



TOWN OF TONAWANDA
2015 BICYCLE MASTER PLAN

Master of Urban Planning
2015 Fall Studio
December 2015





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2015 Bicycle Master Plan
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School of Architecture & Planning



PREPARED BY

**MASTER OF URBAN PLANNING
2015 FALL STUDIO**

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Our thanks to all who participated in the creation of this document.

Town of Tonawanda Bicycle Master Plan

User's Guide

The Town of Tonawanda Bicycle Master Plan was created to be a living, easy-to-use document accessible to a variety of intended audiences. This User's Guide is a unique and innovative addition to this plan in order to make it easy to use. A User's Guide can be useful and conceptually transferrable and used in other areas of interest, projects, plans, or locations such as other towns like Tonawanda. Below you will find a flow chart to help guide you through the plan based on topics or themes that may be of interest to different users

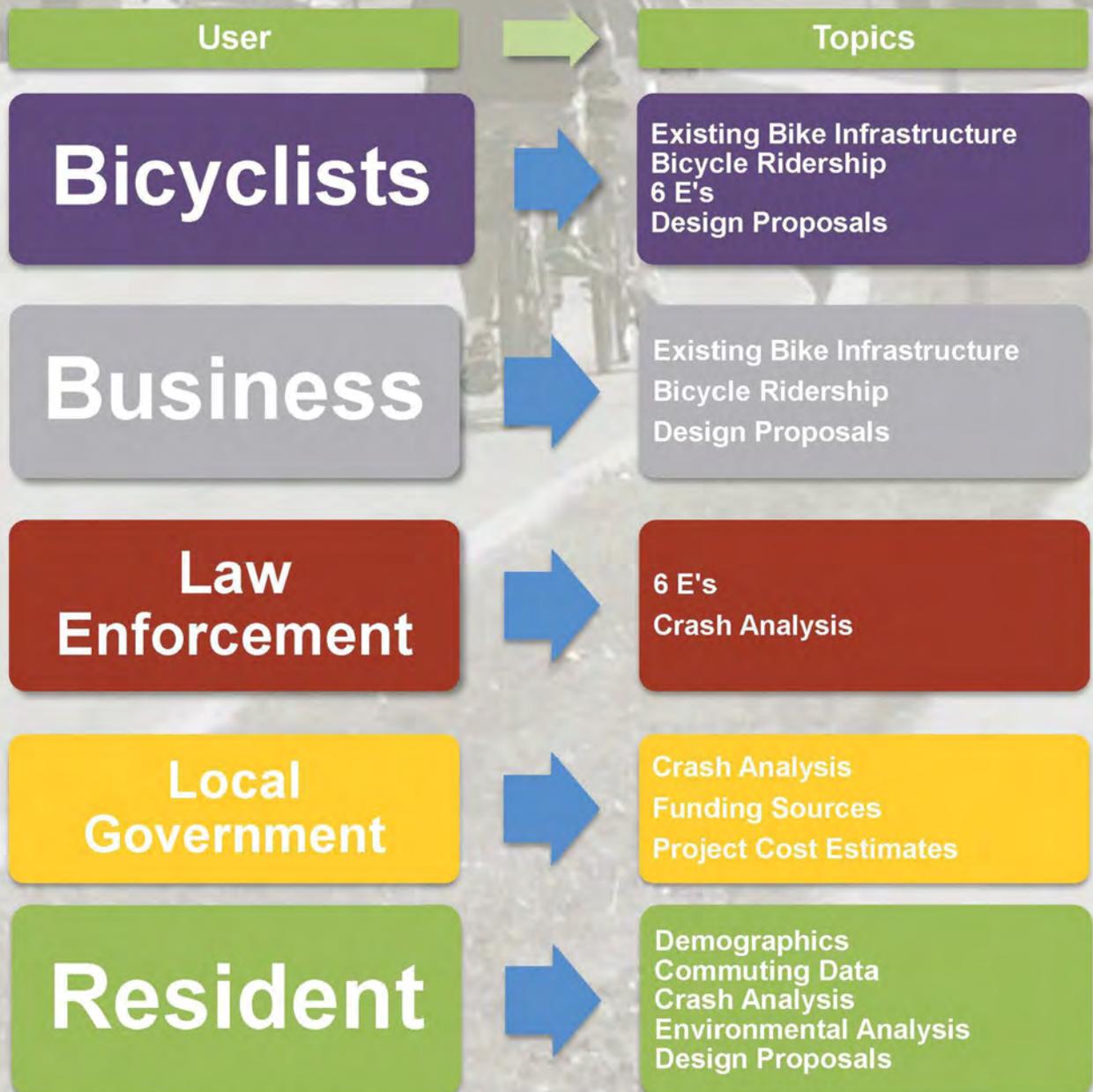


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SECTION I

INTRODUCTION

EXECUTIVE SUMMARY



The Town of Tonawanda Bicycle Master Plan has been prepared to guide the town's future bicycle plans and policies. The plan provides new transportation and recreational alternatives for residents of the town while strengthening existing bicycle facilities. The Town of Tonawanda began a Complete Streets Committee in 2015 to begin to address issues of pedestrians and bicyclists within the town. This plan was created to offer guidance on policies, prioritization, and project proposals to the committee. The plan also functions as a Town of

Tonawanda specific counterpart to the Greater Buffalo-Niagara Regional Transportation Council's 2008 Bicycle and Pedestrian Master Plan for Erie and Niagara Counties.

Town of Tonawanda Key Facts & Figures

Population: 73,567
 Median Age of Residents: 42.8
 Area of the Town: 20.4 square miles
 Miles of Local Road: 167
 Miles of Existing Bike Lanes: 11
 Miles of Proposed Bike Lanes: 12.5
 Number of Schools: 27

The Town of Tonawanda, established in 1836, developed in the mid-1800s after construction of the Erie Canal and again after World War II. Many original homeowners from the post war era still reside in the town. As a result, the town's median age is higher than surrounding communities creating challenges and opportunities. Although there are many reasons for people to move to the Town of

Tonawanda such as favorable tax rates, proximity to the City of Buffalo, access to natural resources for recreation, good schools, and affordable housing the population has decreased in recent years. The Town is now beginning to take moves to actively improve quality of life and attract new businesses and residents, forming the Complete Streets Committee is a part of that effort.

The Town of Tonawanda Bicycle Master Plan strives to provide a logical justification as well as innovative project proposals for the future development of a bicycle network. The plan has potential applications for other inner-ring suburbs and small towns with aging populations as well as arterial corridors with a limited amount of walkability due to suburban sprawl and automobile dependence. Tonawanda as a community offers recreational spaces and employment centers within town borders. The town's location in the Western New York region also provides opportunities for increased bicycle linkages to the City of Buffalo as well as the North and South Campuses of the State University of New York at Buffalo.

This plan proposes nearly 12.5 miles of bike lanes on priority roads, which will strengthen connectivity to destinations within and outside the town for recreational and commuting bicyclists, increasing the number of bike lanes to cover approximately 12 percent of roads in the town. The plan focuses on creating bicycle connectivity to geographic spaces including education nodes, employment nodes, commercial nodes and recreational nodes. Currently, there is a lack of infrastructure on major arterial corridors in the Town of Tonawanda, causing it to be unsafe for bicyclists and limiting bicycle access to the major nodes.

Bikers on Parker Avenue



The Town of Tonawanda's Complete Streets Committee is key to implementing future bicycle facility improvements. Surrounding municipalities have begun to plan for bicycle infrastructure, and have made commitments to implement. Tonawanda's formation of a complete streets committee enables the town government to begin to implement improvements in bicycle infrastructure more effectively. The City of Buffalo is in the process of developing a bicycle plan and the mayor has committed to adding ten miles of bicycle lanes every year. Additionally, the Town of Amherst has a Context Sensitive Highway Report that includes bicycle infrastructure. The Town of Tonawanda Bicycle Master Plan will encourage recreational and commuter bicyclists and enables Tonawanda to keep pace with the region in the addition of bicycle infrastructure. Additionally, adding additional infrastructure will increase the value of the investment in existing of street bicycle and pedestrian trails, such as the Rails to Trails bikeway.

The Town of Tonawanda Bicycle Master Plan consists of three major sections. A background section examines existing conditions within the town as well as the "6 Es" model from the League of American Bicyclists (LAB), which is an approach to bicycle planning that has served as a guide for other municipalities. The 6 Es to the Town of Tonawanda Bicycle Master Plan are Encouragement, Evaluation and Planning, Education, Enforcement, and Equity.

Next, the data analysis section investigates further questions regarding the recreational habits of residents, lapses in infrastructure within the existing bicycle network, as well as other connectivity issues. This section also analyzes trends of bicycle crash reports to assess issues of safety. The analysis section then creates clear guidelines for prioritizing bicycling infrastructure proposals within the town. The data analysis section concludes with a community survey administered in order to collect data on bicycling in the Town of Tonawanda.

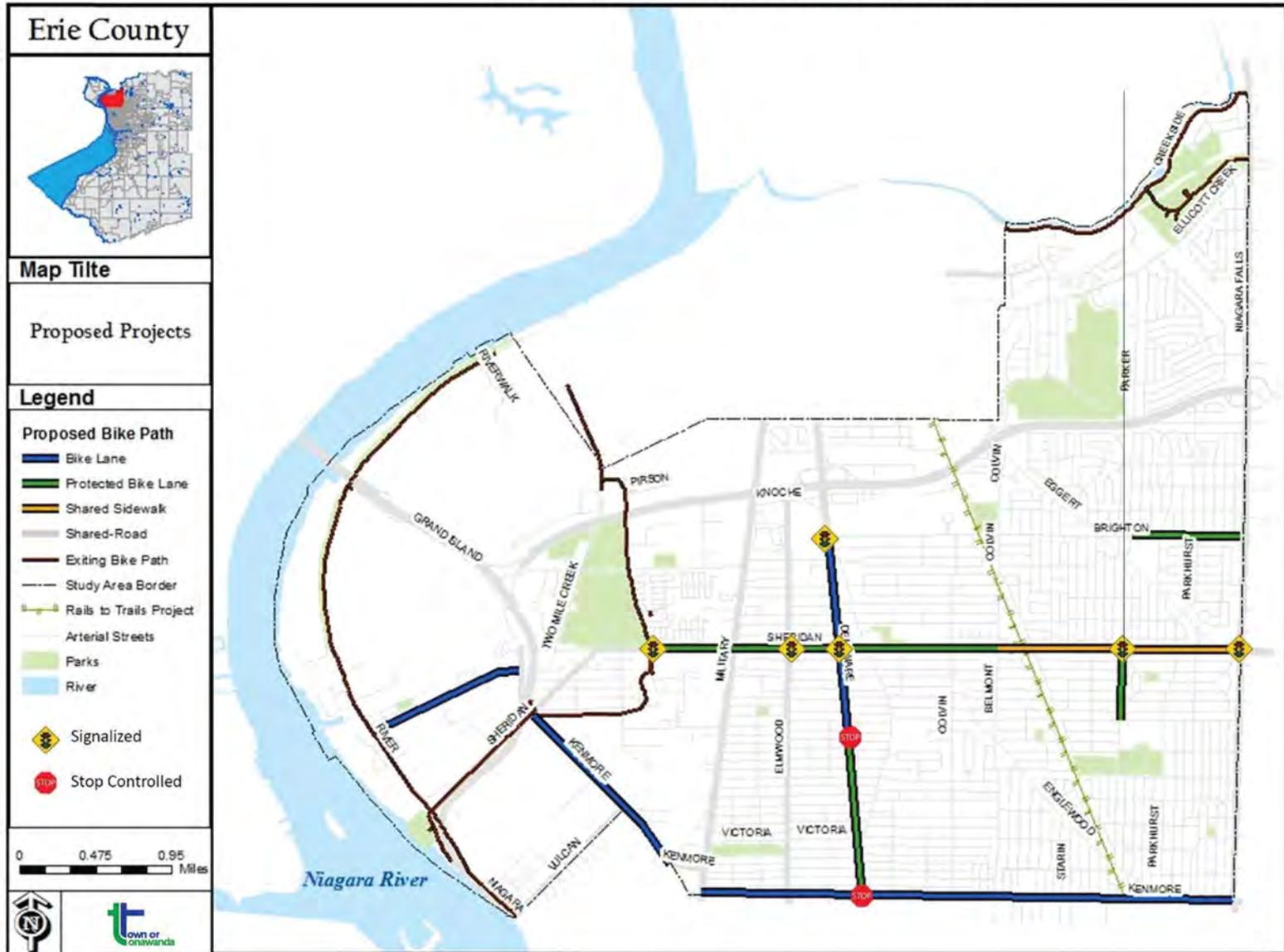


Bicycle-Friendly Town of Tonawanda

The plan prioritizes infrastructure improvement projects based on data gathered by the analysis section which is based on the results of the community survey, the connectivity and network gap analysis, the crash analysis as well as geographic ridership information gathered from Strava, a phone application that tracks bicycling and fitness. The plan concludes with design proposals for 12.5 miles of priority streets and intersections. The bicycle plan will create access to these recreational facilities by bike, strengthening existing facilities and promoting connectivity in the town and the region. Corridors with proposed bike lanes include Sheridan Drive, Delaware Avenue, Parker Boulevard, Brighton Road, Kenmore Avenue, Sheridan Drive, and Sawyer Avenue.

Improving bicycle infrastructure potentially benefits the health of residents by making physical transportation an easier and more alluring choice for both recreation and commuting. The Town of Tonawanda Bicycle Master Plan works to improve quality of life for town residents by proposing improvements of streetscape designed to encourage active transportation. Additionally, the Town of Tonawanda Bicycle Master Plan is innovative in that it provides a useful framework for small towns with insufficient planning resources to implement bicycle infrastructure; therefore it can easily be transferred and used as a guidance for what can be done with limited funding and resources in other similar municipalities.

Proposed Projects in the Town of Tonawanda



PLANNING PROCESS

From September through December 2015, 11 Master's of Urban and Regional Planning students from the University at Buffalo crafted a Bicycle Master Plan for the Town of Tonawanda. Jim Jones, the Town of Tonawanda engineer, was our point of contact for the town. After reading bicycle master plans from around the country, we met with Jim Jones on September 22nd to have a tour of the Town of Tonawanda. He identified problems that the town faces, such as a lack of east/west bicycle corridors, and showed new biking opportunities, such as the Rails to Trails. After this, we conducted an analysis, including a survey geared towards residents in the Town of Tonawanda, in order to identify where bicycle infrastructure is needed most in the town. The survey was open from October 15th through the 18th. After identifying which streets needed bicycle infrastructure the most, we developed design proposals. We also attended a Town of Tonawanda Complete Streets meeting on November 17th; the Complete Streets Committee will be instrumental in implementing proposals.

Overall, with our limited time, we have developed a thorough plan that is a beginning for bicycle planning in the Town of Tonawanda. The plan was presented to the Town of Tonawanda Planning Board on December 2nd, 2015. The Town of Tonawanda Planning Board was extremely interested and receptive of the plan. They shared concerns over biker speed, specifically on recreational paths, as well as costs of bicycle infrastructure. Their feedback was beneficial, and will help guide further studies on bicycle planning in the Town of Tonawanda.

INTRODUCTION

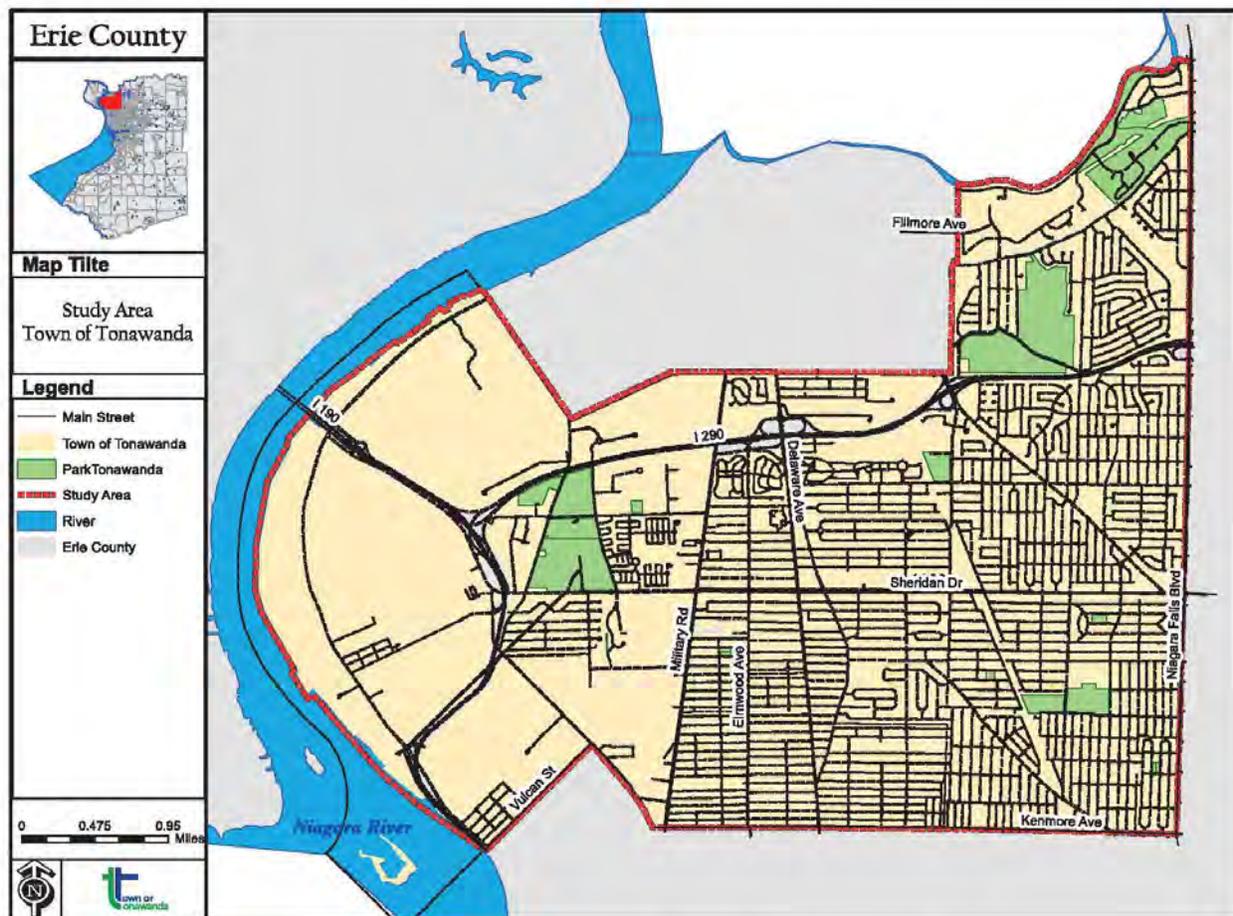
BACKGROUND



The Town of Tonawanda is located within Erie County in Western New York State. The town is in close proximity to Niagara Falls, the City of Buffalo, the Erie Canal, and the Niagara River. This Bicycle Plan aims to create safer and convenient routes in order to promote bicycle use within the Town of Tonawanda and connect the town with the

region. The plan includes bicycle infrastructure recommendations as well as plans for education and encouragement, in order to promote safe alternative forms of transportation. Implementation of the plan will necessitate work and responsibility between multiple stakeholders over many years.

Figure 1.1 Town of Tonawanda

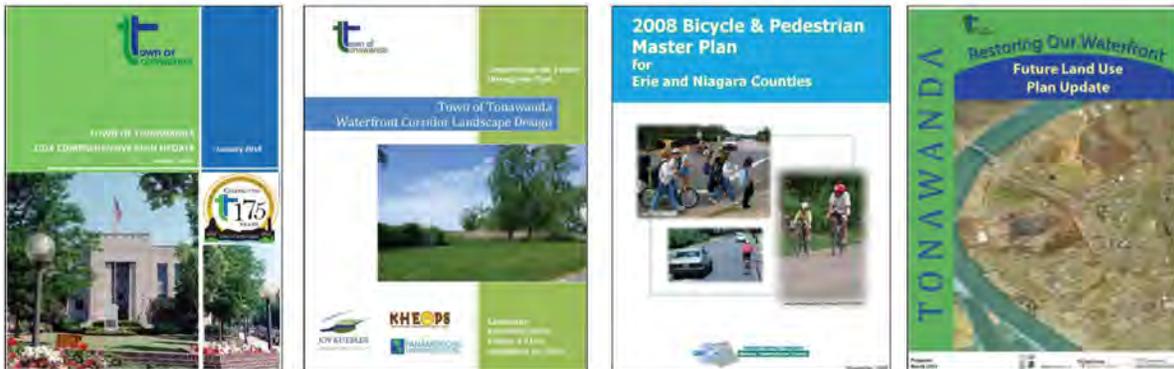


There are many reasons to promote bicycling in the Town of Tonawanda:

- Promoting active transportation helps to create healthier communities (National Complete Streets Coalition: Health, n.d.).
- Bicycle infrastructure can promote tourism. The western side of the Town of Tonawanda borders the Niagara River and the Erie Canal intersects the town, which are already tourist attractions (Flusche, 2012).
- The Town of Tonawanda is much denser in comparison to other suburbs and many residents work within the town, therefore many residents travel short distances. These trips may be suitable by bicycle.
- Promoting bicycle use instead of automobile use may positively affect air quality.
- “Complete Streets” influenced design will create a more equitable transportation system for the residents of the Town of Tonawanda. Providing alternative forms of transportation creates more inclusive and enjoyable neighborhoods.

EXISTING PLANS

- Town of Tonawanda Comprehensive Plan – updated in 2014
- Town of Tonawanda Waterfront Corridor Landscape Design - 2014
- Greater Buffalo-Niagara Regional Transportation Council (GBNRTC) Bicycle & Pedestrian Master Plan for Erie and Niagara Counties - 2008



- Waterfront Land Use Plan - updated in 2014
- Town of Tonawanda Complete Streets Committee – Formed in 2015

OVERVIEW OF EXISTING CONDITIONS IN TOWN OF TONAWANDA

In comparison to surrounding suburbs, the Town of Tonawanda has a high residential density of 3,364.5 persons per sq. mi. The 2014 population estimate for the Town of Tonawanda is 73,274 (U.S. Census Bureau, 2014). Due to the reasonable taxes, caliber and abundance of schools, affordable housing, and quality of services, the Town of Tonawanda draws residents from the region. Additionally, many residents are able to find work in the Town of Tonawanda. In 2010, 22.6 percent of the population worked within the town (U.S. Census Bureau, 2014).

The Town of Tonawanda has over 167 miles of local roads that are under the jurisdiction of the town. The town is well served by bus routes that connect to the City of Buffalo, but it is lacking in east/west routes. Unlike many suburbs, 80 percent of the streets have sidewalks, although many are in disrepair. The existing bicycle facilities in the town are mostly waterfront trails.

BICYCLE PLANNING IN THE REGION

- The Riverwalk Trail is a popular multi-use path in the Town of Tonawanda that borders the Niagara River, providing access to natural resources in the region.
- The Town of Tonawanda is implementing a four-mile Rails-to-Trails project (completion in fall 2015) that will connect the Town of Tonawanda to the City of Buffalo and the City of Tonawanda, enabling riders to safely and conveniently commute between municipalities.

- The Greater Buffalo-Niagara Regional Transportation Council's Bicycle & Pedestrian Master Plan for Erie and Niagara Counties aims to provide safe and convenient bicycle facilities throughout the region.
- The City of Buffalo will soon be releasing a Buffalo Bicycle Facility Master Plan, which will promote bicycle planning in the region. This work is being done collaboratively between the City of Buffalo, GoBike Buffalo and Alta Planning + Design.
- Byron Brown, mayor of the City of Buffalo, has committed to install ten miles of bicycle infrastructure annually.
- In 2008, the City of Buffalo adopted a Complete Streets ordinance. This means that when roads are repaired or constructed in Buffalo, consideration must be given to all commuters, not solely vehicles. Bicycles are included here, as well as pedestrians, disabled persons, public transit users, children, and the elderly.
- The Town of Amherst Bicentennial Comprehensive Plan (2009) states that one of the priority programs relating to transportation is to implement a bicycle and pedestrian network.
- The Town of Amherst has developed a Context Sensitive Highway Report, which includes proposals for multiple bicycle infrastructure projects. One proposal is for Sheridan Drive, which would end at the Town of Tonawanda border.
- In 2014, The Town of Amherst and the Village of Williamsville secured funding to support infrastructure improvements that will benefit bicyclists, increasing connectivity in the region.
- The Erie Canalway Trail is a popular recreational trail; it is 365 miles long and links many communities across the state. The Erie Canal intersects the Town of Tonawanda, bringing recreational riders to the Town.



MISSION

The Town of Tonawanda Bicycle plan aims to promote bicycling in a safe and convenient environment. A strong system of bike facilities can make bicycling a feasible form of transportation in the Town of Tonawanda, hopefully integrating bicycling into residents' form of transportation. Creating a bicycle network that is both accessible to all users and provides connectivity to work and play destinations will help promote equity within the Town of Tonawanda. Bicycle infrastructure in the town of Tonawanda will not only create access throughout the town, but it will connect with other bicycle infrastructure throughout the region. The bicycle plan also aims to educate and encourage residents in the Town of Tonawanda. Both bicyclists and motorists alike will be educated on safety and benefits of bicycling.

PURPOSE

The Town of Tonawanda is committed to implementing bicycle infrastructure along with connecting the town and the region. This will be done by *educating* both bicyclists and motorists, *encouraging* residents to use bicycle transportation, *enforcing* rules to make bicycling safe, and creating *equity* when determining where bicycle infrastructure will go, therefore *connecting* the town. Because the plan is a living document, it will be *evaluated* periodically to determine progress. Many goals in the town's comprehensive plan can be supported with the addition of bicycle infrastructure.

The bicycle plan will address the following goals in the Town of Tonawanda Comprehensive Plan:

1. Building a sustainable community

- "Maintain the safety, high quality of life, public health, and sustainability of our community." *Promoting bicycle transportation will contribute to the health of the community, as well as making it a more environmentally friendly community.*

- "Stewardship of the environment."

With the implementation of bicycle infrastructure, more residents will be inclined to use bicycles instead of cars.

- "How we move – promoting a safe and efficient multi-modal transportation system."

This bicycle plan strongly supports the promotion of other modes of transportation other than vehicular. With the implementation of bicycle infrastructure, bicycling will be made much safer in the Town of Tonawanda, and more locations will be more easily reached by bicycle.

2. Public policies

- "Holistic planning – improve interaction with other communities and agencies."

Throughout the implementation of this bicycle plan, multiple stakeholders will need to be involved. Many agencies will need to work together in order to successfully implement the bicycle plan. Additionally, it will be important to work with surrounding municipalities in order to work towards a regional bike system. This is an opportunity to improve regional planning efforts and strengthen relationships.

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SECTION II

BACKGROUND

EXISTING CONDITIONS

THE TOWN

Tonawanda

The Town of Tonawanda is the fourth largest municipality in Erie County. In 2010 the population was 73,567. Between 2000 and 2010, the population decreased by almost six percent. Interestingly, the density of the Village of Kenmore is higher than the density of the City of Buffalo. The Town of Tonawanda has a higher density than many surrounding suburbs. The 2040 projection for population of the Town of Tonawanda shows an 8.8 percent increase.

Although the population in the Town of Tonawanda has decreased, the number of households has increased. Due to the reasonable taxes, caliber and abundance of schools, affordable housing, and quality of services, the Town of Tonawanda draws residents from the region. Additionally, the many natural and cultural resources are an additional reason for visitors to come to the town.

With 73,567 people, Tonawanda Town is the 22nd most populated city in the state of New York out of 1,538 cities.



The largest Tonawanda Town racial/ethnic groups are White (87.4%) followed by Black (5.3%) and Hispanic (3.1%).



In 2014, the median household income of Tonawanda Town residents was \$49,036. However, 10.2% of Tonawanda Town residents live in poverty.



The median age for Tonawanda Town residents is 42.8 years old.

Land use in the Town of Tonawanda has been influenced strongly by access to natural resources as well as a demand for housing after World War II. The town is divided by Military Road into eastern and western sectors. The western sector borders the Niagara River and is mostly composed of industrial land uses. The eastern sector is mostly residential, but includes some commercial uses along major transportation routes and scattered industrial uses.

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housing, and quality of services, the Town of Tonawanda draws residents from the region. Additionally, the many natural and cultural resources are an additional reason for visitors to come to the town.

The Town of Tonawanda has over 167 miles of local roads that are under the jurisdiction of the town. The town is well served by bus routes that connect to the City of Buffalo, but it is lacking in east/west routes. Unlike many suburbs, 80 percent of the streets have sidewalks, although many are in disrepair. The existing bicycle facilities in the town are mostly waterfront trails. There are some on street bike routes on larger streets, but the Greater Buffalo-Niagara Regional Transportation Council (GBNRTC) rated these as "caution advised" routes (Greater Buffalo-Niagara Regional Transportation Council). The town is lacking bicycle facilities that connect the eastern part of the town with the waterfront (Town of Tonawanda).

SWOT ANALYSIS

A SWOT analysis is a structured planning method to identify the strengths, weaknesses, opportunities, and threats involved in a project. It is useful to understand current conditions as well as plan for future changes.

STRENGTHS

- Existing bicycle facilities, including Riverwalk, Sherwood Greenway, 2-Mile Creek Trail, and Ellicott Creek Park Trail.
- The implementation of the Rails to Trails program in the Town of Tonawanda connecting to the City of Tonawanda and the City of Buffalo.
- Safe Routes to School, a national program to create safe and convenient opportunities for bicycling and walking to schools, has been implemented at Glendale Elementary.
- Relatively flat terrain.
- Funding has been secured by NYS Department of Transportation for a study to change one lane of vehicular traffic into a cycle track in each direction on Sheridan Drive between East Park Drive to Belmont Avenue.



Figure 2.1: Tonawanda Park and Riverwalk in Town of Tonawanda

WEAKNESSES

- The lack of existing east-west bicycle corridors is a problem in the area – there is no convenient way to get from the eastern part of the town of the waterfront.
- Financial costs of implementation and maintenance of bicycle facilities.

OPPORTUNITIES

- Proximity to the Erie Canalway Trail and Riverwalk trail may bring bicycle tourism to the area.
- A large percentage of residents work within the town, therefore they may not commute far to work and may more easily start commuting by bicycle.
- The town has one of the largest school districts in the state.
- There is a growing aging population; retired people may be interested in recreational bicycling.
- The high density of residential and commercial uses in the eastern part of town makes for shorter commutes.
- The Town of Tonawanda is close to both University at Buffalo campuses, where almost 30,000 students attend school.
- Many roads in the town are over 50 years old and need extensive reconstruction; therefore, since they are already being reconstructed it is a great opportunity to include bicycle infrastructure.

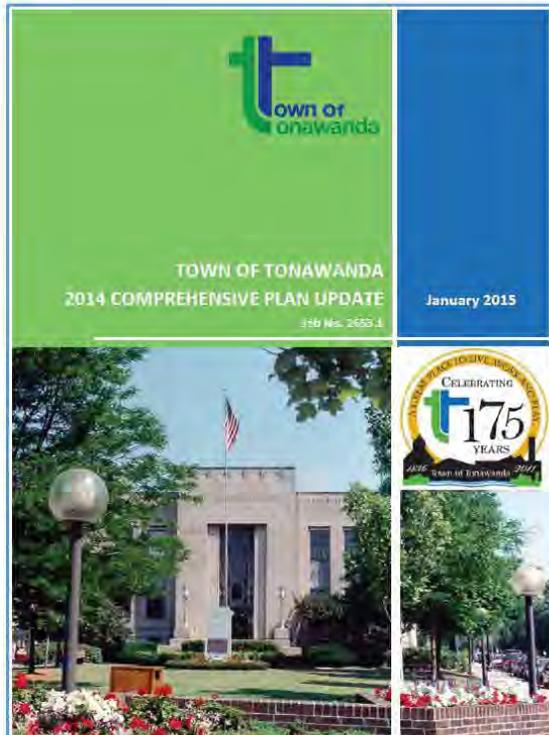
THREATS

- There is a large aging population in the Town of Tonawanda that may be averse to bicycling due to age, safety concerns, or other reasons.
- Residents in the Town of Tonawanda are comfortable with car travel and most census tracts possess high car ownership rates.
- There is concern whether the town is liable if people are hurt on town bicycle facilities if they are considered parks.
- Severe winter weather and associated maintenance costs may affect the feasibility of some types of thoroughfares.

JUSTIFICATION FOR BICYCLE PLAN

Access by cycling, walking, and transit uses to schools, parks, jobs, and shopping areas will be achieved through integrated and connected open space corridors along with the mitigation of barriers to non-auto travel such as state highways, canals, and busy arterials. A focus on smart land use design that is pedestrian supportive and transit friendly will greatly improve connectivity and encourage cycling for residents and non-residents of Tonawanda.

2014 COMPREHENSIVE PLAN INCENTIVE



An essential component of the 2014 Comprehensive Plan Update is the review and analysis of the existing conditions. Before the Steering Committee can chart where the town should be in the future, it is useful to start with a complete understanding of where the Town is today. Section III – Inventory of Existing Conditions provides a comprehensive description of the current physical and programmatic features of the Town, identifying significant changes that need to take place within the Tonawanda area.

The Comprehensive Plan shows a commitment on the part of the community toward a shared vision for its future. This commitment can be helpful in seeking governmental assistance for projects that help move the community toward that vision through the forms of grants. Finally, a Comprehensive Plan helps the community recognize what is important about the town. It identifies what is important to protect, support and encourage, and what elements of the town residents would like to see improved. It

Figure 2.2 2014 Tonawanda Comprehensive Plan

provides a clear assessment of where the town is now, vision on where residents would like to be, and concrete recommendations and strategies to help them get there.

Not all elements included in the plan will be achieved, but the plan contains a source of potential solutions to problems or issues that may arise in the future. It became clear over the course of this effort that people in the Town of Tonawanda are generally satisfied with the town, and residents do not seek major changes. Much of the focus of this document, therefore, is on improving transportation in the town.

The updated Town of Tonawanda Comprehensive Plan will provide guidance for local actions, with an emphasis on guiding redevelopment. It will serve as a basis for land use regulation, community projects, and public and private investment in the Town. It is the intent of this document that it will help guide decision making in the Town of Tonawanda into the future, in a manner that helps maintain features that the community values, while mitigating any potential impacts of future change.

GOBIKE BUFFALO



Figure 2.3: GOBike Buffalo organizational logo

GOBike Buffalo is a leading bicycle advocacy organization in Western New York, and a major partner of GO BNMC (GO Buffalo Niagara Medical Center). GOBike works with the city, the state, private businesses and the community to improve the infrastructure that supports bicyclists, and to increase awareness of the benefits of bicycling.

Plan

The City of Buffalo and GOBike Buffalo are working with Alta Planning + Design and sub-consultants Wendel and Mustard Seed Consultant Group to prepare a vision and action plan for the future of bicycling in Buffalo. The team led a public engagement and planning process over a 10-month period, ending in late spring, 2015. They met with stakeholders and the public to understand current bicycling conditions, and identify opportunities to improve comfort and safety throughout the city and to prioritize routes.

Prioritize

Through public outreach, field work, stakeholder engagement, and traffic modeling, a number of bicycling routes in the city will be identified. The routes will be prioritized depending on how critical a link they are in creating a complete bicycling network. The priority routes will then be illustrated at a high level of detail so that the City of Buffalo can envision how they would be designed and implemented. Where possible, the team will look carefully at protected bike lanes (called "cycle tracks").

Implement

The team will coordinate carefully with a local Stakeholder Committee to create a clear action plan to fund and implement the recommendations identified in the Bicycle Facility Master Plan Update. Funding sources will also be highlighted that can be leveraged to improve Buffalo's bicycling network. The master plan will categorize recommendations into short, mid and long term items, so that the network can be completed in sequences.

RAILS TO TRAILS

R2T Background



Figure 2.4: Rails to Trails Conservancy Logo

The Tonawanda Rail Trail is a four-mile off road trail under construction in the Town of Tonawanda that will span from Kenmore Avenue at the town's southern border with the City of Buffalo to State Street in the City of Tonawanda. The trail is 12-feet wide and the cost of completion is \$2.6 million dollars.

The trail will connect with the North Buffalo Rails to Trails, while at the north end it will link to another trail in development, spanning from State Street to East Niagara Street and the Erie Canalway Trail.

R2T Opportunities

The Project is an investment within the community that will promote connectivity between neighborhoods and allow residents from all over the Trail area to explore Erie County without having to get into an automobile. It provides access and opportunity for bicyclists and pedestrians.

Opening access for alternative travelers is something leaders of the project believe can spark new business, and create new customers.



Figure 2.5 Rails to Trails project in progress in Tonawanda

"There will] be numerous opportunities for people, all along Western New York and all along the bike paths to be able to hop on, get off at a lot of the communities, to be able to bring some much-needed business to those communities." - Tonawanda Mayor Rick Davis (WBFO).

Residents can now traverse communities by biking, jogging, or walking and enjoy access to the waterfront all the way from the Tonawandas to Buffalo. The Rails to Trails concept embraces smart growth principles by providing a variety of transportation choices (Smart Growth Online). The project promotes enhanced walkability and protecting open spaces while reinvesting in established neighborhoods.

CLIMATE AS A CHALLENGE

Tonawanda, New York, averages 39 inches of rain per year, while the US average is 37. Average snowfall is 82 inches. The average US city gets 25 inches of snow per year. The number of days with any measurable precipitation in the Town of Tonawanda is 169 (Climate-data.org). The elevation in Town is from 566-718 feet above sea level, meaning this place is mostly “flat”, and a solid fit for biking activities.



Figure 2.6: Winter challenges of shoveling and clearing snow in neighboring Buffalo, NY

Tonawanda, New York, gets 39 inches of rain per year. The US average is 37. Snowfall is 82 inches. The average US city gets 25 inches of snow per year. The number of days with any measurable precipitation is 169 (Climate overview, 2015).

Mean Temperature	
Summer	67.0° F / 19.4° C
Winter	27.8° F / -2.3° C



Figure 2.7: Tonawanda, NY: Gateway Park in the City of Tonawanda; Photo Credit: City-data.com



Figure 2.8: Tonawanda, NY: Gateway Park in the City of Tonawanda; Photo Credit: City-data.com

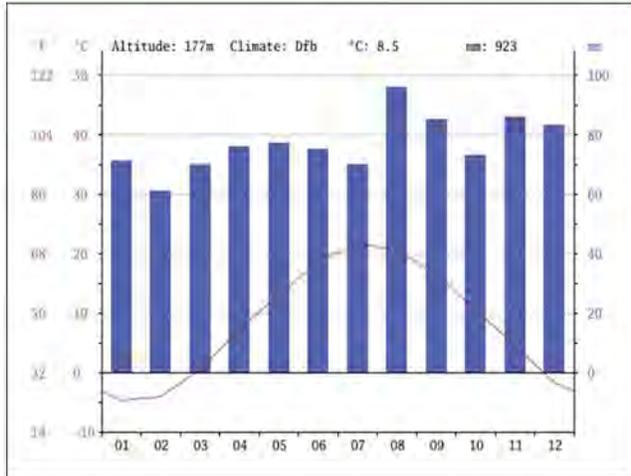


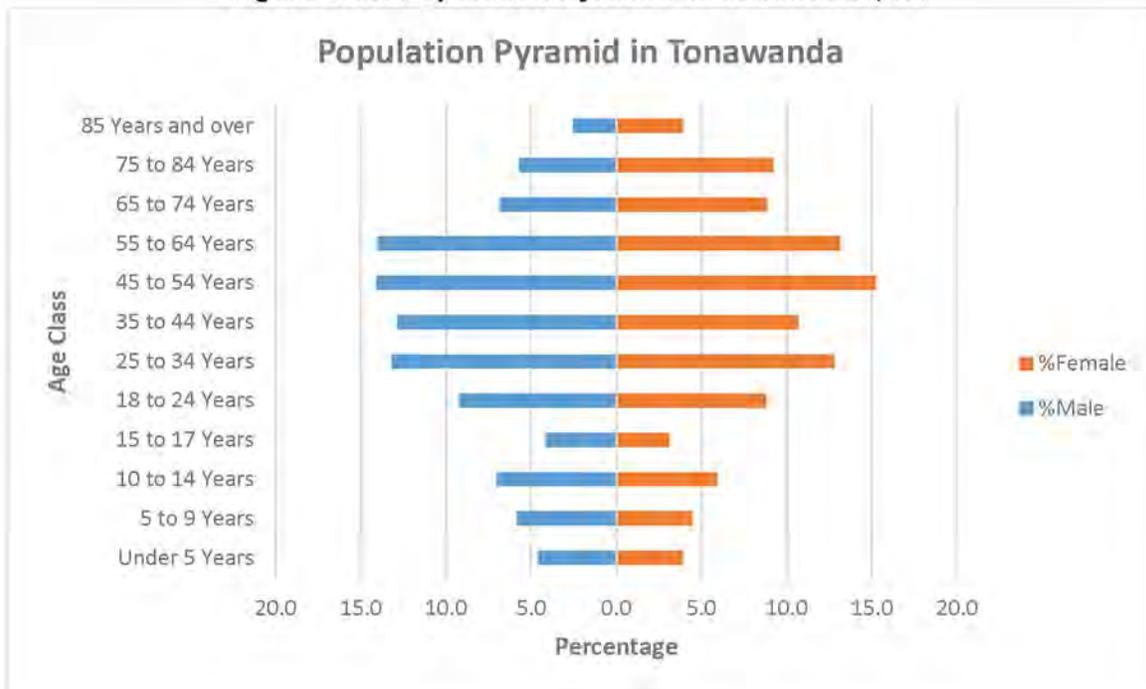
Figure 2.7 Climate in Town of Tonawanda (Climate-data.org, 2014)

On average, there are 157 sunny days per year in Tonawanda, New York. The July high is around 80 degrees. The January low is 9. Our comfort index, which is based on humidity during the hot months, is a 53 out of 100, where higher is more comfortable. The US average on the comfort index is 44 (Sperling's BestPlaces).

The weather conditions in Tonawanda show challenges for improving biking activities on rainy days or during winter. The town must also deal with additional maintenance requirements of streets, sidewalks, and bike paths such as plowing snow and repairing potholes due to the weather conditions.

POPULATION DENSITY AND INCREASED AGING POPULATION

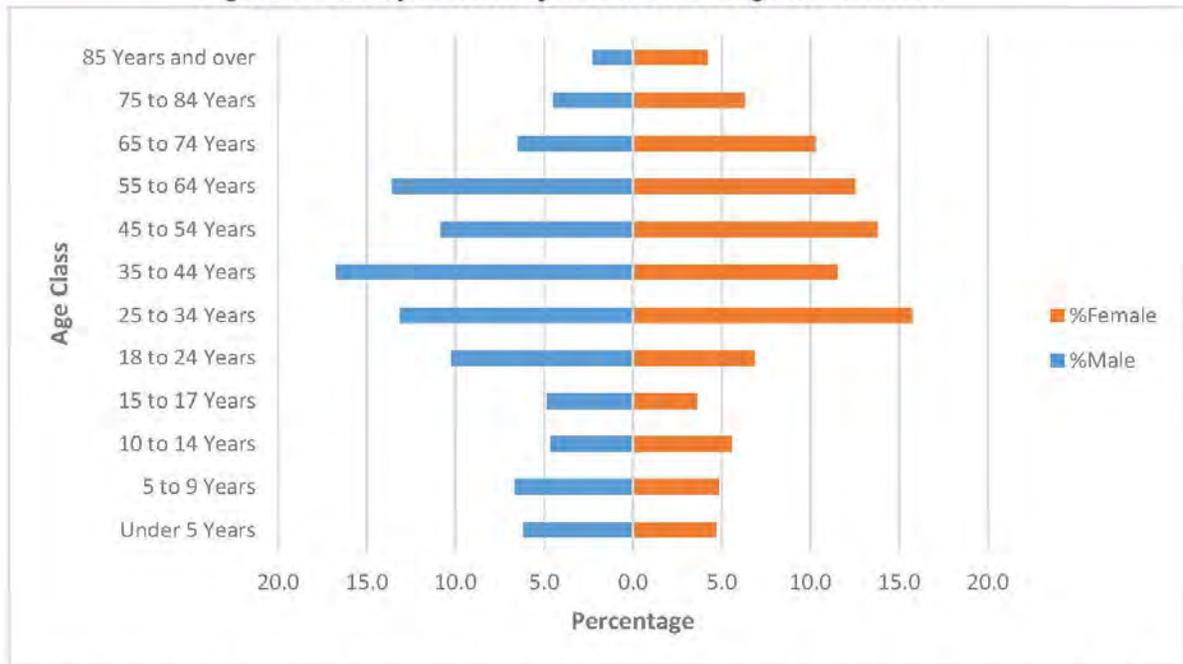
Figure 2.10: Population Pyramid in Tonawanda, NY



Data source: U.S. Census Bureau 2009-2013 American Community Survey 5 Year Data

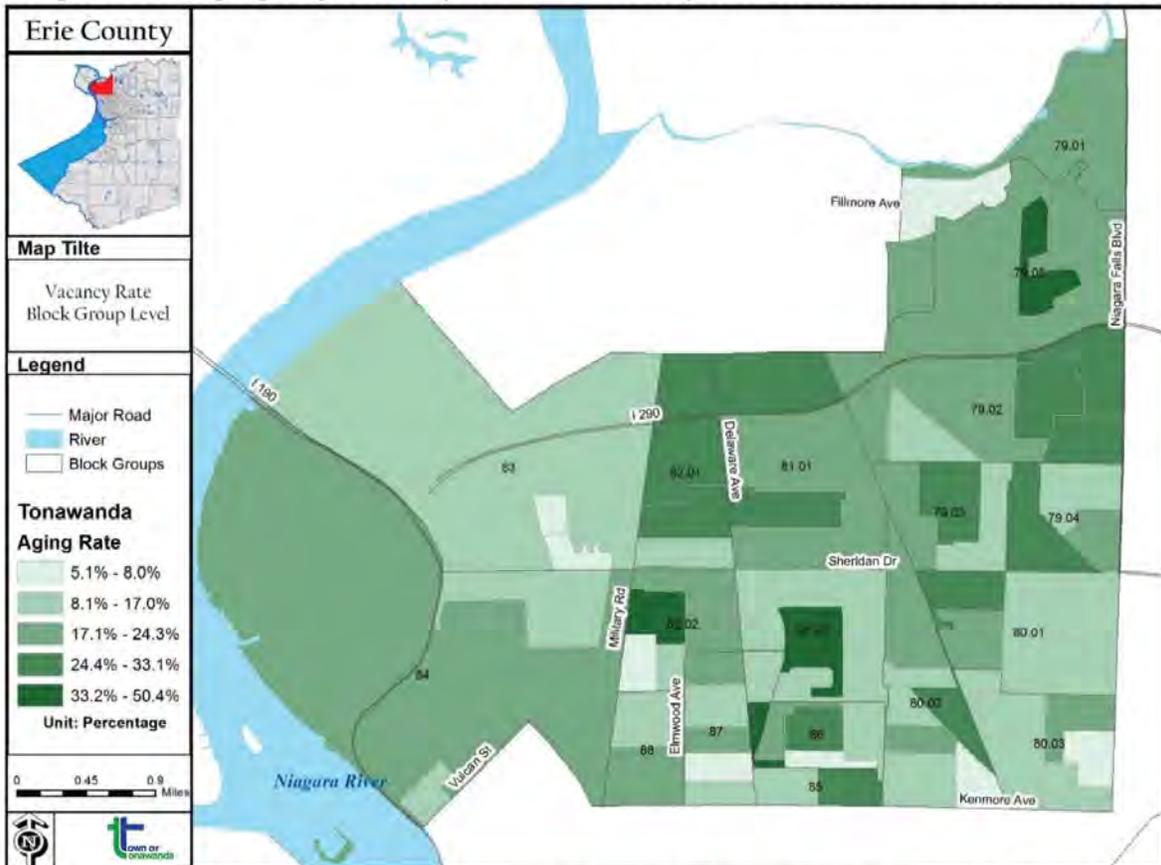
The median age in Tonawanda is 42.8 (U.S. Census Bureau). There is a large aging population in the Town of Tonawanda that might be averse to bicycling, however, a recent national survey reports that over 50% of respondents in age groups 35-44, 45-54, 55-65, and 65+ ride a bike at least once a week during the summer months (National Highway Traffic Safety Administration), so this plan should consider cyclists of all ages. The majority of the sidewalks in the town need to

Figure 2.13 Population Pyramid for Village of Kenmore



Data source: U.S. Census Bureau 2009-2013 American Community Survey 5 Year Data

Figure 2.14 Aging Population (65 Years or more) Rate Distribution in Tonawanda.



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

From the aging population rate distribution map (see figure 2.14), the lowest aging rate (the number of population 65 years old and more divided by the total number of population) is 5.1%, the highest aging rate is up to 50%. In census tract 82.02, 79.06, 81.02 and 86, each of these four census tracts has one block group with high aging rate from 33.2% - 50.4%.

LACK OF BICYCLE INFRASTRUCTURE ON MAJOR ROADS

Over the last 10 years, the Town has actively and aggressively implemented numerous studies, strategic plans and projects recommended in the 2005 Comprehensive Plan. The 2015 update of the Town Comprehensive Plan considers several major changes in circumstances that have occurred since 2005. One is the continued movement towards incorporating pedestrian/bicycle accommodations in transportation planning and "Complete Streets," and the subtle shift away from roads that only accommodate vehicles.

Much progress has been made in the past decade on off-road bicycle trails and pedestrian facilities. However, the on-street bicycle facilities are still in great need as many major roads lack bicycle infrastructure. For the vast majority of people, biking on a major street without bicycle facilities, such as Sheridan Drive, Kenmore Avenue, Colvin Blvd, Englewood Avenue, are stressful and unsafe situations to bike in.



Figure 2.15: Lack of Bicycle infrastructure on Military Road, Tonawanda



Figure 2.16: Lack of bicycle infrastructure on Kenmore Ave, Tonawanda

EXISTING BICYCLE FACILITIES

TYPES OF BICYCLE FACILITIES IN TONAWANDA

Off-road Multi-Use Paths

Multi-use trails can be used by walkers, bicyclists, runners, joggers, those on roller blades, those wheeling strollers, and people in wheelchairs or with walkers. The Town has designated off-road multi-use paths in various locations. Figure 8 depicts existing and proposed multi-use paths.



Figure 2.17: Rails to Trails project.

Work on the Tonawanda Rail Trail project is underway by the Erie County and the NFTA. The project involves the construction of a 12-foot wide paved asphalt recreational trail on the former rail bed of an unused railroad corridor. The existing rail path that is to be converted to the trail extends from Kenmore Avenue to State Street in the City of Tonawanda. The proposed trail will connect with the North Buffalo Rails to Trail project south of the Town, and extends through the City of Tonawanda to connect to the Erie Canalway Trail, which links to the Shoreline Trail. The Tonawanda portion of the trail will create a recreational loop in the Town, complete



Figure 2.18: Riverwalk Trail along River Rd.; Photo Credit: Comprehensive Plan

gaps in the local trails network, and link to other town recreation spots such as Lincoln Park, Kenney Field, the Ken-Ton YMCA and Cardinal O'Hara High School. Design was completed in 2014 and construction was started in the spring of 2015.



Figure 2.19: Rails to Trails project in progress.

On-Street Bicycle Routes

In addition to off-street multi-use trails, certain local streets are considered part of the Regional Bikeway Network by GBNRTC. The existing bike routes are along Military Road, Ensminger Road, Kenmore Avenue, Parker Boulevard, Ellicott Creek Road and the northern portion of Colvin Boulevard (in the vicinity of Brighton Park) (Greater Buffalo-Niagara Regional Transportation Council). However, no on-street facilities such as bike lanes or shared lanes exist within the Town of Tonawanda.

A Regional Bikeway Network offers convenient access to major bicycle travel demand generators for bicyclists across the region. This requires that it extends between these generators and residential centers, and that the connections are safe and attractive. In addition to utilitarian purposes, the network will encourage recreational usage by offering safe and scenic trails for bicyclists and walkers of all abilities.

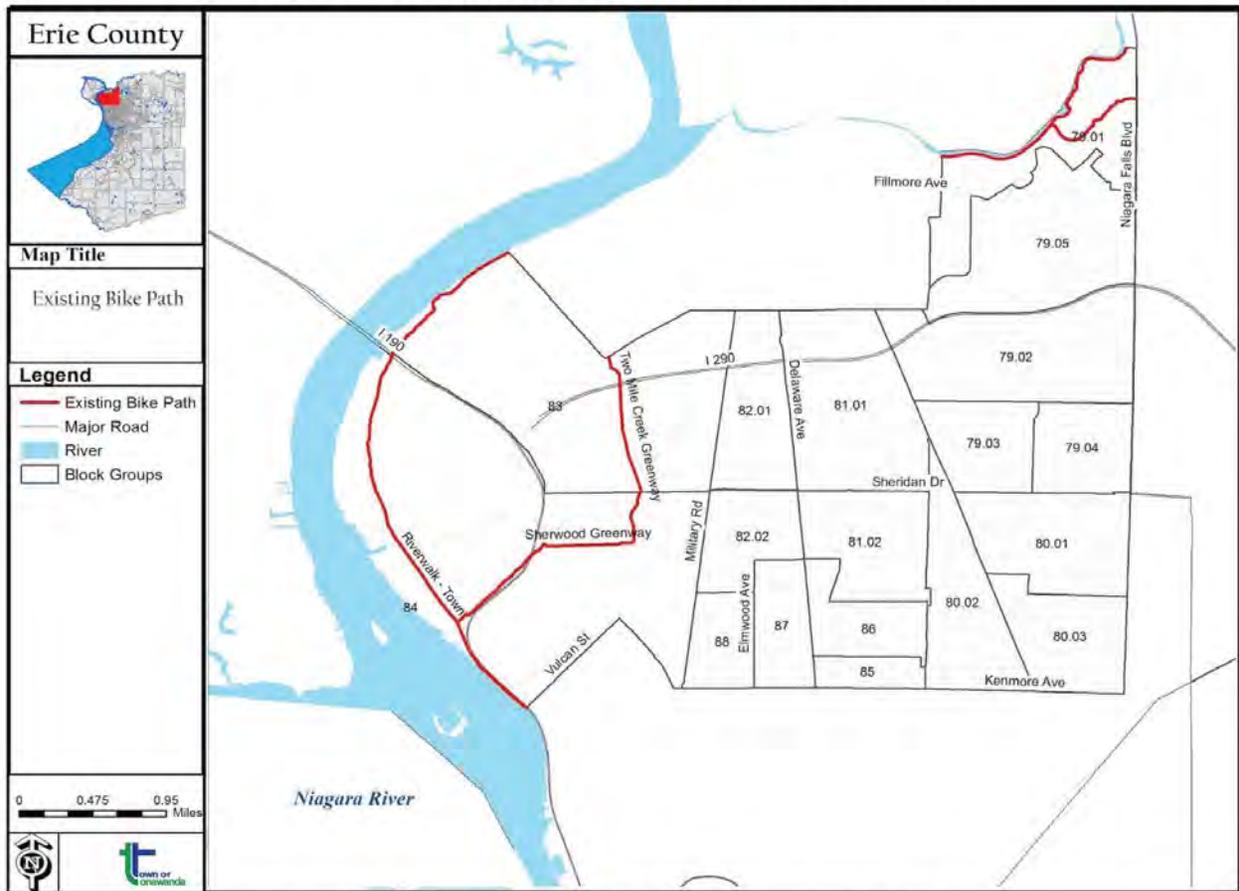
The routes for the Regional Bikeway Network were originally developed through the processes of the 1981 Bicycle Route Plan and the 1998 Bicycle Master Plan for Erie and Niagara Counties. This network plan has been subsequently updated to reflect changing generators and residential patterns as well as to reflect new input from the bicycle community and town and city officials. Several municipalities have in fact added a large number of local circulator routes to the regional system.

Figure 2.20: Existing Bicycle Facilities in Miles

Existing Bike Path	Mileage
Canal Recreation way On-Road	0.94
Canal Recreation way Off-Road	0.98
Two Mile Creek Greenway	1.01
Riverwalk	4.41
Sherwood Greenway	2.04
Ellicott Creek Park Trail	0.83
Total	10.3

Source: 2014 Tonawanda Comprehensive Plan

Figure 2.21: Existing Bicycle Facilities in Tonawanda

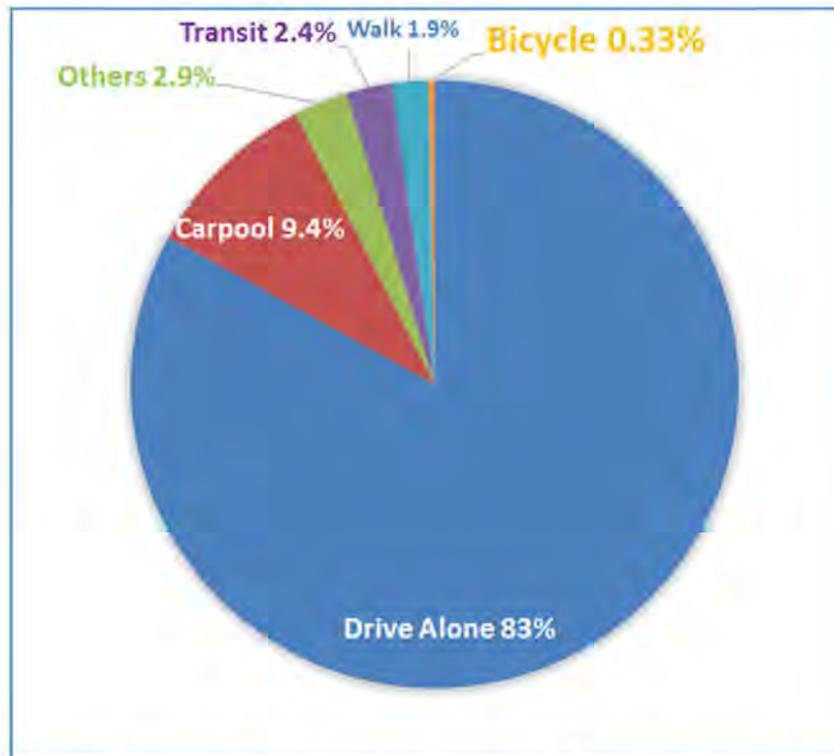


Source: Tonawanda GIS database, retrieved 2015

BICYCLE USAGE STATISTICS

COMMUTING TO WORK

Figure 2.22: Transportation Mode Share of Residents of Tonawanda



Source: U.S. Census Bureau, ACS 5-year survey

Based on 2013 census data, only 0.33% of residents in the Town of Tonawanda commuted to work by bike, while 83% of residents commuted by car, around 2.4% by public transit, and 1.9% by walking (U.S. Census Bureau). Compared to counterpart municipalities, Tonawanda has a fairly typical rate of bicycle commuting.

In the Niagara-Buffalo region, driving to work is by far the most common form of commuting (over 90% in each of the selected municipalities except Buffalo at 77.2% which has the highest public transit usage). Bicycling as a usual mode to work is extremely rare (between 0.3% and 1.1% for each of the selected municipalities). The City of Buffalo has the highest percentage for biking to work at 1.1%.

Figure 2.23: Map of Transportation Mode Share of Residents of Tonawanda

Subject	Town of Tonawanda	City of Buffalo	Town of Amherst	City of Tonawanda	City of North Tonawanda	Town of Grand Island
Workers 16 years & over	37,033	103,849	58,813	7,276	15,276	10,302
Car, truck, van	92.40%	77.20%	90.50%	93.20%	94.10%	94.30%
Drove alone	83.00%	67.30%	83.30%	86.10%	86.30%	89.90%
Carpooled	9.40%	9.90%	7.20%	7.10%	7.80%	4.40%
In 2-person carpool	7.50%	8.20%	5.90%	6.20%	5.90%	3.30%
In 3-person carpool	1.00%	1.00%	0.80%	0.90%	0.80%	0.30%
In 4-or-more person carpool	0.80%	0.70%	0.50%	0.00%	1.10%	0.70%
Workers per car, truck, or van	1.06%	1.07%	1.04%	1.04%	1.05%	1.03%
Public Transportation	2.40%	12.00%	2.10%	0.60%	0.40%	0.80%
Walked	1.90%	6.30%	3%	3.20%	2.20%	0.60%
Bicycle	0.30%	1.10%	0.30%	0.90%	0.30%	0.00%
Taxicab, Motorcycle, other means	1.10%	1.20%	0.80%	1.20%	1.40%	1.00%
Worked at home	1.80%	2.10%	3.30%	0.90%	1.60%	3.30%

SAFETY

In order to assist bicyclists to understand how comfortable they might feel riding along one of the on-street routes of the Regional Bikeway Network, the GBNRTC rated bicycle routes with a Bicycle Level of Service (BLOS). These ratings are based on a quantitative formula that takes into account a number of factors including the surface condition of the road, the width of the shoulder, posted speed, percentage trucks, existence of parked cars, frequently of sewer grates, and the adjacent land use (e.g. commercial vs. residential). The ratings are an average for the section analyzed, and if a section contains marked designated bicycle lanes then these sections are not calculated with a BLOS. The formula generates an A to F rating system, in which A indicates the route is a “ride in the park” and F indicates the riding the route will “feel that your life is in danger” (Greater Buffalo-Niagara Regional Transportation Council).

Table 2.24: Bicycle level of service (BLOS)

Level	Bicycle Level of Service
A	Suitable
B	Caution Advised
C	Caution Advised
D	Caution Advised
E	Extreme Caution - Experienced cyclists
F	Extreme Caution - Experienced cyclists

These routes are included on a two-county “Bicycle Route Guide” map (Greater Buffalo-Niagara Regional Transportation Council) designed to encourage greater bicycle usage in the region. There are currently no plans to assess which routes could be improved to make bicycling more comfortable within the town.

EXISTING CONDITIONS SUMMARY

The area's geographic and demographic characteristics significantly affect the everyday transportation decisions made by bicyclists, pedestrians, transit riders, and motorists. From the most recent information available, only 0.3% of town residents use a bike to commute to work. It also highlights the planning context and policy framework relevant to the future development and implementation of bicycle infrastructure and policy in the town of Tonawanda. Town officials are committed to improving the bicycle infrastructure and culture of the town. This section also highlights commuting mode choice for the Town of Tonawanda as well as its surrounding municipalities. The overall concept is to provide a framework of Tonawanda's existing network of bicycle trails, lanes, and routes. We want to provide cyclists with the opportunity to commute, ride for recreation, and make utilitarian trips.

SITE VISIT CONCLUSIONS

- Bike paths need to take into account the age of riders and be friendly towards the elderly population.
- Access of educational resources for kids and drivers to respect cyclists as legal users of the road.
- Bicycling infrastructure is needed on Sheridan Drive, Parker Boulevard, and Kenmore Avenue.
- Currently, biking down Sheridan Drive is very dangerous.

Bicyclists' needs must be integrated into the Town's projects, policies, and programs. Planning, implementation, and maintenance of roadway, public works, and transit projects will include improvements to accommodate bicyclists of all abilities and ages. A well-connected bicycle infrastructure network will improve safety, the environment, public health, and quality of life for residents, visitors, and businesses. A bicycle friendly Tonawanda will be a more affordable, economically competitive, and sustainable place to live and work.

SIX ESSENTIAL ELEMENTS OF A BIKE-FRIENDLY AREA

The League of American Bicyclists details six essential elements, or the 6 E's, that must be addressed in bicycle master plans to make individual municipalities or regions great places for cycling. They are:

- Encouragement: Creating a strong bike culture that welcomes and celebrates bicycling.
- Evaluation & Planning: Planning for bicycling as a safe and viable transportation option.
- Education: Giving people of all ages and abilities the skills and confidence to ride.
- Enforcement: Ensuring safe roads for all users.
- Engineering: Creating safe and convenient places to ride and park.
- Equity:

For this bike plan, we addressed Engineering through the Design Elements section that is included as a section of the appendix. Although not considered as an essential element by the League of American Bicyclists, we also studied the topic of Equity which is briefly defined as addressing the needs of different social groups and geographic areas. (League of American Wheelmen Inc., 2013)

Figure 2.25: Sample Aspirational Goals for a Bicycle Plan

- **Encouragement Goal 1:** Enhance the local cycling culture to reduce stigmatism and barriers to transportation mode choice.
- **Evaluation Goal 1:** Monitor, measure, and evaluate the Tonawanda Bicycle Master Plan.
- **Evaluation Goal 2:** Ensure that the city qualifies for and pursues the maximum amount of available outside funding for bikeways, other biking facilities, bicycle programming, and staffing.
- **Education Goal 1:** Educate the Town of Tonawanda on effective strategies, programs, and potential networks that reinforce bicycling culture, safety, and infrastructure.
- **Enforcement Goal 1:** Continue the enforcement of bicycle rules and regulations in order to reduce violations and crashes.
- **Enforcement Goal 2:** Develop and sustain an educational dialogue between law enforcement and cyclists.
- **Enforcement Goal 3:** Establish a bicycle mounted police division.
- **Enforcement Goal 4:** Promote programs that reduce incidents of theft and continue efforts to recover stolen bicycles.
- **Enforcement Goal 5:** Enhance educational programs with emphasis on bicycle safety and laws relating to bicycle driving.

ENCOURAGEMENT

INTRODUCTION TO ENCOURAGEMENT

The idea of encouragement is centered on the creation and development of a strong bicycling culture that both welcomes and celebrates bicycling as both a recreational activity and a mode of transportation. The League of American Bicyclists cites many activities that support encouragement as an essential element of a bicycle friendly community, including: bicycle-themed programming activities, route-finding signage, and public bike sharing. This is not an exhaustive list; any activity that allows communities to tap into the large segment of the residents that are interested but concerned about bicycling can help develop and encourage a cycle friendly culture. In the Town of Tonawanda, many opportunities to augment local cycling culture exist.

ENCOURAGEMENT GOALS, OBJECTIVES, AND INITIATIVES

Encouragement Goal 1: Enhance the local cycling culture to reduce stigmatism and barriers to transportation mode choice.

Encouragement Objective 1.1: Pass a Complete Streets Initiative.

Complete Streets is an initiative that aims to develop networks of streets that are safe and accessible for all people, regardless of age, ability, income, ethnicity, or chosen mode of travel. This initiative can take many forms, including adopting ordinances, passing legislative resolutions, and embedding Complete Streets language into plans. According to the National Complete Streets Coalition, over 700 agencies at the local, regional, and state levels have adopted Complete Streets policies. The Town of Tonawanda Comprehensive Plan, last updated in 2014, already has identified a need for the Town to adopt a Complete Streets Policy (Item C&C-3) and uses Complete Streets language throughout the planning document. (Town of Tonawanda)

A resolution supporting multimodal access to the Town's streets requires neither funding sources, nor modification of existing codes. It provides an immediate boost to the visibility and credibility of the initiative. A resolution is simply a short document that is passed and promulgated by a legislative governmental entity. It functions similarly to a motion made in a local government meeting, except that it is transcribed in order to provide clarity and durability. It is usually used to demonstrate a commitment or opinion held by the majority of the legislative body.

The Town has recently been holding stakeholder meetings to help guide the adoption of a Complete Streets policy and is encouraged to continue taking the necessary steps to achieve this goal.

Encouragement Initiative 1.1.1

The passage of a resolution in support of Complete Streets by the Town of Tonawanda Board.

Encouragement Objective 1.2: Commercial Area Outreach

According to the League of American Cyclists, businesses play a critical role in encouraging people to ride by giving them a variety of opportunities and incentives to get on their bikes. Several commercial corridors exist in the Town of Tonawanda, mostly along main arterials and heavily trafficked thoroughfares, including Sheridan Drive and Delaware Avenue. These businesses, as community stakeholders, could be contacted in order to leverage buy-in. The positive economic benefits available to these businesses from increased cyclist business are well documented and can be touted to local eateries and retail establishments.

This outreach should result in a program to encourage businesses to adopt bicycle friendly practices, like the providing of secure and well-lit bicycle parking, promoting commuting to work among their employees, and supporting efforts by local transportation officials to establish more bicycle friendly infrastructure around their establishments.

Encouragement Initiative 1.2.1

The formation of an outreach program that interacts with businesses to encourage the activities which augment bicycle accessibility that are detailed above.

Encouragement Objective 1.3: Identify Existing Off-Street Facilities

Off-street facilities can include amenities like water fountains, bicycle racks and boxes, and tire air pumps that allow cyclists to maintain their bicycles, as well as park them legally, without being forced to park their bicycles in places that are prohibited, obstruct pedestrian flow, or cause other issues. These facilities, while not used to ride on, are nearly as important to consider as bikeways themselves, as they provide support infrastructure that makes riding much easier.

Encouragement Initiative 1.3.1

Complete a spatial inventory of off-street bicycle facilities in order to determine what areas are undersupplied using a geographic information system database.

Encouragement Objective 1.4: Explore Strategic RideShare Partnerships

The new connectivity of the Rails-to-Trails Project currently under construction will allow residents of the Tonawandas easy, speedy, and unprecedented access to both the City of Tonawanda and City of Buffalo. Although many residents already possess bicycles, some do not and opportunities exist for new partnerships between the Town of Tonawanda and bicycle sharing entities. Some

sharing programs, including BikeShare Buffalo already exist and have nodes at locations with easy access to the new R2T route.

The way that sharing programs work is users who subscribe to the system via a membership are allowed access to point-to-point transportation for short distance trips (0.5 to 3 miles). It provides users the ability to pick up a bicycle at any self-serve bike station in the network and return it to any bike station located near their destination. The ability to return the bicycles to any station is the largest advantage of the system, as it allows users to park their bicycles at docking stations and not be responsible for the bicycle after the trip is finished, minimizing the need to find their own bicycle parking or to bring their bicycle with them if they utilize multiple modes of transportation for a trip.

Encouragement Initiative 1.4.1:

Establishment of at least one bicycle sharing node within the Town of Tonawanda.

Encouragement Objective 1.5: Improve Statutory Language on Signage

Recent studies have shown the relative ineffectiveness of signs designed to protect cyclists using the phrase “Share the Road” compared to signs containing more specific, formalized, and statutory language. A study conducted by NC State University found that the “Share the Road” signage did not increase comprehension or perceptions of safety among bicyclists and private motor vehicle commuters. “Bicycles May Use Full Lane” signage showed notable increases in comprehension and is a much more effective sign.

The “Share the Road” signs present in the Town of Tonawanda, especially along arterial and heavily trafficked bicycle routes should be replaced over time with signs containing more effective signage in order to increase safety perceptions. As sixty percent of people fall into the “interested, but concerned” category, increasing the perception of bicycle safety with these citizens may allow for increased ridership and be paired with other bicycle infrastructure to make routes feel even safer.

Encouragement Initiative 1.5.1:

All “Share the Road” signs on roads administrated by the Town of Tonawanda are changed to signs containing statutory language.

Encouragement Objective 1.6: Establish Programming Activities

Bicycle programming activities aimed at promoting cycling culture are essential to encourage citizens to use their bicycles more often. These can take the form of programs like those sponsored by the League of American Bicyclists like National Bike to Work Day, a part of National

Bike Month or smaller and more initiatives that get local citizens to use their bicycles in a planned event.

Large scale recurring bicycle programming has taken hold in the Buffalo-Niagara region with the success of Slow Roll Buffalo, a weekly ride in which hundreds of cyclist ride together, beginning in a different location every week. The popularity of the trips, which are usually around ten miles, is unquestionable and has only grown since the concept was incorporated from a similar program that was founded in Detroit, MI. The slow pace of the ride keeps the group safe and together, and gives riders a unique perspective of Buffalo and its neighborhoods. Hosting a Slow Roll, especially after the opening of the Rails-to-Trails project, would boost bicycling awareness and showcase the exciting changes taking place in the Town of Tonawanda.

Encouragement Initiative 1.6.1

Program an event or coordinate with an established group to hold a large-scale coordinated ride through the Town of Tonawanda.



Figure 2.26: Example of Programming Activity in Omaha; Photo Credit: bmorebikes.com

EVALUATION AND PLANNING

INTRODUCTION TO EVALUATION AND PLANNING

Evaluation is essentially a way for communities to assess how well the plan is doing with respect to bicycle safety and viability as a transportation option, implementation of projects, programs, or policies, and with respect to its goals and objectives. Evaluation is an important element of any plan, hence why it is included as one of the 5 E's of making great places for bicycling. The Tonawanda Bicycle Master Plan is intended to be a living document, so it is important that the plan be updated on a regular basis such as every five or ten years or as needed.

Evaluation is important because it:

- 1) Allows for the tracking of plan implementation and plan performance in meeting needs, mitigating problems, and achieving goals. (Godschalk, Rodríguez, Berke, & Kaiser, 2006)
- 2) Assesses whether the plan is on target with what its goals and objectives are, how well the plan is functioning, and if any modifications need to be made to the plan.
- 3) Provides accountability by making sure that the plan is being followed through and that those involved with the plan are doing their jobs.
- 4) Helps to identify new opportunities or additions to the plan
- 5) Ties the all the four other E's (encouragement, education, engineering, and enforcement) by serving as an assessment of the programs, projects, and policies contained in those elements. (League of American Wheelmen Inc., 2013)

The components of evaluation include:

- 1) Metrics; performance measures to demonstrate how the plan and its elements are performing. (League of American Wheelmen Inc., 2013; Town of Chapel Hill, North Carolina Department of Transportation, & Toole Design Group, 2014) Example: number of bike lanes, percentage of bicycle commuters.
- 2) Benchmarks and the reporting of outcome based performance initiatives on a periodic basis. Benchmarks and performance Initiatives help to keep the plan in check and make sure it's doing what it's intended to. (Town of Chapel Hill et al., 2014)
- 3) A dedicated Bicycle Program Coordinator and an effective Bicycle Advisory committee in order to aid in the creation, implementation, and prioritization of bicycle programs, projects, and policies. (League of American Wheelmen Inc., 2013; Town of Chapel Hill et al., 2014)
- 4) Review by the appropriate town boards, the town council, and the public. (Town of Chapel Hill et al., 2014)
- 5) A progress or status report for the plan; developed and presented to the Town of Tonawanda one and three years after the plan is adopted as well as every two years that follow prior to a plan update. (Town of Chapel Hill et al., 2014)

EVALUATION GOALS, OBJECTIVES, AND INITIATIVES

Evaluation Goal 1: Monitor, measure, and evaluate the Tonawanda Bicycle Master Plan.

Evaluation Objective 1.1

To monitor the progress of the Tonawanda Bicycle Master Plan itself in order to ensure success

Evaluation Initiative 1.1.1

Complete Streets Committee will update the Tonawanda Bicycle Master Plan as needed.

Evaluation Initiative 1.1.2

Complete Streets Committee will consider creating and publishing a plan update every 5 to 10 years, or more frequently if needed.

Evaluation Objective 1.2

Regularly evaluate bicycle programs, policies, and projects to ensure that progress is being made.

Evaluation Initiative 1.2.1

Complete Streets Committee will set aside a time slot on the agenda to discuss evaluation of programs, policies, and projects at all of its meetings. Information discussed will be reported back to the Town of Tonawanda Planning Board at each monthly meeting.

Evaluation Initiative 1.2.2

Complete Streets Committee will create an annual report on the progress of the Town of Tonawanda Bicycle Master Plan's implementation.

Evaluation Objective 1.3

Gain a better understanding of the bicycle flow in the Town of Tonawanda.

Evaluation Initiative 1.3.1

Complete Streets Committee member(s) or other staff member(s) will perform (manually, technically, or electronically, such as Strava or Wikimap), analyze, and report bicycle count data every year to track trends over time.

Evaluation Initiative 1.3.2

Complete Streets Committee will create and publish a yearly report including bicycle count data and analysis.

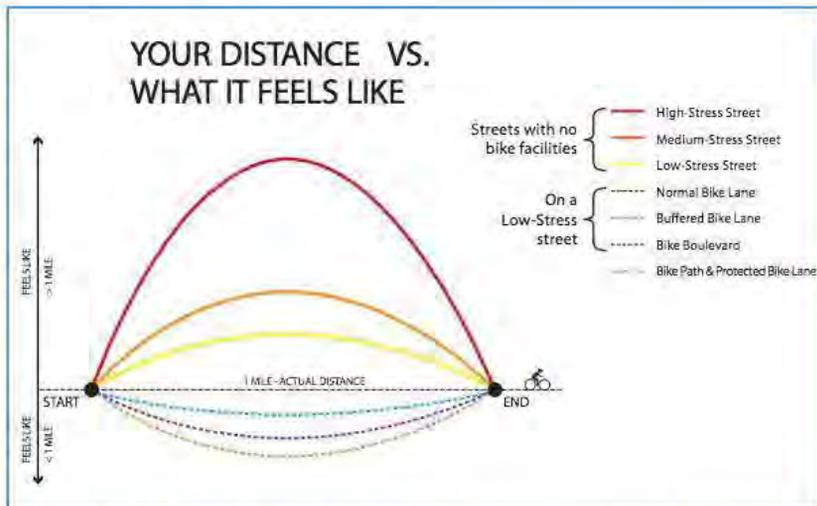


Figure 2.27: Infographic depicting the perception of time based on street type; Photo Credit: Alta Planning + Design

Evaluation Objective 1.4

Gain a better understanding of the bicyclist population in the Town of Tonawanda.

Evaluation Initiative 1.4.1

Complete Streets Committee member(s) or other staff member(s) will analyze bicycle mode share data from American Community Survey (ACS) broken down by age, gender, race/ethnicity, and income if possible, and report that data to the Town of Tonawanda Planning Board in bicycle plan progress report (1-3 years following plan implementation) as well as in updates to the plan.

Evaluation Initiative 1.4.2

Complete Streets Committee will create a yearly report on bicycle mode share data based on information obtained from ACS to track trends over time.

Evaluation Objective 1.5

To monitor and increase the number of bicycle education and outreach programs in the Town of Tonawanda.

Evaluation Initiative 1.5.1

Complete Streets Committee members, other staff members, community organizations, etc. will track and report the number of programs for bicycle education and outreach in the Town of Tonawanda.

Evaluation Initiative 1.5.2

Local school districts and/or community organizations will add a new bicycle education and/or outreach program at least once every five years.

Evaluation Objective 1.6

To improve safety for users of all modes of transportation by using crash data.

Evaluation Initiative 1.6.1

Complete Streets Committee in conjunction with the Tonawanda Police Department will collect, analyze, and report crash statistics annually to track trends over time.

Evaluation Initiative 1.6.2

Complete Streets Committee in conjunction with the Tonawanda Police Department will evaluate the top 10 crash locations involving bicyclists annually and implement countermeasures for at least one of the top 3 intersections per year.

Evaluation Objective 1.7

To reduce bicycle theft in the Town of Tonawanda by using theft prevention systems and registered bicycle VINs.

Evaluation Initiative 1.7.1

Complete Streets Committee in conjunction with the Tonawanda Police Department will track, analyze, and report bicycle theft statistics annually to track trends over time.

Evaluation Initiative 1.7.2

Tonawanda Police Department will increase patrols as needed at particular locations where bicycle theft is most frequent.

Evaluation Objective 1.8

To ensure that all bicycle infrastructure (both active and passive) is regularly maintained.

Evaluation Initiative 1.8.1

Complete Streets Committee member(s), Department of Public Works, or other staff member(s) will continuously track bicycle system complaints reported via 311 calls, Strava, reports to the Town of Tonawanda or Tonawanda Police Department, etc. and report those complaints annually to track trends over time.

Evaluation Initiative 1.8.2

Complete Streets Committee member(s), Department of Public Works, or other staff member(s) will collect, analyze, and report current quality levels of all active and passive bicycle infrastructure regularly.

Evaluation Initiative 1.8.3

Any maintenance, repairs, replacements, etc. of active or passive bicycle infrastructure will be made on an as needed basis by the Department of Public Works in a timely manner.

Evaluation Goal 2: Ensure that the city qualifies for and pursues the maximum amount of available outside funding for bikeways, other biking facilities, bicycle programming, and staffing.

Evaluation Objective 2.1

To maximize available funding for bicycle infrastructure (active and passive).

Evaluation Initiative 2.1.1

Complete Streets Committee and other local government members will allocate Town of Tonawanda resources to leverage outside funding.

Evaluation Initiative 2.1.2

Complete Streets Committee members, other staff members, community organizations, etc. will pursue alternative sources of funding such as grants like Community Development Block Grants (CDBGs), NYSERDA, etc.

EDUCATION

INTRODUCTION TO EDUCATION

To create communities that are bike friendly, more is involved than just teaching children how to ride a bike. People of all ages often need to learn additional skills when it comes to safely riding a bike in public places as well as what type of bike is best suited to an individual's riding skills and habits. Additional training and equipment may be necessary to properly maintain a bike. Obtaining and properly using the right safety equipment is also important for bicyclists of all ages. Good educational programs can also encourage confidence for bicyclists (League of American Wheelmen Inc., 2013).



Figure 2.28: Getty elderly couple riding bicycles; Photo Credit: Mirror.uk

EDUCATION GOALS, OBJECTIVES, AND INITIATIVES

To promote bicycling in a safe and convenient environment, is the mission of the Bicycle Master Plan. This is accomplished in part by providing high quality bicycle education, effective strategies, programs, and networks. This section presents research based strategies, provides a passageway to practical implementation of education programs, initiatives, and policies. Education is an important component of the Bicycle Master Plan vision to encourage bicycle usage, awareness, and culture in the region. This section displays objectives and suggested actions that segue into the support of strong policy and bike infrastructure. Proper implementation of bicycle education will transition the town into a bike savvy region. By carefully addressing and accommodating the needs of all bicyclist- recreational, passive, young old, adventurous and timid- through education, promotes *bike confidence*.

Education Goal 1: Educate the Town of Tonawanda on effective strategies, programs, and potential networks that reinforce bicycling culture, safety, and infrastructure.

Education Objective 1.1

Educate bicyclists, motorists, elected officials and the general public about bicycling.

Education Initiative 1.1.1

Educate motorists and bicyclists on sharing the road. Conduct public safety announcements on following the rules of the road. To implement this objective, conduct community engagement meetings that teach and reinforce the components of cycling; the importance of it, how it's beneficial to the community, what is bike safety on the road, and how to use bike lanes. For motorists, this campaign should address the need to look left prior to turning right, and provide clear passing space. For bicyclists, this campaign should address bicycle lights and lack of visibility when not riding in the road. Refer to the Smart Cycling Student Manual for presentation material.

To prepare presenters to train public on bicycle education, they should have a broad knowledge base on the topic. To acquire this information, it is recommended that trainers participate in League Certified Instructor training course scholarships. The League of American Bicyclists offers certification courses to train those interested in teaching others to ride their bike safely and legally as a form of transportation. League Certified Instructors (LCIs) are a valuable asset to the community and can offer a variety of workshops for adults lacking confidence to ride in traffic as well as children learning to ride for the first time. LCI training courses require a two-and-a-half-day commitment and are offered through the LAB. To facilitate a cadre of cyclists to become LCIs, this program coordinates with the LAB to schedule training course offerings in the community and provide scholarships.

1. Performance Measures:

- a. Publicize dangerous behaviors beginning in 2016; stage an annual "Bicycle Education" announcement, beginning in 2017.
- b. At meetings conduct pre & post-test in order to determine the community baseline knowledge base, and additionally, to measure how much information has been retained after meetings.

Education Objective 1.2

Provide strong bicycle education for primary-age children and aging population.

Education Initiative 1.1.2

We recommend the following programs be implemented:

1. Senior Cyclist Program:

- a. *Older Adult Three-Wheeled Bicycle Program*, a program implemented by Portland Bureau of Transportation, teaches senior citizens about the components of bicycling and advocates for the right to cycle at all ages. This program encourages the activity amongst aging population, and in return, helps confidence with bicycling

- b. To implement the program, suggested action includes collaborating with nursing homes, AARP, and senior affiliated programs to develop a strong interest group.
2. Safe Routes to School:
- a. **Safe Routes to School Program:** Teaches bike safety to children and adolescents on how to ride to school safely. The School travel plans curriculum provides a road map for schools to build successful walking and biking programs. These plans include observations and ideas for addressing the five E's of Safe Routes to School—Education, Encouragement, Enforcement, Evaluation, and Engineering.
 - b. To implement this objective, work with schools through the Safe Routes to School program to teach children how to safely walk and bike to school.
 - c. To fully support this program and expand the reach of the Safe Routes to School program, it is essential to work with partners to promote the program and develop a long-term funding and growth plan.

Education Objective 1.3

Reinforce the health benefits of bicycling.

Education Initiative 1.3.1

1. Market the Health Benefits of Bicycling
- a. Develop campaign that promotes all levels of bicycling; recreational and passive cyclist. Collaborate with area partners to reduce associated cost.
 - b. Connect partners to maximize the effectiveness of existing resources, and programs.
 - c. Create cost effective material and distribute to general public.
 - i. Example is outline in Appendix B
 - c. Host professional development workshops that teach components of cycling, the importance of it, how it's beneficial to the community, what bike safety is, and how to use bike lanes. Empowering literature that discuss the components of cyclist and community engagement tips should be gathered. Refer to Cycling Savvy for additional information.
 - ii. Performance Measure:
 - 1. Publicize bicycle culture campaign beginning in 2016; stage an annual "bicycle culture" announcements, each May during Bike Month.
 - 2. At workshops conduct pre & post-test in order to determine the community baseline knowledge base, and additionally, to measure how much information has been retained after meetings.

Education Objective 1.4

To educate public about bicycle network and improve access to trails/routes.

Education Initiative 1.4.1

1. Market the Tonawanda Bicycle Network

- a. Provide maps of network on Town website
- b. Develop pamphlets network and place them in designated areas in the region, i.e. bike facilities.
- c. Provide workshops that teaches the components of network
- d. Collaborate with area business to develop *Bicycle Network Association* campaign.

i. Performance Measures

1. Survey neighborhoods to gather community participation in developing Bicycle Network Association.
2. Host community engagement meeting to centralize ideas about association.
3. Publicize bicycle culture campaign beginning in 2016; stage an annual "bicycle culture" announcements, each May during Bike Month.



Figure 2.29: Young 'Ride to School' proponents in Serbian newspaper; Photo Credit: Frontal.ba

ENFORCEMENT

INTRODUCTION TO ENFORCEMENT

Laws govern actions by both cyclists and drivers. Those laws must be understood by citizens and law enforcement officials. Enforcement of those laws must be done in a way that makes streets safe for all users. Cyclists should be treated equitably when it comes to using the road. Relations between cyclists and law enforcement officials should promote the safety of streets for all users.

A smart Enforcement policy by a police department can maximize the efforts of Education and Engineering. Enforcement can take many forms from verbal warnings to citations to positive encouragement. Citations and penalties don't always need to be in the form of fines or community service, but can also include local educational opportunities.

The goal of Enforcement should be improved safety. There are many ways to get to that point. Where a motorist's or bicyclist's actions place a person in obvious danger, a crash is narrowly avoided, or a crash occurs, a citation is likely necessary (Benning, 2015).

Certain activities, such as the following, should be the focus of law enforcement personnel:

1. Driving while impaired by drugs or alcohol,
2. Failing to yield the right-of-way,
3. Not looking when entering the roadway or turning at intersections and driveways,
4. Speeding, particularly in neighborhoods and near schools, and
5. Overtaking bicycles in areas where it cannot be done safely

Examples Of Law Enforcement Training

Several consulting firms specialize in providing training to law enforcement personnel regarding bike law enforcement. Kirby Beck Consulting is just one that provides a variety of services to the client seeking a competent expert in bicycle and pedestrian related litigation or training. (Kirby Beck Consulting, 2015)

The League of Michigan Bicyclists offers a "Community Bicycle Safety for Law Enforcement" training designed for both law enforcement and the general public, (Moeller, 2015) however, there does not appear to be a similar service offered in New York. The National Highway Traffic Safety Administration has also produced a 2-hour self-paced interactive training video for all law enforcement officers. (National Highway Traffic Safety Administration)

Police buy-in is an important part of providing safer streets for cyclists. It may be hard to convince some officers of the importance of enforcing traffic laws on both cyclists and drivers when there are other activities that could be considered more worthy of police attention. Using crash data and additional educational opportunities may be two ways for law enforcement officials to become more aware of the issues surrounding making our streets safer. Crash data can allow officers to focus on certain intersections, streets, or actions by drivers or cyclists to focus their attention on the matter to create positive results. Additional training courses for officers can include learning about various aspects of bicycle safety, which laws to emphasize with child and adult bicyclists and with motorists to reduce crashes, how to begin bicycle crash cause identification, and the importance of officers as front line, on-traffic-duty educators (Pedestrian and Bicycle Information Center, 2015b).

Numerous resources exist, including many fine videos and posters showing how bicyclists and drivers should act while using streets. The Chicago Department of Transportation, the Washington Area Bicyclist Association, and the San Francisco Bicycle Coalition and others can serve as models for how they educated both drivers and bicyclists. These organizations survey local bike laws, convey information in an informative and often graphically pleasing way, lobby for changes to bike laws where they may be necessary, and promote other educational programs and events for cyclists of all ages and abilities. They also partner with local law enforcement agencies to build relationships between the two groups.



Figure 2.30: Cyclist rides near R2T right-of-way; Photo Credit: Buffalo News

Bicycle laws must also be enforced equitably. Several cities, including Dallas and Tampa Bay have recently been scrutinized for not doing so. In Dallas, it appears the helmet laws are being enforced unequally in areas that are considered Crime Hot Spots or areas that have a high rate of minorities (Benning, 2015). In Tampa Bay, similar actions by police resulted in 80% of tickets for bicycling violations went to citizens who are black, even though they only represent 26% of the population (Stanley & Zayas, 2015). Police agencies must find a way to equally enforce the laws and not use minor bicycle infractions as ways to harass riders and investigate them for additional crimes.

Enforcement may also need to adapt to changing ridership numbers. In some places where bike ridership has rapidly increased in recent years, there are lingering questions over how to enforce bike laws as times change. In Madison, growing numbers of bicyclists have both strained the relationship between cyclists and drivers, but also given some new perspective since more drivers are also becoming cyclists and are becoming aware of the challenges faced by bicyclists (Elbow,

2013). In Washington DC, situations such as “drivers intimidating cyclists, cyclists antagonizing drivers, pedestrians at the mercy of both bikers and drivers” are becoming more common and all parties claim the police are not doing enough to remedy the situation. The numbers seem to agree with this since enforcement seems to be down if there is a correlation between an increase in riders and a decrease in tickets. It is possible all the new riders are following the laws, but unlikely (Lazo, 2015).

ENFORCEMENT GOALS, OBJECTIVES, AND INITIATIVES

Enforcement Goal 1: Continue the enforcement of bicycle rules and regulations in order to reduce violations and crashes.

Enforcement Objective 1.1

Focusing on the most common violations that lead to crashes can reduce the number of crashes.

Enforcement Initiatives 1.11.1

Targeted enforcement campaigns of regulations such as:

1. Driving while impaired by drugs or alcohol,
2. Failing to yield the right-of-way,
3. Not looking when entering the roadway or turning at intersections and driveways,
4. Speeding, particularly in neighborhoods and near schools, and
5. Overtaking bicycles in areas where it cannot be done safely.

Enforcement Goal 2: Develop and sustain an educational dialogue between law enforcement and cyclists.

These campaigns should be communicated to the public beforehand along with education outreach to remind drivers what the laws are. Targeted enforcement should be done in the spring to coincide with the increased number of cyclists.

Enforcement Objective 1.2

Communication and cooperation are key in developing an enforcement policy. Law enforcement and cyclists need to understand the laws and where enforcement should be targeted to both drivers and cyclists.

Enforcement Initiative 1.2.1

Present a "Community Bicycle Safety for Law Enforcement" training seminar. Topics that can be covered include "Rules of the Road," "How Bicycle Crashes Happen," "Enforcement for Bicycle Safety," "The Police Officer's Role in Bicycle Safety," and "Building Community Partnerships."(Lazo, 2015)

Enforcement Goal 3: Establish a bicycle mounted police division.

Enforcement Objective 1.3

A great way to enforce bike laws is from the seat of a bike. The community will see that the Town values placing law enforcement officers on bikes. It is also a way to build trust between cyclists and law enforcement officers.

Enforcement Initiative 1.3.1

Send officers to a training class such as the "Annual Law Enforcement Bike School" at Ithaca College. This five day course is designed as an entry level training for law enforcement personnel utilizing specialized mountain bikes for patrol activities. The course combines classroom training with practical application exercises (Ithaca College - Office of Public Safety and Emergency Management, 2015).

Enforcement Goal 4: Promote programs that reduce incidents of theft and continue efforts to recover stolen bicycles.

Enforcement Objective 1.4

Providing safe and secure parking facilities where necessary can help encourage cycling and also prevent theft. Partnering with neighboring communities and their bicycle theft prevention programs can enhance the collective efforts.

Enforcement Initiative 1.4.1

Develop a registration system for bicycles where residents can enter the make, model, and serial number of their bike along with their address and phone number. Law enforcement can then aid in returning the bike if it is stolen, lost, or locked up in appropriately. This list can then be cross referenced with the City of Buffalo's Bike Auction and local repair/used bike stores to recover stolen bikes.

Enforcement Goal 5: Enhance educational programs with emphasis on bicycle safety and laws relating to bicycle driving.

Enforcement Objective 1.5.1

Training sessions can consist of video materials such as the National Highway Traffic Safety Association's "Enhancing Bicycle Safety: Law Enforcement's Role" (National Highway Traffic Safety Administration).



Figure 2.31: Bicycle mounted police officer poses in front of statue near Denali; Photo Credit: Fairbanks, Alaska municipal government

EQUITY

INTRODUCTION TO EQUITY

The League of American Bicyclists have broadly defined equity as “the guarantee of fair treatment, access, opportunity, and advancement for all, while at the same time striving to identify and eliminate barriers that have prevented the full participation of some groups” (League of American Wheelmen Inc., 2013). Transportation decisions have the potential to create as well as alleviate problems of inequity through the types of facilities, accommodations, and infrastructure that are prescribed in a geographic area. The Town of Tonawanda Bicycle Master Plan is a transportation plan designed to enable the Town of Tonawanda to enhance its bicycle network and concepts of equity will be incorporated into the policy and project proposals.

The Town of Tonawanda is forming a Complete Street Committee to explore incorporating complete street design elements into future projects within the town. According to the National Complete Streets Coalition, which is the advocacy organization that offers the most influential guidance on policy and design, Complete Streets are:

“Designed and operated to enable safe access for all users. People of all ages and abilities are able to safely move along and across streets in a community, regardless of how they are traveling, regardless of how they are traveling. 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” (Smart Growth America).

The Complete Streets Coalition incorporates concepts of equity within the definition itself. In order to ensure that the Tonawanda Bicycle Master Plan incorporates equity into the final vision criteria will be developed to determine the equity of the envisioned Tonawanda Bicycle Network.

In the report published by the League of American Bicyclists titled *Equity of Access to Bicycle Infrastructure (Prelog, 2015)*, two types of equity are identified: horizontal and vertical. Horizontal equity is associated with the concept of fairness with all groups receiving the same allocation of resources at equal cost and consequence. In application, horizontal equity is that public policies should not favor one group over another. Horizontal equity is most closely related to the concept of egalitarianism which is the concept of all individuals or groups being treated equally regardless of race, gender, age, or income.

Vertical equity contends with impacts across social groups that differ in abilities, needs, and resources. Under vertically equitable policies, recommendations, and proposals would be equitable if they are redistributive in their positive impacts concerning disadvantaged groups and compensate for inequalities. Recommendations and policy proposals that possess these

redistributive effects are often characterized as progressive as they assist disadvantaged groups and work to contain external costs.

Incorporating both visions of equity into the Town of Tonawanda Bicycle Master Plan is possible. In examining American Community Survey 2013 (5 Year estimates) at the census tract and block level for the Town of Tonawanda and the Village of Kenmore, two distinct patterns are identified. The town's population is ageing with the highest concentration of 65 years and older in census tracts north of Sheridan Drive. Also, census tract 83, adjacent to the waterfront and industrial areas has the highest rate of renters, lowest median income, highest minority population, and a large percentage of children under 18.

In examining horizontal equity as it relates to the improvement and expansion of the Tonawanda Bicycle Network it must be accessible by any resident of the town evenly. This can be achieved by ensuring that the physical plan of any ensuing project is designed to be inclusive. Universal design alternatives are detailed in the Design Guidelines section.

Vertical equity will be incorporated into the Tonawanda Bicycle Master Plan by focusing catalyst projects on the neighborhoods within census tract 83. The bicycle network can begin to assist families and individuals residing there by improving the convenience, quality, and time spent walking or riding a bicycle. Census tract 83 also encompasses the waterfront and the neighborhoods within the tract are closest to the Niagara River in the town. Improving the Town's east-west connectivity will also enable people to fully utilize the network from census tract 83. Incorporating the concept of vertical equity into the plan creates an opportunity to create physical connections with the town's most isolated community. Furthermore, the neighborhoods within census tract 83 also have the highest rates of commuting by bicycle at 2.2% and walking at 6.0%. Improving the bicycle network to better serve this community will ensure that the resources devoted to the project will serve communities with higher rates of biking or walking due to economic circumstance.

EQUITY GOALS, OBJECTIVES, AND INITIATIVES

In order to gauge the distribution of vertical equity in the proposed Tonawanda Bicycle Plan a framework for analysis must be created that combines demographic data and connectivity between competing spaces. In the *Equity of Access to Bicycle Infrastructure* released by the Legion of American Bicyclists in September 2015, a systematic approach is taken to measure equity impacts of the bicycle network in the City of Chicago using GIS (Geographic Information Systems) software.

In applying a similar study to the Town of Tonawanda there are considerable differences to take into account. Primarily, the study in the report measured impacts of an existing bicycle network that is well developed. The Town of Tonawanda has a limited existing infrastructure consisting of designated pathways not easily accessible via bicycle from many neighborhoods within the residential areas. This lack of connectivity between existing bicycle pathways limits the current infrastructure in place from being considered a system or network. In examining equity through GIS modeling of a proposed Town of Tonawanda Bicycle Network the plan can offer valuable

resources to decision makers in future choices regarding the implementation of projects and recommendations to more fully develop the network.

The Town of Tonawanda is also a much smaller municipality than the City of Chicago in population and geographic size. Chicago is also a much more socially and economically diverse community. The designers of the study created a Bicycle Equity Index (BEI) which is tailored specifically to Chicago but can be adapted to any conditions in a location. In Chicago, race and income were incorporated. In the Town of Tonawanda, the largest concerns in equity of access are age and income level.

In order to measure equity of the bicycle infrastructure, the researchers began by obtaining a shapefile of the built network. They then created layers consisting of various disaggregated BEI's by block group. The network map layer was then manipulated to create a .25 catchment zone, which is the radius sustainable transportation planners deem to be the furthest for sustainable infrastructure. Within that catchment zone, census block groups were deemed to have access coverage. When a BEI layer is added to the network and catchment zone map. The resulting overlay creates a visual of where bicycle access coverage is already high as well as areas where the BEI is either low or high where access is limited.



Figure 2.32: Davey Oil in front of his family cargo bike shop in Seattle; Photo Credit: Josh Cohen

Advantages to Using this Approach

- Very new study, contacting league of American bicyclists could be very helpful. It is possible that there have not been very many other applications of this method
- Tailoring BEI to be weighted towards seniors and aging.
- Providing a tool that shows equity access to seniors and others in need in a visual may help convince stakeholders to further invest in bicycle and inclusive design facilities.
- Aging in place concern for Town of Tonawanda, providing a tool for mapping where facilities are needed and where they are may help serve the needs of the elderly but the entire community.
- Report outlines a step by step process in appendix for mimicking the study.

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SECTION III

ANALYSIS

INTRODUCTION

To develop a bicycle infrastructure system in the Town of Tonawanda, a study was conducted to determine how projects should be prioritized and what recommendations should be made. The studies collected create an overview of where bicycle infrastructure is needed as well as where current infrastructure is underutilized. Data was incorporated through analyzing crash data from police reports, a GIS study of the proposed bicycle network, a survey on bicycling in the town with over 100 people participating, and using American Community Survey data. Together, these studies create a complete overview of how bicyclists are currently interacting with facilities in the Town of Tonawanda and where future improvements should be made.

The Connectivity and Network Gaps Analysis highlights the spatial elements of the current bicycling network in the Town of Tonawanda by examining what destinations are available within the town to a ride a bicycle to as well as outside of the town. The connectivity analysis was conducted by examining each major automotive corridor in the town. The corridors were then studied further in a GIS study of the bicycle network. This study incorporates land uses, destinations, and existing bicycle infrastructure to identify critical gaps in bicycle infrastructure. A map is included detailing where improvements in the network can be made to increase bicycle connectivity.

The Crash Analysis investigates reported collisions between bicyclists and motorists in the Town of Tonawanda in the years 2011-2013. The data was gathered from NYSDOT and synthesized to produce striking results. These results show that crashes and collisions primarily involve children, most are clustered where major arterials meet residential streets (especially along Sheridan Drive), and all happened during daylight hours. This study suggests that both education and enforcement deficits exists for both motorists and bicyclists within the Town of Tonawanda.

This section explores bicycle usage statistics found in the American Community Survey (ACS) in the Town of Tonawanda with survey results from a survey administered by members of the studio team. The ACS data shows that bicycling for commuting means in the Town of Tonawanda is low at 0.4%. In further examining the census data at the tract level, it is discovered that the reported numbers vary from 0% to 2.2%. The results of the survey show that the actual bicycle ridership numbers are more complicated in the Town of Tonawanda. The survey administered by the studio gathered 113 responses on questions regarding types of bicycle infrastructure preferred and bicycling habits. The survey results showed a critical gap in understanding the current bicycling culture in the town by only using ACS data. Bicycling for recreation is incredibly popular in the Town of Tonawanda with 41.7% of respondents stating that they ride a bicycle one or more times a week for recreation. Furthermore, the surveys administered by members of the studio team reveal that the introduction of bicycle facilities such as designated bicycle lanes or protected bicycle lanes on major arterials like Sheridan Drive may be utilized by the public with 92.2% of respondents reporting they would use them.

Taken together, the data analysis section creates a complete and clear overview of how conditions for bicycling in the Town of Tonawanda can be improved. The survey administered by members of the studio team shows that there is a latent demand for improved bicycle facilities on major arterials for recreational use. Improving connectivity for recreational bicycling may also yield gains in bicycling for commuting purposes utilizing the same infrastructure improvements.

CONNECTIVITY AND NETWORK GAPS

A complete network of bicycle infrastructure in the Town of Tonawanda will improve overall connectivity and will help community members and visitors move around more easily. Projects will be highly equitable if they extend mobility to those who do not drive automobiles, coordinate with the NFTA to enhance public transit, and connect to all neighborhoods throughout the town. These efforts will benefit the environment by reducing auto dependency and reducing vehicle miles traveled in the town. The economy will benefit if all are given access to commercial centers and if streetscapes are improved throughout the town. Public health will be positively impacted if active living and recreational bicycling is encouraged.

The Town of Tonawanda 2014 Comprehensive Plan Update identifies several connectivity needs. This includes improving connectivity to businesses as well as between neighborhoods and economic centers. Another listed need is shoreline recreational amenities along the Niagara River waterfront. The plan calls for connectivity projects to make pedestrian and bicyclist accommodations. The Greater Buffalo Niagara Regional Transportation Council (GBNRTC) prioritizes regional connectivity for bicyclists.

In this study, bicycle connectivity targets are broken down into four major categories. These categories include: connecting neighborhoods to employment and educational centers, connecting neighborhoods to commercial nodes, recreational and waterfront connectivity, and connecting the Town of Tonawanda to the Western New York region. Each category includes specific information regarding how these corridors connect with activity areas or points of interest with no regard given to existing infrastructure or land uses.

The Network Gap Analysis uses geographic informational systems (GIS) to explore and identify where critical gaps exist in the current and proposed bicycle network. The network gap analysis complements the connectivity study by examining what barriers exist between potential bicycling destinations. These barriers include land uses such as vacant land, parking lots, highways, and rail lines. Destinations for bicyclists include employment, education, recreation, commercial, or other community use centers. The GIS data was collected from federal and local agencies including data used in the 2014 Comprehensive Plan: Town of Tonawanda and from the United States Census Bureau's TIGER shape file data for New York's Erie County. The geo-data inventory contains the existing land uses, public facilities, bicycle paths, road locations, and major employers.

Together, the Connectivity Study and the Network Gap Analysis will assist in forming priority project recommendations for the Town of Tonawanda Bicycle Master Plan.

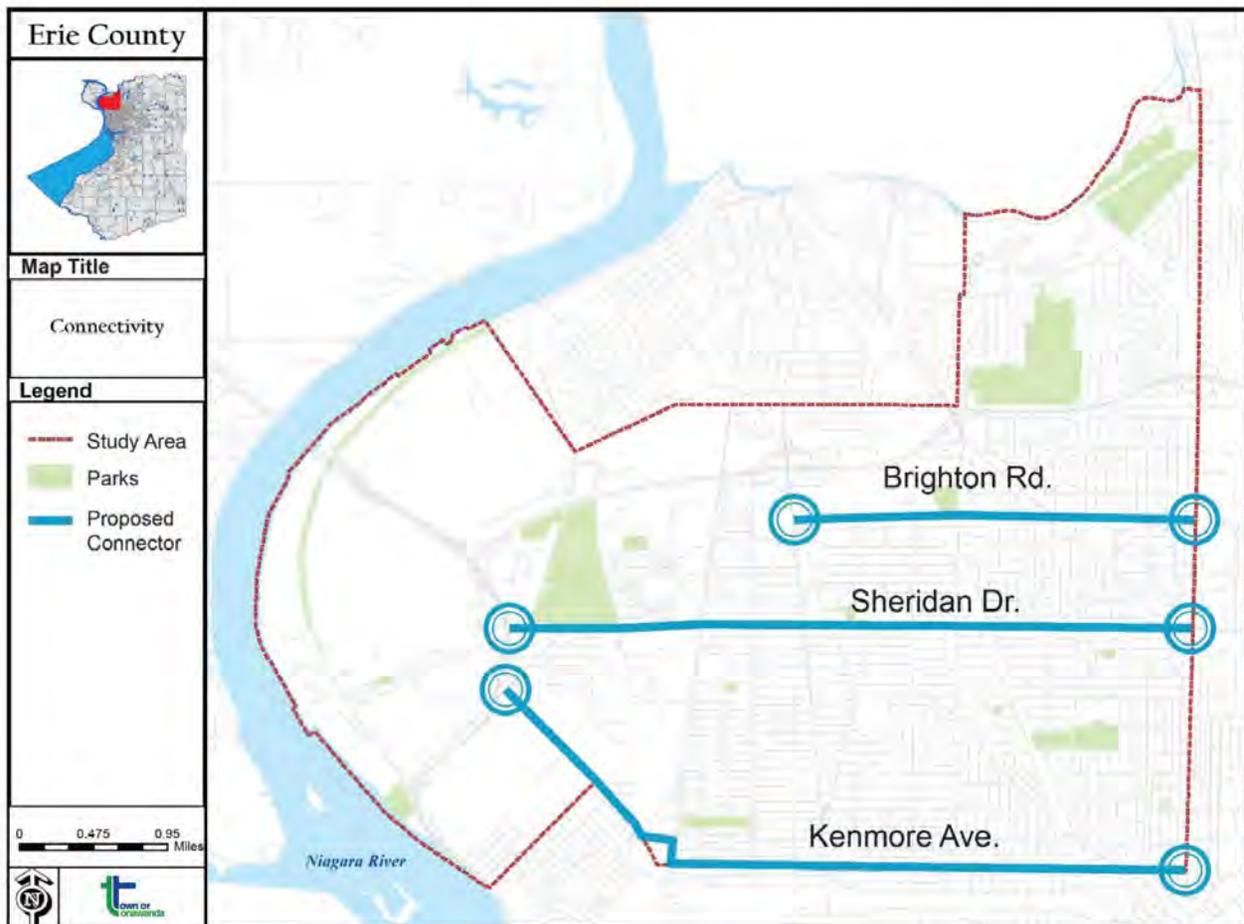
CONNECTIVITY ANALYSIS

Linkages between Neighborhoods and Centers of Employment & Education

The University at Buffalo Regional Institute (UBRI) reports that 3,120 households in the Town of Tonawanda do not have access to a vehicle and that 37% of the town's "most vulnerable" report relying on forms of transportation other than a private vehicle. The most common forms of transportation for this group are public transit and walking (UBRI). More design initiatives for a variety of transportation modes can be beneficial to a significant amount of Tonawanda's population. This includes the development and improvement of bicycle infrastructure.

The UB Regional Institute reports on the top employers in Tonawanda as of 2013. This includes Goodyear Dunlop Tires which is located in Tonawanda's industrial district at the westernmost part of Sheridan Drive. Another major employer, Praxair, Inc., is close to the industrial corridor on East Park Drive. The GM Powertrain Tonawanda Engine Plant on Sheridan Drive and MJ Mechanical Services on Military Road are two other major employers located in the western portion of Tonawanda. Most of Tonawanda's population is concentrated in the eastern portion of town where development is denser. There is little residential land use in the industrial corridor to the west. There are opportunities to expand on existing infrastructure or plan for bicycle infrastructure to connect workers to these places of employment. Table 1 shows the major employers in the Town of Tonawanda in 2014. These 17 major employers are located in the west side of the study Town.

Figure 3.1 Linking Bicycling Facilities and Employment Centers



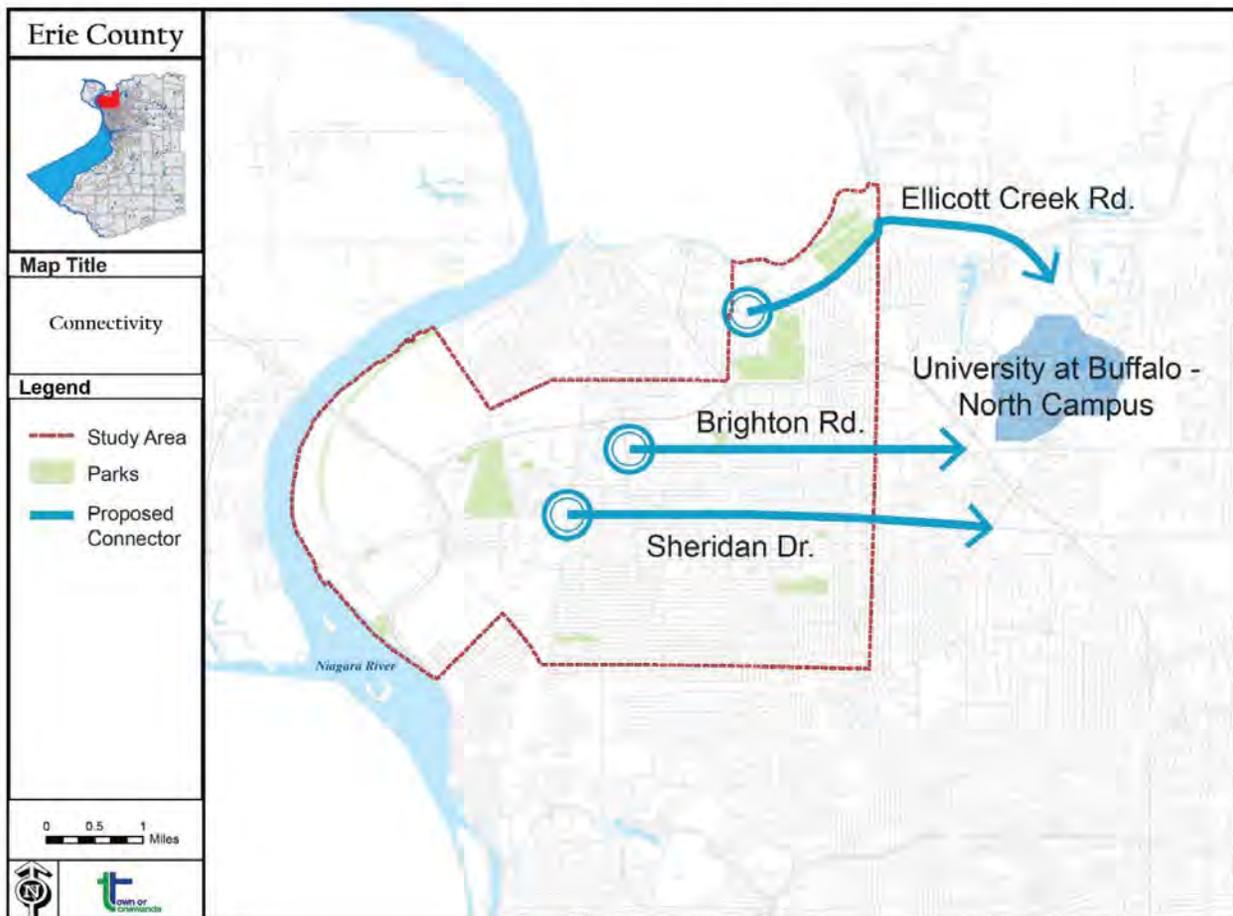
The Sherwood Greenway is located along Sheridan Drive and connects to the Praxair, Inc., Goodyear Dunlop Tires, and GM Powertrain locations. The Town of Tonawanda has proposed a complete streets measure to add cycle tracks to Sheridan Drive that will connect the Rail Trail to the Sherwood Greenway.

Linkages between Neighborhoods and the University at Buffalo

The University at Buffalo is a major research center and a hub of academics and employment for the region. The university employs approximately 6,788 full time employees and has a student population of nearly 30,000. It estimates to have an economic impact of \$1.7 billion annually. The university has a downtown campus in the City of Buffalo and two larger campuses that are directly adjacent to the Town of Tonawanda. Its North Campus is in the Town of Amherst and is located directly east of Tonawanda. Its South Campus is in the northeastern corner of the City of Buffalo, bordering the Town of Amherst. Both campuses are surrounded by busy arterial streets that are generally unsafe for traveling by bicycle.

The Ellicott Creek Trail is a major bicycle way that already provides some connectivity to the North Campus. However, this trail is primarily used for recreation and is not plowed during winter months. There are also dedicated bicycle lanes along Sweet Home Road that could serve as a connector to Tonawanda if adjacent streets are adapted for bicycling. The Tonawanda Rails to Trails project and a complete streets initiative along Kenmore Avenue are two connectors to South Campus that are currently being implemented. Like the Ellicott Creek Trail, The Rails to Trails paths will not be plowed during the winter.

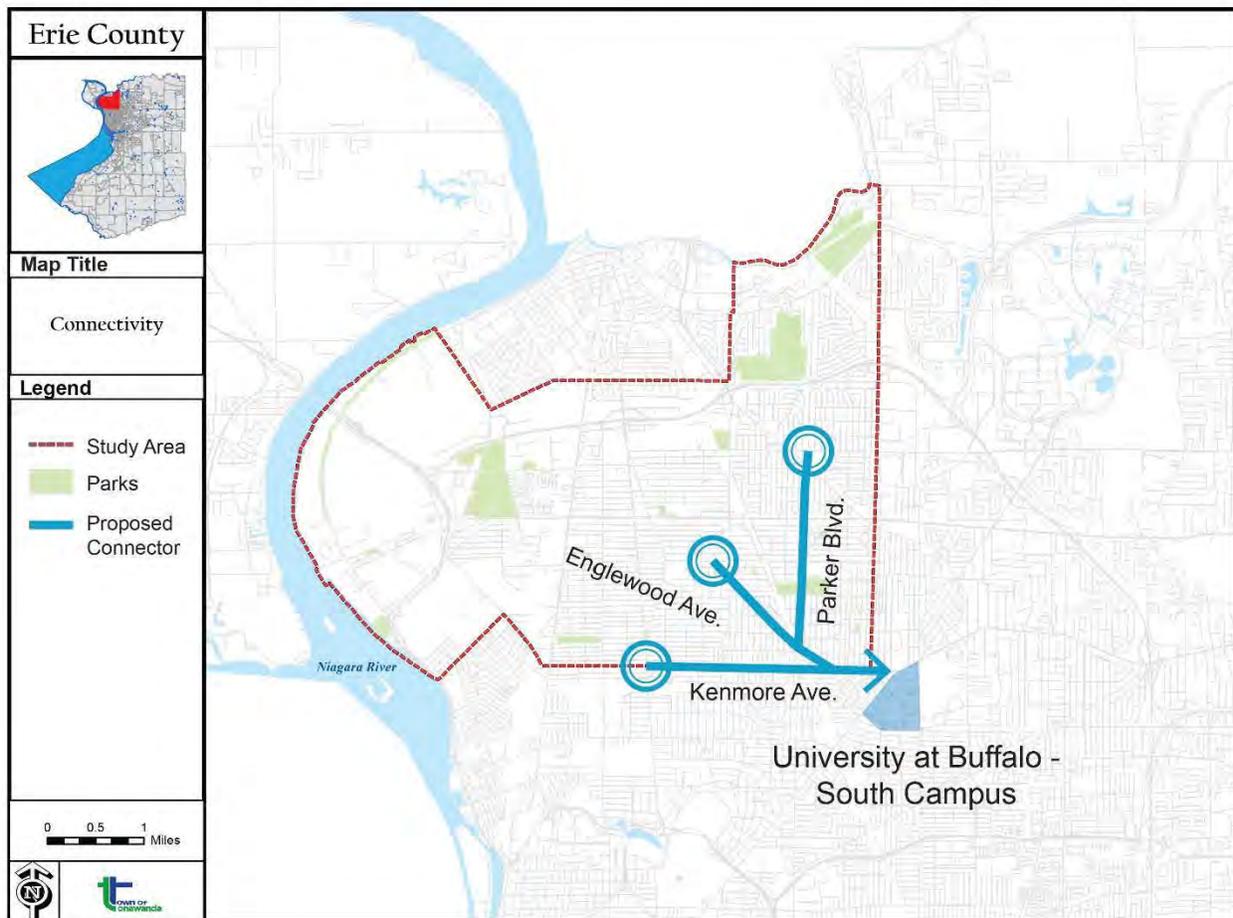
Figure 3.2 Linking Bicycling Facilities and U.B. North Campus



Linkages between Tonawanda and University at Buffalo's South Campus

Once complete, the Rails to Trails project will provide bicycle infrastructure adjacent to the South Campus. A connector along Kenmore Avenue will branch from this path and will provide an east to west connector to the campus. Connectors added along Parker Boulevard and Englewood Avenue will provide additional linkages for residential neighborhoods in Tonawanda.

Figure 3.3 Linking Bicycling Facilities and U.B. South Campus



Linkages between Tonawanda Neighborhoods to Commercial Nodes

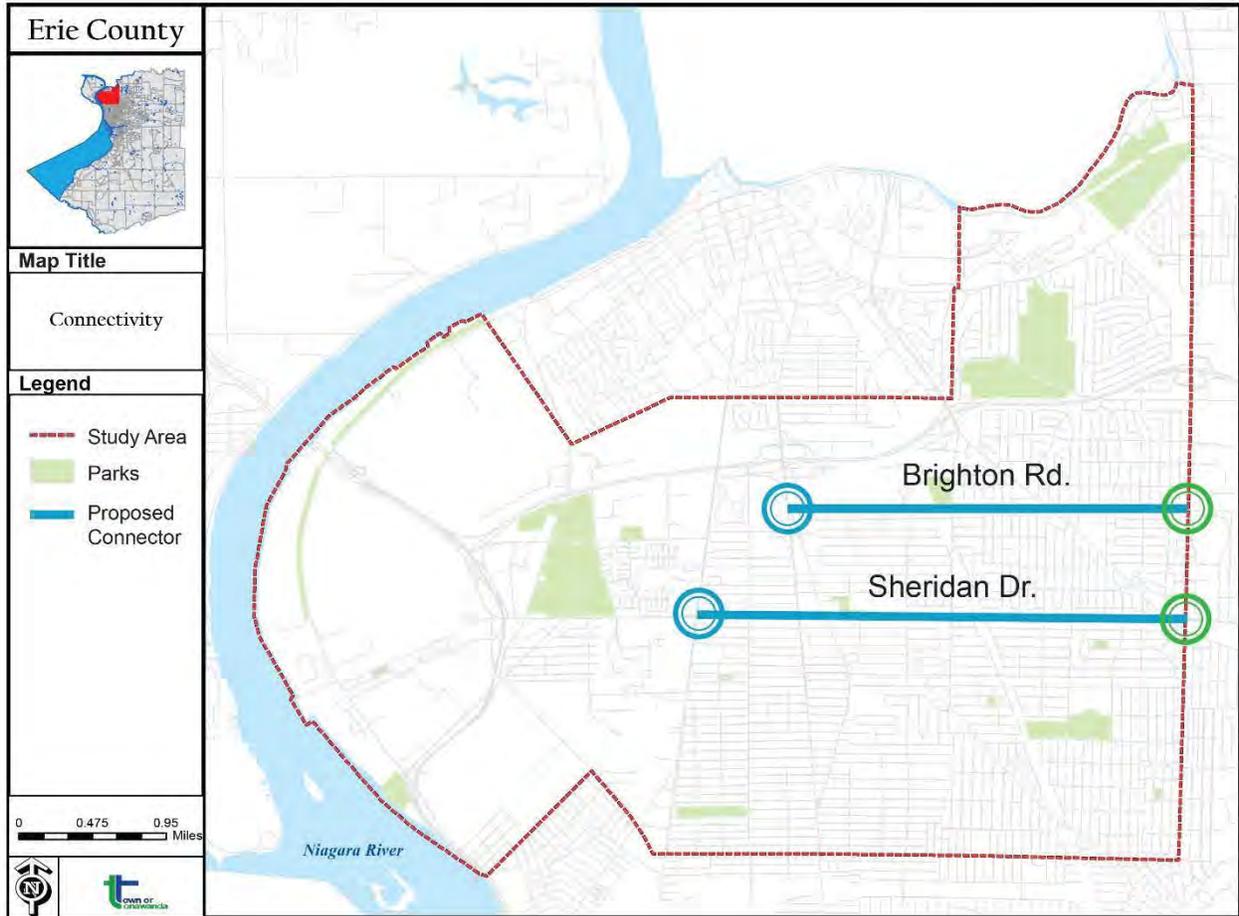
Niagara Falls Boulevard

Niagara Falls Boulevard is a hub of commerce and accommodates a convenient concentration of shopping destinations. The street is a major artery with heavy amounts of traffic. South of Sheridan Drive, the street is made up of four lanes and to the north of Sheridan Drive there are six lanes. Most of the road that sits within Tonawanda has a speed limit of 35 or 40 miles per hour. Heavy traffic and narrow shoulders make this a dangerous place for bicyclists.

The western side of Niagara Falls Boulevard is located in the Town of Tonawanda and the eastern side is within the Town of Amherst. Making this street safe and convenient for bicyclists would

require careful coordination between these two municipalities. Tonawanda has engaged in similar coordination with the City of Buffalo to plan and implement the Rails to Trails program and the Kenmore Avenue complete streets initiative. A similar project along Niagara Falls Boulevard would require more resources and a similar level of inter-governmental coordination.

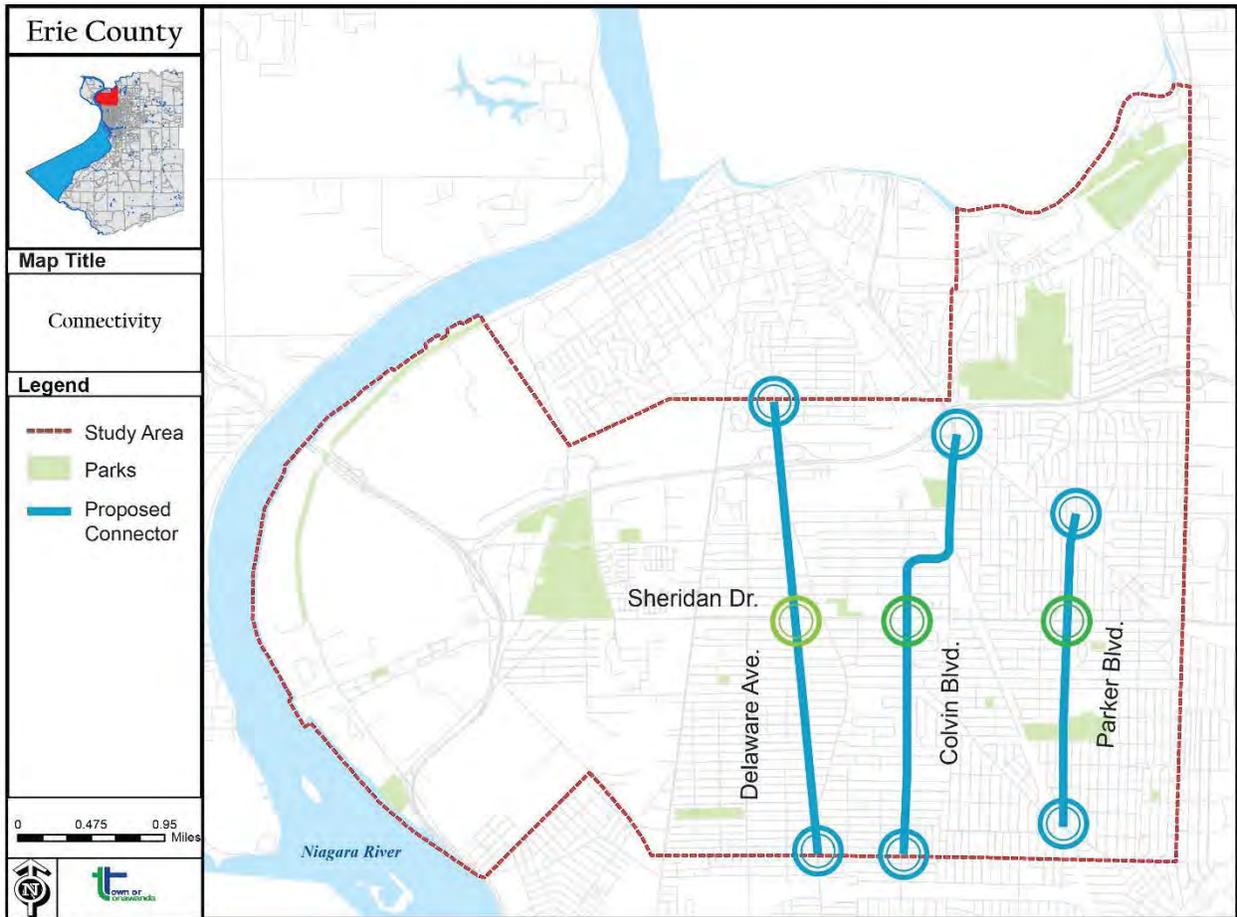
Figure 3.4: Linkages to Niagara Falls Boulevard



Sheridan Drive

A significant amount of commercial amenities exist along Sheridan Drive. This includes restaurants, retail destinations, and other commercial uses. Existing conditions for bicycling along this street have been discussed earlier in this section. If approved and implemented, plans to reduce lanes and add cycle tracks along Sheridan Drive would provide a safer environment for bicyclists. This would also provide connectivity to both centers of employment and centers of commerce. The Rails to Trails project will also provide connectivity to the commercial corridor along Sheridan Drive.

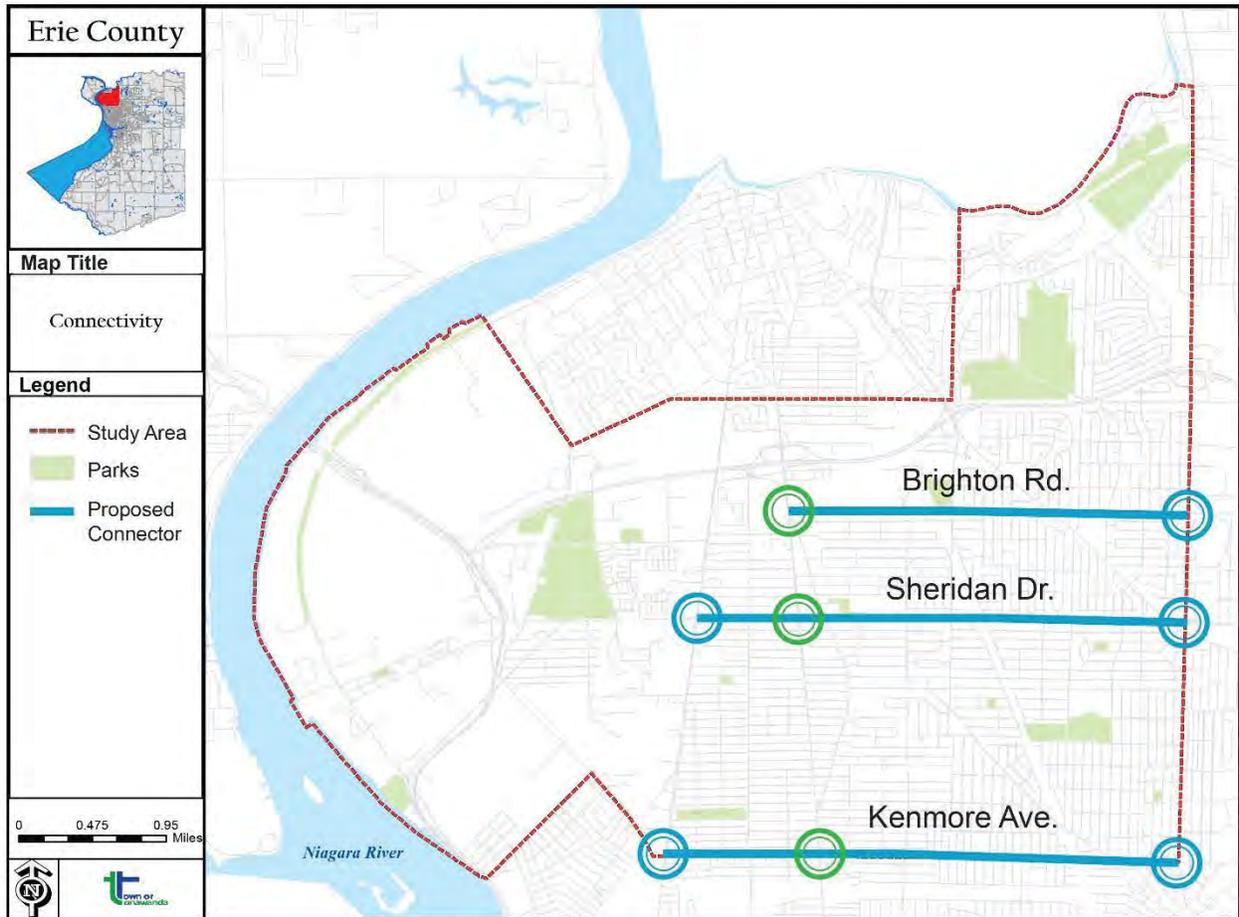
Figure 3.5: Linkages to Sheridan Drive



Delaware Avenue

Another commercial corridor exists along Delaware Avenue. This is a major north-south arterial between Town of Tonawanda and the City of Buffalo. A walkable commercial node exists along this street in the Village of Kenmore. Restaurants and retail destinations are accessible to adjacent neighborhoods by foot. Added connectors can make this commercial center more accessible to neighborhoods that are not directly adjacent to the Village of Kenmore.

Figure 3.6: Linkages to Delaware Ave.



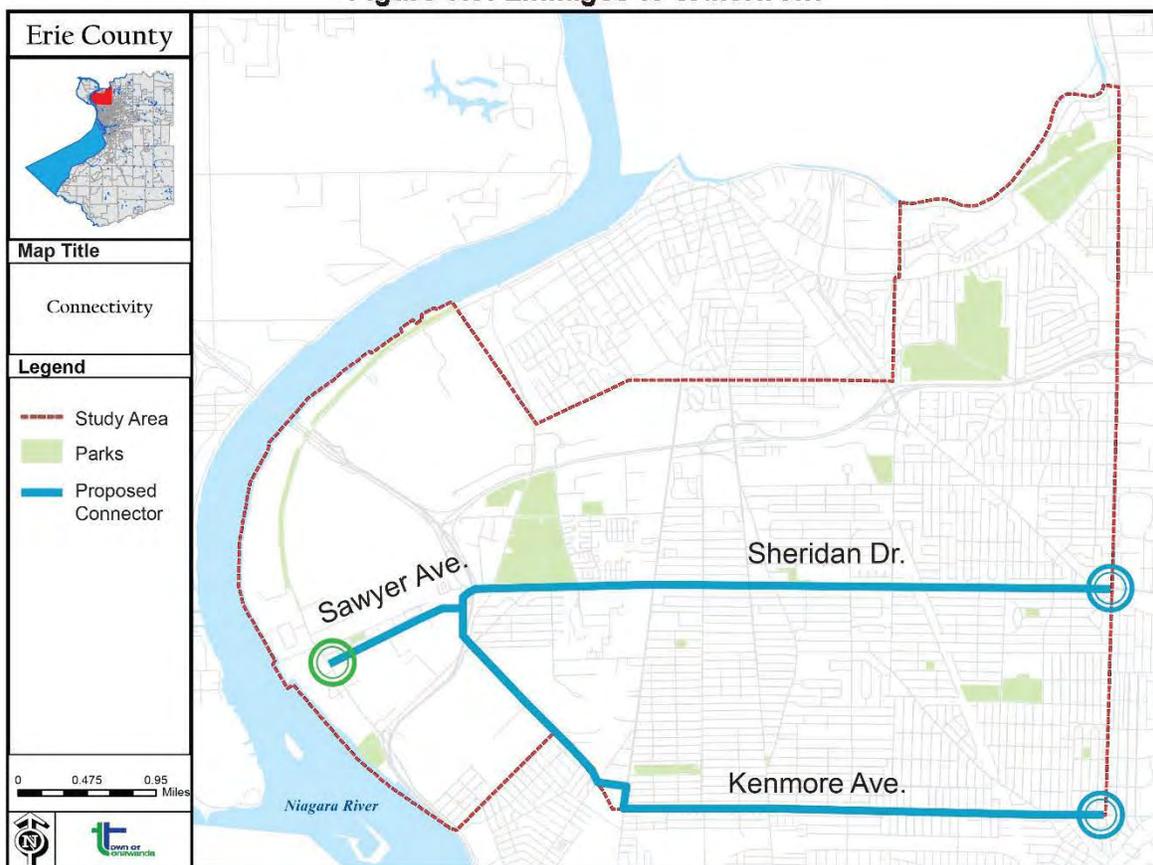
Linkages to Waterfront

There are about six miles of Niagara River shoreline within the Town of Tonawanda. This presents a tremendous opportunity for waterfront recreation and the public use of shoreline spaces. A barrier is formed between most of the town and the waterfront by light industrial uses along the Niagara River and the position of Interstates I-190 and I-290. Several former industrial sites along the river have been successfully remediated, including the Cherry Farm site where a new park is planned. The Town of Tonawanda 2014 Comprehensive Plan Update identifies this site and another park under the Grand Island Bridge as potential projects for waterfront development. The Erie Canalway Trail along the Niagara River is a large, statewide trail. Public recreation would be expanded if this was more easily accessible for those in Tonawanda.

Figure 3.7: Cherry Farm Site



Figure 3.8: Linkages to Waterfront



Linkages to Public Parks & Other Recreation Areas

There are several public parks and other recreational facilities that serve the Town of Tonawanda. Some of the major public parks include Ellicott Creek Park, Sheridan Park, Mang Park, and Lincoln Park. Public outdoor swimming pools are located at Brighton Park, Lincoln Park, and Mang Park. An indoor pool is located at the Aquatics and Fitness Center on Sheridan Drive.

The needs of bicyclists in one region are not limited to one municipality or one neighborhood. Naturally, the needs of cyclists would require them to move throughout a region, from one municipality to the next. A Tonawanda resident may live close to Brighton Road, but may need to travel east to a job in Amherst. He may also wish to take a leisurely ride north into Niagara County or a ride south to attend an event in the City of Buffalo. Municipalities within a region are required to collaborate in order to create regional connectivity. A regional network of bicycle infrastructure must continue seamlessly between towns, villages, cities, and counties. An efficient regional network should be a long-term goal for the Western New York region. Short-term projects must be implemented within the next 5-10 years to better connect the Town of Tonawanda to the rest of Western New York.

Linkages to Surrounding Communities

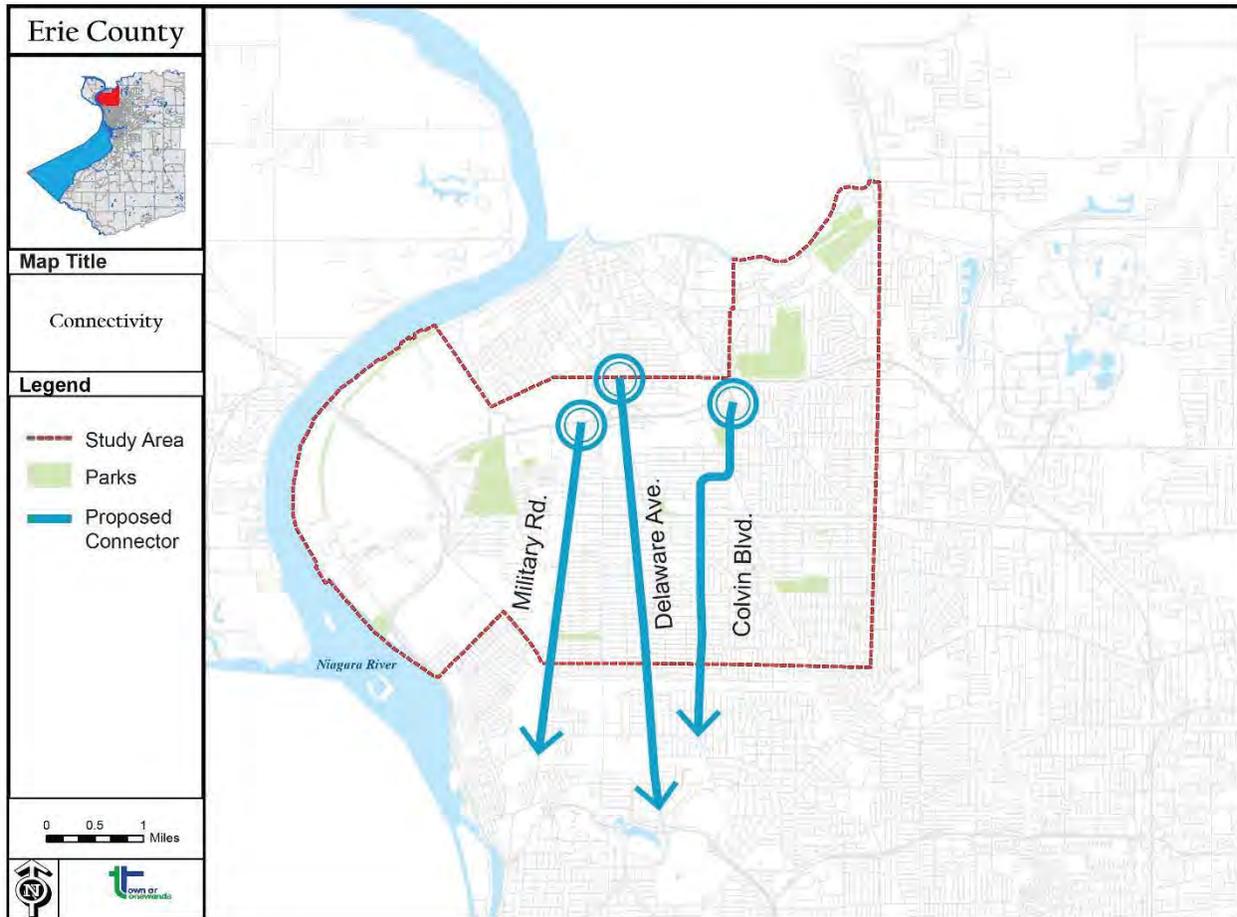
Connecting the Town of Tonawanda to the City of Buffalo

The Rails to Trails program is currently in its first stages of implementation and will connect Tonawanda and Buffalo. The trail is planned to extend south to LaSalle Station on Main Street. This will provide a major linkage to Buffalo's NFTA metro line. LaSalle Station and other stations serving the metro should be equipped with bicycle service stations and air pumps. Changing rooms should be added or bathrooms should be expanded to allow space for commuting cyclists to prepare for work. The stations should also include racks for bicycle parking and covered spaces for long-term storage.

Connectors along Delaware and Elmwood Avenues are two other locations where the Town of Tonawanda would be linked to the City of Buffalo. Delaware Avenue is a wide street that could accommodate a cycle track with the removal of a lane or a reduced speed limit. This would give Tonawanda residents access via bicycle to Delaware Park and its surrounding areas. Similar measures taken on Elmwood Avenue could give residents the same access to the rich commercial district along that street within the City of Buffalo. A connector along Colvin Avenue could also provide access to commerce along Hertel Avenue and recreation in Delaware Park.

Another opportunity for a connector to the City of Buffalo exists along Military Road. A connector along this street would extend south and link to Niagara Street within the City of Buffalo. This would provide access to Buffalo State College and to commercial and cultural destinations on the West Side of Buffalo.

Figure 3.9: Linkages to City of Buffalo



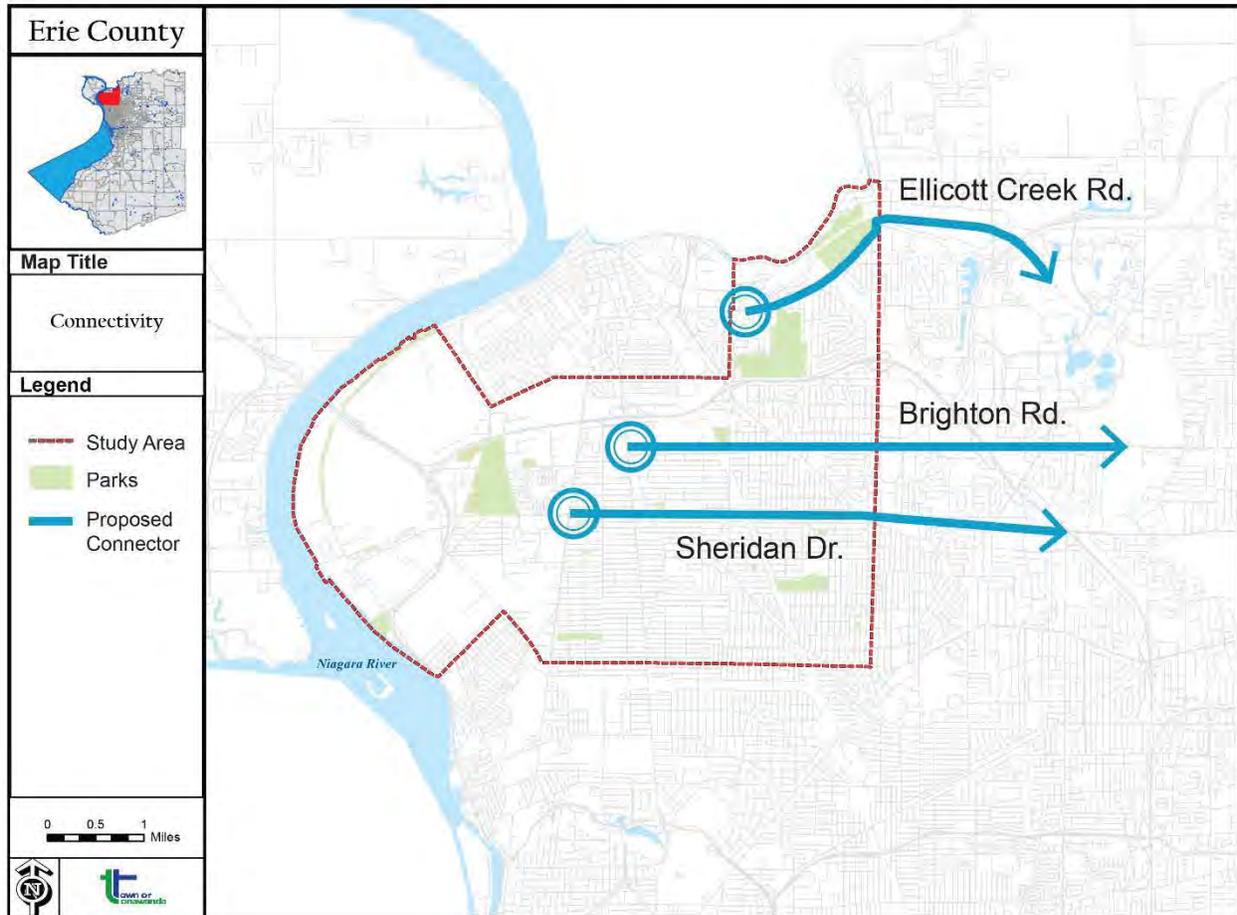
Connecting the Town of Tonawanda to the Town of Amherst

Extending the Sheridan connector eastward past Niagara Falls Boulevard could effectively connect Tonawanda to Amherst. This would provide convenient linkages to shopping plazas and grocery stores close to Sheridan Drive. A similar east-west connection could be made with connectors along Brighton and Maple Roads to the north as well as a connector along Ellicott Creek Road. Zoning ordinances must be adjusted to require bicycle and pedestrian accommodations for site plans and new developments along these streets. Complete streets standards and streetscape beautification initiatives would make these spaces more enjoyable for those to enjoy from outside an automobile. Traffic volumes and patterns need to be assessed to evaluate the feasibility of lane reductions and new speed limits along these major arterials. Safety of all who share the road is a major priority, but the most vulnerable users are bicyclists and pedestrians.

The design of Niagara Falls Boulevard poses a major challenge to connect Tonawanda and Amherst. The expanse of multiple lanes and high volumes of traffic creates a physical barrier between both sides on the boulevard. More trees should be added along the sides of the street and on the wide median. Crossing islands with bicyclist and pedestrian refuge are required for safety when crossing the street. Pedestrian bridges should be considered as an option to make

the street easier to cross. Traffic calming techniques should also be implemented to improve safety. Attractive public spaces would prove to be an effective economic development tool.

Figure 3.10: Linkages to the Town of Amherst



Connect the Town of Tonawanda to the City of Tonawanda

Extending a few of the major connector proposals into the City of Tonawanda is an additional project that could enhance regional connectivity. This would include north-south connectors along Delaware Avenue and Military road, improving access to the downtown commercial district of retail and restaurants within the City of Tonawanda. This would also provide connections to the waterfront along Tonawanda Creek within North Tonawanda.

Connectors along Ellicott Creek Road and the Shoreline Trail along the Niagara River would provide more access to waterfront and recreational assets within the City of Tonawanda. These assets include Veterans Memorial Park, Niawanda Park, as well as restaurants along Niagara Street.

General Linkages to the WNY Region

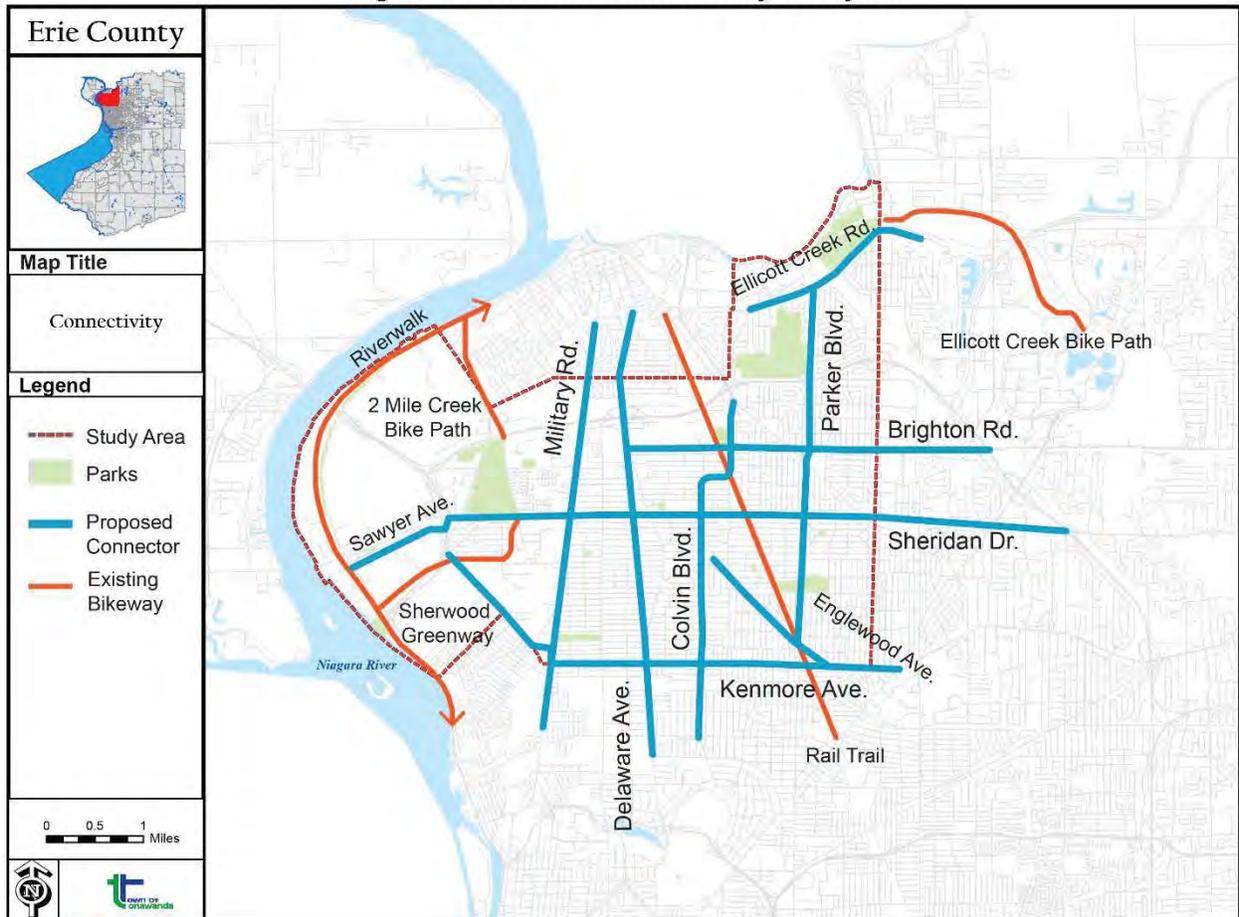
The best locations for regional connectivity exist at off-road cycle tracks that are intended mostly for recreational use. This includes the Riverwalk along Niagara River and the Erie Canalway Trail.

The GBNRTC outlines opportunities for regional connectivity in the 2008 Bicycle and Pedestrian Master Plan for Erie and Niagara Counties. The plan identifies a “Regional Bicycle Network” and rail corridors that could serve as linkages. Regional trails identified include the Riverwalk Trail, the Scajaquada Trail, the Ellicott Creek Trail, and the Erie Canal Trail. Several New York State Bicycle Routes are also identified in the plan.

Total Connectivity Analysis

The map below visualizes how the Town of Tonawanda currently utilizes major arterials to connect to major destination points within the town and region. There is no priority or project recommendation given.

Figure 3.11: Total Connectivity Analysis

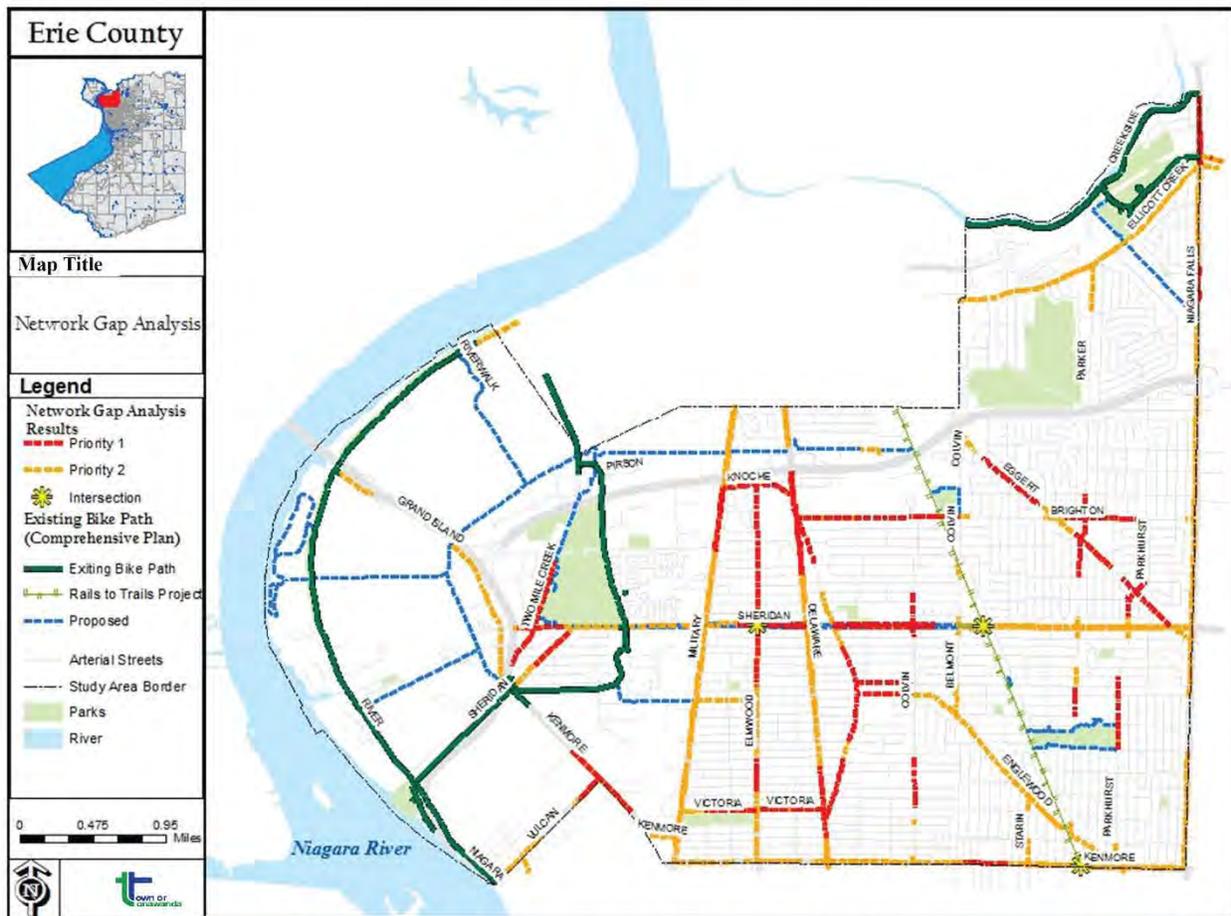


NETWORK GAP ANALYSIS

INTRODUCTION

The map below illustrates the Network Gap Analysis results by highlighting the major arterials in red and yellow that would increase bicycle network connectivity in the Town of Tonawanda. The first priority areas are coded in red, while second priority areas are coded in yellow. This study goes beyond the connectivity analysis by isolating specific sections of major arterials where bicycle facilities are considered to be a priority based on the surrounding land uses.

Figure 3.12: Network Gap Analysis



The Network Gap Analysis determines gaps within the network of the existing, designed, and proposed bicycle paths from the 2014 Comprehensive Master Plan for Town of Tonawanda. According to the design guidelines for the bicycle paths, all the streets with a speed limit greater than 25mph that are considered feasible for bicycle facilities. The Network Gap Analysis prioritizes the identified gaps based on commuting destinations of bicyclists. The results illustrate two prioritization levels for the streets with speed limits higher than 25mph and three critical intersections.

Priority One

In the first priority are sections of streets that are adjacent to high commuting potential land uses such as parks, recreational, and public facilities. These areas have the highest priority to be developed for bicycle facilities in near-term projects. The overall length of this section is 18 miles. Full priority 1 implementation would improve connectivity and linkages to all public facilities such as schools and libraries as well as connect parks and the waterfront. Furthermore, full implementation would also improve connectivity to employment areas.

Priority Two

The second priority are corridors with commercial land uses. These locations are primarily retail stores. Additionally, priority two areas include the major employers in the Town of Tonawanda. The total length of the priority 2 corridors is around 40 miles.

The connectivity and linkage to major employers and retail stores in commercial corridors would be increased by providing bicycle facilities for the second priority.

Intersection Priority

In order to improve the linkage of major corridors, the analysis identifies three intersections with the highest priority to be designed for bicycle facilities. With regards to the existence of the Rails to Trails project, intersections within this corridor have the highest priority to be designed in the short-term. Two of the most important intersections are at the connection points of the Rails to Trails project with Sheridan Drive and Kenmore Avenue. Also, the intersection of Elmwood Avenue with Sheridan Drive is an important priority because of its location at the center of the network and the high priority of corridors.

NETWORK GAP ANALYSIS PROCESS

The purpose of this study is to identify and prioritize critical gaps that exist in the bicycle network. The analysis seeks to identify where improvements can be made in the bicycle network that would service important destinations for riders. These destinations include public facilities (schools, libraries, playgrounds, and hospitals), parks, major employers, and commercial land uses. In addition, the analysis considers infrastructure and land use barriers within the Town of Tonawanda that hinder bicyclists' movement physically. Infrastructure barriers include highways or rail lines within the site. Land use barriers for bicyclists include vacant lands and parking lots. The network gap analysis is built on the connectivity goals and concept of equity. The detailed objectives of the network gap analysis are listed below:

- Identify Important Destinations for Bicyclists
 - a. Parks, Recreational Areas, and the Waterfront
 - b. Major Business Areas and Employers
 - c. Education Centers
 - d. Health Centers
- Identify the Most Important Intersections for Bicyclists.
- Identify Where Critical Gaps Exist

Data Collection

The network gap analysis was conducted by the use of GIS. The data was collected from both federal and local agencies including the 2014 Comprehensive Plan for the Town of Tonawanda and the United States Census Bureau TIGER shape file data for Erie County, New York. The geo-data inventory contains the existing land uses, public facilities, bicycle paths, road locations, and major employers.

Creation of the Network Gap Analysis Map

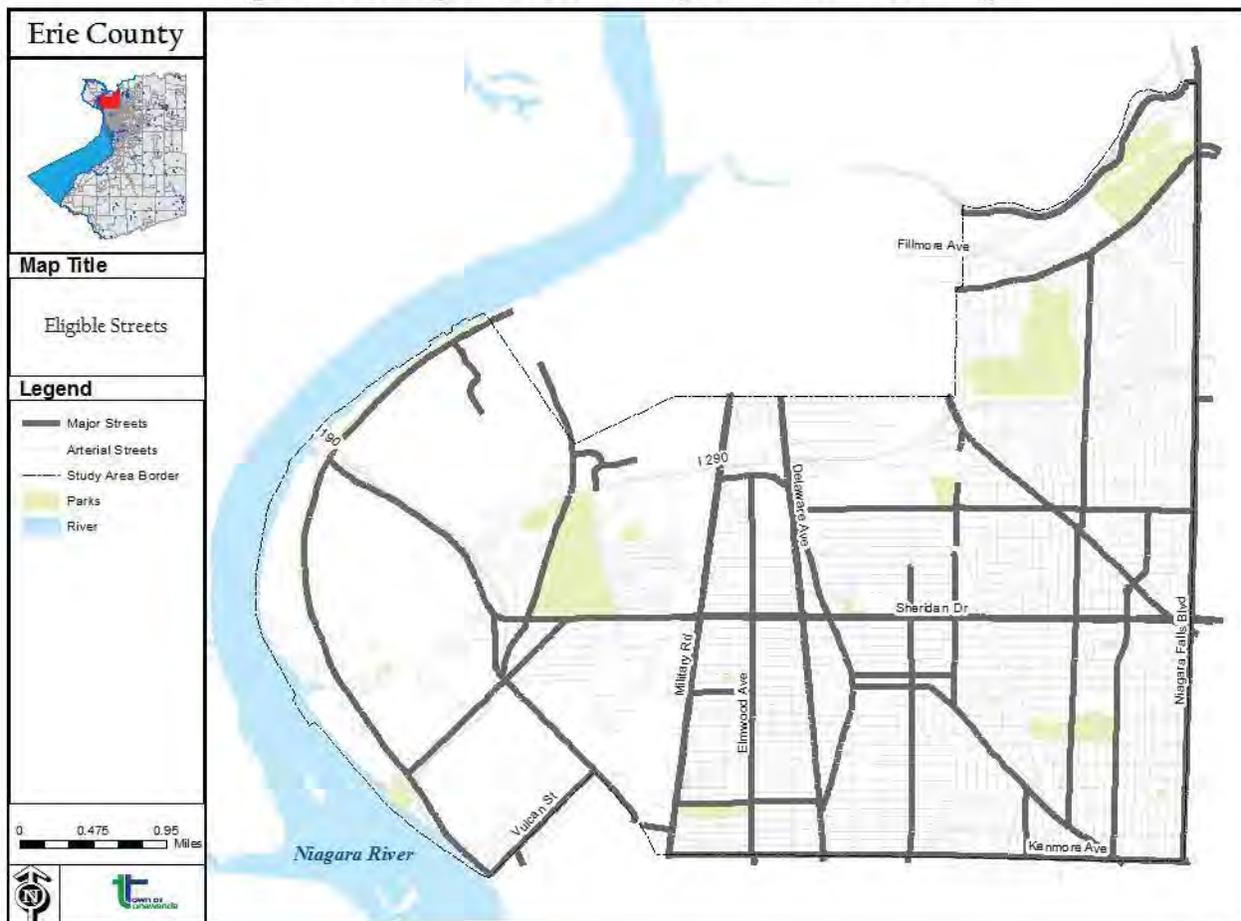
The analysis studied several primary factors in land uses. The following is a brief description of the analysis process:

1. Identifying Eligible Roadways
2. Identifying Network Connection Points
3. Determining Gap Locations
4. Prioritizing Gap Locations

Identifying Eligible Roadways

This analysis prioritizes the eligible roadways for bicycle facilities. According to the design guidelines, streets with speed limits higher than 25 mph are eligible for bicycle facilities. Roadways with speed limits equal or less than 25 mph are considered as residential streets with low traffic volume and thus are not considered in the network gap analysis. Map 1 illustrates major streets with speed limits greater than 25 mph.

Figure 3.13: Major Streets with Speed Limits Over 25 Mph



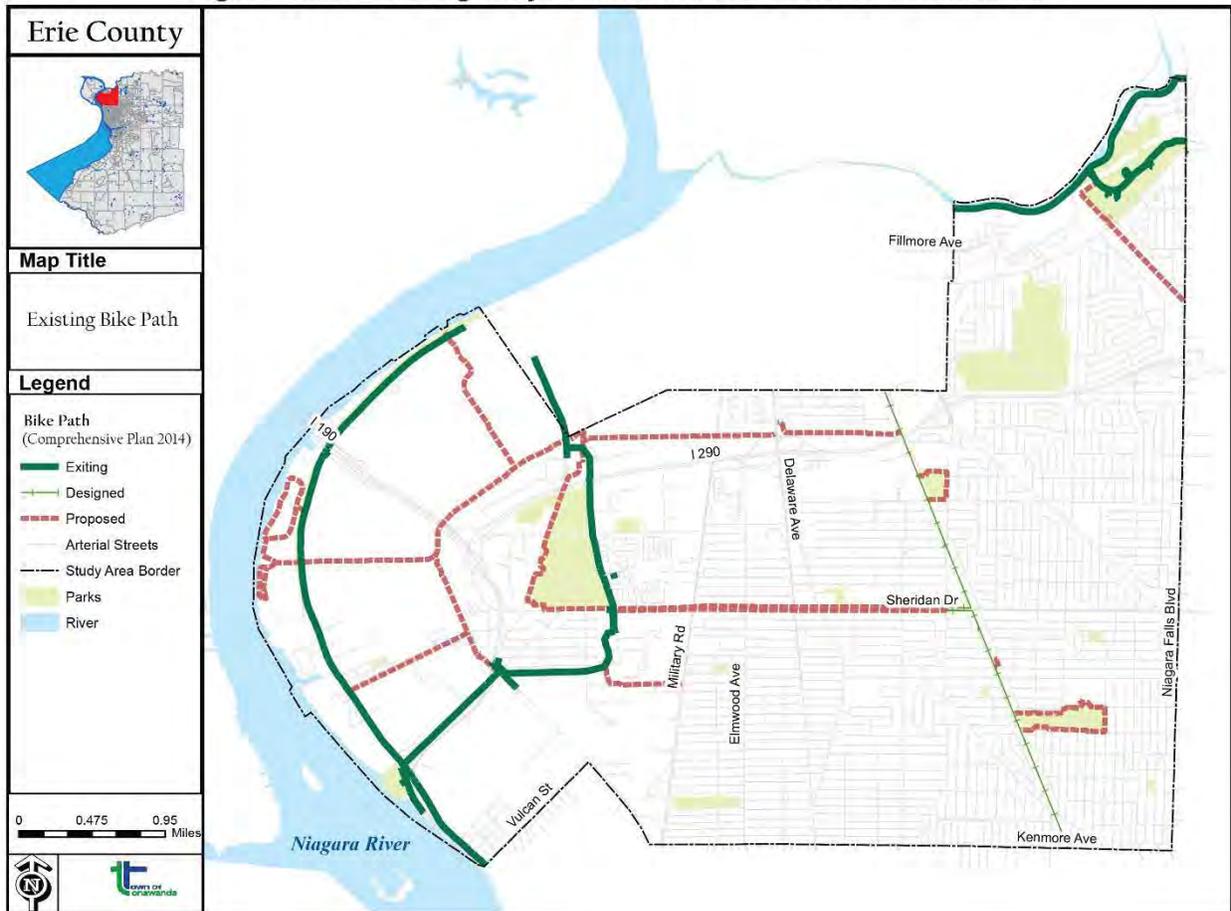
Identifying Key Network Connection Points

Key connection points within the bicycle network have been identified:

- Parks
- Playgrounds
- Recreational areas
- Schools
- Libraries
- Hospital
- Major employers
- Commercial land uses

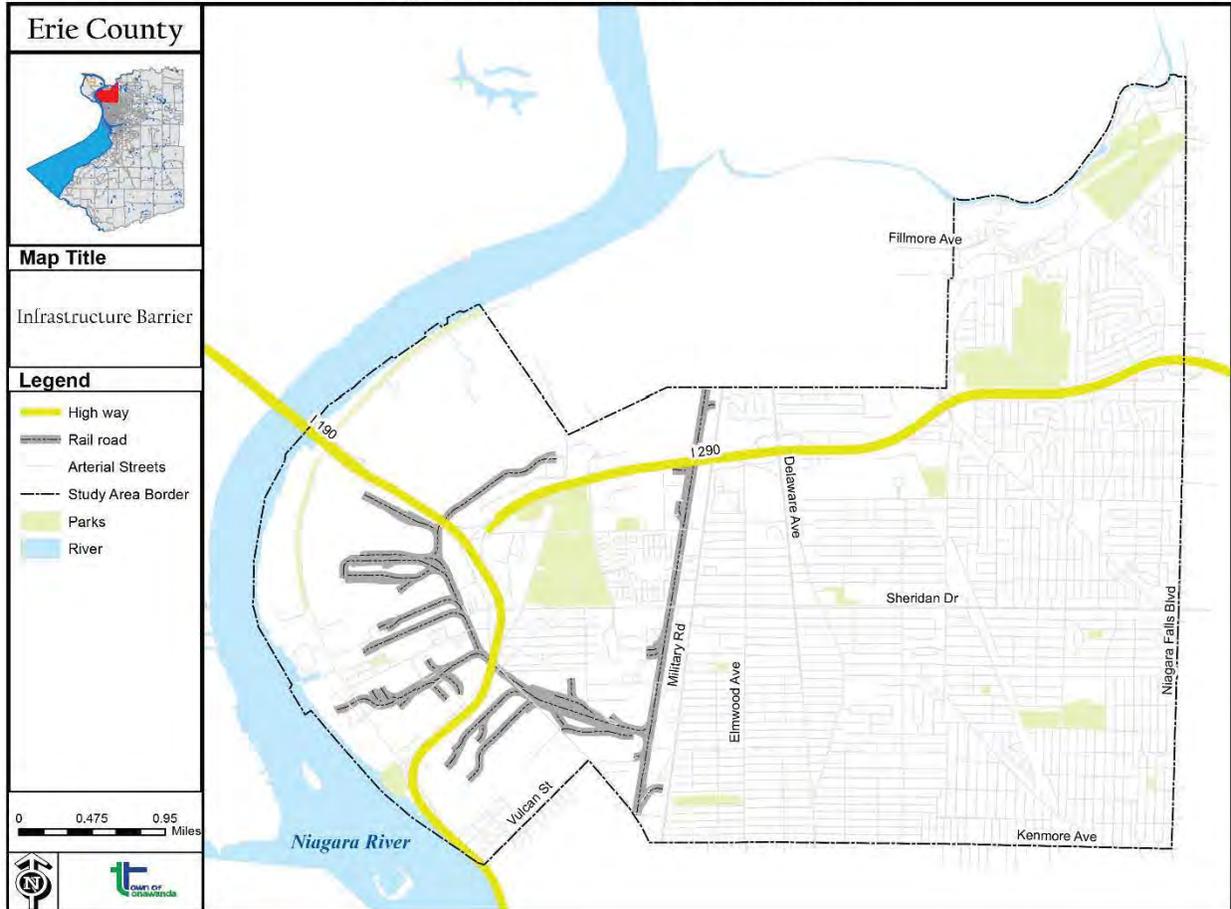
After determining eligible streets for bicycle facilities in the study area, the existing bicycle paths from the 2014 Comprehensive Master Plan for the Town of Tonawanda were considered in the analysis. Also, the Rails to Trails project has been introduced as a designed bicycle path. In addition, the 2014 Comprehensive Master Plan for the Town of Tonawanda also includes proposed bicycle paths. No bicycle facilities and bicycle paths were recommended for the southern and eastern parts of the Town of Tonawanda.

Figure 3.14: Existing Bicycle Paths in the Town of Tonawanda



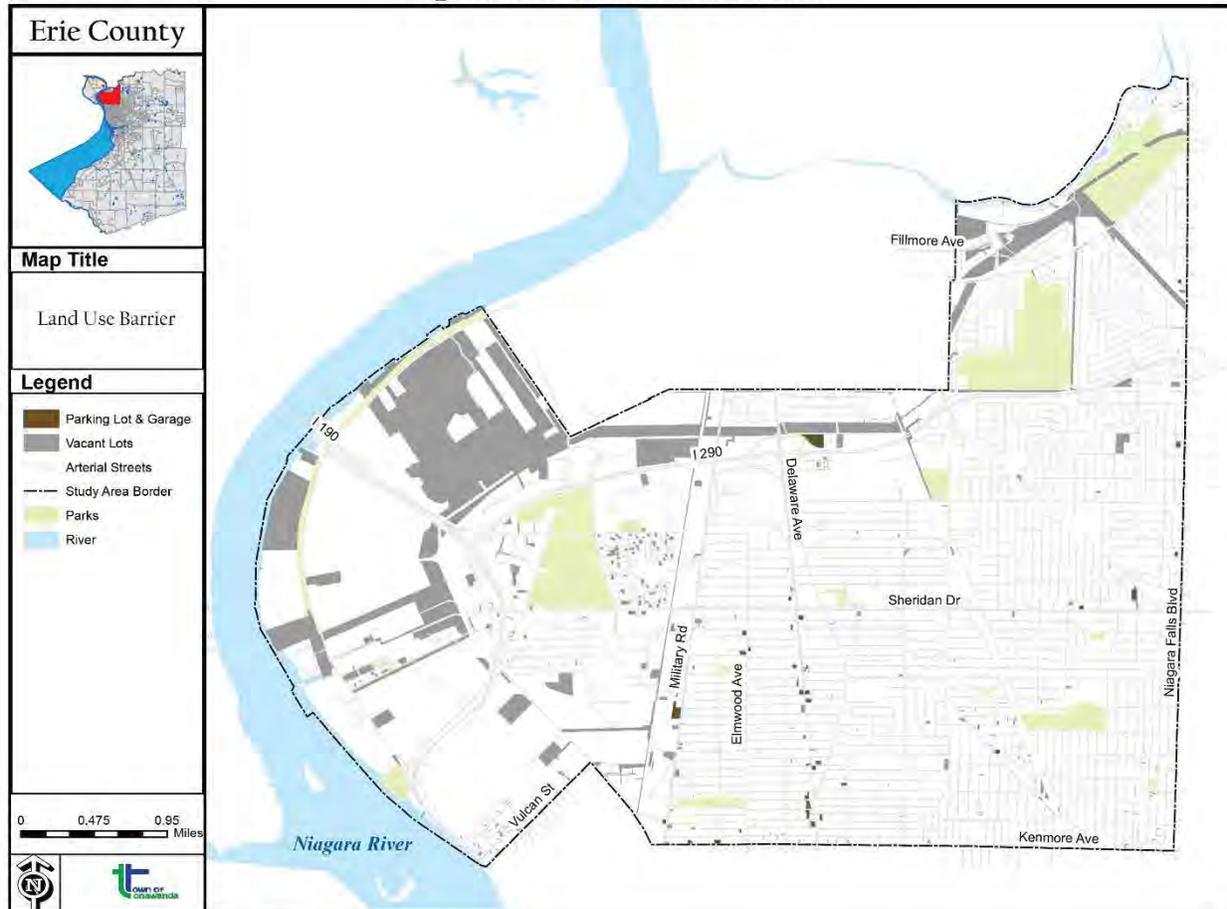
The map of existing highways and rail lines was made in order to identify infrastructure barriers within the Town of Tonawanda. Highways I-190 and I-290 in the Town of Tonawanda have a speed limit of 55mph. These highways and railroads hinder bicycle movement (Figure 15).

Figure 3.15: Infrastructure Barriers



There are also land use barriers such as parking lots and vacant areas which hinder bicycle movement. These land uses discourage bicyclists to cross large expanses with little to no traffic control or surface maintenance.

Figure 3.16: Land Use Barriers



The following maps have been made to recognize the important destinations for bicyclists.

1. Existing Parks, Recreational Areas, and Playgrounds: There are 12 parks within the site. Around 7 of these parks do not have access to bicycle paths.
2. Existing Public Facilities: Existing public facilities in the town of Tonawanda include a library, schools, special schools, religious and cultural facilities, cemeteries and moral associations, and hospitals and health facilities. In the southern and eastern sections of the town, the two libraries, hospital, and most of the schools located on these parts of the town do not have access to bicycle paths.
3. Existing Commercial Lands and Major Employers: Table 1 shows the list of major employers in the Town of Tonawanda with their number of employees in 2014. These 17 major employers are located in the west side of the study area. In addition, there are commercial corridors with retail stores. According to the high number of employees for the major companies and commuters around the retail stores, there is an obvious need for providing bicycle infrastructure.

Figure 17: Parks, Public facilities, Vacant lands, Parking lots, and Commercial Land Uses

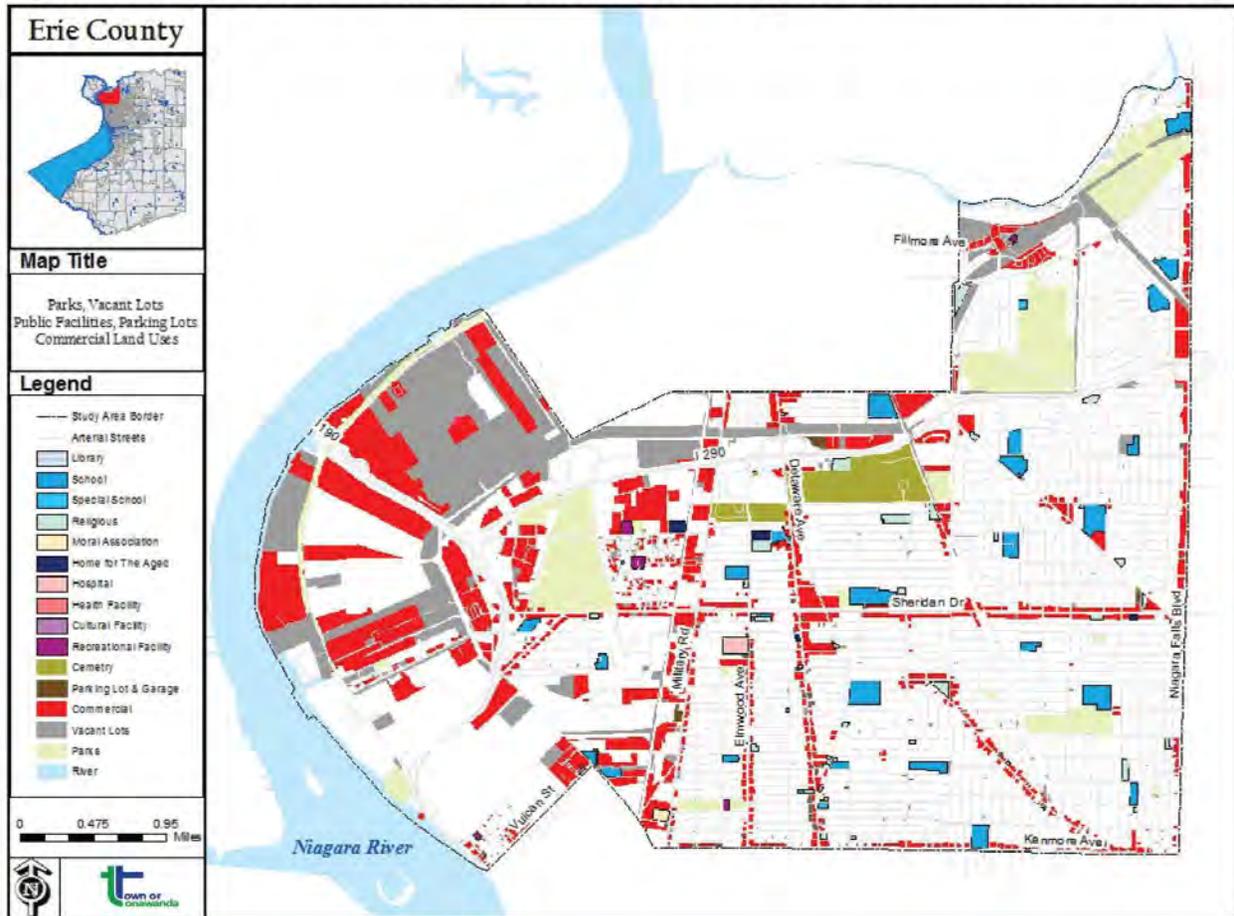


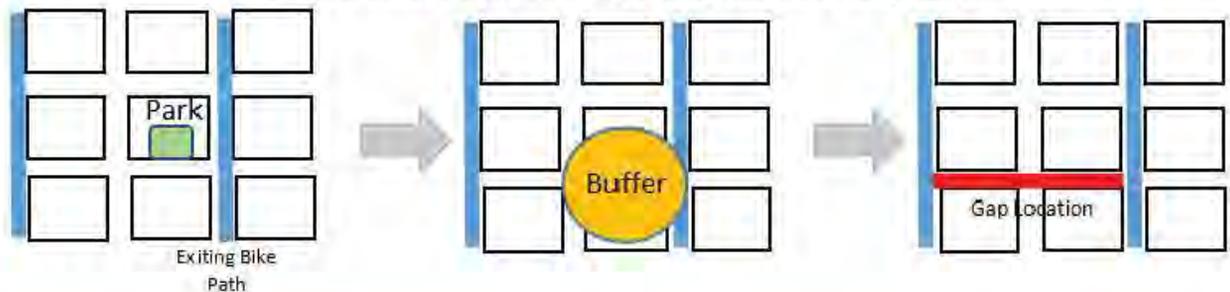
Figure 17: Town of Tonawanda Major Employers

Major Employers	Employees
Praxair	1159
Goodyear-Dunlop Tire	1159
Kenmore Mercy Hospital	1009
FedEx Trade Networks	687
E.I. DuPont de Nemours	660
JW Danforth	640
United Health Care	496
3M Tonawanda	385
Ronco Communications	279
White Directory	350
Schofield Residence	235
Fery Electric	231
NOCO Energy	223
Great Lakes Orthodontics	200
Unifrax	378
Hebeler	158
Coca-Cola	141

Determining Bicycle Network Gap Locations

In order to identify gaps within the existing network of bicycle paths, based on the GIS functions, a ½ mile buffered area around each key destination was considered. The roadways with speed limits greater than 25 mph within the overlapped buffered areas have been selected. The selected sections that do not have any bicycle facilities and existing bicycle paths are the gaps within the bicycle network of the Town of Tonawanda. Finally, the gap corridors were extended to reach to the nearest exiting bicycle path. Figure 19 illustrates the methods that have used in the bicycle network gap analysis.

Figure 3.19: Process of Creating Network Gap Map



CONCLUSION OF CONNECTIVITY AND NETWORK GAP ANALYSIS

The bicycle network gap analysis determines gaps within the corridors with high potential for riding a bicycle. The initial goal of this analysis is to provide connectivity between and around the most attractive land uses for riders while avoiding the location of bicycle paths around highways, rail lines, and parking and vacant lots. The bicycle network gap analysis results assist in further decision making about location proposals for bicycle facilities. The prioritized output from network gap analysis can be combined with the results from the survey conducted by members of the studio team, and Strava analysis to present the most important sections of the Town of Tonawanda for bicycle paths and facilities.

REPORTED CRASH ANALYSIS

INTRODUCTION

Examining crash data between bicyclists and motorists through police reports assists in identifying crucial areas where bicycle infrastructure or improved knowledge of best bicycling and driving practices is needed. Through this data, areas where crashes occur more frequently can be identified and patterns can be ascertained. Crash data for the Town of Tonawanda was compiled from police reports from the years 2011-2013. The majority of the collisions occurred at intersections, especially where a residential street meets a major arterial. Most of the crashes involved juvenile bicycle riders and occurred during daylight hours. During this time period there were 14 crashes between a motorist and a bicyclists resulting in one fatality.

VEHICLE-BICYCLE CRASH CONTEXT

According to the National Highway Traffic Safety Administration, 743 bicyclists were killed in crashes in 2013 across the United States. The majority of fatalities (68%) occurred in urban areas and bicyclists 55 to 59 years old had the highest fatality rate based on population. In Tonawanda, the only fatality was at a very busy intersection. In New York State, 3.3% of all traffic related fatalities were bicyclists. In 2013 in New York State, 40 cyclists were involved in fatal crashes (0.7% of the known severity bicycle crashes). Crashes resulted in serious injuries for 10.2% and moderate injuries for 30.3% of bicyclists involved in crashes. Human factors played a role in 78.5% of crashes in NY in 2013. The most common human factors in were "Pedestrian/Bicyclist/Other Ped Error/Confusion", "Failure to Yield R.O.W.", and "Driver Inattention/Distraction". Each of these factors was responsible for over 20% of crashes and 8 or more fatalities. Vehicular or environmental factors combined for only 9% of crashes.

Bicyclists are 2.3 times more likely to be involved in a fatal crash than a motor vehicle passenger. The benefits resulting from physical activity, such as bicycling, include the prevention of obesity, cardiovascular disease, diabetes, and other chronic conditions, but these benefits must be balanced against the increased injury risks involved with traveling on roadways. These injury risks can be mitigated by proper design, education, and communication through signage.

Published crash data, such as the data presented above, does not tell the whole story about bicycling safety. Not all crashes are reported to the police or other agencies, therefore these numbers may not be totally representative of the real level of safety for cyclists. Also, much larger numbers of "near-misses" go unreported each year. A recent British study shows regular cyclists report experiencing 'very scary' incidents (rated as 3 on a 0-3 scale) weekly and deliberate aggression experienced monthly. Near-misses and non-reported crashes also play a significant role in reducing bicycling. Proper reporting of these actions and enforcement against drivers can improve safety for bicyclists.

TOWN OF TONAWANDA POLICE DATA SUMMARY

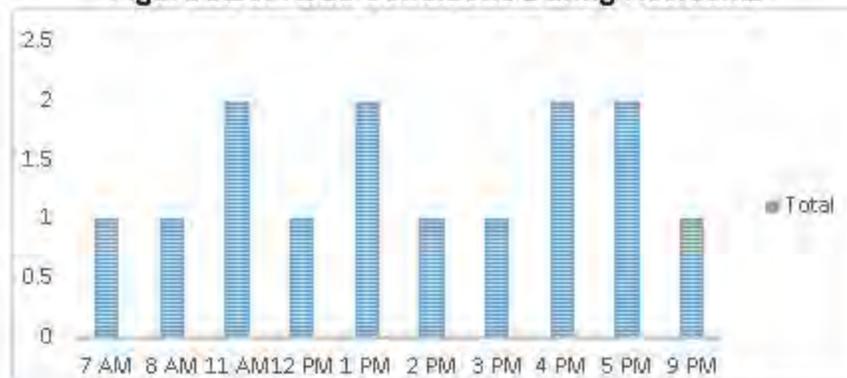
Data collected from Town of Tonawanda police reports identified key causes of accidents involving bicycles with their spatial distribution throughout the town. Overwhelmingly, these crashes occurred at intersections, especially at intersections of minor streets along main thoroughfares, like Sheridan Drive, Delaware Avenue and Niagara Falls Boulevard. This data was derived from police reports in the Town of Tonawanda that occurred between 2011 and 2013 and involved at least one vehicle that was identified as a bicycle. There were 14 crashes during this

period in which a police report was filed and each report details variables like road condition, time, causes, and consequences of the collision. The location of these crashes is taken into account when exploring design alternatives and proposal priorities in order to prevent or lessen the likelihood of these crashes from occurring.

Conditions

The conditions of these crashes varied by time of day. All the crashes occurred between the hours of 7:00 AM to 9:00 PM, but peaked around midday and during the afternoon rush hour. During this period, no collisions reported to the police department occurred outside of daylight hours. Eleven of the fourteen crashes were under normal conditions, like dry pavement and natural light from the sun. The three other crash conditions were darkness, wetness, and snow. As there is increased traffic on the roads during peak usage hours (rush hour), one may expect to find vastly more accidents between bicycles and automobiles during this time. However, accidents are fairly distributed throughout the day.

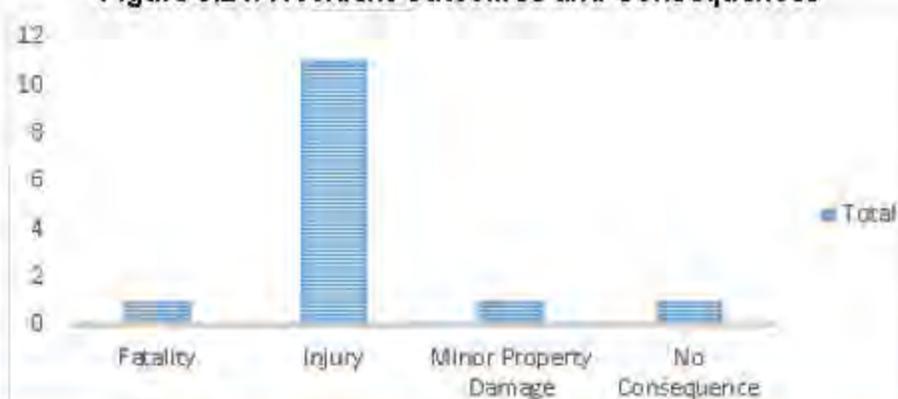
Figure 3.20: Road Conditions During Accidents



Consequences

Collisions can have many adverse consequences, including bodily harm, serious injury, property damage, or can even be fatal, as one collision was during this period. This collision, which took place at Sheridan and Delaware avenue, coupled with two other accidents at this intersection, shows us the dangers posed by this specific crossing. In the Town of Tonawanda, the vast majority of bicycle/automobile collisions filed to the police department resulted in various injuries.

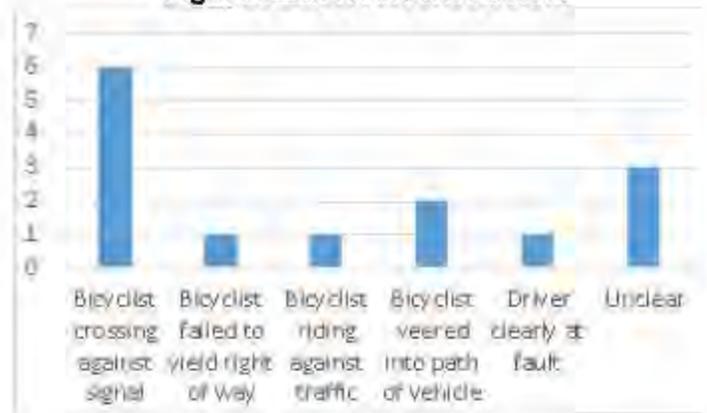
Figure 3.21: Accident Outcomes and Consequences



Causes

The causes of automobile/bicycle collisions in the Town vary from report to report. Generally, the report identifies an action (or several) taken by the driver and cyclist that led to the collision. In most of these reports, the cyclist is identified as taking an action that directly caused the collision. Of the crashes, the majority were cited to be, at least in part, caused by actions taken by the cyclist. As demonstrated in the figure, the majority of bicyclist actions causing crashes were their failure to cross with their signal. A few other causes that were less frequent were: failure to yield right of way, failure to ride with traffic, failure to stay in own path. In only one instance was the action of the driver cited as the primary cause of the collision.

Figure 3.22: Accident Factors



Age

Age seems to play a role in these crashes as well. The figure to the right shows, in terms of age delineations used by the US Census Bureau, the involvement of individuals on bicycles in crashes. Although they make up a small percentage of the population, 64.2% of crashes were caused by children under the age of 17. The largest cohort of riders involved in crashes was the 10-14-year-old group. This has implications for how to reach and educate bicyclists on the rules of the road.

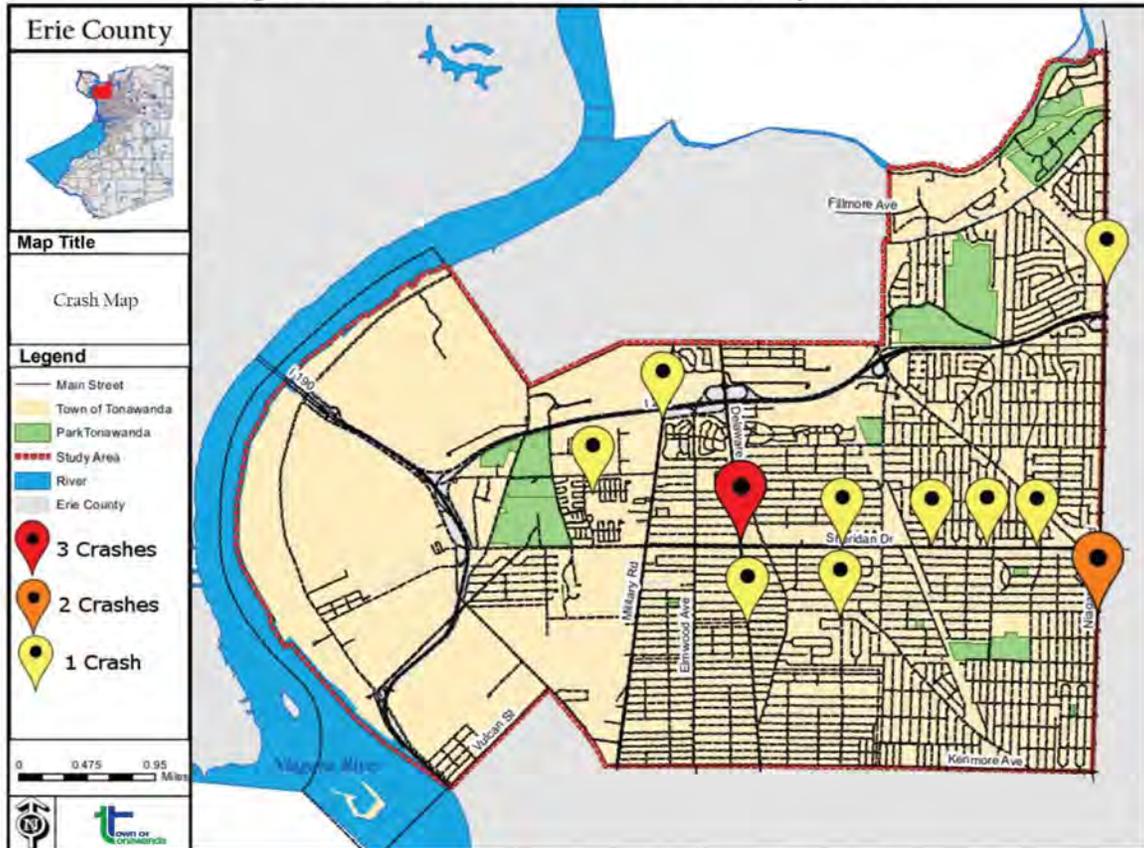
Figure 3.23: Age Distribution of Bicyclists in Collisions



Locations

All of the crashes were located along intersections between major roadways and minor streets. The majority of these occurred on intersections with Sheridan Drive, Delaware Avenue, and Niagara Falls Boulevard and of these, Sheridan Drive had the most of these crashes. As illustrated by the figure, most of these crashes occurred along the longitudinal thoroughfare. Red intersections indicate an intersection with three incidents. Yellow icons denote intersections with one incident, and the orange icon designates those with two incidents.

Figure 3.24 Locations of Crashes with Reports Filed



Conclusions

From this analysis, we can ascertain that the majority of crashes have been caused by decisions made by cyclists, especially decisions to cross thoroughfares against the signal. We can also say that crashes occur mostly during daylight hours, but slightly increase in probability during times of peak traffic. The majority of those involved in these crashes are under the age of 17. Also, we can say that the majority of crashes during this period occurred along Sheridan Drive and other major roadways, especially where these roadways intersect with minor streets, and that the intersection that was most dangerous was that of Delaware and Sheridan.

There are limitations to this data, as not all accidents in this study area would have required the filing of a police report and the period is only of three years and only 14 incidents, or an average of around 5 recorded incidents per year. The small sample size may lead to inaccuracies about trends.

COMMUNITY BICYCLE USAGE DATA AND SURVEY

INTRODUCTION

Quantifying bicycle usage in the Town of Tonawanda will contribute to an understanding of local demand for bicycle infrastructure and facilities. Data on bicycle usage shows how many people use a bicycle to travel and where bicyclists travel most often. There is a limited amount of data available on bicycle usage and travel mode information for the Town of Tonawanda specifically. Data showing national or regional trends is more widely available than local or community information. This analysis section uses data from the U.S. Census Bureau's American Community Survey from 2013 and data from Strava, a mobile app for running and cycling that provides information on recreational bicycling.

This data can guide planners and policy-makers to make decisions regarding potential locations of bicycle infrastructure and facilities in the Town of Tonawanda. This can also help to set future goals and develop measurable objectives when it comes to increasing local bicycle usage levels over time. This section shows that a very small amount of Tonawanda's population use a bicycle as a primary means of transportation.

CENSUS DATA

Data from the 2013 American Community Survey (5-Year Estimates) provides foundational information for quantifying bicycle usage. Table 128 from the ACS shows the means of transportation to work for workers 16 years and over. Table 1 below compares details of travel mode to work between the Town of Tonawanda and Erie County.

Figure 3.25: Means of Transportation to Work for Workers 16 Years and Over

<i>Means of Transportation</i>	Town Tonawanda	Erie County
<i>Car, truck, or van</i>	92.4%	89.3%
<i>Drove alone</i>	83.0%	81.2%
<i>Carpooled</i>	9.4%	8.1%
<i>Public transportation</i>	2.5%	3.9%
<i>Motorcycle</i>	0.1%	0.1%
<i>Bicycle</i>	0.3%	0.4%
<i>Walked</i>	1.9%	3.0%
<i>Other means</i>	1.0%	0.8%
<i>Worked at home</i>	1.8%	2.4%

Source: American Community Survey 2013 (5-Year Estimates)

Those who commute to work by bicycle represent a small percentage of the population. This accounts for 0.3% of Tonawanda's population and 0.4% of those within Erie County. About 4.7% of Tonawanda residents and 7.3% of Erie County residents do not travel to work in a private motorized vehicle. Those who walk or use public transportation may be more likely to travel by bicycle if more infrastructure was provided and if bicycling was safer or more convenient.

Figure 3.26. Bicycling as a Means of Transportation to Work

American Community Survey	Bicycle Usage in Tonawanda
ACS 2005-2009	0.5%
ACS 2006-2010	0.7%
ACS 2007-2011	0.6%
ACS 2008-2012	0.8%
ACS 2009-2013	0.3%

Source: American Community Survey (5-Year Estimates)

Figure 27 shows the percentage of bicycling as a means of transport to work for each census tract within the Town of Tonawanda. The only census tracts with a percentage of population that reported using a bicycle to travel to work are numbers 79.05, 80.01, 82.01, 83, 85, and 88. Census tracts 88 and 80.01 have bicycle usage percentages of 0.9% and 1.0% respectively. About 2.2% of workers older than 16 in census tract 83 use a bicycle as a primary means of transportation to work.

Figure 3.27: Bicycle Usage by Census Tract

Census Tract	Bicycle Usage
79.01	0.0%
79.02	0.0%
79.03	0.0%
79.04	0.0%
79.05	0.7%
80.01	1.0%
80.02	0.0%
80.03	0.0%
81.01	0.5%
81.02	0.4%
82.01	0.4%
82.02	0.0%
83	2.2%
84	0.0%
85	0.8%
86	0.0%
87	0.0%
88	0.9%

Source: American Community Survey 2013 (5-Year Estimates)

Figure 3.28: Spatial Bicycle Usage by Census Tract

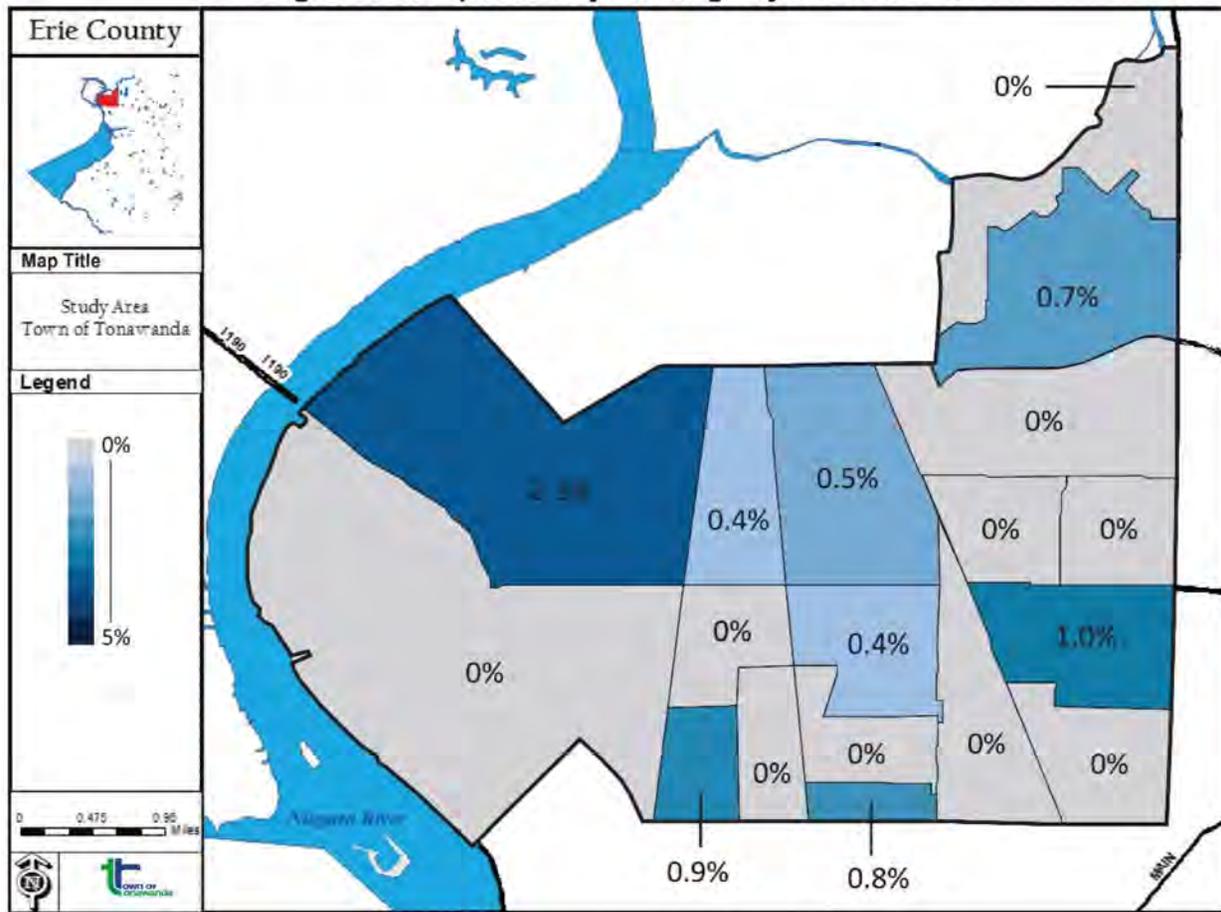


Figure 28 shows bicycle usage by census tract. American Community Survey data shows that the three census tracts with the highest percentages of bicycle usage have median incomes lower than that of the Town of Tonawanda. The town's median income in 2013 was \$52,588. Census tract 80.01 has a marginally lower median income of \$51,639. Census tract 88 has a median income that is slightly lower, at \$45,804. Census tract 83, the area with the highest percentage of bicycle usage, has a median income that is less than half that of the town average. The median income for that census tract is \$23,415.

VOLUNTEERED GEOGRAPHIC INFORMATION

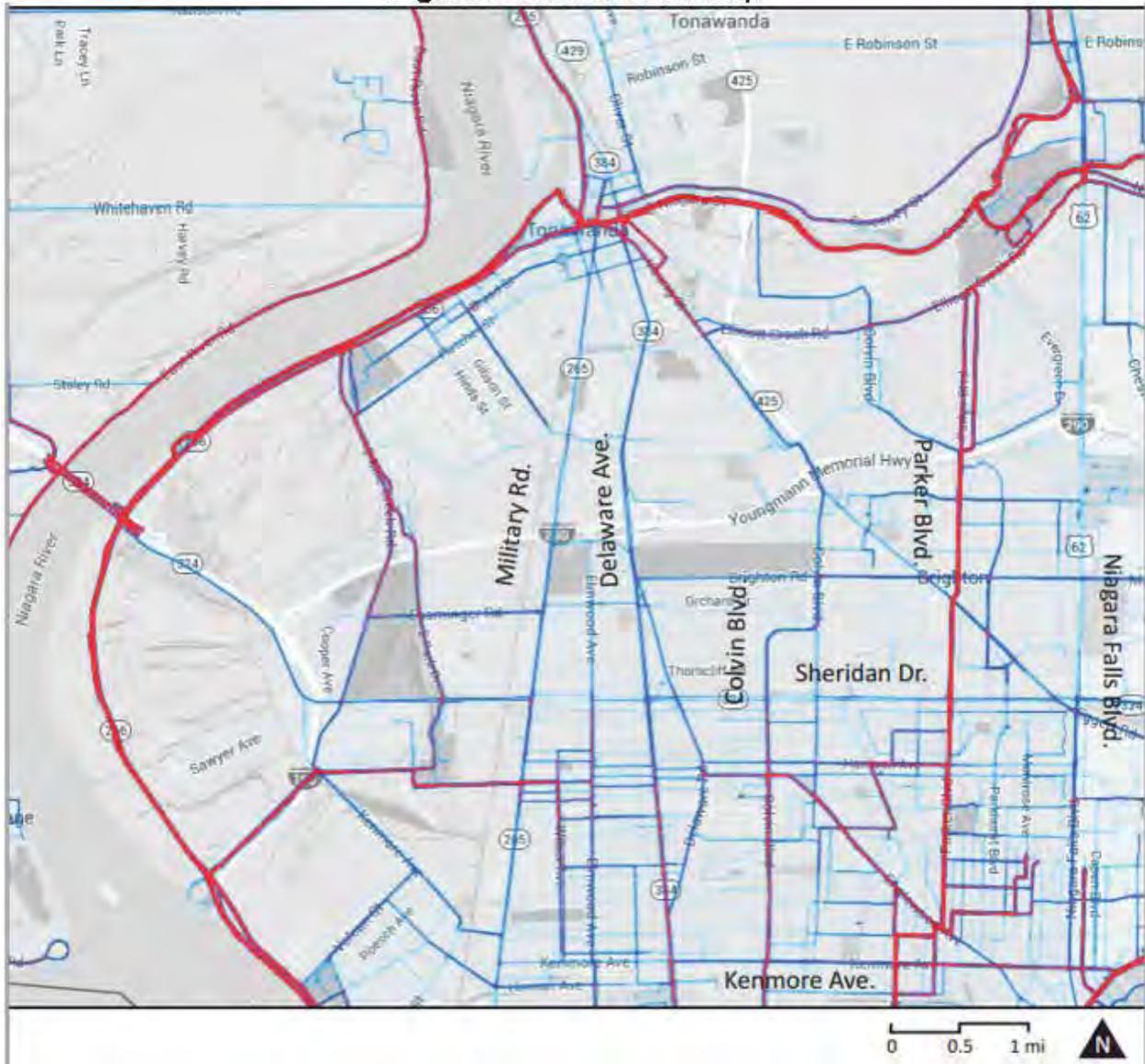
Strava is a smartphone application used by those who walk, run, or bicycle for fitness and exercise. This application uses GPS technology to trace the movements of the user, the speed at which he or she is traveling, and whether he or she is traveling by foot or by bicycle. Data collected by this application is made available to municipalities and organizations for research and transportation planning purposes. It is unknown how many Strava users there are in Tonawanda and in Western New York. This information is valuable to assess recreational bicycling and heat map visualization imagery shows the most frequently traveled paths by bicycle. The map below shows a heat map visualization for the Town of Tonawanda.

The data provided by Strava may only give information regarding recreational bicyclists and trips made for exercise. Recreational bicyclists presumably use Strava when making utilitarian trips

but with the data currently available, it's not possible to determine what share of trips made is recreational and what share is utilitarian (Griffin and Jiao). There are other limitations to the data provided by Strava. Most Strava users are generally young and a disproportionate amount of users are male. These are athletic bicyclists and this does not use a sample that is completely representative of the Town of Tonawanda's population.

The Strava heat map shows streets and paths in the Town of Tonawanda that are most used by bicyclists. Parker Boulevard is the most intensely colored street. This represents the most usage by bicyclists. This same color intensity is seen along the Riverwalk and Ellicott Creek bicycleways. The maps show moderate usage along Englewood Avenue, Harrison Avenue, Delaware Road, Delaware Avenue, Kenmore Avenue, Elmwood Avenue, and Ellicott Creek Road. The Sherwood Greenway and 2 Mile Creek bicycleway show usage by bicyclists presumably to access the Riverwalk path along the Niagara River waterfront. Brighton Road, Ensminger Road, and Wilber Avenue seem to be lightly used.

Figure 3.29: Strava Heat Map



Strava Bicycle Usage Ranking

Streets in the Town of Tonawanda were ranked based on the Strava heat map visualization. This ranking is based on color intensity and represents streets that are most used by bicycles. Streets with speed limits higher than 25 miles per hour were considered. Roads with lower speed limits are mostly residential and are already sufficiently accessible for bicyclists. Results of the community survey and several analyses were also considered when choosing which streets to rank based on Strava data. Some streets with low bicycle will be listed as top priorities because dense traffic or unsafe conditions prohibit bicyclists from using them.

Strava Bicycle Usage Ranking

0 = No usage

1 = Minimal usage

2 = Moderate usage

3 = High usage

Parker Boulevard = 3
Ellicott Creek Road = 2
Delaware Avenue = 2
Colvin Boulevard = 2
Elmwood Avenue = 2
Kenmore Avenue = 2
Englewood Avenue = 2
Starin Avenue = 2
Military Road = 1
Delaware Road = 1
Brighton Road = 1
Eggert Road = 1
Vulcan Street = 1
Sheridan Drive = 0
Niagara Falls Boulevard = 0
Parkhurst Boulevard = 0

COMMUNITY SURVEY

Conducting surveys strengthens a plan by adding credibility, providing information about residents' current active transportation behaviors, their feelings of safety, and their needs in order to feel safer biking in the Town of Tonawanda. Results from the survey guide the goals and objectives presented in the plan. With direct input from residents, there is evidence to show public support for the implementation of bicycle infrastructure. The survey was administered to ensure the input of members of the population identified in the equity section that could potentially utilize bicycle facilities. Analysis of the surveys strengthens the plan by incorporating input from residents of the town into the recommendations of the plan. Moreover, these recommendations will more thoroughly reflect pertinent needs of town residents, and potential bicycle infrastructure will be used to its full potential by those who need it most.

Methods

The survey was administered over the course of 5 days from Thursday October, 15th to Monday October, 19th 2015, with 113 respondents. The surveys were administered through targeted

neighborhood canvasses and online. In total 34 surveys were completed by canvass and 79 were completed online. Questions were designed to provide community input that can be incorporated into sections of the plan dealing especially with infrastructure, connectivity, and design elements.

Figure 3.30: Survey Design

Survey Question:	Reasoning:
<p>Question: How often do you:</p> <ul style="list-style-type: none"> Bicycle for recreation in the Town of Tonawanda Bicycle to commute in the Town of Tonawanda Bicycle to a transit stop/station Walk for recreation in the Town of Tonawanda Walk to commute in the Town of Tonawanda Walk to a transit stop/station <p>Options for answers: Once or more a week, a few times a month, a few times a year, never</p>	<p>This question is to gauge both why people use active transportation in the Town of Tonawanda and how often they do so. This question will provide basic anecdotal evidence for current and potential usage of bicycle infrastructure.</p>
<p>Question: What are the biggest obstacles to biking in the Town of Tonawanda?</p> <ul style="list-style-type: none"> Driving behavior Lack of designated bicycle lanes Dangerous intersections Conditions of roads/bicycle lanes/sidewalks Lack of secure bicycle parking Long distances Weather Health issues Don't have a bicycle <p>Options for answers: very important, somewhat important, not important (select for each obstacle)</p>	<p>Knowing the obstacles to biking that residents face will aid us in determining what type of infrastructure is needed that will promote bicycling in the town.</p>
<p>Question: Would you bicycle on Sheridan Drive if there were the following bicycle facilities:</p> <ul style="list-style-type: none"> Designated bicycle lanes (painted bicycle lane) Protected bicycle lanes (physical barrier from cars) Shared bicycle lanes (with cars) As it is now <p>Options for answers: yes or no</p>	<p>Sheridan Drive has been identified as a route that needs bicycle infrastructure due to the lack of east/west routes existing in the town. Answers from this question will help determine what type of bicycle infrastructure will be most beneficial to bicyclists on this route.</p>
<p>Question: Which street should be prioritized when implementing bicycle facilities? Select one:</p> <ul style="list-style-type: none"> Sheridan Drive Brighton Road Delaware Avenue Elmwood Avenue Niagara Falls Boulevard 	<p>Streets have already been identified, but residents input will provide evidence for which roads are perceived as the most dangerous in their current condition and which are used most by bicyclists.</p>

Kenmore Avenue Parker Boulevard Colvin Boulevard Englewood Avenue Other	
Question: What is your age? 15 and younger 16-24 25-34 35-44 45-54 55-64 65 and over	Because of the large aging population in the Town of Tonawanda, we asked survey participant's age to determine if we represented the population of the town fairly.
Question: Do you feel safe biking in the Town of Tonawanda? Answers on a scale of 1 (very unsafe) to 5 (very safe)	Asking about feelings of safety helps to determine how residents feel in the current physical environment and to provide basic evidence for the purpose of the bicycle plan.
Question: What is your 5-digit zip code? Answers vary	Zip code information is the quickest way to estimate trip origins in proximity to the Town of Tonawanda. Surrounding communities will also be affected by improved bicycle infrastructure.

In order to maximize the number of survey respondents from each age group, different methods were utilized in administering the survey. The most popular platform was online distributed through the Town's website (<http://www.tonawanda.ny.us/>) and advertised on the Town of Tonawanda's Facebook page.

Age was decided to be the most important element of demographic information to be gathered in the survey. The Town of Tonawanda's growing concern with enabling residents to age in place is a major motivating factor in exploring a complete streets policies and implementing inclusive design standards in road construction.

It was an assumption that online survey respondents would be younger than the overall population of Tonawanda. People aged 65 years or older represent 19.11% of the population of the town. Reaching as many respondents aged 65 or above as possible was imperative to gathering their opinions on biking in Tonawanda. In order to incorporate survey responses from older adults, a canvass was conducted in in block group 2 in census tract 81.01 that has the highest rate of older residents in the town at 31.28%. In block group 2, 26 houses were approached out 534 occupied units. This resulted in 17 surveys being collected, 5 of which were from people aged 65 and above. An additional completed survey was gathered from a respondent 65 years or older in block group 3 census tract 83. In total, 8 individuals aged 65 years or older responded to the survey, six were reached door to door. The assumption that the online respondents would be younger proved to be true as 75% of responses from people aged 65 or above came from canvassing.

Door to door canvassing was also utilized to ensure that people of lower incomes were represented in the results so block group 3, census tract 83 was focused on. It was deemed to be intrusive to include income information on the survey itself so focusing on this area allowed low income responses to be included without specifically quantifying their incomes. As discussed in the equity background section, block group 3 has a median income of \$30,536 compared to \$53,667 for the total Town of Tonawanda. In this block group, 17 surveys were collected from 26 doors knocked on out of a total of 305 occupied housing units. Of the surveys collected, the aging population was well represented with 10 of the 17 being above the age of 55. This block group was also chosen due to the high rate of reported bicycle commuting in the ACS 2013 5+ Estimates at 3.02%. Canvassing in this neighborhood greatly increased the potential for low income and bicycle commuters to be included in the results.

Limitations and Biases

The surveys collected are not a representative sample of the population of the Town of Tonawanda due to the small number of responses and the age distribution of the samples compared with census data. The surveys collected still provide a valuable resource in guiding aspects of the planning process for the Town of Tonawanda Bicycle Master Plan. The surveys represent input from community members who would be potential users of any new bicycle facility within the town.

Potential biases also exist with the data due to the various methods the survey was conducted. The majority of responses were completed online, which requires a potential respondent to have access to a computer and internet as well as the time and willingness to complete the survey. Advertising the online survey through the Town of Tonawanda's Facebook page was successful in gathering 70 responses in 5 days. In order to be directed to the survey on the town website, a respondent would need to have been actively following the Town of Tonawanda Facebook page or visiting the page. Individuals following municipal Facebook pages are potentially more likely to be involved and engaged in local civic issues. In viewing the survey responses through this lens, it is likely that the online respondents represented the most active and engaged followers of the Town of Tonawanda Facebook page, potentially leaving out those who are not.

Recognizing the studio's time limit and capacity to undertake a traditional canvass, targeted canvass areas were identified to produce survey results of respondent groups not likely to be reached easily online. Census tract 83 possesses the lowest income population as well as the highest rate of bicycling commuters. Targeting one census block group within the tract for a neighborhood door to door canvass provided results from both low income and potential bicycle commuters. The input from people living within this neighborhood will help bolster the plan in a number of ways, especially within the connectivity section. Canvassing this neighborhood once in a single afternoon limited respondents to only people that were home and had the time to complete the survey.

The second targeted block group for the canvass was census block group 2 in census tract 81.01. This block group contains the highest percentage of the aging population within census tract 81.01, which is already the oldest tract by percentage. Again, this canvass was limited by the potential bias of only dealing with individuals that were home and had the time to complete the survey.

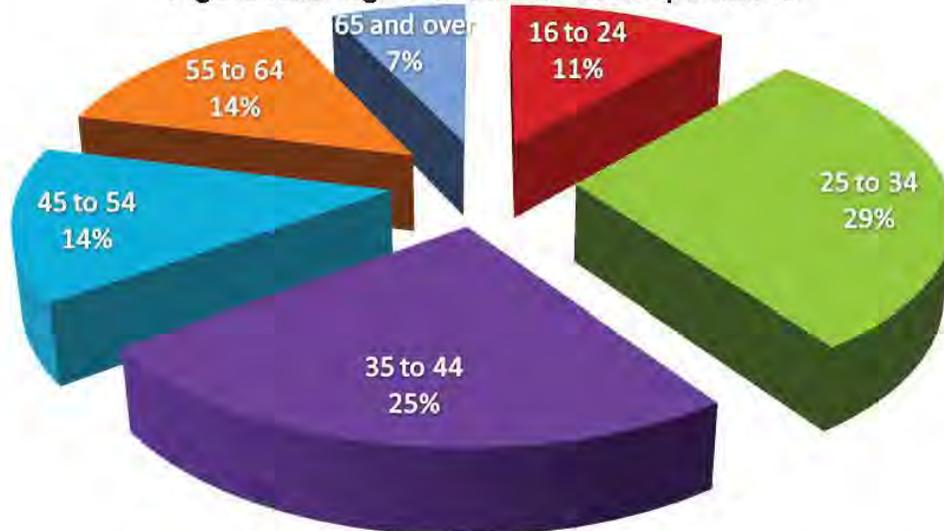
Other potential biases may be present as individuals may or may not have falsely responded the true amount they ride bicycles for either commuting or recreation. Often times, survey responses can become biased as respondents answer questions about personal behavior in a way that

represents their ideal selves vs. actual behavior. This phenomenon may help explain the higher rates reported of bicycle usage in the survey vs national results.

RESULTS AND ANALYSIS

While 43 people were interviewed in person in different places of the Town of Tonawanda, 72 people answered the survey through the online form, resulting in a total of 115 responses. Respondents were fairly well distributed in different age groups and 21% of respondents are 55 years old and over, giving voice to desires of the aging population.

Figure 3.31: Age Distribution of Respondents



The following graphs highlight bicycling behaviors for the respondents of the survey. Almost half of them bicycle at least once or more a week for recreation. A little more than a quarter of them bicycle to commute once or more a week and only 8.8% bicycle to a transit stop. 65.8% of respondents have never rode a bicycle to a transit stop, which reveals that the use of the multi-modal transportation is under the potential, considering existing opportunities

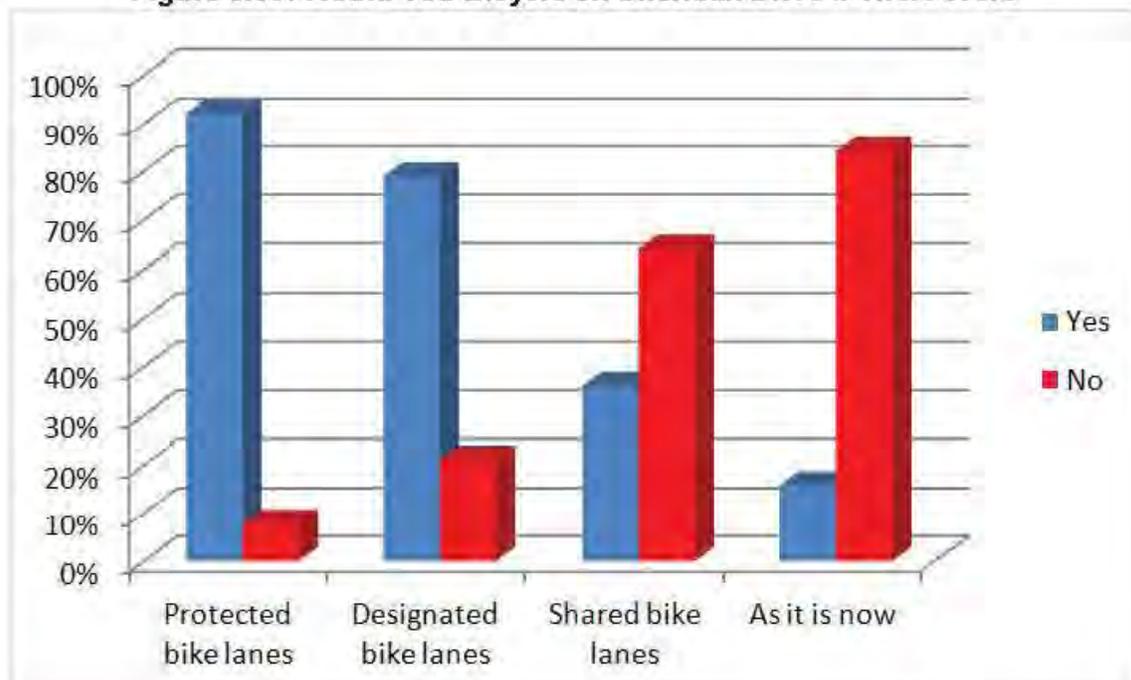
When asked “what are the biggest obstacles to biking in Town of Tonawanda”, 74.3% of respondents considered the lack of designated bicycle lanes as a very important impediment. Dangerous intersections, driving behavior, and conditions of roads, bicycle lanes and sidewalks were also considered by most respondents to be very important barriers to biking. Different from expected, less than a third of people said weather and long distances are a very important reason not to bicycle.

Figure 3.32: What are the biggest obstacles to biking in Town of Tonawanda?

What are the biggest obstacles to biking in Town of Tonawanda?	
Lack of designated bicycle lanes	74.30%
Dangerous Intersections	70.80%
Driving behavior (e.g. speeding)	63.70%
Conditions of Roads/Bicycle Lanes/Sidewalks	59.80%
Lack of secure bicycle parking	41.10%
Weather	27.00%
Long distances	21.60%
Health Issues	18.20%
I don't own a bicycle	6.90%

Survey results show that there is a meaningful increase in the willingness to bicycle on Sheridan Drive depending on the existence of bicycle facilities. While 84.2% answered they wouldn't bicycle on Sheridan Drive as it is now, 78.9% said they would if there were designated bicycle lanes. The percentage goes up to 92.2% when we consider protected bicycle lanes.

Figure 3.33: Would You Bicycle on Sheridan Drive If There Were



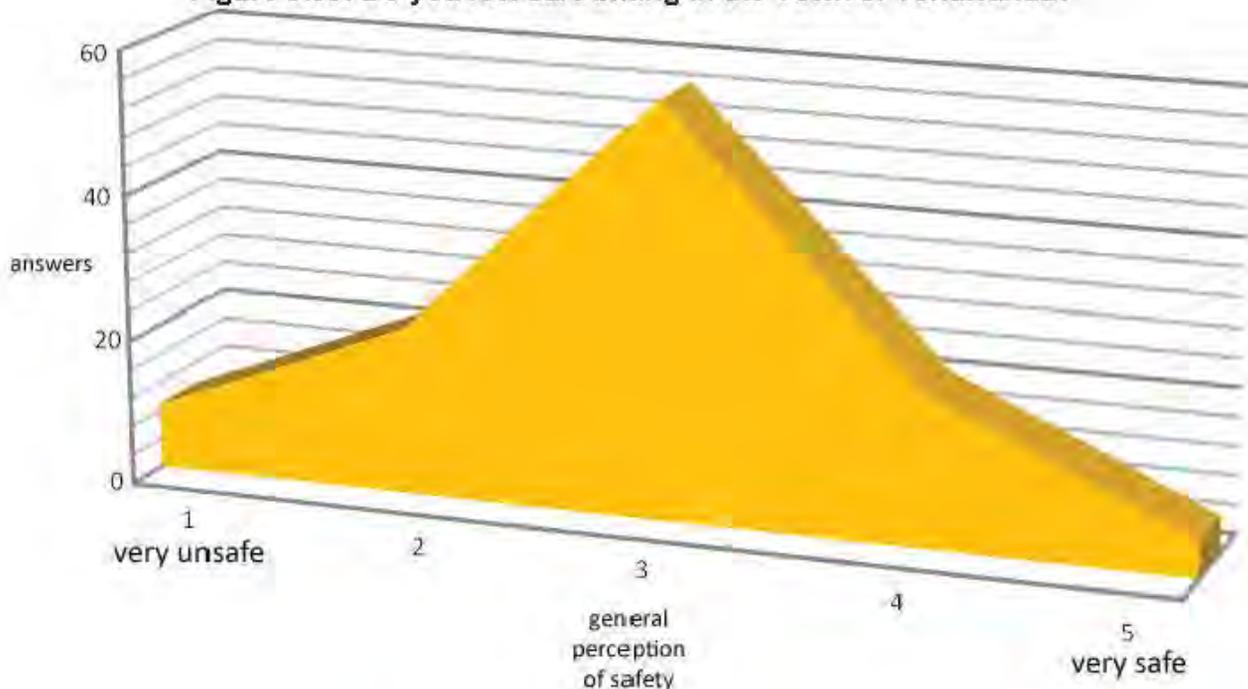
When asked which street should be prioritized when implementing bicycle facilities, 37.5% of respondents answered Sheridan Drive. Delaware Avenue, Niagara Falls Boulevard and Colvin Boulevard each got more than 10% of the selections. The choice for Kenmore Avenue, Elmwood Avenue, Brighton Road and Parker Boulevard varied from 2.7% to 6.3% for each. No respondents selected Englewood Avenue. Military Road, Eggert Road and Creekside Drive were mentioned by some of the respondents, summing up to 7.1%.

Figure 3.34: Which street should be prioritized when implementing bicycle facilities?

Sheridan Drive	36.80%
Delaware Avenue	18.40%
Niagara Falls Boulevard	12.30%
Colvin Boulevard	10.50%
Kenmore Avenue	6.10%
Parker Boulevard	3.50%
Elmwood Avenue	2.60%
Brighton Road	2.60%
Englewood Avenue	0%
Other (Military, Eggert and Creekside)	7.00%

When asked to rank how safe they feel biking in the Town of Tonawanda on a scale from 1 to 5, the mid-point between both extreme safety levels got 48.7% of the answers. The average between all the answers is 2.91, which is slightly closer to very unsafe than to very safe.

Figure 3.35: Do you feel safe biking in the Town of Tonawanda?



SURVEY ANALYSIS CONCLUSION

The survey results produced an overarching theme of respondents identifying infrastructure related issues as reasons they would bicycle more or are not bicycling currently. The main takeaways from the survey are:

- Four out of five of the top identified obstacles were infrastructure related, which speaks to the need for overarching policy that includes consideration of bicycle facilities in all new construction projects.
- There is latent demand for bicycling on Sheridan Drive if designated bicycle lanes or protected bicycle lanes were to be implemented, which may increase the value of the Rails to Trails investment.
- In the Town, 48.7% of people neither feel safe nor unsafe bicycling; increasing bicycle infrastructure may increase perceived safety and driving behavior may be manipulated through infrastructure changes.
- Participants indicated that bicycling is used mostly for recreation, with 41.6% reporting riding a bicycle for this reason once or more a week. Opportunities for recreational bicycle riding incorporated into the overall network will find the most initial usage.

Over half of the respondents of all surveys were aged 25-44, showing that the administration of the survey trended younger than the average population of the town as a whole. The town is concerned with residents being able to age in place as well as maintaining home values and attracting young families. Improving bicycle infrastructure in the town can potentially benefit all age groups. Although the physical survey was administered over a short period of time, it was conducted in a way that focused on populations that would be underrepresented in the online survey. The percentage of residents in the Town of Tonawanda who drive to work is more than that of residents in surrounding municipalities such as the Town of Amherst, the City of Buffalo and the Erie County average. Surveying members of the community adds credibility to the plan and gives feedback as to what types of infrastructure residents will use. Residents' transportation methods, feelings of safety, and opinions on bicycle infrastructure are taken into consideration in all sections of the plan.

Overall, the Survey Analysis and Bicycle Usage Analysis demonstrate that the current ridership in the Town of Tonawanda for commuting by bicycling is very low, yet the rates of bicycling for recreation are very high. Improving connectivity for recreational uses along major arterials will also benefit bicycling commuters with infrastructure improvements. These improvements may enable individuals who currently ride for predominately recreational uses to shift modes and ride for commuting reasons as well if the conditions are perceived as safe.

ANALYSIS CONCLUSIONS

This section provides an overview and analysis of bicycle usage within the Town of Tonawanda. The data included is valuable to planners and policy-makers to produce equitable and logical outcomes when it comes to developing bikeways. This section highlights locations where infrastructure additions are necessary and shows a relationship between low-income populations and dependence on bicycle infrastructure. This relationship is based on the equity background section information as well as the connectivity analysis study.

Each study presented creates an argument for the necessity of improving the connectivity of the bicycle network in the Town of Tonawanda in its own unique way. The studies taken together indicate that there is a confluence of reasons to justify the improvement of Sheridan Drive to include bicycle infrastructure. The survey results indicated that people riding bicycles in the Town of Tonawanda would indeed utilize bicycle infrastructure on Sheridan Drive. The Crash Analysis shows that there is a cluster of collisions along Sheridan Drive. The Network Gap Analysis also indicates that there is a heavy need for bicycle infrastructure on Sheridan Drive based on surrounding land uses. The Connectivity Analysis also demonstrates that Sheridan Drive is a major east/west arterial in the Town of Tonawanda connecting the Waterfront area to the Town of Amherst and bisecting the Town of Tonawanda in near equal halves geographically.

PRIORITIZATION BASED ON ANALYSES

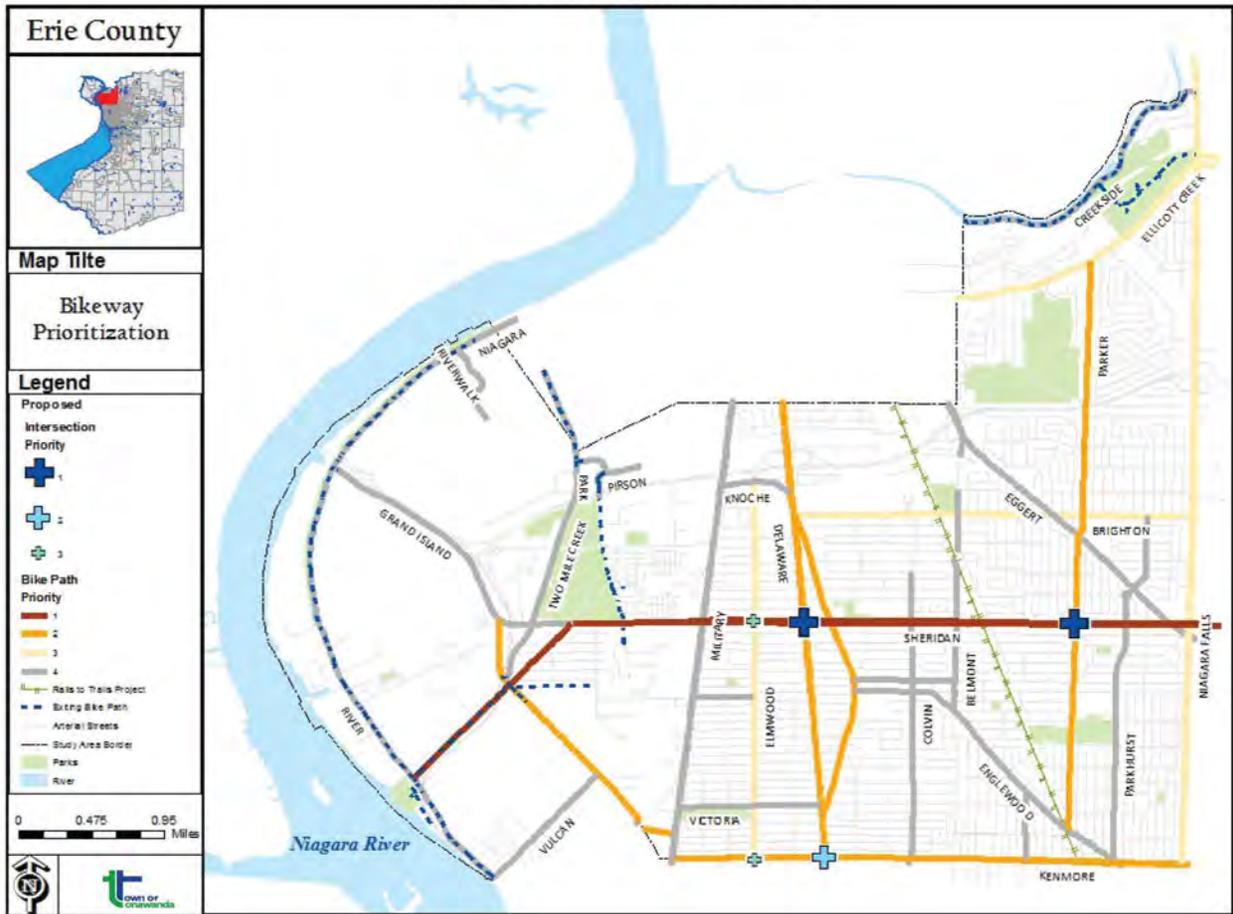
The map below is a prioritization scheme based on the results of the community survey, the connectivity analysis, the network gap analysis, the Crash Analysis, and the Bicycle Usage Analysis and Community Survey. This map includes priority rankings for individual streets and for intersections.

The prioritization has been conducted for both corridors and important intersections within the Town of Tonawanda. The number 1 ranking has the highest priority and should have a design that is implemented in the short-term. The number 2 priorities are considered to be medium range priorities implemented in the near future. The number 3 priorities are considered important, but do not warrant immediate improvements. However, they still are justified in having bicycling infrastructure based on the studies.

The first priority for corridors is Sheridan Drive from Niagara Falls Boulevard to East Park Drive. The second priority is for Delaware Avenue, Parker Avenue, and Kenmore Ave. The third priority corridors are Elmwood Avenue, Ellicott Creek Drive and Niagara Falls Boulevard. The priority 4 is simply the rest of the eligible streets with speed limits higher than 25 mph.

The first priority ranking for intersections are Sheridan Drive at Parker Avenue as well as Sheridan Drive at Delaware Avenue. The second priority ranking is Kenmore Avenue at Delaware Avenue. The third priority ranking intersection for bicycle infrastructure improvements are the intersections of Elmwood Avenue at Sheridan Drive, and Elmwood Avenue at Kenmore Avenue.

Figure 3.36. Prioritization Map



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SECTION IV

PROPOSALS

Prioritization

Several analyses were used to create a prioritization scheme for developing bicycle infrastructure in the Town of Tonawanda. Results of these analyses guided the process of selecting streets and connectors that are most important to the community, and that will effectively form a bikeway network. A survey was distributed to Town of Tonawanda residents to gauge levels of bicycle usage and establish streets of major significance for bicycling.

Figure 4.1 Proposed Connector Network



Figure 4.2 Bicycle Network Gap Analysis

Objectives from the connectivity section, results from the network gap analysis section, and findings from a regional bicycle infrastructure study also shaped this prioritization scheme. Strava is an online fitness application for runners and recreational cyclists. This produces anonymous volunteered geographic information that was used to analyze local bicycle usage. The prioritization system considers current bicycle usage, community input, overall equity, and regional context.

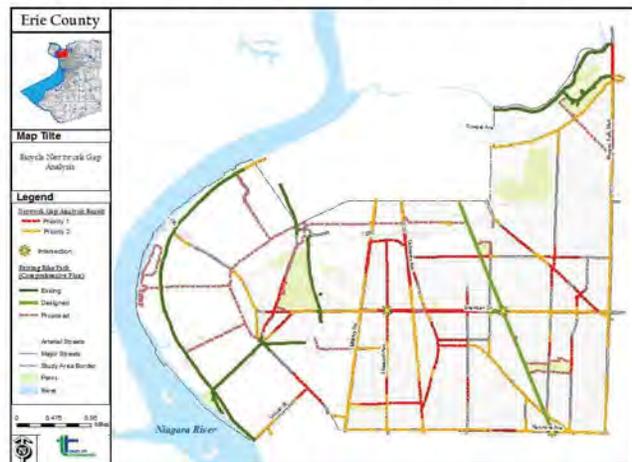


Figure 4.3 Strava Heatmap Town of Tonawanda

The first priority for corridors belongs to Sheridan Dr. The second priority is for Delaware Ave., Parker Ave. and Kenmore Ave. The third propriety is for Elmwood Ave., Ellicott Creek Drive and Niagara Falls Blvd. The priority 4 belongs to the rest of the eligible streets with speed limits higher than 25 mph. According to rankings for intersections, the intersection of Sheridan Dr. with Parker Ave. and also with Delaware Ave. has the highest priority. The second priority is for the intersection of Kenmore Ave. with Delaware Ave. The last priority belongs to two intersections along the Elmwood Ave. with Sheridan Dr., and Kenmore Ave.

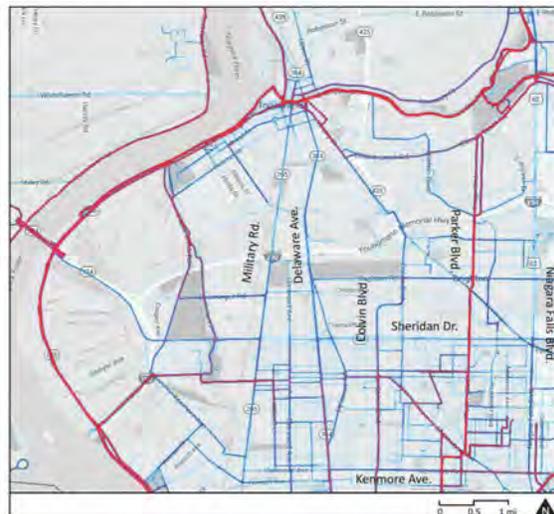


Figure 4.4 Bikeway Prioritization



Table 4.1 Cost Estimations

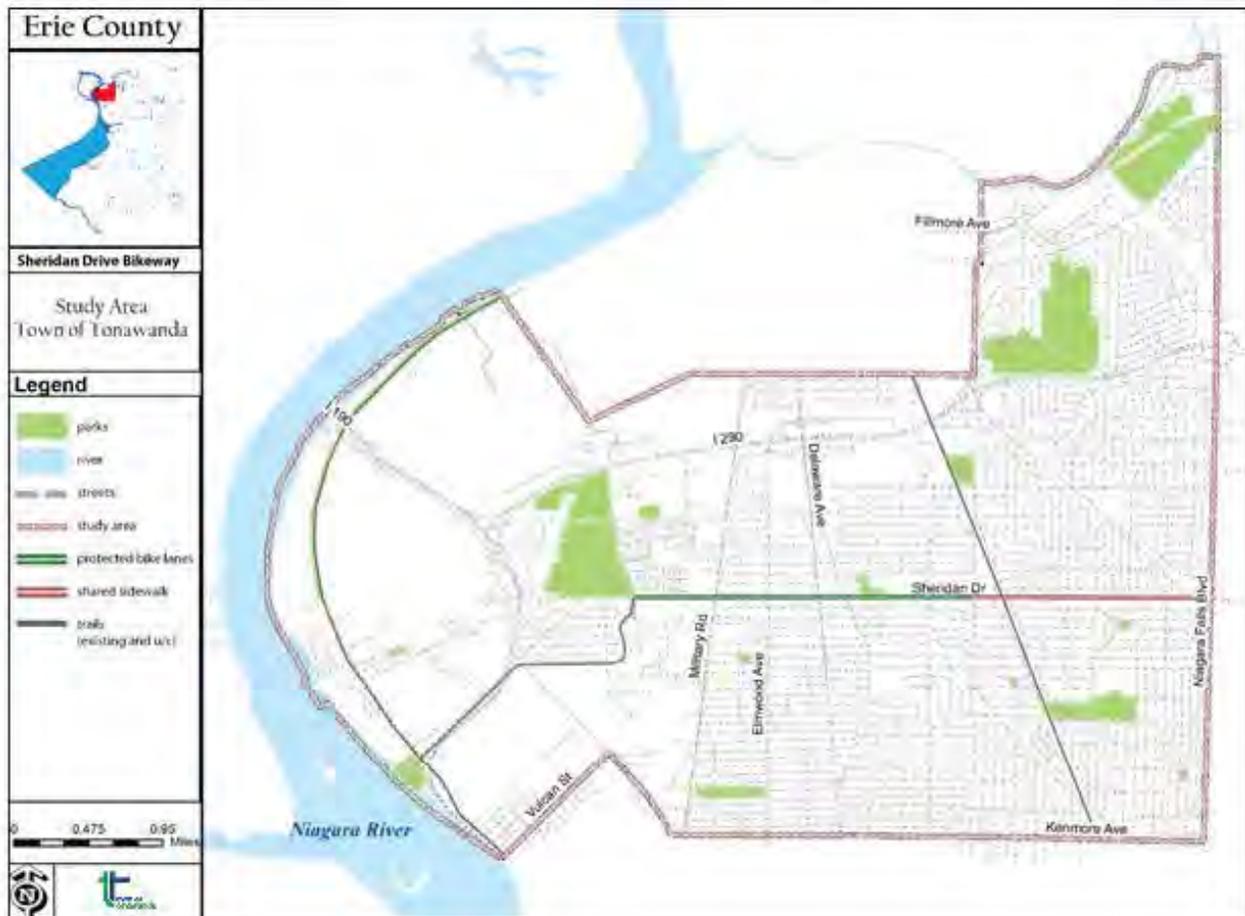
Sheridan Drive	
1. Planning and Design	\$ 335,966.21
2. Capital Improvement Cost	\$ 2,239,774.72
3. Annual Facility Maintenance Cost	\$ 64,932.84
Delaware Avenue	
1. Planning and Design	\$ 114,767.25
2. Capital Improvement Cost	\$ 765,115.00
3. Annual Facility Maintenance Cost	\$ 31,215.60
Kenmore Avenue	
1. Planning and Design	\$ 143,887.01
2. Capital Improvement Cost	\$ 959,246.72
3. Annual Facility Maintenance Cost	\$ 73,224.00
Parker Boulevard	
1. Planning and Design	\$ 41,062.05
2. Capital Improvement Cost	\$ 273,747.00
3. Annual Facility Maintenance Cost	\$ 6,650.28
Brighton Road	
1. Planning and Design	\$ 57,838.65
2. Capital Improvement Cost	\$ 385,591.00
3. Annual Facility Maintenance Cost	\$ 9,636.12
Sawyer Avenue	
1. Planning and Design	\$ 89,575.50
2. Capital Improvement Cost	\$ 597,170.00
3. Annual Facility Maintenance Cost	\$ 73,224.00
Total Capital Improvement Cost	
	\$ 5,220,644.44
Total Annual Facility Maintenance Cost	
	\$ 258,882.84

PRIORITY 1 PROPOSALS

PROPOSAL: SHERIDAN DRIVE	
Item	Estimated Cost
Planning and Design	\$ 335,966.21
Capital Improvements	\$ 2,239,774.72
Annual Maintenance	\$ 64,932.84

Sheridan Dr. Bikeway [3.7 Miles]

Figure 4.5 Sheridan Dr. Bikeway, Protected Bike Lane and Shared Sidewalk Proposal Map



Project Description

Sheridan Drive was determined to be the most crucial corridor within the town to increase connectivity and usefulness of the Town of Tonawanda bicycle network through the connectivity and analysis section. The proposal addresses the lack of bicycling infrastructure by recommending the addition of bicycle facilities in spaces currently occupied by sidewalks and town owned grass between Niagara Falls Blvd and Belmont Avenue. It is also recommended that protected bike lanes be added on street between Belmont Avenue and East Park Avenue. The protected bike lanes will traverse sections of Sheridan Drive that are currently 8 and 4 lanes. In both instances it is recommended that a lane of vehicular traffic be eliminated in favor of protected bicycle lanes. The length of the first priority project area is 3.7 miles in total.

Proposal 1: Niagara Falls Blvd. to Belmont Avenue 1.6 Miles

The intersection at Niagara Falls Blvd on Sheridan Dr. is one of the most heavily trafficked in the region according to Greater Buffalo Niagara Regional Transit Council. The traffic counter just east of the intersection counts 29,423 average annual daily traffic (AADT). The results of the connectivity and analysis section report that bicycling safety is a concern on Sheridan Drive and survey respondents reported that traffic was a factor in feeling unsafe while cycling. In addition, this section of Sheridan Drive is bisected by the Tonawanda Rails to Trails project.

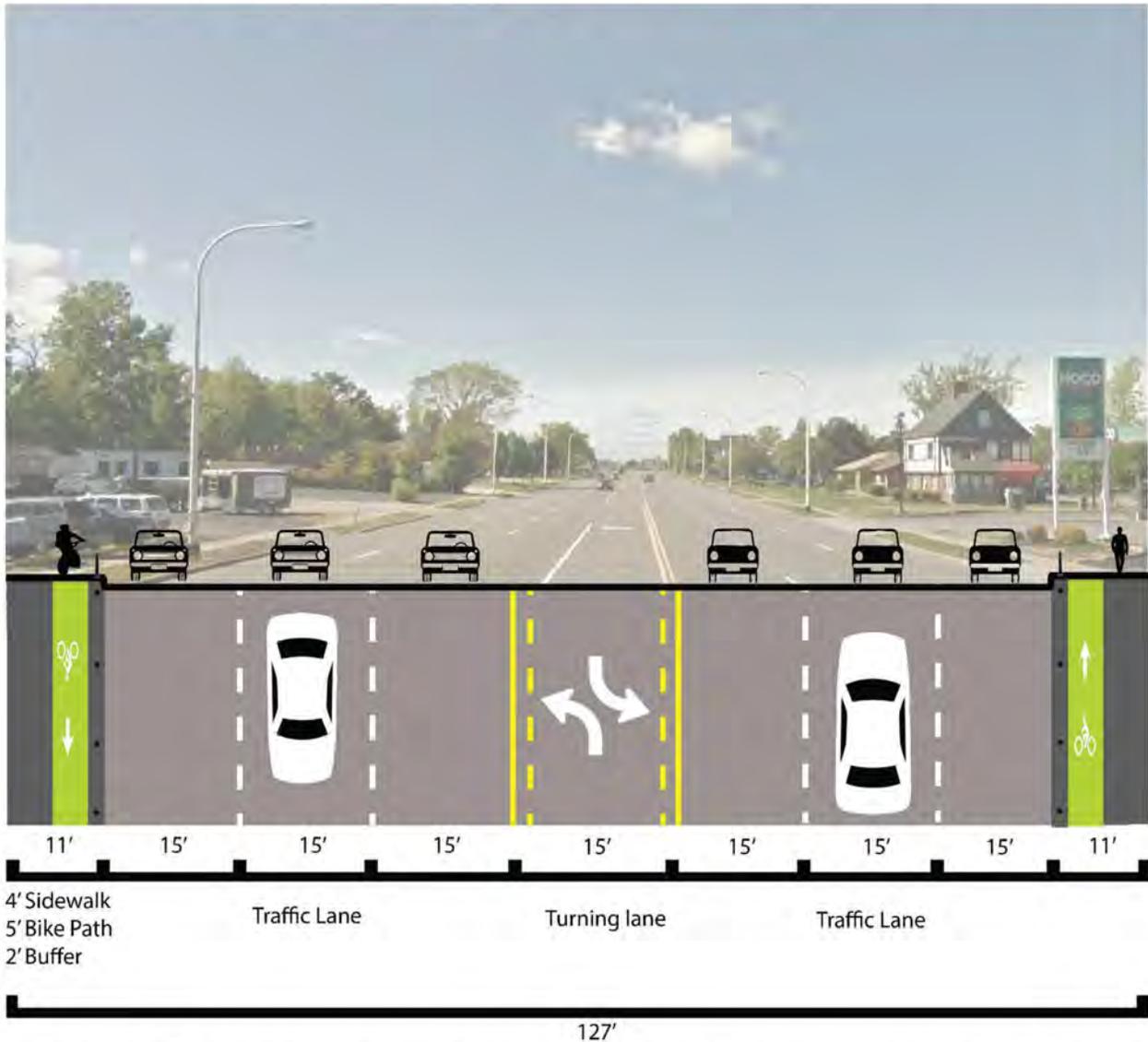
Placing the bicycling facilities in a designated space while shared by pedestrians will increase connectivity to the trail from the commercial and residential areas both east and west of the trail entrance. To alleviate the safety issues of bicycling on street with a large volume of traffic it is recommended that bicycling facilities be added to the sidewalk area. Currently, there is an average of 11 feet of space between the curb and the far edge of the sidewalk in this area. The proposal would reconfigure the sidewalk in this area from its current form to a four-foot-wide pedestrian zone, a five-foot-wide bicycling only zone, and a two-foot buffer.

**Figure 4.6 Sheridan Dr. and Niagara Falls Blvd.
Shared Sidewalk Bicycle Facility Proposal.**



In Figure 4.6 above, a Dutch style intersection is recommended that would use light signals to control the movement of both motor vehicles and bicycles in a highly organized pattern enabling safe crossing areas and opportunities for bicyclists, pedestrians, and motor vehicles.

Figure 4.7 Street Configuration of Proposal and Image of Current Condition



In Figures 4.7 above, a cross section is provided for what the recommendation would look like implemented at the street scale. On this portion of Sheridan Drive, it is not recommended that any changes in lane width or pattern occur outside of signalized intersections due to the high volume of traffic. This street scale represents the existing condition for the vehicular traffic lanes as well as the proposed shared sidewalk on either side of Sheridan Drive.

The cross section above represents the typical vehicular traffic lane widths as well as the typical sidewalk size in the Niagara Falls Blvd. to Belmont Ave. portion of the proposal. As Sheridan approaches intersections lanes often become larger. Again, **the recommendation calls for maintaining the existing three lane pattern of vehicular traffic while upgrading the sidewalk area to be a shared space for pedestrians and bicyclists.** Furthermore, it is recommended that spaces for pedestrians and bicyclists in the sidewalk area be clearly marked but not have any physical barriers. A color scheme is suggested that highlights the two distinct areas such as paint or the use of different types of pavement. Permeable pavement may be used in this area to

provide the color difference as well as absorb surface runoff from surrounding parking lots. Pedestrian and bicycle traffic is limited in this area currently, designating the current pedestrian space to be shared with bicyclists will help maximize usage. Also, candlestick bollards are suggested for the 2' buffer area between the shared sidewalk and the street at every 8 feet. These bollards will provide further demarcation as well as a physical barrier between the two spaces. The American Association of State Highway and Transportation Officials recommends that bollards be added to buffer zones next to shared sidewalks when they are less than 5' wide.

Pros

- Maintains current street configuration required for high volume of traffic
- Requires less construction costs than changing width between curbs
- Provides an effective and clear barrier between street traffic and bicycle and pedestrian spaces
- Maximizes usage of Town of Tonawanda owned property for residents

Cons

- Potential conflicts between Bicyclists and Pedestrians
- Potential for confusion of motorists leaving commercial parking lots
- Potential relocation of urban furnishings may prove expensive
- Intersection at Niagara Falls Boulevard and Sheridan is bordering Town of Amherst, full impact of investment only achievable if Amherst improves bicycle facilities on their portions of Sheridan Drive and Niagara Falls Boulevard

Proposal 2: Belmont Avenue to Military Road 1.6 Miles

The transition between 6 lanes of traffic with a middle turn lane to 8 lanes of traffic with a grassy median occurs very near Belmont Avenue and continues towards the west to Military Road. The preferred recommendation for this section is the elimination of one lane of traffic on either side of the median and replace with a bicycle lane and buffer.

In this section of Sheridan Drive, AADT counts decline as traffic moves west. At the counter just east of the Rail Trail the highest amount of traffic is recorded on Sheridan Drive with 30,450 AADT. The traffic light TMC Totals decline moving west culminating at Military Road where Sheridan Drive has 17,466 AADT. Taking these numbers into account, it is believed that the removal of a lane of vehicular traffic will not result in meaningful delays at peak times.

**Figure 1.8 Bikeway at Belmont Avenue
Transition from Shared Sidewalk to an on road protected bike lane**

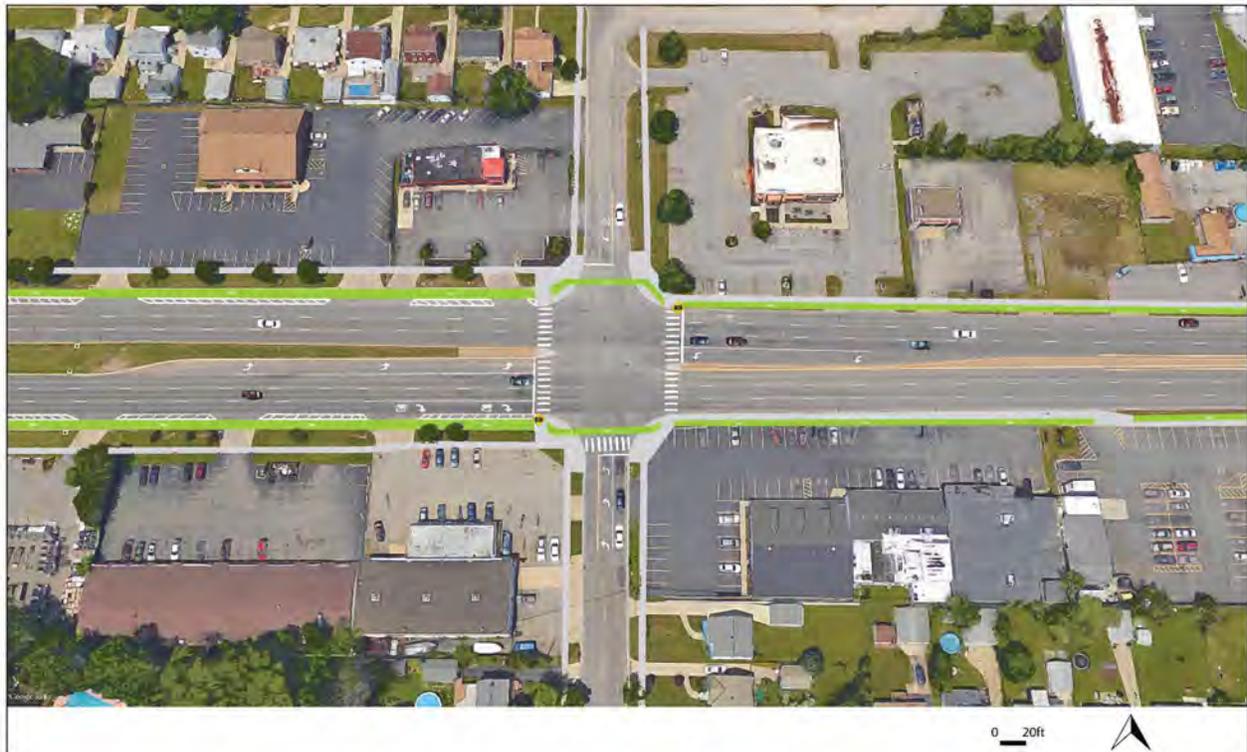


Figure 4.8 above, shows the transition between the shared sidewalk facility and the on street protected bike lane. Furthermore, the median can be replanted and retrofitted to provide service as a rain garden. The buffer and bike lane configuration in figure 5 also enables for vehicular access to commercial parking lots by eliminating the buffer zone directly in front of those entrances while maintain the green bicycle lane. This proposal allows for the clear demarcation for vehicular access to commercial areas while still maintaining designated spaces for bicyclists accentuated for safety by green paint.

Figure 4.9 Street Configuration of Proposal and Image of Current Condition

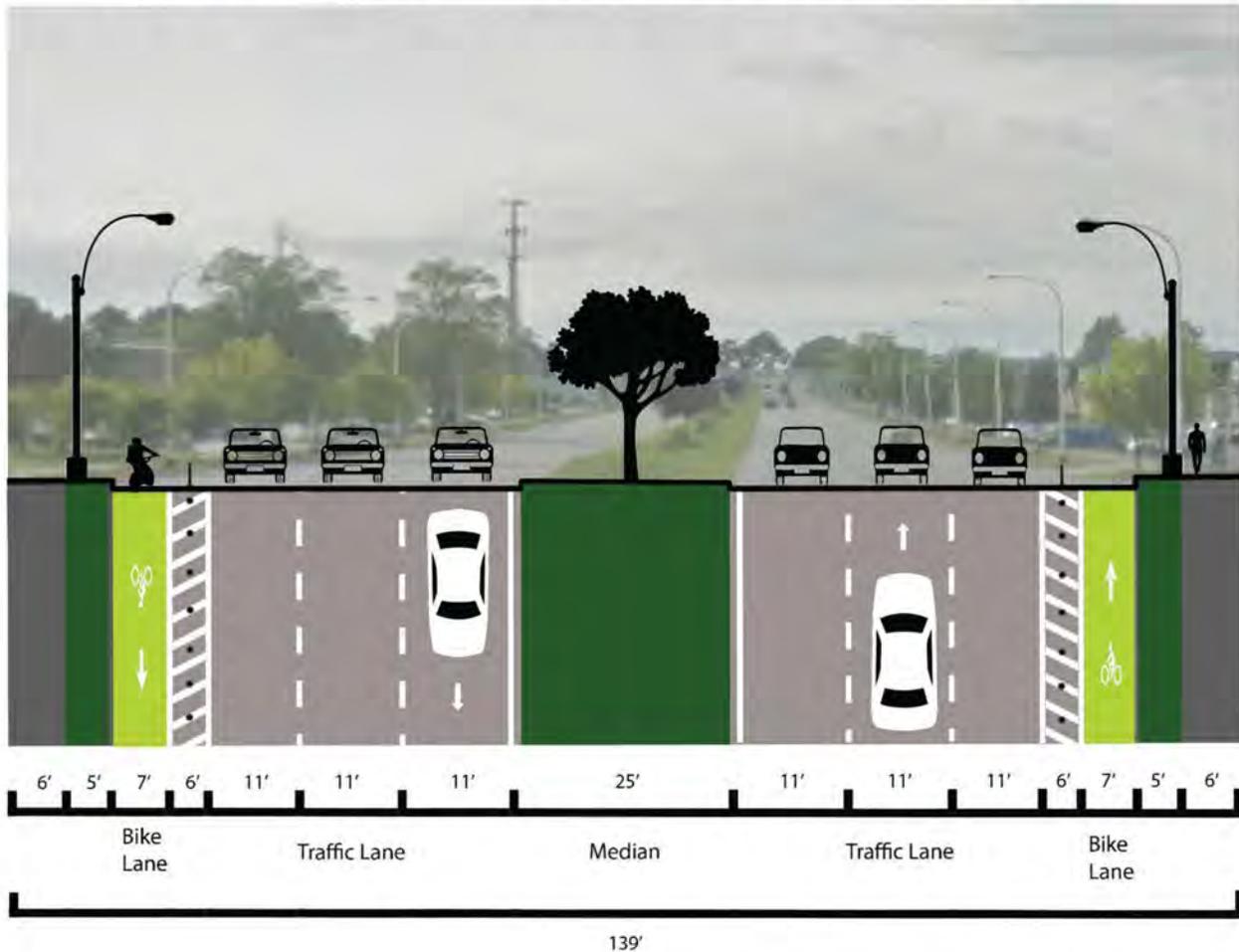


Figure 4.9 above is a typical cross section of the street configuration in this portion and recommends the following improvements in street design

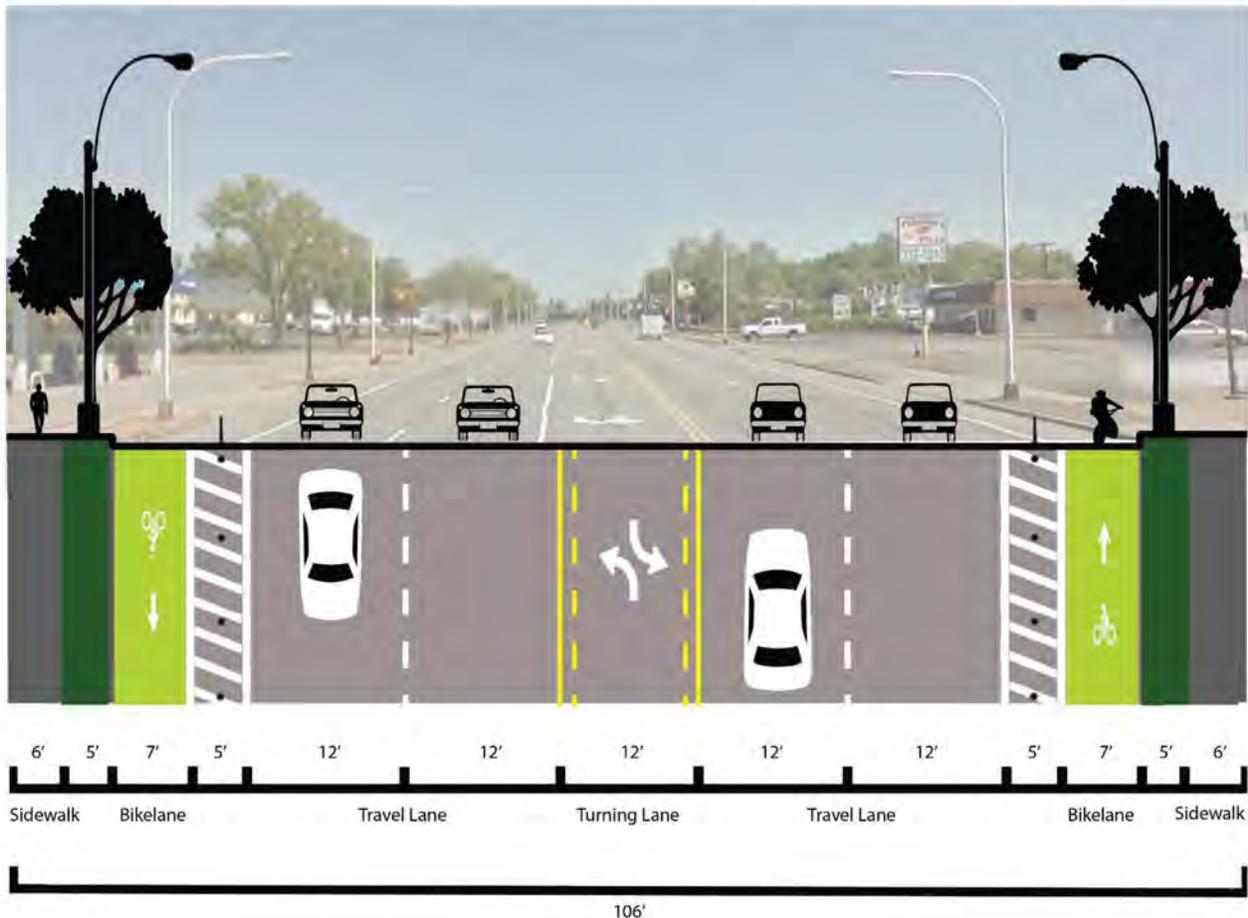
- Eliminating a lane of traffic on both sides of the median
- Utilize the 46 feet of space curb to curb by installing,
 - 7-foot-wide bike lane
 - 6-foot-wide buffer with candlestick bollards
 - 3 – 11-foot-wide traffic lanes in each direction
 - 28-foot-wide median/rain garden
- Pattern to be replicated on both sides of median with no widening

Proposal 3: Military Road to East Park Drive - 0.5 Miles

Sheridan Drive becomes a 4 lane highway west of Military Drive which halves the amount of available lanes for vehicular traffic moving in either direction. This area also has the lowest number of AADT 13,981. With a lower traffic burden it is recommended that the protected bike lane be continued until it reaches the Sherwood Greenway trail at the intersection of East Park Drive.

The section of street from Military Road to East Park Drive varies greatly in width from curb to curb ranging from as low as sixty feet to as high as 130. The current organization of the traffic lanes includes a shoulder line dedicating an outside boundary on both sides. The width of the shoulder varies as well ranging from as little as 2 feet to upwards of 10 feet. The shoulder line currently provides a method of maintaining a sense of continuity of lane width for vehicular traffic while the curb boundary grows wider moving west. Figure 6 depicts a typical cross section of the current street configuration in this portion.

Figure 4.10 Street Configuration of Proposal and Image of Current Condition



Current Street Conditions

- Wide vehicular traffic lanes of 17 and 18 feet

- 22-foot center turning lane
- Marked Shoulder Lines Designating Lane Boundaries
- Curb boundary marking the end of the vehicular traffic area
- Distances between curbs increases moving westward from Military Road
- Cross section depicts a typical configuration

Figure 4.10 details a cross section of the street with the bicycle facility improvements.

- Elimination of shoulder lane
- Addition of 5-foot bike lane
- 7-foot buffer with candlestick bollards
- 13-foot vehicular traffic lanes – reduced from 17 and 18 feet
- 11-foot center turn lane
- The measurements in this cross section represent a typical configuration for the proposed traffic pattern in this portion.

The proposed street configuration is designed to be adjustable to varying road widths in this portion. This portion of Sheridan Drive is also nearest to much of the existing heavy industry in the western portion of the Town of Tonawanda. The existing lane configuration allows for large semi-trucks to maneuver through the street with ease. In the proposed cross section, slightly skinnier lanes are recommended but as design is finalized with professional engineering it is suggested that all lane widths be increased or decreased following the width of the street.

Figure 4.11 is a visual representation of the East Park and Sheridan intersection. At East Park, the on street recommended bicycle facilities will end on Sheridan Drive. In this section, the Sherwood Greenway becomes a much more viable option for continuing to travel west towards the waterfront. The figure below represents the recommended lane configuration at the intersection to direct bicyclists to the Sherwood Greenway Trail.

Figure 4.11 Sheridan Drive and East Park Avenue with Bicycle Lane Linkage to Sherwood Greenway Trail



Cost Estimates

1. Planning and Design	\$ 335,966.21
Service	Total
Drainage and Utilities Surveying	\$ 111,988.74
Detailed Engineering Design	\$ 223,977.47
2. Capital Improvement Cost	\$ 2,239,774.72
Item	Total
On-Road Facility (2.17 miles)	\$ 322,741.60
Buffered Bicycle Lane	\$ 63,971.60
Bollards	\$ 258,770.00
Off-Road Facility (1.60 miles)	\$ 1,326,493.12
Concrete	\$ 375,429.12
Colored pavement	\$ 760,320.00
Bollards	\$ 190,744.00
Niagara Falls Blvd and Sheridan Dr Intersection	\$ 101,140.00
Colored pavement	\$ 16,200.00
Pavement marking symbols	\$ 4,640.00

Town of Tonawanda 2015 Bicycle Master Plan

Crosswalk marking	\$ 24,560.00
Bicycle signal head	\$ 3,740.00
Bulb-out	\$ 52,000.00
Belmont Ave and Sheridan Dr Intersection	\$ 78,850.00
Colored pavement	\$ 5,400.00
Pavement marking symbols	\$ 1,160.00
Crosswalk marking	\$ 18,420.00
Bicycle signal head	\$ 1,870.00
Bulb-out	\$ 52,000.00
East Park Dr and Sheridan Dr Intersection	\$ 31,400.00
Colored pavement	\$ 6,300.00
Pavement marking symbols	\$ 1,740.00
Crosswalk marking	\$ 21,490.00
Bicycle signal head	\$ 1,870.00
Other Signalized Intersections along Sheridan Dr (9)	\$ 249,750.00
Colored pavement	\$ 6,300.00
Pavement marking symbols	\$ 1,160.00
Crosswalk marking	\$ 18,420.00
Bicycle signal head	\$ 1,870.00
Other Unsignalized Intersections along Sheridan Dr (5)	\$ 129,400.00
Colored pavement	\$ 6,300.00
Pavement marking symbols	\$ 1,160.00
Crosswalk marking	\$ 18,420.00
3. Annual Facility Maintenance Cost	\$ 64,932.84
Service	Total
Buffered Bicycle Lane	\$ 20,337.24
Sidewalk Bicycle Path	\$ 28,761.60
Plowing	\$ 15,834.00

Priority 2 Proposals

Proposals	Estimated Cost
DELAWARE AVE	
Planning and Design	\$ 114,767.25
Capital Improvements	\$ 765,115.00
Annual Maintenance	\$ 31,215.60
PARKER BLVD	
Planning and Design	\$ 41,062.05
Capital Improvements	\$ 273,747.00
Annual Maintenance	\$ 6,650.28
KENMORE AVE	
Planning and Design	\$ 143,887.01
Capital Improvements	\$ 959,246.72
Annual Maintenance	\$ 73,224.00

Delaware Ave. Bikeway [2.3 Miles]

Est. Cost: \$157,734-\$195,672

Project Description

Delaware Avenue is ranked as a 2nd priority for additional upgrades in the Town of Tonawanda bicycle network. The portion of Delaware Avenue recommended for the addition of bicycle improvements is the 2.3 miles between Kenmore Avenue in the south and Brighton Road in the north. The proposal includes protected bike lanes in the Village of Kenmore and buffered bike lanes between Kenton Road and Brighton Road.

This plan also includes intersection designs for major intersections including Brighton Road, Sheridan Drive, Delaware Road, and Kenmore Avenue. This project area is predominantly a commercial thoroughfare with residential land uses immediately to the east and west. Delaware Avenue in the Town of Tonawanda is managed jointly by the state and federal highway departments. This corridor has both single and double lane configurations with and without vehicular parking and a speed limit of 35 miles per hour.

The one-mile portion of Delaware Avenue in the Village of Kenmore has on street parking on either side the roadway with 2 vehicular traffic lanes. The portion north of Kenton Road has 4 lanes of vehicular traffic with no parking provided.

Proposal 1: Kenmore Avenue to Kenton Road

Figure 4.12 below examines the existing conditions at the Kenmore Avenue and Delaware Avenue intersection. There are currently no bicycle facilities and pedestrian crosswalks are faded and uninviting. Buffalo's section of Delaware Avenue has 4 lanes of vehicular traffic, 2 moving in either direction while the section in the Town of Tonawanda has only 2 lanes of vehicular traffic. Currently, there is not bike path designed for the Buffalo portion of Delaware Ave where it meets Kenmore Avenue. It is recommended that bicyclists southbound on Delaware Avenue turn onto Kenmore Avenue in order to continue utilizing on street bicycling facilities. A Bike box is recommended for the Delaware Avenue side of the intersection to enable bicyclists to safely turn left and enhance visibility. The arrows across the intersection guide bicyclists to continue onto Kenmore Avenue. Buffered bicycle lanes in each direction with bike box in the southbound Delaware lane to enhance left turns will be added and stop signs will be added for bicyclists traveling south on Delaware Avenue and turning right.

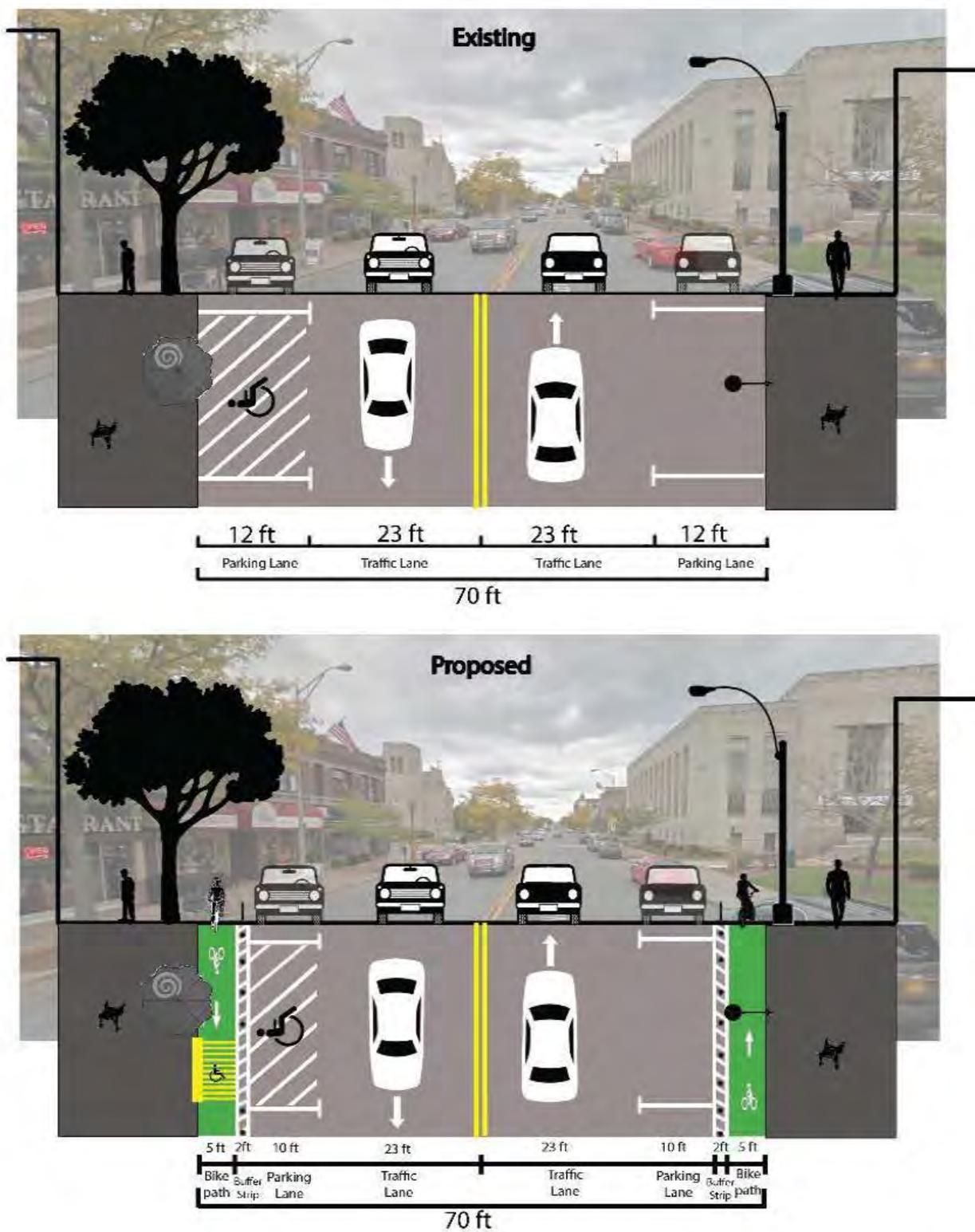
Figure 4.12 Existing intersection for Kenmore Ave. and Delaware Ave



Figure 4.13 Proposed Intersection for Kenmore Ave. and Delaware Ave



Figure 4.14 Existing and Proposed Street Configurations in the Village of Kenmore



This portion of Delaware Avenue is a two-way corridor with 2 traffic lanes in each side. There are parking lanes on each side of the street with designated handicap parking available.

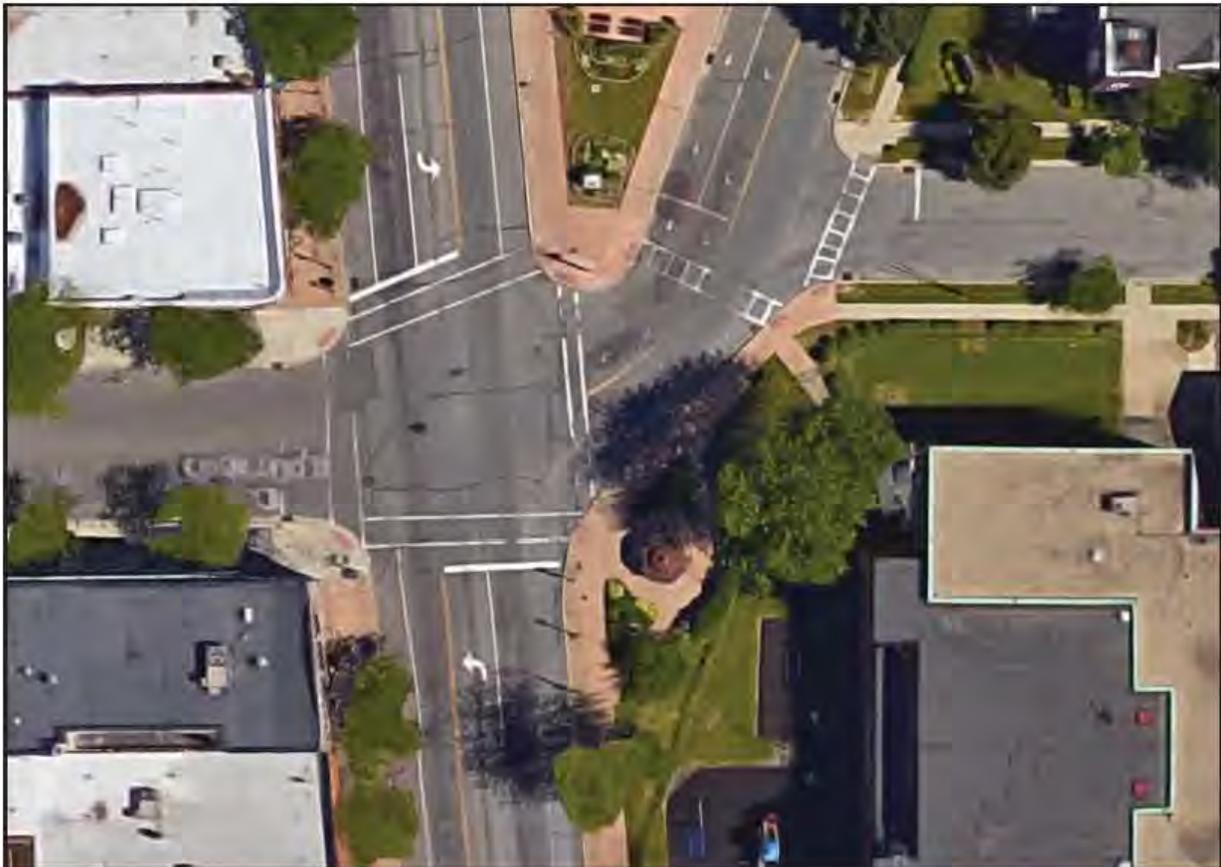
The proposed bike paths width is 5ft with a buffered strip of 2 ft. in each side of the street. The parking lanes are located on the outside of the bicycle lanes to provide protection from moving traffic. The protected bicycling lane will improve the safety of bicyclists and give a safe space for drivers to open and close the car's doors. The width of parking lanes would be reduced to 10 ft. however the width of the traffic lanes will not be changed. This section is adjacent to small business retailers which has a higher traffic congestion justifying the use of parked vehicles as protection. Also, shops and restaurants on the street will benefit from having bicyclists on the portion of the street closest to their doors.

Proposed Street Scape with Bicycle Lanes

- 5' Bicycle Lane
- 2' Buffer
- 10' Parking Spaces
- 23' traffic lanes
- Candlestick Bollards added for additional safety between parked vehicles and bicyclists

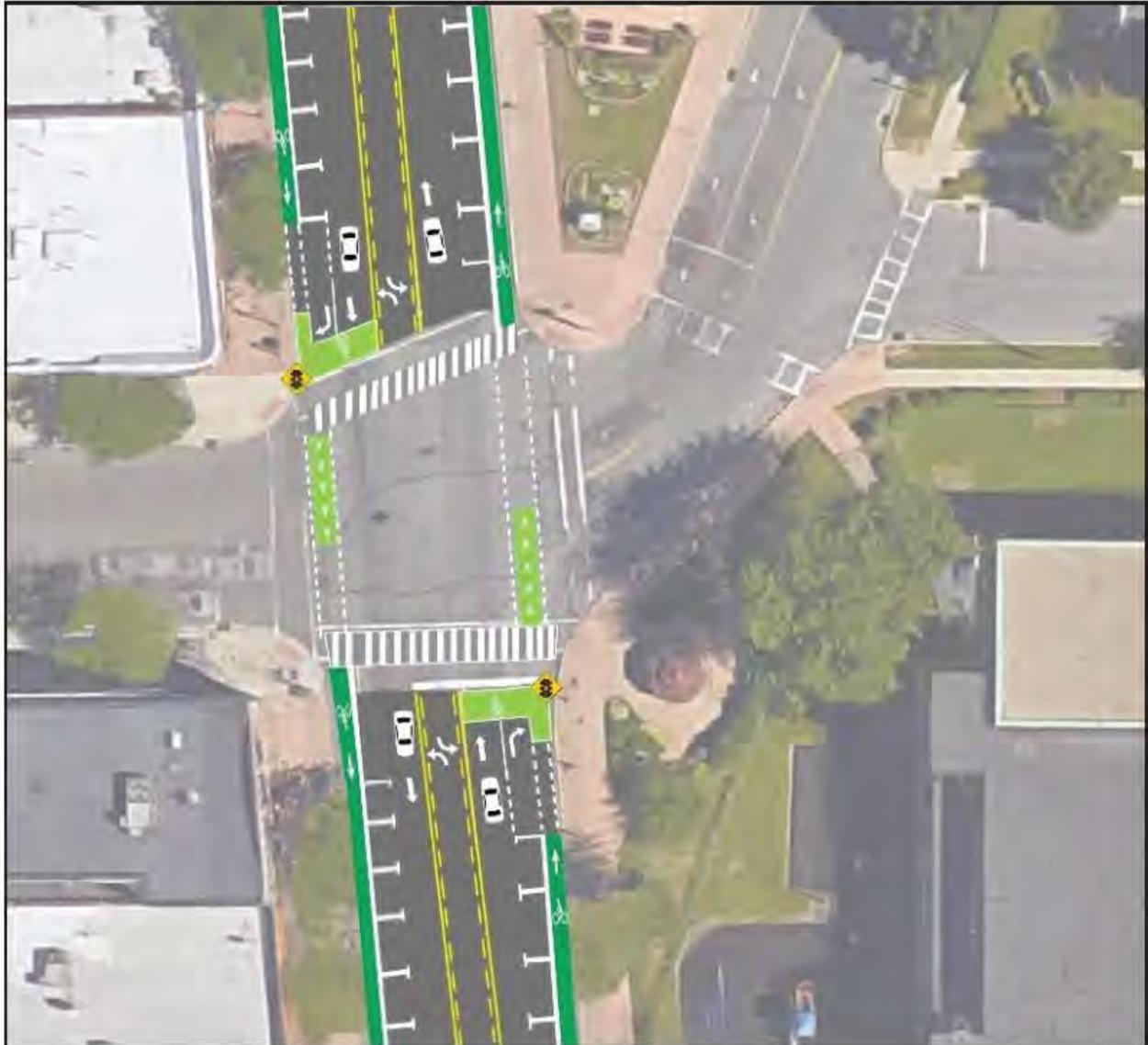
Delaware Road Intersection

Figure 4.15 Existing intersection for Delaware Road and Delaware Avenue



Delaware Road was designed to be a shared-road for bicyclists and is a significant intersection when it meets Delaware Avenue in Kenmore. Currently, negotiating this intersection a bicycle during traffic is precarious due to the lack of designated spaces of bicyclists to occupy.

Figure 4.16 Proposed intersection for Delaware Ave and Delaware Rd with Bike Path



Bike boxes are recommended to be installed at the intersection of Delaware Ave and Delaware Road. The bike boxes increase the safety and visibility of bicyclists while waiting at the intersection. They also provide space for bikers to make turns at the intersections. In addition to bike boxes, two bicycle signals would be installed at two sides of Delaware Ave. to increase the safety and specific time and priority to bikers.

Intersection Upgrades at Delaware Avenue at Delaware Road

- Bike Boxes for left hand turns
- Highlighted conflict areas in intersection
- Designated on street bike lanes
- Parking realigned on street to create protection for bicyclists from traffic

Kenton Road forms the border between the Town of Tonawanda and the Village of Kenmore. North of Kenton Road, Delaware Avenue expands to two lanes of traffic traveling in each direction. The second half of the Delaware Avenue Bicycle Lanes Proposal makes recommendations for improved bicycle facilities on the portion north of Kenton Road. A stop sign is recommended at the intersection of Kenton Road and Delaware Avenue to abate potential conflicts between vehicles and bicyclists as the traffic pattern shifts from 2 vehicular lanes and 2 bicycle lanes to 4 vehicular lanes and 2 bicycle lanes.

Figure 4.16, depicts the two distinct street configurations for Delaware Avenue in the Town of Tonawanda and the Village of Kenmore. The green portion represents the protected bike lanes in the Village of Kenmore and the blue represents the buffered bicycle lane between Kenton Road and Brighton Road.

Figure 4.17 Map of proposed bike path and intersection treatment facilities.

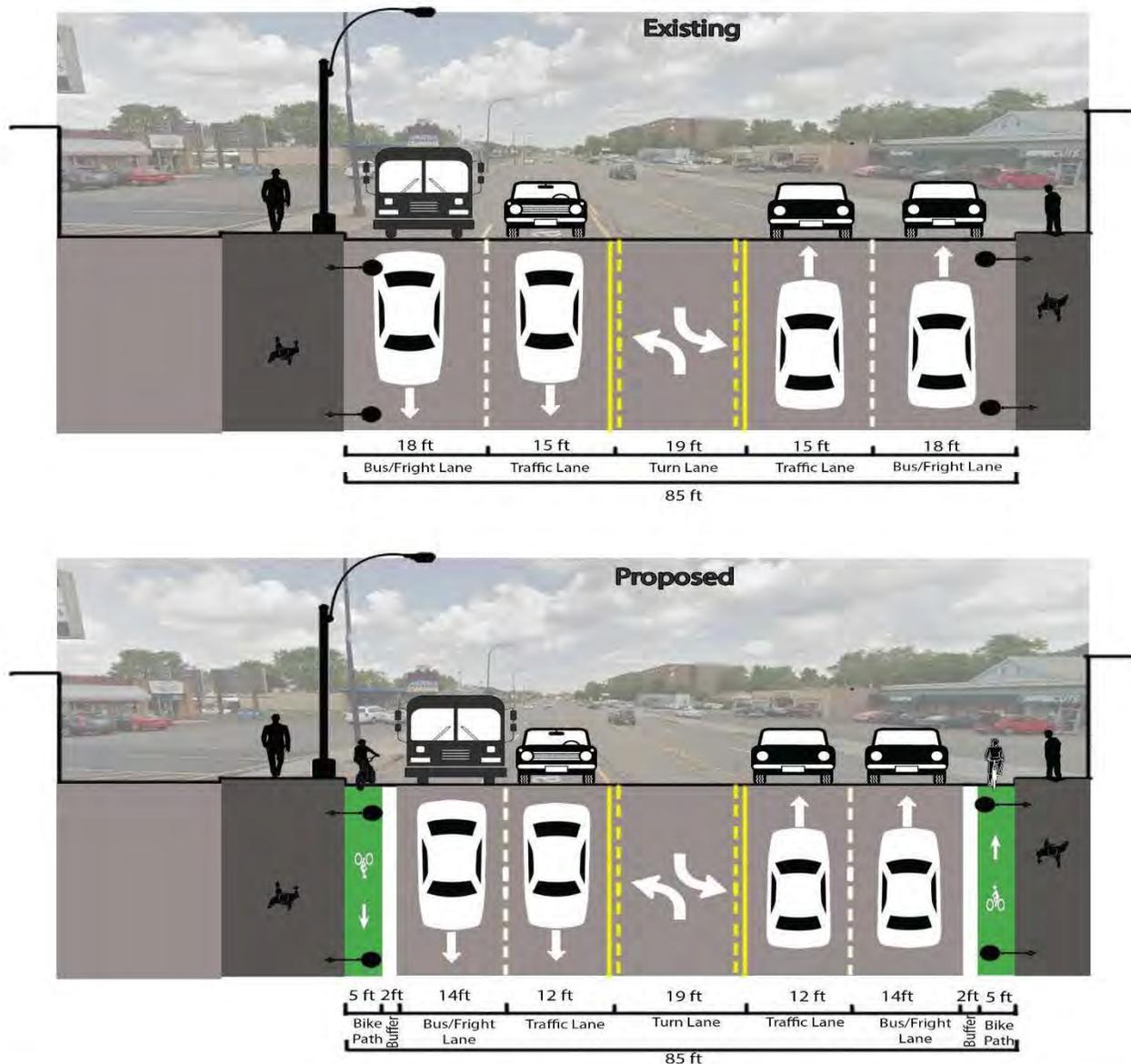


Proposal 2: Kenton Road to Brighton Road

Delaware Avenue north of Kenton is a two-way corridor with 2 traffic lanes in each side (width= 15ft and 18 ft.). There is a turn lane in the middle of the street (width= 19 ft.).

The proposed bicycle path width is 5ft with a buffered strip of 2 ft. to separate passing vehicles and bicyclists. The width of traffic lanes will be reduced to accommodate the new bicycle lanes. The nearest to the curb traffic lane which will be used by buses and freight use would be 14ft. The width of the two other traffic passenger vehicle traffic lanes will be 12 ft. The width of the middle turn lane will not be changed and is 19 ft. Figure 4.17 below depicts the existing conditions of Delaware Avenue as well as the proposed bicycle and traffic lane configurations.

Figure 4. 18 Existing and Proposed Bicycle Plan for Delaware Avenue (Kenton Rd to Brighton Rd)



Delaware Avenue has high level of traffic congestion with 4 lanes traffic lane in each side. In order to increase the safety of bicyclists 4 signals will be installed in each side of the intersection. The intersection will also be upgraded for bicyclists in the Dutch style. When bicyclists cross the intersection turning onto a perpendicular roadway they must follow the green lane around the intersection until the lane and direction desired is reached. The signals will facilitate this bicycle and traffic control. The green lanes enhance the bike path visibility and inform other users that there is a priority use of bikers in the green section of the intersection.

Figure 4.19 Proposed Intersection Upgrades at Delaware Avenue and Sheridan Road



- Protected style bicycle intersection
- 4 signals to control bicycle flow
- Repainted pedestrian crosswalks
- 3 vehicular traffic lanes and designated right turn lanes

Delaware Avenue at Brighton Road Intersection

The proposed bike lanes on Delaware Avenue ends at Brighton Road in the north. The recommendation is to end the lanes as there are few bicycling destinations on accessible by Delaware Avenue north of this point. Brighton Road is a two-way residential corridor with one vehicular traffic lane in either direction. To connect bike paths from Delaware Avenue to Brighton Road. The intersection has been designed with white arrows for bike lanes across the intersection. There would be two bicycle signals at the intersection, one on either side coordinated to direct bicyclists through traffic.

Figure 4.20 Proposed Intersection Improvements at Delaware Avenue and Brighton Road

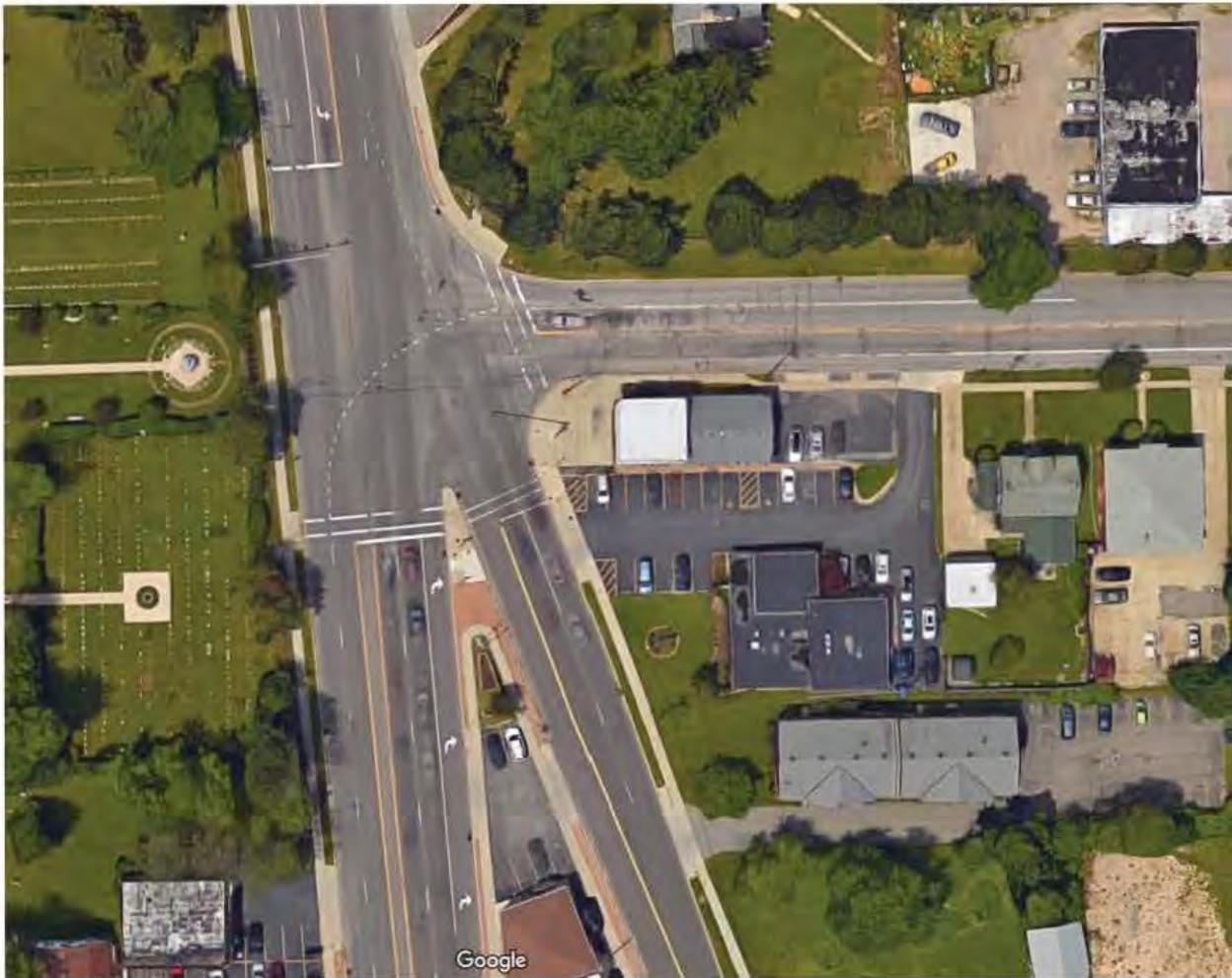


Figure 4.21 Proposed Intersection Improvements at Delaware Avenue and Brighton Road



Recommendations for Delaware Avenue and Brighton Road

- Signals for bicyclists
- Designated laneways in intersection for bicyclists

Delaware Avenue Proposal Summary

The proposed bicycle facilities on Delaware Avenue in the Town of Tonawanda are a priority 2 addition in the needs assessment. The 2.3-mile stretch from Kenmore Avenue in the south to Brighton Road in the north is a transect which begins in a dense environment at the Buffalo city line and ends in a decidedly suburban pattern at Brighton Road. Two different styles of bike lanes were designed to encourage bicycling on Delaware. In the section where street vehicular parking exists the bike lane was designed to be nearest to the sidewalk with a painted buffer and parking lane on the outside of the bike line. This will give the bicyclist enhanced protection from moving traffic in the street. Furthermore, placing the bicyclist closest to the sidewalk and the corresponding shops and restaurants will enhance the bicycling experience on the Village of Kenmore's main commercial thoroughfare. Further north, vehicular parking is not available. In this 1.3-mile section, bike lanes, and painted buffers were designed with smaller vehicular traffic lanes to facilitate multiple modes of transportation. Intersections were also designed to enhance the bicycling experience by improving perceptions of safety by providing designated lanes and bicycle specific signaling.

Cost Estimates

1. Planning and Design	\$	114,767.25
Service		Total
Drainage and Utilities Surveying	\$	38,255.75
Detailed Engineering Design	\$	76,511.50
2. Capital Improvement Cost	\$	765,115.00
Item		Total
On-Road Facility (2.17 miles)	\$	221,060.00
Buffered Bicycle Lane	\$	38,324.00
Bollards	\$	155,036.00
Bicycle Lane with parking	\$	27,700.00
Sheridan Dr and Delaware Ave Intersection	\$	92,040.00
Colored pavement	\$	14,400.00
Pavement marking symbols	\$	3,480.00
Crosswalk marking	\$	18,420.00
Bicycle signal head	\$	3,740.00
Bulb-out	\$	52,000.00
Delaware Rd and Delaware Ave Intersection	\$	27,270.00
Colored pavement	\$	10,800.00
Pavement marking symbols	\$	2,320.00
Crosswalk marking	\$	12,280.00
Bicycle signal head	\$	1,870.00
Kenmore Ave and Delaware Ave Intersection	\$	22,745.00
Colored pavement	\$	3,600.00
Pavement marking symbols	\$	4,060.00
Crosswalk marking	\$	12,280.00

Town of Tonawanda 2015 Bicycle Master Plan

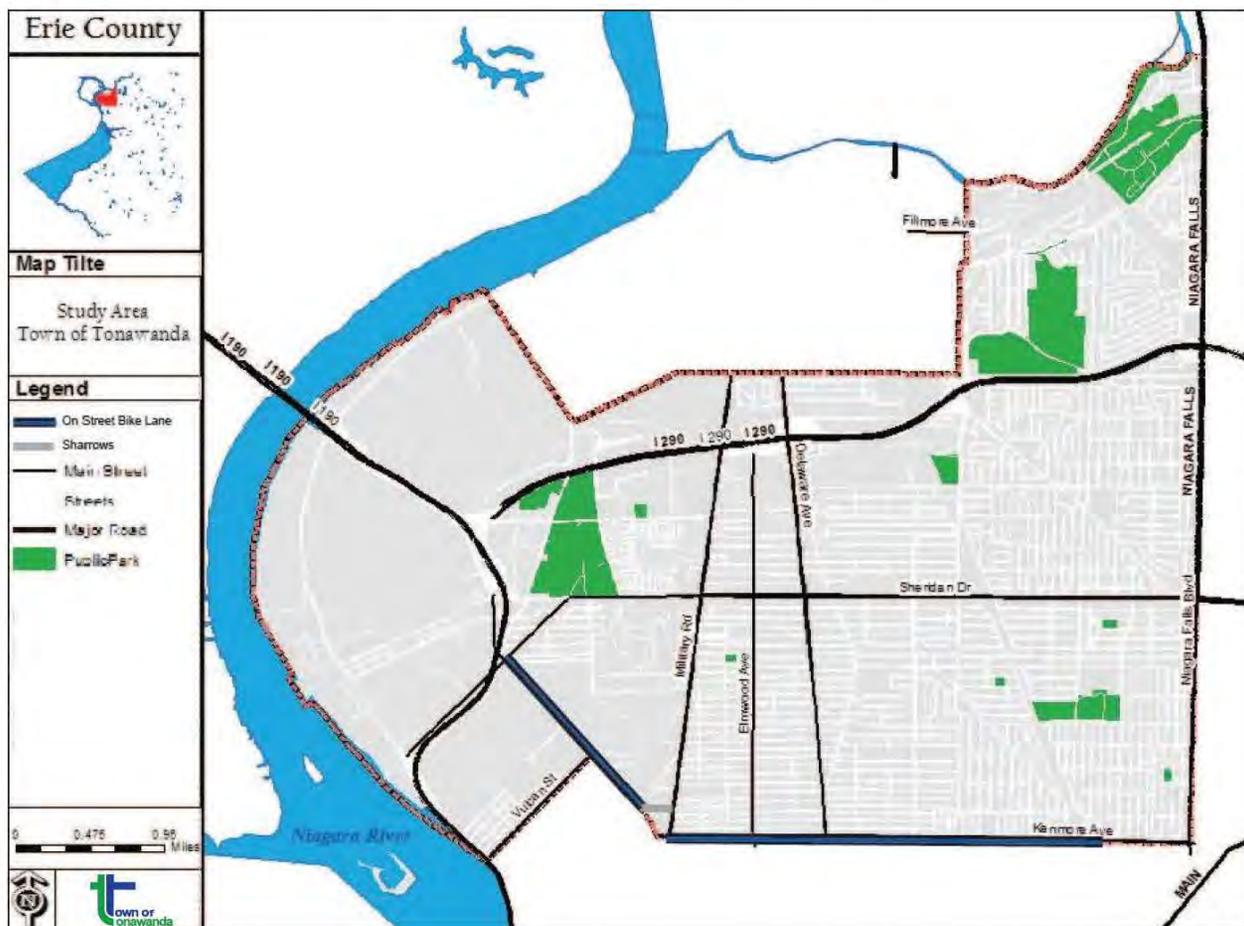
Bicycle signal head	\$	2,805.00
Brighton Rd and Delaware Ave Intersection	\$	33,450.00
Colored pavement	\$	1,800.00
Pavement marking symbols	\$	5,220.00
Crosswalk marking	\$	24,560.00
Bicycle signal head	\$	1,870.00
Other Signalized Intersections along Delaware Ave (1)	\$	27,750.00
Colored pavement	\$	6,300.00
Pavement marking symbols	\$	1,160.00
Crosswalk marking	\$	18,420.00
Bicycle signal head	\$	1,870.00
Other Unsignalized Intersections along Delaware Ave (20)	\$	340,800.00
Colored pavement	\$	3,600.00
Pavement marking symbols	\$	1,160.00
Crosswalk marking	\$	12,280.00
3. Annual Facility Maintenance Cost	\$	31,215.60
Service		Total
Buffered Bicycle Lane	\$	21,555.60
Plowing	\$	9,660.00

Kenmore Avenue Project [4.3 Miles]

The Kenmore Avenue Project will be implemented in two phases. Project 1 will add bike lanes to Kenmore Avenue between the Rail Trail and Military Road. Project 2 will extend bicycle infrastructure to the west from Military Road to Sheridan Drive. This entire project will add 4.2 miles of bikeways to Kenmore Avenue within the Town of Tonawanda. The majority of the plan includes on-street bike lanes on both sides of the street. These lanes will be outlined with white paint and will amount to a total of 8.4 linear miles of bikeway infrastructure.

Most of Kenmore Avenue has relatively wide spaces of unused space or spaces that do not have designated vehicle lanes. These are ideal conditions for a bikeway project that can be implemented over a short period of time with minimal costs. A small portion of Kenmore Avenue does require street widening in order to implement bicycle lanes. The speed limit on Kenmore Avenue is 30 miles per hour and therefore a barrier is not needed between the vehicle lane and bicycle lane.

Figure 4. 22 Kenmore Ave Project Map



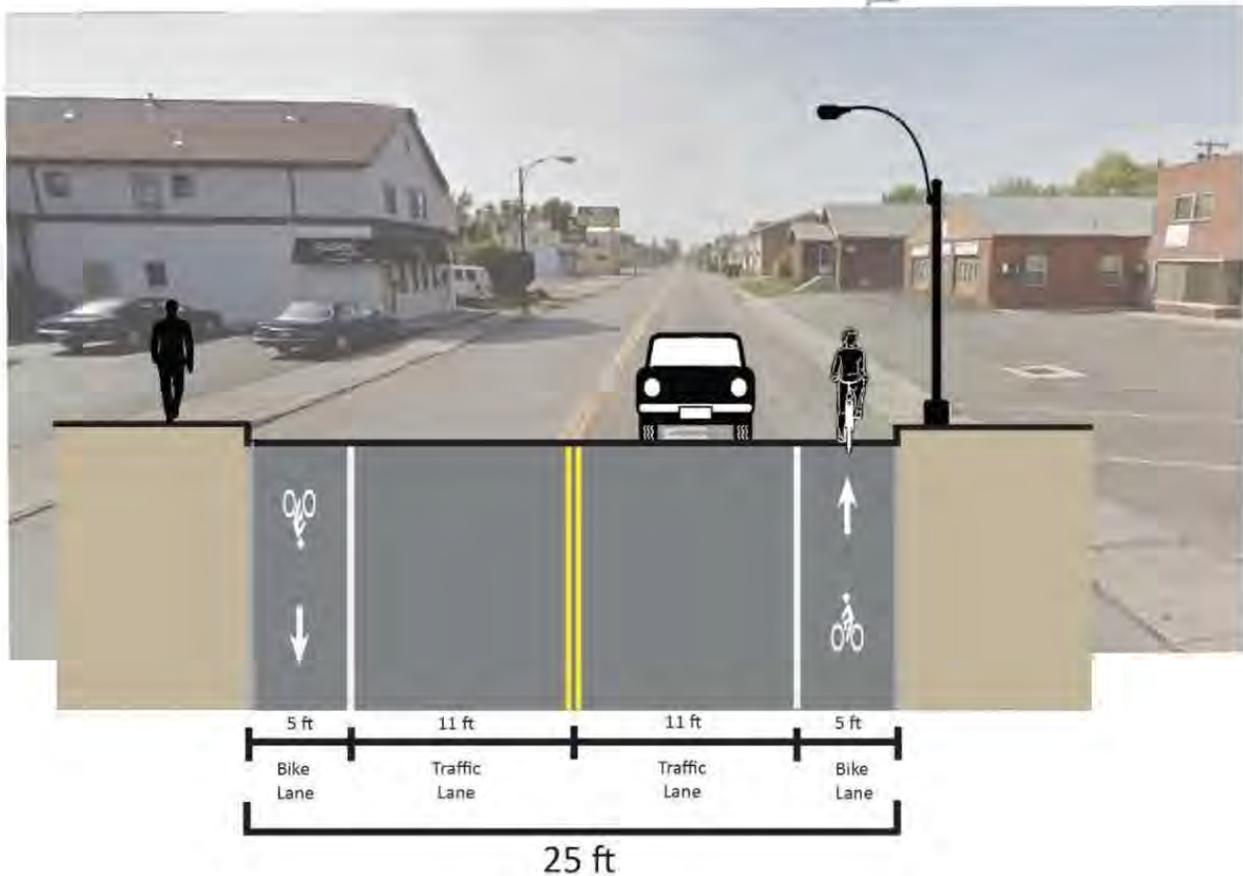
Proposal 1: Rail Trail to Military Road

Proposal 1 will create an east/west traffic corridor for bicyclists, which the Town of Tonawanda currently lacks. Additionally, this will create more bicycle connectivity to the Rails to Trails project, furthering the value of the existing trail. It is recommended that bike lanes be implemented on Kenmore Avenue between the Rails to Trails entrance (near Englewood Avenue) and Military Road.

This stretch of proposed bicycle lanes is 2.7 miles long on each side of the street that will be between four and five feet wide. The street varies between two and three lanes. The section of the street between the Rail to Trail entrance and Colvin Boulevard, which is 1.1 miles long, is slightly too narrow. The street needs to be expanded by two feet on each side in order to implement four-foot bike lanes.

The remaining 1.6 miles of Proposal 1 is wide enough for bike lanes to be implemented. At larger intersections, such as Delaware Avenue, there is no room for bike lanes, therefore arrows guiding bicyclists and alerting motor vehicle drivers will be used. Proposal 1 also includes bicycle infrastructure at four intersections: Delaware Avenue, Colvin Avenue, Elmwood Avenue, and Starin Avenue.

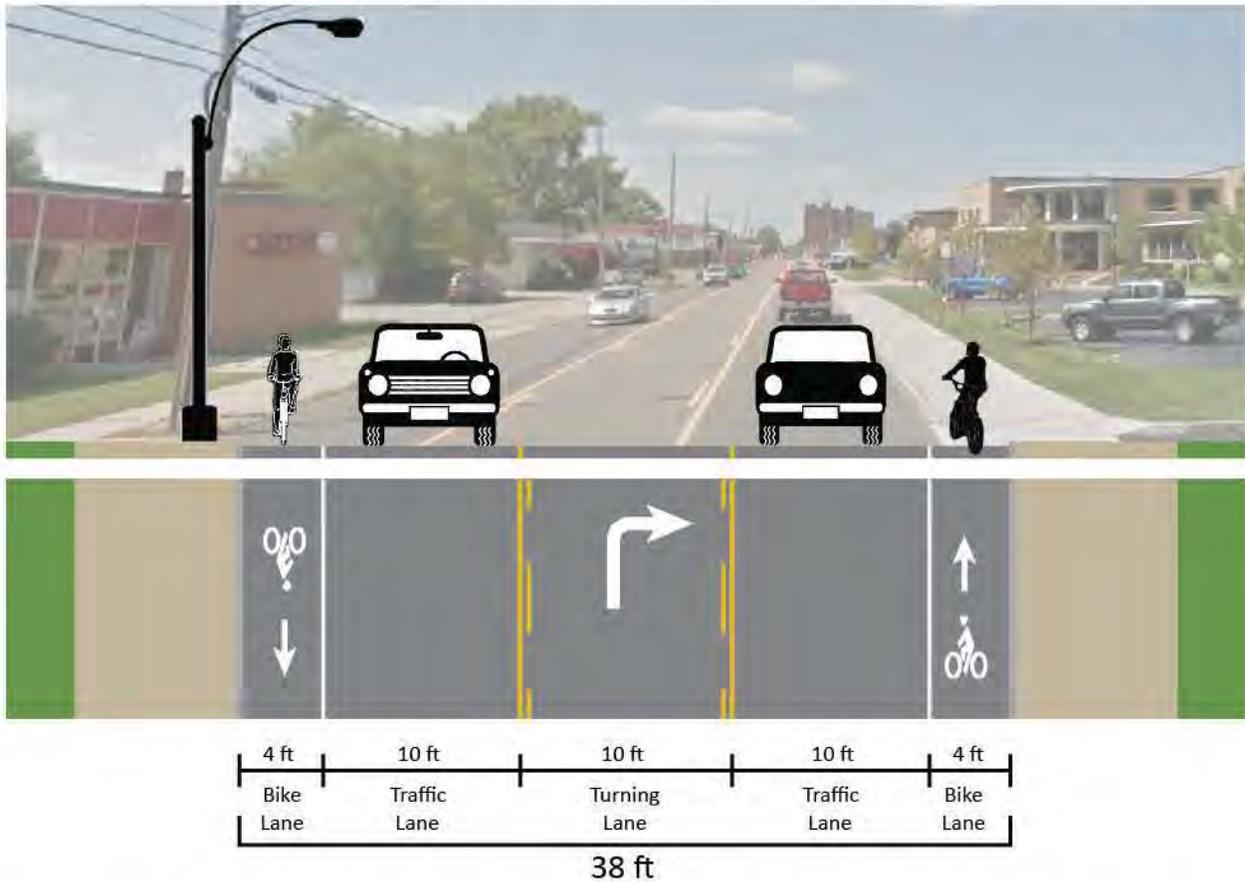
Figure 4.23 Kenmore Two Lane Sections between Rails to Trail and Military



A short section of this part of Kenmore Avenue is only two lanes. The lanes are wide, allowing ample room for bicycle lanes to be implemented. Much of this section of Kenmore Avenue consists of two lanes and a turning lane. As previously stated, a short section does not have enough room for a bike lane without cutting into the sidewalk. The two lane sections on this implementation phase include:

- Hobmoor Avenue to Colvin Avenue– .15 miles
- West of Colvin Avenue almost to Delaware Avenue – .48 miles
- West of Delaware Avenue almost to Elmwood Avenue – .38 miles
- West of Elmwood Avenue to Military Road - .47 miles

Figure 4.24 Kenmore Three Lane Sections between Rails to Trail and Military



Portions of this section of Kenmore Avenue consist of two travel lanes and a turning lane. Near larger intersections, there is a turning lane for left hand turns. The three lane sections on this implementation phase include:

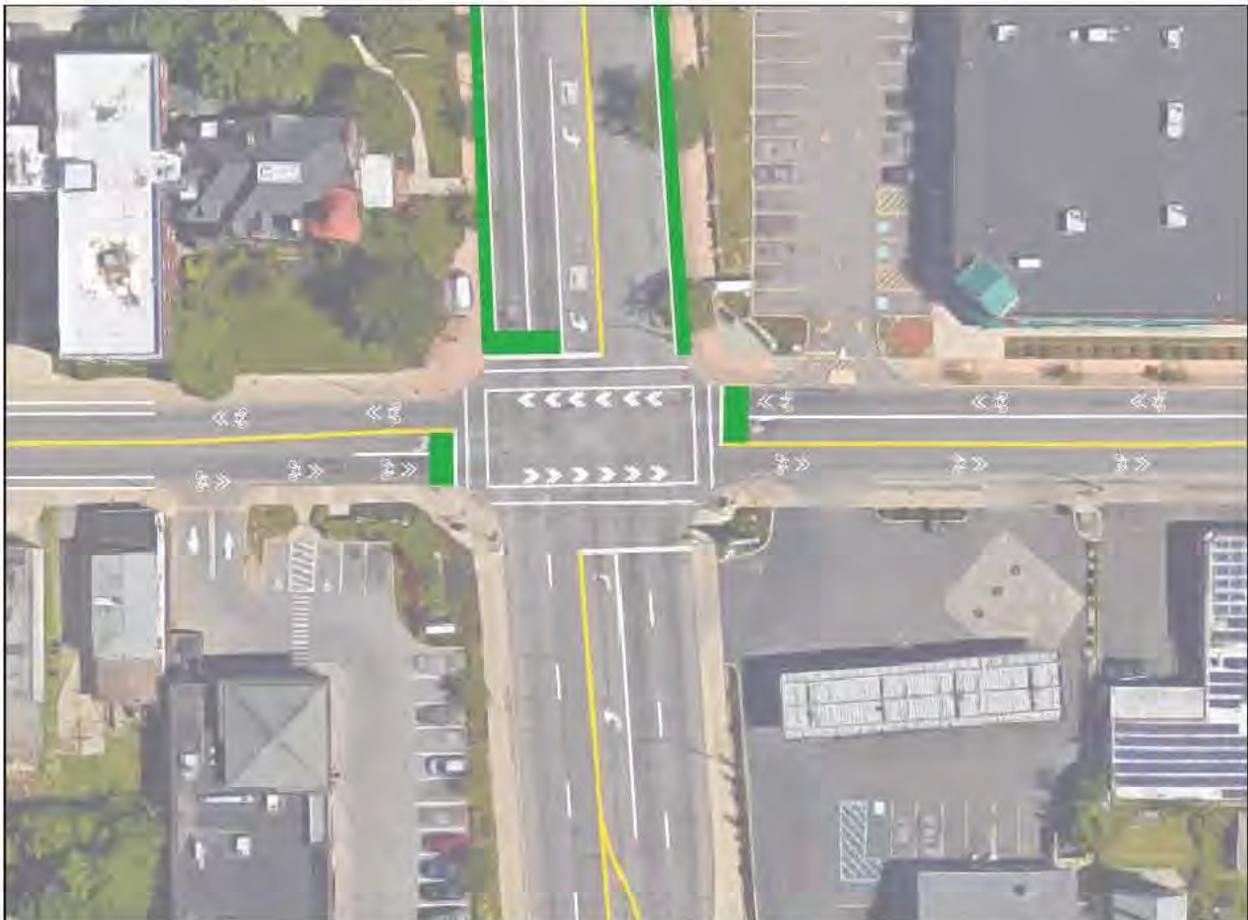
- Rails to Trails to Hobmoor Avenue – .86 miles
- East and West of Colvin Avenue Intersection – .1 miles
- East and West of Delaware Avenue intersection – .08 miles
- East and West of Elmwood Avenue intersection – .08 miles

The Kenmore Avenue and Delaware Avenue intersection has a lot of activity – NFTA buses travel down both streets as well as many vehicles. This intersection sustains pedestrians and bicyclists as well due to the amount of commercial uses and nearby residential neighborhoods.

Bike lanes are proposed for the Northern side of Delaware Avenue as well as both sides of Kenmore Avenue. The Southern border of the Town of Tonawanda ends at this intersection when crossing over Kenmore Avenue. The City of Buffalo's draft bike plan does not include bike lanes on Delaware Avenue, therefore we did not include any arrows guiding bicyclists from Delaware Avenue in the Town of Tonawanda onto Delaware Avenue in Buffalo. Because Delaware is a five lane high traffic road, we proposed a bicycle box for cyclists to wait in when crossing or turning left.

Kenmore Avenue changes from two lanes to three lanes near the intersection, therefore bike lanes could not be continued all the way to the intersection without widening the street. We included "sharrows" guiding the cyclists and altering drivers, so that bicyclists can safely ride through the intersection.

Figure 4.25 Kenmore Avenue and Delaware Avenue



Kenmore intersects with multiple streets that do not currently have proposed bike lanes. These streets include Colvin Avenue, Starin Avenue, and Elmwood Avenue. Arrows will guide the bicyclists through the intersection safely to bike lanes on the other side. Although bike lanes on Kenmore Avenue will not be painted green, they are used here to indicate where they will be located.

Figure 4.26 Intersections with Streets with No Bikeway Infrastructure



Pros

- Mostly maintains current street configuration.
- Maximizes usage of Town of Tonawanda owned property for residents.
- May increase use of Rails to Trails project.
- Designates space for bicyclists on an east/west corridor, which the Town of Tonawanda is currently lacking.
- Creates an east/west corridor on a street that borders the city of Buffalo. This will be beneficial to residents of both the Town of Tonawanda and City of Buffalo

Cons

- Intersections do not provide a designated lane for bicyclists.

- A portion of the street needs to be widened (1.1 miles), which is costly.
- Potential for confusion and conflict at intersections without designated bike lanes.
- Intersection at Delaware and Kenmore borders the City of Buffalo. Full Impact of investment would be achieved if the City of Buffalo implements bicycle facilities on Delaware, which is not included in their draft bicycle plan

Project 2: Military Road to Sheridan Drive

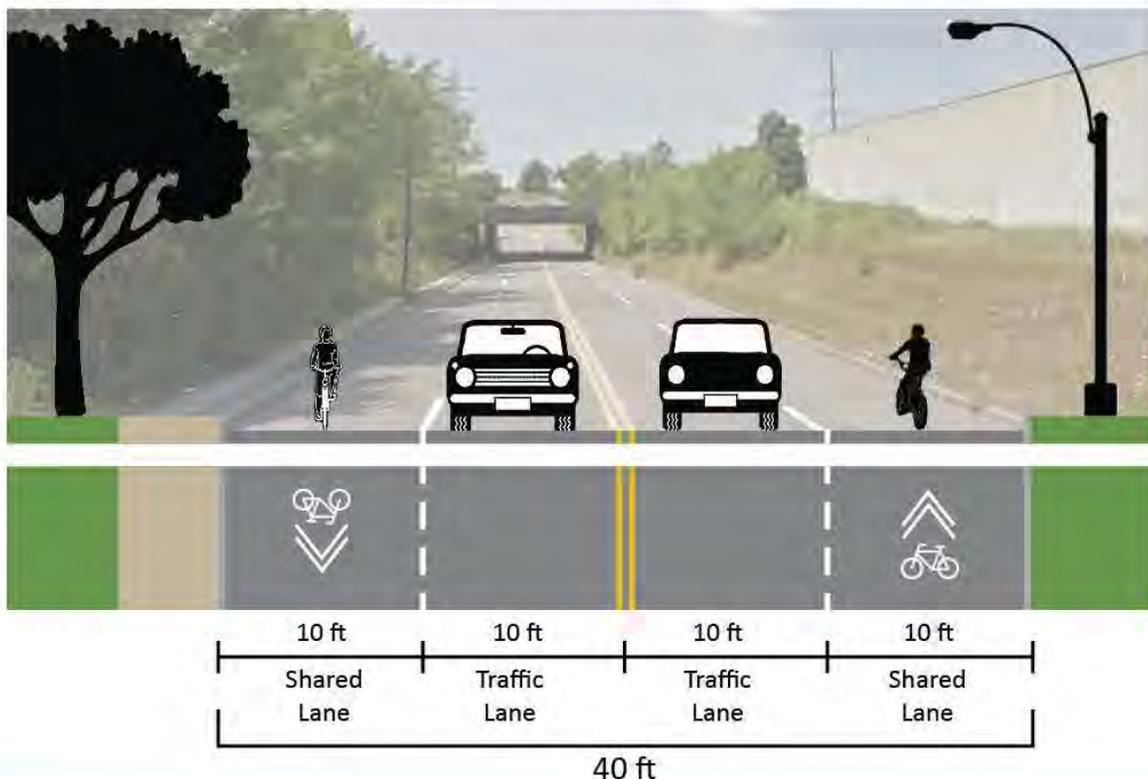
Project 2 is a 1.5 mile proposal that will extend bikeways from Tonawanda's densely populated neighborhoods in the east to areas of employment and industry in the west. This project will also expand recreational opportunities by making the Niagara River waterfront and the Riverwalk trail accessible by bicycle. This project includes sections of the street that are composed of both two and four traffic lanes. Accommodations for bicyclists will be made by adding painted on-street bike lanes along either side of the street, with the exception of a small transitional section of the street that will include shared lane markings. Proposed bike lanes will be between 4 and 6 feet wide.

This project includes

- 1.2 miles of on-street bicycle lanes (2.4 linear miles)
- 0.2 miles of shared lane markings
- A roundabout intersection

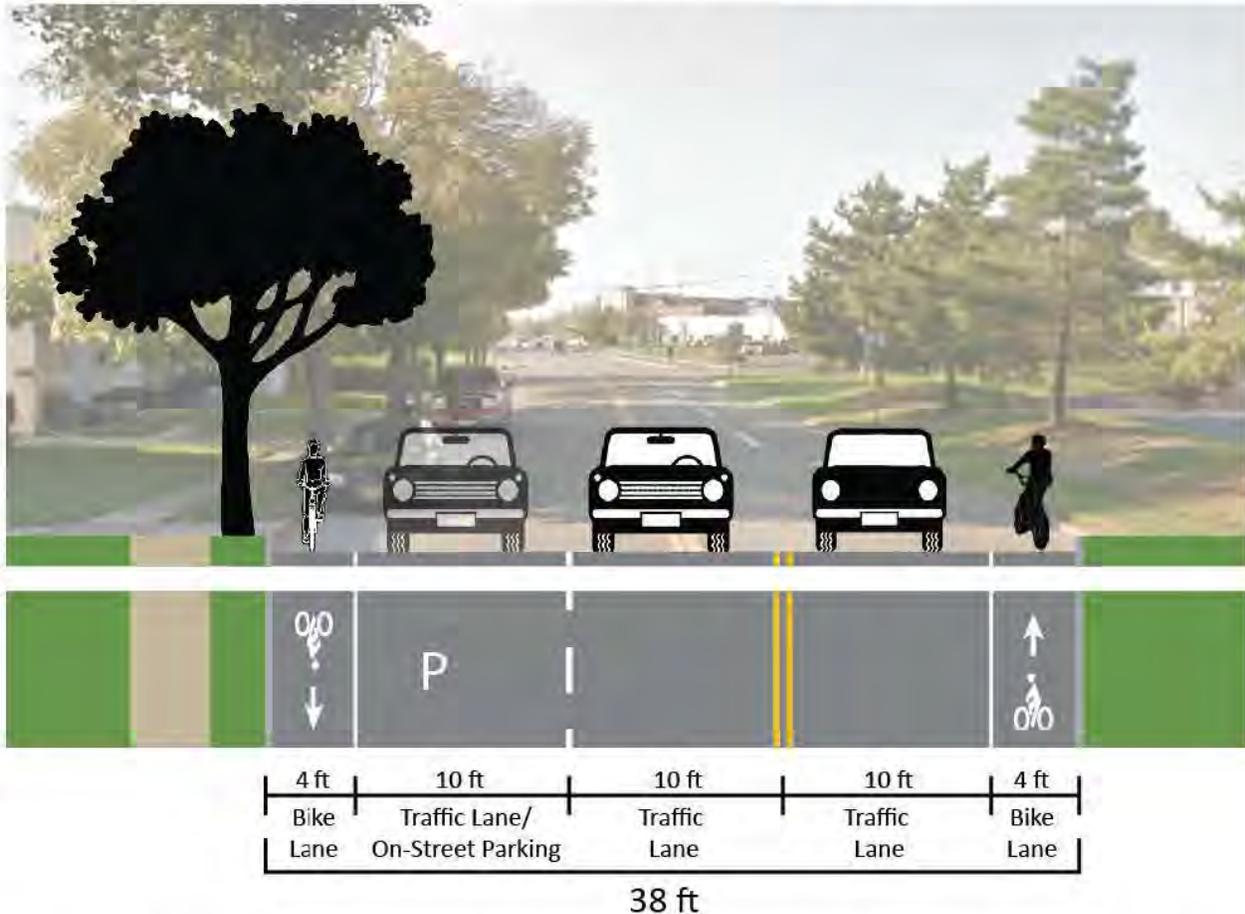
The eastern and western sides of Kenmore Avenue are separated by Military Road. The western portion begins at Military Road 850 feet north from the point where the eastern portion ends. This linear disconnect disrupts the flow of bicycle infrastructure and creates a physical split between Project 1 and Project 2. The Town of Tonawanda Bicycle Master plan does not propose bikeways for Military Road. A long-term bikeway project for Military Road could connect these two projects in the future.

Figure 4.27 Military Rd. to Ontario St.



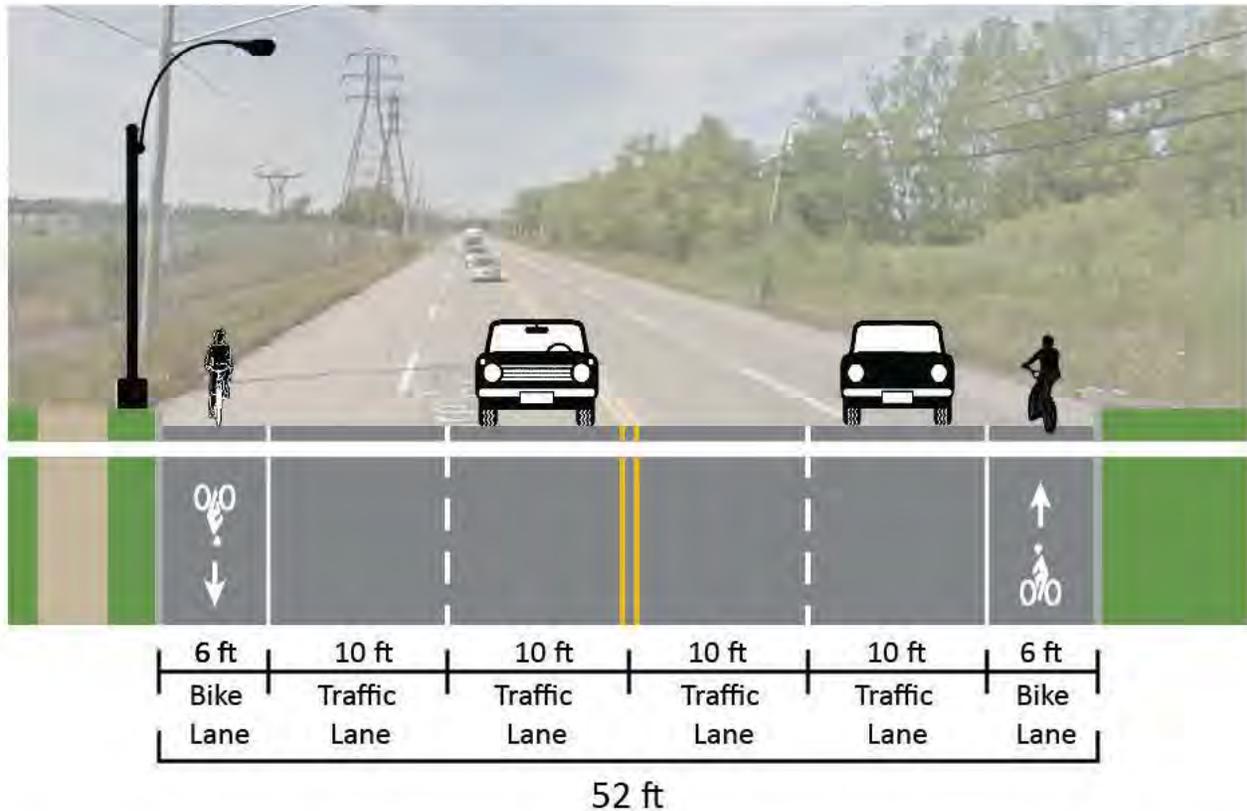
This portion of the street is directly west of Military Rd. and is 1,000 feet (0.2 mi) long. There are four traffic lanes each with a width of 10 feet. For cost-efficiency, this small transitional section of Kenmore Avenue will retain the four existing traffic lanes but shared lane markings will be added to indicate to motorists that bicyclists are users of the road. The existence of a railway bridge and the inclines on either side of the street would make any sort of street expansion too large of a cost for this project.

Figure 4.28 Ontario St. to UAW-GM Blvd



This section of the street is 0.6 miles long and adjacent land uses are mostly residential. The road is 38 feet wide in most places and includes on-street parking on the southwestern side of the street. In order to preserve these spaces for parking the streets center line will be repainted to reduce the northeastern side of the street to one lane. Two lanes will remain on the southwestern side and space for parking will still be available. This road diet reduces this portion of the street from four lanes to three lanes each with a width of 10 ft. This provides space for an on-street bike lane on both sides of the street. The bike lane on the southwestern side will exist between the curb and the parking lane. This creates a seamless transition between bikeways to the north and south of this section and parked cars act as a buffer between cyclists and moving traffic.

Figure 4.29 UAW-GM Blvd. to Sheridan Dr.



This part of Kenmore Avenue is 0.55 miles in length and is 52 feet wide. The four existing lanes of traffic will be preserved but reduced each to a width of 10 feet. This provides 12 feet of space for on-street bicycle lanes. A painted bike lane with a width of six feet will be added to each side of the street. This bikeway section will terminate at Sheridan Drive and will connect to the existing Sherwood Greenway, an off-street path for bicycle use. This will provide direct access to the waterfront and the Riverwalk trail and will connect with proposed bikeway infrastructure along Sheridan Drive.

Figure 4.30 Ontario Street Roundabout



Kenmore Avenue, Ontario Street, and Dunston Avenue meet at the Ontario Street Roundabout. This roundabout is a wide, single-lane area. The entry speed limit for vehicles is 10 MPH and adjacent streets have speed limits of 30 MPH. According to the American Association of State Highway and Transportation Officials (AASHTO), single-lane roundabouts with low speed limits are easy to navigate for bicyclists. Bike lanes adjacent to or within a roundabout present a danger to bicyclists. They encourage cyclists to travel along the outer edges of a roundabout and create conflicts with motorists at entrances and exits (AASHTO).

At this location, Kenmore Avenue will merge into the roundabout with shared lane markings. These shared lane markings will continue until on-street bike lanes begin north of the roundabout. The entire roundabout will be shared between motorists and bicyclists. Yield signage and on-street markings will be added to the two locations where vehicles enter the roundabout. On-street bike lanes with a width of 4 feet will begin where Kenmore Avenue resumes. A tapered area of 40 feet with dotted lines will guide cyclists to transition from the shared-lane area into on-street

designated lanes. This minimal redesign of the roundabout will provide an opportunity to add vegetation to islands and enhance the streetscape.

Pros

- Proposals of painted on-street lanes and markings are feasible
- Project considers cost-efficiency
- Extra space available for bicycle lanes
- Low speed limits
- Street width expansions are not necessary
- Can be implemented within a short period of time
- Provides east-west connectivity from Tonawanda's neighborhoods to the waterfront

Cons

- On-street bike lanes in this project do not have buffers
- Small section of shared-lane markings does not optimize safety
- Military Road separates Project 1 from Project 2
- Kenmore Avenue is the Town of Tonawanda's border with the City of Buffalo and would require a high level of coordination and compromise between municipalities

Cost Estimates

1. Planning and Design	\$ 143,887.01
Service	Total
Drainage and Utilities Surveying	\$ 47,962.34
Detailed Engineering Design	\$ 95,924.67
2. Capital Improvement Cost	\$ 959,246.72
Item	Total
	\$ 449,166.72
Bicycle lane	\$ 46,440.00
Pavement extension	\$ 58,080.00
Curb removal	\$ 112,326.72
Curb replacement	\$ 232,320.00
	\$ 23,680.00
Bicycle lane	\$ 22,360.00
Shared lane	\$ 1,320.00
	\$ 10,780.00
Pavement marking symbols	\$ 4,640.00
Crosswalk marking	\$ 6,140.00

	\$	166,500.00
Colored pavement	\$	6,300.00
Pavement marking symbols	\$	1,160.00
Crosswalk marking	\$	18,420.00
Bicycle signal head	\$	1,870.00
	\$	309,120.00
Pavement marking symbols	\$	1,160.00
Crosswalk marking	\$	12,280.00
3. Annual Facility Maintenance Cost	\$	73,224.00
Service		Total
Buffered Bicycle Lane	\$	71,904.00
Shared lane marking	\$	1,320.00
Plowing	\$	-

Parker Blvd Project [0.45 miles]

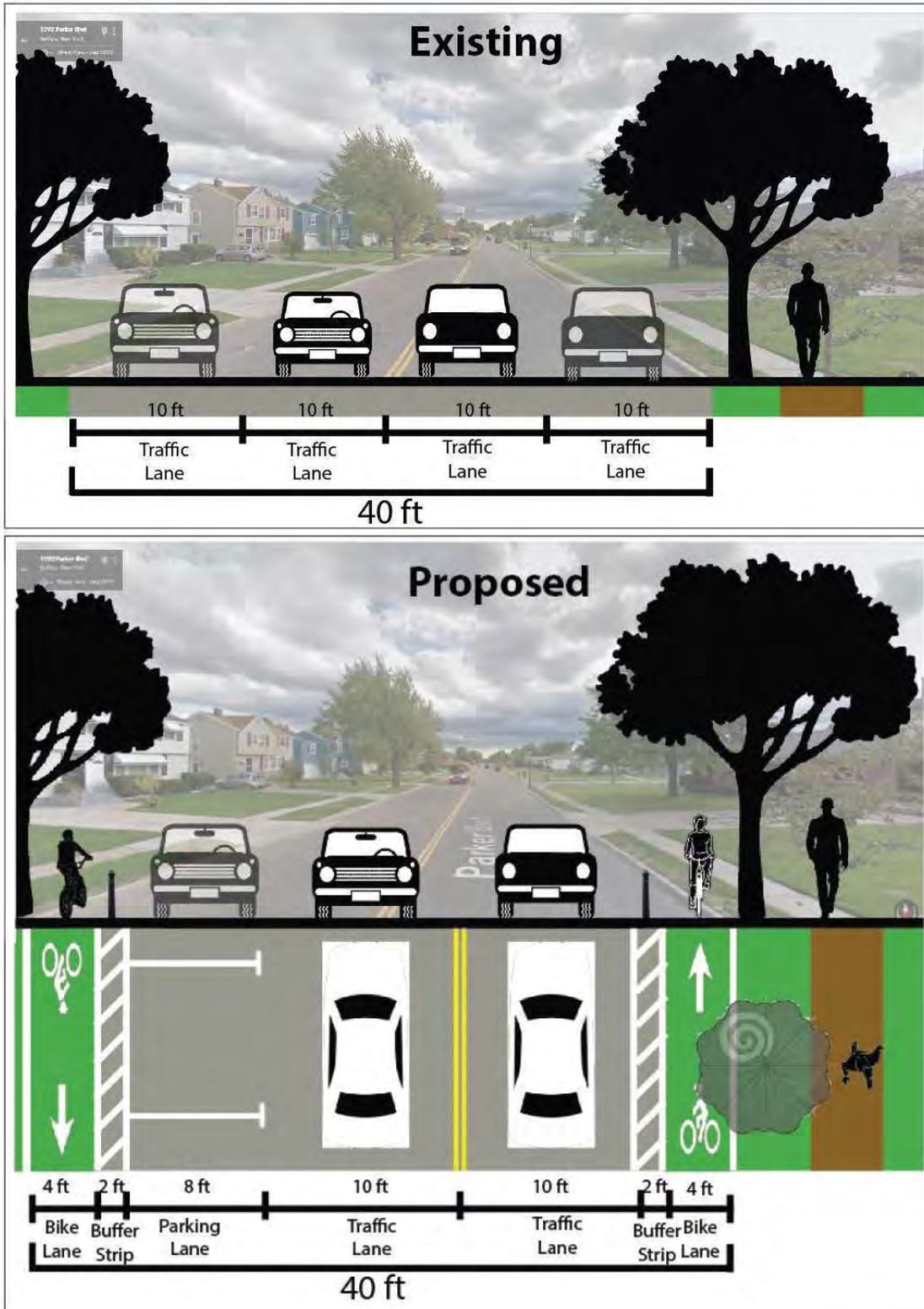
Figure 4. 31 Parker Blvd Project Map



Figure 4.32 Parker Ave

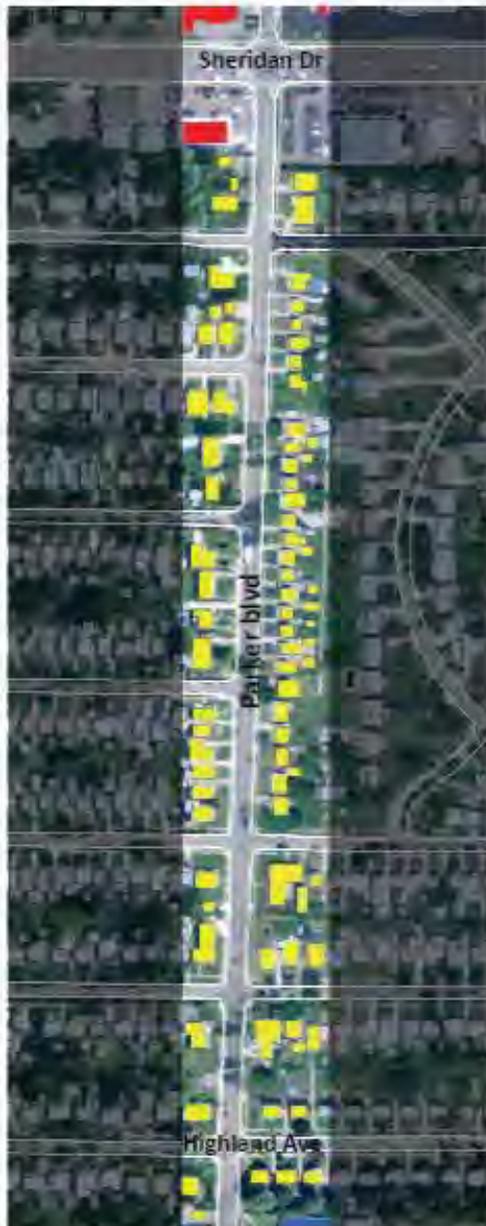
Parking on one side of the street could remain after adding the on-street bike lanes and buffer areas, since this segment has a width of 40 feet, which is eligible for meeting these bikeway design elements by reducing one travel lane. Only 3.5% of respondents to the survey suggested that Parker Blvd. should be prioritized for bicycle infrastructure, but this number could be misleadingly low because the survey was conducted mostly in the western part of the town. In conversations with Town Engineer Jim Jones, Parker Blvd. was identified as a street that residents had asked about improving bike infrastructure. Because of the community assets along Parker Blvd. and the north-south connection it provides, it is still an important part of the bicycle network of the town.

Figure 4. 33 Existing and Proposed Bicycle Plan for Parker Blvd



- 4' Bicycle Lane
- 2' Buffer
- 8' Parking Spaces
- 20' traffic lanes
- Candlestick bollards added for additional safety between parked vehicles and bicyclists

**Figure 4.34 Parker Blvd
Surrounding Land Use**



Existing Condition

This segment of Parker Blvd is a two-way corridor with 2 traffic lanes in each side. There is one parking lane on one side of the street with designated handicap parking available.

Pros

- The proposed bike paths width is 4 ft with a buffered strip of 2 ft. in each side of the street.
- The parking lane is located on the outside of one bicycle lane to protect bicyclists from flowing traffic.
- This protected bicycling lane will also improve the safety of drivers when opening and closing the car's doors.
- The width of parking lanes would be reduced to 8 ft.
- The width of the traffic lanes will decrease to 10 ft since this section is located in residential area which has a relatively low traffic going through.

Cons

- The 1 sided parking area is not fully used due to the lower surrounding residential density, and residents can use their driveway to park cars.
- The road is not highly effective used in terms of the concern above.

But generally speaking, being benefited from the lower traffic neighborhood environment, and the integrated combination to Lincoln Park bike path loop, the bicyclists can be provided with a more comfortable and safe biking experience in this district.

Priority 3 Proposals

Proposals	Estimated Cost
BRIGHTON RD	
Planning and Design	\$ 57,838.65
Capital Improvements	\$ 385,591.00
Annual Maintenance	\$ 9,636.12
PRIORITY 3 INTERSECTIONS	
Planning and Design	Costs included in previous proposals
Capital Improvements	
Annual Maintenance	
SAWYER AVE	
Planning and Design	\$ 89,575.50
Capital Improvements	\$ 597,170.00
Annual Maintenance	\$ 73,224.00

Brighton Rd Project [0.72 miles]

Figure 4.35 Brighton Rd Project Map

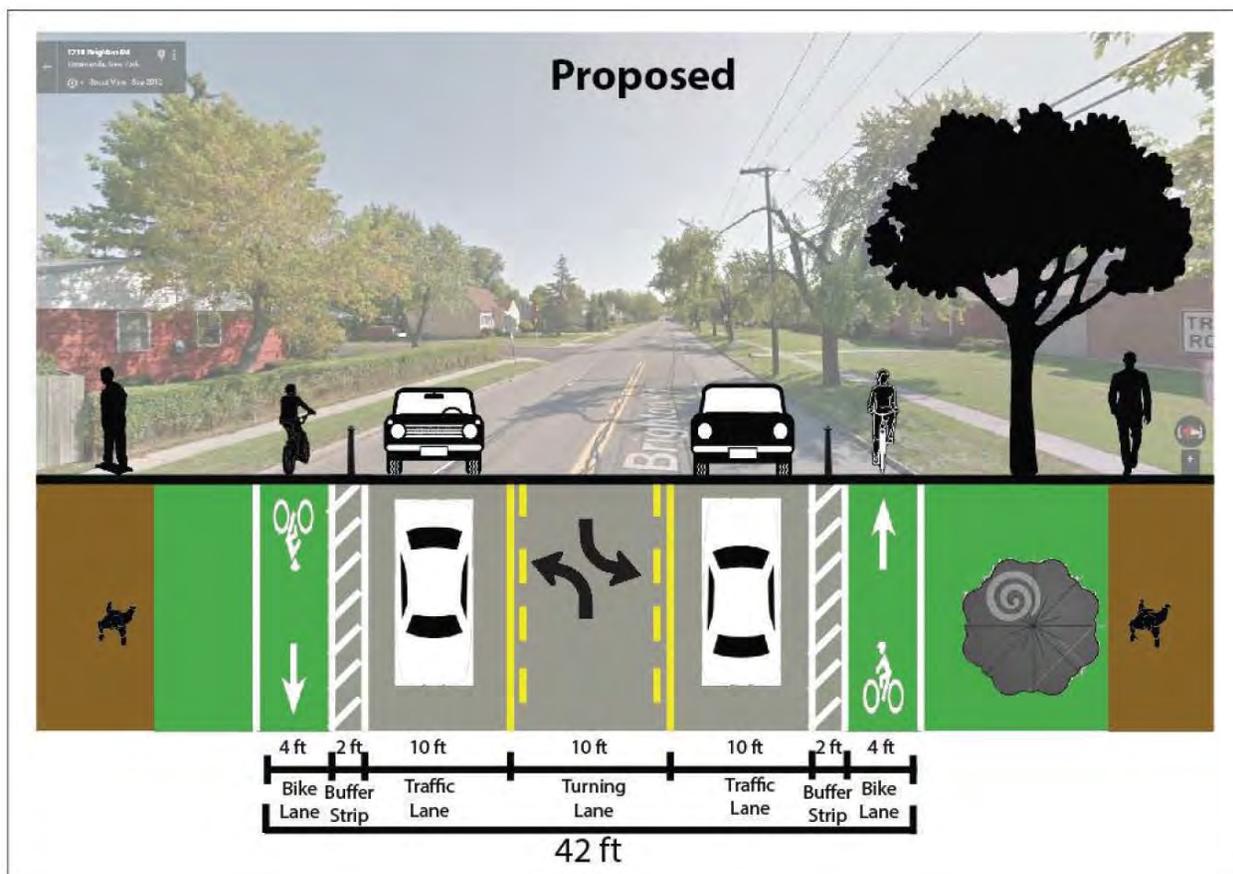
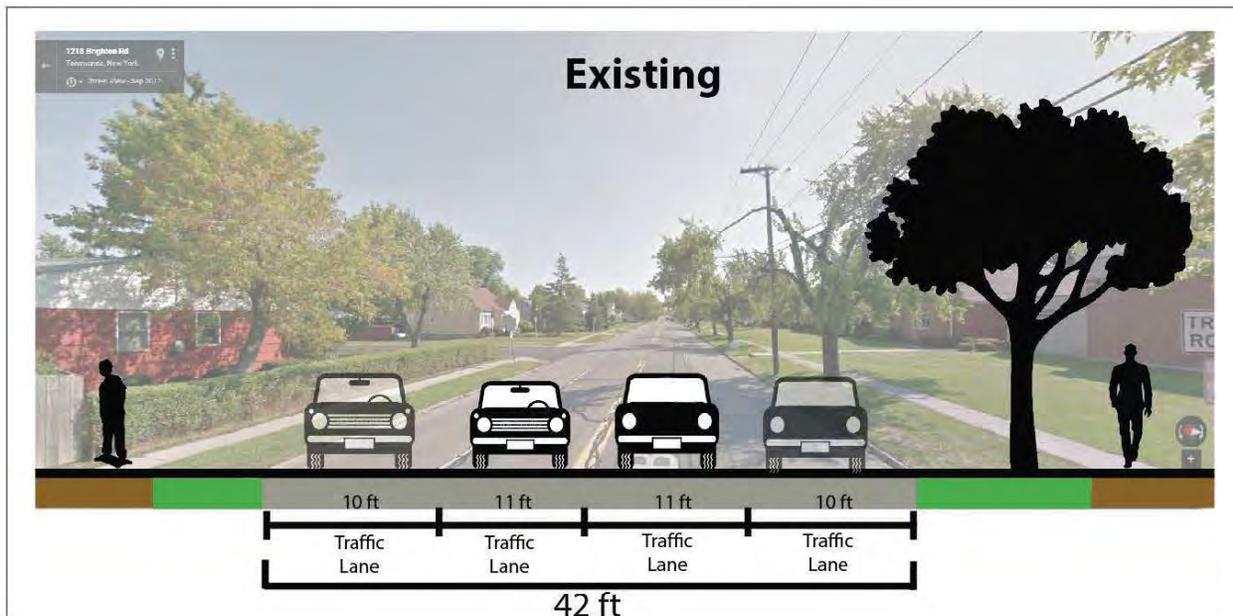


Add protected bike lane (with buffer zone 2' width between bike lane and travel lane); transfer four travel lanes to two travel lanes with one turning lane in the middle. Brighton Rd provides an important east-west bikeway connection Town of Tonawanda to University at Buffalo North Campus. Currently, this section of the street (see Figure 4.36) consists of a wide 4 lane (42 feet), 0.72 mile length road, with a speed limit of 35 miles per hour. The proposed design includes a two-way cycle track on the west side of the road, which would effectively narrow the vehicle travel lanes. This would help to calm traffic along the corridor and improve traffic flow along this section of Brighton Ave, also would be encourage students living in the Town commuting to UB's daily travel behavior since the improvement of bicycling-friendly traveling environment.

Figure 4.36 Brighton Rd. Surrounding Land Use



Figure 4.37 Existing and Proposed Bicycle Plan for Brighton Rd.



This segment of Parker Blvd is a two-way corridor with 2 traffic lanes in each side. There is no parking lanes available for the major function of Brighton Rd. This section is to connect west parts to east parts, and residential driveways are sufficient for parking demands.

Between Parker Blvd. and Niagara Falls Blvd, this proposed infrastructure provides an alternative east-west route through town and connects residential parts of the Town to the commercial areas along Niagara Falls Blvd. This bikeway project potentially encourage more students to ride bikes to the University at Buffalo - North campus and also will expand access to Town of Amherst. We propose the following:

- 4' Bicycle Lane
- 2' Buffer
- 20' Traffic lanes
- 10' Turning lane
- Candlestick Bollards added for additional safety between parked vehicles and bicyclists

Pros

- By reducing four travel lanes into two travel lane plus a 10 ft. turning lane, the protected bike lanes are added along both sides of the street.
- The proposed bike paths width is 4 ft. with a buffered strip of 2 ft. in each side of the street.
- The parking demands from surrounding residents can be meet by the sufficient driveway space between Brighton Rd and residential houses.
- This protected bicycling lane will provide a safe biking environment.
- The width of the traffic lanes will decreased from 11 ft. to 10 ft. Because this section is located in residential area which has a relatively low traffic going through.

Cons

- With the future development of this district, and the population increase, there might be a higher parking demands for on-street parking in this neighborhood.
- One possible solution for this problem is transfer the protected bike lane into shared bike lane both for bikers and pedestrians.

Generally speaking, being benefited from the lower traffic Brighton neighborhood environment, this segment of proposed bike lane will contribute to a more bicycle-friendly area in east Tonawanda and increase connection to University at Buffalo and Town of Amherst.

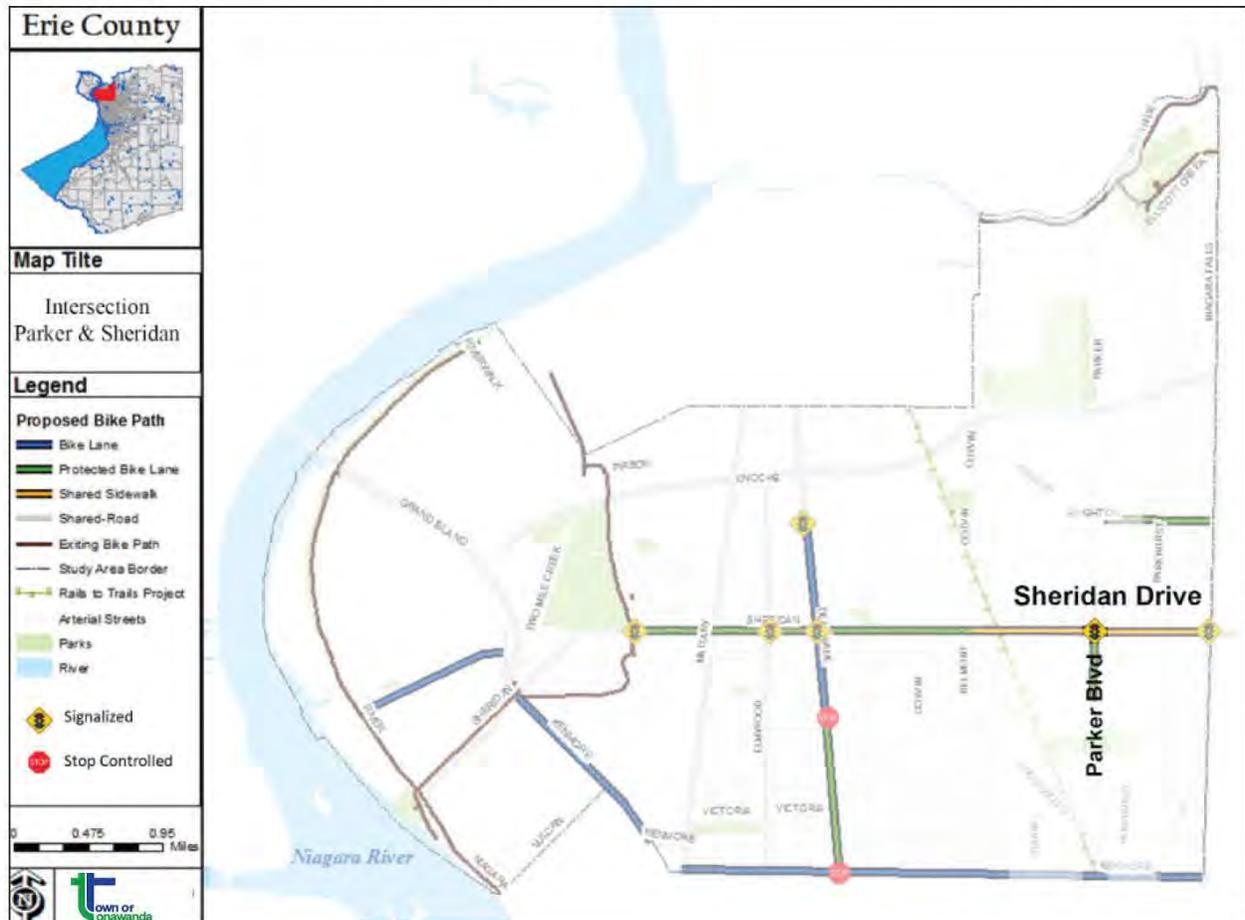
Cost Estimates

1. Planning and Design		\$ 57,838.65
Service		Total
Drainage and Utilities Surveying	\$	19,279.55
Detailed Engineering Design	\$	38,559.10

2. Capital Improvement Cost		\$ 385,591.00
Item		Total
		\$ 104,191.00
Bollards		\$ 84,524.00
Buffered Bicycle Lane		\$ 19,667.00
		\$ 111,000.00
Colored pavement		\$ 6,300.00
Pavement marking symbols		\$ 1,160.00
Crosswalk marking		\$ 18,420.00
Bicycle signal head		\$ 1,870.00
		\$ 170,400.00
Colored pavement		\$ 3,600.00
Pavement marking symbols		\$ 1,160.00
Crosswalk marking		\$ 12,280.00
3. Annual Facility Maintenance Cost		\$ 9,636.12
Service		Total
Buffered Bicycle Lane		\$ 6,654.12
Plowing		\$ 2,982.00

Parker Blvd & Sheridan Dr. Intersection

Figure 4.38 Parker Blvd & Sheridan Dr. Intersection Project Map



Crash data analysis suggested that the intersections of side streets along Sheridan Dr. were the locations of several crashes. At this intersection we connect one proposed north-south bike route with the main east-west bike route. It is expected that bicycle traffic will increase if these proposed routes are built, therefore improvements to the intersection are essential to reduce the probability of crashes.

- Protected Style Bicycle Intersection
- 4 Signals to Control Bicycle Flow
- Repainted Pedestrian Crosswalks
- 3 Vehicular Traffic Lanes in Parker Blvd
- Designated guided right turn lanes

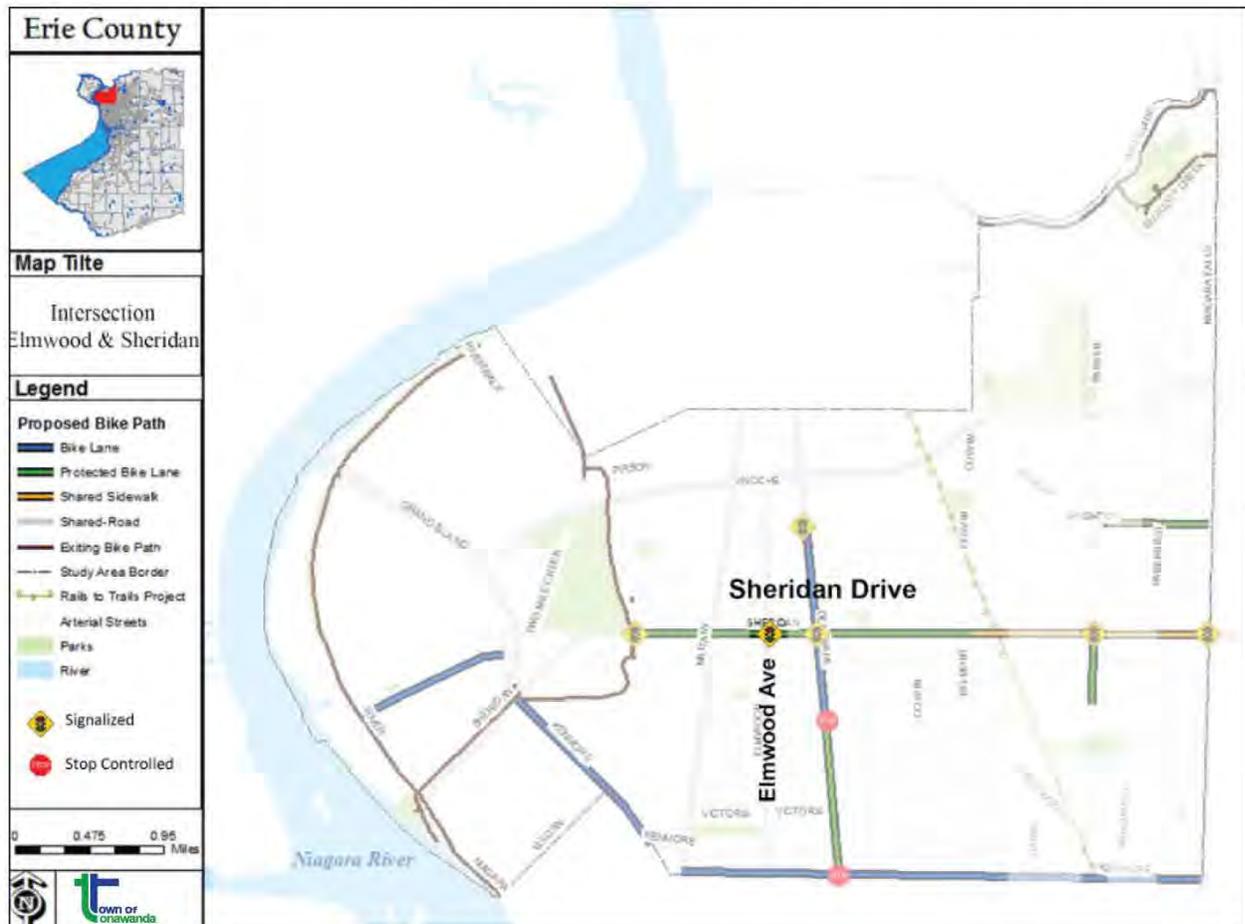
Figure 4.39 Proposed Intersection for Parker Blvd & Sheridan Dr.



The proposed bike lanes on this proportion of Sheridan Drive is "Shared Bike Lane" on the sidewalks. The proposed bike lanes on Parker Blvd are two way on-street protected bike lanes located in the residential area. The recommendation is to provide a smooth and safe crossing environment for bikers. The intersection has been designed with white arrows for bike lanes across the intersection. There would be two bicycle signals at the intersection, one on either side coordinated to direct bicyclists through traffic.

Elmwood Ave. at Sheridan Dr. Intersection

Figure 4.40 Elmwood Ave. at Sheridan Dr. Intersection Project Map



This intersection was selected because it also connects an east-west bike route with a north-south one. It too must be improved to more safely handle the anticipated increased ridership. The proposed bike lanes on this portion of both Sheridan Drive and Elmwood Ave are two-way, on-street protected bike lanes. Additionally, the surrounding land use along Sheridan Drive and Elmwood Ave are for commercial use - small business and retail. The recommendation is to provide a smooth and safe crossing environment for bikers.

The intersection has been designed with white arrows for bike lanes across the intersection. There would be two bicycle signals at the intersection, one on either side coordinated to direct bicyclists through traffic.

- Protected Style Bicycle Intersection
- 4 Signals to Control Bicycle Flow
- Repainted Pedestrian Crosswalks
- 4 Vehicle Traffic Lanes in Elmwood Ave
- Designated guided right turn lanes

Figure 4.41 Proposed Intersection For Elmwood Ave. at Sheridan Dr.



Tonawanda Waterfront Discussion

Figure 4.42 Map of Bikeway Proposal on Sawyer Ave.



Figure 4.43 Sawyer Ave. Plan

The Tonawanda Waterfront is ranked as a 3rd priority for additional upgrades in the Town of Tonawanda bicycle network. The entire portion of Sawyer Avenue from River Road to the west to Kenmore Avenue to the east is recommended for the addition of bicycle improvements. The proposal includes a 5ft. wide bike lane on the 0.3 miles of Sawyer Avenue from River Road to Mildred Street and a 5ft. wide shared use (bicyclist and pedestrian) path on Sawyer Avenue from Mildred Street to Kenmore Avenue. This plan also includes designs for the following intersections: Sawyer Avenue and River Road; Sawyer Avenue and Kenmore Avenue. Adding both bike lanes and a shared use path would allow for better connectivity with existing trails (Riverwalk, 2 Mile Creek Greenway, and Sherwood Greenway) as well as east-west connectivity with the rest of the Town of Tonawanda and surrounding municipalities. Along with the bicycle infrastructure are

proposed painted crosswalks at the intersection of River Road and Sawyer Avenue as well as the intersection of Kenmore Avenue and Sawyer Avenue. Additional improvements to the Waterfront include new trails and a Rail with Trail corridor.

The Sawyer Avenue project starts from River Road to the west and ends at Kenmore Avenue to the east. The length of this corridor is 1 mile with a speed limit of 25 mph. The area is predominantly an industrial thoroughfare with some residential land uses mixed in. Sawyer Avenue is managed by the Town of Tonawanda and Erie County highway departments. This corridor has a two-way traffic configuration (1 lane on each side) without designated spots for parking.

There are two sections along Sawyer Avenue. The first section (River Road to Mildred Street) is 0.3 mile in length, has sidewalks on one side of the street, and does not have any designated parking spots. This section also has two 10ft. wide traffic lanes (one in each direction). The second section (Mildred Street to Kenmore Avenue) is 0.7 mile in length, has no sidewalks, and does not have any designated parking spots. Like the first section, this section has two 10ft. wide traffic lanes (one in each direction).

The proposal for Sawyer Avenue and the rest of the Tonawanda Waterfront is premised on improving connectivity among existing trails as well as east-west connectivity with the rest of the town and neighboring municipalities. Improving connectivity may help to bring more visitors and tourism to the Tonawanda Waterfront. The map on the next page illustrates the proposed bicycle infrastructure and intersection treatment facilities.

Figure 4.44 Proposed Intersection For River Rd. and Sawyer Ave.



Figure 4.45 Proposed Intersection For Sawyer Ave. and Kenmore Ave.

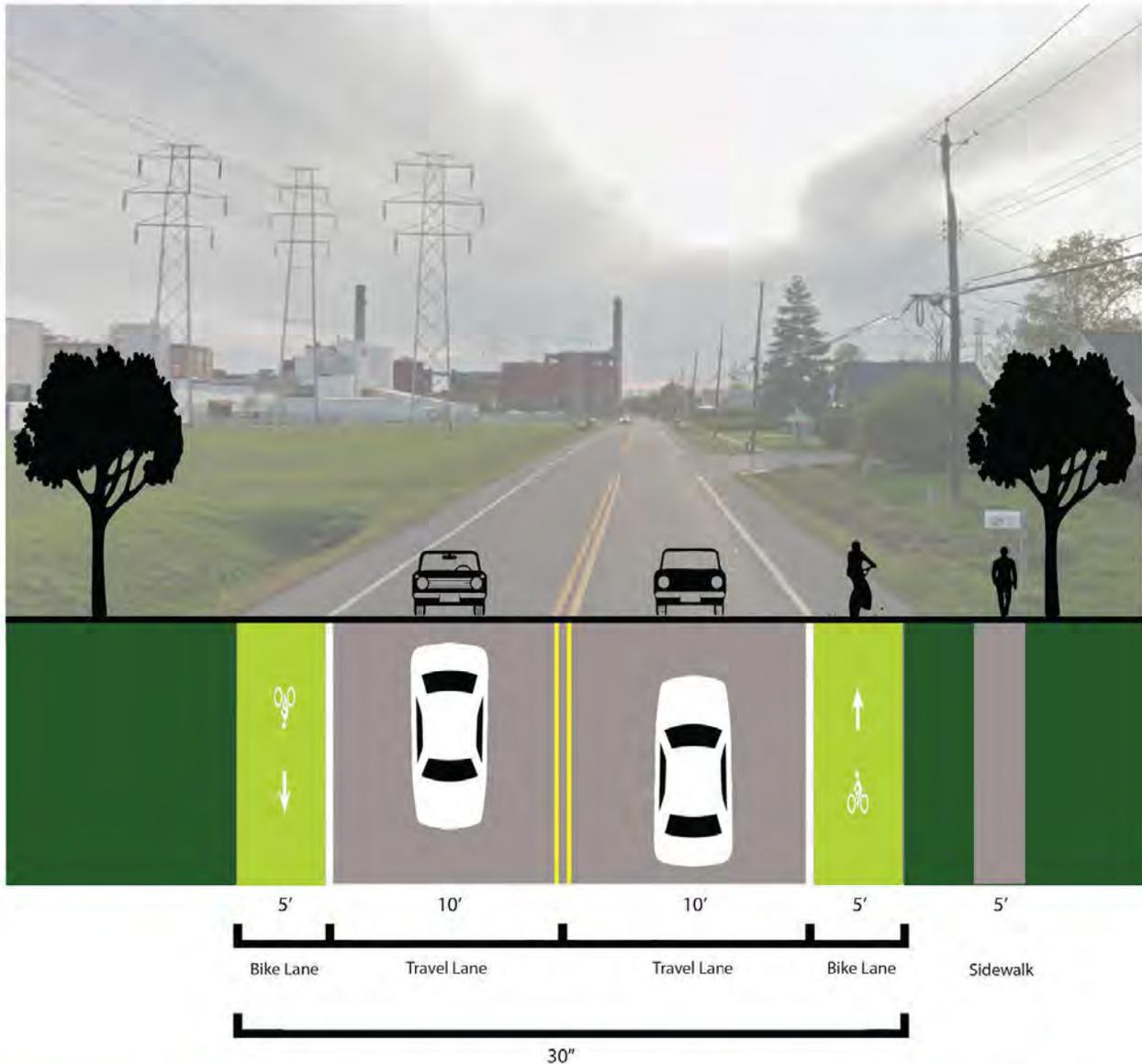


According to Figure 4.43 Map, there are two defined projects along Sawyer Avenue. The first project is for a 5ft. wide, 0.3-mile long bike lane on both sides of the street from River Road to Mildred Street. The second project is for a 5ft. wide, 0.7 mile long shared use (pedestrian and/or bicyclist) path on both sides of the street from Mildred Street to Kenmore Avenue.

On-road Bicycle Facilities Projects

Figure 4.46 illustrates the two sections of Sawyer Avenue with distinct proposed street configurations.

Figure 4.46 Proposed Bicycle Plan for Sawyer Avenue between River Rd. and Mildred St.



Proposed Bicycle Plan for Sawyer Avenue between River Rd. and Mildred St.

Existing Condition

This 0.3-mile section of Sawyer Avenue from River Road to Mildred Street has sidewalks but does not have any existing bicycle infrastructure. This section is a two way traffic corridor with one traffic lane on each side (width = 10ft each). There are no designated lanes for parking or turning in this section of the street.

Proposed Condition

The proposed bicycle facility improvements on this 0.3-mile portion begin at River Road to the west and end at Mildred Street to the east. The proposed bike lane width is 5ft and bike lanes will be placed on both sides of the street. The width of the existing traffic lanes will remain the same at 10ft each.

Proposed Shared Use Path for Sawyer Avenue between Mildred Street and Kenmore Avenue

Existing Condition

This 0.7-mile section of Sawyer Avenue from Mildred Street to Kenmore Avenue does not have sidewalks or any existing bicycle infrastructure. This section is a two way traffic corridor with one traffic lane on each side (width = 10ft each). There are no designated lanes for parking or turning in this section of the street.

Proposed Condition

The proposed bicycle facility improvements on this 0.7-mile portion begin at Mildred Street to the west and end at Kenmore Avenue to the east. The proposed shared use path width is 5ft and shared use paths will be placed on both sides of the street. The width of the existing traffic lanes will remain the same at 10ft each.

The proposed bike lane on Delaware Ave. will start at the intersection of River Road and Sawyer Avenue and will end at the intersection of Mildred Street and Sawyer Avenue. Both River Road and Sawyer Avenue are two-way predominantly industrial corridors. There would be 5ft. wide bike lanes on each side of Sawyer Avenue in this section. In order to connect the existing bike trails (especially the Riverwalk Trail) with Sawyer Avenue, this intersection has been designed with painted crosswalks for bicyclists and pedestrians to safely travel across the intersection. These painted crosswalks help to increase the visibility and safety for bicyclist, pedestrians, and drivers.

The proposed shared use path on Delaware Ave. will start at the intersection of Mildred Street and Sawyer Avenue and end at the intersection of Kenmore Avenue and Sawyer Avenue. Both Kenmore Avenue and Sawyer Avenue are two-way predominantly industrial corridors. There would be 5ft. wide shared use paths on each side of Sawyer Avenue in this section. In order to connect the existing bike trails (especially the 2 Mile Creek Greenway Trail and Sherwood Greenway Trail) with Sawyer Avenue, this intersection has been designed with painted crosswalks for bicyclists and pedestrians to safely travel across the intersection. These painted crosswalks help to increase the visibility and safety for bicyclist, pedestrians, and drivers.

Cost Estimates

1. Planning and Design	\$ 89,575.50
Service	Total

Town of Tonawanda 2015 Bicycle Master Plan

Drainage and Utilities Surveying	\$ 29,858.50
Detailed Engineering Design	\$ 59,717.00
2. Capital Improvement Cost	\$597,170.00
Item	Total
	\$ 492,400.00
Bicycle lane	\$ 17,200.00
Colored pavement	\$ 475,200.00
	\$ 38,170.00
Colored pavement	\$ 1,800.00
Pavement marking symbols	\$ 1,160.00
Crosswalk marking	\$ 9,210.00
Bulb-out	\$ 26,000.00
	\$ 26,280.00
Colored pavement	\$ 1,800.00
Pavement marking symbols	\$ 2,900.00
Bicycle signal head	\$ 1,870.00
	\$ 40,320.00
Pavement marking symbols	\$ 1,160.00
Crosswalk marking	\$ 12,280.00
3. Annual Facility Maintenance Cost	\$ 73,224.00
Service	Total
Buffered Bicycle Lane	\$ 71,904.00
Shared lane marking	\$ 1,320.00
Plowing	\$ -

Trails with Utilities (Electric, Pipeline, and Rail Corridors) Analysis

Within the Town of Tonawanda (and specifically within the waterfront area), there exists the opportunity to incorporate bike trails along existing utility corridors such as electric or pipeline corridors. These sorts of trails have been established in other parts of the county. Numerous legal, operational, and environmental issues need to be solved before establishing a trail and this section aims to discuss some of the solutions.

The Rails to Trails Conservancy provides a tool box with guidelines on negotiating with a utility to allow construction of a trail. Often the trail must be constructed in a way that it does not interfere with the safe operation or maintenance and construction by the utility company. This can be complicated since many utility corridors already have above and below ground lines installed with each requiring different construction activities. Construction activities may require closing of the trail at certain times and this could cause disruptions in the bicycle network if the utility trail is a main component.

Figure 4.47 Electric and Pipeline Transmission in Waterfront in Town of Tonawanda

Challenges along Utilities Corridor

Legally, utility companies may be hesitant to allow citizens on their property due to the potential for injury or death from accidents relating to electric lines or natural gas pipelines. Rarely, due to weather conditions or equipment failure, accidents do occur and they have the potential to harm people nearby. Additionally, the utility company may not own the corridor, but instead just have an easement for their lines which does not allow additional uses such as a trail.

Environmentally, challenges to building a trail in a utility corridor include the need to build bridges or culverts to cross wetlands or streams, the use of pesticides and herbicides to control vegetation growth, and the loss of wildlife habitat are some of the most common. Overhead electric lines also emit electromagnetic fields (EMFs). Some people may be wary of this and the potential link to certain health problems, but research has shown that transient users of trails along electric transmission line corridors have limited exposure to EMFs and should not be negatively impacted by them.

Above ground utilities have very little impact on wetlands and streams during their operation. The lines are able to span sensitive resources. However, a bike trail would need to cross those areas. Additional permits and costs would be associated with these types of projects.

Often, utility companies are allowed to use chemicals such as herbicides to maintain the vegetation along utility corridors so the vegetation does not interfere with the safe operation of the line. These chemicals must be applied by a certified individual in order to limit exposure. Users of the trail should be made aware of any applications of chemicals to limit their exposure as well.

Utility corridors often provide habitat for wildlife. If some of the corridor is used for a trail, this area will be lost as wildlife habitat. Most utility corridors may not look like prime habitat, but some species do prefer the open spaces created by utility corridors. Also, using impermeable surfaces for the trail can change storm water flows within the corridors.

Opportunities along Utilities Corridor

Despite these challenges, trails along utility corridors have been successfully established in many places and have become important links in bicycle networks. The Town of Tonawanda is also at a crucial point with the potential closing of the NRG Huntley Generating Power Plant. It remains to be seen how this will impact the electric transmission line corridors that are common in the western and northern parts of the town. It is possible that one or more of these lines may be decommissioned as well or other changes in the electric grid may render lines unnecessary. The Town should work with National Grid to identify potential locations for a trail network within the utility corridors.

The proposed bicycle facilities in the Tonawanda Waterfront area are categorized as a priority 2 in the needs assessment. The 1-mile stretch of Sawyer Avenue from River Road to the west and Kenmore Avenue to the east is a predominantly industrial corridor with some residential areas mixed in. Two different styles of bicycle infrastructure were proposed given that one section of the street has sidewalks while the other does not. Painted crosswalks were proposed at the two intersections (River Road and Sawyer Avenue; Kenmore Avenue and Sawyer Avenue) in order to facilitate safer crossings for bicyclists and pedestrians as well as improve visibility of them for motorists. In addition, the bike lanes and shared use paths are designed to encourage bicycling in and visitation to the Tonawanda Waterfront area. The proposed bicycle infrastructure seeks to not only improve bicyclist and pedestrian safety, but also to improve connectivity among the existing trail network and municipalities. This area is fortunate to have several existing bike trails, but is in need of better connectivity among them. Ultimately, this proposal intends to promote more awareness of and visitation to the Tonawanda Waterfront by making it a desirable place to bike.

APPENDIX

DESIGN GUIDELINES

CONCERNED REGULATIONS AND DESIGN REFERENCES

Accommodation of bicyclists must be considered at the earliest phases of every project, otherwise there may be significant impacts on project costs, schedule, right-of-way needs and highway geometrics. While FHWA policy (Code of Federal Regulations, Title 23, 652.5) requires that the safe accommodation of bicyclists should be given full consideration during the planning, design and construction phases of Federal-Aid highway projects, New York State Department of Transportation (NYSDOT) has determined that this policy also applies to 100% state funded projects.

The design of a bicycle facility is critical to ensure its proper use and safety. Bicycle facilities should meet approved design standards as set forth by federal and state agencies. Under the United States Code Title 23, section 109 (o), States establish their own design standards for projects not on the National Highway System. It is noteworthy that FHWA supports a flexible approach to bicycle and pedestrian facility design, as expressed in the memorandum on this subject, from 2013.

Standards defined in the Manual on Uniform Traffic Control Devices (MUTCD) are required for all public streets and highways in the United States. This document is published by the FHWA under Code 23 of Federal Regulations (CFR), Part 655, Subpart F. It is heavily focused on pavement markings and vertical signage, presenting requirements for bicyclist traffic control devices in Part 9. The "Guide for Development of Bicycle Facilities" published by the American Association of State Highway and Transportation Officials (AASHTO), was used as an informational document for the development of the sign and marking recommendations in Part 9 of MUTCD.

Section 9A.02 of MUTCD states: "the absence of a marked bicycle lane or any of the other traffic control devices discussed in this Chapter on a particular roadway shall not be construed to mean that bicyclists are not permitted to travel on that roadway". It also states that "all signs, signals, and markings, including those on bicycle facilities, should be properly maintained to command respect from both the motorist and the bicyclist. When installing signs and markings on bicycle facilities, an agency should be designated to maintain these devices".

The NYSDOT Highway Design Manual is the primary source of guidance for detailed highway design in New York State. Chapter 17 includes the design of bicycle facilities, providing minimum design standards for department projects. The document highlights the need to assess the cost effectiveness of all proposed facilities, discouraging dedicated bike lanes on low speed or low volume roadways such as select local streets. On the other hand, it remarks that there is a potential decrease of safety, convenience and travel efficiency as traffic volumes and speeds increase on shared roadways. The manual also presents a formal definition for constituents of the bicycle mobility system:

Bicycle facilities - A general term denoting improvements and provisions made by public agencies to accommodate or encourage bicycling. These include bicycle parking facilities and shared roadways.

Bicycle lane - A portion of a roadway which has been designated by striping, pavement markings and signing for the preferential use of bicyclists.

Bicycle path - A path that is physically separated from motor vehicle traffic by an open space or barrier and may be in the highway right-of-way or an independent right-of-way. The bicycle path serves a transportation use (a recreational loop trail located entirely within a park is an example of a path that does not serve a transportation use). An existing bicycle path is severed or dislocated by the work of a Department project. The bicycle path is an essential environmental requirement mitigating impacts of a Department project. The bicycle path is being constructed at another agency's request and that agency has made the funding arrangements. Providing a bicycle path would be more economical than providing facilities for bicycling on a roadway and assurance can be obtained that the bicycle path will be maintained year round. The potential for use by others (pedestrians, etc.) should also be considered during design to assure the facility will adequately accommodate the intended use as a bicycle path.

Bicycle route - A system or network of roads, streets, paths or ways that are open to bicycle travel and that have been designated by the jurisdiction(s) having authority with appropriate directional and informational route markers (with or without a specific bicycle route number). Established bicycle routes should provide for continuous routing between logical termini.

Shared roadway - A roadway which may or may not be designated and marked as a bicycle route, but which is open to both bicycle and motor vehicle travel and upon which no bicycle lane is designated. Examples may include roads with wide curb lanes and roads with shoulders.

Wide curb lane - The right-most through traffic lane that has a minimum usable width of 3.6m.

In order to provide more detailed instructions to municipalities while designing bicycle facilities, NYSDOT endorses the following informational documents:

- "A Policy on Geometric Design of Highways and Streets" (2011), published by AASHTO to guide public streets out of the National Highway System.
- "Designing Walkable Urban Thoroughfares: A Context Sensitive Approach" (2010), published by the Institute of Transportation Engineers (ITE) and Congress for the New Urbanism to provide guidance for the design of walkable urban thoroughfares in places that currently support the mode of walking and in places where the community desires to provide a more walkable thoroughfare.

- "Guide for the Development of Bicycle Facilities" (2012), published by AASHTO and providing information on how to accommodate bicycle travel and operations in most riding environments.
- "Urban Bikeway Design Guide" (2012), published by National Association of City Transportation Officials (NACTO), which presents state-of-the-practice solutions to create complete streets that are safe and enjoyable for bicyclists.
- "Urban Street Design Guide" (2013), also published by NACTO, which presents the toolbox and the tactics cities use to make streets safer, more livable and economically vibrant.

While Chapter 183 of the Tonawanda Town Code regulates the design and construction of sidewalks, at this moment there are no local ordinances guiding the design and implementation of bicycle facilities.

BICYCLE FACILITIES

BICYCLE FACILITY SELECTION CRITERIA

Confidence, skills and physical aspects of bike riders varies. There are three types of bicycle users:

- Advanced bicyclist
- Basic or less confident adult riders
- Child riders

In order to design appropriate bicycle facilities for all of the aforementioned groups, the following criteria have been addressed: the skill level of users, barriers, crash reduction, directness, accessibility, aesthetics, safety, stops, maintenance, pavement surface quality, traffic operation, intersection conditions, cost and funding, state and local law ordinances.

BICYCLE FACILITY CLASSIFICATION

This section borrows design elements from the “Urban Bikeway Design Guide” (2012) by NACTO, “A Policy on Geometric Design of Highways and Streets” (2011) by AASHTO, and “Cost for Pedestrians and Bicyclists Facilities” (2013) by UNC Highway Safety Research Center.

Bike Lanes

Bicycle lanes are a section of roadway that are designated by special marking, paving or signage. They are exclusively for use of the bicyclists.

- A minimum of 4 feet width is essential for the bike lane.
- If the traffic speed is high a minimum of 5 feet is appropriate to increase safety.
- Together the parking lane, bike lane, and optional buffer should be 14.5 feet.
- Bike lanes are useful on streets with more than 3,000 motor vehicles per mile.
- Bike lanes are helpful on streets with speed limits over 25 mph.
- If the speed limit is over 35 mph there should be a designed separation between riders and motor traffic, such as left-sided bike lanes, buffered bike lanes, or cycle tracks.
- The average cost for bike lanes is \$133,170 per mile.



Figure 5.1: Bike Lane
Source: <http://www.utne.com/>

Buffered Bike Lane

Buffered bike lanes are bike lanes with a designated buffer space that separate them with the travel lane or parking lane.

- Used on streets with high motor vehicle travel speed or excess lane width.
- Lane should be marked with two solid white lines with diagonal hatching that are 2 feet wide or more.
- At intersections the buffer changes to a dashed line.
- Green paint can be used at the entrance of each block.
- The cost for one-way protected bike lane (single direction) is \$6.50 per foot or \$34,320 per mile. For one-way protected bike lanes with two directions, the cost is around \$13.00 per foot or \$68,640 per mile.



Figure 5.2: Buffered Bike Lane in Portland, OR
Source: NACTO

Cycle Track

Cycle tracks are separated paths on-street.

- Appropriate for streets with parking lanes.
- Enhances feelings of safety and confidence.
- Used on streets with high volumes of bicycles and motor vehicles.
- Diagonal white crosshatch markings are used for separating vehicle parking by 3 feet.
- Desired width of cycle tracks is 6.5 feet to 13 feet.
- To prevent pedestrians from entering into the cycle zone, sidewalk curbs and furnishing can be used.
- Green colored pavement may be used.
-



Figure 5.3: Cycle Track in San Francisco, CA
Source: NACTO

Raised Cycle Track

This type of cycle track is vertically separated from motor vehicle traffic. It can be used for both one-way and two-way riding.

- Minimizes maintenance costs due to limited motor vehicle wear.
- Used along higher speed streets with fewer driveways and cross streets.
- It can be separated by raised curb, street furnishings, low vegetation or a parking lane.
- The slope edge should be 4:1.
- For one-way raised cycle tracks, width is 6.5 feet.
- Minimum width at intersections is 5 feet.
- Minimum of 3 feet for parking buffer.
- Two-stage turn boxes need for making turn.



Figure 5.4: Raised Cycle Track in Cambridge, MA
Source: NACTO

- The cost is about \$89,470 per mile, but varies depending on materials used.

Two-Way Cycle Track

Two-way cycle tracks are separated cycle tracks used for riding in both directions. Two-way bicycle lanes on one side of a highway are not acceptable because they promote riding against the flow of motor vehicle traffic. This practice is specifically identified as an illegal operation of a bicycle in the "Vehicle and Traffic Law". The cost is about \$170,000-\$300,000 (per mile).



Figure 5.5: Two-Way Cycle Track in Chicago, IL

Source: <http://www.gjel.com/>

Wide Curb Lane

Wide curb lanes are shared-use facilities where motor vehicles and bicycles are both accommodated in a wider travel lane.

- Curb lane should have, at a minimum, 11.9ft of usable pavement; 13.9 ft. is recommended.

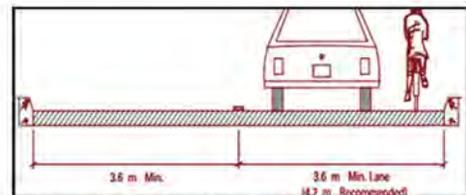


Figure 5.6: Section of the Wide Curb

Source: NYSDOT

Bike Boxes

These are a distinguished area at the beginning of the traffic lane at an intersection. Bike boxes enhance safety and visibility of queuing traffic during red signals.

- Used at signalized intersections with high riders and vehicle volumes.
- More useful for intersections with high tendency for bicycles to make the left-turn or for motorists to make right-turns.
- Hold queuing bicyclists 10-16 feet deep.
- Stop lines for motor vehicles are required.
- Green colored pavement marking should be used.
- A "Yield to Bikes" sign should be placed before reaching the intersection.
- Bike boxes can be used with a specific bicycle signal phase.
- Cost is from \$5,000 to \$6,000 per box installation.



Figure 5.7: Bike Box in Baltimore, MD

Source: NACTO

Intersection Crossing Markings

Bicycle pavement markings on intersections define bike path boundaries. They increase safety and delineate

where bicyclists should cross.

- Appropriate for signalized intersections or streets with bike lanes or cycle tracks.
- Dotted lines with minimum of 6 inches with 2-6 foot spacing.
- Crossing line should match the width and position of the leading bike lane.
- Increased visibility with colored pavement.
- Cost is \$53 per arrow.



Figure 5.8: Intersection Crossing Markings

Source: National Association of Transportation

Two-Stage Turn Queue Boxes

This type of design elements brings more safety for bicyclists at multi-lane signalized intersection from a right side cycle track or right turns from a left side cycle track.

- Appropriate for signalized, multi-lane intersections.
- For streets with high speed and volumes of cyclists and vehicles.
- Help cyclists navigate.
- Green colored paving markings should be used.
- It should be placed within the protected area (on-street parking lane) and in the cross-street to increase visibility.
- A bicycle signal to present the bicycle entrance can be installed.



Figure 5.9: Turn Box in Portland, OR

Source: NACTO

Median Refuge Island

This is a protected space located in the center of the streets for bicycle and pedestrian crossings.

- For streets with high volume and speed and high volume of bicycle crossings.
- Appropriate with protected cycle tracks.
- The width is 10 feet or greater.
- It should be wide enough to accommodate two-way bicycle traffic.
- The length should be greater than 6 feet.
- The height should be 6 inches.
- An angled cut-through (45 degrees) should be used for bicyclists facing oncoming traffic.
- The edge of the raised median should be outlined by retroreflective white or yellow material.



Figure 5.10: Median Refuge Island in Portland, OR

Source: NACTO

- Increase visibility by lighting.
- For signalized intersections push buttons or other detection methods can be used.
- Cost is between \$15,000 to \$30,000 per 100 feet.

Bicycle Signal Heads

An electronically powered traffic control device should be used with an existing signal to split signal phases for an intersection. Bicycle signal heads enhance safety for bicyclists.

- Place in a visible location.
- A complimentary “bicycle signal” sign should be attached to signal.
- Add markings for the parts of the intersection where bicycle travel path is unusual.



Figure 5.11: Bicycle Signal Head
Source: NACTO

Active Warning Beacon

Warning signs at signalized intersections or mid-block crosswalks. These can be activated manually or passively.

- Useful for high-volume pedestrian crossings.
- Can be used in intersections where signals are not warranted.
- For streets with low level of conflict between vehicles and riders.
- Can be installed on median islands.
- Cost \$475 (pavement marking of loop only) or \$1,000-\$2,000 (for loop detector installation).



Figure 5.12: Active Warning Beacon
Source: bikeportland.org

BIKEWAY SIGNING & MARKING

Bikeway signing and marking includes all the infrastructure and treatments with the purpose of highlighting the presence of a bicycle facility.

Bike Route Wayfinding

Wayfinding signage guides bicyclists to find their destinations along bike pathways. Signs should be installed in advance of all turns or decision points. There is no standard color for bicycle wayfinding signage. Costs are around \$30 to \$150 per sign plus installation.

- **Confirmation Signs:**
 - Inform bicyclists and motorists about the location of bikeway.
 - Signs can present destination, distance, and time.
 - Signs can be located every ¼ to ½ mile on off-street facilities and every 2 to 3 blocks along bicycle facilities.

- **Turn Sign:**
 - Turn signs presents the appropriate place for making turns.
 - Signs can show destinations and arrows.

- **Decision Sign:**
 - Illustrates the designated bike route to access a specific destination.
 - Shows destination, arrows, distances and travel times.
 - Should be located near the side of an intersection.



Figure 5.12 Confirmation Signs
Source: NACTO



Figure 5.14: Turn Signs
Source: NACTO



Figure 5.15: Decision Signs
Source: NACTO

COLORED BIKE FACILITIES

This design element increases the visibility, illustrates potential areas of conflict, and fosters the priority of bicyclists.

- Can be located within bike lanes, cycle tracks, turning lanes, or intersections.
- The color green should be used.
- A dashed pattern can be used for merging areas with dashed bicycle lanes.
- A marking can be used as a complementary element.
- The cost of painting is about \$11.50 a square foot. Concrete pavers are \$15 a square foot. Pattern imprint is \$100 a square foot.



Figure 5.16: Colored Bike Facilities
Source: NACTO

Shared Lane Markings

Shared lane markings (SLMs) or “sharrows” are used for roads which are shared between both automobiles and bicycles. SLMs illustrate bicyclist movement and positions.

- This element is used in low traffic roads with speeds less than 25 mph.
- Used to fill a gap in an otherwise continuous bike path.
- Help to transition bicyclists from across traffic lanes.
- Used to direct riders in turns.
- It should be located in the center of bike lane.
- Markings are white with background color of green to enhance visibility.
- Cost is \$100.

Bicycle Parking

Bicycle parking contains bicycle racks (fixed), bicycle lockers (for securely store a single bike), and bicycle stations. The cost for bicycle racks are between \$64 to \$540 per unit. The average cost for covered bicycle parking ranges from \$1,280 to \$2,140.



Figure 5.17: Vancouver, British Columbia

Source: <http://daily.sightline.org/>



Figure 5.18: Columbus, OH

Source: <http://www.columbusunderground.com/>

Curb Ramp

Curb ramps enhance the level of accessibility between the sidewalk and the roadway for disabled people and bike riders. Cost ranges from \$12 to \$37.

Fence or Gate

This element assists in separating pedestrians and cyclists from roadways. The cost of the fence is about between \$363 to \$552 per linear foot, while the cost of the gate ranges from \$500 to \$1500.



Figure 5.19: Charlotte, NC

Source: <http://charmec.org/>

Lighting

In order to increase the safety of the roadway for multi-users, lighting improvements will be needed. Costs can range depending on the manufacturer, the roadway width and specific project factors. Overall, the average range for streetlights is between \$310 to \$13,900.

STREET TYPOLOGIES

A “complete street” is a public space “designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities” (Smart Growth America). Streets should accommodate all users (pedestrians, bicyclists, motorists, public transportation and private cars) appropriately and safely. In order to design streets, we should address architectural and aesthetic issues and see the street function as an eco-system.

BOULEVARD AND MAJOR COMMERCIAL THOROUGHFARES

Ex: Niagara Falls Blvd, Sheridan Drive.

Boulevards are major streets. They have an expansive medians and wide sidewalks. They are prioritized for higher volume traffic operation. They do not have on-street parking. Parking accesses are separated from traffic lanes with an optional element in order to reduce delays and conflicts.

COMMERCIAL CORRIDORS

Ex: Elmwood Ave. & Delaware Ave.

Neighborhood commercial streets such as Elmwood Ave. and Delaware Ave. are vibrant streets. Short-time parking and loading take place in these streets. In addition, access to commercial land uses should be addressed in the design.



Figure 5.20: San Francisco, CA

Source: Google Maps

RESIDENTIAL THOROUGHFARES

Ex: Eggert Rd. & Delaware Rd.

Residential thoroughfares are adjacent to residential land uses. Pedestrians, bicyclists, and automobile are accommodated equally in this type of streets. They are appropriate for low volume and low speed traffic operation.



Figure 5.21: Vancouver, British Columbia

Source: Google Maps

RESIDENTIAL STREET

The volume and traffic speed is low in residential streets. All of the users have equal rights of use. Therefore, this type of streets should function as the shared road. The design elements should assist in increasing safety while reducing the speed of vehicles.



Figure 5.22: Vancouver, British Columbia

Source: Google Maps

OFF-ROAD TRAIL

Bicycle Trails are designed and prioritized for riders. Also by adding some design elements, they can be utilized for pedestrians. Motor vehicles are prohibited to use these trails.



Figure 5.23: Off-Road Trail in Florida

Source:

<http://www.pinellascounty.org/trailgd/>

INTERSECTION TYPOLOGIES

The design of intersections should be modified accordingly when on-street bicycle lanes and/or off-street bicycle paths enter an intersection. Even in streets with bicycle facilities, cyclists are often at the mercy of their fate when at intersections. While meticulously designed to avoid conflicts between car traffic coming and going to different directions, intersections often do not consider cyclist safety as a priority and they are where most accidents happen involving cyclists. The following principles were the guidelines to the definition of the typologies of intervention in Tonawanda.

- Reduction of conflict between bicyclists, as well as other vulnerable road users, and motorized vehicles.
- Facilitation of eye contact and awareness with competing modes.
- Definition of a clear right-of-way for the different modes.
- Consideration of both queueing and merging maneuvers for bicyclists
- Use of elements such as color, signage, medians, signal detection and pavement markings according to the urban context.

BOTH STREETS CONTAINING DESIGNATED BIKE LANES



Figure 5.24: Dutch-Style Intersection in the United States

Source: City of Davis

When two streets counting with bike lanes meet at an intersection, a clear marked right-of-way connects the stretches in both streets. Bicyclists do not stop in the same line as cars, but continue and stop alongside pedestrian crossings. The separation between pedestrian and bicyclists paths must be visible. Cyclists making a right turn don't stop on red lights, what saves time. Bicyclists must be attentive to pedestrians.

ONLY ONE OF THE STREETS CONTAINS DESIGNATED BIKE LANES

When a designated bike lane crosses an intersection with a road with no bicycle infrastructure, there must be horizontal signage to clarify the adequate right-of-way. It must be also clear for cyclists that his path is shared with automobiles. The same solution can be applied to intersections between a dedicated bike lane and a shared road.



Figure 5.25: Bike Lane Markings

Source: NACTO

BOTH STREETS ARE SHARED BY CYCLISTS AND CARS

When both streets are shared by cars and bikes, it is important to have a different paving or color in the whole intersection area as a measure of traffic calming. Car drivers must be aware that bicyclists have priority over them. Cyclists must only slow down while cars stop. This solution is only adequate in parkways and residential streets with limited automobile traffic and low maximum speed of 30 miles per hour.



Figure 5.26: Assen, Netherlands
Source : www.aviewfromthecyclepath.com

TOWN OF TONAWANDA BICYCLE SURVEY

How often do you...

	Once or more a week	A few times a month	A few times a year	Never
Bike for recreation in the Town of Tonawanda	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bike to commute in the Town of Tonawanda	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bike to a transit stop/station	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walk for recreation in the Town of Tonawanda	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walk to commute in the Town of Tonawanda	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walk to a transit stop/station	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What are the biggest obstacles to biking in Town of Tonawanda?

	Very important	Somewhat important	Not important
Driving behavior	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of designated bike lanes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dangerous intersections	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conditions of roads/bike lanes/sidewalks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of secure bicycle parking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Long distances	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Weather	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't own a bike	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Would you bike on Sheridan Drive if there were the following bicycle facilities:

	Yes	No
Designated bike lanes (painted bike lane)	<input type="radio"/>	<input type="radio"/>
Protected bike lanes (physical barrier from cars)	<input type="radio"/>	<input type="radio"/>
Shared bike lanes (with cars)	<input type="radio"/>	<input type="radio"/>
As it is now	<input type="radio"/>	<input type="radio"/>

How would you get to the Town of Tonawanda waterfront...

	As it is now	If there were designated bike lanes
Bike	<input type="radio"/>	<input type="radio"/>
Car	<input type="radio"/>	<input type="radio"/>
Walk	<input type="radio"/>	<input type="radio"/>
I don't go	<input type="radio"/>	<input type="radio"/>

Which street should be prioritized when implementing bicycle facilities?

- Sheridan Drive
- Brighton Road
- Delaware Avenue
- Elmwood Avenue
- Niagara Falls Boulevard
- Kenmore Avenue
- Parker Boulevard
- Colvin Boulevard
- Englewood Avenue
- Other:

What is your age?

- 15 and under
- 16 to 24
- 25 to 34
- 35 to 44
- 45 to 54
- 55 to 64
- 65 and over

Do you feel safe biking in the Town of Tonawanda?

1 2 3 4 5

Very Unsafe Very Safe

TRANSPORTATION USE COMPARISONS

Figure 5.27: Comparison of Town of Tonawanda and City of Buffalo Ridership Trends

Subject	Town of Tonawanda	City of Buffalo
Workers 16 years & over	37,033	103,849
Male Population	18,141	51,436
Female Population	18,892	52,413
MEANS OF TRANSPORTATION TO WORK		
Car, truck, van	92.40%	77.20%
Drove alone	83.00%	67.30%
Carpooled	9.40%	9.90%
In 2-person carpool	7.50%	8.20%
In 3-person carpool	1.00%	1.00%
In 4-or-more person carpool	0.80%	0.70%
Workers per car, truck, or van	1.06%	1.07%
Public Transportation (Excluding Taxicab)	2.40%	12.00%
Walked	1.90%	6.30%
Bicycle	0.30%	1.10%
Taxicab, Motorcycle, or other means	1.10%	1.20%
Worked at home	1.80%	2.10%

Analysis: In the Town of Tonawanda more people depend on automobiles for transportation to work. There is also a -15.7% gap in the percentage of people who tend to drive alone in Tonawanda versus Buffalo. More residents within the City of Buffalo take public transit than residents of Tonawanda. This could be due to the urbanization of the City of Buffalo and its public transportation system. This could also be because less people depend upon the automobile when compared to Tonawanda. More people within the City of Buffalo bike as opposed to Tonawanda, possibly due to unsafe conditions in the town.

Figure 5.28: Comparison of Town of Tonawanda and Town of Amherst Ridership Trends

Subject	Town of Tonawanda	Town of Amherst
Workers 16 years & over	37,033	58,813
Male Population	18,141	30,217
Female Population	18,892	28,596
MEANS OF TRANSPORTATION TO WORK		
Car, truck, van	92.40%	90.50%
Drove alone	83.00%	83.30%
Carpooled	9.40%	7.20%
In 2-person carpool	7.50%	5.90%
In 3-person carpool	1.00%	0.80%
In 4-or-more person carpool	0.80%	0.50%
Workers per car, truck, or van	1.06%	1.04%
Public Transportation (Excluding Taxicab)	2.40%	2.10%
Walked	1.90%	3%
Bicycle	0.30%	0.30%
Taxicab, Motorcycle, or other means	1.10%	0.80%
Worked at home	1.80%	3.30%

Analysis: The Town of Amherst has a higher total population for workers 16 years and over by 21,780 people. In the Town of Tonawanda more people, by a -1.9% difference, depend on the form of an automobile as their means of transportation to work. In Tonawanda more people tend to carpool than they do in the Amherst by a -2.2 % difference. As far as bicycling is concerned, both municipalities shared the same percentage for riders. This could be due to some of the unsafe conditions and lack of biking infrastructure located within the two towns. This shows the work that needs to be done within the Town of Tonawanda for residents to have safe and useable biking conditions.

Figure 5.29: Town of Tonawanda and City of Tonawanda Ridership Trends

Subject	Town of Tonawanda	City of Tonawanda
Workers 16 years & over	37,033	7,276
Male Population	18,141	3,616
Female Population	18,892	3,660
MEANS OF TRANSPORTATION TO WORK		
Car, truck, van	92.40%	93.20%
Drove alone	83.00%	86.10%
Carpooled	9.40%	7.10%
In 2-person carpool	7.50%	6.20%
In 3-person carpool	1.00%	0.90%
In 4-or-more person carpool	0.80%	0.00%
Workers per car, truck, or van	1.06%	1.04%
Public Transportation (Excluding Taxicab)	2.40%	0.60%
Walked	1.90%	3.20%
Bicycle	0.30%	0.90%
Taxicab, Motorcycle, or other means	1.10%	1.20%
Worked at home	1.80%	0.90%

Analysis: The Town of Tonawanda has a higher total population of workers 16 years and over a 29,757-person difference. In the Town of Tonawanda more people, by a -0.8% margin, depend on automobiles as their means of transportation to work. There is also a -3.1% gap in the percentage of people who tend to drive alone in the Town of Tonawanda as opposed to the City of Tonawanda. More people within the City of Tonawanda bike in comparison to the Town of Tonawanda. This gap is -0.6% difference between the two municipalities. This shows the work that needs to be done within the Town of Tonawanda for residents to have safe and useable biking conditions.

Figure 5.30: Town of Tonawanda and City of North Tonawanda Ridership Trends

Subject	Town of Tonawanda	City of North Tonawanda
Workers 16 years & over	37,033	15,276
Male Population	18,141	7,711
Female Population	18,892	7,565
MEANS OF TRANSPORTATION TO WORK		
Car, truck, van	92.40%	94.10%
Drove alone	83.00%	86.30%
Carpooled	9.40%	7.80%
In 2-person carpool	7.50%	5.90%
In 3-person carpool	1.00%	0.80%
In 4-or-more person carpool	0.80%	1.10%
Workers per car, truck, or van	1.06%	1.05%
Public Transportation (Excluding Taxicab)	2.40%	0.40%
Walked	1.90%	2.20%
Bicycle	0.30%	0.30%
Taxicab, Motorcycle, or other means	1.10%	1.40%
Worked at home	1.80%	1.60%

Analysis: The Town of Tonawanda has a higher total population of workers 16 years and over by a -21,757-person difference. In the City of North Tonawanda more people, by a -1.7% difference, depend on the form of an automobile for transportation to work. As evident from the table, more residents within Tonawanda take public transit than residents of North Tonawanda. There is a difference of -2% in this data provided. There is a -0.3% gap according to the data provided by ACS. Both municipalities share the same percentage for riders. This could be due to some of the unsafe conditions and lacking off biking infrastructure located within the two urban areas.

Figure 5.31: Comparison of Town of Tonawanda and Town of Grand Island Ridership Trends

Subject	Town of Tonawanda	Town of Grand Island
Workers 16 years & over	37,033	10,302
Male Population	18,141	5,513
Female Population	18,892	4,789
MEANS OF TRANSPORTATION TO WORK		
Car, truck, van	92.40%	94.30%
Drove alone	83.00%	89.90%
Carpooled	9.40%	4.40%
In 2-person carpool	7.50%	3.30%
In 3-person carpool	1.00%	0.30%
In 4-or-more person carpool	0.80%	0.70%
Workers per car, truck, or van	1.06%	1.03%
Public Transportation (Excluding Taxicab)	2.40%	0.80%
Walked	1.90%	0.60%
Bicycle	0.30%	0.00%
Taxicab, Motorcycle, or other means	1.10%	1.00%
Worked at home	1.80%	3.30%

Analysis: The Town of Tonawanda has a higher total population for workers 16 years and over by a -26,731-person difference. In Grand Island more people, by a -1.9% marginal difference, depend on the use of an automobile as their primary means of transportation to work. The drive alone data provided by ACS was uneven. There was a -6.9% gap between Grand Island and Tonawanda respectively. As evident from the table, more residents within Tonawanda take public transit than residents of Grand Island. There is a difference of -1.6% in this data provided. There is evidence in the table illustrating how many people are more likely walk in Tonawanda versus Grand Island. There is a -1.3% gap according to the data provided by ACS. As far as bicycling is concerned, Grand Island had a zero percentage ridership of bicyclists.

Figure 5.32: Existing Bike Path

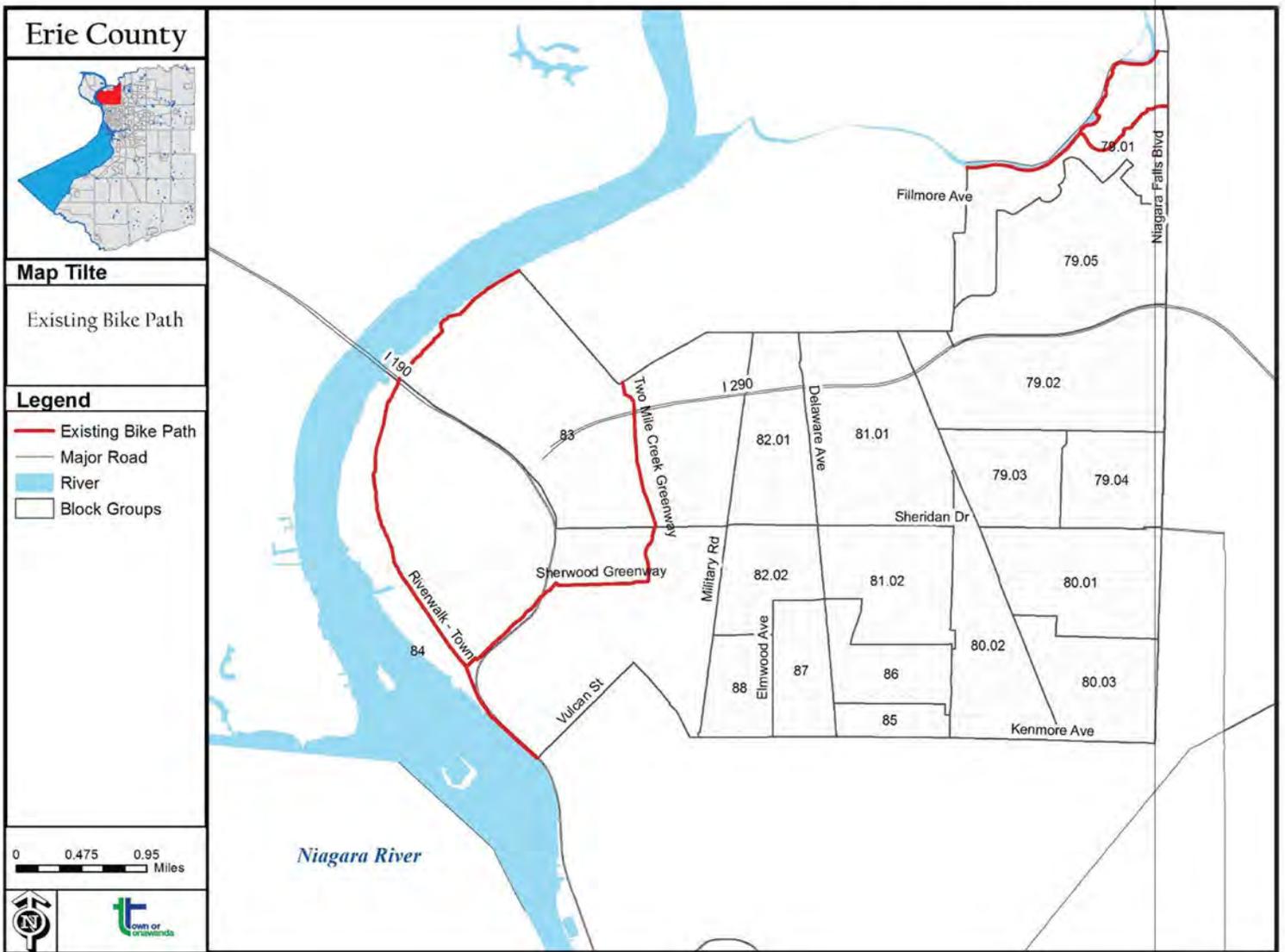


Figure 5.33: Proposed Bike Path

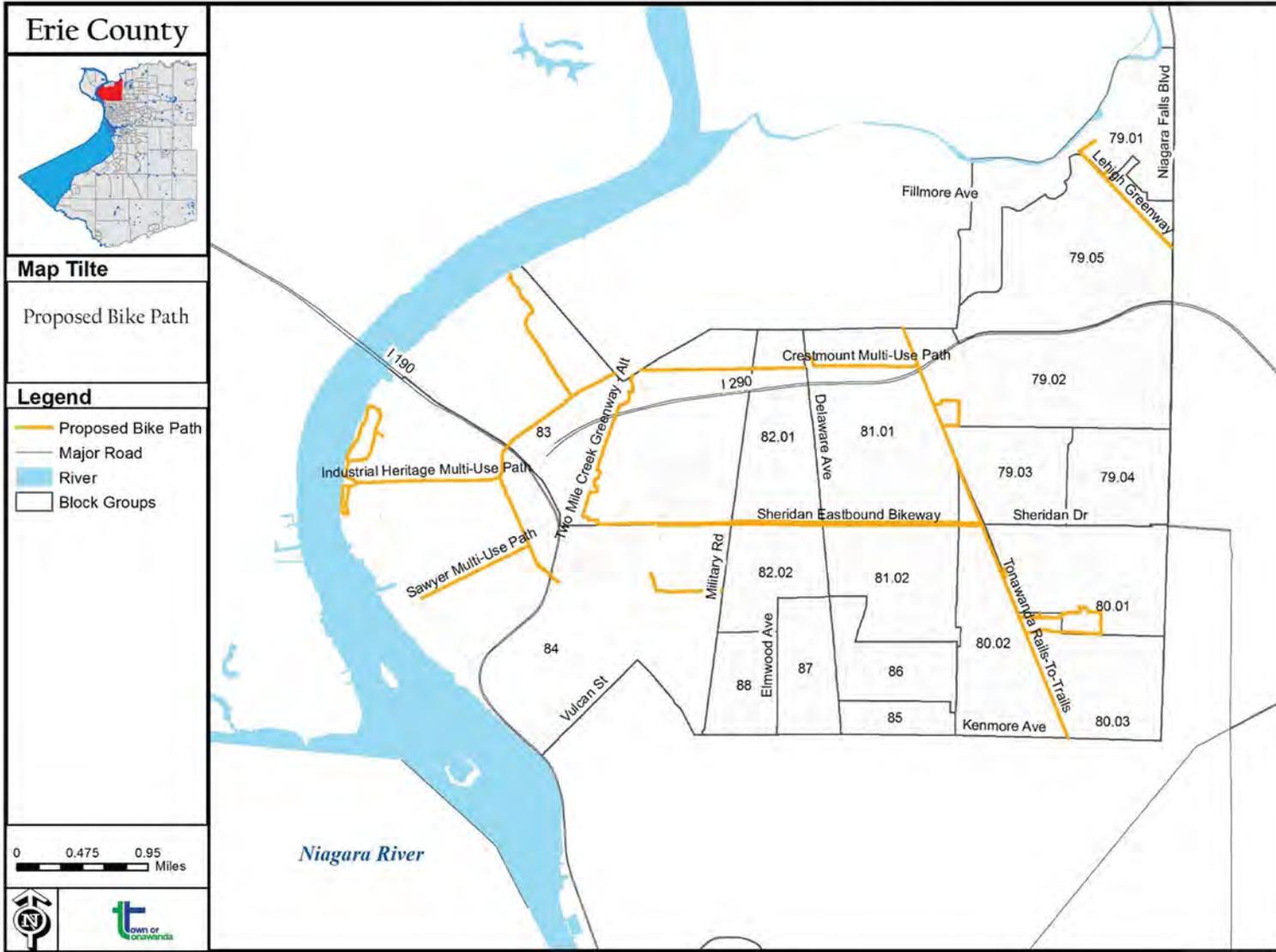


Figure 5.34: Existing & Proposed Bike Path

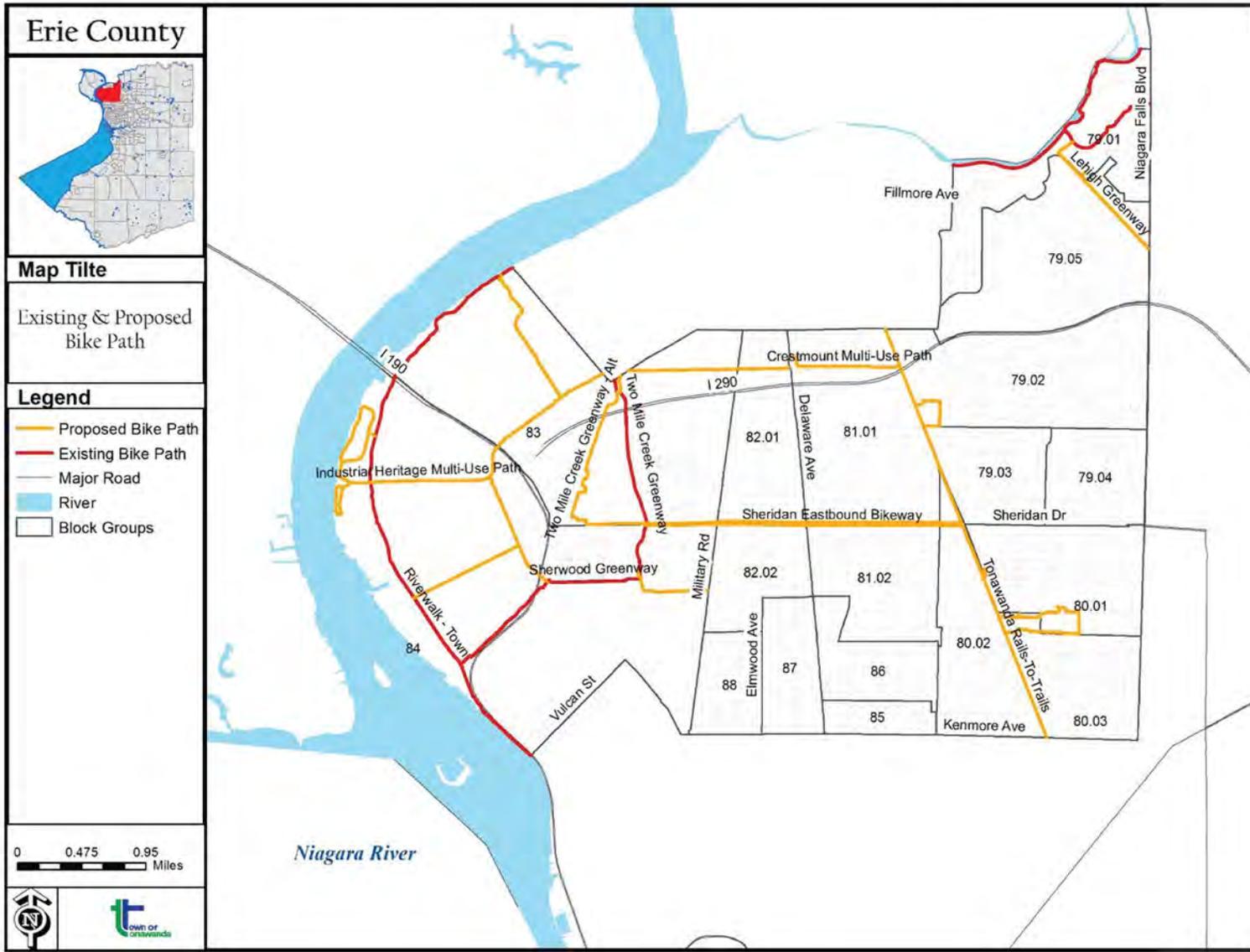


Figure 5.35: Household Income Block Group

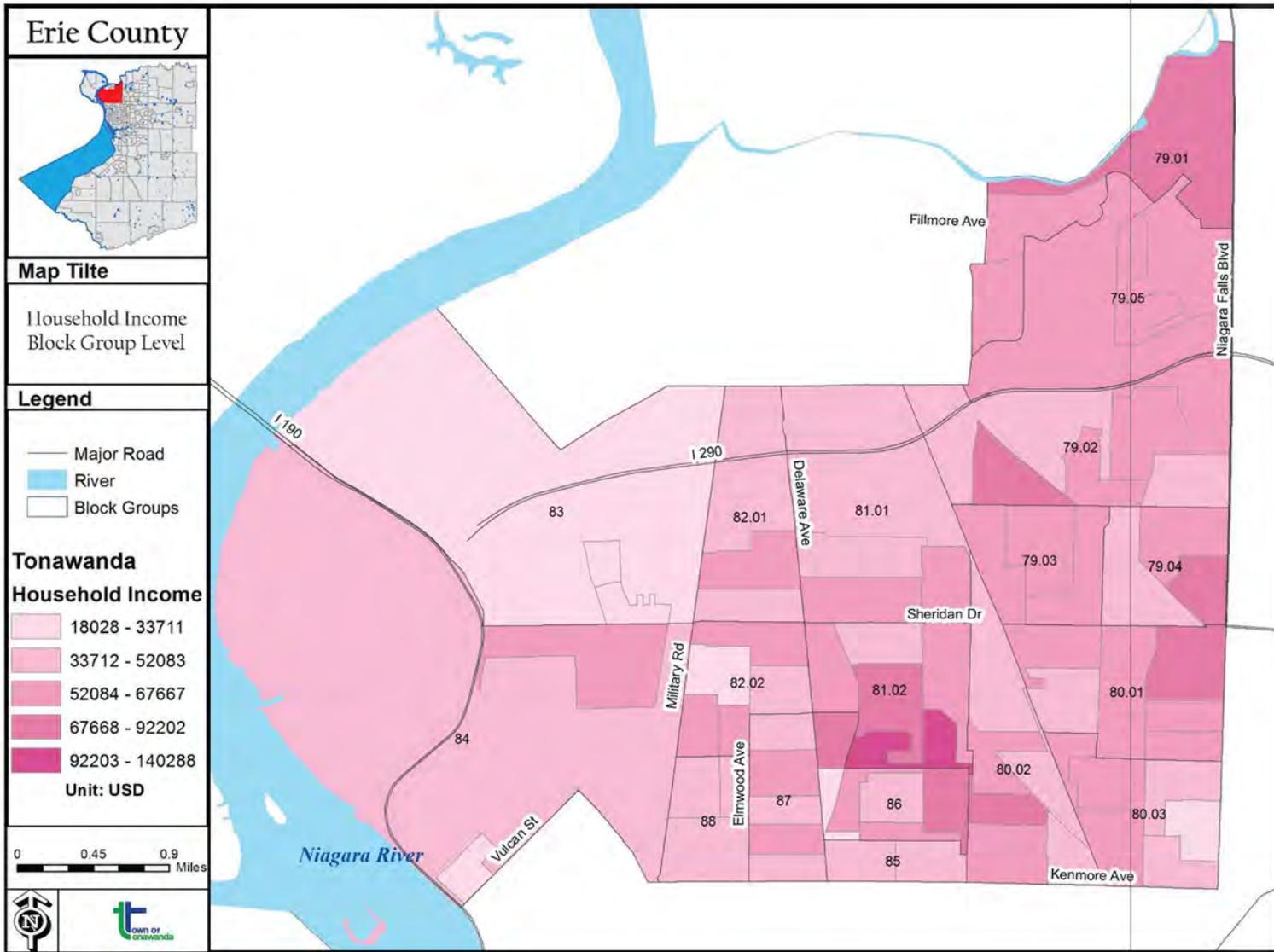


Figure 5.36: Age Rate Block Group Level

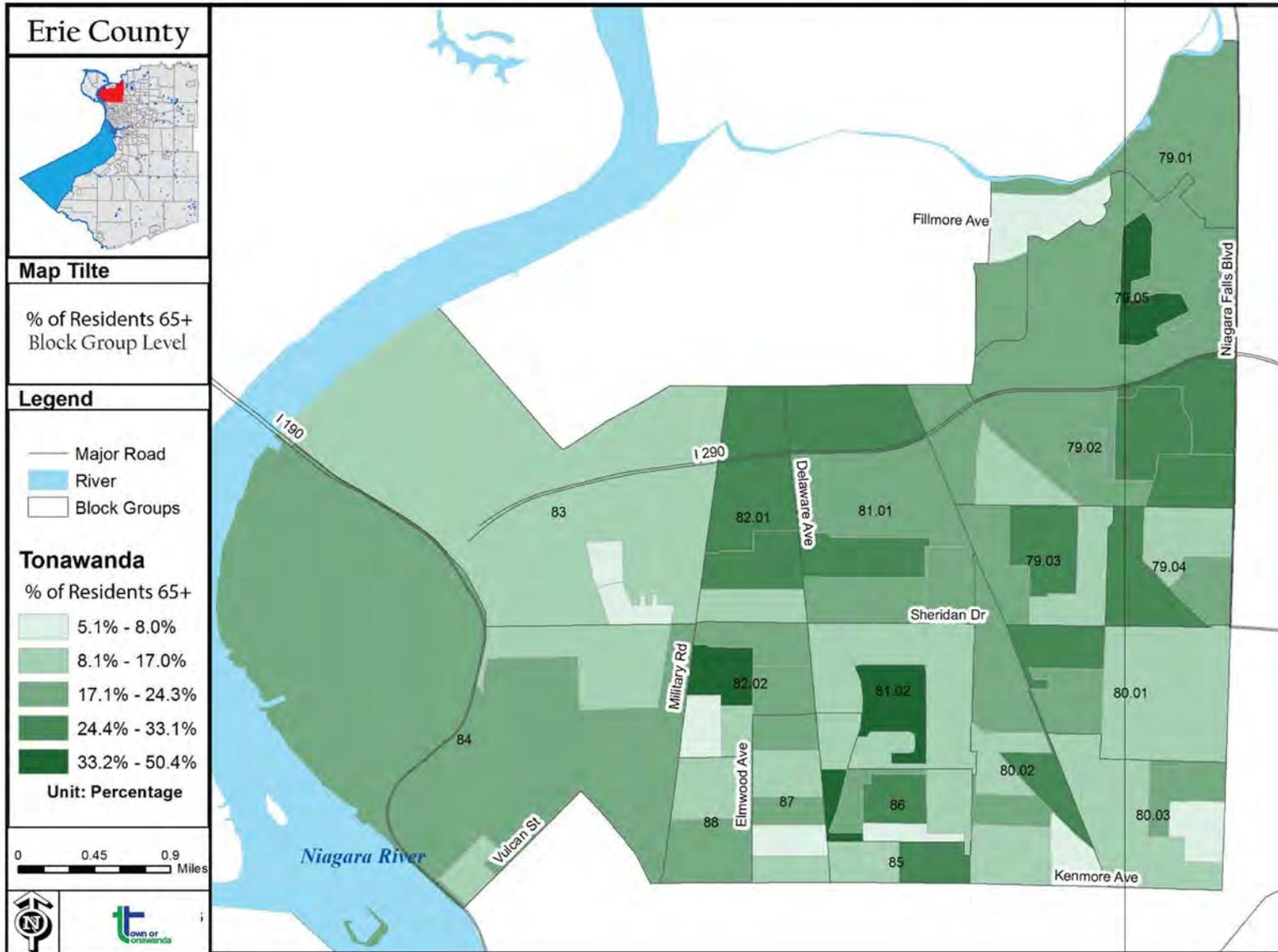


Figure 5.37: Vacancy Rate Block Group Level

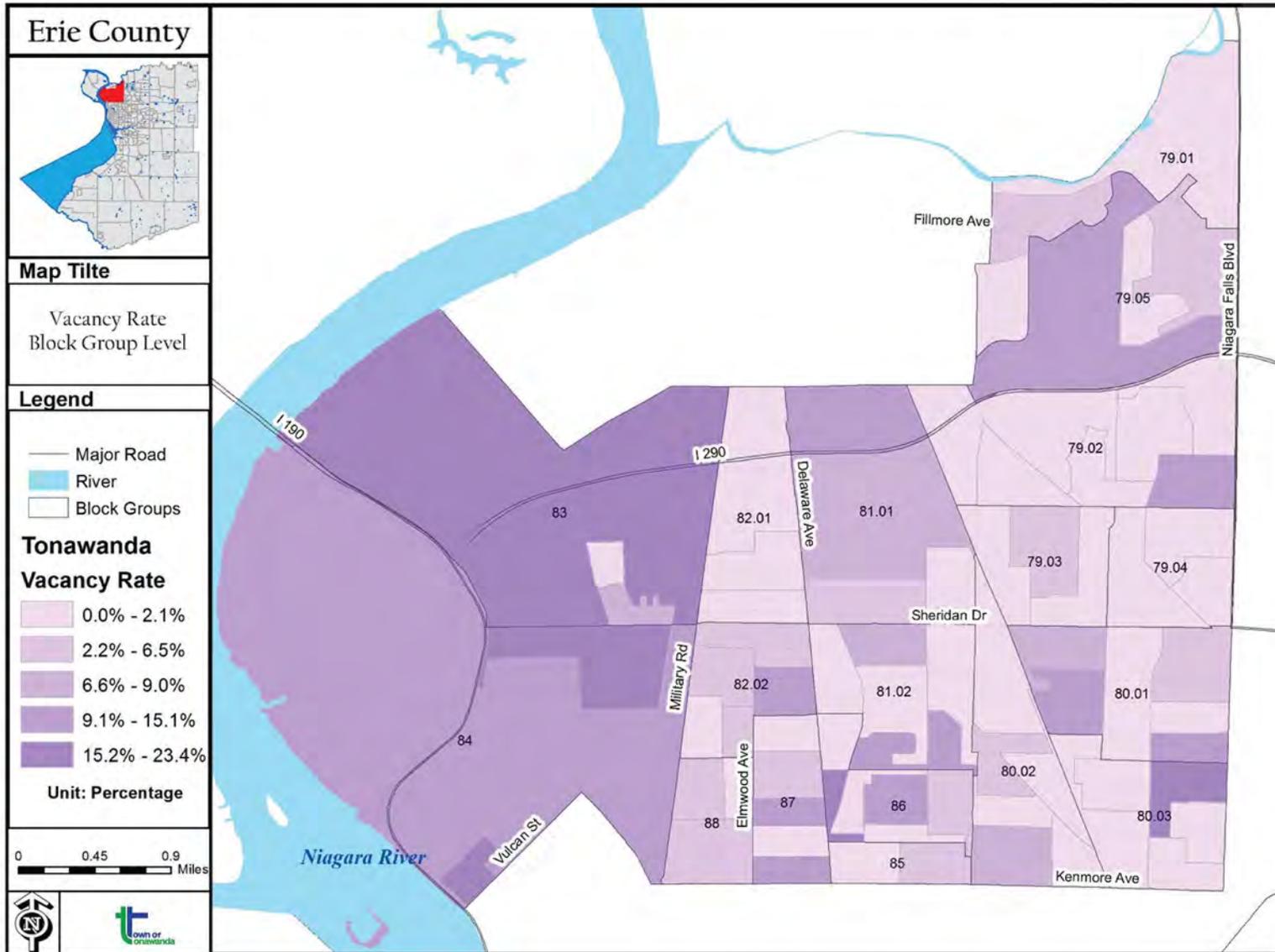


Figure 5.38: Sheridan Drive Expanded Cost Estimates

1. Planning and Design							\$ 335,966.21
Service					Percentage of Capital Improvements Cost	Total	
Drainage and Utilities Surveying					5%	\$ 111,988.74	
Detailed Engineering Design					10%	\$ 223,977.47	
2. Capital Improvement Cost							\$ 2,239,774.72
Item	Description	Unit	Unit Cost	Amount	Information Source	Total	
On-Road Facility (2.17 miles)							\$ 322,741.60
Buffered Bicycle Lane	30" diagonal stripe every 15 feet between two continuous parallel lines sides of street, 20 bikes and arrow symbols per mile both sides. \$165 per bike and arrow symbol includes the material (thermoplastic) and installation costs.	per mile	\$ 29,480.00	2.17	Wichita Bicycle Master Plan	\$ 63,971.60	
Bollards	Flexible polyurethane bollard with 31.5" height, including a reflector stripe. Each bollard is installed with inground mountings every 20 feet on both sides of the street.	each	\$ 226.00	1145	Reliance Foundry Co. Ltd.	\$ 258,770.00	
Off-Road Facility (1.60 miles)							\$ 1,326,493.12
Concrete	6' of 6" thick concrete pavement on both sides of the street.	per square yard	\$ 33.33	11264	Georgia DOT Item Mean Summary	\$ 375,429.12	
Colored pavement	5' wide green asphalt colored pavement at the same level of concrete sidewalk	per square foot	\$ 9.00	84480	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 760,320.00	
Bollards	Flexible polyurethane bollard with 31.5" height, including a reflector stripe. Each bollard is installed with inground mountings every 20 feet on both sides of the street.	each	\$ 226.00	844	Reliance Foundry Co. Ltd.	\$ 190,744.00	
Niagara Falls Blvd and Sheridan Dr Intersection							\$ 101,140.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	1800	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 16,200.00	
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	16	Bid Express Mean Summary	\$ 4,640.00	
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	8	UNC Highway Safety Research Center	\$ 24,560.00	

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Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	4	Bid Express Mean Summary	\$ 3,740.00
Bulb-out	Curb change for protected intersection	each	\$ 13,000.00	4	UNC Highway Safety Research Center	\$ 52,000.00

Belmont Ave and Sheridan Dr Intersection						\$ 78,850.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	600	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 5,400.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	6	UNC Highway Safety Research Center	\$ 18,420.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary	\$ 1,870.00
Bulb-out	Curb change for protected intersection	each	\$ 13,000.00	4	UNC Highway Safety Research Center	\$ 52,000.00
East Park Dr and Sheridan Dr Intersection						\$ 31,400.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	700	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 6,300.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	6	Bid Express Mean Summary	\$ 1,740.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	7	UNC Highway Safety Research Center	\$ 21,490.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary	\$ 1,870.00
Other Signalized Intersections along Sheridan Dr (9)						\$ 249,750.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	700	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 6,300.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	6	UNC Highway Safety Research Center	\$ 18,420.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary	\$ 1,870.00
Other Unsignalized Intersections along Sheridan Dr (5)						\$ 129,400.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	700	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 6,300.00

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Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	6	UNC Highway Safety Research Center	\$ 18,420.00

3. Annual Facility Maintenance Cost						\$ 64,932.84
Service	Description	Unit	Unit Cost	Quantity	Information Source	Total
Buffered Bicycle Lane	Assumes paint for striping and thermoplastic for symbols. All striping markings generally repainted annually at \$1 per linear foot and bike lane symbols replaced every 5 years at \$165 per symbol.	per mile	\$ 9,372.00	2.17	Wichita Bicycle Master Plan	\$ 20,337.24
Sidewalk Bicycle Path	Assumes paint for striping and thermoplastic for symbols. Outside striping marking generally repainted annually at \$1 per linear foot and bike lane symbols replaced every 5 years \$165 per symbol.	per mile	\$ 17,976.00	1.60	Wichita Bicycle Master Plan	\$ 28,761.60
Plowing	Seasonal snow clearing (twice the value for double-width path clearing)	per mile	\$ 4,200.00	3.77	City of Syracuse	\$ 15,834.00

Figure 5.39: Delaware Ave. Expanded Cost Estimates

1. Planning and Design						\$ 114,767.25
Service					Percentage of Capital Improvements Cost	Total
Drainage and Utilities Surveying					5%	\$ 38,255.75
Detailed Engineering Design					10%	\$ 76,511.50
2. Capital Improvement Cost						\$ 765,115.00
Item	Description	Unit	Unit Cost	Amount	Information Source	Total
On-Road Facility (2.17 miles)						\$ 221,060.00
Buffered Bicycle Lane	30" diagonal stripe every 15 feet between two continuous parallel lines sides of street, 20 bikes and arrow symbols per mile both sides. \$165 per bike and arrow symbol includes the material (thermoplastic) and installation costs.	per mile	\$29,480.00	1.3	Wichita Bicycle Master Plan	\$ 38,324.00
Bollards	Flexible polyurethane bollard with 31.5" height, including a reflector stripe. Each bollard is installed with inground mountings every 20 feet on both sides of the street.	each	\$ 226.00	686	Reliance Foundry Co. Ltd.	\$ 155,036.00
Bicycle Lane with parking	2 bicycle lane lines and 20 bike and arrow symbols per mile are added on each side of the roadway to create the bicycle lane. \$165 per bike and arrow symbol includes the material (thermoplastic) and installation costs.	per mile	\$27,700.00	1	Wichita Bicycle Master Plan	\$ 27,700.00
Sheridan Dr and Delaware Ave Intersection						\$ 92,040.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	1600	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 14,400.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	12	Bid Express Mean Summary	\$ 3,480.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	6	UNC Highway Safety Research Center	\$ 18,420.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	4	Bid Express Mean Summary	\$ 3,740.00
Bulb-out	Curb change for protected intersection	each	\$13,000.00	4	UNC Highway Safety Research Center	\$ 52,000.00
Delaware Rd and Delaware Ave Intersection						\$ 27,270.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	1200	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 10,800.00

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Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	8	Bid Express Mean Summary	\$ 2,320.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	4	UNC Highway Safety Research Center	\$ 12,280.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary	\$ 1,870.00
Kenmore Ave and Delaware Ave Intersection						\$ 22,745.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	400	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 3,600.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	14	Bid Express Mean Summary	\$ 4,060.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	4	UNC Highway Safety Research Center	\$ 12,280.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	3	Bid Express Mean Summary	\$ 2,805.00
Brighton Rd and Delaware Ave Intersection						\$ 33,450.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	200	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 1,800.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	18	Bid Express Mean Summary	\$ 5,220.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	8	UNC Highway Safety Research Center	\$ 24,560.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary	\$ 1,870.00
Other Signalized Intersections along Delaware Ave (1)						\$ 27,750.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	700	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 6,300.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	6	UNC Highway Safety Research Center	\$ 18,420.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary	\$ 1,870.00
Other Unsignalized Intersections along Delaware Ave (20)						\$ 340,800.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	400	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 3,600.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00

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Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	4	UNC Highway Safety Research Center	\$ 12,280.00
3. Annual Facility Maintenance Cost						\$ 31,215.60
Service	Description	Unit	Unit Cost	Quantity	Information Source	Total
Buffered Bicycle Lane	Assumes paint for striping and thermoplastic for symbols. All striping markings generally repainted annually at \$1 per linear foot and bike lane symbols replaced every 5 years at \$165 per symbol.	per mile	\$ 9,372.00	2.30	Wichita Bicycle Master Plan	\$ 21,555.60
Plowing	Seasonal snow clearing (twice the value for double-width path clearing)	per mile	\$ 4,200.00	2.30	City of Syracuse	\$ 9,660.00

Figure 5.40: Kenmore Ave. Expanded Cost Estimates

1. Planning and Design							\$143,887.01
Service					Percentage of Capital Improvements Cost	Total	
Drainage and Utilities Surveying					5%	\$ 47,962.34	
Detailed Engineering Design					10%	\$ 95,924.67	
2. Capital Improvement Cost							\$959,246.72
Item	Description	Unit	Unit Cost	Amount	Information Source	Total	
On-Road Facility (2.7 miles) - Phase 1							\$449,166.72
Bicycle lane	2 bicycle lane lines and 20 bike and arrow symbols per mile are added on each side of the roadway to create the bicycle lane. \$165 per bike and arrow symbol includes the material	per mile	\$ 17,200.00	2.7	Wichita Bicycle Master Plan	\$ 46,440.00	
Pavement extension	asphalt pavement	per square foot	\$ 2.00	29040	U. S. Department of Housing and Urban Development	\$ 58,080.00	
Curb removal	curb and gutter removal	per linear foot	\$ 9.67	11616	Bid Express Mean Summary	\$112,326.72	
Curb replacement	concrete curb and gutter installation	per linear foot	\$ 20.00	11616	UNC Highway Safety Research Center	\$232,320.00	
On-Road Facility (1.4 miles) - Phase 2							\$ 23,680.00
Bicycle lane	2 bicycle lane lines and 20 bike and arrow symbols per mile are added on each side of the roadway to create the bicycle lane. \$165 per bike and arrow symbol includes the material	per mile	\$ 17,200.00	1.3	Wichita Bicycle Master Plan	\$ 22,360.00	
Shared lane	20 shared lane marking symbols per mile are added on each side of the roadway to create the shared lane pavement marking facility. \$165 per bike and arrow symbol includes the material (thermoplastic) and installation costs.	per mile	\$ 6,600.00	0.2	U. S. Department of Housing and Urban Development	\$ 1,320.00	
Ontario St and Kenmore Ave Roundabout							\$ 10,780.00

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Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	16	Bid Express Mean Summary	\$ 4,640.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	2	UNC Highway Safety Research Center	\$ 6,140.00
Other Signalized Intersections along Kenmore Ave (6)						\$166,500.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	700	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 6,300.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	6	UNC Highway Safety Research Center	\$ 18,420.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary	\$ 1,870.00
Other Unsignalized Intersections along Kenmore Ave (23)						\$309,120.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	4	UNC Highway Safety Research Center	\$ 12,280.00
3. Annual Facility Maintenance Cost						\$ 73,224.00
Service	Description	Unit	Unit Cost	Quantity	Information Source	Total
Buffered Bicycle Lane	Assumes paint for striping and thermoplastic for symbols. Outside striping marking generally repainted annually at \$1 per linear foot and bike lane symbols replaced every 5 years \$165 per symbol.	per mile	\$ 17,976.00	4.00	Wichita Bicycle Master Plan	\$ 71,904.00
Shared lane marking	Assumes thermoplastic. All SLM symbols generally replaced every 5 years at \$165 per shared lane marking	per mile	\$ 6,600.00	0.20	Wichita Bicycle Master Plan	\$ 1,320.00
Plowing	No additional plowing would be necessary	per mile	\$ -	0.00	-	\$ -

Figure 5.41: Parker Blvd. Expanded Cost Estimates

1. Planning and Design						\$ 41,940.15
Service					Percentage of Capital Improvements Cost	Total
Drainage and Utilities Surveying					5%	\$ 13,980.05
Detailed Engineering Design					10%	\$ 27,960.10
2. Capital Improvement Cost						\$ 279,601.00
Item	Description	Unit	Unit Cost	Amount	Information Source	Total
On-Road Facility (0.49 miles)						\$ 71,881.00
Bollards	Flexible polyurethane bollard with 31.5" height, including a reflector stripe. Each bollard is installed with inground mountings every 20 feet on both sides of the street.	each	\$ 226.00	258	Reliance Foundry Co. Ltd.	\$ 58,308.00
Bicycle Lane with parking	2 bicycle lane lines and 20 bike and arrow symbols per mile are added on each side of the roadway to create the bicycle lane. \$165 per bike and arrow symbol includes the material (thermoplastic) and installation costs.	per mile	\$ 27,700.00	0.49	Wichita Bicycle Master Plan	\$ 13,573.00
Sheridan Dr and Parker Blvd Intersection						\$ 88,440.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	1200	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 10,800.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic.	each	\$ 290.00	12	Bid Express Mean Summary	\$ 3,480.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	6	UNC Highway Safety Research Center	\$ 18,420.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	4	Bid Express Mean Summary	\$ 3,740.00
Bulb-out	Curb change for protected intersection	each	\$ 13,000.00	4	UNC Highway Safety Research Center	\$ 52,000.00
Other Unsignalized Intersections along Parker Blvd (7)						\$ 119,280.00

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Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	400	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 3,600.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	4	UNC Highway Safety Research Center	\$ 12,280.00
3. Annual Facility Maintenance Cost						\$ 6,650.28
Service	Description	Unit	Unit Cost	Quantity	Information Source	Total
Buffered Bicycle Lane	Assumes paint for striping and thermoplastic for symbols. All striping markings generally repainted annually at \$1 per linear foot and bike lane symbols replaced every 5 years at \$165 per symbol.	per mile	\$ 9,372.00	0.49	Wichita Bicycle Master Plan	\$ 4,592.28
Plowing	Seasonal snow clearing (twice the value for double-width path clearing)	per mile	\$ 4,200.00	0.49	City of Syracuse	\$ 2,058.00

Figure 5.42: Brighton Rd. Expanded Cost Estimates

1. Planning and Design							\$ 57,838.65
Service					Percentage of Capital Improvements Cost	Total	
Drainage and Utilities Surveying					5%		\$ 19,279.55
Detailed Engineering Design					10%		\$ 38,559.10
2. Capital Improvement Cost							\$ 385,591.00
Item	Description	Unit	Unit Cost	Amount	Information Source	Total	
On-Road Facility (0.71 miles)							\$ 104,191.00
Bollards	Flexible polyurethane bollard with 31.5" height, including a reflector stripe. Each bollard is installed with inground mountings every 20 feet on both sides of the street.	each	\$ 226.00	374	Reliance Foundry Co. Ltd.		\$ 84,524.00
Buffered Bicycle Lane	30" diagonal stripe every 15 feet between two continuous parallel lines sides of street, 20 bikes and arrow symbols per mile both sides. \$165 per bike and arrow symbol includes the material (thermoplastic) and installation costs.	per mile	\$ 27,700.00	0.71	Wichita Bicycle Master Plan		\$ 19,667.00
Signalized Intersections along Brighton Rd (4)							\$ 111,000.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	700	Guidelines for Analysis of Investments in Bicycle Facilities - Boston		\$ 6,300.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary		\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	6	UNC Highway Safety Research Center		\$ 18,420.00
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary		\$ 1,870.00
Unsignalized Intersections along Brighton Rd (10)							\$ 170,400.00

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Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	400	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 3,600.00
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	4	UNC Highway Safety Research Center	\$ 12,280.00
3. Annual Facility Maintenance Cost						\$ 9,636.12
Service	Description	Unit	Unit Cost	Quantity	Information Source	Total
Buffered Bicycle Lane	Assumes paint for striping and thermoplastic for symbols. All striping markings generally repainted annually at \$1 per linear foot and bike lane symbols replaced every 5 years at \$165 per symbol.	per mile	\$ 9,372.00	0.71	Wichita Bicycle Master Plan	\$ 6,654.12
Plowing	Seasonal snow clearing (twice the value for double-width path clearing)	per mile	\$ 4,200.00	0.71	City of Syracuse	\$ 2,982.00

Figure 5.43: Sawyer Ave. Expanded Cost Estimates

1. Planning and Design							\$ 89,575.50
Service					Percentage of Capital Improvements Cost	Total	
Drainage and Utilities Surveying					5%	\$ 29,858.50	
Detailed Engineering Design					10%	\$ 59,717.00	
2. Capital Improvement Cost							\$ 597,170.00
Item	Description	Unit	Unit Cost	Amount	Information Source	Total	
On-Road Facility (1-mile)							\$ 492,400.00
Bicycle lane	2 bicycle lane lines and 20 bike and arrow symbols per mile are added on each side of the roadway to create the bicycle lane. \$165 per bike and arrow symbol includes the material	per mile	\$ 17,200.00	1	Wichita Bicycle Master Plan	\$ 17,200.00	
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	52800	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 475,200.00	
River Rd and Sawyer Ave Intersection							\$ 38,170.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	200	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 1,800.00	
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00	
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	3	UNC Highway Safety Research Center	\$ 9,210.00	
Bulb-out	Curb change for protected intersection	each	\$ 13,000.00	2	UNC Highway Safety Research Center	\$ 26,000.00	
Kenmore Ave and Sawyer Ave Intersection							\$ 26,280.00
Colored pavement	green asphalt colored pavement over existing pavement	per square foot	\$ 9.00	200	Guidelines for Analysis of Investments in Bicycle Facilities - Boston	\$ 1,800.00	
Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	10	Bid Express Mean Summary	\$ 2,900.00	
Bicycle signal head	furnishing and installing pedestal pole and foundation with LED signal head	each	\$ 935.00	2	Bid Express Mean Summary	\$ 1,870.00	
Other Unsignalized Intersections along Sawyer Ave (3)							\$ 40,320.00

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Pavement marking symbols	bike lane arrows preformed in thermoplastic	each	\$ 290.00	4	Bid Express Mean Summary	\$ 1,160.00
Crosswalk marking	high visibility crosswalk	each	\$ 3,070.00	4	UNC Highway Safety Research Center	\$ 12,280.00
3. Annual Facility Maintenance Cost						\$ 73,224.00
Service	Description	Unit	Unit Cost	Quantity	Information Source	Total
Buffered Bicycle Lane	Assumes paint for striping and thermoplastic for symbols. Outside striping marking generally repainted annually at \$1 per linear foot and bike lane symbols replaced every 5 years \$165 per symbol.	per mile	\$ 17,976.00	4.00	Wichita Bicycle Master Plan	\$ 71,904.00
Shared lane marking	Assumes thermoplastic. All SLM symbols generally replaced every 5 years at \$165 per shared lane marking	per mile	\$ 6,600.00	0.20	Wichita Bicycle Master Plan	\$ 1,320.00
Plowing	No additional plowing would be necessary	per mile	\$ -	0.00	-	\$ -

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