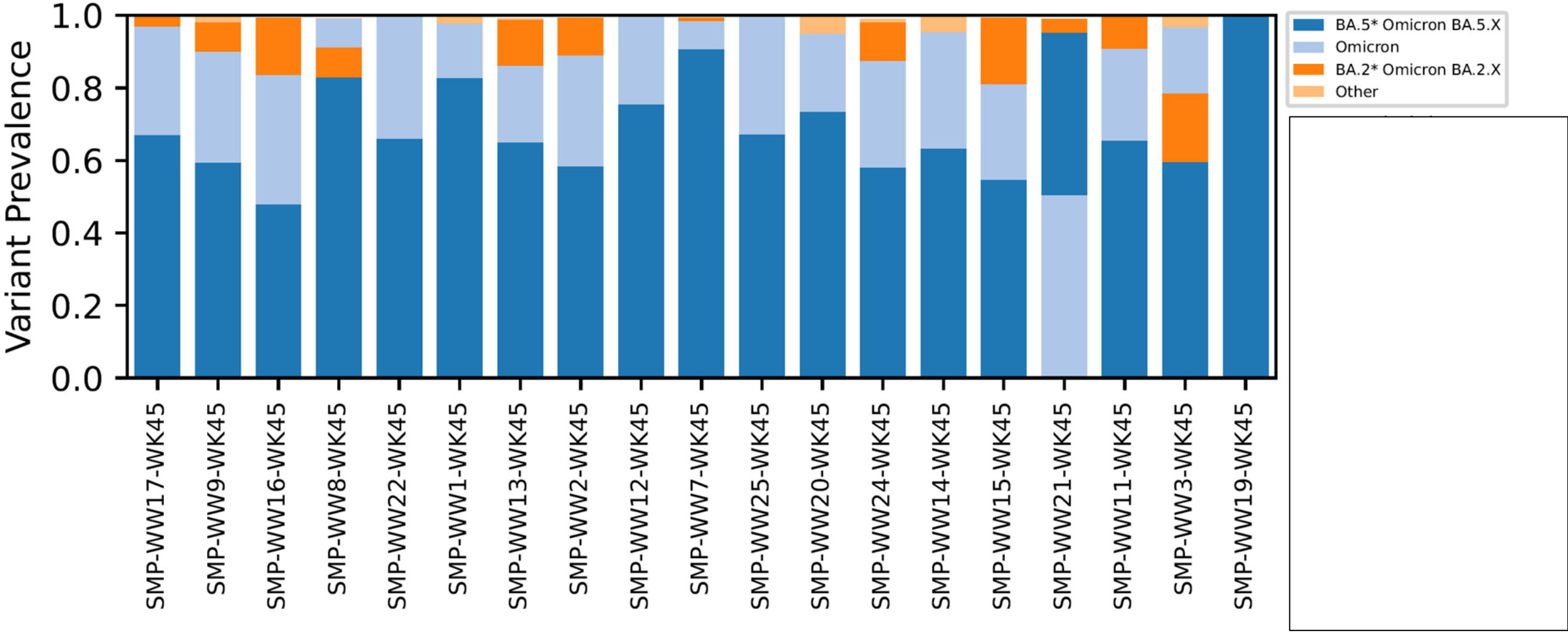
Sequencing: Week 42



Used by permission from DCLS

Disclaimer: The data was generated using a laboratory-developed test, validated by DCLS to support public health surveillance activities. As such, data quality guidelines are still in development. This test only detects lineages incorporated into UShER SARS-CoV-2 global phylogeny and may not detect newly emerging and undescribed variants. The lineage proportions are estimates, not absolute values, and lineages estimated at a lower abundance (<5%) have lower confidence. Wastewater samples are a complex matrix and many factors can affect the detection and estimation of variant proportions.

Sequencing: Week 45



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Future of Wastewater Surveillance

- **<u>Flexible Surveillance Program for Multiple Health Targets</u>**
  - Antimicrobial Resistance
  - Foodborne infections
  - Emerging infections

Uses of Wastewater Surveillance

Sentinel	Local	Building Level
• Screening • Trends • Variants • Broad responses - vaccinations, education	• Subsewershed • Targeted testing & vaccinations • Targeted education • Hotspot tracking	• Initiate testing • Isolate positives • Rapid response

Lessons Learned - Cons

- ✓ Lack of standardized analytical methods hindered the start of the project.
- ✓ Lack of interpretation tools/familiarity slowed acceptance by epidemiologists.
- ✓ Difficulty assessing sensitivity of data for sharing.
- ✓ Ethical concerns over focusing sampling on too tight an area.

Lessons Learned - Pros

- ✓ Working with a single lab is key to uniformity and efficiency.
- ✓ State lab partner utilized existing courier service for sample pickup.
- ✓ Utilized state WEF affiliate to reach out to utilities.
- ✓ Communication is key.

TAKE-HOME MESSAGE

WWS can provide…

- Affordable, population prevalence (pooled samples)
- Early Warning
- Capture of patients with symptoms and without
- Detection of novel variants

… And is completely independent of health-seeking behaviors

(e.g., patient testing, case diagnosis, masking/vaccination, etc.)

~ WASTEWATER DON'T LIE ~

Questions?

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