Strathcona Residents Association
Air Quality Monitoring Project
Case Studies & Annotated Bibliography

Submitted to

Strathcona Residents Association

From

The Firelight Group

On

May 27, 2021

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West Oakland Community Action Plan (West Oakland, California)

Initiative:	**Owning Our Air – The West Oakland Community Action Plan (West Oakland, California)**
Organization(s):	Bay Area Air Quality Management District; West Oakland Environmental Indicators Project
Reference(s):	West Oakland Community Action Plan document, "Volume 1: The Plan" (2019): *https://woeip.org/wp-content/uploads/2020/11/WOEIP-research-Owning-Our-Air-full.pdf*
Key Words:	long-term planning, strong partnerships, stationary sensors, community engagement

Project Overview:

The *Owning Our Air – The West Oakland Community Action Plan* (the Plan within this section) was developed by the West Oakland Community Action Plan Steering Committee in 2018. The Plan aims to "protect and improve community health by eliminating disparities in exposure to local air pollution" by presenting strategies to concurrently reduce air pollutants and reduce residents' exposure to air pollution.

West Oakland is a shore-front neighbourhood that is located in the San Francisco Bay Area. The neighbourhood has a mix of industrial, commercial, and residential uses and is situated adjacent to the Port of Oakland. With a population of approximately 26,000, West Oakland residents face a myriad of challenges, including limited access to health services, high unemployment rates, poverty, and high rates of air pollution.

Air pollutants that affect residents primarily originate from activities at the Port of Oakland (e.g., diesel powered cargo trains, cargo-handling equipment, ships, and harbour crafts), and from vehicles that travel along freeways, arterial roads, and boulevards that encircle and crisscross the neighbourhood. Studies have shown that West Oakland residents experience higher concentrations of air pollution, and the highest levels of diesel particulate matter, compared to many surrounding neighbourhoods. West Oakland residents also have higher rates of asthma, cardiovascular disease, premature death, and other poor health outcomes related to air pollution than other parts of Alameda County and the wider region. In response to the air quality issues, West Oakland's residents and stakeholders developed the *Owning Our Air – The West Oakland Community Action Plan*—the Plan.

The Plan sets goals and targets through to the year 2025 and identifies long-term implementation strategies. The targets and associated strategies were established through a collaborative effort by the following parties:

1. The West Oakland Community Action Plan Steering Committee (Steering Committee) – the Steering Committee includes West Oakland residents, community and local business leaders, and government agency representatives;
2. The West Oakland Environmental Indicators Project (WOEIP); and
3. The Bay Area Air Quality Management District (Air District).

Project Approach

The project approach included identification of pollution sources, primary pollutants of concern, and sensitive receptor locations; development of air quality targets and timelines; and recommendations and strategies for reducing pollution and pollution exposure.

How were pollution sources identified and what data were used?

The Steering Committee identified pollution sources of interest through review of Air District, City of Oakland, and Port of Oakland datasets and emissions inventories, air pollution modeling, air pollution measurements, community surveys and investigations, and their own local knowledge.

The Steering Committee benefitted from long-term (20 years) and ongoing efforts to study air quality in West Oakland by the Air District, WOEIP, and community partners such as researchers at University of California Berkley (for the Air District-funded West Oakland Monitoring Study), Environmental Defence Fund, Google and Aclima. This work included the completion of detailed air quality assessments for all West Oakland neighbourhoods using data collected from one hundred sensors installed in residents' yards, at schools, seniors' centres, and businesses.

What are the main pollutants of concern?

The main pollutants of concern were those determined to have the greatest health impact in West Oakland and include fine particulate matter (PM2.5), diesel particulate matter (diesel PM), and other toxic air containments (TACs).

What are the key sources of pollution?

1. Major highways surrounding the community. This includes I-880 on the west and south, I-80 and I-580 to the north, and I-980 to the east;
2. Permitted stationary sources, such as recycling facilities, a wastewater treatment plant, back-up diesel generators, gas dispensing facilities, and paint spray booths;
3. Truck-related businesses that generate truck trips in West Oakland and in and out of the Port of Oakland, including magnet sources that attract truck trips, such as the U.S. Post Office on 7th Street;

4. Port-related sources, including drayage trucks, cargo-handling equipment, ships and harbor craft, and trains traveling through the Union Pacific and BNSF rail yards located at the Port of Oakland; and
5. Construction and area sources, such as backyard burning, restaurants and businesses with commercial cooking operations.

Outcomes: air quality targets, sensitive receptors and locations, and exposure reduction strategies

To inform the Steering Committee's selection of strategies and air quality targets for the plan, the Air District conducted extensive technical analysis of air quality impacts in West Oakland. They used computer modeling to answer two key questions:

1. What sources contribute most to community impacts from air pollution in West Oakland?
2. How much must emissions be reduced, and from what sources, to meet the community's goals?

Using this information, the Steering Committee set a specific air quality target level for each pollutant of concern and an aspirational timeline for achieving this level. For example:

> *By 2025, local emission sources will contribute to the average West Oakland residential neighborhood a concentration of diesel PM of no more than 0.25 µg/m3 (micrograms per cubic meter). (Action Plan 2019:4-5)*

The Steering Committee also identified sensitive receptor locations and developed strategies to reduce exposure such as relocating truck routes, planting trees and other vegetative barriers, and installing high efficiency air filtration systems in homes.

Key Findings

Strong Partnerships

The Plan benefitted from strong partnerships, including partnerships with the public institutions with the authority to implement the plan (e.g., Port of Oakland Authority, and the City of Oakland), and partnerships enabling funding and data access (e.g., academic institutions, regional Air District).

Enabling Legislation

The Plan also benefitted from enabling legislation in California under Assembly Bill 617 (AB-617), which directs communities and air districts to work together to address air pollution and related health effects. The presence of enabling legislation increases the likelihood that such plans are implemented and enforced.

Additional Resources:

Document	*Link*
Owning Our Air Summary (2019)	https://www.baaqmd.gov/~/media/files/ab617-community-health/west-oakland/100219-files/owning-our-air-plan-summary-pdf.pdf?la=en
Tracking Air Quality Block by Block (2017) Los Angeles Daily News	https://www.dailynews.com/2017/04/15/tracking-air-quality-block-by-block/
West Oakland Monitoring Study DRAFT	https://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CARE%20Program/DRI_WOMS_final_report.ashx?la=en

Initiative for Healthy Air & Local Economies (INHALE) (Toronto, Etobicoke, and Hamilton, Ontario)

Initiative:	Initiative for Healthy Air & Local Economies (INHALE) (Toronto, Etobicoke, and Hamilton, Ontario)
Organization(s):	Toronto Environmental Alliance; Environment Hamilton
Reference(s):	INHALE Project Website: https://www.inhaleproject.ca/about
Key Words:	mobile sensors, citizen science, advocacy, air-quality mapping

Project Overview

The Initiative for Healthy Air & Local Economies (INHALE) was a two-year (2014-2016) local air quality monitoring pilot project implemented in downtown Toronto, Etobicoke, and Hamilton, Ontario. INHALE sought to raise awareness about air quality issues in these locales and "to put local air quality monitoring into the hands of community members." INHALE was a partnership project between two community environmental groups: Toronto Environmental Alliance and Environment Hamilton. Program funding was attained through the Metcalf Foundation, a community granting agency.

INHALE's project organizers were driven by the belief that raising resident awareness about air quality challenges in their communities would increase citizen advocacy for outcomes such as improved transit and greener public spaces.

INHALE realized that the broad scale of air quality data collected by the province generally inhibits clear understanding of "street" level or community-scale air quality that residents are experiencing every day. INHALE's primary outcome was the creation of the Fresh Air Finder, an online air quality database that used community collected GPS and air monitor data to create a community map of air quality "hot spots" for particulate pollution.

Project Approach

How did INHALE engage communities and encourage participation in the initiative?

INHALE organizers engaged residents in the initiative through outreach and education efforts such as door to door canvasing, attendance at festivals (e.g., Janes Walk, Open Streets Toronto) and farmers' markets, and through a partnership with a local community health centre. Program awareness largely increased through self-promotion, including via the program's

website, word of mouth, and production of e-newsletters, public posters, post cards, and t-shirts.

INHALE was volunteer-driven and volunteers represented diverse backgrounds and demographics. In South Etobicoke, for example, seventy volunteers signed up to advocate for the initiative, twenty-one were trained on how to use air quality monitoring devices, and twelve volunteers actively engaged in data collection.

How was air quality data collected?

A total of five Dylos air quality monitors and GPS data loggers were deployed for data collection. The devices are reportedly easy to operate and attach to backpacks, bikes, baby strollers, walkers or scooters, allowing volunteers to move normally through their local neighbourhoods while simultaneously collecting air quality data. The Dylos monitors record data every ten seconds and measure fine particulate matter ($PM_{2.5}$). Volunteers were trained to use and troubleshoot the devices; a troubleshooting guide is also accessible via the project website. Typically, volunteers would borrow the monitors for up to two weeks at a time.

Key Findings

Publicly accessible, visible data encouraged engagement and action

Collected data was used to map air pollution (fine particulate matter) hotspots in the three sampled neighbourhoods and results were displayed online. The initiative proved to provoke community actions. In one example, two volunteers, residents of a South Etobicoke pollution hotspot, used the results to advocate for tree planting in their neighbourhood. Environmental groups used the data to engage with city councillors on air pollution issues and to further educate and inspire advocacy and citizen science in their communities around the issue of air quality.

Achievement of positive outcomes despite some data challenges

The mobile air monitors could give false readings if it was a really humid day, and the collected data does not represent the complete picture of air quality in surveyed communities. However, INHALE's intent was not data collection for technical analysis, but data collection to increase community awareness, dialogue, and advocacy. INHALE's successes inspired other similar community air quality monitoring efforts in Canada (e.g., the Breathe Easy initiative in Ottawa).

Additional Resources:

Document	*Link*

VICE article about INHALE	https://www.vice.com/en/article/78kkpe/i-put-an-air-quality-monitor-on-my-bike-and-went-looking-for-smog-Toronto-INHALE-TEA
Ecology Ottawa air quality webinar featuring INHALE	https://www.youtube.com/watch?v=hwZZP_Ggdkk&feature=emb_logo

Breathe Easy – Ottawa, Ontario

Initiative:	Breathe Easy (Ottawa, Ontario)
Organization(s):	Ecology Ottawa, Sierra Club Canada
Reference(s):	Breathe Easy Project Website: https://ecologyottawa.ca/campaigns/active-city/breatheeasy/
Key Words:	stationary sensors, mobile sensors, citizen science, advocacy, air-quality mapping

Project Overview

Breathe Easy is a community-level project by Ecology Ottawa and Sierra Club Canada (Ottawa Chapter), which began in 2020 and is inspired by the INHALE model. Breathe Easy uses air quality data collected at Ottawa's arboretum as a baseline, and collects additional data around selected sensitive receptors such as daycares, schools, and seniors' centres.

Breathe Easy's objective is to promote citizen science in and around Ottawa as well as inform the Ottawa community about air quality in the city. The initiative seeks to increase dialogue between residents, city staff, and elected officials regarding the best path forward for consistent monitoring or Ottawa's air quality. Other partners and funding sources for Breathe Easy include Ottawa Sustainability Fund and Trottier Family Foundation.

Project Approach

How is air quality monitored via Breath Easy?

During the summer months Ecology Ottawa staff and volunteers monitor forty sites (twenty "A" sites and twenty "B" sites, comparing between them and to the arboretum baseline) within the city. Each site is monitored four times to capture natural variation. Volunteers also used mobile air quality monitors to collect data while walking, riding, or rolling through sampled neighbourhoods. The data was then matched to the GPS coordinates for each of the sites and a site average is established.

Key Findings

Publicly available data enables user engagement

Data collected through Breathe Easy is presented through an online interactive map, which allows the user select for the total air quality average, morning & afternoon averages, and weekday and weekend averages.

Breathe London (Pilot Project) – London, UK

Initiative:	Breathe London (London, UK)
Organization(s):	Environmental Defense Fund with several NGOs, academic institutions, and corporate partners
Reference(s):	Breathe London Technical Report: https://www.globalcleanair.org/files/2021/02/BL-Pilot-Final-Technical-Report.pdf Breathe London Blueprint Guide: https://www.globalcleanair.org/files/2021/02/EDF-Europe-BreatheLondon_Blueprint-guide.pdf
Key Words:	low- cost monitoring, mobile monitoring, stationary monitoring, mapping, best practices

Project Overview

Breathe London was a two-year pilot project that aimed to collect data to inform data-driven solutions for improving London air quality and fostering healthier, stronger communities. The project was led by the Environmental Defense Fund in collaboration with support from several NGOs, academic institutions, and corporate partners.

The pilot project had three main objectives:

1. Test the reliability and accuracy of a lower-cost stationary sensor network.
2. Characterise the spatial patterns of air pollution, identify hotspots and assess the impact of policy interventions.
3. Provide hyperlocal air pollution data to the public.

Project Approach

Breathe London utilized three data collection methods: (1) a stationary sensor network, (2) a mobile mapping collection, and (3) a “hyper local” wearable study that looked at how air pollution may impact children’s health. Each method is described below.

Stationary Sensor network

The project established a stationary sensor network comprised of one hundred locations across London, each collecting air quality data for approximately two years. Each sensor "pod" (i.e., location) had several sensors that provided near real-time measuring of five different pollutants (nitrogen dioxide, nitric oxide, particulate matter ($PM_{2.5}$ and PM_{10}), carbon dioxide, and ozone). The pods also measured environmental conditions and all data was uploaded to a website. Site selection for the monitors sought to strategically address gaps in London's existing network of regulatory sensors, and to ensure all thirty-two London boroughs were represented.

Mobile mapping deployment

Mobile air quality mapping was completed using two Google Street View cars installed with sensors to measure air pollution. The vehicles operated and measured pollution for one year, driving over 40,000 km during that time period. Mobile mapping deployment measured black carbon, carbon dioxide, lung deposited surface area, nitric oxide, nitrogen dioxide, ozone and particulate matter $PM_{2.5.}$

"Wearables" Study

Another component of Breathe London examined children's exposure to air pollution during peak-risk times. This component was undertaken by Imperial College of London, which worked with five primary schools, over 250 children, and thirty-three teachers who were each given wearable sensors to carry to and from school over a five-day period (i.e., one week of school). Teachers learned about air pollution through resources provided to them by the university. The study found that children were exposed to higher levels of pollution during the morning commute to school compared to their time at school itself. Commuting to school along busier roads resulted in higher exposure than quieter streets.

Key Findings

Best practices guidance

Using Breathe London data, Environmental Defense Fund published a best practice guide titled "Breathe London Blueprint: How cities can use hyperlocal air pollution monitoring to support their clean air goals". The guide outlines best practices for completing air quality monitoring studies, and how hyper-local monitoring can identify pollution hot spots, measure effectiveness of existing mitigations, and raise public awareness about air quality issues.

Data production enabled policy review, program expansion

Breathe London data was used to evaluate and inform City of London air quality policy. The pilot program was expanded and made permanent in 2021; one hundred additional sensors will be installed at priority locations throughout London. The program will also allow community

groups, businesses, individuals and schools to “buy in” to the network at a low cost and host a sensor in a location of their choice.

Additional Resources:

Document	*Link*
Breathe London website (current, expanded program)	https://www.breathelondon.org/
Breath London pilot program website	https://breathelondon.edf.org/about.html
Environmental Defense Fund article	https://edf.org/blog/2019/01/18/mapping-its-own-air-pollution-london-can-help-cities-worldwide

Additional Cases of Interest

Boston Community Assessment of Freeway Exposure and Health (CAFEH) Study (Tufts University, Boston, MA)

Key Words: Multi-partnership, freeways, health outcomes, ultrafine particulates

This air quality study focused on six communities located close to major freeways in greater Boston. The study was a community-based participatory research project which engaged community partners in each project phase from study design and proposal writing, to leading the study, and collecting, analyzing and interpreting data. Study goals were to investigate potential linkages between exposure to air pollutants from highway traffic and cardiac health of highway adjacent communities. Air quality monitoring measured ultrafine particulates (FP), and health studies measured blood pressure and c-reactive (CRP) protein in adults.

Resources:

Source	*Link*
CAFEH website	https://www.cafehresearch.org/

Chemical Valley (Aamjiwnaag First Nation & City of Sarnia, Ontario)

Key Words: petrochemical, cumulative effects, low-tech monitoring, health impacts

Chemical Valley is known as one of the most polluted places in Canada, which hosts a highly concentrated petrochemical industry. Aamjiwnaag First Nation (AFN) have commissioned several air quality and environmental reports, which have documented the high rates of cancer in the area, as well as fertility and birthing issues. Residents are most concerned with benzene release from petrochemical processing, the lack of cumulative effects monitoring currently taking place, and a polluter-enabling federal/provincial regulatory framework. Chemical leaks and spills are often not reported by industry in the area. In response, AFN has experimented with low-tech monitoring techniques such as a “Bucket Brigade” for monitoring air quality locally within the reserve.

Resources:

Source	*Link*
VICE article, “The Chemical Valley”	https://www.vice.com/en/article/4w7gwn/the-chemical-valley-part-1

Ecojustice article, “Return to Chemical Valley"	https://ecojustice.ca/return-to-chemical-valley/

Urban air quality citizen science Phase 1: Review of methods and projects (Scottish Environmental Protection Agency, Scotland, UK)

Key words: citizen science, low-cost monitoring, air quality monitoring equipment, mobile monitoring

This 2013 Scottish Environmental Protection Agency-commissioned report explores available air quality monitoring technologies and how they could be applied in a citizen science context. The report compares different technologies according to cost, reliability, and accuracy. The report also highlights low-cost air quality monitoring techniques using bio-indicators: plant species that indicate a high concentration of a particular pollutant in the air. Report authors compiled a large list of citizen science air quality programs from all over the world. Study partners include the NERC Centre for Ecology & Hydrology, Institute of Occupational Medicine, The Conservation Volunteers, and the University of Aberdeen.

Resources:

Source	*Link*
Phase 1 report	https://www.environment.gov.scot/media/1129/urban-air-quality-citizen-science-phase-1.pdf

Mapping for Change (London, UK)

Key Words: Mapping, stationary monitoring, toolkit, nitrogen dioxide

Mapping for change is a citizen science initiative that helps communities build maps to track trends in different areas (noise, air and odour pollution). Mapping for Change produces visual tools that can be used to show decision-makers and community members the extent of pollution in an area. The project used stationary diffusion tubes over a 4-week time period to measure nitrogen dioxide in communities. Samples were collected and analyzed in a lab and then placed on a map. The map was colour-coded based on the amount of pollution in relation to pollution thresholds implemented by the European Union. Mapping for Change has an online toolkit with guidance for setting up monitoring stations using diffusion tubes in order to measure nitrogen dioxide.

Resources:

Source	*Link*
Mapping for Change, "Citizen Science"	https://mappingforchange.org.uk/services/citizen-science/
Environmental Defense Fund blog post on Mapping for Change	https://www.edf.org/blog/2019/01/18/mapping-its-own-air-pollution-london-can-help-cities-worldwide
Example maps produced through the initiative	https://uclondon.maps.arcgis.com/apps/MapSeries/index.html?appid=6311fdd392494a78ac63a7f1ea0a7127 https://communitymaps.org.uk/project/air-quality-monitoring?layer=1&center=51.5019:-0.1044:10

South Coast Air Quality Management District Clean Air Plans (South Coast, California)

Key Words: Buy back programs, regional monitoring, planning, pilot programs

The South Coast Air Quality Management District (AQMD) creates Clean Air Plans that are regional to local in scope and target specific pollutants. The plans measure air quality against national and state standards. South Coast AGMD's intention is to use results from pilot projects completed in two communities to develop guidance for future projects in other communities. Program successes include a reduction in airborne pollutants achieved through buy-back programs for household pollution sources (e.g., buying back residents' gas-powered lawnmowers to encourage investment in cleaner technologies) and offering rebates for electric vehicles.

Resources:

Source	*Link*
South Coast AGMD Clean Air Plans	http://www.aqmd.gov/home/air-quality/air-quality-studies/special-monitoring/clean-air-plans

South Coast AQMD Clean Communities Plan	http://www.aqmd.gov/home/air-quality/air-quality-studies/special-monitoring/clean-air-plans/clean-communities-plan

Tools for Community Organizing (US Environmental Protection Agency, USA)

Citizen Science Handbook: Quality Assurance & Documentation (US Environmental Protection Agency 2019)

This document outlines tools & procedures guidance for effective dissemination and documentation of collected data. It includes expectations for quality assurance and best practices for conducting volunteer led research projects.

Air Sensor Toolbox – US Environmental Protection Agency

This website provides various links and resources related to air quality monitoring including sensor performance and use, understanding sensor data readings, research projects and other resources.

Resources:

Source	*Link*
Citizen Science Handbook (US EPA 2019)	https://www.epa.gov/sites/production/files/2019-03/documents/508_csqapphandbook_3_5_19_mmedits.pdf
Air Sensor Toolbox (US EPA)	https://www.epa.gov/air-sensor-toolbox