A PUBLIC HEALTH ASSESSMENT OF THE NORTH ST. PAUL LIVING STREETS PLAN

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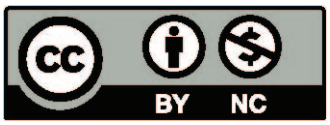

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I. INTRODUCTION

The City of North St. Paul is a suburb located in eastern Ramsey County, 16 miles from the Twin Cities. The city was founded in the 1870's as a commercial and industrial town along with residential neighborhoods.[1] Today, this historical small town continues to maintain and preserve its unique history while looking forward to improving the city's infrastructure to foster an environmentally sustainable natural and built environment.

To achieve this vision, the City of North St. Paul has proposed a 20-year Capital Improvement Plan that will address the needs of upgrading major infrastructure within the city. The Capital Improvement Plan includes a proposal for the city to adopt a Living Streets Plan that will directly respond to growing public health concerns relating to stormwater management, pedestrian movement, and active living. The plan describes a "Living Street" as:

> "...efficient use of the public rights-of-way. It is about enhancing the functionality of these public corridors. It starts by preserving the important function of accommodating traffic, parking, and underground utilities, but additionally improves accommodations for pedestrians, bicycles and nature in the form of street trees and rainwater gardens." [2]

As public health graduate students at the University of Minnesota School of Public Health, our mission is to use education, research, and community engagement to enhance population health. Studying within the Division of Environmental Health Sciences, we strive to understand the influence our environment (both natural and built) has on human health.

Healthy people and healthy communities are public health priorities. Between 2000 and 2050, the proportion of people living in urban areas is projected to rise from 46.6 to 69.6%.[3] Such increased urbanization highlights the need for modern infrastructure and health promotion supporting urban populations.

Urban developments have increased the percentage of stormwater runoff, which enters surface waters that ultimately impair near-by lakes, rivers, and streams. Urbanization has also increased our dependence on motor vehicles for movement and has shifted the balance away from accommodating other modes of transportation. Additionally, there are growing trends of physical inactivity and sedentary lifestyles among children and adults that will impact health outcomes.

The North St. Paul Living Streets Plan is an active approach to developing sustainable solutions for these, and other, public health concerns. The purpose of this report is to provide a comprehensive public health response and recommendations to the staff of the City of North St. Paul. Highlighted in this report are discussions covering the topics of stormwater management, pedestrian movement, and the plan's impact on active living. However, given the scope of this plan, there are many subjects that deserve more time and attention. These suggestions are listed in the Further Works and Studies section. In addition, many of the most pertinent questions that may arise regarding the topics covered in this report can be found in the Frequently Asked Questions (FAQ) and Concerns section. It is our hope that the City of North St. Paul will take the findings of our research into consideration and find this report helpful when discussing the implementation and adoption of the Living Streets Plan.

II. STORMWATER MANAGEMENT: RAIN GARDENS AND THE REDUCTION OF IMPERVIOUSNESS

OUR MOST PRECIOUS RESOURCE

Minnesota, the land of 10,000 lakes, is known for its bountiful water resources. We are surrounded by beautiful lakes, rivers, and streams throughout the state. Our waters not only offer numerous recreational opportunities but also provide critical habitat for fish and wildlife. We rely on it for drinking, cooking, and agriculture, and its quality directly affects health, wellness, and public safety. Water is one of our most valuable resources, yet we often take it for granted. Recently, concerns about our water quality have been growing. The Minnesota Pollution Control Agency samples water throughout the state; measuring and categorizing our lakes. When a water body exceeds certain limits, it is placed on the MPCA Impaired Waters List. As of July 2013, a total of 3,643 rivers, lakes, and wetlands were surveyed. Of the waters surveyed, 2,171 impairments were identified; 624 of these were new impairments since 2010.[4] Included on this list is a lake fed by a watershed of North St. Paul. Much of the water that falls on North St. Paul is transported over lawns, pavement, roads, and roofs, and eventually flows into Kohlman Creek which then flows into Kohlman Lake. Water, however, does not follow boundaries or property lines; the Kohlman Lake watershed also covers areas of Maplewood, Gem Lake, White Bear Lake, Vadnais Heights, Little Canada, and Oakdale.

Water that flows above the ground, especially due to storm events, is generally labeled as 'runoff.' Runoff, or 'stormwater runoff', increases flooding, picks up pollutants from streets, parking lots, and lawns, which then flow into streams and lakes.[5] Traditional methods to divert stormwater runoff are accomplished through an underground network of pipes which are then

diverted to holding ponds or discharged directly into surface waters.[6] This is currently an effective way to remove excess stormwater but does little to treat the runoff before it is again released into the environment. Due to the nature of this process, water temperature rises when water flows over asphalt and during transport underground. In addition, the receiving lakes and rivers see an increase in pollutants and nutrients, and a decrease in water clarity. With fewer permeable surfaces for water to infiltrate into the ground, there is less groundwater available to recharge surface waters. This means that during high precipitation events, water that would have normally seeped into the ground and slowly recharged surface waters now flows over the ground as runoff, resulting in more flash floods and channel scouring.[6]

PURPOSE OF A RAIN GARDEN

The Living Streets Plan outlines these issues and offers several options for remediation; particularly through the installation of rain gardens/bioretention areas, increasing green space, and increasing pervious surfaces by narrowing roadways. Currently, most of the stormwater flows into our storm drains and is diverted into our rivers and lakes, untreated. Pollutants such as salts, oils, fertilizers, herbicides and pesticides, animal waste, and sediment collect over time, impacting our waters. Rain gardens help by collecting stormwater runoff, allowing the extra surge to slowly seep into the ground. Native plantings in rain gardens and nearby plants and trees benefit from this, allowing roots to grow deep into the soil further infiltrating nutrients into the soil. Beyond localized benefits, rain gardens recharge local and regional aquifers, protect against flooding, and protect streams and lakes from harmful pollutants such as fertilizers, pesticides and oil.[5] In fact, they allow about 30% more water to soak into the ground compared

to a patch of traditional lawn.[5] Figure 1 diagrams the main concept behind rain garden design, also generally called a bioretention area. This design uses best management practices; increasing infiltration and removing pollutants from stormwater runoff.

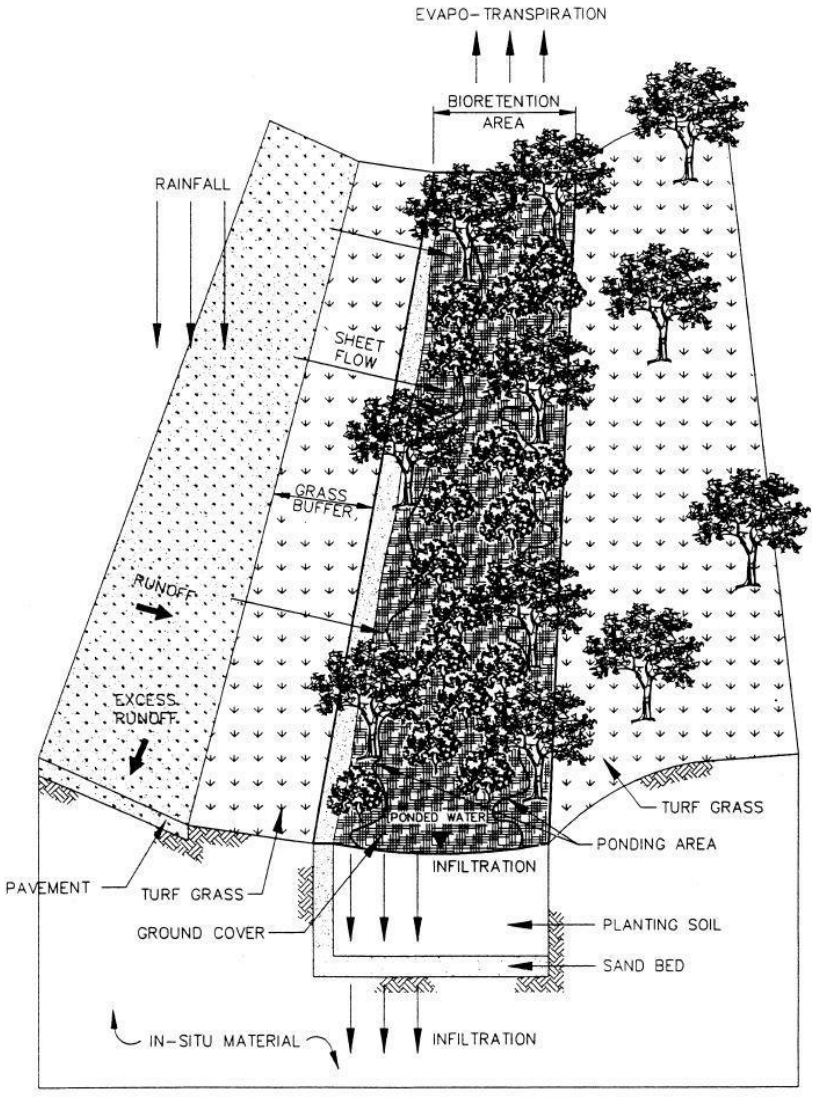

Figure 1. A basic bioretention design. Bioretention is a best management practice developed by the Prince George's County, MD, Department of Environmental Resources. Figure adapted from source 7.

There are many types of rain gardens, and though they come in all shapes and sizes, the size of a rain garden is very important, as well as the slope of the area and the soil type. Even

when reducing the size of an adequate rain garden by as much as 30%, it can still control almost 90% of runoff.[5]

IMPACTS OF IMPERVIOUSNESS

Rain gardens increase the collection and infiltration of stormwater, but they also contribute to the total amount of pervious surface in an area. The opposite of this, impervious surfaces, include roads, parking lots, sidewalks, rooftops, etc. Figure 2 outlines differing amounts of impervious areas. The amount of impervious surface in an area is a good indication of the impact urban development has on our water systems.[8]

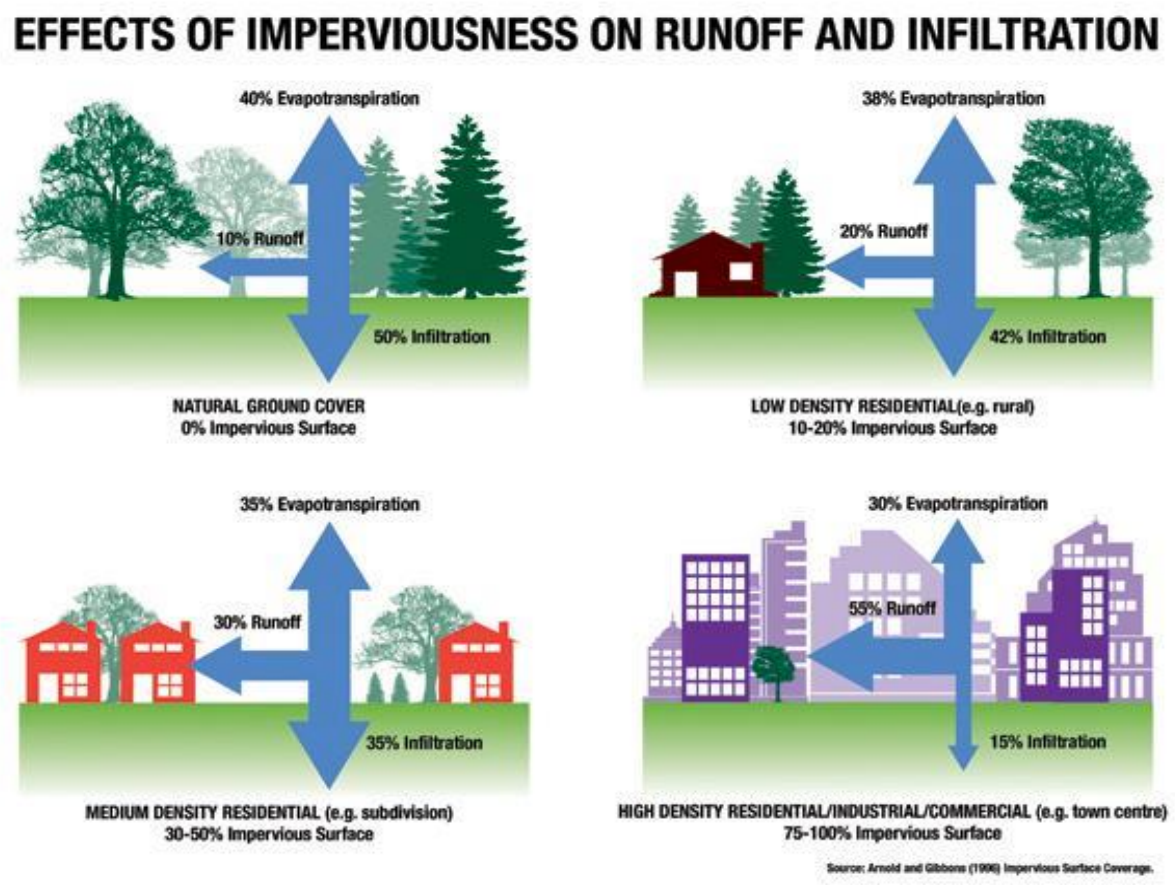

Figure 2. This illustration depicts the percentage of stormwater runoff as urbanization increases. Figure adapted from source 9, 10.

Several publications and studies have focused on imperviousness and the effects this has on water quality including channel instability, erosion, flooding, pollutant loads, water temperature increases, and negative effects on biota. It is important to note that many of these factors can be attributed to the speed at which water flows, or the 'travel time of overland flow'.[11] One effect of impervious surfaces and speed of water flow is channel instability on waterways. As surface waters see more severe and frequent flooding, the increased flow causes stream and river banks to widen or down-cut stream beds. This type of channel instability can increase erosion and habitat destruction.[8] In the Pacific Northwest, research has suggested there is a threshold for stability at around 10% imperviousness.[12, 13] When there is additional watershed development over 10%, channels consistently show erosion and additional instability.[8] Research has been conducted in several different areas, taking into account many variables, and employing widely different methods have all resulted in a similar conclusion: that there is very little stream degradation at low levels of imperviousness (near 10% imperviousness).[8] This highlights the potentially large impact a pervious surface has on water quality. The most important thing to note is that imperviousness can be controlled, managed, and measured.

One main source of impervious surfaces are rooftops, however, impervious surfaces used for vehicles exceed the area the rooftops contribute. According to Schueler, "transport-related imperviousness comprised 63 to 70% of total impervious cover at the site in 11 residential, multifamily and commercial areas where it had actually been measured". Suburban areas are where you will see this prevalent aspect emerge most often.[8] It is this type of area rain gardens

are traditionally installed, directly addressing the increasing amount of impervious surfaces. The volume impact of these surfaces has also been studied - from over 40 runoff monitoring sites across the country, the site runoff coefficient as a result of site impervious cover was measured (Figure 3).

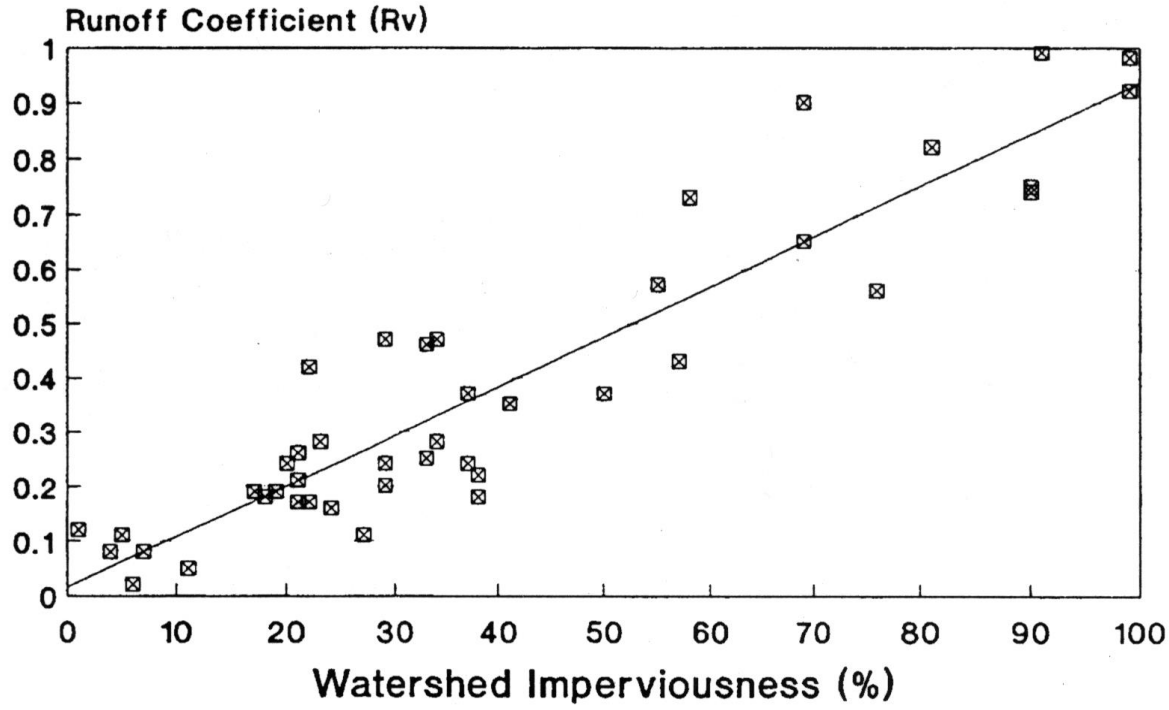

Figure 3 illustrates the increase in the site runoff coefficient as a result of site impervious cover, developed from over 40 runoff monitoring sites across the nation. The runoff coefficient ranges from zero to one and expresses the fraction of rainfall volume that is actually converted into storm runoff volume. Figure adapted from source 8.

The coefficient was expressed by the fraction of rainfall volume that is actually converted into storm runoff volume. This study found that the total runoff volume for a one-acre parking lot is 16 times the amount produced by an undeveloped meadow.[8] For example, if there was a one-inch rainstorm, the total runoff from the one-acre meadow would "fill a standard size office to a depth of about two feet (218 cubic feet). By way of comparison, if that same acre was

completely paved, a one-inch rainstorm would completely fill your office, as well as the *two* next to it".[8]

SOURCES OF POLLUTANTS

Many studies have consistently shown that urban pollutants in waterways are directly related to the amount of impervious surfaces in watersheds. In fact, imperviousness was found to be the most predictive variable when studying pollutant loads found in waterways.[8] Reducing overall stormwater loads is one of the most beneficial aspects of a rain garden; notably because stormwater carries a myriad of pollutants and sediment. The broad spectrum of pollutants that surface runoff contains can have several effects on receiving waters such as oxygen depletion, eutrophication (increased supply of organic matter/algae blooms), species stress and toxicity.[14] Nitrogen and phosphorus are some of the top pollutants of surface waters causing issues such as toxic algal blooms, lowered oxygen, fish kills, and biodiversity harm (aquatic plants and animals).[15] These chemicals also negatively affect recreational use and impact the aesthetic value of surface waters.[15] Unfortunately, a large source of these pollutants are from non-point sources. Point sources are easier to target and test (i.e. a pipe carrying waste water directly into a water body) but a non-point source, such as stormwater runoff, is much more difficult to measure and regulate. In addition, non-point sources of contamination can originate from a wide variety of activities over wide areas, and are affected by changes in the weather.[15] Another common pollutant, volatile organic compounds (or VOCs) are found in water systems and include gasoline-related compounds like toluene and xylene and chlorinated compounds such as chloroform and trichloroethene. A study in 1997 by the U.S. Environmental Protection Agency

found that VOCs were potential contaminants of 38% of community water systems in the United States.[16] VOCs can enter both surface and groundwater once released into the environment through point and non-point sources. They can be found in several common products including fuels, solvents, paints, adhesives, deodorants and refrigerants.[16] Statistical tests and models of air and water VOCs suggest that urban land surfaces are the main non-point source of most VOCs.[16] Again, the non-point source in this case originates from surface runoff over impervious surfaces.

NATURAL POLLUTION REMOVAL

Pollutants aren't all directly carried into open water bodies; some stormwater is able to infiltrate into soils as it is transported and stored (e.g. in stormwater retention ponds and wetlands). Not only do retention ponds and wetlands enable some control over peak stormwater flows, but they can actively remove and filter water pollutants. The observation that wetlands act as a natural filtration and treatment system has led to their application to stormwater runoff treatment. Pooling and collecting of water in a large enough area gives long retention times and is an effective method of particulate matter removal.[14] Soils have been found to be one of the main mediums for the attenuation of heavy metals from stormwater runoff. A study was conducted using boxes mimicking rain gardens to measure the potential of soils for metal adsorption and absorption. When the pH was at 7, adsorption was over 90% for lead, over 80% for copper and between about 50% and 70% for zinc. Though sorption of metals was found in the study, there was some variability due to pH levels and the non-homogeneous nature of soil.[14] In the same study, organic nitrogen, ammonia, and ammonium (also called Total

Kjeldahl Nitrogen or TKN) removal was measured in rain garden/bioretention boxes. Several effluent ports were installed at different depths in the boxes to measure at which points higher TKN removal occurs. They also found that there was an overall removal of TKN and that depth was an important factor in the amount observed. In the upper ports, effluent showed a reduction of TKN at 38% to 57% and at middle and lower ports there was a reduction of 68% to 75%.[14] Specific measurements of ammonium removal also showed similar results. Though reduction at the top of the box was negligible, the lower ports showed an average reduction of 60% and data from a larger rain garden box showed a reduction of 79% at the lower port.[14] Though this study used boxes to mimic rain gardens, other studies have measured rain gardens in the field. Unfortunately, study on rain gardens has not been a widely researched topic. The U.S. geological Survey (USGS) conducted a study during 2002-04 to address this lack of information. Surface and subsurface water was measured in five rain gardens in the Minneapolis-St. Paul metropolitan area to evaluate their effect on water quality. The rain gardens measured were recently constructed, however, so additional research on mature rain gardens may have differing hydrologic characteristics and results. The study found that suspended solids, including nutrients, were measured at much lower levels in outflow as compared to inflow.[17] Size and design of the rain gardens was found to be a very important aspect of their effectiveness at reducing overflow and proper infiltration of runoff. Differing soil properties was found to be a contributing factor to rain garden effectiveness. Clay soils caused more water to flow over the rain gardens whereas sandy or gravelly soils encouraged infiltration.[17] Other important factors contributing to effectiveness included contributing drainage area, frequency and duration of storm events, capacity to store runoff and increase

infiltration before overflow occurs, vegetation type, and materials used in the construction of the base of the rain garden. The study found quite a bit of variability from some of the measured rain gardens but were still able to make some conclusions based on the average results. There was a general reduction of chlorine and nitrite plus nitrate nitrogen concentrations compared to background conditions in one of the rain gardens. There were no consistent trends for changes of phosphorus concentrations in surface water, but they did find that concentrations were generally lower in the overflow as compared to the inflow.[17] Overall, the study found that there was some reduction of certain contaminants but there was also high variability between rain gardens. Additionally, the rain gardens that were studied were recently constructed. Further study on rain gardens as they mature may shed some light on long term benefits of rain garden use. It is clear based on several studies regarding rain gardens that a common factor affecting infiltration is the construction. If the original soil type is appropriate, and the design and construction are adequate for the chosen area, a rain garden has the potential to mimic a natural wetland; allowing added infiltration and possible filtration of numerous contaminants.

RISING TEMPERATURE OF OUR WATERS

Many kinds of green spaces filter out contaminants, but rain gardens have the added benefit of stormwater *retention*. The capacity of a rain garden to hold water for a short time allows infiltration, but also has another added benefit—slowing down water transport and bypassing impervious surfaces. Impervious surfaces, especially dark colored ones such as pavement, absorb and reflect heat from the sun. In warmer times of the year, areas near

impervious surfaces can have an air temperature 10 to 12 degrees warmer than the original green spaces they replaced. Further, the addition of impervious surfaces may have resulted in a removal of tree cover – an important source of shade, cooling, and protection from solar radiation.[8] These increased water temperatures can have several negative effects on aquatic ecosystem processes like biological productivity, stream metabolism, contaminant toxicity, and the loss of aquatic biodiversity.[18] Like the level of pollutants found in waterways, temperature rise in surface waters is also directly related to the imperviousness of the contributing watershed. A six month study of 5 different streams with different levels of impervious cover had average temperatures that were higher than a forested reference stream. The temperature increase of the streams were directly related to the size of the impervious areas in the source watersheds. In fact - the study found that the main contributing factor to stream warming was the imperviousness of the watershed area. Additionally, the temperature was impacted by a lack of plant and tree cover over water; raising temperatures further.[8]

EFFECTS ON BIODIVERSITY

The study of aquatic insects can be very telling of the water quality of a stream, as well as shed some light on the overall environmental health of the ecosystem and its' biodiversity. Aquatic insects are also at the base of the food chain; many species rely on these insects for survival. Several studies have shown a correlation between impervious surfaces and impaired aquatic biodiversity. In one study of 23 sampling stations located in headwater streams in the Anacostia watershed in Maryland, diversity was rated as good to fair in streams with less than 10% impervious cover. However in almost all of the sampling stations with impervious cover

over 12%, poor diversity was noted.[8, 19] In another study of streams in the coastal plain and piedmont of Delaware, macroinvertebrate diversity was measured. Macroinvertebrates are animals with no backbone but are visible with the naked eye; they are often studied to assess water quality because they are sensitive to differing chemical and physical conditions. In the study, macroinvertebrate diversity suffered at around 12 to 15% impervious cover.[20] Though in many studies it is difficult to determine the exact correlation between impervious surfaces and biodiversity and at what level the environmental quality becomes "poor", it is safe to conclude that very few, if any, streams can support a healthy diverse aquatic insect community at high levels of impervious cover (around 25% or more).[8] Fish biodiversity also begins to show signs of reduction at higher levels of imperviousness. In one study, four subwatersheds in the Maryland Piedmont were sampled for fish species. As the area of imperviousness increased, the number of fish species dropped. Similar to the biodiversity of aquatic insects, fish also show a higher decrease in biodiversity at a level of 10 to 12% imperviousness – two sensitive species of fish (trout and sculpin) were no longer found in streams at this level. Additionally, at the 20% level of impervious area, four more species were no longer found in the study stream. At 55% imperviousness, only two species of fish remained.[8] Some of these statistics may seem alarming, but it must be noted that many of these studies compared differing levels of development in urban areas to streams and waterways found apart from developed areas. One can assume that there will be some effects on a stream going through an urban environment compared to an undeveloped meadow, for example. Initially, one might think we must keep imperviousness under 10% to improve our waterways, but this is generally not feasible. One method that has been proposed is to classify urban streams based on their already existing impervious cover and

sensitivity, and attempt to manage water quality considering already existing infrastructure.[8] Under this classification system, watersheds with higher levels of imperviousness may still see improvement through minimizing downstream pollutant loads, controlling of bacteria, and removal of stormwater efficiently, by encouraging redevelopment, and increasing greenways.

GREENER SOLUTIONS

Impervious surfaces in urban areas will always exist, though the amount of impervious surface can always be managed and controlled. The choice to include added green space, increased tree cover, and features like rain gardens will only benefit the quality of water running into our lakes and streams. In particular, the implementation of rain gardens is an incredibly efficient use of space creating not only a method for water retention and treatment, but also added biodiversity and aesthetic beauty. Initially, the installation of a rain garden will be more work than a similar sized area of lawn, but maintenance is low after the plants mature. They require some weeding and watering in the first two years, and may require some thinning in later years as plants mature. The dead and dormant plants can be left over winter, but should be cut back in the spring to allow new shoots to emerge.[21] Through careful selection of native plants, rain gardens can act as habitat for birds, butterflies, and other beneficial insects.[5] The addition of grasses, sedges, and rushes with the flowering species create diversity of root growth and depth. These varied types of roots contribute to healthy plant competition which in turn allows the plants to outgrow and out-compete other species such as weeds. When the rain garden has matured with a mixture of flowering plants and deep rooted plants, and the root system has become established, weeds will naturally decline.[5] The listed benefits of rain gardens

such as increased neighborhood insect and plant diversity and added aesthetic beauty are direct and observable, however the unseen benefits of rain gardens are more far-reaching and valuable to the future of our water resources.

III. URBAN GREEN SPACE

THE VALUE OF AN URBAN FOREST

People like trees, flowers, gardens, and birds. In fact, contact with nature may offer benefits beyond the purely aesthetic, as studies have shown improvements to both physical and mental health.[22] A design objective included in the North St. Paul Living Streets Plan is to use vegetation to enhance the urban forest.[2] The U.S. Department of Agriculture defines urban forests as broadly including "urban parks, street trees, landscaped boulevards, public gardens, river and coastal promenades, greenways, river corridors, wetlands, nature preserves, natural areas, shelter belts of trees and working trees at industrial brownfield sites".[23] With street redevelopment comes the opportunity to improve upon the city's natural landscape. The environmental benefits of trees have long been understood - they lower the air temperature and reduce stormwater, they aid in the addition of organic matter to the soil and prevention of erosion, they move water to the groundwater table, and perhaps most importantly, trees filter the air we breathe and produce oxygen.[2] What may come as more of a surprise are the community-wide benefits of adding trees and vegetation to residential and commercial settlements. Trees absorb traffic noise, increase privacy and enhance safety.[24] Tree-lined streets

have been shown to calm traffic, both by reducing the speed of drivers and also reducing the frequency and severity of crashes.[25] In addition, pedestrians, children, and pets are encouraged to stay on walkways and out of harm's way because of the physical and mental barrier street trees and sidewalk gardens create.[24] In one Chicago neighborhood, higher levels of "greenery" even translated to lower levels of crime, including domestic violence.[26] Explanations for this result range from the idea that green spaces are used more frequently and thus increase neighborhood vigilance to the thought that those living in greener surroundings feel a greater sense of community and less mental fatigue - two factors that reduce violent behavior.[26] Finally, unrelated to public health but still of community benefit, data collected on trees and sidewalk gardens were found to increase residential property values in Portland, OR[27] and increase revenues in inner-city shopping districts.[28] The City of North St. Paul additionally suggests lower heating and cooling costs can be achieved with strategically placed trees on residential property.[29] Figure 4 displays some of the attributes of trees.

NEIGHBORHOOD GREENNESS AND HEALTH

Evidence backing the need for neighborhood greenness can be found all over the world. A survey of Seattle, WA residents indicated people living in a neighborhood with more street trees and other plants judged walking distances to be less and therefore were more likely to travel on foot.[30] Increasing the amount of grass, gardens, trees, and plantings throughout a community not only aids in reducing imperviousness but also can be linked to the perceived general health of residents.[31] A 2006 study from the Netherlands discovered proximity to green space proved to be more than just a luxury, and in addition to offering aesthetic beauty, also concluded people

living in a greener environment to have better self-perceived health than those living in a less green environment.[31] A related study conducted in the UK found that moving to greener urban areas was associated with sustained mental health improvements.[32] These data provide valuable insight for city planners, suggesting substantial public health benefits from policies that increase natural green space.[32]

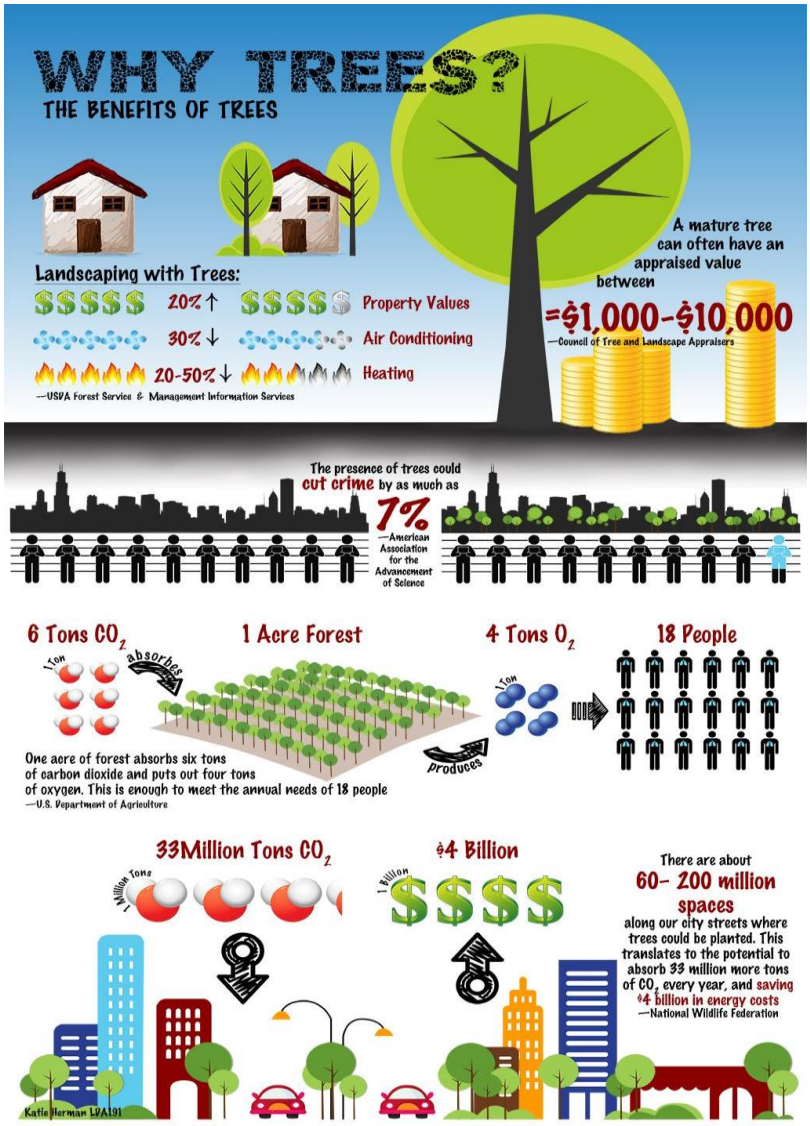

Figure 4 depicts the economic, social, and health benefits of trees. Figure adapted from source [33].

URBAN FORESTRY CHALLENGES

Many factors influence health, ranging from the personal to the societal and environmental. The influence the natural environment has on individuals and communities variable among and within urban areas, but nevertheless is indicative of the important contributions urban forests have on quality of life.[34] While there is some evidence to suggest natural green space can inspire physical activity, the relationship remains a complex one. Simply enhancing a neighborhood with trees, gardens, and plantings doesn't necessarily mean a health benefit will be gained by those surrounding the landscape. A majority of residents need incentives to get outdoors and enjoy these green spaces. Paring community outreach and education initiatives with landscape and infrastructure enhancements may be the best way to emphasize the value physical activity and demonstrate how these living streets elements can benefit everyday life.

Sustaining an attractive, green, urban landscape doesn't come without a commitment to its management and maintenance, however. A broad range of natural and human-caused challenges exist that are said to only be compounded by climate change.[35] Invasive species and diseases have the potential to cause significant damage to urban forests; specifically the pine beetle, gypsy moth, emerald ash borer and the fungi that cause Dutch elm disease and chestnut blight.[35] Similarly, invasive plants are of concern because of their ability to alter the structure of the ecosystem by the removal and replacement of native plants.[35] The health of urban green spaces can also be affected by high rates of pollution. Ozone has been shown to reduce tree growth and increase susceptibility to drought while damage-causing heavy metals and other toxic particles have been found in urban soils.[35] Managing the benefits of an urban forest and its

development requires an understanding of the public health, ecological, and economic values urban green space provides. Fortunately, there are now a myriad of local and national organizations ready and willing to collaborate with our nation's cities on ways to achieve environmental sustainability.

GREENSTEP NSP

Conservation and growth of the urban forest is just one way a city can realize the "green" potential of its streets. In 2012, the City of North St. Paul went a step further by becoming a Minnesota GreenStep City. The GreenStep program is voluntary and free to Minnesota cities, challenging them to achieve specific sustainability and quality-of-life goals based on a compilation of 28 best practices.[36] Completion of action items under the topics of buildings and lighting, land use, transportation, environmental management, and economic and community development earn a city benefits and recognition.[36] Many of these action items directly relate to the objectives of the Living Streets Plan. For example, the City of North St. Paul met an urban forest goal when it was certified as a Tree City USA in April of 2014. In addition to observing Arbor Day, this status requires communities maintain a tree board/department, a tree care ordinance, and a forestry program.[37] The city's rain garden policy is also considered an efficient stormwater management best practice action while its promotion of biking as a mode of transportation earned 2 star-level GreenStep achievement. Expanding on these existing programs and policies would guide the City of North St. Paul down a path towards implementing a more robust Living Streets Plan.

IV. PEDESTRIAN MOVEMENT: SIDEWALKS

PEDESTRIAN SAFETY

An integral part of the North St. Paul Living Streets Plan is to develop and foster complete streets that are pedestrian-friendly and will encourage and promote the well-being of the community. Streets are a valuable piece of the city and should take into consideration the different modes of transportation available, including: motor vehicles, bicyclists, and pedestrians.[38]

According to national data, walking and bicycling represents 11.4% of all trips taken in the United States (10.4 % and 1.0%, respectively) and account for 14.9% of roadway fatalities. However, only 2.1% of federal funding supports improvement projects for pedestrian and bicyclists (Figure 5).[39] Further, 27% of all trips made by pedestrians are children under the age of 16 or over the age of 65 years.[39] Although walking represents a small percentage of all transportation travel, nationwide, there has been an increase in the percentage of individuals choosing to commute by walking.[39] In Minnesota, the percentage of bicycling and walking has increased by 78% and 16%, respectively.[40] The Minnesota Complete Streets Coalition also estimates that approximately 40% of Minnesotans, including children, the elderly, and individuals with a disability, do not drive. Also, within the last 10 years, 20,000 injuries and deaths occurred involving pedestrians and bicyclists in Minnesota.[41] Figure 6 illustrates the walking and bicycling trends from 1990 to 2011. These national and state statistics demonstrates a strong need to address pedestrian movement safety on Minnesota streets and in the City of North St. Paul.

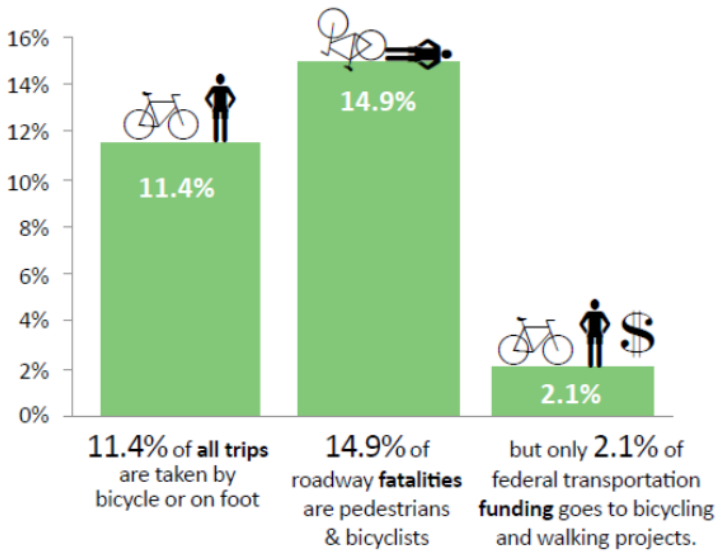

Figure 5 illustrates the percentage of all trips made by walking and bicycling, the percentage of fatalities involving this group and the percent of federal funds allocated for projects. Figure adapted from source [39].

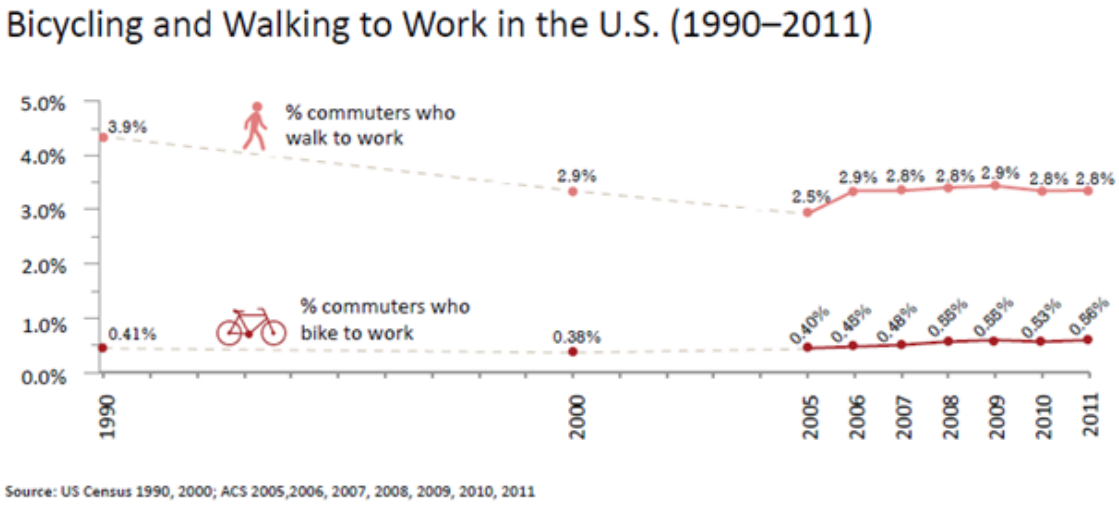

Figure 6 shows the percentage of individuals who commute to work by walking and bicycling. The trend indicates an increase of walking and bicycling within the last few years. Figure adapted from source [39].

WHERE THE SIDEWALK BEGINS

One solution for creating a safe, more pedestrian-friendly environment is through the establishment and maintenance of sidewalks in the community. Similar Living Streets Plans from other cities have noted that trials and sidewalks provide safe routes for non-motor vehicle

transportation, exercise, relaxation or commuting for users of all ages and abilities.[42] Sidewalks provide pedestrians with the ability to safely travel to and from destinations on a paved path that is separate from the road.[43]

According to the Minnesota Department of Transportation (MnDOT) Best Practice Report, sidewalks are a proven safeguard for pedestrian travel and has demonstrated to reduce pedestrian related traffic accidents by as much as 50 to 90%. When considering where sidewalks should be implemented, the MnDOT report recommends sidewalks on arterials and collector roadways. Additionally, sidewalks should be made a priority for streets that serve as connecting points between neighborhoods, schools, and local stores and should also be placed in areas with high traffic volume where shoulders do not exist.[43] Creating a buffer between the walkway and roadway can further enhance the safety of sidewalks. The use of boulevard green space, rain gardens, or tree plantings in this buffer zone allows for additional space between pedestrians and motor vehicles.

PERVIOUS SIDEWALKS

Consideration for pervious concrete, as opposed to standard concrete, to construct sidewalks may also aid in capturing stormwater and reduce the amount of impervious surface. Figure 7 shows the difference in appears between pervious and standard concrete. A drawback to this approach is a limited amount of current data available regarding performance, durability, and maintenance of pervious pavement. In a pilot study of pervious pavement, the City of Bloomington has noted that pervious surfaces required more maintenance compared to traditional pavement. In addition, their preliminary results indicated that surfaces seal off with

use and liquid brine salt leads to erosion. The city has also cited another project in the City of Shoreview indicating that pervious concrete has worked well since implementation (S. Segar, personal communication, January 22, 2014). Currently, it is estimated that the cost of pervious sidewalk is approximately 2.5 to 3 times more expensive than traditional concrete. The higher cost of pervious sidewalks is mainly attributed to the engineering and design required to achieve a porous surface that will be able to infiltrate runoff (M. Thompson, personal communication, April 21, 2014).

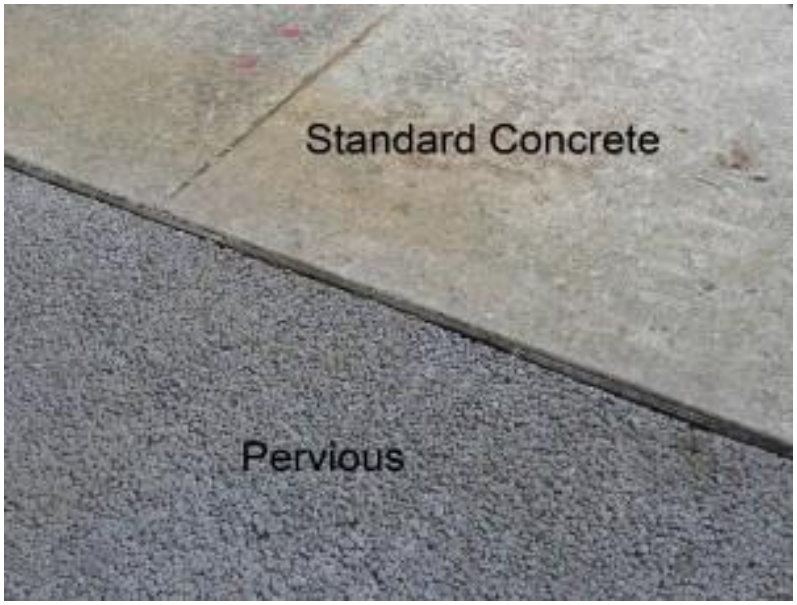

Figure 7 illustrates the aesthetic differences between pervious concrete and standard concrete as a building material option for sidewalks. Figure adapted from source [44].

SAFE ROUTES TO SCHOOL

Over the past several years, there has been a decline in the rate of children walking or bicycling to school. In 2005, it was estimated that only 16% of children were walking or bicycling to school compared to 48% in 1977.[45] A 2011 survey suggests that the lack of sidewalks is one of several barriers that prevent children from walking to school.[46] This suggests that the built

environment is able to influence behavioral choices concerning active travel. Providing the infrastructure to support active travel may aid in encouraging physical activity and provide safe and direct routes to schools for young children. The Safe Routes to School initiative first began during the 1970's in Denmark in response to high rates of pedestrian accidents involving children. The movement progressed through Europe and eventually the United States in the 1990's.[45] Although there are declines in active travel to school, there are growing rates of physical inactivity and obesity among young children. Additionally, walking to school remains one of the most risky modes of transportation for school aged children.[45] The decline in active travel to school and increase in physical inactivity have prompted national and state initiatives to develop programs that will help increase physical activity and provide safe routes to school.

The National Center for Safe Routes to School heads the Safe Routes to School initiative in the United States. In 1998, funds were allocated for a pilot program to begin in Marin County California and Arlington, Massachusetts.[47] Additionally, in 2005, a federal bill was also passed that allocated funds for states to initiate Safe Routes to School Programs. Through this law, it encourages the development of campaigns and infrastructure to increase safety and promote active travel to school.[46] A study evaluating five sidewalk improvement projects for Marin County, California's Safe Routes to School program found that three out of the five sites saw an increase in active travel.[45] The study also found that prior to the sidewalk improvement project, 75% of child pedestrians were observed walking along the shoulder of the roadway. After construction was complete, this number was reduced to 5%.[45] Figure 8 illustrates an example of a sidewalk improvement project for California's Safe Routes to School. The United States Department of Health and Human Services Healthy People 2020 is also encouraging to promote

physical activity through increasing children walking to school. The initiative has set a national goal to increase the proportion of trips of 1 mile or less made to school by walking among children and adolescents aged 5 to 15 years.[48]

Figure 8 demonstrates the before and after results of a sidewalk improvement project as part of California's Safe Routes to School Program. Figure adapted from source [45].

In Minnesota, the Department of Transportation supports a Safe Routes to School program and since 2006, 101 communities have participated in creating a plan for Safe Routes to School.[49] MnDOT provides grant funding for infrastructure and non-infrastructure improvement

project that will provide safe routes for children to use. North St. Paul can work in partnership with the MnDOT Safe Routes to School program to ensure the safety of children walking to school. The city can also positively contribute to the national and state Safe Routes to School initiatives through implementation of pedestrian-friendly streets as outlined in the Living Streets Plan.

SIDEWALK CONCERNS

Sidewalks are an important feature of the North St. Paul Living Streets Plan that can enhance pedestrian movement and benefit overall public health. Often times, residential sidewalks connect a neighborhood to a broader network of trails, increasing access to destinations while at the same time improving the safety of travelling the route. However, planning sidewalk projects in neighborhoods where none exist may be met with apprehension from some residents. Concerns that may arise with the new construction of sidewalks include shoveling in the winter, an increase in crime and invasion of privacy, a reduction in property values, and under-utilization. The City of North St. Paul can alleviate some of the uneasiness through community outreach and educational efforts that focus on the big picture inter-connectedness of the city and its benefits. Highlighted in the Frequently Asked Questions and Concerns section of this report, is a further discussion of responses relating to sidewalk concerns.

V. ACTIVE LIVING

THE CASE FOR AN ACTIVE LIVING APPROACH

Both nationally and internationally, communities around the world are responding to the Active Living movement. A concept deeply rooted in public health, Active Living aims to integrate physical activity into daily life. Community designers, policy officials, transportation planners, and others are supporting a campaign primarily spurred by our nation's obesity epidemic and the serious associated health risks. Over the past few decades, physical activity levels have declined in many developed countries only to give rise to more sedentary lifestyles.[3] Obesity is poised to become the leading health problem in the United States, where 65% of the population was overweight or obese in 2007.[50] Research shows overweight individuals die at as much as 2.5 times the rate of non-obese individuals.[22] Despite facing such grave statistics, only 48% of Americans met the Physical Activity Guidelines in 2008.[51] Obesity rates among children are also cause for serious public health concern. Overweight youth have significant health consequences including increased risk of developing type 2 diabetes, cardiovascular complications and other physical and psychological problems.[52] Additionally, childhood obesity has been shown to lead to obesity as an adult.[53] Our nation's increasing rates of obesity can be seen in Figure 9.[54]

Obesity Trends Among U.S. Adults, CDC Behavioral Risk Factor Surveillance System
(BMI ≥ 30, or about 30 lbs. overweight for a 5' 4" person)

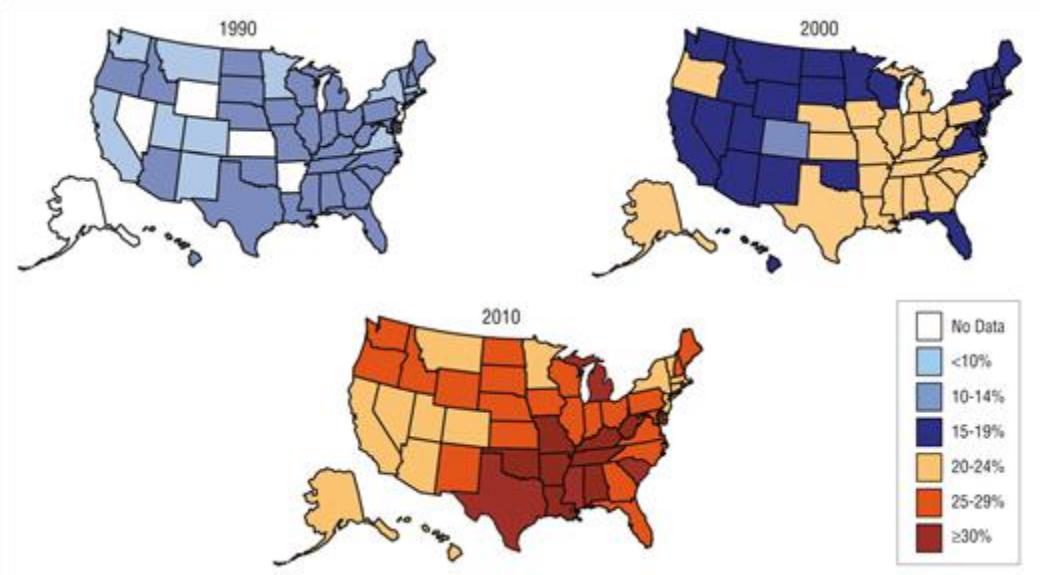

Figure 9. These U.S. maps illustrate the rise in adult obesity during the past three decades. As of 2010, over half the states had rates of obesity at 25% or greater. Figure adapted from source [54].

Physical activity offers numerous health benefits to not only youth, but to people of all ages. With many urban areas due for revitalization, local governments across the country are seizing the moment to couple infrastructure improvements with health promotion. Strategies and interventions to support active lifestyles, improve pedestrian safety, and increase neighborhood connectivity are at the forefront of the Active Living approach. Beyond its health benefits, Active Living offers synergies in relation to other municipal objectives.[55] With street reconstruction projects on the horizon, an opportunity exists for the City of North St. Paul to become an Active Living community.

INVESTING IN THE FUTURE

Opportunities for Active Living are valuable to all populations within a community.[56] When neighborhoods are safe, well maintained, and have appealing scenery, children and families are more likely to be active.[57] Research shows that Active Living[58]:

- Improves physical and mental health
- Decreases risk of chronic disease and associated medical costs
- Reduces transportation costs
- Improves air quality
- Builds safer, stronger communities
- Improves quality of life

Unique factors are also associated with physical activity in youth specifically and include access to recreational facilities, schools, destinations, and public transportation; the presence of sidewalks and controlled intersections; the proportion of green space; and also the number of cars.[52] Before residents of North St. Paul can make the commitment to active lifestyles, however, they need the infrastructure to do so. While several factors contribute to physical inactivity, environmental barriers and physical obstacles present avoidable challenges. The percentage of adults who get enough physical activity is 15% higher in neighborhoods that have sidewalks than it is in those that don't.[57] Missing or disjointed sidewalks and unsafe street crossings create physical obstacles to walking and biking.[58] Furthermore, research shows less traffic and the presence of sidewalks in good condition were associated with more walking or biking to school and other destinations.[59] Figure 10 illustrates this and other Active Living statistics.[60] Increasing the connectivity of a community also has its health benefits. Residents of mixed-land-use (residential and commercial) or high-density neighborhoods were likely to be more active because of opportunities to walk to destinations.[59]

Figure 10. This infographic highlights several studies reporting positive health gains following enhancements to infrastructure and promotion of the Active Living concept. Figure adapted from source [60].

BENEFITS OF A WALKABLE COMMUNITY

It is estimated that 50% of all trips in the United States are three miles or less and 25% of trips are less than a mile away from the origin, yet approximately 70% of those trip are made by a motor vehicle.[39] By connecting more people to places, communities can reduce the need to

depend on a motor vehicle for these short trips. Street connectivity and a walkable community allow residents easier access to the community. Unnecessarily long routes between destinations may discourage individuals from walking, therefore, providing direct and shorter routes may increase and encourage walking behavior.[61, 62] In addition, studies have suggested that street connectivity increases activity levels and also fosters a sense of community that allows for more interactions between citizens. When neighbors have an opportunity to interact more frequently with one another, it promotes trust which translates to increased community engagement and involvement.[63, 64] Results from a survey study in Galway, Ireland indicated that individuals living in more walkable neighborhoods were more likely to know other citizens in their community, engage in social events, and participate more frequently in political issues compare to individuals living in a car-dependent neighborhood.[64]

Other benefits of a walkable community may include the potential to influence physical activity[65] by creating a built environment that provides easy accessibility to community amenities such as parks, trails, and local stores. Studies have indicated that individuals walk more when their neighborhoods are more walkable and have more sidewalks.[66] When active modes of transportation are made more readily available, our dependence on motor vehicles is minimized[67] which in turn can reduce energy consumption.[61] Alternatives to driving also limit

10 THINGS YOUR CITY CAN DO TO PROMOTE ACTIVE LIVING
1. Join Let's Move Cities and Towns, a campaign to engage municipal leaders to help end childhood obesity.
2. Adopt a Complete Streets policy, ensuring access and connectivity to multimodal transportation for all users.
3. Convert vacant or paved lots into playgrounds, parks or community gardens.
4. Form partnerships with local schools to develop Safe Routes to School programs and/or joint-use agreements for community access to recreational facilities.
5. Conduct an inventory of parks, open space, vacant land, sidewalks and recreational facilities; engage residents and area stakeholders to identify needs and opportunities to create, expand or enhance these areas.
6. Create a welcoming, safe, and attractive environment — beautify streets, parks, and trails by ensuring adequate tree canopy, lighting, attractive landscaping, art, benches and safety features.
7. Implement appropriate and attractive traffic-calming design features.
8. Create policy to evaluate the health impacts of all new development.
9. Support community programming such as festivals, charity walks/runs and entertainment in parks.
10. Develop public education campaigns to encourage active living.

Figure 11. Recommendations for Active Living promotion from the National League of Cities. Figure adapted from source Zborel, T., & Rozsa, S. (2011). Healthy people, healthy places – building sustainable communities through active living. National League of Cities Municipal Action Guide.

carbon emissions that contribute to climate change, improve air quality, and preserves the natural environment.[41, 67]

ACTIVE LIVING RAMSEY COMMUNITIES

In 2004, with stakeholder support, Active Living Ramsey Communities was created in partnership with cities, governmental organizations and community groups to "create and promote environments that make it safe, accessible, and efficient for everyone to integrate physical activity into their daily lives".[68] The vision of this approach aligns with many of the objectives within the North St. Paul Living Streets Plan, including an effort to bring about changes in design, transportation, and policies to encourage and support active living. In addition to offering bike and walking maps and an interactive healthy lifestyles tool on its website, the coalition also provides opportunities for involvement and advocacy. Ramsey County is spearheading the Active Living movement in the northeast metro area. Figure 11 is a list of what North St. Paul and other cities around the country should consider in order to foster active lifestyles among their residents.

VI. LIVING STREETS STORIES

METRO AREA LIVING STREETS POLICIES

A new trend is taking shape in cities around Minnesota. As infrastructure ages and deteriorates, Living Streets, Complete Streets, and Green Streets policies are being written that will reinvent our roadways. The City of Edina, Minnesota has written and passed a policy in 2013 that not only speaks to the vision and principles of Living Streets, but also supports other community goals like the City's 2008 Comprehensive Plan and the City's Storm Water Pollution Prevention Plan. Currently, a plan is being developed that will: meet the needs of all users and all modes of transportation, provide interconnected street and sidewalk networks, keep street pavement widths to a minimum, incorporate streetscape ecosystems, and educate and engage residents and stakeholders.[69] Similar to the North St. Paul Living Streets Plan, a commitment to stormwater management and support for active lifestyles will also be highlighted in Edina's version. The plan is anticipated to be complete by the end of 2014 (M. Nolan, personal communication, April 8, 2014).

The City of Maplewood, Minnesota has been a leader in metro area rain garden programs for nearly two decades. This dedication to stormwater management is prominent in the City's Living Streets Policy, adopted in 2013. Since 1996, over 700 home and 60 city rain gardens have been installed in conjunction with street reconstruction projects.[42] This program is voluntary for residents and supported through an Environmental Utility Fund fee collected quarterly from both commercial and residential properties.[42] Participation and compliance earn property owners a credit towards this fee. This is just one such approach towards sustainable

community development accented in a more comprehensive Living Streets Policy. The City of Maplewood will also be using this policy to "…enhance biking and walking conditions, enhance the safety and security of streets, calm traffic, create livable neighborhoods, enhance the urban forest, reduce life cycle costs, and improve neighborhood aesthetics".[42] Implementation of these goals will be proposed on a project-by-project basis (S. Love, personal communication, April 21, 2014).

GREEN STREETS FOR BLUE WATERS

Maplewood is not the only municipality in the Twin Cities with a successful rain garden program. Hoping to set its own precedent, the City of Bloomington is demonstrating how communities can implement stormwater remediation in their neighborhoods through the Green Streets for Blue Waters program. Partially funded by the state's Clean Water Land and Legacy Amendment, this project was created to address the impaired Minnesota River – the most polluted body of water in the state.[70] The river's low dissolved oxygen designation stems from an overabundance of phosphorus entering the river system. Excess phosphorus from yards, agricultural sites, and impervious surfaces lead to unnatural blooms of algae and other aquatic plants, which can be harmful to human health.

Bloomington is installing curb-cut rain gardens and pervious pavement on public rights-of-way and private land in order to infiltrate and naturally clean stormwater. Thus far, approximately 50 rain gardens have been planted since the program's inception in 2009 (S. Segar, personal communication, January 22, 2014). Following an initial soil assessment, participants are recruited on a voluntary basis where they then work with the city to plan and

construct their rain garden. This project is expected to capture 1.5 tons/year of sediment, 15 pounds/year of phosphorus, and 18 ac-ft/year of stormwater volume generated by nearby residential areas.[70]

MINNESOTA'S COMPLETE STREETS CITIES

Before a street can become "living" it must be "complete". While not as all-encompassing as a Living Streets Policy, becoming a Complete Streets city means that streets are "planned to be safe and accessible for pedestrians, transit riders, bicyclists, and drivers – all users, regardless of age or ability".[71] As part of a national coalition, the Minnesota chapter claims more than 25 participating cities, with many more likely to move resolutions following the passage of the state Complete Streets legislation in 2010. MnDOT is tasked with overseeing the planning and implementation of our state's transportation projects, ensuring the principles of Complete Streets be considered during all phases of development. The benefits of a Complete Street are numerous, some of which include enhancements to safety, accessibility, health, equity, and community building.[71] Similar benefits have been shown in this assessment of the North St. Paul Living Streets Plan, further proving that regardless of the type of street redevelopment proposal, cities can anticipate a positive impact following implementation.

VII. CONCLUSIONS AND PUBLIC HEALTH RECOMMENDATIONS

The North St. Paul Living Streets Plan has thoughtfully addressed solutions relating to stormwater management, pedestrian movement, and active living. The research behind this public health assessment has indicated that the benefit of rain gardens and pervious surfaces, urban green space, sidewalks, and active lifestyles could advance the population health of the North St. Paul community. However, while this assessment highlighted important public health issues, addressing citizen concerns and continued engagement with the community should be strengthen in order to better gain support for the plan.

Based on our literature review and analysis of the North St. Paul Living Streets Plan, our team recommends rain gardens as a beneficial, cost-effective mechanism in capturing stormwater run-off, reducing localized flooding, and increasing water infiltration. Other added benefits of rain gardens include aesthetic beauty, the increase of biodiversity, and the ability to limit pollution of near-by lakes. Based on our findings, we also recommend enhancements to the urban green space of North St. Paul, the implementation of sidewalks for safe pedestrian movement, and the endorsement of an Active Living approach to municipal redevelopment. Overall, our research suggests the execution of the Living Streets Plan will advance the livability of the community. With the adoption of the Living Streets Plan, the City North St. Paul will positively move forward as a leading example of an urban ecosystem that fosters a sustainable environment.

VIII. FURTHER WORK AND STUDIES

Further work and studies are needed to address additional public health concerns that were not explored in this assessment. We recommend the following for further analysis:

- An in depth cost and benefit analysis of pervious surfaces for roads, sidewalks, and parking lots as a best-management practice to reduce municipal imperviousness
- Maximizing effectiveness of road salt application without overuse and its possible alternatives
- The use of high phosphorus and nitrogen fertilizers and the effectiveness of limiting their use in urban environments
- The long term effectiveness of rain garden soil treatments
- Long-term benefits of rain gardens, to include studies on rain gardens as they mature
- The influence of active transportation on energy consumption
- Addition or enhancement of marked pedestrian crosswalks
- The long-term sustainability of a newly developed urban forest

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FREQUENTLY ASKED QUESTIONS (FAQ) AND CONCERNS

Will my rainwater garden become a mosquito breeding ground?

No, mosquitoes need pooled standing water for 3-7 days to complete their entire life cycle from egg to larva to an adult flying insect, and rainwater gardens should infiltrate within 24-48 hrs.

Will my rainwater garden plug up over time?

No, in fact as plants become more established, the plant roots open up pores in the soil increasing infiltration performance. If installed, a sediment trap should catch most of the sediment, but remove any that may get by.

What kind of maintenance is required for a rain garden?

Initially, the installation of a rain garden will be more work than a similar sized area of lawn, but maintenance is low after the plants mature. They require some weeding and watering in the first two years, and may require some thinning in later years as plants mature.

Will I have to water during a drought?

Maybe. During initial establishment the plants will need water and during severe drought they may need to be watered as well. Choosing native plants will increase their chance of success and be lower maintenance. In addition, you can place plants tolerant of wet or moist soils in lower parts of the garden, and plants that like drier soils towards the edge.

Will the pollutants in the stormwater contaminate my plants and ground?

No, the majority of research on this topic has found that pollutants such as fertilizers, oils, metals, etc. from stormwater runoff is filtered out in the mulch, compost, organic matter and soils of rain gardens and ultimately is biodegraded by microorganisms in the soil, particularly near the root-zones of the plants.

A lot of water pools up in a spot in my yard, is this a good place for a rain garden?

Probably not. Rain gardens should drain after 24 hours; a location in a lawn that does not drain may indicate poor soils (high in clay), a high water table, or a poor slope. It may be possible to install a rain garden but there may be a lot more work involved for these areas.

Who is responsible for all of these new trees?

The City of North St. Paul forestry staff provides on-going maintenance of trees located on public property.

Will trees need to be cut down in order to accommodate sidewalks?

No. To avoid the removal of trees, sidewalks can be built to curve around them.

Sidewalks are an invasion of privacy.

Sidewalks are meant to provide safe passage for pedestrians that is separate from the road. Sidewalks will be built on public right-of-ways and can help promote neighborliness.

Sidewalks will promote and attract crimes.

Currently, there is no research literature to suggest that sidewalks increase crimes. According to the U.S. Federal Highway Administration, sidewalks allow for more pedestrian activity and therefore more "eyes on the streets". This may help reduce street crimes.

I do not want to be responsible for shoveling the sidewalk in the winter.

The City of North St. Paul could choose to create a city ordinance stating that residents are not required to shovel sidewalks during the winter. Similar policies have been put in place in near-by cities. It is ultimately up to the city to decide city ordinances, however citizens could encourage the city to implement such policy.

I do not want sidewalks in my neighborhood because no one will use them.

Sidewalks offer pedestrians a safe space to travel that is separate from the roadway. To encourage residents, the City of North St. Paul may have to couple this new infrastructure with a community health promotion initiative or a sidewalk campaign event to maximize the use of new sidewalks.

What will happen to the property value of homes with the added sidewalks?

According to the Federal Highway Administration, a walkable neighborhood generally has a higher property value because it is more desirable to live in neighborhoods where there are safe routes to near-by destinations.

What is Active Living?

Active Living is an approach to community design that encourages and integrates physical activity into daily life.

How is public health connected to the way communities are built?

Multiple public health concerns, including obesity and pedestrian safety, can be addressed through thoughtful community design. Mixed-use development that is walkable, accessible, connected, and convenient will provide incentives for physical activity and safe, active transportation.