



APPLICATION OF WASTEWATER-BASED EPIDEMIOLOGY TO TRACK COMMUNITY DISEASE

Ian Bradley, Ph.D.

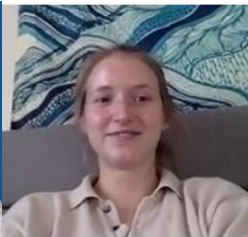
Yinyin Ye, Ph.D.



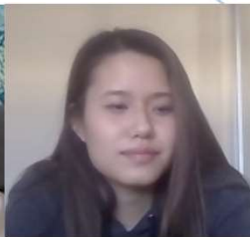
**Mahbub
Alam
(PhD)**



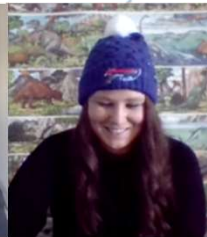
**Chonglin
Zhu
(PhD)**



**Scout
McLerran
(MS)**



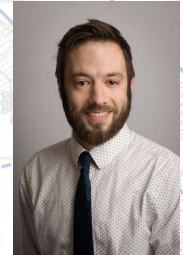
**Annemarie
Pillsbury
(MS)**



**Christie
Rajcic
(MS)**



**Emily
Segelhurst
(MS)**



**Ian Bradley
(Assistant Prof CSEE &
RENEW)**



**Maddy
Benson
(UG)**



**Willa
Egan
(UG)**



**Vicky
Huang
(UG)**



**Daniel
Bedoya
(UG)**



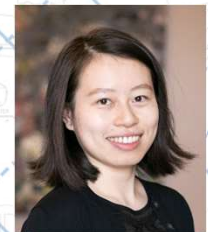
**Sydney
Gallo
(UG)**



**Danya
Hanin
(UG)**



**Joyce
Wang
(UG)**



**Yinyin Ye
(Assistant Prof
CSEE)**

UB University at Buffalo The State University of New York

UB Wastewater Committee: John Tomaszewski, Ian Bradley, Yinyin Ye, Jean Wactawski-Wende, Tom Russo, Jeff Angiel, Brian Foti, Greg Wilding, Craig Abbey, Brian Haggerty

Joseph Fiegl, P.E., BCEE – Erie County

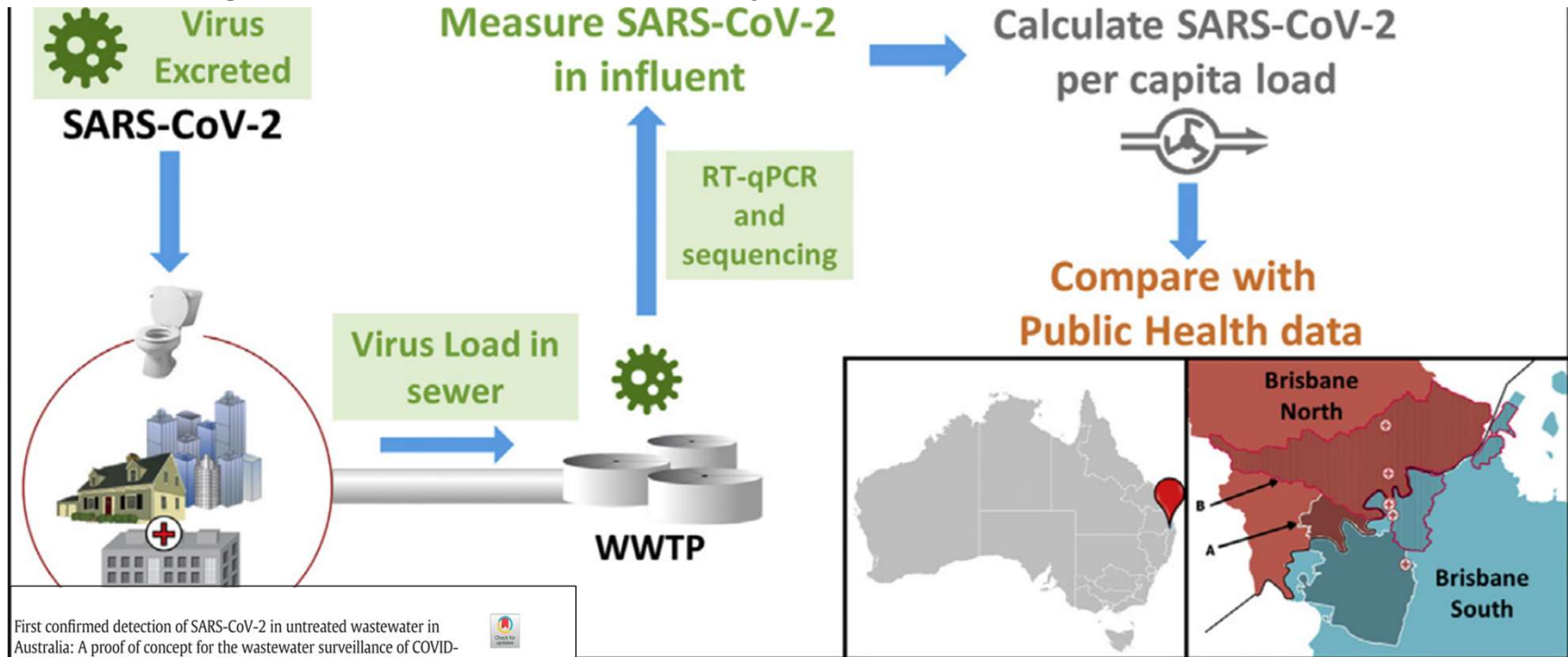


Department of Environment and Planning
Division of Sewerage Management

**Gale Burstein, MD, MPH, FAAP,
Erie County Department of Health**

Wastewater Based Epidemiology (WBE)

“Any substance that is **excreted by humans** and is **stable in wastewater** can be used to **back-calculate** the original concentration excreted by the **served population**”

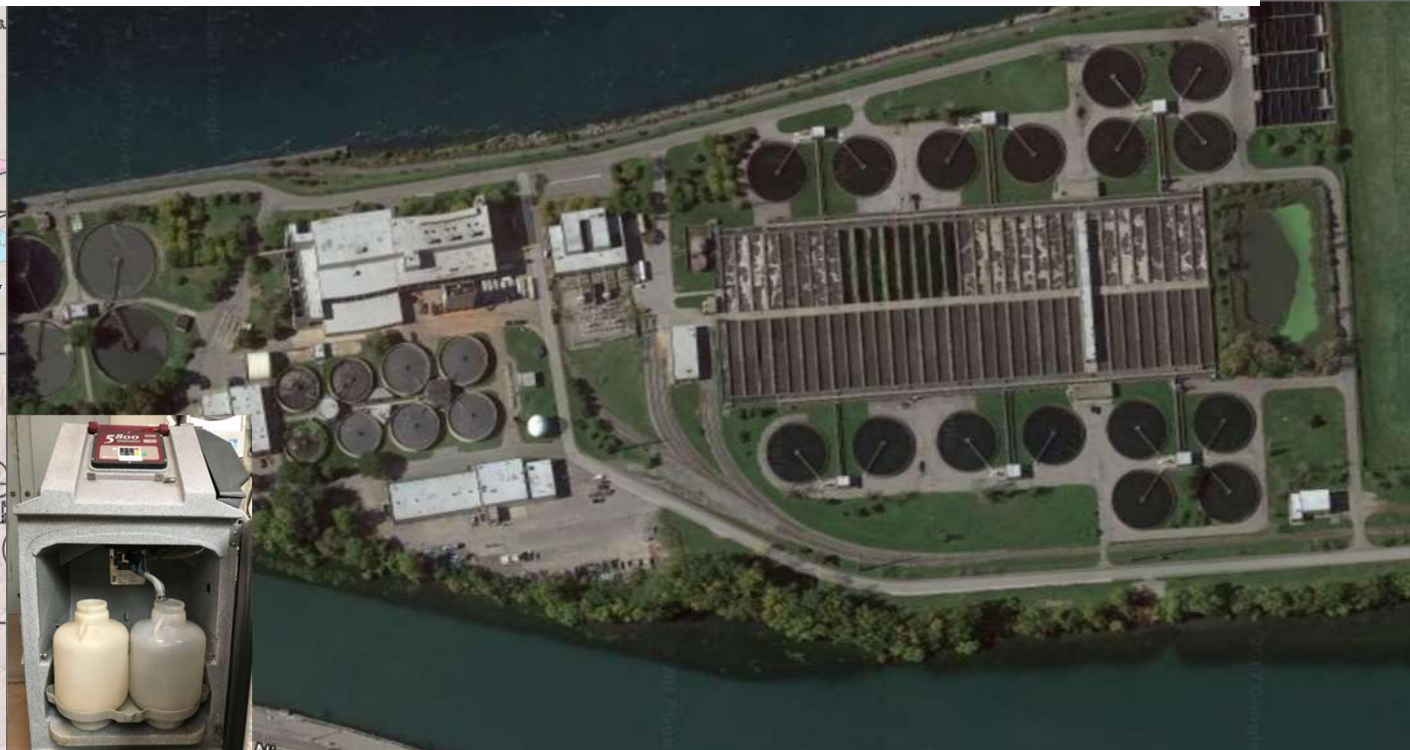
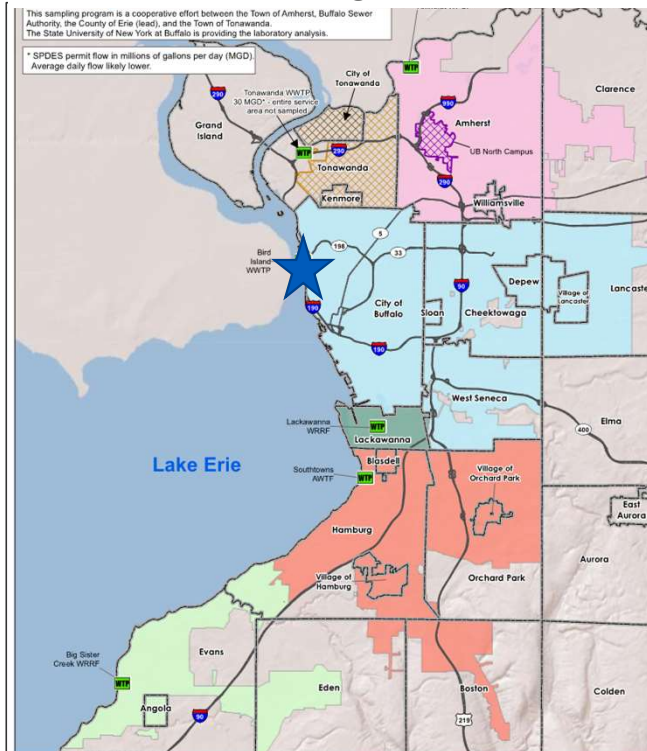


First confirmed detection of SARS-CoV-2 in untreated wastewater in Australia: A proof of concept for the wastewater surveillance of COVID-19 in the community

Warish Ahmed^{a,*}, Nicola Angel^b, Janette Edson^b, Kyle Bibby^c, Aaron Bivins^c, Jake W. O'Brien^d, Phil M. Choi^d, Masaaki Kitajima^e, Stuart L. Simpson^f, Jiaying Li^g, Ben Tschärke^h, Rory Verhagen^h, Wendy J.M. Smithⁱ, Julian Zaugg^j, Leanne Dierens^k, Philip Hugenoltz^l, Kevin V. Thomas^d, Jochen F. Mueller^d

Wastewater Based Epidemiology (WBE)

“Any substance that is **excreted by humans** and is **stable in wastewater** can be used to **back-calculate** the original concentration excreted by the **served population**”



Wastewater sampling at the point of treatment can give us a community “pooled” sample



Contents lists available at ScienceDirect

Science of the Total Environment

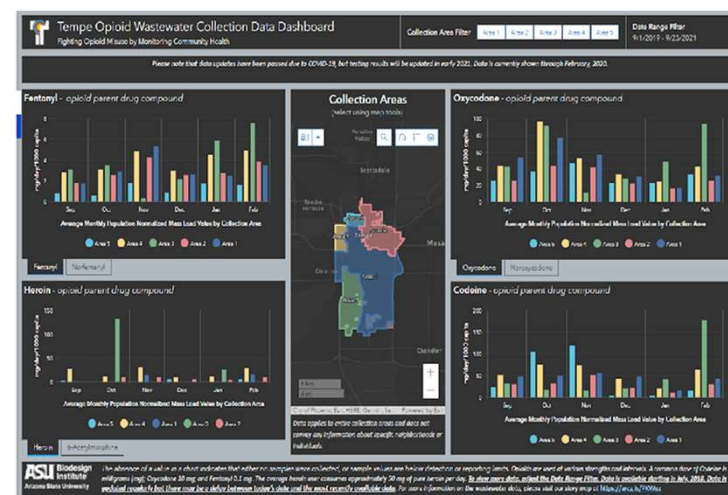
journal homepage: www.elsevier.com/locate/scitotenv



First confirmed detection of SARS-CoV-2 in untreated wastewater in Australia: A proof of concept for the wastewater surveillance of COVID-19 in the community

Warish Ahmed^{a,*}, Nicola Angel^b, Janette Edson^b, Kyle Bibby^c, Aaron Bivins^c, Jake W. O'Brien^d, Phil M. Choi^d, Masaaki Kitajima^e, Stuart L. Simpson^f, Jiaying Li^d, Ben Tschärke^d, Rory Verhagen^d, Wendy J.M. Smith^g, Julian Zaugg^b, Leanne Dierens^b, Philip Hugenoltz^b, Kevin V. Thomas^d, Jochen F. Mueller^d

^a CSIRO Land and Water, Ecosciences Precinct, 41 Boggo Road, QLD 4102, Australia
^b Australian Centre for Ecogenomics, School of Chemistry and Molecular Biosciences, The University of Queensland, St Lucia, QLD 4072, Australia
^c Department of Civil & Environmental Engineering & Earth Science, University of Notre Dame, 156 Fitzpatrick Hall, Notre Dame, IN 46556, USA
^d Queensland Alliance for Environmental Health Sciences (QAEHS), The University of Queensland, 20 Cornwall Street, Woolloongabba, QLD 4103, Australia
^e Division of Environmental Engineering, Faculty of Engineering, Hokkaido University, North 13 West 8, Kita-ku, Sapporo, Hokkaido 060-8628, Japan
^f CSIRO Land and Water, Lucas Heights, NSW 2234, Australia
^g CSIRO Agriculture and Food, Bioscience Precinct, St Lucia, QLD 4067, Australia





Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

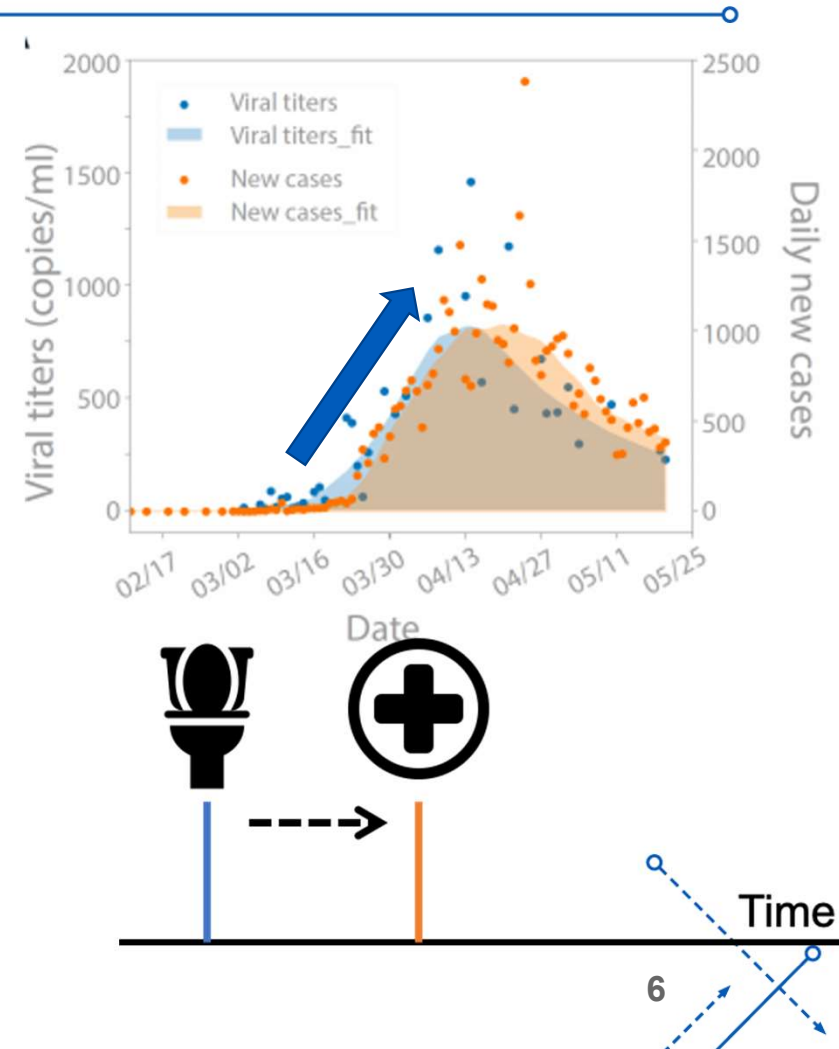
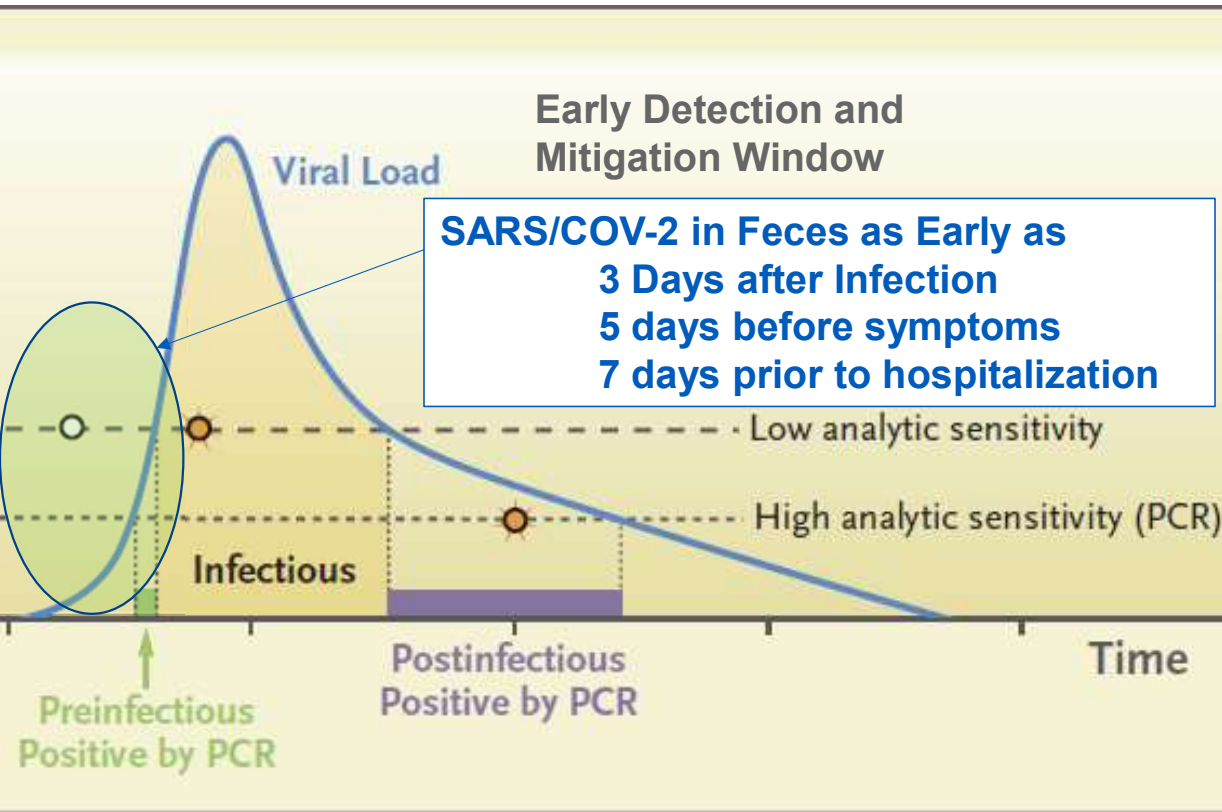


First detection of SARS-CoV-2 in untreated wastewaters in Italy

Giuseppina La Rosa^{a,*}, Marcello Iaconelli^a, Pamela Mancini^a, Giusy Bonanno Ferraro^a, Carolina Veneri^a, Lucia Bonadonna^a, Luca Lucentini^a, Elisabetta Suffredini^b

^a Department of Environment and Health, Istituto Superiore di Sanità, Rome, Italy
^b Department of Food Safety, Nutrition and Veterinary Public Health, Istituto Superiore di Sanità, Rome, Italy

Wastewater Based Epidemiology



National Wastewater Surveillance System (NWSS)

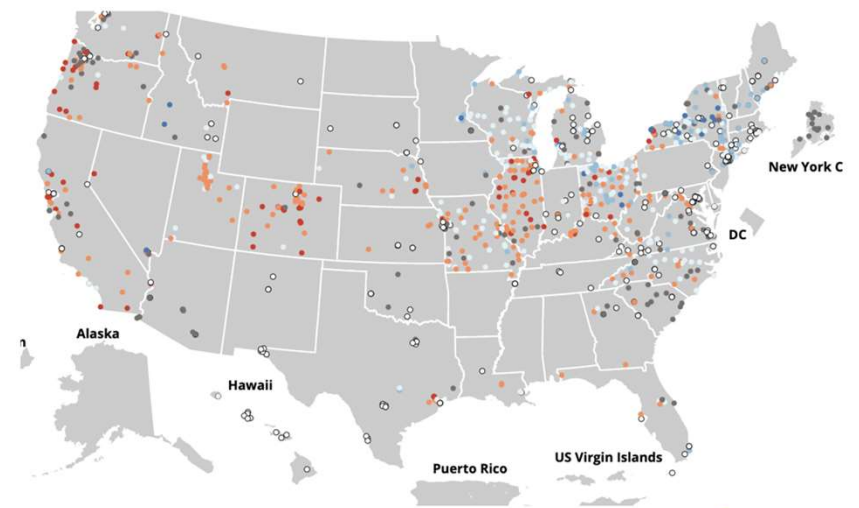
COVIDPoops19 Summary of Global SARS-CoV-2 Wastewater Monitoring Efforts by UC Merced Researchers

Est. HERE, Garmin, USGS, EPA | Est. HERE

Powered by Esri

Please follow [@COVIDPoops19](#) for wastewater SARS-CoV-2 updates. Funded by [NSF](#). Country data from [COVID-19 WHO Dashboard](#). Link to our [paper](#) for our methods. Want to be added to the Map? Fill out this [form](#).

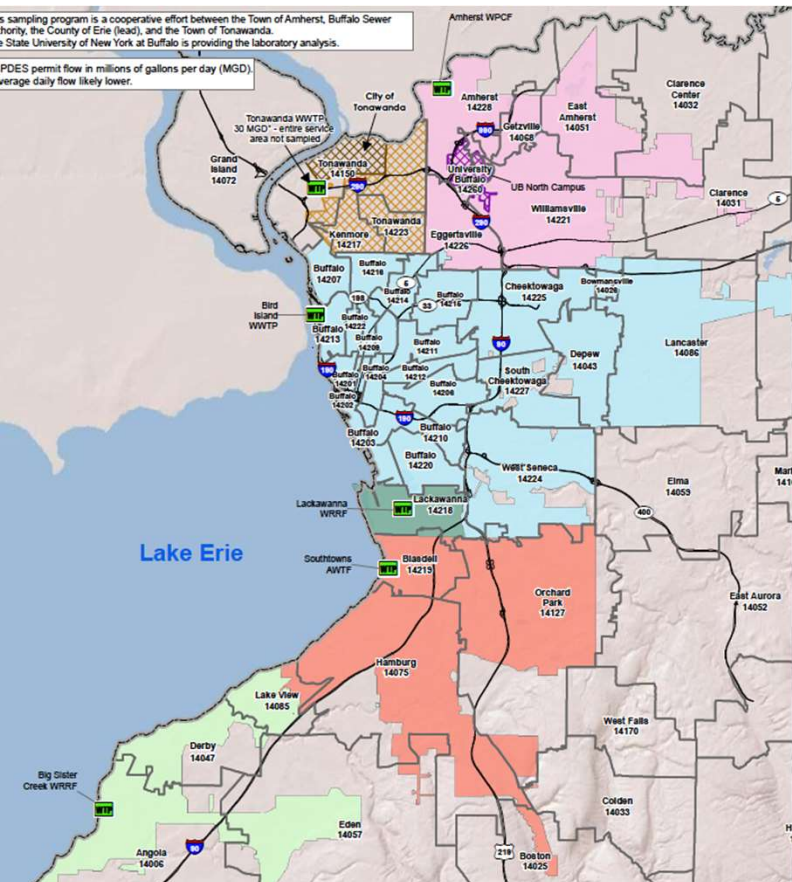
Category	Count	Last Update
Dashboards	152	28 seconds ago
Universities	283	28 seconds ago
Countries	70	28 seconds ago
Sites	3,813	28 seconds ago



<https://ucmerced.maps.arcgis.com/apps/opstdashboard/index.html#/c778145ea5bb4daeb58d31afee389082>

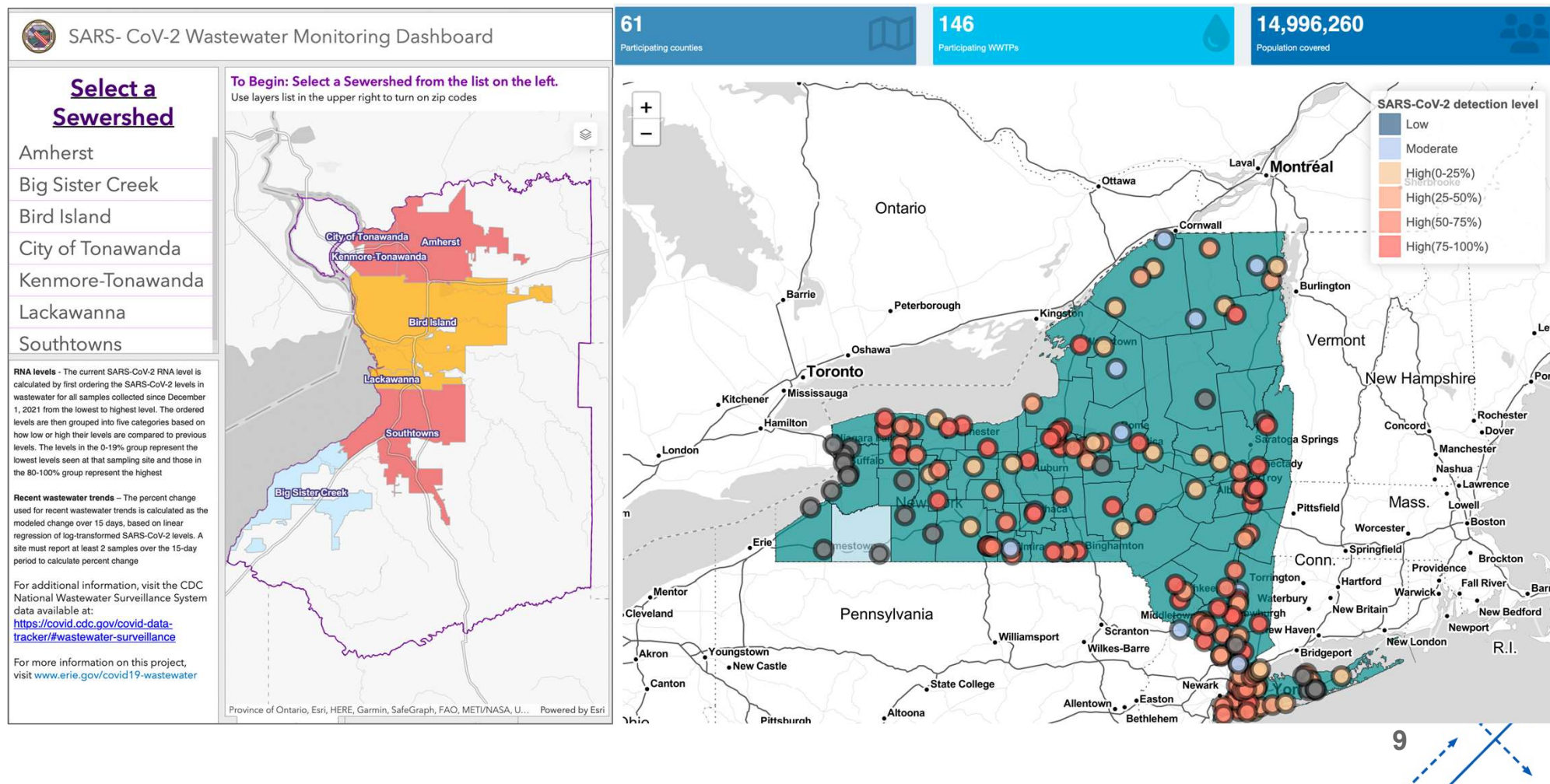


The Erie County WW Surveillance Program has collected data over 2 years throughout the pandemic.

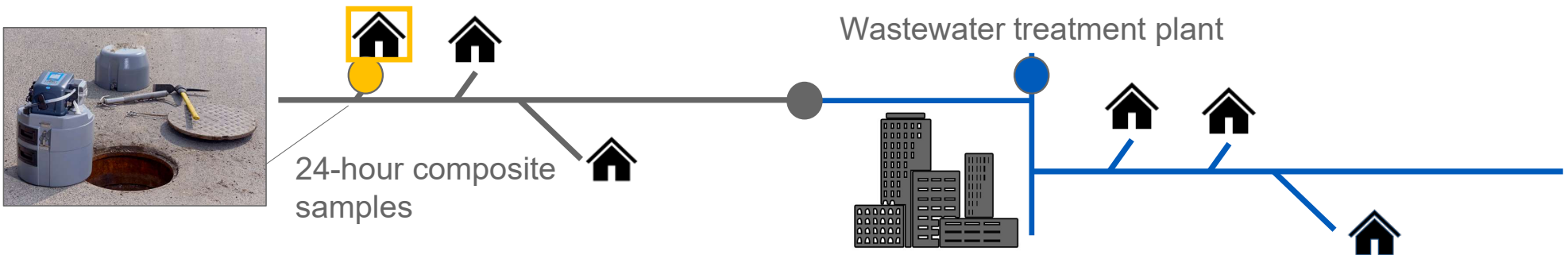


Treatment Plant	Permit Flow (MGD)	Rural, Suburban, or Urban	Estimated Population (2018 Census)	Sewer Type (S/C)
Amherst	48	Suburban	140,324	S
Big Sister Creek	7.7	Rural	29,853	S
Lackawanna	4.5	Suburban/Rural	17,859	S
Southtowns	16	Suburban/Rural	94,616	S
City of Tonawanda	2.5-5	Suburban	14,873	SC
Kenmore-Tonawanda	25	Suburban	70,470	S
Bird Island	180	Urban	437,357	C

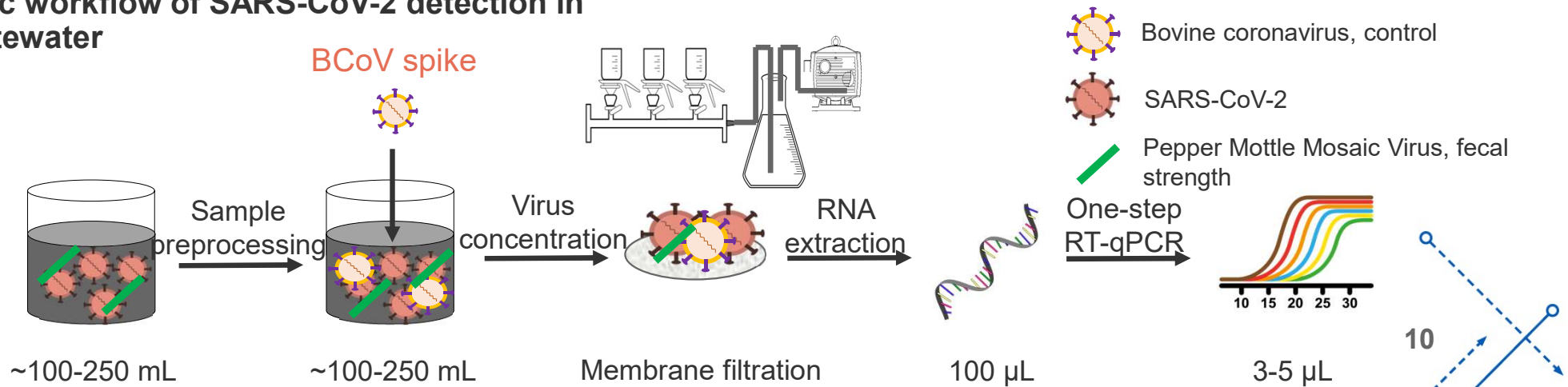
NYSDOH has implemented a State-wide surveillance network, which is continuing to expand.



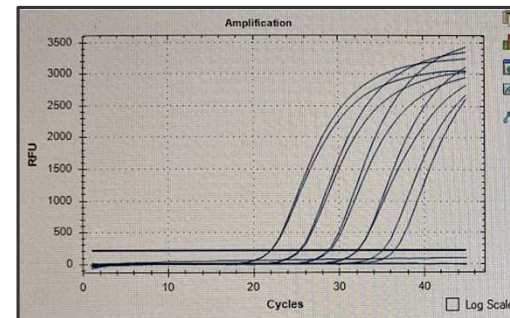
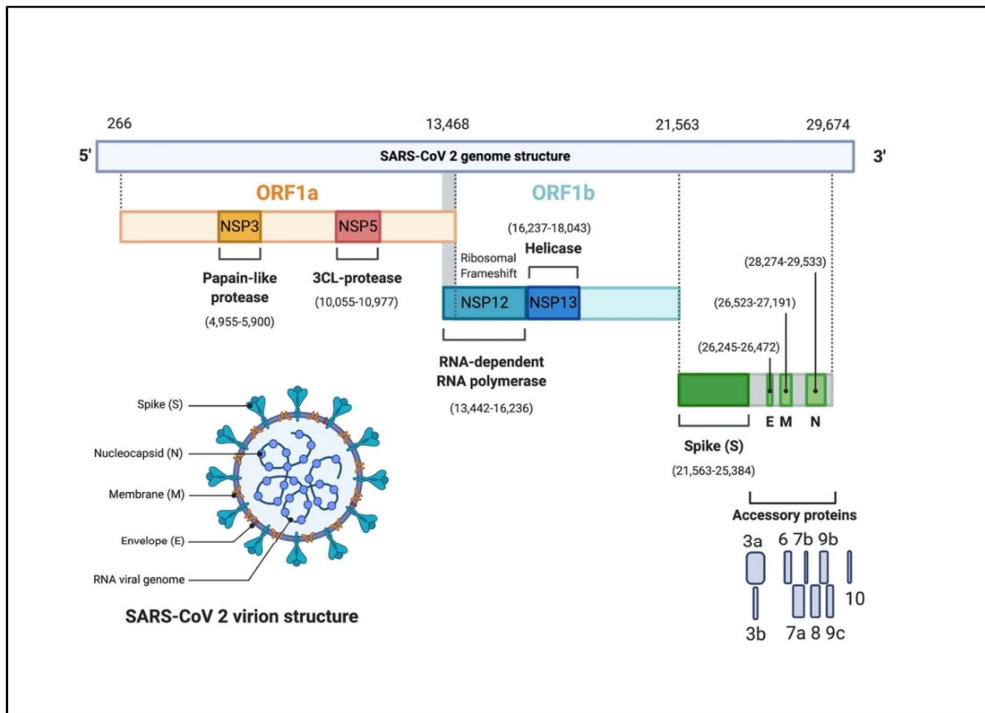
Monitoring genes in wastewater could track disease presence and burden in the community



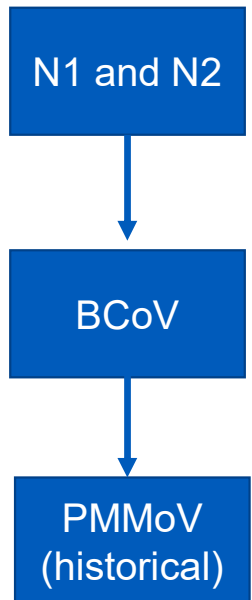
Basic workflow of SARS-CoV-2 detection in wastewater



RT-qPCR is done with N gene followed by BCoV (recovery) and PMMoV (fecal strength).



Standard curve of SARS-CoV-N gene positive control





SARS- CoV-2 Wastewater Monitoring Dashboard

Select a Sewershed

- Amherst
- Big Sister Creek
- Bird Island
- City of Tonawanda
- Kenmore-Tonawanda
- Lackawanna
- Southtowns

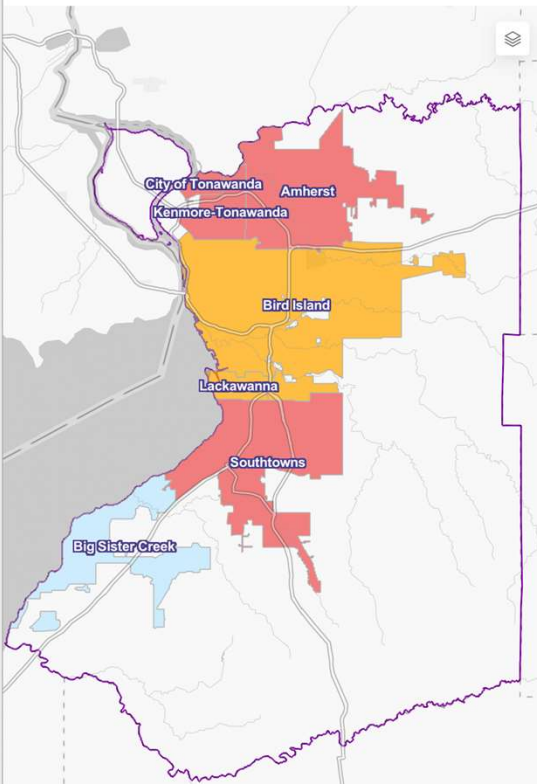
RNA levels - The current SARS-CoV-2 RNA level is calculated by first ordering the SARS-CoV-2 levels in wastewater for all samples collected since December 1, 2021 from the lowest to highest level. The ordered levels are then grouped into five categories based on how low or high their levels are compared to previous levels. The levels in the 0-19% group represent the lowest levels seen at that sampling site and those in the 80-100% group represent the highest

Recent wastewater trends - The percent change used for recent wastewater trends is calculated as the modeled change over 15 days, based on linear regression of log-transformed SARS-CoV-2 levels. A site must report at least 2 samples over the 15-day period to calculate percent change

For additional information, visit the CDC National Wastewater Surveillance System data available at: <https://covid.cdc.gov/covid-data-tracker/#wastewater-surveillance>

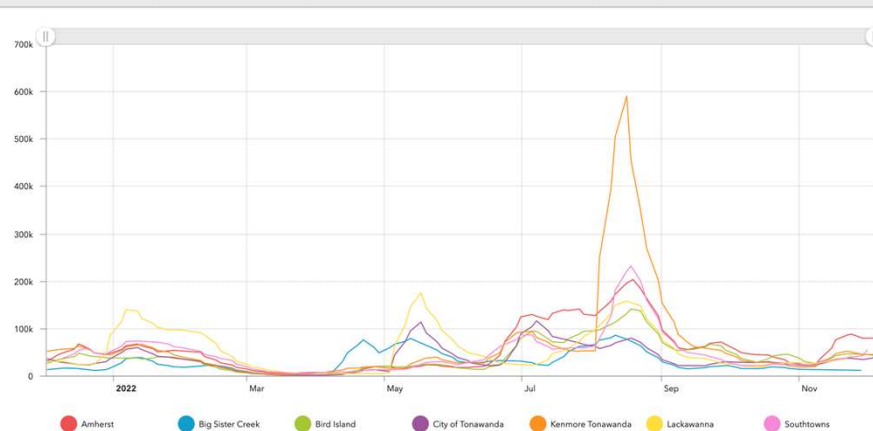
For more information on this project, visit www.erie.gov/covid19-wastewater

To Begin: Select a Sewershed from the list on the left.
Use layers list in the upper right to turn on zip codes



Province of Ontario, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, U... Powered by Esri

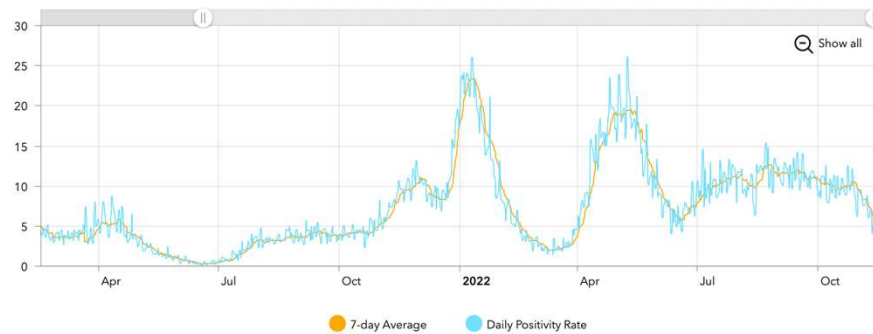
Selection required on one or more elements




All Sewersheds

Smoothed Trend

Historic RNA Copy Region - N2





SARS- CoV-2 Wastewater Monitoring Dashboard

Select a Sewershed

- Amherst
- Big Sister Creek
- Bird Island
- City of Tonawanda
- Kenmore-Tonawanda
- Lackawanna
- Southtowns

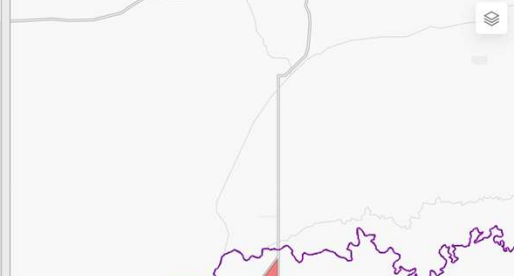
RNA levels - The current SARS-CoV-2 RNA level is calculated by first ordering the SARS-CoV-2 levels in wastewater for all samples collected since December 1, 2021 from the lowest to highest level. The ordered levels are then grouped into five categories based on how low or high their levels are compared to previous levels. The levels in the 0-19% group represent the lowest levels seen at that sampling site and those in the 80-100% group represent the highest

Recent wastewater trends - The percent change used for recent wastewater trends is calculated as the modeled change over 15 days, based on linear regression of log-transformed SARS-CoV-2 levels. A site must report at least 2 samples over the 15-day period to calculate percent change

For additional information, visit the CDC National Wastewater Surveillance System data available at: <https://covid.cdc.gov/covid-data-tracker/#wastewater-surveillance>

For more information on this project, visit www.erie.gov/covid19-wastewater

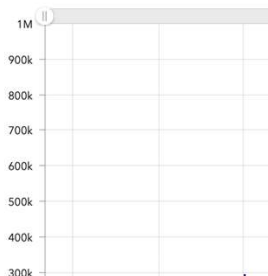
To Begin: Select a Sewershed from the list on the left.
Use layers list in the upper right to turn on zip codes



RNA Levels Map

Recent Wastewater Trends Map


Amherst Collection Area - Population: 140,324



All Sewersheds

Smoothed Trend

Historic RNA Copy Region - N2



7-day Average

Daily Positivity Rate

NYS Testing Trends

Daily Counts

RNA Levels Map

Total Virus Level Compared to Past Data (Percentile)

- 0% to 19%
- 20% to 39%
- 40% to 59%
- 60% to 79%
- 80% to 100%

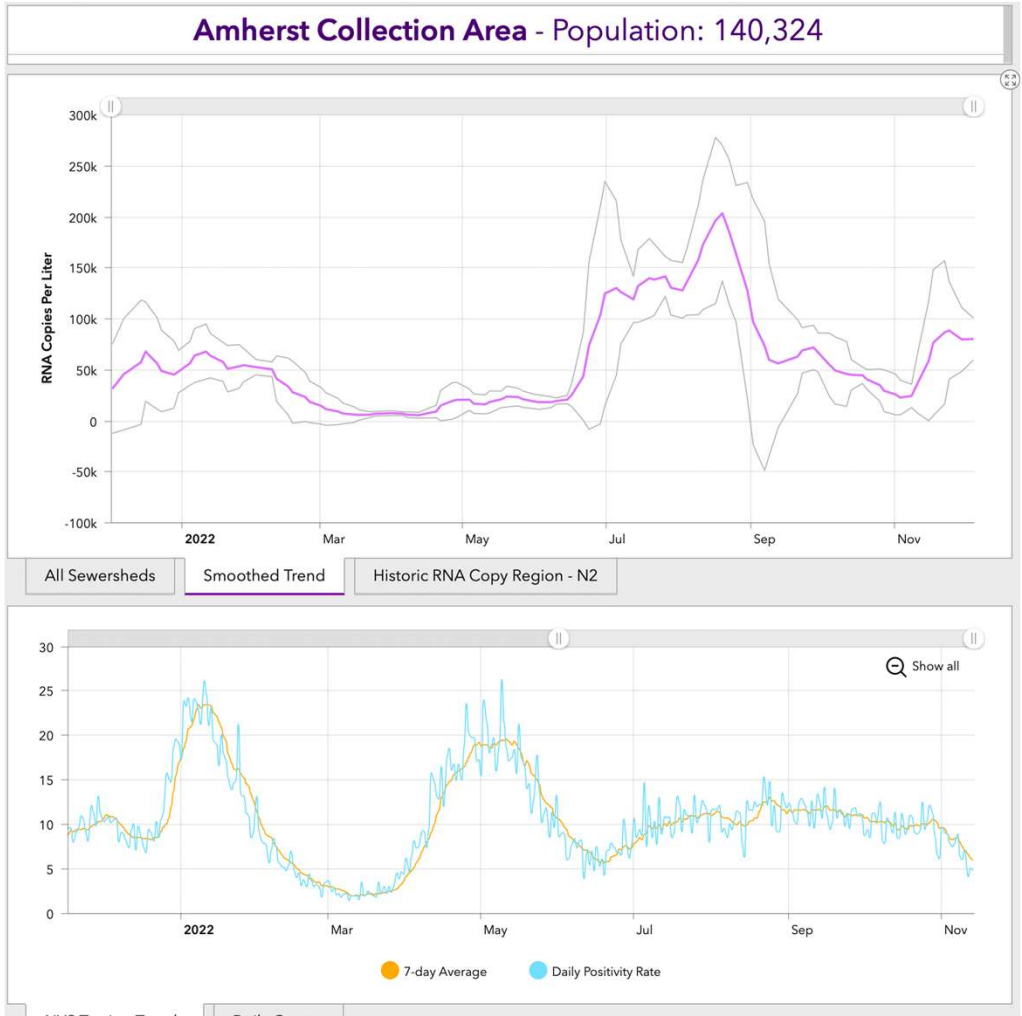
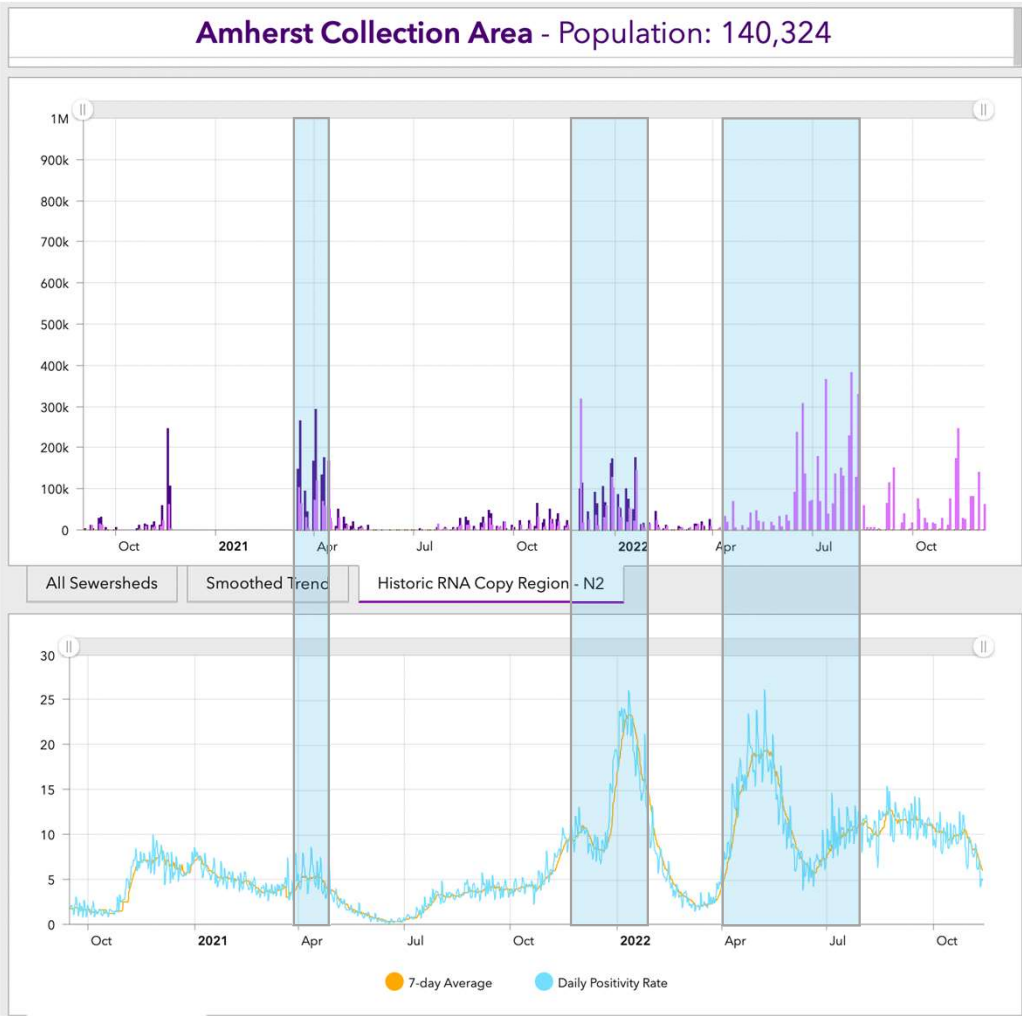
Recent Wastewater Trends Map

15-Day Change in Virus Levels (Percentage)

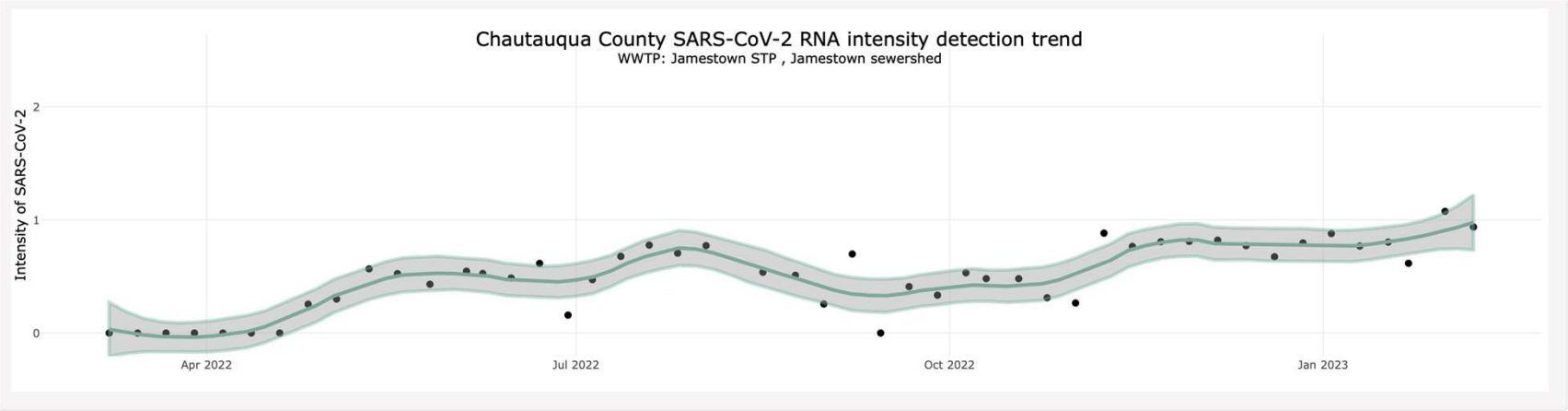
- 100%
- 99% to -10%
- 9% to 0%
- 1% to 9%
- 10% to 99%
- 100% to 999%
- 1000% or more

Data in this dashboard is provided by the County of Erie and University at Buffalo. This website and its contents herein, including all data, mapping, and analysis is provided to the public strictly for educational and academic research

Wastewater data collect over the last two years mirrors each wave of the pandemic

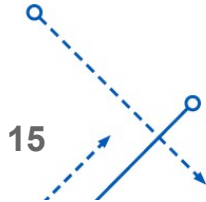
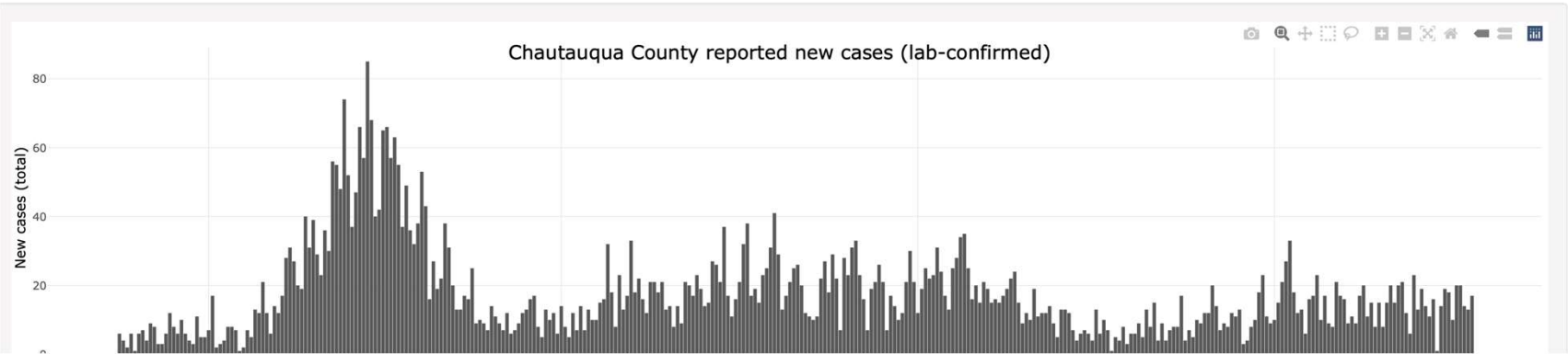


Wastewater data collect over the last two years mirrors each wave of the pandemic



Trend graph description show / hide

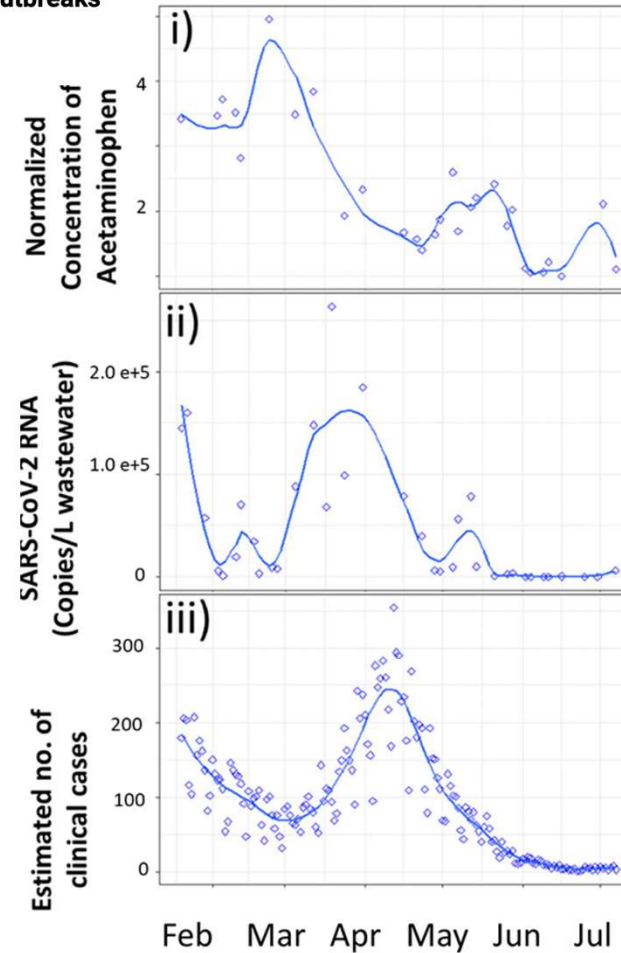
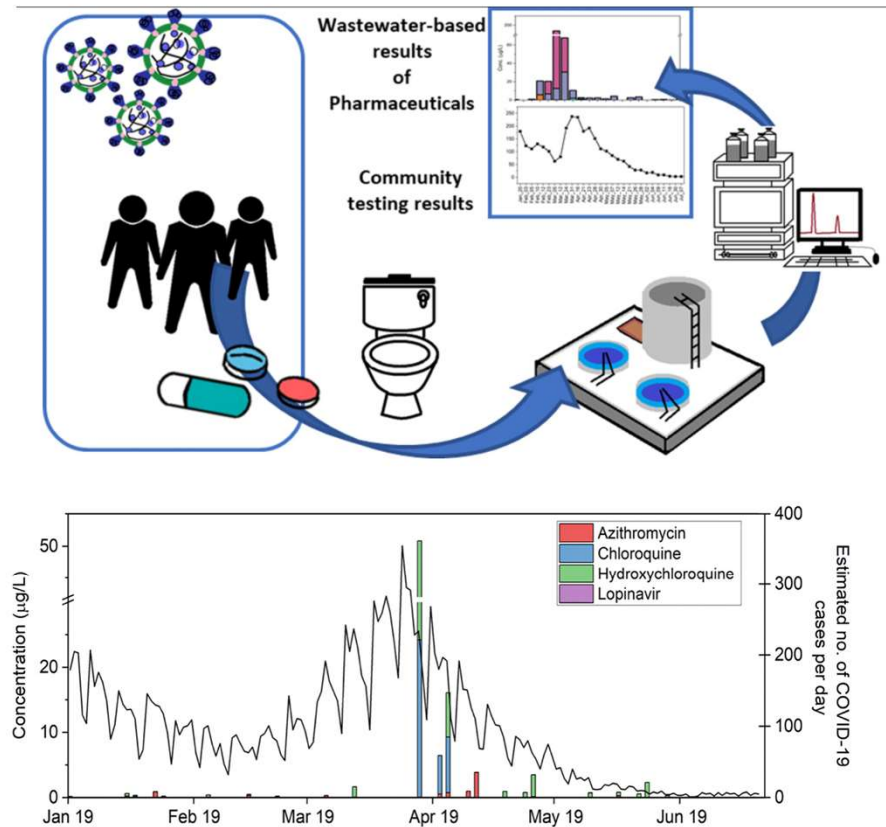
base data



In addition to biological data, we can capture chemical data for comparison

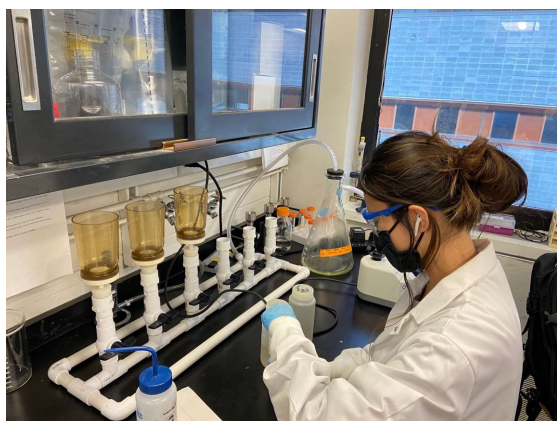
Complementing RNA Detection with Pharmaceutical Monitoring for Early Warning of Viral Outbreaks through Wastewater-Based Epidemiology

Lahiruni M. Halwatura, Isabella S. McLerran, Daniel L. Weglarski, Zia U. Ahmed, Yinyin Ye, Ian M. Bradley, and Diana S. Aga*



We are testing cost-effective wastewater processing methods to meet various needs of viral analysis.

Electronegative membrane filtration (EMF)



Tangential-flow ultrafiltration (UF) and wastewater solids



Photo: Douglas Levere

Nanotrap® magnetic beads



Acknowledgements



UB Genomics and Bioinformatics Core: Jennifer Surtees, Don Yergeau, Jonathan Bard, Natalie Lamb, Alyssa Pohlman, Amanda Boccolucci, Jamaal Emerson, Brandon Marzullo, Norma Nowak

UB Wastewater Committee: John Tomaszewski, Jean Wactawski-Wende, Tom Russo, Jeff Angiel, Brian Foti, Greg Wilding, Craig Abbey, Brian Haggerty

New York State Wastewater Network: Milagros Neyra, Dustin T. Hill, Lydia J. Bennett, Christopher Dunham, Mohammed Alazawi, Brenden Bedard, Mary Collins, Austin Fehrman, Christopher Gobler, Alejandro Godinez, Hyatt Green, Brianna Hanson, Tabassum Insaf, Haley Kappus-Kron, Daniel Lang, Elliot J. Moran, Dana Neigel, Shailla J. Raymond, David A. Larsen

Erie County collaborators: Joseph Fiegl, Gale Burstein



**Department
of Health**



**Erie County
Department of
Health**



Public Health
Prevent. Promote. Protect.

