

Air Quality, Health, and Economic Impacts of the Remington Tech Park Facility

Prepared for Piedmont Environmental Council

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Executive Summary

This report evaluates the potential air-quality, public-health, and health economic impacts attributable to the Phase 1 on-site power system proposed for the Remington Technology Park Data Center in Fauquier County, Virginia, as described in the December 2025 air permit application submitted to the Virginia Department of Environmental Quality. The analysis estimates population-level health impacts from long-term exposure to fine particulate matter (PM_{2.5}) and PM_{2.5}-forming emissions. It is not a regulatory compliance analysis; rather, it complements the air-permitting process by applying peer-reviewed air-quality methods and EPA health-impact methodologies to estimate the extent to which the facility's emissions affect population health across surrounding and downwind communities.

The primary analysis evaluates the Phase 1 permitted-emissions scenario, reflecting the emissions the applicant is seeking authorization to emit. This scenario is not based on full operation of all installed equipment. The permit application estimates annual turbine emissions based on an average of approximately nine of thirteen turbines operating at 85% load, making the primary scenario a plausible permitted operating condition rather than a theoretical maximum. Because actual future emissions may be lower, this report also evaluates sensitivity scenarios at 75% and 50% of permitted emissions.

Principal Findings

The proposed facility would add measurable PM_{2.5} pollution increases across nearby and downwind communities. Estimated facility-attributable emissions indicate that the Phase 1 power system would increase annual-average PM_{2.5} concentrations across portions of Northern Virginia. The largest estimated concentration increases occur near the proposed facility and extend into downwind areas including Fauquier County, Stafford County, Fredericksburg, and Spotsylvania County. At the community level, the highest estimated increases occur in Remington, Midland, and Bealeton.

Estimated health damages attributable to the permitted-emissions scenario are significant. Using EPA health-impact methods, the Phase 1 permitted-emissions scenario is estimated to result in approximately 1.5–2.8 additional premature deaths per year and \$25–42 million per year in health-related damages. These damages are driven primarily by premature mortality, with additional impacts including asthma onset, asthma symptoms, respiratory illness, cardiovascular outcomes, hospital admissions, school loss days, and lost productivity.

Lower actual emissions would reduce impacts, but the sensitivity analyses still show measurable health burdens. Estimated impacts scale with annual emissions: the permitted-emissions scenario is estimated to result in approximately 1.5–2.8 premature deaths per year, about 1,300 asthma symptom cases per year, and \$25–42 million in annual health damages; at 75% of

permitted emissions, these estimates decline to approximately 1.2–2.1 deaths, about 1,000 asthma symptom cases, and \$18–32 million in damages; and at 50% of permitted emissions, they decline to approximately 0.8–1.4 deaths, about 670 asthma symptom cases, and \$12–21 million in damages.

Population exposure is not limited to the communities closest to the facility. The highest concentration increases occur near the facility, but total public-health burden also depends on how many people are exposed. Stafford County accounts for the largest share of estimated population exposure, followed by Spotsylvania County, Prince William County, and Fauquier County. Approximately 355,500 people live in census tracts with estimated annual PM_{2.5} increases greater than 0.01 µg/m³, and approximately 16,400 people live in tracts with increases greater than 0.05 µg/m³.

The proposed facility also adds to an area with existing fossil-fuel power generation infrastructure. Two nearby gas-fired power plants already operate along Lucky Hill Road, and the proposed Phase 1 power system would be permitted to emit approximately the same amount of direct PM_{2.5} annually as the combined 2025 actual PM_{2.5} emissions from those facilities. This comparison provides regional context for the scale of the proposed emissions.

Overall, the findings indicate that the Phase 1 on-site power system proposed in the December 2025 air permit application would add measurable air pollution and health burdens to surrounding communities. While actual impacts would depend on future operating levels, emissions controls, and facility utilization, the analysis consistently indicates that the proposed emissions are associated with measurable increases in PM_{2.5} exposure and adverse health impacts across the surrounding region.

Introduction

This report evaluates the potential air-quality and public-health impacts associated with the Phase 1 on-site power system proposed for the Remington Technology Park Data Center in Remington, Virginia (Fauquier County). The facility is currently the subject of a pending air permit application with the Virginia Department of Environmental Quality (VA DEQ) Northern Regional Office (Registration No. 74172), submitted on December 23, 2025. If approved, the facility would be authorized to operate thirteen Solar PGM130 natural gas-fired turbines for continuous prime-power generation and numerous Caterpillar 3516E diesel-fired generators proposed as non-emergency units.

Because future facility operations are inherently uncertain, this report evaluates multiple emissions scenarios rather than attempting to predict a single future operating condition. Specifically, we evaluate a *Phase 1 Permitted Emissions Scenario* as well as reduced-emissions sensitivity scenarios representing lower levels of annual emissions. These scenarios are intended to characterize a plausible range of potential impacts rather than forecast a specific future operating outcome.

Using these emissions scenarios, we estimate how the proposed on-site power system could increase fine particulate air pollution (PM_{2.5}) in nearby communities in Fauquier County, Culpeper County, and the broader downwind region, and we estimate the associated public-health and economic impacts attributable to those increases in PM_{2.5} exposure. This report focuses on population-level health impacts rather than regulatory compliance. It is intended to inform public discussion regarding the potential air-quality and health implications of the proposed facility.

Scientific foundation and independence

This assessment was conducted independently and was not prepared by or on behalf of the project proponent, the Virginia Department of Environmental Quality, or any other regulatory authority. The analysis relies on publicly available permit documentation, peer-reviewed scientific literature, and established air-quality and health-impact assessment methods.

The assessment follows two well-established scientific frameworks. First, it estimates how emissions disperse and chemically transform in the atmosphere to form fine particulate matter (PM_{2.5}). Second, it estimates how resulting increases in PM_{2.5} exposure may translate into adverse health outcomes and associated economic damages. These methods are widely used in the peer-reviewed scientific literature and are consistent with approaches employed by federal agencies and academic researchers to evaluate the public-health impacts of air pollution.

Health impacts and economic damages are estimated using established epidemiologic and public-health valuation frameworks that have been developed and refined over decades of scientific research. All major assumptions, data inputs, and analytical methods are documented

to promote transparency and reproducibility. The analysis was conducted by environmental health scientists with expertise in air pollution exposure assessment, atmospheric modeling, epidemiology, and biostatistics. The results should not be interpreted as a substitute for regulatory compliance analyses conducted as part of the permitting process, but rather as a complementary assessment of the potential population-level health impacts associated with the facility's emissions.

What is PM_{2.5} and why does it matter?

Fine particulate matter smaller than 2.5 micrometers in diameter (PM_{2.5}) is one of the most harmful forms of air pollution.¹ Because of its microscopic size (roughly 30 times smaller than the width of a human hair), PM_{2.5} can penetrate deep into the lungs and enter the bloodstream, triggering inflammation throughout the body.²

A large body of scientific evidence links exposure to PM_{2.5} with a wide range of adverse health outcomes, including asthma exacerbation, respiratory and cardiovascular disease, heart attack, stroke, and premature death.³ According to major public-health assessments, PM_{2.5} accounts for the majority of the roughly eight million global deaths each year attributed to air pollution, making it a leading environmental risk factor worldwide.⁴ High-risk groups include children, asthmatics, and older adults with pre-existing heart and lung conditions. Many of these populations are concentrated in sensitive locations—such as schools, daycare centers, nursing homes, and residential communities—making the proximity of emission sources to these areas an important consideration.

How PM_{2.5} Forms in the Atmosphere

PM_{2.5} originates from both direct and indirect sources. Primary PM_{2.5} is emitted directly into the air from combustion processes such as power generation, vehicle exhaust, and industrial activity. Secondary PM_{2.5} forms when gases such as sulfur dioxide (SO₂), nitrogen oxides (NO_x), ammonia (NH₃), and volatile organic compounds (VOCs) react in the atmosphere, often in the presence of sunlight. These reactions convert the gases into fine sulfate, nitrate, and organic particles that become part of the PM_{2.5} mixture people breathe. Together, these pathways contribute to ambient PM_{2.5} exposure that affects regional air quality and public health.

PM_{2.5} Health Risks Persist Below Federal Air-Quality Standards

A large body of scientific evidence shows that health risks from PM_{2.5} decrease as exposure decreases, but there is no clear threshold at which those risks disappear completely.⁵ Large

¹ American Lung Association, “Particle Pollution.”

² US Environmental Protection Agency, “Particulate Matter (PM) Basics.”

³ Birnbaum et al., “Measuring The Impact Of Air Pollution On Health Care Costs”; Di et al., “Association of Short-Term Exposure to Air Pollution With Mortality in Older Adults”; Wu et al., “Evaluating the Impact of Long-Term Exposure to Fine Particulate Matter on Mortality among the Elderly.”

⁴ Health Effects Institute and IHME, “State of Global Air Report 2025.”

⁵ American Lung Association, “Particle Pollution.”

national studies involving more than 60 million Medicare beneficiaries have found measurable health effects associated with long-term PM_{2.5} exposure even at concentrations below current federal air-quality standards.⁶

Importantly, meeting a federal air-quality standard does not mean that air pollution poses no health risk. A large body of scientific evidence has found that health risks from PM_{2.5} continue even at concentrations below current federal air-quality standards. EPA has recognized that the National Ambient Air Quality Standards (NAAQS) are not intended to represent a threshold below which health effects no longer occur. Rather, they are regulatory standards designed to provide broad public-health protection across the population.

In practical terms, this means that additional PM_{2.5} pollution can still increase health risks in areas that meet federal air-quality standards. This report quantifies how emissions from the proposed facility may contribute to those incremental health risks. It does not evaluate whether the facility complies with federal air-quality standards, which is a separate regulatory question.

Emissions Inputs and Scope of Analysis

Facility and Emissions Scope

This analysis evaluates the air-quality and health impacts attributable to the Phase 1 on-site power configuration proposed for the Remington Technology Park Data Center in Remington, Virginia (Fauquier County). In this report, “Phase 1” refers to the on-site power system proposed to serve Buildings 1 and 2, including the thirteen Solar PGM130 natural gas-fired turbines, associated black-start generators, and diesel-fired generators associated with Buildings 1 and 2. The full permit application also describes a later Phase 2 buildout involving Buildings 3 through 6 and additional diesel generators. Those later Phase 2 sources are not included in the Phase 1 emissions profile used in this report. This distinction is important because the full facility-wide permit application totals are higher than the Phase 1 emissions analyzed here.

Emissions Scenarios

Future facility operations are uncertain, so this report evaluates a *Phase 1 Permitted Emissions Scenario* and two lower-emissions sensitivity scenarios. The primary analysis uses the *Phase 1 Permitted Emissions Scenario*, based on the annual emissions proposed in the permit application. This scenario is important because it represents the emissions the applicant is seeking authorization to emit and the emissions envelope that would guide future operation if the permit is approved.

⁶ Di et al., “Air Pollution and Mortality in the Medicare Population”; Wu et al., “Evaluating the Impact of Long-Term Exposure to Fine Particulate Matter on Mortality among the Elderly”; Cork et al., “Methods for Estimating the Exposure-Response Curve to Inform the New Safety Standards for Fine Particulate Matter”; Josey et al., “Air Pollution and Mortality at the Intersection of Race and Social Class.”

While actual future emissions may be lower, the *Phase 1 Permitted Emissions Scenario* reflects a plausible operating configuration described in the application rather than a theoretical full-capacity operation of all equipment. The application states that annual turbine operation is calculated based on an average of nine of thirteen turbines operating at approximately 85% load. The application also states that the permitting scenario is designed to keep facility-wide NO_x emissions below 100 tons per year, allowing the source to remain synthetic minor.

Because actual annual emissions may be lower than the permitted emissions, this report also evaluates two sensitivity scenarios: a *75% Reduced-Emissions Scenario* and a *50% Reduced-Emissions Scenario*. These scenarios do not represent specific turbine capacity factors or operating schedules. Rather, they illustrate how estimated air-quality and health impacts would change if actual annual emissions were lower than the proposed permitted limits.

Pollutants Included

The pollutant totals below correspond to the Phase 1 Permitted Emissions Scenario, not the full six-building buildout emissions reported elsewhere in the permit application. These Phase 1 emissions include 30.01 tons per year (tpy) of PM_{2.5}, 74.95 tpy NO_x, 9.51 tpy SO₂, 4.52 tpy VOC, and 56.71 tpy NH₃.

These pollutants were included because they contribute either directly or indirectly to PM_{2.5} exposure. PM_{2.5} is emitted directly from combustion sources, while NO_x, SO₂, VOCs, and NH₃ contribute to the formation of secondary PM_{2.5} through atmospheric chemical reactions.

Scope of the Assessment

This report evaluates changes in annual-average PM_{2.5} exposure and the resulting health and economic impacts attributable to emissions from the proposed facility. The analysis focuses on population-level impacts associated with long-term exposure to PM_{2.5} and does not evaluate regulatory compliance, short-term peak concentrations, or facility-specific permit requirements.

Unlike many screening-level assessments, this analysis explicitly includes ammonia (NH₃) emissions identified in the permit application. Ammonia is an important precursor to secondary PM_{2.5} formation, reacting with NO_x and SO₂ in the atmosphere to form ammonium nitrate and ammonium sulfate particles. Including NH₃ emissions allows a more complete assessment of secondary PM_{2.5} formation and associated health impacts.

Analytical Approach and Methodology

Overview

This analysis uses a multi-step framework to estimate potential air-quality and public-health impacts from the Remington Technology Park Data Center's proposed Phase 1 on-site power system. The analysis translates Phase 1 permitted emissions into estimated changes in annual-average fine particulate matter (PM_{2.5}), population exposure, and associated health and economic impacts. The analysis is not a regulatory compliance demonstration. Rather, it is designed to estimate population-level health impacts associated with long-term PM_{2.5} exposure from the Phase 1 emissions scenario described above.

1. Source representation and release assumptions

The emissions source was located using the coordinates reported in the Virginia Department of Environmental Quality air permit application. For modeling purposes, Phase 1 emissions were represented as a single aggregated elevated point source. This approach is appropriate for a regional screening analysis focused on annual-average PM_{2.5} exposure, where the primary question is how the combined emissions affect population-level health impacts.

Because the project remains in the pre-construction permitting phase, representative release parameters were derived from technical specifications for the proposed Solar PGM130 turbines. The modeled source was assigned a stack height of 50 feet (15.2 m), stack diameter of 9 feet (2.7 m), exhaust velocity of 71.8 ft/s (21.9 m/s), and exhaust temperature of 849°F (454°C). These parameters were used to approximate the long-term dispersion of emissions from the site.

2. Dispersion and atmospheric chemistry modeling

The analysis uses the Intervention Model for Air Pollution (InMAP) to estimate how emissions from the facility disperse and chemically transform in the atmosphere, contributing to downwind changes in annual-average PM_{2.5} exposure. InMAP incorporates long-term meteorological conditions, terrain, and key atmospheric chemistry processes to estimate both primary PM_{2.5} impacts and secondary PM_{2.5} formation from precursor emissions.⁷ Model outputs consist of gridded estimates of incremental annual-average PM_{2.5} exposure attributable solely to the facility.

⁷ Tessum et al., "InMAP"

Why InMAP Was Used

The objective of this analysis is to estimate population-level PM_{2.5} exposure and associated health impacts from both directly emitted PM_{2.5} and secondary PM_{2.5} formed from precursor pollutants such as NO_x, SO₂, VOCs, and NH₃. Because secondary particle formation can occur over regional scales and may contribute substantially—and in some cases dominate—total annual-average PM_{2.5} exposure from combustion sources, these processes must be represented in the modeling framework.

InMAP is a peer-reviewed atmospheric chemistry model designed to estimate changes in annual-average PM_{2.5} exposure, including both direct emissions and secondary PM_{2.5} formed downwind.⁸ While computationally simpler than full chemical transport models such as CMAQ or CAMx, InMAP is derived from and calibrated against those models and is widely used for screening-level assessments of source-specific PM_{2.5} exposure and health impacts.⁸⁻⁹ Full chemical transport models can require days to weeks of computation on high-performance computing systems and are generally used for detailed regulatory or research applications. InMAP was specifically developed to provide efficient estimates of marginal changes in PM_{2.5} exposure and health impacts while retaining the atmospheric processes most relevant to those questions.

AERMOD serves a different purpose. It is the EPA-recommended model for many regulatory permitting applications and is particularly well suited for estimating near-field concentrations and demonstrating compliance with air-quality regulations.⁹ However, AERMOD does not explicitly simulate the atmospheric chemistry that converts precursor gases into secondary PM_{2.5}.¹⁰ InMAP was selected because it is designed to answer the specific question addressed in this report: how emissions from the proposed facility may influence regional PM_{2.5} exposure and population-level health impacts over time. The results should be interpreted as screening-level estimates of annual-average exposure and health burden that complement, rather than replace, regulatory permitting and compliance analyses.

3. Estimating community exposure and exposure burden

InMAP produces gridded estimates of incremental annual-average PM_{2.5} concentrations attributable to the estimated emissions. These concentration increments were aggregated to policy-relevant geographies, including census tracts, counties, cities, and towns. Exposure estimates were calculated using population-weighted averaging. This means that areas where more people live contribute more to the reported exposure values than sparsely populated

⁸ Tessum et al., “InMAP”

⁹ US Environmental Protection Agency, “Air Quality Dispersion Modeling - Preferred and Recommended Models.”

¹⁰ US Environmental Protection Agency, Guidance for PM_{2.5} Permit Modeling.

areas. In practical terms, the analysis estimates the average pollution increase experienced by residents, rather than the average pollution increase across land area.

The analysis also estimates population exposure burden, defined as the product of the PM_{2.5} concentration increase and the number of people exposed. This metric captures both the size of the pollution increase and the size of the affected population, helping identify the places that contribute most to total facility-attributable exposure. For all tract-, county-, and state-level population totals and exposure burden calculations, this analysis uses 2022 American Community Survey (ACS) 5-year population estimates, ensuring consistency with authoritative demographic data.¹¹

4. Demographic and Socioeconomic Assessment

To characterize the populations most affected by estimated PM_{2.5} increases due to the facility, this analysis includes a demographic and socioeconomic assessment using publicly available data from the American Community Survey (ACS) and Centers for Disease Control and Prevention (CDC).¹² Census tracts were grouped based on estimated increases in annual-average PM_{2.5} exposure (e.g., $\geq 0.01 \mu\text{g}/\text{m}^3$, $\geq 0.05 \mu\text{g}/\text{m}^3$), and population-weighted averages were calculated for key demographic and health indicators.

Demographic and socioeconomic indicators—including race and ethnicity, poverty rate, median household income, median property value, and age distribution—were derived from ACS 5-year estimates. Health and vulnerability indicators include adult asthma prevalence from CDC PLACES and the CDC/ATSDR Social Vulnerability Index (SVI).¹³ Results describe the characteristics of populations living in tracts experiencing different levels of estimated PM_{2.5} increase. These tract-level characteristics were compared with state and national averages to assess whether estimated PM_{2.5} impacts disproportionately affect lower-income or historically marginalized communities.

5. Health and Economic Impact Estimation

We estimated health impacts and associated economic damages attributable to the facility's potential PM_{2.5} emissions using the U.S. Environmental Protection Agency's Co-Benefits Risk Assessment (COBRA) tool.¹⁴ COBRA is a nationally recognized, screening-level public-health assessment model that estimates population-level health and economic effects attributable to changes in fine particulate matter concentrations. The model applies peer-reviewed concentration–response functions linking long-term PM_{2.5} exposure to outcomes such as premature mortality, hospital admissions, cardiovascular events, asthma exacerbations, and lost

¹¹ US Census Bureau, “American Community Survey 5-Year Data (2009-2023)” ; CDC, “Health Outcomes.”

¹² US Census Bureau, “American Community Survey 5-Year Data (2009-2023)” ; CDC, “Health Outcomes.”

¹³ CDC, “Social Vulnerability Index.”

¹⁴ US Environmental Protection Agency, “CO-Benefits Risk Assessment (COBRA) Web Edition.”

workdays. These impacts are monetized using standard economic valuation methods to estimate annual health-related damages.

For this analysis, COBRA was used to evaluate emissions from an industrial combustion source located in Fauquier County, Virginia, with annual emissions consistent with all three emission scenarios. COBRA estimates resulting changes in PM_{2.5} exposure, health outcomes, and economic damages across the contiguous United States, accounting for both the magnitude of the emissions change and the size of the affected population. COBRA was specifically developed to answer screening-level policy and planning questions regarding the magnitude of health impacts associated with changes in air pollution. Accordingly, it is used here to estimate the approximate population-level health and economic impacts attributable to emissions from the proposed Phase 1 power system. Results should be interpreted as screening-level estimates of long-term population impacts rather than predictions of individual risk or regulatory compliance outcomes.

Results: Estimated Air Pollution Impacts from the Phase 1 Power System

Regional Distribution of PM_{2.5} Increases

Figure 1 shows the estimated increase in annual-average PM_{2.5} exposure attributable to the Phase 1 Permitted Emissions Scenario for the Remington Technology Park Data Center. The highest PM_{2.5} increases occur in census tracts closest to the facility, with peak impacts concentrated in southern Fauquier County and eastern Culpeper County.

At the regional scale (Figure 1), elevated PM_{2.5} exposure extends beyond the immediate vicinity of the facility into surrounding portions of Stafford County, Fredericksburg City, and Spotsylvania County, with exposure decreasing as distance from the source increases. Table 1 summarizes these regional patterns at the county level, ranking counties by their annual PM_{2.5} concentration increase. Stafford County experiences the largest estimated average increase (0.02 µg/m³), followed by Fauquier County (0.019 µg/m³).

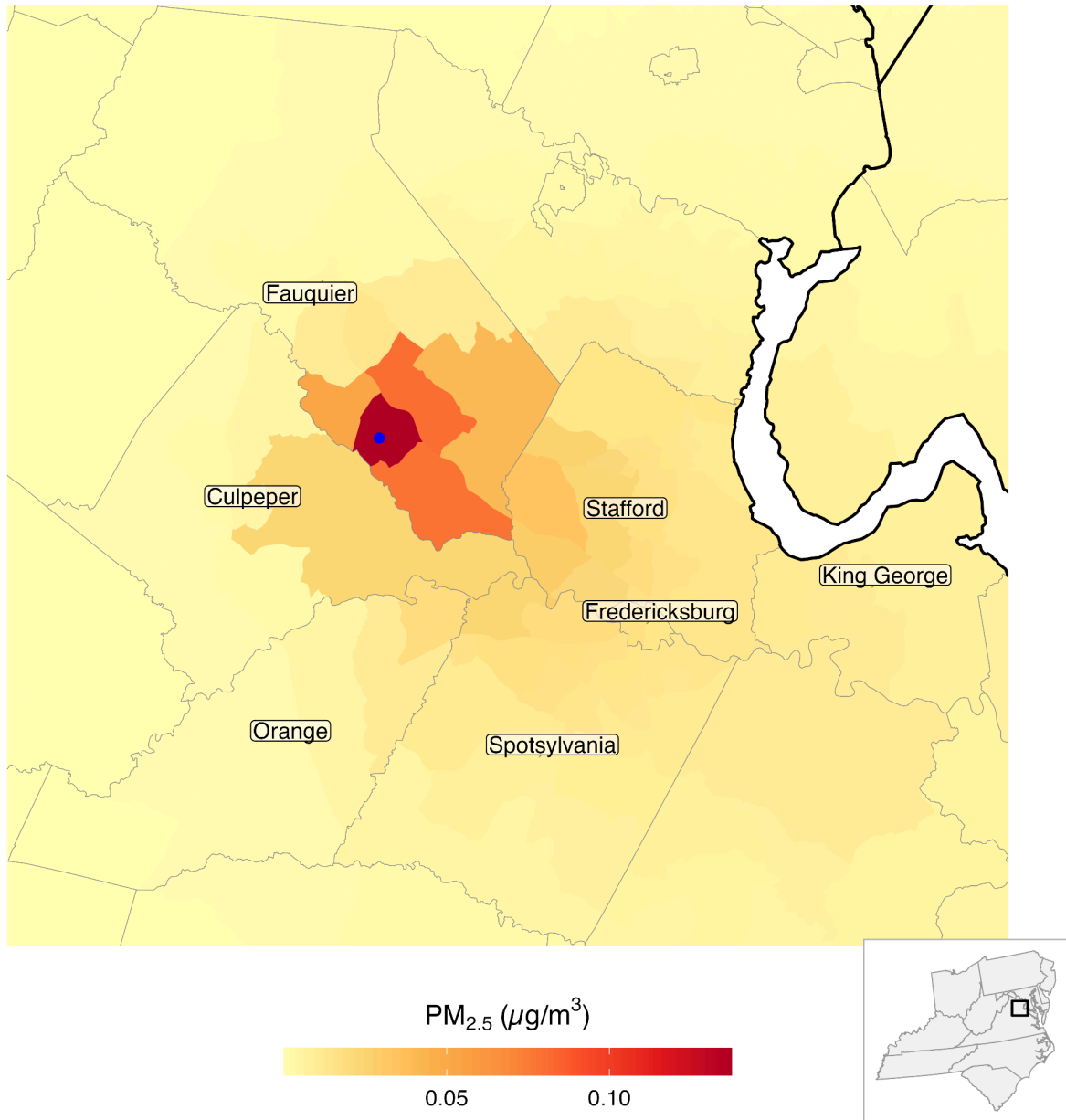


Figure 1. Estimated regional distribution of annual-average PM_{2.5} increases attributable to the Remington facility. Colors show the estimated increase in annual PM_{2.5} exposure across census tracts (µg/m³), representing the average additional pollution residents would experience due to facility emissions. The blue dot marks the facility location in Fauquier County, Virginia. County boundaries are shown for reference, and county names are labeled where at least one census tract shows an increase of 0.01 µg/m³ or greater. The inset map shows the study area's location and extent within the eastern United States.

Table 1. Estimated increases in annual-average $PM_{2.5}$ attributable to the Remington facility, summarized by county, independent city, or equivalent jurisdiction. Values represent the estimated increase in annual $PM_{2.5}$ exposure experienced by residents of each area ($\mu\text{g}/\text{m}^3$). Population estimates are from the 2022 American Community Survey, rounded to the nearest 100.

County / Jurisdiction	State	Population	Average annual facility-attributable $PM_{2.5}$ exposure ($\mu\text{g}/\text{m}^3$)
Stafford County	Virginia	157,600	0.02
Fauquier County	Virginia	73,300	0.019
Fredericksburg city	Virginia	28,300	0.017
Spotsylvania County	Virginia	141,100	0.013
King George County	Virginia	27,000	0.01
Orange County	Virginia	36,600	0.006
Caroline County	Virginia	31,200	0.006
Westmoreland County	Virginia	18,500	0.006
Essex County	Virginia	10,600	0.005
Richmond County	Virginia	9,000	0.004

Community-Level Exposure Patterns

While county- and census tract-level maps illustrate the broader regional dispersion of pollution, community-level results provide a clearer picture of how exposure would be experienced by residents in specific towns, census-designated places, and neighborhoods. Figure 2 presents estimated increases in annual-average $PM_{2.5}$ exposure for communities across Fauquier County, Stafford County, Fredericksburg City, and surrounding areas.

Community-level analysis reveals substantial variation in exposure over relatively short distances. Communities located nearest the facility and along the primary transport corridor experience $PM_{2.5}$ increases approximately two to three times higher than those observed in more distant population centers. The largest estimated increases occur in communities located near and downwind of the Remington facility, particularly in southeastern Fauquier County and western

Stafford County.

As shown in Table 2, the highest estimated PM_{2.5} increases occur in Remington (0.049 µg/m³), Midland (0.047 µg/m³), and Bealeton (0.042 µg/m³). These communities are all located within several miles of the proposed facility and experience the greatest estimated increases in annual-average PM_{2.5} exposure.

Although the largest increases in exposure occur in smaller communities closest to the facility, overall public health impacts are determined by both pollution levels and the number of people exposed. Consequently, larger population centers such as Fredericksburg, Stafford Courthouse, Falmouth, and surrounding suburban communities may contribute substantially to the total health burden despite experiencing lower concentration increases than communities immediately adjacent to the facility.

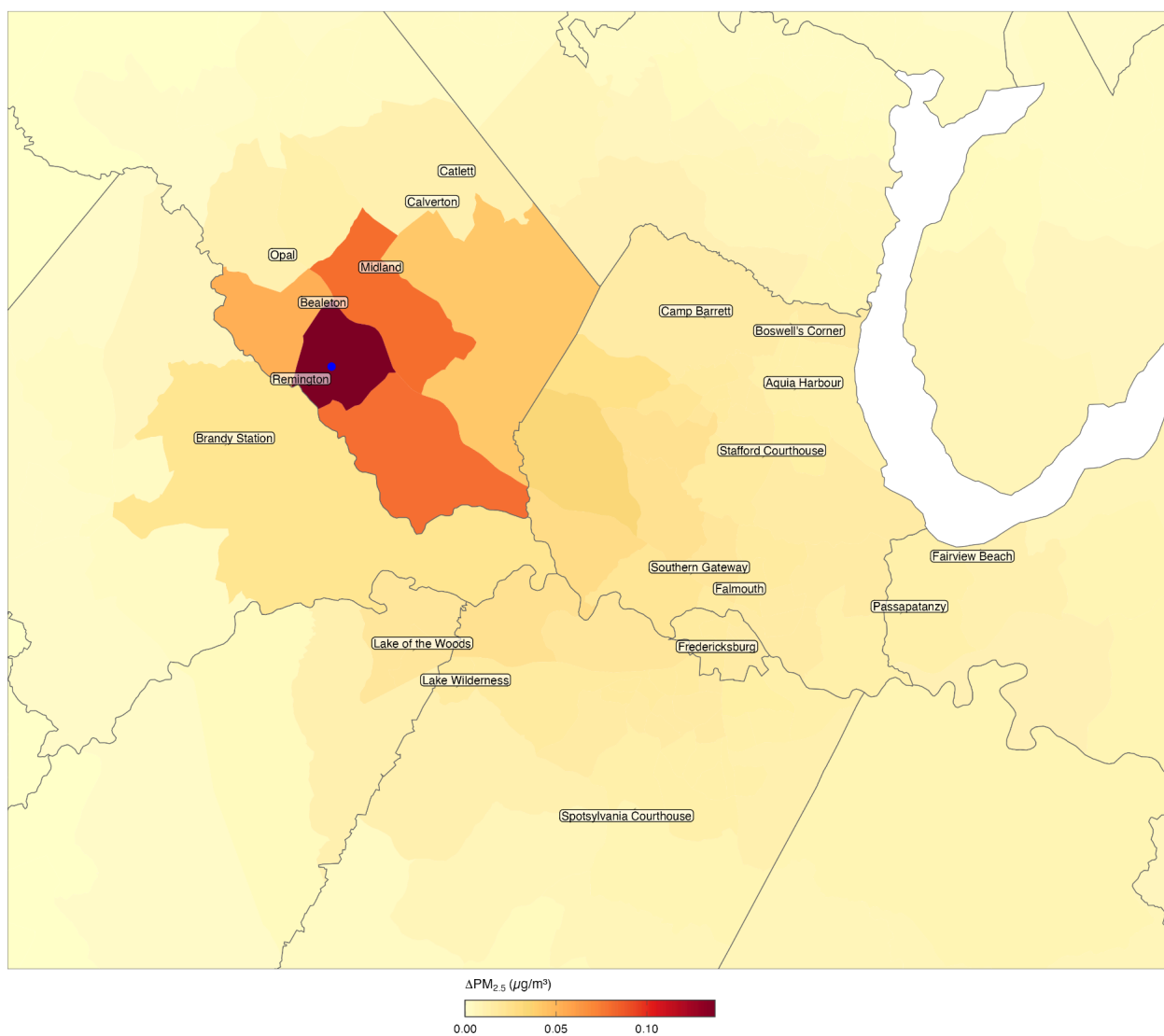


Figure 2. Estimated community-level annual-average $PM_{2.5}$ exposure increases attributable to the Remington facility. Colors show estimated annual $PM_{2.5}$ increases across communities near and downwind of the facility. The darkest areas indicate the highest estimated exposure increases. Labeled communities are those with estimated increases of $0.01 \mu\text{g}/\text{m}^3$ or greater. Numeric community-level estimates are reported in Table 2. The blue dot marks the proposed facility location in Fauquier County, Virginia.

Table 2. Communities with the highest increases in estimated annual-average $PM_{2.5}$ attributable to the Remington Data Center facility. Values represent the estimated increase in annual $PM_{2.5}$ exposure ($\mu\text{g}/\text{m}^3$) within each community.

Communities	State	Population	Annual increase in $PM_{2.5}$ exposure ($\mu\text{g}/\text{m}^3$)
Remington	Virginia	800	0.049
Midland	Virginia	200	0.047
Bealeton	Virginia	4,700	0.042
Southern Gateway	Virginia	2,600	0.022
Falmouth	Virginia	4,700	0.018
Calverton	Virginia	100	0.018
Camp Barrett	Virginia	1,500	0.018
Stafford Courthouse	Virginia	5,000	0.018
Fredericksburg	Virginia	28,300	0.017
Lake of the Woods	Virginia	8,400	0.017

Population Pollution Exposure Burden and Distribution of Impacts

Public health impacts depend on both the size of the pollution increase and the number of people exposed. To account for both factors, we calculated each county's share of the total population exposure burden attributable to the Remington facility.

Table 3 summarizes the distribution of this exposure burden across the study region. Stafford County accounts for the largest share of total facility-attributable exposure (21.17%), reflecting both relatively high $PM_{2.5}$ increases and a large exposed population. Spotsylvania County accounts for an additional 12.86% of the total burden, while Prince William County contributes 12.09% despite experiencing lower average $PM_{2.5}$ increases because of its substantially larger population. Fauquier County, where the facility is located, accounts for 9.55% of the total

exposure burden. Together, these four counties account for more than half of all estimated population exposure attributable to the facility.

Although average estimated PM_{2.5} increases are smaller in more distant jurisdictions, highly populated areas such as Fairfax County, Fredericksburg City, and Charles County, Maryland still contribute meaningfully to overall exposure because large numbers of residents are affected. At the state level, Virginia accounts for 88.79% of the total estimated exposure burden, followed by Maryland (9.42%) and the District of Columbia (0.93%).

Table 3. Distribution of population exposure burden from estimated PM_{2.5} increases attributable to the Remington facility, summarized by county. Share of PM_{2.5} exposure burden represents each county's percentage of the total population exposure across the study region, accounting for both the size of the PM_{2.5} increase and the number of people exposed.

County	State	Population	Share of facility-attributable annual PM _{2.5} exposure burden	Average facility-attributable annual PM _{2.5} exposure (µg/m ³)
Stafford County	Virginia	157,600	21.17%	0.02
Spotsylvania County	Virginia	141,100	12.86%	0.013
Prince William County	Virginia	481,100	12.09%	0.004
Fauquier County	Virginia	73,300	9.55%	0.019
Fairfax County	Virginia	1,145,400	5.11%	0.001
Fredericksburg city	Virginia	28,300	3.22%	0.017
Charles County	Maryland	167,000	2.89%	0.003
St. Mary's County	Maryland	113,800	2.32%	0.003
Virginia Beach city	Virginia	457,900	2.09%	0.001
Henrico County	Virginia	333,100	1.82%	0.001

Demographic and Socioeconomic Profile of Exposed Communities

Table 4 summarizes the demographic and socioeconomic characteristics of residents living in census tracts with elevated estimated PM_{2.5} exposure attributable to the Remington facility. Approximately 355,500 people live in census tracts with estimated annual PM_{2.5} increases greater than 0.01 µg/m³, while approximately 16,400 residents live in tracts with increases exceeding 0.05 µg/m³. No census tracts experience estimated increases greater than 0.1 µg/m³.

The demographic profile of higher-exposure communities generally reflects the population characteristics of the Stafford, Spotsylvania, and Fauquier County areas surrounding the facility. Census tracts with the highest estimated exposures are predominantly White and have lower poverty rates, higher household incomes, and higher property values than Virginia and national averages. Overall, the projected exposures are concentrated primarily in suburban and rural Northern Virginia communities with relatively high incomes and low poverty rates.

Table 4. Average demographic and socioeconomic characteristics of census tracts with estimated annual-average PM_{2.5} exposure increases above selected thresholds

Metric	>0.01 µg/m ³	>0.05 µg/m ³	Virginia	National Average
Total Population Affected	355,500	16,400	8,624,500	331,097,600
Poverty Rate (%)	7.5	7.4	10.2	12.5
White (%)	64.4	82.8	63.5	65.9
Black (%)	17.6	7.4	18.9	12.5
Hispanic (%)	13	15.4	10	18.7
Asian (%)	3.2	0.6	6.9	5.8
Age 65+ (%)	12.7	12	16	16.5
Median Household Income (\$)	117,200	104,300	100,600	75,100
Median Property Value (\$)	403,900	409,400	389,000	281,900
SVI* (0-100)	31.8	43.5	39.9	–
Adult Asthma Prevalence (%)	10.4	10.5	10.1	10.5

*SVI (Social Vulnerability Index) is a CDC/ATSDR metric ranging from 0–100 that reflects community vulnerability based on socioeconomic conditions, household characteristics, minority status, and housing and transportation factors.¹⁵

Health-Related Economic Impacts from the Remington Facility

To estimate health impacts associated with emissions from the Remington Technology Park Data Center, we used the U.S. EPA's Co-Benefits Risk Assessment (COBRA) model. COBRA links changes in air pollution to health outcomes using peer-reviewed epidemiologic relationships and estimates the associated economic costs.

Using emissions consistent with the proposed permit limits, COBRA estimates that facility emissions would result in approximately 1.5–2.8 additional premature deaths annually and \$25–42 million in annual health-related damages (Table 5). Most of these damages are attributable to premature mortality, with additional impacts including asthma onset, respiratory illness, cardiovascular disease, hospital admissions, and lost productivity. A complete listing of health outcomes is provided in Appendix A.

Fine particulate matter (PM_{2.5}) accounts for the majority of estimated damages (\$16–34 million annually), while ozone formed from NO_x emissions contributes an additional approximately \$9 million per year. These estimates represent changes in statistical risk across the exposed population and should not be interpreted as predictions of specific individual outcomes.

¹⁵ CDC, "Social Vulnerability Index."

Table 5. Selected annual health impacts and monetized damages attributable to emissions from the Remington Technology Park Data Center under the Phase 1 permitted emissions scenario.

Health outcome	Estimated annual impact	Estimated annual cost
Premature mortality	1.5–2.8 deaths	\$23–40 million
Asthma onset	8 new cases	\$0.6 million
Asthma symptoms	1,300 cases	\$0.3 million
Nonfatal heart attacks	0.7 cases	\$0.1 million
Respiratory Emergency Room admissions	2.9 cases	< \$0.01 million
Total PM _{2.5} -related health costs	—	\$16–34 million
Ozone-related health costs	—	\$8.8 million
Total health-related costs	—	\$25–42 million

Health impacts represent annual changes in statistical risk estimated using the EPA COBRA model and should not be interpreted as predictions of specific individual outcomes. Estimated impacts are rounded for clarity. Total health-related costs include both PM_{2.5}- and ozone-related impacts. A complete listing of health outcomes is provided in Appendix A.

Cumulative Health Damages Over Time

The estimates presented above represent annual health impacts. If the facility were to operate under the Phase 1 permitted-emissions scenario for multiple years, these annual impacts would accumulate over time. Because the future operating life of the on-site power system is uncertain, Table 6 presents cumulative health damages assuming operating periods of 5, 10, 20, and 30 years.

Under these assumptions, total undiscounted health damages would range from approximately \$125–\$210 million over 5 years to \$750 million–\$1.26 billion over 30 years. Applying a 2% discount rate reduces these totals to approximately \$118–\$198 million over 5 years and \$560–\$941 million over 30 years in present-value terms. These estimates are not predictions of how long the facility will operate. Rather, they illustrate how annual health impacts would

accumulate over time if emissions remained near the levels assumed in the Phase 1 permitted-emissions scenario.

Table 6. Estimated cumulative health damages under the Phase 1 permitted-emissions scenario.

Assumed Operating Life	Total Damages over Operating Life (\$)	Present value of total damages (2% discount rate; \$)
5 years	125 million – 210 million	118 million – 198 million
10 years	250 million – 420 million	225 million – 377 million
20 years	500 million – 840 million	409 million – 687 million
30 years	750 million – 1.26 billion	560 million – 941 million

Note: Values represent cumulative health-related damages assuming annual impacts remain between \$25 million and \$42 million. Present-value estimates apply a 2% discount rate.

Health Impacts Under Reduced-Emissions Scenarios

The primary analysis assumes emissions consistent with the Phase 1 permitted-emissions scenario. This scenario does not represent full operation of all thirteen turbines; the permit application bases annual turbine emissions on approximately nine turbines operating at 85% load. The reduced-emissions scenarios therefore should not be interpreted as operation at 75% or 50% capacity. Instead, they represent cases in which actual annual emissions are 75% or 50% of the Phase 1 permitted-emissions scenario.

As shown in Figure 3, reducing annual emissions primarily decreases the magnitude of estimated PM_{2.5} concentration increases while preserving the overall geographic pattern of impacts. Communities nearest the proposed facility continue to experience the largest increases across all scenarios, although the intensity of those increases declines approximately in proportion to emissions.

Remington VA – Tract-Level $\Delta PM_{2.5}$ by Emission Scenario

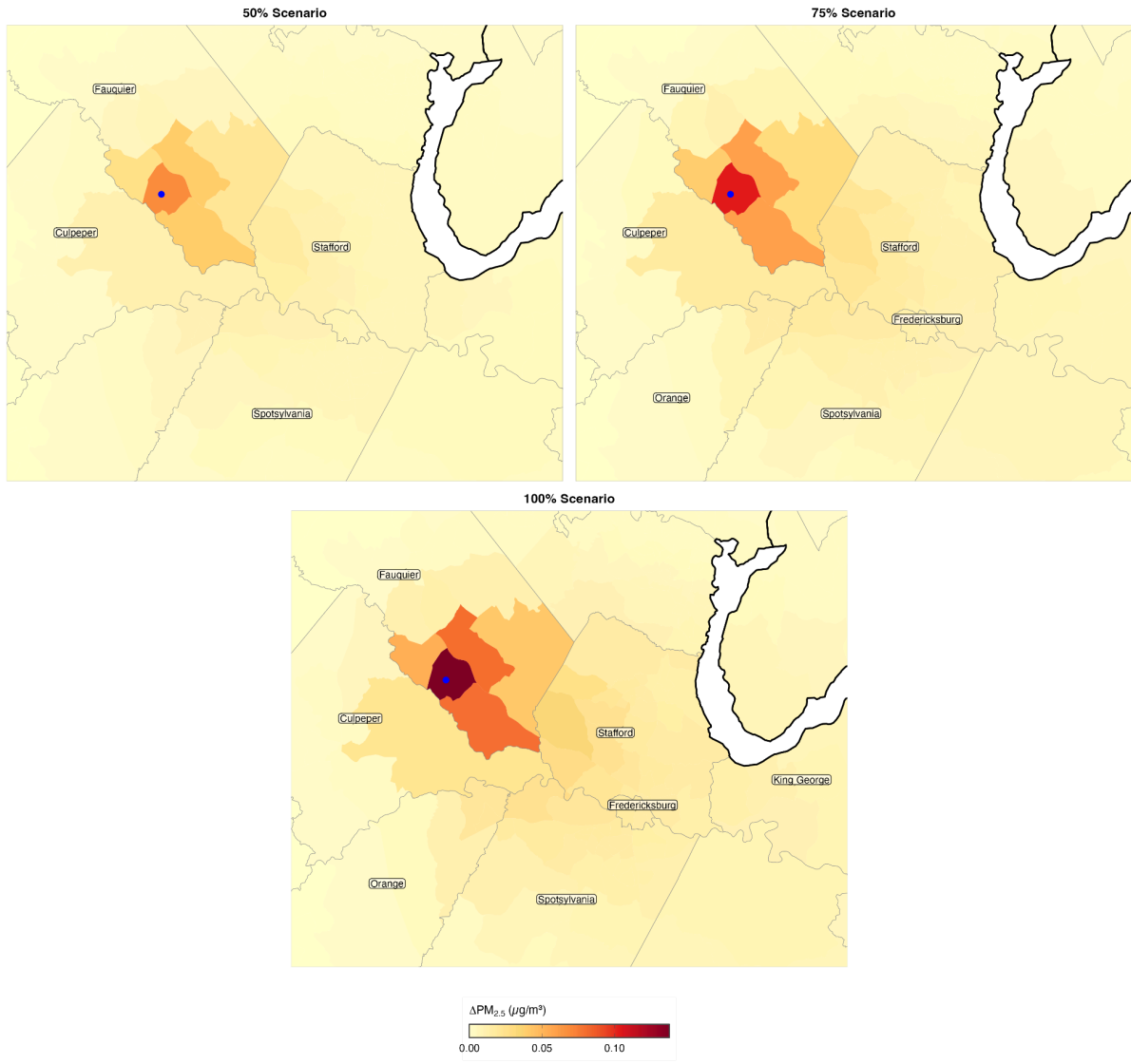


Figure 3. Sensitivity analysis of estimated annual-average $PM_{2.5}$ increases under lower-emissions scenarios. Panels compare estimated $PM_{2.5}$ concentration increases assuming annual emissions equal to 50%, 75%, and 100% of the Phase 1 permitted-emissions scenario. All panels use the same color scale, so lighter colors in the lower-emissions panels indicate approximately proportional reductions in estimated $PM_{2.5}$ impacts. The blue dot marks the proposed facility location.

Estimated health impacts similarly decline approximately in proportion to emissions. Under the 75% Reduced-Emissions Scenario, COBRA estimates approximately 1.2–2.1 additional premature deaths annually and \$18–32 million in annual health damages. Under the 50% Reduced-Emissions Scenario, estimated impacts decline to approximately 0.8–1.4 additional premature deaths and \$12–21 million in annual damages. By comparison, the Phase 1 permitted-emissions scenario is associated with approximately 1.5–2.8 additional premature deaths and \$25–42 million in annual damages.

These results show that lower emissions would reduce health impacts, but even substantially lower-emissions scenarios remain associated with measurable public-health impacts across the region.

Table 7. Estimated annual health impacts under alternative emissions scenarios.

Emissions Scenario*	Premature mortality (annual deaths)	Asthma symptoms (annual cases)	Total annual health damages
Permitted emissions scenario	1.5–2.8 deaths	1,300	\$25–42 million
75% Reduced Emissions Scenario	1.2–2.1 deaths	1,000	\$18–32 million
50% Reduced Emissions Scenario	0.8–1.4 deaths	670	\$12–21 million

*Scenarios represent annual emissions equal to 100%, 75% and 50% of the Phase 1 permitted emissions scenario and should not be interpreted as turbine utilization rates or capacity factors.

Regional Context: Existing Power Generation Sources

The proposed Remington Technology Park would be located in an area that already hosts fossil-fuel power generation infrastructure. Two nearby gas-fired combustion turbine facilities—Dominion's Remington Combustion Turbine Station and ODEC's Marsh Run Generation Facility—operate in the Lucky Hill Road area and are classified as major air pollution sources. Marsh Run is a natural-gas peaking facility designed to operate during periods of high electricity demand.

Historical emissions data indicate that these facilities already contribute direct PM_{2.5} and PM_{2.5}-forming precursor pollutants to the regional airshed. In 2025, the two facilities together reported approximately 354 tons of NO_x, 29 tons of PM_{2.5}, 12 tons of SO₂, and 15 tons of VOC emissions. By comparison, the proposed Remington Technology Park Phase 1 permitted-emissions scenario would emit approximately the same amount of direct PM_{2.5} annually as the combined 2025 PM_{2.5} emissions from these two nearby power plants, while also

adding substantial emissions of NO_x, SO₂, VOCs, and ammonia that can contribute to secondary PM_{2.5} formation.

This comparison highlights that the proposed facility would not be introducing combustion emissions into an otherwise emissions-free setting. Rather, it would add another large source of combustion-related air pollution in a community that already hosts power generation infrastructure. Unlike traditional peaker plants, which generally operate intermittently during periods of elevated electricity demand, the Remington application proposes an onsite turbine system intended to provide prime power for data center operations, with continuous operation anticipated once commissioned. As a result, the facility should be evaluated not only as an individual emissions source, but also within the broader context of the growing energy infrastructure being developed to support Northern Virginia's expanding data center sector.

Conclusion

This analysis evaluated the potential air-quality, health, and economic impacts associated with the proposed Phase 1 power system at the Remington Technology Park Data Center. Results indicate that emissions from the facility are estimated to increase annual-average PM_{2.5} concentrations across portions of Northern Virginia, with the largest estimated increases occurring near the facility and extending into downwind communities in Fauquier County, Stafford County, Fredericksburg, and Spotsylvania County.

Using EPA health-impact methodologies, these estimated increases in PM_{2.5} concentrations were associated with measurable population-level health impacts, including premature mortality, cardiovascular and respiratory disease, asthma-related outcomes, and associated economic damages. Under the Phase 1 permitted-emissions scenario, annual health damages were estimated at approximately \$25–42 million.

Sensitivity analyses showed that estimated impacts scale with annual emissions. Lower-emissions scenarios produced proportionally lower estimated health impacts and economic damages, but all scenarios evaluated remained associated with measurable public-health impacts. Importantly, the permit application bases annual turbine emissions on an average of approximately nine of thirteen turbines operating at 85% load, making the primary scenario evaluated in this report a plausible permitted operating condition rather than a theoretical maximum.

Overall, the findings indicate that operation of the proposed Phase 1 power system would be associated with measurable increases in annual-average PM_{2.5} concentrations and corresponding population-level health impacts across the surrounding region. The proposed facility would also add a new combustion-related emissions source in an area that already hosts fossil-fuel power generation infrastructure, placing the estimated impacts in the context of an existing regional power-generation corridor.

Appendix A. Detailed EPA COBRA Health Impact Results

Health impacts were estimated using the U.S. Environmental Protection Agency's Co-Benefits Risk Assessment (COBRA) model, which links changes in air pollutant emissions to population exposure, health outcomes, and monetized damages using peer-reviewed concentration-response functions and economic valuation methods.

The primary analysis evaluated the Phase 1 Permitted-Emissions Scenario using annual emissions from the Remington Technology Park air permit application: 30.01 tons of primary PM_{2.5}, 9.51 tons of SO₂, 74.95 tons of NO_x, and 4.52 tons of VOCs. NH₃ emissions were included in the InMAP air-quality modeling used to estimate secondary PM_{2.5} formation; Appendix A reports the pollutant inputs and health endpoints as represented in the EPA COBRA health-impact outputs. According to the application, these emissions are based on an average of approximately nine of thirteen turbines operating at 85% load rather than continuous operation of all installed turbines.

Two reduced-emissions sensitivity scenarios were also evaluated:

- 75% Reduced-Emissions Scenario: annual emissions equal to 75% of the Phase 1 permitted-emissions scenario.
- 50% Reduced-Emissions Scenario: annual emissions equal to 50% of the Phase 1 permitted-emissions scenario.

These scenarios represent alternative annual emissions levels and should not be interpreted as turbine utilization rates, capacity factors, or specific operating schedules. All results represent estimated annual health impacts and monetized damages across the contiguous United States using EPA COBRA default concentration-response functions and valuation assumptions. Monetary values are reported in 2023 dollars.

Notes:

- *For clarity, this table presents COBRA-estimated impacts as positive “additional” cases and positive “monetized damages.” The EPA COBRA web tool reports these same changes using a negative sign convention to indicate increased adverse outcomes (i.e., negative “health benefits”).*
- *For mortality outcomes, COBRA reports a range of estimates reflecting alternative peer-reviewed epidemiological concentration–response functions (“Low” and “High”).*
- *All monetary values are expressed in 2023 dollars and rounded, consistent with standard COBRA output conventions.*
- *Health impacts reflect contributions from both PM_{2.5} exposure and ozone (O₃) formation, with ozone-related impacts driven primarily by elevated NO_x emissions.*

- For clarity and consistency with EPA COBRA web outputs, changes in incidence are rounded to one decimal place (or whole numbers where appropriate), and monetary values are rounded to the nearest thousand or million dollars.

A.1 Phase 1 Permitted-Emissions Scenario (100%)

Health Endpoint	Pollutant	Change in Incidence (annual cases)	Monetary Value (annual dollars)
Mortality (All Cause)	PM _{2.5} O ₃	1.5 to 2.8	\$23M to \$40M
Nonfatal Heart Attacks	PM _{2.5}	0.74	\$62,000
Infant Mortality	PM _{2.5}	0.01	\$160,000
Hospital Admissions, All Respiratory	PM _{2.5} O ₃	0.189	\$4,600
Emergency Room Visits, Respiratory	PM _{2.5} O ₃	2.9	\$4,600
Asthma Onset	PM _{2.5} O ₃	8.1	\$610,000
Asthma Symptoms	PM _{2.5} O ₃	1300	\$270,000
Emergency Room Visits, Asthma	O ₃	0.01	\$9
Lung Cancer Incidence	PM _{2.5}	0.087	\$3,800
Hospital Admissions, Cardio-/Cerebrovascular Disease	PM _{2.5}	0.16	\$4,500
Hospital Admissions, Alzheimer's Disease	PM _{2.5}	0.42	\$9,500
Hospital Admissions, Parkinson's Disease	PM _{2.5}	0.07	\$1,700
Stroke Incidence	PM _{2.5}	0.07	\$4,400
Hay Fever / Rhinitis	PM _{2.5} O ₃	51	\$57,000
Cardiac Arrest, Out of Hospital	PM _{2.5}	0.02	\$1,100

Emergency Room Visits, All Cardiac	PM _{2.5}	0.4	\$860
Minor Restricted Activity Days	PM _{2.5}	1100	\$130,000
School Loss Days	O ₃	430	\$730,000
Work Loss Days	PM _{2.5}	180	\$56,000
Total PM _{2.5} Health Effects	—	—	\$16M to \$34M
Total O ₃ Health Effects	—	—	\$8.8M
Total Combined Health Effects	—	—	\$25M to \$42M

A.2 75% Reduced-Emissions Scenario

Health Endpoint	Pollutant	Change in Incidence (annual cases)	Monetary Value (annual dollars)
Mortality (All Cause)	PM _{2.5} O ₃	1.2 to 2.1	\$17M to \$30M
Nonfatal Heart Attacks	PM _{2.5}	0.55	\$46,000
Infant Mortality	PM _{2.5}	0.008	\$120,000
Hospital Admissions, All Respiratory	PM _{2.5} O ₃	0.14	\$3,400
Emergency Room Visits, Respiratory	PM _{2.5} O ₃	2.1	\$3,500
Asthma Onset	PM _{2.5} O ₃	6	\$460,000
Asthma Symptoms	PM _{2.5} O ₃	1000	\$200,000
Emergency Room Visits, Asthma	O ₃	0.008	\$7
Lung Cancer Incidence	PM _{2.5}	0.066	\$2,900
Hospital Admissions, Cardio-/Cerebrovascular Disease	PM _{2.5}	0.12	\$3,400
Hospital Admissions, Alzheimer's Disease	PM _{2.5}	0.32	\$7,100
Hospital Admissions, Parkinson's Disease	PM _{2.5}	0.055	\$1,300
Stroke Incidence	PM _{2.5}	0.053	\$3,300
Hay Fever / Rhinitis	PM _{2.5} O ₃	39	\$43,000
Cardiac Arrest, Out of Hospital	PM _{2.5}	0.014	\$840
Emergency Room Visits, All Cardiac	PM _{2.5}	0.3	\$640

Minor Restricted Activity Days	PM _{2.5}	790	\$99,000
School Loss Days	O ₃	320	\$550,000
Work Loss Days	PM _{2.5}	130	\$42,000
Total PM _{2.5} Health Effects	—	—	\$12M to \$25M
Total O ₃ Health Effects	—	—	\$6.6M
Total Combined Health Effects	—	—	\$18M to \$32M

A.3 50% Reduced-Emissions Scenario

Health Endpoint	Pollutant	Change in Incidence (annual cases)	Monetary Value (annual dollars)
Mortality (All Cause)	PM _{2.5} O ₃	0.77 to 1.4	\$11M to \$20M
Nonfatal Heart Attacks	PM _{2.5}	0.368	\$31,000
Infant Mortality	PM _{2.5}	0.005	\$79,000
Hospital Admissions, All Respiratory	PM _{2.5} O ₃	0.094	\$2,300
Emergency Room Visits, Respiratory	PM _{2.5} O ₃	1.4	\$2,300
Asthma Onset	PM _{2.5} O ₃	4	\$310,000
Asthma Symptoms	PM _{2.5} O ₃	670	\$130,000
Emergency Room Visits, Asthma	O ₃	0.006	\$5
Lung Cancer Incidence	PM _{2.5}	0.04	\$1,900
Hospital Admissions, Cardio-/Cerebrovascular Disease	PM _{2.5}	0.078	\$2,200
Hospital Admissions, Alzheimer's Disease	PM _{2.5}	0.212	\$4,700
Hospital Admissions, Parkinson's Disease	PM _{2.5}	0.037	\$870
Stroke Incidence	PM _{2.5}	0.035	\$2,200
Hay Fever / Rhinitis	PM _{2.5} O ₃	25.7	\$29,000
Cardiac Arrest, Out of Hospital	PM _{2.5}	0.009	\$560
Emergency Room Visits, All Cardiac	PM _{2.5}	0.198	\$430

Minor Restricted Activity Days	PM _{2.5}	526	\$66,000
School Loss Days	O ₃	214	\$360,000
Work Loss Days	PM _{2.5}	89	\$28,000
Total PM _{2.5} Health Effects	—	—	\$7.9M to \$17M
Total O ₃ Health Effects	—	—	\$4.4M
Total Combined Health Effects	—	—	\$12M to \$21M

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