

Assessing water quality conditions in vulnerable communities in the Chesapeake Bay watershed

July 26th 2023

Andrew Sekellick

Leah Staub

Tristan Mohs

U.S. Geological Survey, Maryland-Delaware-D.C. Water Science Center

What is a vulnerable community?

The conditions that affect public health often disproportionately impact specific communities due to a history of neglect and marginalization.

Compounding factors can increase vulnerability to disasters or long-term environmental hazards.



What is a vulnerable community?

Poverty, minority status, housing, and other factors can intensify human suffering and financial loss during a disaster.

The range of factors can be difficult to summarize for use by planners and public health officials.

**Enduring historical influences +
Present-day challenges +
Future climate change effects →
Increase in impacts on vulnerable communities**

Why focus on vulnerable communities?

PUBLIC HEALTH

People of Color Breathe More Unhealthy Air from Nearly All Polluting Sources

A trend of disproportionate exposure to deadly air pollution among Asian, Hispanic and Black people persists in most cases regardless of the emission source, a study finds

By Robin Lloyd on April 28, 2021

Why focus on vulnerable communities?






Why focus on vulnerable communities?

PUBLIC HEALTH

People of Color Breathe Unhealthy Air from Near Polluting Sources

PM_{2.5} polluters disproportionately and systemically affect people of color in the United States

CHRISTOPHER W. TESSUM , DAVID A. PAOLELLA , SARAH E. CHAMBLISS , JOSHUA S. APTE , JASON D. HILL , AND, JULIAN D. MARSHALL [Authors Info &](#)

SCIENCE ADVANCES • 28 Apr 2021 • Vol 7, Issue 18 • DOI: 10.1126/sciadv.abf4491

A trend of disproportionate exposure to deadly air pollution among Asian people persists in most cases regardless of the emission source, a study

April 28, 2021

Study Finds Exposure to Air Pollution Higher for People of Color Regardless of Region or Income

Published September 20, 2021



Why focus on vulnerable communities?

PUBLIC HEALTH

People of Color Breathe Unhealthy Air from Near Polluting Sources

A trend of disproportionate exposure to deadly air pollution among Asian people persists in most cases regardless of the emission source, a study finds

Study Finds Exposure to Air Pollution Affects People of Color Regardless of Income

Published September 20, 2021



Redlining means 45 million Americans are breathing dirtier air, 50 years after it ended

Boyle Heights, a heavily Latino area in Los Angeles singled out for its 'detrimental racial elements,' has one of the highest pollution scores in California

PM_{2.5} polluters disproportionately and systemically affect people of color in the United States

CHRISTOPHER W. TESSUM , DAVID A. PAOLELLA , SARAH E. CHAMBLISS , JOSHUA S. APTE , JASON D. HILL , AND, JULIAN D. MARSHALL  [Affiliations](#) [Authors Info & Contributions](#)

SCIENCE ADVANCES • 28 Apr 2021 • Vol 7, Issue 18 • DOI: 10.1126/sciadv.abf4491



By Darryl Fears

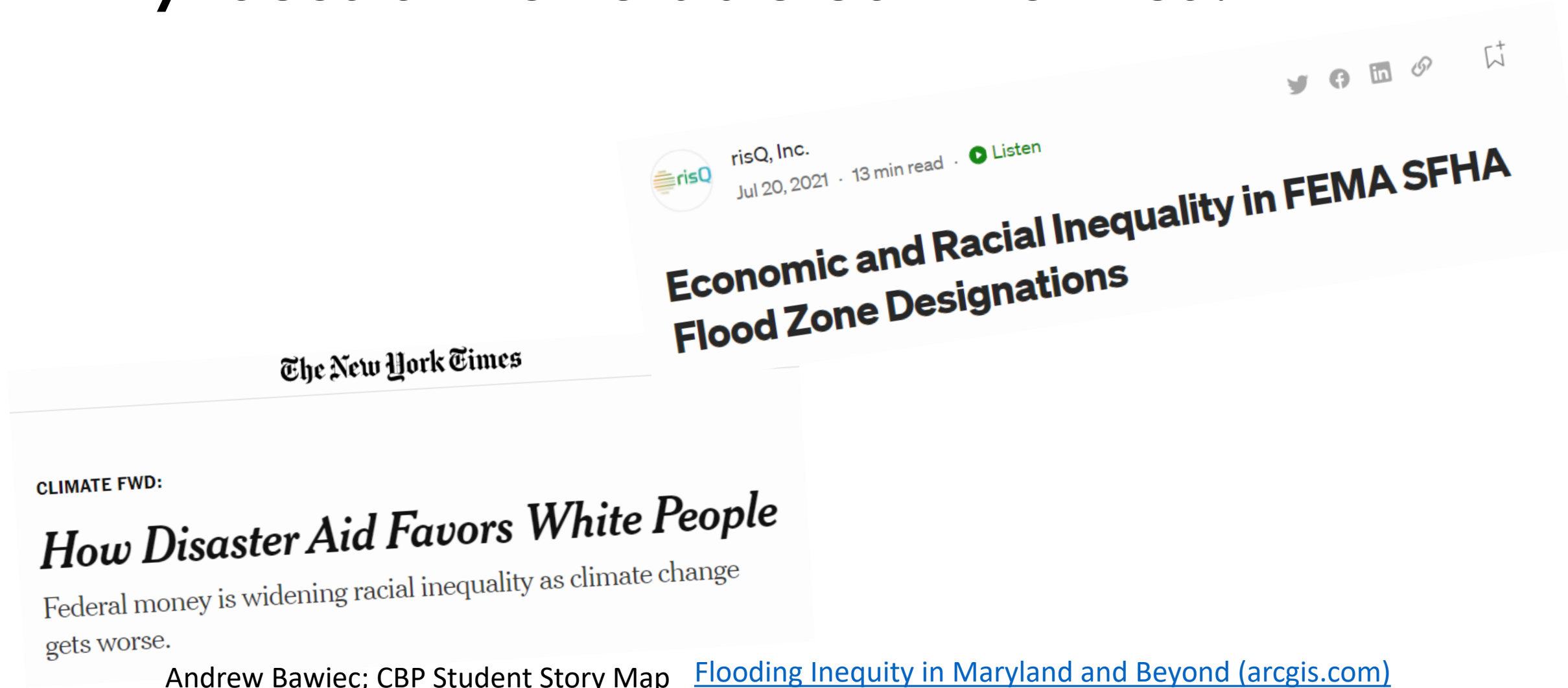
March 9, 2022 at 8:00 a.m. EST

Why focus on vulnerable communities?



[Flooding Inequity in Maryland and Beyond \(arcgis.com\)](https://arcgis.com)

Why focus on vulnerable communities?



The collage features three overlapping news snippets. The top snippet is from 'risQ, Inc.' dated July 20, 2021, with a 13-minute read time and a 'Listen' button. The headline reads 'Economic and Racial Inequality in FEMA SFHA Flood Zone Designations'. The middle snippet is from 'The New York Times' under the 'CLIMATE FWD:' section, with the headline 'How Disaster Aid Favors White People' and a sub-headline 'Federal money is widening racial inequality as climate change gets worse.' The bottom snippet is from 'Andrew Bawiec; CBP Student Story Map' with the headline 'Flooding Inequity in Maryland and Beyond (arctis.com)'.

risQ, Inc.
Jul 20, 2021 · 13 min read · Listen

Economic and Racial Inequality in FEMA SFHA Flood Zone Designations

The New York Times

CLIMATE FWD:

How Disaster Aid Favors White People
Federal money is widening racial inequality as climate change gets worse.

Andrew Bawiec; CBP Student Story Map [Flooding Inequity in Maryland and Beyond \(arctis.com\)](#)

Why focus on vulnerable communities?

E&E NEWS

POLICY

Advisers Rebuke FEMA for Racial Disparities in Disaster Aid


Disaster Aid

A federal panel set up after Hurricane Katrina warned that aid disproportionately helps wealthier areas

By Thomas Frank, E&E News on January 7, 2021

The New York Times

isQ, Inc.

isQ, Inc.
Jul 20, 2021 · 13 min read ·  Listen

isQ, Inc.
Jul 20, 2021 · 13 min read ·  Listen

Economic and Racial Inequality in FEMA SFHA Flood Zone Designations

CLIMATE FWD:

How Disaster Aid Favors White People

Federal money is widening racial inequality as climate change gets worse.

Andrew Bawiec; CBP Student Story Map [Flooding Inequity in Maryland and Beyond \(arcgis.com\)](https://arcgis.com)

This information is preliminary and is subject to revision. Not for Citation or Distribution.

Why focus on vulnerable communities?

E&E NEWS
POLICY

Advisers Rebuke FEMA for Racial Disparities in Disaster Aid

A federal panel set up after Hurricane Katrina

Disasters in Disaster Aid

A federal panel set up after Hurricane Katrina warned that aid disproportionately helps wealthier areas

By Thomas Frank, E&E News on January 7, 2021

The New York Times

CLIMATE FWD:


CLIMATE FWD.

How Disaster Aid Favors White People

by [Kaitlyn Green](#) and [Kaitlyn Green](#) climate change

Federal money is widening racial inequality as climate change gets worse.

isQ, Inc.

isQ, Inc.
Jul 20, 2021 · 13 min read ·  Listen

isQ, Inc.
Jul 20, 2021 · 13 min read ·  Listen

Economic and Racial Inequality in FEMA SFHA Flood Zone Designations

Why FEMA Aid Is Unavailable To Many Who Need It The Most

By Rebecca Hersher

By **Rebecca Hersher**
Published June 29, 2021 at 5:01 AM EDT

Andrew Bawiec; CBP Student Story Map [Flooding Inequity in Maryland and Beyond \(arcgis.com\)](https://arcgis.com)

This information is preliminary and is subject to revision. Not for Citation or Distribution.

Why focus on vulnerable communities?

America the Beautiful

Justice40

Executive Orders 14008 & 12898

**Executive Order to Revitalize
Our Nation's Commitment to
Environmental Justice for All**

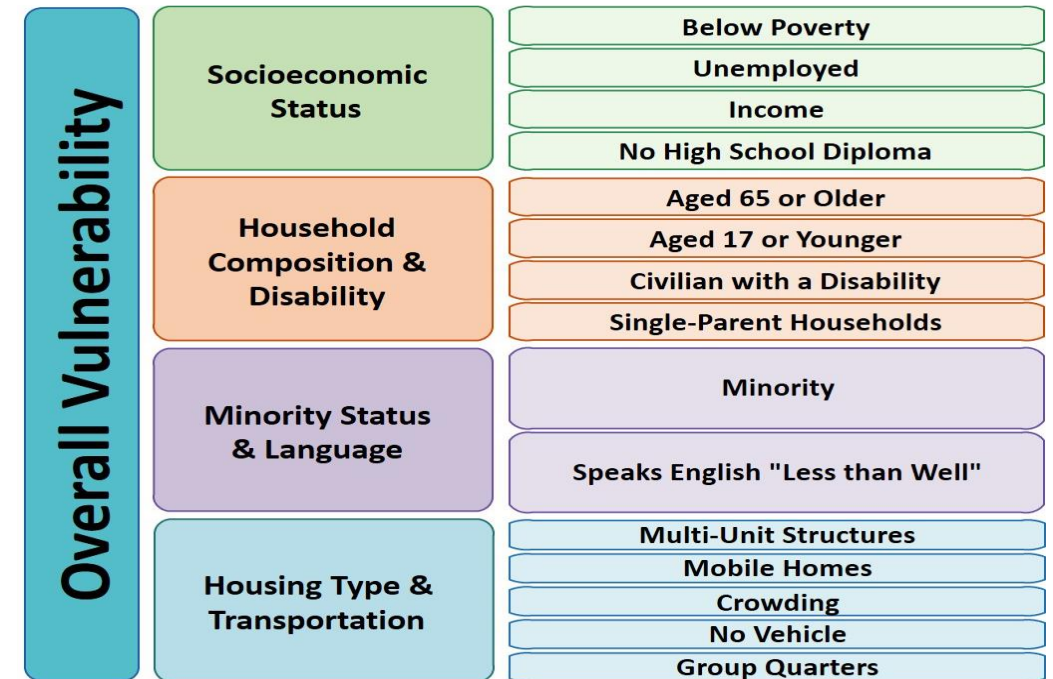
...and it's the right thing to do!

- Conserve America's Lands
 - and Waters
- Support Healthy Communities
 - Address the Climate Crisis
 - Empowering Workers
- Securing Environmental Justice
 - Remediation/Reduction of legacy pollution
 - Clean water infrastructure
- **Promote the latest science, data, and research, including on cumulative impacts.**

CDC Social Vulnerability Index

The Centers for Disease Control (CDC) combines a set of factors into a social vulnerability index (SVI).

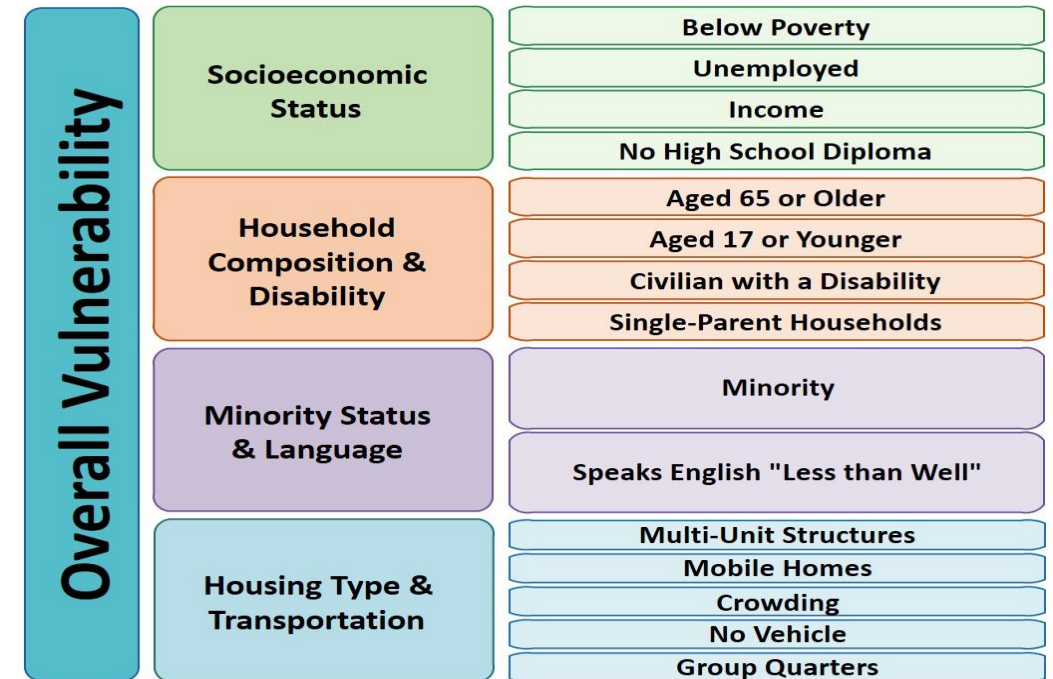
The SVI is calculated at the Census tract scale for select years from 2000 to 2020.



CDC Social Vulnerability Index

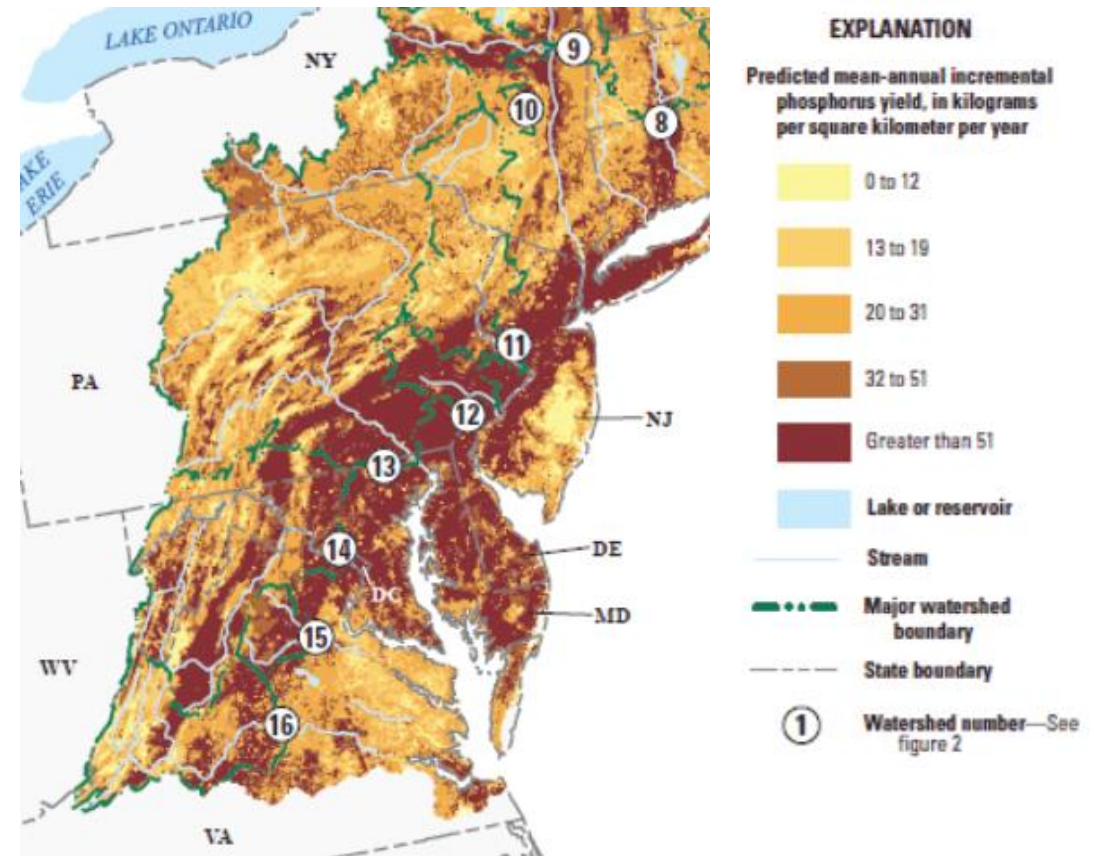
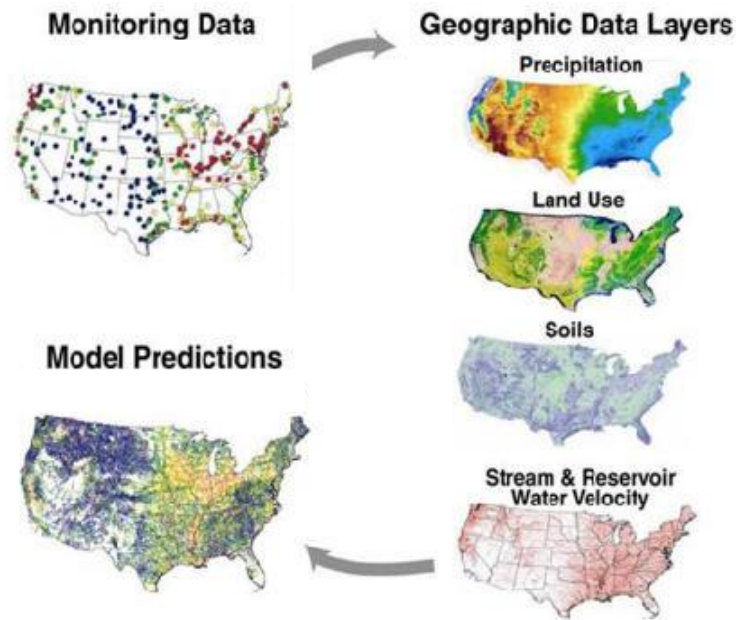
A census tract receives a “flag” if it is in the top 10% of values to indicate high vulnerability.

Flags are calculated for individual factors and can be summed for theme and overall values.



What do our existing water quality models tell us about conditions in vulnerable communities?

SPARROW models provide wall-to-wall predictions of water quality conditions.



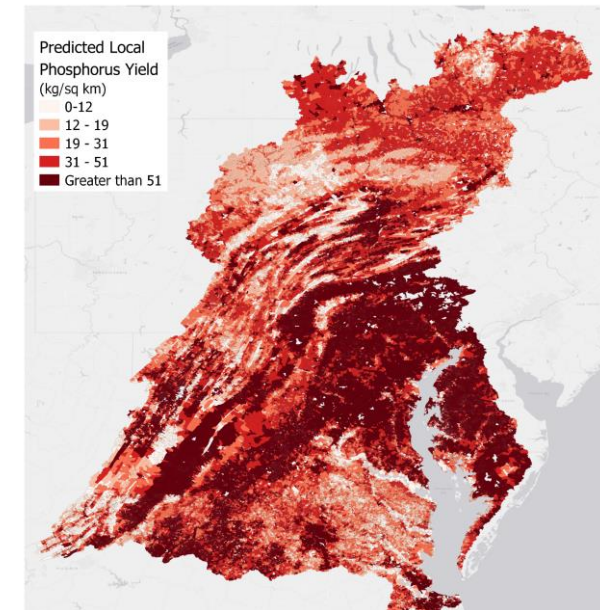
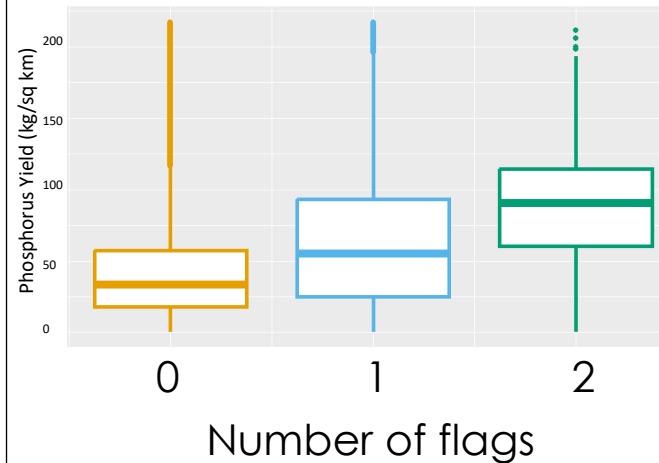
What do our existing water quality models tell us about conditions in vulnerable communities?

SPARROW water quality model predictions were compared with SVI theme 3 flags.

Preliminary statistical analysis suggests a possible relationship between predicted in-stream nutrient loads and SVI risk factors.

Excessive nutrients in streams and waterbodies can lead to harmful algal blooms, drinking-water treatment issues, and other negative health effects.

Predicted Local Phosphorus Yields and SVI Theme 3 Flags



Minority Status
& Language

Minority

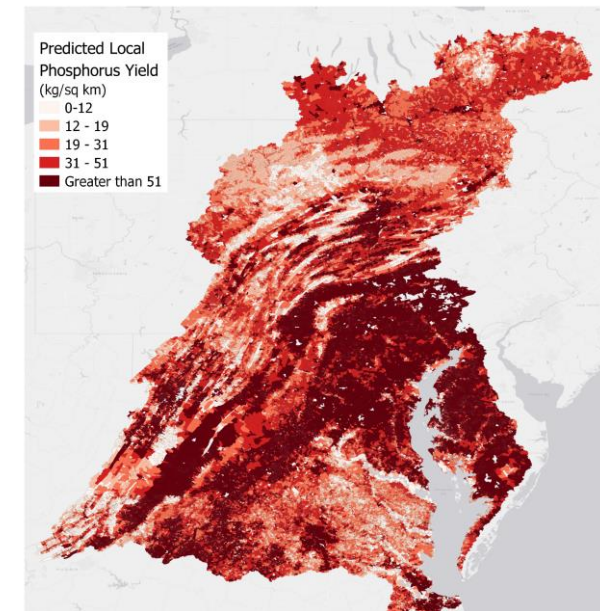
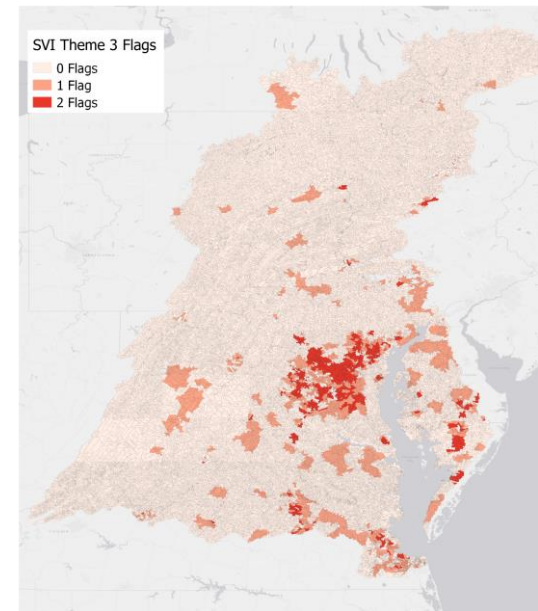
Speaks English "Less than Well"

What do our existing water quality models tell us about conditions in vulnerable communities?

SPARROW water quality model predictions were compared with SVI theme 3 flags.

Preliminary statistical analysis suggests a possible relationship between predicted in-stream nutrient loads and SVI risk factors.

Excessive nutrients in streams and waterbodies can lead to harmful algal blooms, drinking-water treatment issues, and other negative health effects.



Minority Status
& Language

Minority

Speaks English "Less than Well"

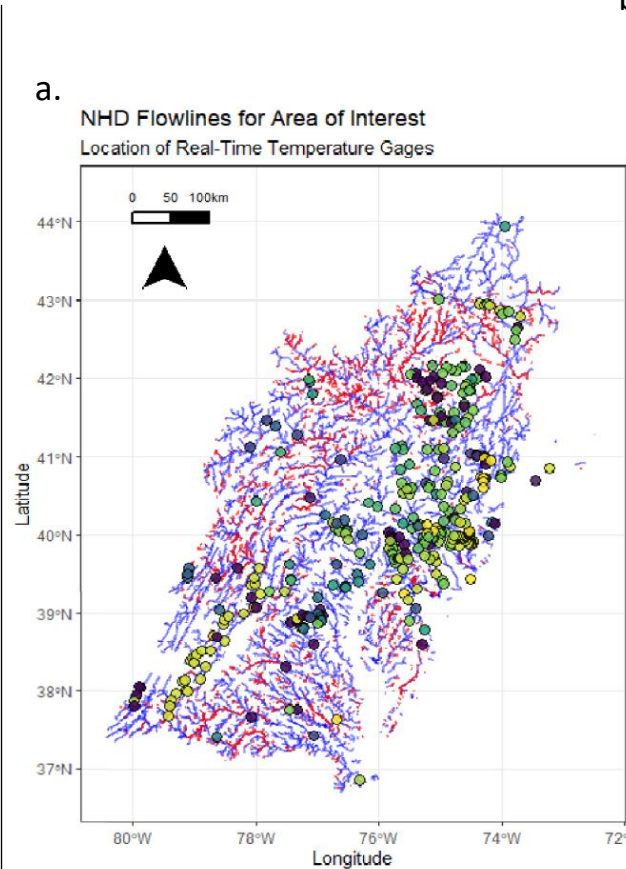
Does our current monitoring network represent the full range of social conditions?

USGS gage networks are designed for a variety of objectives and with different constraints.

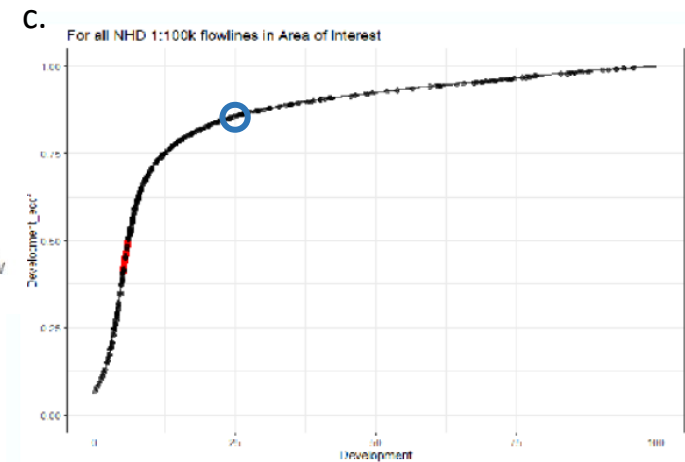
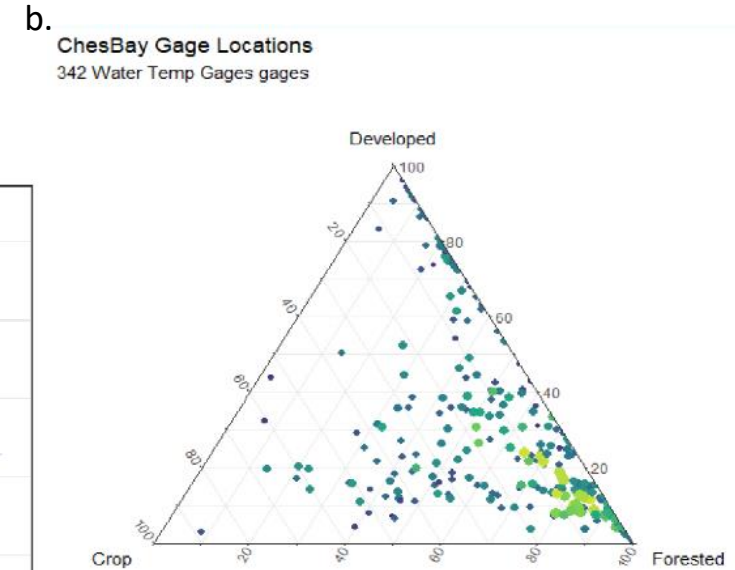
Objectives generally are not related to a community's social vulnerability.

Network analyses identify gaps for monitoring and modeling.

Including SVI risk factors could identify disadvantaged communities that lack sufficient monitoring of flood conditions or exposure to poor water quality.



Workflow in development by Cashman et al.



Network optimization challenges

An Objective Approach for Designing Stream Monitoring Networks: Scott W. Ator, Joel D. Blomquist, Gregory E. Schwarz, and Andrew J. Sekellick

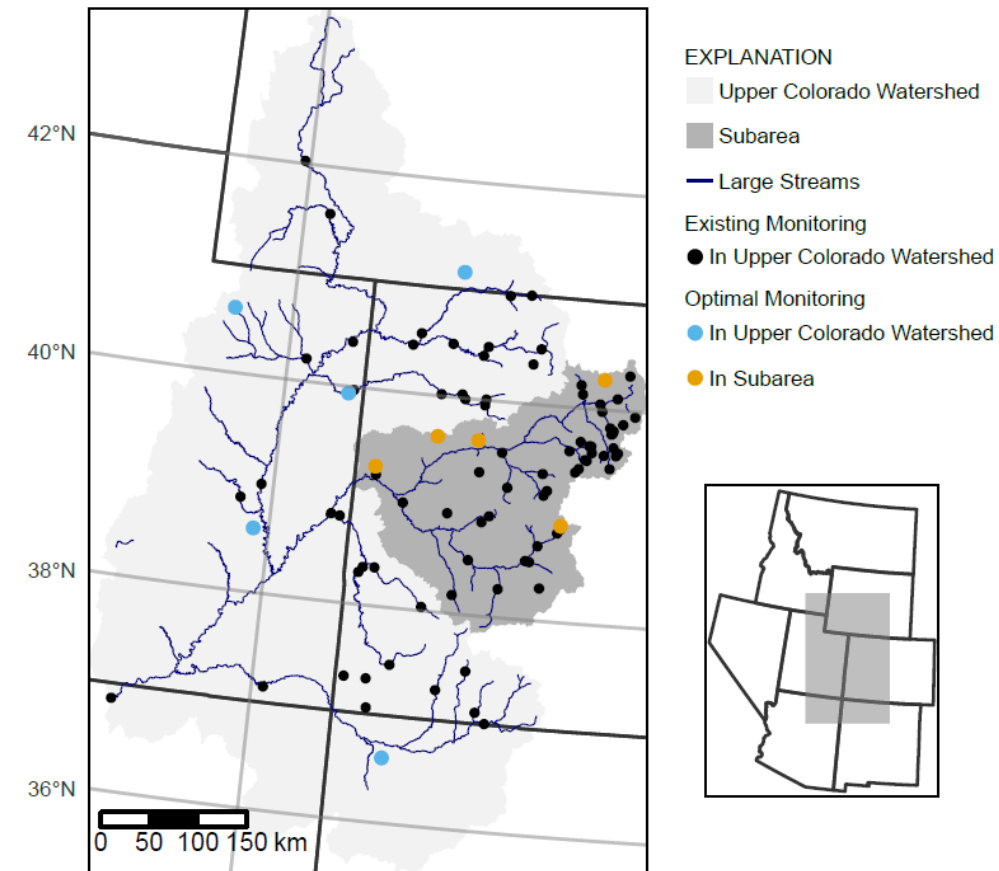
Stream conditions are affected by complex and interacting conditions.

- Sources of water and contaminants
- Natural conditions
- Human activities

Streams are spatially diverse and distributed throughout the landscape.

Monitoring locations selected to minimize:

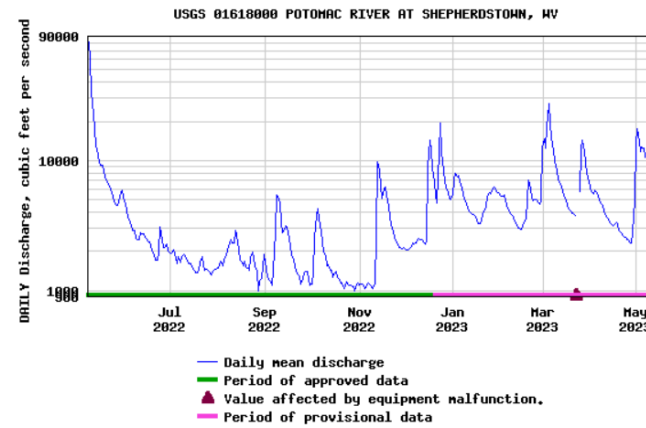
- Knowledge gaps
- Redundancies



Stream gaging



Photo credit: David Fisher



- Flood warnings
- Infrastructure Design
- Floodplain Mapping
- Monitor pollutant discharge
- Protect water quality
- Education and Research
- Recreational

Next steps

Evaluate relationships between all SVI factors and SPARROW water quality predictions.

These analyses could also be performed with other models or spatial data layers (CAST, pesticides, toxic contaminants, etc).

Perform gage network analysis to identify the range of social conditions represented in our monitoring network.

Evaluate network for both flood warning and assessment of contaminants.

Interdisciplinary collaboration opportunity to investigate human and socioeconomic impact.

Presentations and posters

- **Poster - USGS Chesapeake Bay Workshop: June 27th-19th 2022**
- **Presentation - USGS Socio-Hydrology Team: Sept 9th 2022**
- **Presentation - Maryland Water Monitoring Council: Dec 15th 2022**
- **Presentation - Center All Hands: Jan 12th 2023**
- **Poster - UMBC MOU signing tour: April 21st 2023**
- **Presentation - Maryland Silver Jackets meeting: May 9th 2023**
- **Presentation - NER DEIA Council meeting: May 11th 2023**
- **Presentation - USGS EJ Task Force: June 6th 2023**