Hearing the Highway

Suitable Sites for Noise Barriers in Massachusetts

Traffic Noise is a Health Risk

Route I-93 in Medford borders homes and play areas. Regional highways that were inserted into older urban neighborhoods are a source of noise exposure in Massachusetts.

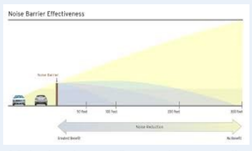
Common Activities	dBA	Highway Traffic Noise
Jet Engine at 300 meters	110	
Gas Lawn Mower at 1 meter	100	
Food Blender	90	Diesel Truck at 15 meters
Noisy Urban Area, Daytime	80	
Vacuum cleaner at 1 meter	70	
Normal Speech at 1 meter	60	Heavy Traffic at 90 meters
Quiet Urban Daytime	50	
Quiet Urban Nighttime	40	
Concert Hall (Background)	30	
Recording Studio	10	
Threshold of human hearing	0	

From CalTrans Disrict 11 Noise Barrier Information Sheet for Interstate 180 (2014)

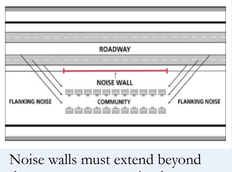
Longterm exposure to noise is linked to increased blood pressure, cardiovascular, gastrointestinal, and neurological disease, cognitive and mental health problems, and all-cause mortality. The U.S. Environmental Protection Agency Noise Effects Handbook (1981) recommends that outdoor 24-hour average noise be limited to 55 A-weighted decibels (dBA) in residential areas.

People living near busy roads may be exposed to this level of daily noise. Outside of occupational settings, Americans are most likely to be exposed to chronic, harmful noise levels from transportation.

How Noise Barriers Work



Noise barriers on flat terrain are usually effective in reducing noise by 5-10 dBA within 60 meters of the road. Benefits may extend up to 90 meters. (Wisconsin DOT Noise Barrier handbook)



Noise walls must extend beyond the receptor community due to flanking noise. (Virginia DOT Noise Barriers Manual)

Route I-95 and Winn Street Interchange in Burlington (Google Earth)

The Massachusetts Department of Transportation will construct noise barriers on limited-access highways when average noise during the loudest hour of the day exceeds 70 dBA at residences or 75 dBA at parks, schools, hospitals, and other uses of concern.

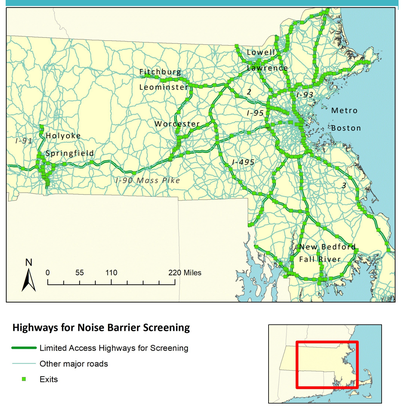
Topography Matters. Walls and berms can reduce highway noise by 5 to 10 dBA, to a safer level, by blocking line-of-sight propagation of sound waves. They are not effective if the receivers (homes and other buildings, parks and other spaces) are significantly higher or lower than the roadbed.

Barriers must extend horizontally beyond the receptors they are protecting, 4 times the distance between the receptor and the travel lane. Therefore barriers work best on limited-access highways not interrupted by intersections or topography.

Neighborhoods near exit ramps cannot usually be protected by barriers—in spite of the fact that much of highway-related traffic noise originates from accelerating and decelerating traffic on exit ramps and their intersections with local roads.

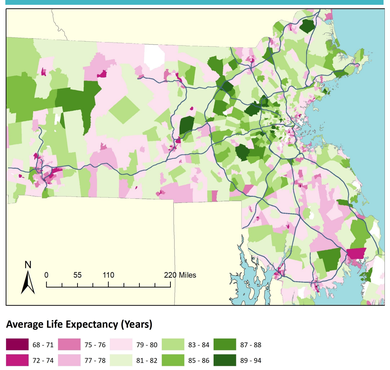
Ranking Potential Noise Barrier Sites for Public Health Impact

Limited Access Highways with High Traffic Volume



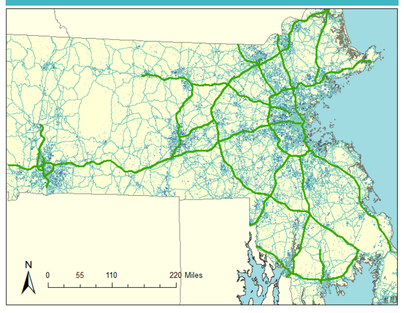
Limited access highways are suitable for noise barriers because they have uninterrupted distances between exits. Their traffic volumes exceed 60,000 daily trips and they run through heavily populated areas, so they have high noise impact up to 100 meters from travel lanes.

Average Life Expectancy from Birth 2010-2015



The expected length of life for a child born in a census tract is used as a measure of neighborhood health, and vulnerability to transportation noise. Low-life-expectancy tracts tend to cluster in densely populated urban areas and economically depressed areas.

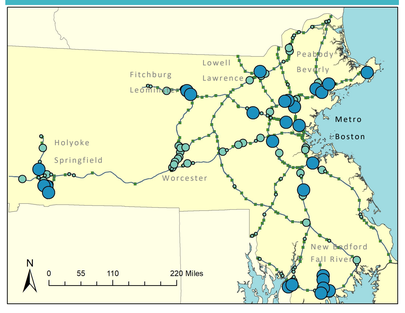
Residential and Recreation Population Density



LU21 Code	Description	Block Density (pop/km^2)	Density Score
7	Participatory Recreation	NA	7
8	Spectator Recreation	NA	7
9	Water-based Recreation	NA	7
38	Very Low Density Residential	NA	0
13	Low Density Residential	700	1
12	Medium Density Residential	2,900	4
11	High Density Residential	6,500	9
14	Multifamily Residential	10,500	14

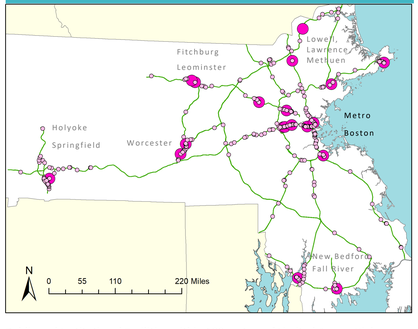
Block residential density within 100 meters of the selected highways was calculated, with additional weighting for active recreation (parks and play areas) in that zone. These are places where the most people are likely to experience high average daily noise levels from traffic.

Best Barrier Sites Based on Population Density



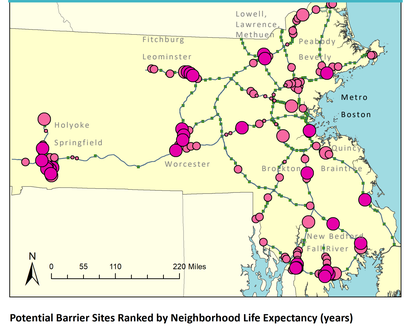
140 highway segments were found potentially suitable for noise barriers, and ranked by population density within 100 meters of the road where barriers would have the most public health impact. They cluster where highways cut through cities.

K-12 Schools, Hospitals and Longterm Care Facilities



19 schools, hospitals and longterm care facilities, and 296 other public and institutional facilities identified by Land Use code, are within 100 meters of the selected highways. These should be evaluated for noise protection including noise barriers.

Best Barrier Sites Based on Community Health



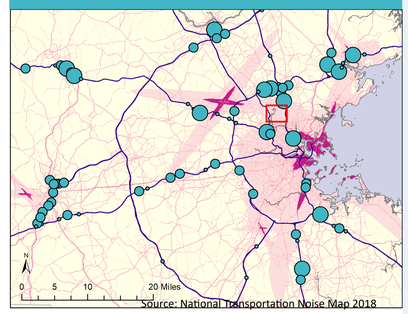
Life expectancy was used as an alternate way to rank potential noise barrier sites. Prioritizing this measure of community health and vulnerability yielded a slightly different order and "top 30" candidate sites.

MassDOT also considers **project feasibility, cost, and community acceptance** of noise barrier locations. Google Streetview was used to screen out sites with complex ramp configurations, unsuitable topography, insufficient right of way, and existing protective barriers.

This screening found that when population and public health impacts are given priority, many of the best sites for highway noise barriers are found in densely settled older cities. These are also likely to be areas where the community health, measured by life expectancy, is poorer.

Noise Beyond the Highway

24-hour Average Transportation Noise in Eastern MA



Massachusetts residents are exposed to unhealthy chronic noise from roads other than limited-access highways, and from aviation.

Noise reducing solutions beyond highway noise barriers are needed

Traffic Noise in an Urban Area (Medford Center)

Most unhealthy traffic noise is not within 100 meters of a limited-access highway, and therefore cannot be mitigated by noise barriers. In new development, we can avoid exposing large populations to road noise through better land use planning and zoning.

An Alternative Solution to Noise: Building Insulation and Ventilation

Residential and school sound insulation programs are effective in reducing aviation and traffic-related noise and air pollution, indoors where people spend up to 90% of their time. Insulation also reduces heating and cooling costs, improves comfort, and protects vulnerable people during extreme heat and cold. Insulation with ventilation means residents can keep windows closed in warm months, shutting out noise and pollution.

Map Projections and References

Map Projection: NAD 1983 State Plan Massachusetts Mainland FIPS 2001

Data sources: MassGIS; U.S. Environmental Protection Agency "Noise, A Health Problem", 1978; U.S. Department of Transportation, Bureau of Transportation Statistics, National Road and Aviation Noise Map; U.S. Centers for Disease Control and Prevention, Small Area Life Expectancy Project.

Tufts

Martha Ondras

May 3, 2019

CEE-187 Spring 2019