Vancouver Community
2025 Environmental Justice Report

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Executive Summary

The Vancouver Community Report provides community information, demographic data, greenhouse gas emissions data, and information about criteria air pollutant (CAPs) levels and their health impacts. This document provides information about air quality and health impacts to those who live, work, and play in the Vancouver community.

For more information about the background and methodology of this document, please visit the *2025 Environmental Justice Report: Overburdened Communities Highly Impacted by Air Pollution* (2025 EJ Report).

Community Overview

The Vancouver community was identified as overburdened and highly impacted by air pollution because it met the statewide screening criteria based on the Washington Environmental Health Disparities map[1] ranking and the EJScreen demographic index.[2] It also experiences elevated levels of short-term exposure to fine particulate matter ($PM_{2.5}$), as well as cumulative criteria air pollution driven by $PM_{2.5}$, ozone (O_3) and nitrogen dioxide (NO_2). Community identification is described in more detail in the Overburdened Communities Highly Impacted by Air Pollution StoryMap.

Land Area: 29 sq. mi

Population: 109,146

County: Clark

Municipal Government: Vancouver City Council

Ecology Region: Southwest

Local Clean Air Authority: Southwest Clean Air Agency

Local Health Jurisdiction: Clark County Public Health

Primary languages spoken: English, Spanish

Primary pollutant of concern: Short-term $PM_{2.5}$, cumulative criteria air pollution

Geographic characteristics

Vancouver is in Clark County in Southwest Washington and is the fourth largest city in the state. The designated community includes most of the city of Vancouver and is bounded by Interstate 205 on the east and the Columbia River to the south and west. Vancouver is a transportation hub, with heavy roadway, train, and port activity. In addition to local pollution sources, it is likely impacted by pollution sources in the larger city of Portland, Oregon, across the Columbia River.

[1] Washington Environmental Health Disparities map https://doh.wa.gov/data-and-statistical-reports/washington-tracking-network-wtn/washington-environmental-health-disparities-map
[2] EJScreen demographic index https://www.epa.gov/ejscreen

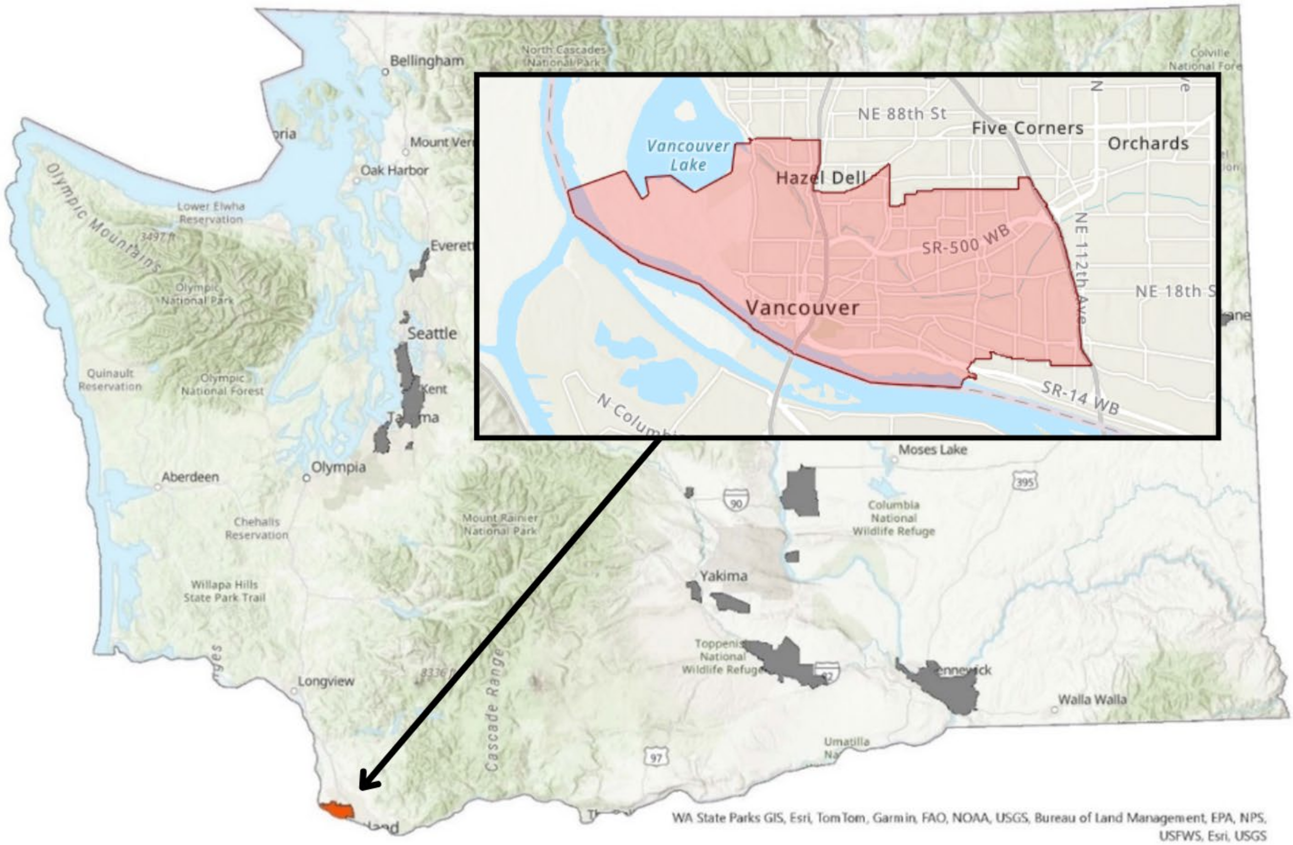

Figure 1. Map of the 16 overburdened communities highly impacted by air pollution in Washington state (gray), with Vancouver highlighted (red).

Socioeconomic characteristics

About one-third of Vancouver's population are people of color; among them, the largest groups are people who identify as Hispanic or multiracial. Nearly 3 in 10 residents in Vancouver are children.[3,4] Many Vancouver residents commute into the greater Portland metropolitan area for work, school, or recreational activities.

[3] American Community Survey Data https://www.census.gov/programs-surveys/acs/data.html

[4] WA Office of Financial Management, Estimates of April 1 population by age, sex, race and Hispanic origin https://ofm.wa.gov/data-research/population-demographics/forecasts-projections/age-sex-race-and-hispanic-origin/information/

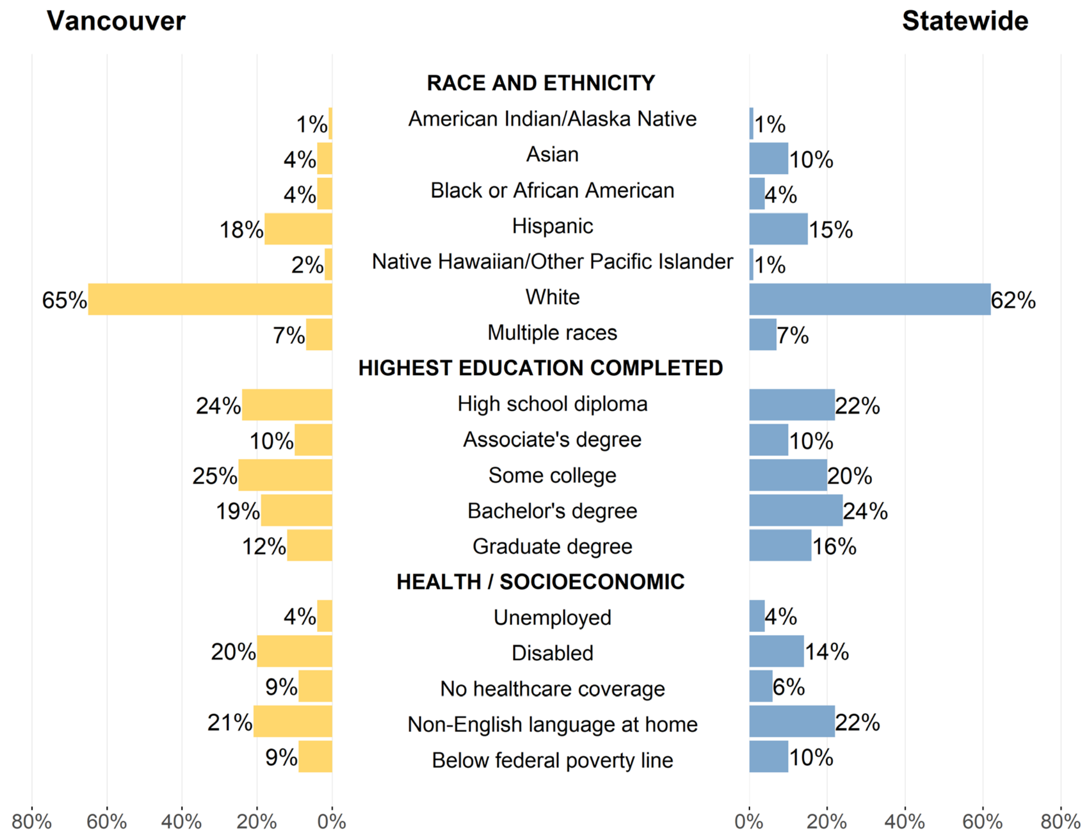

Figure 2. Sociodemographic characteristics of the Vancouver community compared to statewide percentages, based on Washington State's 2024 estimated population of 8,035,700.[5]

Health characteristics

According to 2022 CDC health survey data,[6] Vancouver has elevated prevalences of chronic health conditions among individuals aged 18 years and older relative to the statewide population, including asthma (12.2% vs. 11.4%), cardiovascular disease (6.1% vs. 5.7%), COPD (6.6% vs. 5.7%), diabetes (10.9% vs. 9.6%), and stroke (3.4% vs. 3.1%). These prevalences are not necessarily attributable to air pollution. Community and statewide prevalences that have overlapping 95% confidence intervals, as shown in Figure 3, might not be statistically significant.

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[5] WA Office of Financial Management, Nov 2024 Data Tables, Population by age and sex https://ofm.wa.gov/wp-content/uploads/sites/default/files/public/dataresearch/pop/stfc/stfc_2024.xlsx

[6] U.S. Centers for Disease Control and Prevention, PLACES Data Portal https://www.cdc.gov/places/tools/data-portal.html

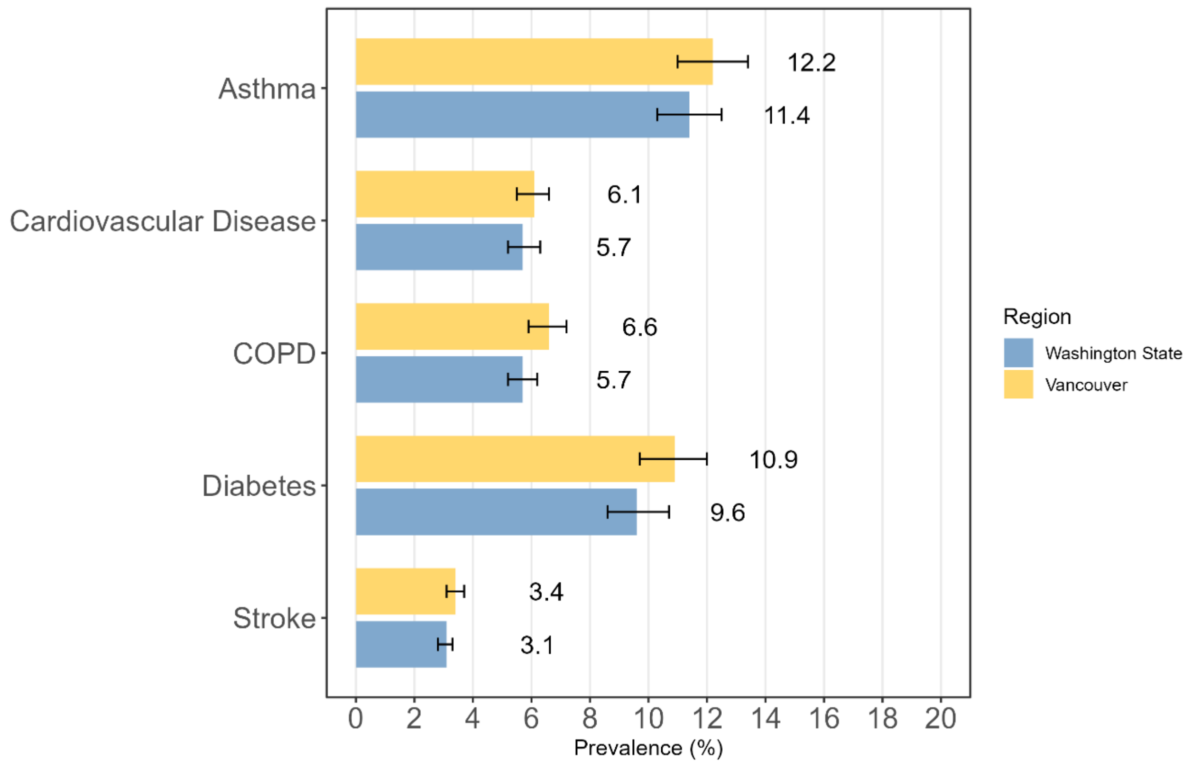

Figure 3. *Prevalence of chronic health conditions among people ages 18 years and older in Vancouver census tracts compared with Washington State.*

Data come from CDC PLACES, 2024 release, which uses 2022 survey data.[6] Yellow and blue bars indicate the estimated prevalence of each condition. Black lines indicate the 95% confidence interval.

Air Monitoring

In the Vancouver community, there is one regulatory $PM_{2.5}$ monitor (Vancouver-NE 84th St) owned and operated by the Southwest Regional Clean Air Agency (SWCAA). Ecology installed five additional low-cost, high accuracy $PM_{2.5}$ sensors (SensWA) in 2025, and data from these sensors will be included in the next biennial EJ Report. The Vancouver-Blairmont Dr ozone (O_3) monitor is outside the community boundary; however, because O_3 is a regional pollutant, Ecology considers the concentrations measured there to be representative of O_3 within the Vancouver community (Figure 4). No other criteria air pollutants are currently monitored in this community.

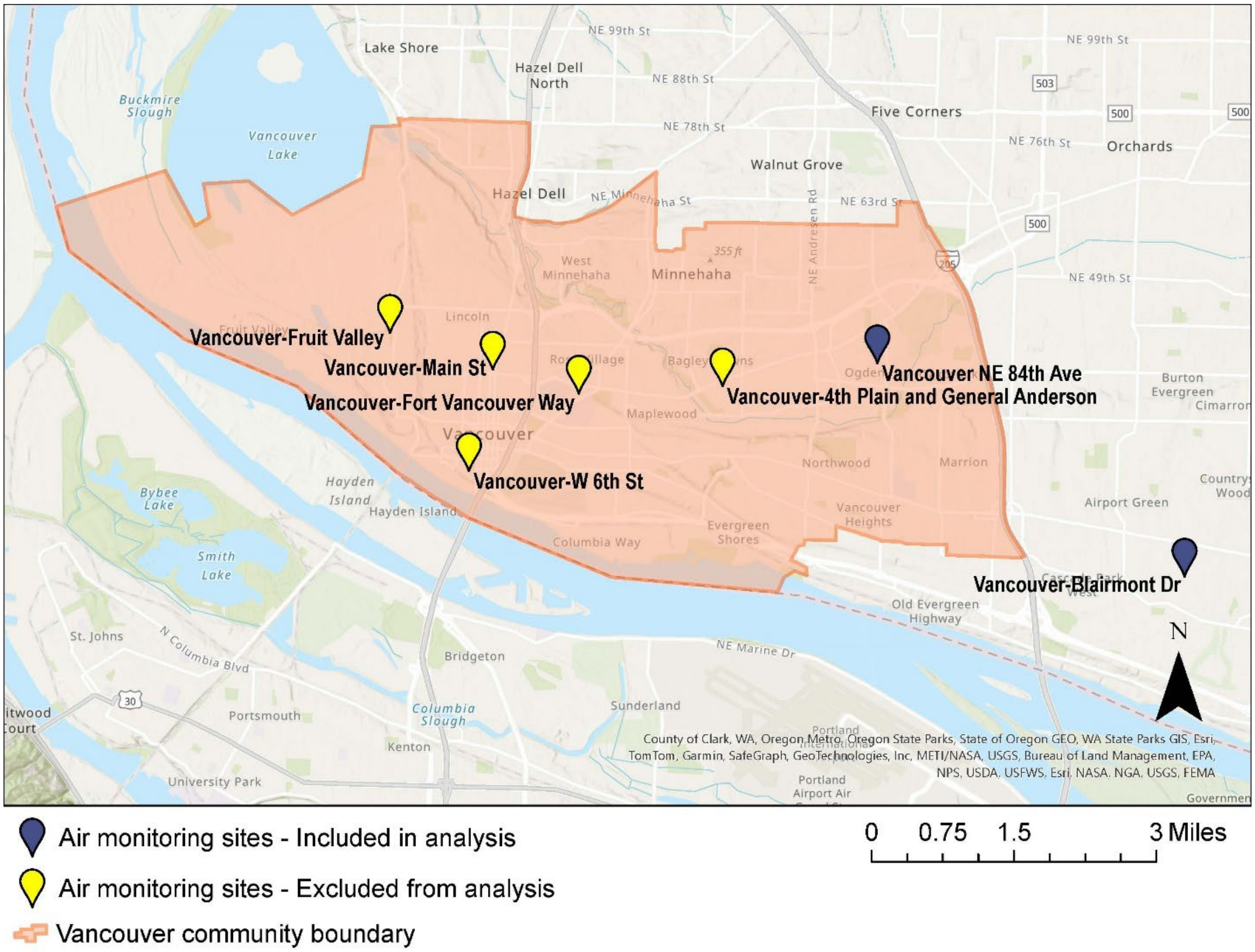

Figure 4. Map of Vancouver air monitoring sites.

Table 1. Vancouver criteria air pollutant monitors.

Monitoring Site	Type	Site Owner	Pollutants Monitored
Vancouver-NE 84th Ave	Regulatory	SWCAA	$PM_{2.5}$
Vancouver-Blairmont Dr	Regulatory	SWCAA	O_3

Criteria Air Pollution

This report summarizes criteria air pollution (CAPs) concentrations in the Vancouver community from 2022 through 2024. CAPs concentrations for $PM_{2.5}$ and O_3 are reported using data from the Washington State Air Monitoring Network and calculated according to the Environmental Protection Agency's (EPA) methodology. More information about the methods can be found in the methods section of the 2025 EJ Report.

In addition to analyzing monitored criteria air pollution concentrations, we calculated the number of days per year residents of the Vancouver community experienced unhealthy air quality, according to EPA's Air Quality Index (AQI). The AQI is a six-category color-coded scale used to communicate daily air quality levels to the public. Days when an AQI above 100 are considered "unhealthy for sensitive groups" or worse.

Between 2022-2024, the Vancouver community experienced an annual average of 1.7 days with unhealthy air (Figure 5). In comparison, between 2020-2022, the annual average was 4.3 days. From 2022-2024, the unhealthy air was primarily caused by wildfire smoke.

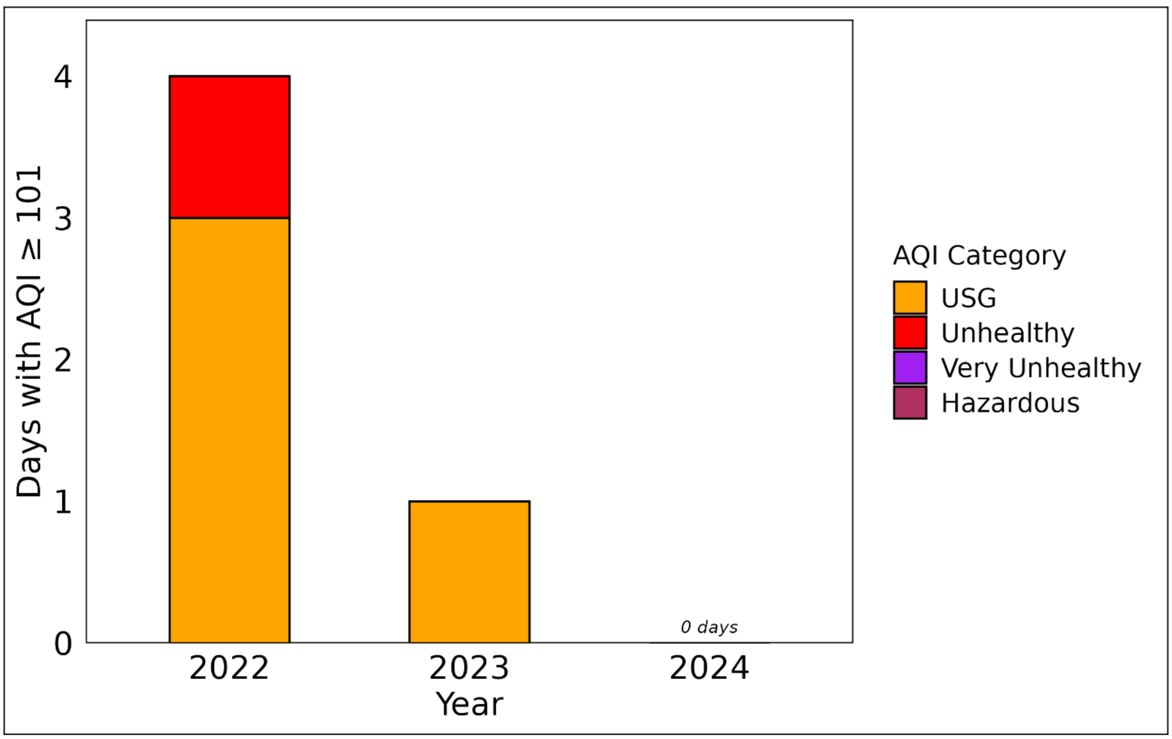

Figure 5. *Number of days 2022-2024 with unhealthy air quality. Includes days impacted by wildfire smoke.*

Table 2 includes 24-hour $PM_{2.5}$ (98th percentile) concentrations. $PM_{2.5}$ concentrations are measured over 24-hour periods in micrograms per cubic meter (µg/m³). The EPA establishes national ambient air quality standards (NAAQS), which define the maximum allowable levels (thresholds) for each criteria pollutant. The NAAQS threshold for 24-hour $PM_{2.5}$ (98th percentile) is 35 µg/m³. The design value for 24-hour $PM_{2.5}$ (98th percentile) is a statistic that describes the air quality of a location relative to the NAAQS over a three-year period and is used to describe short-term fine particulate exposure.

At the Vancouver-NE 84th Ave monitoring site, the 24-hour $PM_{2.5}$ (98th percentile) concentrations showed a downward trend between 2022 and 2024. In 2022 and 2023, there were multiple days when the daily average $PM_{2.5}$ concentrations exceeded 35.4 µg/m³ due to wildfire smoke; however, the three-year design value remained below the NAAQS threshold. The values in brackets in Table 2 exclude wildfire-impacted days when the 24-hour average $PM_{2.5}$ concentrations exceeded 35.4 µg/m³.

Table 2. ***24-hour $PM_{2.5}$ (98th percentile) concentrations and 2024 design value, 2022–2024.*** *Brackets [ ] exclude wildfire days when the 24-hour average $PM_{2.5}$ concentration exceeded 35.4 µg/m³. 24-hour $PM_{2.5}$ (98th percentile) NAAQS is 35 µg/m³.*

Monitoring Site	2022 24-hour 98th Percentile	2023 24-hour 98th Percentile	2024 24-hour 98th Percentile	2024 Design Value
Vancouver-NE 84th Ave	29.4 [26.4]	25.4 [24.8]	16.6 [16.6]	24 [23]

NAAQS = national ambient air quality standards, PM = particulate matter, µg/m³ = micrograms per cubic meter

Figure 6. ***24-hour $PM_{2.5}$ (98th percentile) concentrations, 2022-2024.*** *Annual concentrations calculated with and without days elevated from wildfire smoke. Dark blue bar includes three complete years of data, 2022-2024; dashed line is the federal limit (NAAQS) for 24-hr $PM_{2.5}$.*

Table 3 includes annual mean $PM_{2.5}$ concentrations between 2022 to 2024 and 2024 design values. The annual $PM_{2.5}$ design value is a three-year average of annual mean $PM_{2.5}$ concentrations used to describe long-term exposure. The annual means remained below the federal standard from 2022-2024, with a slight downward trend from year-to-year. With wildfire-impacted days excluded, the 2024 design value was reduced by approximately 7% (Table 3). In 2024, there was little impact from wildfire smoke shown by the annual mean $PM_{2.5}$ concentration.

*Table 3. **Annual mean $PM_{2.5}$ concentration and 2024 design value, 2022–2024**. Units are in µg/m³. Brackets [ ] exclude wildfire days when the average $PM_{2.5}$ concentration exceeded 15.0 µg/m³. Annual $PM_{2.5}$ NAAQS is 9.0 µg/m³.*

Monitoring Site	2022	2023	2024	2024 Design Value
Vancouver-NE 84th Ave	7.70 [6.88]	6.40 [6.22]	4.45 [4.35]	6.2 [5.8]

NAAQS = national ambient air quality standards, PM = particulate matter, µg/m3 = micrograms per cubic meter

For O_3, design values are a three-year average of the annual 4th-highest daily maximum 8-hour concentration at a monitor site. The ambient O_3 concentrations remained below the NAAQS threshold (Table 4). The monitor recorded O_3 concentrations during "ozone season", which is May-September.

*Table 4. **The 4th highest daily maximum 8-hour average O_3 (ppm) and 2024 design value, 2022-2024.***

Monitoring Site	Pollutant	2022	2023	2024	2024 Design Value	NAAQS Level	Form
Vancouver-Blairmont Dr	O_3	0.063	0.062	0.056	0.060	0.070 (ppm)	Annual 4th highest daily maximum 8-hour concentration, averaged over 3 years

ppm = parts per million

Health Impacts of Criteria Air Pollution

We estimated the number and rate of deaths and morbidities associated with $PM_{2.5}$ and ozone concentrations by age range and using health effect estimates from peer-reviewed studies (Appendix B, Table 2 in the 2025 EJ Report). All estimates are rounded to the nearest whole number. We present ranges of deaths or morbidities where multiple studies assessed that health outcome.

$PM_{2.5}$

We estimated 32 deaths by any cause (38 deaths per 100,000 population, Table B1) related to yearly $PM_{2.5}$ exposure. Among older adults, we estimated 23 total deaths (119 deaths per 100,000 population) each year associated with annual $PM_{2.5}$ exposure (Table B2).

Among different racial and ethnic groups (Figure 7), we estimated most $PM_{2.5}$ related deaths by any cause per year to be among non-Hispanic White people (30 deaths among 18–84-year-olds). However, when accounting for the ages of people in each racial and ethnic group[7], the annual age-adjusted mortality rate was highest among Hispanic people (54 deaths per 100,000 population) and non-Hispanic Black people (52 deaths per 100,000 population).

Figure 7 is based on the study by Pope et al. (2019),[8] where AIAN refers to American Indian and Alaska Native; NH to non-Hispanic; and NHOPI to Native Hawaiian and Other Pacific Islander. The bars indicate the 95% confidence interval (CI) for each rate.

[7] Age-adjusted mortality rates represent the mortality rate if the age distribution in that race category matched the age distribution of the total Washington State population. This allows for better comparability given that different race groups can have different age distributions and the risk of death is higher in older age groups. We see higher age-adjusted rates for race categories other than the non-Hispanic White group given that these groups are generally younger in overburdened communities compared to the statewide age distribution; when we standardize these groups to the state age distribution (which has a higher proportion of older people) the estimated mortality rates are higher. More information about our age-adjustment methods can be found in the 2025 EJ Report.

[8] Pope, C.A., 3rd, Lefler, J.S., Ezzati, M., Higbee, J.D., Marshall, J.D., Kim, S.Y., Bechle, M., Gilliat, K.S., Vernon, S.E., Robinson, A.L., & Burnett, R.T. (2019). Mortality Risk and Fine Particulate Air Pollution in a Large, Representative Cohort of U.S. Adults. *Environmental Health Perspectives*, 127(7), 77007.

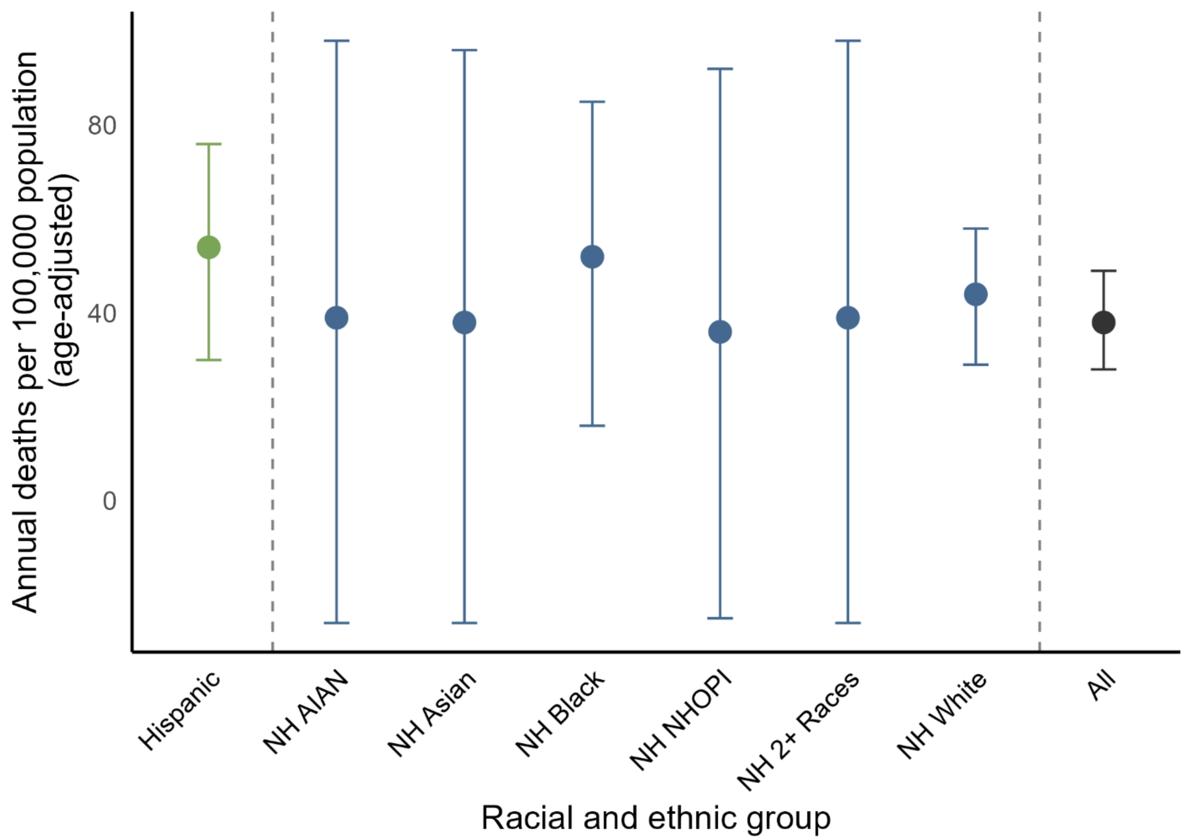

Figure 7. Age-adjusted annual death rates by any cause associated with annual $PM_{2.5}$ exposure among ages 18-84 by racial and ethnic group in Vancouver.

When assessing specific causes of death related to yearly $PM_{2.5}$ concentrations (Table B3), we estimated 11 deaths due to cardiovascular disease (12 deaths per 100,000 population), 9 to 15 deaths due to ischemic heart disease (13 to 22 deaths per 100,000 population), and 2 to 3 deaths per year due to lung cancer (2 to 4 deaths per 100,000 population) among adults.

Regarding non-fatal health outcomes (Table B3), we estimated that 14 hospital admissions (16 visits per 100,000 population) for acute non-fatal myocardial infarction were associated with yearly $PM_{2.5}$ concentrations among adults. Additionally, 9 lung cancer diagnoses per year were associated with annual $PM_{2.5}$ exposure among all people (13 diagnoses per 100,000 population).

Daily $PM_{2.5}$ exposure (Table B4) was associated with 1 death by any cause (1 per 100,000 population) among all people and 2 deaths (11 per 100,000 population) among older adults ages 65 to 99. For non-fatal conditions, daily $PM_{2.5}$ was associated with 3 acute non-fatal myocardial infarction admissions (3 per 100,000 population) among all adults, 12 respiratory admissions (61 per 100,000 population) among older adults ages 65 to 99, 6 asthma hospital admissions (7 per 100,000 population) among people ages 0 to 64 years. Additionally, 15 to 28 asthma-related emergency department (ED) visits (14 to 26 per 100,000 population) among all people and 6 asthma-related ED visits (29 per 100,000 population) among youths ages 0 to 17 years were associated with daily $PM_{2.5}$ exposure.

Ozone

We estimated that O_3 exposure during the warm season (Table B5) was associated with 6 seasonal deaths by any cause among older adults (33 deaths per 100,000 population). Daily O_3 exposure was associated with 2 deaths by any cause (2 per 100,000 population), 34 asthma-related ED visits (31 per 100,000 population) among all people and 24 respiratory hospital admissions (124 per 100,000 population) among older adults ages 65–99.

Greenhouse Gas Emissions

Greenhouse gas emissions data for the Vancouver overburdened community highly impacted by air pollution include: 1) Emissions from greenhouse gas reporting entities per RCW 70A.65[9] and WAC 173-441,[10] -446;[11] and 2) Mobile source emissions.[12]

We did not collect information or model greenhouse gas emissions from other sources at this time. The greenhouse gas information provided in this report aligns with the Climate Commitment Act's (CCA) requirements. For further information on methods and statewide results, refer to the 2025 EJ Report.

Facilities

Washington State requires certain businesses that emit more than 10,000 metric tons of carbon dioxide equivalents (MT CO_2e) to report to the Washington Greenhouse Gas Reporting Program.[13] Businesses that emit over 25,000 MT CO_2e are also subject to the Cap-and-Invest Program (covered sources). Each reporting facility is required to follow a compliance plan.

In the Vancouver community, five facilities (Figure 8; Table 5) within and near the community boundary reported their emissions in 2023, compared to four in 2022. The total reported emissions from these facilities was 695,179 MT CO_2e in 2022 and 736,686 MT CO_2e in 2023, a 6% year-to-year increase. Some facilities in other communities report biogenic carbon (biogenic

[9] Greenhouse Gas Emissions – Cap-and-Invest Program https://app.leg.wa.gov/RCW/default.aspx?cite=70A.65
[10] Reporting of Emissions of Greenhouse Gases https://app.leg.wa.gov/WAC/default.aspx?cite=173-441
[11] Climate Commitment Act – Program Rule https://app.leg.wa.gov/WAC/default.aspx?cite=173-446
[12] Environmental Justice Review https://app.leg.wa.gov/RCW/default.aspx?cite=70A.65.020
[13] Mandatory greenhouse gas reports https://ecology.wa.gov/air-climate/reducing-greenhouse-gas-emissions/tracking-greenhouse-gases/mandatory-greenhouse-gas-reports

CO_2) [14] emissions, which are expected to be partially recaptured as part of the natural carbon cycle. For reporting purposes, biogenic CO_2 is subtracted from total metric tons of CO_2e, even though it has the same atmospheric warming effect as non-biogenic CO_2. There were no facilities that reported biogenic CO_2 in Vancouver. Since 2020, total reported greenhouse gas emissions from facilities within and near OBCs have decreased by 20.3%, and by 6.3% after subtracting biogenic CO_2 emissions. Some year-to-year fluctuations in emissions from individual facilities are expected.

In 2023, Leichner Landfill was added as a new reporter. As a landfill, it is exempt from CCA coverage because Washington implemented a landfill-specific methane reduction program, adopted by Ecology in 2024 under Chapter 173-408 WAC.[15] All landfills in Washington with annual greenhouse gas emissions of 10,000 MT CO_2e or higher are required to report to Ecology.

[14] Biogenic carbon refers to greenhouse gases released from the combustion, decomposition, or processing of materials derived from biological sources – such as wood, paper, biomass fuels, agriculture residues, food waste, or biogas. Under the Washington Greenhouse Gas Reporting Program, these emissions are reported separately from fossil-derived emissions because they result from carbon that circulates within the short-term natural carbon cycle rather than long-term carbon stores. Biogenic CO_2 acts the same way in the atmosphere as non-biogenic CO_2. Anthropogenic processes that include these emissions reduce a facility's environmental impact.

[15] Landfill Methane Emissions https://app.leg.wa.gov/wac/default.aspx?cite=173-408

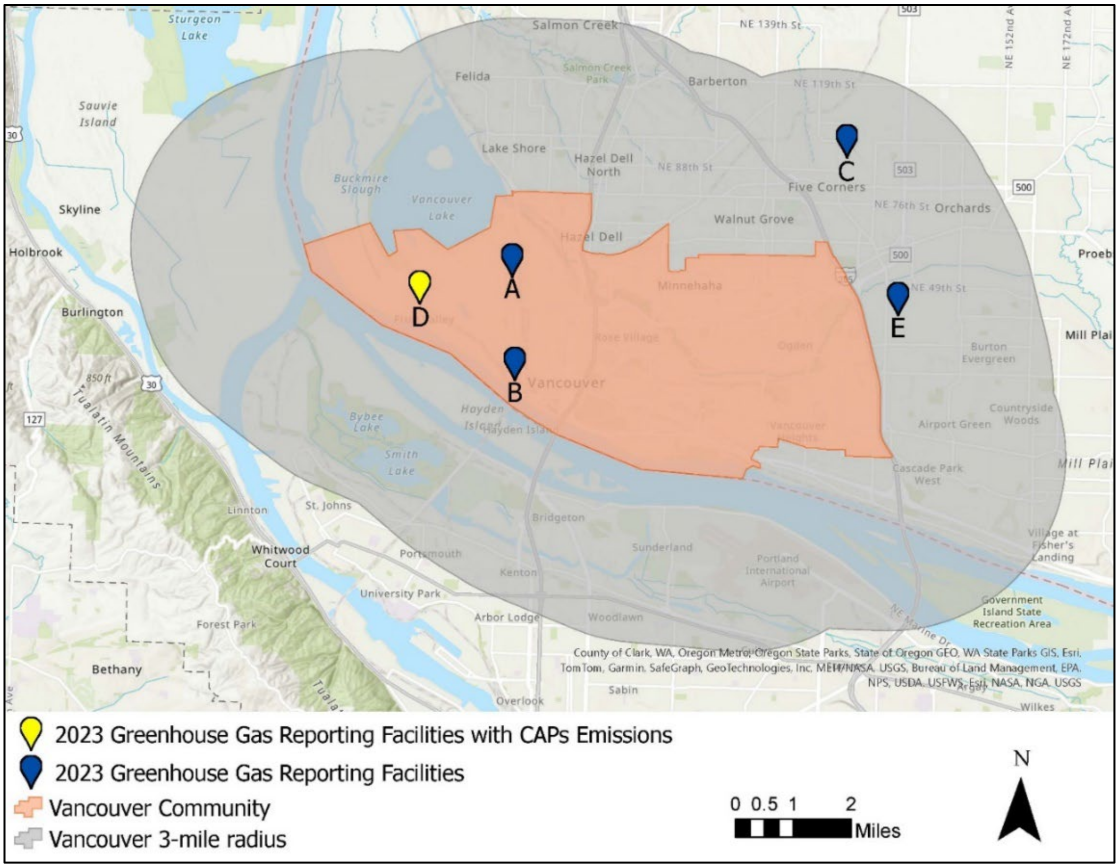

Figure 8. Reporting facilities as of 2023 that are in or near the Vancouver community boundary. Facility letters correspond with Table 4.

The emissions in Table 4 are in MT CO_2e. Each greenhouse gas uses a conversion factor known as its Global Warming Potential (GWP), in this case AR4 GWP[16], to convert emissions into CO_2e. A GWP describes how much heat a greenhouse gas traps in the atmosphere relative to carbon dioxide over a specific time horizon (20, 100, or 500 years). AR4 GWPs are published in the 2007 Intergovernmental Panel on Climate Change (IPCC).[17] The Greenhouse Gas Reporting Program uses AR4 GWPs mainly for regulatory stability, consistency, and alignment with other federal programs.

[16] Reporting of Emissions of Greenhouse Gases https://app.leg.wa.gov/WAC/default.aspx?cite=173-441
[17] Intergovernmental Panel on Climate Change https://www.ipcc.ch/

Table 3. Facility emissions in or nearby[18] the Vancouver community. Biogenic CO_2 is in brackets [ ].

	Facility Name/City	Facility Sector	Within Community Boundary	CCA-Covered Facility[19]	Source of CAPs[20]	2022 Emissions ($MTCO_2e$)	2023 Emissions ($MTCO_2e$)
A	Frito Lay - Vancouver	Food Production	Yes	No	No	14,163 [0]	13,363 [0]
B	Great Western Malt - Vancouver	Food Production	Yes	No	No	15,701 [0]	11,815 [0]
C	Leichner Landfill - Vancouver	Waste	Nearby	Exempt	No		620 [0]
D	River Road Generating Plant - Vancouver	Power Plants	Yes	Yes	Yes	653,928 [0]	700,250 [0]
E	SEH America - Vancouver	Manufacturing	Nearby	No	No	11,387 [0]	10,638 [0]

Washington has local natural gas distribution and bulk electricity transmission companies that report emissions on a statewide basis, in which the emissions cannot be disaggregated.

Bonneville Power Administration (BPA) operates electricity infrastructure that runs through the community, and they provide electrical transmission statewide. They are excluded from this analysis because electric power entities like BPA report greenhouse gas emissions associated with electricity imports on a statewide basis. Some BPA transmission stations use a potent greenhouse gas called sulfur hexafluoride (SF_6) to insulate electrical equipment. Bonneville is

[18] "Nearby" refers to facilities within a three-mile radius of the community boundary that were included in this analysis.
[19] Large emitters of greenhouse gases, specifically those emitting 25,000 or more MT CO_2e annually in Washington State that are part of the Cap-and-Invest program established by the Climate Commitment Act.
[20] Major sources of criteria air pollutants are designated in the Air Operating Permit program. A major source is any stationary source that has the actual or potential to emit ≥100 tons per year for any air pollutant. Many sources emit far below the threshold. More information can be found at https://ecology.wa.gov/regulations-permits/permits-certifications/air-quality-permits/air-operating-permit

not covered by the CCA for this reporting period, nor is it a source of CAP emissions. Statewide emissions were 3,496 CO_2e in 2022 and 21,935 MT CO_2e in 2023.

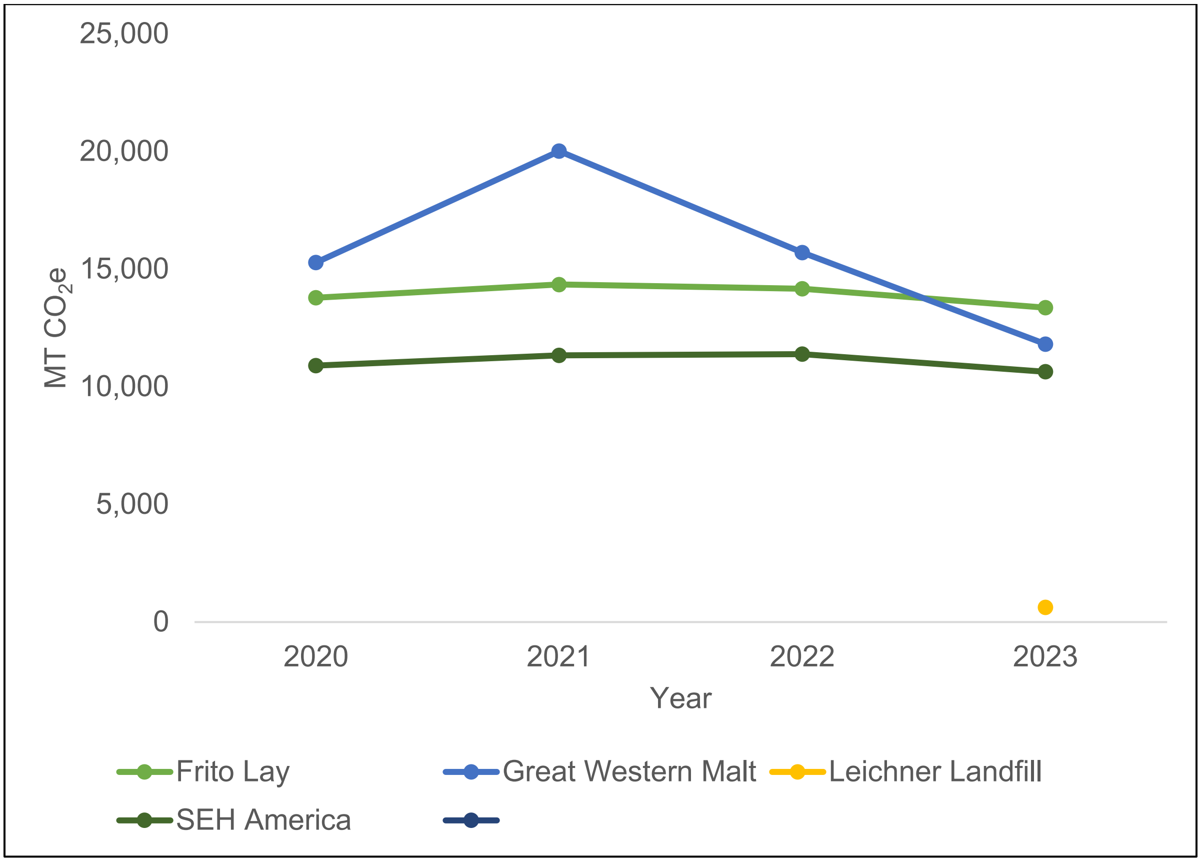

Figure 9. Greenhouse gas reporting facilities and their emissions from 2020-2023.

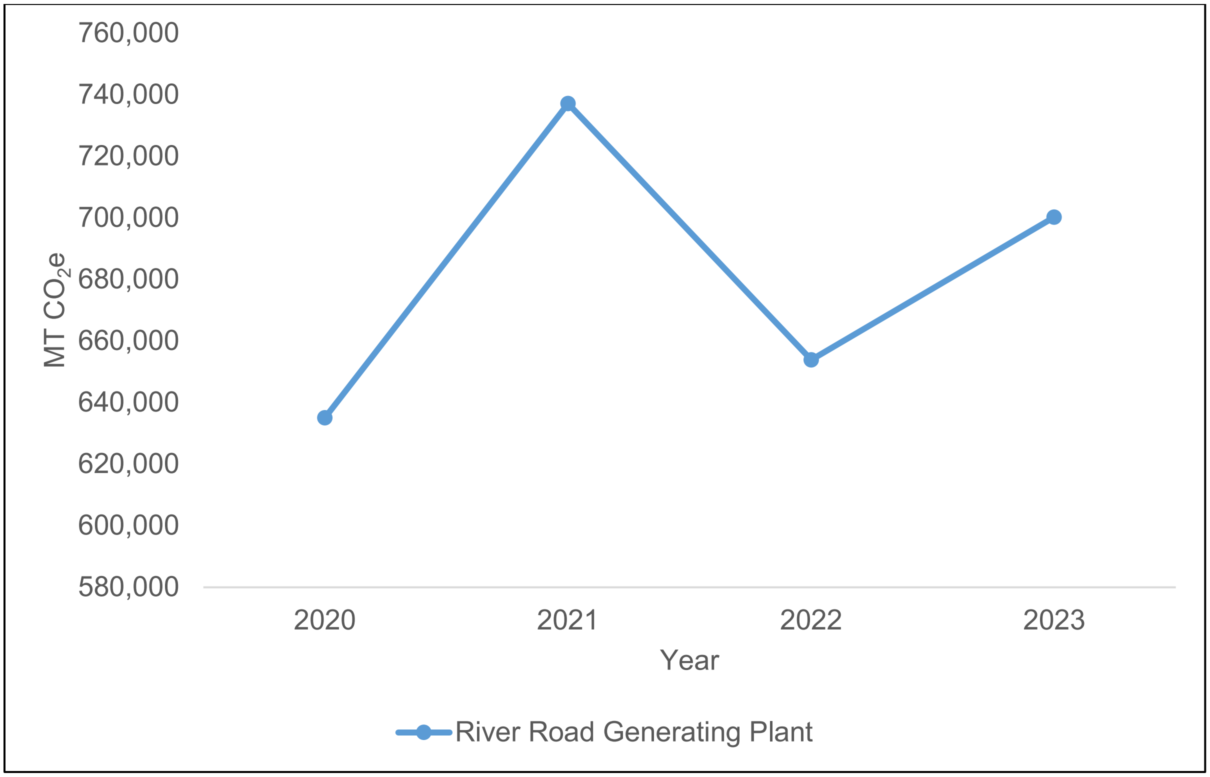

Figure 10. River Road Generating Plant greenhouse gas emissions from 2020-2023 (for visibility, facility is separated due to the difference in emission ranges).

Mobile sources

In the Vancouver community, greenhouse gas emissions from mobile sources increased by 21% from 2020 to 2021 (Table 5) but have decreased by 5.4% between 2019 to 2021.[21] Mobile sources consist of on-road and non-road emissions. The drop in emissions in 2020 was largely due to a decrease in vehicle traffic that was attributed to the COVID-19 pandemic.[22,23]

Similar to Table 4, the results in Table 5 use AR5 GWPs to convert greenhouse gas emissions into CO_2e. In 2013-2014, the IPCC published AR5 GWPs and AR6 GWPs in 2021-2022. The Washington Greenhouse Gas Emissions Inventory[24] uses AR5 GWPs in mobile source emission

[21] Improving Air Quality in Overburdened Communities Highly Impacted by Air Pollution 2023 Report https://apps.ecology.wa.gov/publications/SummaryPages/2302115.html
[22] Washington State Greenhouse Gas Emissions Inventory: 1990-2021, Jan 2025 https://apps.ecology.wa.gov/publications/SummaryPages/2414077.html
[23] Reducing Greenhouse Gas Emissions from the Transportation Sector through Climate Planning, Dec 2024 https://www.epa.gov/system/files/documents/2024-12/420f24042.pdf
[24] Washington State Greenhouse Gas Emissions Inventory: 1990-2021, Jan 2025 https://apps.ecology.wa.gov/publications/SummaryPages/2414077.html

estimates, as the inventory models for greenhouse gas accounting are revised as science improves.

Table 4. Greenhouse gas emissions from mobile sources per capita from 2020-2021.

Population	2020 Emissions (MT CO_2e)	2020 Per Capita MT CO_2e	2021 Emissions (MT CO_2e)	2021 Per Capita MT CO_2e
103,388	323,803	3.1	391,705	3.8

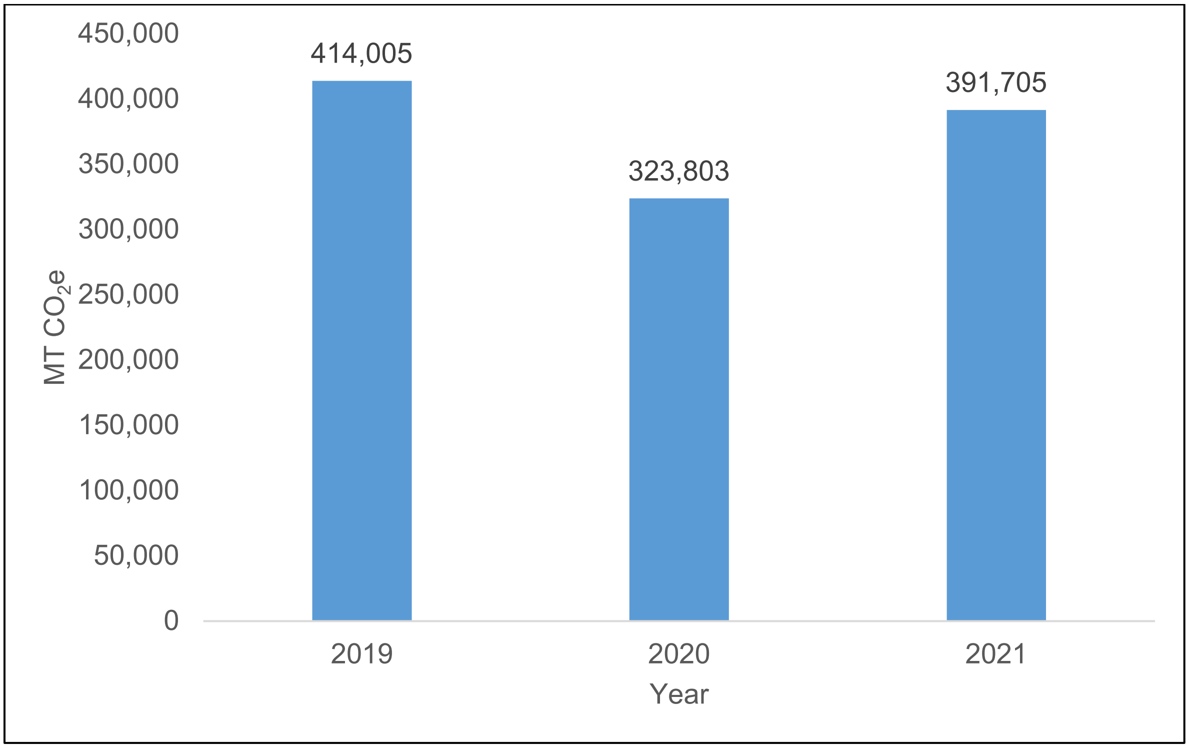

Figure 11. Annual greenhouse gas emissions from mobile sources in the Vancouver community, 2019-2021.

Community Resources

These resources provide more information about air quality and health in the Vancouver community:

- Clark County Public Health Assessment and Evaluation information page[25]
- Clark County Public Health CHA/CHIP information page[26]
- Clark County 2023 Community Health Improvement Plan[27]
- Clark County 2023 Community Health Assessment[28]
- Healthy Columbia Willamette Collaborative 2022 Community Health Needs Assessment[29]
- PeaceHealth Southwest Medical Center 2022-2025 Community Health Needs Assessment[30]
- Zero-emission and electric vehicles mapping tool | WSDOT[31]
- Home | Washington Climate Action[32]

[25] https://clark.wa.gov/public-health/health-assessment-and-evaluation
[26] https://clark.wa.gov/public-health/community-health-assessment-and-improvement-plan
[27] https://clark.wa.gov/sites/default/files/media/document/2024-05/final-chip-report_feb-24.pdf
[28] https://clark.wa.gov/sites/default/files/media/document/2024-05/final_clark-county-cha_feb-24.pdf
[29] https://clark.wa.gov/sites/default/files/media/document/2022-09/HCWC%20CHNA%202022%208.2.22-%20significantly%20compressed.pdf
[30] https://www.peacehealth.org/sites/default/files/2022-04/21-ADMIN-260620-Columbia%20Network-Graphics-sup_Southwest%20%282%29.pdf
[31] https://wsdot.wa.gov/business-wsdot/grants/zero-emission-vehicle-grants/zero-emission-and-electric-vehicles-mapping-tool
[32] https://climate.wa.gov/

Appendix A. Criteria Air Pollution

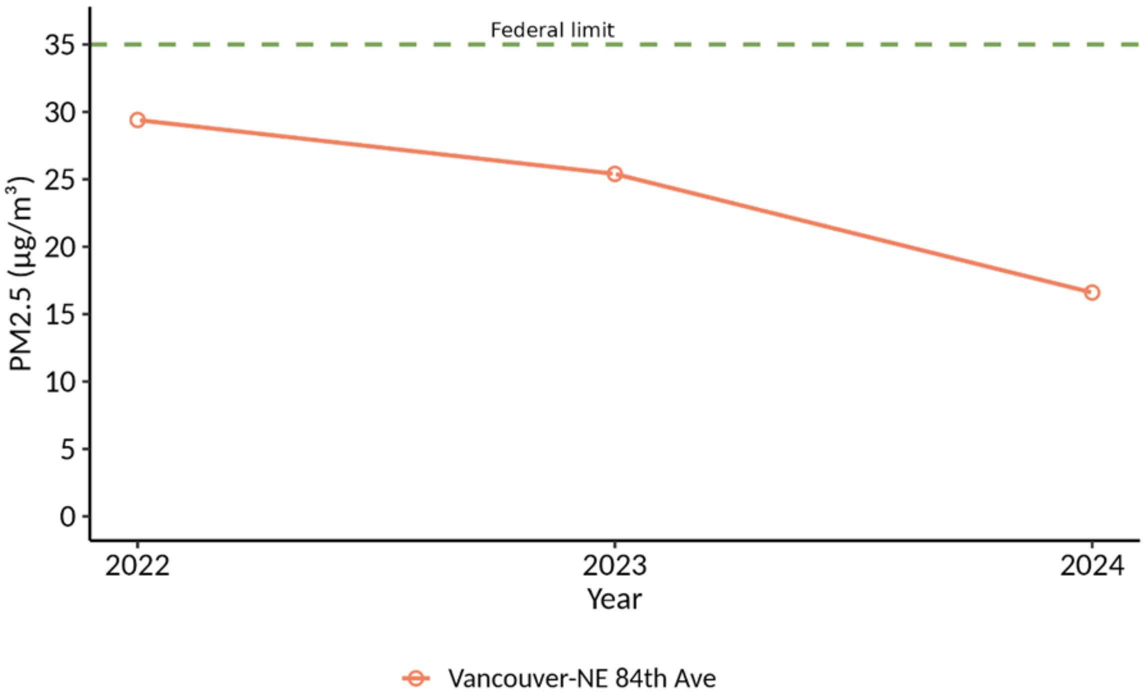

Figure A1. 24-hr $PM_{2.5}$ (98th percentile) concentrations at the Vancouver monitoring site. Days impacted by wildfire smoke are included. Dashed line is the federal limit for 24-hr $PM_{2.5}$ (35 µg/m³).

Appendix B. Supplemental Health Impacts Tables

Table B1. Estimated annual deaths by any cause related to yearly $PM_{2.5}$ exposure among 18–84-year-olds in Vancouver by racial and ethnic group, 2022–2023 (based on effect estimates in study by Pope, et al., 2019[8]).

Racial and Ethnic Group	Population (18-84-year-olds)	Estimated Annual Deaths [95% CI]	Estimated annual deaths per 100,000 population [95% CI]	Estimated age-adjusted annual deaths per 100,000 population [95% CI]
All	85,501	32 [23 to 41]	38 [27 to 48]	38 [28 to 49]
Hispanic	12,305	3 [2 to 4]	24 [14 to 34]	54 [30 to 76]
Non-Hispanic AIAN	718	<1 [0 to 1]	38 [-26 to 95]	39 [-26 to 98]
Non-Hispanic Asian	3,331	1 [-1 to 3]	39 [-27 to 99]	38 [-26 to 96]
Non-Hispanic Black	3,015	1 [0 to 2]	38 [12 to 63]	52 [16 to 85]
Non-Hispanic NHOPI	1,396	<1 [0 to 1]	19 [-13 to 47]	36 [-25 to 92]
Non-Hispanic 2+ races	4,958	1 [-1 to 3]	26 [-17 to 64]	39 [-26 to 98]
Non-Hispanic White	59,779	30 [19 to 40]	50 [33 to 67]	44 [29 to 58]

AIAN: American Indian and Alaska Native; CI: confidence interval; NHOPI: Native Hawaiian and Other Pacific Islander

Race categories only include people who identify as non-Hispanic to reflect the race categories used in the study by Pope, et al.

Population is the average of the 2022 and 2023 Washington State Office of Financial Management estimates for the census tracts that comprise this overburdened community.

The age-adjusted rate indicates the expected rate if the age distribution in this overburdened community matched that of Washington State.

Table B2. Estimated annual deaths by any cause related to yearly $PM_{2.5}$ exposure among 65–99-year-olds in Vancouver by racial and ethnic group, 2022–2023 (based on effect estimates in study by Di, et al., 2017[33]).

Racial and Ethnic Group	Population (65-99-year-olds)	Estimated Annual Deaths [95% CI]	Estimated annual deaths per 100,000 population [95% CI]	Estimated age-adjusted annual deaths per 100,000 population [95% CI]
All	19,166	23 [22 to 23]	119 [115 to 122]	114 [110 to 117]
Hispanic	702	1 [1 to 1]	114 [98 to 128]	134 [116 to 151]
AIAN	213	<1 [range <1]	112 [69 to 153]	111 [68 to 152]
Asian	764	1 [1 to 1]	97 [76 to 116]	97 [77 to 117]
Black	406	1 [1 to 1]	187 [180 to 194]	199 [191 to 207]
2+ races	761	1 [1 to 1]	110 [67 to 150]	119 [73 to 163]
NHOPI	98	<1 [range <1]	88 [54 to 121]	91 [56 to 124]
White	16,924	11 [11 to 12]	67 [64 to 69]	66 [63 to 68]

AIAN: American Indian and Alaska Native; CI: confidence interval; NHOPI: Native Hawaiian and Other Pacific Islander

Race categories include people who identify as Hispanic and non-Hispanic to reflect the race categories used in the study by Di, et al.

Population is the average of the 2022 and 2023 Washington State Office of Financial Management estimates for the census tracts that comprise this overburdened community.

The age-adjusted rate indicates the expected rate if the age distribution in this overburdened community matched that of Washington State.

[33] Di, Q., Wang Y., Zanobetti, A., Wang, Y., Koutrakis, P., Choirat, C., Dominici, F., Schwartz, J.D. 2017. Air Pollution and Mortality in the Medicare Population. *The New England Journal of Medicine*, 376(26), pp. 2513-2522.

Table B3. Annual mortality and morbidity associated with yearly $PM_{2.5}$ exposure (yearly 24-hour average concentrations) in Vancouver, 2022-2023. Brackets [ ] include 95% confidence interval.

Health Outcome	Age Group	Source of Risk Estimate	Population	Estimated Annual Number [95% CI]	Estimated annual rate per 100,000 population [95% CI]
Deaths – Any cause	65 to 99	Di et al., 2017[34]	19,166	23 [22 to 23]	119 [115 to 122]
Deaths – Any cause	18 to 84	Pope et al., 2019[35]	85,501	32 [23 to 41]	38 [27 to 48]
Deaths – Cardiovascular disease	18 to 99	Alexeeff et al., 2023[36]	87,638	11 [4 to 17]	12 [5 to 19]
Deaths – Ischemic heart disease	30 to 99	Jerrett et al., 2017[37]	69,506	10 [7 to 12]	14 [11 to 18]
Deaths – Ischemic heart disease	30 to 99	Krewski et al., 2009[38]	69,506	15 [12 to 18]	22 [18 to 26]
Deaths – Ischemic heart disease	30 to 99	Pope et al., 2019[39]	69,506	9 [7 to 12]	13 [10 to 17]
Deaths – Lung Cancer	30 to 99	Krewski, et al., 2009[40]	69,506	3 [1 to 4]	4 [2 to 6]

[34] Di, Q., Wang Y., Zanobetti, A., Wang, Y., Koutrakis, P., Choirat, C., Dominici, F., Schwartz, J.D. 2017. Air Pollution and Mortality in the Medicare Population. *The New England Journal of Medicine*, 376(26), pp. 2513-2522.

[35] Pope, C.A., 3rd, Lefler, J.S., Ezzati, M., Higbee, J.D., Marshall, J.D., Kim, S.Y., Bechle, M., Gilliat, K.S., Vernon, S.E., Robinson, A.L., & Burnett, R.T. (2019). Mortality Risk and Fine Particulate Air Pollution in a Large, Representative Cohort of U.S. Adults. *Environmental Health Perspectives*, 127(7), 77007.

[36] Alexeeff SED, K.Van Den Eeden, S.Schwartz, J.Liao, N. S.Sidney, S. Association of Long-term Exposure to Particulate Air Pollution with Cardiovascular Events in California. *JAMA Network Open*. 2023;6(2):e230561.

[37] Jerrett, 2017. Comparing the Health Effects of Ambient Particulate Matter Estimated Using Ground-Based Versus Remote Sensing Exposure Estimates. *Environmental Health Perspectives*. 2017 Apr;125(4):552-559. doi: 10.1289/EHP575. Epub 2016 Sep 9.

[38] Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA

[39] Pope, C.A., 3rd, Lefler, J.S., Ezzati, M., Higbee, J.D., Marshall, J.D., Kim, S.Y., Bechle, M., Gilliat, K.S., Vernon, S.E., Robinson, A.L., & Burnett, R.T. (2019). Mortality Risk and Fine Particulate Air Pollution in a Large, Representative Cohort of U.S. Adults. *Environmental Health Perspectives*, 127(7), 77007.

[40] Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA

Health Outcome	Age Group	Source of Risk Estimate	Population	Estimated Annual Number [95% CI]	Estimated annual rate per 100,000 population [95% CI]
Deaths – Lung Cancer	30 to 99	Turner et al., 2016[41]	69,506	2 [0 to 3]	2 [1 to 4]
Hospital Admissions – Acute Non-Fatal Myocardial Infarction	18 to 99	Alexeeff, et al., 2023[42]	87,638	14 [8 to 20]	16 [9 to 23]
Lung Cancer Diagnoses	30 to 99	Gharibvand et al., 2016[43]	69,506	9 [3 to 14]	13 [4 to 20]

CI: confidence interval. CIs are inversely proportional to population sizes reflecting higher uncertainty when estimating effects with smaller numbers of people. CIs that include 0 indicate that it is plausible that no deaths are associated with PM2.5 in this group in this community.

Population is the average of the 2022 and 2023 Washington State Office of Financial Management estimates for the census tracts that comprise this overburdened community.

The age-adjusted rate indicates the expected rate if the age distribution in this overburdened community matched that of Washington State.

Health outcomes were selected based on the availability of effect estimates for that outcome relevant to the Washington population in the scientific literature. Where multiple effect estimates exist, we listed the model results separately for each. See the 2025 EJ Report for more information.

[41] Turner, M.C., Jerrett, M., Pope, C.A., III, Krewski, D., Gapstur, S.M., Diver, W.R., Beckerman, B.S., Marshall, J.D., Su, J., Crouse, D.L., & Burnett, R.T. (2016). Long-term ozone exposure and mortality in a large prospective study. *American Journal of Respiratory Critical Care Medicine* 193(10): 1134-1142.
[42] Alexeeff SED, K.Van Den Eeden, S.Schwartz, J.Liao, N. S.Sidney, S. Association of Long-term Exposure to Particulate Air Pollution with Cardiovascular Events in California. *JAMA Network Open*. 2023;6(2):e230561.
[43] Gharibvand, L., Shavlik, D., Ghamsary, M., Beeson, W.L., Soret, S., Knutsen, R., & Knutsen, S.F. (2016). The association between ambient fine particulate air pollution and lung cancer incidence: results from the AHSMOG-2 study. *Environmental Health Perspectives* 125 (3): 378?384

Table B4. Annual mortality and morbidity associated with daily $PM_{2.5}$ exposure (daily 24-hour average concentrations) in Vancouver, 2022-2023. Brackets [ ] include 95% confidence interval.

Health Outcome	Age Group	Source of Risk Estimate	Population	Estimated Annual Number [95% CI]	Estimated annual rate per 100,000 population [95% CI]
Deaths – Any cause	0 to 99	Ito et al., 2013[44]	109,517	1 [0 to 1]	1 [0 to 1]
Deaths – Any cause	65 to 99	Zanobetti et al., 2014[45]	19,166	2 [1 to 3]	11 [7 to 14]
Deaths – Cardiovascular disease	0 to 99	Liu et al., 2022[46]	109,517	1 [0 to 2]	1 [0 to 2]
Deaths – Respiratory	0 to 99	Liu et al., 2022[47]	109,517	2 [0 to 3]	1 [0 to 3]
Hospital Admissions – Acute Non-Fatal Myocardial Infarction	18 to 99	Sullivan et al., 2005[48]	87,638	3 [-3 to 8]	3 [-4 to 9]

[44] Ito, K., Ross, Z., Zhou, J., Nádas, A., Lippmann, M. and Thurston, G.D., 2013. NPACT Study 3. Time-series analysis of mortality, hospitalizations, and ambient $PM_{2.5}$ and its components. National Particle Component Toxicity (NPACT) Initiative. https://www.healtheffects.org/publication/national-particle-component-toxicity-npact-initiative-integrated-epidemiologic-and

[45] Zanobetti, A., Dominici, F., Wang, Y. and Schwartz, J.D., 2014. A national case-crossover analysis of the short-term effect of $PM_{2.5}$ on hospitalizations and mortality in subjects with diabetes and neurological disorders. *Environmental Health*, 13(1), p.38.

[46] Liu, R.A., Wei, Y., Qiu, X., Kosheleva, A. and Schwartz, J.D., 2022. Short term exposure to air pollution and mortality in the US: a double negative control analysis. *Environmental Health*, 21(1), p.81.

[47] Liu, R.A., Wei, Y., Qiu, X., Kosheleva, A. and Schwartz, J.D., 2022. Short term exposure to air pollution and mortality in the US: a double negative control analysis. *Environmental Health*, 21(1), p.81.

[48] Sullivan, J., L. Sheppard, A. Schreuder, N. Ishikawa, D. Siscovick and J. Kaufman. 2005. Relation between short-term fine-particulate matter exposure and onset of myocardial infarction. Epidemiology. Vol. 16 (1): 41-8.

Health Outcome	Age Group	Source of Risk Estimate	Population	Estimated Annual Number [95% CI]	Estimated annual rate per 100,000 population [95% CI]
Hospital Admissions – Acute Non-Fatal Myocardial Infarction	18 to 99	Zanobetti et al., 2009[49]	87,638	3 [1 to 4]	3 [2 to 5]
Hospital Admissions – All Respiratory	65 to 99	Zanobetti et al., 2009[50]	19,166	12 [7 to 17]	61 [35 to 86]
Hospital Admissions – Asthma	0 to 64	Sheppard et al., 2003[51]	90,352	6 [2 to 10]	7 [3 to 11]
ED Visits – Asthma	0 to 99	Mar et al., 2010[52]	109,517	28 [7 to 48]	26 [6 to 44]
ED Visits – Asthma	0 to 99	Slaughter, J. C., et al., 2005[53]	109,517	15 [-13 to 41]	14 [-12 to 37]

[49] Zanobetti, A., Franklin, M., Koutrakis, P. and Schwartz, J., 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. *Environmental Health*, 8(1), p.58.
[50] Zanobetti, A., Franklin, M., Koutrakis, P. and Schwartz, J., 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. *Environmental Health*, 8(1), p.58.
[51] Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
[52] Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. *Inhalation Toxicology*. Vol. 22 (6): 445-8.
[53] Slaughter, J. C., E. Kim, L. Sheppard, J. H. Sullivan, T. V. Larson and C. Claiborn. 2005. Association between particulate matter and emergency room visits, hospital admissions and mortality in Spokane, Washington. *Journal of Exposure Analysis and Environmental Epidemiology*. Vol. 15

Health Outcome	Age Group	Source of Risk Estimate	Population	Estimated Annual Number [95% CI]	Estimated annual rate per 100,000 population [95% CI]
ED Visits – Asthma	0 to 17	Norris, G., et al., 1999[54]	21,879	6 [3 to 9]	29 [15 to 41]

ED: emergency department; CI: confidence interval. CIs are inversely proportional to population sizes reflecting higher uncertainty when estimating effects with smaller numbers of people. CIs that include 0 indicate that it is plausible that no deaths are associated with PM2.5 in this group in this community.

Population is the average of the 2022 and 2023 Washington State Office of Financial Management estimates for the census tracts that comprise this overburdened community.

The age-adjusted rate indicates the expected rate if the age distribution in this overburdened community matched that of Washington State.

Health outcomes were selected based on the availability of effect estimates for that outcome relevant to the Washington population in the scientific literature. Where multiple effect estimates exist, we listed the model results separately for each. See the 2025 EJ Report for more information.

Table B5. Annual mortality and morbidity associated with seasonal and daily O_3 exposure (seasonal and daily 8-hour maximum concentrations) in Vancouver, 2022-2023. Brackets [ ] include 95% confidence interval.

Health Outcome	Age Group	Source of Risk Estimate	Population	Estimated Annual Number [95% CI]	Estimated annual rate per 100,000 population [95% CI]
Deaths – Any cause (Seasonal)	65 to 99	Di, et al. 2017[55]	19,166	6 [4 to 8]	33 [23 to 44]

[54] Norris, G., et al. An association between fine particles and asthma emergency department visits for children in Seattle. *Environmental Health Perspectives*, 1999. 107(6): p. 489-93.
[55] Di, Q., Wang Y., Zanobetti, A., Wang, Y., Koutrakis, P., Choirat, C., Dominici, F., Schwartz, J.D. 2017. Air Pollution and Mortality in the Medicare Population. *The New England Journal of Medicine*, 376(26), pp. 2513-2522.

Health Outcome	Age Group	Source of Risk Estimate	Population	Estimated Annual Number [95% CI]	Estimated annual rate per 100,000 population [95% CI]
Deaths – Any cause (Daily)	0 to 99	Zanobetti and Schwartz, 2008[56]	109,517	2 [1 to 3]	2 [1 to 3]
ED Visits – Asthma (Daily)	0 to 99	Mar and Koenig, 2009[57]	109,517	34 [9 to 56]	31 [8 to 52]
Hospital Admissions – All Respiratory (Daily)	65 to 99	Schwartz, 1995[58]	19,166	24 [7 to 39]	124 [36 to 205]

ED: emergency department; CI: confidence interval. CIs are inversely proportional to population sizes reflecting higher uncertainty when estimating effects with smaller numbers of people. CIs that include 0 indicate that it is plausible that no deaths are associated with O3 in this group in this community.

Population is the average of the 2022 and 2023 Washington State Office of Financial Management estimates for the census tracts that comprise this overburdened community.

Age-adjusted rate indicates the expected rate if the age distribution in this overburdened community matched that of Washington State.

Health outcomes were selected based on the availability of effect estimates for that outcome relevant to the Washington population in the scientific literature. Where multiple effect estimates exist, we listed the model results separately for each. See the 2025 EJ Report for more information.

[56] Zanobetti, A. and Schwartz, J., 2008. Mortality displacement in the association of ozone with mortality: an analysis of 48 cities in the United States. *American Journal of Respiratory and Critical Care Medicine*, 177(2), pp.184-189.
[57] Mar, T.F. and Koenig, J.Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. *Annals of Allergy, Asthma & Immunology*, 103, 474-479.
[58] Schwartz, J., 1995. Short term fluctuations in air pollution and hospital admissions of the elderly for respiratory disease. *Thorax*, 50(5), pp.531-538.