# Noise Barriers in Somerville

## A Health Lens Analysis

# Thank you to all the participants who contributed to this project!

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# Project Description

## Introduction to Somerville and the 1-93 Corridor

The City of Somerville is an inner core community abutting Boston to the northwest. At 4.1 square miles in size and a population of over 75,000, Somerville is the most densely populated city in New England.[1] In addition to the local transit hub of Davis Square subway and bus station, Somerville is host to multiple regional transportation connectors, both highways and commuter rails, which connect people across the region to Boston and the other inner core communities. Interstate 93 (I-93), bisecting the northeastern portion of the city, is one such regional transportation connection.

The section of I-93 that runs through Somerville was completed in 1973. Its construction led to the demolition of an existing neighborhood and business district and brought decreased property values and high levels of traffic. [2, 3] Today, the Somerville section of I-93 carries four lanes of northbound and southbound traffic. Over 200,000 vehicles travel through Somerville per day, largely in service of people living outside of the City on their way to Boston or Cambridge. [4] With this traffic comes high levels of noise and air pollution, to which nearby residents are exposed.

The neighborhoods adjacent to I-93 are some of the most densely populated areas in Somerville, particularly along Mystic Ave in Winter Hill. In addition to accommodating many residents, the I-93 corridor is home to several outdoor recreation attractions, Foss Park and the Blessing of the Bay Boathouse among them. In general, residents of the neighborhoods near I-93 are more racially and ethnically diverse than Somerville as a whole, have a larger proportion of youths, are less affluent and less educated, and include a higher proportion of non-English speakers.



*Figure 1 Map of Interstate 93 in Somerville and Nearby Neighborhoods*

## Project Overview

In the 1970s the state agreed, in response to protests and evidence of I-93's impacts, to erect noise barriers along the highway in Somerville to partially reduce noise and air pollution for people living near the interstate. However, these promised mitigations never materialized.

In 2017, CAFEH (the Community Assessment of Freeway Exposure and Health Study), a collaboration of The Somerville Transportation Equity Partnership (STEP), Tufts University, and The Welcome Project, partnered with the Metropolitan Area Planning Council (MAPC) to conduct a Health Lens Analysis (HLA). Given the history of Somerville's stretch of I-93 and the community's continued interest in noise barriers as a mitigation measure, we proposed that the HLA assess:

1) How the health and wellbeing of residents is currently being impacted by the proximity of the highway;

2) How effective noise barriers would be at mitigating identified impacts;

The community-driven HLA culminated in a participatory design charrette to generate evidence-based design recommendations for the near-highway neighborhoods. Throughout the process, we sought to increase awareness of near roadway air pollution and noise exposure, as well as how the quality of the public realm impacts residents.

## State and Federal Noise Barrier Programs

The Massachusetts Department of Transportation (MassDOT) considers the installation of noise barriers only to provide mitigation of highway traffic noise. MassDOT considers installation of noise barriers for highways that meet one of the following standards:

1) New highway construction or substantial alteration in situations where noise exceeds a threshold standard (Type I Projects)

2) Existing Interstate highways where noise exceeds a threshold standard (Type II Projects)

MassDOT's Noise Abatement Program for both Type I and II projects uses Federal Highway funds for the mitigation of highway traffic noise. The Federal Highway Administration (FHWA) is the federal agency responsible for administering the program. Therefore, compliance with FHWA regulations is a prerequisite for the granting of federal funds for construction or reconstruction projects. The FHWA regulations are explained in greater detail in the Noise Monitoring Report, found on the CAFEH Website.

MassDOT limits its Type II Noise Abatement Program to locations that are on its Type II Noise Barrier Priority List. This list originates from a 1988 statewide noise study which designated areas most adversely affected by highway traffic noise. The current Type II Noise Barrier Priority List includes 53 locations and 17 additional locations from the former Massachusetts Turnpike Authority.

**As an existing interstate highway, I-93 in Somerville does not currently meet the criteria for a Type I project nor is it on the Type II Noise Barrier Priority List. Mass DOT does not recognize air pollution as a valid basis for sound walls.**

# Health Lens Analysis

## Introduction to Health Lens Analysis

An HLA is an assessment of a potential policy or project based on its implications for health. The approach for conducting an HLA is both methodical and iterative, and seeks to answer the general question, "How and to what extent do we anticipate a proposed project will positively and negatively impact health?" With a better understanding of health implications, the objective of an HLA is to inform the drafting of policy and to recommend implementation strategies.

The HLA approach is informed by an understanding of health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."[5] Under this definition, health is the result of a range of factors. Genetics, individual behavior, health care access and quality all influence health, yet evidence suggests that the social, economic, and physical environment of communities can have a far greater effect on how long and how well people live. [6] Conditions like unaffordable or unsafe housing, a lack of green open spaces or exposure to high roadway traffic are examples that adversely affect health outcomes. As low-income communities and people of color experience these conditions more frequently, these populations may disproportionately experience negative health outcomes.

## The Health Lens Analysis Framework

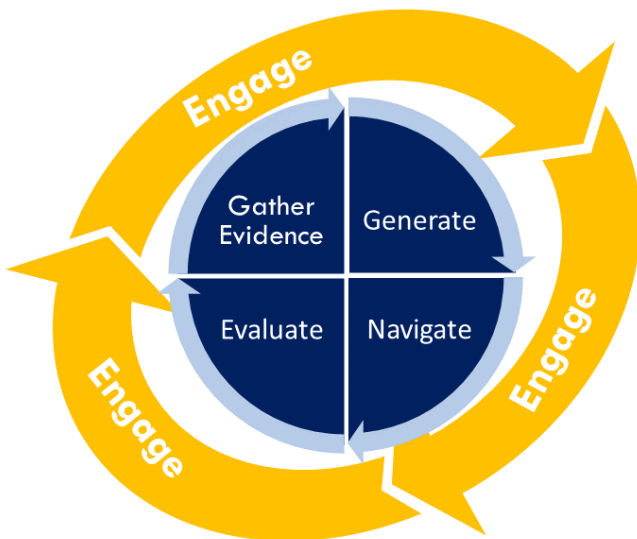The HLA framework includes five stages as follows:[7]



*Figure 2 the Health Lens Analysis Framework*

1. Engage: establish and strengthen collaborative relationships with relevant stakeholders, including agencies, community members, and others.

2. Gather Evidence: use qualitative and quantitative evidence to identify connections between public health targets and policy goals.

3. Generate: develop evidence-based policy recommendations and reports.

4. Navigate: guide the recommendations through the decision-making process

5. Evaluate: assess the effectiveness of the HLA. Evaluate the HLA process itself, determine whether the HLA recommendations were adopted into the final policy, and measure the health outcomes and impacts of the policy.

These stages are iterative; that is, once new information is gained during the HLA process, previous stages can be revisited and refined to improve policy development. To the extent possible, this HLA includes the stages typical of HLAs.

# Engagement

Installation of noise barriers along I-93 in Somerville was initially proposed by Somerville community representatives on the CAFEH project team as the focus of this HLA. Somerville residents of the highway-adjacent neighborhoods have a history of protesting construction of I-93, strong evidence of the negative impacts of the highway on their health and well-being, and a long sustained interested in advocating for mitigation measures.

In November 2017, we hosted a discussion at Tufts University for key stakeholders to propose a project on the installation of noise barriers along I-93 and to establish a collaborative relationship. State representatives, senators, City of Somerville Ward Aldermen, and community leaders were among those who attended. Among these stakeholders, there was consensus that there was concern about noise and air pollution exposure in Somerville and agreement to collaborate on an HLA with noise barriers as its focus. However, stakeholders indicated that they did not want to have "tunnel vision" when it came to recommendations coming out of the process; asking that alternatives to traditional, physical barriers be considered as well.

Over the next year (December 2017 to November 2018), we led a community outreach effort focused on the States Avenues section of East Somerville and the Mystic Avenue neighborhood in Winter Hill. Particular effort was made to engage new immigrants, who are more vulnerable to neighborhood change and might have trouble dealing with health issues due to barriers like accessing transportation or language differences, and youth, who have greater risk of harm from environmental exposures. The Welcome Project's Liaison Interpreter Program of Somerville (LIPS), bilingual high school students who are trained interpreters, participated in and were available at all community events associated with the HLA process.
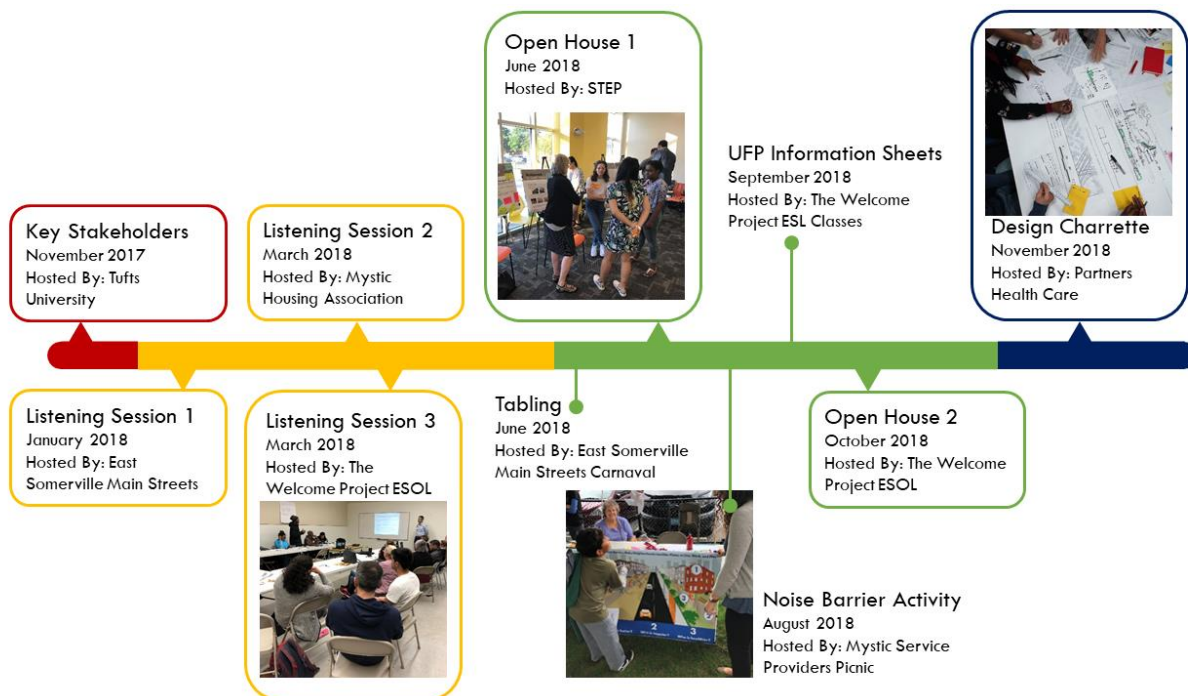


*Figure 3 Timeline of HLA Community Engagement*

Three listening sessions were held to identify potential linkages between installation of noise barriers along I-93 and health outcomes, vulnerable populations, and available data sources. While a wide range of health concerns related to noise barrier installation were discussed during these sessions, air quality, noise, and quality of the public realm in the near-highway neighborhoods surfaced as a priority concerns for participants.

Two open houses were held to present the evidence gathered from the noise monitoring campaign and ten years of CAFEH's academic research on the effects of ultrafine particulates (UFP) on the health of near-highway residents in Somerville; provide indicators of social and physical environment quality; and offer a synthesis of the literature on noise barriers. During these meetings, we collected questions and concerns regarding noise barrier installation from the community. Display boards from these meetings can be found at on the [CAFEH Website](#).

Our team members also participated in various Somerville community events and attended The Welcome Project's adult English language learner's class. We shared information about past research on UFP along the I-93 corridor and raised awareness about the HLA project at each event.

The HLA project culminated in a community participatory design charrette (an intensive, hands-on planning session) held at Partners HealthCare in Somerville. This day-long event brought together community residents, local government, environmental scientists, public health experts, building and landscape architects, planners and urban designers to develop evidence-based approaches to reduce residential exposure to highway air pollution and noise and to improve the public realm The findings of this community event are the basis of our recommendations. A full report can be found on the [CAFEH Website](#).

# Evidence - Social Determinants

Social determinants of health are conditions of the environments in which people are born, live, learn, work, and age.[8] Demographic, social and economic factors, such as income, race and education, are among the most important social determinants of health.[9] The availability of resources (such as quality education and job opportunities) and the conditions of the social environment (such as concentrated poverty) can have a significant influence on population health outcomes.

Poor health outcomes can be made worse by the interaction between individuals and their social environment. For example, exposure to social stressors (such as racial discrimination or poverty) can increase inflammation, which may increase an individual's vulnerability to environmental exposures such as air and noise pollution.

Social determinants are in part responsible for the unequal and avoidable differences in health status within and between communities. Systemic policies, practices and economic and political structures which disadvantage racial and ethnic groups interact to generate and reinforce health inequities.

From the perspective of social determinants, the near I-93 neighborhoods (Figure 1) are at risk of being unhealthy communities. We found that the near-highway neighborhoods had a larger proportion of people of color, households in poverty, residents who were foreign born, and children than Somerville as a whole. (Figure 4). Accordingly, most of the areas near I-93 in Somerville are considered Environmental Justice areas.

## Vulnerable Populations

As part of our engagement process, we asked residents to identify groups of people who may be harmed more than others by current conditions. Understanding the presence of these populations in the near-roadway neighborhoods gives us an added measure of vulnerability to traffic-related health impacts. It also informed our assessment of noise barriers and development of possible recommendations.

*Evidence from Somerville*

Certain life stages are more susceptible, including children, pregnant women, and older adults. Somerville, with the largest population of residents between 25 and 34 years of age per capita in the country, is a young city.[10] However, fewer (1 in 10) residents are children (under 18 years of age).[11] This is not the case in the near-highway
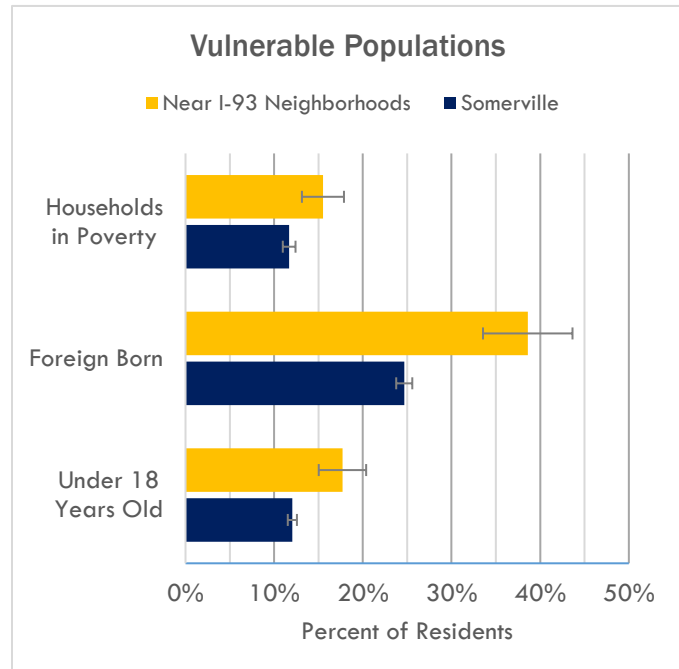


*Figure 4 Vulnerable Populations in Somerville and Near-I-93 Neighborhoods, Source: U.S. Census Bureau; American Community Survey (ACS), 5-Year estimates, 2012-2016*

neighborhoods, where 1 in 5 residents are children. The proportion of older adult residents (over 65 years old) is similar to citywide rates. We were unable to collect data on pregnancy.

Groups marginalized by race/ethnicity, and/or English proficiency are vulnerable due to systemic barriers to economic opportunities, housing, education, health care access, and more. The diversity of Somerville is seen in its population of 4,931 public school students, where 53 languages are spoken. The neighborhoods next to I-93 are some of the most racially and ethnically diverse areas of the City. [10] Of the area near I-93, half of the residents are People of Color, compared to the city average of 3 in 10. [11] A much larger percent of residents in these neighborhoods were foreign born. Happily, very few residents are linguistically isolated (less than 3%).

Groups marginalized by socioeconomic status can also be vulnerable to systemic barriers to amenities and services. Unemployment across Somerville is low (less than 3% of labor force), yet there are residents who have jobs but still earn low-incomes. Disproportionately, these residents live in the Winter Hill, Ten Hills, and East Somerville neighborhoods.[12] This can be seen in Figure 5, where there is a significantly smaller proportion of near I-93 residents who have a household income over $150,000 and a significantly greater proportion who have incomes under $15,000, as compared to the City as a whole.
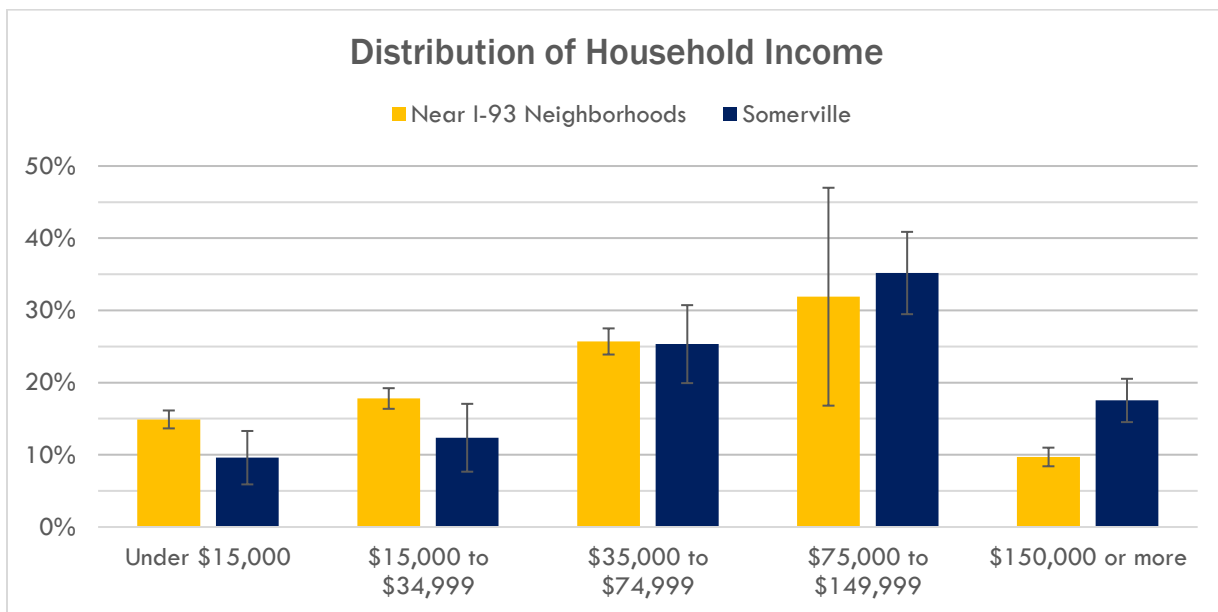


*Figure 5 Distribution of Household Income, Source: U.S. Census Bureau; American Community Survey (ACS), 5-Year estimates, 2012-2016*

Those with existing health conditions, such as persons having an acute or chronic respiratory or cardiovascular illness, are especially vulnerable due to the detrimental effects of environmental pollutants. Citywide, the near-highway neighborhoods have some of the highest prevalence of current asthma (11%, 95% CI [10.5, 11.8]), high blood pressure (26.1%, 95% CI [25.3, 27]), COPD (5.5%, 95% CI [4.9, 6.2]), coronary heart disease (4.5%, 95% CI [4.2, 4.9]), stroke (2.5%, 95% CI [2.2, 2.7]), and diabetes (8.2%, 95% CI [7.7, 8.7]).[13]

# Evidence - Physical Determinants

Resident health is influenced by the physical characteristics of the neighborhoods in which they are born, live, learn, work, and age. Known as the physical determinants of health, these factors include:

- Exposure to pollutants and other toxins or physical hazards;
- Natural environment, such as plants, weather, or climate change;
- Housing and homes;
- Transportation options and physical barriers; and
- Aesthetic elements, such as good lighting, trees, or well-maintained parks.[8]

Session participants and key stakeholders stated repeatedly that exposure to near-roadway air and noise pollutions were top concerns. Our discussions also raised related concerns around the role of housing quality in resident exposure to pollution.

Outside of air and noise pollution, the physical determinant participants were most interested in was aesthetics, specifically the appearance of the barriers and how their installation could improve the quality of the public realm. There was an overall interest in increasing vegetation in the near-highway communities, whether through vegetated barriers or increased plantings in the near-highway neighborhoods.

## Near-Roadway Air and Noise Pollution

- Meeting participants were very concerned about air and noise pollution.

- While all air includes air pollution, people who live, work or go to school near busy roadways (20,000 or more vehicles per day) face increased exposure. Air pollution is often elevated near busy roadways, especially within the first 100-300 meters. This elevated air pollution near busy roadways is called traffic-related air pollution, or TRAP. TRAP is made up of the particles and gases produced by cars, trucks, and other vehicles.

- Of the particles and gases in near roadway air pollution, there is evidence suggesting that UFP are a primary concern. UFP are so small they easily get into people's lungs, blood and brain. UFP have also been the focus of sophisticated health research in the near highway neighborhoods of Somerville.

- Sound and noise are not the same thing. Sound is a physical measure of pressure in air produced by a source; the unit of measurement for sound is the decibel. Noise is an unwanted or disturbing sound.[14] Sound becomes unwanted (i.e. noise) when it either interferes with normal activities, such as sleeping, or diminishes one's quality of life.[14]

- There is evidence linking both UFP and extended exposure to very high noise to increased risk for diseases caused by inflammation. While inflammation in the case of an infection is beneficial, long-term low-grade inflammation can increase your risk for heart disease, respiratory disease, and neurological health conditions. People living in Somerville with higher exposure to UFP tend to have higher levels of inflammation in their blood vessels.[15] Noise annoyance increases the risk for chronic stress and night-time noise exposure can disturb sleep, leading to the body's inability to regulate blood pressure.[16]

♦ Discussions of noise and air pollution also raised concerns about the role of housing quality in resident exposure. Older housing usually does not have mechanical ventilation that can filter out air pollution so it allows outdoor pollutants to accumulate indoors. Nearly two thirds of the housing in the study area was built before 1940.[11]

### *Evidence from Somerville*

While larger particles in air pollution tend to be spread over large geographic areas, UFP concentrations are usually elevated locally near pollution sources, such as traffic. The CAFEH study has been doing research on UFP in the Somerville neighborhoods bordering I-93 since 2008. [1] This research found that, on average, UFP concentrations increase the closer you are to the interstate and that the residents who live in these neighborhoods are being exposed to more UFP than those in other parts of Somerville. Air quality monitoring in the near highway neighborhoods showed that UFP concentraions are higher during colder weather (winter especially), on the downwind side of I- 93, when wind speed was low (calm air conditions), and during rush hours. CAFEH's predictive model of UFP in Somerville shows that average UFP levels across the Winter Hill, East Somerville, and Ten Hills neighborhoods are higher than other parts of Somerville and that estimated levels are particularly high adjacent to I-93 and along Broadway.

A noise monitoring study conducted for this HLA found that noise was also elevated near I-93.[2] Automobile travel creates noise from engines, wheel contact with pavement, wind, horns and sirens. Because noise diminishes with distance from its source, the most serious transportation noise problems are generally experienced next to major transportation corridors. We found that, with a single exception, sound levels exceeded both government residential and health-based sound thresholds at all sites monitored in the near I-93 neighborhoods.

High traffic on local highways, such as Mystic Avenue, contributed to the high noise levels. Locations monitored along Mystic Ave in Somerville were dually impacted from



*Figure 6 Plots of data from a mobile monitoring trips near I-93 in Somerville. Darker red indicates higher concentrations of UFP. Source: Durant, 2010; Padró-Martínez, 2012*

roadway noise along Mystic Ave and highway noise from I-93. At several sites, the sound level meters captured the increased intensity of both local roadway noise and highway noise at the higher meter elevations. Meaning that noise levels were highest on the third floor and higher on the second floor than the first.

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[1] A summary of the extensive research on air quality and health the CAFEH study has conducted in the Somerville neighborhoods bordering Interstate-93 can be found on the CAFEH Website.

[2] To describe current noise conditions, a field team of Tufts-affiliated engineers and public health scientists conducted a noise monitoring campaign during the summer of 2018 in the Somerville neighborhoods along the I-93 corridor. The details of this effort and the findings can be found on the CAFEH Website.

CAFEH researchers conducted a preliminary risk assessment for the population living within a quarter mile of the highway in Somerville. The researchers applied risk estimates from eight high quality studies to the population living near the highway in Somerville. They used separate risk estimates for children under 10 years of age and adults. From this they estimated the number of deaths or new cases of eight diseases. The table below provides estimates of each health outcome over 5 years due to near roadway exposures for the Somerville population:

| Condition | Expected cases over 5 years *(error estimates)* |
|---|---|
| Coronary heart disease (CHD) | 22 (0-52) |
| Death from CHD | 44 (17-78) |
| Ischemic stroke | 32 (1 to 78) |
| Death post-stroke | 5 (0 to 11) |
| Type 2 diabetes | 1 (7 to 256) |
| Lung cancer | 16 (2 to 36) |
| Childhood asthma | 52 (3 to 138) |
| Childhood autism | 4 (0 to 11) |

The main estimate is a best guess of the risk while the range takes into consideration at least part of the error in the estimate. For example, we estimate that there will be 44 deaths from coronary heart disease due to near highway exposure, with a range of as low as 17 and as high as 78 cases. All epidemiology of exposures and health has error associated with it. In fact, it is likely that the real error is larger than reported here since the studies were conducted in populations that differ from the population near the highway in Somerville. Regardless, the estimates are consistent with large numbers of serious health outcomes in both adults and children due to near highway exposures. A detailed exposure estimate table can be found on CAFEH Website.

## Quality of the Public Realm

♦ We found that there was a lot of interest in the aesthetics of proposed barriers and the opportunity presented by their installation to improve the quality of the public realm.

♦ Although participants felt that a noise barrier, as a visual reminder that the highway was being buffered, may improve residents' sense of well-being, there was also concern that an unadorned barrier could be harsher to look at than the roadway. Critical to ensuring that noise barriers enhance rather than hurt the quality of the public realm, is community participation, connection, and feelings of ownership of the installation.[17]

♦ There was a clear preference for incorporating vegetation into noise barrier design and overall general interest in increasing greenery in the near-highway communities. Meeting participants also expressed interest in public art or murals as part of noise barrier installation.

♦ Participants noted that vegetation was "calming and soothing." There is research evidence that exposure to green spaces are good for human health. Exposure and access to natural

environments have been associated with improved health outcomes like lower mortality rates, more physical activity, healthy birth weights and decreased symptoms of mental well-being and reduced stress depression.[18] Views of outdoor vegetation have been reported to reduce self-reported noise annoyance.[19]

♦ Feelings of ownership of neighborhood streets and outdoor spaces is associated with improved perceptions of safety and security. Residents who feel safer are more likely to meet daily physical activity recommendations.[20]

♦ One concern in conversations with residents was that investments in the public realm could lead to gentrification. While there is no consensus on the impact of noise barriers on housing prices, green open space has been shown increase property values.[21] Should the area experience gentrification, low-income homeowners and low-to-moderate income renters are most susceptible to displacement.[22] [23] Lower-income populations were identified earlier in this report as being disproportionately represented in the study area. Meeting participants also expressed concern about certain populations, such as new immigrants or the elderly, being more vulnerable to gentrification than others.

### Evidence from Somerville

There is an identified need for open space across Somerville.[24] There are roughly 158 acres of publicly-accessible open spaces within Somerville, about 6% of the City's land.[10] This translates to about 2 acres of open space for every 1,000 Somerville residents; Boston has 7.6 acres per 1,000 residents.[25] While these findings show that residents across the City deserve additional high-quality open space, it is especially critical for the neighborhoods near I-93.

The neighborhoods near I-93 do have some notable open spaces with greenery. These include the Foss, Chuckie Harris, Blessing of the Bay, Sylvester Baxter, and Draw 7 parks and two privately-run community gardens.[26] [27] Residents spoke positively of the Mystic River and associated parks, specifically the Blessing of the Bay boathouse and the recently improved Chuckie Harris Park. It is important that installation of noise barriers not reduce access to these amenities.

Despite some green spaces, meeting participants spoke to an overall lack of street trees and the limited number of green spaces. A 2017 report found that the Mystic River edge has good tree cover, Mystic Ave along I-93 has some volunteer shrubs and trees, and there is a consistent planting of young trees in the Mystic Apartments. Even so, there was overall a lack of significant vegetation in the near highway neighborhoods.[28]

Beyond the absence of greenery, residents did not like the sight and smells related to the interstate corridor. This created a pedestrian environment that was described as a barrier to accessing the Mystic River and nearby MBTA stations. The walking pathways underneath the I-93 viaduct were seen as particularly problematic; participants described them as "dirty" and "dark." These experiences may cause stress and discourage people from using the limited open and green space that is nearby.

Meeting participants also gave serious consideration to the lifespan and maintenance of noise barriers; especially if they involve greenery or art.

# Evidence - Noise Barriers

Traditional noise barriers are made out of concrete and range in height from 12 to 18ft. More modern materials, vegetation, and art can be used to improve barriers' appearance and performance. **There is considerable evidence that noise barriers reduce both near-roadway air and noise exposures.**

Noise barriers can reduce noise when they are tall enough to break the line of sight from the highway. The reduction of environmental noise from barriers is easily noticeable. However, geographic conditions may limit barrier installation and efficacy.

Noise barriers can also reduce air pollution. In general, the higher the barrier, the higher the reduction in air pollution downwind of the highway (the direction the wind is blowing). Yet, when wind is not perpendicular to the highway, pollutants can build up at the edges of noise barriers. Wind also increases on-road pollution and, at breaks in the barrier (for cross streets), will lead to elevated pollution levels at the gaps.

To ensure that noise barriers improve the perceived quality of the public realm, it is critical that the community be involved in design considerations so that they are satisfied with the aesthetics, safety and environmental enhancements of the barrier. Good maintenance is essential to sustaining positive perceptions.



*Figure 7 Particle Dispersion and Noise Barriers. Source: Hagler et al, 2011*

Research and outreach consistently found that participants in our process prefer the esthetics of barriers that include vegetation; [17, 29, 30, 31] it has been found that residents who find noise barriers attractive report less noise annoyance.[30] Additionally, combining noise barriers with dense vegetation was shown to significantly enhance subjects' perception of noise barrier performance.[30,31]

While exposure to vegetation can lead to both improved health outcomes and gentrification, there is not yet evidence that the scale and type of green space provided by a noise barrier is sufficient to catalyze either of these changes.

In certain conditions, plant barriers can reduce noise and air pollution itself. However, to reduce noise and air pollution with plants alone, plant barriers must be 35+ feet thick, 16+ feet high, with no gaps in foliage and evergreen, and not subject to change by season.[32] These conditions would be difficult to design and maintain in the context of near highway neighborhoods in Somerville. In combination, however, plants and solid noise barriers may reduce more air pollution than either barrier alone.[33]
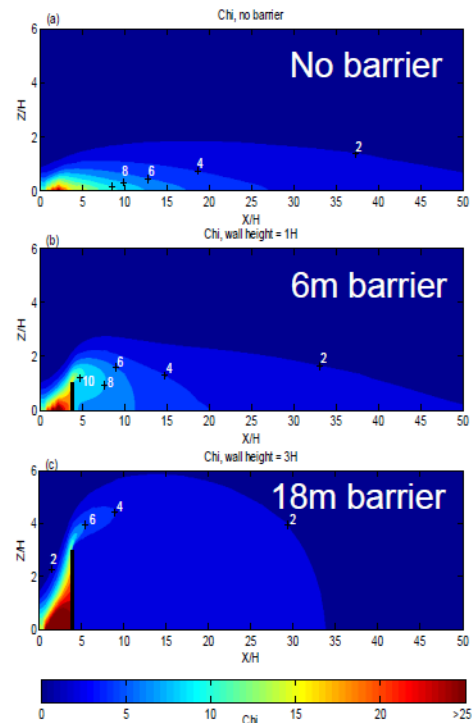
Vegetated noise barriers may also contribute to efforts by the city to increase greenery. The City set a goal of adding 125 additional open space acres by 2030, a difficult benchmark for a city with limited undeveloped land.  The installation of green noise barriers along I-93 would increase green space and vegetation in some of Somerville's densest residential and highest-need neighborhoods.

## Pathways to Health

Based on the evidence from the literature, we anticipate that noise barriers would reduce exposure to air and noise pollution and, with community engagement and consideration of aesthetics, improve the quality of the public realm.

We illustrated the predicted changes associated with the installation of noise barriers (Figure 8). Thus, with installation of noise barriers we would expect that near-highway residents would be at a reduced risk for heart disease, neurological conditions, respiratory disease, poor mental health, and cognitive decline.
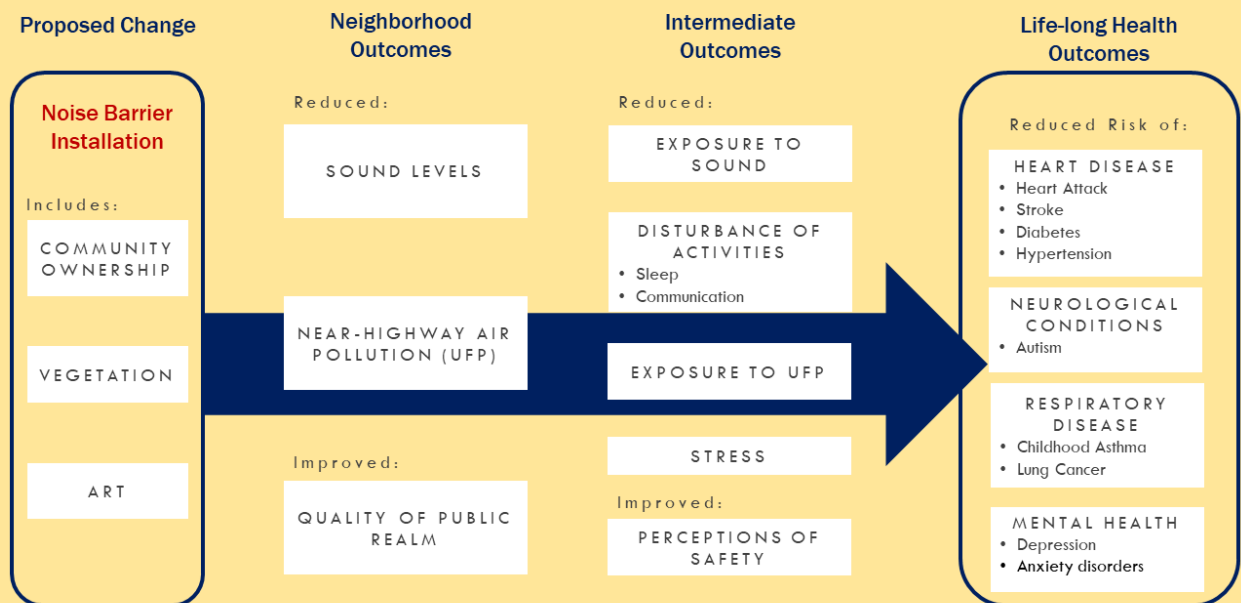
*Figure 8 Pathway diagram of the effect of noise barrier installation on health*

# Generate

We conclude that there is substantial evidence for benefits from building noise barriers along I-93.

Yet, MassDOT only considers new noise barrier installation when: 1) there is an active expansion or widening project for the highway, or 2) for locations that were included on the 1988 Noise Barrier Priority List.

Since the current regulatory process is not considering I-93 in Somerville for noise barriers, we engaged architects, urban designers and planners, environmental health scientists, and other stakeholders in a participatory design charrette to generate initial ideas and recommendations for the site. Because siting constraints and environmental conditions do not make all locations along I-93 equally strong candidates for hosting noise barriers, charrette participants were encouraged to include recommendations beyond walls alone. A full report from the charrette can be found on the CAFEH Website.
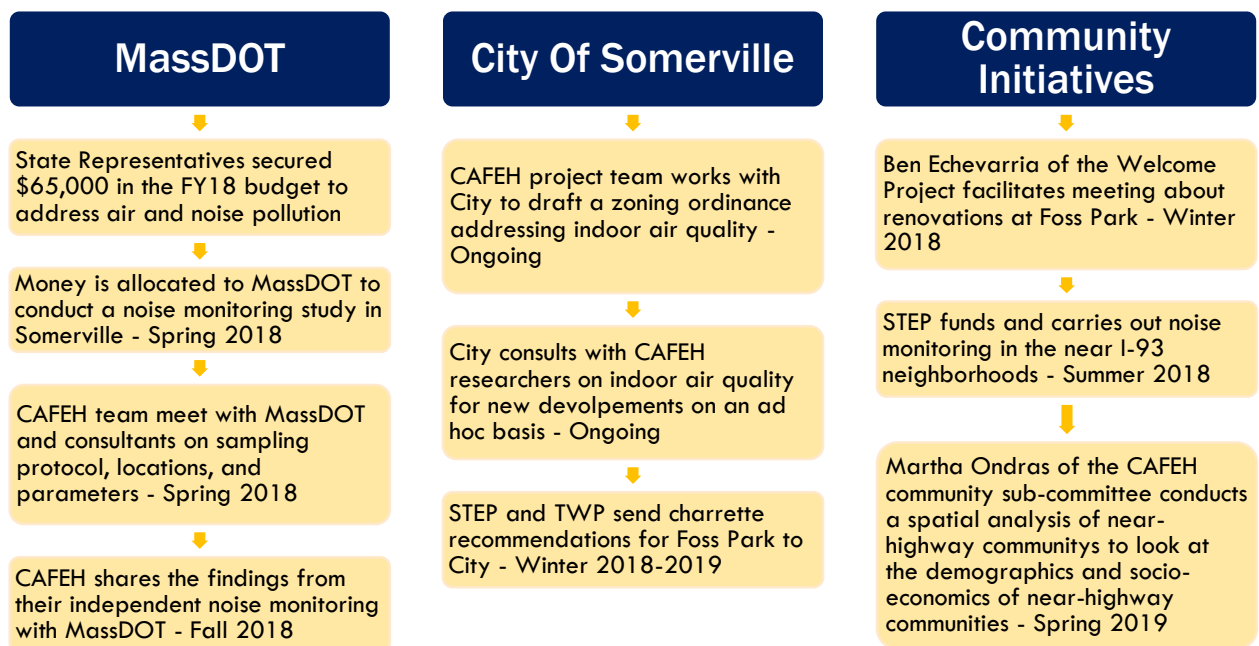
## Final Recommendations

♦ **Mystic Ave:** a noise barrier may not be suitable for this neighborhood because there are many street openings along the highway that would let noise and air pollution into the neighborhood. Therefore, remediation for protective measures may need to be at the building level. Proposed solutions included vegetated double façades for Mystic Apartments, weatherizing buildings, improved mechanical ventilation with HEPA filtration, and enhanced green buffers for public open spaces

♦ **States Avenue:** a tall noise barrier along the I-93 ramp near the States avenues area of East Somerville would substantially reduce resident exposure to noise and air pollution. However, because some of the homes are extremely close to the proposed intervention, noise barrier design should address aesthetics and views carefully. Proposed solutions included a 15 to 20-foot clear noise barrier with anti-bird strike patterns and green plantings.

♦ **Ten Hills:** A short noise barrier along the Mystic River Path, leading from the boat house along the river, would reduce exposure for those using the trail and the Boathouse. A taller, 15ft + wall, would be need further east for the residential neighborhood as the residences are elevated relative to the highway. The walking pathways underneath the I-93 viaduct in this neighborhood were also identified as problematic. Proposed solutions include glass barriers and improvements to the underpass area.

♦ **Foss Park:** Impacted on two sides by McGrath Highway and I-93, Foss Park would require protections along both edges. Proposed solutions included constructing a multi-purpose sports building or a large vegetated berm as a barrier along the Northeast edge and murals or climbing walls along the McGrath edge.

# Navigate

As the current MassDOT plans for noise barrier installation do not include I-93 in Somerville, this HLA was not intended to influence an on-going decision. Rather, the project was meant to raise awareness of noise barriers as a possible solution and to gather evidence which could influence policy discussions. To this end, the final recommendations, the noise monitoring report, and the HLA write-up will be disseminated to key stakeholders, including state representatives, state senators, City of Somerville Ward Aldermen, and community leaders – the same stakeholders who met to kick off this process.

Over the course of this HLA we have been able to inform and jump start other projects. These are captured below:

| MassDOT | City Of Somerville | Community Initiatives |
|---|---|---|
| State Representatives secured $65,000 in the FY18 budget to address air and noise pollution | CAFEH project team works with City to draft a zoning ordinance addressing indoor air quality - Ongoing | Ben Echevarria of the Welcome Project facilitates meeting about renovations at Foss Park - Winter 2018 |
| Money is allocated to MassDOT to conduct a noise monitoring study in Somerville - Spring 2018 | City consults with CAFEH researchers on indoor air quality for new devolpements on an ad hoc basis - Ongoing | STEP funds and carries out noise monitoring in the near I-93 neighborhoods - Summer 2018 |
| CAFEH team meet with MassDOT and consultants on sampling protocol, locations, and parameters - Spring 2018 | STEP and TWP send charrette recommendations for Foss Park to City - Winter 2018-2019 | Martha Ondras of the CAFEH community sub-committee conducts a spatial analysis of near-highway communitys to look at the demographics and socio-economics of near-highway communities - Spring 2019 |
| CAFEH shares the findings from their independent noise monitoring with MassDOT - Fall 2018 | | |

# Final Summary

The focus of this community-led HLA was to engage residents and stakeholders around noise barriers and to collect evidence related to current conditions and barrier efficacy. Over the course of the project, we collected data, reviewed the literature, and spoke with the community to learn how I-93 affects the health and well-being of Somerville's near-highway residents.

The CAFEH study documented that UFP are elevated next to I-93 in Somerville and that people with higher exposure to these particles have higher levels of inflammation, which is associated with cardiovascular risk. Our data collection during the HLA also showed that sound levels next to the highway exceed both regulatory and health-based thresholds. Our preliminary risk assessment estimated large numbers of serious health outcomes in both adults and children due to these near highway exposures.

We also found that the residents of these near-highway neighborhoods have serious concerns about their health. They saw the influence of I-93 in everything from dark soot on their windows to unsafe walkways under the dirty highway underpass. To them, noise barriers were not just a protective measure against air and noise pollution, but also an opportunity to improve the quality of their neighborhood.

There was a clear preference for incorporating vegetation into noise barrier design as well as a broader interest in increasing green space generally in the near-highway communities. Meeting participants expressed interest in public art or murals as part of noise barrier installations. The city has a goal of adding 125 additional open space acres by 2030.  Thoughtful, installation of noise barriers along I-93 that are responsive to resident concerns could provide an opportunity to increase greenery within some of Somerville's densest residential and highest-need neighborhoods while reducing noise and air pollution exposure.

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