Central Corridor Workshop:

Using Health Data as a Design Tool

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A report summarizing the proceedings from a workshop held in Saint Paul, MN on May 14, 2014

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In the spirit of using existing data sets to streamline the assessment process, all maps included in this report were originally developed for other publications. All map and data sources are acknowledged under each figure and in the references section.

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The report is available online through the Biositu, LLC website: http://biositu.com/publications2

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Executive Summary

This report summarizes the proceedings from a workshop held in Saint Paul, MN on May 14, 2014, introducing the roles that population health data and Health Impact Assessments (HIAs) can play in the real estate development process. This report walks through the six steps comprising a full-blown HIA; however, the workshop emphasized the first two steps of the HIA process (screening and scoping) and the value that health considerations bring to the design process in general. The design recommendations presented under Step 4 (p. 31) draw heavily from green building practices — many of which offer potential health benefits — to demonstrate the value of matching design strategies with the health needs of a specific location.

LOCATION

The workshop compared the demographic, socioeconomic, behavioral, and environmental health risk factors associated with three neighborhoods in Saint Paul along the new Central Corridor light rail line.[1] The light rail project, coupled with related transit oriented development upgrades, is anticipated to spark economic revitalization in these neighborhoods. Related initiatives include the Bike Walk Central Corridor Action Plan[2] and a sustainable energy and transportation pilot project called the Energy Innovation Corridor.[3] The three case studies included in this report all represent efforts to bolster economic revitalization along the corridor without leading to the involuntary relocation of lower income residents.

PURPOSE

The primary purpose of the workshop was to demonstrate to developers, design teams, and planners the value that population health data can add to the design process. Its secondary purpose was to educate public health professionals about opportunities for engagement with development and design teams at different stages of the project delivery process.

LIMITATIONS

The major limitations associated with conducting a half-day simulation workshop were twofold. The event format did not allow for the level of community input that would enrich a full-blown HIA. It also did not allow time for the group to prioritize health concerns and subsequently conduct the ultimate assessment using a mixture of quantitative and qualitative methods. Consequently, the workshop concluded at the end of the scoping phase (step 2 in the HIA process). This report parallels the workshop's emphasis on the screening and scoping steps of the HIA process, with the bulk of the document devoted to background material and the resulting input from workshop participants. Examples of design recommendations (step 4) that could have been generated through a technical assessment (step 3) have been incorporated to illustrate the diversity of outputs that could be generated by a full-blown HIA depending on the development's location and building type.

OUTCOMES

In spite of its limitations, the workshop achieved its goals of raising awareness of the intersection between health and design within two professions that do not habitually collaborate with each other: real estate development and public health.

Introduction

HEALTH AND THE BUILT ENVIRONMENT

The built environment is an influential driver of both health and disease. While it can be difficult to trace a direct line between a single design feature and a single health outcome, a growing body of evidence points to the potential for design to play a more active role in supporting healthy outcomes and reducing exposure to conditions that can lead to negative health outcomes. This is particularly true for efforts to reduce the burden of chronic disease and enhance community resilience to climate change.

Chronic Disease

Chronic disease is the leading cause of mortality in the U.S.[4] It is also responsible for more than 75% of the $2.6 trillion spent in the U.S. each year on medical care.[5] For example, chronic medical conditions associated with modifiable risk factors (e.g., smoking, nutrition, weight, and physical activity) represented six of the ten costliest medical conditions in the United States in 2008, with a combined medical care expenditure of $338 billion.[6] While the built environment can not solve this challenge on its own, it is a major contributor to both the problem and its ultimate solution. For example, in spite of the majority of health care expenditures being directed to increasing access to clinical care, designing a supportive environment can actually be twice as influential in reducing the burden of disease.[7]

Climate Change

Climate change is also a major and growing health concern, both in the U.S. and globally.[8,9] Direct health effects include illness, injury, and death after exposure to extreme weather events such as: heat waves, flooding, and hurricanes.[9] Knowlton et al. (2011) estimated that the health costs associated with just six climate change-related events over the past decade resulted in an additional $14 billion above and beyond the estimated losses in property, assets, and infrastructure that characterize typical assessments of the economic effects of natural disasters.[10] Shifting patterns of temperature and precipitation — combined with land use and social factors — are also resulting in indirect health effects, such as shifts in the temporal and geographic range of disease carrying animals (also known as vectors).[9] Similar to the case of chronic disease, modifying the built environment to prepare for the anticipated changes associated with climate change can yield economically beneficial results – along the lines of a $15 return on each dollar of investment.[11]

Contextual Health Data

While it is possible to paint a general picture of ways design can influence health, the reality is that health outcomes can change dramatically from one neighborhood to the next based on differences in land use, population characteristics, and socioeconomic conditions. Step 2: Scoping (p. 10) illustrates the significant differences that can sometimes be found when comparing even two adjacent neighborhoods with each other. Contextual health data analysis takes these variations into account to identify the priority health concerns of a specific population.

If the population expected to occupy a new development does not conform with the socioeconomic or demographic profile of the surrounding community, both populations (i.e., building occupants and the surrounding community) can be incorporated into the contextual health data analysis process.

WORKSHOP PARTICIPATION AND REPORT ORGANIZATION

The workshop reviewed all six steps in the HIA process, the pros and cons of applying the HIA methodology to a design project, and the benefits and barriers to incorporating HIAs into the design process. The majority of the conversation among workshop participants focused on opportunities to apply contextual health data to a development project (regardless of whether or not the project follows through with a full HIA) and the first two steps of the HIA process: screening and scoping.

Input from workshop participants is incorporated in this report alongside background research. It is particularly salient in Figures 2, 3, and 8, as well as the visual analyses located throughout Step 2: Scoping (p. 10). Step 3: Assessment (p. 29) and Step 4: Design Recommendations (p. 31) were developed after the workshop based on participant comments.

Using Health Impact Assessments as a Design Tool

INTRODUCTION TO HEALTH IMPACT ASSESSMENTS (HIAs)

HIAs are a public health tool used to identify the most significant health impacts associated with a policy or project. While all HIAs follow a six-step process (Figure 1), in many ways their strength is in their flexibility. Their reliance on quantitative or qualitative information can shift, depending on the needs of the policy or project to be assessed. Some HIAs can be labor-intensive, particularly if they partner with community groups and researchers to collect new data sets. But, many times, they take advantage of existing data sets to streamline the assessment process. In all cases, their goal is to develop non-biased recommendations about the likely health co-benefits and co-harms associated with a proposed policy or project.

Figure 1 lists the major activities associated with each step included in a full HIA.

Figure 1: Six Steps to Conducting a Health Impact Assessment

1. Screening	▪ Define project. ▪ Verify HIA is feasible (early enough in project schedule, adequate budget, data sources available, etc.)
2. Scoping	▪ Set HIA parameters. ▪ Identify research / data collection methodology. ▪ Establish which data will be collected.
3. Assessment	▪ Assess the project's potential co-benefits and co-harms to population health.
4. Recommendations	▪ Propose opportunities to enhance potential co-benefits and reduce potential co-harms. ▪ Accompany recommendations with an explanation of how the proposed strategy could be integrated into the stated goals for the project.
5. Reporting	▪ Develop clear and concise report to inform design decisions. ▪ If possible, incorporate into initial sustainability charrette.
6. Evaluating	▪ Use the project's stated goals to evaluate the extent to which the HIA's recommendations are incorporated into the final design. For example: Were HIA recommendations displaying strong synergies with LEED,[12] Living Building Challenge,[13] or Architecture 2030[14] objectives prioritized in the final design?

Figure 2 lists some of the pros and cons associated with applying HIAs to the design process. On the positive side, they are a recognized and respected methodology that has been used in the public health sector (particularly in Europe) for many years.[15] They are designed to build consensus by using data and evidence to produce unbiased recommendations. On the negative side, because they are not commonly used as part of the development process, the cost of conducting an HIA may not be included in the base project budget or the project schedule — which can lead to complaints that performing a health assessment might delay the overall project. Finally, data that is mapped down to the census block or census block group level may not be readily accessible. As will be demonstrated in the Scoping section of this report, data provided at larger spatial scales may not provide sufficient information to guide certain design decisions.

Figure 2: Pros and Cons of Applying the HIA Methodology to a Design Project

PROs	CONs
1. Systematic way to incorporate health metrics into the design process.	1. Usually not included in the base project budget.
2. Recognized methodology.	2. Perception that it will take too long to complete.
3. Goal is to provide unbiased recommendations.	3. Data is not always available, particularly at small spatial scales.

WHEN SHOULD AN HIA BE CONDUCTED?

While HIAs are still an emerging tool in the U.S., it is becoming more common for them to be conducted in connection with transportation projects (particularly Transit Oriented Development) and environmental policies and projects.[16]

In some cases, HIAs are conducted in conjunction with Environmental Impact Assessments (EIAs). However, they are generally not fully incorporated into EIAs; because, HIAs are generally considered more successful when they are used to build consensus around a project. EIAs, on the other hand, are regulatory in nature and may therefore result in litigation. A major benefit of conducting HIAs alongside EIAs is their emphasis on social equity and community engagement. EIAs on their own may not address all of the populations that would be affected by a proposed policy or project.[16,17]

In Minnesota, a number of HIAs have been conducted since 2006, thanks to generous support from the Association of State and Territorial Health Officials (http://astho.org/), the Centers for Disease Control and Prevention (http://www.cdc.gov/), and the Health Impact Project (http://www.healthimpactproject.org/) — a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts. These include:

- an assessment of how the Central Corridor transportation project will affect social equity;[18] and,
- an assessment of ways health and climate change considerations could be better integrated into the Minnesota Environmental Impact Assessment Worksheet.[19]

For more information about HIAs in Minnesota, visit the Minnesota Department of Health HIA website: http://www.health.state.mn.us/divs/hia/hiainmn.html

Timing is key. If the HIA is carried out too early in the development process, not enough information will be available to develop recommendations. If it is carried out too late, it will not be able to influence the building and site design. The ideal time for completing an HIA of a development project is early in the schematic design phase — after the project goals have been set but while the design itself is still in flux.

It is also important to remember that HIAs are not the only way to apply population health data to a real estate development project. For example, a contextual health data analysis of the development site and its immediate surroundings should be developed as early as possible to establish a baseline and probable future health profile of the site and neighborhood. Regardless of whether or not the project pursues a full-blown HIA later on in the design process, a contextual health analysis can help guide critical decisions such as site selection and project scope.

WHY AREN'T HIAs APPLIED MORE OFTEN AT THE DEVELOPMENT SCALE?

Figure 3 lists a number of the benefits associated with using HIAs to inform the design process, as well as several barriers that can stand in the way. If implemented with an eye to synergies, HIAs can simultaneously benefit population health, the built environment, and behavioral choices. They can also generate metrics estimating the potential cost savings associated with certain recommendations. And, they can provide the platform for moving conversations related to real estate development to a longer term and larger scope than is typical in current practice.

Figure 3: Benefits and Barriers to Incorporating HIAs into the Design Process

Benefits

1. Identify the health needs of a population.
2. Improvements in population health, such as: reduced obesity rates, reduced asthma rates, etc.
3. Improvements to the built environment, such as: reduced urban heat island effect, increased localized resilience to climate change, etc.
4. Improvements in healthy choices, such as: increased walking, purchasing healthier food, reducing the use of toxic chemicals in the home environment, etc.
5. Direct cost savings: health care, energy use, etc.
6. Shift development conversation from short-term profits to longer-term thinking.
7. Allows bottom up approach to improving health status: solve a specific problem first, then hold a larger conversation about how to transfer the economic benefits to the entity(ies) making the investment.
8. Demonstrate to potential funders and preventive health care providers that the project is meeting an unmet need.

Barriers

1. Lack of understanding among the future occupants of the ways in which the built environment can impact health.
2. Lack of meaningful interaction with future occupants, which is necessary to translate their needs for health, quality of life, and comfort into green design strategies.
3. Perception that HIAs will add cost and time to the project schedule without generating a measurable return on investment.
4. Design considerations that are not required by the building code are often not a priority for development teams. In some cases, antiquated building codes may stand in the way of implementing health-promoting design strategies.
5. Professionals with joint expertise in public health and green building are in short supply.
6. It's not just about design. Operations and maintenance also need to be included in the assessment.

Workshop participants identified a number of perceptions that pose a challenge to conducting HIAs on real estate development projects, most notably a general lack of awareness among professionals in both the building industry and the public health sector about the relationship between decisions made by design teams and population health outcomes. It naturally follows that public health data and considerations are not typically incorporated into current development and design practice. And, largely for this reason, when an HIA or contextual health analysis is proposed for a development project, it may be rejected as an added cost and delay to the project schedule. Of course, this objection fades away if the HIA is incorporated into the project budget and schedule from the beginning.

While the barriers identified above can largely be overcome by building consensus within the team regarding the value of bringing health data to bear on design and development decisions, several technical and logistical barriers can limit the HIA's effectiveness as a design tool if not addressed. From the developer's perspective, it can be difficult to monetize health co-benefits and co-harms associated with a specific development. And, current funding and building code requirements often stand in the way of adding new considerations, such as health, to already complicated compliance rubrics. While the workshop did not address these concerns in detail, several examples were raised of ways a development project could monetize health interventions. For example, one participant shared that a development was not able to secure a potential investor, because the developer was not able to produce metrics demonstrating how the new project was designed to fill gaps in existing neighborhood health care and social services. As municipalities begin to prioritize efforts to reduce the prevalence of chronic disease and increase community resilience to climate change, they may begin incentivizing evidence-based design strategies that will help the City meet its goals — particularly in underserved neighborhoods such as the three included in this report. Even the private sector has started to experiment with ways to monetize health benefits. Health impact bonds, a twist on the more widely known social impact bond, use capital raised by private investors to perform environmental health interventions (such as reducing allergens in the home) that are estimated to reduce health care claims.[20] If claims are, in fact reduced, the health insurer shares a portion of the savings with the investors.[20] A project's specific circumstances will dictate which approach it takes to recouping the investment in an HIA or contextual health analysis. However, it is clear that health metrics are becoming more relevant than ever before to the financing structure of individual developments.

On a practical level, conducting an HIA may require bringing additional consultants onto the project team. As workshop participants noted, professionals with joint expertise in public health and green building are in short supply. And, while experts in operations and maintenance are not, a cultural or institutional barrier may stand in the way of including them in the design process (Figure 3).

Applying HIAs to the Real Estate Development Process
Example: Twin Cities Central Corridor

STEP 1: SCREENING

Case Studies

The workshop used affordable housing case studies from two Saint Paul neighborhoods along the Central Corridor as a basis for comparison (Table 1). This report also includes a third case study (a single family retrofit) in an adjacent neighborhood along the corridor, which was included in a presentation delivered the day following the workshop at the USGBC Minnesota Chapter's IMPACT conference (Table 1). All three case studies are ongoing development projects located in the neighborhoods identified in Table 1. In addition to their differing locations and building types, all three developments are at different stages of the project delivery process – ranging from early visioning to construction. These differences provided the opportunity to consider contextual health data's evolving role on a project as the design moves from an abstract idea to a desired form and on into construction and occupancy.

The remainder of the report will compare the characteristics of these three case studies during each phase of the HIA process to illustrate how both the project scope and the surrounding context can influence the types of recommendations generated by a health assessment.

Table 1: Case Study Comparison

	Project Type	Location	Project Phase
Case Study #1	Mixed Income, Mixed-Use Development – with a low-income, single mother housing component	Southwestern quadrant of the Hamline-Midway neighborhood	Visioning
Case Study #2	Single Family Retrofit	Center of the Frogtown neighborhood	Construction
Case Study #3	Affordable Housing Mixed-Use Development – incorporating community development services targeted to neighborhood residents	Northeastern quadrant of the Summit-University neighborhood	Late Design Development

STEP 2: SCOPING

Community Health Profile

All of the data used in the HIA simulation were drawn from publicly available data sets. The benefits of this approach are speed and efficiency. Using existing data sets also contributed to the workshop's goal of making health data analysis accessible to the development and design fields. However, this approach also limited the HIA in certain ways. For example, neighborhood-level health data was not readily available. As a result, health data sets were confined to larger spatial scales such as the zip code, city, and county levels. A potential data source that was not included in this report is the community health needs assessment conducted by non-profit hospitals in compliance with the requirements of the Affordable Care Act.[21] Many times these assessments include neighborhood-level analyses that would provide a more detailed understanding of the population health context surrounding a site than was available for inclusion in this report.

The workshop used the leading health concerns in Ramsey County related to chronic disease and climate change as the basis for conducting the first few steps of an HIA. The top five leading causes of death in

Ramsey County[22] (Figure 4) mirror the top five leading causes of death in the U.S., although not in the same order.[23] The prevalence of two of the major risk factors for cancer, heart disease, and stroke — diabetes (Figure 6) and obesity (Figure 7) — are lower in Ramsey County than in the U.S. as a whole, although not as low as the state of Minnesota. The fourth leading cause of death — Chronic Lower Respiratory Disease — refers to a group of diseases affecting the lower respiratory tract, such as bronchitis, emphysema, and asthma.[23] The fifth leading cause of death — Unintentional Injury — refers to deaths caused by accidents, such as: motor vehicle collisions, falls, and accidental suffocation or drowning.[23]

The two health effects of climate change included in the report — extreme heat and vector-borne disease (Figure 5) — were selected to align with the Minnesota Department of Health's focus on these two health effects through their participation in the CDC's Climate Ready States and Cities Initiative.[24] Heat waves are a health concern in Minnesota because climate models predict them to occur more frequently and with more intensity in the future. Minnesotans are generally not acclimatized to experiencing long periods of hot, humid weather, a condition that is exacerbated by the fact than many homes are not air-conditioned.[25] The other priority health effect of climate change — vector-borne disease — refers to infectious diseases that are carried and transmitted by insects such as mosquitoes and ticks, sometimes in a give-and-take cycle with animal hosts such as birds.[26] Changes in temperature and precipitation, such as those induced by climate change, can influence the geographic range, seasonality, and abundance of each link in the cycle: pathogens, vectors, and animal hosts.[26] Other priority climate change-related health effects not covered by this report include extreme weather events, air pollution and allergens, water quality and quantity, and water- and food-borne diseases.[27]

Figure 4: Leading Causes of Death in Ramsey County[22]

1. Cancer
2. Heart Disease
3. Stroke
4. Chronic Lower Respiratory Disease
5. Unintentional Injury

Figure 5: Priority Health Effects of Climate Change for Minnesota[24]

1. Extreme Heat Events
2. Vector-borne Diseases

Figure 6: Type 2 Diabetes Adults[18,28]

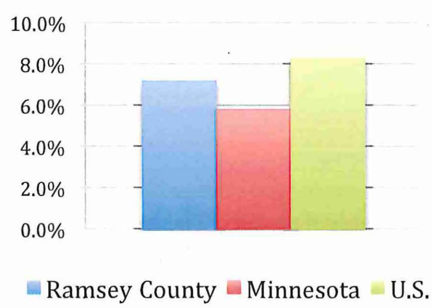


Figure 7: Overweight/Obese Adults[18,29]

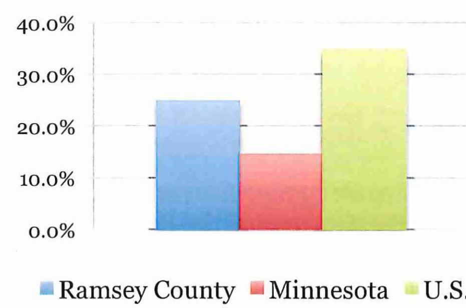


Figure 8 identifies the major demographic, socioeconomic, behavioral, and environmental risk factors associated with the six health concerns reviewed during the workshop. These risk factors were used to identify similarities and differences between the case study neighborhoods (Figures 9-25). Many of the demographic and socioeconomic risk factors also refer to the populations that are most vulnerable to the possibility of involuntary migration to less expensive neighborhoods in the metropolitan region unless development along the Central Corridor increases housing and job opportunities for them. The three case studies highlighted by this report are all examples of projects that provide opportunities for existing residents while also responding to the anticipated changes catalyzed by the light rail project.

The design strategies listed in Figure 8 are examples of strategies that may reduce the risk of negative outcomes associated with the six priority health concerns outlined above. However, these strategies should be used with caution unless the development and design team verify their potential health benefit by performing a literature review or initiating a research project to measure their relative effectiveness. For example, the obesity-reduction design strategies in the Active Design Guidelines[30] are supported by a review of the public health literature. Similar research efforts will be necessary to start identifying a set of design strategies that have the potential to benefit other health concerns, such as those included in this report.

Figure 8: Risk Factors and Potential Design Strategies by Health Concern

Demographic and Socioeconomic Risk Factors

	Cancer	Heart Disease	Stroke	CLRD	Injury	Heat Events	Vector-Borne Diseases
African Americans	O 18	O 18					
Native Americans	O 18						
Low SES*				O 31	O 32	O 33	O 34
Children				O 31	O 35	O 33	O 36
Elderly				O 37	O 35	O 33	
Elderly Living Alone						O 33	
Elderly Living in Nursing Homes						O 25	
Outdoor Workers/Recreation						O 38	O 36
Pre-existing Health Conditions			O 39	O 37			O 36
Level of Acclimatization						O 38	

Behavioral and Environmental Risk Factors

	Cancer	Heart Disease	Stroke	CLRD	Injury	Heat Events	Vector-Borne Diseases
Tobacco	O 40	O 41	O 39	O 37			
Blood Pressure		O 41					
Cholesterol		O 41					
Type 2 Diabetes		O 41					
Diet	O 40	O 41					
Physical Activity	O 40	O 41	O 39				
Overweight/Obese	O 40	O 41	O 39				
Sun Exposure	O 40						
Hormones	O 40						
Drug/Alcohol Use	O 40		O 39		O 42		
Microbes	O 40						
Ionizing Radiation (i.e., radon)	O 40						
Carcinogenic Chemicals (e.g., formaldehyde, brownfields, etc.)	O 40						
Occupational Hazard				O 37	O 42		
Indoor Air Pollutants (cleaning agents, CO, CO_2, dust, mold, pests, pesticides, VOCs)				O 37			

Outdoor Air Pollutants (CO, dust, herbicides, ozone, particulate matter, pesticides, pollen)				O 37			
Allergens				O 37			
Access to Vehicle					O 42		
Protective Equipment (seatbelt, helmet)					O 42		
Unsafe Home/Community Environments					O 42		
Unsafe Consumer Products					O 42		
Land Use Configuration							O 26
Vegetation/Impervious Surface						O 38	
Urban Heat Island Effect						O 25	
Access to Air Conditioning						O 25	
Top Floor of Building						O 25	
Power Outage						O 25	
Presence of Sitting Water							O 26
Protective Clothing							O 26
Building/Property Maintenance							O 26

Design Strategies by Health Concern

Cancer

- Designate the property as smoke-free or provide a dedicated outdoor space for smoking.
- Active Living strategies (e.g., stairs, outdoor play spaces, exercise rooms, etc.).
- Kitchen/dining space encouraging preparation of fresh foods.
- Outdoor areas with shade.
- Limit environmental chemical exposure.
- Active living and healthy food strategies listed under Heart Disease.

Heart Disease

Active Living

- Provide easy and safe access to multiple modes of alternative transportation, such as public transit.
- Provide safe and accessible pathways onto and through the property for alternative forms of transportation (e.g., pedestrians, cyclists, etc.).
- Provide bicycle storage and showers, and host a Nice Ride station (https://www.niceridemn.org/).
- Right size parking to discourage dependence on single-occupancy cars.
- Encourage community-school partnerships to promote student walking and cycling.
- Enhance the streetscape surrounding the site to encourage walking.
- Participate in neighborhood policing efforts to enhance both real and perceived safety.
- Host recreation programs that provide an opportunity for both physical activity and social cohesion.
- Improve sidewalks, lighting, and accessibility for wheelchairs, strollers, etc.
- Provide exercise amenities, such as an indoor playroom, an indoor exercise room, and an exterior tot lot or playground.

Access to Healthy Food

- Provide on-site healthy food options, such as a grocery store or a CSA pick-up site.
- Avoid locating the project in areas surrounded by unhealthy food options.

	• Host farmers markets that accept food stamps. • Construct an on-site community garden or partner with community groups to rehabilitate nearby vacant lots into community gardens.
Stroke	See design recommendations under Heart Disease.
Chronic Lower Respiratory Disease	▪ Designate the property as smoke-free or provide a dedicated outdoor space for smoking. ▪ Specify low allergen building materials that are easy to clean, such as hard floor surfaces rather than carpet. ▪ Provide increased ventilation in common areas and kitchens, coupled with filtration media that is high efficiency but not too expensive for the tenants to replace. ▪ Design the ventilation system to balance natural and mechanical ventilation. ▪ Establish green building operations protocols such as integrated pest management and green cleaning practices. Engage residents in their implementation. ▪ Perform proper maintenance to avoid haboring or exacerbating allergens and asthma triggers. ▪ Locate doors, windows, and outdoor air intakes away from pollution sources. ▪ Plant vegetation to screen the development from pollution sources, such as major roads.
Unintentional Injury	▪ Discourage jaywalking by funneling site access for pedestrians and cyclists to street intersections. ▪ Provide safe and accessible pathways onto and through the property for alternative forms of transportation (e.g., pedestrians, cyclists, etc.). ▪ Perform proper building maintenance to reduce the risk of accidents caused by unsafe conditions.
Extreme Heat Events	▪ Incorporate passive design strategies to reduce solar heat gain. ▪ Construct pocket parks within the development. ▪ Provide water fountains, misting stations, and interactive water features. ▪ Plant landscaping that shades the building and exterior hardscapes. ▪ Focus energy efficiency measures on the roof and attic to reduce solar heat gain during summer months. (Example strategies: light colored or vegetative roof, increased attic insulation, etc.) ▪ Fit out common areas with air conditioning and designate them as public cooling centers during heat events. ▪ Fit out the basement for use as an in-house cooling center during extreme heat events. ▪ Install screens on doors and windows to encourage use of natural ventilation while protecting occupants from exposure to mosquitoes. ▪ Suspend utility shutoffs and provide transportation and financial assistance to low income residents during extreme heat events.
Vector-Borne Diseases	▪ Install screens on doors and windows to encourage use of natural ventilation while protecting occupants from exposure to mosquitoes. ▪ Design site landscaping to discourage mosquitoes and other disease-carrying pests and encourage their natural predators. ▪ Repair holes, cracks, moisture penetration, and other deficiencies in the building envelope that could allow entry and/or food and harborage to pests. ▪ Target elimination of standing water in the development's maintenance plan.

*Low SES stands for "low socioeconomic status": populations with limited access to the resources (financial, human, and social) needed to succeed in their societal context.[43]

Demographic and Socioeconomic Risk Factors

This section explores in more detail the links between health outcomes and four demographic / socioeconomic risk factors: poverty, race/ethnicity, education, and age. All four of these risk factors also contribute to the existing populations' vulnerability to being priced out of the neighborhood if its economic base changes too rapidly. It is therefore important to consider the potential economic impact of design recommendations on neighborhood residents in addition to the potential health and environmental impacts of the development. For several risk factors, small scale spatial data (in some cases down to the Census block) was available, showing marked variations both from neighborhood to neighborhood and within each neighborhood.

POVERTY

Poverty has been associated with health outcomes such as:

- *Reduced Life Expectancy:* Life expectancy for children born into Twin City neighborhoods with the lowest average household income is 76 years, compared with 84 years for children born into more affluent neighborhoods.[44]
- *Unintentional Injury:* If sidewalks and intersections are not safe, lack of access to a car can lead to car/pedestrian collisions.[18] Poverty has also been associated with unintentional injuries occurring in homes that are poorly constructed and/or maintained.[45]
- *Risk of Exposure to Heat Events:* Economically constrained populations are at higher risk of exposure to heat events, because they may not have access to reliable air conditioning. And, their homes and workplaces may not be adequately insulated.[25]
- *Risk of Exposure to Disease-Carrying Vectors:* Poorly maintained properties may provide pests with readily available food, water, and harborage.[26]

In 2009, the Federal Poverty Level, which is used to determine eligibility for federally funded services such as the Low-Income Home Energy Assistance Program,[46] was defined as $18,310 for a family of three.[47] The lowest category in Figure 10 (less than $35,000) approximates the relative poverty level for the Twin Cities that year: 185% of the Federal Poverty Level,[48] or $33,874.

Visual Analysis: Case Study Neighborhoods (Figures 9 & 10)

Hamline-Midway: SW Quadrant	*Frogtown: Center*	*Summit-University: NE Quadrant*
15-30% of the population lives in poverty. Poverty is not as prevalent in this neighborhood in general as the City of Saint Paul or the other two case study neighborhoods.	Close to 60% of Frogtown residents live in poverty, with the largest cluster in the center of the neighborhood. Frogtown as a whole has the highest concentration of poverty among the three case study neighborhoods.	Close to 45% of Summit-University residents live in poverty, significantly more than the City of Saint Paul. The NE quadrant, particularly north of the freeway, is home to the highest concentration of poverty in the neighborhood.

Figure 9: Population in Poverty by Census Block

Map Credit: Metro Transit. Central Corridor Transit Service Study Existing Conditions Report.[49]
Data Source: 2009 American Community Survey

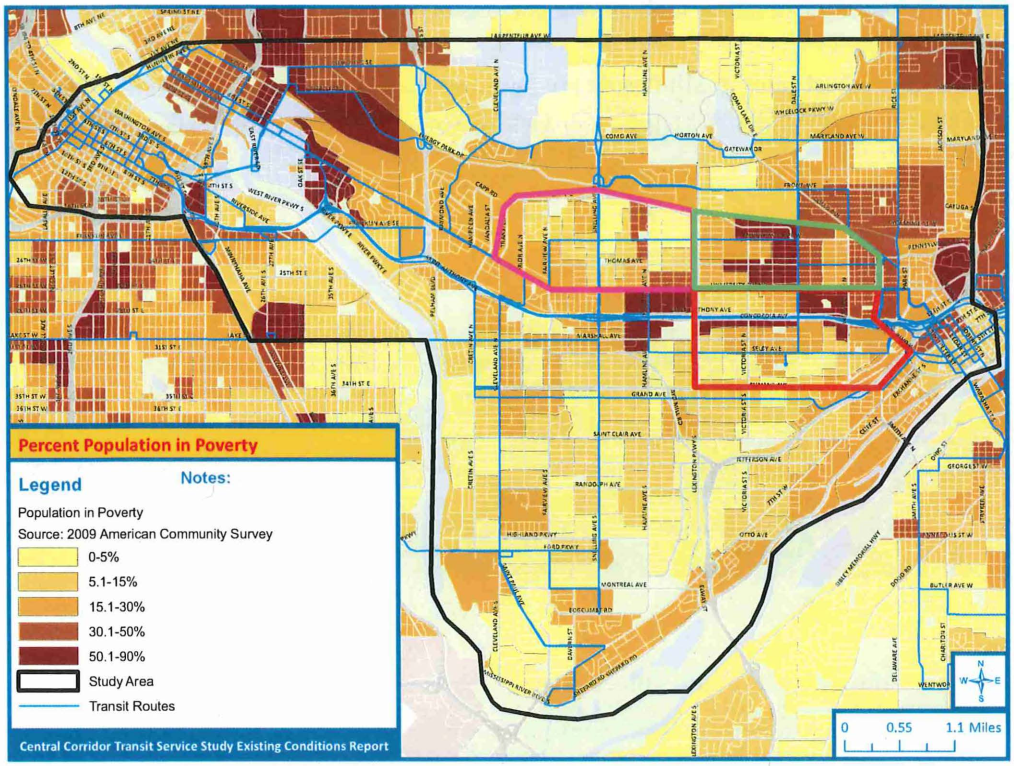
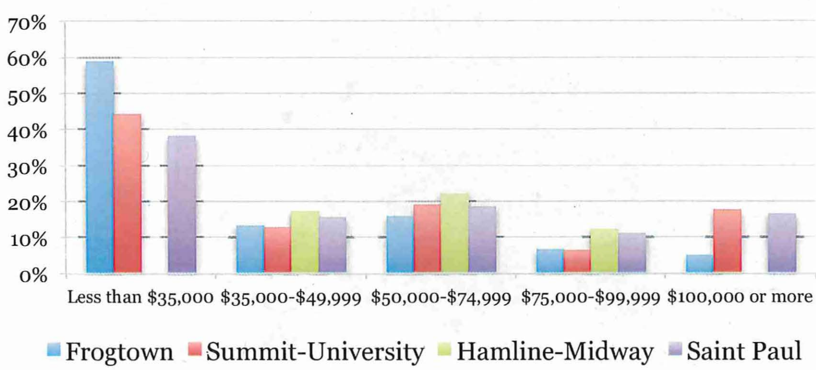


Figure 10: Percent Population by Income Level (2009)

Data Source: Minnesota Compass. Saint Paul Neighborhood Profile: Planning Districts 7, 8, & 11.[50-52]



RACE & ETHNICITY

Disparities in health outcomes have been observed among a number of minority populations, for example:

- *Cancer:* Rates are disproportionately high among persons of color and American Indian populations in Minnesota.[22]
- *Heart Disease:* The highest rates in Minnesota are found among American Indian populations.[22]
- *Stroke:* Rates are disproportionately high among African American women and Asian men in Minnesota.[22]

Visual Analysis: Case Study Neighborhoods (Figures 11 & 12)

Hamline-Midway: SW Quadrant	*Frogtown: Center*	*Summit-University: NE Quadrant*
Hamline-Midway has a much higher percentage of Whites (69%) in comparison with both the other case study neighborhoods and the City of Saint Paul (56%). However, data is not shown in Figure 11 for portions of the SW quadrant.	Frogtown has by far the lowest percentage of White residents among the three corridor neighborhoods (21%), less than half of the percentage in the City of Saint Paul (56%). The majority of the population (over 60%) is divided roughly equally between African Americans and Asian/Pacific Islanders.	35% of the residents in Summit-University are African Americans, largely clustered north of the freeway.

Figure 11: Racial & Ethnic Majorities by Census Block (2010)
Map Source: Saint Paul Department of Planning and Economic Development.
Data Source: U.S. Census 2010. All race groups shown (except Hispanic) are non-Hispanic.

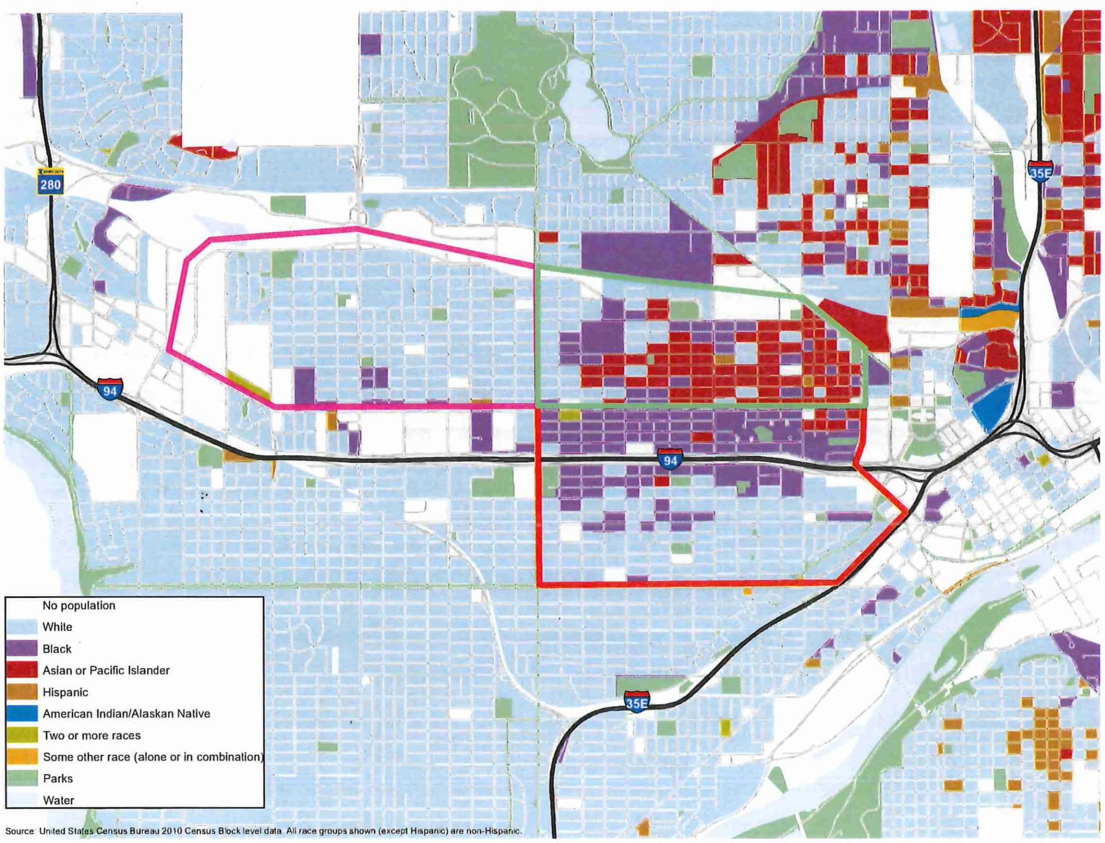
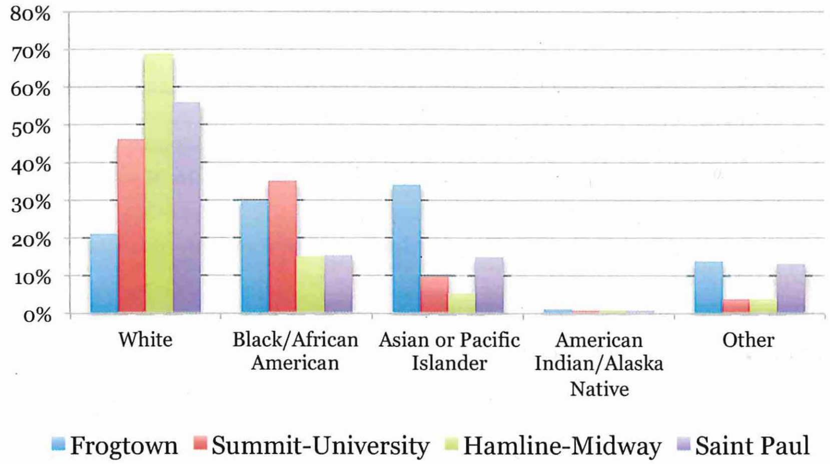


Figure 12: Percentage Population by Race (2009)
Data Source: Minnesota Compass. Saint Paul Neighborhood Profile: Planning Districts 7, 8, & 11.[50-52]



EDUCATIONAL ATTAINMENT

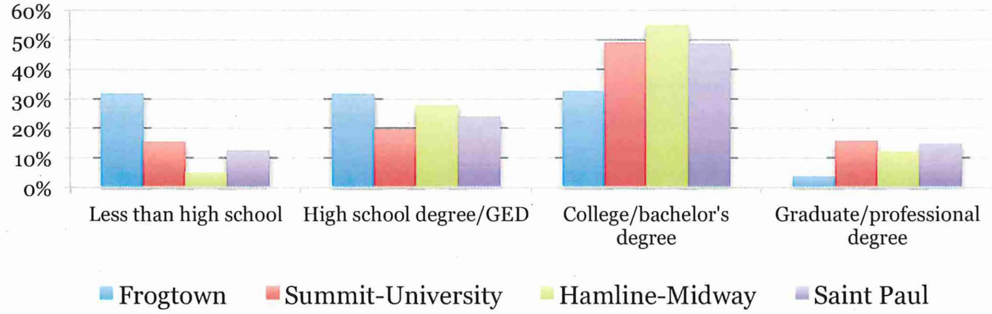
Similar to poverty rates, educational attainment can influence general health status. For example, research funded by the Blue Cross Blue Shield Foundation of Minnesota found that life expectancy for children born into Twin City neighborhoods with the lowest percentage of adult educational attainment was 77 years, compared with 83 years for children born into the most educated neighborhoods.[44]

No map was available at the census block group or census block levels. So, it was not possible to determine whether differing levels of educational attainment are clustered in certain areas of the case study neighborhoods or spread uniformly throughout them.

Visual Analysis: Case Study Neighborhoods (Figure 13)

Hamline-Midway: SW Quadrant	*Frogtown: Center*	*Summit-University: NE Quadrant*
Residents in Hamline-Midway are more highly educated than both the other case study neighborhoods and the City of Saint Paul as a whole, with 67% having attained a college degree or higher. This circumstance is likely due to the high concentration of university-age students living in the area.	Frogtown represents by far the lowest educational achievement of the three case study neighborhoods, with less than 40% of adults attaining a college degree or higher.	35% of Summit-University residents have attained a high school degree or less. The percentage of college and graduate degrees are similar to the City of Saint Paul as a whole.

Figure 13: Percentage Population by Educational Attainment (2009)
Data Source: Minnesota Compass. Saint Paul Neighborhood Profile: Planning Districts 7, 8, & 11.[50-52]



VULNERABLE AGE GROUPS

Children and the elderly are vulnerable to a wide variety of health concerns, including:

- *Chronic Lower Respiratory Disease:* Preventable respiratory diseases like asthma are increasing among children and the elderly worldwide.[37]
- *Unintentional Injury:* Unintentional injury is the leading cause of death for ages 1-44 and the ninth leading cause of death for ages 65 and above.[53] The leading causes of death caused by unintentional injury for children under age 5 are suffocation and drowning; from ages 5 to 24, the leading cause is motor vehicle collision. And, the leading cause of death for ages 65 and above is an unintentional fall.[35]
- *Heat Events:* Children under 5 years old and adults 65 and older are at higher risk of heat-related illness than the general population.[33]
- *Vector-borne Disease:* Children are at a higher risk of negative consequences from infectious diseases because their immune systems are under development.[36]

Visual Analysis: Case Study Neighborhoods (Figures 14-16)

Hamline-Midway: SW Quadrant	*Frogtown: Center*	*Summit-University: NE Quadrant*
A cluster of nursing homes are located immediately south of the western end of the neighborhood. A slightly lower percentage of children under 5 and elderly 65 and above live in the neighborhood in comparison with the other case study neighborhoods and the City of Saint Paul as a whole. But, the neighborhood hosts a much higher percentage of college age residents (almost 20%).	35% of Frogtown residents are aged 17 and below, a significantly higher percentage than the other two case study neighborhoods or the City of Saint Paul as a whole. On the other hand, the percentage of adults 65 and above is lower than the City of Saint Paul (7% versus 9% in Saint Paul). And, no nursing homes are located in the neighborhood.	The neighborhood hosts a cluster of nursing homes on its eastern end. Overall, a slightly lower percentage of children and elderly live in the neighborhood in comparison with the City of Saint Paul (7% children versus 8% in Saint Paul; 8% elderly versus 9% in Saint Paul).

Figure 14: Population 65 and Older and Nursing Homes by Census Block Group

Map Source: Metro Transit. Central Corridor Transit Service Study Existing Conditions Report.[49]

Data Sources: Metropolitan Council 2010 Generalized Land Use Inventory. U.S. Census 2010. Minnesota Department of Health, Health Care Facility and Providers Database (2011).

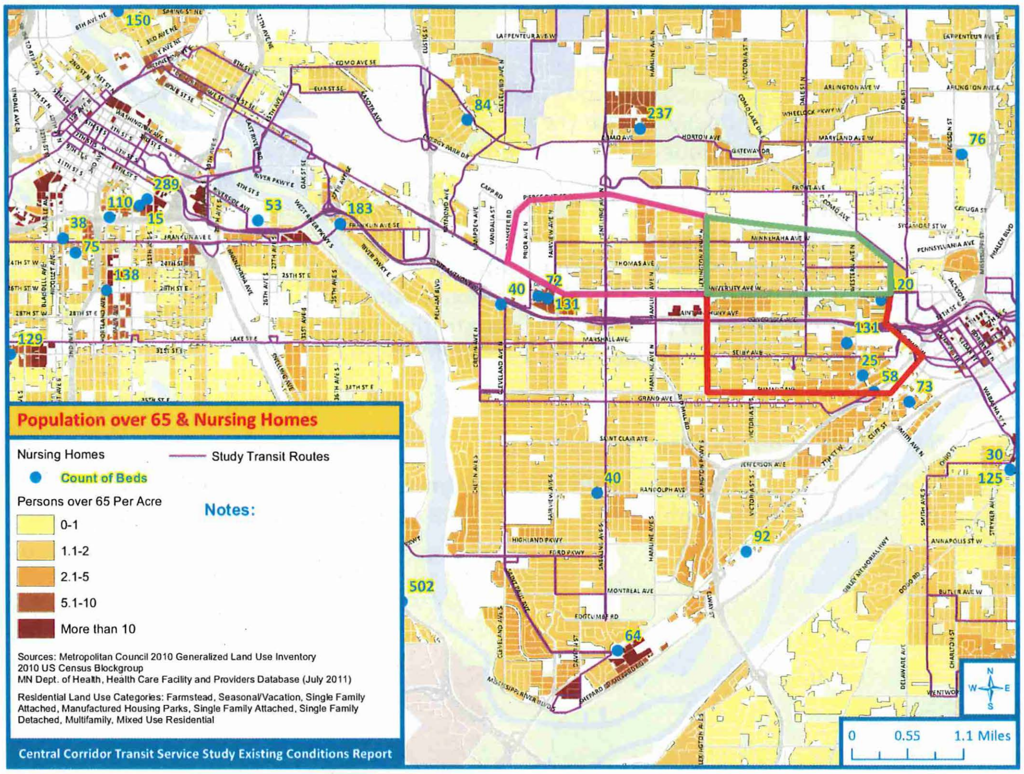


Figure 15: Percent Population by Age (2009)

Data Source: Minnesota Compass. Saint Paul Neighborhood Profile: Planning Districts 7, 8, & 11.[50–52]

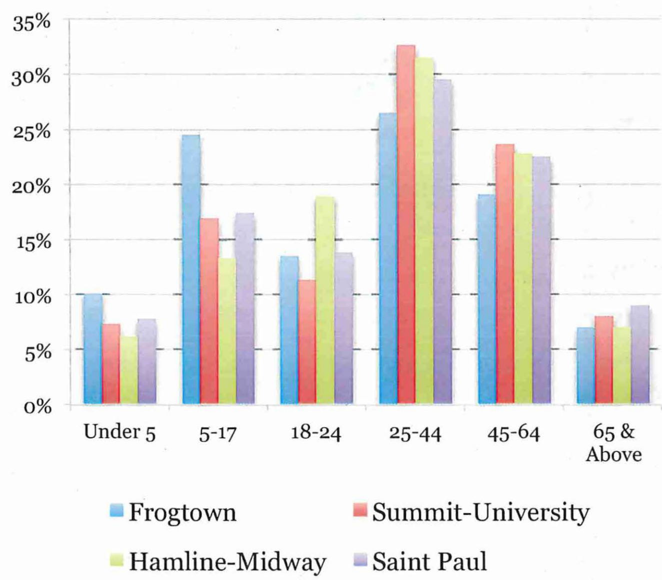
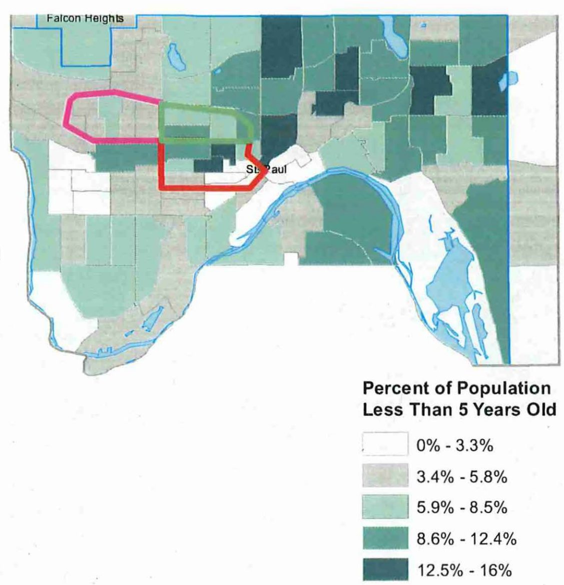


Figure 16: Percent Population < 5 Years Old

Map Source: Minnesota Department of Health[54]

Data Source: 2010 American Community Survey 5-Year Estimates, Census Tracts



Behavioral and Environmental Risk Factors

This section explores in more detail the links between health outcomes and behavioral and environmental risk factors related to chronic disease and extreme heat events. Where available, maps illustrate changing conditions both between the case study neighborhoods and within each neighborhood.

ASTHMA

Asthma is one of a number of respiratory diseases identified under the umbrella term Chronic Lower Respiratory Disease.[23] The Central Corridor neighborhoods in Saint Paul have higher asthma rates than in the rest of the Twin Cities or the state of Minnesota, with the highest rates near downtown and the Capitol.[18] Asthma can be triggered by both indoor and outdoor environmental allergens and irritants.[37] Indoor triggers include: pests, mold, environmental tobacco smoke, fumes from (for example) pesticides and cleaning chemicals, and emissions from products of combustion such as boilers.[37] Exposure to airborne chemicals in outdoor air is also a risk factor for chronic lower respiratory disease.[37] The major source of outdoor air pollution in the Twin Cities is vehicular traffic, particularly along highways and busy arterial roads.[18] It is estimated that the Central Corridor neighborhoods south of University Avenue and on the western edge of Saint Paul are exposed to the highest concentration of outdoor air pollution in the city, due to their close proximity to two major thoroughfares: I-94 and SR-280.[18]

Visual Analysis: Case Study Neighborhoods (Figures 17 & 18)

All three case study neighborhoods are at moderately high risk of asthma. Data was not readily available at a smaller spatial scale. It is therefore not possible to identify clusters of high and low asthma prevalence in each neighborhood.

Figure 17: Age-Adjusted Asthma Hospitalizations per 10,000: All Ages, by Zip Code, 2007-2011[55]
Map Source: Minnesota Environmental Public Health Tracking Program. Data Source: Minnesota Hospital Association. Hospital Discharge Data.

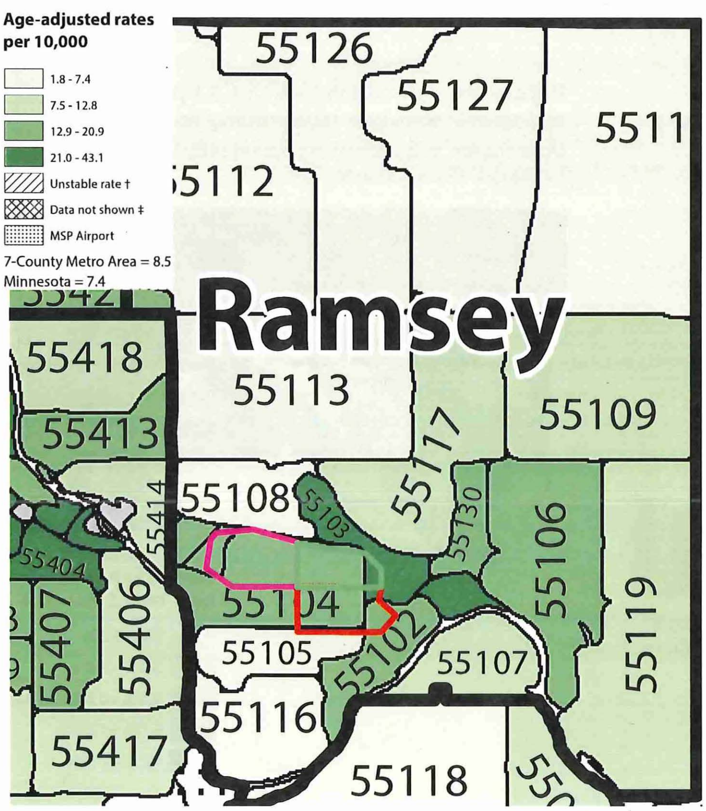
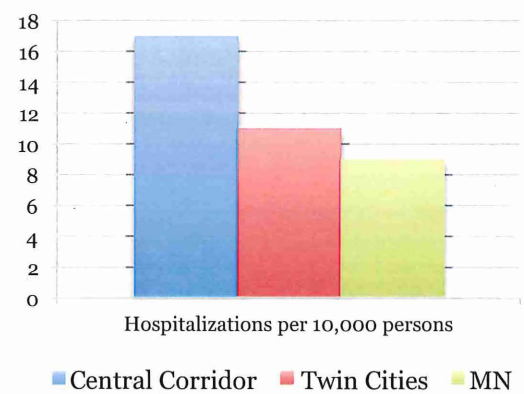


Figure 18: Asthma Hospitalizations per 10,000 (2008)[18]
Data Source: National Center for Chronic Disease Prevention. Behavioral Risk Factor Surveillance System.



CHRONIC DISEASE & INJURY

The built and natural environment can contribute to both positive and negative health outcomes for a number of chronic diseases, as well as the risk of unintentional injury. For example:

- *Access to Healthy Food:* Providing access to healthy food can assist in maintaining a healthy weight, which reduces the risk of cancer, heart disease, and stroke.[39–41] In general, the Central Corridor has a high level of access to healthy food. 64% of Central Corridor residents live within walking distance of a grocery store.[56] 84% live within walking distance of a store with prepared food.[56] Areas with lower access to healthy foods are south of I-94, west of downtown, and on the north side of the central and western portions of the corridor.[56] Additionally, according to workshop participants, the City of Saint Paul has lowered barriers to hosting farmers markets, and a number of community gardens are located in the Summit-University and Frogtown neighborhoods. Finally, the new light rail line will increase residents' access to the farmers market in downtown Saint Paul.
- *Access to Parks:* Proximity to parks assists in maintaining a healthy weight, which reduces the risk of cancer, heart disease, and stroke.[39–41] Only 7% of residents in the Metro area (excluding Hennepin County) with access to parks and other recreational amenities are not physically active on a regular basis, compared to 23% without access.[57] Nearby parks can also circumvent socioeconomic barriers associated with some forms of organized physical activity. For example, 47% of low income residents identify membership fees as a barrier to physical activity.[57] These populations are also 3 times as likely as higher income residents to cite facility hours and distance as barriers to physical activity.[57]
- *Exposure to Poor Housing Conditions:* Poor indoor air quality in blighted housing is a risk factor for chronic lower respiratory disease.[37]
- *Exposure to Environmental Chemicals:* Exposure to carcenogenic chemicals in the environment is a risk factor for cancer.[40]
- *Unintentional Injury:* Unsafe sidewalks and intersections create a barrier to active forms of transportation, such as walking. From 2003-2007, there were 48 vehicle/pedestrian crashes on University between Beacon and Cedar, compared to 35 vehicle/bicycle crashes.[18] Close to one half took place between Beacon and Hamline.[18] Given past evidence of unsafe sidewalks and intersections,[18] the projected increase in population density along the Central Corridor may lead to increased injuries and fatalities. However, the Central Corridor reconstruction project may have improved street and intersection safety for non-motorized modes of transportation.

Visual Analysis: Case Study Neighborhoods (Figures 19-20)

Hamline-Midway: SW Quadrant	*Frogtown: Center*	*Summit-University: NE Quadrant*
Food stores are not abundant in this area. One leak site and one petroleum brownfield are identified on the CEED Environmental Justice Atlas. The area includes one large park and several pocket parks. The industrial sites within and immediately west of the neighborhood might generate hazards, such as air pollution, in addition to those identified by the CEED map.	Frogtown is well provided with both grocery stores and prepared food stores. However, it suffers from a high concentration of blighted housing. One large park is located in the center of the neighborhood. One petroleum leak site is located on the railroad tracks.	Summit-University has slightly better access to food stores, community gardens, and farmers markets than Hamline-Midway. Blighted housing is clustered on the northern edge, between the freeway and University. The NE quadrant includes two large parks.

Figure 19: CEED Environmental Justice Atlas: Food Stores, Contaminated Sites, Blighted Housing, Median Household Income[58]

Data Sources: American Community Survey, 2010. City of Saint Paul, 2012. Minnesota Pollution Control Agency Site Data, 2010. Google. CEED 2013. Visit the CEED website for the most up to date version of this map: http://www.ceed.org

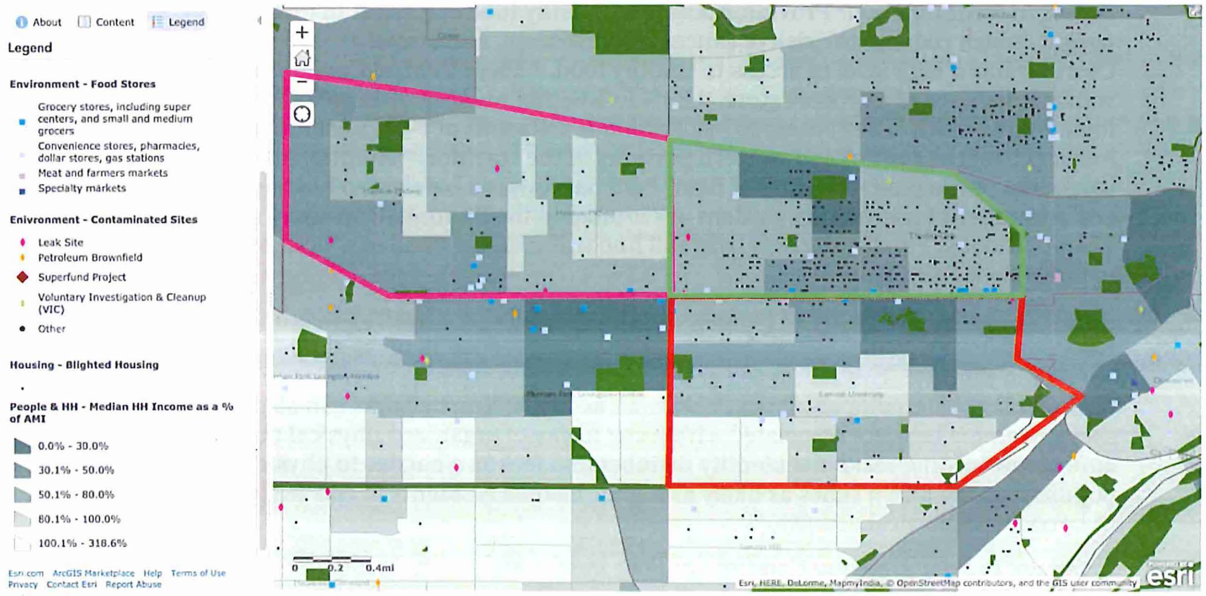
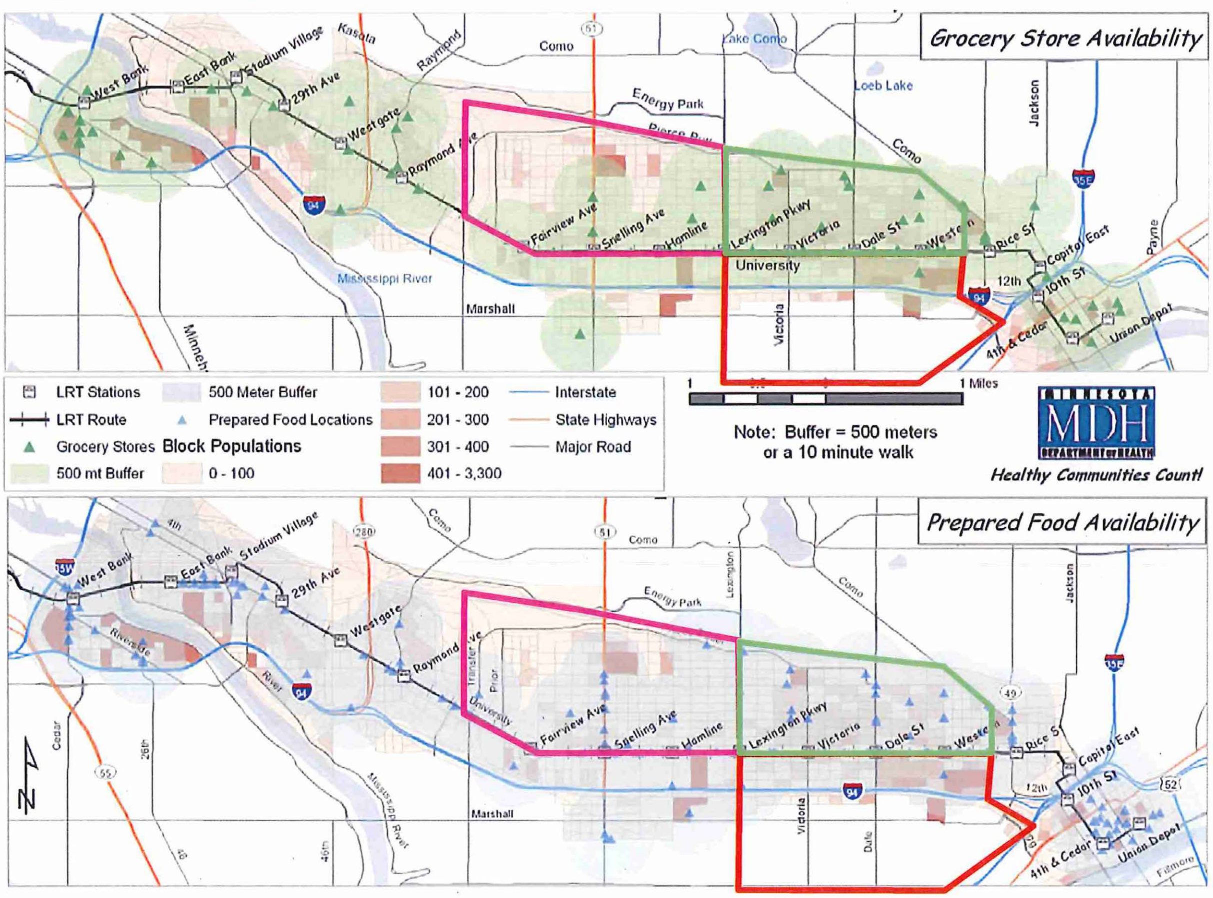


Figure 20: Central Corridor Food Availability (2010)[56]

Map Source: Minnesota Department of Health.



CLIMATE CHANGE VULNERABILITY: HEAT

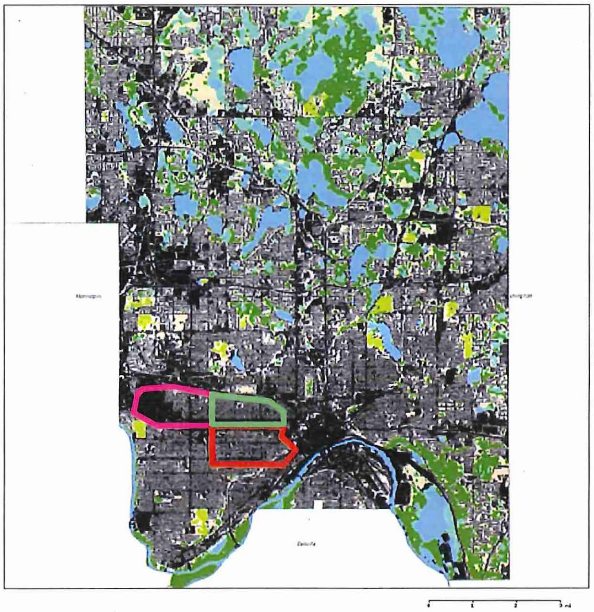
A number of environmental factors, when coupled with human factors, increase the risk of negative health outcomes during and following extreme heat events. For example:

- *Impervious Surface:* Exacerbates the urban heat island effect, which increases occupant exposure during extreme heat events.[25] This is particularly dangerous for children under five years old, one of the populations most vulnerable to heat-related illnesses.[25]
- *Access to Parks:* Increasing vegetation can reduce the urban heat island effect, thereby reducing population exposure.[25]
- *Poverty Level:* Families with limited resources may not have access to a reliable source of air conditioning – potentially increasing their exposure during extreme heat events.[25]
- *Poor Housing Conditions and Energy Poverty:* Low SES populations, particularly if they live on the upper floors of multi-family housing units, are at a higher risk of heat-related injuries and death than populations with ready access to air conditioning.[25]

Visual Analysis: Case Study Neighborhoods (Figures 21-23)

Hamline-Midway: SW Quadrant	*Frogtown: Center*	*Summit-University: NE Quadrant*
The SW quadrant of the neighborhood has 80% or higher impervious cover. However, that same area has a negligible population of children living in poverty. The entire neighborhood exhibits moderate to high vulnerability to energy poverty, with a Census block group in the NE quadrant identified as low vulnerability. Blighted housing is sprinkled throughout the neighborhood. The neighborhood parks may help mitigate the urban heat island effect in the blocks immediately surrounding them.	Frogtown exhibits a slightly higher percentage of impervious surface than the Summit-University neighborhood. More than 44% of children are living in poverty along University Avenue and in the eastern half of the neighborhood. Over half of the neighborhood exhibits high vulnerability to energy poverty. The remainder is at moderate vulnerability. Only the NW quadrant is relatively free of a high density of blighted housing. Only one large park and two pocket parks are shown. They may help mitigate the urban heat island in the blocks immediately surrounding them.	The impervious surface for the majority of the neighborhood falls within the 11-40% range. A few pockets show a lower percentage of impervious surface, but the land cover data is not provided at the level of granularity needed to identify the reason for pockets of pervious surfaces. The northern two thirds of the neighborhood have a high percentage of children living in poverty (more than 40% in most of the area). The entire neighborhood falls into either moderate or high vulnerability to energy poverty (i.e., the ability to pay energy bills). And, blighted housing is sprinkled throughout the neighborhood. The parks dotted throughout the neighborhood may help mitigate the UHI effect somewhat.

Figure 21: Ramsey County Land Cover and Impervious Surface Area (2002)
Map Source: University of Minnesota Remote Sensing and Geospatial Analysis Laboratory[60] *Data Source: Landsat*



Land Cover	Acres	Percent	Impervious Intensity (%)	Acres	Percent	Weighted Impervious Area (%)
Agriculture	2,183	2.01	0	30,757	28.29	0
Forest	8,915	8.2	1-10	6,758	6.21	0.29
Grassland	1,025	0.94	11-25	14,407	13.25	2.45
Extraction	0	0	26-40	19,188	17.65	5.86
Water	8,720	8.02	41-60	18,709	17.21	8.46
Wetland	4,652	4.28	61-80	8,877	8.16	5.69
Urban	83,237	76.55	81-100	10,039	9.23	8.58

Figure 22: Percent of Children < 5 Years Old Living At or Below the Poverty Level by Census Tract
Map Source: Minnesota Climate and Health Program[59]
Data Source: 2010 American Community Survey

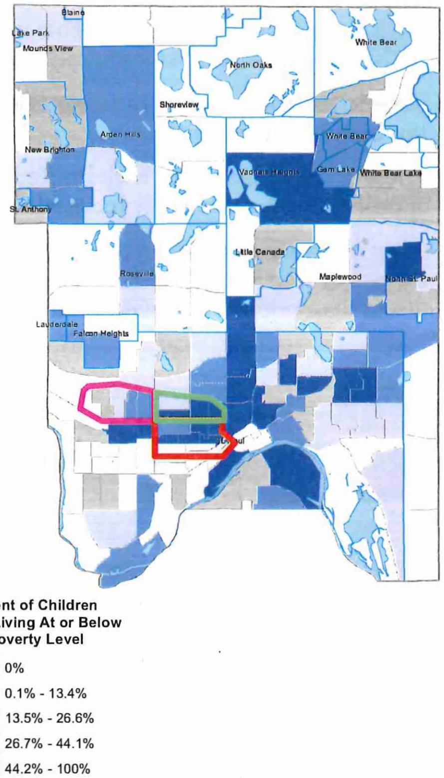
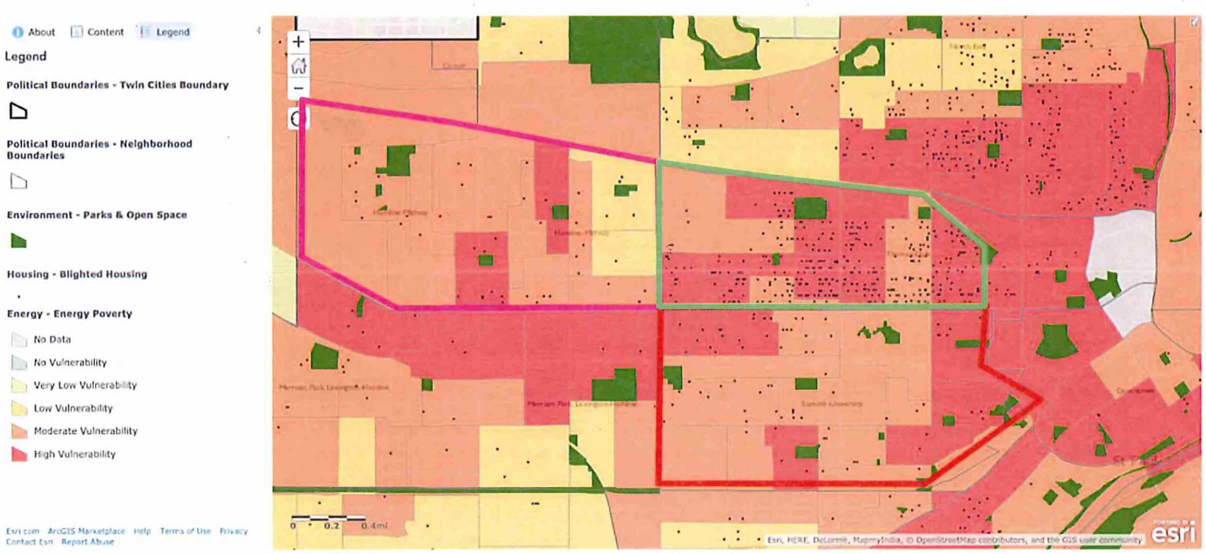


Figure 23: CEED Environmental Justice Atlas: Parks and Open Space, Blighted Housing, Energy Poverty[58]

Data Sources: Metropolitan Council, Generalized Land Use 2010 for the Twin Cities Metropolitan Area. City of Saint Paul, 2012. U.S. Census 2010. American Community Survey 2012.
Visit the CEED website for the most up to date version of this map: http://www.ceed.org



ENERGY INNOVATION CORRIDOR

All three case studies are required by the City of Saint Paul to comply with a high standard of sustainable development and to be certified through a green building standard such as Enterprise Green Communities. These requirements set targets for energy conservation, stormwater management, indoor environmental quality, and other green building features. For more information about sustainable building requirements in the City of Saint Paul, please visit: http://www.sustainablebuildingpolicy.umn.edu/saintpaul/

Additionally, the case studies fall within the Energy Innovation Corridor — a sustainable energy and transportation demonstration project along the Central Corridor.[3] Many of the Energy Innovation Corridor's stated goals[61] (Table 2) also offer opportunities for co-benefits (and some unintentional co-harms) to public health.

Table 2: Potential Population Health Effects Associated with Energy Innovation Corridor Goals

Goals	*Co-Benefits to Health*	*Co-Harms to Health*
1. **Avoid Carbon Dioxide Emissions**	Reduce cancer rates.[62] Reduce rates of chronic lower respiratory disease.[62]	The building design might increase indoor air pollutants and reduce a building's passive survivability* if it focuses exclusively on energy efficiency measures that tighten the building envelope and rely on centralized control of mechanical systems to condition the building.[63,64]
2. **Economic Impact**	Improve overall health status due to poverty reduction.[44]	Low SES populations may not benefit proportionally from economic development activities along the Central Corridor.[18]
3. **Energy Savings**	Reduce exposure to extreme heat events and enhance a building's passive survivability.*[65] Reduce rates of chronic lower respiratory disease.[62]	See item 1 above.
4. **Renewable Energy**	Enhance a building's passive survivability.*[65]	
5. **Smart Energy Technologies**	Improve overall health status due to poverty reduction.[44]	See item 2 above.
6. **Alternative Transportation**	Reduce cancer rates.[62] Reduce heart disease rates.[62]	If traffic congestion remains high along major roadways, individuals taking alternative forms of transportation may be at a higher risk of exposure to outdoor air pollutants that could trigger or exacerbate chronic lower respiratory diseases like asthma.[62] Unless the infrastructure is designed to protect pedestrians and cyclists, using these forms of transportation may put them at increased risk of injury.[18] Street improvements implemented as part of the Central Corridor reconstruction may have reduced the risk of injury in some neighborhoods.

*Passive survivability is a building's ability to continue to function during utility outages.[65]

Visual Analysis: Case Study Neighborhoods (Figure 24)

A number of Energy Innovation projects fall within the case study neighborhoods. Hamline-Midway includes a bike sharing station, two LEED certified projects, and an energy efficiency project. And, Frogtown and Summit-University share three bike share stations, an energy efficiency project, and an electric vehicle charging station.

Energy Innovation Corridor Projects Falling Within the Three Case Study Neighborhoods:

Green Flag Icon

- Electric vehicle charging station at University and Rice.

Blue Flag Icon

- Energy makeover of Lao family community center.
- Lighting retrofit of NAPA Auto Parts.

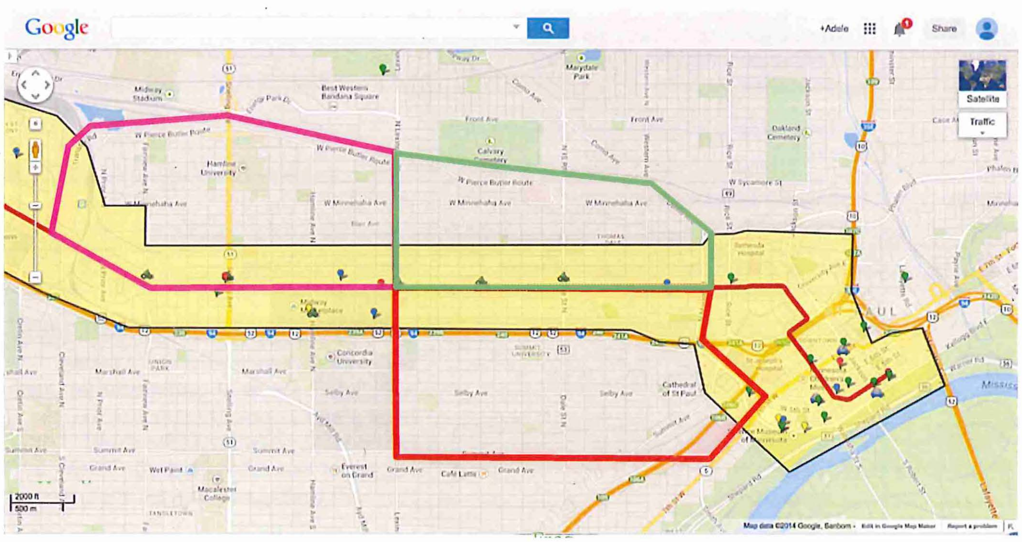
Red Flag Icon:

- LEED Gold certified — Wilder Center
- LEED EB certified — Spruce Tree Centre

Cyclist Icon

- Nice Ride MN stations.

Figure 24: Energy Innovation Corridor[66]



STEP 3: ASSESSMENT

Due to time constraints, Step 2 marked the end of the Central Corridor workshop. However, sufficient information was gathered during the half-day session to complete a preliminary assessment and develop a set of design recommendations for each of the three case studies.

Table 3 outlines the major health risk factors by case study area. Some risk factors — such as the high percentage of African Americans in Case Study 3 and the low access to fresh food in Case Study 1 — affect more than one health concern. As a result, even though four out of the six health concerns were selected to develop design recommendations, a number of the recommendations included under Step 4 of this report could also benefit health concerns, such as stroke, that are not highlighted in the next section.

Table 3: Health Risk Factor Prioritization by Case Study

	Case Study 1: Mixed Income Mixed-Use Development in SW Quadrant of Hamline-Midway	*Case Study 2: Single Family Retrofit in Center of Frogtown*	*Case Study 3: Affordable Housing Mixed-Use Development in NE Quadrant of Summit-University*
Chronic Disease Cancer	1. Lower access to grocery stores and other sources of healthy food than the other case study neighborhoods. 2. High traffic streets. 3. Industrial area immediately west of the neighborhood.	1. High percentage of African-Americans and Asian/Pacific Islanders.	1. High percentage of African-Americans. 2. High traffic streets.
Heart Disease	1. Lower access to grocery stores and other sources of healthy food than the other case study neighborhoods.		
Stroke	1. Lower access to grocery stores and other sources of healthy food than the other case study neighborhoods.	1. High percentage of African-Americans and Asian/Pacific Islanders.	1. High percentage of African-Americans.
Chronic Lower Respiratory Disease	1. High traffic streets.	1. High percentage of children. 2. Blighted housing.	1. Cluster of nursing homes on the eastern edge of the neighborhood. 2. High traffic streets.
Injury	1. High concentration of university-age residents, who are more likely to use alternative forms of transportation.[67] 2. Past evidence of unsafe sidewalks and intersections (motor vehicle collisions).	1. High percentage of populations in poverty, who may not have access to car transportation. 2. Past evidence of unsafe sidewalks and intersections (motor vehicle collisions).	1. High percentage of populations in poverty, who may not have access to car transportation. 2. Past evidence of unsafe sidewalks and intersections (unintentional falls).
Climate Change Extreme Heat	1. High percentage of impervious surface.	1. High percentage of children. 2. High vulnerability to energy poverty. 3. Combines a high percentage of impervious surfaces with a high percentage of children living in poverty.	1. Cluster of nursing homes on the eastern side of the neighborhood. 2. Moderate to high vulnerability to energy poverty. 3. Combines a high percentage of impervious surfaces with a high percentage of children living in poverty.

Vector-borne Disease		1. High percentage of children. 2. Concentration of blighted housing, which could provide harborage to disease-carrying pests.	
Priority Health Concerns by Case Study	**Heart Disease** **CLRD** **Extreme Heat** **Vector-borne Disease**	**Cancer** **CLRD** **Extreme Heat** **Vector-borne Disease**	**Cancer** **CLRD** **Injury** **Extreme Heat**

A full-blown HIA would likely use a quantitative method like spatial analysis, correlation analysis, or developing an index to validate the initial prioritization. That step is not included in this summary report.

STEP 4: DESIGN RECOMMENDATIONS

Tables 4 through 6 apply the general risk factors and potential design strategies developed in Figure 8 to the specific neighborhoods and building types represented by the three case studies. The recommended design strategies vary a good deal, even though:

- they all address overlapping health concerns;
- the case study projects are located in adjacent neighborhoods; and,
- all three case studies are affordable housing developments.

The differences between the three sets of prioritized design strategies demonstrate the cumulative importance of subtle differences in the demographic, socioeconomic, behavioral, and environmental risk factors on and immediately surrounding a development.

Table 4: Case Study 1: Mixed Income Mixed-Use Development in the SW Quadrant of Hamline-Midway

Health Concerns	*Prioritized Design Strategies*
Heart Disease CLRD Heat Vector-borne Disease	1. Provide safe and accessible pathways onto and through the property for alternative forms of transportation (e.g., pedestrians, cyclists, etc.).
	2. Provide bicycle storage and showers, and host a Nice Ride station (the local bike share program).
	3. Right size parking to encourage alternative transportation.
	4. Include a pocket park as part of the development design to mitigate the urban heat island effect.
	5. Host recreation programs for all ages (including mother/baby programs) that provide an opportunity for physical activity and social cohesion.
	6. Provide water fountains, misting stations, and interactive water features for children.
	7. Provide on-site healthy food options in the property's retail spaces.
	8. Specify low allergen building materials that are easy to clean, such as hard floor surfaces rather than carpet.
	9. Install ceiling fans and operable windows with screens to encourage natural ventilation while protecting residents from mosquitoes and other pests.
	10. Install an uninterruptable power supply in certain common areas using a direct connection to on-site renewable energy installation(s).
	11. Establish green building operations protocols such as integrated pest management and green cleaning practices. Engage residents in their implementation.

Table 5: Case Study 2: Single Family Retrofit in the Center of Frogtown

Health Concerns	*Prioritized Design Strategies*
Cancer CLRD Extreme Heat Vector-borne Disease	1. Design the kitchen/dining space to encourage preparation of fresh foods.
	2. Install landscaping that prioritizes shading the house, deterring mosquitoes, and cultivating edible plants.
	3. Remove asthma triggers from the interior, such as: carpet, off gassing materials, deteriorated building envelope, etc.
	4. Make sure all sources of mold have been removed from existing building materials and are not reintroduced by new assemblies such as fiberglass batt insulation.
	5. Focus energy efficiency measures on the roof and attic to reduce solar heat gain during summer months. (Example strategies: light colored or vegetative roof, increased attic insulation, etc.)
	6. Repair holes, cracks, moisture penetration, and other deficiencies in the building envelope that could allow entry and/or food and harborage to pests.
	7. Install combination storm shutters/screens on doors and windows to encourage use of natural ventilation.
	8. Vent the basement to protect for radon contamination and fit it out for use as an in-house cooling center during extreme heat events.
	9. Encourage the new homeowners to use integrated pest management and green cleaning practices to retain a low allergen environment.

Table 6: Case Study 3: Affordable Housing Mixed-Use Development in the NE Quadrant of Summit-University

Health Concerns	*Prioritized Design Strategies*
Cancer CLRD Injury Extreme Heat	1. Discourage jaywalking by funneling site access for pedestrians and cyclists to street intersections.
	2. Designate the property as smoke-free or provide a dedicated outdoor space for smoking.
	3. Locate doors, windows, and outdoor air intakes away from pollution sources.
	4. Plant vegetation to screen the development from pollution sources, such as major roads.
	5. Host on-site farmers markets, a community garden, and/or a CSA drop-off site.
	6. Specify low allergen building materials that are easy to clean, such as hard floor surfaces rather than carpet.
	7. Provide increased ventilation in common areas and kitchens, coupled with filtration media that is high efficiency but not too expensive for the tenants to replace.
	8. Provide outdoor shaded areas for all ages, including playground equipment, to encourage physical activity.
	9. Install ceiling fans and operable windows with screens to encourage natural ventilation while protecting residents from mosquitoes and other pests.
	10. Fit out common areas with air conditioning and designate them as public cooling centers during heat events.
	11. Establish green building operations protocols such as integrated pest management and green cleaning practices. Engage residents in their implementation.

FINALIZING THE HIA

The final two steps in the HIA process are Reporting and Evaluation. A full-blown HIA would include the development of a report similar to this one to walk stakeholders through the results of the assessment and to present the design recommendations outlined in the previous section. The last step would evaluate the extent to which the design recommendations were subsequently incorporated into the final design.

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Central Corridor Workshop: Using Health Data as a Design Tool

May 14, 2014
Saint Paul, MN

ADELE HOUGHTON
AIA; MPH; LEED AP BD+C, O+M, ND
President, Biositu, LLC

Overview

1. Public Health and Data
2. Design Sets the Context for Two Major Health Concerns
3. Evidence of Green Building's Influence on Community Health
4. Role of HIAs in Land Use & Development – example from AK

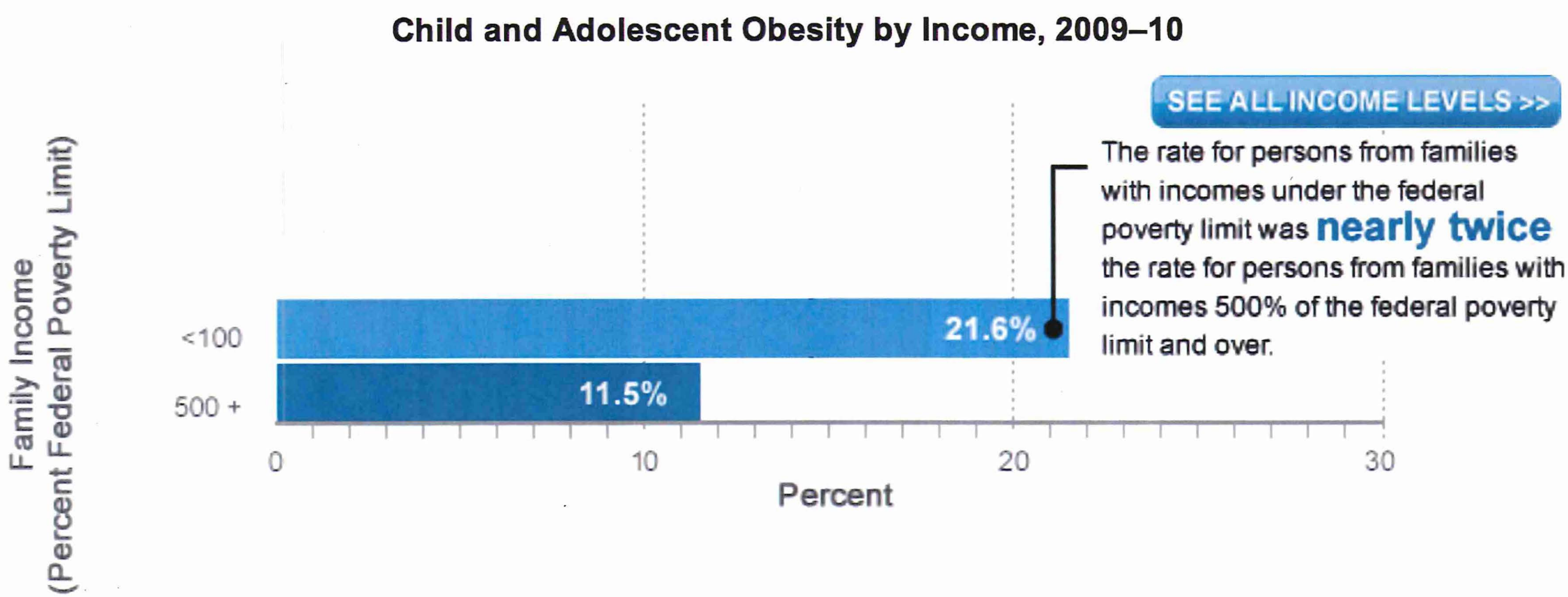
Overview

1. Public Health and Data

Public Health Role in Data Collection

Long-term Trends

Healthy People 2020

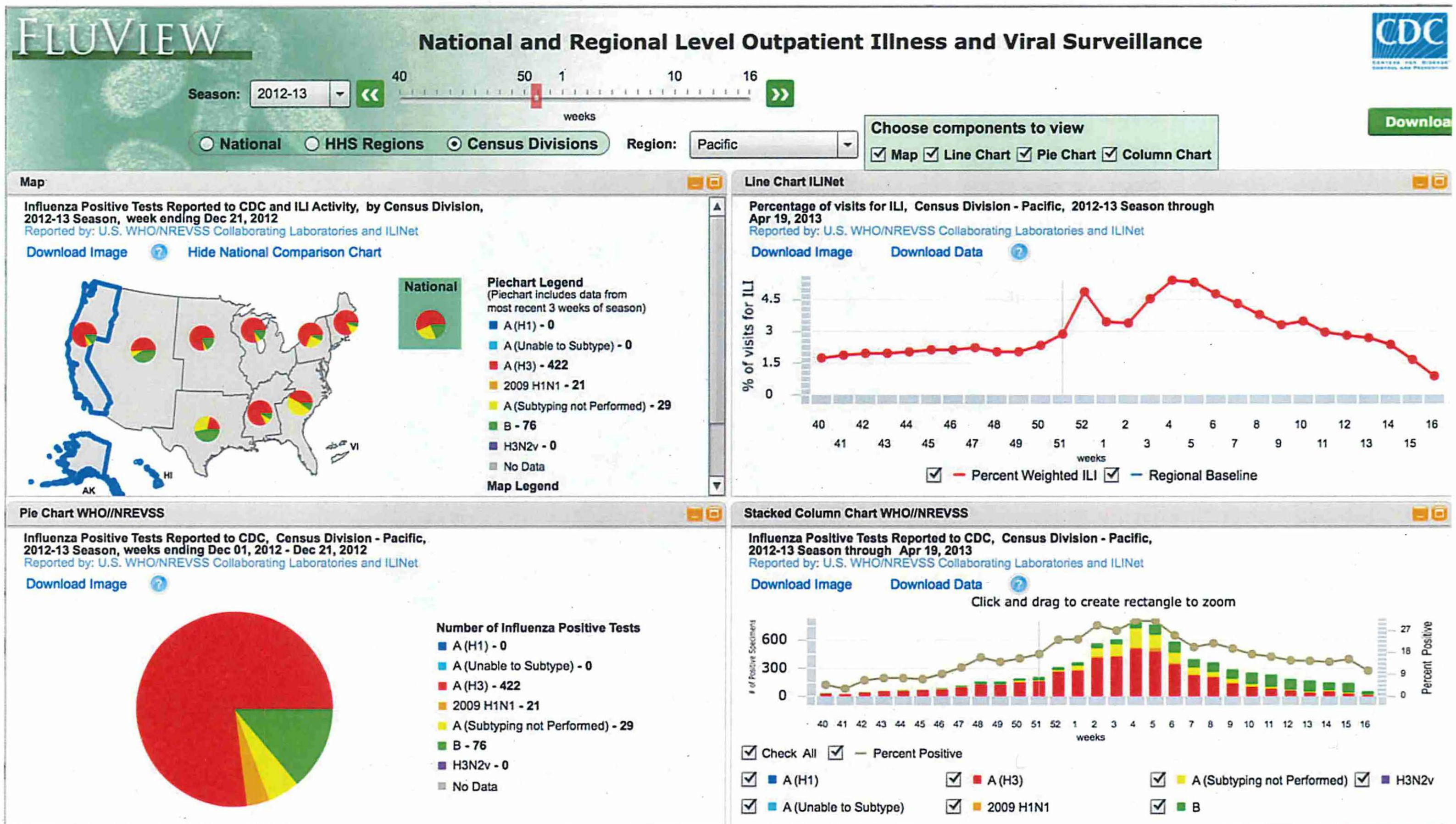


NWS-10.4: Obesity in Children and Adolescents
Source: National Health and Nutrition Examination Survey (NHANES), CDC, NCHS

Public Health Role in Data Collection

Responding to Outbreaks

FluView

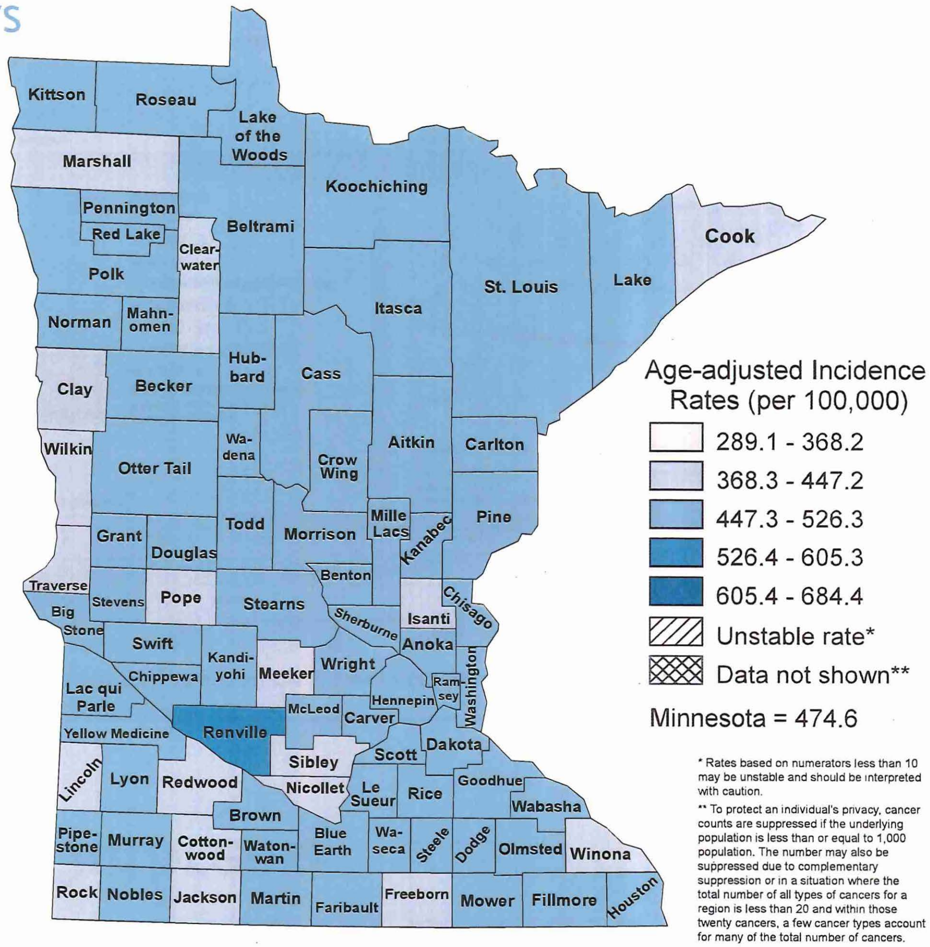


Source: http://gis.cdc.gov/grasp/fluview/fluportaldashboard.html

Public Health Role in Data Collection

Environmental Public Health Tracking

Cancer Indicators

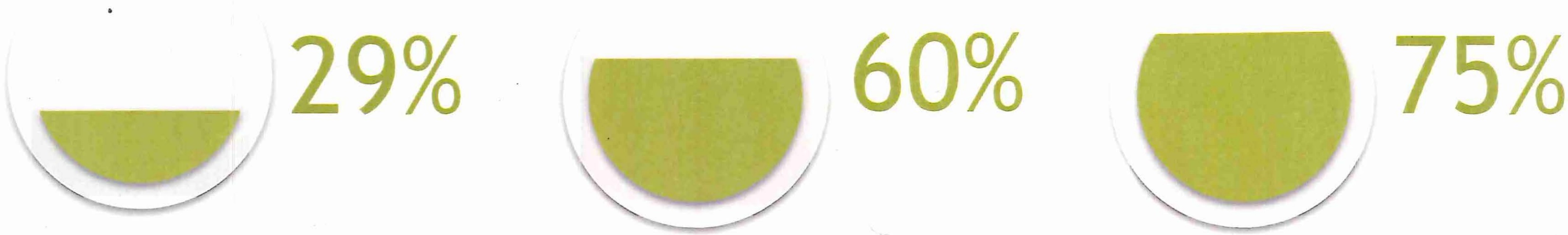


Age-Adjusted Incidence Rates per 1000,000. All Cancer Types Combined. 2005-2009. Both Sexes.
Source: http://www.health.state.mn.us/divs/hpcd/tracking/index.html

Overview

2. Design Sets the Context for Two Major Health Concerns

PROBLEM: Chronic Disease



Total increase in U.S. medical care spending

Costliest medical conditions

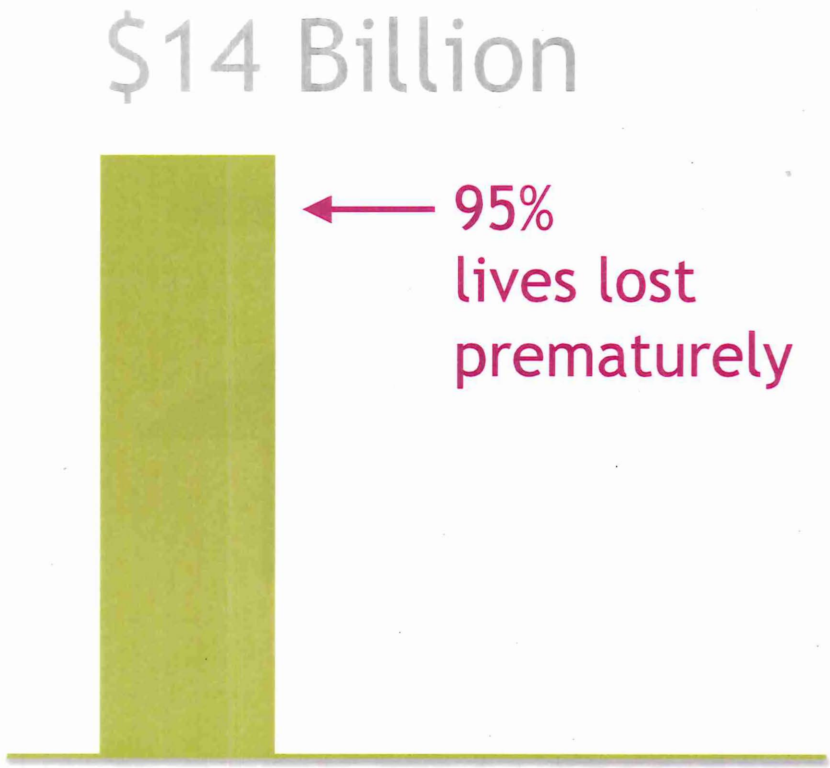
Cost of medical care

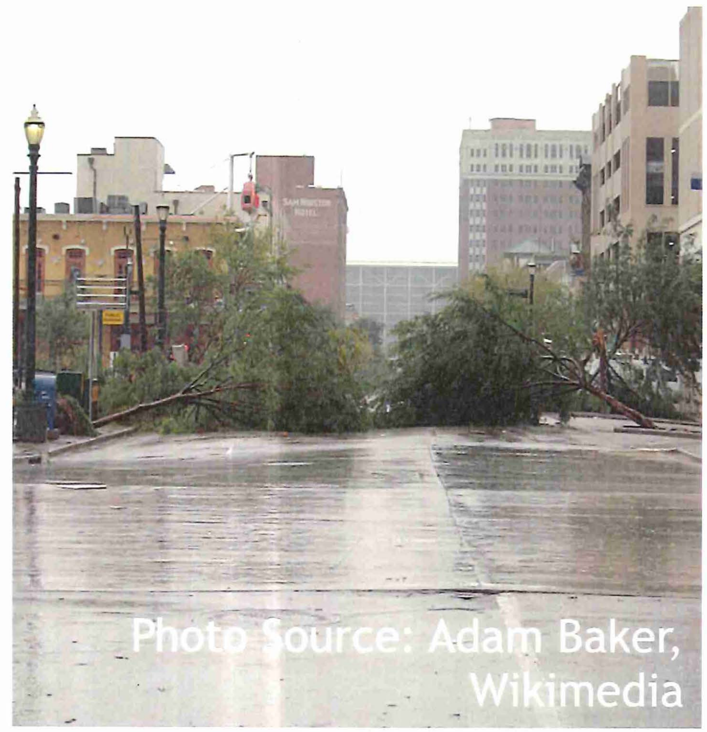
Institute of Medicine. *For the Public's Health: Investing in a Healthier Future*. The National Academies Press. Washington, D.C. 2012.

BUILT ENVIRONMENT SOLUTION

Bipartisan Policy Center. *Lots to Lose: How America's Health and Obesity Crisis Threatens our Economic Future*. June 2012.

PROBLEM: Climate Change-Related Events





Source: Knowlton K, Rotkin-Ellman M, Geballe L, Max W, Solomon G. Six Climate Change-Related Events in the United States Accounted for About $14 Billion in Lost Lives and Health Costs. *Health Affairs* 30(11):1-10. 2011.

SOLUTION: Climate Change-Related Events

Healy A, Malhotra N. Myopic Voters and Natural Disaster Policy. Am. Polit. Sci. Rev. 2009;103(03):387.

Overview

3. Evidence of Green Building's Influence on Community Health

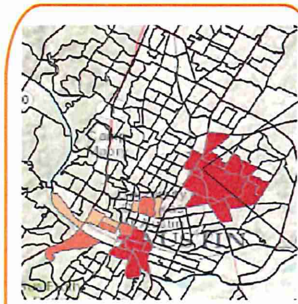
Literature Review

LEED for New Construction Credits: Resilience Potential

LEED Credits *(description)*	**Extreme Heat Resilience Literature Review**	**Flooding Resilience Literature Review**
SSc1: Site Selection *Avoid building on: prime farmland; land in 100-year flood plain; endangered species habitat; land within 100 feet of wetlands or 50 feet of water bodies; park land.*	✓	✓
SSc2: Development Density and Community Connectivity *Locate project in a dense urban area or close to both a residential area and at least 10 basic services (i.e., grocery stores, etc.)*	✓	
SSc4.1: Alternative Transportation—Public Transportation Access *Locate project near bus/rail lines.*		✓
SSc4.4: Alternative Transportation—Parking Capacity *Provide preferred parking areas for carpools/vanpools.*		✓
SSc5.1: Site Development—Protect or Restore Habitat *Limit disturbance of habitat on greenfield sites. Restore habitat on previously developed habitat.*	✓	✓
SSc5.2: Site Development—Maximize Open Space *Increase vegetated open space.*	✓	✓
SSc6.1: Stormwater Design—Quantity Control *Reduce the volume of stormwater that leaves the site after heavy precipitation events.*	✓	✓
SSc6.2: Stormwater Design—Quality Control *Clean stormwater of total suspended solids.*	✓	✓
SSc7.1: Heat Island Effect—Nonroof *Install light colored and pervious paving (i.e., roads, sidewalks, parking lots, etc) or place at least 1/2 of all parking spaces under cover.*	✓	✓
SSc7.2: Heat Island Effect—Roof *Install light colored or vegetated roofs.*	✓	✓
WEc1: Water Efficient Landscaping *Reduce potable water use for irrigation by 50% or 100%.*		✓
WEc2: Innovative Wastewater Technologies *Reduce potable water use for sewage conveyance.*		✓
WEc3: Water Use Reduction *Reduce potable water use for interior fixtures (i.e., toilets, lavatories, showers, etc.)*		✓
EAc1: Optimize Energy Performance *Reduce energy use in the building.*	✓	
EAc2: On-Site Renewable Energy *On-site installation of solar, wind, or other renewable energy source.*	✓	
EAc3: Enhanced Commissioning *Perform commissioning (i.e., quality control) on all energy, domestic hot water, lighting, and renewable energy systems. Review building operations within 10 months after substantial completion of construction.*	✓	
IEQc7.1: Thermal Comfort—Design *Design air conditioning (HVAC) systems and building envelope to meet standards for temperature, humidity, and airflow.*	✓	

Literature Review

Conceptual Model



Opportunity: Enhance community resilience to climatic events.

LEED Credits → Environmental Determinants of Health → Risk of Exposure → Community Resilience → Co-Benefits to Health / Co-Benefits to Built Environment

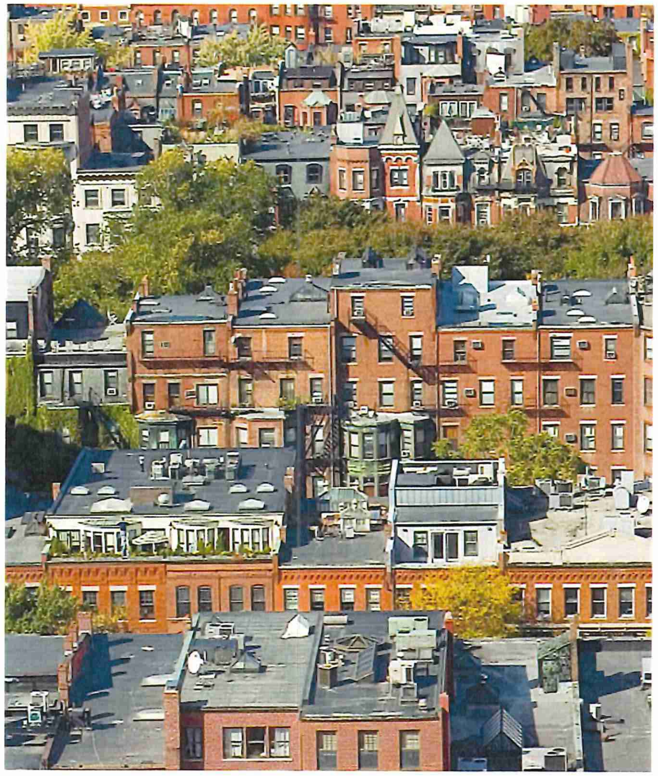
Literature Review

Example Results: Extreme Heat

- Percentage vegetation in neighborhoods with vulnerable populations
- Exposure to high temperatures in urban areas
- Power outages exacerbated by heat (EA/IEQ)

Literature Review

Example Results: Extreme Heat



- Reduce the urban heat island effect

Literature Review

Example Results: Extreme Heat


Photo Source: Lamiot

- Reduce the urban heat island effect
- Reduce burden on the building's air conditioning system
- Reduce burden on the municipal electrical grid

Literature Review

Example Results: Extreme Heat

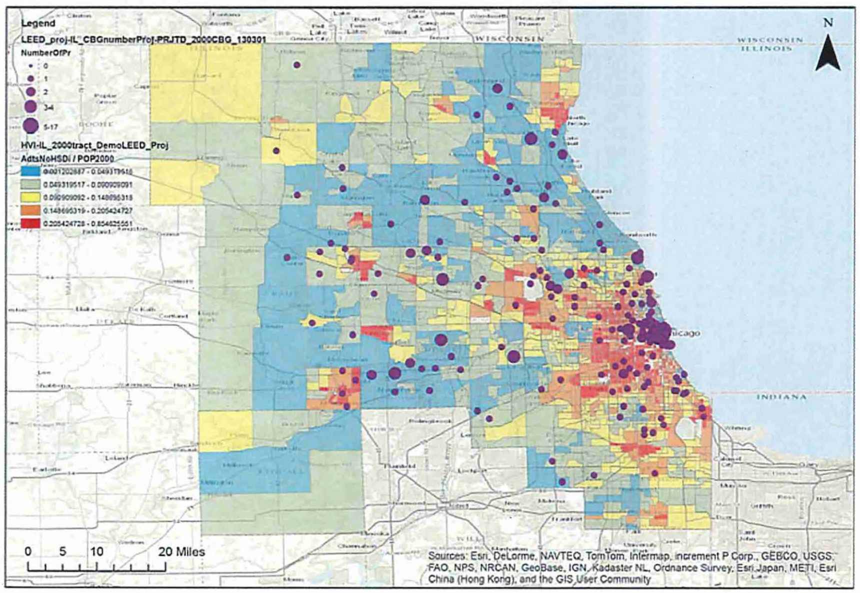
- Reduce vulnerability to heat stress (SS/IEQ)
- Reduce heat-related injuries and death (SS/IEQ)
- Passive survivability (EA)

Co-Benefits to Health

Spatial Correlation Analysis

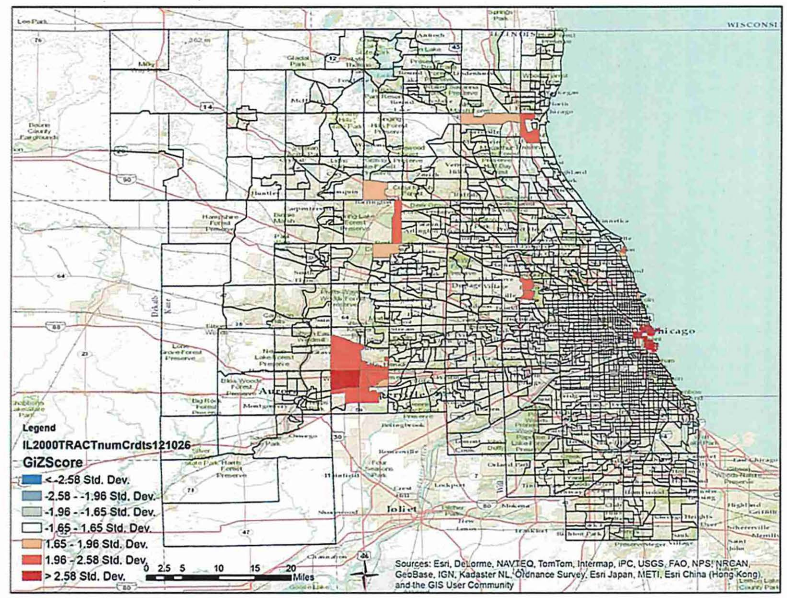
Heat Vulnerability Index

Overlaid with Number of LEED Certified Projects



Hot Spots

Number of LEED Certified Projects

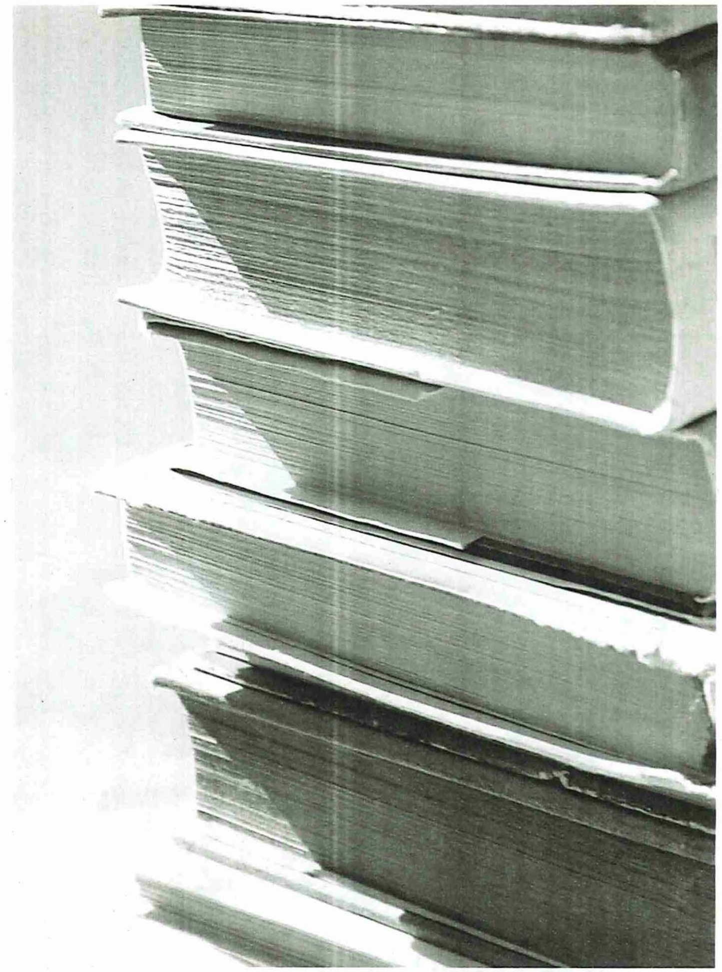


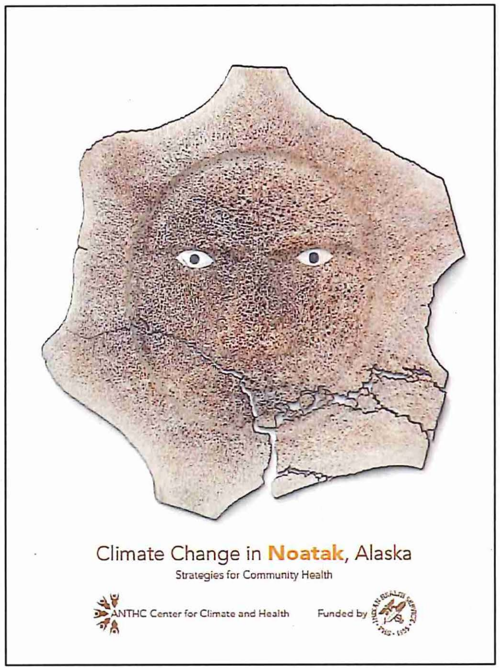
Overview

4. Role of HIAs in Land Use & Development - example from AK

Six Steps to Conducting an HIA

1. Screening
2. Scoping
3. Assessment
4. Recommendations
5. Reporting
6. Evaluating





- 500 residents
- No road access
- Mostly Inupiat
- Economy dominated by subsistence activities

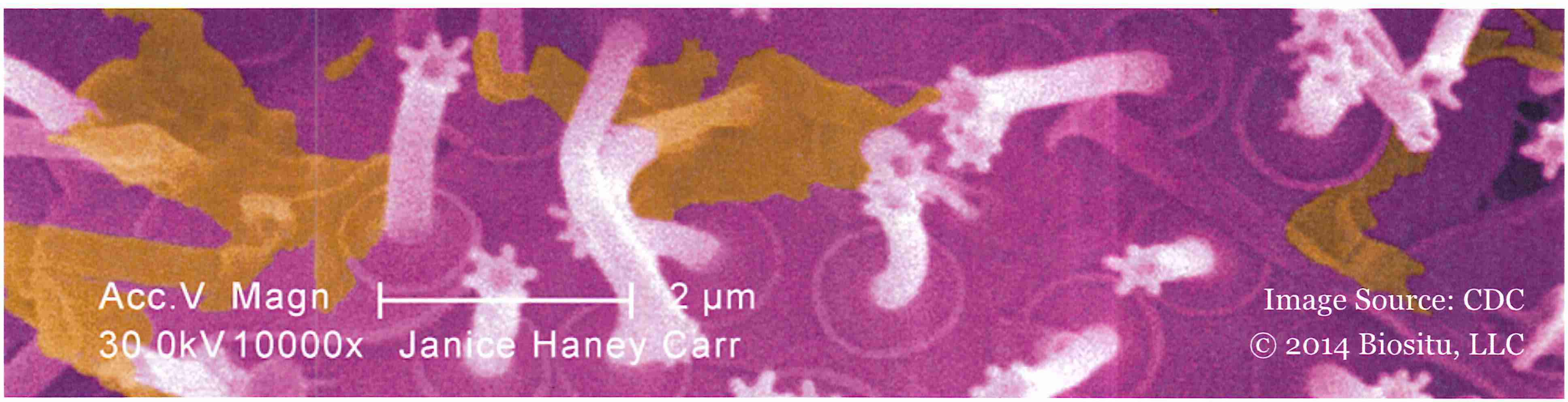
Credit: *Climate Change in Noatak, Alaska: Strategies for Community Health.* (2011) ANTHCC Center for Climate and Health.

Centralized Water & Wastewater Infrastructure

- Seasonal water shortages
- Seasonal compromised water quality
- Wastewater plant's foundation subsiding & cracking
- Risk of fuel shortages

Health Risks

- Water shortages
- Exposure to waterborne contaminants such as giardia from compromised water quality
- Risk of infections due to interruption of services
- Compromised food security



Imagine you were designing a replacement health clinic...

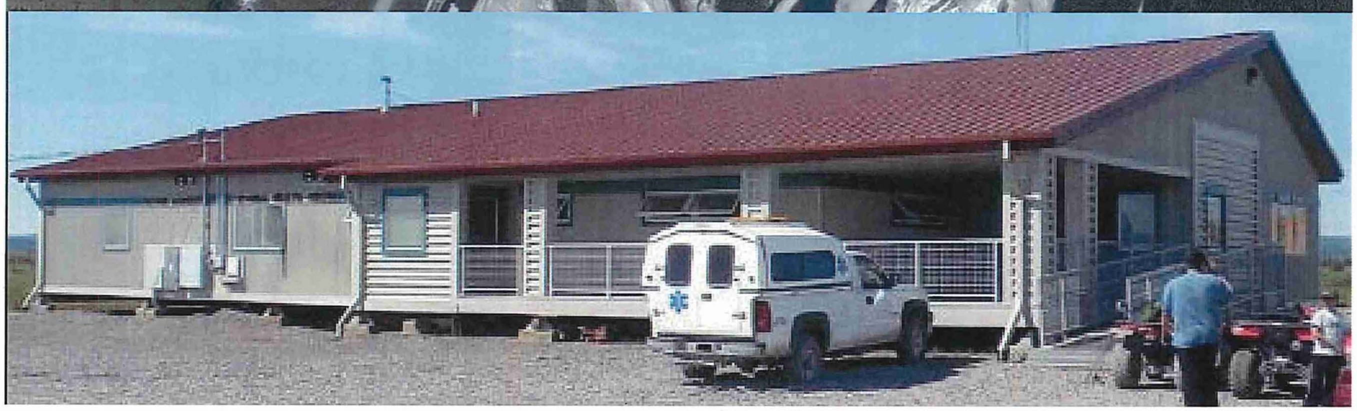


Image Credit: Noatak Health Clinic.
Photo Credit: Michael Brubaker, 2010.
Source: *Climate Change in Noatak, Alaska: Strategies for Community Health*. (2011) ANTHCC Center for Climate and Health.
Map Credit: Google Maps 2011

Concluding Questions

- Why aren't HIAs applied more often at the development scale?
- What are the barriers to incorporating them into the design process?
- If they were incorporated...
  - How would HIAs improve design?
  - How would a design influenced by HIA recommendations improve population health?

Workshop Schedule

Applying HIA Methodology to Design Process

1:30 – 2:00	Step 1, Screening
2:00 – 3:00	Step 2, Scoping
3:00 – 3:30	Step 3, Assessment
3:30 – 3:45	Break
3:45 – 4:00	MPCA Commissioner John Linc Stine
4:00 – 4:30	Step 4, Design Recommendations
4:30 – 4:40	Step 5, Reporting
4:40 – 4:50	Step 6, Evaluating
4:50 – 5:00	Applying HIAs to Future Design Projects in the Twin Cities