

COMMUNITY-LEVEL AIR
POLLUTION
MONITORING IN
HAMILTON ONTARIO

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PRELIMINARY FINDINGS

- Data presented is based on preliminary findings and subject to change.

PROJECT PARTNERS



- Project Funding



- Oversight
- Coordination
- Project Management



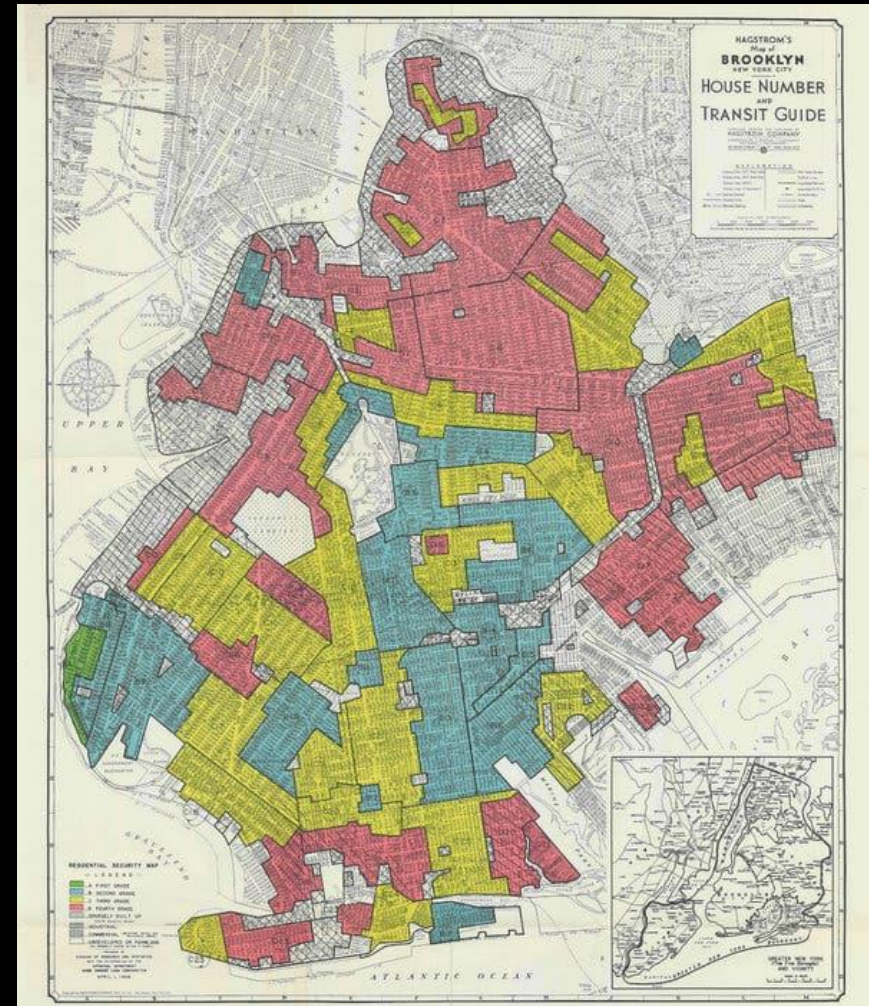
- Community Engagement

ENVIRONMENTAL (IN)JUSTICE

- Social movement adopted by academics
- Synonyms: environmental racism or environmental inequality
- Unfair exposure to environmental pollutants across socio-economic gradients

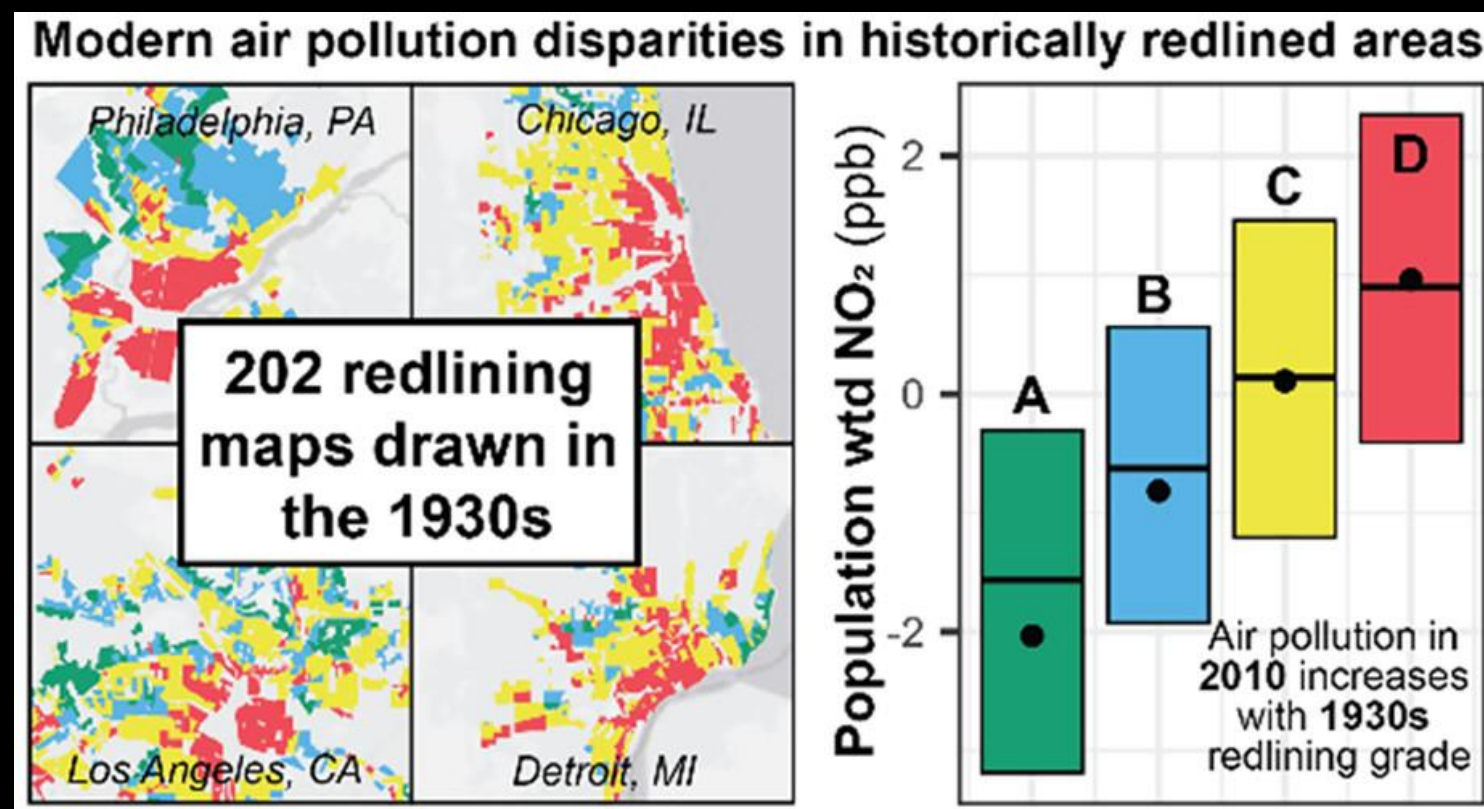
ENVIRONMENTAL JUSTICE & AIR POLLUTION

- Most heavily studied in the US
- Spatial patterns align with historic redlining practices
- Government maps that outlined areas where Black residents lived and were therefore deemed risky investments



HISTORICAL REDLINING IS ASSOCIATED WITH PRESENT-DAY AIR POLLUTION DISPARITIES IN U.S. CITIES

Haley M. Lane, Rachel Morello-Frosch, Julian D. Marshall, and Joshua S. Apte
Environmental Science & Technology
Letters 2022 9 (4), 345-350
DOI: 10.1021/acs.estlett.1c01012



CANADIAN CONTEXT

- Environmental Justice is far less developed as a social movement in Canada
 - Less scholarship has occurred on the topic

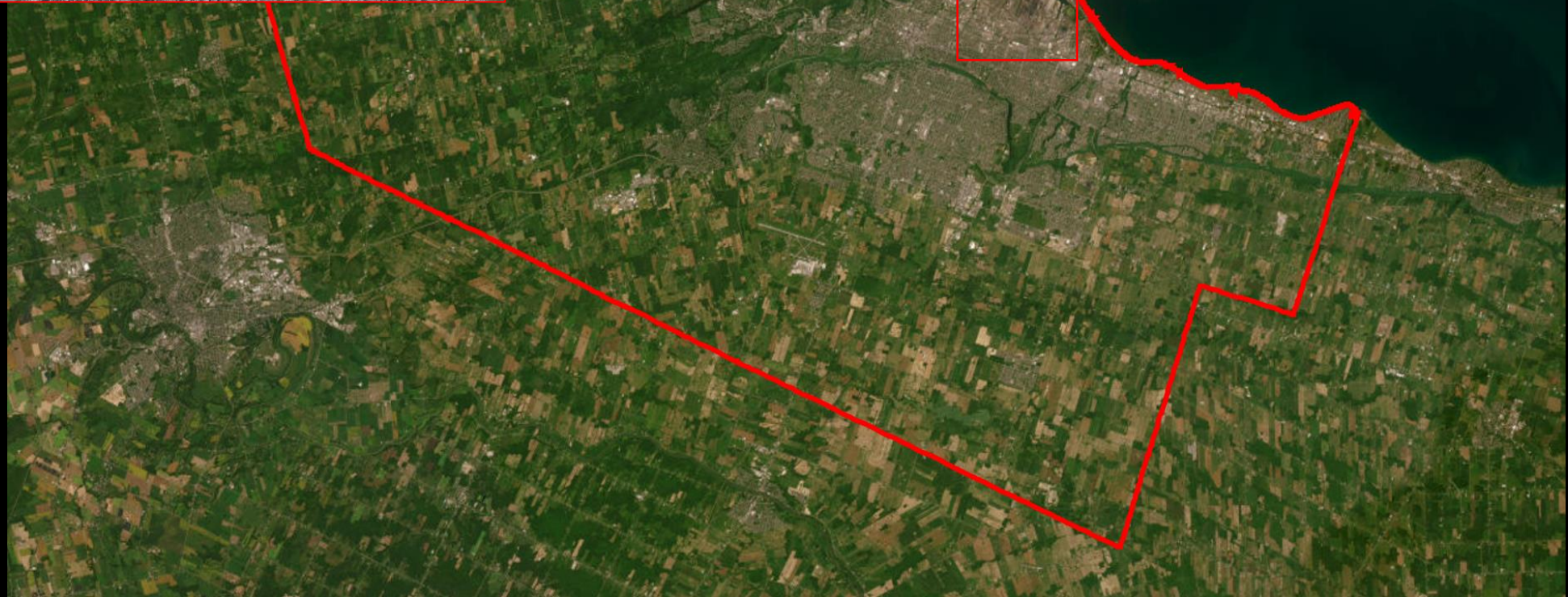
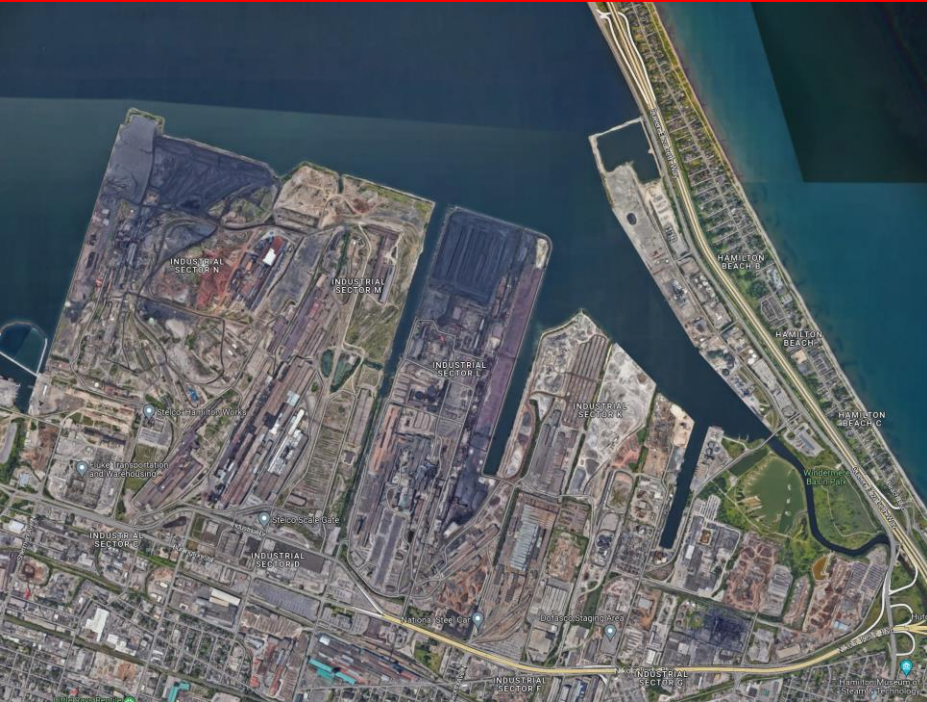
Spatiotemporal Perspectives on Air Pollution and Environmental Justice in Hamilton, Canada, 1985–1996

Michael Buzzelli, Michael Jerrett, Richard Burnett & Norm Finklestein

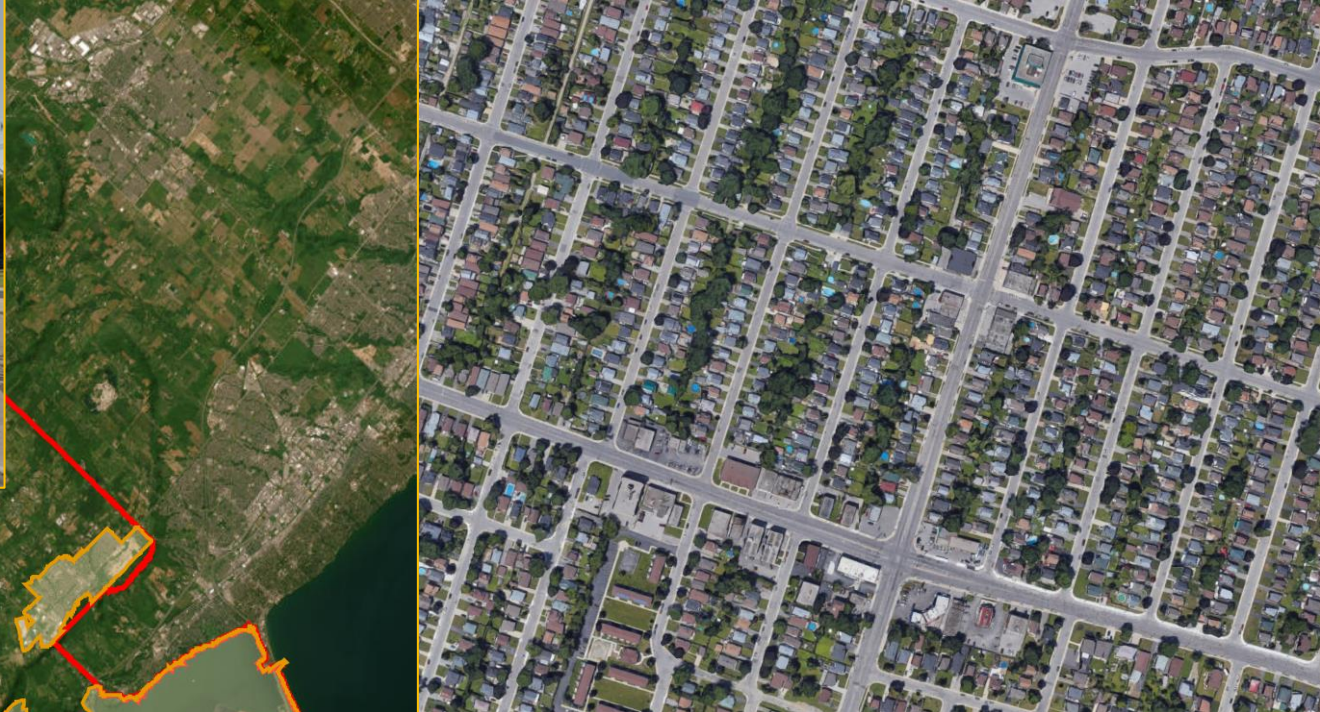
Pages 557-573 | Published online: 29 Feb 2008

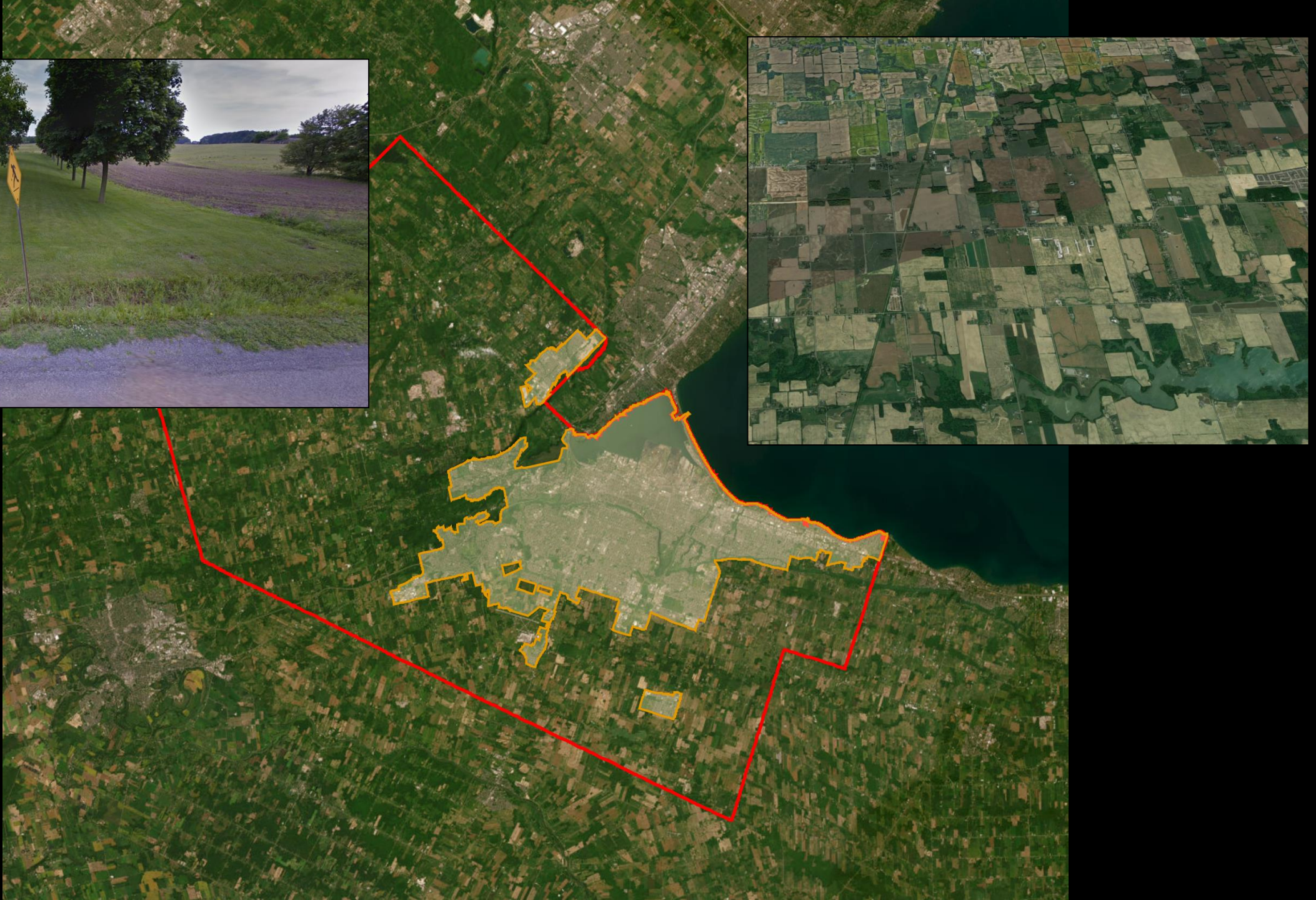
- Hamilton, Ontario, is one location that has been studied with injustice identified.
 - Strength of the associations declines over time as emissions become more dispersed.







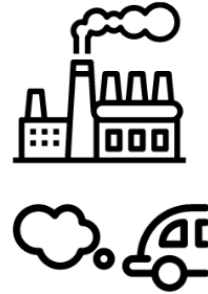




RESEARCH GOALS

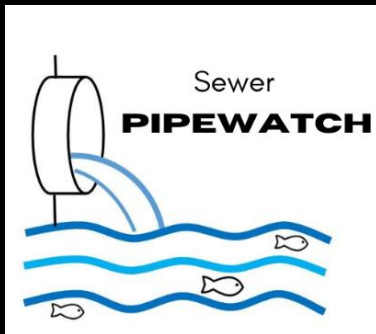
- Assess spatial and socioeconomic differences in pollution exposure across Hamilton.

Air Quality Monitoring in Hamilton: Giving Community A Voice



Environment Hamilton led a series of community meetings for the project.

- Environment Hamilton is a NGO active in the community



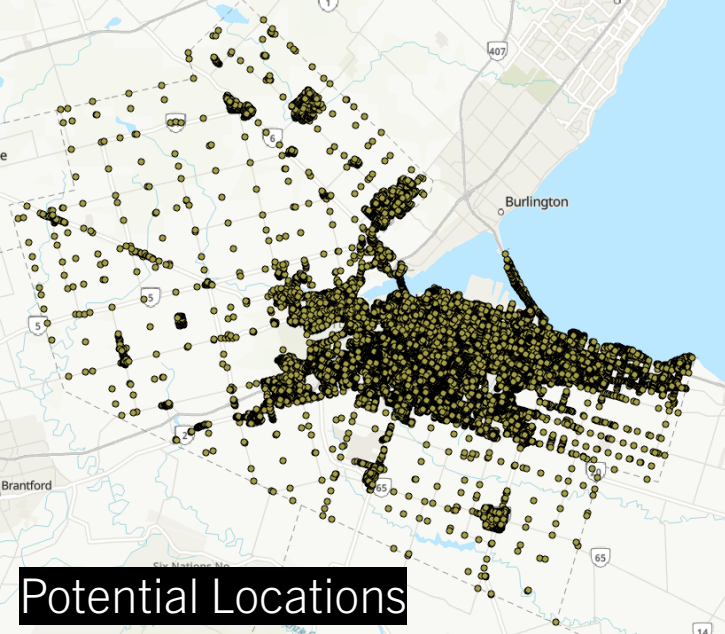
- Areas of concern were solicited in a public meeting, online through email, and in a web form.

Points of Community Pollution Concern

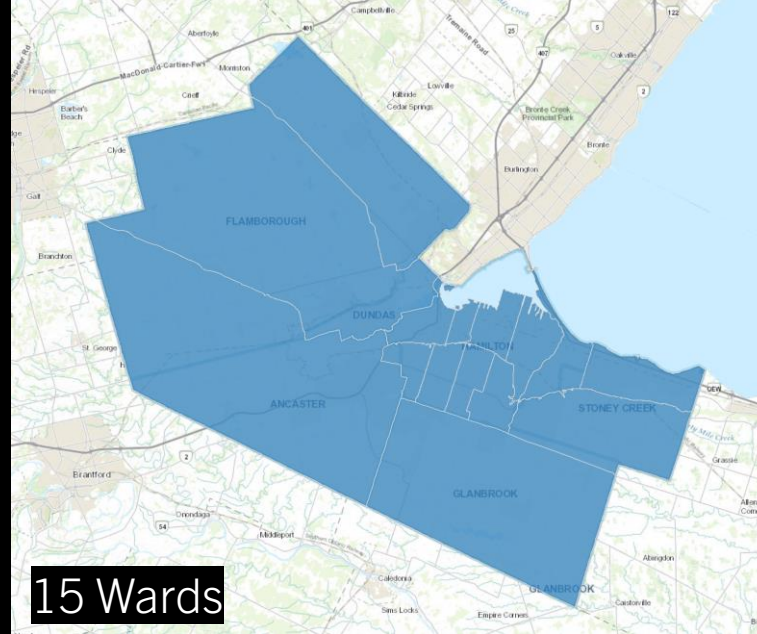


OBJECTIVES FOR AIR SAMPLING

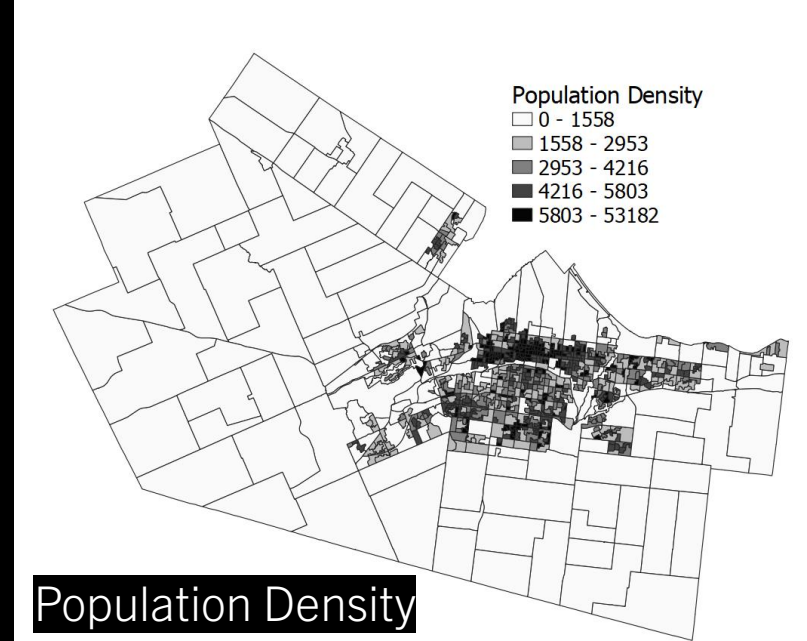
- Stratify sampling across socio-economic and expected air pollution gradients (Project)
- Measure air pollution in all Hamilton Wards (City of Hamilton)
- Sample near community points of concern (Community)
- Increase sampling based on population density (City of Hamilton)
- Co-location of passive samplers with active monitors from the Ministry of the Environment, Conservation & Parks and Hamilton Air Monitoring Network (MECP)



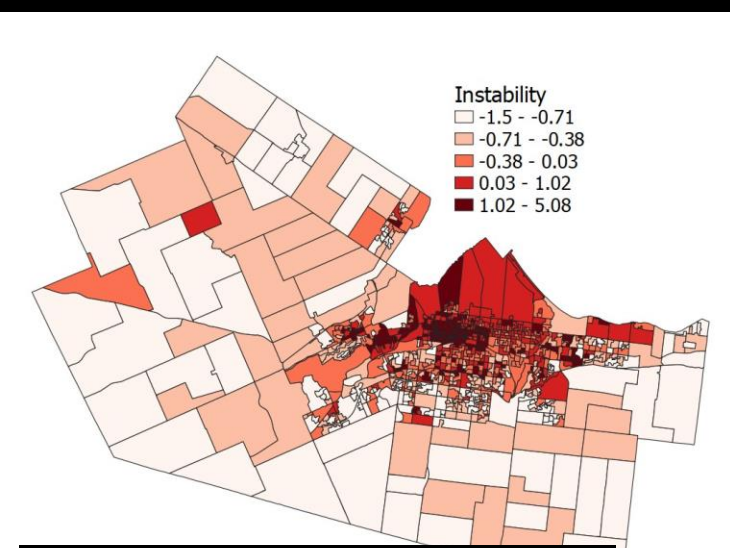
Potential Locations



15 Wards



Population Density



Ontario Marginalization Index

Residential Instability

- family or housing instability

Material Deprivation

- access and attain basic material needs

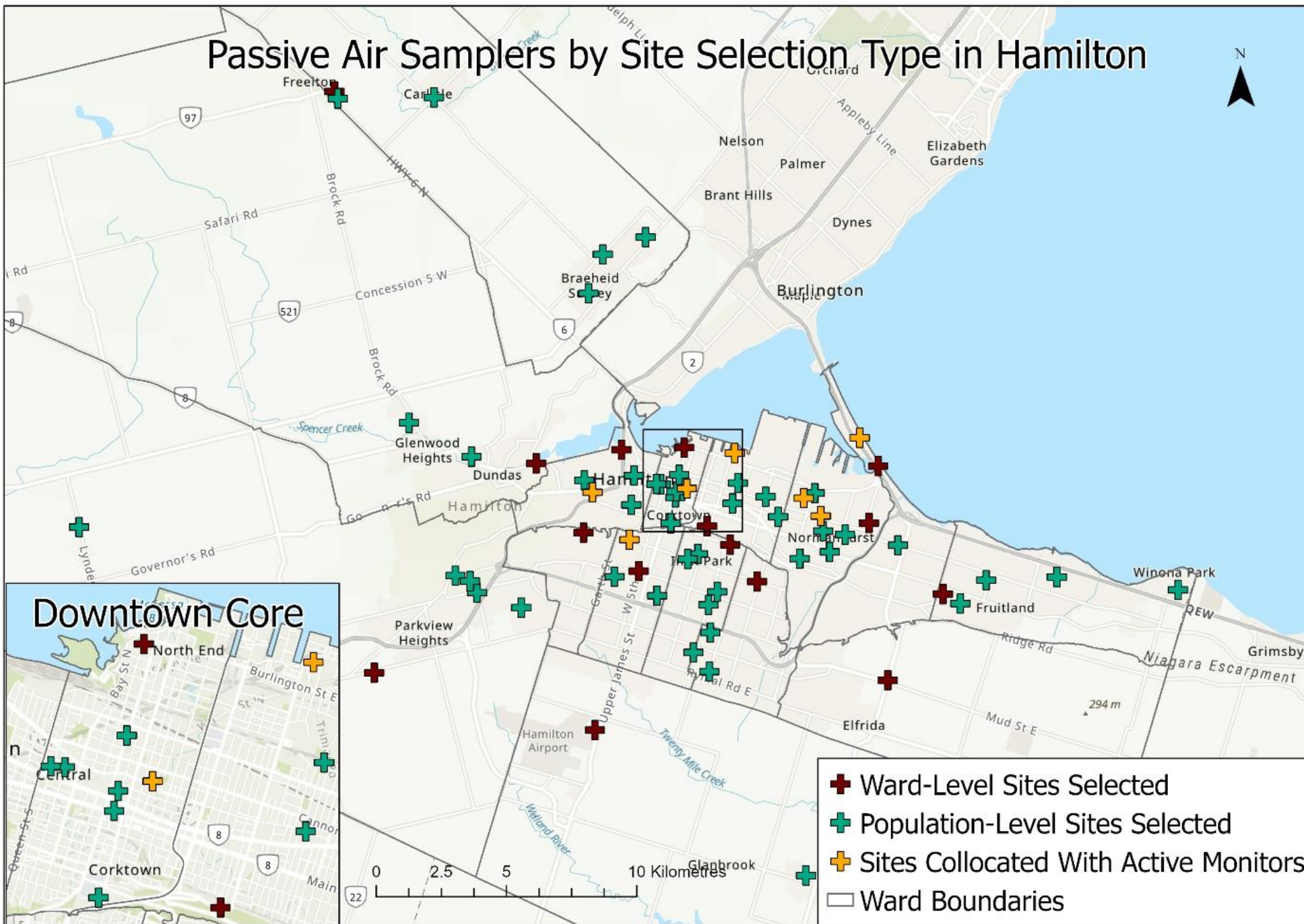
Dependency

- people who do not have income from employment

Ethnic Concentration –

recent immigrants and/or people belonging to a visible minority group

Passive Air Samplers by Site Selection Type in Hamilton



- + Sampled Seasonally
- + Sampled Seasonally
- + Sampled Monthly

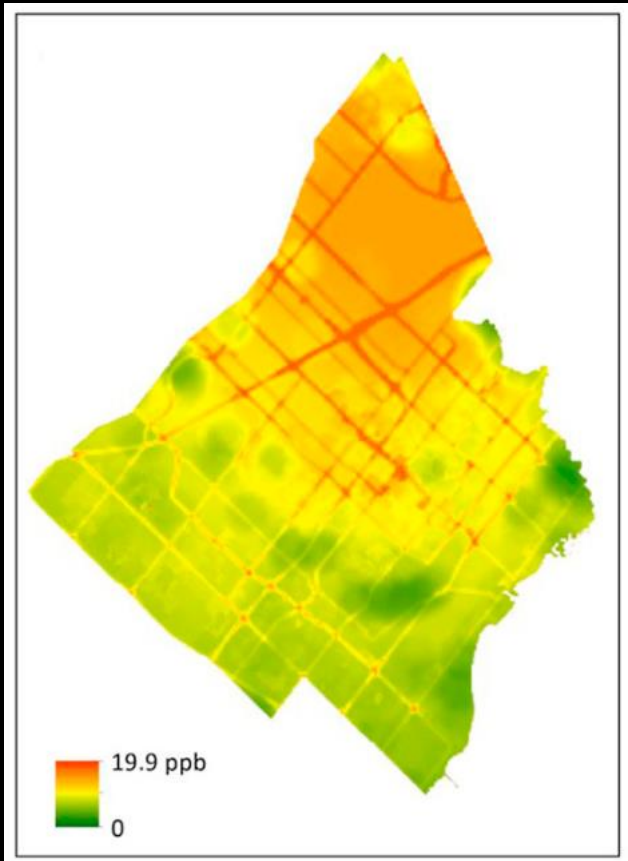
Sampling Completed
 Feb 2022 to Apr 2022
 July 2022 to Dec 2022

On-going
 Jan 2023 to June 2023

- + Ward-Level Sites Selected
- + Population-Level Sites Selected
- + Sites Collocated With Active Monitors
- Ward Boundaries

WITHIN AND BETWEEN CITY POLLUTION

Mississauga – Nitrogen dioxide (NO₂)
November 2018 to Feb 2019



MECP Monitoring Data for NO₂

Grand Bend: 3.7 ppb

Cornwall: 8.2 ppb

Kitchener: 8.4 ppb

Barrie: 8.5 ppb

Mississauga: 9.0 ppb

Sarnia: 9.0 ppb

Brampton: 10.3 ppb

Oakville: 10.5 ppb

Burlington: 10.6 ppb

Ottawa Downtown: 10.7 ppb

Hamilton West: 12.9 ppb

Windsor Downtown: 13.4 ppb

Hamilton Downtown: 14.0 ppb

Toronto Downtown: 14.0 ppb

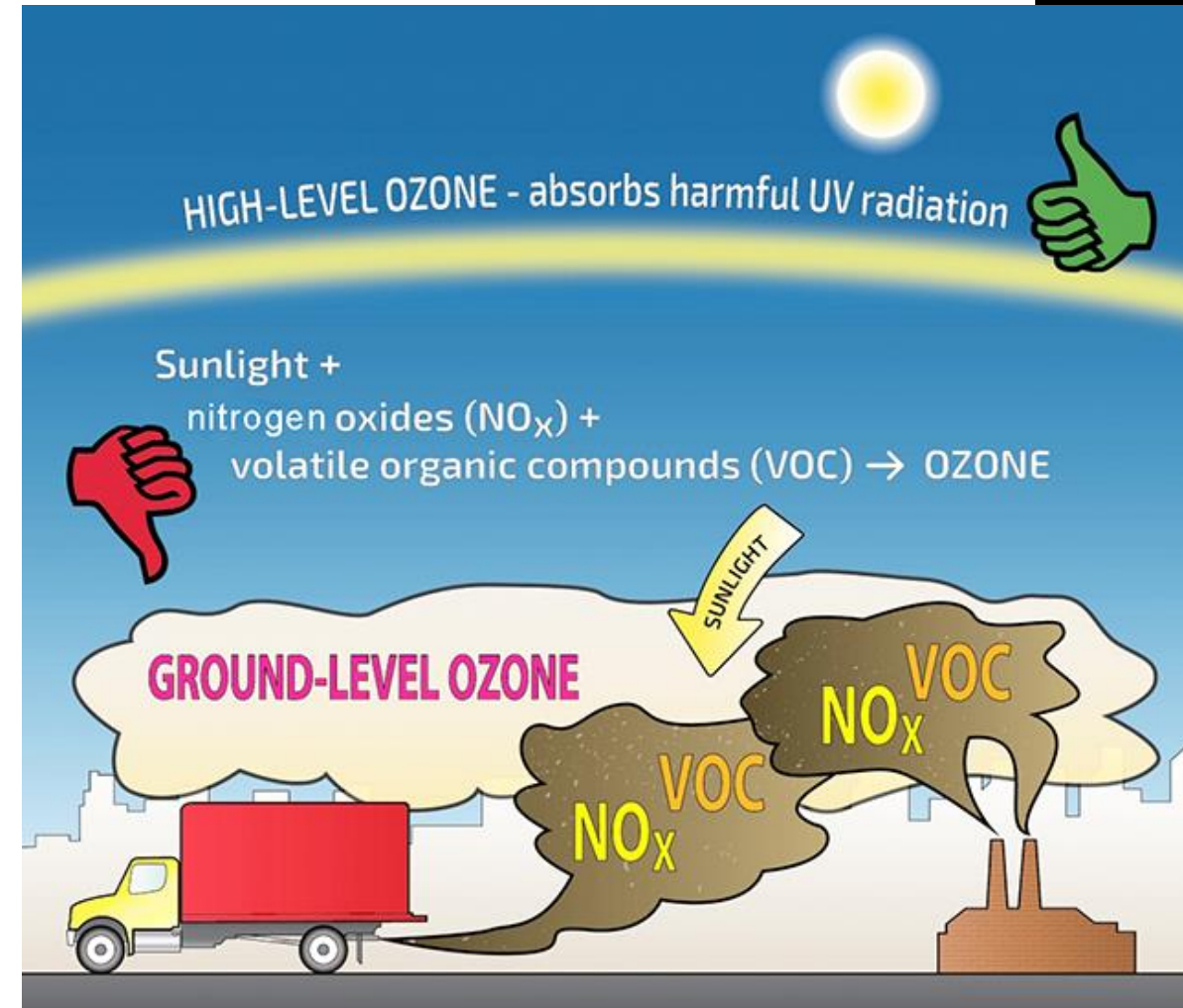
POLLUTANTS MEASURED

- Nitrogen dioxide, Nitric oxide & Nitrogen oxides (NO₂ + NO_x)
- Ozone
- Sulphur dioxide
- Benzene, Toluene, Ethylbenzene & Xylene (BTEX)
- Polycyclic Aromatic Hydrocarbons

- Length of Study: February 2022 through to June 2023
- Total Number of Sites: 67

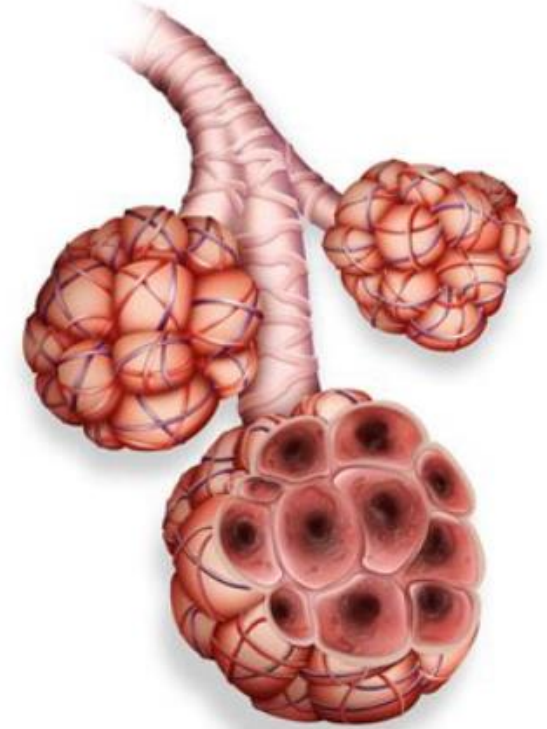
OZONE

- A secondary pollutant, which means it is not directly emitted.
- Forms in the presence of sunlight from nitrogen oxides and volatile organic compounds (VOCs)



OZONE HEALTH EFFECTS

- Acute exposure mortality
- Acute respiratory symptom days
- Asthma symptom days
- Chronic exposure respiratory mortality
- Minor restricted activity days
- Respiratory emergency room visits
- Respiratory hospital admissions

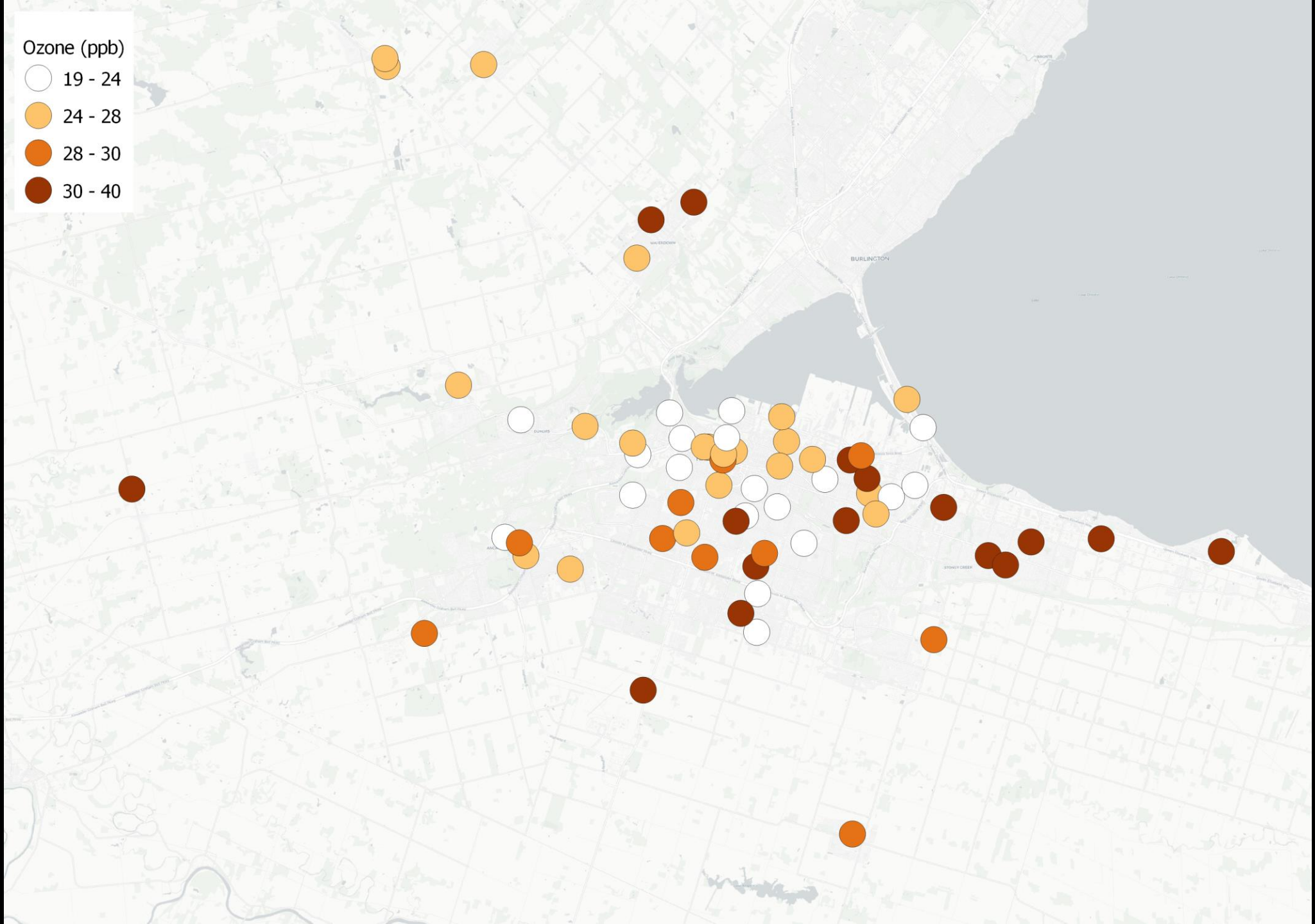


Ozone can cause the muscles in the airways to constrict, trapping air in the alveoli. This leads to wheezing and shortness of breath.

<https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution>

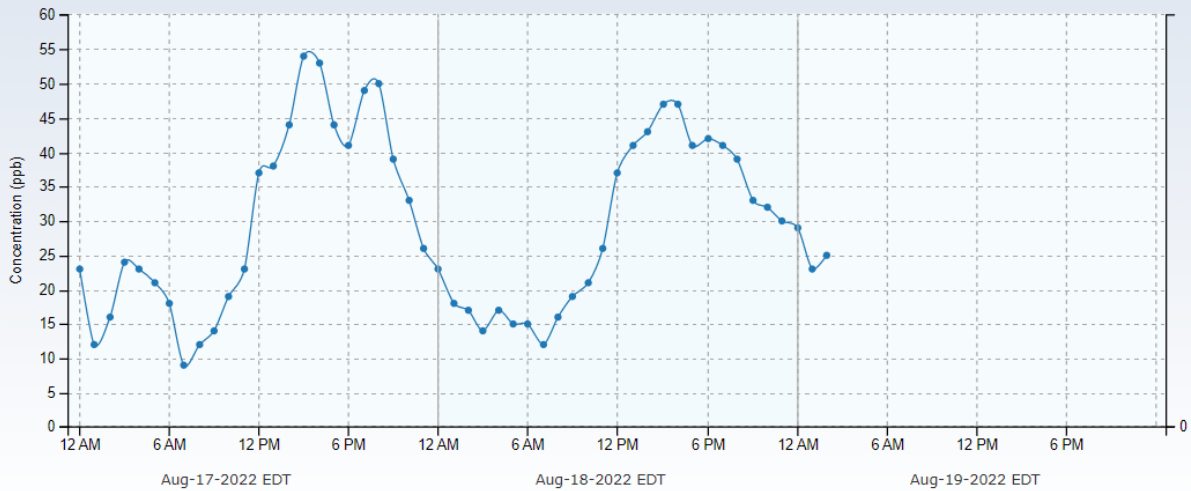
Ozone (ppb)

- 19 - 24
- 24 - 28
- 28 - 30
- 30 - 40



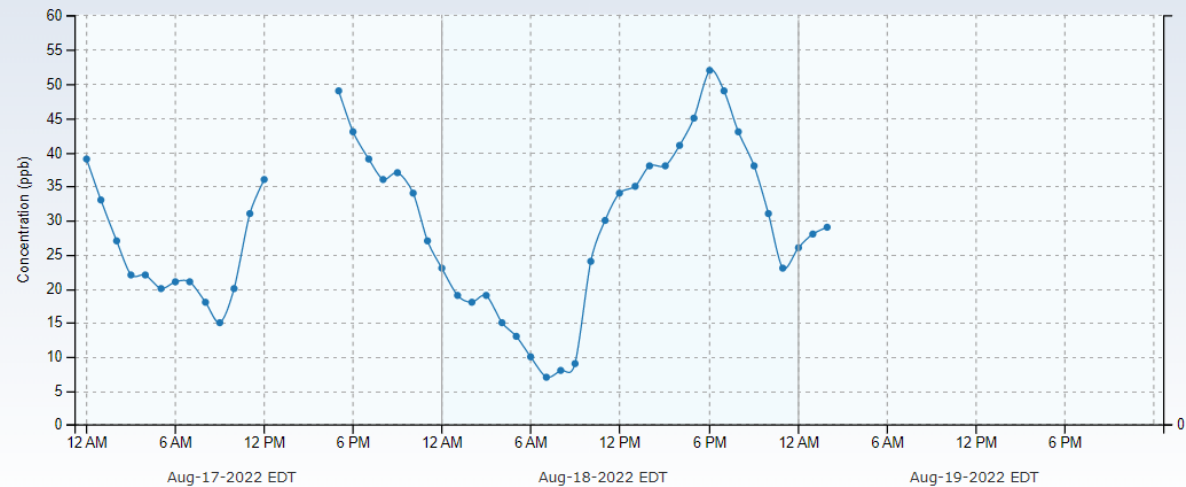
Hamilton Downtown: Hourly Ozone Readings

From Aug-17-2022 EDT to Aug-19-2022 EDT.



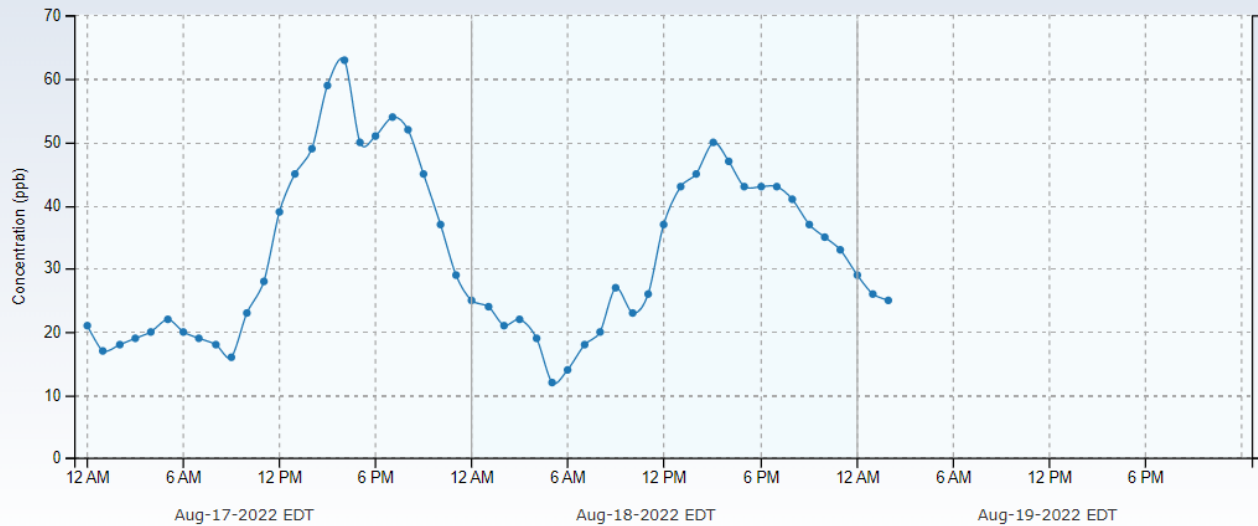
Chatham: Hourly Ozone Readings

From Aug-17-2022 EDT to Aug-19-2022 EDT.



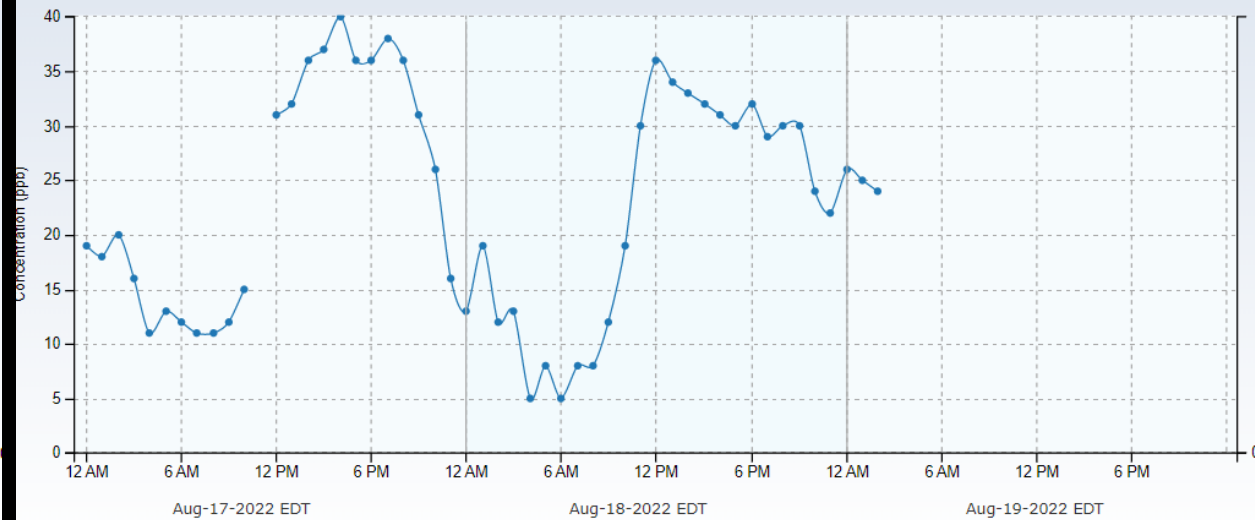
Hamilton Mountain: Hourly Ozone Readings

From Aug-17-2022 EDT to Aug-19-2022 EDT.



Sudbury: Hourly Ozone Readings

From Aug-17-2022 EDT to Aug-19-2022 EDT.

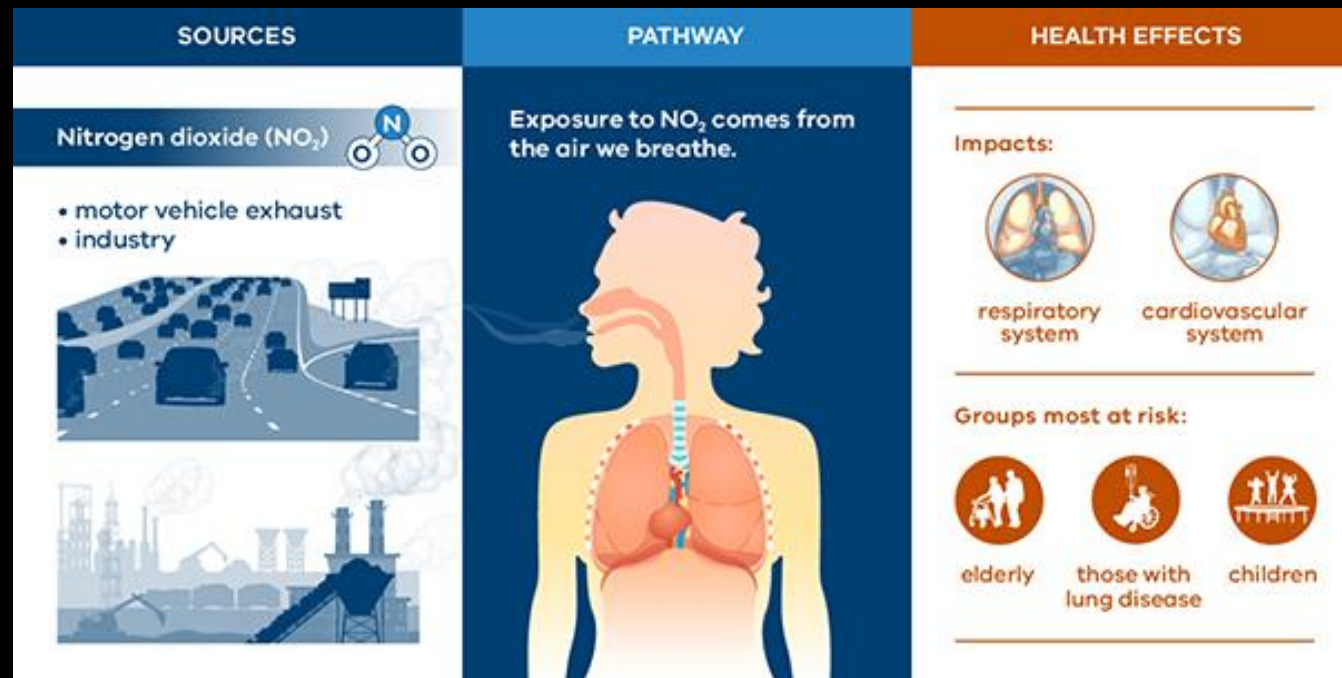


GENERAL TAKEAWAY

- Ozone is a short-lived air pollutant
- No obvious hot spots at this point in sampling
- Any Hamilton monitoring stations should be able to capture any Ozone concerns and report in real time.
- Avoid outdoor activities when Ozone is high, particularly those who are “at-risk”

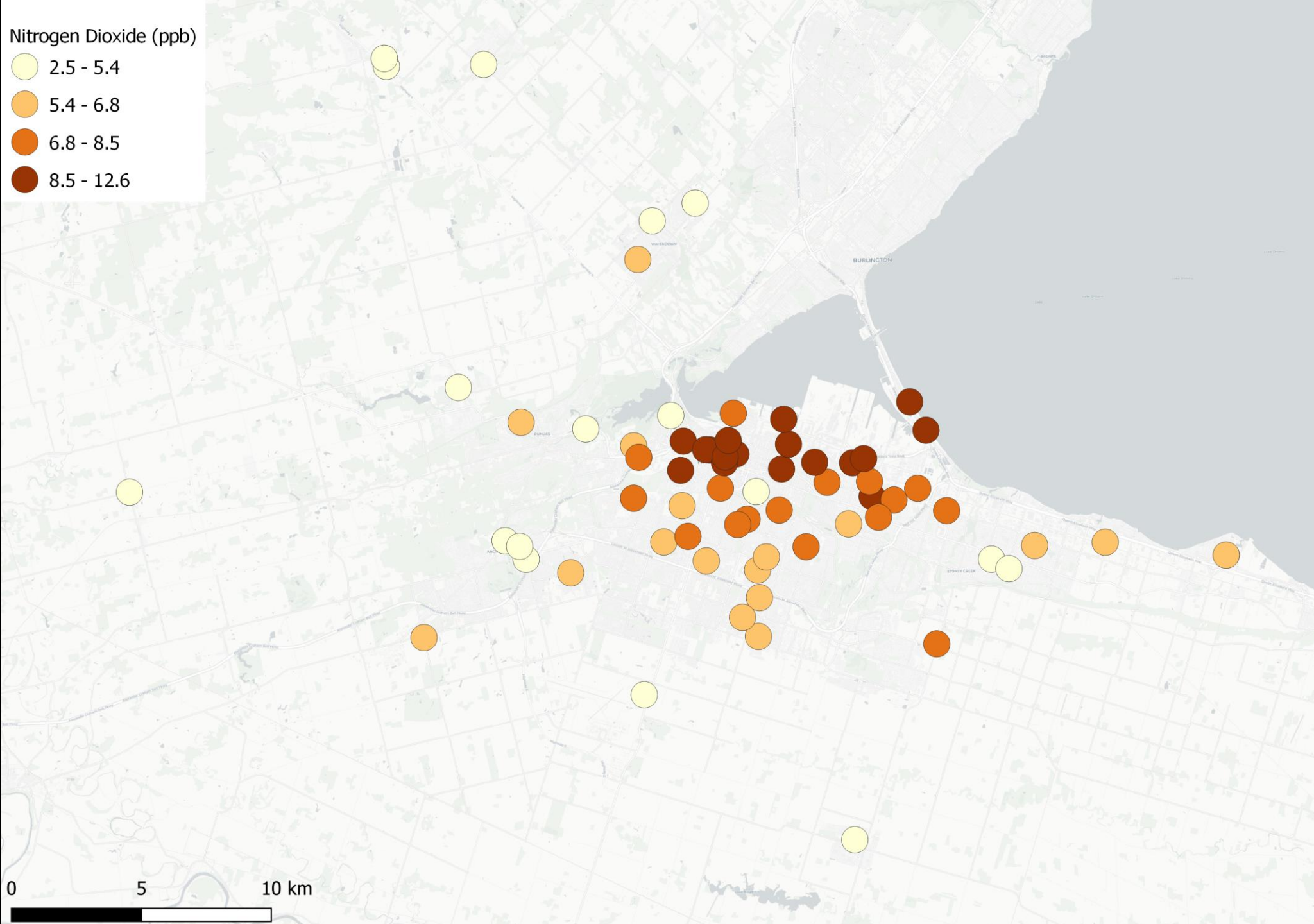
NITROGEN DIOXIDE

- Primarily emitted from fossil fuel burning as nitric oxide and then quickly converts to NO_2
- $\text{NO} + \text{O}_3 = \text{NO}_2 + \text{O}_2$



Nitrogen Dioxide (ppb)

- 2.5 - 5.4
- 5.4 - 6.8
- 6.8 - 8.5
- 8.5 - 12.6



GENERAL TAKEAWAY

- Concentrations higher in the lower city
- Major highways have less of a role than maybe expected in spatial differences

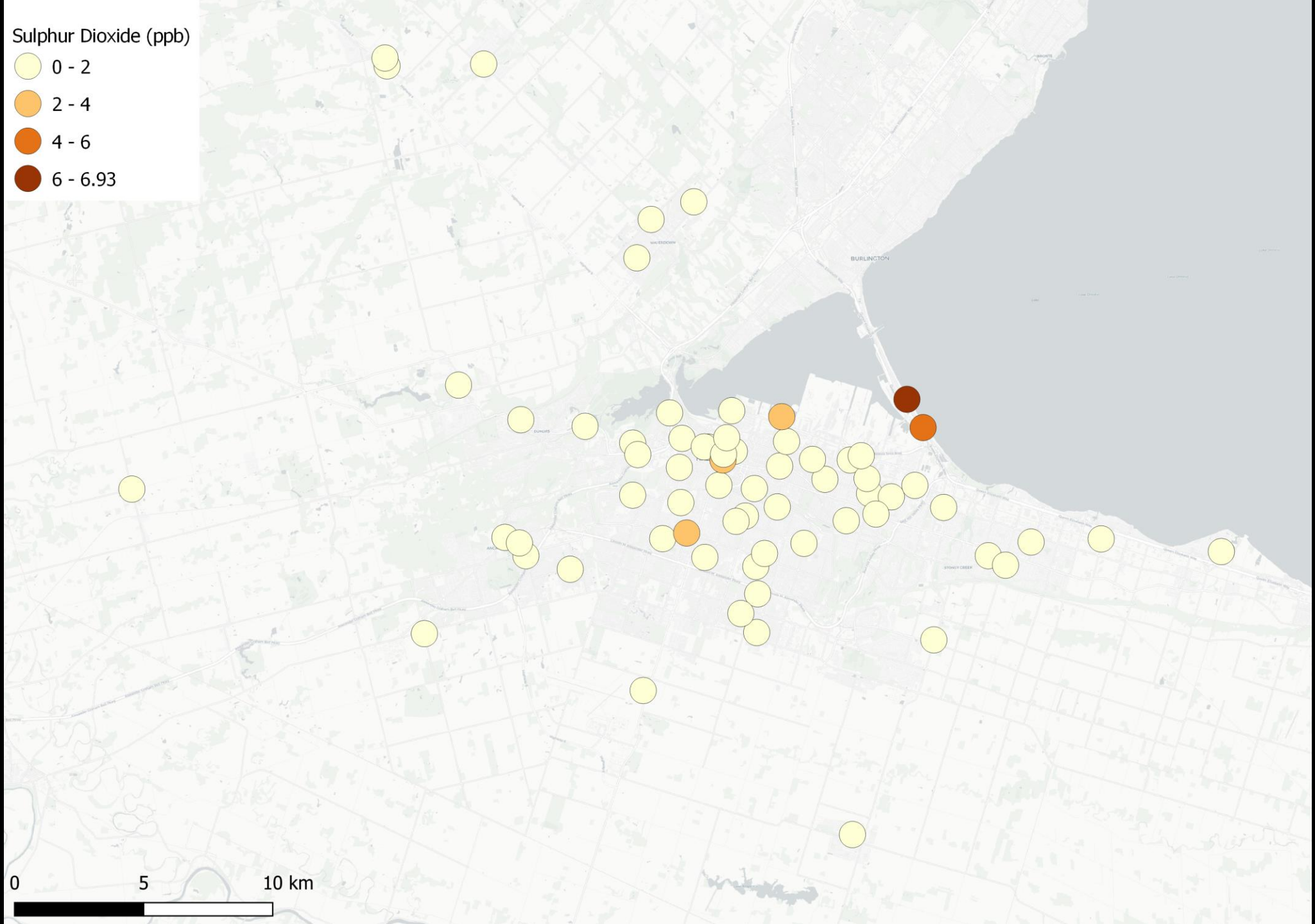
SULPHUR DIOXIDE

- Industrial air pollutant – sulphur removed from gasoline
- Irritates the respiratory tract and increases the risk of tract infections.
- It causes coughing, mucus secretion and aggravates conditions such as asthma and chronic bronchitis
- Cardiovascular disease



Sulphur Dioxide (ppb)

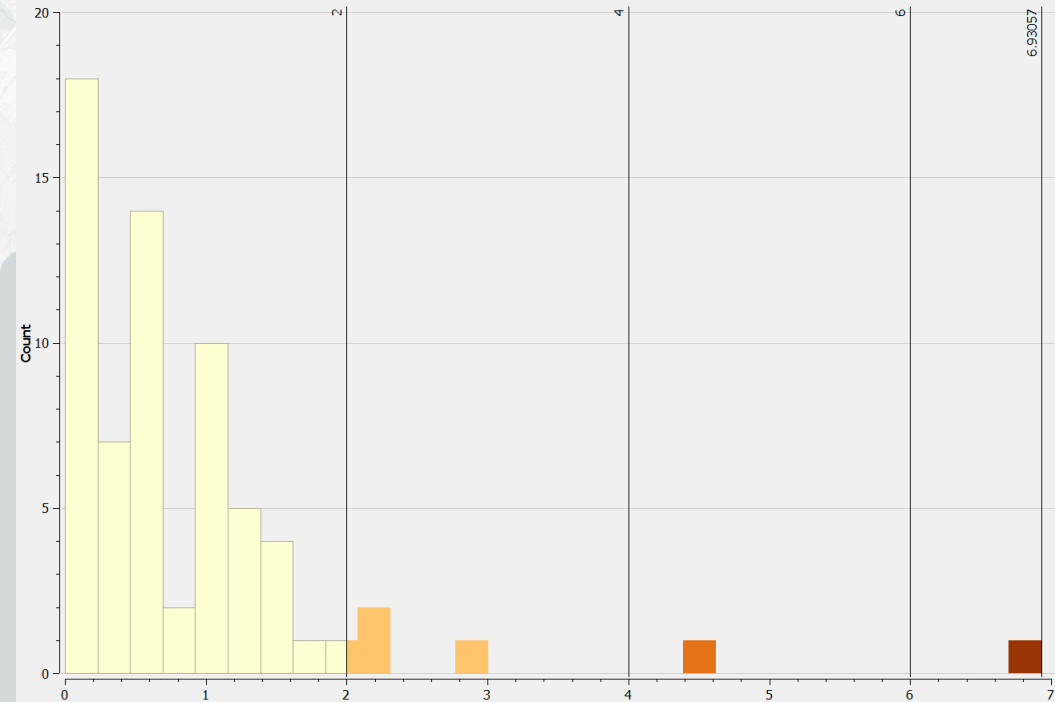
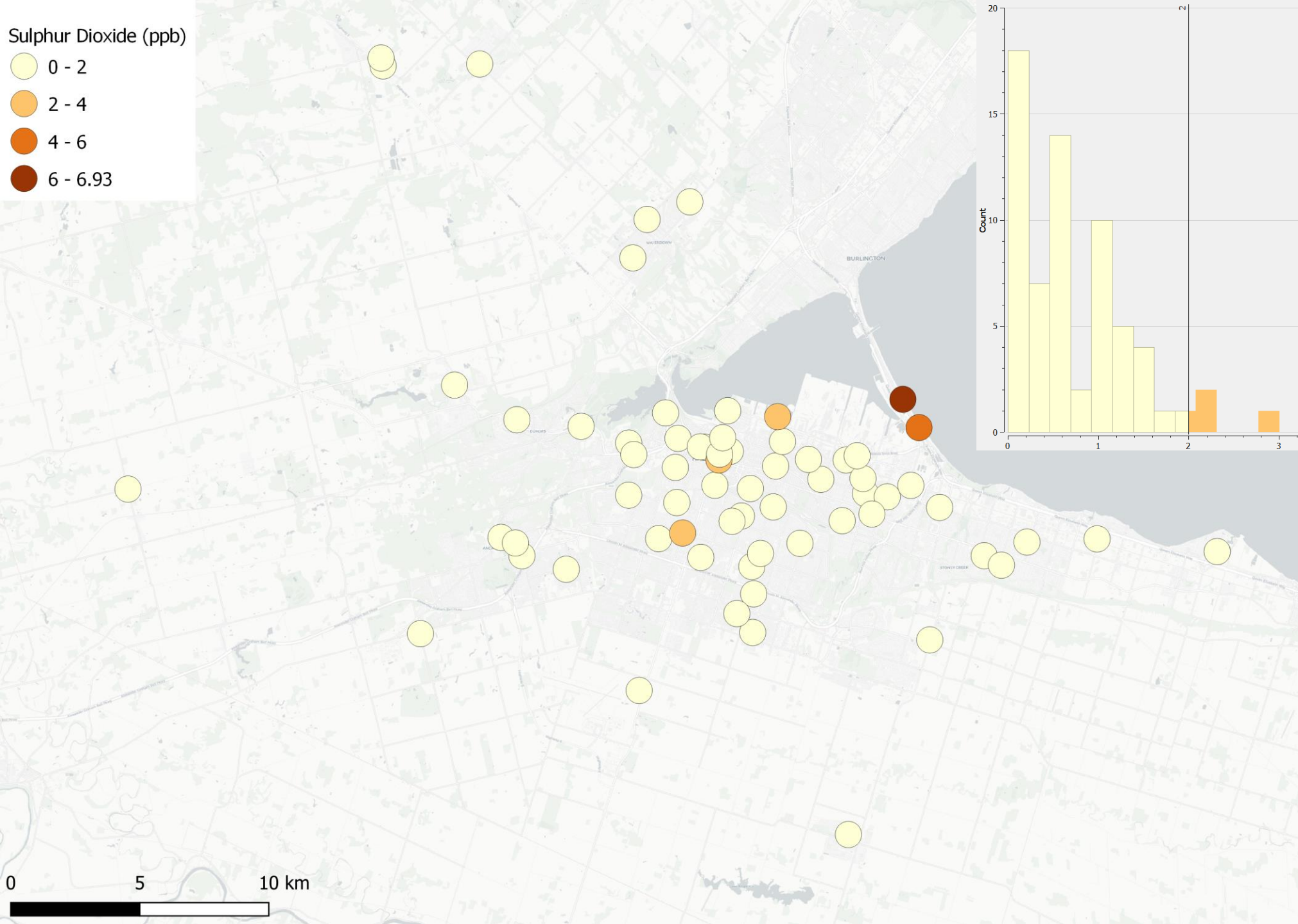
- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 6.93



0 5 10 km

Sulphur Dioxide (ppb)

- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 6.93



GENERAL TAKEAWAY

- Very isolated issue within Hamilton
- Evidence suggested industrial emissions with three well-known sources in Hamilton
 - Birla Carbon Canada Inc 2021 – 4,724 tonnes of SO₂ released to air
 - ArcelorMittal Dofasco - 4,330 tonnes of SO₂ released to air
 - Stelco - 2,563 tonnes of SO₂ released to air

CONCLUSIONS FOR THE COMMUNITY

Ozone – base your outdoor activity levels on AQI / MECP
Monitoring

NO₂ – Exposure occurs primarily in the lower city.

SO₂ – Isolated area of concern (Beach Blvd).