Catalyst for Regional Progress
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Pleasant Street Improvements HIA

A health impact assessment of proposed improvements to Pleasant Street in Northampton, MA

August 2015

Active Transportation

Safety from Traffic

Green Space

Affordable Housing

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Disclaimer:

The conclusions of this report are those of the authors and do not necessarily represent the official position of or endorsement by the Centers for Disease Control and Prevention or the Massachusetts Department of Public Health.

Northampton Pleasant Street Improvements Rapid HIA

Guide to This Document

This is a Health Impact Assessment (HIA) that investigates the relationship between health and proposed improvements to Pleasant Street in Northampton, Massachusetts. Part I provides background on the project this HIA evaluates, reviews what an HIA is, discusses the HIA process, and provides background information about the health and demographic makeup of Northampton, Massachusetts. Part II examines in detail the pathways to health that might be impacted by the proposed improvements, explaining our methodology and describing the expected changes in health outcomes. Finally, Part III summarizes the conclusions from Part II and provides recommendations for the City of Northampton and organizations and individuals related to Pleasant Street improvements.

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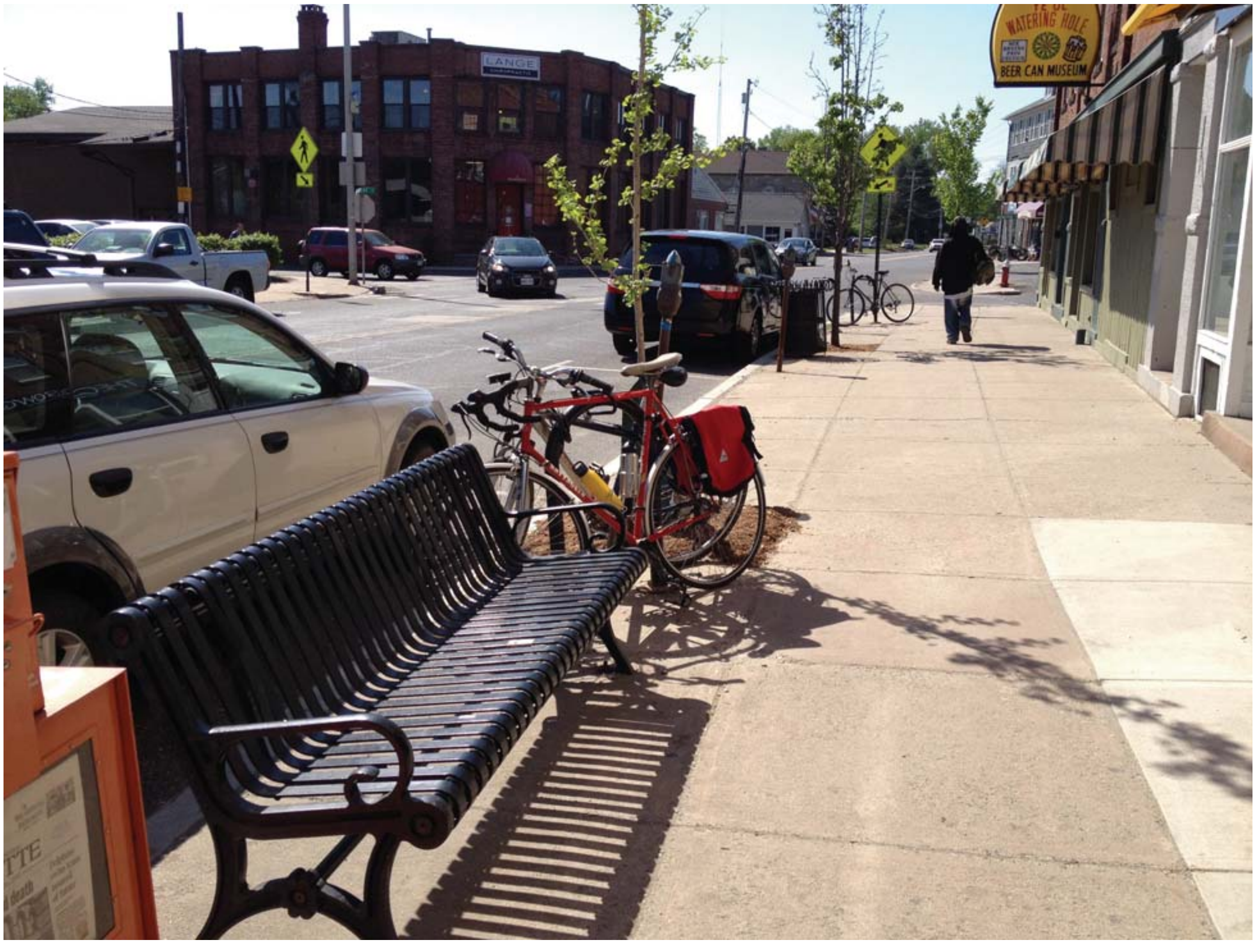

Part I: Background

Background on the Health Impact Assessment (HIA)

This rapid Health Impact Assessment (HIA) evaluates potential health impacts of planned street improvements on Pleasant Street in Northampton, MA being developed by the City of Northampton's Planning and Sustainability Department, and Department of Public Works. The HIA paralleled the development of project design from concept level to 25% design submission and the subsequent development of a grant application for MassWorks funding for the street improvement project. This is an ideal stage to integrate HIA into the street improvement process because the initial design ideas have formed but there is still an opportunity for recommendations from the HIA to influence final design decisions. Conducting an HIA at this stage of a project does, however, require a rapid HIA process because plans and ideas can progress to completion in just a few months.

The HIA was conducted by Pioneer Valley Planning Commission (PVPC), in partnership with the Massachusetts Department of Public Health (MDPH), and Metropolitan Area Planning Commission (MAPC). This work was supported by Massachusetts Department of Public Health through funds made available from the Centers for Disease Control and Prevention, National Center for Environmental Health.

Goals

The immediate goals of the HIA were to make specific recommendations about project design to improve its health benefits and mitigate health risks—including sidewalk improvements, bike infrastructure design, and crosswalk siting and design; to learn about the project's potential long-term impact on the health of neighborhood residents and users of Pleasant Street including the potential for mode shift (auto to pedestrian and/or bicycles) and disparate impacts on various populations. Overall, the HIA was seen as an opportunity to help the city prioritize which aspects of the streetscape deserved the most budgetary and design attention based upon potential health impacts. The city viewed the economic quantification of health impacts as a key outcome of the HIA—in part because project cost/benefit is key communication point for city residents and potential funders at the state level. The city also viewed the project as an opportunity to build in-house understanding and expertise in HIAs so that the city can begin to incorporate Health Impact Assessments more broadly in planning work.

This rapid HIA is one of three HIAs that are focused on the health impacts of Massachusetts state policies and procedures related to Preparing for Success (formerly called Planning Ahead for Growth). Preparing for Success is a state government initiative in which funding, regulatory reform, and technical assistance are targeted toward designated "priority areas" for economic development and conservation. This is intended to increase cooperation across all state agencies and other levels of government and to maximize the value of investments in a time of limited means. For example, MassWorks, a state grant program, gives points to project applications that are located within designated priority areas; Pioneer Valley Planning Commission considers designated priority areas when it is selecting projects for free technical assistance through District Local Technical Assistance (DLTA). The "PM+Health Screening HIA" investigates the potential impacts of explicitly incorporating health considerations into the priority mapping process. This HIA investigates a representative place-based project that is both within a designated priority development area and seeking funding through MassWorks. In this context, the HIA provides insight into how state economic development, planning, housing, conservation, and transportation policies and programs may impact health. It exemplifies how an HIA can be incorporated into future Preparing for Success-related projects. The HIA also directly informs state-level grant funders of the potential health impacts of the proposed project.

Finally, the Pioneer Valley MPO recently revised its scoring criteria for projects seeking funding through the Transportation Improvement Program (TIP). The new scoring provides credit for projects that have received an HIA. This HIA serves as a model for other TIP project proponents as they assess the value of HIA for their projects. In particular the assessment of the health economic assessment of active transportation may be of value for future TIP projects or other complete streets efforts.

Health Impact Assessments

HIAs aim to describe the potential health effects of plans, policies, or programs (National Research Council 2011). This is a rapid HIA due to its short timeframe and limited resources, which narrowed the breadth of issues we could consider, our ability to collect original data, and the level of analysis we could accomplish. However, this HIA used a comprehensive HIA framework developed by the Metropolitan Area Planning Council (MAPC) for their HIA, *Transit Oriented Development and Health: A Health Impact Assessment to Inform the Healthy Neighborhood Equity Fund* (hereafter HNEF). The HNEF framework includes a set of pathways that apply to most neighborhood development and transportation plans, policies and projects. The combination of the comprehensive HNEF framework and a rapid HIA provides a unique format to quickly provide relevant information to decision makers in a timely manner.

HIA Process

The standard steps of an HIA include screening, scoping, assessment, recommendations, reporting, and monitoring.

Screening

Screening determines if the HIA will add value to the decision-making process and whether or not there is a potential for significant health impacts of the proposed policy/plan/project. The screening process for this HIA took place in January-March 2015 and involved a selection process at Massachusetts Department of Public Health (DPH) that included discussions with MAPC and PVPC to ensure their participation in the HIA process. Potential projects in the Pioneer Valley region were solicited from three communities: Springfield, Holyoke and Northampton MA. The Pleasant Street project was chosen because of its potential to provide health impact information about the relationship between state development policies and place-based projects, as well as the specific relationship between street improvement projects and health. Additionally, the HIA was seen as an opportunity to provide PVPC and the City of Northampton Planning and Engineering Departments with experience in HIA. Finally, project decision makers in Northampton's Office of Planning and

Sustainability expressed strong interest in the HIA and a commitment to considering its findings in their decisions.

Scoping

The objective of scoping is to create a plan and timeline for conducting an HIA that identifies priority issues, research questions, methods, and participant roles. Scoping was conducted between March and June 2015. The scope was primarily defined a public forum/walk audit held on June 10, 2015. Participants in the public forum prioritized the pathways to be studied. Research questions, and methods were defined and refined through Advisory Committee meetings and project team meetings between DPH, PVPC and MAPC.

Assessment and Recommendations

The assessment step provides a profile of existing conditions and evaluates the potential health impacts of the Pleasant Street improvement proposal. To conduct the assessment with the time and resources available for this HIA, we focused on accessible secondary resources. Assessment (Part II) is followed by evidence-based and theory-based recommendations (Part III) to mitigate negative and maximize positive health impacts of the project.

Reporting

Reporting communicates the findings and recommendations reached through the HIA process to stakeholders and decision-makers. The report summarizes the key health impact issues, which consider the nature and magnitude of the potential health impacts as well as their distribution in the target population. This is then followed by recommendations to maximize positive heath determinants and outcomes. For the present HIA, the audience for the report includes local decisions makers in the City of Northampton, Northampton residents, other planners in the PVPC region, state-level decision makers related to planning, economic development, transportation, and conservation.

Monitoring

Once HIA findings are disseminated in a report, the monitoring phase begins. The objective of monitoring is to review the effectiveness of the HIA, if decisions were implemented as planned, and track and evaluate the actual health outcomes as a result of the project. Monitoring will include ongoing discussions within PVPC and include tracking the use of HIA recommendations in the final street improvement plans.

Stakeholder Engagement

An advisory committee was established early in the project and was a prime means of enabling stakeholder involvement in the project. Advisory committee members were selected based on their representation of diverse stakeholders, and their ability to provide technical expertise and/or knowledge of local conditions. The advisory committee included the following members:

Sarah Bankert, Healthy Hampshire and worker in neighborhood
Joanne Campbell, Valley CDC and property developer in neighborhood
Tom Douglas, architect and neighborhood business-person
Wayne Feiden, Planning and Sustainability Department, Northampton
Kim Gilhuly, Human Impact Partners and neighborhood resident
Jim Laurila, Department of Public Works, Northampton
Carolyn Misch, Planning and Sustainability Department, Northampton
Ryan O'Donnell, Northampton City Councilor (Ward 3)
Kathleen Szegda, Partners for a Healthier Community
Ben Wood, Mass Department of Public Health and worker in neighborhood

The advisory committee met about monthly between May and August and generated valuable feedback and direction throughout the project.

A public forum/walk audit provided the primary opportunity for direct stakeholder engagement. The event was held on June 10, 2015. It was widely publicized in the local newspaper, various email lists, twitter, facebook, websites, and through targeted flyering. The event initially attracted about 25 participants. The event was designed to create a public spectacle in order to draw in additional participants, who might not normally choose to attend an event. During the course of the evening, we estimate that we captured input from about a dozen additional people. Input was collected through a variety of means, flipchart notes, surveys, and a dotting prioritization exercise. In addition, the event was covered by the local newspaper and TV station, which had the effect of extending the conversation about Pleasant Street Improvements and the HIA throughout the community.

The project team made an active effort to gather direct stakeholder input via facebook, twitter, and email. This netted a small number of comments.

Existing Conditions

Project Background for Pleasant Street Improvements

Pleasant Street in Northampton, Massachusetts is viewed by the city as "the most important gateway to Northampton from Interstate 91. It is also, second only to Main Street, the most important mixed-use area in the city." (Source: City of Northampton, Planning and Sustainability. "Pleasant Futures MassWorks Project.")

Significant changes are in the works along Pleasant Street in Northampton, MA. Amtrak Service was restored to Northampton in the winter of 2014. The train platform is located on Pleasant St. There is potential for transit-oriented development in the future. Two significant mixed-use housing projects have recently been permitted on Pleasant Street. The first will redevelop 129 Pleasant Street and will provide about 80 mixed-income housing units in addition to about 4,500 square feet of commercial space. The second will redevelop the former Northampton Lumber property. It will include 45-60 affordable housing units and 5,000 square feet of commercial space.

Meanwhile, the City of Northampton is in the process of taking over a portion of Pleasant St from Mass Department of Transportation (MassDOT)—from Holyoke Street/Michelman Avenue to Hockanum Road. This provides the city with the opportunity to redesign Pleasant Street's streetscape and overhaul it. To that end, the city engaged Nitsch Engineering to complete design work for streetscape improvements. Nitsch Engineering completed a 25% design plan in August 2015, during the course of the HIA. The City of Northampton submitted a grant application to MassWorks to fund project implementation at the conclusion of the HIA in September 2015. The project area for the Pleasant Street Improvements is shown in Figure 1.

Streetscape improvements on Pleasant Street are intended to serve both existing residents and to support the redevelopment of the street. Current residents describe Pleasant Street as "ill-defined, bipolar, car-centric, and unpleasant" (Source: "Pleasant Futures W3NA"). They recognize its potential desiring a future with these features, "improved-crosswalk, trees, multi-modal, key-arrival spot." Regarding redevelopment, the infrastructure investments are viewed by the city as critical for two reasons. "First these investments are a necessary precondition for any market-driven investments. Elements of the streetscape are somewhat hostile to pedestrians, obsolete, and just plain tired. Second most of these investments would otherwise be required as permit conditions for new investments, but the project pro-formas cannot carry the costs of these investments, leading to a stand-off" (Source: City of Northampton, Planning and Sustainability. "Pleasant Futures MassWorks Project").

Figure 1: Pleasant Street Improvements Project Area

Streetscape Existing Conditions

The public realm of Pleasant St. has approximately three different characters. The north section from Main St. to about Pearl Street has a traditional downtown urban form with three and four story buildings creating a consistent street wall on both sides of the street. There is one traffic lane in each direction and on-street parallel parking on both sides. Sidewalks typically have a brick edging strip next to the road. Street trees are fairly consistent and of substantial size. Crosswalks are frequent and visible—some have curb extensions. Motorists generally follow Northampton's downtown custom and stop for pedestrians in crosswalks.

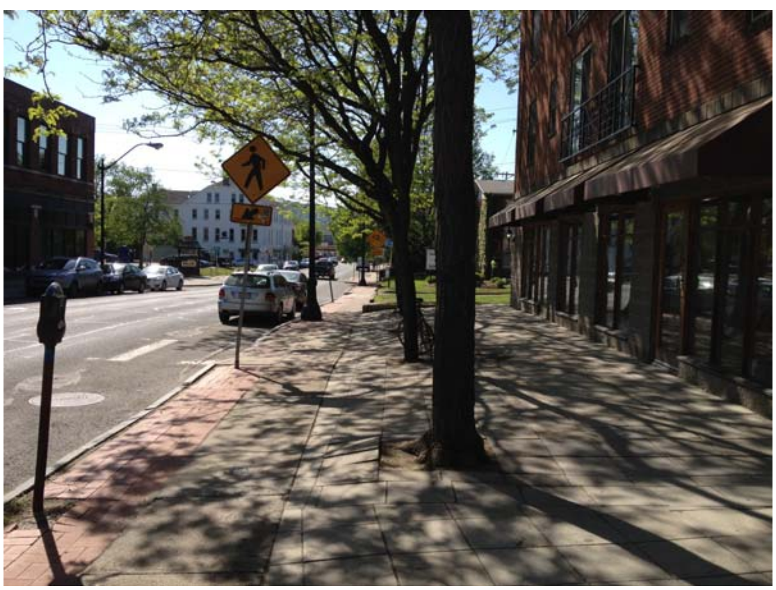

Figure 2 and Figure 3: North section of Pleasant Street

The middle section of Pleasant Street from about Strong Avenue to about Michelman Avenue (just south of Northampton Coffee, and Ye Olde Watering Hole) has a transitional character between an urban street type and a state highway type. The street wall is less continuous: building heights are more varied, some buildings come to the edge of the sidewalk, but others have front or side parking, or a front lawn. On-street parking is present, but less utilized. Brick edging on sidewalks and curb extensions are not present. Crosswalks are less closely spaced than on the northern section and motorists are less likely to stop for pedestrians in the crosswalk. Street trees are generally smaller and there are many gaps between trees, including evidence of several trees that have recently been removed and not replaced.

Figure 4 and Figure 5: Middle section of Pleasant Street

The south section of Pleasant Street, from Holyoke Street/Michelman Avenue to the Intersection with Conz Street reflects both State Highway layout and commercial strip-type frontage design. Front parking is the norm in this section, buildings are generally set far back from the street, sidewalks are narrow, street trees are generally absent, there is no on-street parking, and crosswalks are few and far between. Traffic speeds are noticeably faster in this section. In particular vehicles travelling south "step on the gas" on this section of street. While the current project excludes the northernmost and southernmost parts of Pleasant Street (it covers Hampton Avenue to Hockanum Road), it includes all three character-types.

Figure 6, Figure 7, and Figure 8: South section of Pleasant Street.

Concept Sketch for Pleasant Street Improvements

Early in the HIA process, Northampton completed a concept sketch showing potential improvements for Pleasant Street. This concept design was the basis for much of the scoping phase of the HIA. The concept design showed the potential for:

- Restoration of granite curbs at several curb cuts (predominantly curb cuts that are not currently active)
- Improvements to the NH&NCL Rail Trail crossing at Pleasant Street
- Improved crosswalks at Kingsley Avenue and Holyoke Street.
- Curb extensions with sunken parklets, trees, benches and stormwater infiltration at Kingsley Avenue and Holyoke Street
- New concrete sidewalks on Holyoke Street
- The addition of on street parking between Holyoke Street and Hockanum Road
- The addition of cycle tracks (also known as separated bicycle lanes) and/or a bike lane between Holyoke Street and Hockanum Road
- The addition of a tree belt on the east side of Pleasant Street for the southern half of the street between Holyoke Street and Hockanum Road
- Narrowing of the mouth of Hockanum Road at Pleasant Street.

Sewer improvements for the HAP Housing project at Northampton Lodging site are not shown on the concept sketch, but they are an integral part of the MassWorks project and so were up for consideration by the HIA. In fact, the potential MassWorks application is strongly related to both the Valley CDC and HAP Housing affordable housing developments—in that street improvements are seen as being necessary for the viability of those projects. Impacts of affordable housing were therefore considered as part of the scope for the HIA.

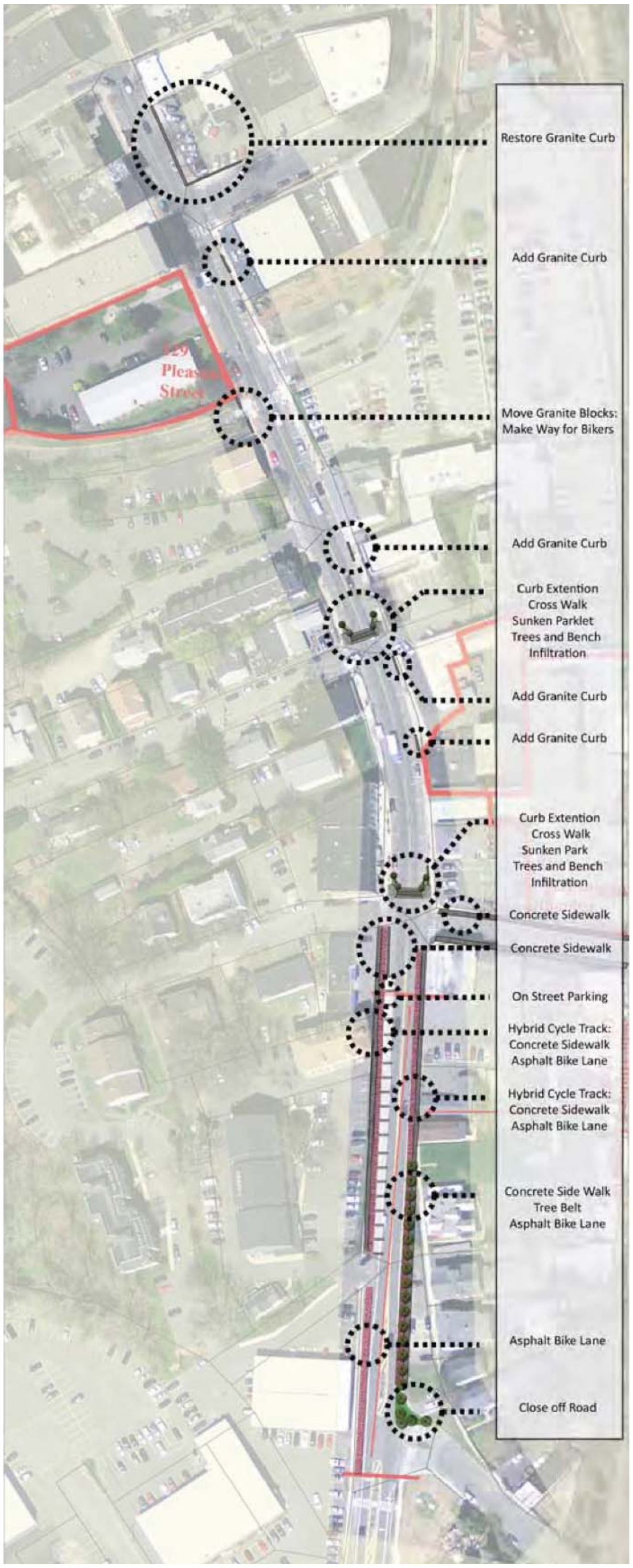

Figure 9: Concept Sketch for Pleasant Street Improvements

Draft Concept Plan

Design plans were developed over the course of the HIA. The Assessment and Recommendations sections below refer to a set of 25% Design Plans from August 2015 that were not released to the public and so are not included in this report. The Draft Concept Plan below is largely the same as the versions on which the HIA was based. This plan was released to the public after the completion of the HIA and so is included here.

Figure 10: Draft Concept Plan, Pleasant Street, Northampton. September 23, 2015.

The following three figures show the left, middle and right sections of the image above in a larger format.

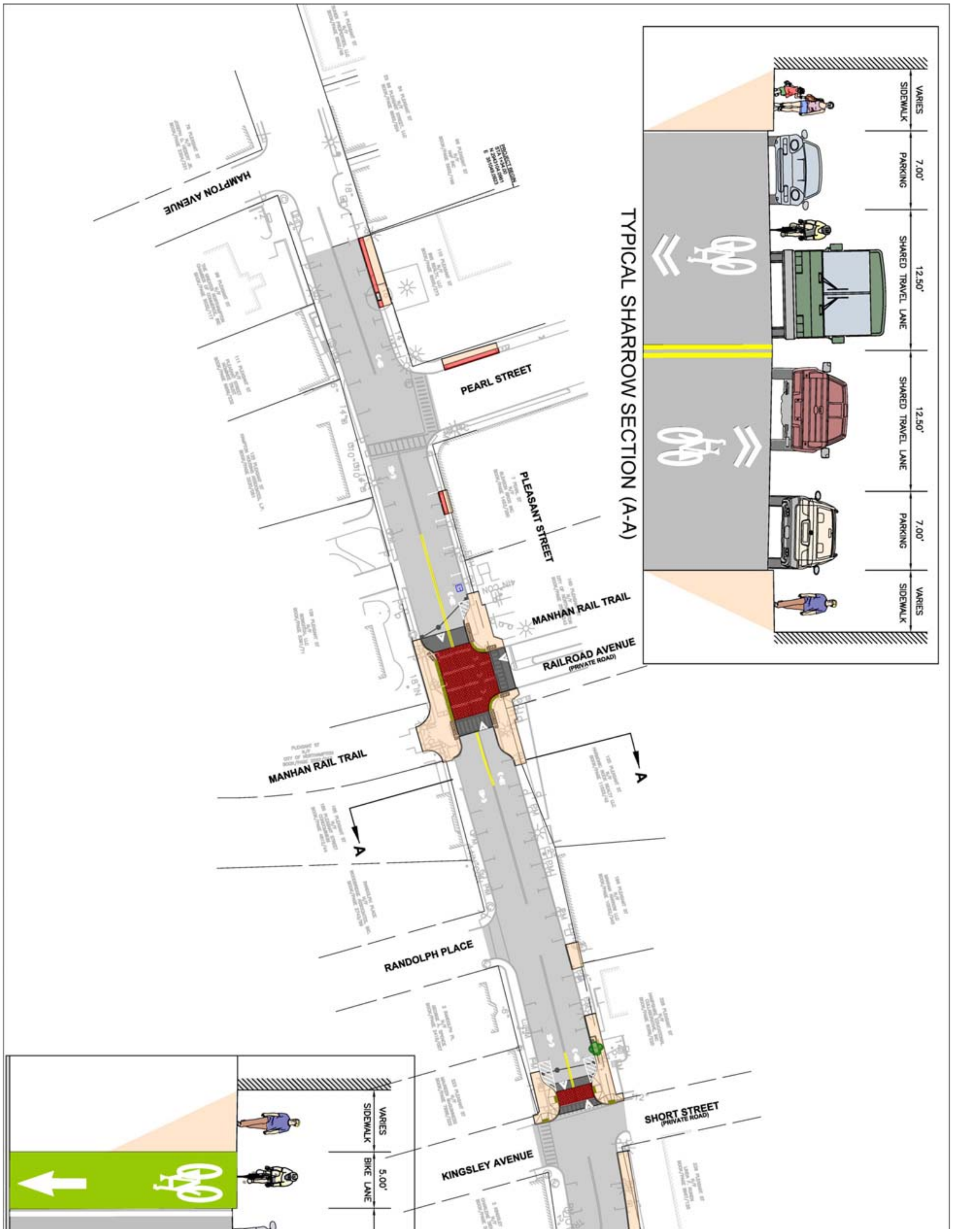

Figure 11: Left portion of Draft Concept Plan, Pleasant Street, Northampton. September 23, 2015.

Figure 12: Middle portion of Draft Concept Plan, Pleasant Street, Northampton. September 23, 2015.

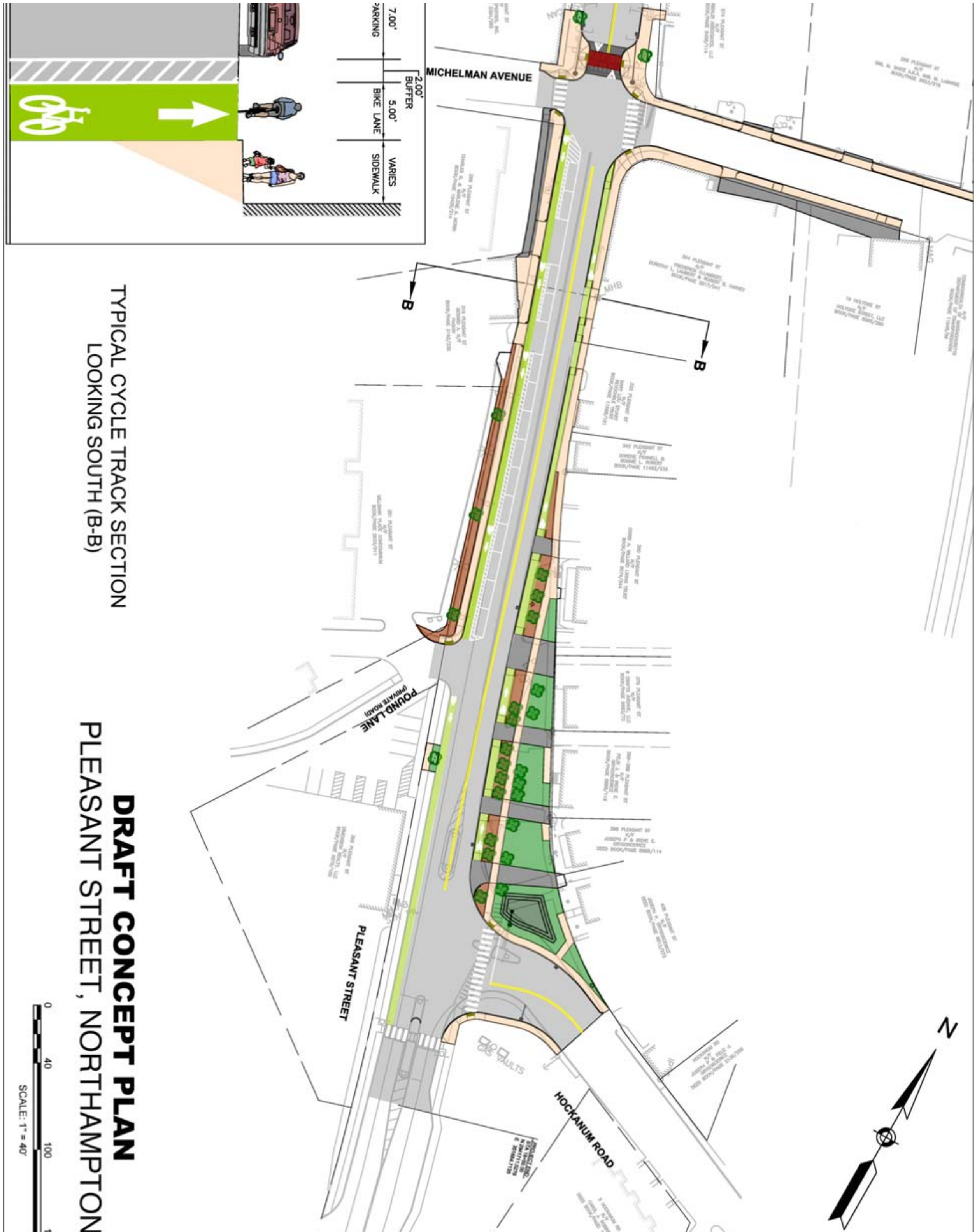

Figure 13: Right portion of Draft Concept Plan, Pleasant Street, Northampton. September 23, 2015.

Study Area--Health Data

We gathered baseline health data for the 01060 zip code of Northampton where Pleasant Street is located, as well as for the surrounding zip codes within two miles of 01060. We choose two miles as our metric because it is a standard planning estimate of how far a typical person will bicycle to a destination for utilitarian purposes.

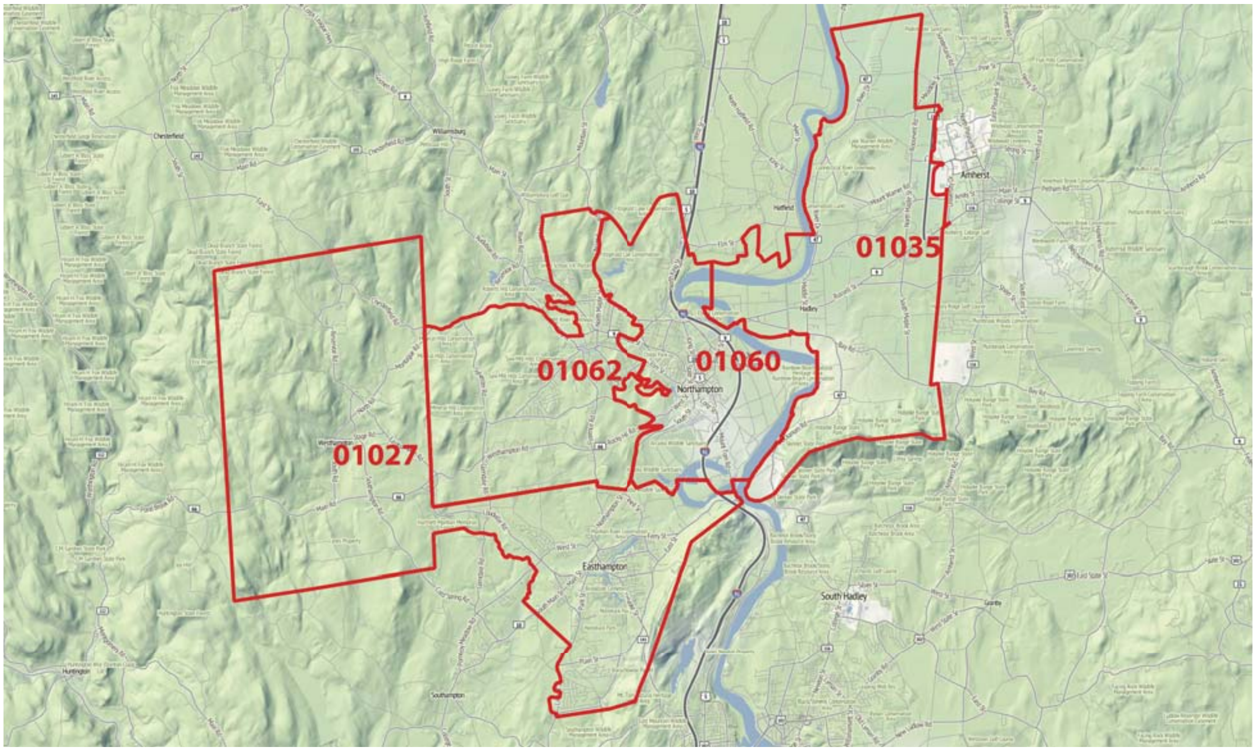

Figure 14: The areas outlined in red show the zip codes for which we gathered health data. 01060 is the primary study area. It includes downtown Northampton (except Smith College) and the remainder of the eastern third of the Northampton.

Data was gathered by Massachusetts Department of Public health from two sources, the Behavioral Risk Factor Surveillance System (BRFSS) data and Hospitalization Data, and analyzed by PVPC. The BRFSS is an annual telephone survey that collects data on health conditions, risk factors, and behaviors.

BRFSS Data

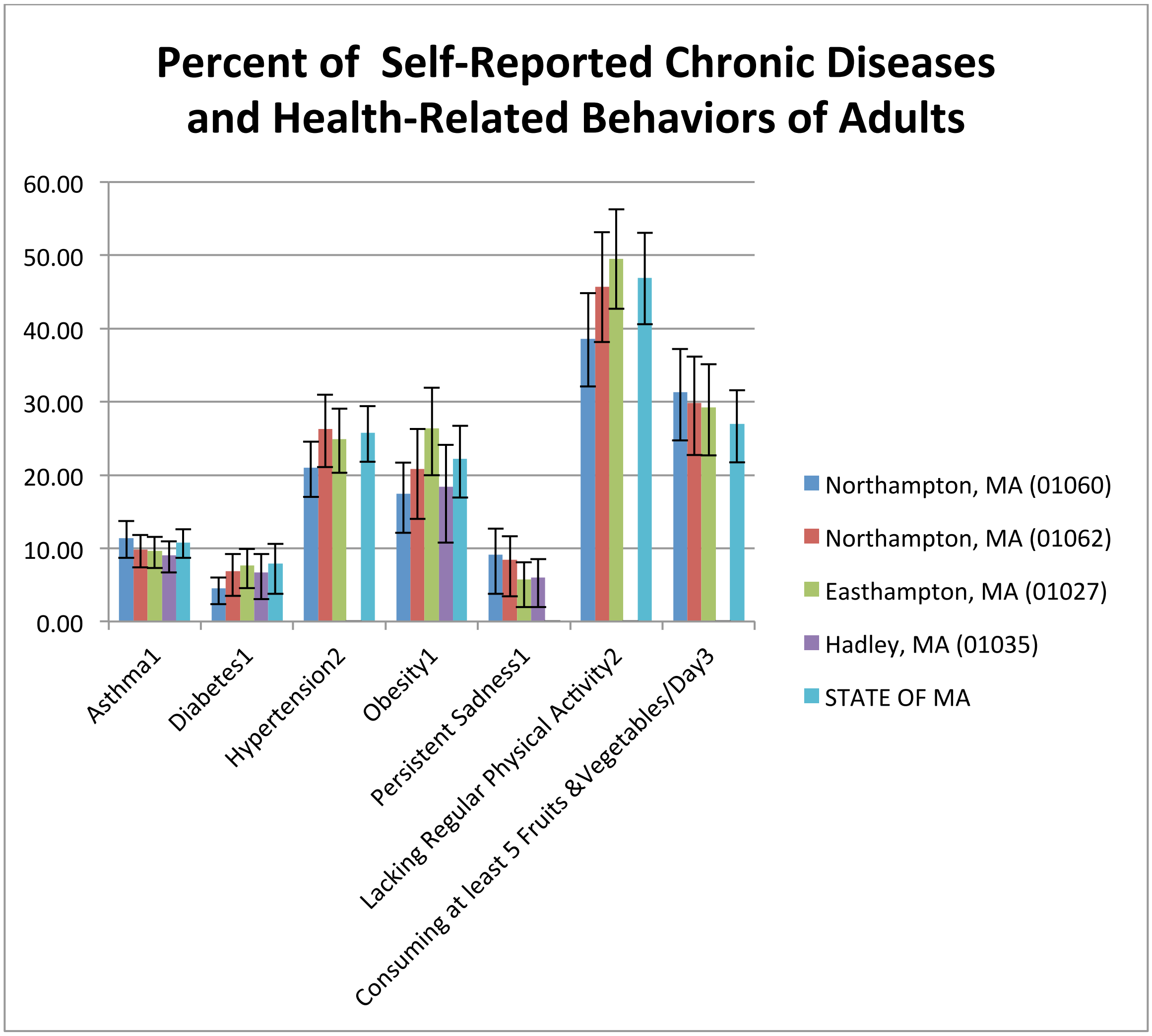

Figure 15: BRFSS data for Northampton and neighboring communities. (1- Source: Behavioral Risk Factor Surveillance System, Calendar Year 2006-2010. 2- Source: Behavioral Risk Factor Surveillance System, Calendar Year 2001, 2003, 2005, 2007, 2009. 3- Source: Behavioral Risk Factor Surveillance System, Calendar Year 2002, 2003, 2005, 2007, 2009). Some data was supressed due to small sample size.

Figure 15 shows the prevalence of common self-reported chronic disease measures and health-related behaviors from BRFSS. The 01060 zip code is relatively healthy compared to the State of Massachusetts, which is in turn healthy compared to the nation as a whole. On most measures, the 01060 zip code is comparable to the surrounding zip codes (01062-Florence/Leeds, 01027-Easthampton, and 01035-Hadley). Compared to neighboring zip codes, 01060 has slightly lower prevalence of Diabetes, Hypertension, and Obesity (all are preventable and positively influenced by physical activity).[1] The 01060 zip code has slightly worse health outcomes compared to its neighbors and the state average for Asthma and Persistent Sadness.

The 01060 zip code has slightly better health behaviors than its neighbors and the state. A lower proportion of residents report that they are Lacking Regular Physical Activity and a higher proportion report that they are Consuming 5 or more Fruits and Vegetables than neighboring areas. Although 01060's rates of health-related behaviors are comparatively good, they still show a much room for improvement: nearly 40% of adults are not getting regular physical activity and only 30% are consuming the recommended 5 servings of fruits and vegetables per day.

None of the observed differences between communities shown by the BRFSS between are statistically significant. The confidence intervals for this data set BRFSS zip code data are relatively large due to small sample sizes.

Hospitalization Data

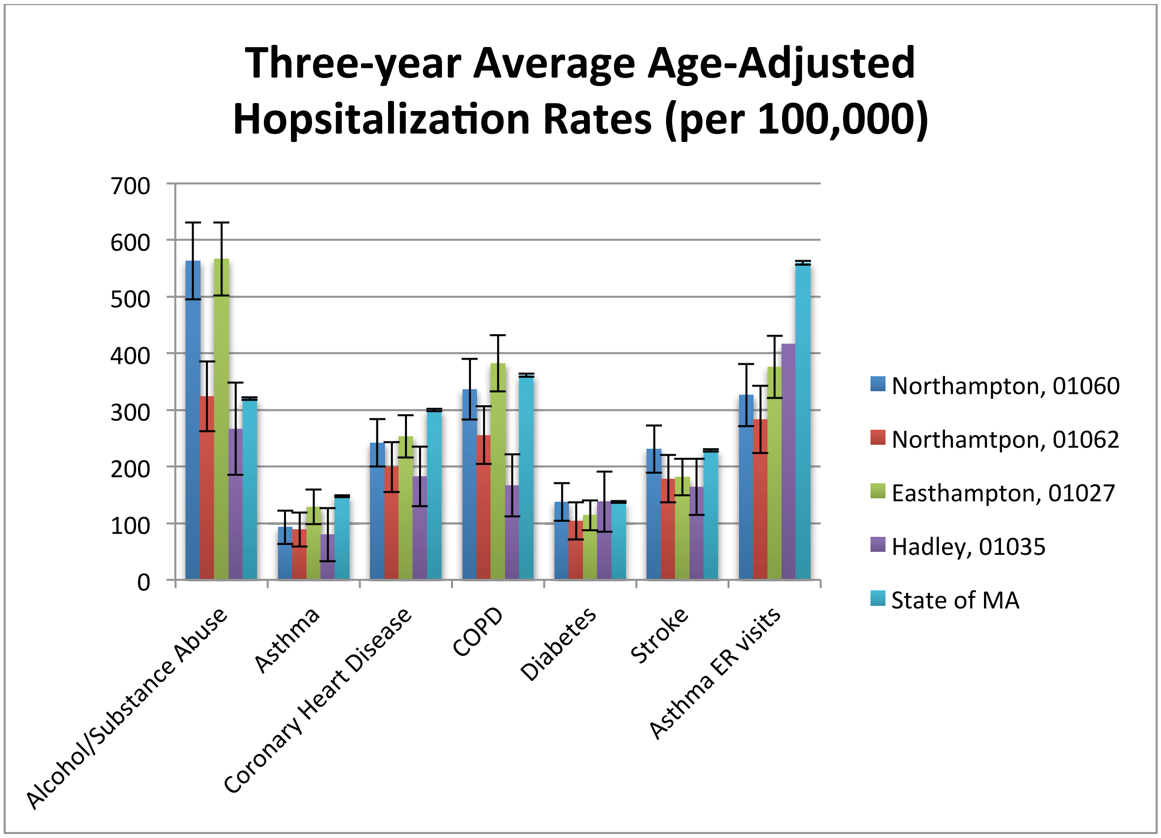

Figure 16: Age-adjusted hospitalization rates for Northampton and neighbors. Source: Center for Health Information Analysis (CHIA), Uniform Hospital Discharge Database System (UHDDS), Inpatient Hospitalization and Emergency Department Data, Calendar Year 2010-2012.

[1] Confidence intervals for this BRFSS zip code data are high due to small sample size and therefore results are not-significant

At 92.85 per 100,000 the Asthma rate for 01060 is significantly lower than the state rate of 147.72 per 100,000. Chronic Obstructive Pulmonary Disease (COPD) is on par with the State and neighborhing zip codes, except Hadley which has lower rates of COPD. Diabetes rates are on par with both the state and neighboring zip codes. Asthma ER visits are significantly better than the state (see Figure 16). Cardiovascular Disease (1168.09 per 100,000) is significantly better than the state (1318.36 per 100,000), but worse than 01062 (888.4 per 100,000). (see Figure 13).

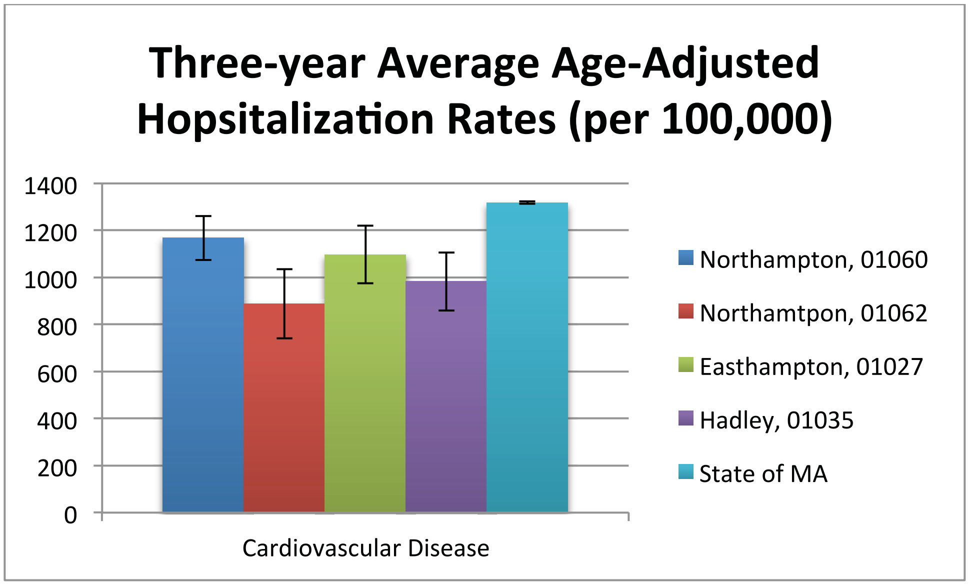

Figure 17: Cardiovascular disease. Age-adjusted hospitalization rates for Northampton and neighbors. Source: Center for Health Information Analysis (CHIA), Uniform Hospital Discharge Database System (UHDDS), Inpatient Hospitalization and Emergency Department Data, Calendar Year 2010-2012.

Alcohol/Substance Abuse are significantly worse than the state average (562.84 vs. 320.01 per 100,000), other parts of Northampton (01062), and Hadley. Rates are on par with Easthampton (see Figure 19). This is supported by anecdotal evidence from personal conversations and input from the Walk Audit, as well as physical evidence. We observed a large number of alcoholic bottles in trash and litter on Pleasant Street (see Figure 18).

Figure 18: Evidence of Alcohol use on Pleasant Street. Nip bottles in a trash can and some of many nip bottles on a lawn on Pleasant Street. Both of these locations are adjacent to a liquor store.

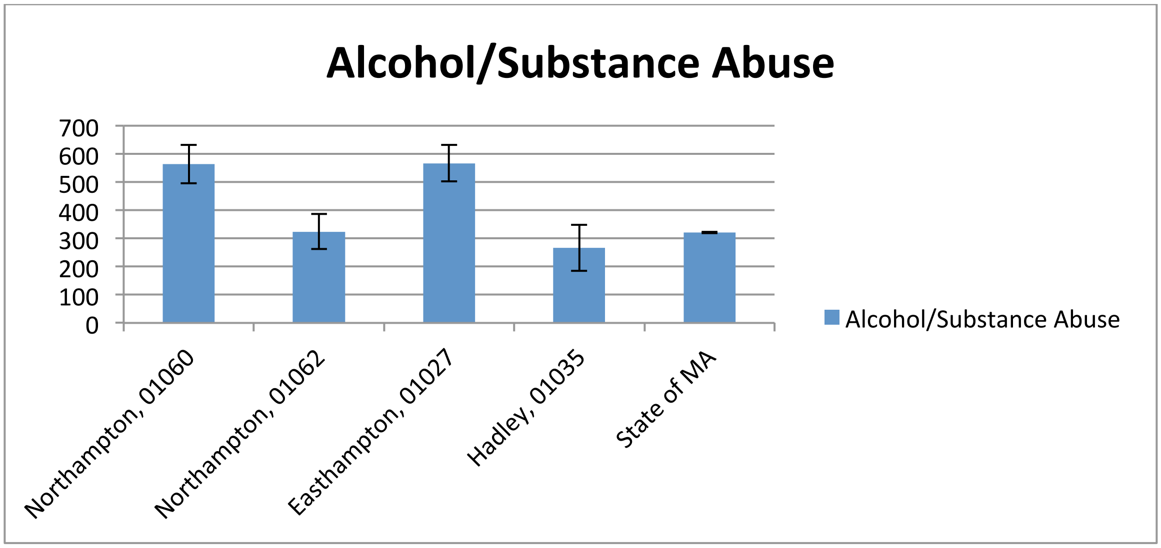

Figure 19: Alcohol/Substance Abuse Rates. Age-adjusted hospitalization rates for Northampton and neighbors. Source: Center for Health Information Analysis (CHIA), Uniform Hospital Discharge Database System (UHDDS), Inpatient Hospitalization and Emergency Department Data, Calendar Year 2010-2012.

Mental Health ER visits are quite significantly worse than the State or its neighbors (see Figure 20). The rate per 100,000 is 3576.31 for 01060 vs. 1048.53 for Hadley and 2195.59 for the state. Mental Health ER visits have the highest rates of the categories described above.

This is supported by anecdotal evidence from stakeholders. Mental health is a key health concern for this HIA.

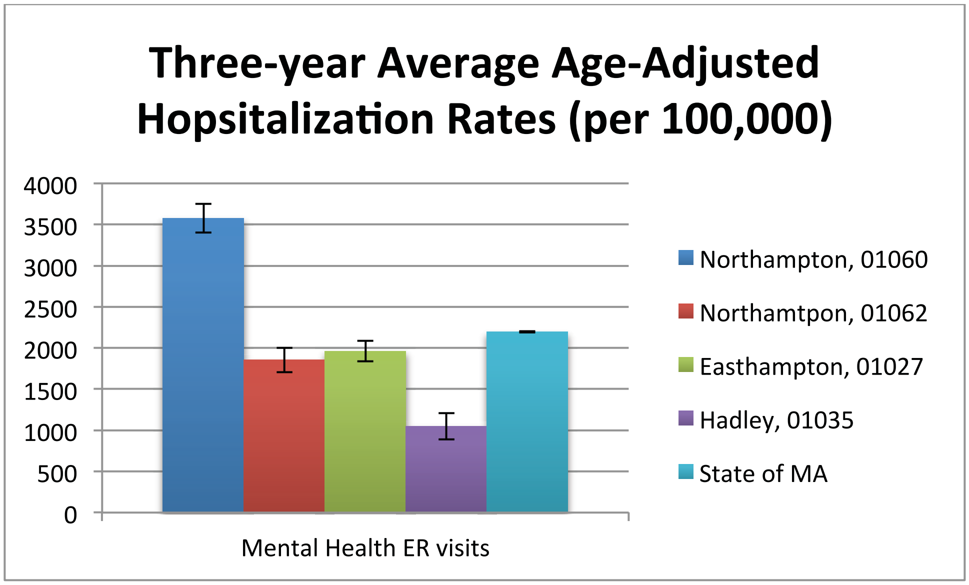

Figure 20: Mental Health ER visits. Age-adjusted hospitalization rates for Northampton and neighbors. Source: Center for Health Information Analysis (CHIA), Uniform Hospital Discharge Database System (UHDDS), Inpatient Hospitalization and Emergency Department Data, Calendar Year 2010-2012.

The HIA advisory committee put forth several hypotheses about the prevalence of mental health disorders in Northampton, including: the legacy of the Northampton State Hospital, the presence of the VA hospital, the presence of the Hampshire County Jail and House of Correction, and the numerous support services and generally supportive attitude provided by the community of Northampton. Homelessness is also likely a factor. The region as whole has high rates of homelessness compared to the state of Massachusetts (Pioneer Valley Planning Commission 2013) and homelessness is strongly associated with alcohol, drug and mental health conditions (Fazel et al. 2008; Fischer and Breakey 1991)

Summary of Baseline Health Conditions

Overall, health in 01060 is on par with neighbors and better than the state for some conditions (Asthma, Cardiovascular disease).

BRFSS data indicates a relatively high level of physical activity and consumption of health food, when compared to the state and surrounding communities, but there is still room for improvement.

Substance abuse and mental health are significant issues in 01060 and should be considered by the HIA.

Differences in health outcomes between the 01060 zip code and its neighbors likely reflect socioeconomic factors more than built environment characteristics. That said, the built environment has the ability to influence the health of people (plus or minus) from what would be expected given their socioeconomic status.

Even if rates for some health outcomes are better in 01060 than for the state as a whole, there is always room for improvement.

Study Area--Demographic Data

All data is for the 01060 zip code unless otherwise noted.

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
SEX AND AGE				
Total population	15,026	+/-513	15,026	(X)
Male	6,104	+/-388	40.6%	+/-2.2
Female	8,922	+/-460	59.4%	+/-2.2
Under 5 years	480	+/-144	3.2%	+/-1.0
5 to 9 years	697	+/-201	4.6%	+/-1.3
10 to 14 years	565	+/-125	3.8%	+/-0.8
15 to 19 years	1,405	+/-238	9.4%	+/-1.5
20 to 24 years	1,992	+/-317	13.3%	+/-2.0
25 to 34 years	2,702	+/-365	18.0%	+/-2.4
35 to 44 years	1,624	+/-244	10.8%	+/-1.6
45 to 54 years	1,873	+/-229	12.5%	+/-1.5
55 to 59 years	892	+/-197	5.9%	+/-1.3
60 to 64 years	855	+/-193	5.7%	+/-1.3
65 to 74 years	1,184	+/-173	7.9%	+/-1.1
75 to 84 years	373	+/-97	2.5%	+/-0.6
85 years and over	384	+/-110	2.6%	+/-0.7
Median age (years)	34.2	+/-1.2	(X)	(X)
18 years and over	12,907	+/-464	12,907	(X)
Male	4,995	+/-349	38.7%	+/-2.2
Female	7,912	+/-393	61.3%	+/-2.2
RACE				
One race	14,767	+/-517	98.3%	+/-0.7
White	12,371	+/-499	82.3%	+/-3.3
Black or African American	655	+/-265	4.4%	+/-1.7
American Indian and Alaska Native	38	+/-32	0.3%	+/-0.2
Asian	1,358	+/-343	9.0%	+/-2.2
Native Hawaiian and Other Pacific Islander	8	+/-13	0.1%	+/-0.1
Some other race	337	+/-284	2.2%	+/-1.9
Two or more races	259	+/-100	1.7%	+/-0.7

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
HISPANIC OR LATINO AND RACE				
Hispanic or Latino (of any race)	1,190	+/-356	7.9%	+/-2.3
Not Hispanic or Latino	13,836	+/-577	92.1%	+/-2.3

Table 1: Demographics of Study Area showing Sex, Age and Race. Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey

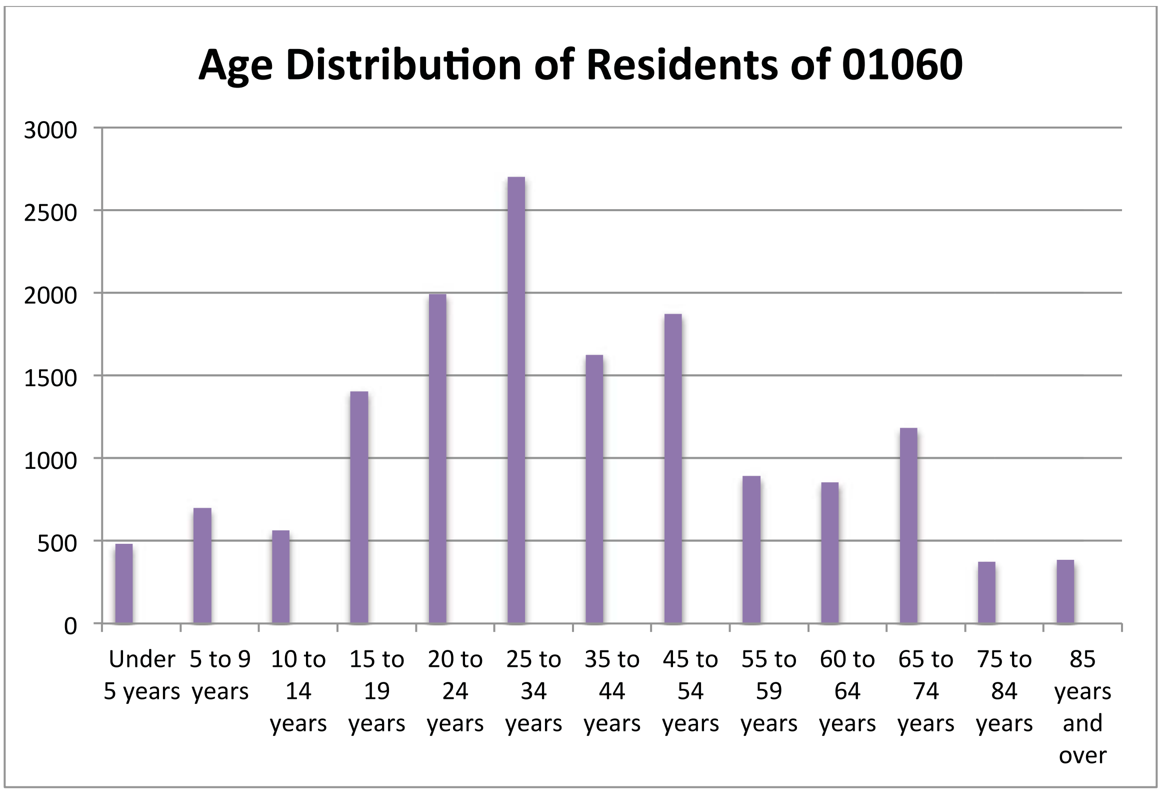

Figure 21: Age Distribution of Residents in 01060. Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey

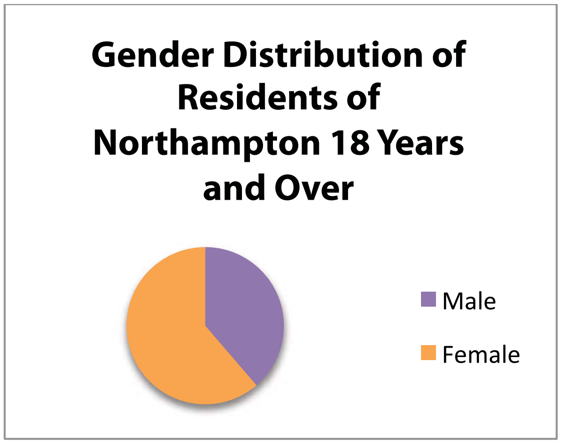

Figure 22: Gender distribution of residents of Northampton 18 years and over. Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey

Subject	Number	Percent
HOUSING OCCUPANCY		
Total housing units	7,307	100.0
Vacant housing units	525	7.2
Homeowner vacancy rate (percent)	1.8	(X)
Rental vacancy rate (percent)	4.0	(X)
HOUSING TENURE		
Occupied housing units	6,782	100.0
Owner-occupied housing units	2,819	41.6
Population in owner-occupied housing units	6,202	(X)
Average household size of owner-occupied units	2.20	(X)
Renter-occupied housing units	3,963	58.4
Population in renter-occupied housing units	7,023	(X)
Average household size of renter-occupied units	1.77	(X)

Table 2: Housing characteristics in the study area. Source: U.S. Census Bureau, 2010 Census.

	ZCTA5 01060			
Subject	Estimate	Margin of Error	Percent	Percent Margin of Error
EMPLOYMENT STATUS				
Population 16 years and over	13,217	+/-461	13,217	(X)
In labor force	9,491	+/-488	71.8%	+/-2.5
Percent Unemployed	(X)	(X)	6.9%	+/-1.7
Not in labor force	3,726	+/-351	28.2%	+/-2.5

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
COMMUTING TO WORK				
Workers 16 years and over	8,637	+/-507	8,637	(X)
Car, truck, or van -- drove alone	4,776	+/-428	55.3%	+/-3.8
Car, truck, or van -- carpooled	621	+/-166	7.2%	+/-1.9
Public transportation (excluding taxicab)	403	+/-166	4.7%	+/-1.9
Walked	1,533	+/-251	17.7%	+/-2.7
Other means	455	+/-147	5.3%	+/-1.7
Worked at home	849	+/-216	9.8%	+/-2.3
Mean travel time to work (minutes)	20.4	+/-1.4	(X)	(X)
INCOME AND BENEFITS (IN 2013 INFLATION-ADJUSTED DOLLARS)				
Total households	6,471	+/-252	6,471	(X)
Less than $10,000	366	+/-115	5.7%	+/-1.8
$10,000 to $14,999	564	+/-160	8.7%	+/-2.5
$15,000 to $24,999	750	+/-165	11.6%	+/-2.5
$25,000 to $34,999	647	+/-143	10.0%	+/-2.1
$35,000 to $49,999	816	+/-186	12.6%	+/-2.8
$50,000 to $74,999	1,131	+/-209	17.5%	+/-2.9
$75,000 to $99,999	743	+/-155	11.5%	+/-2.3
$100,000 to $149,999	725	+/-138	11.2%	+/-2.1
$150,000 to $199,999	335	+/-110	5.2%	+/-1.7
$200,000 or more	394	+/-91	6.1%	+/-1.4
Median household income (dollars)	52,607	+/-4,194	(X)	(X)
Mean household income (dollars)	76,042	+/-6,869	(X)	(X)
With earnings	5,326	+/-303	82.3%	+/-3.2
Mean earnings (dollars)	73,371	+/-4,446	(X)	(X)
With Social Security	1,479	+/-198	22.9%	+/-2.8
Mean Social Security income (dollars)	15,483	+/-1,559	(X)	(X)
With retirement income	802	+/-156	12.4%	+/-2.4
Mean retirement income (dollars)	24,598	+/-4,934	(X)	(X)
With Supplemental Security Income	383	+/-140	5.9%	+/-2.2
Mean Supplemental Security Income (dollars)	8,678	+/-1,333	(X)	(X)

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
With cash public assistance income	180	+/-75	2.8%	+/-1.2
Mean cash public assistance income (dollars)	6,091	+/-3,141	(X)	(X)
With Food Stamp/SNAP benefits in the past 12 months	714	+/-135	11.0%	+/-2.1
HEALTH INSURANCE COVERAGE				
Civilian noninstitutionalized population	14,741	+/-518	14,741	(X)
With health insurance coverage	14,142	+/-512	95.9%	+/-1.3
With private health insurance	11,359	+/-516	77.1%	+/-2.8
With public coverage	4,260	+/-472	28.9%	+/-2.9
No health insurance coverage	599	+/-193	4.1%	+/-1.3
PERCENTAGE OF FAMILIES AND PEOPLE WHOSE INCOME IN THE PAST 12 MONTHS IS BELOW THE POVERTY LEVEL				
All families	(X)	(X)	8.8%	+/-4.2
All people	(X)	(X)	17.4%	+/-3.7

Table 3: Various demographic details in the study area. Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey

Vehicles Available	Estimate	Margin of Error	Percent	Percent Margin of Error
Occupied housing units	6,471	+/-252	6,471	(X)
No vehicles available	745	+/-161	11.5%	+/-2.5
1 vehicle available	3,556	+/-260	55.0%	+/-3.3
2 vehicles available	1,659	+/-199	25.6%	+/-2.8
3 or more vehicles available	511	+/-126	7.9%	+/-1.9

Table 4. Vehicles available to household in the study area. Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey. Data for zip code 01060

More complete demographic information can be found in the Appendix.

Part II: Assessment

Intro to Health Pathways

This HIA is based on a model developed by Metropolitan Area Planning Council (MAPC) for the HIA, *Transit-Oriented Development and Health: A Health Impact Assessment to Inform the Healthy Neighborhood Equity Fund,* hereafter HNEF ("Healthy Neighborhoods Equity Fund HIA | Metropolitan Area Planning Council" 2015). The HNEF HIA identified 12 key pathways linking neighborhood development and health based on stakeholder input and literature reviews. The pathways are broadly applicable to HIAs that relate to land use, economic development, or transportation planning.

Figure 23: Pathways linking neighborhood development and health from HNEF HIA

The following diagram, also from the HNEF HIA, illustrates how changes in the built environment can impact health outcomes.

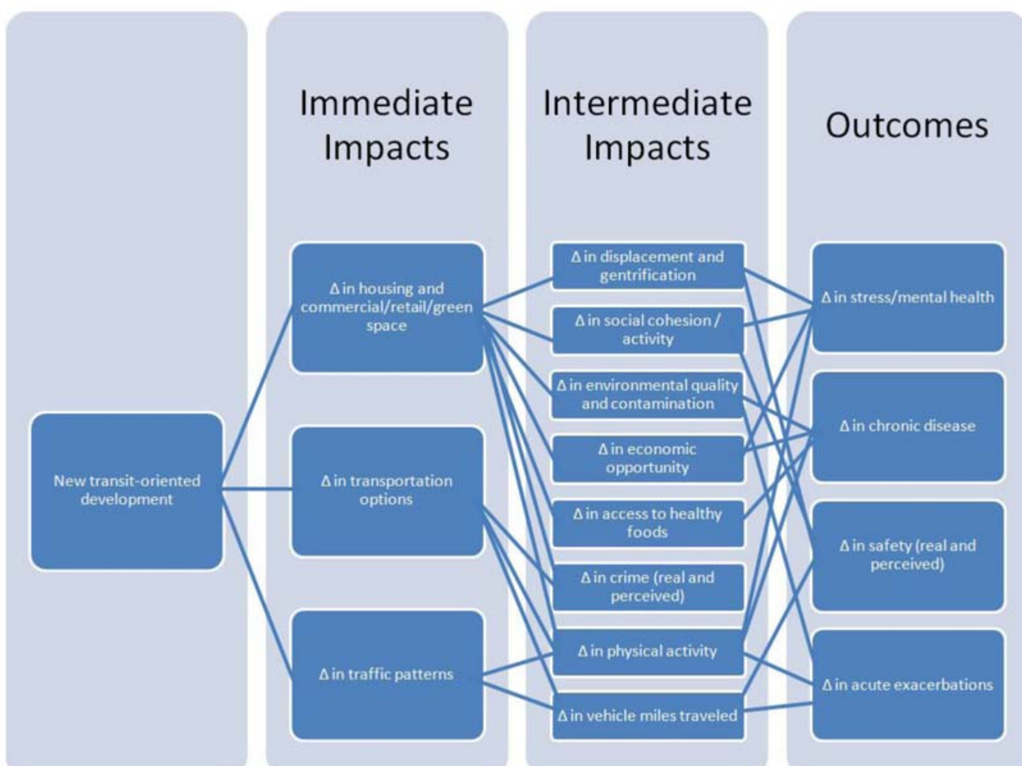

Figure 24: Pathways diagram from HNEF HIA.

This Pleasant Street Improvements HIA used the HNEF pathways as a starting point for our scoping discussions. During Advisory Committee meetings, and the walk-audit/public forum we discussed which pathways were most important to assess for this HIA. The walk-audit was designed to ensure that social and economic determinants of health were addressed—they could easily be missed when discussing a street improvement project—by planting speakers along the route who were asked to address some of the social and economic pathways above: social cohesion, economic opportunity, affordable housing (see the appendix for the walk audit map which describes topic areas). The walk-audit concluded with a dotting exercise in which participants prioritized the most important pathways to assess. The top priorities were clear: Walkability/Active Transportation, Safety from Traffic and Affordable Housing. These pathways were also quite well aligned with the decision at hand and the type of information the City thought would help their decision making. The project team decided to assess a fourth pathway—Greenspace/Greenery—based on its relevance to the decision at hand and preliminary literature reviews which revealed that greenspace has numerous co-benefits in addition to health benefits (James F. Sallis et al. 2015).

Figure 25: Focus areas for the HIA as ranked by Walk Audit participants. Active Transportation, Safety from Traffic, and Affordable Housing were clear priorities.

Pathways Linking Pleasant Street Improvements and Health

Pathways are used to consider links between the proposed change and health impacts. The pathways represent a systems approach to discovering the potential impacts that a plan, policy, or project may cause, from immediate impacts to long-term health outcomes. The main pathways that this HIA evaluates include:

Active Transportation – includes the number of pedestrian and bicyclist trips (including walking and bicycling that is part of a trip using another mode, for example walking to a bus stop).
Safety from Traffic – focuses on the number and severity of traffic-related crashes, injuries, and fatalities.
Affordable Housing – examines changes in the availability of affordable housing in the Pleasant Street area, shifting demographics, and changes in susceptible populations.
Green Space (including street trees and parklets) – includes exposure to green, natural environments.

These pathways describe how streetscape improvements can lead to health and health-related outcomes such as routine physical activity; traffic-related crashes and subsequent injuries or fatalities; and mental health including depression.

In Part II, we discuss these pathways. For each pathway, we describe the pathway from the Pleasant Street Improvement proposal to a potential health outcome, profile the existing conditions relevant to the pathway, explain our methodology for estimating the effect of the proposal on the pathway, evaluate either quantitatively or qualitatively how the proposal will impact the pathway, and provide a summary on the overall impact of the project on the pathway.

Literature Review Methods

All literature reviews were primarily conducted through PubMed and Google Scholar to identify the established links between the pathway in question and health. Literature and research reviewed included peer-reviewed articles, gray literature, and official government documents. Additional methods and/or search terms for each individual pathway are listed below.

Pathway	**Additional Pathway-Specific Literature Review Methods**
Active Transport	Within the Active Transport literature review, the team examined the body of evidence specific to how elements of street design can affect health behaviors related to active transport, including routine walking and bicycling.
Safety from Traffic	For the Safety from Traffic pathway, we conducted a literature review to identify how street design can reduce the potential for conflicts between vehicles and pedestrians or cyclists.

Affordable Housing	The literature review for the affordable housing pathway focused on the links between access to affordable housing and health.
Green Space (including Street Trees and Parklets)	For this pathway, we assessed the emerging literature linking exposure to green spaces, including street trees and parklets, to health outcomes, including physical activity, mental health, air quality, and social interactions.

Table 5: Literature Review Methods for Pathways

Pathway 1: Active Transportation

Background

The health benefits of routine physical activity have been well established, yet less than half (48%) of all adults meet the Surgeon General's recommended minimum of 30 minutes of moderate intensity physical activity on most days of the week (Centers for Disease Control and Prevention 2010; Besser and Dannenberg 2005; Freeland et al. 2013). A recent study by Lee et al. (2012) estimates that physical inactivity causes 6% of the global burden of disease from coronary heart disease, 7% of type 2 diabetes, 10% of breast cancer, 10% of colon cancer, 9% of premature mortality. If inactivity were decreased by 10% to 25%, between 533,000 and 1.3 million deaths could be prevented worldwide every year (Lee et al. 2012).

In recent years, consistent research has linked features of the built environment to active transport, defined as walking, biking, and public transportation (which typically requires some walking or biking). This literature demonstrates that active transport correlates with characteristics including: density, mixed land-use, availability of destinations, street design, and distance to transit (Ewing and Cervero 2010; Freeman et al. 2012; Giles-Corti et al. 2013; McCormack and Shiell 2011; Litman 2013). Supported by concepts from the field of transportation planning, land use patterns shape the proximity of destinations and transportation systems connect destinations, which together determine the feasibility of walking, cycling, or mass transit use. Neighborhoods that have higher population densities, access to destinations, more grid-like street patterns, and access to high quality bicycle and pedestrian infrastructure are positively associated with physical activity. Additionally, several studies show that walking to and from transit help people meet physical activity recommendations (Besser and Dannenberg 2005; Freeland et al. 2013; Lachapelle et al. 2011). Furthermore, there is emerging research that housing type and tenure, local and sub-regional density, bus service, and off- and on-street parking availability play a more important role than rail access (Chatman 2013).

In sum, there is convincing evidence that the built environment is associated with physical activity and active transport, although it is important to note that most studies are cross-sectional and observational (Ewing and Cervero 2010; Freeman et al. 2012; McCormack and Shiell 2011; Ding and Gebel 2012).

Previous HIAs have revealed that the health economic benefits of increased physical activity are quite substantial and that these benefits are typically larger than the health economic value of the other pathways this HIA assesses (Mueller et al. 2015). For this reason, Active Transportation was given by far the most attention in the assessment phase of this HIA.

Baseline Conditions—Active Transportation

Existing Mode Share in Northampton

The best available data for travel patterns in Northampton comes from two sources. The American Community Survey (ACS), administered by the US Census Bureau, measures the breakdown of "means of transportation to work for adults over 16" and is available at the zip code level. The Massachusetts Travel Survey included several measures of active transportation. Data is only available at the regional level.

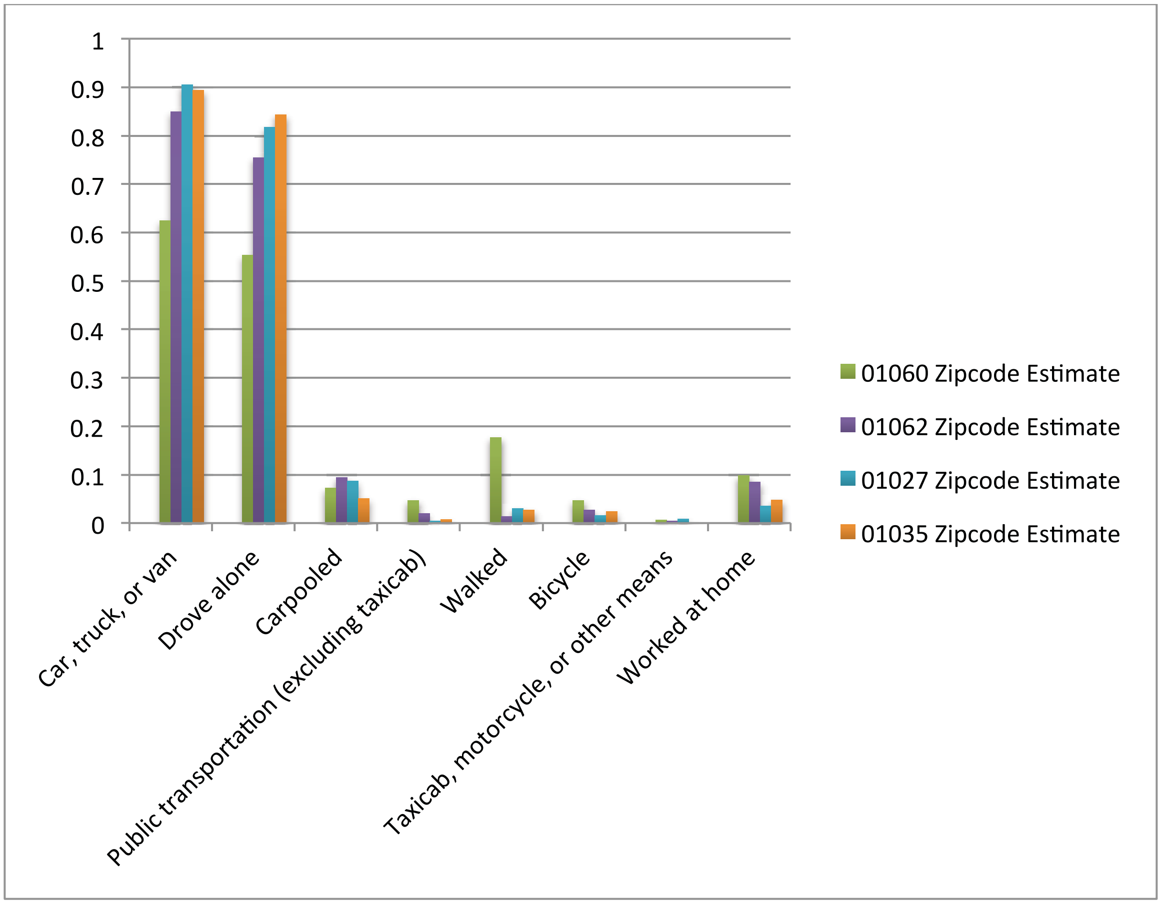

Figure 26: 2009-2013 American Community Survey Means of Transportation to Work

The 2009-2013 American Community Survey shows mode share for various forms of travel to work. In The graph above shows all zip codes within 2 miles (biking distance) of Pleasant Street. **The area immediately surrounding Pleasant Street (01060-downtown Northampton) has by far the greatest percentage of people walking to work, significantly more people bicycling or taking public transportation to work and more working from home. The combination of those modes results in significantly fewer people driving alone to work as compared to neighboring zip codes.**

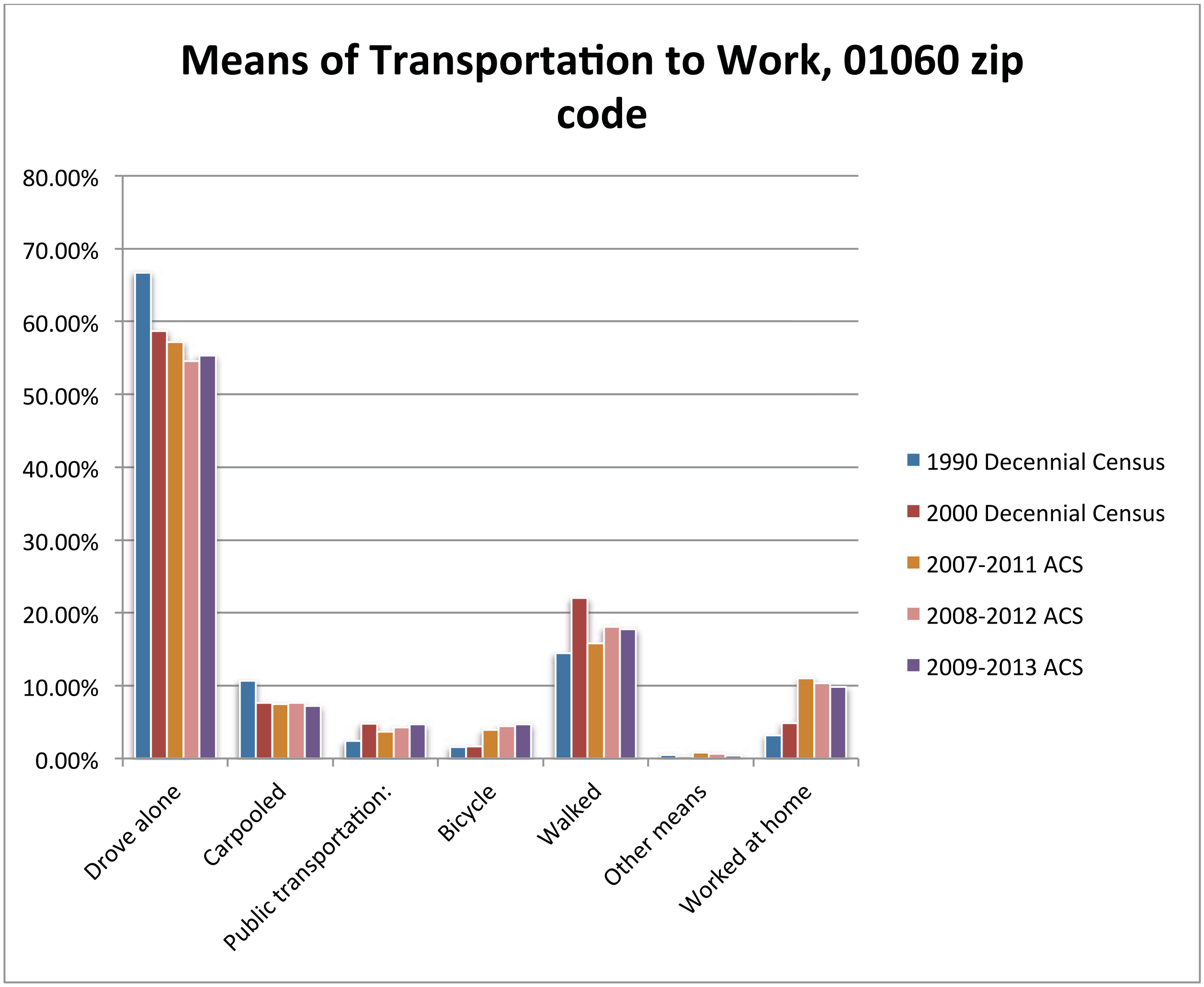

Figure 27: Change in Mode Share over time for Northampton

Figure 27 shows trends in mode share over time for the 01060 zip code. **The trend in the 01060 zip code is toward a decrease in driving alone, increasing levels of bicycling and working at home.** The evidence on walking shows general increases in people walking to work, with a large spike in 2000 that has not been reached again since (although this may be due to changes in sampling methodology from the Decennial Census to the ACS, particularly that the Decennial Census collects data only in April—a nice month to walk—while the ACS collects year round). Public transportation, carpooling, and other means are likely holding steady.

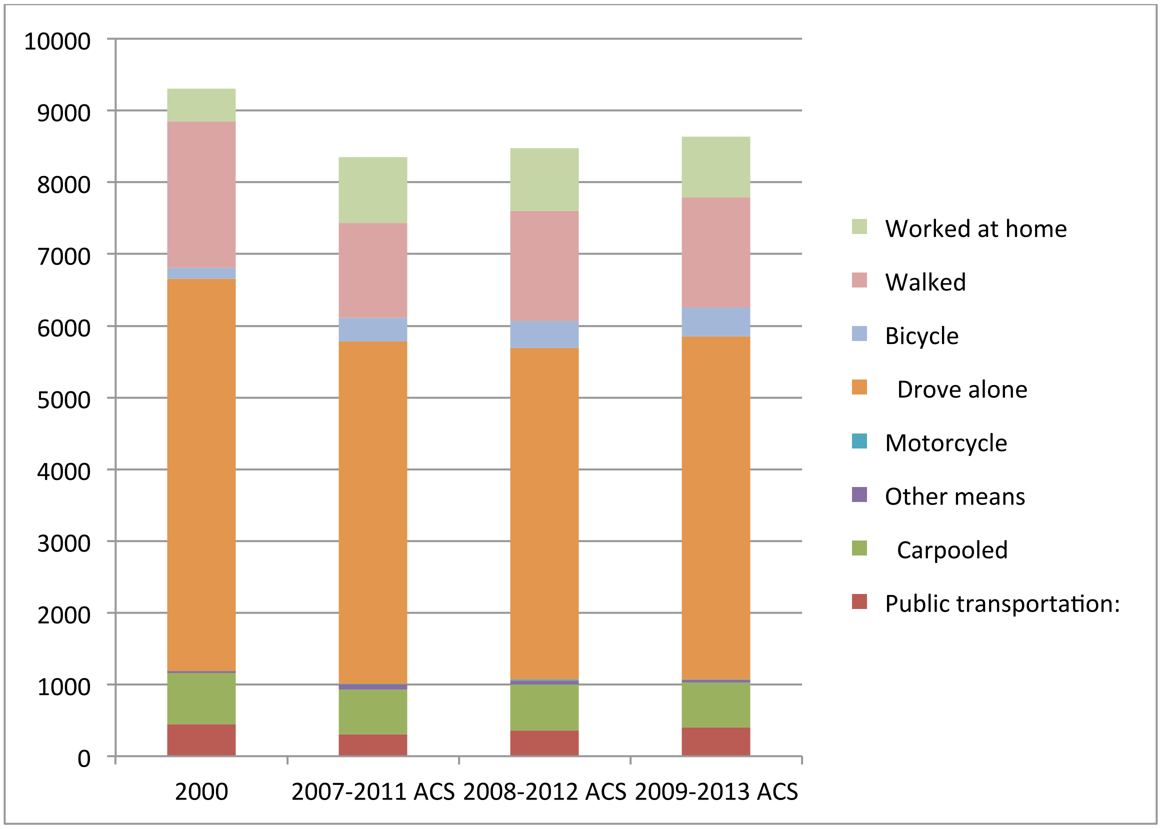

Figure 28: Change in Mode Share over time for Northampton

Overall, the number of workers in Northampton has declined from about 9,300 in 2000 to about 8,500 for the latest ACS count, which is about an 8.5% drop (which may be due to a sampling difference between the decennial census and the ACS). The percentage of commuters who are driving declined by about 4%, from 66.3% of commuters in 2000 to 62.5% in latest ACS. The percentage of walkers also declined about 4% from 22% of commuters in 2000 to 17.75% in 2013 (again, this may reflect sampling differences between the decennial census and the ACS). Bicyclists increased about 3% from 1.65% of commuters in 2000 to 4.7% for the latest ACS. **There are nearly 3 times more bicycle commuters in 01060 than there were 13 years ago.**

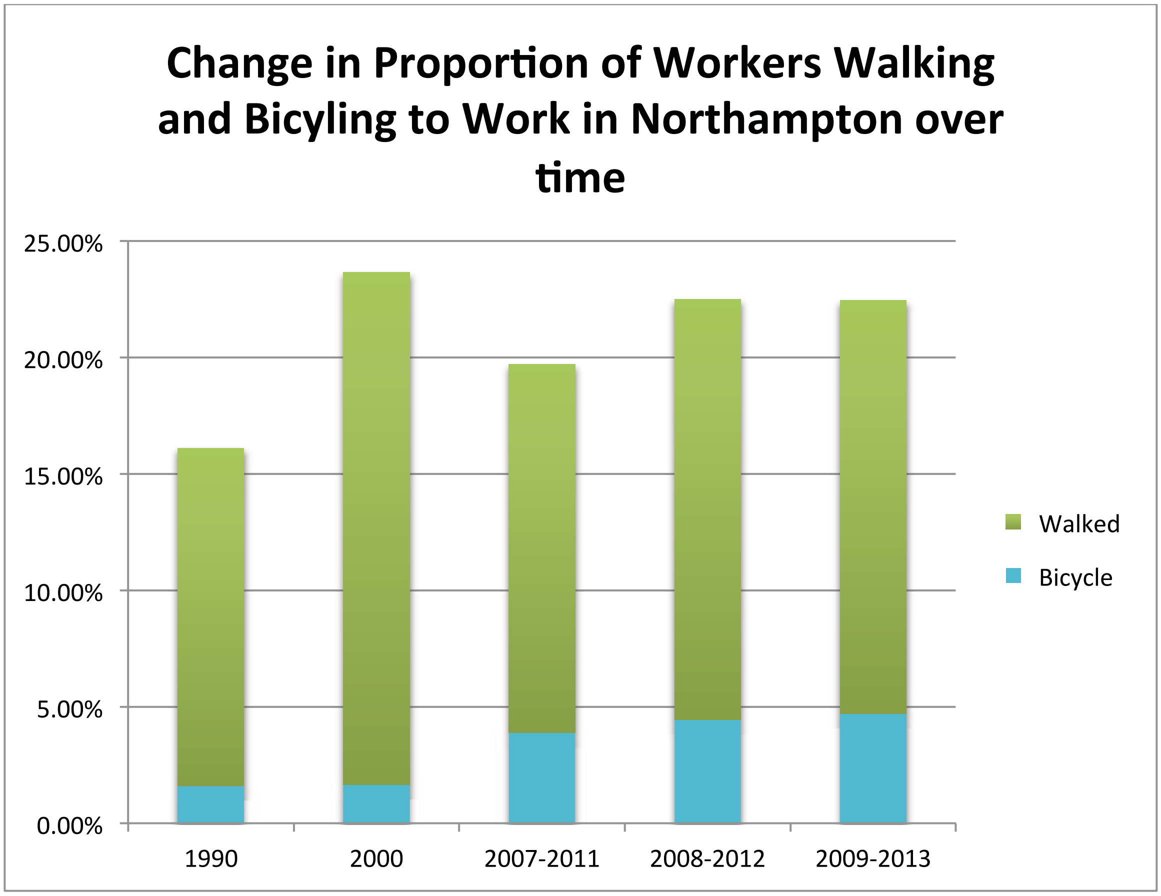

Figure 29: Changes in active transportation trips Northampton over time

After a large jump from 1990 to 2000, the number of active commuters has held relatively steady, while driving alone workers have fallen. **The number of bicycle commute trips is growing at a faster rate than walking commute trips.** From this data, it is unclear whether bicycle commute trips are replacing walking or whether they are be adding to the total number of active commuters.

Compared to the region, residents of Northampton's 01060 zip code walk and bike to work significantly more than average. The regional average is about 4.5% walking and 1.3% biking to work . **Northampton's percent of active commuters is 3 to 4 times greater than the regional average.**

PVPC-60: All Trip Modes (Weighted)

Transportation Mode	Count	Percent
Walk	321837	13.6%
Bike	29757	1.3%
Auto/Van/Truck Driver	1295841	54.8%
Auto/Van/Truck Passenger	558839	23.6%
Public Bus	75832	3.2%
Train	3525	0.1%
Dial-A-Ride/Paratransit	8062	0.3%
Taxi	5094	0.2%
School bus	60887	2.6%
Motorcycle Driver	2280	0.1%
Motorcycle Passenger	678	0.0%
Other, SPECIFY	3802	0.2%
Total	2366432	100.0%

PVPC-61: Mode to Work (Weighted)

Mode to Work	Count	Percent
Works from home	15493	5.5%
Walk	12485	4.5%
Bike	3726	1.3%
Auto/Van/Truck Driver	211362	75.6%
Auto/Van/Truck Passenger	20511	7.3%
Bus / Public Transit	10716	3.8%
Dial-A-Ride/Paratransit	644	0.2%
Motorcycle Driver	159	0.1%
Other, SPECIFY	2857	1.0%
Don't Know	1067	0.4%
Refused	682	0.2%
Total	279701	100.0%

Table 6: Mass Travel Survey. Selected tables showing results for PVPC region

In the Pioneer Valley region as a whole, people report walking far more for non-work trips than for work trips (Table 6). They walk for about 13.6% of all trips, while they only walk for 4.5% of work trips. It is important to note that in the Pioneer Valley only 7.6% of trips are related to work, so mode share for "all trips" is far more representative of overall travel behavior than mode share for work commute trips. **If the regional pattern holds true for Northampton—that people make about 3 times as many non-work walking trips as work walking trips—then we can estimate that residents of the 01060 zip code may make upwards of 50% of all trips by walking.[2]**

There is no data source that documents the overall number of bicycle trips made by residents of 01060. The Massachusetts Travel Survey provides the best available data for non-work bicycle trips—with data available for the region and state, but finer scales. For the region as whole, the bicycle mode share for work-trips and "all trips" was the same (1.3%). By contrast, for the state overall, the percentage of bicycle trips to work was higher than percentages of bicycle trips for "all trips." This contradictory evidence points to the difficulty of extrapolating from bicycle mode share to mode share for all trips. This is compounded by the uniqueness of Northampton's bike path network. The city's rail trails provide long-distance low-stress routes that are suitable for both recreational and functional riding by a wide range of cyclists. Those routes have access points that are close to relatively dense residential neighborhoods, connect to job clusters (downtown Northampton, Florence, Easthampton, Amherst, Hadley, Smith College, Northampton Industrial Park, Village Hill, Leeds VA Medical Center, and UMass), and goods and services (downtown Northampton, King Street,

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[2] Walking commute share for Northampton is 17.75%. The percent of all trips made by walking in Northampton is unknown. So we can extrapolate from the regional pattern to the local one. The regional ratio of "walking for all trips" to "walking for work trips" in the Pioneer Valley is 13.6% / 4.5 = 3.02. We multiply 3.02 by 17.75%, which gives us 53.6% as an estimate of the percentage of all trips made by walking in 01060.

Florence, Easthampton, Hadley, Amherst). Given that commuters in Northampton are demonstrating increasing use of bicycles, it is reasonable to conclude that they are also choosing to take a larger percentage of non-work trips by bike as well.

The lack of data recording overall bike trips is a well-known problem. A study published in the Transportation Research Record proposed a method for estimating overall bicycle trips from census commute to work data (Barnes and Krizek 2005). The study compared census commute to work data with actual counts of bicyclists in the Twin Cities, Minnesota as well as data from 15 metropolitan statistical areas (MSAs) and 34 states. They found that commute trips were a good indicator of the overall level of bicycling—in other words one can extrapolate from commute trips to get a reasonable estimate of all trips by bicycle per day. Their study showed that following equation provided a reasonable estimate of bicycle trips:

$$A = 0.3\% + 1.5 * C$$

A is the percentage of adults who ride a bicycle in a day and C is the bicycle commute share from the census "Means of Transportation to Work" table.

Using the formula above for 01060, **we can estimate that 7.35% of adults make a bicycle trip daily** (7.35%= .3% + 1.5 *4.7%). In 2013, the adult population of the 01060 zip code in 2013 was 11,122(U.S. Census Bureau 2015b), so **about 817 adult residents of 01060 ride a bicycle per day**.

Pleasant Street Traffic Count Data

PVPC conducted traffic counts on Pleasant Street using two methods. Vehicle trips were counted using an Automatic Traffic Recorder (ATR) at two locations: Pleasant Street south of the intersection with Hockanum Road, and Pleasant Street south of the intersection with Pearl Street (see Figure 30). The ATR was in place at the Hockanum Road intersection from the 19th through the 21st of May. The ATR was active at the Pearl Street intersection from the 2nd through the 29th of June. It is important to note that these dates fell after many college students left the region for the summer, so the counts may be somewhat low compared to traffic volumes in September-early May when school is in session.

Pedestrian and bike trips were counted manually at the intersection of Pleasant Street and the New Haven and Northampton Canal Line Rail Trail (hereafter NH&NCL Rail Trail) on June 3, 2015 from 4:00 p.m. to 5:45 p.m. (see Figure 30). The Turning Movement Count (TMC) recorded the direction of travel for all bikes and pedestrians entering the intersection.

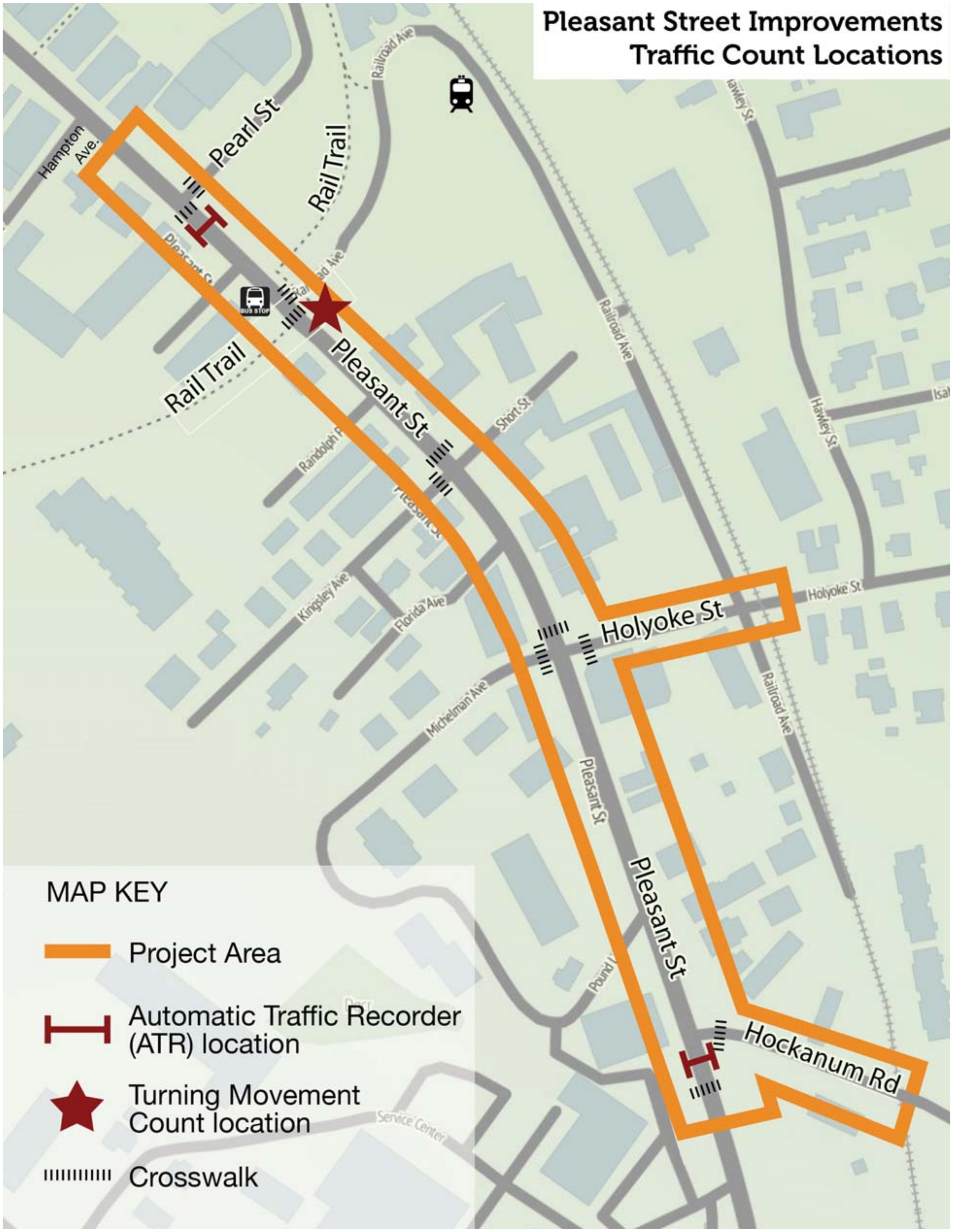

Figure 30: PVPC Traffic Count Locations

Comparing the peak hour volumes for motor vehicles, pedestrians and bicyclists on Pleasant Street confirms the commute mode share data from the Census. The P.M. peak hour volume for motor vehicle traffic just south of Pearl Street was 755, while there were 152 pedestrians (20%) and 38 bicyclists. **Pedestrians make up about 16% of the traffic volume of Pleasant Street at peak hour, while bicyclists contribute 4% of the peak hour traffic. Pedestrians and bicycles represent 20% of the traffic at peak hours on Pleasant Street.**

Motor Vehicles, Peak Hour Traffic Count
Pleasant St., south of Hockanum Rd.

	North	South	Total
AM	464	669	**1133**
PM	616	638	**1254**

Average Daily Traffic: 15,219

Motor Vehicles, Peak Hour Traffic Count
Pleasant St., south of Pearl St.

	North	South	Total
AM	456	344	**800**
PM	377	378	**755**

Average Daily Traffic: 11,412

Table 7 and Table 8

Walkers & Bicyclists, Peak Hour Traffic Count
Pleasant St. at Manhan Rail Trail crossing (PM)

	North	South	East	West	Total
Walkers	83	69	24	36	**212**
Bicyclists	15	23	24	25	**87**
					299

Table 9

A large number of pedestrians and bicycles are also using the NH&NCL Rail Trail, where PVPC recorded about 60 pedestrians at peak hour and 50 bicycles at peak hour. While there are nearly three times as many pedestrians on Pleasant Street at peak hour than on the NH&NCL Rail Trail (152 on Pleasant St versus 60 on the NH&NCL Rail Trail), a greater percentage of bicyclists are traveling on the NH&NCL Rail Trail—50 bicyclists on the NH&NCL Rail Trail versus 38 on Pleasant Street. This appears to indicate the **bicyclists choose to use the NH&NCL Rail Trail over the street when possible**. This is supported by examining the respective directional choices pedestrians and bikes made at the intersection of the NH&NCL Rail Trail and Pleasant Street. The majority of pedestrians on Pleasant Street choose to stay on Pleasant Street, while the majority of pedestrians on the trail also choose to turn onto Pleasant Street. For bicyclists the opposite is true. The majority of bicyclists on Pleasant Street choose to turn onto the Trail while the majority of bicyclists on the Trail choose to stay on the trail rather than turn onto Pleasant Street. This seems to indicate that bicyclists prefer the Trail over Pleasant Street—this inference is supported by the literature—in general bicyclists strongly prefer protected lanes over riding in lanes shared with cars and trucks (Tilahun, Levinson, and Krizek 2007; Stinson and Bhat 2003; Jarjour et al. 2013).

	Pedestrians	Bicyclists
Pleasant turning onto NH&NCL Rail Trail	51	37
Pleasant thru	241	24
NH&NCL Rail Trail turning onto Pleasant	66	16
NH&NCL Rail Trail thru	45	53

Table 10

Composite route choices, pedestrians & bicyclists:

Pedestrians choosing NH&NCL Rail Trail	96
Pedestrians choosing Pleasant	307
Bikes choosing NH&NCL Rail Trail	90
Bikes choosing Pleasant	53

Table 11

Disparities in Active Transportation

Data showing walking and biking rates in Northampton by income, education, age or race were not available. Local data related to gender is discussed below. According to national data, walking and biking rates are highest amongst younger people, people with no children, and people who are from the lowest income groups. Bicycling rates are higher for males than females. Education is also related to bicycling rates. Among education categories, people with a graduate or professional degree have the highest rates, followed by the least educated people, with a trough in between. Nationwide people who identify as "some other race" or "two or more races" have the highest rates of walking followed by Asians, Hispanic/Latinos, and Blacks, with Whites having the lowest rates. Nationwide people who identify as "some other race" or "two or more races" have the highest rates of bicycling followed by Hispanics, Whites, Asians, and Hispanic/Latinos, with Blacks having the lowest rates. (McKenzie 2014). Investments in bike infrastructure will likely have long-term preventative health benefits. Some investments in pedestrian and bicycle infrastructure also will reduce rates of collisions with motor vehicles— which disproportionately affect young people, males, and older adults. Meanwhile, people with lower socioeconomic status walk more for utilitarian purposes than people with higher status. This population has generally has worse health outcomes and so may benefit more from investments that facilitate walking for utilitarian purposes.

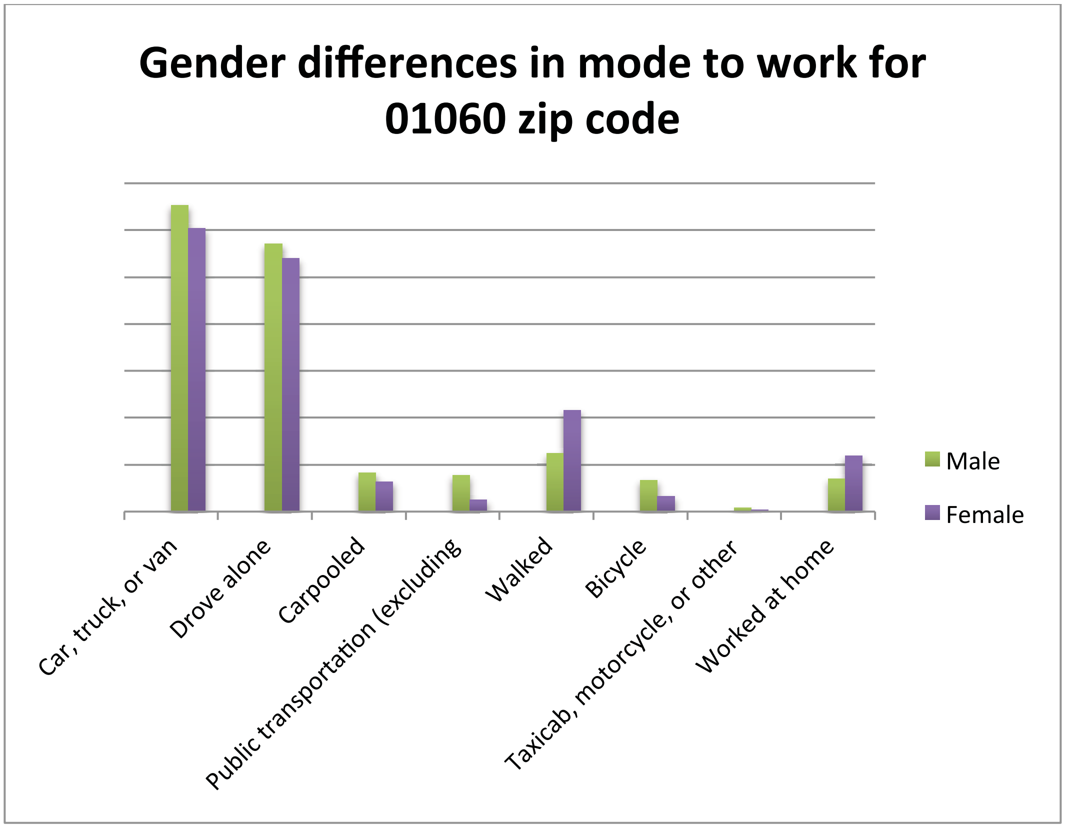

Figure 31: Gender difference in active commuting travel in Northampton

There are striking differences mode share between males and females in 01060. The most significant differences show up in active transportation, where **nearly double the percentage of females walks to work than males**. On the other hand, **nearly double the percentage of males bicycle**, while the **percentage of males who use public transportation is triple that of females**. Overall **a greater percentage of females (25%) use active transportation to work than males (19%)**. On average, males spend longer commuting (23 minutes per day versus 18 minutes per day). These gender patterns hold true across the U.S. Nationwide, almost all of the growth in bike commute share has come from males between the ages of 25 and 64 and currently females represent only about 24% of U.S. bike commuters (Pucher, Buehler, and Seinen 2011). This gender difference may be due to females being more sensitive to safety concerns when bicycling than males (several studies cited in Pucher, Buehler, and Seinen 2011). It is possible that the relatively low numbers of males walking to work is related to differences in where males and females work; a greater number of males work outside of Northampton than females (55% versus 49%). For many residents of Northampton, work may be too far away to walk or bicycle to.

Findings about Existing Conditions for Active Transportation on Pleasant Street

Overall, Northampton has a high proportion of people who use active transportation, as compared to the region and the state—though almost 40% of residents still lack any regular physical activity. The percent of bicyclists appears to be increasing and likely mirrors the development of the bike network.

Active transportation trips appear to be replacing driving trips, and bike trips appear growing at a faster rate than walking trips—both of which should have a positive influence on health outcomes in the area. We estimate that up to 50% of trips in the 01060 zip code are made on foot. We estimate that about 7.35% of adult residents of 01060 currently bicycle per day. Males and females show disparities in choice of mode of active transportation, with more females walking to work than males and males bicycling and taking public transportation more than females. Infrastructure improvements should take gender preferences into account.

Pleasant Street is a pedestrian and bicycle street as well as auto street with about a twenty percent of the peak hour trips being made by active transportation. Bicyclists seem to prefer the rail trail to Pleasant Street—as shown both by overall counts and turning movements.

Northampton's bike and pedestrian networks have regional significance—they provide a rare location where people who want to make the healthy choice to use active transportation for daily activities can do so.

Assessment of Potential Health Impacts of Pleasant Street Improvements on Active Transportation by Mode

Because infrastructure improvements for walking and bicycling are different, we assessed the health impacts of Pleasant Street improvements on walking and bicycling separately.

Walking for Active Transportation

Introduction

The built environment does seem to influence prevalence of walking for active transportation. The most important built environment factors for increasing utilitarian walking include proximity to destinations, land use mix or diversity, intersection density, and connectivity (McCormack and Shiell 2011; Sallis et al. 2015; Ewing and Cervero 2010). Residential density has shown mixed results, with some studies showing increased density positively influence walking levels while and others show the opposite (Sallis et al. 2015). Mixed results may reflect the concentrated pockets of crime and poverty in some high-density areas. Both high and low income individuals benefit from more walkable neighborhoods with increases in overall physical activity (Sallis et al. 2009). Use of buses and trains is related to the distance from residences to transit stops (Ewing and Cervero 2010; Giles-Corti et al. 2013) and the average user of transit walks 19 minutes per day to and from transit (Besser and Dannenberg 2005). Street-scale pedestrian design including the presence of amenities such as street furniture, lighting and shading is moderately related to general walking and improvements in health (McCormack and Shiell 2011; Sallis et al. 2015; Heath et al. 2012). A lack of free workplace parking influences uptake in walking to work; pleasant routes predict its maintenance (Panter et al. 2013). Some quasi-experimental studies have shown increased walking after installation of greenways or trails, while others have not (McCormack and Shiell 2011). Recreational walking is associated with proximity to recreational destinations and positive perceptions of neighborhood aesthetics (Giles-Corti et al. 2013; McCormack et al. 2013). Self-selection is a factor in neighborhood-level rates of walking for active transportation. Walkable neighborhoods attract people who want to walk. On the other hand, nationwide, there is a undersupply of walkable places: there are more people who want walkable places than places for them (Lawrence D. Frank et al. 2015; Leinberger and Alfonzo 2015; Lawrence Douglas Frank et al. 2007). If a person who wants to walk lives in a low-walkability neighborhood he or she is unlikely to walk frequently. Both the desire to walk and the presence of a supportive environment are required for high rates of walking (Lawrence Douglas Frank et al. 2007).

Existing Conditions

Northampton shows high levels of walking for commuting. Measures of general walking behavior are not available, but extrapolating from mode share and Massachusetts Travel Survey data, it is possible that residents of the 01060 zip code make up to 50% of their trips by walking on average. Northampton, especially downtown including Pleasant Street, is one of few rare walkable places in the region. It has developed a culture of walking for active transportation, both attracting people who want to walk for active transportation, and supporting them through comprehensive land use planning and pedestrian improvements. This likely gives Northampton a competitive advantage economically and bolsters its health outcomes compared to similar communities.

Pleasant Street is generally supportive of walking. Its strengths include numerous destinations within close proximity to residential neighborhoods, a diversity of land uses, and proximity to a greenway/rail trail. Some moderately dense residential neighborhoods immediately abut Pleasant Street to the east, and there are some residents who live on Pleasant Street itself. However, access from adjacent residential neighborhoods and general network connectivity are fair. Physical impediments limit access to Pleasant Street from both the east (railroad tracks) and the west (the former bed of the Mill River). Intersection density is high and block lengths on the west side of the street are short, but streets are generally dead ends. Block lengths on the east side are long due to the limited number of railroad crossings. Buildings are generally attractive and well-kept. Building setbacks are generally short, although some have front parking. Sidewalks are of adequate width. The condition of sidewalks is variable: there are some significant cracks and heaves in places; tactile warning strips are missing at some street crossings. There is a dearth of benches on the street; those that are present are heavily used, especially at the NH&NCL Rail Trail crossing and in front of Northampton Coffee. Street trees cover is sparse with several tree pits showing evidence of trees that were recently removed. Crosswalks are frequent; some crosswalk markings are in good repair, and others are not. Area residents generally perceive Pleasant Street crosswalks as unsafe.

Assessment of potential impact of Pleasant Street Improvements on Walking for Active Transportation

Based on the draft 25% design plans for Pleasant Street Improvements, the project would have a moderate positive impact on walking for active transportation. The largest benefits would come from the project's direct and indirect support for additional housing and commercial development on Pleasant Street, which will in turn increase walking for active transportation. Pleasant Street Improvements will support the feasibility of the Valley CDC and HAPHousing projects. The Pleasant Street improvements will pay for aspects of streetscape construction that would otherwise have to be shouldered by the Valley CDC and HAPHousing projects. In addition the Pleasant Street improvements should improve the financial viability of the ground floor commercial spaces provided by the mixed-use projects by improving their aesthetic appeal and moderately increasing foot traffic. Meanwhile the two mixed-use projects will increase active transportation by bringing new residents who can take advantage of the positive opportunities for active transportation provided by Pleasant Street and providing new commercial space (ideally retail space), which might inspire additional walking trips by residents and workers from adjacent neighborhoods. For more on this topic see the section about Affordable Housing. In the long-term Pleasant Street Improvements are intended to support revitalization of the neighborhood, which could result in additional residential density and desirable destinations—again resulting in increased active transportation.[3]

Proposed improvements will have moderate impacts on network connectivity for Pedestrians. No new connections are proposed, but existing conditions are slated for substantial upgrades. Pleasant Street crosswalks at Holyoke Street/Michelman Avenue, Kingsley Avenue/Short Street, and the NH&NCL Rail Trail/Railroad Avenue will all be revamped. Design plans show curb extensions and raised crosswalks at all three locations. In addition improved sidewalks are shown on Holyoke Street, extending to the railroad underpass on the south side and to Hawley Street on the north side. Both Holyoke Street and NH&NCL Rail Trail are major network connectivity points to Pleasant Street. Improvements at these locations, especially crosswalks improvements may improve pedestrians' perception of safety and therefore result in some additional active transportation trips. Safety impacts are discussed further below.

Additional improvements that will positively influence walkability include new or improved curb ramps with tactile warning strips at Holyoke Street, Michelman Avenue, Kingsley Avenue, Short Street, the NH&NCL Rail Trail, and Railroad Avenue. These improvements will have disproportionate benefit for people with mobility or sight impairments. Raised crosswalks will also benefit people with mobility impairments by reducing the height differential between the sidewalk and the crosswalk. Narrowing and straightening the entrance to Hockanum Road will reduce pedestrian crossing times and improve walkability. The addition of 26 street trees will provide shade and improve attractiveness of the street, especially in the area just north of Hockanum Road where new trees will form a nearly complete canopy. Curb cut closures and sidewalk improvements are proposed at the corner of Pearl Street and Pleasant Street, at The Elevens, at Yes Computers, south of Short Street on the east side of Pleasant Street. Closing curbs where driveways are not currently active will support existing walkability for the long-term. The closure of the curb cut south of Short Street will be a significant improvement in attractiveness and perceived safety. New sidewalks should reduce tripping hazards and particularly improve walkability for people with mobility and site impairments.

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[3] The multiple feedback loops between the street improvements, the mixed-use projects, changes in broader neighborhood land use and demographics, and walking rates illustrate why it is difficult to clearly demonstrate causality between a specific infrastructure improvement and walking rates overall.

Proposed narrowing of travel lanes between Holyoke Street and Hockanum Road will likely slow traffic in this area and improve walkability by improving perception of safety (for more information see the section about Safety from Traffic below). Additional on street parking on the west side of Pleasant Street south of Michelman Avenue will have the same effect.

Improvements in walkability will have disproportionate benefits for populations of concern from an equity perspective. New low and moderate residents will have the opportunity to take advantage of Pleasant Streets walkability. People with mobility and sight impairments will benefit from physical improvements to sidewalks, curb ramps, and crosswalks. Women, who make up a large percentage of walking commuters will also benefit from the proposed improvements.

Bicycling for Active Transportation

Introduction

As previously discussed, Northampton has relatively high levels of bicycling in Northampton. Overall the physical activity from bicycling outweighs risks from injury or air pollution based on a cost-benefit approach. (Teschke, Reynolds, et al. 2012). This topic is increasingly being studied. Bicycling has significant health benefits including overall fitness, decreased cardiovascular risk, and decreased mortality (Oja et al. 2011; Andersen L et al. 2000). Bicycling is generally more vigorous than walking. For example, biking to work requires about 6.8 METs[4], while walking to work requires about 4.0 METS (Ainsworth et al. 2015).

Bicyclists are a relatively small segment of the overall population. **Bicycle facilities, have a high impact for a relatively small population.**

Broad land use patterns, including residential density, proximity to jobs and services, and connectivity appear to affect bicycling rates. As was discussed in the assessment of walking for active transportation above, if improvements to Pleasant Street result in increased residential density and access to jobs and services, it is reasonable to conclude that they will also positively impact cycling rates. In particular, the city should focus on increased employment, retail, restaurant, and service opportunities on Pleasant Street.

Climate, hilliness, weather and local culture are also major determinants of bicycling (Heinen, van Wee, and Maat 2010). Convenient routes are associated with uptake of cycling to work (Panter et al. 2013). Some quasi-experimental studies have found that installation of cycle tracks, greenways and bike paths results in increased bicycling, others studies have not (McCormack and Shiell 2011). Several studies of route choices by regular bicyclists have found that bicyclists prefer dedicated bicycle facilities including bike lanes, separated paths, and cycle tracks, and bicycle boulevards (Stinson and Bhat 2003; Dill 2009). Bicycle use for active transportation has increased significantly in the United States in recent years. Gains are concentrated in a small number of places and almost all the increase

[4] A MET, or metabolic equivalent, is a measure of how much energy a physical activity requires.

has been amongst men aged 25-64 (Pucher, Buehler, and Seinen 2011). Communities that have invested in bicycle interventions including physical infrastructure, land use policy reform, and bicycle promotion programs have experienced significant increases in bicycling (Pucher, Buehler, and Seinen 2011; Pucher, Dill, and Handy 2010).

The decision whether to bike or not seems to be strongly tied to concerns about traffic safety, which are in turn shaped by specific infrastructure designs and personal preferences. In general bicyclists prefer low volume roads with no more than one lane of traffic in each direction, they dislike on-street parking, and they strongly prefer separate facilities such as bike paths or cycle tracks (Heinen, van Wee, and Maat 2010). Bicycle safety improvements attract proportionately more people to bicycling than the actual safety reduction, "i.e. a 10% increase in safety results in a greater than 10% increase in the share of people bicycle commuting (Noland 1995)." While men currently make up the majority of very active bicyclists, the biggest opportunity to increase physical activity through bicycling is among casual or infrequent bicyclists, especially women, older adults, and children. These populations may be more sensitive to perceptions of unsafe traffic and may require dedicated bicycle infrastructure (like separated bicycle lanes) before they will be willing to bicycle more. This is discussed more in the section on Traffic Safety for bicycling below.

The relationship between infrastructure, perceived safety and bicycling rates is very complex as illustrated in the diagram by Macmillan et al in Figure 32.

For the purpose of our assessment we have not taken feedback loops into account and we will discuss bicycle safety from traffic more extensively below.

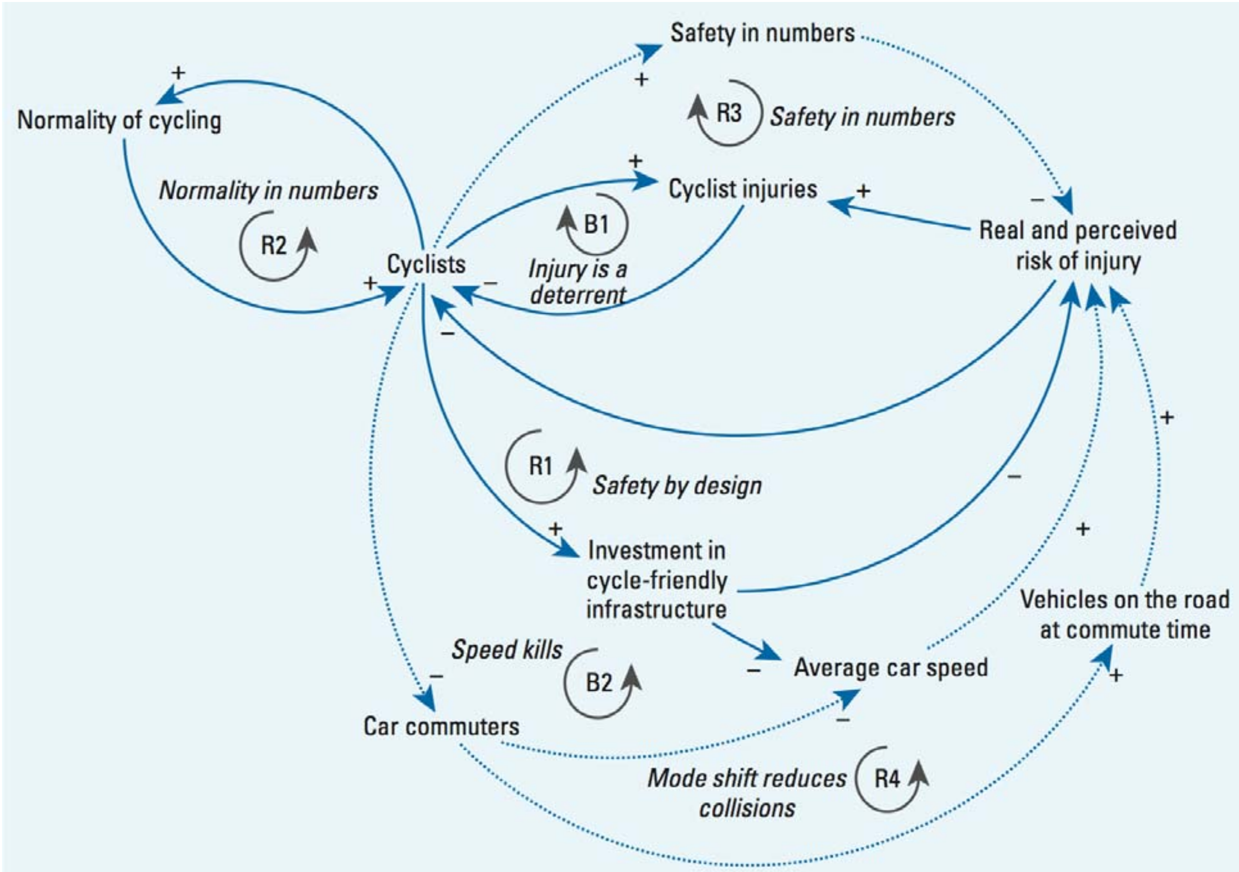

Figure 32: A causal loop diagram for bicycle commuting illustrates the complex pathways that affect levels of bicycle commuting and its safety. "Dotted lines denote loops identified by stakeholders and the literature, but where local data suggests they are currently inactive. Arrows with a positive sign (+) indicate that a change in the originating variable leads to a corresponding change in the variable at the arrowhead. Arrows with negative signs (–) indicate that a change in the originating variable leads to a change in the opposite direction for the arrowhead variable (R, reinforcing or positive feedback loop; B, balancing or negative feedback loop)." (Macmillan et al. 2014)

The remainder of our assessment of bicycling for active transportation focuses on how infrastructure improvements may impact bicycle rates and how that may impact health. Proposed changes on Pleasant Street that will likely improve perception of safety by bicyclists and therefore contribute to increases in cycling rates include, the proposed cycle tracks between Holyoke Street and Hockanum Road, improvements to the NH&NCL Rail Trail crossing of Pleasant Street, and vehicle speed reductions resulting from the narrowing of Hockanum Road's mouth, raised crosswalks, and curb extensions, the addition of on-street parking south of Michelman avenue, and the narrowing of vehicle travel lanes between Holyoke Street and Hockanum Road.

Assessment of potential impact of Pleasant Street Improvements on Bicycling for Active Transportation

How much of a role does Infrastructure play in rates of active transportation by bicycle?

A literature review of the relationship between street infrastructure interventions and levels of active transportation by bicycle shows correlations (Dill 2009; Heinen, van Wee, and Maat 2010; Pucher, Buehler, and Seinen 2011; Pucher, Dill, and Handy 2010; McCormack and Shiell 2011), but definitive causal relationships are difficult to discern. This may be due to the complexity of designing randomized controlled trials for major infrastructure investments. In general, the literature shows that both self-selection and walkability/bikability are related to the rate of active transportation in a community (Lawrence Douglas Frank et al. 2007) In other words, Northampton likely both attracts people who want to walk and bike, and enables them to make active trips by providing a supportive environment. This helps explain both the overall high rates of active transportation and the change in bicycling levels over time seen in the census commute to work data discussed earlier.

In order to roughly assess the strength of the relationship between bicycling levels and bike infrastructure we gathered mode share data for Massachusetts communities that are similar to Northampton. The identification of similar communities was based on a published analysis that grouped Massachusetts communities based on socioeconomic factors, land use patterns, and health outcomes (Arcaya et al. 2014). We did a rough eyeball grading of the bike networks for the selected Massachusetts communities based on Mass DOT's bike network GIS layer. Networks were assigned a grade based on approximate length of miles of bike infrastructure, degree of connectivity of the network, and connectivity to bike networks in neighboring communities. We then plotted the bike network grades against bike to work mode share.[5] There appears to be a very strong correlation between the quality of a community's bike network and the percent of commuters who bike to work.[6] The latent class analysis selection of similar communities helps to control for most non-built environment characteristics, but it does not rule out self-selection i.e. that people who like biking settle in certain communities including Northampton, Somerville and Cambridge.

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[5] Bike networks were graded from 0, 1, 2 or 3. 0 represents no bike facilities, 3 represents relatively robust bike networks. The grades were then converted to percent so that they could be presented on the same scale as the bike-mode share.

[6] Similar communities are based on a latent-class analysis by MAPC and others that considered socioeconomic factors, land use patterns, and health outcomes. Two similar communities, Natick and Belmont are not shown because commute data was not available for them.

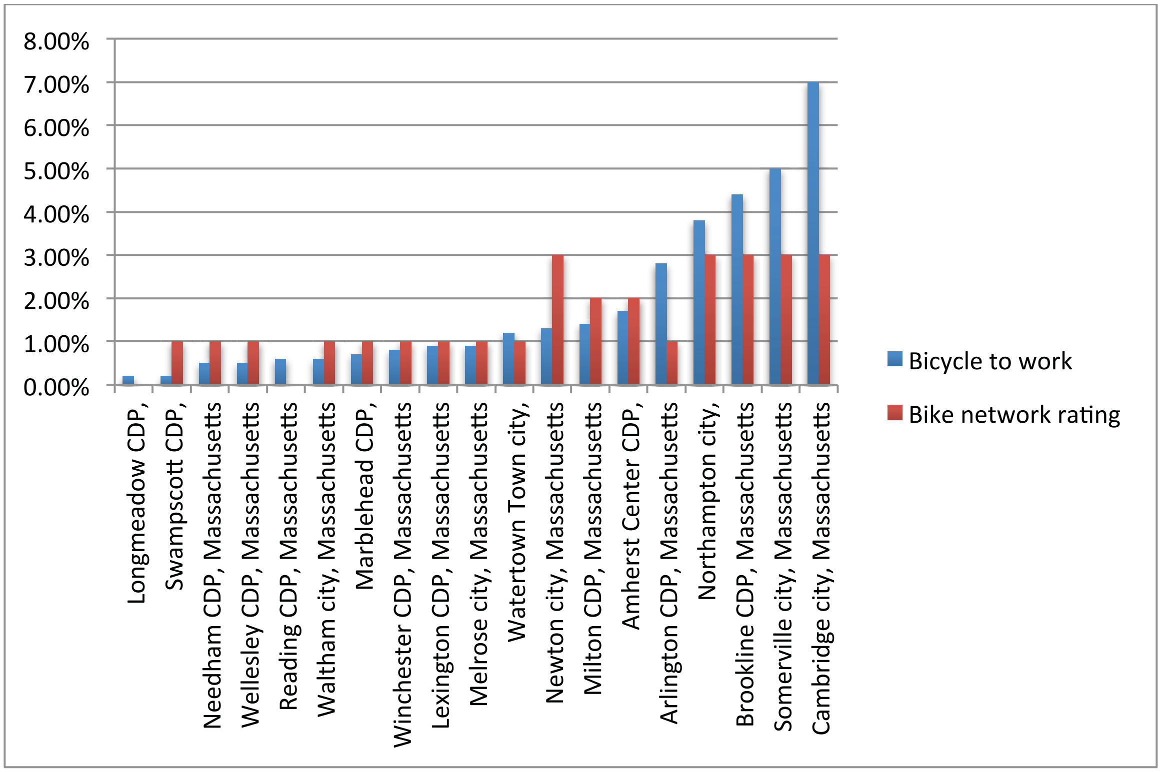

Figure 33: Mode share compared to bike network quality in communities, which are similar to Northampton. By focusing on similar communities, the graph controls for socioeconomic and built environment factors to some degree.

Comparing the build-out of the network with the increase in active transportation provides further support for the hypothesis that the bike network induces bike trips in Northampton. **The majority of the bike network has been built out since 1990—the same period during which Northampton has experienced large increase in rates of bicycling and walking to work.**

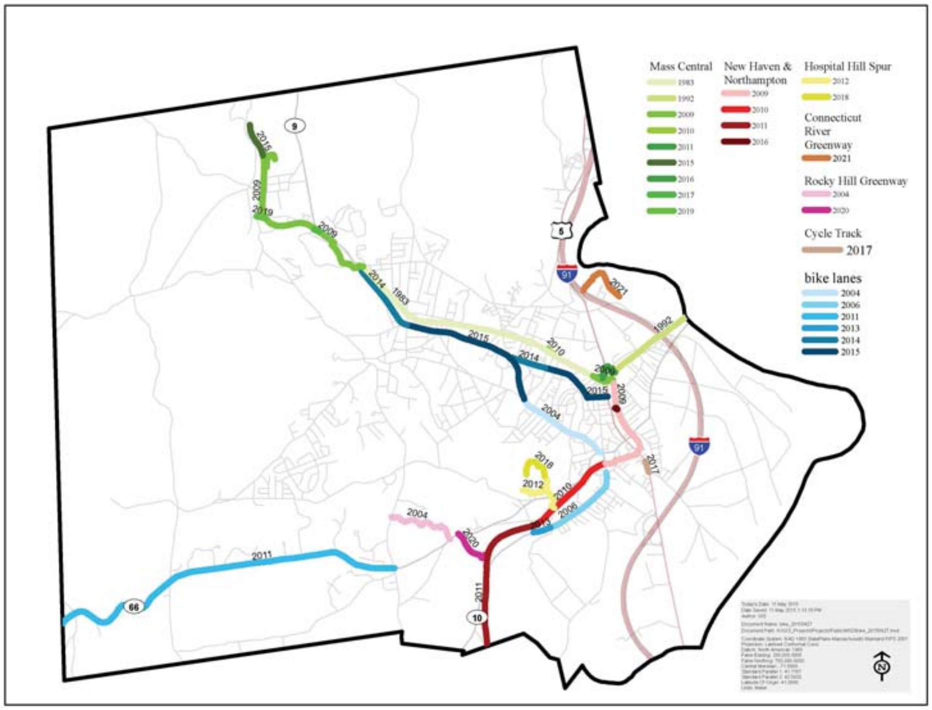

Figure 34: Build out of Northampton's bike network over time (includes future lanes and trails). Shows that all but one trail (from Stop and Shop to Florence) were built out since 1990.

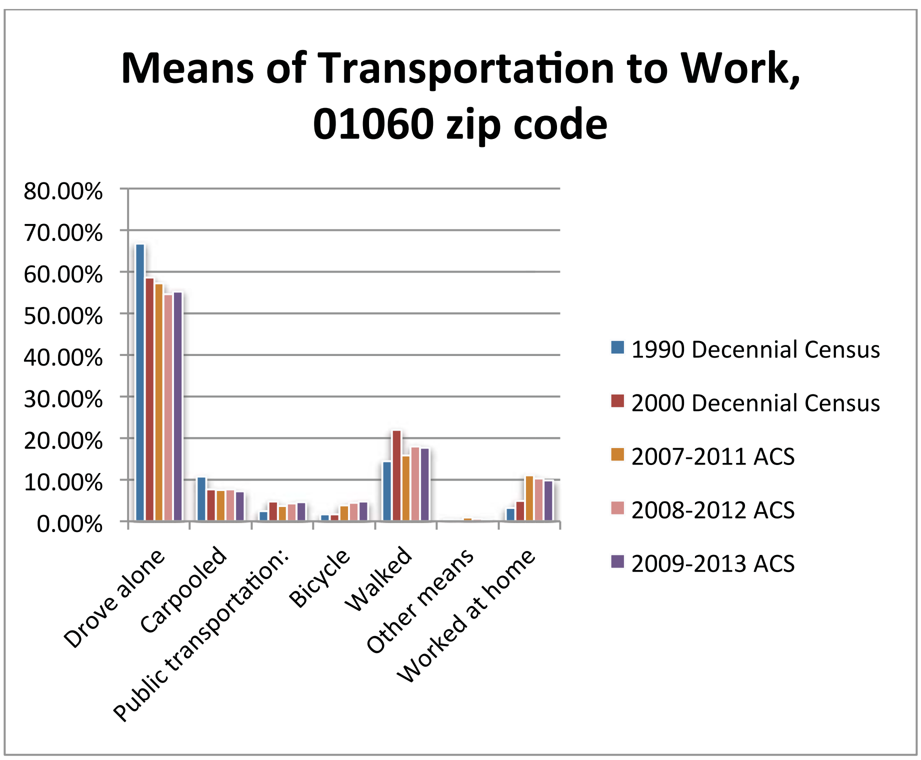

Figure 35: Mode share for commuters over time in 01060. Increases in active transportation since 1990 parallel the build out of the bike and pedestrian network.

Based on the strength of the the evidence above—the correlation between bike networks and bike commuting levels while controlling for demographic, land use, and health outcome similarities; the strong correlation between the growth of Northampton's bike network and increases in its bicycle commute mode share; and literature about what motivates people to choose to ride a bike (road safety is the primary concern)—**we conclude that the continued development of bike infrastructure in Northampton is a necessary component of increased levels of bicycling for active transportation.** While we can not say the degree to which infrastructure causes people to ride a bicycle, it seems clear that *without* infrastructure improvements, levels of bicycling would be unlikely to continue to increase along present trend lines. Based on this, our subsequent assessment assumes that bike network improvements do influence bicylcing rates and that infrastructure improvements on Pleasant Street will have the same magnitude of influence on bicycling rates as each of the incremental bike network improvements that the city has made over the past 25 years.

Health Economic Benefits of Physical Activity due to increased bicycling

We used the Health Economic Assessment Tool (HEAT) for Bicycling from the World Health Organization to assess the health impacts of changes in bicycling physical activity levels related to Pleasant Street improvements. The HEAT tool provides an order of magnitude estimate of the health impacts of changes in active transportation levels resulting from specific interventions. Based on "before" and "after" data entered by the user, it calculates the monetary cost or benefit of a proposed intervention. The model and data underlying the HEAT Tool is based on a robust review of peer-reviewed published journal articles conducted by leading experts in the field (Kahlmeier et al. 2014). Essentially, HEAT estimates changes in all-cause mortality due to changes in physical activity levels. It then calculates a monetary value of the change in mortality based on "the value of statistical life." The value of statistical life is "most commonly derived using a method called willingness to pay. The willingness to pay shows how much a representative sample of the population (who, in this instance, are potential victims) would be willing to pay (in monetary terms) for example for a policy that would reduce their annual risk of dying from 3 in 10,000 to 2 in 10,000" (Kahlmeier et al. 2014). Numerous HIAs have used the HEAT Tool to assess the health benefits of changes in levels of bicycling or walking and the practice is well accepted (Mueller et al. 2015).

The HEAT Tool requires the following input information:

- Current levels of bicycling (number of people bicycling; number of bicycling trips an average person makes in a day; average trip duration, or length; number of trips per year)
- Projected future levels of bicycling (number of people bicycling; number of bicycling trips an average person makes in a day; average trip duration, or length; number of trips per year)
- Proportion of change in bicycling activity attributable to the intervention
- The build up time to reach the full level of cycling
- Mortality rate for the study area
- The value of statistical life for the study population
- The time period over which savings will be estimated
- The discount-rate to be applied to future-benefits

Our method for developing inputs to the HEAT Tool is based loosely on a method developed by Thomas Gotschi for a health impact assessment of proposed bicycle network improvements for Portland Oregon (Gotschi 2011). We began from the assumption that interventions on Pleasant Street will make an incremental contribution to Northampton's bicycle network that is comparable to the improvements the city has made over the past 25 years. In other words, we assume that investments on Pleasant Street will be no more and no less significant than past improvements, and that they will have equivalent affects on bicycle ridership as past bike infrastructure improvements. Therefore, we projected that if the improvements on Pleasant Street are implemented, the current rise in biking levels will continue along current trend lines. Based on this assumption, we used statistical functions in Microsoft Excel to draw trend lines for future bicycling based off U.S. Census Commute to Work data for the 01060 zip code from 1990 to 2008-2013 ACS (see Figure 36).

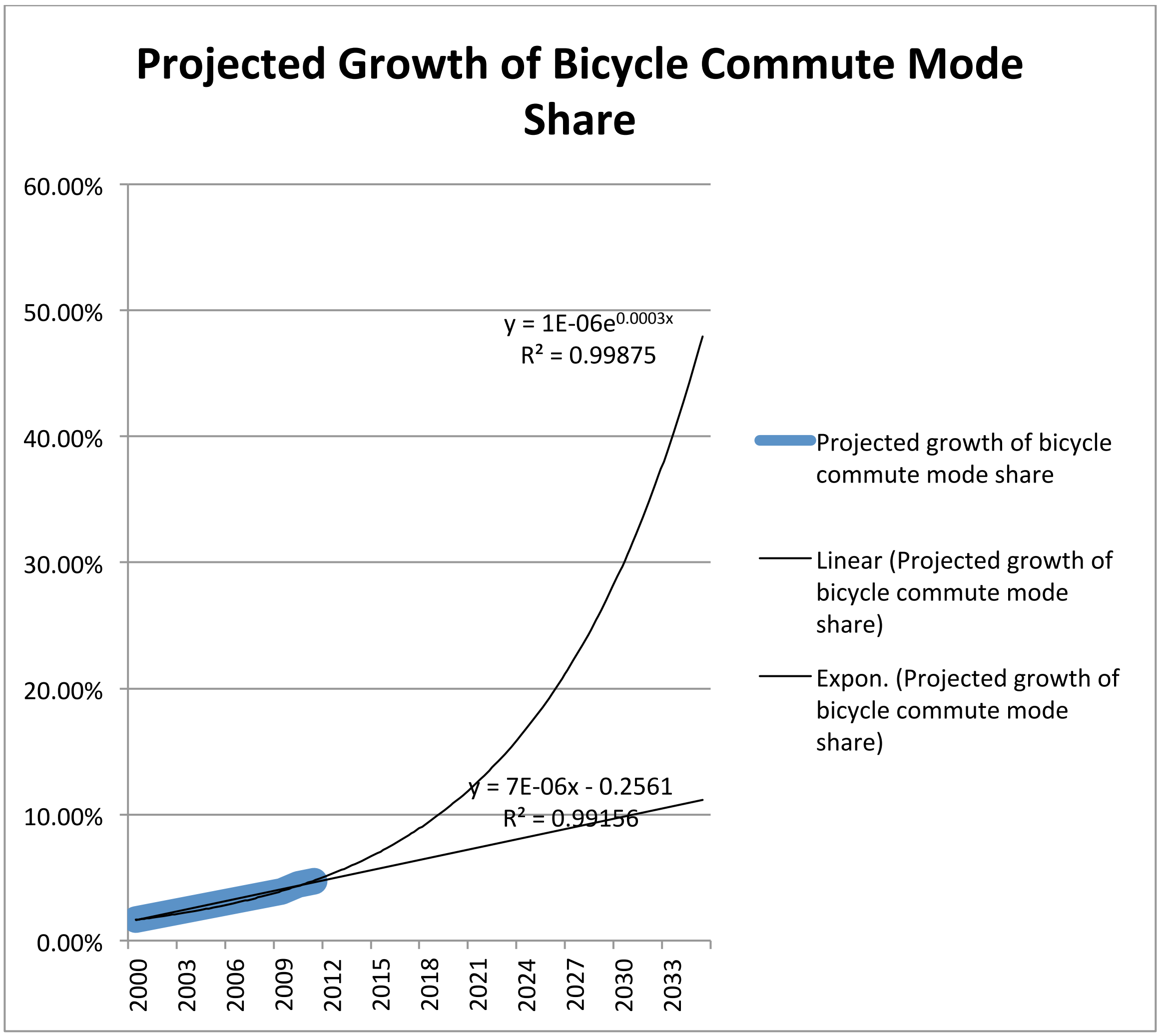

Figure 36: Projected Growth of Bicycle Commute Mode Share

Based on the Census data from 2000, 2007-2011, 2008-2012, and 2009-2013, there were two curves that fit the data very well. The first is a linear growth pattern using least squares with an R^2 of .99156. This curve projects that bike commute share will be at 6.28% by 2017 (when Pleasant Street improvements would be implemented) 7.64% in 2022, 9% by 2027, and 11.73% by 2037 (see Table 12). An exponential growth curve fit the data slightly better (R^2=.99875). It predicts mode share reaching 8.46% by 2017, 13.69% by 2022, 22.14%% by 2027, and 57.91% by 2037.

Projected bicycle commute mode share for Northampton's 01060 zip code		
Year	**Linear Growth based on least squares**	**Exponential Growth**
2011 (actual data: 4.7%)	4.65%	4.75%
2017	6.28%	8.46%
2022	7.64%	13.69%
2027	9.00%	22.14%
2037	11.73%	57.91%

Table 12

The levels of commuter bicycling predicted for 2037 by the exponential growth model are currently unprecedented in Massachusetts. However, parts of Portland, Oregon currently have a bicycle mode share approaching 33% ("Portland Bicycle Count Report 2012" 2013), several European cities have a mode share in the 40%-50% range ("Cycling Mode Share for 700 Cities" 2014), and as of 2012, mode share in the U.S. topped out at 52% for the census tract representing Stanford University (Schneider and Stefanich 2014). Levels of bicycling are increasing dramatically across the United States "especially near universities and in gentrified neighborhoods near the city center" (Pucher, Buehler, and Seinen 2011)—a description that fits the Pleasant Street neighborhood well—so present expectations may not be a good guide to future possibilities.

For this assessment we choose to use the conservative estimates of future bike trips provided by the linear growth model. We believe that the linear growth model may underestimate the health economic impacts of infrastructure improvements.

As discussed earlier, bicycle commute mode share likely under-represents overall bike-trips. We used the formula developed by Barnes and Krizek (A = 0.3% + 1.5 * C), to estimate the growth in bicycling for all trips by adults in Northampton over time. We then subtracted commuters from this % to get "the percentage of non-commuter adults who ride a bicycle at least once a day" (NCA=0.3% + .5C, where NCA is non-commuting adult cyclists and C is commuting cyclists).

We choose to calculate the physical activity health benefits of cycling for commuters and all other adults separately. This gives us a more accurate picture of health benefits for two reasons. First, it enables us to assign more accurate trip lengths to the populations. Second, the Barnes and Krizek formula tells us only how many adults take at least one trip per day. It does not tell us how many additional trips that adult may take per day. On the other hand, we can assume that a bicycle commuter takes 2 trips per day (one to work and one from work).

Estimates for the number of commuting bicyclists and other adults who bicycle at least once per day are shown in Table 13 and Table 14. HEAT's method is based on mortality for an adult population 20-65, so the number for riders below are calculated from the 9,938 adults aged 20-64 in the 01060 zip code (U.S. Census Bureau 2015b). We assumed the population of 01060 would essentially remain flat through 2035, based on population projections from the Donahue Institute, which show the total population of Northampton increasing slightly to 2025 (less than 1%) and then decreasing slightly to 2035 (2.7% from 2010 levels) ("Massachusetts Population Projections" 2015).

Projected bicycle commuters aged 20-64 in Northampton's 01060 zip code. Based on linear growth model.		
year	**%**	**Number of people**
2011	4.65% (actual data: 4.7%)	462
2017	6.28%	624
2022	7.64%	760
2027	9.00%	895
2037	11.73%	1166

Table 13

Projected non-commuter adults (aged 20-64) who ride a bicycle at least once per day for Northampton's 01060 zip code. Based on linear growth model.		
year	**%**	**Number of people**
2011	2.63%	261
2017	3.44%	342
2022	4.12%	410
2027	4.80%	477
2037	6.16%	613

Table 14

To estimate health benefits of bicycling, the HEAT tool requires user input about how much bicycling the population does before and after the intervention. The best data available is at the national level. The National Household Travel Survey provides data on trip length by mode and destination (see Table 15). The average bicycle trip nationwide is 2.26 miles long. Commuting trips are longer than average (3.54 miles), while the average of non-commuting trips is (1.85 miles). We entered 7.08

miles/day for bicycle commuters into the HEAT tool (two trips at 3.54 miles). For non-commuting bicyclists we entered 1.85 miles.

Miles per trip by mode and destination

	Bicycle	Walk
Refused		0.67
Don't know	1.13	0.61
Not ascertained	.	0.36
Home	2.16	0.71
Work	3.54	0.67
School/Daycare/Religious activity	1.48	0.56
Medical/Dental services	2.67	0.74
Shopping/Errands	1.48	0.56
Social/Recreational	2.41	0.86
Family personal business/Obligations	1.65	0.53
Transport someone	1.06	0.51
Meals	2.08	0.47
Other reason	2.42	1.19
All	2.26	0.7
Average of all trips other than work	1.85	0.6475

Table 15 (US Department of Transportation-Federal Highway Administration 2015)

Other inputs to HEAT were:

- The mortality rate for Northampton for ages 20-65: 457 per 100,000 (see Table 23 in the Appendix for mortality rates by age in Northampton).
- The value of statistical life in 2015: $9.6 million based on an estimate from the U.S. Department of Transportation (Trottenberg 2013).

We ran two scenarios in HEAT. Scenario A calculated the increase in ridership between 2017 and 2018, attributed all of that increase to the Pleasant Street improvements, and then estimated the health benefits of that increase in ridership being sustained over 20 years. The second scenario calculated the increase in ridership between 2017 and 2037. It attributed 6.7% of the increase in ridership to Pleasant Street improvements and then estimated the health benefits of the increase in ridership over 25 years.[7]

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[7] The scenarios differ primarily in how changes in ridership were attributed to investments on Pleasant Street. Both scenarios assume a linear relationship between investments and increased ridership. Over the past 15 years Northampton has averaged about one bicycle network improvement per year (including both rail trail and on-road bike lane projects). We assumed the rate of bike network improvements will remain steady over the next 20 years and that each improvement has roughly equivalent affects on ridership. The rationale for Scenario A is: Pleasant Street improvements are the only improvement in the pipeline for the year 2017 that will significantly affect 01060, so we assumed

For each scenario, health benefits for commuting cyclists and non-commuting cyclists were calculated separately and then added together. **The estimated health-economic benefits of physical activity due to increased bicycling described by Scenario A are $4,635,000 over 20 years. The estimated economic health benefits of physical activity due to increased bicycling described by Scenario B are $3,482,000.** Full results are in shown in Table 16 and below:

Scenario A

	Commuters	Non-Commuters	Combined (all riders)
Increase in riders (2017-2018)	27	13	40
Miles/day/rider	7.08	1.85	
Reduced risk of mortality for cyclists compared to non-cyclists	34%	9%	
% of change in ridership attributed to intervention	100%	100%	
Deaths prevented per year	0.04	0.01	0.05
Assessment period (years)	20	20	
The average annual benefit, averaged over assessment period	$353,000	$44,000	$397,000
the total benefits accumulated over assessment period	**$7,068,000**	**$889,000**	**$7,957,000**
the maximum annual benefit reached by this level of cycling, per year, is:	$405,000	$51,000	$456,000
Year when maximum level of benefit is realized:	7	7	
When future benefits are discounted by 5 % per year[8]:			
the current value of the average annual benefit, averaged across the assessment period is:	$206,000	$26,000	$232,000
the current value of the total benefits accumulated over 20 years is:	**$4,117,000**	**$518,000**	**$4,635,000**

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that for the year 2017-2018, all increases in ridership would be attributable to the Pleasant Street improvement. The rationale for Scenario B is: Northampton has averaged about 1 bike network improvement per year over the past 15 years. We assumed that rate would hold steady for the next 20 years. Assuming all projects are equal, Pleasant Street Improvements can be attributed with 6.7% (1/20th) of increases in ridership over the next 20 years. Because the HEAT Tool assumes a 5-year build up for health impacts, we extended the evaluation timeline to 25 years to account for the full health benefits of the riders at year 20. So Scenario A attributes the project with a large portion of the health benefits for a small number of bicyclists, while Scenario B attributes a small portion of benefits for a larger number of riders. Future assessments could refine this method by assigning relative weight to improvements based on location, size of improvement (e.g. miles of infrastructure), adjacent population characteristics, degree of connectivity improvement, and desirability of improvement based on input from local riders.

[8] Discounting future benefits is a standard practice in transportation planning. 5% is the default setting in HEAT.

Table 16: Results of HEAT Tool modeling for Scenario A

Scenario B

	Commuters	Non-commuters	Combined
Increase in riders (2017-2037)	542	271	813
Miles/day/rider	7.08	1.85	
Reduced risk of mortality for cyclists compared to non-cyclists	34%	9%	
% of change in ridership attributed to intervention	6.67	6.67	
Deaths prevented per year	0.06	0.01	0.07
Assessment period (years)	25	25	
The average annual benefit, averaged over assessment period	$281,000	$37,000	$318,000
the total benefits accumulated over assessment period	**$7,022,000**	**$922,000**	**$7,944,000**
the maximum annual benefit reached by this level of cycling, per year, is:	$542,000	$71,000	$613,000
Year when maximum level of benefit is realized:	26	26	
When future benefits are discounted by 5 % per year:			
the current value of the average annual benefit, averaged across the assessment period	$123,000	$16,000	$139,000
the current value of the total benefits accumulated over the assessment period	**$3,078,000**	**$404,000**	**$3,482,000**

Table 17: Results of HEAT Tool modeling for Scenario B

The level of health economic benefit from increases in physical activity due to infrastructure improvements is consistent with the results of previous studies (Mueller et al. 2015; Cavill et al. 2008; Gotschi 2011). A recent meta-analysis of HIAs on this topic found a median benefit-cost ratio of 9:1—of which about 50% was due to physical activity (Mueller et al. 2015). While the expected costs of bicycle improvements on Pleasant Street were not available at the time of publication, the expected total project budget for street improvements is expected to be around $1.1 million**. At this cost, health benefits from increases in bicycle ridership alone would result in benefits that are three to four times the project costs over 20-25 years.**

The health benefits that would be provided by Pleasant Street improvements are in addition to health benefits that the city is already experiencing as result of current bicycling. We used the HEAT tool to estimate the value of 2011 levels of bicycling using the methods and inputs described above. **The model shows that annual health economic benefits of 2011 levels of bicycling are about $7,271,000** (See Table 18).

Estimated annual health economic benefits of 2011 levels of bicycling in 01060	Commuters	Non-commuters	Combined
Cyclists	462	261	723
Miles/day/rider	7.08	1.85	
Reduced risk of mortality for cyclists compared to non-cyclists	35%	9%	
% of change in ridership attributed to intervention	100%	100%	
Deaths prevented per year	less than 1	less than 1	
Assessment period (years)	1	1	
The average annual benefit	$6,664,000	$970,000	$7,634,000
When future benefits are discounted by 5 % per year:			
the current value of the average annual benefit	**$6,347,000**	**$924,000**	**$7,271,000**

Table 18: Estimated annual health economic benefits of 2011 levels of bicycling in 01060

When these annual benefits are projected over a 20 year period, the result is a raw value of $152,680,000 and a 5% discounted per year value of $95,120,000 (see Table 19). According to Wayne Feiden, Planning Director for the City of Northampton, the city has invested about $15,000,000 in bike paths and bike lane striping to date (Feiden and Sussman 2015). **The estimated health economic benefits of past investments in the bicycle network vastly outweigh their costs.**

Estimated 20-year health economic benefits of 2011 levels of bicycling in 01060	Commuters	Non-commuters	Combined
Cyclists	462	261	723
Miles/day/rider	7.08	1.85	
Reduced risk of mortality for cyclists compared to non-cyclists	35%	9%	
% of change in ridership attributed to intervention	100%	100%	

Deaths prevented per year	less than 1	less than 1	
Assessment period (years)	20	20	
The average annual benefit, averaged over assessment period	$6,664,000	$970,000	$7,634,000
the total benefits accumulated over assessment period	**$133,280,000**	**$19,400,000**	**$152,680,000**
When future benefits are discounted by 5 % per year:			
the current value of the average annual benefit, averaged across the assessment period	$4,152,000	$604,000	$4,756,000
the current value of the total benefits accumulated over the assessment period	**$83,040,000**	**$12,080,000**	**$95,120,000**

Table 19: Estimated 20-year health economic benefits of 2011 levels of bicycling in 01060

The health economic benefits of Northampton's high bicycling rates are substantial and largely attributable to the investments that have been made in the city's bicycle network. We estimate that Northampton's 2011 levels of bicycling currently provide health economic benefits worth about $7.3 million a year due to increased physical activity. If that level of bicycling continues over the next 20 years, the health benefits will be worth $95-150 million—about 10 times what has been invested in the bicycle network to date. Pleasant Street Improvements are likely to inspire additional physical activity from bicycling worth $3.5 to $4.6 million over 20 years—more than twice the entire project cost for the Pleasant Street Improvements.

Health Disparity Concerns about Bicycling for Active Transportation

Connections to Holyoke via Route 5

While conditions on Pleasant Street do not affect most Holyoke residents on a day-to-day basis, Northampton is a major potential draw for Holyoke bicyclists. 14% of Holyoke residents say they would like to bike to Northampton, but currently do not. An additional 23% say they would like to bike to existing trails—many of which are located in Northampton (Massachusetts Bicycle Coalition 2013). A bicycle activity heat map from Strava (Figure 37) shows that Route 5 from Holyoke to the NH&NCL Rail Trail crossing on Pleasant Street is a heavily traveled bicycle route ("Strava Global Heatmap" 2015).

Although Northampton and its trails are desirable destinations, residents of Holyoke state that the route to Northampton is dangerous. In a recent survey, Holyoke residents cited Northampton Street

(Route 5, which becomes Pleasant Street in Northampton) in Holyoke as that city's most dangerous road for cycling. Holyoke recently added a bike lane to a portion of Northampton Street near the Northampton town line, but the remainder of the road still remains to be improved, both in Holyoke and in Northampton. It appears that there is adequate right of way on Pleasant Street south of Hockanum Road to provide sidewalks and a bicycle lane or separated bicycle lane (cycle track).

Figure 37: Heat map showing frequently logged bicycle trips. The brighter the blue line, the more trips have been logged. The data and map are from Strava—an online service where users upload GPS data of bicycling and running trips.

Improved bicycling conditions on Pleasant Street could benefit all people, but residents of Holyoke warrant special consideration. There is a significant socioeconomic disparity between the population of Holyoke and the population of Northampton. Holyoke has a much lower median household income ($43,909 vs. $74,715), and almost three times the poverty rate (31.7% vs. 13.1%) ("Community Profiles | PVPC" 2015). Socioeconomic disparities are very strongly correlated with health outcome disparities ("Our Approach | County Health Rankings & Roadmaps" 2015) and indeed Holyoke has significantly worse health outcomes than Northampton, including higher rates of obesity, diabetes, and cardiovascular disease—conditions for which physical activity reduces risk ("Prevention and Wellness Trust Fund Data" 2013). While residents of Northampton report relatively high rates of physical activity, residents of Holyoke report relatively low-rates of physical activity ("Prevention and Wellness Trust Fund Data" 2013). All people benefit from additional physical activity, but the health benefits are greater for those who are on the low end of the activity scale (Woodcock et al. 2011).

Better bicycle connections to Northampton could have disproportionate benefit for cyclists from Holyoke because those connections could: 1. open greater social and economic opportunities, which could result in long-term health benefits; 2. contribute to increases in physical activity levels, which could have disproportionate benefits based on the health background of Holyoke's population compared to Northampton's population.

Pathway 2: Traffic Safety

Introduction

Motor vehicle crashes are responsible for more than 30,000 fatalities each year in the United States (National Center for Environmental Health 2012). Automobile collisions are one of the leading causes of death among people 34 years old and younger, and account for 3.2 million nonfatal injuries annually. Motor vehicle crashes impact pedestrians and bicyclists as well as motorists. In 2013, 743 cyclists and 4,735 pedestrians were killed in traffic crashes in the United States (National Highway Traffic Safety Administration 2015b). In 2013, males accounted for 69% of pedestrian fatalities and 87% of pedalcyclist fatalities. Children aged 5 to 9 have the highest population-based fatality rate, while older pedestrians (65+) are more likely than younger pedestrians to be struck at intersections (Retting, Ferguson, and McCartt 2003).

Large numbers of pedestrians and cyclists are injured in motor vehicle collisions each year: 66,000 pedestrians and 48,000 cyclists nationwide in 2013 (National Highway Traffic Safety Administration 2015b). In Massachusetts, the fatality rate for pedestrians involved in motor vehicle traffic crashes is 1.02 per 100,000 pedestrians, which is lower than the national average of 1.5 per 100,000. However, pedestrians account for 20.0% of motor vehicle traffic crash fatalities in the state, compared to 14.5% nationwide (National Highway Traffic Safety Administration 2015a). The fatality rate for pedalcyclists in Massachusetts is .9 per million people compared to 2.35 per million for the U.S.

	Injury Rate (U.S.)	**Fatality Rate (MA)**	**Fatality Rate (U.S.)**	**Percent of Total Traffic Fatalities (MA)**	**Percent of Total Traffic Fatalities (US)**
Pedestrian	21 per 100,000	1.02 per 100,000	1.05 per 100,000	20.9%	14.5%
Pedalcyclist	152 per million people	.9 per million people	2.35 per million people	1.8%	2.3%

Source: National Highway Traffic Safety Administration

Alcohol involvement is a major factor in pedestrian injuries and fatalities (both for the motor vehicle operators and the pedestrians) (Retting, Ferguson, and McCartt 2003). Populations who walk or bicycle frequently will have increased exposure to motor vehicles and therefore increased risk of injury or death—this includes active commuters, and poorer people who tend to do more utilitarian walking.

The speed of a motor-vehicle is a major factor in traffic collisions. Increased speed reduces a driver's cone of vision, reduces their available reaction time, and increases stopping distances once a driver detects the need to avoid an accident. Chance of injury also rises disproportionately with greater speed (Rosén and Sander 2009). As an example, a pedestrian hit at 35 mph is nearly three times more likely to die than if they are hit at 25 mph (Tefft 2013). A recent Massachusetts HIA found that reducing the default speed limit on local roads from 30 mph to 25 mph statewide would prevent 2,200 crashes, 18 fatalities and 1,200 injuries per year ("Speed Limit Reduction on Local Roads | Metropolitan Area Planning Council" 2015).

Figure 38: A simulation of a driver's cone of vision based on speed of travel. At 15mph (top) the entire street and sidewalks are visible. At 25mph the cone of vision narrows to the vehicular travel lanes and the driver is less likely to see pedestrians entering a crosswalk. Simulation from NAACTO.org based on these studies: A. Bartmann, W. Spijkers and M. Hess, "*Street Environment, Driving Speed and Field of Vision*" Vision in Vehicles III (1991).
W. A. Leaf and David F. Preusser. **Literature review on vehicle travel speeds and pedestrian injuries**. (Washington, D.C.: U.S. Dept. of Transportation, National Highway Traffic Safety Administration, 1999).

Increased numbers of pedestrians and bicyclists out and about is associated with decreased injury and fatality rates per pedestrian or bicyclists—an effect know as "safety in numbers." Some hypothesize that drivers pay more attention to pedestrians and bicyclists when they are more common; others believe the causal mechanism has not been determined (Jacobsen 2015; Bhatia and Wier 2011). Reducing the number of vehicles on the road, by replacing driving trips with walking or biking trips could reduce traffic injuries and fatalities, but it would require a very large mode shift (50% plus shift from driving to walking and bicycling) to accomplish this (Elvik 2009). The change in overall system safety accompanying mode shift is related to the infrastructure available to pedestrians and cyclists; for example, a shift from short driving trips to bicycling on dangerous roads may increase the overall number of traffic accident injuries, whereas a shift to cycling on separated bicycle facilities might reduce the number of traffic accidents injuries (Wegman, Zhang, and Dijkstra 2012).

The configuration of the street network itself may play a major role in traffic safety. More dense grid-like street networks appear to have lower fatality rates for all modes of transportation—motor vehicles, pedestrians, and bicycles. The working theory is that dense grid-like networks result in lower speeds (Marshall and Garrick 2011). This type of network is also a strong predictor of increased rates of walking and bicycling and so provides a win-win with increased physical activity and decreased accident fatalities.

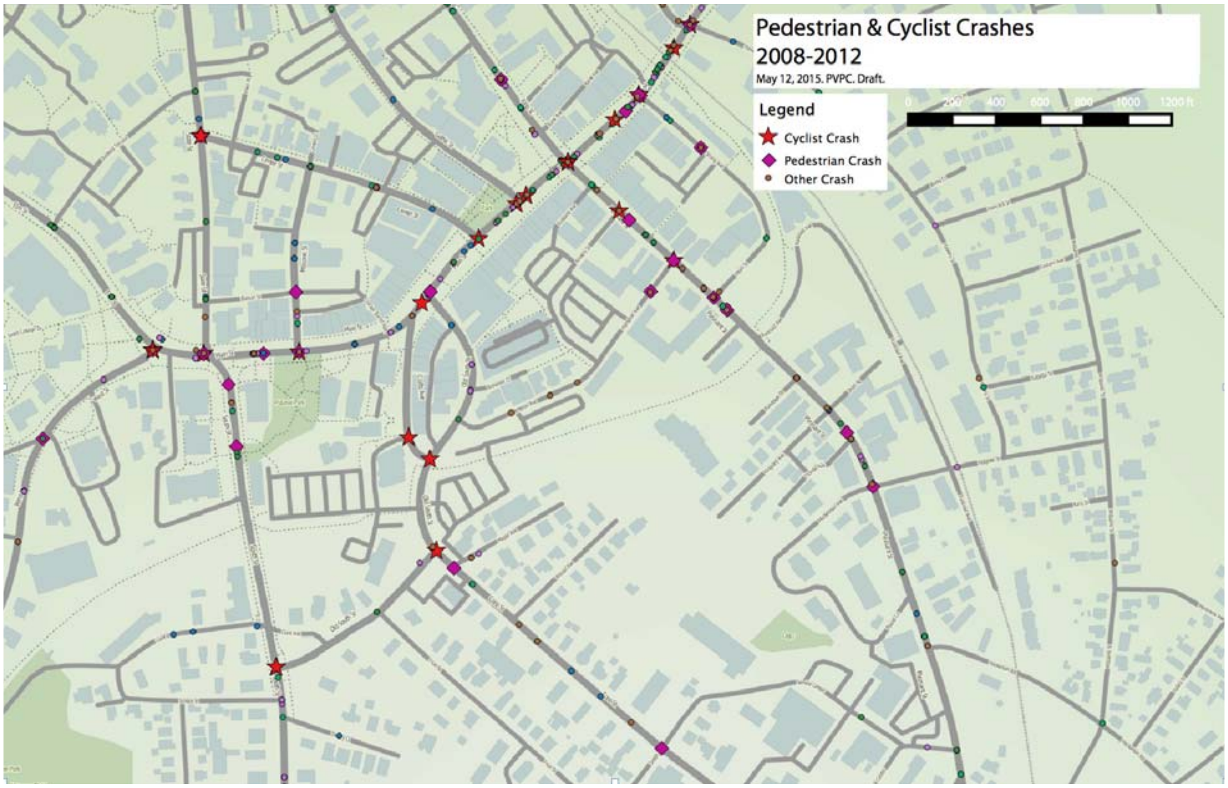
Adjacent land uses appear to be associated with traffic safety for all modes. A study of motor vehicle crashes in San Antonio, Texas found that, big box stores, and strip commercial were associated with increases in motor vehicle crash incidence, including for pedestrians and bicyclists. Pedestrian-scale retail uses were associated with decreases in the incidence of motor vehicle crashes. "Each additional strip commercial use is associated with a 2.2% increase in motorist crashes, and each additional big box store is associated with a 7.7% increase in motorist crash incidence. Stated another way, each additional strip commercial use increases motorist crash incidence by about four times as much as adding one million miles of vehicle travel, and each additional big box store increases crash incidence by roughly 14 times as much as adding one million miles of vehicle travel (Dumbaugh and Li 2010)." For reference, there are about 11 million vehicle miles traveled per day in the Pioneer Valley (PVPC 2015).

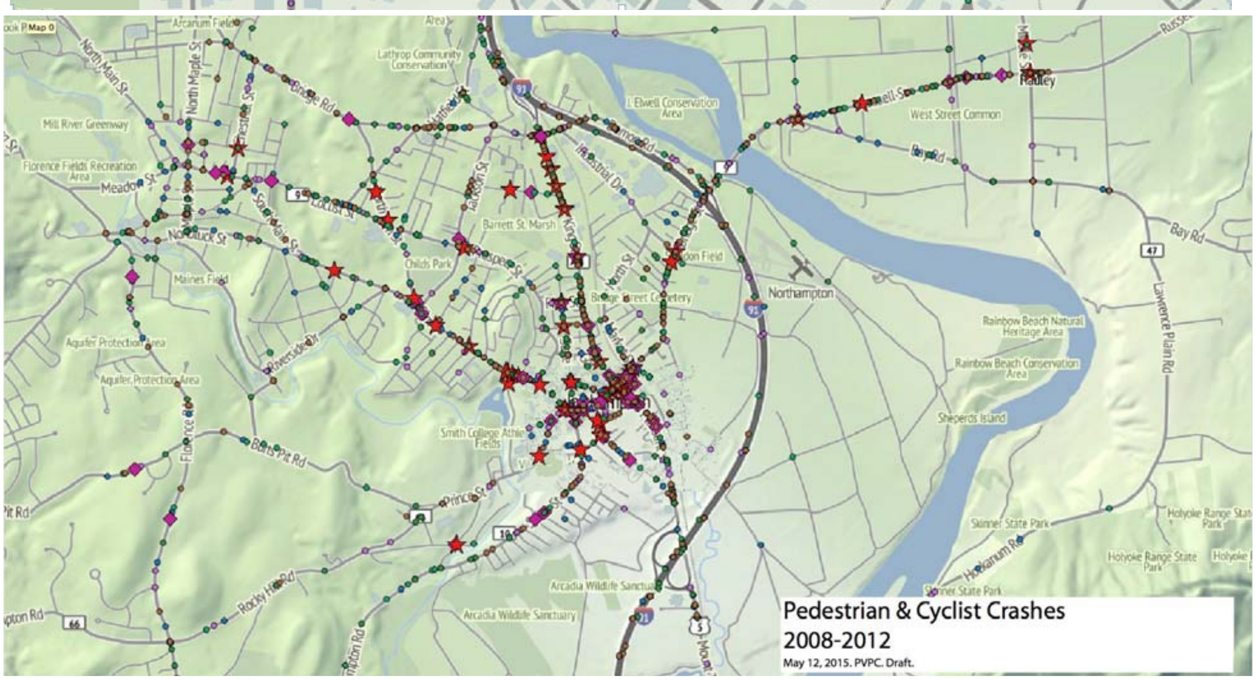
Pedestrian injuries and fatalities can be reduced through three means:

- reducing the speed of motor vehicles,
- separating vehicles and pedestrians,
- and making pedestrians more visible (Retting, Ferguson, and McCartt 2003).

The same framework likely applies to cyclists as well.

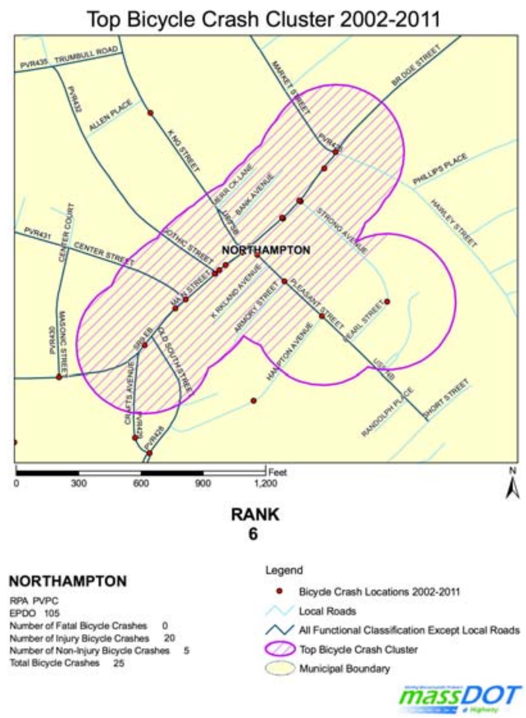
Pleasant Street Health Impact Assessment (HIA) Accidents (2008-2012) & Traffic Volumes





Using PVPC's GIS crash data layers, we analyzed data on all crashes that took place within 2 miles of Pleasant Street from 2008-2012. In total, there were 636 automobile crashes, 1 fatality, and 181 non-fatal injuries. Of the 636 overall crashes, 13 involved cyclists, and 15 involved pedestrians. Of the 15 crashes that involved pedestrians, 13 (87%) led to non-fatal injuries. Eleven out of 13 cyclist crashes involved non-fatal injuries.

Pleasant Street is part of the 6th worst bicycle crash cluster in the State, as ranked by MassDOT (MassDOT 2013).



Between 2008-2012, the study area (Pleasant Street between Hampton Ave and Hockanum Road) had 7 pedestrian crashes and 1 bicyclist crash—all of which were collisions with passenger cars. Of the crashes, 7 resulted in non-fatal injuries, while one resulted in property damage only. The 5-year crash average for pedestrians was 1.2. The 5-year crash average for pedestrians was 0.2. MassDOT cautions that about 20% of reported crashes are not coded for location and therefore not included in the dataset from which we drew our information. In addition, pedestrian and bicycle crashes are likely to be severely underreported to the police. An analysis in the Netherlands that compared police reports with hospital data found that only 59% of bicycle/motor vehicle crashes resulting in serious injuries were reported, and that only 4% of crashes in which no-motor vehicle was involved were reported (Wegman, Zhang, and Dijkstra 2012).

Pedestrian and Bicyclist Crashes on Pleasant Street between Hampton Ave and Hockanum Road

Pedestrians **Bicyclists**

	Non-Fatal Injuries	Fatal Injuries	Property Damage Only	Non-Fatal Injuries	Fatal Injuries	Property Damage Only
2008	2					
2009	1		1			
2010	1					
2011				1		
2012	2					
TOTAL	**6**	**0**	**1**	**1**	**0**	**0**
5-year Crash Average						
		Pedestrians	1.2		**Bicyclists**	.2 per year

Pedestrian and bicycle safety may be of particular concern for residents who do not have the opportunity to reduce accident risk by getting in a car. 11.5% of households in 01060 do not have a vehicle available (U.S. Census Bureau 2015a).

Assessment of potential impact of Pleasant Street Improvements on Safety from Traffic--Walking

Introduction

Proven measures to improve pedestrian safety that are relevant to Pleasant Street Improvements include speed management, sidewalks, pedestrian refuge islands, and increased roadway lighting. Advanced stop lines, and in pavement flashing lights show some promise but have not been evaluated fully enough. Traffic calming, including speed humps, has shown mixed results, varying from a 25% decrease in pedestrian crashes after implementation, to no impact (Retting, Ferguson, and McCartt 2003). A recent study found that traffic calming does result in both higher rates of walking and increased safety among children (Rothman et al. 2014).

Marked crosswalks do not appear to reduce the risk of injury for pedestrians, though results vary by design and location (Retting, Ferguson, and McCartt 2003; Macdonald, Sanders, and Supawanich 2008). In some circumstances crosswalks at unsignalized intersections (i.e. no traffic light is present) may be more dangerous than not having a crosswalk at all (Retting, Ferguson, and McCartt 2003; Macdonald, Sanders, and Supawanich 2008). One study of 282 crosswalks where older pedestrians (65+) had been hit by cars, found that 3.6-fold higher risk of motor vehicle-pedestrian collision at marked crosswalks with no traffic signal or stop sign (Koepsell et al. 2002). Crosswalks at mid-block locations may be particularly problematic because drivers do not expect cross traffic. Generally, the relative safety of marked versus unmarked crosswalks declines with increased numbers of lanes, higher traffic volume, and faster speeds (Zegeer et al. 2005). Based on FHWA recommendations, Pleasant Street might have increased pedestrian crash risk "if crosswalks are added without other pedestrian facility enhancements (FHWA 2015, 10)." See the Appendix for a table showing crosswalk marking recommendations for uncontrolled locations based on average daily traffic (ADT), number of lanes, and speed.

Emerging research seems to indicate that unsignalized crosswalks can be made safer if they employ multiple treatment methods—the combination of overhead flashing lights and raised surfaces seems particularly effective (Macdonald, Sanders, and Supawanich 2008). Pedestrian refuge islands also improve crosswalk safety (Retting, Ferguson, and McCartt 2003; Macdonald, Sanders, and Supawanich 2008). Crosswalk bumpouts reduce pedestrian crossing times and therefore reduce risk of injury (van Hengel 2013).

Crosswalk striping style does seem to have an impact on pedestrian safety. "High-visibility" crosswalk markings, especially "continental" and "bar pairs" styles of markings do appear to be safer than transverse markings. Currently, crosswalks on Pleasant Street are marked with the continental pattern. The bar pair pattern may provide better longevity, since spacing for vehicle tires can be controlled more. The triple four pattern may offer similar advantages as bar pairs, and also provide a less slippery channel for pedestrians (McGrane and Mitman 2013).

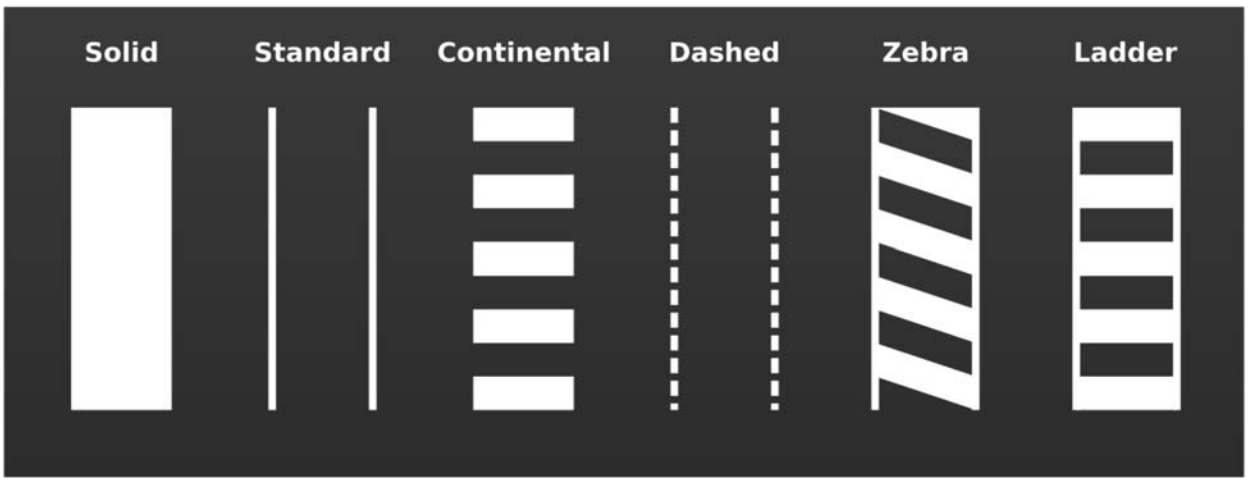


Figure 39: Crosswalk marking styles. Standard marking above is also referred to as Transverse.

Crosswalks and improved crosswalks appear to have a greater impact on pedestrian behavior than driver behavior (Macdonald, Sanders, and Supawanich 2008). A study of crosswalks installed in Amherst at Amherst College found a slight reduction in driver speed whereas pedestrian compliance jumped from 54% to 96% after installation (Dulaski 2006). This indicates that designers of crosswalks have a serious responsibility to ensure that their crosswalks are in fact relatively safe. Otherwise they run the risk of channeling pedestrians into an unsafe situation and giving them a false sense of safety. This may be particularly true in Northampton where drivers generally obey state law and stop for pedestrians in crosswalks; as a result Northampton pedestrians may be more likely to step out into traffic at a crosswalk than pedestrians in other communities.

Existing Conditions

The project area on Pleasant Street currently has complete sidewalks, which should contribute to pedestrian safety. There is one protected median at the crosswalk south of Hockanum Street. Participants in the walk audit felt this median had improved pedestrian safety by marking an entrance to town, slowing traffic and making the crosswalk more visible. It also provides a refuge for crossing pedestrians. There are no advanced stop lines, or in-pavement flashing lights in the study area. Street lighting was not evaluated.

Adjacent land uses should have a generally positive effect on pedestrian safety. As a percentage of frontage, pedestrian-oriented uses outweigh strip commercial uses.

The street network may or may not be contributing to pedestrian safety. Northampton has a reasonably connected street network, but as discussed earlier, Pleasant Street itself is relatively disconnected from that network. This may be compounded by Pleasant Street's role as a significant arterial connecting I-91, downtown Northampton, and Route 9, and King Street shopping areas.

There is one explicit traffic calming measures within the study area—the paired center islands and related travel deflection south of Hockanum Road. In addition, the presence of on-street parking, street trees, and pedestrian-oriented urban design may serve as traffic calming and slow traffic. Congestion also slows traffic at peak hours and may reduce pedestrian crash injury severities—though congestion can also exacerbate visibility challenges at crosswalks.

Following traffic speed, crosswalks are likely the most significant aspect of the study area affecting pedestrian safety. The crosswalks on Pleasant Street are perceived to be unsafe by neighborhood residents. In particular, residents dislike the crosswalk at Holyoke Street, which they feel suffers from sight line issues due to on-street parking, a curve in the road to the north, which limits visibility for cars heading south. In addition the crosswalk is on the edge of downtown immediately adjacent to the transition to state highway. Neighborhood residents feel that some drivers are still "in highway mode" when they reach the Holyoke Street crossing and are not looking for pedestrians. Observation of the street by project did indicate that drivers begin to speed up as the travel south on Pleasant Street. The mid-block crossing

Our literature review and the crash data mirrored what we heard from stakeholders: the crosswalks on Pleasant Street at Holyoke Street, and Kingsley Avenue are likely not contributing to pedestrian safety. Crosswalks at Hockanum Road do incorporate enhancements for pedestrian safety (a median, and curb extensions respectively) and may improve pedestrian safety.

Assessment of Proposed Changes

The Draft 25% Plan for Pleasant Street Improvements has several features that should affect pedestrian safety. Raised crosswalks are proposed at Holyoke Street, and Kingsley Avenue. A raised intersection is proposed where the NH&NCL Rail Trail crossed Pleasant Street. All three locations also feature curb extensions. The combination of these improvements should improve pedestrian safety over existing conditions.

The crosswalk improvements should be seen as a necessity, rather than a luxury. They will likely bring the safety of the existing crosswalks up to par. In other words, after the improvements the crosswalks will likely be about as safe, or slightly safer, than not having a crosswalk at all.

The alternative to improving the crosswalks would be to remove the crosswalk marking. Removing crosswalk markings would require much more aggressive traffic calming to reduce traffic speeds dramatically. This approach does not seem like an acceptable or safe solution given the value that local culture and state law place on marked crosswalks.[9] In addition, removing the crosswalks would likely negatively impact perceived safety and walkability, which would negatively impact population health through reductions in physical activity.

As discussed elsewhere, street network improvements that could lead to a reduction in traffic volume, could have significant impacts on pedestrian safety on Pleasant Street. One study found "a 30% reduction in the traffic volume would reduce the total number of injured pedestrians by 35% and the average risk of pedestrian collision by 50% at the intersections under analysis (Miranda-Moreno, Morency, and El-Geneidy 2011)." However, given the context of Pleasant Street, street network connectivity improvements would be extremely difficult because of the physical impediments to greater connectivity including the rail line and the buried Mill River.

Improved pedestrian connectivity could reduce exposure to motor vehicles and improve pedestrian safety. Key improvements to consider include adding sidewalks to Service Center Road, creating additional pedestrian paths between Pleasant Street and Conz Street, and creating a pedestrian path between Conz Street and the South Street neighborhoods.

The narrowing and realignment of the mouth of Hockanum Road should improve pedestrian safety, by slowing traffic entering and exiting Hockanum Road. The elimination of a small portion of the protected median at the crosswalk south of Pleasant Street will likely not have a safety effect, but may impact perception of safety for the short-term, and may be perceived as a loss by local residents.

As discussed in the Assessment of Walking for Active Transportation, the addition of street trees, the narrowing of travel lanes, and the addition of raised crosswalks should all reduce motor vehicle speeds. Lower speeds should reduce the both the number and severity of vehicle-pedestrian collisions.

Safety improvements will disproportionately several groups of people:

- people who live and work near Pleasant Street, and those who visit it frequently.
- People who walk more, likely including people who do not own cars, and those who use active transportation
- Older adults will benefit disproportionately because injury severity from motor vehicle accidents is generally worse for older adults than younger people.
- People with lower incomes who are less likely to own cars, more likely to walk for utilitarian purposes

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[9] Massachusetts State Law requires motor vehicles to yield to pedestrians in marked crosswalks, while state highway regulations require pedestrians to yield to motorists at any point other than a marked crosswalk.

In sum, the proposed improvements to Pleasant Street should result in decreased pedestrian injuries and fatalities over existing conditions. The improvements will likely be relatively small, but will affect a relatively large population. Traffic collisions are relatively infrequent events but they are often catastrophic and therefore have a large societal impact, as shown in Table 20 below. In addition, because they are a leading cause of death for young people, their health and economic impact is outsized from the perspective of years of potential life lost is particularly grave. Avoidance of a small number of pedestrian-motor vehicle crashes that results in a fatal or serious injuries could offset the project cost as well as sparing individual and community pain and suffering.

Type of Injury	Medical Cost	Work Loss Cost	Combined Cost
Fatal	$24,000	$1,201,000	**$1,224,000**
Non-fatal Hospitalization	$64,000	$141,000	**$205,000**
Emergency Department, Treated & Released	$3,000	$3,000	**$7,000**

Table 20: Cost of injuries due to crashes between pedestrians and motor vehicles. Numbers show average U.S. cost for 2013 for a single incident. Data is from the Center for Disease Control's WISQARS website (CDC 2014)

Assessment of potential impact of Pleasant Street Improvements on Safety from Traffic—Bicycling

Introduction

Perception of traffic safety appears to be a major driver of whether a person chooses to bicycle or not. Recent literature has focused on four types of transportation bicyclists: Strong and Fearless, Enthused and Confident, Interested but Concerned, No Way No How ("Four Types of Transportation Cyclists | Bicycle Counts | The City of Portland, Oregon" 2015). These four types have different sensitivities to safety and evaluate bike routes by different criteria. While a "strong and fearless" rider may opt for the shortest route, interested but concerned cyclists are more likely to plan routes based on perceived safety. The latter group is far larger than the former. A recent study found that 85% of Interested but Concerned riders would be more likely to ride if they were physically separated by a barrier (see Figure 40) (Monsere, Dill, and MacNeil 2014). The popularity of the rail trails in Northampton and surrounding communities reflects the perceived safety of physically separated bike infrastructure.

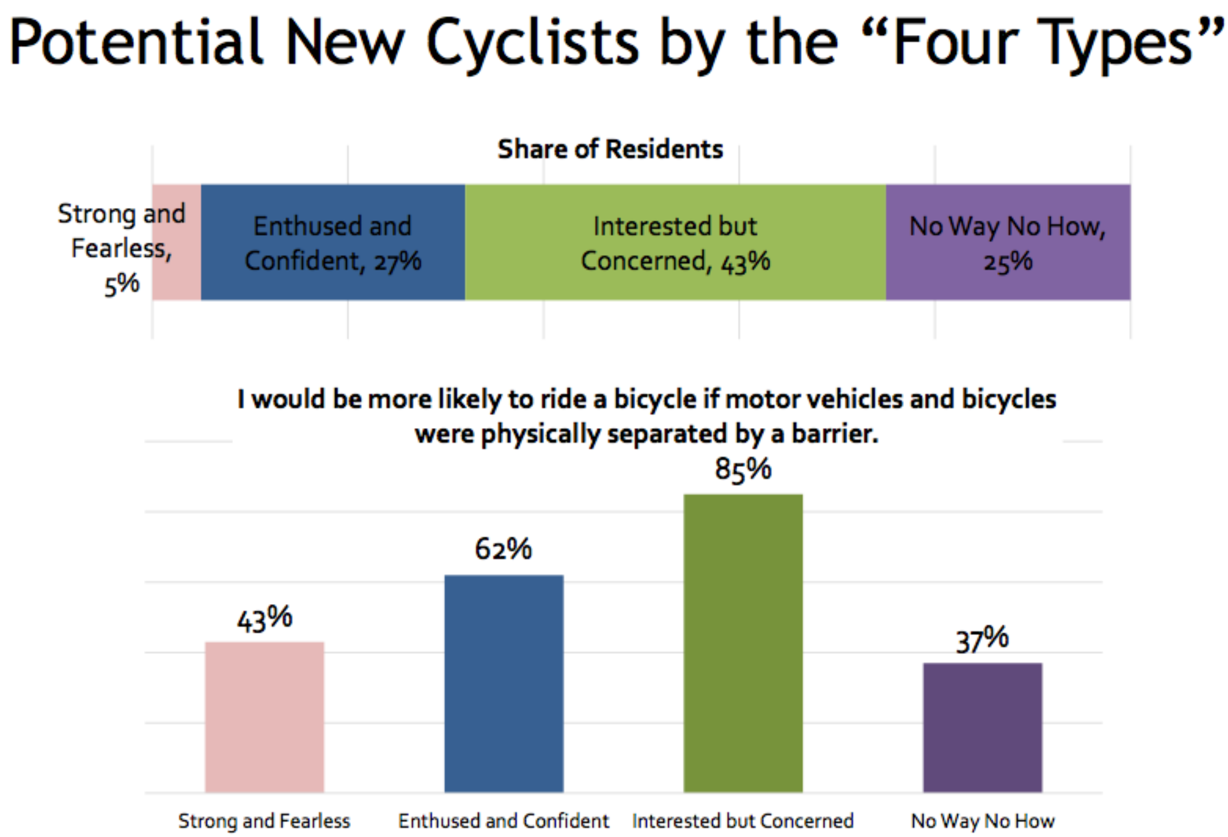


Figure 40: Four Types of Cyclists (Monsere, Dill, and MacNeil 2014)

Existing Conditions

As discussed earlier, there was one reported bicycle-motor vehicle collision in the five years for which data was available. This likely under-represents both accident rates and bicycle injury in the study area because of under reporting. Part of the study area is within the sixth worst bicycle crash cluster in the state as ranked by MassDOT. Their data (from 2002-2011) for the larger crash cluster showed a bicycle injury crash rate average of 2.2 per year, versus our data which showed a injury crash rate average of .2 per year for the study area only. Northampton has witnessed several fatal bicycle crashes in recent years, including one at the intersection of Main Street and Pleasant Street in 2012.

Stakeholder comments indicate that Pleasant Street is perceived to be unsafe by many people. Numerous stakeholders voiced some variant of "I would never ride my bike on Pleasant Street." One walk audit participant explained that carrying her bike up the stairs at the railroad/bike path crossing on Main Street was preferable to riding Pleasant Street to the bike path entrance at Railroad Avenue. During site visits to Pleasant Street, bicyclists were observed riding against traffic and riding on the sidewalks—both may indicate that bicyclists do not feel comfortable riding with traffic on Pleasant Street. Several stakeholders expressed a fear of being "doored." A smaller number of stakeholders said they were perfectly comfortable riding in traffic on Pleasant Street.

There are currently no dedicated bicycle facilities on Pleasant Street itself. However the NH&NCL Rail Trail intersects the street and likely serves as an alternate route for many would-be Pleasant Street bicyclists.

As discussed in the Active Transportation section of this report, a turning movement count performed by PVPC found 38 bicyclists on Pleasant Street and 49 bicyclists on the NH&NCL Rail Trail at peak hour. See Table 21 below.

Walkers & Bicyclists, Peak Hour Traffic Count
Pleasant St. at Manhan Rail Trail crossing (PM)

	North	South	East	West	Total
Walkers	83	69	24	36	**212**
Bicyclists	15	23	24	25	**87**
					299

Table 21: Peak Hour Bicyclist and Pedestrian Counts at the intersection of Pleasant Street and the NH&NCL Rail Trail.

Assessment

Actual injury risk for bicyclists has many complex causes, including characteristics of the accident itself: features of the bicyclist (age, helmet use, etc.), what the bicyclists hits (a pole, another bicyclists, speed and weight of a motor vehicle, the angle in which the bicyclist strikes another object, etc. Then there are factors that increase or decrease the risk of an accident occurring, including bicycle facility type (bike lane, bike path, etc.), the speed of motor vehicles, visibility, surface slickness, the number of bicyclists and pedestrians in the area, local culture, etc.

Pleasant Street improvements are likely to influence at least three of these variables: bicycle facilities, motor vehicle speed, and the number of bicyclists and pedestrians.

Facilities changes that could affect bicycle safety include:

- the proposed cycle tracks between Holyoke Street and Hockanum Road,
- shared lane markings between Holyoke Street and Pearl Street.
- intersection improvements to the NH&NCL Rail Trail crossing of Pleasant Street,

Changes that could affect motor vehicle speed include:

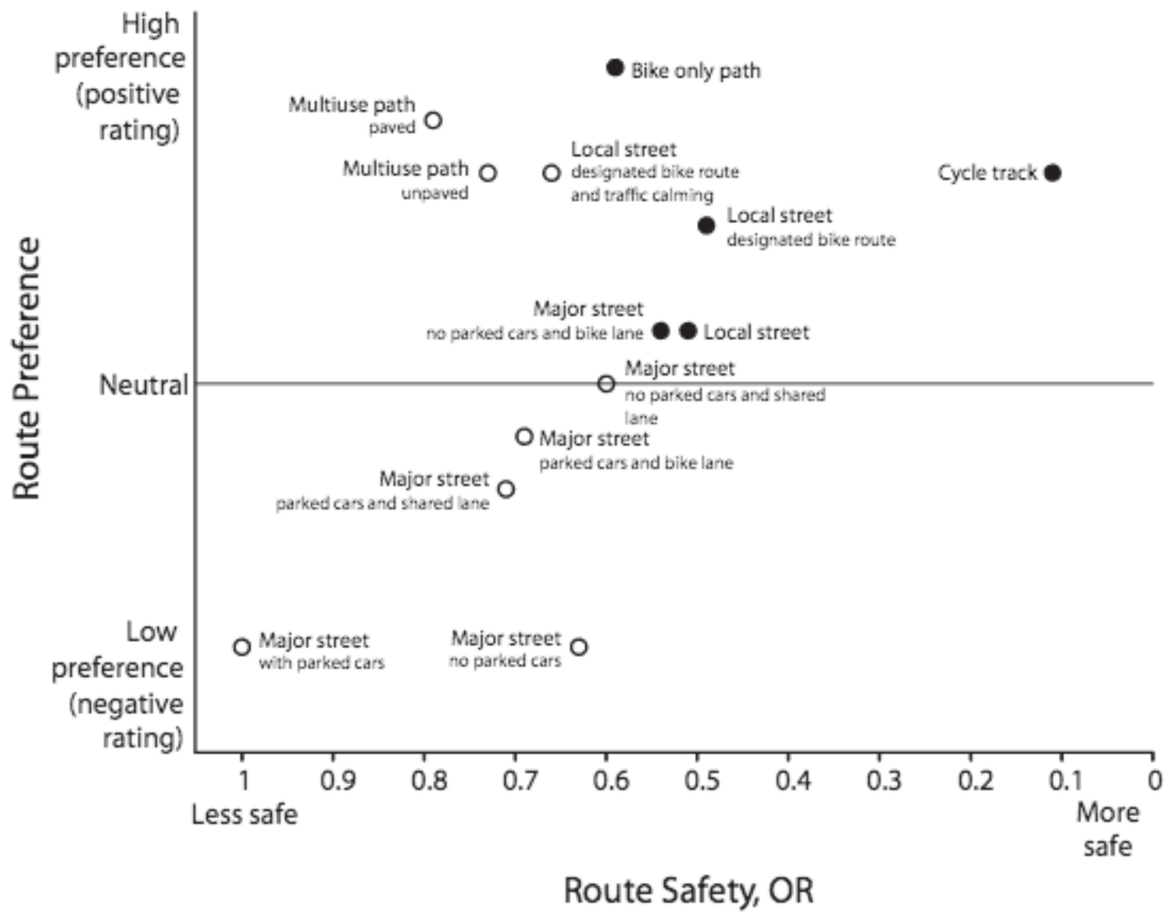
- the narrowing of vehicle travel lanes between Holyoke Street and Hockanum Road,
- the addition of on-street parking south of Michelman avenue,
- the addition of street trees,
- the narrowing of Hockanum Road's mouth,
- raised crosswalks, and curb extensions,
- raised intersection at Railroad Avenue/NH&NCL Rail Trail

In addition, Pleasant Street improvements will likely result in a mode shift from driving a car to walking and bicycling. This mode shift would reduce the number of motor vehicles on the road—reducing motor vehicle crash risk for all modes.

We will discuss cycle tracks, shared lane markings, improvements to the NH&NCL Rail Trail/Railroad Ave intersection, and increased numbers of bicyclists below. The other changes have been discussed previously and conclusions are similar for bicyclists and pedestrians: slower motor-vehicle speeds reduce accident risk and severity.

The proposed design for Pleasant Street includes cycle tracks, which are relatively unknown in the Pioneer Valley. Walk audit participants expressed some skepticism of the proposed cycle tracks, citing the short distance that the cycle track will cover, the greater need for other investments (particularly crosswalk improvement) and the sense that a cycle track is more desirable between Holyoke St and the NH&NCL Rail Trail crossing. These concerns may, in part, reflect a lack of familiarity with cycle tracks; there are currently no cycle tracks in Northampton.

Cycle tracks have been well received and heavily used in communities where they have been installed. Recent literature shows high levels of safety for cycle tracks (Lusk et al. 2013; Reynolds et al. 2009; Harris et al. 2013; Kittelson & Associates, Inc. et al. 2013). Cycle tracks appear to be vastly safer than roads with no bike facilities—like Pleasant Street currently—and safer than bike lanes or multi-use path—like Northampton's rail trails. A recent case-crossover study examined the routes taken by bicyclists that were involved in accidents. By comparing the infrastructure where accidents occurred with other randomly selected control locations on the same route, the study was able to evaluate the safety of bicycle infrastructure while controlling for riders' personal characteristics, weather, time of day, etc. The study showed that "cycle tracks had the lowest injury risk, about one ninth of the reference route type [major streets with parked cars and no bike infrastructure]. Bike lanes on major streets with no parked cars and off-street bike paths had nearly half the risk of the reference." Local streets and no car parking on major streets were also associated with risk reduction. Interestingly, injury reduction on multiuse paths (like Northampton's rail trails) was not significant. Shared lanes also did not significantly reduce injury (Teschke, Harris, et al. 2012).



Source. Route preference data from 2006 Metro Vancouver opinion survey.[24]
Note. OR = odds ratio. Closed circles represent route types with positive preference rating and adjusted injury OR < 0.6 (safest route types). Open circles represent route types with negative or neutral preference rating or adjusted injury OR ≥ 0.6. "Sidewalk or other pedestrian path" was not included because this route type was not queried in the preference survey. ORs for injury risk are plotted in reverse order.

FIGURE 1—Route preference vs route safety of 13 route types: route safety data from the injury study in the cities of Vancouver and Toronto, Canada, 2008–2009.

Figure 41: Route preference vs. route safety of 13 route types. Image from Teschke, Harris, et al, 2012.

Intersection improvements at the NH&NCL Rail Trail crossing will likely reduce crash risk in two ways. First, widening of the mouth of the NH&NCL Rail Trail, and the additional pathway directional choices provided by the raised intersection may reduce cyclist-only crashes (loss of balance, collision with a fixed object, etc.). Bicyclist-only crashes generally have lower injury severity than crashes with motor vehicles, but they do make up about half all bicyclist accidents (Teschke, Harris, et al. 2012). Second, and more significantly, if the raised intersection significantly reduces motor vehicle speeds, then it will reduce injury for bicyclists. One study found that if motor vehicle speeds at intersections are below

30kmh (18.6 mph), the odds ratio for risk of bicycle injury is .52 compared to speeds above 30kmh (Harris et al. 2013).

Increased numbers of bicyclists in Northampton may result in decreased accident rates per bicycle trip across Northampton as a whole (see the discussion of "safety in numbers" above). However, studies that examined safety in numbers effects for small areas, and for specific infrastructure improvements have been less conclusive (Harris et al. 2013). Our best guess is that risk of injury will remain flat as a result of increased bicyclists. This mirrors results from Portland, Oregon, which saw a decrease in bicyclist crashes and fatality rates of 50% between 1991 and 2006, and no discernable increase in bicycle crashes or fatalities over the same period (Gotschi 2011).

Because reported bicycle crashes are very infrequent, we do not believe that the current bicycle crash rate for Pleasant Street has statistical significance; the sample size is too small to discern meaningful patterns based on existing infrastructure. Therefore it is not possible to estimate the future number of bicycle crashes on Pleasant Street or their health economic impacts. However, we can use results of previous studies to estimate a percent reduction in crashes compared to existing conditions for the different segments of Pleasant Street.

We estimate that if proposed cycle tracks are built on Pleasant Street between Hockanum Road and Holyoke Street, that street segment would experience about a 90% reduction in the number of crashes that would happen under base line conditions—a very significant reduction. The sections of Pleasant Street that will be marked as a shared road will likely not see a change in accident rates as a result of that intervention. The intersection improvements at the NH&NCL Rail Trail will likely result in a reduction of injury at that spot of around 50% or more (assuming motor vehicle speeds drop significantly).

Increased safety from traffic due to Pleasant Street Improvements will disproportionately benefit several groups: males, who are vastly overrepresented in bicycle crashes; people in their 20's and people who have low incomes, who have high rates of bicycling; and people 40+ who have high rates of bicycle injuries. In addition, it appears that improved perception of safety resulting from cycle tracks will disproportionately benefit females. A study of separated bikeways in five U.S. cities found that after installation, women reported increasing how often they rode a bicycle more than men (Monsere, Dill, and MacNeil 2014). See Figure 42.

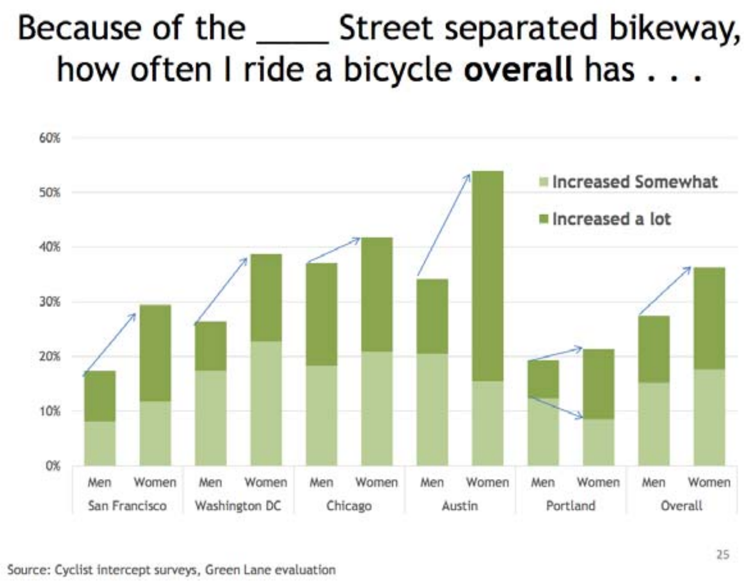


Figure 42: Survey results after installation of cycle tracks in several cities (Monsere, Dill, and MacNeil 2014)

The projected injury reductions on Pleasant Street will affect a very small number of people, but will have very large positive impacts for those individuals and society as a whole. Crashes between motor vehicles and bicycles are often catastrophic events with large economic, physical, and emotional impacts—including health care costs, lost productivity, and a chilling affect on other potential bicyclists. The estimated cost of single bicycle fatality is over $2 million. Injuries that require hospitalization cost about $200,000. Injuries for which the bicyclists is treated at the emergency department and then released cost about $8,000 on average. These numbers provide averages based on all ages and sexes. Because bicycle injury disproportionately affects young people, the impacts on lost lifetime productivity are outsized. For example, eliminating a single fatality of a male between 20-29 would result in a savings of $2.4 million.

Type of Injury	Medical Cost	Work Loss Cost	Combined Cost
Fatal	$33,000	$2,040,000	**$2,073,000**
Non-fatal Hospitalization	$56,000	$143,000	**$199,000**
Emergency Department, Treated & Released	$3,000	$4,000	**$8,000**

Table 22: Cost of injuries due to crashes between pedalcyclists and motor vehicles. Numbers show average U.S. cost for 2013 for a single incident. Data is from the Center for Disease Control's WISQARS website (CDC 2014)

It is clear that potential injury reductions resulting from Pleasant Street Improvements would have a positive health impact for Pleasant Street bicyclists. Eliminating a single bicyclist fatality would have health economic impacts that would outweigh the total expected project cost for Pleasant Street Improvements.

Pathway 3: Greenness/Trees

Background

There is significant evidence that the vegetation (especially physical activity in the presence of vegetation) has positive health impacts, including increases in physical activity, decreased cardiovascular disease, increased feelings of well-being, improved attention, decreased stress and anxiety (James et al. 2015). Recent studies have found that green spaces, such as parks, parklets, trails, and other open spaces, and vegetation, including street trees, improve individual health and the community-social environment (Weich et al. 2002; James et al. 2015). Access to parks, open space, and greenery may protect against poor mental health outcomes (Parra et al. 2010; Sugiyama et al. 2008) by encouraging more socializing and thus fostering greater social support and encouraging more socializing, particularly among women (Fan, Das, and Chen 2011; Leventhal and Brooks-Gunn 2003; Truong and Ma 2006; Maas et al. 2006). Access to green space in particular may also provide opportunities for physical activity or provide members of a community with sanctuary from stress (Stigsdotter et al. 2010; van den Berg et al. 2010; Maas et al. 2009). Communities with greater levels of social cohesion have better health outcomes than those with low levels. Providing a community recreation spot that promotes social interaction could reduce social isolation, which causes greater stress levels and other negative health impacts (Berkman and Kawachi 2000; Kawachi and Kennedy 1997)

Further research suggests that the presence of trees themselves, in addition to other vegetation, may also promote community health. Trees and other vegetation remove air pollutants and promote cleaner and more breathable air (Jim and Chen 2008). Trees have significant environmental benefits such as "carbon sequestration, air quality improvement, storm water attenuation, and energy conservation (Roy, Byrne, and Pickering 2012)." By providing shade for streets and buildings, trees reduce the presence of heat islands, UV exposure and skin cancer risk (Grant, Heisler, and Gao 2002; Stanton et al. 2004). Reduced temperatures provided by tree cover provide both actual and perceived thermal comfort for people—both in immediate proximity and in areas downwind (Klemm et al. 2015; Klemm et al. 2013). Finally, trees more so than bushes or shrubs may also play an important role in promoting positive mental health outcomes and positive social behavior (Taylor, Kuo, and Sullivan 2001) and have even been linked to reductions in crime (Kuo and Sullivan 2001)— a study of Baltimore City and County, MD found that "a 10% increase in tree canopy was associated with a roughly 12% decrease in crime…[and that] the magnitude was 40% greater for public than for private land (Troy, Grove, and O'Neil-Dunne 2012)."

The presence of greenspace and trees may be linked to increased walking. A study of school children in London, Ontario found that likelihood of active travel to school by children increased the more street trees there were along the route (Larsen et al. 2009). While analysis of a cohort study in Paris found that green spaces and quality open spaces were associated with higher levels of recreational walking (Chaix et al. 2014).

Finally, a study of the impacts of stormwater infiltration through green infrastructure, found that new installation of green infrastructure was associated with lower rates of narcotics possession (18%-27% less), narcotics manufacture (15-21%) and burglaries (5-6%) up to ½ mile away from the installation.

The study controlled for a variety of neighborhood and demographic characteristics. (Kondo et al. 2015).

Table 8: Open Spaces / Parks / Trails Summary Scores						
Built Environment Attribute	Physical Health	Mental Health	Social Benefits	Environmental Sustainability	Safety / Injury Prevention	Economic Benefits
Presence, proximity	54+ 3.5(0)	88.5+	26.5+ 4(0)	16+ 4(0)	11+	7.5+ 4(0)
Design features	3.5+		7.5+			
Trails						11.5+
Physical activity programs/ promotion		4.5+	4+	4+	4+	
Incivilities					3.5+	
Public gardens			4.5+		4.5+	

Figure 43: Table showing range of benefits from Open Space/Parks/Trails. A + in a cell indicates positive impacts, 0 indicates nuetral impact, - indicates negative impacts (not shown here). The number next to the + or 0 indicates the strength of existing evidence. The table shows very strong evidence for benefits from the proximity of green space related to physical health, mental health and social benefits. (Note: this table also includes effects of vegetation in general) (James F. Sallis et al. 2015).

The literature on the impacts of greenness is somewhat inconsistent in its application of terms—it is difficult to discern whether positive impacts result from vegetation in general, or public open space. That said, **it is clear that greenness has substantial health benefits—particularly with regard to mental health, which is a major concern in Northampton—and greenness has substantial additional social, environmental and economic benefits, all of which are also strongly related to population health.**

Assessment of potential impact of Pleasant Street Improvements on Greenness/Trees

The Draft 25% Plans for Pleasant Street show that 26 new street trees will be planted. All but four of these will be planted between Hockanum Road and Holyoke Street, and the vast majority of the new trees in this road section will be planted on the east side of Pleasant Street where there is a large city-owned right of way. This location should provide ample room for new trees to survive and thrive.

In general, new trees should result in the health benefits outlined above, including impacts related to carbon and stormwater storage, temperature modulation, and air quality. New trees will likely have positive mental health impacts on stress and anxiety levels, attention, and feelings of well-being.

New trees will support active transportation and safety from traffic. The proposed generous tree planting north of Hockanum Road, in particular may create a new visual gateway for Pleasant Street—underscoring street changes that will signal that motorists are entering town and should slow down. New trees in curb extensions at crosswalks may be perceived as "fixed-object" dangers by drivers and thereby encourage drivers to slow down (Dumbaugh 2006).

A new raingarden is proposed for the intersection of Hockanum Road and Pleasant Street. The vegetation in this garden will have similar effects as outlined for trees above.

Two new trees are proposed to be located in stormwater infiltration structures. These two sites may have unique benefits, including stormwater infiltration itself (minor reductions in local flooding, water cleansing), and potential reductions in substance abuse rates as suggested by a study of green infrastructure in Philadelphia (Kondo et al. 2015). The infiltration structures may also improve the success of the trees themselves.

Pine bark mulch strips are proposed for tree belts between the cycle track and the sidewalk on the east side of Pleasant Street just north of Hockanum road, and on the west side of Hockanum road just south of Michelman Ave. If these mulch strips were replaced with vegetation they would be more likely to positively impact health.

New trees on Pleasant Street will have economic benefits including potential for increased property values, reductions in building energy costs, and the creation of a sense that Pleasant Street is a desirable place to live, work, and be. These economic benefits support the City's long-term goals of neighborhood revitalization and could in turn have positive health impacts for a broad range of people through a variety of pathways.

Pathway 4: Affordable Housing

Background

A 2007 review of the health benefits of affordable housing reveals myriad health benefits of affordable housing (Lubell, Crain, and Cohen 2007). Families who spend greater than 30% of their gross household income on housing costs may have insufficient funds to meet other essential needs. This can have a disproportionate impact on the health of children, as children in low-income households not receiving housing subsidies are more likely to suffer from iron deficiencies, malnutrition and underdevelopment than children in similar households receiving housing assistance (Frank et al. 2006; Alan Meyers et al. 2005; A Meyers et al. 1993). Affordable housing may improve health outcomes by redirecting household financial resources for the purchase of nutritious food and for health care expenditures. By providing families with greater residential stability, affordable housing reduces frequent moves, overcrowding, eviction and foreclosure, which may reduce stress levels, depression and feelings of hopelessness (Guzman, Bhatia, and Durazo 2005; Kappel Ramji Consulting Group 2002; Bartlett 1997). Households with limited affordable housing options may live in substandard and inadequate housing which increases the risk of lead poisoning in children, asthma attacks, and injury (Jacobs et al. 2002). Poor quality or poorly maintained housing may also contain mold, dust mites, cockroaches and rodents: allergens that contribute to asthma and other respiratory illnesses (Cohn et al. 2006; P. Breysse et al. 2004). Emerging research suggests that affordable housing may help individuals living with chronic diseases such as HIV/AIDS, diabetes and hypertension better maintain their treatment regimens and achieve higher rates of medical care (Aidala et al. 2001; Kinchen and Wright 1991; National AIDS Housing Coalition 2005; Riley et al. 2005; Ledergerber et al. 1999).

By providing households with access to neighborhoods of opportunity, certain affordable housing strategies can reduce stress, increase access to amenities and generate important health benefits. Families who can only find affordable housing in very high-poverty areas may be prone to greater psychological distress and exposure to violent or traumatic events. Randomized trials have demonstrated that adults who were offered the opportunity to move to a low-poverty area experienced significant improvements in mental health at levels comparable to those achieved with "some of the most effective clinical and pharmacologic mental health interventions"(Kling, Liebman, and Katz 2007)." Girls who were offered the opportunity to move to a low-poverty area also had better mental health, showed benefits in the education domain, and engaged in fewer risk behaviors compared to children remaining in high-poverty neighborhoods (Leventhal and Dupéré 2011).

In HUD's "Moving to Opportunity" experiment, several thousand randomly selected families who lived in public housing were offered vouchers to move to better neighborhoods. Results showed significant health benefits for those who moved to better neighborhoods including a "reduction of extreme obesity and diabetes by fully 40-50% (Ludwig et al. 2013)." Recent follow up on the participants of the study showed significant economic advantages for pre-teen children who moved to low-poverty areas. Compared to control groups, they went on to earn 31 percent more per year by their mid-twenties, were more likely to attend college, were more likely to live in a better neighborhood as adults (Chetty, Hendren, and Katz 2015). Because socioeconomic characteristics are some of the most influential determinants of health, these results indicate that enabling children to move to a better neighborhood may result in long-term health improvements—which could span generations.

Affordable housing can also help victims of domestic violence escape the physical and mental health trauma caused by abuse and avoid the health risks associated with homelessness by providing permanent or transition housing options (Moracco et al. 2004; Menard 2001; Eisenstat and Bancroft 1999).

Assessment of potential impact of Pleasant Street Improvements on Affordable Housing

Northampton has a relatively high percentage of affordable housing compared to many other communities in the region--11.8% in 2000 (Northampton Housing Partnership 2011)--but residents still face significant housing challenges. As Northampton's *Housing Needs Assessment and Strategic Housing Plan* concluded, "The convergence of demographic and housing trends – increasing numbers of households, lower incomes, increasing poverty, rising prices, lower housing production, declining supply of rentals, difficulty in obtaining financing, large up-front cash requirements for homeownership and rentals – all point to a growing affordability gap (Northampton Housing Partnership 2011)." A third of households in 01060 with a mortgage pay more than 30% of their income for housing, while 45% of renters do so (U.S. Census Bureau 2015a). It should be noted that renters, who are particularly challenged, make up 56% of households in 01060 (U.S. Census Bureau 2015a). Finding affordable housing in Northampton is particularly challenging for low and moderate income individuals and families and people with disabilities. "As of Feb. 2015, there were 188 elderly and disabled individuals and 25 families on the [Northampton] housing authority's "eligible" waiting list for public housing (Newberry 2015).

Pleasant Street improvements are related to two affordable housing projects which have been permitted but which have not begun construction. The first project is by HAPHousing. It will replace Northampton Lodging, an existing SRO (Single Room Occupancy) on Pleasant Street. It is slated to provide 72 units, of those 48 will be reserved for people making up to 60% of area median income (AMI), and 16 of those will be slated for people who make up to 30% of area median income (Contrada 2015; Antonelli 2014). The second project will be built by ValleyCDC on the former site of Northampton Lumber. It will provide 55 affordable units ranging from one to three bedrooms and 5,300 square feet of commercial space (Cain 2015). There is strong demand for the types of units and price points that the projects will provide. These projects are expected primarily to draw tenants from Northampton, Amherst, Hadley and South Hadley and secondarily from Easthampton and Holyoke (Antonelli 2014).

Both affordable housing projects will benefit from the proposed improvements to Pleasant Street in three ways. First, the street improvements will likely make the neighborhood aesthetically more appealing, which will improve the market, potential of both projects especially for the commercial space in the Valley CDC project. Second, some of the Pleasant Street improvements would otherwise have to be performed by the two affordable housing projects, which would increase their costs. Third, the MassWorks grant for Pleasant Street improvements will include funding sewer improvements for the HAPHousing project. If awarded, this will result in a significant cost savings for HAPHousing, which will make their development more feasible.

We can expect that the affordable housing projects will have several positive health impacts. By providing relatively low-cost housing, they will likely reduce money- and housing-related stress for tenants, which may result in improved mental and physical health. By freeing up income for other purposes than housing, the may enable residents to make other health supporting decisions, such as purchasing healthy food, or visiting a doctor. The two new apartment buildings are likely to provide "healthier housing"—no exposure to lead paint, minimal mold, and better indoor air quality, than many other rental properties from which tenants may move.

The positive health impacts that are likely to accrue from Pleasant Street improvements due to increases in active transportation, increased safety from traffic, and increased green space, will have disproportionate benefits for the new residents of the Valley CDC and HAP Housing apartment buildings. We cannot predict where new residents might otherwise live, but there are few locations in the Pioneer Valley that offer a built environment that better supports health. As part of downtown Northampton, Pleasant Street provides one of very few locations in the Pioneer Valley where residents can carry out virtually all daily tasks using active transportation. Residents of the new apartment buildings on Pleasant Street will be within walking or biking distance from an elementary school, several parks, a post office, the library, both a full-line and three small groceries, and two seasonal farmers markets, PVTA bus stops, and Northampton's bus and train stations. While Pleasant Street itself lacks vegetation, adjacent neighborhoods have a robust street tree canopy, and several thousand acres of farmland nearby provide an immense amount of green space. In short, many of the built environment correlates of health are in place on Pleasant Street. While traffic safety for pedestrians and bicyclists is a major concern in the area, the city is making active efforts to improve traffic safety. In addition to the cycle track, and crosswalk improvements previously described, the city is currently part of a MassDOT pilot program to improve safety for pedestrians and bicyclists, which will include increased traffic safety education by the police.

At the same time, there are some health concerns about the new affordable housing on Pleasant Street.

The conversion of Northampton Lodging into an apartment building reduces the number of SRO units in Northampton for which there is a strong need (Northampton Housing Partnership 2011). HAPHousing intends to relocate as many existing residents of Northampton Lodging as possible, but we have some concern some current residents of Northampton Lodging may end up without adequate, or any, housing.

Pleasant Street is a major street with high motor-vehicle traffic volumes. PVPC counted about 15,000 cars per day on Pleasant Street at Hockanum Road and about 11,000 cars per day at Pearl Street. The 25% draft plans for Pleasant Street Improvements estimated daily traffic at 20,225 in 2011. There is an extensive body of literature linking vehicular air pollution to mortality and hospitalizations due to asthma exacerbation, chronic lung disease, heart attacks, ischemic heart disease, and major cardiovascular disease (US EPA and Abt Associates, Inc 2010; Roman et al. 2008; Schwartz et al. 2008;

Health Effects Institute 2003; Moolgavkar 2000b; Moolgavkar 2000a; Peters et al. 2001a). In particular there are concerns for people who reside within close proximity of high volume roads and diesel train lines. The Valley CDC apartment building will be located adjacent abuts the Northampton's train tracks which serve both freight trains and Amtrak trains. While train volumes are currently low, they are expected to increase in the future.

Northampton's high rates of alcohol and substance abuse may also negatively impact future residents of Pleasant Street. Pleasant Street is home to a liquor store and several bars and clubs. Several area residents and business people we spoke to described avoiding the street when bars and clubs let out on weekends due to high numbers of drunken people. They describe frequent fights and vandalism (Douglas and Sussman 2015). New residents of Pleasant Street may not have the opportunity to simply avoid the street, particularly if residents work second or third shift.

Finally, the crosswalk at Holyoke Street, which is perceived to be unsafe by area residents, will likely become safer if improvements are implemented. However, as an unsignalized crosswalk on the edge of downtown it will continue to provide some risk to pedestrians. Residents of the Valley CDC property will have this crosswalk at their front door and will have an unusually high exposure to it. This exposure may be compounded if the residents have high rates of utilitarian walking, as many lower income individuals do.

Overall, we conclude that the affordable housing projects on Pleasant Street will have substantial health benefits, and that the health benefits provided by other improvements to Pleasant Street will disproportionately benefit future residents of those buildings, both because of their proximity to the improvements and because of because of population-level health and demographic characteristics the new residents will likely bring. Health impact concerns related to new housing on Pleasant Street can be mitigated to some degree by efforts from the City of Northampton, HAPHousing, and ValleyCDC.

Part III:
Recommendations

Impact Table

Health Determinant & *Health Behaviors and/or Conditions Most Impacted*[10]	Evidence linking Determinant to Health Outcomes[11]	Strength & Direction of Health Impact	Size of Impacted Population[12]	Time Frame[13]	Disproportionately Impacted Populations	Findings
Active Transportation Physical Activity Mental Health & Brain Development Chronic Disease (Cardiovascular Disease, Obesity, Diabetes, Pancreatic Cancer, Breast Cancer, Endometrial, Colon & Rectal Cancers)	**Walking for Active Transportation** A very robust body of literature links physical activity to a panoply of health benefits (listed on the left). Both high and low income individuals benefit from more walkable neighborhoods with increases in overall physical activity (Sallis et al. 2009). Consistent research has linked features of the built environment to active transport, defined as walking, biking, and public transportation (which typically requires some walking or biking). Active transport correlates with mixed land-use, street network connectivity, availability of destinations, residential density, street design, and distance to transit (Ewing and Cervero 2010; Freeman et al. 2012; Giles-Corti et al. 2013; McCormack and Shiell 2011; Litman 2013). Street-scale pedestrian design including the presence of amenities such as street furniture, lighting and shading is moderately related to general walking and improvements in health (McCormack and Shiell 2011; Sallis et al. 2015; Heath et al. 2012). Recreational walking is associated with proximity to recreational destinations and positive perceptions of neighborhood aesthetics (Giles-Corti et al. 2013; McCormack et al. 2013).	Medium positive impact	Large	Commences immediately, and continues indefinitely. Most significant impacts attained after 5+ years.	• Females • Older Adults • People with mobility impairments • People with visual impairments • People with low-incomes • People who do not own cars	• The Pleasant Street area provides a regionally significant location where multiple factors support walking for active transportation. Its walkability is reflected in high commute share for walking (20%) and supports positive health outcomes for a variety of conditions. • People who walk to work in 01060 are twice as likely to be female than male. • The proposed improvements would have a moderate positive impact on walking for active transportation. • The largest benefits would come from the project's direct and indirect support for additional housing and commercial development on Pleasant Street, which will in turn increase walking for active transportation • Proposed improvements—especially improvements at major network connectivity points and reduced vehicle speeds as a result of traffic calming measures—may positively influence perceptions of safety and therefore inspire some new walking trips • Recreational walking may increase due to improved aesthetics • New curb ramps, raised crosswalks, sidewalk replacement, will improve walkability, especially for people with mobility and/or sight impairments, and older adults.

[10] Color coding represents strength of evidence in the literature. Dark purple indicates strong evidence. Medium purple indicates moderate evidence. Light purple indicates some evidence.
[11] This table only provides a brief summary of evidence, for a more extensive literature review please see the full report for the Pleasant Street Improvements Health Impact Assessment the Healthy Neighborhood Equity Funds Health Impact Assessment.
[12] Small population is less than 5% of 01060 population. Medium population is 5-19% of population of 01060. Large is 20%+ of 01060. Very large is 50%+ of 01060.
[13] Baseline for timeframe is 2017.

	Bicycling for Active Transportation Bicycling has significant health benefits including overall fitness, decreased cardiovascular risk, and decreased mortality (Oja et al. 2011; Andersen L et al. 2000). The benefits of physical activity from bicycling outweigh risks from injury or air pollution based on a cost-benefit approach. (Teschke, Reynolds, et al. 2012). Broad land use patterns, including residential density, proximity to jobs and services, and connectivity appear to affect bicycling rates. Climate, hilliness, weather and local culture are also major determinants of bicycling (Heinen, van Wee, and Maat 2010). Convenient routes are associated with uptake of cycling to work (Panter et al. 2013). Some quasi-experimental studies have found that installation of cycle tracks, greenways and bike paths results in increased bicycling, others studies have not (McCormack and Shiell 2011). Several studies of route choices by regular bicyclists have found that bicyclists prefer dedicated bicycle facilities including bike lanes, separated paths, and cycle tracks, and bicycle boulevards (Stinson and Bhat 2003; Dill 2009). Bicycle use for active transportation has increased significantly in the United States in recent years. Gains are concentrated in a small number of places and almost all the increase has been amongst men aged 25-64 (Pucher, Buehler, and Seinen 2011). Communities that have invested in bicycle interventions including physical infrastructure, land use policy reform, and bicycle promotion programs have experienced significant increases in bicycling (Pucher, Buehler, and Seinen 2011; Pucher, Dill, and Handy 2010).	High positive impact	Medium	Commences immediately, and continues indefinitely. Most significant impacts attained after 5+ years.	• Adult males, especially those in their 20's. • Females, parents with young children, and older adults • People with low-incomes • People who do not own cars	• Northampton's existing bike network has regional significance because it provides a robust supportive environment for active transportation. • Past bike network improvements in Northampton appear to have increased bicycling rates—nearly 3 times more people commute to work by bicycle now than they did in 2000. • Bicyclists on Pleasant Street appear to prefer the New Haven and Northampton Canal Line Rail Trail to Pleasant Street. • Bicycle commuters in Northampton are twice as likely to be male than female • Continued development of bike infrastructure in Northampton is a necessary component of increased levels of bicycling for active transportation • If current levels of investment in bike infrastructure continue, we conservatively estimate that 01060's bike commute to work mode share will reach 11.7% by 2037 and that an additional 6.16% of the area's population will ride a bike at least once a day. • Proposed bicycle infrastructure improvements to Pleasant Street, including proposed cycle tracks and the improved crossing of the New Haven and Northampton Canal Line Rail Trail at Pleasant Street will result in additional bicycle trips. • The estimated health economic benefits of increased bicycle trips will be between $3.5million and $4.6 million over 20 years. This provides a benefit to cost ratio for the Pleasant Street Improvements of at least 3:1. • The health economic benefits of increased levels in bicycling due to past bicycle network improvements in Northampton are worth about $150million (or $95million if discounted at 5% per year). This is roughly 10 times the amount that has been invested to date. • Bicycle infrastructure improvements to Pleasant Street may have a disproportionate benefit for bicyclists from Holyoke because those connections could: 1. open greater social and economic opportunities, which could result in long-term health benefits; 2. contribute to increases in physical activity levels, which could have disproportionate benefits based on the health background of Holyoke's population compared to Northampton's population.

Safety from Traffic Injuries Physical Activity	**Walking—Safety from Traffic** Motor-vehicle collisions are a significant risk for pedestrians. Collisions are relatively rare on a population level, but often have catastrophic consequences. In Children aged 5 to 9 have the highest population-based fatality rate, while older pedestrians (65+) are more likely than younger pedestrians to be struck at intersections (Retting, Ferguson, and McCartt 2003). In 2013, males accounted for 69% of pedestrian fatalities. Alcohol and motor-vehicle speed are significant factors in the chance of accidents and their severity. Increased numbers of pedestrians and bicyclists is associated with decreased injury and fatality rates per pedestrian or bicyclists—an effect know as "safety in numbers" (Jacobsen 2015; Bhatia and Wier 2011). Highly connected street networks and pedestrian-scale retail uses are associated with improved pedestrian safety from traffic. Proven measures to improve pedestrian safety include speed management, sidewalks, pedestrian refuge islands, and increased roadway lighting. Advanced stop lines, and in pavement flashing lights show some promise but have not been evaluated fully enough. Traffic calming, including speed humps, has shown mixed results (Retting, Ferguson, and McCartt 2003). Marked crosswalks do not appear to reduce the risk of injury for pedestrians, though results vary by design and location (Retting, Ferguson, and McCartt 2003; Macdonald, Sanders, and Supawanich 2008). Emerging research seems to indicate that unsignalized crosswalks can be made safer if they employ multiple treatment methods—the combination of overhead flashing lights and raised surfaces seems particularly effective (Macdonald, Sanders, and Supawanich 2008). Pedestrian refuge islands also improve crosswalk safety (Retting, Ferguson, and McCartt 2003; Macdonald, Sanders, and Supawanich 2008). Crosswalk bumpouts reduce pedestrian crossing times and therefore should reduce risk of injury (van Hengel 2013).	High positive impact	Small[14]	Commences immediately, and continues indefinitely	• Older adults • People with low-incomes • People who do not own cars • People with high rates of utilitarian walking and bicycling • Future residents of Valley CDC and HAPHousing properties	• Between 2008-2012, there were 7 reported pedestrian/motor-vehicle crash, six of those involved non-fatal injuries, the seventh resulted in no injury. Reported crashes likely significantly under represent actual crashes. • Narrowing travel lanes between Holyoke Street and Hockanum Road, adding raised crosswalks with curb extensions, and adding street trees should result in reduced motor vehicle speeds, which will reduce the number and severity of vehicle-pedestrian crashes. • The three proposed raised crosswalks with curb extensions should improve pedestrian safety from traffic over existing conditions. • The narrowing and realignment of the mouth of Hockanum Road should improve pedestrian safety by slowing traffic.The improvements will likely be relatively small, but will affect a relatively large population. • Avoidance of a small number of pedestrian-motor vehicle crashes that results in a fatal or serious injuries could offset the project cost as well as sparing individual and community pain and suffering.

[14] Although many people walk, the number injured in traffic accidents is relatively small.

	Bicycling—Safety from Traffic Perception of traffic safety appears to be a major driver of whether a person chooses to bicycle or not. Recent literature has focused on four types of transportation bicyclists: Strong and Fearless, Enthused and Confident, Interested but Concerned, No Way No How ("Four Types of Transportation Cyclists | Bicycle Counts | The City of Portland, Oregon" 2015). These four types have different sensitivities to safety and evaluate bike routes by different criteria. While a "strong and fearless" rider may opt for the shortest route, interested but concerned cyclists are more likely to plan routes based on perceived safety. The latter group is far larger than the former. A recent study found that 85% of Interested but Concerned riders would be more likely to ride if they were physically separated by a barrier (Monsere, Dill, and MacNeil 2014). Males accounted for 87% of pedalcyclist fatalities in 2013. Recent literature shows high levels of safety for cycle tracks (Lusk et al. 2013; Reynolds et al. 2009; Harris et al. 2013; Kittelson & Associates, Inc. et al. 2013). Cycle tracks appear to be vastly safer than roads with no bike facilities—like Pleasant Street currently—and safer than bike lanes or multi-use path—like Northampton's rail trails. A recent case-crossover study showed that cycle tracks had the lowest injury risk of bike infrastructure types, about one ninth of the risk of major streets with parked cars and no bike infrastructure. (Teschke, Harris, et al. 2012).	High positive impact	Small	Immediate, and continues indefinitely	• Adult males, especially those in their 20's. • People with low-incomes • People who do not own cars • Older adults	• There was one reported bicycle/motor vehicle crash between 2008-2012. It resulted in non-fatal injuries. The northern part of the study area is part of the 6th highest bicycle crash cluster in the state. Bicycle crashes are likely vastly under-reported and historic crash data does not provide meaningful information about likely future rates. • Pleasant Street improvements are likely to influence at least three variables that will impact future bicycle injury rates: bicycle facilities, motor vehicle speed, and the number of bicyclists and pedestrians. • Cycle tracks, as proposed for Pleasant Street between Hockanum Road and Holyoke Street, are significantly safer than other bicycle facilities—about 9 times safer than existing conditions. • Intersection improvements at the crossing of the New Haven and Northampton Canal Line Rail Trail will likely reduce bicyclist injury from both bicyclist-only crashes and bicyclist-motor vehicle crashes. • Increased numbers of bicyclists in Northampton may decrease accident rates per bicycle trip across the city as a whole, while risk of injury on Pleasant Street will likely remain the same as a result of "safety in numbers." A decrease in overall system safety as a result of increased bicyclists is not likely. • Improved safety will disproportionately benefit males, especially males in their 20's , and older adults. • Improved perceptions of safety for bicycling may have more positive impact on female bicycling rates than male bicycling rates. • Potential injury reductions resulting from Pleasant Street Improvements will have positive health impacts for Pleasant Street bicyclists. Eliminating a single bicyclist fatality would have health economic impacts that would outweigh the total expected project cost for Pleasant Street Improvements.

Green Space & Trees Mental Health Social Cohesion Asthma COPD Melanoma Crime (Real or Perceived)	Access to parks, open space, and greenery may protect against poor mental health outcomes (Parra et al. 2010; Sugiyama et al. 2008) by encouraging more socializing and thus fostering greater social support and encouraging more socializing, particularly among women (Fan, Das, and Chen 2011; Leventhal and Brooks-Gunn 2003; Truong and Ma 2006; Maas et al. 2006). Trees and other vegetation remove air pollutants and promote cleaner and more breathable air (Jim and Chen 2008). By providing shade for streets and buildings, trees also mitigate heat islands, UV exposure and skin cancer risk (Grant, Heisler, and Gao 2002; Stanton et al. 2004). Finally, trees in particular have been linked to positive social behavior (Taylor, Kuo, and Sullivan 2001), and even to reductions in crime (Kuo and Sullivan 2001).	Medium positive impact	Large	Immediate, and continues indefinitely	• People with high stress levels and /or mental health conditions • People with high rates of utilitarian walking and bicycling • People susceptible to heat stress	• 26 new street and a rain garden are proposed • New trees should result in positive health impacts due to carbon and stormwater storage, temperature modulation, and air quality improvement. • New trees will likely have positive mental health impacts on stress and anxiety levels, attention, and feelings of well-being. • New trees will support active transportation and safety from traffic. • New trees will likely have economic benefits including potential for increased property values, reductions in building energy costs, and the creation of a sense that Pleasant Street is a desirable place to live, work, and be. These economic benefits could in turn have positive health impacts for a broad range of people through a variety of pathways.
Affordable Housing Mental Health Substance Abuse Children's Development Diabetes Consumption of healthy food	A 2007 review of the health benefits of affordable housing reveals myriad health benefits of affordable housing (Lubell, Crain, and Cohen 2007). Affordable housing reduces frequent moves, overcrowding, eviction and foreclosure, which are associated with higher stress levels, depression and feelings of hopelessness (Guzman, Bhatia, and Durazo 2005; Kappel Ramji Consulting Group 2002; Bartlett 1997). These problems can disproportionately affect children, as several studies found that children in low-income households not receiving housing subsidies are more likely to suffer from iron deficiencies, malnutrition and underdevelopment than children in similar households receiving housing assistance (Frank et al. 2006; Alan Meyers et al. 2005; A Meyers et al. 1993). The location of affordable housing matters. Affordable housing located in high-opportunity neighborhoods has shown "reduction of extreme obesity and diabetes by fully 40-50% (Ludwig et al. 2013)." As well as significant economic advantages for pre-teen children who moved to low-poverty areas. (Chetty, Hendren, and Katz 2015). These results indicate that affordable housing that enables children to move to a better neighborhood may result in long-term health improvements—which could span generations.	High positive impact	Small	Impacts from affordable housing itself: 5+ years Impacts from related pathways: see above	• People with low-moderate incomes • Children	• Proposed improvements will support two affordable housing projects in the pipeline for Pleasant Street: Valley CDC at former Northampton Lumber and HAPHousing at Northampton Lodging. Improvements will support the market potential for both projects, and will reduce costs for the projects improving their feasibility. • The proposed affordable housing developments will likely reduce money-related stress for tenants, which will improve mental and physical health and potentially enable residents to make health supporting decisions like purchasing healthy food or visiting a doctor. • The proposed new housing will provide "healthier housing" than existing options (no lead pain, reduced mold, improved indoor air quality). • Positive health impacts from active transportation, safety from traffic, and green space will have disproportionate benefits for new residents of the ValleyCDC and HAPHousing projects. • Air quality impacts on new housing should be investigated further and mitigated as necessary. • Impacts of alcohol and substance abuse on residents of Pleasant Street should be investigated further and mitigated as necessary.

Recommendations[15]

Recommendations for Active Transportation—Walking

1. **Continue the city's efforts to redevelop Pleasant Street into a more vibrant mixed-use neighborhood with greater residential density**. A revitalized Pleasant Street neighborhood would like increase walking (and biking) rates for existing neighborhood residents and new residents who would be in close proximity to the highly walkable downtown area.
    a. Northampton's Office of Planning and Sustainability should continue to develop a neighborhood plan for Pleasant Street.
    b. Work to ensure equity of participation in the plan's creation by all affected populations. Set targets for participation of people with low socioeconomic status, older adults, people affected by mental health and substance abuse challenges in the neighborhood, and people who do not own cars.
    c. Consider encoding the neighborhood plan in meaningful zoning changes with particular attention to built form, a mix of uses that serves neighborhood residents, higher density, and long-term affordability for a diverse population.
    d. Numerous factors point to the value of high quality urban design on Pleasant Street, including public input that expressed desire for an attractive place, the need to slow traffic on Pleasant Street which can be aided by architecturally signaling to drivers that they are entering a walkable place, and the positive relationship between attractive places and recreational walking levels (Panter et al. 2013). In light of the desire for high quality urban design, consider adopting a form-based code for Pleasant Street.
2. Consider which populations the city wants to support and target interventions to that population. Populations of concern include:
    a. Older adults given the proximity of the Senior Center to Pleasant Street and the aging of Northampton's population in general. Benches, shade, lack of tripping hazards and public restrooms are prime features of walking network for older adults.
    b. Nearby residents with lower socioeconomic status. Lower socioeconomic status is associated with increased levels of utilitarian walking (Li et al. 2014). With two new affordable housing developments on Pleasant Street, the street will likely see an increase in utilitarian walking.
    c. Older adults with lower socioeconomic status may be of particular concern as they have both high levels of utilitarian walking and greater risk of injury from falls while walking (Li et al. 2014).
    d. Residents who are exposed to drunkenness and associated violence late at night when bars and clubs are active.
3. Continue to work toward greater pedestrian connectivity between Pleasant Street and adjacent neighborhoods. Pleasant Street is relatively cut off from residential neighborhoods to

[15] Note: all recommendations are intended to be implemented by Northampton's Department of Planning and Sustainability unless otherwise noted.

its east and west due to the railroad and underground Mill River respectively. The small number of connections that do exist—Holyoke Street and Hockanum Street on the East; Service Center, Wright Ave, and informal pedestrian paths between Conz Street and Pleasant Street on the West—deserve significant attention for pedestrian comfort.

   a. Continue to explore pedestrian (and bike) connections over or under the railroad tracks
   b. Continue to explore pedestrian connections along the former bed of the Mill River
   c. Work toward a legitimate, sanctioned and well designed pedestrian and bicycle-only path from the vicinity of the Senior Center to Pleasant Street.

Recommendations for Active Transportation—Bicycling

1. Improvements to bike infrastructure on Pleasant Street are a worthwhile investment. The health economic benefits due to increased physical activity from bike network improvements are substantial. From a societal perspective, they result in a benefit-cost ratio that is at least 3:1.
2. Because increases in bicycling are strongly related to perceptions of traffic safety, the city should pay particular attention to improvements that will result in improvements in perceived and actual safety for bicyclists.
   a. Cycle tracks are generally perceived as being very safe in places where they have been implemented. They also appear to be the most safe form of bicycle facility
   b. Reducing motor-vehicle traffic volumes and speeds can have a significant impact on bicyclist comfort and safety.
3. Develop a long-term plan for bike connections between Northampton and Holyoke. This plan could be developed in cooperation with the City of Holyoke. Note: Holyoke is currently developing a bike network plan with assistance from PVPC.
4. Bicycle improvements should be supported by neighborhood land use planning to increase desirable destinations, employment opportunities, and diverse housing options that are affordable to a broad range of Northampton residents.

Recommendations for Safety from Traffic—Walking

Issue: Crosswalk safety at Holyoke Street (and Roberto's to a lesser degree)

Recommendations

1. Improving the crosswalk at Holyoke Street should be a high priority for Pleasant Street improvements. Consider multiple treatments to alert cars of the crosswalk including flashing lights and a raised surface.
2. Pedestrian education is a key aspect of safety at crosswalks. Signage can remind pedestrians to "look both ways even in Northampton."
3. Work to reduce traffic speeds on Pleasant Street with the eventual goal of reducing the posted speed limit to 20 mph. (Speed limits can not be set below the 85^{th} percentile of actual traffic speed). Measures to reduce traffic speed include:

    a. Implementing the traffic calming measures included in the 25% design plan,
    b. Actively enforcing the speed limit and the legal requirement that motorists yield for pedestrians in marked crosswalks.
4. Improve site lines for the Holyoke Street crosswalk by selectively removing on-street parking from the west side of Pleasant Street to open view channels to the crosswalk for vehicles travelling south on Pleasant Street.

Issue: Sidewalk Quality. *Cracked an uneven sidewalks on Pleasant Street present a tripping hazard, which is particularly of concern to older adults, for whom falls are a leading cause of injury.*

Recommendations

1. Repair or replace cracked or uneven sidewalks. Provide pedestrian clearways that are at least 6' wide that are free of obstructions and which have smooth high grip surfaces (avoid use of bumpy surfaces like brick in pedestrian clearways).
2. Ensure that sidewalk maintenance is part of regular municipal operations and that it gets the same or greater attention than road paving.
3. Ensure that snow is promptly removed from sidewalks.
    a. The city should consider a broad policy change to clear snow from sidewalks in commercial centers.
    b. Alternatively, explore creation of a BID or other landowner consortium to cooperatively remove snow.

Issue: Perceived safety of railroad underpass at Holyoke Street. *The underpass at Holyoke Street provides several safety concerns including a narrow crosswalk adjacent to a narrow road, and fear of crime. These concerns should be taken seriously given the mental health and substance abuse problems Northampton faces.*

Recommendations

1. Implement the 25% design plan, which includes new sidewalks on both sides of Holyoke Street up to the Railroad Underpass.
2. Improve lighting for the underpass.
3. Work with the railroad, to ensure that the underpass remains in good repair with maintained vegetation, no dripping water, etc.
4. Consider adding art to the underpass
5. The Northampton Lumber redevelopment should add more "eyes on the street" in this area and improve perceptions of safety. Ensure that the site design does not provide areas that could be perceived as unsafe (hiding places) adjacent to the underpass.

Issue: Design of future pedestrian improvements. *Planning improvements for pedestrian safety requires a good understanding of existing conditions. While crash data can provide some insight into the safety of roads and intersections, the relatively rareness of crashes makes it difficult to distinguish significant patterns from random events. In addition, a lack of baseline data about pedestrian activity makes it difficult to quantify the relative risk pedestrians versus other modes, and therefore the relative need for improvements by mode.*

Recommendations

1. Some studies have found that collecting information on "traffic conflicts" is more effective than use of crash data, to identify potential safety issues, particularly in areas with low numbers of crashes (less than 5 per year). The City of Northampton could consider incorporating traffic conflict counts into future planning for pedestrian improvements.
2. Collect regular pedestrian activity counts throughout the city. Begin to build an understanding of overall walking levels by population, including numbers of trips, purposes and locations of trips, and "walking miles traveled (WMT). Measure local pedestrian crash risk rates by person, by trip, and by WMT.
    a. There are a variety of counting techniques available including manual counts, video-based counts, infrared counters. In addition there is emerging technology that may be used for pedestrian counts including cell phone data, pedometers, and fit bits.
    b. Compile pedestrian data from previous traffic impact studies conducted for development proposals.

Recommendations for Safety from Traffic--Bicycling

Issue: Access to the bike path from the neighborhoods east of Pleasant Street is challenging. *Residents greatly appreciate the bike path but feel cut off from it.*

Recommendations

1. Explore possibilities for a safer connection for bicyclists between Holyoke Street and the NH&NCL Rail Trail. Options include:
    a. Adding a cycle track or bike lane between Holyoke Street and the NH&NCL Rail Trail. This option has low feasibility because the road in this section is narrow and adding bike lanes or a cycle track would require removing some on street parking. Removing on-street parking is in conflict with the results of a recent parking study and the city's policy both of which place a high value on on-street parking. In addition the proposed curb extensions at crosswalks would infringe on space for a cycle track.
    b. Provide an off-street bike connection from Holyoke St to the rail trail via a path that parallels the train tracks on the backsides of parcels. There are a small number of parcels between Holyoke Street and the rail trail, but so far City efforts to gain an easement have been unsuccessful. Consider leveraging this access as part of future development approvals.
    c. Establish Hawley Street as a bike boulevard with improvements to the intersection of Hawley and Main Streets and better bike access to the Rail Trail at Main Street. The latter may require an improved bike ramp or a bike elevator, both of which are very costly elements.

Issue: Awkward crossing Pleasant Street at the NH&NCL Rail Trail. *Some bicyclists find the S shaped movement that they must do at the crossing to be awkward. Some also perceive crossing the parking lot driveway to be unsafe.*

Recommendations

1. Recommendation: Implement the design shown in the Draft 25% plan. The double crosswalk will provide additional pathways for bicyclists. Widening the entrance to the NH&NCL Rail Trail on the west side of Pleasant Street will improve turning radius issues. The raised table between the two crosswalks will slow traffic existing Railroad Avenue, and will increase driver awareness of the crosswalks.
2. Consider providing a pedestrian activated signal at the crossing similar to the King St or Damon Road bike path crossings.

Issue: Access to medical facilities at Atwood Drive (Route 5)

The new medical facilities off Route 5 at Atwood Drive are relatively inaccessible for people without a car. This exacerbates an existing issue in the Cooley-Dickinson hospital service area, in which a small but significant portion of the population experiences great hardship when trying to access medical services (Pioneer Valley Planning Commission and United Way Hampshire County 2015). This issue was raised by participants in public outreach, and advisory committee meetings. The location at Atwood Drive presents several challenges: its distance from residential areas puts beyond a comfortable distance for many people who would consider active transportation; while much of Route 5 is perceived to be unsafe, the exit 18 I-91 highway interchange is perceived to be particularly dangerous. Planned improvements to Pleasant Street considered in this HIA, and the planned roundabout at Pleasant Street and Conz Street, will ease conditions for active transportation to Atwood Drive. Bike and pedestrian Improvements to the remainder of Route 5 to Atwood Drive, and Holyoke as discussed above, are also necessary.

Recommendations

1. See active transportation, bicycling recommendations above for this issue.

Recommendations for Greenness/Trees

1. Invest in robust tree and vegetation planting along Pleasant Street. Aim for full shading of all sidewalks and cycle tracks on Pleasant Street at the time of maturity.
2. Investigate why street trees seem to be in poor health on Pleasant Street. Make the necessary investments to ensure the long-term survival of street trees. Consider installing larger tree pits (with open bottoms if possible), grates to prevent compaction, protection for immature trees, improved soil, regular watering and fertilization as needed. Installation of bike racks, may reduce damage to immature trees due from bicyclists who use them to lock their bikes.
3. It is likely that the same amount of money spent on tree planting would have more significant health benefits than investment in highly designed parklets in curb bumpouts.
4. Maintaining and enhancing tree cover upwind of Pleasant Street will likely have significant impacts on the thermal comfort of the street. Prevailing winds in Northampton are generally from the west, so increasing tree cover in the area between Pleasant Street and Conz Street,

including the proposed Mill River Greenway, will likely improve the thermal comfort on Pleasant Street.

Recommendations for Affordable Housing

1. Ensure that current residents of Northampton Lodging are placed in adequate housing (HAPHousing)
2. Continue to work to develop new SRO housing in Northampton (City of Northampton)
3. Investigate air quality impacts further.
    a. Locate building air intakes away from Pleasant Street and the train tracks.
    b. Consider installing HEPA air filtration. (ValleyCDC and HAPHousing)
4. Investigate impacts of alcohol and substance abuse on residents of Pleasant Street. Mitigate when possible.
5. Consider giving housing preference to individuals who do not own cars and those who express an interest in using active transportation in order to maximize the potential health benefits from active transportation provided by the Pleasant Street location (ValleyCDC and HAPHousing).

Appendix & References

Additional Pathways that warrant Further Investigation

This rapid HIA prioritized assessment of pathways that appeared to be most directly related to the decisions at hand. However, the HIA was built on a comprehensive HIA framework developed by MAPC for the Healthy Neighborhood Equity Fund HIA[16]. Based on this framework, as well as concerns raised during the HIA process, the following pathways appear to warrant further investigation. We've listed them in order from the highest priority to lower priority.

1. Air Quality. Both motor-vehicle traffic and the trains that travel on the east side of Pleasant Street are very likely to negatively impact air quality on Pleasant Street. Populations of concern: residents of Pleasant Street, especially those on the east side (and nearby streets); pedestrians and bicyclists; people who work on Pleasant Street
2. Gentrification/Displacement: residents of Pleasant Street and adjacent neighborhoods may be displaced if the neighborhood is revitalized over the long term. Anecdotal evidence of displacement due to high home purchase costs, and high rents arose during the course of the HIA. Displacement of existing businesses may also be an issue in the long-term.
3. Safety from Crime—especially perceptions of safety. Stakeholders expressed mixed perceptions of crime. Many said they neighborhood felt safe. Others said that the area might not feel safe—especially on weekend evenings when bars and clubs let out.
4. Social Cohesion. Stakeholders described a neighborhood with relatively high social cohesion. Will neighborhood revitalization impact neighborhood social cohesion?
5. Economic Opportunity. Economic opportunity has profound impacts on health and neighborhood development. Long commutes point to a large number of Northampton residents commuting out of the city for work—which in turns shows that those residents are finding better economic opportunities elsewhere. Likewise anecdotal evidence of displacement indicates that some portion of the population who want to live in the Pleasant Street area cannot afford to do so.

Additional Populations that warrant Further Investigation

1. Our assessment focused on adult populations. Neighborhood changes may impact children differently than adults. Impacts on children warrant additional investigations. Particular focus areas include: Transportation to school, Safety from Traffic, Air Quality Impacts, and how health behaviors of children (like walking or bicycling) are mediated by their parents' perception of neighborhood characteristics.

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[16] The HNEF HIA report is at: http://www.mapc.org/sites/default/files/HNEF%20HIA%20Report%20v5_0.pdf. Additional related information (including updated literature reviews) and tools for assessment are at: http://www.mapc.org/transportation-health

Mortality Rates for Northampton

Incidence Rates of Hospitalizations in Northampton, MA, Calendar Year 2008-2010	
Condition	**Rate (per 100,000)**
Deaths by age group	
Under 5 yrs	101.10
5 to 9 yrs	28.32
10 to 14 yrs	15.14
15 to 19 yrs	76.72
20 to 24 yrs	76.82
25 to 29 yrs	112.98
30 to 34 yrs	40.82
35 to 39 yrs	65.91
40 to 44 yrs	220.80
45 to 49 yrs	267.32
50 to 54 yrs	1060.17
55 to 59 yrs	971.38
60 to 64 yrs	1283.82
65 to 69 yrs	1950.84
70 to 74 yrs	3000.95
75 to 79 yrs	4476.25
80 to 84 yrs	6723.83
85 yrs and older	13545.74

Table 23: Mortality rates for Northampton. Data provided by Massachusetts Department of Public Health

Selected Demographic Data for 01060

	ZCTA5 01060			
Subject	**Estimate**	**Margin of Error**	**Percent**	**Percent Margin of Error**
SEX AND AGE				
Total population	15,026	+/-513	15,026	(X)
Male	6,104	+/-388	40.6%	+/-2.2
Female	8,922	+/-460	59.4%	+/-2.2
Under 5 years	480	+/-144	3.2%	+/-1.0
5 to 9 years	697	+/-201	4.6%	+/-1.3
10 to 14 years	565	+/-125	3.8%	+/-0.8
15 to 19 years	1,405	+/-238	9.4%	+/-1.5
20 to 24 years	1,992	+/-317	13.3%	+/-2.0
25 to 34 years	2,702	+/-365	18.0%	+/-2.4

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
35 to 44 years	1,624	+/-244	10.8%	+/-1.6
45 to 54 years	1,873	+/-229	12.5%	+/-1.5
55 to 59 years	892	+/-197	5.9%	+/-1.3
60 to 64 years	855	+/-193	5.7%	+/-1.3
65 to 74 years	1,184	+/-173	7.9%	+/-1.1
75 to 84 years	373	+/-97	2.5%	+/-0.6
85 years and over	384	+/-110	2.6%	+/-0.7
Median age (years)	34.2	+/-1.2	(X)	(X)
18 years and over	12,907	+/-464	12,907	(X)
Male	4,995	+/-349	38.7%	+/-2.2
Female	7,912	+/-393	61.3%	+/-2.2
65 years and over	1,941	+/-199	1,941	(X)
Male	835	+/-142	43.0%	+/-6.1
Female	1,106	+/-170	57.0%	+/-6.1
RACE				
Total population	15,026	+/-513	15,026	(X)
One race	14,767	+/-517	98.3%	+/-0.7
Two or more races	259	+/-100	1.7%	+/-0.7
One race	14,767	+/-517	98.3%	+/-0.7
White	12,371	+/-499	82.3%	+/-3.3
Black or African American	655	+/-265	4.4%	+/-1.7
American Indian and Alaska Native	38	+/-32	0.3%	+/-0.2
Asian	1,358	+/-343	9.0%	+/-2.2
Native Hawaiian and Other Pacific Islander	8	+/-13	0.1%	+/-0.1
Some other race	337	+/-284	2.2%	+/-1.9
Two or more races	259	+/-100	1.7%	+/-0.7
Race alone or in combination with one or more other races				
Total population	15,026	+/-513	15,026	(X)
White	12,601	+/-489	83.9%	+/-3.2
Black or African American	761	+/-276	5.1%	+/-1.8
American Indian and Alaska Native	102	+/-57	0.7%	+/-0.4
Asian	1,414	+/-345	9.4%	+/-2.2

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
Native Hawaiian and Other Pacific Islander	21	+/-25	0.1%	+/-0.2
Some other race	420	+/-286	2.8%	+/-1.9
HISPANIC OR LATINO AND RACE				
Total population	15,026	+/-513	15,026	(X)
Hispanic or Latino (of any race)	1,190	+/-356	7.9%	+/-2.3
Not Hispanic or Latino	13,836	+/-577	92.1%	+/-2.3

Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey

Subject	Number	Percent
HOUSING OCCUPANCY		
Total housing units	7,307	100.0
Occupied housing units	6,782	92.8
Vacant housing units	525	7.2
For rent	165	2.3
Rented, not occupied	18	0.2
For sale only	52	0.7
Sold, not occupied	34	0.5
For seasonal, recreational, or occasional use	84	1.1
All other vacants	172	2.4
Homeowner vacancy rate (percent)	1.8	(X)
Rental vacancy rate (percent)	4.0	(X)
HOUSING TENURE		
Occupied housing units	6,782	100.0
Owner-occupied housing units	2,819	41.6
Population in owner-occupied housing units	6,202	(X)
Average household size of owner-occupied units	2.20	(X)
Renter-occupied housing units	3,963	58.4
Population in renter-occupied housing units	7,023	(X)
Average household size of renter-occupied units	1.77	(X)

Source: U.S. Census Bureau, 2010 Census.

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
EMPLOYMENT STATUS				
Population 16 years and over	13,217	+/-461	13,217	(X)
In labor force	9,491	+/-488	71.8%	+/-2.5
Civilian labor force	9,491	+/-488	71.8%	+/-2.5
Employed	8,839	+/-505	66.9%	+/-2.8
Unemployed	652	+/-164	4.9%	+/-1.2
Armed Forces	0	+/-19	0.0%	+/-0.3
Not in labor force	3,726	+/-351	28.2%	+/-2.5
Civilian labor force	9,491	+/-488	9,491	(X)
Percent Unemployed	(X)	(X)	6.9%	+/-1.7
Females 16 years and over	8,050	+/-386	8,050	(X)
In labor force	5,565	+/-361	69.1%	+/-3.3
Civilian labor force	5,565	+/-361	69.1%	+/-3.3
Employed	5,163	+/-382	64.1%	+/-3.7
Own children under 6 years	600	+/-155	600	(X)
All parents in family in labor force	427	+/-135	71.2%	+/-12.3
Own children 6 to 17 years	1,376	+/-274	1,376	(X)
All parents in family in labor force	1,124	+/-256	81.7%	+/-10.3
COMMUTING TO WORK				
Workers 16 years and over	8,637	+/-507	8,637	(X)
Car, truck, or van -- drove alone	4,776	+/-428	55.3%	+/-3.8
Car, truck, or van -- carpooled	621	+/-166	7.2%	+/-1.9
Public transportation (excluding taxicab)	403	+/-166	4.7%	+/-1.9
Walked	1,533	+/-251	17.7%	+/-2.7
Other means	455	+/-147	5.3%	+/-1.7
Worked at home	849	+/-216	9.8%	+/-2.3
Mean travel time to work (minutes)	20.4	+/-1.4	(X)	(X)
OCCUPATION				
Civilian employed population 16 years and over	8,839	+/-505	8,839	(X)
Management, business, science, and arts occupations	4,935	+/-466	55.8%	+/-3.9

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
Service occupations	1,548	+/-284	17.5%	+/-3.3
Sales and office occupations	1,627	+/-277	18.4%	+/-2.7
Natural resources, construction, and maintenance occupations	287	+/-128	3.2%	+/-1.4
Production, transportation, and material moving occupations	442	+/-132	5.0%	+/-1.5
INDUSTRY				
Civilian employed population 16 years and over	8,839	+/-505	8,839	(X)
Agriculture, forestry, fishing and hunting, and mining	89	+/-69	1.0%	+/-0.8
Construction	170	+/-97	1.9%	+/-1.1
Manufacturing	437	+/-160	4.9%	+/-1.8
Wholesale trade	175	+/-90	2.0%	+/-1.0
Retail trade	839	+/-187	9.5%	+/-2.0
Transportation and warehousing, and utilities	92	+/-56	1.0%	+/-0.6
Information	263	+/-107	3.0%	+/-1.2
Finance and insurance, and real estate and rental and leasing	250	+/-101	2.8%	+/-1.1
Professional, scientific, and management, and administrative and waste management services	856	+/-203	9.7%	+/-2.1
Educational services, and health care and social assistance	4,105	+/-388	46.4%	+/-3.7
Arts, entertainment, and recreation, and accommodation and food services	894	+/-238	10.1%	+/-2.7
Other services, except public administration	488	+/-155	5.5%	+/-1.8
Public administration	181	+/-92	2.0%	+/-1.0
INCOME AND BENEFITS (IN 2013 INFLATION-ADJUSTED DOLLARS)				
Total households	6,471	+/-252	6,471	(X)
Less than $10,000	366	+/-115	5.7%	+/-1.8
$10,000 to $14,999	564	+/-160	8.7%	+/-2.5
$15,000 to $24,999	750	+/-165	11.6%	+/-2.5
$25,000 to $34,999	647	+/-143	10.0%	+/-2.1
$35,000 to $49,999	816	+/-186	12.6%	+/-2.8

Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
$50,000 to $74,999	1,131	+/-209	17.5%	+/-2.9
$75,000 to $99,999	743	+/-155	11.5%	+/-2.3
$100,000 to $149,999	725	+/-138	11.2%	+/-2.1
$150,000 to $199,999	335	+/-110	5.2%	+/-1.7
$200,000 or more	394	+/-91	6.1%	+/-1.4
Median household income (dollars)	52,607	+/-4,194	(X)	(X)
Mean household income (dollars)	76,042	+/-6,869	(X)	(X)
With earnings	5,326	+/-303	82.3%	+/-3.2
Mean earnings (dollars)	73,371	+/-4,446	(X)	(X)
With Social Security	1,479	+/-198	22.9%	+/-2.8
Mean Social Security income (dollars)	15,483	+/-1,559	(X)	(X)
With retirement income	802	+/-156	12.4%	+/-2.4
Mean retirement income (dollars)	24,598	+/-4,934	(X)	(X)
With Supplemental Security Income	383	+/-140	5.9%	+/-2.2
Mean Supplemental Security Income (dollars)	8,678	+/-1,333	(X)	(X)
With cash public assistance income	180	+/-75	2.8%	+/-1.2
Mean cash public assistance income (dollars)	6,091	+/-3,141	(X)	(X)
With Food Stamp/SNAP benefits in the past 12 months	714	+/-135	11.0%	+/-2.1
Families	2,432	+/-213	2,432	(X)
Less than $10,000	97	+/-72	4.0%	+/-2.9
$10,000 to $14,999	76	+/-68	3.1%	+/-2.8
$15,000 to $24,999	139	+/-64	5.7%	+/-2.6
$25,000 to $34,999	130	+/-58	5.3%	+/-2.4
$35,000 to $49,999	211	+/-88	8.7%	+/-3.5
$50,000 to $74,999	453	+/-135	18.6%	+/-4.9
$75,000 to $99,999	381	+/-116	15.7%	+/-4.4
$100,000 to $149,999	469	+/-108	19.3%	+/-4.5
$150,000 to $199,999	183	+/-78	7.5%	+/-3.3
$200,000 or more	293	+/-90	12.0%	+/-3.5
Median family income (dollars)	81,053	+/-9,303	(X)	(X)
Mean family income (dollars)	109,234	+/-16,343	(X)	(X)
Per capita income (dollars)	33,655	+/-3,077	(X)	(X)

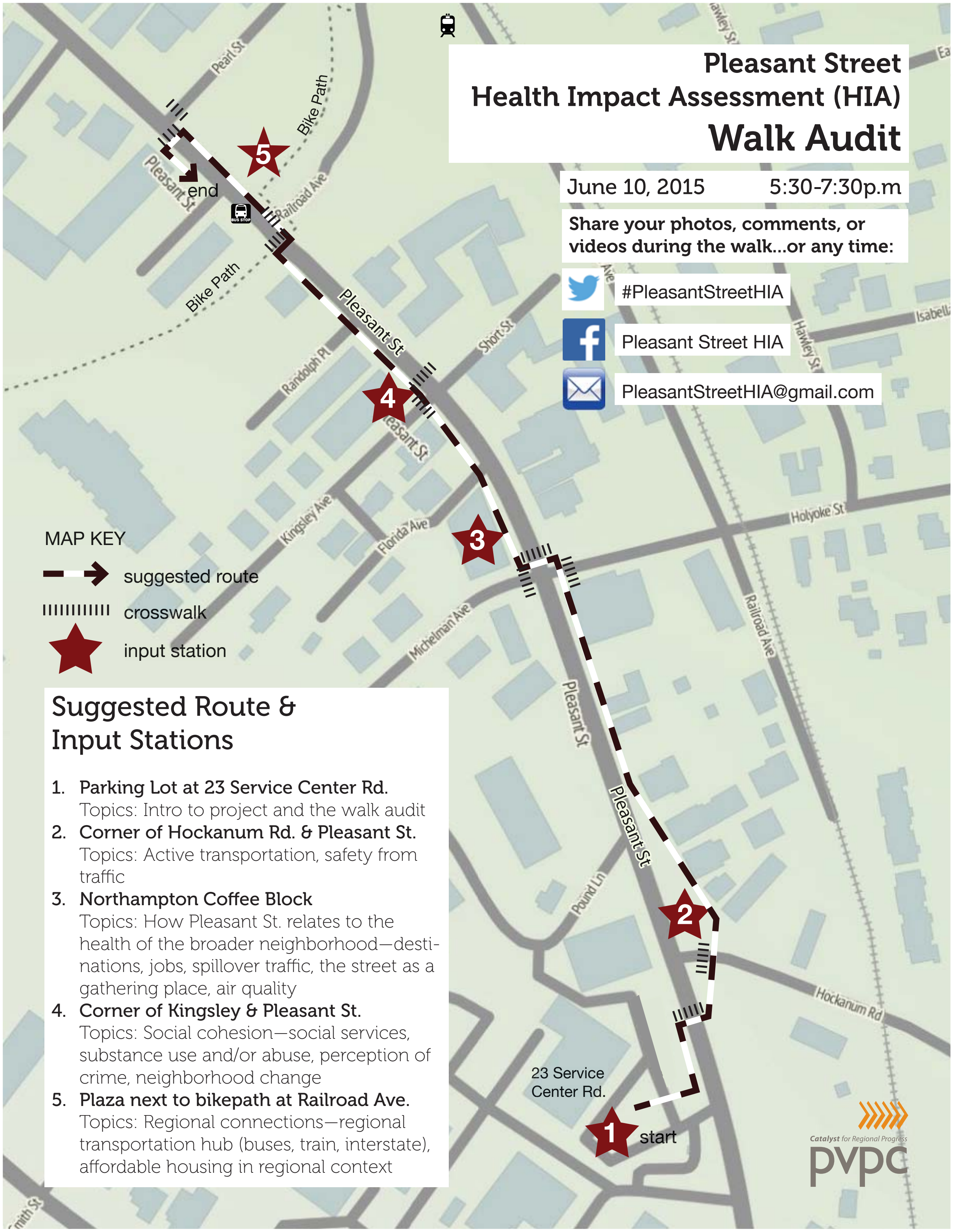
Subject	ZCTA5 01060			
	Estimate	Margin of Error	Percent	Percent Margin of Error
Nonfamily households	4,039	+/-252	4,039	(X)
Median nonfamily income (dollars)	37,051	+/-4,126	(X)	(X)
Mean nonfamily income (dollars)	53,856	+/-5,886	(X)	(X)
Median earnings for workers (dollars)	26,295	+/-2,581	(X)	(X)
Median earnings for male full-time, year-round workers (dollars)	50,047	+/-8,286	(X)	(X)
Median earnings for female full-time, year-round workers (dollars)	53,795	+/-8,631	(X)	(X)
HEALTH INSURANCE COVERAGE				
Civilian noninstitutionalized population	14,741	+/-518	14,741	(X)
With health insurance coverage	14,142	+/-512	95.9%	+/-1.3
With private health insurance	11,359	+/-516	77.1%	+/-2.8
With public coverage	4,260	+/-472	28.9%	+/-2.9
No health insurance coverage	599	+/-193	4.1%	+/-1.3
Civilian noninstitutionalized population under 18 years	2,097	+/-324	2,097	(X)
No health insurance coverage	32	+/-51	1.5%	+/-2.4
Civilian noninstitutionalized population 18 to 64 years	10,906	+/-412	10,906	(X)
In labor force:	8,752	+/-443	8,752	(X)
Employed:	8,127	+/-455	8,127	(X)
With health insurance coverage	7,759	+/-426	95.5%	+/-1.7
With private health insurance	7,018	+/-424	86.4%	+/-2.6
With public coverage	973	+/-202	12.0%	+/-2.4
No health insurance coverage	368	+/-142	4.5%	+/-1.7
Unemployed:	625	+/-160	625	(X)
With health insurance coverage	589	+/-161	94.2%	+/-4.6
With private health insurance	292	+/-103	46.7%	+/-13.3
With public coverage	312	+/-130	49.9%	+/-14.4
No health insurance coverage	36	+/-27	5.8%	+/-4.6
Not in labor force:	2,154	+/-247	2,154	(X)
With health insurance coverage	2,006	+/-247	93.1%	+/-4.8
With private health insurance	1,600	+/-230	74.3%	+/-6.6
With public coverage	544	+/-146	25.3%	+/-6.3
No health insurance coverage	148	+/-106	6.9%	+/-4.8

Subject	ZCTA5 01060 Estimate	Margin of Error	Percent	Percent Margin of Error
PERCENTAGE OF FAMILIES AND PEOPLE WHOSE INCOME IN THE PAST 12 MONTHS IS BELOW THE POVERTY LEVEL				
All families	(X)	(X)	8.8%	+/-4.2
With related children under 18 years	(X)	(X)	16.6%	+/-8.1
With related children under 5 years only	(X)	(X)	6.8%	+/-10.6
Married couple families	(X)	(X)	6.2%	+/-4.6
With related children under 18 years	(X)	(X)	12.5%	+/-10.8
With related children under 5 years only	(X)	(X)	0.0%	+/-17.4
Families with female householder, no husband present	(X)	(X)	18.5%	+/-10.2
With related children under 18 years	(X)	(X)	26.8%	+/-13.7
With related children under 5 years only	(X)	(X)	48.4%	+/-43.3
All people	(X)	(X)	17.4%	+/-3.7
Under 18 years	(X)	(X)	27.4%	+/-12.3
Related children under 18 years	(X)	(X)	27.4%	+/-12.4
Related children under 5 years	(X)	(X)	24.1%	+/-17.2
Related children 5 to 17 years	(X)	(X)	28.3%	+/-12.8
18 years and over	(X)	(X)	15.5%	+/-2.7
18 to 64 years	(X)	(X)	17.0%	+/-3.2
65 years and over	(X)	(X)	7.4%	+/-4.5
People in families	(X)	(X)	12.9%	+/-5.8
Unrelated individuals 15 years and over	(X)	(X)	22.8%	+/-3.9

Subject

Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey

Walk Audit Map and Survey



Walk Audit Questionnaire

Name (optional):
Address (optional):
Email (optional): ☐ Check if you would like email updates about the HIA

How do you currently interact with Pleasant Street and how does that affect your health?

What are you hoping will change about Pleasant Street and how will that change affect your health?

What are you afraid will change about Pleasant Street and how will that change affect your health?

What is the most important question for the Health Impact Assessment to answer?

Is there anything else you would like the people conducting the HIA to know?

Recommendations for installing marked crosswalks and other needed pedestrian improvements at uncontrolled locations.*(Zegeer et al. 2005)

Roadway Type (Number of Travel Lanes and Median Type)	Vehicle ADT ≤ 9,000			Vehicle ADT >9,000 to 12,000			Vehicle ADT >12,000-15,000			Vehicle ADT > 15,000		
	Speed Limit**											
	≤ 48.3 km/h (30 mi/h)	56.4 km/h (35 mi/h)	64.4 km/h (40 mi/h)	≤ 48.3 km/h (30 mi/h)	56.4 km/h (35 mi/h)	64.4 km/h (40 mi/h)	≤ 48.3 km/h (30 mi/h)	56.4 km/h (35 mi/h)	64.4 km/h (40 mi/h)	≤ 48.3 km/h (30 mi/h)	56.4 km/h (35 mi/h)	64.4 km/h (40 mi/h)
Two lanes	C	C	P	C	C	P	C	C	N	C	P	N
Three lanes	C	C	P	C	P	P	P	P	N	P	N	N
Multilane (four or more lanes) with raised median***	C	C	P	C	P	N	P	P	N	N	N	N
Multilane (four or more lanes) without raised median	C	P	N	P	P	N	N	N	N	N	N	N

* These guidelines include intersection and midblock locations with no traffic signals or stop signs on the approach to the crossing. They do not apply to school crossings. A two-way center turn lane is not considered a median. Crosswalks should not be installed at locations that could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex or confusing designs, a substantial volume of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices. Adding crosswalks alone will not make crossings safer, nor will they necessarily result in more vehicles stopping for pedestrians. Whether or not marked crosswalks are installed, it is important to consider other pedestrian facility enhancements (e.g., raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic-calming measures, curb extensions), as needed, to improve the safety of the crossing. These are general recommendations; good engineering judgment should be used in individual cases for deciding where to install crosswalks.

** Where the speed limit exceeds 64.4 km/h (40 mi/h), marked crosswalks alone should not be used at unsignalized locations.

*** The raised median or crossing island must be at least 1.2 m (4 ft) wide and 1.8 m (6 ft) long to serve adequately as a refuge area for pedestrians, in accordance with MUTCD and American Association of State Highway and Transportation Officials (AASHTO) guidelines.

C = Candidate sites for marked crosswalks . Marked crosswalks must be installed carefully and selectively. Before installing new marked crosswalks, an engineering study is needed to determine whether the location is suitable for a marked crosswalk. For an engineering study, a site review may be sufficient at some locations, while a more indepth study of pedestrian volume, vehicle speed, sight distance, vehicle mix, and other factors may be needed at other sites. It is recommended that a minimum utilization of 20 pedestrian crossings per peak hour (or 15 or more elderly and/or child pedestrians) be confirmed at a location before placing a high priority on the installation of a marked crosswalk alone.

P = Possible increase in pedestrian crash risk may occur if crosswalks are added without other pedestrian facility enhancements. These locations should be closely monitored and enhanced with other pedestrian crossing improvements, if necessary, before adding a marked crosswalk.

N = Marked crosswalks alone are insufficient, since pedestrian crash risk may be increased by providing marked crosswalks alone. Consider using other treatments, such as traffic-calming treatments, traffic signals with pedestrian signals where warranted, or other substantial crossing improvement to improve crossing safety for pedestrians.

In some situations (e.g., low-speed, two-lane streets in downtown areas), installing a marked crosswalk may help consolidate multiple crossing points. Engineering judgment should be used to install crosswalks at preferred crossing locations (e.g., at a crossing location at a streetlight as opposed to an unlit crossing point nearby). While overuse of marked crossings at uncontrolled locations should be avoided, higher priority should be placed on providing crosswalk markings where pedestrian volume exceeds about 20 per peak hour (or 15 or more elderly pedestrians and/or children per peak hour).

Marked crosswalks and other pedestrian facilities (or lack of facilities) should be routinely monitored to determine what improvements are needed.

References

Ainsworth, BE, WL Haskell, SD Herrmann, N Meckes, DR Basset JR, C Tudor-Locke, JL Greer, J Vezina, MC Whitt-Glover, and AS Leon. 2015. "The Compendium of Physical Activities Tracking Guide." *Compendium of Physical Activities*. Accessed August 26. https://sites.google.com/site/compendiumofphysicalactivities/home.

Andersen L, Schnohr P, Schroll M, and Hein H. 2000. "ALl-Cause Mortality Associated with Physical Activity during Leisure Time, Work, Sports, and Cycling to Work." *Archives of Internal Medicine* 160 (11): 1621–28. doi:10.1001/archinte.160.11.1621.

Antonelli. 2014. "LIHTC Market Study on 155 Pleasant Street and 256 Pleasant Street, Northampton MA 01060."

Arcaya, Mariana, Timothy Reardon, Joshua Vogel, Bonnie K. Andrews, Li Wenjun, and Thomas Land. 2014. "Tailoring Community-Based Wellness Initiatives with Latent Class Analysis -- Massachusetts Community Transformation Grant Projects." *Prev Chronic Dis* 11 (130215).

Barnes, Gary, and Kevin Krizek. 2005. "Estimating Bicycling Demand." *Transportation Research Record: Journal of the Transportation Research Board* 1939 (January): 45–51. doi:10.3141/1939-06.

Berkman, L. F., and I. Kawachi. 2000. *Social Epidemiology*. Oxford University Press, USA.

Besser, Lilah M., and Andrew L. Dannenberg. 2005. "Walking to Public Transit: Steps to Help Meet Physical Activity Recommendations." *American Journal of Preventive Medicine* 29 (4): 273–80. doi:10.1016/j.amepre.2005.06.010.

Bhatia, Rajiv, and Megan Wier. 2011. "'Safety in Numbers' Re-Examined: Can We Make Valid or Practical Inferences from Available Evidence?" *Accident Analysis & Prevention* 43 (1): 235–40. doi:10.1016/j.aap.2010.08.015.

Cain, Chad. 2015. "Northampton Planning Board, Architecture Panel OK Valley CDC $20 Million Housing Project | GazetteNet.com." Newspaper. *Gazettenet.com*. January 8. http://www.gazettenet.com/news/15146311-95/northampton-planning-board-architecture-panel-ok-valley-cdcs-20m-housing-project-for-pleasant-street.

Cavill, Nick, Sonja Kahlmeier, Harry Rutter, Francesca Racioppi, and Pekka Oja. 2008. "Economic Analyses of Transport Infrastructure and Policies Including Health Effects Related to Cycling and Walking: A Systematic Review." *Transport Policy* 15 (5): 291–304. doi:10.1016/j.tranpol.2008.11.001.

CDC. 2014. "CDC - Injury - WISQARS Cost of Injury Reports." September 18. https://wisqars.cdc.gov:8443/costT/.

Chaix, Basile, Chantal Simon, Hélène Charreire, Frédérique Thomas, Yan Kestens, Noëlla Karusisi, Julie Vallée, Jean-Michel Oppert, Christiane Weber, and Bruno Pannier. 2014. "The Environmental Correlates of Overall and Neighborhood Based Recreational Walking (a Cross-Sectional Analysis of the RECORD Study)." *The International Journal of Behavioral Nutrition and Physical Activity* 11 (1): 20. doi:10.1186/1479-5868-11-20.

Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz. 2015. "The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment." Working Paper 21156. National Bureau of Economic Research. http://www.nber.org/papers/w21156.

"Community Profiles | PVPC." 2015. Accessed August 25. http://www.pvpc.org/community-profiles.

Contrada, Fred. 2015. "Northampton Lodging, next to Homeless Shelters the Only Refuge of the Poor | Masslive.com." *Masslive*. February 12. http://www.masslive.com/news/index.ssf/2015/02/northampton_lodging_next_to_ho.html.

"Cycling Mode Share for 700 Cities." 2014. August 8. http://www.cityclock.org/urban-cycling-mode-share/#.Vdi0GzBVhBc.

Dill, Jennifer. 2009. "Bicycling for Transportation and Health: The Role of Infrastructure." *Journal of Public Health Policy* 30 (March): S95–110. doi:10.1057/jphp.2008.56.

Douglas, Thomas, and Dillon Sussman. 2015. Thomas Douglas, personal communicationPhone.

Dulaski, Daniel M. 2006. "An Evaluation of Traffic Calming Measures and Their Impact on Vehicular Speeds on an Urban Principal Arterial Roadway on the Periphery of an Activity Center." In . http://trid.trb.org/view/2006/C/793652.

Dumbaugh, Eric. 2006. "Design of Safe Urban Roadsides: An Empirical Analysis." *Transportation Research Record: Journal of the Transportation Research Board* 1961 (January): 74–82. doi:10.3141/1961-09.

Dumbaugh, Eric, and Wenhao Li. 2010. "Designing for the Safety of Pedestrians, Cyclists, and Motorists in Urban Environments." *Journal of the American Planning Association* 77 (1): 69–88. doi:10.1080/01944363.2011.536101.

Elvik, Rune. 2009. "The Non-Linearity of Risk and the Promotion of Environmentally Sustainable Transport." *Accident; Analysis and Prevention* 41 (4): 849–55. doi:10.1016/j.aap.2009.04.009.

Ewing, Reid, and Robert Cervero. 2010. "Travel and the Built Environment." *Journal of the American Planning Association* 76 (3): 265–94. doi:10.1080/01944361003766766.

Fazel, Seena, Vivek Khosla, Helen Doll, and John Geddes. 2008. "The Prevalence of Mental Disorders among the Homeless in Western Countries: Systematic Review and Meta-Regression Analysis." *PLoS Med* 5 (12): e225. doi:10.1371/journal.pmed.0050225.

Feiden, Wayne, and Dillon Sussman. 2015. Wayne Feiden, personal communication.

FHWA. 2015. "Lesson 10 - Federal Highway Administration University Course on Bicycle and Pedestrian Transportation, July 2006 - FHWA-HRT-05-103." Accessed September 3. http://www.fhwa.dot.gov/publications/research/safety/pedbike/05085/chapt10.cfm.

Fischer, P. J., and W. R. Breakey. 1991. "The Epidemiology of Alcohol, Drug, and Mental Disorders among Homeless Persons." *The American Psychologist* 46 (11): 1115–28.

"Four Types of Transportation Cyclists | Bicycle Counts | The City of Portland, Oregon." 2015. Accessed September 3. http://www.portlandoregon.gov/transportation/article/158497.

Frank, Lawrence D., Suzanne E. Kershaw, James E. Chapman, Monica Campbell, and Helena M. Swinkels. 2015. "The Unmet Demand for Walkability: Disparities between Preferences and Actual Choices for Residential Environments in Toronto and Vancouver." *Canadian Journal of Public Health = Revue Canadienne De Santé Publique* 106 (1 Suppl 1): eS12–21.

Frank, Lawrence Douglas, Brian E. Saelens, Ken E. Powell, and James E. Chapman. 2007. "Stepping towards Causation: Do Built Environments or Neighborhood and Travel Preferences Explain Physical Activity, Driving, and Obesity?" *Social Science & Medicine*, Placing Health in Context, 65 (9): 1898–1914. doi:10.1016/j.socscimed.2007.05.053.

Gibbs, Robert J. 2011. *Principles of Urban Retail Planning and Development*. Wiley.

Giles-Corti, Billie, Fiona Bull, Matthew Knuiman, Gavin McCormack, Kimberly Van Niel, Anna Timperio, Hayley Christian, et al. 2013. "The Influence of Urban Design on Neighbourhood Walking Following Residential Relocation: Longitudinal Results from the RESIDE Study." *Social Science & Medicine* 77 (January): 20–30. doi:10.1016/j.socscimed.2012.10.016.

Gotschi, Thomas. 2011. "Costs and Benefits of Bicycling Investments in Portland, Oregon." *Journal of Physical Activity & Health* 8 Suppl 1 (January): S49–58.

Harris, M. Anne, Conor C. O. Reynolds, Meghan Winters, Peter A. Cripton, Hui Shen, Mary L. Chipman, Michael D. Cusimano, et al. 2013. "Comparing the Effects of Infrastructure on Bicycling Injury at Intersections and Non-Intersections Using a Case-Crossover Design." *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention* 19 (5): 303–10. doi:10.1136/injuryprev-2012-040561.

"Healthy Neighborhoods Equity Fund HIA | Metropolitan Area Planning Council." 2015. Accessed August 28. http://www.mapc.org/hnef.

Heath, Gregory W, Diana C Parra, Olga L Sarmiento, Lars Bo Andersen, Neville Owen, Shifalika Goenka, Felipe Montes, and Ross C Brownson. 2012. "Evidence-Based Intervention in Physical Activity: Lessons from around the World." *The Lancet* 380 (9838): 272–81. doi:10.1016/S0140-6736(12)60816-2.

Heinen, Eva, Bert van Wee, and Kees Maat. 2010. "Commuting by Bicycle: An Overview of the Literature." *Transport Reviews* 30 (1): 59–96. doi:10.1080/01441640903187001.

Jacobsen, P. L. 2015. "Safety in Numbers: More Walkers and Bicyclists, Safer Walking and Bicycling." *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention* 21 (4): 271–75. doi:10.1136/ip.9.3.205rep.

James F. Sallis, Chad Spoon, Nick Cavill, Klaus Gebel, Debbie Lou, Mike Parker, Christina M. Thornton, Amanda L. Wilson, Carmen L. Cutter, and Ding Ding. 2015. "Making the Case for Designing Active Cities." Active Living Research. http://activelivingresearch.org/making-case-designing-active-cities.

Jarjour, Sarah, Michael Jerrett, Dane Westerdahl, Audrey de Nazelle, Cooper Hanning, Laura Daly, Jonah Lipsitt, and John Balmes. 2013. "Cyclist Route Choice, Traffic-Related Air Pollution, and Lung Function: A Scripted Exposure Study." *Environmental Health* 12 (1): 14. doi:10.1186/1476-069X-12-14.

Kahlmeier, Sonja, paul kelly, Charlie Foster, Thomas Gotschi, Nick Cavill, Hywell Dinsdale, James Woodcock, et al. 2014. "Health Economic Assessment Tools (HEAT) for Walking and for Cycling. Methodology and User Guide. Economic Assessment of Transport Infrastructure and Policies. 2014 Update." World Health Organization Regional Office for Europe. http://www.euro.who.int/en/health-topics/environment-and-health/Transport-and-health/publications/2011/health-economic-assessment-tools-heat-for-walking-and-for-cycling.-methodology-and-user-guide.-economic-assessment-of-transport-infrastructure-and-policies.-2014-update.

Kawachi, I., and B. P. Kennedy. 1997. "Socioeconomic Determinants of Health: Health and Social Cohesion: Why Care about Income Inequality?" *Bmj* 314 (7086): 1037.

Kittelson & Associates, Inc., Sam Schwartz Engineering, DPC, Robert Schneider, and William Hunter. 2013. "Appendix A: Literature Review - Separated Bike Lane Planning and Design Guide - Publications - Bicycle & Pedestrian Program - Environment - FHWA." December. http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/page18.cfm.

Klemm, Wiebke, Bert G. Heusinkveld, Sanda Lenzholzer, Maarten H. Jacobs, and Bert Van Hove. 2015. "Psychological and Physical Impact of Urban Green Spaces on Outdoor Thermal Comfort during Summertime in The Netherlands." *Building and Environment* 83 (January): 120–28. doi:10.1016/j.buildenv.2014.05.013.

Klemm, Wiebke, SANDA Lenzholzer, B. G. Heusinkveld, and BERT van Hove. 2013. "Towards Green Design Guidelines for Thermally Comfortable Streets." In *PLEA 2013 E Conference on Passive and Low Energy architecture,[Munich, Germany, PLEA Proceedings 2013]*. http://mediatum.ub.tum.de/doc/1169391/1169391.pdf.

Koepsell, Thomas, Lon McCloskey, Marsha Wolf, Anne Vernez Moudon, David Buchner, Jess Kraus, and Matthew Patterson. 2002. "Crosswalk Markings and the Risk of Pedestrian–Motor Vehicle Collisions in Older Pedestrians." *JAMA* 288 (17): 2136–43. doi:10.1001/jama.288.17.2136.

Kondo, Michelle C., Sarah C. Low, Jason Henning, and Charles C. Branas. 2015. "The Impact of Green Stormwater Infrastructure Installation on Surrounding Health and Safety." *American Journal of Public Health* 105 (3): e114–21. doi:10.2105/AJPH.2014.302314.

Larsen, Kristian, Jason Gilliland, Paul Hess, Patricia Tucker, Jennifer Irwin, and Meizi He. 2009. "The Influence of the Physical Environment and Sociodemographic Characteristics on Children's

Mode of Travel to and From School." *American Journal of Public Health* 99 (3): 520–26. doi:10.2105/AJPH.2008.135319.
Lee, I-Min, Eric J Shiroma, Felipe Lobelo, Pekka Puska, Steven N Blair, and Peter T Katzmarzyk. 2012. "Effect of Physical Inactivity on Major Non-Communicable Diseases Worldwide: An Analysis of Burden of Disease and Life Expectancy." *The Lancet* 380 (9838): 219–29. doi:10.1016/S0140-6736(12)61031-9.
Leinberger, Christopher B., and Mariela Alfonzo. 2015. "Walk This Way:The Economic Promise of Walkable Places in Metropolitan Washington, D.C." *The Brookings Institution*. Accessed July 23. http://www.brookings.edu/research/papers/2012/05/25-walkable-places-leinberger.
Li, Wenjun, Elizabeth Procter-Gray, Lewis A. Lipsitz, Suzanne G. Leveille, Holly Hackman, Madeleine Biondolillo, and Marian T. Hannan. 2014. "Utilitarian Walking, Neighborhood Environment, and Risk of Outdoor Falls among Older Adults." *American Journal of Public Health* 104 (9): e30–37. doi:10.2105/AJPH.2014.302104.
Ludwig, Jens, Greg J. Duncan, Lisa A. Gennetian, Lawrence F. Katz, Ronald C. Kessler, Jeffrey R. Kling, and Lisa Sanbonmatsu. 2013. "Long-Term Neighborhood Effects on Low-Income Families: Evidence from Moving to Opportunity." Working Paper 18772. National Bureau of Economic Research. http://www.nber.org/papers/w18772.
Lusk, Anne C., Patrick Morency, Luis F. Miranda-Moreno, Walter C. Willett, and Jack T. Dennerlein. 2013. "Bicycle Guidelines and Crash Rates on Cycle Tracks in the United States." *American Journal of Public Health* 103 (7): 1240–48. doi:10.2105/AJPH.2012.301043.
Macdonald, Elizabeth, Rebecca Sanders, and Paul Supawanich. 2008. "The Effects of Transportation Corridors' Roadside Design Features on User Behavior and Safety, and Their Contributions to Health, Environmental Quality, and Community Economic Vitality: A Literature Review." *University of California Transportation Center*, November. http://escholarship.org/uc/item/12047015.
Macmillan, Alexandra, Jennie Connor, Karen Witten, Robin Kearns, David Rees, and Alistair Woodward. 2014. "The Societal Costs and Benefits of Commuter Bicycling: Simulating the Effects of Specific Policies Using System Dynamics Modeling." *Environmental Health Perspectives* 122 (4): 335–44. doi:10.1289/ehp.1307250.
Marshall, Wesley E., and Norman W. Garrick. 2011. "Evidence on Why Bike-Friendly Cities Are Safer for All Road Users." *Environmental Practice* 13 (01): 16–27. doi:10.1017/S1466046610000566.
Massachusetts Bicycle Coalition. 2013. "Biking In Holyoke: A Needs Assessment." Massachusetts Bicycle Coalition. http://massbike.org/wp-content/uploads/2013/09/Biking-in-Holyoke_Final_small.pdf.
"Massachusetts Population Projections." 2015. Accessed August 25. http://pep.donahue-institute.org/.
MassDOT. 2013. "2011 Top Crash Locations Report." MassDOT. https://www.massdot.state.ma.us/Portals/8/docs/traffic/CrashData/11TopCrashLocationsRpt.pdf.
McCormack, Gavin R., Christine M. Friedenreich, Billie Giles-Corti, Patricia K. Doyle-Baker, and Alan Shiell. 2013. "Do Motivation-Related Cognitions Explain the Relationship between Perceptions of Urban Form and Neighborhood Walking?" *Journal of Physical Activity & Health* 10 (7): 961–73.
McCormack, Gavin R., and Alan Shiell. 2011. "In Search of Causality: A Systematic Review of the Relationship between the Built Environment and Physical Activity among Adults." *International Journal of Behavioral Nutrition and Physical Activity* 8 (1): 125. doi:10.1186/1479-5868-8-125.
McGrane, Ann, and Meghan Mitman. 2013. "An Overview and Recommendations of High-Visibility Crosswalk Marking Styles," August. http://trid.trb.org/view.aspx?id=1345919.
McKenzie, Brian. 2014. "Modes Less Traveled—Bicycling and Walking to Work in the United States: 2008–2012 American Community Survey Reports By Brian McKenzie." U.S. Census Bureau. https://www.census.gov/prod/2014pubs/acs-25.pdf.

Miranda-Moreno, Luis F., Patrick Morency, and Ahmed M. El-Geneidy. 2011. "The Link between Built Environment, Pedestrian Activity and Pedestrian-Vehicle Collision Occurrence at Signalized Intersections." *Accident; Analysis and Prevention* 43 (5): 1624–34. doi:10.1016/j.aap.2011.02.005.
Monsere, Christopher, Jennifer Dill, and Nathan MacNeil. 2014. "Lessons from Green Lanes: Evaluating Protected Bike Lanes in the U.S." presented at the Pro Walk Pro Bike Pro Place, Pittshburgh, PA, September 9.
Mueller, Natalie, David Rojas-Rueda, Tom Cole-Hunter, Audrey de Nazelle, Evi Dons, Regine Gerike, Thomas Götschi, Luc Int Panis, Sonja Kahlmeier, and Mark Nieuwenhuijsen. 2015. "Health Impact Assessment of Active Transportation: A Systematic Review." *Preventive Medicine* 76 (July): 103–14. doi:10.1016/j.ypmed.2015.04.010.
National Highway Traffic Safety Administration. 2015a. "Traffic Safety Facts 2013 Data: Pedestrians," February. http://trid.trb.org/view.aspx?id=1345731.
———. 2015b. "Traffic Safety Facts 2013 Data: Overview," July. http://trid.trb.org/view/2015/M/1364672.
Newberry, Laura. 2015. "Northampton: Demand for Public Housing Is Rising with Cost of Rent, Data Shows | Masslive.com." March 3. http://www.masslive.com/news/index.ssf/2015/03/northampton_number_of_public_h.html.
Noland, Robert B. 1995. "Perceived Risk and Modal Choice: Risk Compensation in Transportation Systems." *Accident Analysis & Prevention* 27 (4): 503–21. doi:10.1016/0001-4575(94)00087-3.
Northampton Housing Partnership. 2011. "City of Northampton, Massachusetts Housing Needs Asssessment and Strategic Housing Plan." City of Northampton, MA. http://www.northamptonma.gov/DocumentCenter/View/2096.
Oja, P., S. Titze, A. Bauman, B. de Geus, P. Krenn, B. Reger-Nash, and T. Kohlberger. 2011. "Health Benefits of Cycling: A Systematic Review." *Scandinavian Journal of Medicine & Science in Sports* 21 (4): 496–509. doi:10.1111/j.1600-0838.2011.01299.x.
"Our Approach | County Health Rankings & Roadmaps." 2015. Accessed August 25. http://www.countyhealthrankings.org/our-approach.
Panter, Jenna, Simon Griffin, Alice M. Dalton, and David Ogilvie. 2013. "Patterns and Predictors of Changes in Active Commuting over 12 Months." *Preventive Medicine* 57 (6): 776–84. doi:10.1016/j.ypmed.2013.07.020.
Pioneer Valley Planning Commission. 2013. "State of the People Report 2013 | PVPC." Pioneer Valley Planning Commission. http://www.pvpc.org/stateofthepeople.
Pioneer Valley Planning Commission, and United Way Hampshire County. 2015. "Getting to Healthy: Improving Access to Care -- a Study for the Cooley Dickinson Health Care (CDHC) Healthy Communities Committee."
"Portland Bicycle Count Report 2012." 2013. City of Portland, Oregon. http://www.portlandoregon.gov/transportation/article/448401.
"Prevention and Wellness Trust Fund Data." 2013. unpublished: source--Ben Wood, MDPH.
Pucher, John, Ralph Buehler, and Mark Seinen. 2011. "Bicycling Renaissance in North America? An Update and Re-Appraisal of Cycling Trends and Policies." *Transportation Research Part A: Policy and Practice* 45 (6): 451–75. doi:10.1016/j.tra.2011.03.001.
Pucher, John, Jennifer Dill, and Susan Handy. 2010. "Infrastructure, Programs, and Policies to Increase Bicycling: An International Review." *Preventive Medicine* 50 Suppl 1 (January): S106–25. doi:10.1016/j.ypmed.2009.07.028.
PVPC. 2015. "2016 Regional Transportation Plan | PVPC." Accessed September 3. http://www.pvpc.org/content/2016-regional-transportation-plan.
Retting, Richard A., Susan Ferguson, and Anne McCartt. 2003. "A Review of Evidence-Based Traffic Engineering Measures Designed to Reduce Pedestrian–Motor Vehicle Crashes." *American Journal of Public Health* 93 (9): 1456–63. doi:10.2105/AJPH.93.9.1456.

Reynolds, Conor C. O., M. Anne Harris, Kay Teschke, Peter A. Cripton, and Meghan Winters. 2009. "The Impact of Transportation Infrastructure on Bicycling Injuries and Crashes: A Review of the Literature." *Environmental Health: A Global Access Science Source* 8: 47. doi:10.1186/1476-069X-8-47.

Rosén, Erik, and Ulrich Sander. 2009. "Pedestrian Fatality Risk as a Function of Car Impact Speed." *Accident; Analysis and Prevention* 41 (3): 536–42. doi:10.1016/j.aap.2009.02.002.

Rothman, Linda, Ron Buliung, Colin Macarthur, Teresa To, and Andrew Howard. 2014. "Walking and Child Pedestrian Injury: A Systematic Review of Built Environment Correlates of Safe Walking." *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention* 20 (1): 41–49. doi:10.1136/injuryprev-2012-040701.

Roy, Sudipto, Jason Byrne, and Catherine Pickering. 2012. "A Systematic Quantitative Review of Urban Tree Benefits, Costs, and Assessment Methods across Cities in Different Climatic Zones." *Urban Forestry & Urban Greening* 11 (4): 351–63. doi:10.1016/j.ufug.2012.06.006.

Sallis, James F., Brian E Saelens, Lawrence D Frank, Terry L Conway, Donald J Slymen, Kelli L Cain, James E Chapman, and Jacqueline Kerr. 2009. "Neighborhood Built Environment and Income: Examining Multiple Health Outcomes." *Social Science & Medicine (1982)* 68 (7): 1285–93. doi:10.1016/j.socscimed.2009.01.017.

Sallis, James F., Chad Spoon, Nick Cavill, Jessa K. Engelberg, Klaus Gebel, Mike Parker, Christina M. Thornton, et al. 2015. "Co-Benefits of Designing Communities for Active Living: An Exploration of Literature." *The International Journal of Behavioral Nutrition and Physical Activity* 12: 30. doi:10.1186/s12966-015-0188-2.

Schneider, Robert, and Joseph Stefanich. 2014. "Neighborhood Characteristics That Support Bicycle Commuting: Analysis of the Top 100 US Census Tracts." Transportation Research Board. http://docs.trb.org/prp/15-3320.pdf.

"Speed Limit Reduction on Local Roads | Metropolitan Area Planning Council." 2015. Accessed September 22. http://www.mapc.org/speed-limit-reduction-local-roads.

Stinson, Monique, and Chandra Bhat. 2003. "Commuter Bicyclist Route Choice: Analysis Using a Stated Preference Survey." *Transportation Research Record: Journal of the Transportation Research Board* 1828 (January): 107–15. doi:10.3141/1828-13.

"Strava Global Heatmap." 2015. *Strava Labs*. Accessed August 25. http://labs.strava.com/heatmap/.

Teschke, Kay, M. Anne Harris, Conor C. O. Reynolds, Meghan Winters, Shelina Babul, Mary Chipman, Michael D. Cusimano, et al. 2012. "Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study." *American Journal of Public Health* 102 (12): 2336–43. doi:10.2105/AJPH.2012.300762.

Teschke, Kay, Conor C. O. Reynolds, Francis J. Ries, Brian Gouge, and Meghan Winters. 2012. "Bicycling: Health Risk or Benefit?" *UBC Medical Journal* 3 (2): 6–11.

Tilahun, Nebiyou Y., David M. Levinson, and Kevin J. Krizek. 2007. "Trails, Lanes, or Traffic: Valuing Bicycle Facilities with an Adaptive Stated Preference Survey." *Transportation Research Part A: Policy and Practice* 41 (4): 287–301. doi:10.1016/j.tra.2006.09.007.

Trottenberg, Polly. 2013. "Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses." U.S. Department of Transportation. http://www.transportation.gov/sites/dot.dev/files/docs/vot_guidance_092811c.pdf.

Troy, Austin, J. Morgan Grove, and Jarlath O'Neil-Dunne. 2012. "The Relationship between Tree Canopy and Crime Rates across an Urban-Rural Gradient in the Greater Baltimore Region." *Landscape and Urban Planning* 106 (3): 262–70. doi:10.1016/j.landurbplan.2012.03.010.

U.S. Census Bureau. 2015a. "ACS 2009-2015 Table DP04 for 01060 Zip Code." Accessed August 30. http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.

———. 2015b. "DP05: ACS DEMOGRAPHIC AND HOUSING ESTIMATES, 2009-2013 American Community Survey 5-Year Estimates for 01060 Zip Code." *American FactFinder - Results*.

Accessed August 23. http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.
US Department of Transportation-Federal Highway Administration. 2015. "2009 NHTS Average Person Trip Length (miles, Travel Day) Average Person Trip (PT) Length by Mode and Purpose." Accessed August 23. http://nhts.ornl.gov/tables09/fatcat/2009/aptl_TRPTRANS_WHYTRP1S.html.
van Hengel, Drusilla. 2013. "Build It and They Will Yield: Effects of Median and Curb Extension Installations on Motorist Yield Compliance." In . http://trid.trb.org/view/2013/C/1241821.
Wegman, Fred, Fan Zhang, and Atze Dijkstra. 2012. "How to Make More Cycling Good for Road Safety?" *Accident Analysis & Prevention*, Safety and Mobility of Vulnerable Road Usears: Pedestrians, Bicyclists, and Motorcyclists, 44 (1): 19–29. doi:10.1016/j.aap.2010.11.010.
Woodcock, James, Oscar H Franco, Nicola Orsini, and Ian Roberts. 2011. "Non-Vigorous Physical Activity and All-Cause Mortality: Systematic Review and Meta-Analysis of Cohort Studies." *International Journal of Epidemiology* 40 (1): 121–38.
Zegeer, Charles V., J. Richard Stewart, Herman H. Huang, Peter A. Lagerwey, John Feaganes, and B. J. Campbell. 2005. "Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines," September. http://trid.trb.org/view/2005/M/767638.