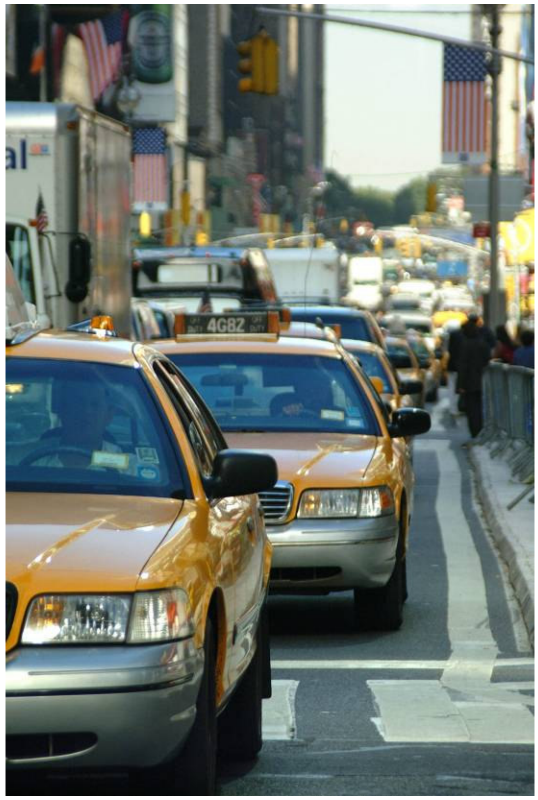
All Choked Up



HEAVY TRAFFIC, DIRTY AIR
AND THE RISK TO NEW YORKERS

MARCH 2007

ENVIRONMENTAL DEFENSE

finding the ways that work

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Executive summary

New York is a city of superlatives. It's America's oldest big city and a place that's constantly reinventing itself. It's a place where millions of people raise their families and build careers, a destination spot for tourists and immigrants from around the world, and a cultural and financial center. Over the next quarter of a century, the city's population is expected to grow by nearly a million people, with 750,000 new jobs helping to boost the economy.

City streets are congested, smog and soot reduction goals are not being met, and transit is overcrowded. How will the city handle this growth? What are the implications for traffic, air pollution and our health? This paper addresses a critically important aspect of this challenge: the threat to New Yorkers' health posed by air pollution from traffic.

Recent science suggests there is a 500-foot or greater risk zone from air pollution around heavily used roadways. Within this risk zone, vehicle emissions are concentrated at levels higher than background concentrations, and the risks of various diseases, including cancer, heart disease, and respiratory ailments, can increase. The traffic pollutants especially relevant to health include particulate matter (soot), volatile organic compounds and nitrogen oxides (precursors to smog).

These risk zones have a significant impact on New Yorkers. Over two million people live within 500 feet of a congested street or highway. Furthermore, large numbers of health facilities, schools, and playgrounds are located within this 500-foot zone. A city as densely constructed and populated as New York must take notice of the health risks from motor vehicle air pollution and act to reduce them.

Congestion pricing systems are a key part of the solution. Such systems have already been implemented in London, Singapore and Scandinavia with impressive results. Their benefits include improved air quality and increased funding for new transit. A part of the solution must be to clean up the dirtiest vehicles on the roads by replacing old engines, filtering vehicles' emissions, and enforcing existing laws designed to reduce pollution. In addition to these actions directed to reduce motor vehicle air pollution, we call for expanded air quality monitoring to help scientists and policymakers better understand differences among local microenvironments.

Health consequences of traffic: A compelling science story

Science has long shown that air pollution from trucks and cars is bad for health. To date, federal air pollution regulations have tended to focus on regional or city-wide pollution targets, rather than street-level exposures.[1] In the last decade, a growing number of researchers around the world have examined the actual street-level exposures to air pollution. This science points to local health risks more severe than ambient air pollution measures would suggest.

A critical mass of scientific evidence shows a health risk zone close to major roadways. The risk zone extends from about 500 to 1500 feet, varying by pollutant and health effect. For New York this means that people living within two to six blocks of a busy road are likely at higher risk. The core scientific studies that point to the health implications outlined in this report are divided into two categories. Some studies measure the actual street-level air pollutant exposures; others document the impaired health of people living close to roads. The health effects seen with greater intensity closer to busy roads include cancer, heart disease, impaired childhood lung development, asthma attacks and lung disease in adults.

The risk zone

Over the last ten years, there has been an accumulation of public health studies showing that air pollution exposure levels are greater close to roadways than are typically reported through regional air pollution measurements. There will always be some variability, because traffic pollution is affected by the mix of vehicles on a roadway, wind and weather, topography, and the buildings around the roads. Congestion itself has an effect: Stop-and-go traffic releases as much as three times the pollution of free-flowing traffic.[2]

Dr. Ying Zhou and Dr. Jonathan Levy, researchers at the Harvard School of Public Health (HSPH), recently synthesized much of the related research from the last decade. They concluded that there is a zone of increased exposures surrounding major roadways, i.e. an area in which increased health risks would be expected. The synthesis was based on 30 peer-reviewed studies and three government regulatory reports that characterized how air pollution levels and health risks changed with distance from a roadway. It identified the factors that would potentially influence the findings, including distance from the road, type of pollutant, emission rates, background pollution concentrations, and meteorological conditions.

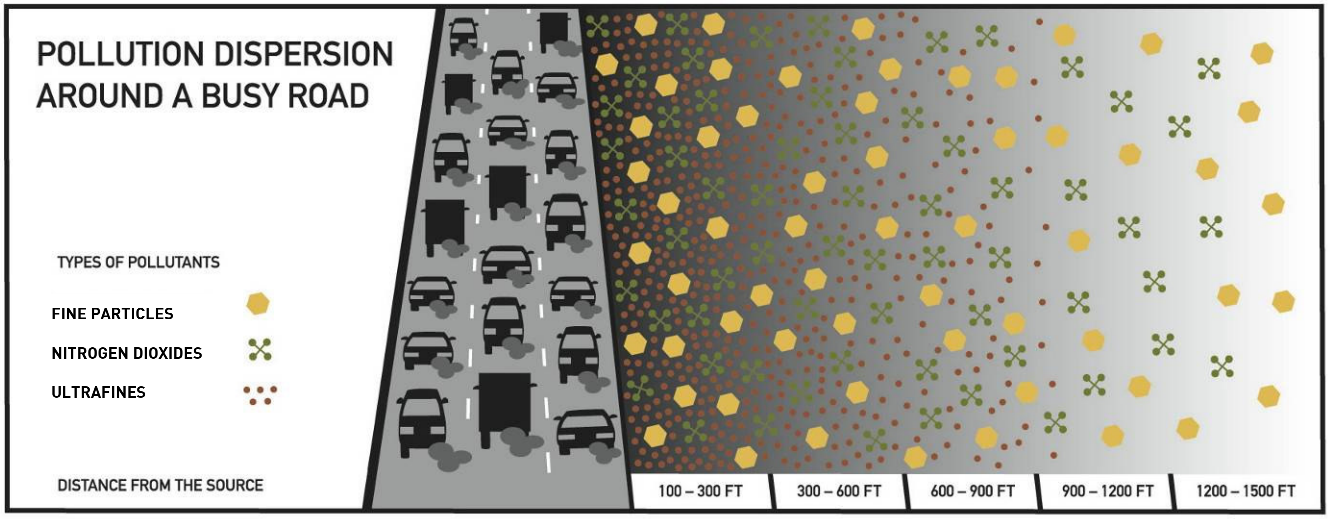
Zhou and Levy concluded that the size of the area around the road where pollution levels were noticeably higher varied by pollutant. For the following three traffic-related pollutants known to cause health problems, they summarized the distance from the road where levels are high enough to increase health risks.

- Particulate matter (soot from gasoline or diesel): 500 to 1500 feet
- Nitrogen dioxide (NO_2): 600 to 1500 feet
- Ultrafine particle count (the smallest soot particles): 300 to 1000 feet

Taking all the different traffic-related pollutants as a whole, a risk zone of 500 to 1500 feet around a major roadway is supported by this meta-study.

FIGURE 1

Traffic spreads pollution up to 1500 feet from the roadway



Tailpipe pollution can travel 1500 feet or farther from the roadway. Three pollutants types and their impact range are depicted.

Multiple health risks

Recent research has also inferred that there are increased health risks and harmful health effects within the pollutant dispersion zone. Researchers have looked at different groups of people, health effects, and distances from the roadway. Studies of men, women and children all show increased health risks associated with job-related and residential proximity to a busy road.

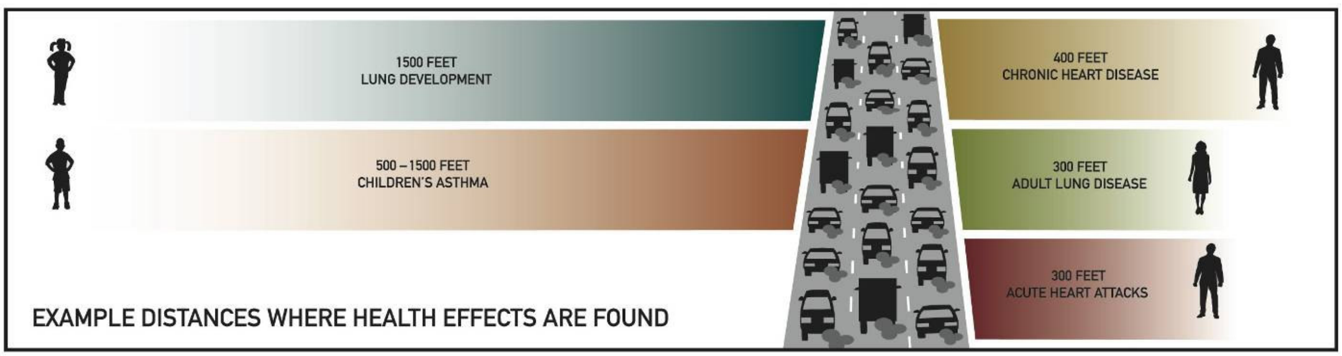
As a whole, the traffic and health studies present a wide range of health effects. Most commonly studied have been asthma and lung disease (especially in children), and heart disease. Traffic emissions, and especially diesel soot, are widely implicated in triggering asthma attacks and impairing lung function. Some studies have found associations between traffic-related exposures and stroke, cancers, including childhood leukemia, and adverse reproductive outcomes. Outlined below is some of the recent science:

- *Childhood Respiratory Consequences:* Children are especially vulnerable to the effects of traffic-related air pollution; studies show increased prevalence of asthma,[3,4] respiratory symptoms,[5,6] and stunted lung development.[7] A key study from 2005 found that the risk of asthma increased 89% for each quarter-mile closer children lived to a major roadway; the follow-up 2007 study found decreased lung air flow function for children living within about 1500 feet of a major roadway.[8]
- *Cancer Risks:* Higher exposure to traffic emissions was associated with increased risk of breast cancer among women in Erie and Niagara Counties of New York State.[9] A study in Stockholm found a 40% increase in lung cancer risk for the group with the highest average traffic-related NO_2 exposure.[10] A Danish study reported rates of Hodgkin's disease increasing by 51% in children whose mothers were exposed to higher levels of NO_2 during pregnancy.[11] Although some studies

have not shown associations, some studies have shown links between traffic and cancer.

- *Heart Disease:* A Los Angeles study found that if researchers more accurately estimate exposures, based on localized rather than ambient air pollution levels, estimates of risk of death from heart attacks triple.[12] Another study from Worcester, Massachusetts found a five percent increased risk of acute heart attack for each kilometer closer a subject lived to a major roadway.[13]
- *Dangerous Diesel Concentrations:* Multiple studies have found serious health effects from exposure to heavy-duty diesel trucks, including increased mortality rates. Diesel emissions on busy roads have been associated with triggering asthma attacks, and may play a role in the initial onset of asthma.[14]

FIGURE 2
Health findings near traffic



Many researchers have published findings of significant health effects related to proximity to traffic. The studies differ in selection of sample groups, exposure indicators, and other variables. Taken as a whole, these studies show effects from 300 feet to as far as 1500 feet away from busy traffic.

Implications for New York City

The science described above is of special concern in large cities like New York, where millions of people live, work and play close to heavy traffic. New Yorkers are particularly vulnerable, given the city's combination of an extremely dense population and many local roads that carry large volumes of traffic. Also, it is important to note that even the background air quality in New York City does not yet meet key Clean Air Act standards for nitrogen oxides and particulate matter.

Many New Yorkers at risk

As a first step toward understanding the scale of the potential threat in New York City, the maps in the Appendix to this report seek to paint an initial picture of the scale of the problem. Based on the science described above, we mapped a simple 500-foot risk zone around the city's most congested streets, which were selected based on criteria used by the New York Metropolitan Transportation Council that define heavily congested and high volume streets. To be conservative, 500 feet was selected because it is at the lower end of the dispersion distances found in the scientific literature. As shown above, different pollutants may have even larger zones of impact. For this report, local wind, weather, seasonal changes, and building heights were not accounted for when mapping the zones;

these factors can create variations in concentrations. Future research can answer questions about differences in specific exposures from street to street.

Combining census data with this simple and conservative view of the risk zone, startling results emerged:

- *People*: Two million people in New York City live within 500 feet of major roadways. The census data used was based on residential use only; people working in these zones were not included. In Manhattan, over 75% of the total population lives within 500 feet of a congested road.
- *Places*: Many facilities catering to sensitive populations, like schools and standalone playgrounds, are also inside these zones. For example, in Brooklyn, over 35% of both health facilities and standalone playgrounds are within this 500-foot risk zone. The maps in Figure 3 and the Appendix show the percentage of children, elderly and minorities that live within the 500 foot risk zone in each borough. Table 1 shows the absolute number of individuals affected; Table A-1 in the Appendix provides this information in percentages. In the Bronx, these risk zones comprise 23% of the borough's land area.
- *Sensitive populations*: Risk zones were mapped for busy roads in all five boroughs. Figure 3 shows the 500-foot zone for the Manhattan population 18 years of age and younger. Populations minority populations and people 65 years of age and older were also mapped (see Appendix). Deeper colors show higher proportions of the mapped population.

TABLE 1

Populations living in the traffic pollution risk zone

New York City borough	Total population in risk zone	18 years and younger	65 years and over	Minority
Bronx	218,900	66,700	24,900	143,200
Brooklyn	595,700	158,800	61,300	399,100
Manhattan	1,217,700	204,000	149,200	515,400
Queens	379,300	85,200	51,800	211,700
Staten Island	36,300	9,300	4,100	6,200
TOTAL	**2,447,900**	**521,000**	**291,300**	**1,276,600**

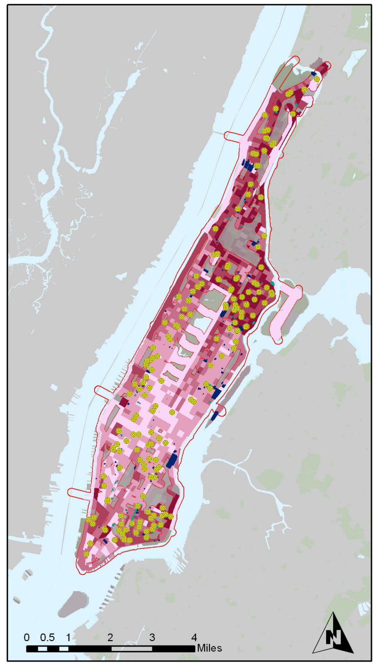
FIGURE 3

Children and youth at risk

This Manhattan map overlays the population 18 years of age and younger on the 500-foot zone. Deeper red colors show higher percentage of youth residential populations.

% of Population 18 and Under

- 0% - 5%
- 6% - 12%
- 13% - 20%
- 21% - 30%
- 31% - 80%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot areas



Risk and disease in New York City

The second step in understanding the scale of the problem is looking at the disease rates and risks in New York City, which underscore the impact of traffic-related pollutants. The lifetime cancer risk due to diesel exhaust in both Bronx County and Queens County is over 900 times the acceptable EPA standard, while New York County's risk is over 3000[15] times that limit. Vehicle emissions contribute over 80% of the total cancer risk from hazardous air pollutants in New York City.[16] As described above, diesel emissions have been associated with asthma and its symptoms. New York's asthma statistics are staggering: An astounding 300,000 children and 700,000 adults living in New York City have been diagnosed with asthma.[17] Furthermore, in 2000, New York City's children were twice as likely to be hospitalized for asthma as the average American child.[18] Since people with asthma are much more sensitive to air pollutants than people with healthy lungs, this means there are roughly a million New Yorkers who need special protection from noxious air.

Health Facts:

- 1 out of 8 New Yorkers has been diagnosed with asthma at some point in his or her life
- 300,000 children in NYC have been diagnosed with asthma.
- In 2000, NYC children were almost twice as likely to be hospitalized because of asthma attacks as the average U.S. child.
- Compared to over 3000 counties, Queens County's diesel pollution risk ranks as the 10th unhealthiest in the nation.
- 20-30% of children have been diagnosed with asthma in central Harlem, Central Brooklyn and the South Bronx; this is more than double the national average.

Rising traffic levels in New York

Minimizing these health problems requires a two-pronged solution: managing traffic growth rates and cleaning up dirty vehicles. While New Yorkers have relatively low rates of car ownership and benefit from an extensive public transportation system, Manhattan is the only county in the country with more jobs than residents.[19] That means that many of those workers drive from or through the other boroughs, exacerbating existing traffic snarls throughout the city. Since the 1920s, vehicle travel into Manhattan south of 60th

Street (the Central Business District or CBD) has increased by an average of seven percent annually. If that trend continued for the next 25 years, it would mean one million vehicles per day entering the CBD.[20] Given the already high level of congestion, that volume of traffic would be untenable.

Even under scenarios that include traffic management improvements, vehicle-miles traveled in the Bronx are expected to increase by almost ten percent, to ten million miles per day. In Queens, the average speed will drop to 13.8 miles per hour. Currently, drivers in the New York region spend more than the equivalent of a full work week each year stuck in traffic.[21] These increases in traffic and congestion require multifaceted actions to provide a healthy and livable New York for the twenty-first century.

Congestion in New York:
- wastes 200 million gallons of fuel annually
- costs $13 billion in productivity losses, wasted fuel, travel costs, lost jobs
- spews 166,000 tons of pollutants each year
- slows average traffic speeds to just 8 mph in rush hour

Solutions

Fortunately, solutions to this challenge exist – and in many cases, real-world examples of success point the way forward. There are essentially three different types of solutions: 1) Incentives, like congestion pricing, that encourage less driving at congested times and finance new transit; 2) Clean-vehicle technologies, especially targeting the oldest and dirtiest engines; and 3) Land-use rules and developer incentives that reduce the need to drive, and separate schools, homes and other sensitive populations from heavy traffic. A part of the solution must also be to continue refining the science with air pollution monitoring programs at the local level.

Congestion pricing for healthy urban centers and busy corridors

Cities around the world are beginning to use congestion pricing systems to cut traffic in their urban centers and along heavily used corridors. The idea is simple: Use a price signal, an electronically-collected toll, to charge drivers to use the most congested roads at the most congested times. Like airline ticket prices, prices can be made cheaper at off-peak times and higher at the most congested times. For big cities with congested central business districts, a "cordon" scheme like London's can reduce traffic and emissions in the urban center by giving drivers an incentive to drive into the city during off-peak times. For busy highway corridors, congestion pricing can be used to maintain a free flow of traffic. In all cases, revenues from pricing can be used to benefit travelers themselves, by helping to pay for innovative transit choices and faster travel. This section describes successful congestion pricing programs and draws some lessons for New York City.

London: Pricing in a World Financial Capital[22]

Starting in 2003, London gave its drivers a new incentive: It began charging them a premium to drive into the city's congested business district, where traffic gridlock was deemed to threaten the city's economic competitiveness and quality of life. A remarkable thing happened. Congestion quickly dropped an average of 30%. Average traffic speed increased 37%. Emissions of the most dangerous air pollutants and greenhouse gases have dropped. Particulate matter (PM_{10}) emissions are down by 12%, as are nitrogen oxides

(NO_x). Fossil fuel consumption and carbon dioxide (CO_2) emissions are also down by 20%.[23]

London raised hundreds of millions of dollars in new revenue, which it invested in better transit, delivering immediate benefits to the commuters affected by the charge.

Photo: Getty Images

New buses, financed by the congestion charge, boosted bus ridership almost 40%. Use of bicycles has also increased. Initial public skepticism has turned into support, and London's Mayor Ken Livingston enjoyed popular re-election after adopting the charge.

A key point in the London experience is that neighboring areas have *not* received increased traffic. After a short adjustment period, a free ring road has traffic levels comparable to 2002 levels. This is despite the fact that skeptics initially argued that traffic in neighboring areas would increase as drivers attempted to bypass the charge.

The net revenue from the system is substantial: For the 2006 fiscal year, the system generated $250 million of revenue after capital and operating expenses. That money is dedicated to transit improvements. In fact, a key to London's success is that bus service was expanded to provide alternatives for commuters that might otherwise find it more convenient to drive. Not only that, but both existing and new bus lines provide shorter and more predictable travel times. This is despite a 37% increase in ridership. Taxis also move more quickly, yielding time and cost savings for passengers. Based on these successes, in February 2007, London doubled the size of the congestion pricing zone and is now considering plans to begin targeting its benefits more specifically to winning air pollution benefits for its neighborhoods.

A final measure of London's success is the satisfaction of those involved. Seventy-eight percent of charge payers are satisfied with the operation of the scheme. Of those who traveled to, or within the zone during the first year, 80% or more say measures such as ease of travel, crowding, stress, and safety are the same as before or better. Seventy-one percent of businesses reported that business has not been hurt.[25]

The London system:[24]

- £8 ($16US) charge in effect from 7:00-6:30pm Mon. – Fri.
- exemptions for certain vehicles such as taxis and emergency responders
- multiple payment options
- enforced by secure license plate snapshots
- penalties range from $100-$300

Singapore: Early leader in congestion pricing

Singapore was one of the first large cities to adopt congestion pricing, starting in 1975 with a flat-rate $3 charge to enter the central business district (CBD) during morning rush hours. Later, this was mirrored with an afternoon rush hour charge for traffic exiting the CBD, a lower midday CBD charge, and a charge for use of the city's outer ring road during certain hours. Singapore established a more sophisticated per-entry charge in 1998 that varied the charges by time of day. A second cordon area focused on a major commercial center adjacent to the CBD was added in 2005.[26]

Singapore highlights:[26]

- 10 mph increase in average speed
- 25% fewer traffic accidents
- 45% reduction in traffic
- use of public transportation increased by almost 20%
- 176,400 fewer pounds of CO2 emitted

Today, toll rates at different locations change over the course of the day, and are raised or lowered every three months to keep roadways operating at the travel speeds producing optimal traffic flow. As a testament to the flexibility of the system, after finding that roads in some locations were not congested on Saturdays, those tolls were eliminated.

Stockholm: Another success story

Stockholm initiated a trial period of cordon pricing for its central city for the first half of 2006. As in London, positive results led to an increase in support. Before the trial, only 31% of residents were in favor of the congestion charge. Two months after the trial, voters passed a referendum to reinstate the charge. A recent poll says 67% of respondents now agree, "It was good that the new government had decided to reintroduce the system."[28] Given its success, the congestion pricing system enjoys broad support from liberal and conservative political groups.

Stockholm highlights:[27]

- Reduced traffic by 15%
- 10-14 percent reduction in CO_2 emission
- May prevent 30 premature deaths by reducing NO_x

Photo: Getty Images

Norway: Pricing for three cities

Norway has put ring road charging systems into practice in several cities, including Oslo (the capital), Bergen, and Trondheim. Their systems yielded traffic reductions of about six to ten percent. Initial revenues tended to be invested in new roads, and Trondheim now also uses the money raised for projects such as bicycle paths and a fleet of free bicycles for public use. Times and charges vary between the cities, as does the size of the ring, but all use electronic transponders with manual payment mechanisms as an alternative. Currently, Oslo is considering a plan for a major expansion of their toll ring system to manage traffic and fund improved public transportation and roads. Leaders of Norway's two major political parties reached agreement some years ago to support the strategy.

Lessons for New York City

In the United States, the idea of using price signals to cut congestion is beginning to catch on. The U.S. Department of Transportation announced a $130 million grant program in early 2007 to help cities cut congestion with tools like pricing. In New York City, the Hudson River crossings have had a higher toll at peak times since 2001. San Francisco is studying congestion pricing for its downtown.

In New York City, the key would be to design a system that: 1) delivers real traffic reduction to all boroughs, especially for communities already burdened with high traffic, congestion and asthma rates; and 2) helps finance much needed mass transit improvements, including new clean-fuel bus service to neighborhoods that don't have good subway access. We can learn from the systems and experiences described above, and apply them to New York's unique circumstances.

The benefits for health at the street level could be large. For example, the Partnership for New York City recently researched how a traffic reduction in Manhattan's CBD below 60th Street would affect traffic in the rest of the city.[29] It chose a traffic reduction of about 15%– comparable to what London achieved through congestion pricing in its own CBD. The modeling predicts that if traffic volumes (number of vehicle trips) to Manhattan's CBD were reduced by just 15%, traffic congestion (or vehicle hours traveled) in the zone would drop about 30% – similar to London's experience. An overall traffic volume reduction would result in decreased congestion and increased travel speeds. We estimate that the ensuing air pollution and climate benefits of such a change could be on a par with the benefits enjoyed by Londoners.

Equally remarkable, though, are the benefits that neighborhoods outside the CBD would likely experience. Because of New York's specific traffic patterns, traffic congestion is estimated to drop 25% or more in Long Island City and downtown Brooklyn, and 18% in the 125th Street corridor in Harlem.

The system would be expected to earn revenue – as much as $500 million or more per year – that could be invested in transit:[30] new clean-fuel express bus lines to neighborhoods poorly served by transit and stalled projects like the Second Avenue Subway. Together, the reduction in traffic volume, the air quality benefits of reducing gridlock and the creation of new transit choices could bring a powerful package of benefits to all New Yorkers.

Clean up engines

Another way to reduce health-damaging exposures to mobile source pollutants is to clean up the emissions of the dirtiest vehicles on the road. There are three basic strategies that work here.

Replace the Dirtiest Fleets – and Spur Transitions to Hybrid and other Alternatives

The first step is to simply replace the oldest and dirtiest vehicles with newer ones that meet or exceed the most advanced federal emissions standards. In New York City today, for example, school buses can stay on the road for up to 18 years. Other states, including New Jersey, have cut that retirement age to 12 years or less, spurring a switch to cleaner engines. For taxi, radio car and other fleets constantly on the road, switching to hybrids and other advanced technologies needs immediate policy support.

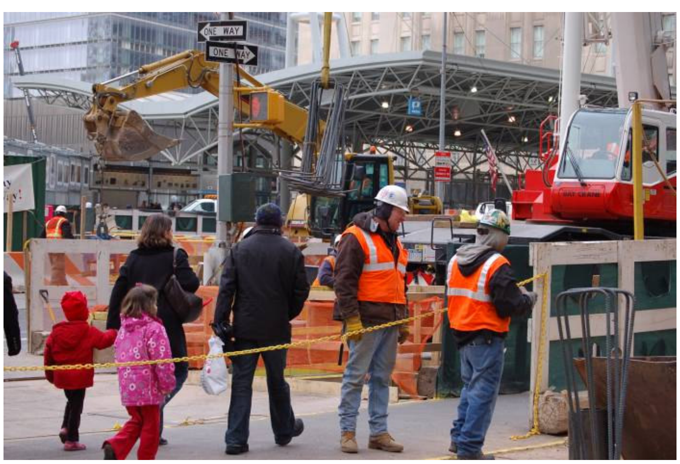


Photo: Mel Peffers

Retrofit Remaining Diesels with Filters

Diesel filter technology has proven very effective at cutting up to 90% of dangerous particulate matter emissions from diesel vehicles.[31,32] On a national basis, every dollar invested in retrofit technology yields $13 in public health benefits.[33] For New York, the value could be even higher since the city's population density is so high. New York City has already passed laws requiring public fleets and machinery used in the execution of public contracts to install best available retrofit technology. Several states have noted these benefits and are investing heavily in diesel clean-up measures.[34] For example, California has committed $140 million a year to this purpose through its Carl Moyer program.

Enforce Anti-Idling

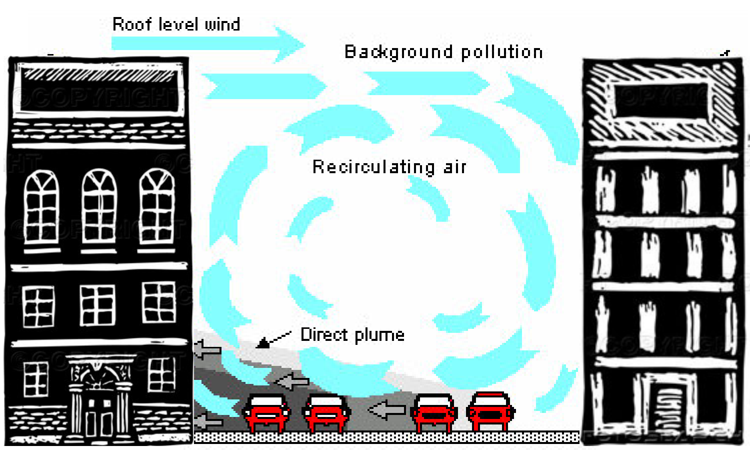
Idling cars and trucks deliver levels of pollution often higher than moving vehicles. New York City already has anti-idling laws, but little is done to enforce them. The solutions exist: tasking city agencies with enforcement; finding ways for the public to report scofflaws; and, where appropriate, using technologies like electrified truck stops so that trucks that need to run on-board systems can do so without idling their diesel engines.

The role of siting and design

The American Academy of Pediatrics wrote in 2004: "Siting of school and childcare facilities should include consideration of proximity to roads with heavy traffic and other sources of air pollution. New schools should be located to avoid 'hot spots' of localized pollution."[35] In some places, government policy reflects this concern. For example, the science of impacts on children's heath motivated the state of California to prohibit the siting of schools within 500 feet of a highway.

Just last year, in one the country's most polluted valleys, the San Joaquin Valley Air Pollution Control District adopted a new incentive system to encourage developers to build in ways that minimize traffic pollution. The "Indirect Source Rule" calls on builders to either "build green" or to pay a per-unit fee that the air district then invests in local clean air measures. The "build green" incentive is focused specifically on reducing emissions, for example with transit-oriented development, safe bike paths and sidewalks.

FIGURE 5
Air patterns in urban canyons



Local variations in geography, meteorology, and building size can affect the exact pattern of air pollution distribution. For example, prevailing air circulation patterns can trap traffic pollution in urban canyons. This pollution can concentrate along city sidewalks where people walk and breathe.
Adapted from the OSPM Model description.[38]

Monitor local pollution: What do people actually breathe?

Current air quality monitors were established largely to understand overall regional air quality.[36] As described by the authors of a Los Angeles heart disease study, "The assessment of air pollution exposure using only community average concentrations likely underestimates the health burden attributable to elevated concentrations in the vicinity of sources. [T]hese effects are diminished when using average concentrations for the entire community."[37] The EPA recommends placing air monitors away from "hot spots" like heavily used roadways: "EPA believes it is not appropriate to specifically require any number of monitors to be placed in microenvironment or hot spot locations."[39]

Local variations in topography, wind patterns, and other physical features like "urban canyons" (see Figure 5) can work to concentrate pollutants, shift risk zones or otherwise alter the precise spatial characteristics of exposure. In big cities, millions of people live, work and play directly in these microenvironments. While there are a growing number of traffic and health studies, few combine actual monitored values with health effects. Improving roadside monitoring systems will allow for better understanding of health effects and show if people near roadways are at levels exceeding standards.

This paper has outlined practical solutions that can achieve these goals. City and local governments now have a unique opportunity to step in and protect their citizens.

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Appendix: Risk zone maps & New York City statistics

Mapping method

This Appendix includes maps of each borough. They were created with GIS (Geographic Information Systems) using spatial data from several sources. The health risk zones were mapped around busy roads using both highway classifications and traffic congestion information. First, U.S. Census Bureau classifications for interstate and state highways, class A10-A25, were mapped. These highways are comparable to those shown to have health impacts in the public health literature. Second, heavily congested streets were added to the maps. Congested streets were determined using New York Metropolitan Transportation Council (NYMTC) information for peak morning and afternoon 4-hour periods.

Using these busy, congested roads, a 500-foot health risk zone was mapped around these corridors. Using data from the U.S. Census Bureau (year 2000 data at the block group level), information was gathered on the number, age and race of people in the zone. Minorities are all non-white racial groups as defined by the Census Bureau. The maps use color densities to show the percentage of people in each zone; the darker the color, the greater the percentage of people in that zone for the mapped population. For example, along the Bronx River Parkway (a risk zone), a very high percentage of people are aged 18 and younger, few are 65 and older.

The maps also include places where sensitive populations may be exposed to traffic pollution, such as public schools, playgrounds, and health facilities. This data came from New York City PLUTO files (2004) and is sourced from the Departments of City Planning (DCP) and Finance. PLUTO identifies the land use of whole parcels according to primary tax lot information. The schools are public elementary, junior high schools and senior high schools. Health facilities include hospitals, sanitariums, mental institutions, infirmaries, health centers, child centers, clinics, nursing homes, and adult care facilities.

As with all GIS mapping, we recognize that there may be limitations in the data sets and classifications. For example, given the way playgrounds are characterized by PLUTO, this category includes only standalone playgrounds, and not those on school grounds or located with other recreational facilities. By using this data set, we avoid "double-counting" playgrounds. There are more playgrounds altogether, both inside and outside the risk zones we described.

Environmental Defense is continuing to refine the understanding of actual exposures in urban areas, especially in New York. Future air studies and GIS mapping runs will incorporate additional data sources to improve understanding of neighborhood-level exposure and health risks.

New York statistics

These maps show the extensive potential health risks for New Yorkers. Table A-1 complements Table 1 in the report, giving the population results in percentages. Table A-2 summarizes the facility information related to where sensitive populations (i.e. children, elderly) might be located along with the land area in the risk zone; Table A-3 represents this information as a percentage, based on the data as presented in the databases described above.

TABLE A-1
Percentage of population living in the traffic pollution risk zone

New York City borough	Total population in risk zone	18 years and younger	65 years and over	Minority
Bronx	16%	16%	18%	16%
Brooklyn	24%	24%	22%	28%
Manhattan	79%	75%	80%	73%
Queens	17%	16%	13%	17%
Staten Island	8%	8%	8%	6%
TOTAL	**31%**	**26%**	**28%**	**29%**

TABLE A-2
Number of facilities and land area in the traffic pollution risk zone

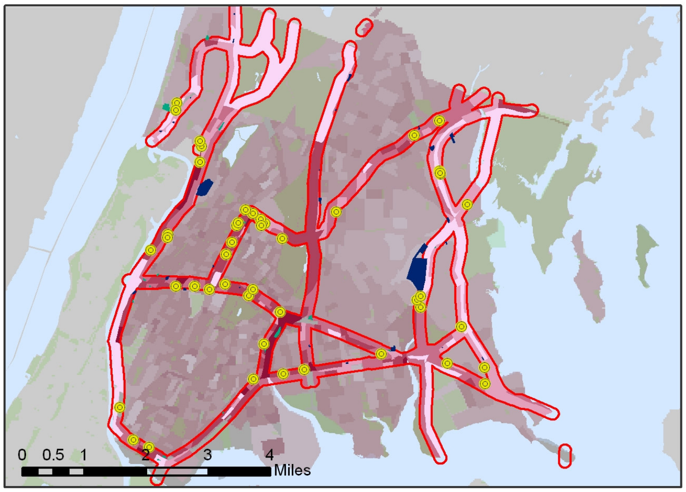
	Health facilities	Public schools	Standalone playgrounds	Land area (sq. mile)
Bronx	32	58	29	9.53
Brooklyn	129	133	59	16.18
Manhattan	147	176	70	17.63
Queens	71	56	25	21.00
Staten Is.	5	5	3	5.63
TOTAL	**384**	**428**	**186**	**69.97**

TABLE A-3
Percentage of facilities and land area in the traffic pollution risk zone

	Health facilities	Public schools	Standalone playgrounds	Land area
Bronx	19%	17%	22%	23%
Brooklyn	36%	26%	38%	22%
Manhattan	84%	73%	82%	77%
Queens	39%	13%	29%	19%
Staten Is.	10%	5%	8%	10%
TOTAL	41%	27%	37%	23%

The Health Risk from Congestion in the Bronx

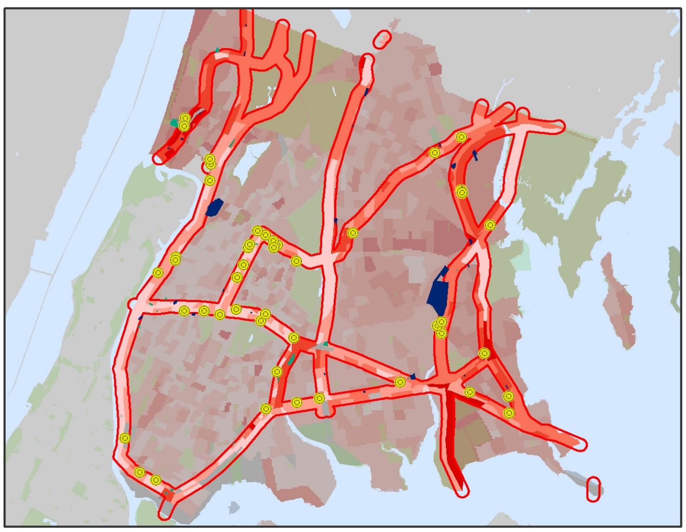
At-risk populations falling within 500 ft of the borough's congested roadways



Youth Population 18 and Under

% of Population 18 and Under

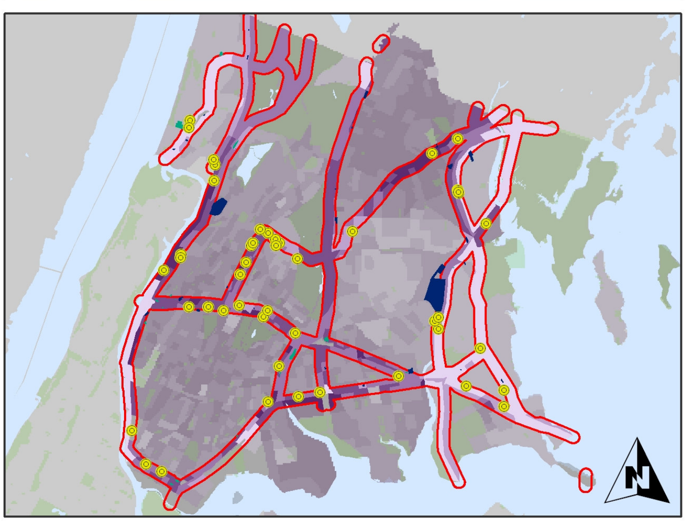
- 0% - 15%
- 16% - 25%
- 26% - 35%
- 36% - 50%
- 51% - 75%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area



Elderly Population 65 and Over

% of Population 65 and Over

- 0% - 5%
- 6% - 10%
- 11% - 20%
- 21% - 30%
- 31% - 75%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area



Minority Population

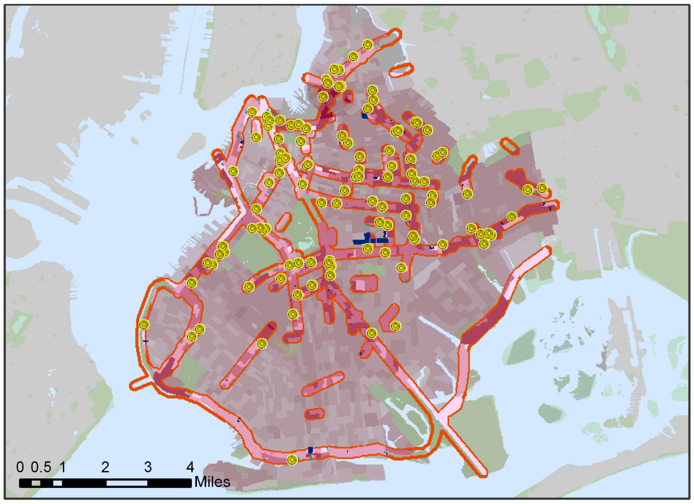
% of Population Considered Minority*

- 0% - 25%
- 26% - 50%
- 51% - 75%
- 76% - 90%
- 91% - 100%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area

Minorites are considered to be all non-white racial groups as defined by the U.S. Census

The Health Risk from Congestion in Brooklyn

At-risk populations falling within 500 ft of the borough's congested roadways



Youth Population 18 and Under

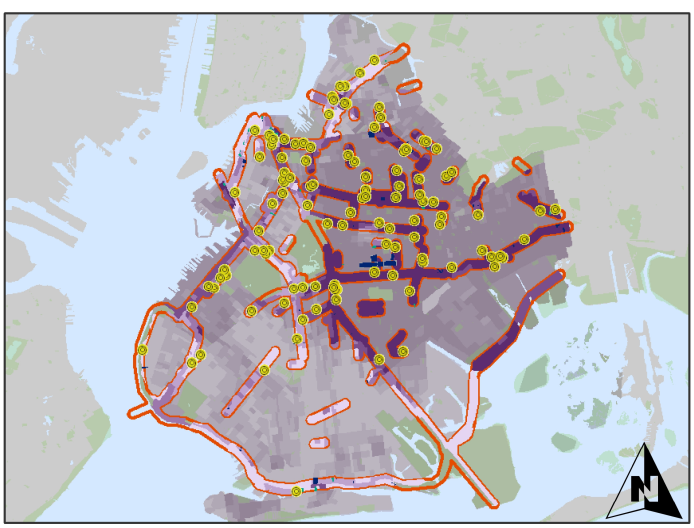
% of Population 18 and Under

- 0% - 10%
- 11% - 20%
- 21% - 30%
- 31% - 50%
- 51% - 100%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area

Elderly Population 65 and Over

% of Population 65 and Over

- 0% - 5%
- 6% - 15%
- 16% - 25%
- 26% - 45%
- 46% - 65%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area



Minority Population

% of Population Considered Minority

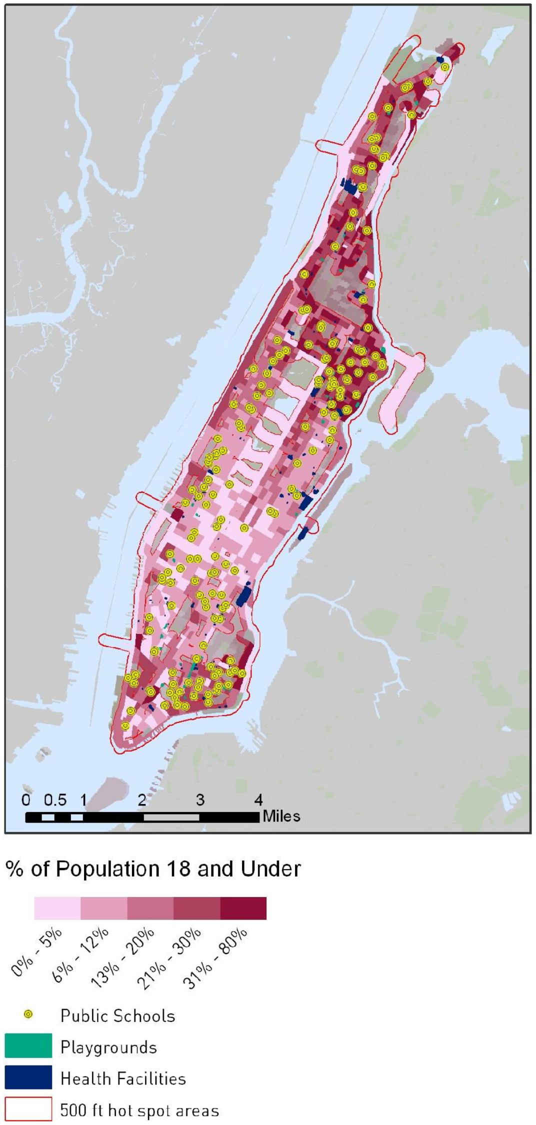
- 0% - 20%
- 21% - 40%
- 41% - 60%
- 61% - 80%
- 81% - 100%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area

Minorities are considered to be all non-white racial groups as defined by the U.S. Census

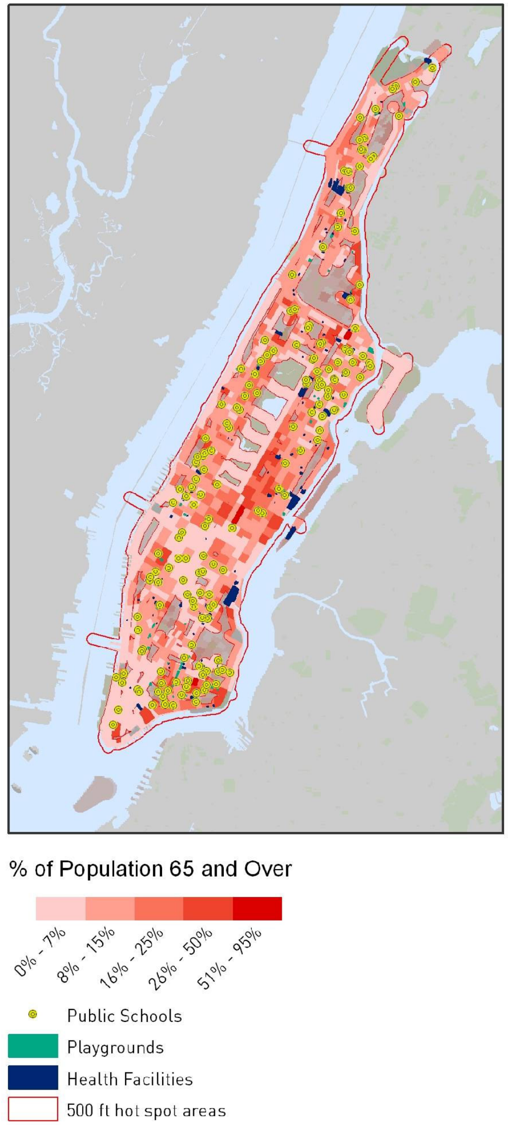
The Health Risk from Congestion in Manhattan

At-risk populations falling within 500 ft of the borough's congested roadways

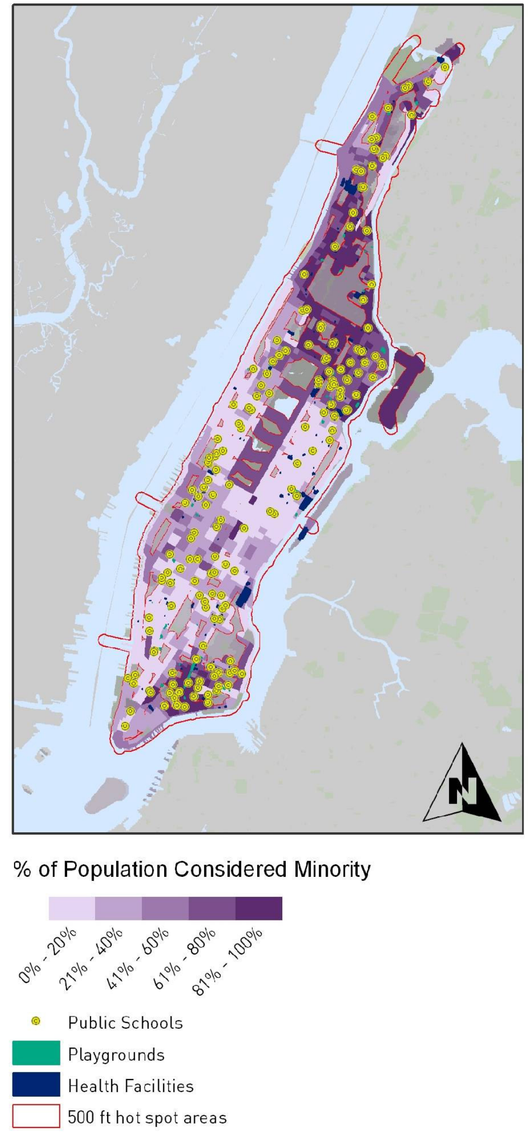
75% of Youth Population (18 & under)



80% of Elderly (65 & over)

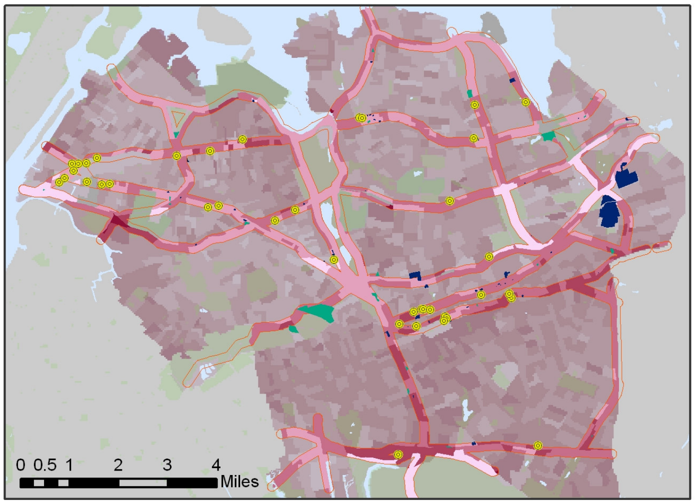


73% of Minorities considered to be all non-white racial groups as defined by the U.S. Census



The Health Risk from Congestion in Queens

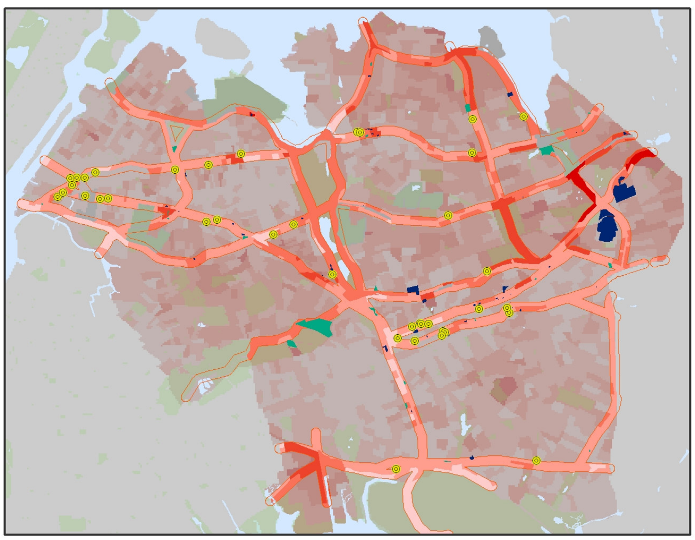
At-risk populations falling within 500 ft of the borough's congested roadways



Youth Population 18 and Under

% of Population 18 and Under

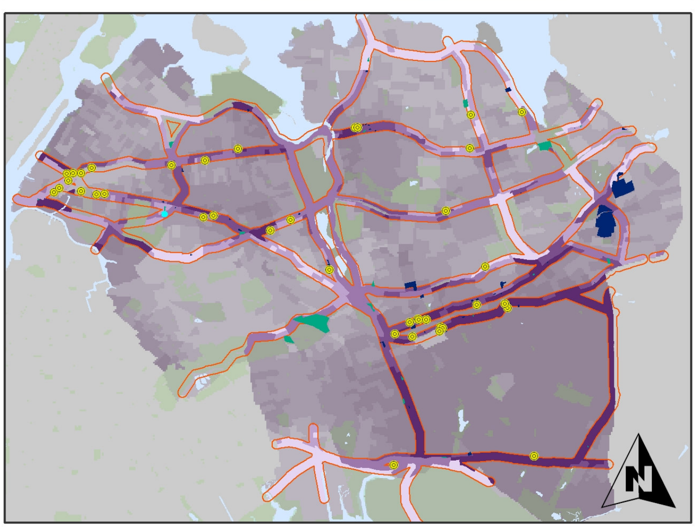
- 0% - 10%
- 11% - 20%
- 21% - 30%
- 31% - 40%
- 41% - 60%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area



Elderly Population 65 and Over

% of Population 65 and Over

- 0% - 5%
- 6% - 15%
- 16% - 25%
- 26% - 50%
- 51% - 100%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area



Minority Population

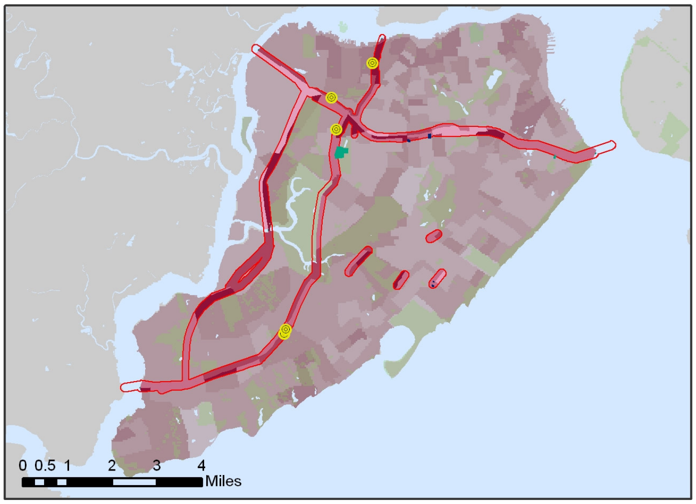
% of Population Considered Minority*

- 0% - 20%
- 21% - 40%
- 41% - 60%
- 61% - 80%
- 81% - 100%
- Public Schools
- PLaygrounds
- Health Facilities
- 500 ft hot spot area

Minorites are considered to be all non-white racial groups as defined by the U.S. Census

The Health Risk from Congestion in Staten Island

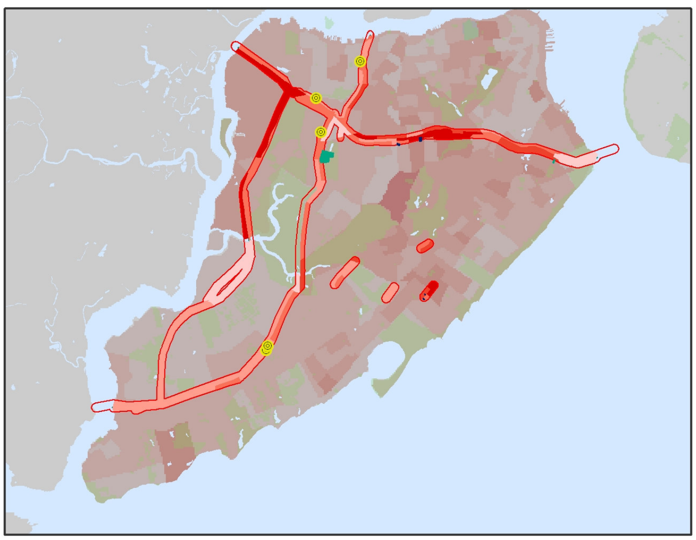
At-risk populations falling within 500 ft of the borough's congested roadways



Youth Population 18 and Under

% of Population 18 and Under

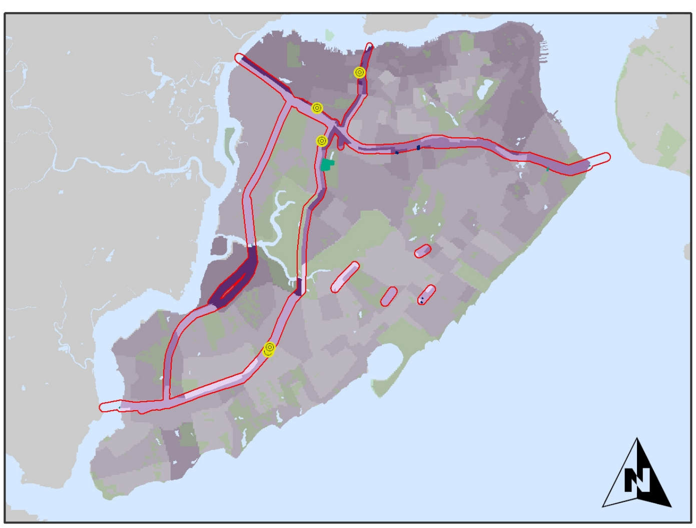
- 0%
- 1% - 20%
- 21% - 25%
- 26% - 30%
- 31% - 37%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area



Elderly Population 65 and Over

% of Population 65 and Over

- 0% - 5%
- 6% - 10%
- 11% - 15%
- 16% - 20%
- 21% - 32%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area



Minority Population

% of Population Considered Minority

- 0% - 5%
- 6% - 15%
- 16% - 30%
- 31% - 50%
- 51% - 100%
- Public Schools
- Playgrounds
- Health Facilities
- 500 ft hot spot area

Minorites are considered to be all non-white racial groups as defined by the U.S. Census