

Transportation and mode shifting of Northfield, MN: promoting and growing a network for active transportation to schools as part of implementing a climate action plan

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I. Executive Summary

Increasing amounts of carbon dioxide and other greenhouse gases leak into the atmosphere each year due to increase use of diesel-based vehicles. This overuse of transportation, specifically from personal cars, comes from the convenience and agency they provide as towns increasingly expand and become disjointed. Because of this, towns such as Northfield, MN can influence these poor transportation behaviors with sprawlike town layouts and unconnected neighborhoods, specifically with regards to an increase in car and bus use to and from schools. Consequently, increased vehicle usages increase traffic and dangerous conditions for students to get to and from school also reducing likelihood of residents taking up healthier more sustainable walking and biking methods.

In moving towards creating an environmentally-friendly town, Northfield is taking steps to locate, evaluate, and remove any inhibitors by creating a Climate Action Plan. Other municipalities have too created action plans and some have successfully accomplished their transportation goals in increasing biking and walking. To aid in the creation of Northfield's Climate Action Plan, we focus on transportation demand and mode-shifting at Northfield's public schools to address concerns of environmental hazard, health, and safety. We argue for schools to implementate policies and programs that promote active transportation to schools, and we ask the City to return to past infrastructure updates at schools and evaluate their effectiveness before moving forward.

II. Introduction

The impacts of climate change are instrumental and continuing to worsen with the increase of greenhouse gas (GHG) emissions in the atmosphere. The largest culprit for the GHG

emission from the United States comes from transportation.¹ Overuse of cars for personal convenience combined with freight vehicles for material transportation greatly impact CO₂ levels and further climate change effects.² This in mind, the best way to counter this trend is to diverge from social norms of taking motorized transportation and commit to more environmentally friendly and socially considerate alternative modes of transportation. Active transportation encompasses all forms of nonmotorized transportation including biking and walking, as a substitute from the traditional motorized forms of transportation. This shift away from car based dependence results in decreased emissions of environmentally and physically harmful greenhouse gases. Carbon dioxide, nitrous oxide, and other GHGs are emitted from combustion-based car engines and are released into the atmosphere through vehicle exhausts.^{3 4}

Individual communities such as Northfield can aid in reconstructing transportation norms. More specifically, reconstructing transportation norms in Northfield can be facilitated by eliminating current barriers such as alleviating safety concerns among parents, increasing the connectivity of neighborhoods to each school, and implementing long-term active transportation promotional programs.

Children who begin walking and biking to school at a young age are more likely to maintaining an active lifestyle as they age while those who are overweight have a greater chance of being obese.⁵ Active transportation is not only a way to reduce GHG emissions, but is also a means of exercise and has been shown to decrease the risk of obesity related health problems.^{5 6}

¹ "Sources of Greenhouse Gas Emissions." EPA. April 11, 2018.

² "Sources of Greenhouse Gas Emissions: Transportation Sector Emissions." EPA. April 11, 2018.

³ How Much Carbon Dioxide Is Produced from Burning Gasoline and Diesel Fuel? - FAQ - U.S. Energy Information Administration (EIA).

⁴ "Basic Information about NO₂." EPA. September 08, 2016.

⁵ Mueller, Natalie, David Rojas-Rueda, Tom Cole-Hunter, Audrey De Nazelle, Evi Dons, Regine Gerike, Thomas Götschi, Luc Int Panis, Sonja Kahlmeier, and Mark Nieuwenhuijsen. "Health Impact Assessment of Active Transportation: A Systematic Review." *Preventive Medicine* 76 (2015): 103-14.

Moreover, families who switch to non-motorized forms of transporting their children to school can also see economic benefits stemming from reductions in gas based spending and car maintenance.⁷

In this paper we will analyze policies that both Northfield and other municipalities have taken in order to address the gaps in Northfield's implementation of Northfield's climate action plan. From these gaps we will create recommendations to further the steps Northfield can take to facilitate alternative transportation to and from the public schools as a means of reducing greenhouse gas emissions in the wake of climate change.

Based off of other municipalities, the strongest approach to increase the effectiveness of active transportation is through Safe Routes to School Act, and active transportation to school initiatives (ATS) which aid in promoting long term walking and biking to school. The Safe Routes to School Act aims to reverse childhood obesity and inactivity while subsequently reduces community traffic and increase air quality. ACT initiatives contain six policies aiding in active transportation, four of which would be beneficial to Northfield and will be explained in depth later in the paper.

Analyzing transportation mode shifts from a narrow section of Northfield before applying recommendations to the broader community aids in more accurate and beneficial guidance. Furthermore, from our analysis of what Northfield has done to implement and aid active transportation, we have found that no follow ups have been conducted to determine their degree of impact on increasing alternative modes of transportation. For this reason Northfield's next step should be to conduct studies on the effectiveness of previous implementations before

⁶ Lavizzo-Mourey, Risa, and J. Michael McGinnis. "Making the Case for Active Living Communities." *American Journal of Public Health* 93, no. 9 (September 2003): 1386-388.

⁷ "Economic Benefits of Biking and Walking." Pedestrian and Bicycle Information Center.

continuing to make more changes. This in return will promote the most beneficial allocation of Northfield's resources.

III. Topic Importance

A. Overview of Greenhouse Gases (GHGs)

In 2016, the United States of America produced 5,795 million metric tons of unsequestered greenhouse gases.⁸ The emissions of these GHGs were broken down by the Environmental Protection Agency (EPA) to their economic sector source. This breakdown showed the two largest contributors of GHGs were transportation, making up 28.5% (1,651 million metric tons) of GHG contributions, and electricity, making up 28.4%⁹ (1,645million metric tons), both of which are increases from the previous 2010 emissions study.¹⁰ Focusing on transportation, the majority of greenhouse gases (1,504 million metric tons) emitted by this sector was carbon dioxide.¹¹

The carbon dioxide emitted into the atmosphere is produced by the combustion of diesel-based fuels⁴. Specifically within the transportation sector, the biggest culprits for the emission of CO₂ “include passenger cars and light-duty trucks, including sport utility vehicles, pickup trucks, and minivans.”¹² Although this is viewed from a national level, individual towns such as Northfield are not exempt from these trends. Cutting back on diesel

⁸ "Inventory of U.S. Greenhouse Gas Emissions and Sinks," EPA, April 16, 2018.

⁹ "Sources of Greenhouse Gas Emissions." EPA. April 11, 2018. *The Industrial sector produced 22% (1,275 mil mt) of GHGs, Commercial/ Residential responsible for 11% (637 mil mt) of 2016's 5,795 million metric tons of gases and the smallest economic sector contributor was Agriculture at 9% (521.5 mil mt).*

¹⁰ "Transportation ." National Climate Assessment. 2014.

¹¹ "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." How Much Carbon Dioxide Is Produced from Burning Gasoline and Diesel Fuel? - FAQ - U.S. Energy Information Administration (EIA).

¹² "Sources of Greenhouse Gas Emissions: Transportation Sector Emissions." EPA. April 11, 2018.

based transportation in towns by getting drivers to switch to walking, biking, and other alternative forms of transportation can significantly lower GHG emissions.

B. Social, economic, and other benefits of school based active transportation

Within Northfield, factors such as the town's layout and infrastructural issues such as traffic congestion and sidewalk gaps contribute to the increasing use of car-based transportation. More specifically, Northfield residents with children increase their car usage by dropping off and picking up their kids to and from school each day. This, combined with the practice of idling with the engine on while waiting in drop-off and pick-up lines, emits unnecessary amounts of carbon dioxide and nitrous oxide into the atmosphere. N₂O in particular is noted by the EPA to cause both long and short term respiratory problems, especially with children.¹³ Reducing car emissions and car use through active transportation to and from schools can lower the health risks associated with inhaling these gases through car exhaust. Nonmotorized transportation to schools has shown to reduce cardiovascular disease reducing family health care costs and promotes a happier life for those who participate.¹⁴

Additionally, within Northfield, a reduction in car use as the main form of transportation can also save families money. If an average student living 1 mile from school walked or cycled to and from school instead of using a car, their family could save 35.5 gallons of fuel per school year.¹⁵ At current gas prices, each family would save \$101 a year on gas. This value, of course, would increase the further the distance from the school, as both the middle and high schools service the entirety of Northfield and some of the surrounding towns.

¹³ "Basic Information about NO₂." EPA. September 08, 2016.

¹⁴ "Health Benefits of Biking and Walking." Pedestrian and Bicycle Information Center.

¹⁵ Hugh, Brent. "Walk/ Bike to School Savings Calculator." Missouri Bicycle and Pedestrian Federation. October 3, 2013.

Infrastructure changes which increase the use of active transportation to Northfield schools can also have a positive effect on the rest of the community. A study conducted by the National Association of Realtors found that six in ten homebuyers prioritize communities and neighborhoods within walking distance to schools over spread out areas with less opportunities for walking.¹⁶ By insuring easier movement between schools, Northfield can further increase its appeal to new homebuyers and improve the neighborhood quality for existing residents.

While this paper focuses on implementing active transportation on a school level, many of the health and economic benefits families with students would experience through active transportation can be applied to areas of the community that share, or are in, proximity to school facilities. Implementations that increase walking and biking such as sidewalks, bike lanes, and crossing signs and guards are public and would have effects on any potential user, student or otherwise. This is especially the case for Northfield's high school, as it is situated next to the community center and the senior center. Similarly, Greenvale Elementary is near a retirement community and its residents will likely benefit from the resulting increase in feasibility of walking throughout the neighborhood.

Furthering this point, changes that prove effective are easily adaptable to areas of Northfield not in proximity to the public schools. Some inhibitors of active transportation found in the vicinity of the public schools may be similar to inhibitors found in other parts of the community. Focusing small scale at the school level first allows for specific practices to be tested and then analysed. Once these changes are found to counter impediments to nonmotorized transportation to schools, the solutions can then be applied to the greater Northfield area.

¹⁶ Litman, Todd. "Quantifying the Benefits of Nonmotorized Transportation for Achieving Mobility Management Objectives." Victoria Transport Policy Institute. March 28, 2010. pp 8.

C. Northfield Layout Affects Carbon Emissions

The city of Northfield is an old town situated in Rice County, a rural farm county of south central Minnesota. There are no mountains, large bodies of water, or other natural barriers to restrict the growth of the town, so it is essentially free to expand in all directions. It is also the home of two private liberal arts colleges. These various factors contribute to the sprawling feel of modern Northfield.

Currently, the residential housing in Northfield near the downtown is limited and expensive. The average value of a single family home in Northfield is \$186k, which is more than both the State and national averages, and much higher than that of surrounding communities (Nearby towns of Dundas and Faribault average home values \$160k and \$135k, respectively).¹⁷ As a result of the cost of housing near the downtown area, Northfield's population is expanding to outlying areas of town and in a rather haphazard manner. Subdivisions are springing up in remote areas presumably to take advantage of less expensive real estate prices¹⁸ while allotting new lower maintenance houses.

Northfield's sprawl contributes to the necessity for parents to drive their children to Northfield's only middle school, located in the very south central portion of the town. Due to this, the southern location of Northfield Middle School essentially ensures that as Northfield's population expands, many of the new residents will have continuously longer commutes to get to the middle school. This reality only increases the likelihood that more individual cars will be used in that commute. The negative ecological GHG effects will only increase as a result of suboptimal locations of both schools and new housing developments.

¹⁷ "Rice County, Minnesota." Coldwater, Ohio People.

¹⁸ Mathers, William. "Location Value." Realmarkits. 2013.

The distance to the school is only part of the issue. It is likely that commuting safety is an even more important factor in the effort to encourage walking and biking school commuters.

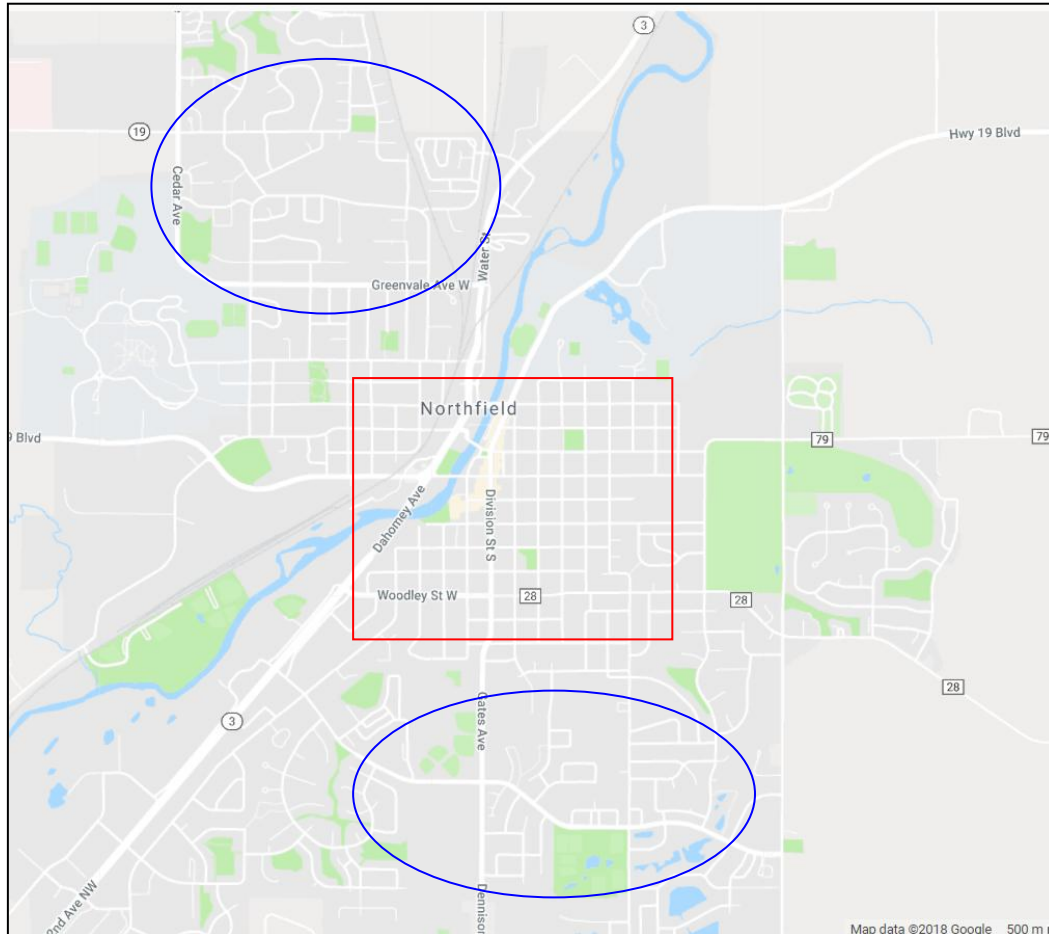


Figure 1. Downtowns gridded layout indicated by the red square compared to the blue ovals of the more sprawling subdivisions influences the amount of people able to participate in active transportation.

D. Community Safety Influence of CO₂ Emissions

The city of Northfield is largely rectangular in shape with an outstretched appendage in the very north of town jutting straight off to the northwest (recall that the middle school is in the south of town). The town is dissected by not only a major river, but also by a rail line and two major highways. The Cannon River dissects the town diagonally running from the southwest

corner through the heart of the town and exiting through the northeast corner. The rail line follows along the north side of the river and also dissects the town diagonally. Highway 19 comes in from the west directly into the center of the town then turns left and exits out through the northeast. Highway 3 comes in from the southwest corner, runs diagonally through the center of town where it briefly joins with Highway 19, then it splits off and turns directly north before exiting north-northeast of town. Being in farm country, large trucks are constantly crisscrossing Northfield on Highways 19 and 3. Additionally, Northfield is home to Post Consumer Brands, which contributes its share of large trucks along with work commuters to the local highway system. With this, the long produce and coal-laden trains that hurtle diagonally through town at random intervals provides a potentially dangerous mix for young school commuters to potentially navigate on their own. For instance, a student that lives on Independence Drive in the relatively new northern subdivision of Northfield would have to walk or bike about two miles straight south, then find their way across the rail line, Highway 3, Highway 19, and the Cannon River before continuing another mile or so south to the middle school. This sort of commute is not only long but extremely dangerous.

It is important to note that creating a safe alternative transportation environment for students is not a new topic to Northfield. In 2008, a comprehensive study of land use and transportation was done in Northfield “to describe the key findings of the current transportation network as to plan for its future management and expansion.”¹⁹ More specific to this analysis, in 2009 a consulting group was brought in to look at the reasons why so few children in the Northfield public school system walk or bike to school. In August of that year they published a report called “Safe Routes To School Plan” for the City of Northfield.²⁰ The analysis in this

¹⁹ "Comprehensive Plan: Transportation." City of Northfield Minnesota. Dec. 17, 2008. pp 7.1.

²⁰ Safe Routes to School Plan City of Northfield. (2009). Northfield: SRF Consulting group, Inc.

study focused mainly on what they describe as “designated walking areas” around the three Northfield elementary schools and the middle school. These walking areas were defined as a circle approximately .75 mile diameter circle around the elementary schools, and a one mile diameter circle around the middle school. The study then looked at impediments to walkers and bikers within those areas. As an example, the assessment of Greenvale Park Elementary School the noted a high volume of car traffic along Greenvale Avenue, a road south of the school that wraps around two sides of the school. As a result, this analysis found that crossing guards are needed for at least two Greenvale Avenue intersections. The study also found that areas near the school lacked enough “continuous” sidewalks.

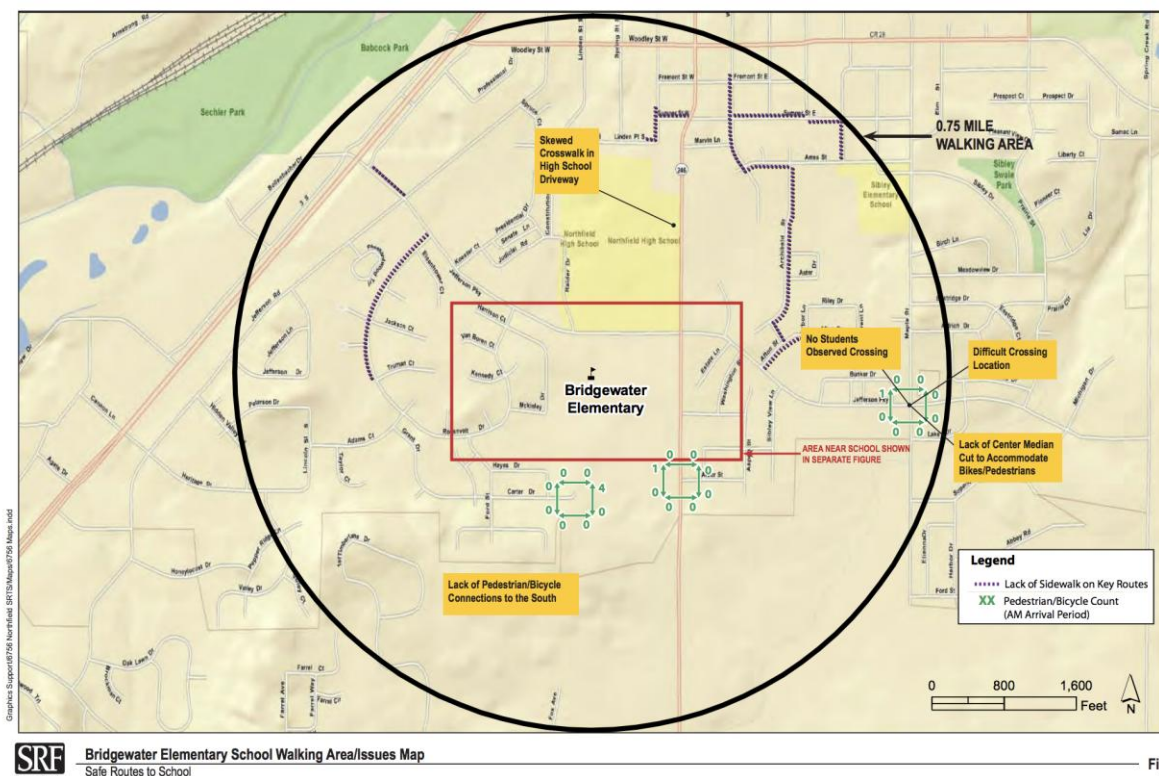


Figure 2. Safe Routes to School assessment of Bridgewater Elementary in Northfield, MN. The assessment evaluates accessibility of the school within a 0.75 mile radius. Sidewalk gaps are indicated by purple dots, green boxes indicate problematic crossing areas with specifics expressed in yellow boxes.

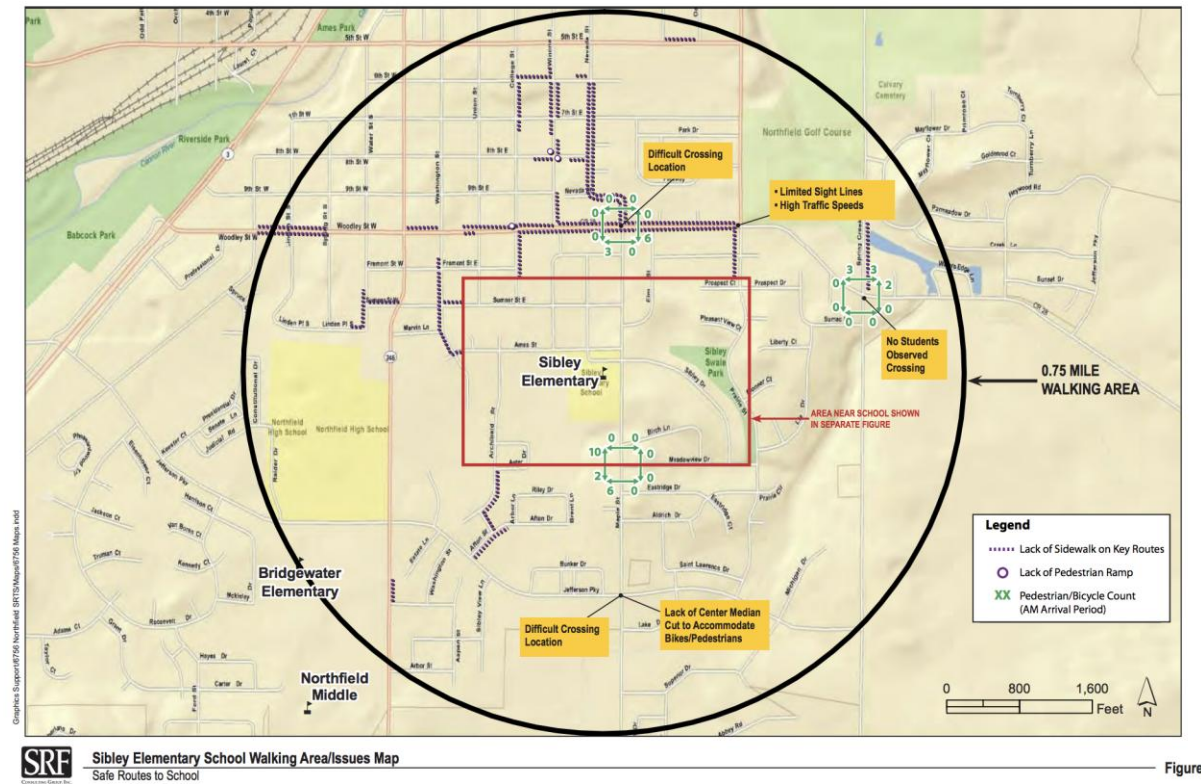


Figure 3. Safe Routes to School assessment of Sibley Elementary in Northfield, MN. The assessment evaluates accessibility of the school within a 0.75 mile radius. Sidewalk gaps are indicated by purple dots, green boxes indicate problematic crossing areas with specifics expressed in yellow boxes.

The scope of this study was largely focused on these walking areas. And in the case of at least two of the elementary schools, the limited scope was largely sufficient. The draw from these schools would have been largely contained within that walking area, so proposals to alleviate safety concerns inside the .75 mile diameter circle could be seen to encourage an increase in walking and biking student commuters. However, as previously noted, Northfield has only one middle school serving the entire city and parts of neighboring towns. At the time of this study, Northfield alone encompassed an area of approximately 4,100 acres (just under 8 square miles). A 1-mile diameter area of study around the middle school would be largely insufficient to impact the majority of the student commuters. At best, it would have a fractional effect on the goal of reducing the negative ecological impact of the middle school commuting

community. In addition, as Betsey Buckheit noted in her November 2015 article titled “Small Town, Big Picture... Still Not a Safe Route To School”, Northfield’s largest elementary school, Bridgewater Elementary, is directly connected to the high school and middle school campuses. Beyond the relatively large draw of Bridgewater, it also has to contend with traffic from the middle and high schools. As Buckheit says, “All of our public school children grade 6 and above + our largest elementary school will now attend school in the same area.... we have the safety of hundreds of our children to consider as we try to also manage the vastly increased [vehicle] traffic through the area...”²¹ With this in mind, what are the remaining options for student commuters?

Cars are widely regarded as the most convenient form of transportation and as a result of this convenience, have become the most ecologically disastrous form of transportation. This is not because a car expels more CO₂ or other GHGs than buses or trains, but because of a car’s pollution per person per mile. Consider a car with just 2 occupants driving the 4 mile round trip to Northfield Middle School 5 days a week, every week for the 9 month school year. According to the EPA, if that car averages 22 miles per gallon, then that one car, commuting one child, would release .29 metric tons of CO₂ into the atmosphere each school year.²² Multiply that level of emissions by the approximately 1,200 elementary schoolers attending Northfield elementary schools, and the nearly 1,000 middle and the 1,250 high schoolers, it results in approximately 1,000 metric tons of CO₂ released into the Northfield atmosphere every school year just by car-commuting students. That number doesn’t even count methane and nitrous oxide also released through the combustion of fossil fuels in gasoline, which are both considered by the EPA to have

²¹ Buckheit, Betsey. "Still Not a Safe Route to School." Small Town, Big Picture. November 18, 2015.

²² "Greenhouse Gas Emissions from a Typical Passenger Vehicle." EPA. May 10, 2018.

an even higher global warming potential (GWP) than CO₂.²³ With its excessive addition of GHGs into the atmosphere, car traffic is incredibly damaging for the environment. But given the obstacles to foot or bike commuting already discussed, are there better options? How about buses?

1. *Busing Alternatives*

According to the American School Bus Council, the average school bus replaces approximately 36 passenger cars on the daily commute to school.²⁴ With an average 7 miles per gallon (mpg), the math would suggest an 11 fold decrease in GHG (approximately 1/3 the fuel economy versus a car, but only 97 buses per day verse 3500 cars). However, there are some significant assumptions in this calculation that materially skew this comparison. First is the assumption that buses have the same emission per gallon as cars. Buses, which typically use diesel gas, emit approximately 10% more CO₂ per gallon than cars do.²⁵ Even more significantly, the math suggests that each bus would have the same four mile round trip that the average car in our calculation has. Due to the layout of the town, a bus would likely have to travel many miles winding through streets and neighborhoods, stopping and starting frequently (reducing mpg) in order to load up the average of 36 children before it begins its trip to school. Then, after school the bus would have to repeat the circuitous trip to offload their commuters. Because of this, the average bus's mileage per day would dwarf that of the average car while at the same time incurring reduced mpg from frequent stops and starts and emitting more GHG per gallon than cars. The cumulative effect of this would be a

²³ "Understanding Global Warming Potentials." EPA. February 14, 2017.

²⁴ "Environmental Benefits." American School Bus Council.

²⁵ 19.5 http://www.urop.uci.edu/journal/journal11/03_naviaux.pdf.

partial - if not significant - offset to the apparent ecological efficiency of transporting by bus verse by car. As previously discussed, Northfield's residential layout only adds to the inefficiency (and mileage) of bus pickup routes. Although buses are better for the environment than cars, they still contribute significantly to the GHG emissions in Northfield.

IV. What Northfield is Doing

A. Summary of Actions

In 2008, the City of Northfield updated their Comprehensive Plan (CP), which outlines long-term plans to manage community growth. The CP had the following vision statement for the City moving forward: "Northfield values its unique heritage as a mill and college town, and will reflect its community identity by preserving its historic and environmental character, and enhancing its quality of place through a progressive and sustainable development pattern."²⁶ The CP then outlines Key Directions for the community that would carry out this vision statement, one of which is "promoting an ethic of sustainability in all city activities."²⁷ In accordance with this, the City set the following as a land use objective: "Opportunities will be created to walk and bike throughout the community."²⁸ The City recognized, and continues to recognize, that opportunities for biking, walking, and other non-motorized transportation, otherwise known as active transportation, could be created to displace the large amount of cars on roads and reduce traffic congestion while simultaneously increasing air quality.

²⁶ "Comprehensive Plan: Introduction." City of Northfield, Minnesota. Dec. 17, 2008. pp 1.6.

²⁷ Ibid. pp 1.5.

²⁸ "Comprehensive Plan: Land Use." City of Northfield, Minnesota. Dec. 17, 2008. pp 4.13.

In 2009, the City of Northfield received a Safe Routes to School (SRTS) grant in order to “make it safer and easier for students to walk and bicycle to school.”²⁹ SRTS is a national program created in part “to help reverse the alarming nationwide increase in childhood obesity and inactivity,” however, the program has also benefited communities through reduced traffic congestion and improved air quality.³⁰ With the grant, the City of Northfield conducted a school safety study to assess transportation practices at schools. The study’s objective was to “increase safety and convenience for students walking and biking to school, making it a more appealing transportation choice,” and focused on the four Northfield public schools for grades K-8: Bridgewater, Greenvale Park, and Sibley Elementary Schools, and Northfield Middle School. The study identified key issues at each school site and offered both non-infrastructure and infrastructure recommendations to make the schools more easily accessible for active transportation to and from schools. Table 1 lists some highlighted key issues.

| School | Key Issues |
|---------------------------|---|
| Bridgewater Elementary | <ul style="list-style-type: none"> - High traffic speeds, volumes, and congestion at TH 246 and Jefferson Parkway cause the School District to restrict students from walking or bicycling through this intersection because of safety concerns. - Lack of a center median cut to accommodate bicycles and pedestrians at the intersection of Jefferson Parkway and Maple Street. - Lack of sidewalks on key routes near the school. |
| Greenvale Park Elementary | <ul style="list-style-type: none"> - Lack of sidewalk on the west side of Lockwood Drive between the existing school trail and the park across from Wilson Court. - The intersection of Lincoln Street and Cannon Valley Drive has relatively significant traffic volumes and is difficult to cross. - Lack of a continuous sidewalk from the south (Highland Avenue) to the existing trail from Lathrop Drive. |
| Sibley Elementary | <ul style="list-style-type: none"> - Lack of sidewalk on the east side of Maple Street that connects the existing trail to Sibley Drive. Crossing guards currently assist students in crossing Maple Street. |

²⁹ Safe Routes to School Plan City of Northfield. (2009). Northfield: SRF Consulting group, Inc.

³⁰ <https://www.dot.state.mn.us/saferoutes/about.html>

| | |
|--------------------------|---|
| | <ul style="list-style-type: none"> - Lack of pedestrian ramps and crosswalks at the intersections of Maple Street/Sibley Drive and Maple Street/Ames Street. - The intersection of Maple Street and Woodley Street has relatively significant traffic volumes and is difficult to cross due to the large roadway widths of both Maple Street and Woodley Street. |
| Northfield Middle School | <ul style="list-style-type: none"> - High traffic speeds, volumes, and congestion at TH 246 and Jefferson Parkway cause the School District to restrict students from walking or bicycling through this intersection because of safety concerns. - High traffic speeds along TH 246 in front of the main Northfield Middle School access prevents students from safely crossing TH 246. |

Table 1: Key Issues and Recommendations for Northfield K-8 schools

A separate program that Northfield has partaken in to reduce automobile usage and create safer and better opportunities for biking and walking is the Complete Streets program. Complete Streets are “designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities. Complete Streets make it easy to cross the street, walk to shops, and bicycle to work. They allow buses to run on time and make it safe for people to walk to and from train stations.”³¹ Implemented policies are evaluated based on criteria that encourages policy makers to design policies in which “communities direct their transportation planners and engineers to routinely design and operate the entire right of way to enable safe access for all users, regardless of age, ability, or mode of transportation... every transportation project will make the street network better and safer for drivers, transit users, pedestrians, and bicyclists.”³² The National Complete Streets Coalition (NCSC) promotes and evaluates adopted Complete Streets policies as part of its mission to “promote the development and implementation of policies and professional practices that ensure streets are safe for people

³¹ <https://smartgrowthamerica.org/program/national-complete-streets-coalition/>

³² Ibid.

of all ages and abilities, balance the needs of different modes, and support local land uses, economies, cultures, and natural environments.”³³

Northfield implemented their Complete Streets policy (City Council Resolution 2012-064) in July of 2012 to ensure “all streets within the City are planned, funded, designed, constructed, operated and maintained to safely accommodate users of all ages and abilities.”³⁴ The Purpose of the policy highlights long-term cost savings in improved public health, better environmental stewardship, reduced fuel consumption, and reduced demand for motor vehicle infrastructure while continuing to implement principles from and consistent with the CP.³⁵ Upon evaluation, Northfield’s Complete Streets policy was highlighted by the NCSC as one of ten policies adopted in 2012 that displayed exemplary policy language and could serve as a model for communities across the country.³⁶

The issues presented in the SRTS study have been highlighted to and known by the City of Northfield since the study was completed in 2009, and since then improvements to school-travel infrastructure have occurred; sidewalk gaps near Sibley Elementary have been filled; school speed zones have been established at Sibley, Greenvale, and the middle schools; and user activated crossing signals have been placed at the middle school. Despite these improvements and Northfield’s exemplary policy language in the Complete Streets policy, the success of the infrastructure and policy updates have not been evaluated, so we are unable to determine how successful these updates were. It is part of our recommendation, which will be elaborated on further in this paper, that Northfield return to these implementations and measure their effectiveness and success before moving forward with more changes.

³³ Ibid.

³⁴ <https://www.ci.northfield.mn.us/732/Complete-Streets-Taskforce>

³⁵ City of Northfield Complete Streets Policy. (2012). City of Northfield.

³⁶ “The Best Complete Streets Policies of 2012.” (2012). The National Complete Streets Coalition: Smart Growth America.

1. *Summary of Future Plans*

While some implementations have already occurred, Northfield still has plans for continued improvement. As previously mentioned, the City's CP outlines long-term plans to manage city growth. The CP as a whole presents the opportunity for improving walking and biking conditions to schools, but principles 11 and 12 and their respective subcomponents in the "Land Use" chapter are guidelines that have great potential to specifically and directly impact school transportation practices:

11. Places will be better connected, in part to **improve the function** of the street network and also to **better serve neighborhoods**

(a). The street pattern will be improved to keep local traffic off major arterials, and **high-speed through traffic off local streets**.

(b). A **better connected grid or modified grid street system** is the preferred network for future development and redevelopment.

(c). The development, redevelopment, or land intensification along commercial corridors will incorporate traditional patterns reflected in "Old Northfield", which emphasizes **pedestrian mobility** and the relationships of buildings to one another and the public realm.³⁷

12. Opportunities will be created to **walk and bike** throughout the community.

(a). The design of local streets will **encourage pedestrian and bicycle** movement through features such as sidewalks, bikeways, narrower street widths, and high quality planter and buffer strips to **protect the pedestrian**.

(b). Sidewalks, walking trails and bikeways will be **connected** to public parks and other destinations...³⁸

Around the same time the CP was updated and published in 2008, Northfield's Park and Recreation Advisory Board produced the Parks, Open Space, and Trail System

³⁷ "Comprehensive Plan: Land Use." City of Northfield, Minnesota. Dec. 17, 2008. pp 4.13.

³⁸ Ibid.

Plan (System Plan). The System Plan is intended to be consistent with and complement the vision, goals, and policies of the CP.³⁹ The parks, open space, and the trail system is intrinsically linked to Northfield schools,⁴⁰ and some objectives and policy statements of the “Trail Corridors Acquisition and Development” section of the System Plan overlaps with the community’s need for improved walking and biking routes to school. The following two objectives and subsequent policy statement show this overlap and where school transportation practices could benefit:

- To allow for relatively **uninterrupted** hiking, biking, and other uses **to and through the City’s park and open space system and developed areas**
- **To safely protect users** from developmental encroachment and **associated vehicular traffic**
- The trail system shall be developed to **minimize conflicts between pedestrians and vehicles**⁴¹

The approved trails from the System Plan can improve transportation practices to schools; on-street bike routes pass right in front of Greenvale Park Elementary, Bridgewater Elementary, and Northfield Middle School; an on-street bike lane runs by Sibley Elementary; core linking trails pass by and connect Northfield High School, Bridgewater Elementary, and Northfield Middle School; and local/neighborhood trails are located next to all Northfield public schools.

In the summer of 2017, Northfield began planning and designing the 2018 Street Improvement Project to reconstruct Division Street (from 6th Street to 8th Street) and 7th

³⁹ “Parks, Open Space, and Trail System Plan.” City of Northfield, Minnesota. Brauer & Associates, LTD. 2008. pp 2.1.

⁴⁰ Ibid. pp 2.2.

⁴¹ Ibid.

Street (from Water Street to Washington Street), and complete an overlay of Washington Street (from Woodley Street to 2nd Street).⁴² Most notably, the Washington Street overlay is within the 0.75-mile transportation boundary of Sibley Elementary, and while this is only one of many streets on the path to Sibley, the potential does exist for improved ATS practices.

Northfield is also currently working towards becoming a Step 4 Minnesota GreenSteps city. Minnesota GreenSteps Cities is a voluntary program designed to help cities achieve sustainability and quality-of-life goals through the implementation of various Best Practice actions under five key areas: buildings and lighting, land use, transportation, environmental management, and resilient economic and community development.⁴³ The City of Northfield is working to complete eight required Best Practice actions in order to achieve Step 4 status; two of these required actions have the potential to directly impact school transportation practices: create a network of complete, multimodal green streets, and promote active living and alternatives to single-occupancy car travel.⁴⁴

V. Significant Impacts

A. Evaluating effectiveness and impact of implementations by other municipalities

1. *School-level actions*

Eyler et al. conducted a multisite study of nine schools across seven states to identify specific policies and factors at schools that influenced the success or failure of

⁴² <https://www.ci.northfield.mn.us/1140/2018-Division-St-7th-St-and-Washington-S>

⁴³ <https://greenstep.pca.state.mn.us/index.cfm>

⁴⁴ <https://www.ci.northfield.mn.us/727/Progress>

ATS initiatives.⁴⁵ Six types of policies were deemed to directly influence the overall success of ATS initiatives, but we have only extrapolated three of the identified policies as actually being adaptable by schools to promote ATS initiatives and reduce car ridership. The following three policies worked in conjunction with school-wide participation in Walk to School Day and promotion of ATS for an overall decrease in car ridership:

- School zone speed limit and enforcement: establishing school zones decreases risk of injury to pedestrians while encouraging ATS
- Student drop-off zones: schools worked with local businesses to establish drop-off zones where students could be dropped off a short distance away from the school and walk the remaining distance with others
- School start and dismissal times: schools modified start and dismissal times to allow for walkers and bikers to leave school buildings before car riders to avoid accidents and reduce the risks to pedestrians

The three remaining policies we do not believe to be adaptable by Northfield schools are no-transport zones, school siting, and school choice. No-transport zones are a designated area around schools where children are not provided bus services due to the close proximity to schools. Northfield schools have established no-transport zones, but the no-transport zones just feed into the issue of drop off lines as routes to schools within these zones are considered unsafe for ATS by parents.⁴⁶

⁴⁵ Eyler, A. A., R. C. Brownson, M. P. Doescher, K. R. Evenson, C. E. Fesperman, J. S. Litt, D. Pluto, L. E. Steinman, J. L. Terpstra, P. J. Troped, and T. L. Schmid. "Policies Related to Active Transport to and from School: A Multisite Case Study." *Health Education Research* 23, no. 6 (2007): 963-75.

⁴⁶ Bloom, Charles, et al. "Northfield Middle School Transportation Study." Carleton College. (2014).

School siting policies affect the kinds of ATS initiatives that can be implemented and, to an extent, the success of the initiatives, but cannot actually be promoted by schools. School siting is determined on a city level and is outside the scope of this study, but would be a great point of future research as Northfield is a growing city. As for school choice, a parent or student's decision on which school to attend does not promote ATS initiatives, unless the school was picked specifically for the ATS initiatives. As this is not usually the case, we did not include school choice as a way for schools to promote ATS initiatives.

In 2009, the town of Jackson, MI published a study analyzing the effects of its multi-approach projects with active living programs created to target elementary school children. The study found that school-level promotion of, and consistent year-to-year participation in, ATS programs like Walk to School Day increased the percentage of students regularly using ATS, with the percentage of the student body that was using ATS doubling over a two-year time period.⁴⁷ Elementary schools in the Jackson Public Schools system also implemented SRTS teams consisting of staff, parents, and volunteers at each school to aid in evaluating school safety and planning of future implementations.

The products of its programs, combined with the Safe Route to School initiative, not only increased elementary school children's preference for walking and/ or biking but also increased the connectivity of neighborhoods to the school. The implementation of more sidewalks and pathways, as well as the town's ability to address high traffic crossings increased the participation in ATS. In the success of this active living community intervention, Jackson was able to become a more pedestrian friendly

⁴⁷ Hendricks, Kristin, et al. "Transforming a Small Midwestern City for Physical Activity: From the Sidewalks Up." *Journal of Physical Activity and Health* 6, no. 6 (2009): 690-98.

environment where children were able to engage in healthy habits supported by their parents. Parents in return, by not driving their children to school were able to break free of the long obnoxious drop-off lines.

Due to the mode shift of transportation to and from school, the study of Jackson, MI noted an overall decrease in car usage by parents. As a result, each car not used for drop offs resulted in an annual reduction of approximately 330lbs of carbon dioxide per car.⁴⁸ At the time this study began during the 2004-05 school year, there were 3,041 children enrolled in elementary schools within the Jackson Public Schools system.⁴⁹ The study observed four elementary schools from 2004 to 2007 that had at least two consecutive years of participation in Walk to School Day and found an overall 31% increase in students using ATS. This switch from cars to ATS resulted in approximately 38.5 tons of carbon emissions reduced by the four Jackson elementary schools from 2004-2007.⁵⁰ ⁵¹ ⁵² These seemingly small yet frequent uses of cars emits CO₂ and other GHGs at an alarming rate. It's clear that ATS practices over fuel burning vehicles is a great step towards reducing the overall GHG emissions and combating climate change.

2. City-level actions

Infrastructure changes on routes to school have the most significant and direct impacts on increasing ATS practices and reducing emissions from car ridership and congestion.⁵³ Infrastructure changes directly impact the perceived and actual safety of a

⁴⁸ <https://my.umbc.edu/groups/casualcarpooling/files/4511>

⁴⁹ <https://www.mischooldata.org/DistrictSchoolProfiles2/StudentInformation/StudentCounts/StudentCount.aspx>

⁵⁰ The study did not name the four schools from which data was collected. As such, this is a rough estimate based on overall enrollment data for elementary schools in Jackson for the 2004-05 school year.

⁵¹ Hendricks, Kristin, et al. "Transforming a Small Midwestern City for Physical Activity: From the Sidewalks Up." *Journal of Physical Activity and Health* 6, no. 6 (2009): 690-98.

⁵² <https://my.umbc.edu/groups/casualcarpooling/files/4511>

⁵³ "Safe Routes to School and Traffic Pollution: Get Children Moving and Reduce Exposure to Unhealthy Air." (2012). Safe Routes to School National Partnership. pp 27.

route to school, and as shown in a study conducted by students from Carleton College, the most-cited reason parents gave for choosing to drive their kid(s) to school rather than allowing them to walk or bike was the unsafe travel conditions on routes to school.⁵⁴

Eugene, OR received \$600,000 in SRTS grants for infrastructure improvements at the local middle school which included new walking paths, crosswalk upgrades with pedestrian refuges, and school zone signage.⁵⁵ These infrastructure changes increased ATS at the middle school by 15% and saw a 24% reduction in traffic volumes from 2007-2010. For every household that switched from car travel to ATS, 330 pounds of carbon dioxide emissions were reduced per car per year.⁵⁶ For Eugene, this equates to approximately 8.75 tons of carbon dioxide emissions reduced over one year at the middle school.

B. Recommended actions and social, environmental, and economic impacts

As previously stated, Northfield has implemented various infrastructure changes to increase pedestrian safety to schools. However, Northfield has not followed up on the effects of these implementations; as such, there is no way to measure the success or effectiveness of these infrastructure changes. We would like to emphasize that above all else, Northfield should return to these infrastructure changes and evaluate the effectiveness of each before moving forward with any new actions. It is difficult to move forward and improve when it's unclear whether or not an implementation was actually effective at accomplishing its intended purpose.

Once previous implementations have been evaluated, we recommend the following actions, broken up into school- and city-levels, be taken:

⁵⁴ Bloom, Charles, et al. "Northfield Middle School Transportation Study." Carleton College. (2014).

⁵⁵ "Safe Routes to School and Traffic Pollution: Get Children Moving and Reduce Exposure to Unhealthy Air." (2012). Safe Routes to School National Partnership. pp 27.

⁵⁶ <https://my.umbc.edu/groups/casualcarpooling/files/4511>

School-level

- Safe Routes to School teams should be implemented at each school to assess and reassess school safety and serve as guides and resources for planning of future implementations
- Long-term and consistent participation in ATS programs, such as Walk to School Day
- Increased education on bike and pedestrian safety for parents, staff, and students
- Establishing drop-off and pick-up policies at all schools

City-level

- School-specific infrastructure changes based on recommendations from the 2009 SRTS study conducted in Northfield

The school-level recommendations are most heavily influenced by the success of programs and strategies from the Jackson, MI study and the multisite study conducted by Eyler et al. As we have shown and stated before, small yet frequent uses of cars emits CO₂ and other GHGs at an alarming rate, which when compounded with the sheer volume of cars that are used for school transportation results in staggering levels of emissions being released annually. School-level intervention in car ridership and promotion of ATS practices show great potential for drastic reductions in GHG emissions. It is imperative that Northfield schools do all they can to promote ATS and follow the footsteps of Jackson schools to decrease car ridership.

The City's responsibilities lie in ensuring routes to school are safe and maintained to increase and further encourage ATS. As previously stated, infrastructure changes have the most direct impact on participation in ATS. The study conducted by Carleton College shows that evaluating and increasing the safety of routes to schools could change the perception that parents

have of the safety of ATS, making it more likely parents will make the switch from driving to school to allowing kid(s) to participate in ATS practices.⁵⁷ The potential for reducing emissions is greatest when the City works with schools to ensure that routes to school are safe for children.

The co-benefits for both levels of implementations are numerous and long-lasting; various studies show that physical habits and environmental stewardship developed during childhood and early adolescence carry through to habits and behaviours and thinking towards the environment in adulthood⁵⁸; by instilling and encouraging ATS practices at a young age, it is highly likely that the children of Northfield will grow up to embrace active transportation, potentially resulting in declining car ridership throughout the community and reducing the City's emissions. An active transportation lifestyle also creates more possibilities to connect the Northfield community through routes accommodating non-motorized transportation as increasing participation in active transportation would lead to more identification of areas that are disconnected from the community by pedestrians. As connectivity increases, travel distances decrease, creating more opportunities to choose active transportation over cars travel, and route options increase, allowing more direct travel between destinations.⁵⁹ Infrastructure changes in particular will better connect the greater Northfield community to itself, which falls in compliance with principle 11 of "Land Use" in the CP:

⁵⁷ Bloom, Charles, et al. "Northfield Middle School Transportation Study." Carleton College. (2014).

⁵⁸ Nancy M. Wells, and Kristi S. Lekies. "Nature and the Life Course: Pathways from Childhood Nature Experiences to Adult Environmentalism." *Children, Youth and Environments* 16, no. 1 (2006): 1-24. <http://www.jstor.org/stable/10.7721/chilyoutenvi.16.1.0001>.

⁵⁹ "Roadway Connectivity: Creating More Connected Roadway and Pathway Networks." Victoria Transport Policy Institute. January 2, 2017. <http://www.vtpi.org/tdm/tdm116.htm>.

11. Places will be better connected, in part to improve the function of the street network and also to better serve neighborhoods⁶⁰

Economically speaking, school-level implementations require little to no funding, and programs such as Walk to School Day have materials and resources for teaching and promotion openly available for schools interested in participating. Infrastructure changes will be costly initially and potentially in maintenance, however, the connectivity to the greater Northfield community increases opportunities for transactions between businesses and consumers traveling by foot or bike.⁶¹

VI. Key issues in implementation

A. Key policy questions

In designing and implementing policies for the Climate Action Plan, decision makers should consider short- and long- term impacts of policies and whether the intended impact is feasible in the intended time span. Environmental impacts are not always obviously seen right away. For instance, participation in a recurring and low-cost program, like Walk to School Day, would have impacts that would become visible over time, but would not be immediately obvious. The impacts of such a program would probably not be seen until the children grew up and began making choices influenced by the habits and thinking brought on through exposure to, and participation in, the program. Over time, Northfield would see reductions in GHG emissions from cars with increased community connectivity, and as community connectivity continues to increase the need for cars will continue to decrease, which in turn results in decreased emissions,

⁶⁰ "Comprehensive Plan: Land Use." City of Northfield, Minnesota. Dec. 17, 2008. pp 4.13.

⁶¹ "Roadway Connectivity: Creating More Connected Roadway and Pathway Networks." Victoria Transport Policy Institute. January 2, 2017. <http://www.vtpi.org/tm/tm116.htm>.

creating a feedback loop of connectivity and emissions reductions. We find the long-term environmental benefits of participation in ATS programs outweighs the lack of immediately obvious benefits, and we encourage the City to help promote ATS programs in schools in whatever capacity is available.

On the other hand, implementing infrastructure changes around schools would see some immediate changes, but long-term maintenance, as well as initial installation, have large costs that need to be factored in to determine the value and success of the changes. Again, we emphasize that Northfield has already completed various infrastructure changes around the schools, and understanding the effects and impacts of these changes is crucial before moving forward with more changes.

Policy makers should also consider whether an implementation will impact one school, one *type* of school (like elementary/middle/high school, or a school that is along a specific road), generally all schools, or extend into the community. The most effective implementations will be those that create environmental, social, and economic benefits for schools that can reach into the greater Northfield community. The co-benefits outlined in the previous section are a few examples of how implementations at schools could benefit the community.

While slightly outside the scope of this paper, the material and methods for which infrastructures will be constructed should also be taken into consideration. It can be difficult to eliminate environmental hazards in the construction and implementation process, but decision makers should prioritize eco-friendly materials and methods of construction and operation over others. This can be as simple as implementing school speed zones using signs made from recycled materials, or as ambitious as constructing a user-activated crossing signal that runs on renewable energy. It would be contradictory to construct a user-activated crossing signal meant

to reduce car emissions only to have this new structure be powered by electricity and produce its own emissions as it operates.

B. Pros and cons of implementation

While we have carefully thought out our offered recommendations, we recognize that there is no one perfect solution and every implementation has pros and cons. Following up on previous implementations and evaluating effectiveness helps decision-makers make judgements on allocating money for projects that are shown to be the most helpful and do the most to combat climate change through active transportation practices at schools, thus allowing continuation of actions in other areas surrounding the schools and potentially reaching even further out into the community. However, Northfield has made many infrastructure changes around the schools, and evaluating all these changes will take time and resources, putting off further implementations and infrastructure changes until evaluations are complete. And while infrastructure changes are the most effective and direct at impacting ATS practices, they are also the most expensive. More is explained about possible sources of funding for infrastructure changes in the next section, but funding cannot be guaranteed for new infrastructure changes.

School-level implementations could require resources the City may not have; for instance, implementing SRTS teams at schools requires resources for training team members to adequately evaluate implementations around the schools, and Northfield may not have these resources as the initial SRTS study conducted in 2009 was done by an outside consulting group. A remedy to this would be to hire someone from the consulting group to come in and train a group of people on SRTS policies and learn how to effectively evaluate safety around schools. It would be costly to bring in a consultant to train people, but once a group has been trained, the new trainees could then take their knowledge and teach and share it with others on their team,

and this trickle-down of information and strategies would eliminate the need to rehire a consultant for more training.

Policies that directly impact the parents driving the kids to schools, like establishing specific drop-off or pick-up times, could raise concerns and objections from parents. People usually aren't willing to change their habits, so the biggest challenge here will be to get parents to willing learn how to best participate in a new and unfamiliar system. Along this vein, while most of the school-level implementations are directed at the students, it must be kept in mind that, especially for younger children, parents are the ones that make the decision on whether their child walks or gets driven to school. Parents and guardians must be kept in the loop about any new implementations and concerns must also be taken into account before finalizing decisions and actions. Implementations should be directed at parents as much as the students, as getting parents and guardians on board with strategies is absolutely vital to promoting ATS.

C. Funding options

School-level implementations will require little to no funding, so any funding that is necessary should be obtained through the City and/or school district if possible, but we do not anticipate funding school implementations to be a major issue. Walk to School Day offers promotional and teaching material online for free for any participating school, so there would be no extraneous costs there. Relying on volunteer efforts for SRTS teams and to teach classes on bike and pedestrian safety would also eliminate costs to the City.

Main sources of funding for infrastructure changes will be state- and federally-funded grants, like a SRTS infrastructure grant. These grants are highly competitive, but Northfield has already done tremendous work in starting to identify and evaluate areas of improvement; and

with recognition as one of the best Complete Streets policies in America, the possibility of obtaining such a grant is increased.

VII. Conclusion

Cars are a necessity of modern life and offer new levels of convenience for motorists, but there is an irony in this convenience turning into a hinderance with extensive wait times in drop-off and pick-up lines at schools. Children are restricted from participating in ATS by parents due to unsafe routes to school, and these small trips to drop kids off at school add up to equal extensive emissions being released into the atmosphere and contributing to climate change. Northfield's Climate Action Plan can reverse these contributions to climate change through actions taken by Northfield Public Schools and by the City itself, and these actions include implementing SRTS teams at each school to assess and reassess school safety; long-term and consistent participation in ATS programs; increased education on bike and pedestrian safety for parents, staff, and students; establishing drop-off and pick-up policies at all schools; and implementing school-specific infrastructure changes based on recommendations from the 2009 SRTS study conducted in Northfield. But before any of these actions are carried out, Northfield must first revisit previous infrastructure changes near schools and evaluate the effectiveness of these implementations for promoting ATS. The City of Northfield is moving forward in its environmental stewardship and fostering a community of environmental awareness; what now remains is for the City's Climate Action Plan to address the ongoing issues surrounding its schools and create lasting improvements for future generations to continue moving forward with the City towards a greener Northfield.

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