From Air Pollution to Solutions:

Using low-cost sensors to understand and reduce exposure to air pollution

Kathryn Savoie, Ph.D.
Director of Equity & Environmental Justice

Jeff Gearhart
Research Director

ECOLOGY CENTER

Presentation overview

1) Explore **how low-cost sensors are used** by individuals & community groups to understand air pollution
2) Understand **benefits and limitations** of low-cost sensors
3) Some examples of **how low-cost sensors are being used in Detroit**
4) How to take individual and collective action to **reduce exposures**


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Sensors can **reveal patterns** of exposure

& **inform actions** to reduce exposure

Sensors help **educate others**

Sensors can help **educate** community members, and middle and high school students **about air quality**

- **Reliable, easy to use, low-maintenance** sensor
- Want to monitor air quality in **varied locations**
- Used sensors to measure **particulate matter and other pollutants**

High school students in the Be A Good Neighbor program use sensors to explore urban air quality in Hamtramck, Michigan

Data helped students "see" air pollution

Sensors can help identify **varied PM2.5 concentrations,** such as peaks at **intersections** and close to **sources of PM,** such as industry, railyards, and near freeways

"When trains entered the subway station, the sensor readings got all spikey."

Community workshop on air quality and air monitoring at Georgia Street Community Garden, August 2020 (left); Purple Air Monitor (right)

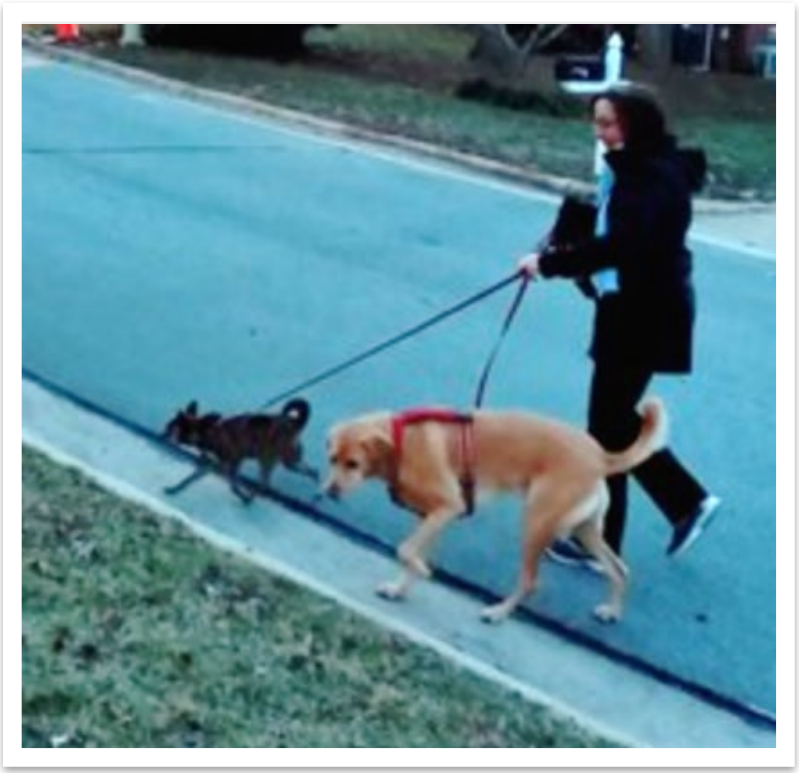
Jeff Gearhart, Ecology Center Research Director at Ecology

Education about air quality and air sensors at the Georgia Street Community Collective Health Fair, August 2020

Sensors inform **personal choices**

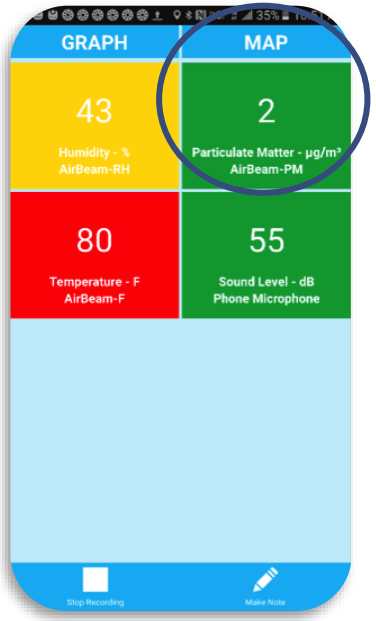
Lisa wondered whether PM exposure **worsened her family's health**

- Husband and daughter had **health problems potentially affected by PM exposure**
- Wanted to monitor air quality in **varied locations**, outdoors and indoors



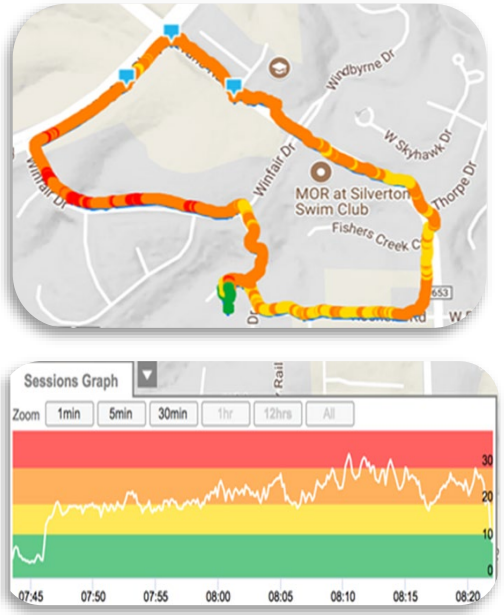
Using a portable sensor to estimate outdoor PM

AirBeam Sensor +



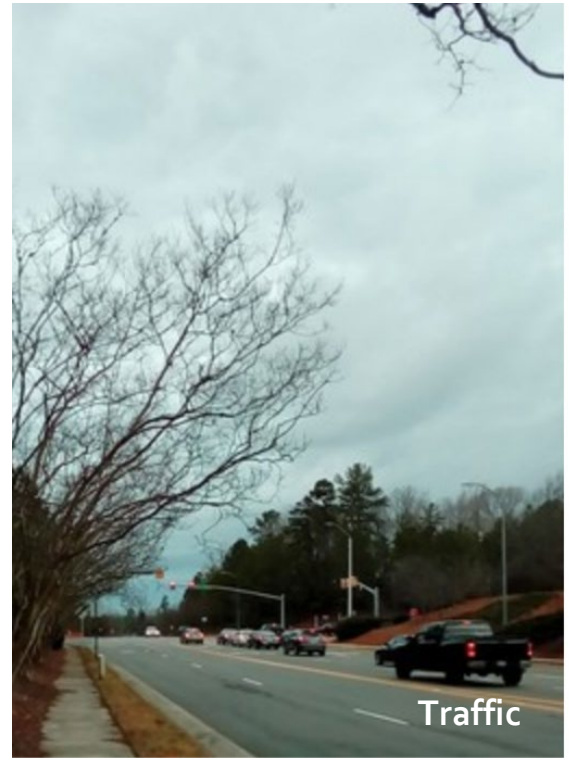
Android App =

PM2.5 readings +

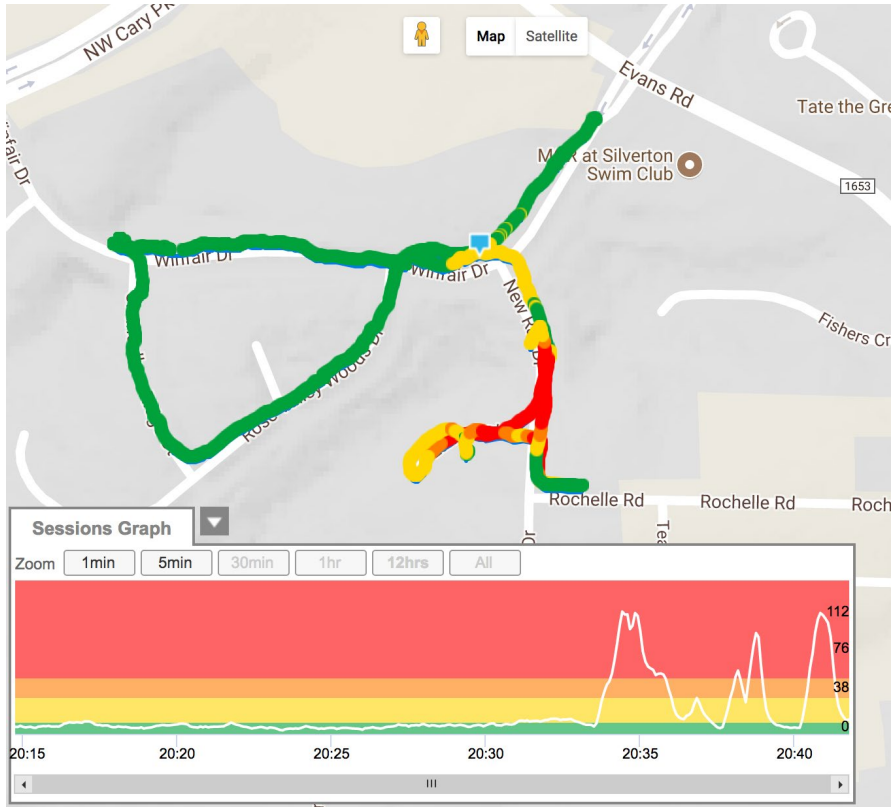


Map and graph

What are some potential sources of particle pollution Lisa might encounter on her walks?



What might explain this area of high PM2.5?



Air Beam Data

Peak PM: 112 µg/m³

Friday, Jan 26, 2018

AQI: Good

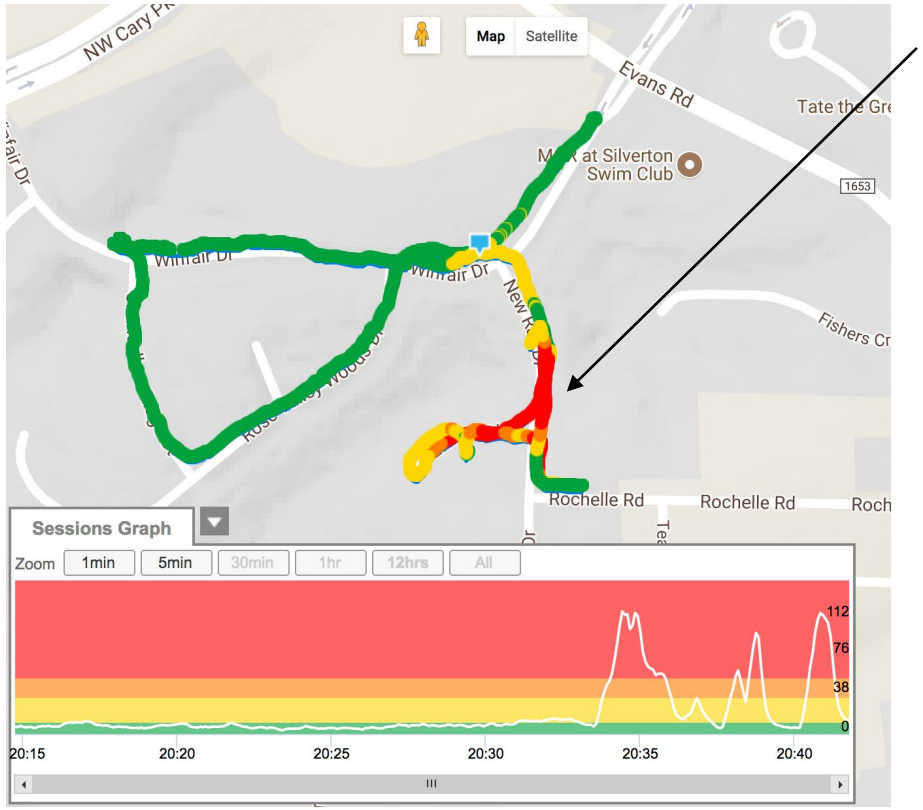
Evening: 25 minute walk

Temp: 53°F

Relative humidity: 35%

Sky: after dark, not windy

Wood smoke can impact PM2.5 levels



Strong smell of **wood smoke** during Friday evening walk

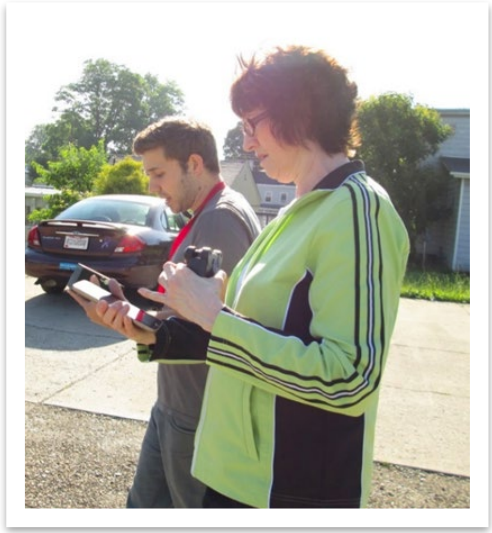
Data informed choices to reduce PM exposure

PM2.5 varied:

- **By time of day** and **weather conditions**
- Higher near roads with **heavy traffic** and sources of **wood smoke**

Lisa and family **spend less time near these sources** at times with high readings

Sensors help **investigate local sources**



Donna wondered whether BBQ restaurant was **harming neighbors' health**

- Neighborhood got **smoky** when BBQ was cooking
- Wanted **fast measurements** that **could be shared with others**, including media

Data identified restaurant as local PM source

Chronic exposure to these levels **may pose a health risk**, especially for sensitive populations

"The sensor helped us draw attention to this local source of air pollution."

Interpreting sensor readings

334 µg/m³

1-minute particle pollution ($PM_{2.5}$) readings *Not for regulatory purposes*	
Low **0-29 µg/m3**	Enjoy your outdoor activities.
Medium **30-69 µg/m3**	If medium readings continue (for an hour or more), use the Air Quality Index to plan outdoor activities.
High **70 - 499 µg/m3**	You may be near a source of particle pollution like dust, smoke or exhaust. Check the Air Quality Index to plan outdoor activities.
Very High **≥500 µg/m3**	You may be near a source of particle pollution like dust, smoke or exhaust. Check the Air Quality Index to find out if you should adjust outdoor activities. Very high readings may mean the sensor is not working properly.

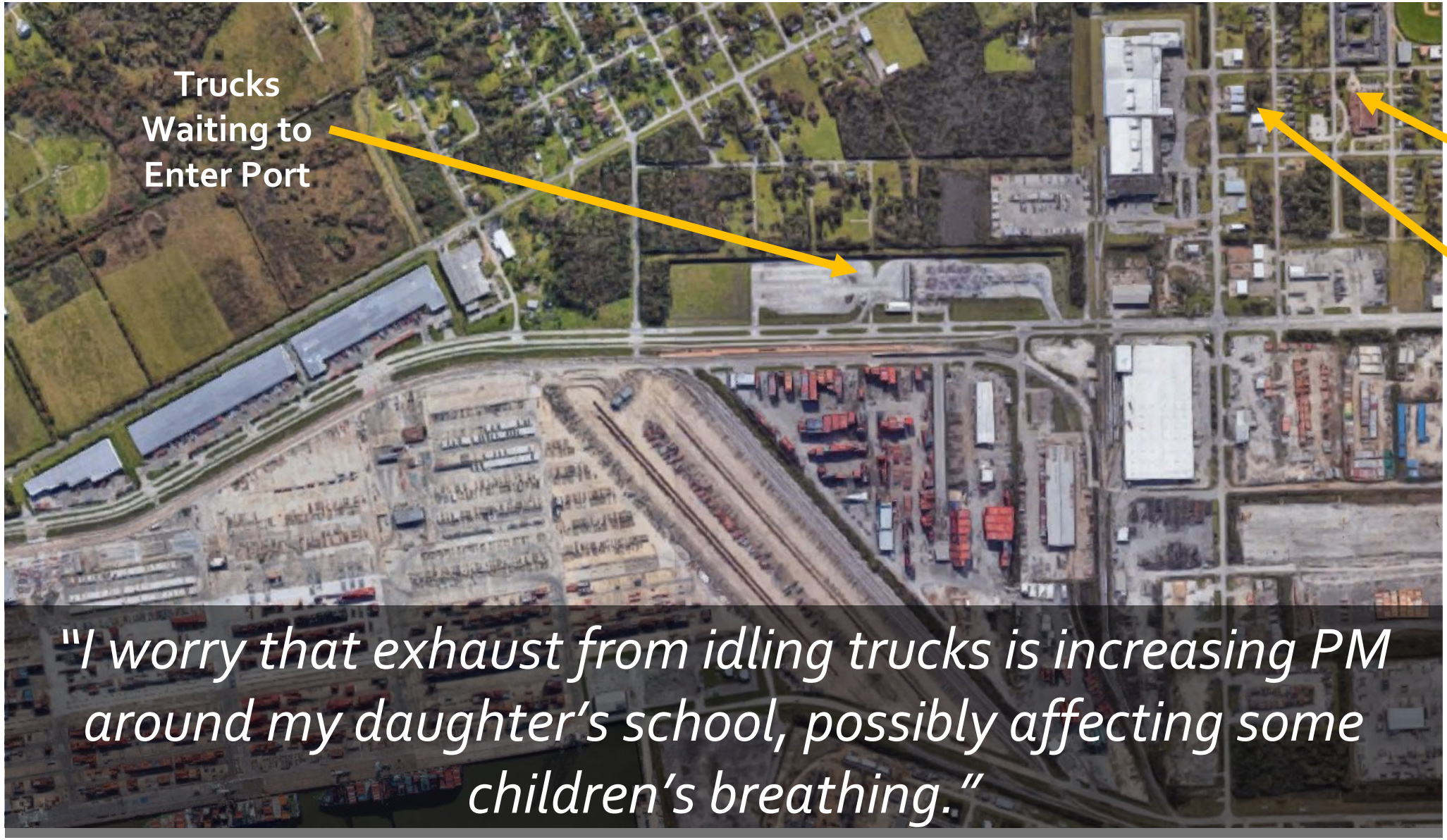
These readings prompted the Health Department to collect its own data

https://www.epa.gov/air-sensor-toolbox/what-do-my-sensor-readings-mean-sensor-scale-pilot-project

Sensors **enable community action** to reduce exposure

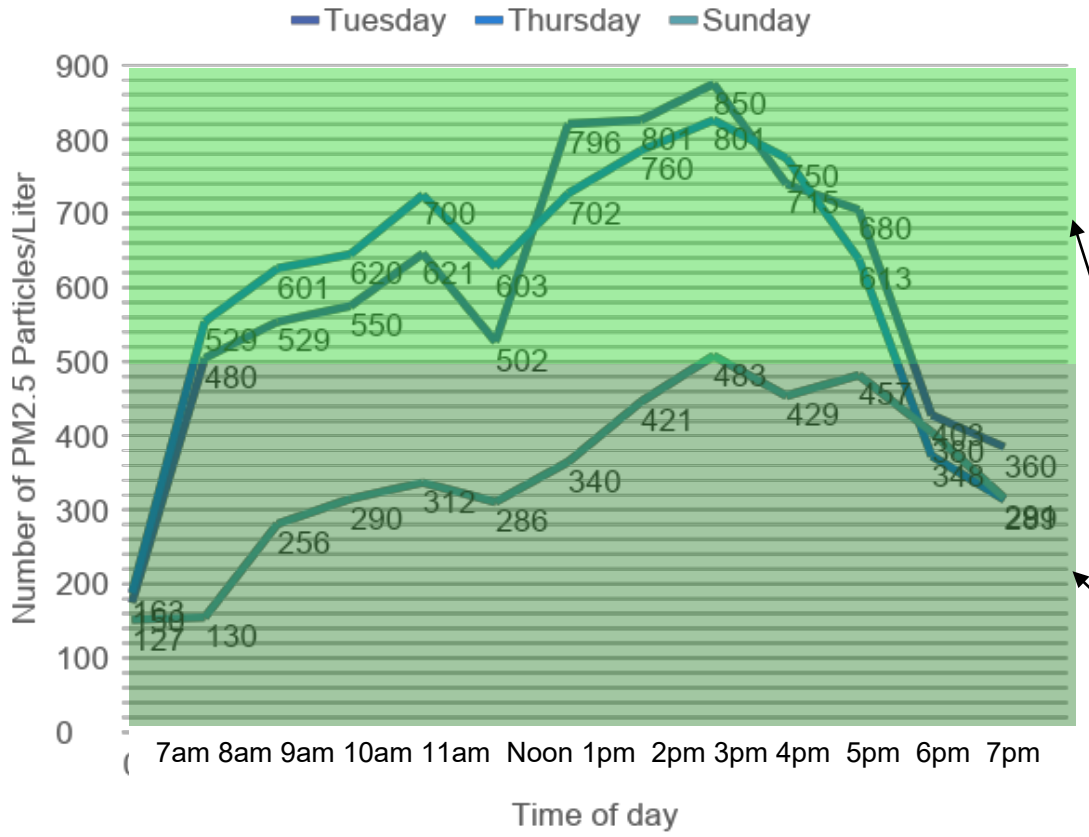
Marta and other parents were concerned about **PM exposure in the schoolyard**

- Neighborhood is near a **major port** that hosts a **large container terminal**
- **High volume** of **daily truck traffic**



"I worry that exhaust from idling trucks is increasing PM around my daughter's school, possibly affecting some children's breathing."

Data demonstrated daily PM patterns



Particle Counts (pp_)	Estimated Mass (µg/m³)	Rating	Description
8001 - 16000	321 - 640	Very High	This level of particles is unsafe and warrants more serious long-term health effects if sustained.
4001 - 8000	161 - 320	High	Air pollution levels are dangerous and everyone may experience coughing, itchy eyes or other symptoms. This level of particles may significantly trigger asthma and allergy symptoms. Work to decrease values as soon as possible or consider wearing a mask.
2001 - 4000	81 - 160	Elevated	Air pollution is unacceptably high and problematic for all persons due to significant particulate loading in the air. Brief exposures to this level often occur from cleaning, such as vacuuming a carpet. If this level is sustained during the nighttime, consider investing in an air filter for the bedroom.
1001 - 2000	41 - 80	Slightly Elevated	Air quality is problematic for vulnerable populations (elderly, respiro-compromised individuals or children). This level of pollution warrants taking steps to try to reduce: turn on your kitchen hood vent, consider opening or closing a window as appropriate, etc.
501 - 1000	21 - 40	Moderate	Air quality poses a slightly elevated risk of asthma, allergy and arrhythmia symptoms. Frequently seen moderate level of particulates are often caused by human behavior (cooking, candle burning, etc.).
0 - 500	0 - 20	Good	Air quality is considered good and there is little risk of particulates causing harm to your health.

https://www.specksensor.com/support/tech-specs

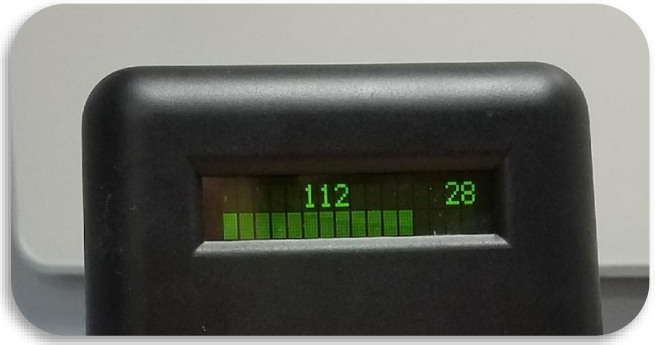
There were **increases in** PM2.5 in homes around the school **during times of heavier truck traffic** at the port

Sensors **reveal patterns** & **inform action**

1. **Educate about air pollution**
2. **Understand personal exposure**
3. **Identify local sources**
4. **Advocate for cleaner air**

Limits of sensor results

- **Differ from AQI** values
  - 1-minute sensor readings ≠ 24 hr averages (as reported on the AQI)
- **Can be inaccurate** due to
  - Environmental factors, such as temperature & high humidity
  - Low PM2.5 concentrations
  - Calibration (or "tuning") error



Despite limitations, sensors can show patterns and help identify questions for further exploration.

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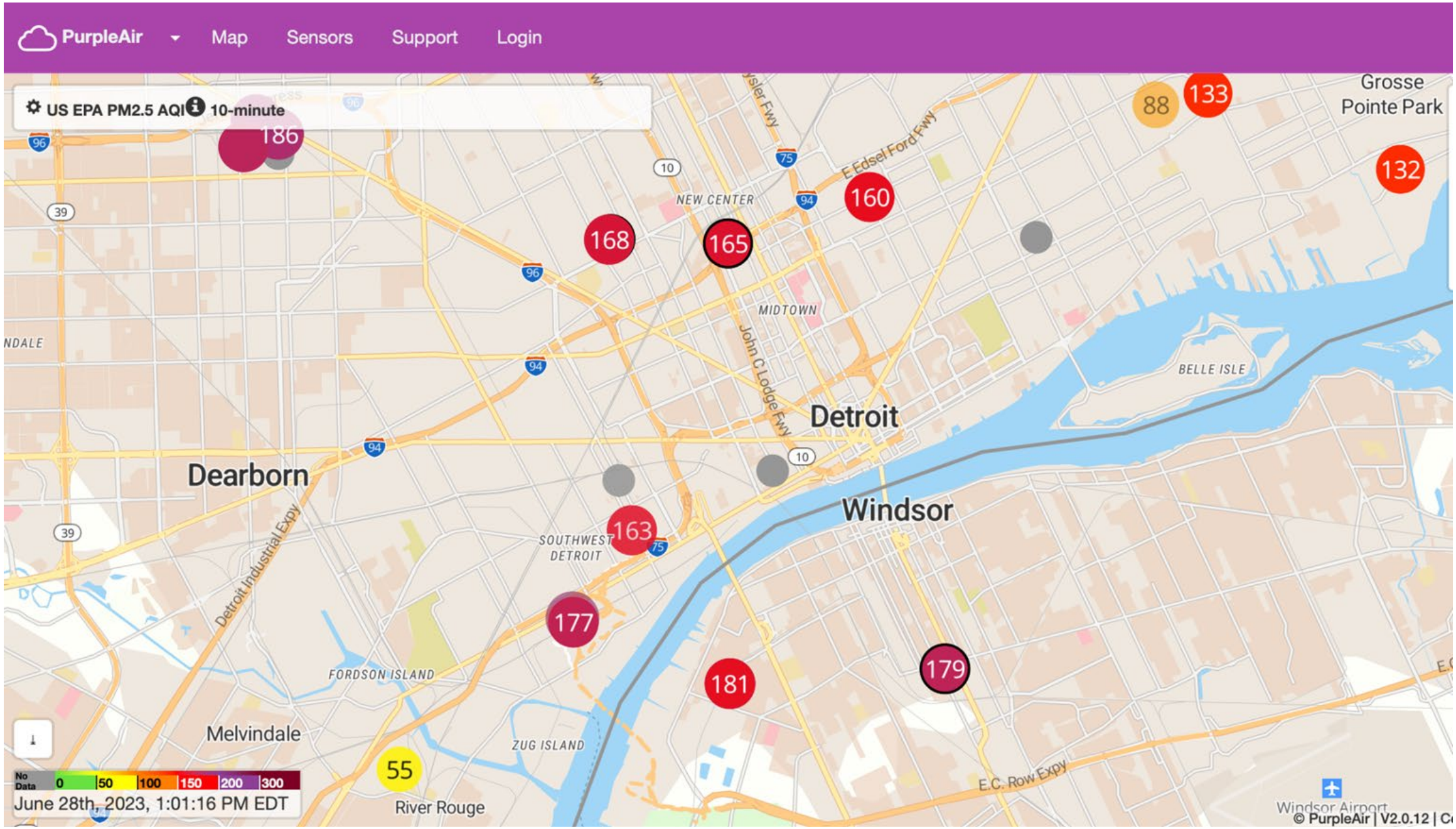
Co-Location with EPA Air Monitors

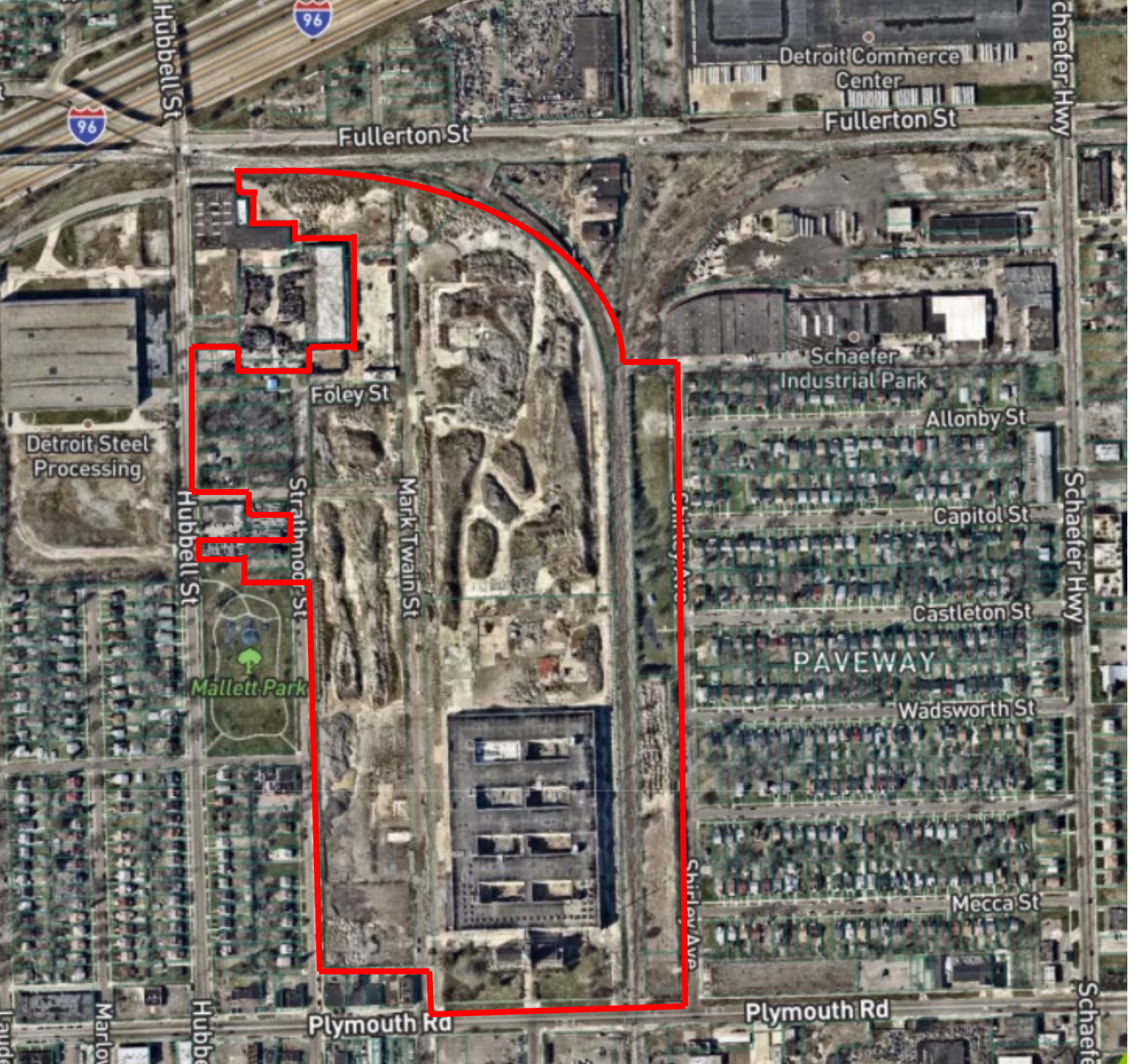
How are sensors are being used in Detroit?

Purple Air Monitors

- Measure $PM_{2.5}$ and PM_{10}
- Do not measure other pollutants
- Require wi-fi and electricity
- Data is collected and uploaded every couple of minutes onto a publicly available website
- Collects data on air conditions
  - temperature & humidity



PurpleAir.com/map



Detroit People's Platform & Paveway Community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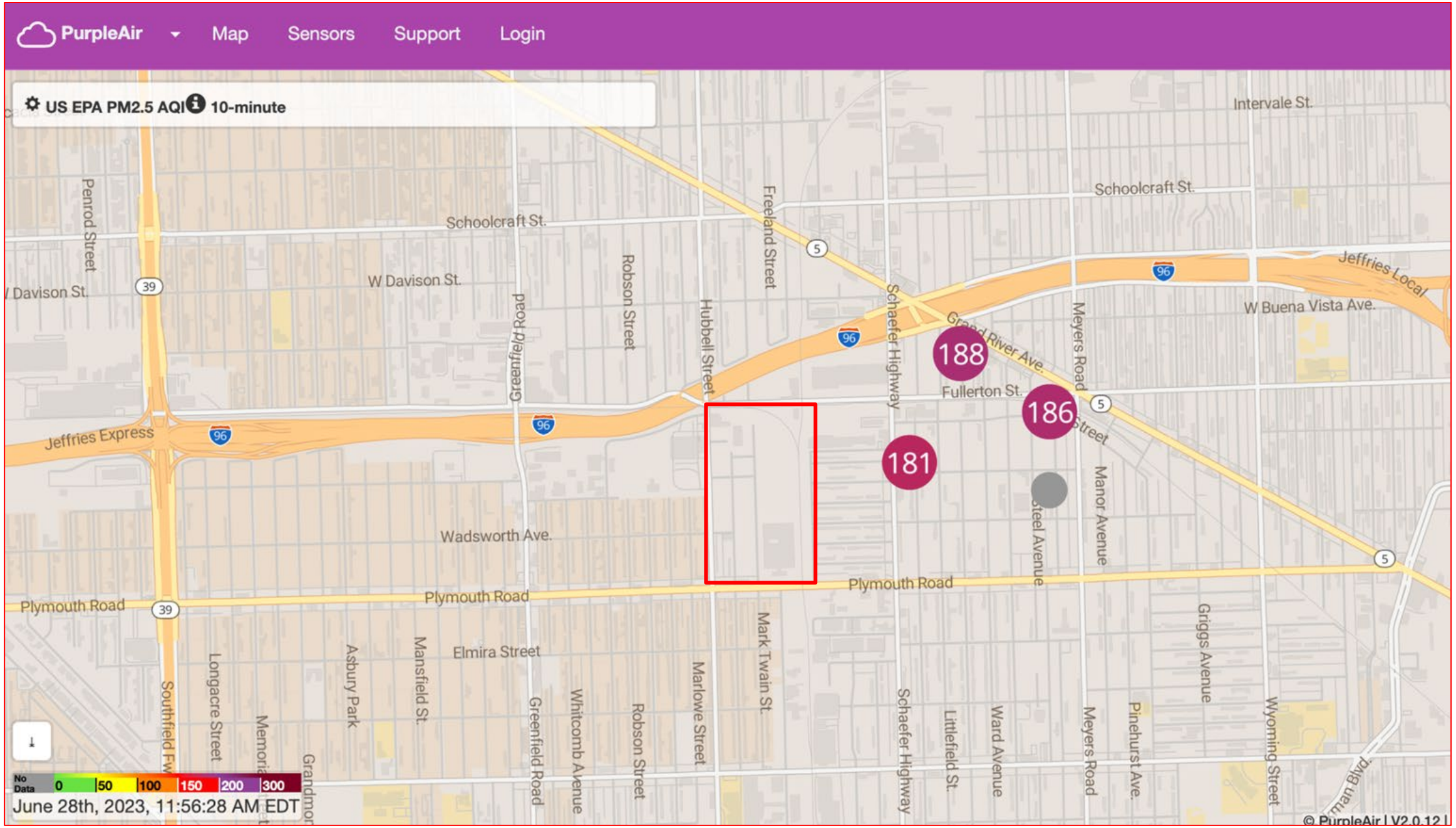
PurpleAir
Map
Sensors
Support
Login
US EPA PM2.5 AQI
10-minute
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186
181
Fullerton St.
Schoolcraft St.
W Davison St.
Jeffries Express
Jeffries Local
W Buena Vista Ave.
Grand River Ave.
Wadsworth Ave.
Plymouth Road
Elmira Street
Intervale St.
Penrod Street
Freeland Street
Robson Street
Hubbell Street
Greenfield Road
Schaefer Highway
Meyers Road
Manor Avenue
Steel Avenue
Griggs Avenue
Wyoming Street
Mark Twain St.
Marlowe Street
Whitcomb Avenue
Asbury Park
Mansfield St.
Longacre Street
Southfield Fwy
Littlefield St.
Ward Avenue
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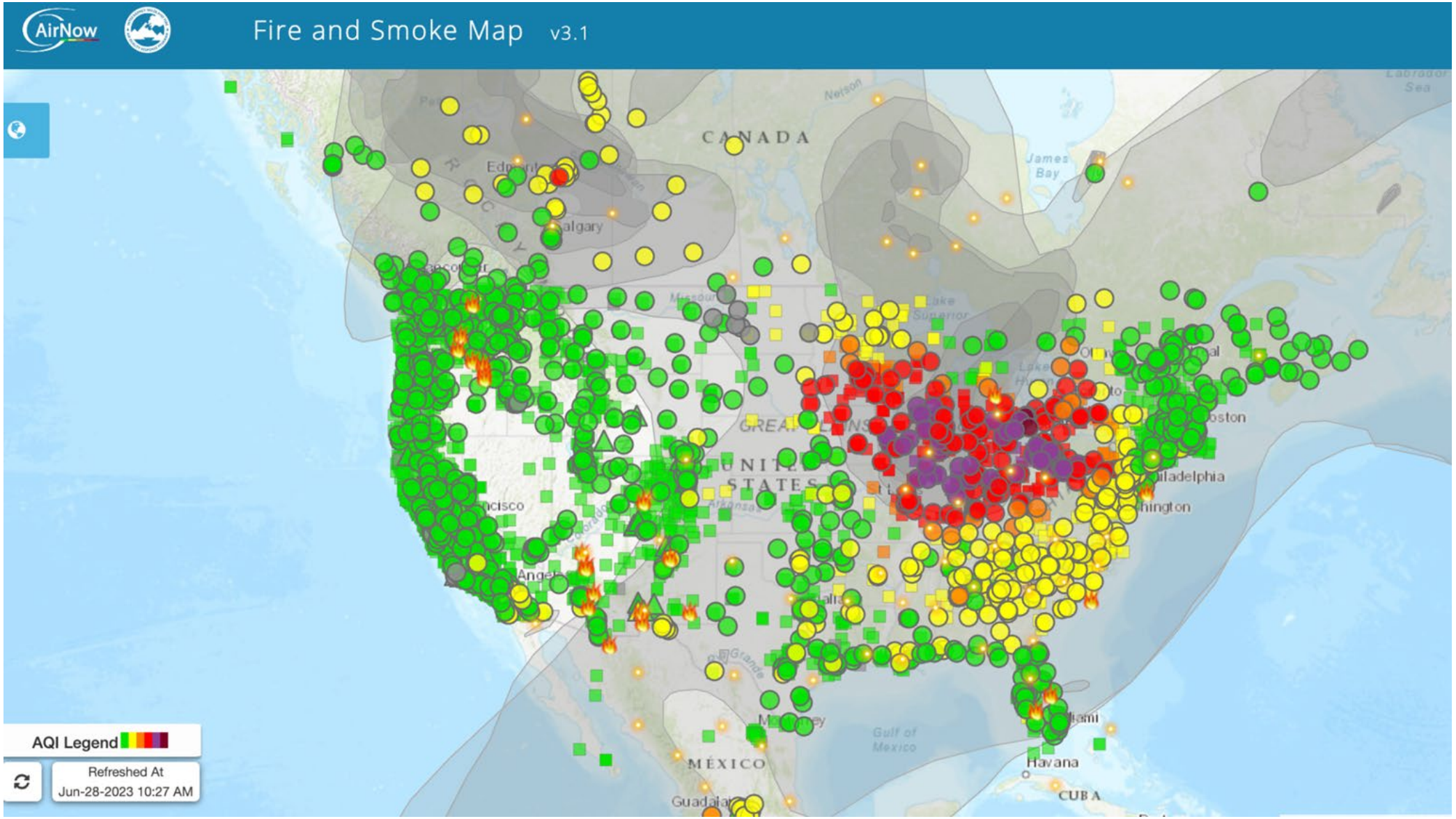
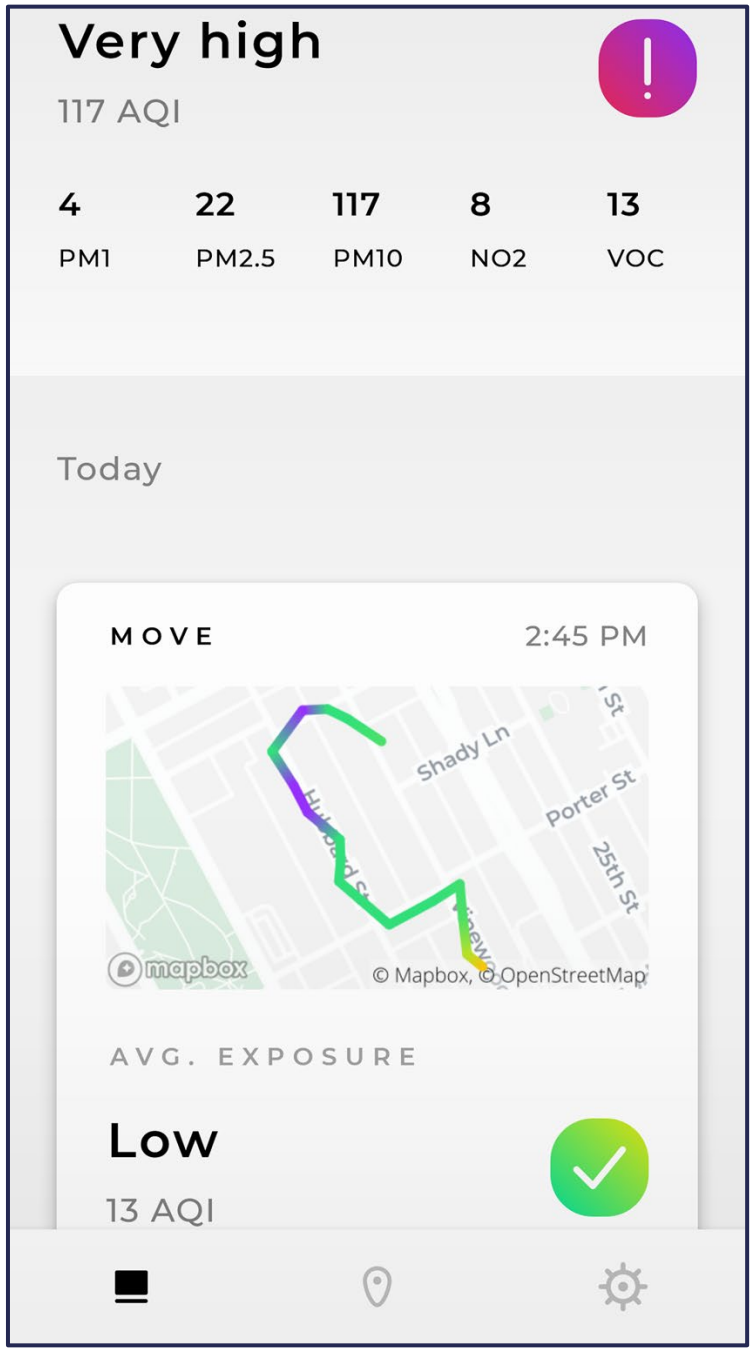


EPA Air Now - Fire & Smoke Map, Screenshot 6/28/23, 10:47 AM

Plume Flow2

- hand-held/wearable sensor
- Used with mobile phone app with GPS
- Measures PM1, PM2.5, PM10, NO2, and VOC
- Using with many youth and community-based groups to learn about air quality



Clarity Node S

- Solar battery powered
- Monitors for PM, 03 (ozone) and NO2

TSI Blue Sky monitors

Simultaneously measures PM2.5, PM10 mass concentrations, temperature, relative humidity, barometric pressure, O_3, CO, CO_2, NO_2, and SO_2

Monitor installation at Fort Berthold Reservation, North Dakota, June 2023

SENSIT SPOD for Air Toxics

- solar-powered sensor system
- combines wind and real time Volatile Organic Compounds (VOC) measurement to detect plumes and help locate the source of emissions
- Triggered and integrated canister sampling included, takes air sample when threshold level exceeded

SPOD with canister (in metal box) installed near New Town, ND on Fort Berthold Reservation to measure VOCs from fracking flares

Air Quality Monitoring Projects in Detroit

- **Southwest Detroit Environmental Vision** - trucking in SW Detroit
- **Southwest Detroit Community Benefits Coalition** - impacts of new Gordie Howe International Bridge
- **Eastside Community Network** - truck traffic and Stellantis plant
- **Detroit People's Platform** - trucking associated with AMC development

Air Quality Monitoring Projects in Detroit

- **Henry Ford Health System** - study of air pollution and lung health
- **Wayne County** - 100 stationary monitors, 500 mobile monitors for children with asthma
- **University of Michigan CAPHE project** - black carbon monitors
- Recently awarded EPA grants for community-based monitoring:
  - **Green Door Initiative**
  - **City of Detroit**
  - **Asthma and Allergy Foundation of Michigan**
  - **Wildlife Habitat Council**

Take Action
to reduce exposure to air pollution

What you can do as an individual

Be aware of air pollution sources

- **Air sensors can make you aware of sources of air pollution** in your outdoor environment
- **Eliminate sources** when possible or **minimize exposure**

- **Use AQI forecast** to plan outdoor activities
  - Wildfire smoke - stay indoors when levels of pollution are high, do not exercise outdoors, wear a mask
  - When **PM is high outdoors**, it may be **high indoors** – unless building has a good filtration system

Collective Action has the greatest impact

Create partnerships to address community-wide exposures

Create a **air quality action plan** to address local air quality issues

Join with others to **advocate for clean air and protection of public health**

Join Us for A Community Conversation about Clean Air

Join us and hear about what's happening in your community to create cleaner air for all. Share your ideas on how we can work together to protect clean air.

WHEN: October 26th, 2022
6:00 pm to 7:30 pm

WHERE: Kemeny Recreation Center
2260 South Fort Street
Detroit, MI 48217

SCAN FOR ZOOM LINK

FOR VIRTUAL ATTENDANCE:
https://bit.ly/AQKemeny
Meeting ID: 854 5734 7033 | Dial-in 312-626-6799

Contact:
Original United Citizens of Southwest Detroit 48217
Theresa Landrum, t_landrum05@yahoo.com, 313-399-0735

Ecology Center
Jeff Gearhart, jeffg@ecocenter.org, 734-369-9276

A Special Thanks to Our Sponsors

Southwest Detroit 48217 · CRSD · Detroit People's Platform · sdev · Detroit Hamtramck Coalition for Advancing Healthy Environments · Ecology Center · Eastside Community Network · Southwest Detroit Community Benefits Coalition · greendoor initiative

COVID-19 safety is a priority for these community meetings. We strongly encourage all attendees to follow COVID-19 safety guidelines.

Collective Action

Air Quality Sensor Learning Collaborative

quarterly meetings focused on learning and building collaboration

Working groups on air monitoring, policy, and communications to support clean air and protect public health

THANK YOU!

Questions?

Kathryn Savoie,
kathryn@ecocenter.org
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