

North Seattle and Shoreline Community 2025 Environmental Justice Report



Publication Information

This report is available on the Department of Ecology's website at <https://apps.ecology.wa.gov/publications/summarypages/2502037.html>

Contact Information

Air Quality Program

P.O. Box 47600

Olympia, WA 98504-7600

Phone: 360-407-6800

Website: [Washington State Department of Ecology](https://www.ecology.wa.gov/)

ADA Accessibility

The Department of Ecology is committed to providing people with disabilities access to our information and services by meeting or exceeding the requirements of state and federal laws.

To request an ADA accommodation, email aqoutreach@ecy.wa.gov, call 360-407-6800, or call Ecology through the Washington Telecommunication Relay for services including text telephone (TTY) at 711 or through your preferred relay service provider. Visit [Ecology.wa.gov/ADA](https://ecology.wa.gov/ADA) for more accessibility information.

Executive Summary

The North Seattle and Shoreline Community Report provides community information, demographic data, greenhouse gas emissions data, and information about criteria air pollutant levels (CAPs) and their health impacts. This document provides information about air quality and health impacts to those who live, work, and play in the North Seattle and Shoreline 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 North Seattle and Shoreline 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 map¹ ranking and the EJScreen demographic index.² It also experiences elevated levels of short-term fine particulate matter (PM_{2.5}) with some contribution from nitrogen dioxide (NO₂) and ozone (O₃). Community identification is described in more detail in the [Overburdened Communities Highly Impacted by Air Pollution StoryMap](#).

Land Area: 4.5 sq. mi

Population: 41,628

County: King

Municipal Government: Seattle, Shoreline City Councils

Ecology Region: Northwest

Local Clean Air Authority: Puget Sound Clean Air Agency

Local Health Jurisdiction: Seattle-King County Public Health

Primary languages spoken: English, Spanish, Chinese

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



Geographic characteristics

This community is in north King County and includes parts of Seattle, the largest city in the state, and Shoreline, a suburb north of Seattle. It is primarily residential and includes all or part of the Ridgecrest and Briarcrest neighborhoods in Shoreline, as well as all or part of the Northgate, Lake City, Bitter Lake, and Greenwood areas of Seattle. One of the most heavily trafficked sections of Interstate 5 in Washington passes through and runs adjacent to the North Seattle and Shoreline community, contributing to the local air pollution.

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>

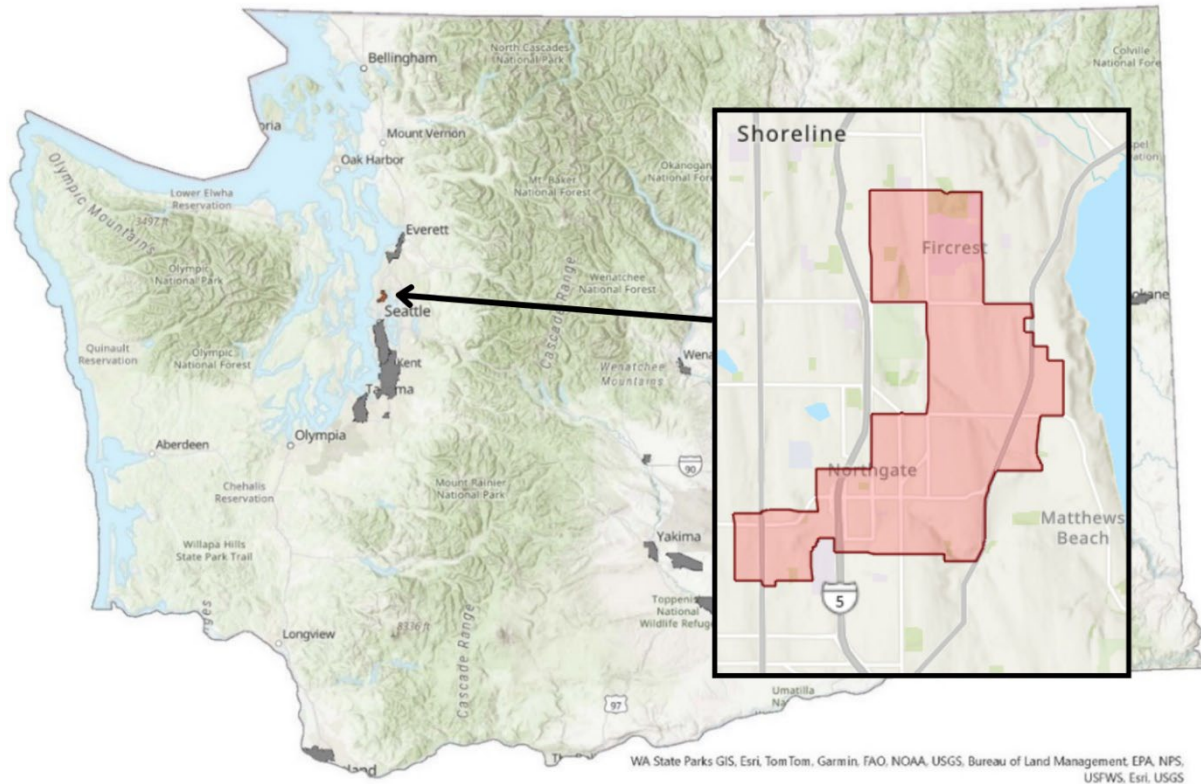


Figure 1. Map of the 16 overburdened communities highly impacted by air pollution (gray) in Washington state, with North Seattle and Shoreline highlighted (red).

Socioeconomic characteristics

Like other parts of King County, this community is ethnically diverse, with relatively large shares of residents who are Black, Asian American, or Hispanic. North Seattle and Shoreline has the second-highest share of workers among the 16 identified communities who are employed in education, legal, community service, arts, and media occupations. Of the 16 communities, this community also has the highest share of residents over age 65, who may be particularly susceptible to health impacts from air pollution.^{3,4}

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/>

North Seattle and Shoreline

Statewide

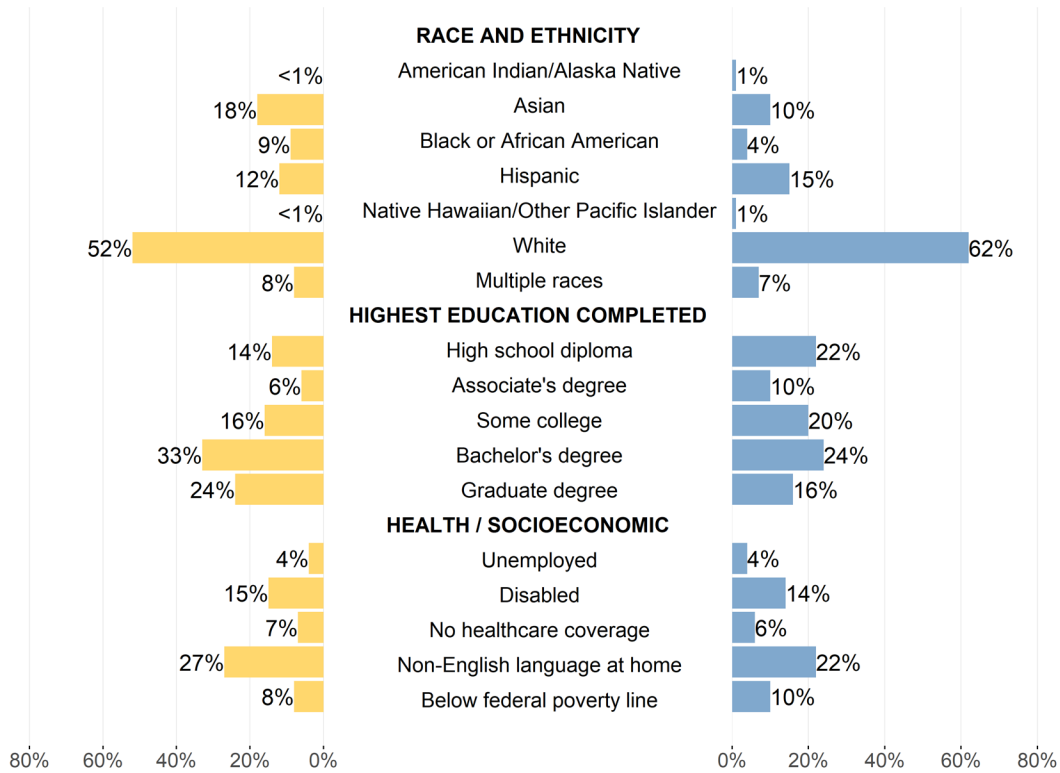


Figure 2. Sociodemographic characteristics of the North Seattle and Shoreline community compared to statewide percentages, based on Washington State's 2024 estimated population of 8,035,700.⁵

Health characteristics

According to 2022 CDC health survey data,⁶ North Seattle and Shoreline has lower prevalences of chronic health conditions among individuals aged 18 years and older relative to the statewide population, including asthma (10.0% vs. 11.4%), cardiovascular disease (4.3% vs. 5.7%), COPD (3.9% vs. 5.7%), diabetes (7.2% vs. 9.6%), and stroke (2.4% 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.

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>

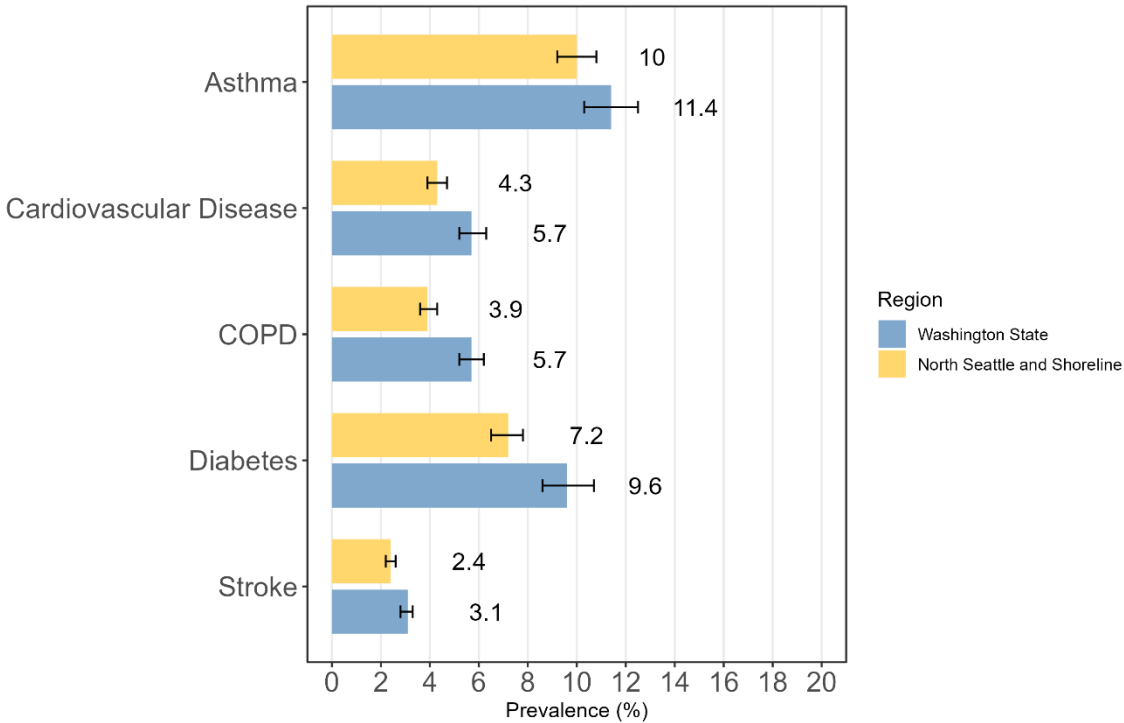
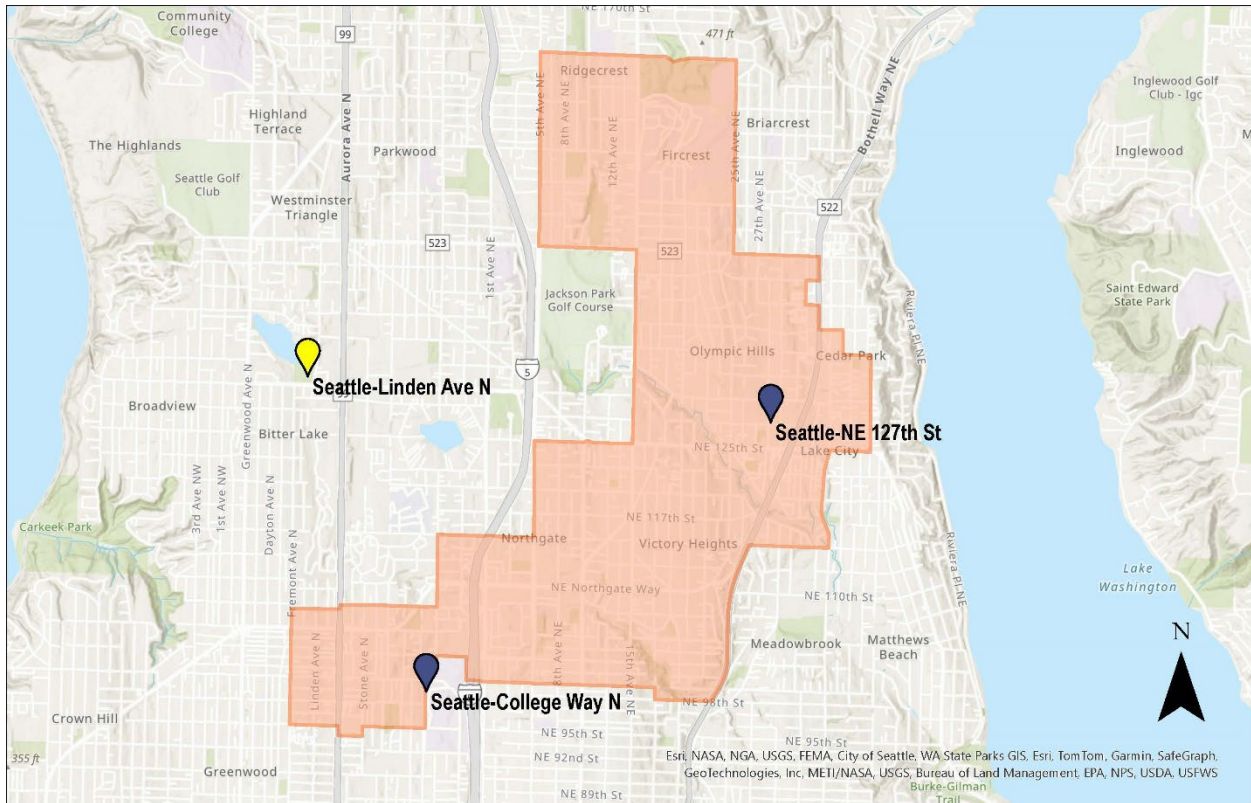





Figure 3. Prevalence of chronic health conditions among people ages 18 years and older in North Seattle and Shoreline census tracts compared with Washington State.

Data are 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 2024, Ecology’s Northwest Regional Office (NWRO) installed two PM_{2.5} sensors (SensWA) in the North Seattle and Shoreline community using Climate Commitment Act (CCA) funding (Figure 4; Table 1). The low-cost, high accuracy sensors provide community-specific data that will be used to track trends in PM_{2.5} concentrations over time. No other criteria air pollutants are currently monitored in the community.



-  Air monitoring sites - Included in analysis
-  Air monitoring sites - Excluded from analysis
-  North Seattle and Shoreline community boundary

0 0.5 1 Miles

Figure 4. Map of North Seattle and Shoreline air monitoring sites.

Table 1. North Seattle and Shoreline criteria air pollutant monitors.

Monitoring Site	Type	Site Owner	Pollutants Monitored
Seattle-NE 127 th St	SensWA ¹	Ecology-NWRO	PM _{2.5}
Seattle-College Way	SensWA ¹	Ecology-NWRO	PM _{2.5}

¹ Installed as part of Climate Commitment Act implementation

Criteria Air Pollution

This report summarizes criteria air pollution (CAPs) concentrations in the North Seattle and Shoreline community in 2024. CAPs concentrations for PM_{2.5} are calculated using data from the

Washington Ambient Air Monitoring Network and reported according to the Environmental Protection Agency’s (EPA) methodology. More information can be found in the background and methods sections of the 2025 EJ Report.

Table 2 includes 24-hour PM_{2.5} (98th percentile) summary statistics. 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.

We calculated 24-hour PM_{2.5} (98th percentile) concentrations using partial-year data, as the Seattle-College Way N monitor was installed in April 2024 and the Seattle-NE 127th St monitor was installed in July 2024 (Table 2; Figure 5). Using the available 2024 data, the 24-hour PM_{2.5} concentrations were below the NAAQS. Values shown in brackets in Table 2 exclude wildfire-impacted days when 24-hour average PM_{2.5} concentrations exceeded 35.4 µg/m³.

Table 2. 24-hour PM_{2.5} (98th percentile) summary statistics (2024). Units are in µg/m³. Brackets [] exclude wildfire days when 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 98 th Percentile	2023 24-hour 98 th Percentile	2024 24-hour 98 th Percentile	2024 Design Value
Seattle-NE 127 th St	DNC	DNC	<i>15.2</i> <i>[15.2]</i>	*
Seattle- College Way N	DNC	DNC	<i>14.4</i> <i>[14.4]</i>	*

Italics indicate incomplete annual data, DNC = data not collected, NAAQS = national ambient air quality standards, PM = particulate matter, µg/m³ = micrograms per cubic meter, * = incomplete data for 3-year design value.

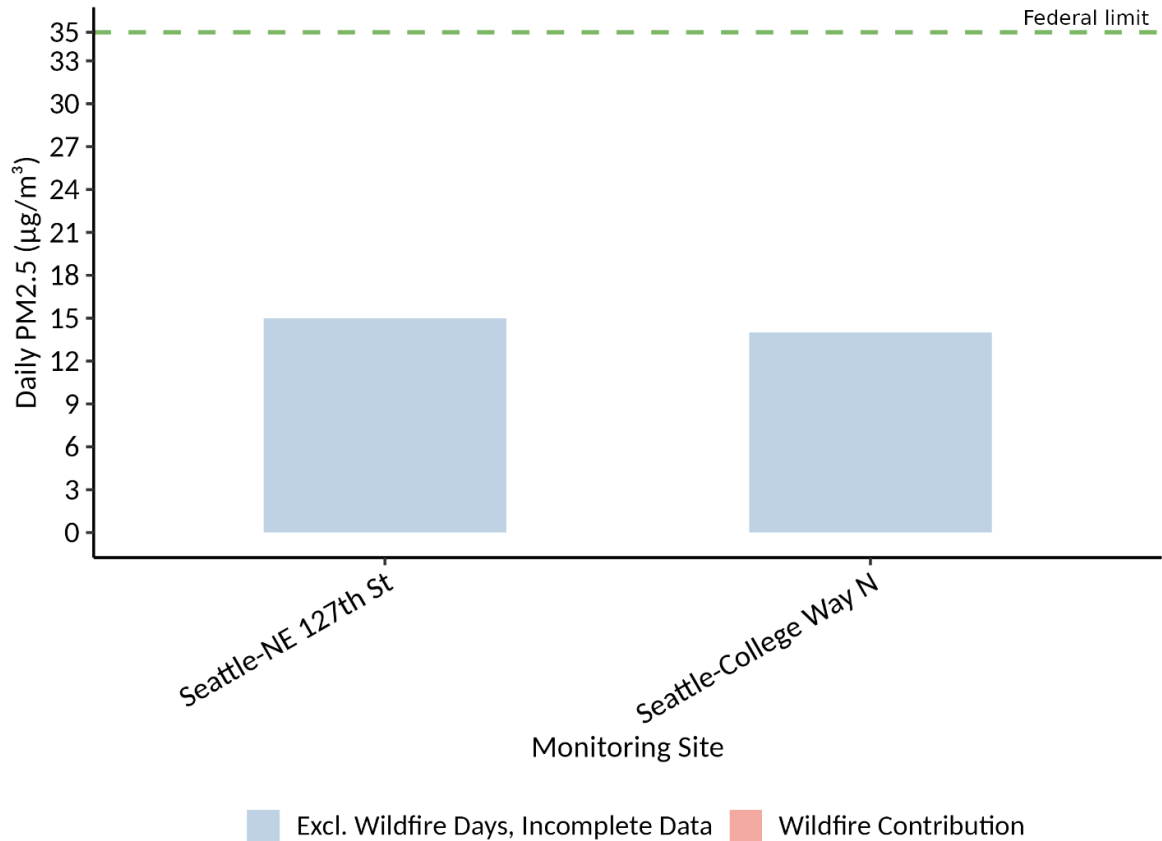


Figure 5. **24-hour PM_{2.5} (98th percentile) summary statistics, 2024.** Annual summary statistics calculated with and without days elevated from wildfire smoke. Light blue bars include average of available data from 2024. Dashed line is the federal limit (NAAQS) for 24-hr PM_{2.5}.

Table 3 includes annual mean PM_{2.5} concentrations for 2024. The annual PM_{2.5} design value is a three-year average of annual mean concentrations used to describe long-term exposure; however, we did not have three-years of data available. Using available 2024 data, the annual mean PM_{2.5} concentrations remained below the NAAQS threshold of 9.0 µg/m³. Future publications of the biennial EJ Report will include additional years of PM_{2.5} data.

Table 3. Annual mean PM_{2.5} concentrations (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
Seattle-NE 127 th St	DNC	DNC	<i>5.50</i> <i>[5.50]</i>	*
Seattle-College Way N	DNC	DNC	<i>4.31</i> <i>[4.31]</i>	*

Italics indicate incomplete annual data, DNC = data not collected, NAAQS = national ambient air quality standards, PM = particulate matter, µg/m³ = micrograms per cubic meter, * = incomplete data for 3-year design value.

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 10 deaths by any cause (25 deaths per 100,000 population, Table B1) related to yearly PM_{2.5} exposure. Among older adults, which is a smaller portion of the population, we estimated 15 total deaths (94 deaths per 100,000 population) each year associated with annual PM_{2.5} exposure (Table B2).

Among different racial and ethnic groups (Figure 6), we estimated most PM_{2.5} related deaths by any cause per year to be among non-Hispanic White people (7 deaths among 18–84-year-olds). However, when accounting for the ages of people in each racial and ethnic group⁷, the annual

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.

age-adjusted mortality rate was highest among Hispanic people (45 deaths per 100,000 population) and non-Hispanic Black people (37 deaths per 100,000 population).

Figure 6 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.

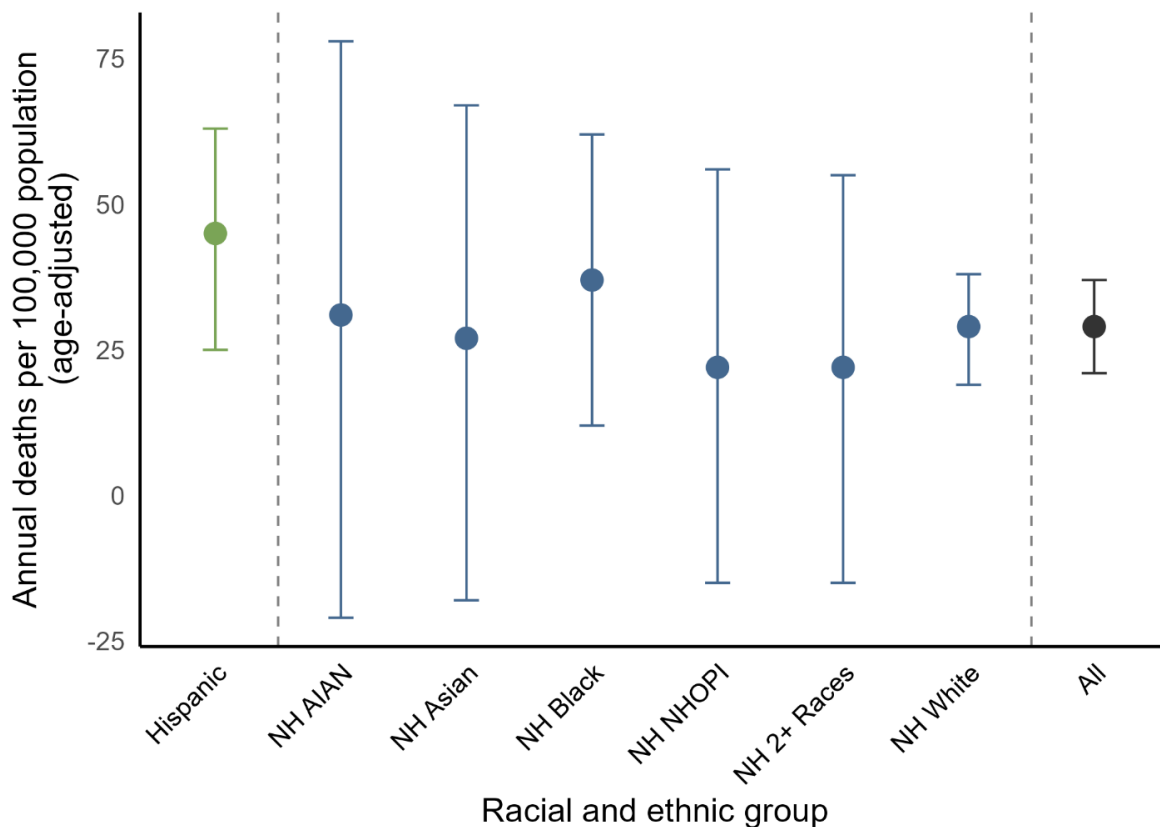


Figure 6. Age-adjusted annual death rates by any cause associated with yearly PM_{2.5} exposure among ages 18-84 by racial and ethnic group in North Seattle and Shoreline.

When assessing specific causes of death related to yearly PM_{2.5} concentrations (Table B3), we estimated 3 deaths due to cardiovascular disease (8 deaths per 100,000 population), 3 to 6 deaths due to ischemic heart disease (10 to 17 deaths per 100,000 population), and 0 to 1 death per year due to lung cancer (2 deaths per 100,000 population) among adults.

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.

Regarding non-fatal health outcomes (Table B3), we estimated that 3 hospital admissions (6 visits per 100,000 population) for acute non-fatal myocardial infarction were associated with yearly PM_{2.5} concentrations among adults. Additionally, 3 lung cancer diagnoses per year were associated with annual PM_{2.5} exposure among all people (9 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 1 death by any cause (8 per 100,000 population) among older adults ages 65 to 99. For non-fatal conditions, daily PM_{2.5} was associated with 0 to 1 acute non-fatal myocardial infarction admission (1 per 100,000 population) among all adults, 3 respiratory admissions (40 per 100,000 population) among older adults ages 65 to 99, 1 asthma hospital admission (3 per 100,000 population) among people ages 0 to 64. Additionally, 5 to 9 asthma-related emergency department (ED) visits (9 to 17 per 100,000 population) among all people and 6 asthma-related ED visits (74 per 100,000 population) among youths ages 0 to 17 years were associated with daily PM_{2.5} exposure.

Ozone

We estimated that O₃ exposure during the warm season (Table B5) was associated with 1 seasonal death by any cause among older adults ages 65 to 99 (9 deaths per 100,000 population). Daily O₃ exposure was associated with <1 death by any cause (1 per 100,000 population), 6 asthma-related ED visit (5 per 100,000 population)] among all people, and 3 respiratory hospital admissions (43 per 100,000 population) among older adults ages 65-99.

Greenhouse Gas Emissions

Greenhouse gas results for the North Seattle and Shoreline overburdened community highly impacted by air pollution include: 1) Emissions from greenhouse gas reporting entities per RCW 70A.65⁹ 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.

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>

Facilities

Washington State requires certain businesses that emit more than 10,000 metric tons of carbon dioxide equivalents (MT CO₂e) to report to the Washington Greenhouse Gas Reporting Program.¹³ Businesses that emit over 25,000 MT CO₂e are also subject to the Cap-and-Invest Program (covered sources). Each reporting facility is required to follow a compliance plan.

There are no major stationary sources of greenhouse gas emissions in or nearby¹⁴ the North Seattle and Shoreline community. There were no facilities reported in the 2023 report¹⁵ or in 2022 and 2023, resulting in no change from year-to-year. The absence of reporting facilities does not mean that industrial sectors do not exist, however this community is primarily residential.

There are some facilities in other communities that report biogenic carbon (biogenic CO₂)¹⁶ emissions, which are expected to be partially recaptured as part of the natural carbon cycle. For reporting purposes, biogenic CO₂ is subtracted from total metric tons of CO₂e, even though it has the same atmospheric warming effect as non-biogenic CO₂. There were no facilities that reported biogenic CO₂ in North Seattle and Shoreline. 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 CO₂ emissions. Some year-to-year fluctuations in emissions from individual facilities are expected.

¹³ Mandatory greenhouse gas reports <https://ecology.wa.gov/air-climate/reducing-greenhouse-gas-emissions/tracking-greenhouse-gases/mandatory-greenhouse-gas-reports>

¹⁴ “Nearby” refers to facilities within a three-mile radius of the community boundary that were included in this analysis.

¹⁵ Improving Air Quality in Overburdened Communities Highly Impacted by Air Pollution: 2023 Report <https://apps.ecology.wa.gov/publications/SummaryPages/2302115.html>

¹⁶ 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 CO₂ acts the same way in the atmosphere as non-biogenic CO₂. Anthropogenic processes that include these emissions reduce a facility’s environmental impact.

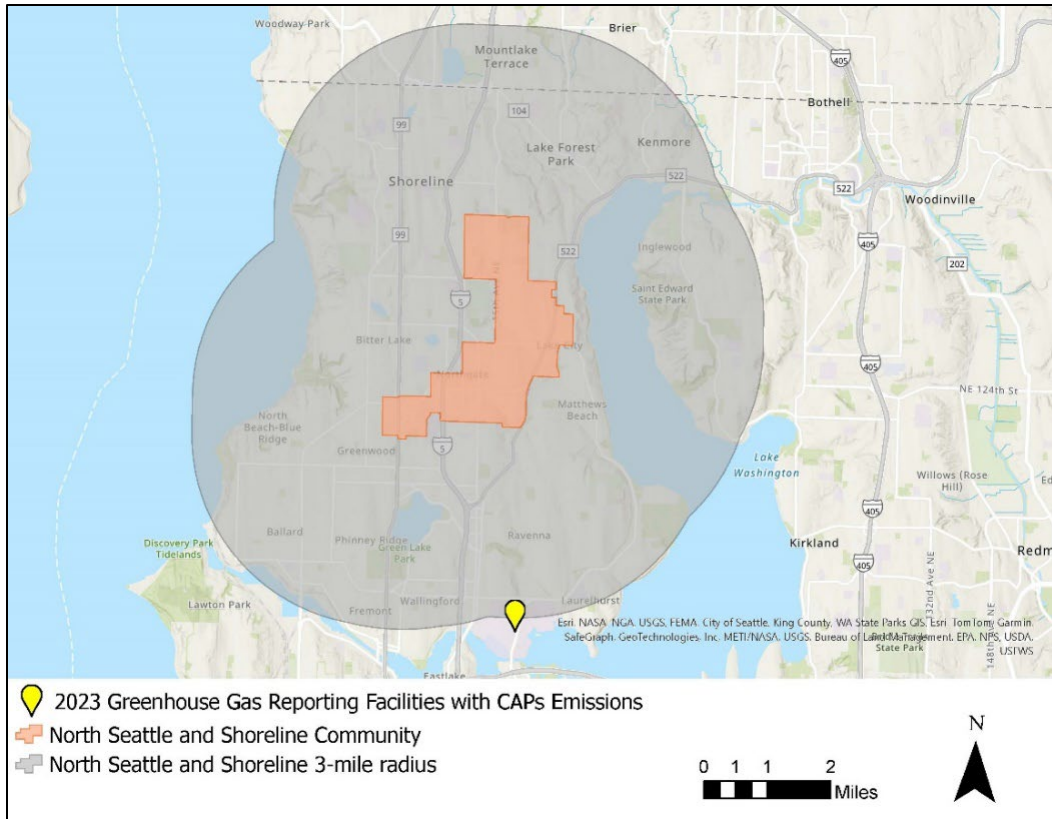


Figure 7. North Seattle and Shoreline community boundary and 3-mile radius include no greenhouse gas reporting facilities.

Mobile sources

In the North Seattle and Shoreline community, greenhouse gas emissions from mobile sources increased by 21% from 2020 to 2021 (Table 4), but have decreased by 5.4% between 2019 to 2021.¹⁷ 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.^{18,19}

¹⁷ Improving Air Quality in Overburdened Communities Highly Impacted by Air Pollution 2023 Report <https://apps.ecology.wa.gov/publications/SummaryPages/2302115.html>

¹⁸ Washington State Greenhouse Gas Emissions Inventory: 1990-2021, Jan 2025 <https://apps.ecology.wa.gov/publications/SummaryPages/2414077.html>

¹⁹ Reducing Greenhouse Gas Emissions from the Transportation Sector through Climate Planning, Dec 2024 <https://www.epa.gov/system/files/documents/2024-12/420f24042.pdf>

The results in Table 4 are in units of MT CO₂e. Each greenhouse gas uses a conversion factor known as its Global Warming Potential (GWP), in this case AR5 GWP²⁰, to convert emissions into CO₂e. 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). In 2013-2014, the Intergovernmental Panel on Climate Change (IPCC)²¹ published AR5 GWPs and AR6 GWPs in 2021-2022. The Washington Greenhouse Gas Emissions Inventory uses AR5 GWPs in mobile source emission 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 ₂ e)	2020 Per Capita MT CO ₂ e	2021 Emissions (MT CO ₂ e)	2021 Per Capita MT CO ₂ e
39,997	146,728	3.7	177,498	4.4

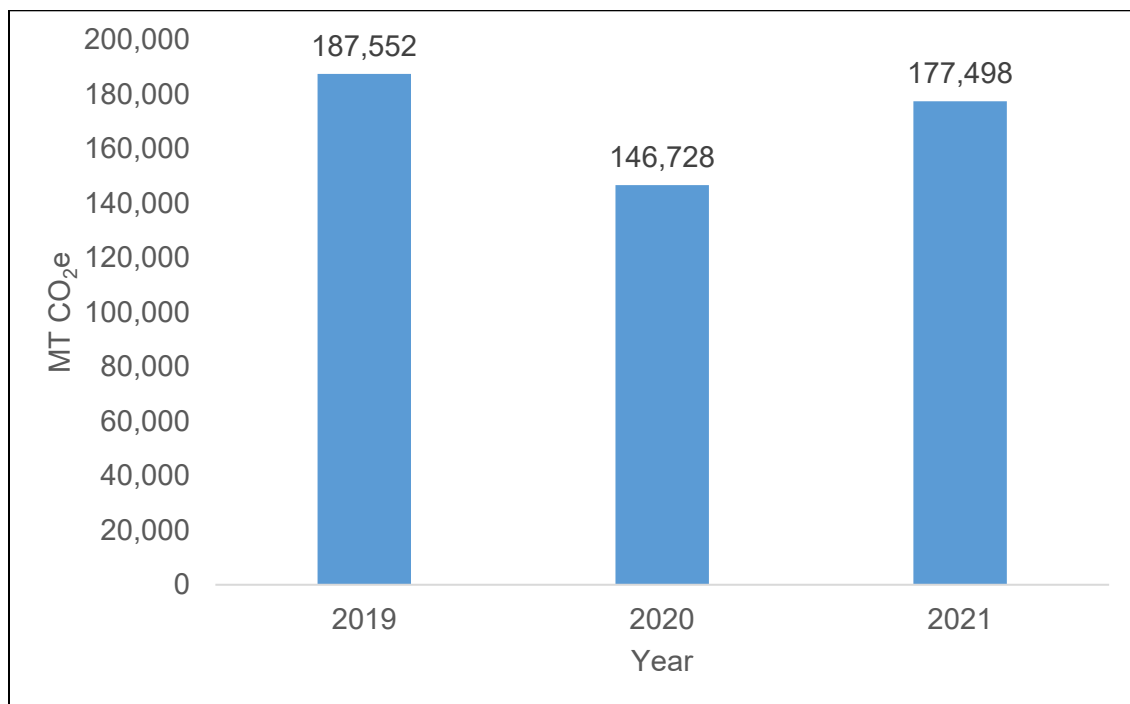


Figure 8. Annual greenhouse gas emissions from mobile sources in the North Seattle and Shoreline community, 2019-2021.

²⁰ Reporting of Emissions of Greenhouse Gases <https://app.leg.wa.gov/WAC/default.aspx?cite=173-441>

²¹ Intergovernmental Panel on Climate Change <https://www.ipcc.ch/>

Community Resources

These resources provide more information about air quality and health in the North Seattle and Shoreline community:

- [King County Community Health Needs Assessment information](#)²²
- [Virginia Mason Franciscan Health - Community Health Needs Assessment information](#)²³
- [King County Hospitals for a Healthier Community 2024-2025 Community Health Needs Assessment](#)²⁴
- [Providence Swedish 2024 King County Community Health Needs Assessment](#)²⁵
- [Seattle Children's 2022 Community Health Assessment](#)²⁶
- [Public Health-Seattle/King County - Community Health Indicators](#)²⁷
- [Public Health-Seattle/King County - Public health data](#)²⁸
- [Communities Count - Data for King County Communities](#)²⁹
- [Zero-emission and electric vehicles mapping tool | WSDOT](#)³⁰
- [Home | Washington Climate Action](#)³¹

²² <https://kingcounty.gov/en/dept/dph/about-king-county/about-public-health/chna>

²³ <https://www.vmfh.org/about-vmfh/why-choose-vmfh/reports-to-the-community/community-health-needs-assessment>

²⁴ <https://cdn.kingcounty.gov/-/media/king-county/depts/dph/documents/reports/chna/2024-2025-hhc-chna-report.pdf?rev=8f9684eda4ea4a0f93b0981d7ca00ffd&hash=6575EAE5EDBE57F8E3A4538E989AD8DA>

²⁵ <https://www.swedish.org/-/media/project/psjh/providence/socal/files/about/community-benefit/pdfs/2024-2025-chna-report.pdf?rev=86cd9bd48c764b15962deddf1484892d&hash=A1A7ED2E0F4E011981325A7E7C90FEAF>

²⁶ <https://www.seattlechildrens.org/globalassets/documents/about/community/2022-community-health-assessment-cha.pdf>

²⁷ <https://kingcounty.gov/en/dept/dph/about-king-county/about-public-health/data-reports/population-health-data/community-health-indicators>

²⁸ <https://kingcounty.gov/en/dept/dph/about-king-county/about-public-health/data-reports>

²⁹ <https://www.communitiescount.org/>

³⁰ <https://wsdot.wa.gov/business-wsdot/grants/zero-emission-vehicle-grants/zero-emission-and-electric-vehicles-mapping-tool>

³¹ <https://climate.wa.gov/>

Appendix A. Criteria Air Pollution

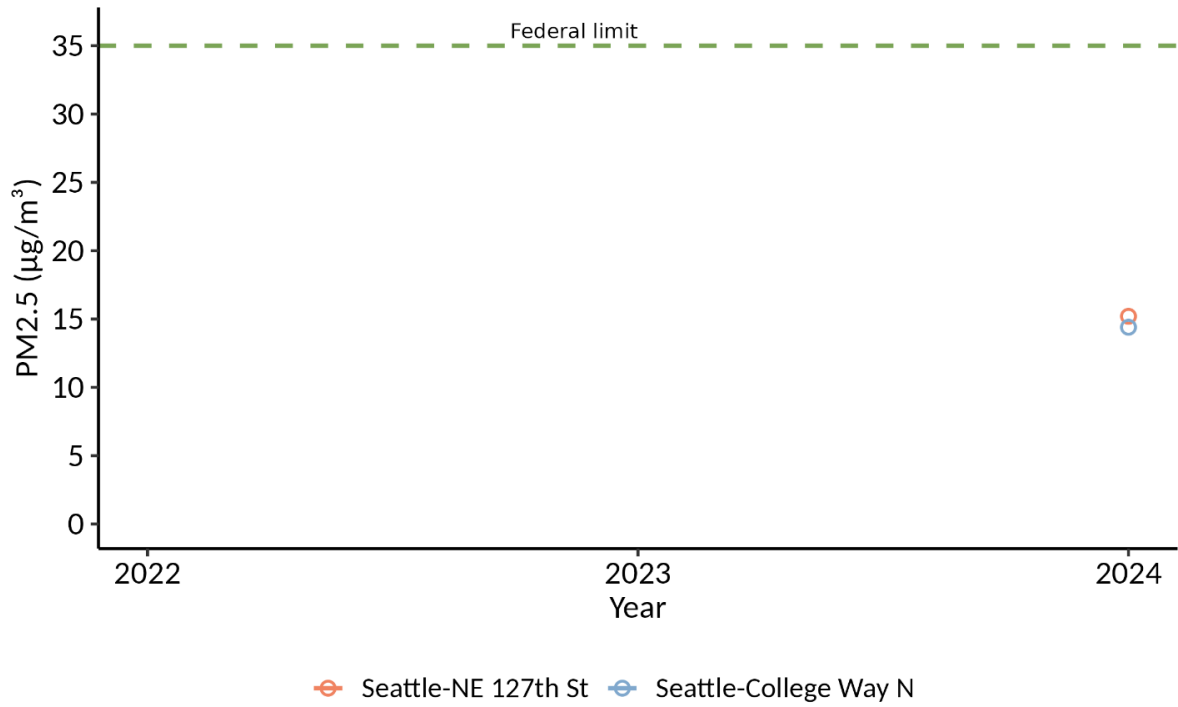


Figure A1. 24-hour $PM_{2.5}$ (98th percentile) concentrations at North Seattle and Shoreline monitoring sites. Days impacted by wildfire smoke are included. Dashed line is the 24-hr $PM_{2.5}$ NAAQS ($35 \mu\text{g}/\text{m}^3$).

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 North Seattle and Shoreline by racial and ethnic group, 2022–2023 (based on effect estimates in study by Pope, et al., 2019⁸).

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	42,493	10 [7 to 13]	25 [18 to 31]	29 [21 to 37]
Hispanic	4,289	1 [1 to 1]	23 [13 to 32]	45 [25 to 63]
Non-Hispanic AIAN	229	<1 [range <1]	25 [-17 to 64]	31 [-21 to 78]
Non-Hispanic Asian	8,111	2 [-1 to 4]	21 [-14 to 53]	27 [-18 to 67]
Non-Hispanic Black	3,662	1 [0 to 2]	27 [8 to 44]	37 [12 to 62]
Non-Hispanic NHOPI	139	<1 [range <1]	11 [-7 to 28]	22 [-15 to 56]
Non-Hispanic 2+ races	2,714	<1 [0 to 1]	11 [-8 to 28]	22 [-15 to 55]
Non-Hispanic White	23,349	7 [4 to 9]	29 [19 to 39]	29 [19 to 38]

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 North Seattle and Shoreline by racial and ethnic group, 2022–2023 (based on effect estimates in study by Di, et al., 2017³²).

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	7,835	7 [7 to 8]	94 [92 to 97]	90 [88 to 93]
Hispanic	299	<1 [range <1]	104 [90 to 118]	111 [96 to 126]
AIAN	47	<1 [range <1]	77 [47 to 105]	78 [48 to 106]
Asian	1,342	1 [1 to 1]	88 [70 to 106]	85 [67 to 102]
Black	428	1 [1 to 1]	146 [141 to 152]	171 [165 to 178]
NHOPI	12	<1 [range <1]	98 [60 to 134]	111 [68 to 152]
2+ races	226	<1 [range <1]	63 [39 to 86]	71 [44 to 98]
White	5,780	4 [3 to 4]	61 [59 to 64]	57 [54 to 59]

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.

³² 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 North Seattle and Shoreline, 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 ³³	7,835	7 [7 to 8]	94 [92 to 97]
Deaths – Any cause	18 to 84	Pope et al., 2019 ³⁴	42,493	10 [7 to 13]	25 [18 to 31]
Deaths – Cardiovascular disease	18 to 99	Alexeeff et al., 2023 ³⁵	43,428	3 [1 to 5]	8 [3 to 12]
Deaths – Ischemic heart disease	30 to 99	Jerrett et al., 2017 ³⁶	32,904	4 [3 to 4]	11 [8 to 14]
Deaths – Ischemic heart disease	30 to 99	Krewski et al., 2009 ³⁷	32,904	6 [4 to 6]	17 [14 to 20]
Deaths – Ischemic heart disease	30 to 99	Pope et al., 2019 ³⁸	32,904	3 [2 to 4]	10 [8 to 13]

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.

³⁴ 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.

³⁵ 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.

³⁶ 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.

³⁷ 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

³⁸ 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.

Deaths – Lung Cancer	30 to 99	Krewski, et al., 2009 ³⁹	32,904	1 [0 to 1]	2 [1 to 3]
Deaths – Lung Cancer	30 to 99	Turner et al., 2016 ⁴⁰	32,904	<1 [0 to 1]	2 [0 to 2]
Hospital Admissions – Acute Non-Fatal Myocardial Infarction	18 to 99	Alexeeff, et al., 2023 ⁴¹	43,428	3 [1 to 4]	6 [3 to 9]
Lung Cancer Diagnoses	30 to 99	Gharibvand et al., 2016 ⁴²	32,904	3 [1 to 5]	9 [3 to 15]

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 PM_{2.5} 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.

³⁹ 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

⁴⁰ 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.

⁴¹ 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.

⁴² 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 North Seattle and Shoreline, 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 ⁴³	51,280	<1 [range <1]	<1 [0 to 1]
Deaths – Any cause	65 to 99	Zanobetti et al., 2014 ⁴⁴	7,835	1 [0 to 1]	8 [6 to 11]
Deaths – Cardiovascular disease	0 to 99	Liu et al., 2022 ⁴⁵	51,280	<1 [0 to 1]	1 [0 to 1]
Deaths – Respiratory	0 to 99	Liu et al., 2022 ⁴⁶	51,280	<1 [0 to 1]	1 [0 to 2]
Hospital Admissions – Acute Non-Fatal Myocardial Infarction	18 to 99	Sullivan et al., 2005 ⁴⁷	43,428	<1 [-1 to 1]	1 [-1 to 3]

⁴³ 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>

⁴⁴ 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.

⁴⁵ 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.

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 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.

Hospital Admissions – Acute Non-Fatal Myocardial Infarction	18 to 99	Zanobetti et al., 2009 ⁴⁸	43,428	1 [0 to 1]	1 [1 to 2]
Hospital Admissions – All Respiratory	65 to 99	Zanobetti et al., 2009 ⁴⁹	7,835	3 [2 to 4]	40 [23 to 57]
Hospital Admissions – Asthma	0 to 64	Sheppard et al., 2003 ⁵⁰	43,445	1 [1 to 2]	3 [1 to 5]
ED Visits – Asthma	0 to 99	Mar et al., 2010 ⁵¹	51,280	9 [2 to 15]	17 [4 to 30]
ED Visits – Asthma	0 to 99	Slaughter, J. C., et al., 2005 ⁵²	51,280	5 [-4 to 13]	9 [-8 to 25]
ED Visits – Asthma	0 to 17	Norris, G., et al., 1999 ⁵³	7,851	6 [3 to 8]	74 [38 to 108]

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 PM_{2.5} in this group in this community.

⁴⁸ 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.

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 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.

⁵¹ 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.

⁵² 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

⁵³ 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.

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 O₃ exposure (seasonal and daily 8-hour maximum concentrations) in North Seattle and Shoreline, 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 ⁵⁴	7,835	1 [0 to 1]	9 [6 to 11]
Deaths – Any cause (Daily)	0 to 99	Zanobetti and Schwartz, 2008 ⁵⁵	51,280	<1 [range <1]	1 [0 to 1]
ED Visits – Asthma (Daily)	0 to 99	Mar and Koenig, 2009 ⁵⁶	51,280	6 [1 to 10]	12 [3 to 20]
Hospital Admissions – All Respiratory (Daily)	65 to 99	Schwartz, 1995 ⁵⁷	7,835	3 [1 to 6]	43 [12 to 72]

⁵⁴ 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.

⁵⁵ 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.

⁵⁶ 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.

⁵⁷ Schwartz, J., 1995. Short term fluctuations in air pollution and hospital admissions of the elderly for respiratory disease. *Thorax*, 50(5), pp.531-538.

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.