Greenways In America: The Ecosystem Services of Urban Greenways and their Neighborhood Benefits

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Greenways In America:

The Ecosystem Services of Urban Greenways and their Neighborhood Benefits

Bryan Kiel
Abstract

This senior thesis consists primarily of an ethnography of successful American greenways, highlighting the greenways’ general ecosystem services, including their provisioning, regulating, and supporting ecological services. A greenway is defined as an urban trailway with some sort of inherent, defined, or named utility beyond recreation. I first detail the environmental and urban histories of greenways in America, and then discuss the ecological, economic and social benefits the greenways provide. Four case study cities and five other supplementary cities were visited, and various methods of research were conducted in person, including on-trail assessment, interviews, and a survey on usage. Using this primary, as well as secondary, data, I defend a little-researched hypothesis of the greenway as a tool for neighborhood cohesion. Finally, I add an “upshot” section about greenways in New York City, and the potential lessons from the successes of greenways in other North American cities.

Key words: greenways, ecosystem services, ecological economics, urban planning, environmental history
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Introduction: Why Greenways?

When Charles Little wrote *Greenways for America* in 1995, he envisioned a new form of open space that would protect resources and connect humans once again with the American land. Since his writing, American funding for greenways, or trailways with some purpose or utility beyond recreation, has steadily risen. In 2015, the Federal Highway Administration’s Recreational Trails Program gave just over $80 in apportioned funds to projects supporting recreational pathways across the country, roughly 75% more than in 2000, and over 10 times more than when the program started in 1993. And while we see social issues in our cities persist or grow altogether, from obesity and public health issues to crime and economic inequality, urban planners and policymakers are attempting to solve problems on the ground by changing the way we see and interact with our built environment. Tools such as park-building, economic development, and transportation improvements, then, are all ways for our city leaders to affect urban livelihoods for the benefit of all. I will show how greenways in America can be a tool to solve a variety of ecological, economic, and social ills in an urban setting.

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1 Little, Charles. *Greenways for America* (Baltimore: Johns Hopkins Press, 1990.) 3-10  
2 Recreational Trails Program exec summary  
I first wish to describe my definition of a greenway to better identify the type of infrastructure this thesis will assess. To limit the scope of this project, I have assigned the definition of a greenway to mean any urban trail that is closed to motor vehicles and has some sort of planned use beyond recreation alone. Other definitions have been used elsewhere-- the City of Seattle defines Neighborhood Greenways as streets close to main arterial roads that can better provide so that people who walk or ride bicycles feel safe and comfortable. Nor does my definition include the Greenway of Tolkien’s Middle-Earth, an old grassy road from Gondor to Andor used by men, elves, dwarves, and others of the Third Age. Most importantly, the definition excludes many park paths that don’t have a major planned component beyond its purpose in the park. This includes facilities like the High Line, bike paths in parks like in Central Park, or dirt hiking trails found in most nature preserves. These may serve similar benefits as the greenways I detail, but do not fall into the scope of my definition for purposes of this research.

This thesis will look at the ecological, economic, and social services from an ethnographic perspective, which will describe a range of services from a number of urban communities. Words like ‘benefit’ and ‘service’ will be used interchangeably. I hope to make a well-rounded sustainability case for the implementation of greenways in major urban areas for the benefit of the Earth, the people, and their well-being. With travel in cities in the United States and Canada for purposes of research, I will draw upon my experiences to qualify the ecological, economic, and social benefits that greenways can provide urban areas.

From cities like Denver, we see how greenways provide added benefits to ecological restoration. The “people” component of greenways in restoration projects ensures a deeper sense

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4 http://seattlegreenways.org/about/
of ecological connection, or biophilia, which ensures better protection of the land. Cities like Boulder use their greenways as a flood conveyance system to take in water along the creeks and brooks that may flood in the city. Thus, the ecosystem here is protective. And in many cities like Portland or Minneapolis, where a large number of residents use the greenways for pollution-free commutes, one can quantify their reduced carbon footprint, as vehicles contribute about 28% of greenhouse emissions in the U.S.\(^5\)

In cities like Minneapolis, we will see a few clear examples of the sort of economic development that can make greenways a tenet of “trail-oriented development.”\(^6\) Portland’s greenway-based bike system has created new business opportunities for entrepreneurs who market to those who use the greenway on a frequent basis. And in Seattle, we will see how some of the top-rated greenways can drastically increase the economic viability and value of the surrounding homes and neighborhoods.

Finally, cities like Boston have built one greenway as a “lid” to another infrastructural project, the Big Dig, to service its inner city as well as those who wish to drive through.\(^7\) In Washington, D.C., a public health initiative has advocated the benefits of “active transportation,” with greenway construction being a central tool. And finally, in places like Davis, California, we will explore how greenways provide an off-road network of pathways that connect residential corridors to other public amenities. In general, these greenways are providing a tool for social cohesion.

\(^5\) https://climate.dot.gov/about/transportations-role/overview.html
\(^7\) http://www.rosekennedygreenway.org/about-us/
In the first chapter, I will explore the history of greenways, from its earliest landscaping inception to its implementation as a tool of equitable urban planning. In the second chapter, I will explore the ecological services greenways provide, and build a data-driven case for the environmental benefits of urban greenways. In the third chapter, I will explore the economic services of greenways, demonstrating that greenways can be a source of economic stability and development. In the fourth chapter, I will explore the social services of greenways, and propose the greenways’ unique position as an infrastructural tool to build social cohesion. Finally, in the fifth chapter, I will explore further design considerations of greenways, and hypothesize how New York City might integrate these considerations in its own urban fabric.

**Chapter 1. The History of Urban Greenways**

**Parkways.** In his book *Greenways for America*, Charles E. Little starts by saying “the tracks of the great park-maker, Frederick Law Olmsted, are all over the modern greenway movement. Arguably, if any single person ‘invented’ the idea of greenways, it was he.”

Olmsted’s contributions to parks and the American landscape are numerous: Central Park, Riverside Park, the City of Buffalo park system, the campus of Stanford University, the Master Plan of Riverside, Illinois, and “Emerald Necklace” system of parks and trails in Boston. Many of Olmsted’s parks have been lauded for their combination of natural features, many styles of European-garden design, and a strict attention to detail that have made them world-famous. In the 19th century, one of the largest social calamities in New York was the lack of open space for residents to escape the hecticness of the city. Olmsted and his frequent partner of Calvert Vaux

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8 Little, 7
9 http://www.olmsted.org/the-olmsted-legacy/frederick-law-olmsted-sr
10 Girardet, Herbert. *Cities People Planet* (Chichester, West Sussex: John Wiley & Sons, 2004) 115-156
however sensed that no matter how great a park is, they still needed to be linked to their residential neighborhoods.

If parks alone couldn’t connect residents with nature, then a new style of green space needed to be designed that may act as the connector. This led to the implementation of parkways in the United States, most notably the Eastern and Ocean Parkways in Brooklyn. These original parkways were intended as “shaded pleasure drives” to connect parks, other natural amenities and the neighborhoods where residents live.\(^\text{11}\) In a city like Boston, a greenway like the so-called Emerald Necklace connected a host of parks within the city, the first sort of “strip park” in the country that was 4.5 miles long and bisected a number of different neighborhoods.\(^\text{12}\)

By the early 20th century, the nature of the parkway changed, and their accommodation of automobiles became central to the development of leafy suburbs outside of the city. By 1940, there were 19 parkways comprising well over 150 miles in the New York metropolitan area alone, most of which had innate use by commuters and automobile transportation around the region.\(^\text{13}\)

**20th Century Considerations.** The history of greenways does not pick back up until a few decades after the original parkways of Olmsted. American planner and forester Benton MacKaye, most famous for the founding of the Appalachian Trail, had proposed in 1928’s *The New Exploration: A Philosophy of Regional Planning* that there should be a series of traditional urban “parkways” for open space, as well as the implementation of “green belts,” a border of

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\(^\text{11}\) Little, 11-12  
\(^\text{12}\) Ibid., 12  
\(^\text{13}\) https://www.dot.ny.gov/display/programs/scenic-byways/parkways-no-detailed-info
mandated open land to block urban sprawl. In 1959, William “Holly” Whyte first used the word ‘greenway’ to describe Edmund Bacon’s plan for the development of Northwest Philadelphia, where a whole street pattern would be laid out, “[providing] for a series of cohesive neighborhood units, with a series of ‘greenways’ and parks in between.” These thinkers and others called for the implementation of linear green space to define the growth and use of cities, a planning tool still used today.

The environmental movement of the 1960’s started to emphasize new ideas of land conservation, which led to an international interest in greenways as “ecological corridors.” One of the most famous contributions to this research came from Phillip Lewis, who taught landscape architecture at the University of Wisconsin at Madison. He mapped hundreds of individual natural amenities in the state, and found that 90% of these resources fell along specific corridors that he used to plan the Wisconsin Heritage Trail Proposal. This meant that greenways, once a social institution, could now be seen in an environmental context.

During the President’s Commission on Americans Outdoors in the USA, (1987), a greenway network for the country was advocated to serve as a linkage between natural spaces and the urban areas where many folks live. In his doctoral dissertation, Jack Ahem says that the President’s Commission and the work of Little in 1990 was important in actually defining what a greenway was. Little gives these definitions:

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15 Little, 23-24
16 Ahern, Jack. “Greenways in the USA: Theories, Trends, and Prospects” in Greenways as Strategic Landscape Planning (Wageningen University, The Netherlands) 38-39
17 Ahern, Jack. Greenways as Strategic Landscape Planning (Wageningen University, The Netherlands) 108
18 Little, Preface to Greenways for America
1. A greenway is a linear open space established along either a natural corridor, such as a riverfront, stream valley, or ridgeline, or overland along a railroad right-of-way converted to recreational use, a canal, scenic road, or other route. Greenways in the USA: theory trends and prospects 109

2. Any natural or landscaped course for pedestrian or bicycle passage.

3. An open-space connector linking parks, nature reserves, cultural features, or historic sites with each other and with populated areas.

4. Locally, certain strip or linear parks designated as parkway or greenbelt.

The Growth of Modern-Day Urban Greenways. The growth of greenways then can be seen as a global movement, meaning one that can take place in rural as well as urban areas, across the world. Their implementation in cities seems crucial to providing a social service that a sense of biophilia, or connection to nature, can provide.\(^\text{19}\) Before the 1990, American cities could specify specific urban greenways that offered multi-modal access and an assortment of other socio-environmental benefits. The Olmsted Brothers, heirs to the park-building legacy of their father, helped devise the 40-mile loop in Portland, Oregon. Through traditional land acquisition, the city and surrounding municipalities were able to acquire land to build out the loop, but work has still not been completed in the 100 years since.\(^\text{20}\)

In Minneapolis, the roughly 40-mile Grand Rounds National Scenic Byway is an almost continuous loop for bikes and pedestrians that was built in congruence with a automobile byway in the 1930’s, and bisects major parts of the city and its acclaimed park system.\(^\text{21}\) According to Andy Singer, former head of the St. Paul Bicycle Coalition, Minneapolis had little bike infrastructure before the 1990’s, and in accordance little cycling on the streets or for transportation occurred.

\(^{19}\) Hellmund and Smith, 32-34

\(^{20}\) Little, 76-80

\(^{21}\) https://www.minneapolisparks.org/parks__destinations/trails__parkways/grand_rounds_scenic_byway_system
These cities show a plan in place with little ground for implementation. The watershed moment that would change how cities built and implemented greenways came in the 1990’s. In 1992, a number of federal grant mechanisms were created by the Federal Highway Authority to develop bike and pedestrian programs across the U.S. for a number of environmental and social purposes, including air pollution mitigation, traffic calming, highway and pedestrian safety, and recreational trail expansion.\textsuperscript{22, 23} Since then, each state has a designated bike/ped coordinator, and $11.2 billion has been given out for over 33,000 projects, many of which have been implemented in urban settings.

Singer highlights the advocacy of Representative Jim Oberstar in the United States House of Representatives (D-MN). Rep. Oberstar, who served on the House Infrastructure and Transportation Committee, championed the inclusion of bike and pedestrian funds to federal transportation funding bills like the SAFETEA-LU act of 2005.\textsuperscript{24} This accelerated the improvements in federal grant programs like the Transportation Investment Generating Economic Recovery grant program (TIGER), the Highway Safety Improvement Program (HSIP), the Surface Transportation Block Grant Program (STBG), the Transportation Alternatives Program (TAP), and the Recreational Trails Program (RTP).\textsuperscript{25}

Singer says that cities who had updated bicycle and greenways plans early on in federal grant appropriations were the biggest benefactors of funding, and increased the prospects of successful projects. Minneapolis, for instance, had a bike plan as early as 2001, and an

\begin{itemize}
  \item[22] https://www.fhwa.dot.gov/environment/air_quality/cmaq/
  \item[23] https://www.fhwa.dot.gov/environment/safe_routes_to_school/
  \item[24] https://www.fhwa.dot.gov/safetealu/summary.htm
  \item[25] US DOT Transit, Highway, and Safety Funds (Rev. 12 Aug. 2016) , “Pedestrian and Bicycle Funding Opportunities”
\end{itemize}
already-established parks department who managed a system of recreational trails within the city. The city’s application for new projects, such as the Cedar Lake LRT Regional Trail, were thus prioritized over cities with little capacity to field greenway projects. In turn, cities that were less prepared with plans for infrastructure like greenways fell to the wayside and had to play catch-up in applying for grants. Singer says this hurt the prospects of cities like St. Paul, just across the river from Minneapolis. St. Paul had only passed their bike plan in 2015, and therefore any bi-city connections were significantly lacking.

**Funding and Implementing a Greenway Vision.** Grants like the Transportation Alternatives Program (TAP) give priority to improving surface transportation, particularly non-highway related projects. In a state like New York with a $250,000 minimum requirement, the TAP encourages major projects that can have major environmental, economic, and social implications. Local examples the 9th Avenue Cycle Track, which was awarded roughly $2 million from the TAP program, as well as $14 million in matching funds, and has been contributing to a large uptick in cycling in the city since 2009.

Federal grants have provided funds to virtually all major urban greenway projects in the country, including the Springwater Corridor in Portland, Ore. and the Bethesda Trolley Trail in Bethesda, Md. Federal grants have also ignited the giving of state agencies, non-profit foundations, and private donations for a host of projects. The Midtown Greenway in Minneapolis, one of the best used urban greenways in the country, has benefited from grants

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26 http://www.minneapolismn.gov/bicycles/WCMS1P-135610  
27 http://trade.railstotrails.org/state_profile?state_id=35  
28 http://taimages.railstotrails.org/1-Ped-Bike-Facilities/Ninth-Avenue-Cycle-Track/  
29 http://taimages.railstotrails.org/3-Rail-Trails
from the City of Minneapolis, foundations like the McKnight Foundation, and private entities like perennial bike supporter New Belgium Brewing Company.  

Most major cities in the United States are currently planning for greenways that connect their residents and neighborhoods without the need for a car. There are a number of organizations and surveys that help communities promote and track the growth of greenways and their benefits. Since 2004, the Rails-to-Trails Conservancy has helped mapped for than 25,000 miles of trails in the United States, including urban bikeways and greenways in almost every major city over 500,000.  

**Tracking Greenways’ Impact.** The League of American Bicyclists has also instituted their own quantitative analysis for mapping how “bicycle friendly” a community is. Having a developed bicycle infrastructure network is important, and greenways have been a major part of this network in the United States. In order to achieve Bronze-level certification, a community’s total bicycle network mileage must be 26% of the total road mileage. This figure goes up incrementally for the silver and gold levels, with Platinum being at 45%. Four cities in the United States have attained this Platinum Certification: Portland, Ore., Davis, CA, and Boulder and Fort Collins, CO. The Diamond-Level Certification would require this figure to be at 70%, a status no city has attained.  

Other organizations that provide strong quantitative data on the benefits and expansion of greenways include the East Coast Greenway Alliance, which oversees the vision of a 3,000 mile interconnection of greenways from Key West to the Canadian border in Calais, Maine. They

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31 [https://www.traillink.com/trailsearch/](https://www.traillink.com/trailsearch/)
32 League of American Bicyclists, *The Building Blocks of a Bicycle Friendly Community*
provide detailed reports on the expansion of greenways along the proposed route through 16 states and Washington, D.C. In 2016, more than 300 miles of the route was signed, as well as the construction of 40 miles of new greenway, representing $50 million in bike and pedestrian investments.  

Federal agencies have been instrumental in collecting relevant data regarding the benefits of active transportation and positive effects of greenways for cities. The Center for Disease Controls and Prevention tracks data related to public health and the expansion of cycling infrastructure as it pertains to air quality, vehicle safety figures and crash mitigation, and improved fitness for youth and adults. The Federal Highway Administration and the Bureau of Transportation Statistics have conducted quantitative analyses on the benefits of greenways.

By and large it is local state departments of transportation and city officials who have tracked this data. The Arlington County, Virginia Department of Environmental Services has one of the most robust data sets regarding bike counts along roadways and especially greenways. The Portland Bureau of Transportation frequently updates their statistics on biking in the city, including greenway use. Their biggest investment in greenway infrastructure, TriMet’s Tilikum Crossing, counts the daily number of bike crossings, which in the summer averages over 3000 a day.

In Boulder, CO., where greenways are managed as part of a city-wide flood conveyance system, specific environmental data is collected by the staff engineers to track not only use of people, but their environmental impact in curbing flood discharge, particularly in the spring.

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34 Center for Disease Controls, “CDC Recommendations for Improving Health through Transportation Policy”
In San Jose, trail counts on designated sections help planners determine where improvements need to be made, and help the city understand urban growth throughout the trails.

In this chapter, we have discussed the history of greenways, how the modern urban greenway has been conceived as an environmental and social service, and the many tools and stakeholders that fund, build, and track urban greenways on a quantitative level. Landscape Architect Steve Durrant of Alta Planning and Design believes it is up to the implementing agencies and municipalities to track how these greenways are being used for improvements and other initiatives. Durrant says cities that are best investing into their cities are acting on those “back-burner” plans by tracking current use, and implementing funding mechanisms to support further development. A small sales tax in St. Louis, for instance, has generated sufficient funds for the Great Rivers Greenway District, which in turn has kept trails along the Mississippi and Missouri Rivers in good repair as greenways for recreation and even transportation.

In the modern reality of funding competition and metrics-based projects, meeting bike plans involves serious tracking in order to make greenways as sustainable as possible. Perhaps the most concrete improvements that greenways can make for cities are environmental sustainability services. From CO₂ remissions to restoration improvements, the next chapter will explore how greenways can be a missing link in the urban quest for a green lifestyle.

Chapter 2: Putting the ‘Green’ in Greenways: An Ecological Assessment

37 City of Boulder, “Bear Canyon Creek Mitigation Plan Recommended Improvements”
38 City of San Jose, “Trails Annual Report 2015-16”
39 Interview with Steve Durrant, Bronx, 27 Sept. 2016
Environmental Impact of Transportation. Since the beginning of industrialization, the urbanized portion of our land has been steadily growing. This is both a reflection of human demographics and behaviors. Between 1900 and 2000, the global population grew from 1.2 billion to 6.1 billion. In the same era, the population of people living in urban areas went from 14% to 47%. The growth of these cities is in line with the concentration of jobs in urbanized areas, a phenomenon Herbert Girardet classifies as a “product of fossil fuel technologies.”

In the 2005 Millennium Ecosystem Assessment, a team of core writers concluded in its “Summary for Decision-Makers” that while “changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people.” This means that our built environment has come at the cost of serious environmental degradation, one that could have serious implications if not quickly addressed.

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40 Girardet, 3-9
In Figure 1, we see that many indicators of “well-being” have various relations to supporting, provisioning, and regulating ecosystem services. Many of these ecosystem services have salient and visible applications in the natural environment; in the built environment, however, examples of these services have generally been ignored or diminished. In the chapter, we will cite examples of how ecosystem services can be diminished within an urban environment, and how greenways can serve to protect, enrich, or support some of these natural services for cities.
According to Girardet, access to personal transport via the automobile has dramatically changed our urban form, and cities designed with the car in mind, as well as national systems with cars used to link cities, dominated the built environment of the 20th century.\textsuperscript{42} Cities that saw its boom after the emergence of the car, including large American cities like Houston, Phoenix, Dallas, and Charlotte, are planned across a very large area. Los Angeles’ mega-region is also symbolic with freeways, rush-hour traffic, and single-family, detached homes spread over hundreds of square miles.

These types of cities require personal vehicles for travel; because of their prevalence, combined with truck transportation, aviation, public transportation and other emission-based transportation, the National Climate Assessment stated that in 2010, “the U.S. transportation sector accounted for 27\% of all U.S. heat-trapping greenhouse gas emissions, with cars and trucks accounting for 65\% of that total.”\textsuperscript{43} According to the IPCC’s \textit{Climate Change 2014 Synthesis Report Summary for Policymakers}, the unprecedented increase in greenhouse gases has a direct causal connection to observed increased global average temperatures over the past century, saying specifically that “It is extremely likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together.”\textsuperscript{44}

Besides the issue of greenhouse gas emissions and the related climate change effects, there are other direct impacts from fossil-fuel based travel as well. The EPA’s Office of Transportation and Air Quality regularly reports on the status of vehicle emissions and air

\textsuperscript{42} Girardet, 134-140)
\textsuperscript{43} U.S. Global Change Research Program, \textit{2014 National Climate Assessment}
\textsuperscript{44} Intergovernmental Panel on Climate Change, \textit{Climate Change 2014 Synthesis Report Summary for Policymakers}
pollution near major roadways. Many of their reports detail increased levels of health issues directly related to vehicle emissions, especially in children and elderly demographics.\textsuperscript{45} According to a 2010 CDC report on the subject, diseases such as asthma, general lung impairment, and cardiovascular morbidity have increased presence in populations that live within 150 meters of a major highway.\textsuperscript{46} There is clear evidence then that our current transportation model is environmentally dangerous for larger climate-change concerns, and local public health concerns.

**Environmental Status of North American Cities.** As already explored, personal transportation and the advent of the car has had major influences on the growth of cities in the past 100 years. Edward L. Glaeser, an economist and one of the most notable contemporary academics on the sustainability of cities, has published findings that detail the environmental impact of city dwellers. In a study of 48 metropolitan regions, those who live in the central city will categorically have lower greenhouse gas emissions than those living in suburbs.\textsuperscript{47} The reasoning is due to the natural consequences of living a highly-urban lifestyle: a more congested lifestyle that lacks the need of a car, a smaller living situation such as an apartment, and other accessible features that require less energy for living, working, and playing.

This has of course not always been the case for cities. For centuries, urban areas were known to have some of the worst environmental conditions, with city-dwellers residing in their urban environment strictly for a job. This “dirty city” concept is not strictly history; smog still

\textsuperscript{45} Environmental Protection Agency, *Near Roadway Air Pollution and Health: Frequently Asked Questions* (2014)
smothers major cities across the world, as as recently as 1952, the Great Smog event in London killed 10,000 people in the span of 5 days. This is one of the greatest man-made environmental disasters of all time, owed in part to weather conditions and coal emissions that were stifling the city in early December.\textsuperscript{48} Air pollution from a number of sources in the early 20th century brought about reforms, as the 1952 London event inspired the UK’s 1956 Clean Air Act.

Waterways in America’s cities have a long history of environmental abuse as well. According to the National Resources Defense Council, 40% of America’s lakes and rivers are unaccessible for safe fishing.\textsuperscript{49} The EPA has specifically focused work on Urban Waters to help reclaim them as an asset, rather than a danger for cities.\textsuperscript{50} Through a number of remediation and wildlife restoration projects, officials are trying to re-invigorate water bodies in cities for recreational and ecosystem-based use.

Waterways can also be a source of other environmental issues. In September 2013, a week-long storm in Colorado flooded many rivers throughout the Front Range region, including water bodies in the cities of Denver and Boulder. Damage was extensive to both public and private land, including significant housing damage.\textsuperscript{51} In Northeast Denver and Commerce City, CO, flooding of the Sand Creek damaged much of the surrounding land, including parkland. As part of the rebuilding efforts, the Sand Creek Regional Greenway Partnership has redone much

\textsuperscript{49} https://www.nrdc.org/issues/water-pollution#priority-why-matters
\textsuperscript{50} https://www.epa.gov/urbanwaterspartners/19-designated-urban-waters-locations
\textsuperscript{51} Call with Floyd Bebler, 15 May 2016
of the Greenway in sustainable fashion to prevent further damage.\textsuperscript{52} Similar flooding in Boulder affected parkland in that city as well.\textsuperscript{53}

Cities also have a problem in connecting its residents with the benefits that experience in nature can provide. In the South Bronx, advocate Majora Carter has said that residents have \(\frac{1}{5}\) the amount of greenspace as the city average, even though the Bronx in general has the highest percentage of parkland of all five boroughs. There’s a lack of connection between green space and people, even if that green space exists.\textsuperscript{54}

Now that we’ve identified major environmental concerns that both transportation systems and cities possess, I will explore how greenways can benefit the city and its ecological services.

**Greenways as Sustainable Transportation Infrastructure.** One of the biggest services greenways provide is greenhouse gas remissions. Many greenways are used for specific commuting purposes. In 2014, the Denver-Aurora region had roughly 1,307,000 commuters. In the same year, the Cherry Creek trail averaged about 1,800 bikers a day in the downtown region, according to a bike count by the Colorado Department of Transportation. Many of these rides were commuters, based on the spikes during weekday morning and rush hour periods.\textsuperscript{55} In a commuter count I conducted on May 18, 2016, the Cherry Creek Trail had over 300 evening commuters on bikes, from 4:15-5:30, which falls in line with these studies.\textsuperscript{56}

\begin{footnotes}
\footnotetext[52]{http://sandcreekgreenway.org/newsevents/flood-recovery/}
\footnotetext[53]{https://scied.ucar.edu/boulder-floods}
\footnotetext[54]{American Society of Landscape Architects, “Interview with Majora Carter, Founder, Sustainable South Bronx and The Majora Carter Group.” alsao.org}
\footnotetext[56]{Bryan Kiel, “Denver Day 1 Field Notes” (note: see bibliography for description of Field Notes)}
\end{footnotes}
On a central section of Seattle’s Burke-Gilman Trail, at NE 70th Ave, the trail saw 1734 bikers and pedestrians on a Friday in late August, 2016, again with significant booms during the morning and evening rush hours (50.2% of these bikers came during the morning rush hours of 7-10am and evening rush hours of 4-7pm)\(^\text{57}\)

Many cities with a strong network of greenways that I visited for research purposes show numbers also have some of the highest bike mode-share statistics for transportation in the country. Greenways encourage zero-emission, active transportation in these cities because of their ease of use. In Denver, users of the greenways talked about the trails as a type of “bike highway” that one would access from their homes to get to where they need to go.\(^\text{58}\) Trails like Portland, Oregon’s Springwater Corridor were connected with other bike infrastructure like the Willamette Eastbank Esplanade and the Tilikum Crossing to complete an off-road bike network. The more connections that were made between greenways, the more bikers and other non-motorist commuters were encouraged to use the trails. In a city like Portland with 7.75 million metric tonnes of CO\(_2\) from transportation, the greenway’s service to commuters to not drive can make an important impact in reducing emissions.\(^\text{59}\)

Similar connections have also seen increases in greenway traffic for commuting in cities like Minneapolis (the Midtown Greenway and the Hiawatha Bike trail), Seattle (the Burke-Gilman trail and the Fremont Ave Bridge), and in San Jose (the Guadalupe River Trail and major Downtown San Jose thoroughfares)\(^\text{60}\) The reason for the increased use of connected trails are most likely numerous. One possible reason with limited evidence is the idea that trails

\(^ {57}\) https://data.seattle.gov/Transportation/Burke-Gilman-Trail-north-of-NE-70th-St-Bike-and-Pe/2z5v-ecg8/data
\(^ {58}\) Bryan Kiel, “Denver Day 2 Field Notes”
\(^ {60}\) Bryan Kiel, “San Jose Field Notes,” “Minneapolis Wednesday Field Notes,” “Seattle Day 1 Field Notes”
with little interference feel safer than biking on the road, which means people prefer them over on-street bike facilities. On Seattle’s Burke-Gilman’s trail, ridership on portions that are completed are better than the unconnected ones, according to Mike Schwindeller’s thesis

*Negotiating Ballard’s Missing Link of the Burke-Gilman Trail*.\(^6^1\)

**Greenways as Environmental Restoration Tools.** Greenways serve other environmental benefits beyond its ability to attract emission-free transportation. In Boulder, the greenway system’s use by people is actually secondary; the ancillary purpose of the greenways for the City of Boulder is a flood conveyance system. Christin Shepherd, an Environmental Engineer employed by the City of Boulder, says that the “greenways of Boulder are synthesized with natural conduits, the creeks. Protection and communal interaction with the creeks is the basis here for successful greenways.”\(^6^2\) Six creeks in the city have pathways connected that are supposed to hold the extra water in case of a flood. These systems proved useful during the previously mentioned floods in Boulder in September 2013.

In Boston, the Rose Kennedy Greenway was conceived in 1991 after construction began on the “Big Dig,” a massive transportation project that put Interstate 93 underground. The Greenway was proposed as a “lid” project, and opened in 2008 as a linear park lining the pathway of the highway. The Greenway not only serves as an environmental amenity to Downtown Boston with a strong horticultural culture, but its symbolic nature of replacing a raised highway demonstrates the greenways purpose to restore nature to our cities.

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\(^6^1\) Mike Schwindeller, *Negotiating Ballard’s Missing Link of the Burke-Gilman Trail* (Seattle: University of Washington, 2014) 8-19

\(^6^2\) Interview with Christin Shepherd, Boulder, 20 May 2016
Greenways as Catalysts for Biophilia in Cities. Finally, there is an important role greenways are playing in adding a sense of biophilia, or a people-connection, with nature. At the Sand Creek’s Nature Center in Denver, the ecological legacy of the creek is taught in an educational and interpretive way. In this case, the greenway acts as a conduit between the ecosystems of the region and the people visiting. Denver also provides an even better example of connecting its residents with nature on the South Platte River Greenway. In 2015, the Johnson Habitat Park opened on the greenway, a playspace “equipped with a grass field, natural play areas, better access to the river and a campsite that includes a fire pit.” According to Jay Henke, a Senior Landscape Architect for the City of Denver, the park also serves as the base for environmental education programs that prep city children for excursions into the Rockies. Thus the South Platte River Greenway serves as a conduit to groundbreaking environmental moments for residents of the City of Denver.

In Portland, The Marine Drive Trail serves two ecological connections. For one, it is part of the larger 40 Mile Loop, a landscape solution designed in the early 20th century to create a sort of recreational greenbelt around the city of Portland. It also connects folks from the city to natural amenities, including beaches and parks, along the large Columbia River to the North of the City. Along a system of greenways, all planned in the 40 Mile Loop, one can bike uninterrupted from the center of Portland to the River along the Marine Drive Trail and other greenways in the city. In Minneapolis, natural features like its “Chain of Lakes” have been part

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63 Joe Vaccarelli, “Johnson Habitat Park Officially Opens” Denver Post, 30 June 2015
64 “Interview with Jay Henke,” Denver, 19 May 2016
65 http://40mileloop.org/wordpress/?page_id=6
of a large trail system for decades, providing a natural escape from the city center as early as the turn of the 20th century.

Finally, the greenways’ importance to linking open space ought to be noted as well. The Burke-Gilman Trail in Seattle terminates at Golden Gardens Park, a well-populated beach park on the Puget Sound. In the Bronx, the Bronx River Greenway terminates at Soundview Park, and connects a bunch of otherwise unconnected parks along the river such as Concrete Plant Park, Starlight Park, Bronx Park, and Shoelace Park. Finally, the confluence of the Cherry Creek and the South Platte River has created one of the best-used open spaces in all of Colorado, the Confluence Park, which sees heavy use by foot and bike.

The typical American city features a number of environmental issues like pollution, greenhouse gas emissions and susceptibility to natural disasters which have been compounded by systemic ecological failures in the transportation system. Greenways have important services that can make cities operate more sustainably. As a mode of sustainable transportation infrastructure, they encourage residents and others to travel emission free. They also act as a tool for ecological restoration along natural corridors like creeks and waterways. Finally, they add a sense of biophilia by connecting the urban residents to the natural world that is not usually available to all residents in the city. In the next chapter, we will explore the economic services greenways provide that can benefit cities, creating a “business case” for the creation of greenways.

**Chapter 3: The Business of Greenways: An Economic Overview**
Defining and Qualifying Economic Sustainability. Since the advent of the car, economies have spatially increased immensely. Major commercial institutions like the shopping mall, drive-through fast food and big box stores have spread out economic zones far beyond traditional urban centers. The return to cities, however, has emphasized the need to rethink how we can reclaim outdated infrastructure for more people, with new concepts like adaptive reuse gaining more favor than before.\(^{66}\) Extensive research has also shown that cyclists and non-driving consumers tend to purchase just as much, if not more, than their automobile-based counterparts over longer periods of time.\(^{67}\) As greenways are a form of sustainable development that prioritizes non-motorized transportation, their economic services are well-documented in a variety of applications in the United States.

Writing for the Harvard Business Review, Yvon Chouinard, Jib Ellison, and Rick Ridgeway write about economic sustainability as simply recognizing “that the viability of business itself depends on the resources of healthy ecosystems--fresh water, clean air, robust biodiversity, productive land--and on the stability of just societies.”\(^{68}\) Economic sustainability, like ecological sustainability, recognizes the finite resources of the planet, and a careful study demonstrates the consequences that may come when we pursue economies that don’t recognize the need for healthy ecosystems in the long term. And just as businesses need nature to thrive, we have also created economies that inherently harm the planet and its ecosystem services.

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\(^{67}\) Kelly Clifton, “Consumer Behavior and Travel Choices: A Focus on Cyclists and Pedestrians” 92nd Annual Meeting of the Transportation Research Board, January 2013.

Chouinard, Ellison, and Ridgeway write about how we have “struggled to make progress on reducing the damage business does to the world.”

Still, some of the strongest examples of economic sustainability exist inside urban settings. Cities that have withstood the test of time generally have boasted a multitude of services; Paris at once and over the course of centuries been a center for trade, service, industry, transportation, retail, and banking, and New York has learned to redevelop neighborhoods with the ultimate goal of attracting more people, rather than providing goods. Diversity in business and in the people that benefit from them mean that urban economies can stay afloat when one industry takes a negative turn. A lack of economic inequality also has correlations with sustainable cities: countries like Denmark, Sweden, and the Netherlands, which rank highly on the World Bank Gini Income Inequality Index, all have major cities leading in urban sustainability.⁶⁹

Figure 2. Sustainability Pillars Source: thwink.org
http://www.thwink.org/sustain/glossary/images/ThreePillars_ArchitecturalSimple.png

As a pillar of sustainability, economic well-being is central to supporting an equitable and attainable standard of living. The United Nations Development Programme (UNDP) uses the Human Development Index to “determine a standard of living and ultimately map “key dimensions of human development.”\(^70\) Using the Gross National Income per capita as a quantitative standard, mixed with other factors such as life expectancy and an educational index, the UNDP sees the HDI as one part in a larger project to determine what human development entails, including indices in poverty, human security, empowerment, and biodiversity. As an indicator for human well-being, economic factors go hand in hand with social and environmental factors.

**Infrastructure and Economics.** In most every nation and in cities especially, infrastructure plays a critical role in supporting economies. The United Nations recognizes the importance of infrastructure in sustainable development, with one of the Sustainable Development Goals being to “Build resilient infrastructure, promote sustainable industrialization and foster innovation.”\(^71\) In the United States alone, the American Society of Civil Engineers estimates over that over $100 billion has been lost from the United States economy due to congestion.\(^72\) The number of roadways, bridges, and other pieces of transportation infrastructure facing a state of bad repair could lead to even more tragic consequences. The Federal Highway Administration similarly agrees that the money we spend on transportation projects is far too low compared to the needs to sustain an efficient regional and national transportation network.

In cases where investments have been made to promote economic sustainability in infrastructure, the results have been promising. The oft-cited case of Curitiba, Brazil is one example of a city that has found continued success through equitable means of transportation. The UN Sustainable Development Knowledge Platform’s case study of Curitiba shows that the sustainable solutions they have implemented since 1968 have reduced flood mitigation expenditures by promotion of park development in flood-prone areas, created about 50,000 direct and 150,000 indirect job in the Curitiba Industrial City, a strictly regulated industrial park, and has reduced transportation time in general through the perfected use of Bus Rapid Transit.73

In Miller, the case study on Curitiba highlights the steep gains the city made in GDP per capita, which was 65% above average in 1996, after being no more well off than any other Brazilian city before its sustainability transformation.74 Closer to home in Arlington, Virginia, 40 years of transit-oriented development has built up one of the best linear business corridors in the country, leading to the highest county or city-wide per capita income in the state, and the second-highest in the country, per the American Community Survey.75

Infrastructure can also have severe negative consequences for people as well. In his popular book *Triumph of the City*, Edward Glaeser writes that as the Detroit economy started to slip in the 1970’s, leaders built a series of grand buildings with the hope that the development would reverse the down-trending economic indicators. Glaeser writes that “the tendency to think that a city can build itself out of decline is an example of the edifice error, the tendency to think that abundant new building leads to urban success….The failures of urban renewal reflect a

74 Miller, 586.
75 https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP03&prodType=table
failure at all levels of government to realize that people, not structures, really determine a city’s success.”

In the Bronx, our system of highways and expressways has severely cut off local economies from thriving, as the traditional urban form of interconnected streets loses its power, and economic zones become severely limited.

**Greenways as servicable infrastructure.** Knowing infrastructure has an enhanced role in building economies, the greenway as a piece of transportation infrastructure in cities can play an impactful role as well. One of the clearest ways greenways and other sorts of urban trails can impact cities is through property values. And while many have argued that trailways can decrease property values, collected studies have for decades proved otherwise. The Headwater Economics Research Group estimates that from most surveys conducted on property values and proximity to trails, property values of homes near trails can often rise five to ten percent. This longitudinal survey of real estate surveys demonstrates at least a trend, but specific examples show just how impactful the relationship can be. An often-cited survey from the Seattle Engineering Department in 1987 shows that just 16 years after the Burke-Gilman was built, had positive effects on perceptions of property ownership on the trail, actual property values, and became a marketable economic asset for real estate agents.

Beyond increased property rates, trails have the ability to generate new types of businesses and connect existing ones in new ways. In San Jose, home to a number of large tech companies, recreational greenways have slowly gained a large number of commuting cyclists. According to the San Jose Parks Trail Program, 58% of the 1000 or so bikers who use the trail on

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a weekday use it for commuting. Executives from companies like Cisco and Oracle have cited the Guadalupe River Trail as an asset for employees, and Colin Heyne with the Silicon Valley Bike Coalition cites these companies as active participants in the trail planning process.

In Colorado, the US 36 Bikeway is one of the most recent developments in bridging the gap between Denver and Boulder. With a number of “solutions” sponsored by 36 Commuting Solutions, a non-profit which has sponsored local economic development along the highway and better alternative transportation options between the two cities, including Bus Rapid Transit. Planning officials view the bikeway, which runs adjacent to the highway for 18 miles, and ties into local bicycling facilities and connects to the six US 36 RTD Stations. There is also wayfinding signage to guide bicyclists to existing bike paths and trail systems within the corridor.

Greenways that provide economic services are also proficient at developing new or innovative types of businesses. A strong example from Portland is Go By Bike, a local bike parking and service company that works with the Portland Aerial Tram for commuters who use the tram to get to the Oregon Health and Science University. Go By Bike is located right off a major cycle track near the Tilikum Crossing, a car-restricted bridge over the Willamette River which connects to a number of greenways in Portland including the Springwater Connector and the Eastbank Esplanade. With no economic hubs connected to bike infrastructure, these enterprises would have little grounds for success.

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79 https://sanjoseca.gov/DocumentCenter/View/6518
80 Interview with Colin Heyne, San Jose, 18 Aug. 2016.
81 http://commutingsolutions.org/us-36-projects/u-s-36-bikeway/
82 http://www.gobytram.com/about/
Trail-Oriented Development. As examples of economic benefits of greenways show up in urban areas across the country, trails have become legitimized as an important tool for enhancing economic development. To this end, the Urban Land Institute published the report *Active Transportation and Real Estate: The Next Frontier*. The 2016 report outlines a number of projects that have spurred real estate investment and development in cities across the country, but also highlights infrastructural projects like Minneapolis’ Midtown Greenway as major economic assets for a neighborhood. The report demonstrates that over $750 million in real estate development has occurred by developers who hope to build close to the greenway, while property values along the greenway have increased by 90 percent.83

Soren Jensen, the Executive Director of the Midtown Greenway Coalition says businesses in the area have a serious interest in the greenway. Over 750 businesses are members, many of which “adopt” sections of the greenway for sponsorship purposes. Soren believed the benefit here comes from the fact that private land is adjacent to the greenway; in essence, the greenway serves as a connector between residents, businesses, and economic districts rather than just a recreational amenity.84

Developments like MoZaic in the Uptown section of Minneapolis cite the greenway specifically as a key amenity to being Class A Office Space. The owners of MoZaic, the Ackerberg Group, say that “The ease of access to our project—including from the Midtown Greenway—definitely allowed us to charge premium rental rates. Whether employees get to the building by car, bus, [or] bike or on foot, MoZaic offers tremendously diverse transit options.

83 Urban Land Institute, “Active Transportation and Real Estate: The Next Frontier” Washington, D.C: The Urban Land Institute, 2016.
84 Interview with Soren Jensen, Minneapolis, 22 May 2016.
After opening, MoZaic saw immediate success and maintained a 100 percent occupancy rate as of 2016.” The Ponce City Market in Atlanta, Gotham West in Hell’s Kitchen, Manhattan, and The Flats at Bethesda Avenue in Bethesda all feature similar qualities along the BeltLine, Hudson River Greenway, and Capital Crescent Trails, respectively.

In all, greenways provide noticeable economic benefits to communities that other types of transportation infrastructure or recreational areas cannot provide on their own. From increased property values to new and innovative businesses, and use as bike highways to major business districts, greenways are part of a solution to create localized economies based on active transportation.

There is a need for further research in the field. The economic potency of non-motorized consumers is well documented, as observed in the Clifton’s research. While greenways have key roles to play, as seen in trail-oriented development, concrete economic services are supported mostly by qualitative examples than by quantitative data. Therefore, more research, including metric-based surveys, should be taken to evaluate the impact of the economic services greenways provide. Next, we will look at the broader social implications of localized communities based on trails, and the groundbreaking benefits communities can gain.

**Chapter 4: Connecting Communities**

After studying a number of greenway systems in multiple regions across the United States, my research on the ecological and economic services of greenways has confirmed some of the previous literature that highlights these benefits. Less talked about are the social services that greenways may provide urban areas. In the Millennium Ecosystem Assessment’s
breakdown of Ecosystem Services and Constituents of Well-Being, a number of social benefits are included in the “Cultural Services” section like ‘Aesthetic,’ ‘Educational,’ ‘Spiritual,’ and ‘Recreational’ services. I will demonstrate how greenways provide these services, but focus on the direct services of social cohesion, and defend the hypothesis that greenways are the best infrastructural promoter for social cohesion.

**Cultural Services.** The most obvious benefit of greenways is to provide recreational services for cities. Frederick Law Olmsted, cited previously and considered one of the foremost designers of park and open spaces, writes:

> Consider that [Central Park and Prospect Park] are the only places in their associated cities where, in 1870, you will find a body of Christians coming together, all classes largely represented, with a common purpose, not at all intellectual, each individual adding by his mere presence to the pleasure of all others, all helping to the greater happiness of each.  

Olmsted is referring to the general social benefits parks provide. Greenways, as linear parks, thus provide all the benefits that open spaces provide cities in general. Cities recognize these benefits and natural alignments of purpose by housing greenway operations and management under the Parks and Recreation agency. In Denver in 2016, Jay Henke served as the Trails Manager and a Senior Landscape Architect, working with a number of operating agencies to best manage and improve their system of greenways, including the Cherry Creek, South Platte River Trail, Sand Creek Regional Greenway, and a number of ancillary trails to the major trunks.

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Because greenways focus on movement, their recreational use promotes healthy forms of exercise and leisure time. In Minneapolis, where the Midtown Greenway Coalition conducted a survey on greenway use, 71 percent of respondents said they use the greenway for recreation. Based on field research conducted, a majority of the greenway users on the Midtown Greenway and Cedar Lake Trail are bikers. Other types of users noted include joggers, walkers, and in-line skaters. In Seattle, a hilly city with lots of elevation gains, many greenways exhibited a “spandex” culture, or a group of bikers who wear biking uniforms, usually indicative of cyclists who are riding for exercise or recreation.

Beyond recreation, many greenways also featured a number of aesthetic benefits listed in the Millennium Ecosystem Assessment as “cultural services.” On the Mountains to Sound Greenway, a long trail system connecting the City of Seattle to the Cascade Mountains east of the city, tunnels along the route hold murals and other street art. This can also be seen along greenways in Portland, while in Toronto on the Lake Shore Boulevard Trail, visual aids painted on the pathway indicate where cyclists should slow down before a heavily trafficked section of the path, or at an intersection.

Some of the most clear aesthetic services is the natural beauty that greenways can provide. In Seattle, the Elliot Bay Trail follows the shoreline of the Puget Sound, linking a number of parks and other cultural amenities of the city like the Pike Place Market and the Olympic Sculpture Park along a beautiful route with views of the Sound, Mount Rainier, and the

87 Bryan Kiel, “Minneapolis Sunday Field Notes,” Minneapolis Monday Field Notes,” “Minneapolis Wednesday Field Notes”
88 Kiel, “Seattle Day 1 Field Notes.”
89 Bryan Kiel, “Toronto Field Notes.”
Cascades. In Portland, the Marine Drive Trail follows a scenic route along the Columbia River, connecting other trails to beaches and parks along the historic waterway. Finally, in San Jose the Coyote Creek trail and the Guadalupe River trail terminate at the southern stretches of the San Francisco Bay, with the Coyote Creek greenway turning into a more scenic nature trail for residents.

Social Cohesion of Current Infrastructure.

Social Cohesion is an ambiguous term with many definitions. I hope to use a broadly agreed upon definition, which is used by the Canadian federal government’s Social Cohesion Research Network: “Sum over a population of individuals’ willingness to cooperate with each other without coercion in the complex set of social relations needed by individuals to complete their courses.”

This definition is formulated by considering three key components: (1) social cohesion appears to be based on the willingness of people in a society to cooperate with each other in the diversity of collective enterprises… (2) that social cohesion is different from social order, which encourages concepts like shared values, conformity and social orderliness which have traditionally been tied to cohesion, and (3) an affinity between social cohesion and liberal social values. To the Social Cohesion Research Network, these traits make a strong community. Thus,

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90 Kiel, “Seattle Day 1 Field Notes”
I will evaluate the social services of infrastructure in context of how well they promote social cohesion, using the given definition.

While all roads have major utility considerations, highways have often been considered one of the largest tools planners and policymakers can use to change a social framework. The Since their prevalence in the 1950’s, high-speed expressways and other types of separated highways have been used as a “cure” for cities that were crowded, stagnant, or otherwise seen as “diseased” by planners. As the traditional model for economic success was suburbanization, highways provided the necessary arteries to connect the heart of the city to other parts of the metropolitan area. But as Jane Jacobs notes in the introduction to her classic The Death and Life of Great American Cities, planners and policymaker’s view of “diseased” was ignorant of thriving, if poor, communities, and was generally ethnically and racially biased. Highways were often put right through city centers where these communities lived, creating high-speed arterials for suburban folks, but barriers to social cohesion for urban residents displaced or separated by highways.

Some of the most devastating examples have occurred in the Bronx, NY. A series of expressways including the Cross Bronx, Major Deegan, Bruckner, and Sheridan were built between the late 1930’s to 1960’s to accommodate growing traffic across the New York Metropolitan area, including growing truck traffic. These expressways were part of a $800,000,000 program to build highways in the city. With construction led by master builder, Parks Commissioner and Chairman of the Triborough Bridge Authority Robert Moses, the Cross-Bronx was also federally funded as a slum-clearance project, which displayed over 1500

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families who lived in the East Tremont section of the Bronx. As Semuels notes in her analysis of highways, tactics that furthered segregation and forced community upheaval almost always sent levels of social cohesion downwards.

Highways can have other negative impacts as well. In areas near major highways in the Bronx, asthma rates are much more increased, mostly due to the highway system which converges near residential areas in the borough. According to to South Bronx Environmental Health and Policy Study conducted by NYU Wagner Graduate School of Public Service, the South Bronx has been especially affected, due to 20 percent of school children from Pre-Kindergarten to Eighth grade attending a school within 150 meters of a major highway, compared to 10 percent for the rest of the city. High asthma rates is a key indicator of environmental health, which has serious concerns for the public health of a community, and the ability for a community to achieve its own ends, a central tenet in the theory of social cohesion.

**Greenways’ Social Services.** Through qualitative analysis of greenways in the case study cities visited, my hypothesis is that greenways provide services that benefit social cohesion. In Boulder, the greenway system connects residential areas throughout the town to a trunk system of pathways that intersects some of the largest social gathering areas in the City, including the University of Colorado, Pearl Street Mall, the Boulder Public Library, and Central Park. According to Christin Shepherd, the greenways are frequently used by younger families.

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95 Semuels, “The Role of Highways in American Poverty.”
and children, and create social capital out of the natural amenities the greenways are designed to protect.

In Minneapolis, veteran greenways like the Cedar Lake Trail have spurred a number of social enterprises that are easily accessible along the pathway. The Bronx Park Community Garden was active on a Sunday afternoon, with some members saying they would pass the garden while riding on the greenway before deciding to join as members themselves. Another cyclist on the Cedar Lake Trail cited the cities ease of cycling as one of the biggest reasons she has decided to continue to live in Minneapolis, despite harsh winters. With social amenities like community gardens and a well-connected greenway network, Minneapolis attracts active community members who use the greenway and its facilities in a diverse number of ways.

In San Jose, the Guadalupe River Trail connects downtown San Jose with a number of businesses, an economic service explored before. Along the way, the trail also connects other social and transportation amenities such as parkland, nature preserves, and even the San Jose International Airport. These connections highlight the potential for a greenway to provide the necessary connections most highways would provide, while still following the ecological, economic, and social services dynamic greenways follow in all cities studied.

Portland’s greenways demonstrate a number of innovative solutions, including controversial uses that have tested the resolve and interests of a community. On the Eastbank Esplanade, a number of cultural and infrastructural amenities tie the trailway into a deeply urban fabric; bridge crossings, museums, parks, and waterfront activities like boat tours and kayak

97 Interview with Christin Shepherd, Boulder CO, 20 May 2016
98 Kiel, “Minneapolis Sunday Field Notes”
rentals all abutt the Esplanade. More controversially, the Springwater Corridor in Eastern Portland has been the home for large homeless encampments, which has irked many local residents and businesses. With over 500 individuals living on the trail in the summer of 2016, the Multnomah County sheriff’s department employed clearing measures to ensure the “safety and cleanliness” of the trail for all users.99 While greenways provide little suitable residential space, the fight between “open-range campers” and residents who use the trail for traditional uses provides interesting precedent for how cities can envision public space. In this case, the greenway is stirring the pot on social cohesion, challenging the traditions and norms of a community, while providing an example of yet another example of diverse social use and interaction on greenways.

Perhaps the best example of positive social cohesion that is enabled through greenways is the trails of Davis, California. According to Steve Tracy, an urban designer who is board member of the nonprofit Bike Davis, Davis’ residential growth has generally included the construction of public land between housing rows, providing space for a system of trails. This system, known as the Davis Greenbelt, connects blocks at the end of the street with a branch of the greenbelt, which then connects to parks, schools, public pools, and many other public amenities without any street interference. Schools and houses are planned with the greenbelt in mind; Steve noted many since most greenways never bisect a street, parents feel safe letting their

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children as young as six bike to school on their own.\textsuperscript{100}

\begin{figure}[h]
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\includegraphics[width=\textwidth]{davis_bike_map}
\caption{Davis, CA Bike Map with Greenbelt Connections, maps.google.com}
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Davis’ greenbelt system provides a strong sense of autonomy to children and others who want to get around the town without competing with cars. Perhaps most impressive is the fact that Davis is quite segregated by two major highways: CA-113 and I-80. With four pedestrian-only bridges, multiple bike lanes on overpasses and greenways purposefully connecting neighborhoods, the highways pose little threat to the strong social cohesion that the town enjoys.

The University of California at Davis, by far the largest institution in the city, has worked with the city to mimic its own trail system. In the new “West Village”, a mixed use development

\textsuperscript{100} Bryan Kiel, “Interview with Steve Tracy,” Davis, 18 Aug. 2016
is prominently built along a bike pathway, connecting West Village with the main campus across CA-113. West Village’s mix of uses, from housing to academic offices and recreational amenities, ensures around-the-clock presence, which gives frequent life to the greenway. The path from West Village to the main parts of campus is actually the fastest route of any mode of transportation, which encourages use as well. The path also connects to more recreational trails which leave the city, which encourages a more diverse group of people using it, including recreational cyclists and commuting cyclists.

In urban areas where open green space is either unavailable or hard to access, greenways play a final integral role in connecting residents with nature. In Richard Louv’s *Last Child in the Woods*, Louv presents the concept of a “nature-deficit disorder” in which humans, especially children, can have noticeable behavioral and other social-relationship problems and limitations due to a lack of exposure to the natural world. While Nature-deficit disorder is not a diagnosable condition, Louv said later in an editorial that he believes it is rather a social condition, one that especially affects urban communities.

In a return to the Bronx, we may be puzzled at Louv’s assertion. The borough happens to be one of the greenest in the city, with major parks like Van Cortlandt Park and Pelham Bay Park composing a large part of the borough. However, with the vast majority of the population living south of these amenities, access is quite difficult. Amenities like the Bronx River Greenway, funded by City, State, Federal funding, as well as private donations, have a major role in connecting the residential population to the large green spaces. Similar linear parks exist in

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101 http://westvillage.ucdavis.edu/origins
Boston with the Rose Kennedy Greenway, Minneapolis with the Midtown and Cedar Lake Greenways, and in San Jose with the Coyote Creek Greenways.

In all, the social services of greenways are probably the least studied amenities by experts in bike infrastructure and park planning. In my case studies and secondary research, there seems to be numerous qualitative analysis for a variety of benefits, much of which is centered around the enhancement of social cohesion in communities. Further research should try and quantify what services infrastructure can actually provide to concepts of social cohesion, and determine the effect a greenway may have. Next, I will conclude my study by noting some design trends of successful greenways, and hypothesize about the benefits greenways can provide the Bronx and New York City as a whole.

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<tr>
<th>Summary List of Social Groups which interact on Greenways</th>
<th>Example of Group Users</th>
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<tr>
<td>Group</td>
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<tr>
<td>Age Groups</td>
<td>Teenage Users</td>
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<td>Ethnic Groups</td>
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<td>Geographic-Based Groups</td>
<td>Users who live in Close Proximity</td>
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<td>Occupation Status Groups</td>
<td>Student Users</td>
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<td>Racial Groups</td>
<td>Black Users</td>
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<tr>
<td>Recreation Groups</td>
<td>Casual Cycling Users</td>
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</tbody>
</table>
Residential Groups       Suburban Users
Socioeconomic Status Groups       Upper-Middle Class Users
Transportation Groups       Rush Hour Commuting Users

Figure 4. Summary List of Social Groups which would add to a greater sense of Social Cohesion

Chapter 5: Linking the Big Apple: Design Methods and Lessons Learned for New York City

I wish to finally highlight a number of design considerations that were found on successful greenways that could be considered here in New York. I hope to highlight a few innovative approaches to design, construction, use, and the maintenance of greenways, and create a list of three policy recommendations that the City of New York can use to expand their already large network of greenways. In the process, I hope to show how greenways have already impacted New York City, and how their expansion can alter specific communities, alleviate congestion for transit systems, and work with a growing on-street bicycle network to improve active transportation in the city.

The first design consideration I’m interested in is the greenway’s use as recreation. In most cities, the greenway system is managed by the Department of Parks and other open-space officials. In Denver, the trailways beyond main trunks in the city center have strong recreational purposes which encourage a variety of folks to use the trail. On the Lakewood Gulch Trail, a satellite trail off the South Platte River trail, a disc golf course follows the greenway, a planned design to add varied use. Just as well, extensions of the South Platte River trails in northern Adams County are landscaped to the existing natural features, creating a scenic trail that attracts many sorts of recreationalists. Cyclists that I talked with included men from miles away, who
enjoyed cycling long distances with each other, and found that the greenways were amenable to long distance trips and shorter ones with their spouses.  

Another encouraging feature of a greenway was its level of flatness. The most popular greenways visited were almost always flat. This could exist for a number of reasons, including the fact that flatter land is more tolerant of high-density living, or the most scenic greenways followed a natural flat corridor. Indeed, greenways that were less hilly, such as the I-205 Multi-Use Path in Portland, featured less users even though its northern and southern greenway connections, namely the Marine Drive Trail and the Springwater Corridor, were well used by recreational users and commuters, respectively. The Midtown Greenway in Minneapolis, Burke-Gilman Trail in Seattle followed railways, part of a larger “rails-to-trails” development that is popular in repurpose-based design. In many other cities like San Jose, Denver, and

Figure 5. The South Platte River Trail in Adams County, CO follows a Natural corridor along the River, creating a sustainable and enjoyable trailway.

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103 Kiel, Denver Day 1 Field Notes
Boulder, the decision to follow natural corridors that are flat (creeks, rivers, and hill ridges) creates flatter surfaces for more popular use.

A second major design consideration is the signage on the greenway. Wayfinding, placemaking, sponsorship, and identification signage all contribute to the character of a greenway. Generally, the best greenways for transportation had adequate signage that allowed a user to know their location, distance to major destinations, and locations and directions of other landmarks. On the major greenways in Denver, the Cherry Creek trail and the South Platte River trail, signs led to major destinations like downtown Denver, the Auraria educational Campus (home to three major higher education institutions in Denver), sports and entertainment districts like Mile High Stadium, and directions to other satellite greenways (and the neighborhoods and major roads those greenways served).

In Minneapolis, signage had a few purposes as well. The Cedar Lake trail featured consistent mileage markers going towards and away from downtown, and maps and other wayfinding markers were present along the full route, even as it left the City of Minneapolis and entered suburban Hennepin County. This continuation of signage spoke to the high level of coordination that greenway officials conduct in order to maintain successful greenways inside the city and into their suburban stretches.

Even more interestingly, consistently-spaced signage along the Midtown Greenway in Minneapolis featured the names of major sponsors of the greenway. While one can take this to mean mere advertising, Soren Jensen of the Midtown Greenway Coalition said this sort of signage encouraged local businesses to become members, bolstering the small business community in the Midtown Section of Minneapolis, and creating better social connections.
between the greenway and its residents. Similar advertising could be seen for greenway sponsors on the Sand Creek Regional Greenway in Denver and Commerce City, CO, where local industrial companies like Xcel Energy have sponsored volunteer days and greenways cleanups.

In Seattle, the King County Parks and Recreation Division brands much of their greenways with maps and informational signage that includes their brand, creating a strong sense of ownership that helps build the idea of a greenway network. An even better type of placemaking signage is featured very often along the Rose Kennedy Greenway in Boston, where informational signs tell of the history of the greenway and describe the lush horticultural elements of the park. And perhaps the most innovative sign seen on a greenway is Toronto’s use of maple leaves. These painted features in front of intersections and driveways along the Lake Shore Boulevard served as a visual que for greenway users to slow down and be vigilant for

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104 Interview with Soren Jensen, Minneapolis, 22 May 2016.
105 King County Parks and Recreation Division, “Regional Trails in King County,” 2013
crossing traffic. The cultural marker is not only a distinguishing feature of the trail (an example of place-making), but also a practical traffic sign.

In places where signage is lacking or of a low quality, the quality of the greenway may be affected too. On the Cedar Lake trail in Hennepin County, MN, maps along the trail were noted by other recreational cyclists new to the trail to be inadequate. In other places like the High Line Canal Trail in Southeast Denver and Aurora, CO, the trail greatly lacked signage. In turn through-cyclists were few and far between, even though it connected to the well-used Cherry Creek Trail.

Figure 7. The painted Maple Leaves on the Lake Shore Boulevard Trail in Toronto indicate a crossing with vehicles, a well-designed and useful visual indicator.
Finally, a third important design consideration for planners is the greenway’s connection to public transportation. While some trails like the Guadalupe River Trail and the Coyote Creek Trail in San Jose lacked this entirely, others were planned to be connected to public transportation when the corridor was built. One of the most clear examples is on the Lakewood Gulch Trail in Denver. The eponymously named trail follows the Lakewood Gulch, a stream from the Front Range of the Rocky Mountains which flows into the South Platte River. The greenway runs parallel with the W Light Rail line for two miles, which steadily climbs in elevation to the town of Golden in the foothills of the Rockies. This connection is great for cyclists who may be interested in cycling down into the city, on a network of street-paths and greenways, but take public transportation back up the hill.

Multi-modal commuting is a possible option for car-free commutes on greenways as well. The Burke-Gilman trail has a newly designed overpass connector to the University of Washington light rail station, which would connect commuting cyclists coming south of the Burke-Gilman to Downtown Seattle on multi-modal trips. In Portland, the newest bridge over the Willamette River, the Tilikum Crossing, is open to just cyclists, busses, and the MAX light rail service, one of the most well-designed transit-friendly, car free bridges in the world. The Midtown Greenway, which sits on the land of an old freight railway, now is studying the costs and benefits of a potential streetcar that would run directly parallel with the Greenway, an initiative that the Midtown Greenway supports, and which ridership could be large.\footnote{Interview with Soren Jensen, Minneapolis, 22 May 2016.}
Portland’s public transportation service goes one step further: unlike most other public transportation agencies, the transportation agency Tri-Met has no cap on the number of bikes allowed on their light rails, and designates many spots for bikes. Caltrain, a one-line commuter rail service between San Jose and San Francisco, is also progressive in regards to the number of bikes they allow on, with designated bike cars on every train that runs, during peak and off-peak hours.

In New York, these three design considerations can help city planners implement some of the top greenways in the country. Already, greenways like the Hudson River Greenway, the Brooklyn Waterfront Greenway, and the Bronx River Greenway feature a variety of uses, integrate many different users, and have unique ecological benefits, from greenhouse gas remissions to conservation efforts of forest ecosystems. By enhancing recreational access of our present greenways, users may feel more at home with their ecological setting, and feel more connected to the natural history of the city.

Additionally, required signage can make our greenways more safe, useful, and interesting. Uncompleted sections of the Brooklyn Waterfront Greenway and the Bronx River Greenway create hazardous conditions when cyclists don’t have a clear approach. Additionally, it is hard to tell which cross-street you are near on some parts of the Hudson River Greenway. These examples of poor signage take away from the greenways’ intended use.

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107 https://trimet.org/bikes/
108 Interview with Sebastian Petty, San Mateo, Aug. 16, 2016
Finally, greenways can have huge implications in a city where public transportation is being choked by ridership and traffic congestion. To encourage better harmony between our public transportation systems and our greenways, greenways should be reviewed along current transit corridors to see whether implementation would relieve traffic conditions for busses or congestion issues for subways. This seems most appropriate an option for above-ground trains that follow street corridors like the 4 train over Jerome Ave in the Bronx, the 1 train over Broadway in the Bronx, and the 7 train in Queens.
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109 *Field notes were conducted throughout trips and interviews. Notes taken electronically were categorized by day the notes were taken, while handwritten notes were prescribed a page in the notebook I took with on my travels.


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### Appendix 1: List of Cities and Greenways

<table>
<thead>
<tr>
<th>City, State</th>
<th>Greenway Name</th>
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<tbody>
<tr>
<td>Denver, Colorado</td>
<td>South Platte River Trail</td>
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<td></td>
<td>Cherry Creek Trail</td>
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<td></td>
<td>Sand Creek Regional Greenway</td>
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<td>High Line Canal Trail</td>
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<td>Boulder, Colorado</td>
<td>Boulder Creek Trail</td>
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<td>U.S. 30 Bikeway</td>
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<tr>
<td>Minneapolis, Minnesota</td>
<td>Midtown Greenway</td>
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<td></td>
<td>Cedar Lake Trail</td>
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<td></td>
<td>Hiawatha Bike Trail</td>
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<td>Dinkytown Greenway</td>
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<td>Boston, Massachusetts</td>
<td>Rose Kennedy Greenway</td>
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<td>Toronto, Ontario</td>
<td>Lake Shore Boulevard Greenway</td>
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<tr>
<td>San Jose, California</td>
<td>Guadalupe River Trail</td>
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<td>Coyote Creek Trail</td>
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<td>Portland, Oregon</td>
<td>Eastbank Esplenade</td>
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<td>Springwater Corridor</td>
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<td>I 205 Multi-Use Path</td>
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<td>Columbia Slough Trail</td>
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<td>Marine Drive Trail</td>
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<td>Seattle, Washington</td>
<td>Burke-Gilman Trail</td>
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<td>Area</td>
<td>Greenway</td>
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<tr>
<td>Interurban Trail</td>
<td>Mountains-to-Sound Greenway</td>
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<td>Elliott Bay Trail</td>
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<td>New York, New York</td>
<td>Bronx River Greenway</td>
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<td>Hudson River Greenway</td>
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