Context & Proposal

Installation of a Noise Barrier along I-93

SOMERVILLE TRANSPORTATION EQUITY PARTNERSHIP

The Welcome Project
Education and advocacy with Somerville's immigrant communities

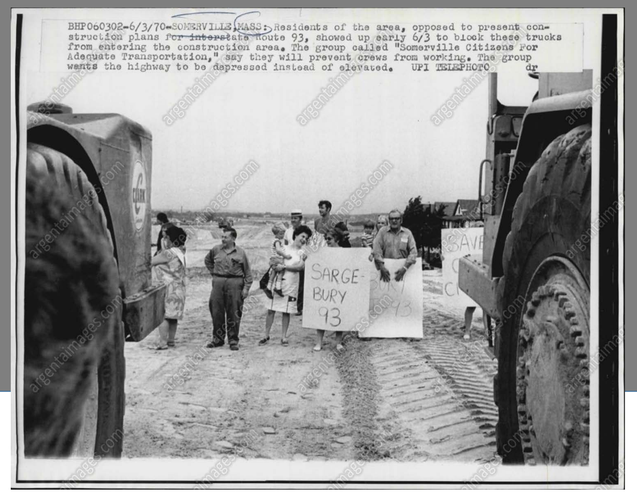
MAPC
METROPOLITAN AREA PLANNING COUNCIL

COMMUNITY ASSESSMENT OF FREEWAY EXPOSURE & HEALTH

Tufts UNIVERSITY

Context

I-93 in Somerville



Somerville residents in protest 1-93

- When I-93 was built in the 1970s the state was supposed to build noise barriers to reduce noise for people living near the highway. **It Never Happened.**
- Today, many Somerville residents still face potential health risks because they live near I-93 and are exposed to high noise and air pollution levels.
- Research shows that noise barriers reduce noise pollution and also can reduce exposure to near roadway air pollution from traffic. If designed properly, noise barriers can provide additional benefits such as:
  - Improved appearances
  - Enhanced community livability
  - Introduction of or increase in roadside vegetation

Traffic along 1-93 in Sommerville

How might noise barriers improve the health of residents?

The I-93 Noise Barrier Health Impact Assessment (HIA) will answer this question using the following process:

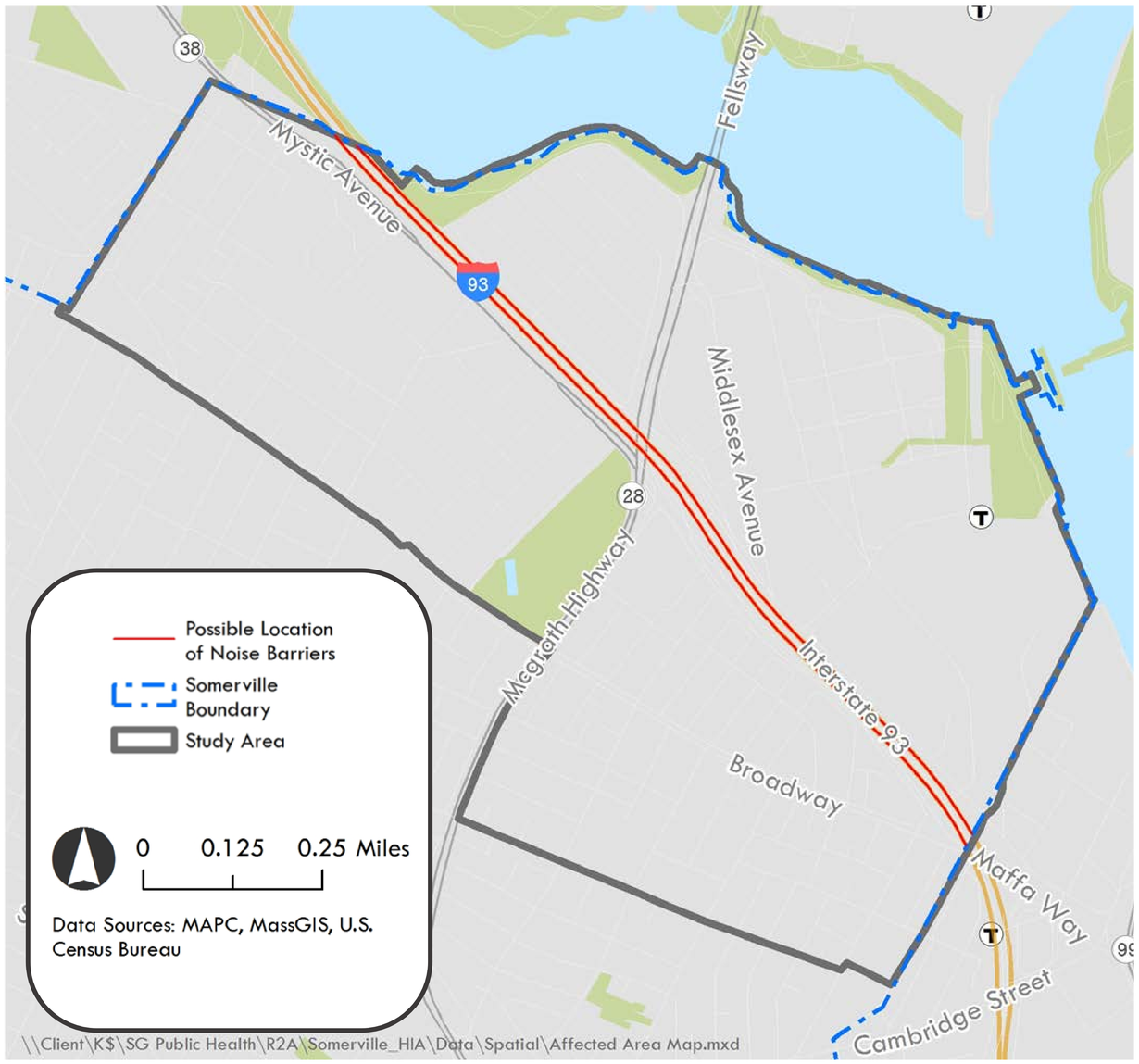
- Consider social, physical, and mental health and wellness,
- Engage a broad group of stakeholders – from health experts to residents, and
- Use a mix of qualitative and quantitative data and methods.

The HIA will provide an evidence-informed estimate of how noise barriers along I-93 might impact the health and well-being of the surrounding community. It will then offer health-promoting recommendations that address the impacts that are identified.

References: Shelton, William C. (2007, December 27). *Holding our breath.* http://www.thesomervilletimes.com/archives/2720
Shelton, William C (2017, January 22) *We've already paid for the GLX.* http://www.thesomervilletimes.com/archives/64688

Proposal

Noise Barriers along I-93



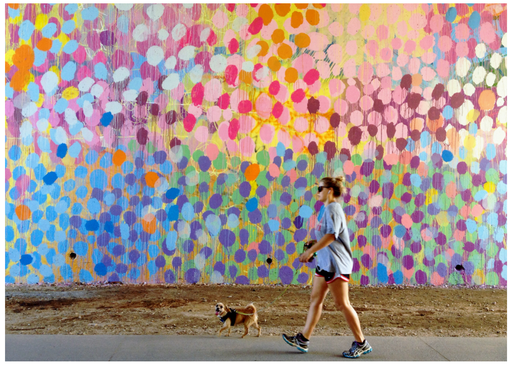
What might noise barriers look like?

Rhode Island Avenue

Mystic Avenue

Traditional noise barriers are made out of concrete and are 12-18ft high (as illustrated above). More modern materials, vegetation, and art can be used to make barriers more appealing.

Potential Noise Barrier Materials & Appearances



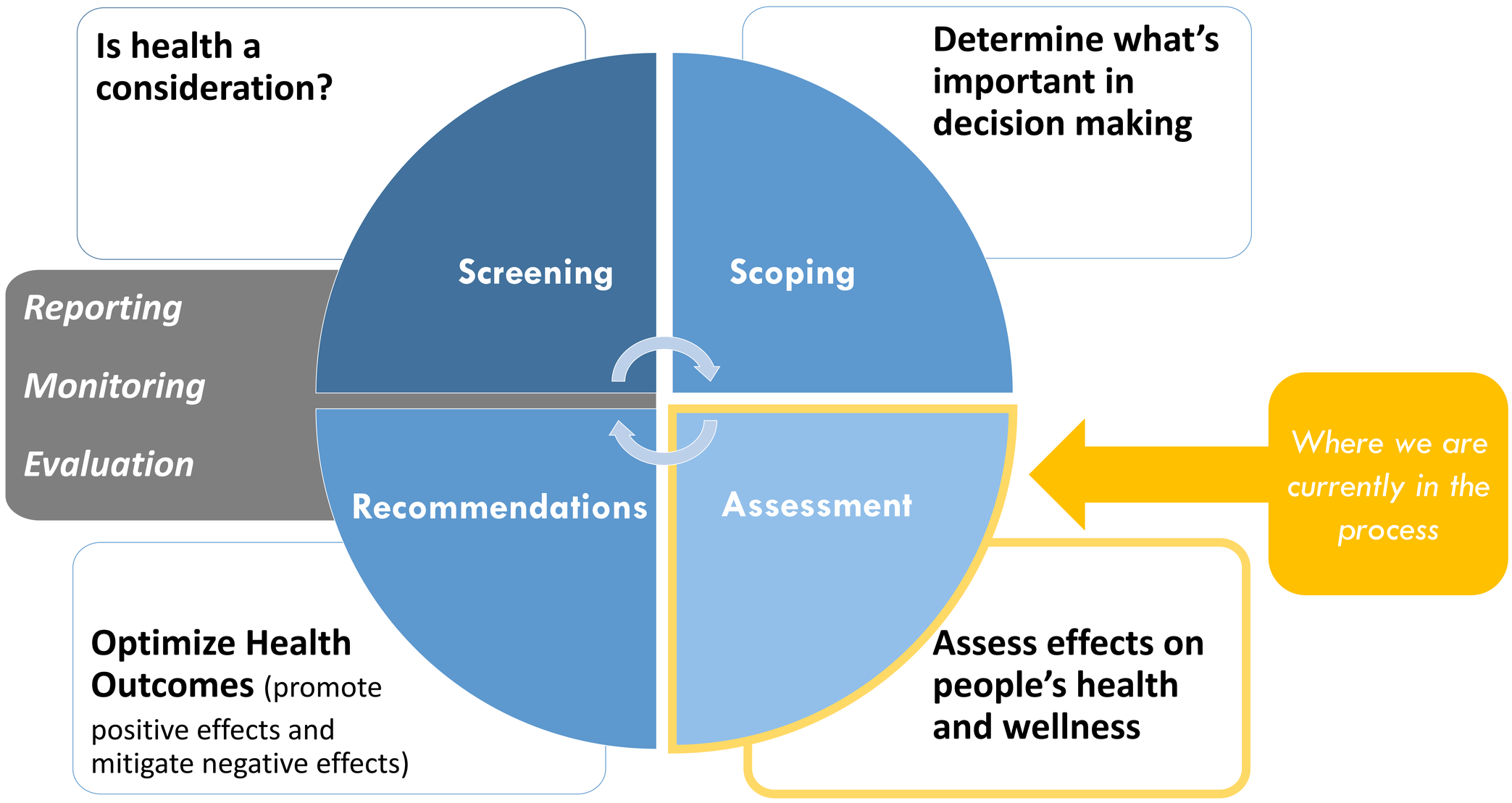
References: MassDOT presentation GLX corridor
Rich Baldauf, *U.S. Environmental Protection Agency*. "Urban built and green infrastructure impacts on local air pollution." 05/07/18

What is an Health Impact Assessment (HIA)?

An **HIA** is *a* systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program or project on the health of a population and the distribution of those effects within the population. Health impact assessment provides recommendations on monitoring and managing those effects.

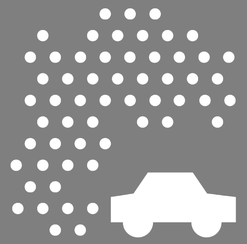
- National Research Council, 2011

HIA Process


Is health a consideration?
Screening
Determine what's important in decision making
Scoping
Reporting
Monitoring
Evaluation
Recommendations
Assessment
Where we are currently in the process
Optimize Health Outcomes (promote positive effects and mitigate negative effects)
Assess effects on people's health and wellness

Background

Traffic-Related Air Pollution



What do we know about air pollution?

All air includes air pollution, but people who live, work or attend school near busy roadways face increased health exposure. Air pollution is often highly elevated near large transportation sources, especially within 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 emitted by cars, trucks, and other vehicles.

For this HIA, we focused on Ultrafine Particles (UFP), the smallest of particles in TRAP. We chose this focus for 2 primary reasons;

1) Of the particles and gases in near roadway air pollution, we think UFP are the largest concern; UFP are so small they easily get into people's lungs, blood and brains.

2) We have over 10 years of site-specific, peer-reviewed research on UFP and their impact on the health of Somerville's residents; this is an incredible resource.

What health conditions are we worried about?

People with higher exposure to UFP tend to have higher levels of inflammation and swelling. There is credible evidence connecting UFP exposure to diseases caused by inflammation, such as:

- **Heart Disease**
  - Heart Attack
  - Stroke

- **Respiratory Disease**
  - Childhood Asthma
  - Lung Cancer

- **Neurological Health Conditions**
  - Childhood Autism

References:

Lane KJ, Levy JI, Scammell MK, Peters JL, Patton AP, Reisner, Lowe L, Durant JL, Zamore W, Brugge D. Association of modeled long-term individual exposure to ultrafine particles with inflammatory and coagulation biomarkers, *Environment International,* 2016, 92–93: 173–182.

Patton AP, Collins C, Naumova EN, Zamore W, Brugge D, Durant JL. An hourly regression model for ultrafine particles in a near-highway urban area. *Environmental Science and Technology*. 2014, 48:3272–3280.

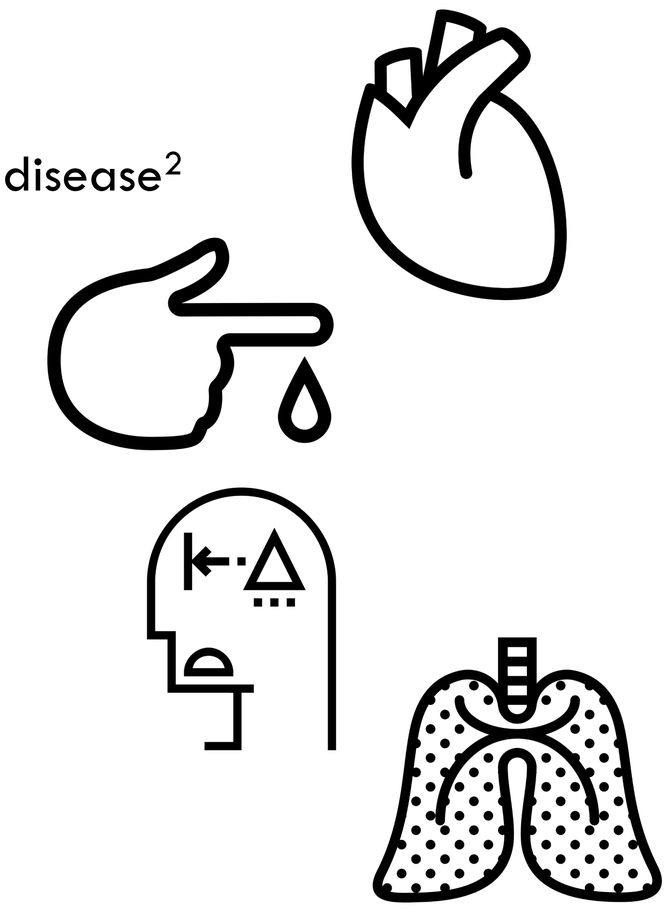
Lane KJ, Levy JI, Scammell MK, Patton AP, Durant JL, Mwamburi M, Zamore W, Brugge D. Effect of time-activity adjustment on exposure assessment for traffic-related ultrafine particles. *Journal of Exposure Science and Environmental Epidemiology*. 2015; 25:506–516.

Current Conditions

TRAP in East Somerville

Living near a freeway is related to a:

- 12% increase in coronary heart disease[1]
- 54% increase in death from coronary heart disease[2]
- 42% increase in stroke[3]
- 20% increase in post-stroke mortality[4]
- 86% increase in childhood autism[8]
- 81% increase in type 2 diabetes[5]
- 86% increase in childhood autism[8]
- 37% increase in lung cancer[6]
- 83% increase in childhood asthma[7]



[1]Kan H et al., *Environ Health Perspect* 2008; [2]Gan WQ et al., *Epidemiology* 2010; [3]Kulick ER et al., *Stroke* 2018; [4]Wilker EH et al., *J Stroke Cerebrovasc Dis* 2013; [5]Zhao Z et al., *Int J Environ Res Public Health* 2016; [6]Puett RC et al., *Environ Health Perspect* 2014; [7]Gauderman WJ et al., *Epidemiology* 2005; [8]Volk HE et al., *Environ Health Perspect* 2011

Role of Noise Barriers

TRAP in East Somerville

What will noise barriers change?

Proposed Change	Immediate Impacts	Mid-term Impacts	Long-Term Outcomes
Installation of Noise Barrier	Reduction in UFP concentration "downwind," within 150' of corridor	Reduction of exposure to UFP	Reduced risk of: **Heart Disease** - Heart Attack - Stroke **Respiratory Disease** - Childhood Asthma - Lung Cancer **Neurological Health Conditions** - Childhood Autism
	Increase in UFP concentration on highway	Increased Exposure to UFP	Increased risk of: Heart Disease, Respiratory Disease and Neurological Health Conditions (see above)

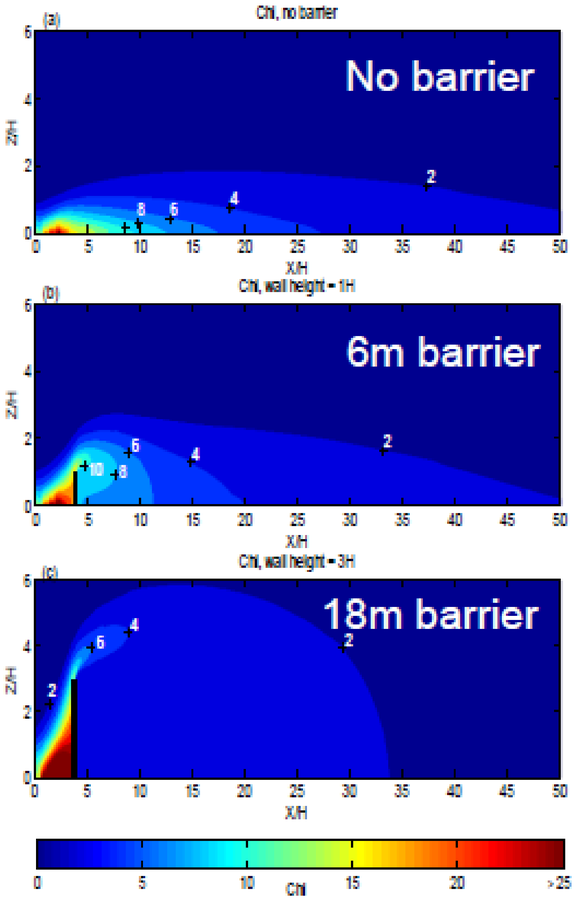
When properly designed, research shows that noise barriers can provide downwind air quality benefits.

Pollutant levels decrease downwind as barrier height increases.

Noise barrier design can affect the level of pollution reductions; Pollution can go over and wrap around barrier edges or be trapped on the upwind side of the barrier.

While providing large, long-term benefits to near-roadway residents, noise barriers may increase short-term exposure for drivers on the roadway.

Noise Barrier Impact on Air Pollution Dispersion



Hagler et al. 2011, Atmos. Environ, 45(15), pp.2522-2530

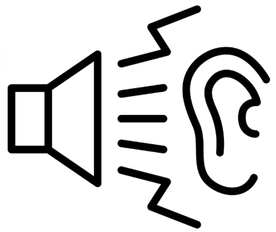
References: Rich Baldauf, *U.S. Environmental Protection Agency.* "Urban built and green infrastructure impacts on local air pollution." 05/07/18

Background

Sound Levels

What do we know about noise exposure?

The traditional definition of noise is “unwanted or disturbing sound”. Sound becomes unwanted when it either interferes with normal activities such as sleeping, conversation, or disrupts or diminishes one’s quality of life.



Noise can be pervasive in urban environments, causing annoyance, sleep disturbance, and stress.

Taken together, there is a growing body of evidence that traffic-related air pollution and noise can cause heart disease.

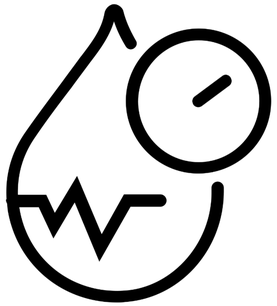
Noise has a large impact on our health. The World Health Organization (WHO) estimates that least 1 million years of healthy lives (DALYs) are lost every year in western European countries because of environmental noise.

References:
Environmental Protextion Agency, **Clean Air Act Title IV - Noise Pollution.** https://www.epa.gov/clean-air-act-overview/clean-air-act-title-iv-noise-pollution

What health conditions are associated or affected by noise exposure?

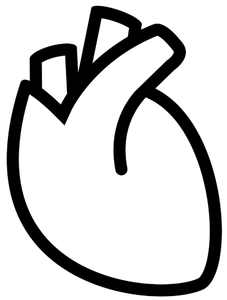
Noise annoyance increases the risk for chronic stress.

Night-time noise exposure can disturb sleep, causing increased blood pressure.



Extended exposure to very high noise can lead to inflammation or swelling. While inflammation in the case of an infection is a good thing, long-term inflammation can increase your risk for **heart disease**, including:

- Coronary Artery Disease
- Hypertension
- Stroke
- Diabetes
- Heart Failure

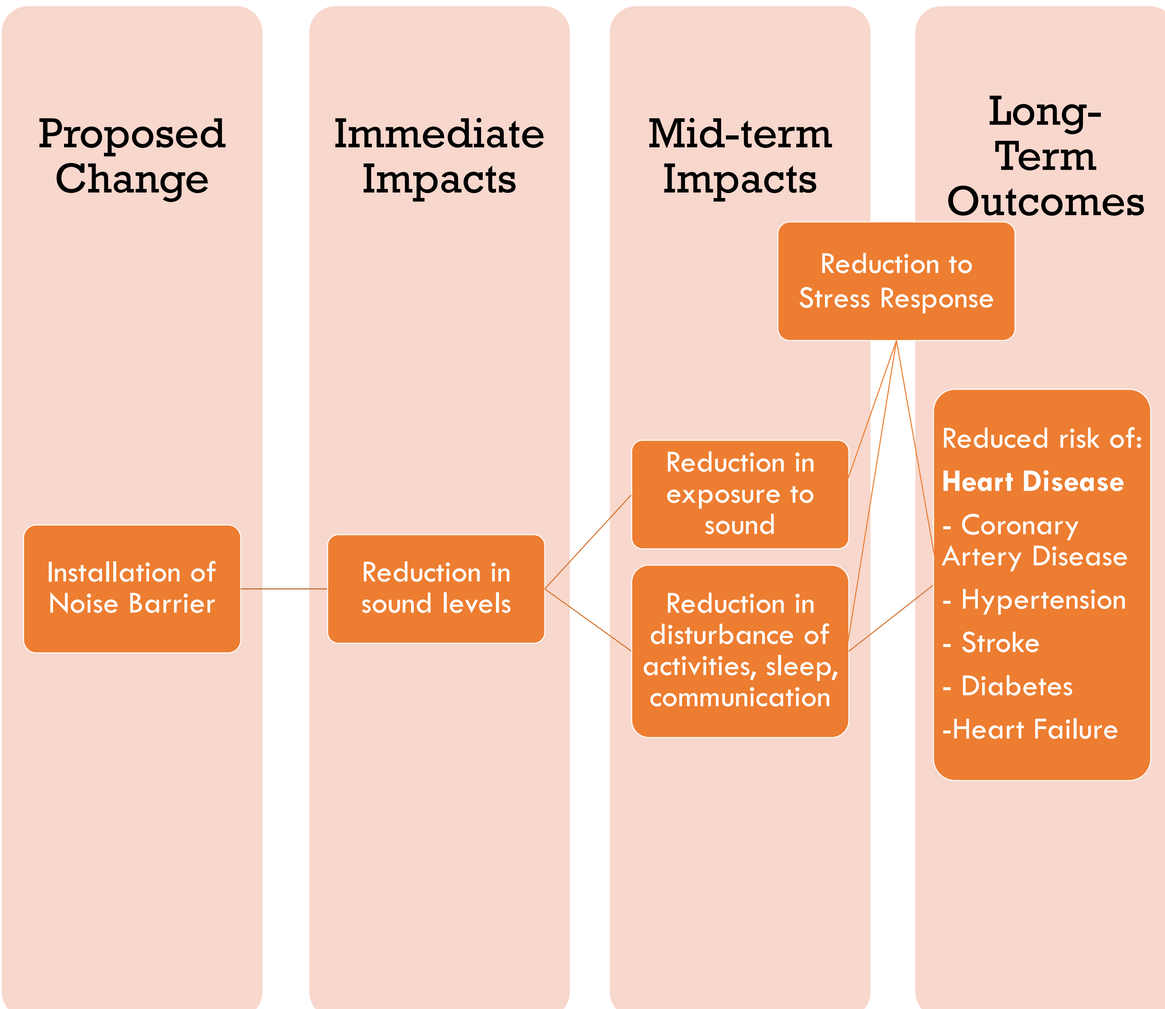


References:
Münzel, T., Herzog, J., Schmidt, F. P., & Sørensen, M. (2017). Environmental stressors and cardiovascular disease: the evidence is growing.
Münzel, T., Schmidt, F. P., Steven, S., Herzog, J., Daiber, A., & Sørensen, M. (2018). Environmental noise and the cardiovascular system. *Journal of the American College of Cardiology*, *71*(6), 688-697.
Haralabidis A.S., Dimakopoulou K., Vigna-Taglianti F., et al. (2008) Acute effects of night-time noise exposure on blood pressure in populations living near airports. Eur Heart J 29:658–664

Role of Noise Barriers

Sound Levels in East Somerville

What will Noise Barriers change?



How do we measure change?

We conducted a site walkover to identify potential sites within the area for monitoring roadway noise. Assessment will use six (6) REED SD-4023 noise analyzers.

Partners are working with residents and business owners at selected sites to host the REED noise monitors.

We will collect two weeks of roadway noise data from the sites at selected residential/commercial sampling locations to measure and assess road/traffic noise impacts.

References:
Münzel, T., Herzog, J., Schmidt, F. P., & Sørensen, M. (2017). Environmental stressors and cardiovascular disease: the evidence is growing.
Münzel, T., Schmidt, F. P., Steven, S., Herzog, J., Daiber, A., & Sørensen, M. (2018). Environmental noise and the cardiovascular system. *Journal of the American College of Cardiology*, *71*(6), 688-697.

Background

Quality of Built Environment

What we know

Exposure and access to **green spaces** is associated with improved mental well-being and reduced stress as well as higher levels of outdoor physical activity.

The quality, availability and accessibility of **outdoor public spaces** is correlated with residents reporting positive social interactions among themselves and neighbors.

Public art, such as murals and sculptures, has been found to have beneficial effects on mental health in addition to improved feelings control over one's life.

In relation to the items above, **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.

Related Health Conditions or Risk Factors in Impact Area

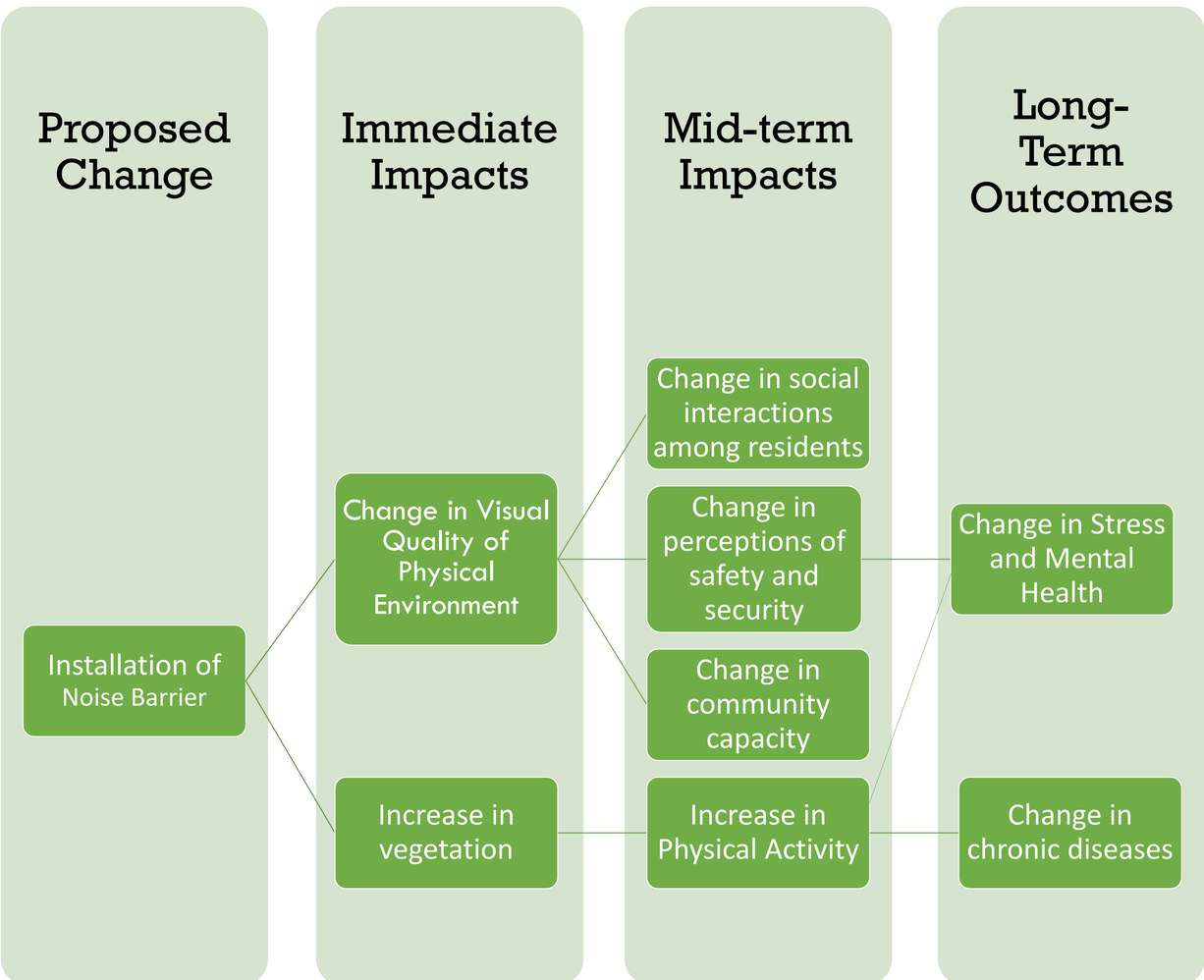
- Participants from earlier meetings reported perceiving a lack of trees along neighborhood streets and green open spaces in the neighborhoods adjacent to the interstate.
- Participants expressed positive feelings of views of the Mystic River; conversely, residents did not like the sight and noises related to the interstate corridor.
- The recent improvements to Harris Park and Playground were cited positively by participants.
- According the Wellbeing of Somerville report (2018):
  - 31% of high school students self-report mental health issues, including depression.
  - Mental health historically is a top cause of hospitalizations among residents 25-39 years old; indications of racial/ethnic disparities.
  - Heart disease has historically been a leading cause of death among residents 40-64 years old.
  - Historically, lung cancer is leading cause of cancer death. Lung cancer is higher in Somerville than the rest of the state, even though Somerville has lower smoking rates.

References:
Urban Design and Mental Health. **How Urban Design can Impact Mental Health.** https://www.urbandesignmentalhealth.com/how-urban-design-can-impact-mental-health.html
Tebes JK, Matlin SL, Hunter B, et al. Porch Light Program: Final evaluation report. The Consultation Center at Yale. Yale School of Medicine; 2015. *Accessed on February 4, 2016*

Proposed Impact

Quality of Built Environment

Proposed Impact Pathways



Preliminary Estimated Impacts

Noise barriers have other positive attributes with air quality only one of many potential benefits.

- Noise barriers reduce noise and can improve aesthetics.
- Roadside vegetation can also reduce noise, if properly designed will improve aesthetics.
- Noise barriers enhance community livability.
- Generally improve public health - exposure to green space has been associated with better physical and mental health.