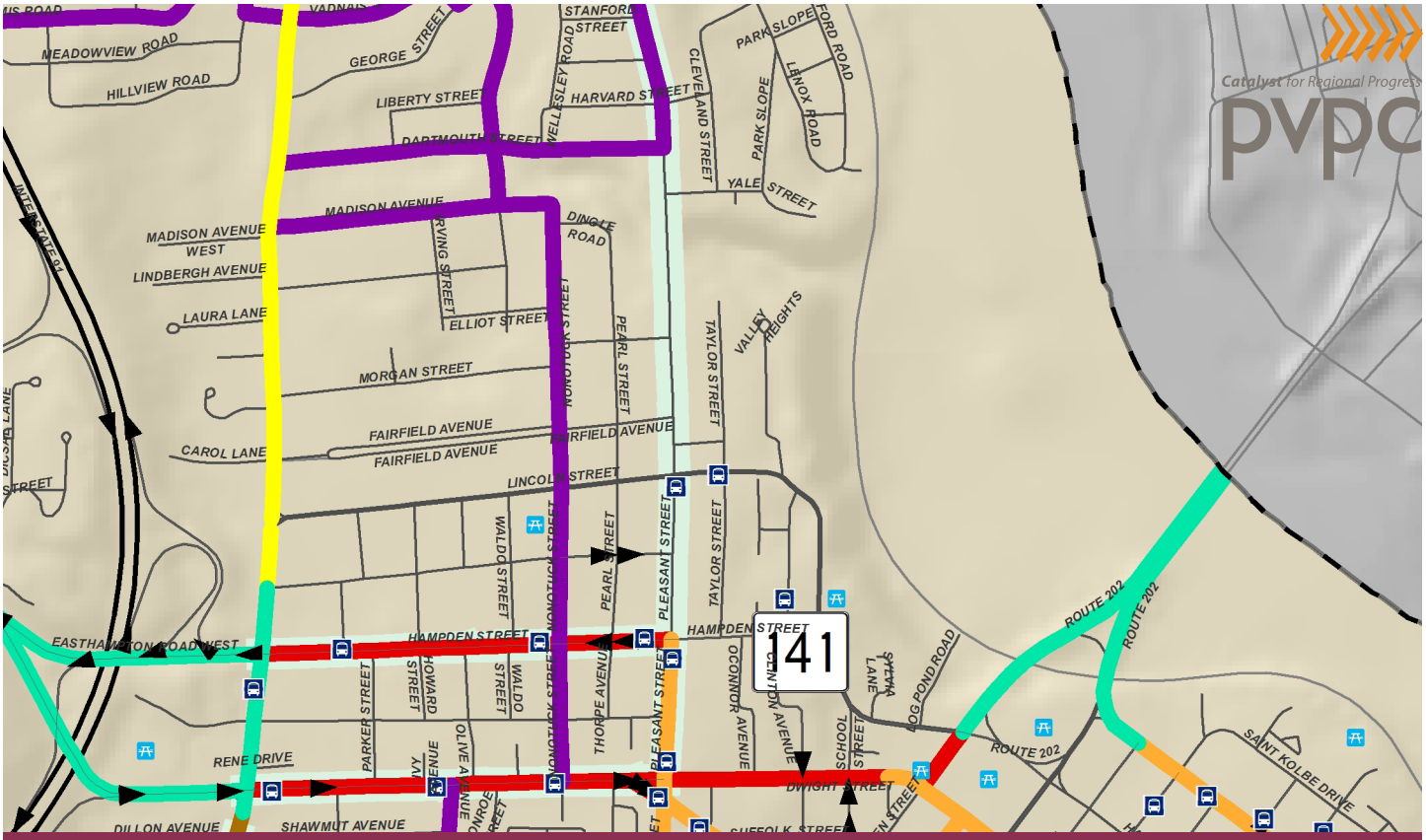
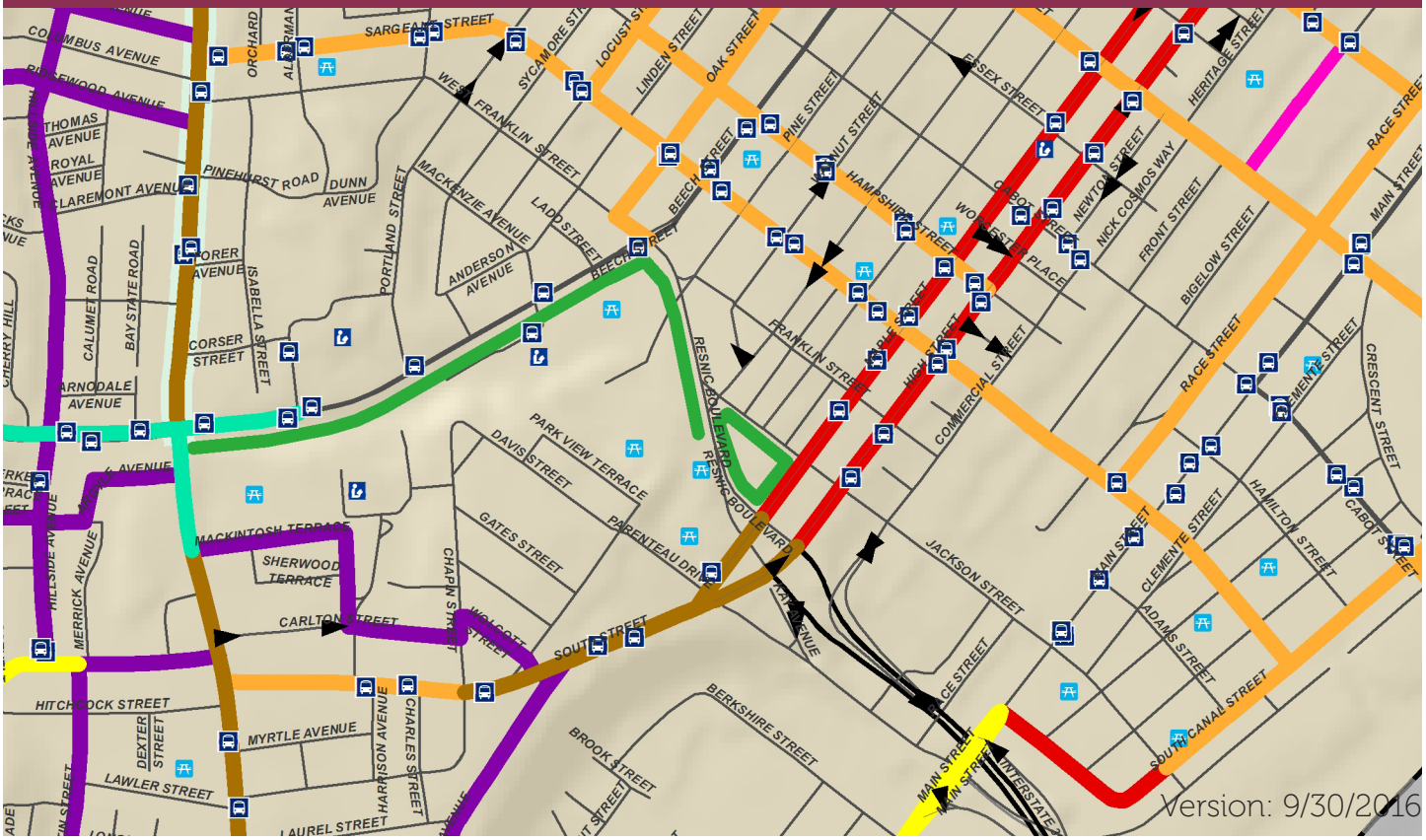


Holyoke Bike Network Plan



Version: 9/30/2016

Holyoke Bike Network Plan

Prepared For:
The City of Holyoke in consultation with Mass in Motion, the Office of Planning and Economic Development, the Department of Public Works, and the Holyoke Bike/Ped Committee

Prepared By:
Pioneer Valley Planning Commission

This project was made possible by funding from Mass in Motion, an initiative of the Massachusetts Department of Public Health and was prepared in cooperation with the Massachusetts Department of Transportation and the U.S. Department of Transportation - Federal Highway Administration. The views and opinions of the Pioneer Valley Planning Commission expressed herein do not necessarily state or reflect those of the U.S. Department of Transportation or the Massachusetts Department of Public Health.

Version: 9/30/16

Introduction

The Holyoke Bike Network Plan is intended to guide the City of Holyoke as it plans and implements a complete streets network, with a focus on bicycle facilities. This document:

- evaluates how well the city's street network is serving bicyclists,
- prioritizes where bicycle infrastructure improvements are most needed,
- identifies key streets that, when improved, can form a bicycle network that will provide access to most parts of the city for bicyclists with varying skill and confidence levels.

Ultimately, the plan sketches out a Proposed Bicycle Network network that strives to be convenient, safe, comfortable, and well-connected for diverse bicyclists. It classifies the Bicycle Network into a set of typical street-types and presents a range of options for improving those street-types to accommodate bicyclists.

This plan responds to one of the three key recommendations in the 2013 plan "Biking in Holyoke: A Needs Assessment," which recommended that the city "... create a comprehensive bicycle plan to address the intersections and roads identified above. Ultimately, having a comprehensive plan is needed in order to undertake deliberate efforts at expanding the bicycle network in the most effective way possible."

The Bike Network Plan was developed largely using GIS (map-based) analysis. GIS is an effective tool for capturing an overview of general conditions for bicycling in the city and reveals key patterns related to where improvements might be most feasible and effective.[1] GIS analysis was supplemented by several site visits to Holyoke and virtual reconnaissance using Google Street View. The plan builds off of past planning and public outreach captured in past plans including *Biking in Holyoke*, *Center City Vision Plan* (VHB, 2009), *City of Holyoke-Center City: Downtown Pedestrian Plan* (WalkBoston 2013), and *Green Streets Guidebook* (The Conway School, 2014).

The maps shown in this plan can be viewed through an online interactive GIS format at: http://tinyurl.com/znup78e. The online viewer enables a user to turn layers on and off, change layer transparency, and see underlying data embedded in the GIS layers.

1 The underlying data for the GIS analysis may contain some errors. Please keep in mind that random isolated errors in the maps do not indicate that the overall analysis is flawed, just that a specific bit of underlying data was wrong.

Executive Summary

Among communities in the Pioneer Valley region, Holyoke is uniquely-positioned to take advantage of the widespread enthusiasm for bicycling that has resulted in dramatic increases in bicycle ridership across the nation.

Downtown Holyoke, in particular, is ripe for bicycle improvements for three reasons:

1. Its "bones are good." Streets are laid out in a grid system with short blocks that enable bicycle trips to be relatively short and convenient. In addition, a gridded street network tends to slow traffic and disperse it. Both factors make Holyoke's streets more comfortable for cyclists than fast and high volume suburban arterials that dominate other parts of the Pioneer Valley.
2. Existing speed limits throughout much of the city are relatively low. Slow speeds make streets safer and more comfortable for bicycling.
3. The population of Holyoke would benefit substantially from increased opportunities to bicycle safely. Several key demographic factors that are linked with higher rates of bicycling are present in Holyoke, particularly in the population that resides downtown. These factors include a high proportion of households who do not own a car or own only one car, a high proportion of low-income residents, and a high proportion of young people. For many downtown residents, bicycling could be a means of day-to-day mobility. In addition, much of Holyoke's population has relatively poor health outcomes. Increased physical activity from bicycling could have outsized population health benefits.

While Holyoke has the potential to substantially increase bicycling activity, and to reap the economic, environmental, and health benefits of that change, there are some challenges that need to be negotiated:

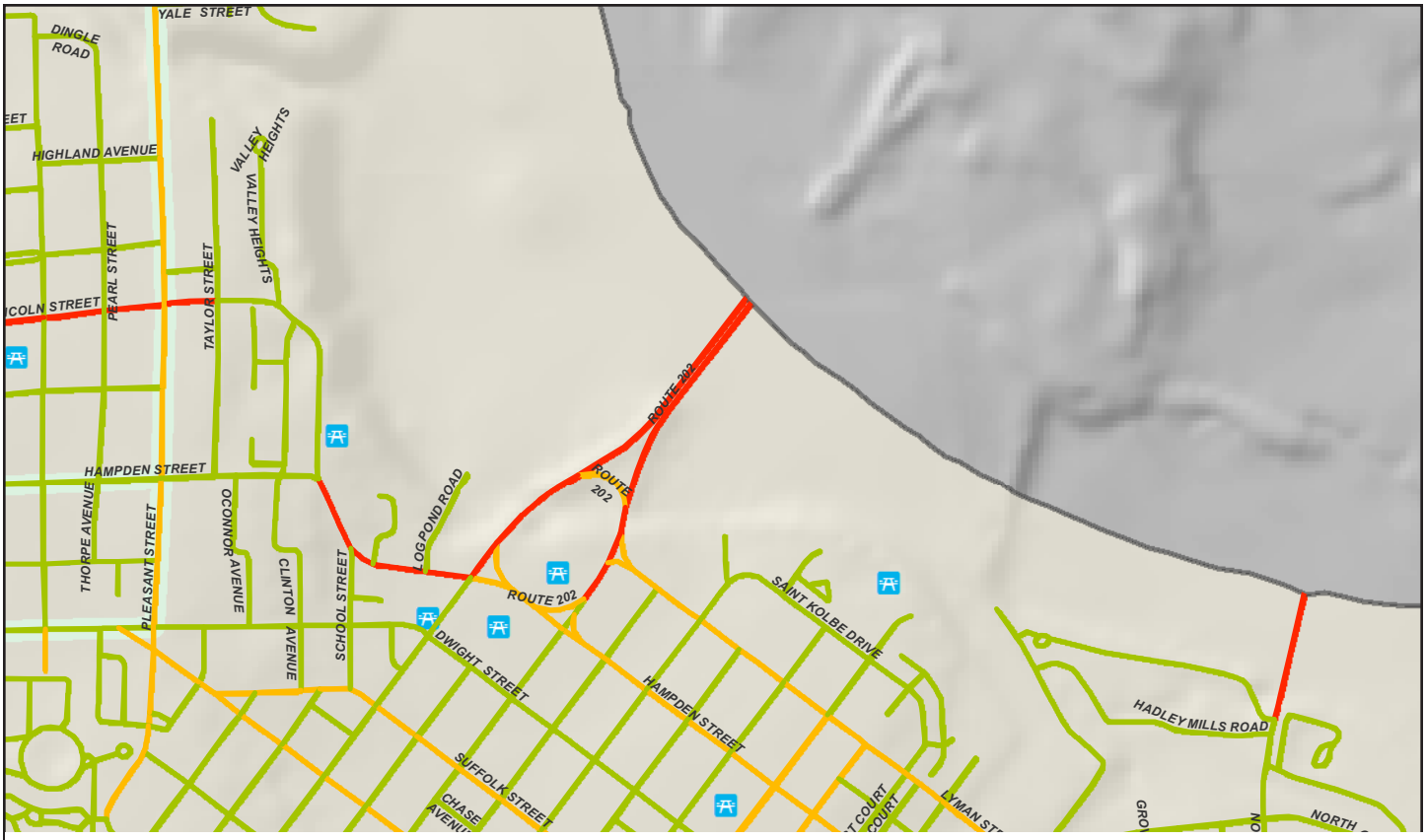
1. Existing streets and rights of way are generally narrow. While this likely slows traffic, it also means that there is inadequate space in most locations to add bike lanes without narrowing motor vehicle travel lances or reducing on-street parking.
2. Most routes that connect to adjacent communities present a high level of stress or physical challenges for bicyclists. Challenging routes include bridges over the Connecticut River to Chicopee and South Hadley, routes which climb Mount Tom, and arterials with high traffic speeds and volumes.
3. Some key streets in Holyoke—in particular Maple and High Streets are two-lane one way streets. These streets are stressful for bicyclists and make travel to key destinations less convenient.
4. Motor vehicle collisions with bicyclists (and pedestrians) in Holyoke are all too common. These collisions are not only harmful for those involved, but they can be a significant deterrent for people who are considering bicycling. Collisions involving pedestrians and bicyclists are concentrated downtown. Infrastructure improvements, education of drivers, bicyclists and pedestrians, and stepped up enforcement of traffic safety laws could help improve the situation.
5. Steep slopes between downtown and the rest of Holyoke are a substantial deterrent to bicycling.

The Proposed Bicycle Network Map in this plan outlines an approach to capitalize on Holyoke's strengths and overcome its challenges to make all of Holyoke better for bicycling. The Proposed Bicycle Network, when implemented, will provide low

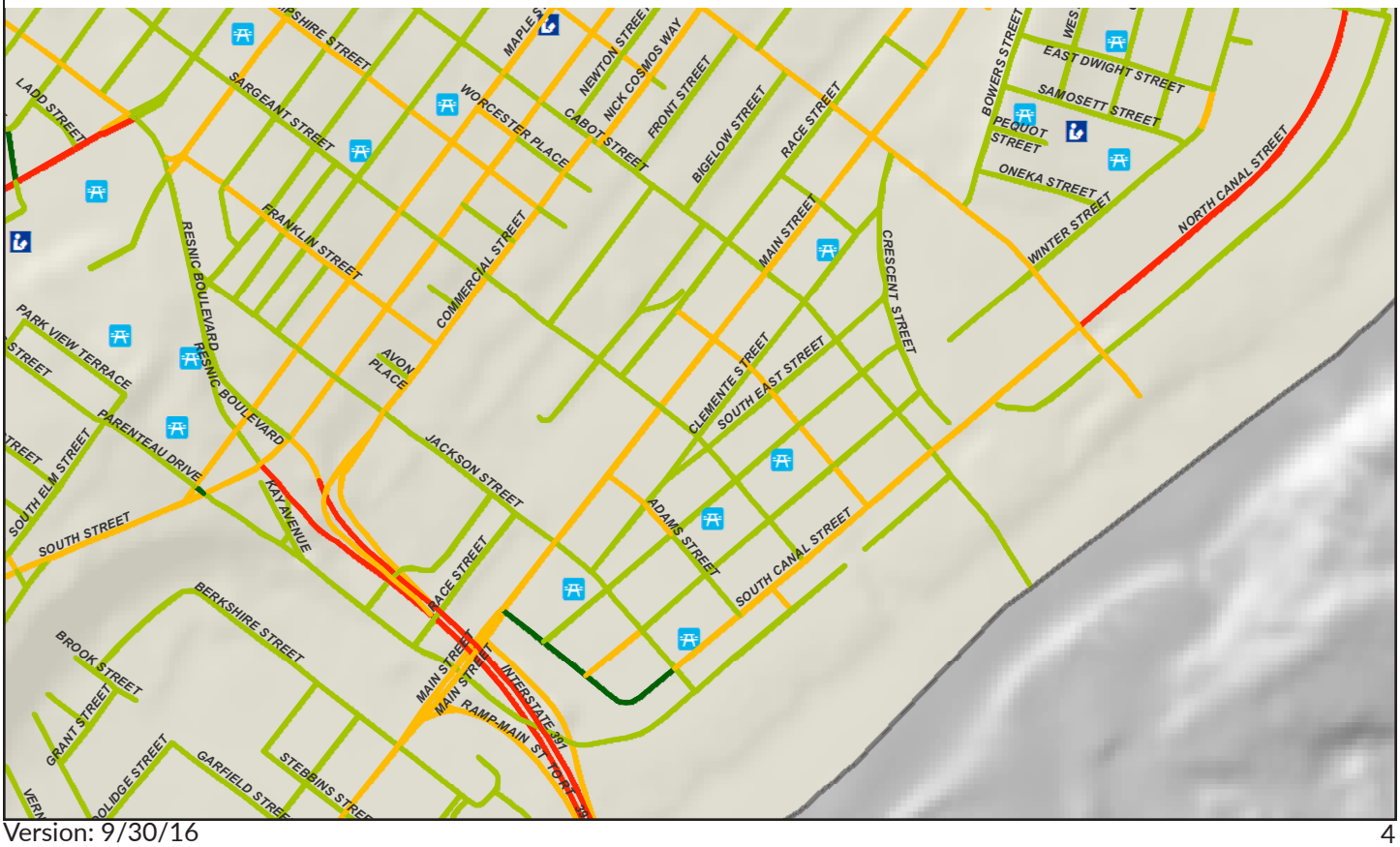
to moderate stress bicycling routes that connect virtually all parts of Holyoke and neighboring communities. The Proposed Bicycle Network Map calls out key streets that make up the network. It divides the streets into a set of “street types.” For each street type a variety of potential cross-sections is shown. The various cross-sections represent a variety of compromises, some maximize comfort for bicyclists, others prioritize motor vehicle traffic or parking to a greater extent.

Some streets in Holyoke will require significant improvements for bicycling. For example, Maple and High Streets are key destinations for bicycling in the city, have relatively high ridership, and have substantial crash clusters. These streets would benefit from the construction of separated bicycle lanes, which are both preferred by most bicyclists and are also significantly safer than standard bicycle lanes or shared lanes). Other locations in the city will require more modest improvements like restriping of lanes, or traffic calming.

Holyoke has a valuable opportunity to remake and rebrand itself as a bicycle-friendly city. This plan provides useful information that can help decision makers prioritize improvements. It provides a long-tem vision of a comprehensive network that can be implemented step-by-step over time. We encourage the people of Holyoke, its elected and officials and its staff, to work together to take the next steps toward a more bicycle-friendly city.



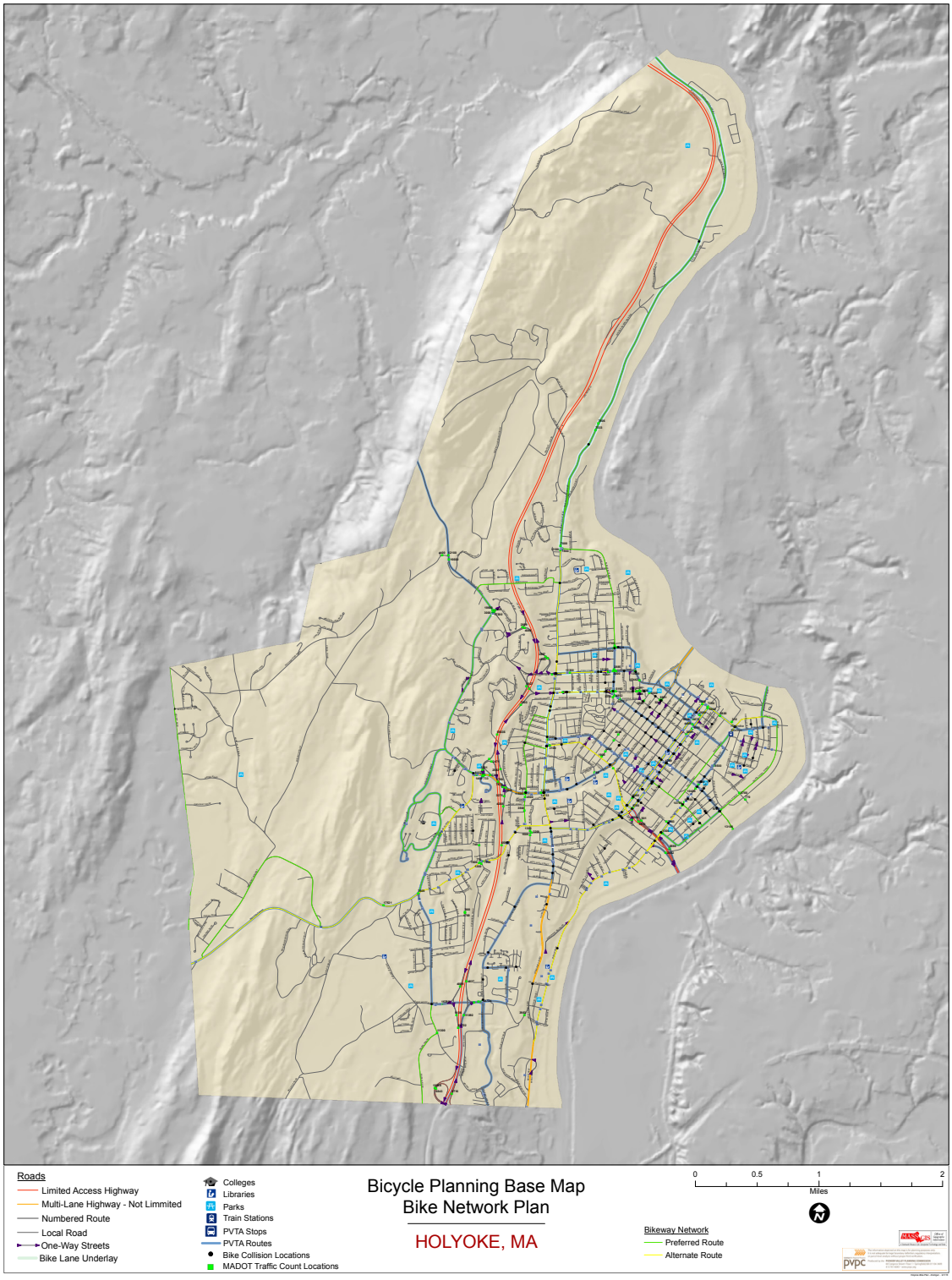
Existing Conditions Analysis



Bicycle Planning Base Map

What is it?

This map shows key information for bicycle network planning including traffic volumes, bus lines and stops, one way streets, previous crashes, etc. The data for "Bicyclists' Preferred Routes" are the result of a previous PVPC project that solicited input from bicyclists on which roads they preferred to use. This data may be biased toward more confident and active riders.



Bicycle Level of Traffic Stress (LTS) Analysis

What is it?

The Bicycle Level of Stress Analysis categorizes streets in Holyoke by "level of traffic stress," a method for bike network planning that is becoming increasingly accepted. The LTS analysis categorizes road segments into four levels: LTS 1, LTS 2, LTS 3, LTS 4. LTS 1 is the least stressful for bicyclists. LTS 4 is quite stressful for most bicyclists. The four LTS levels correspond to the four kinds of bicyclists as currently described in bicycle planning literature, "No Way, No How," "Interested, but Concerned," "Enthused and Confident," "Strong and Fearless." LTS 1 suits children and "Interested but Concerned" riders. LTS 2 suits "Interested but Concerned" riders. LTS 3 suits "Enthused and Confident" riders. LTS 4 suits "Strong and Fearless" riders or is not suitable for bicyclists. The idea behind the analysis is that riders will often not use a street segment or intersection that exceeds the level of traffic stress that they are comfortable with. High stress segments and intersection are a barrier for a bicyclist moving through the city. The bike network becomes fragmented when the LTS level exceeds a rider's comfort.

For more details on the LTS methodology see the Appendix.

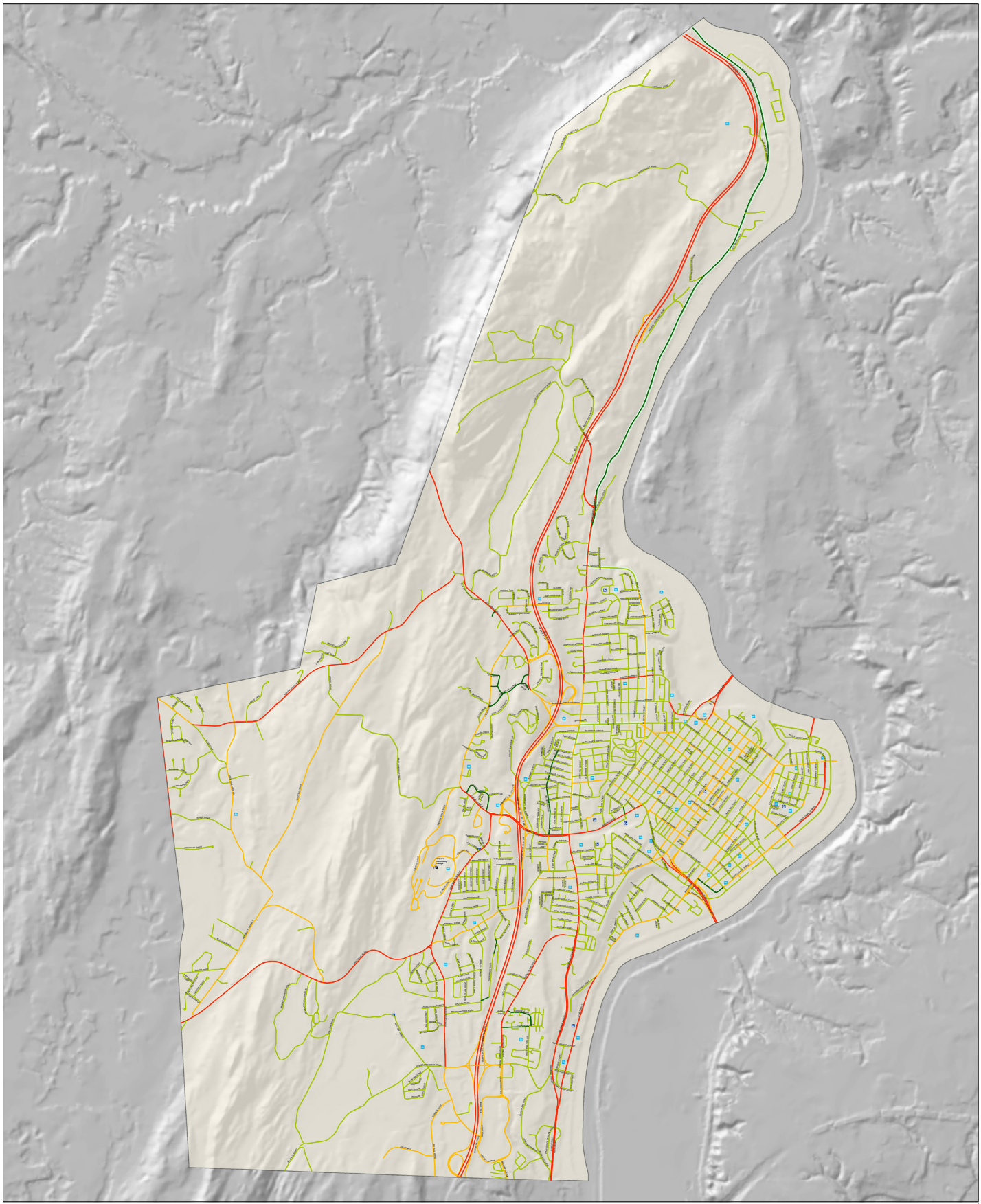
What does it show?

The LTS analysis shows that Holyoke has a relatively low-stress bicycle network already in place. The vast majority of Holyoke is at LTS 2. It should be suitable for "Interested but Concerned" riders. However, there are key routes that are LTS 3 which fragment the network. These are concentrated downtown. They include Maple, High and Appleton—streets that are key destinations and key connections. Also it is quite noticeable that almost all key connections to adjacent communities are at LTS 4. That creates barriers for riding into and out of Holyoke for all but the most experienced riders. (Northampton Street at its northern end is an exception).

Holyoke's numerous hills, driver and bicyclist behavior, frequency of crashes, other street design factors, and local culture, may temper the positive results of the LTS analysis. Many of Holyoke's streets may be more stressful than the analysis shows.

The LTS analysis points toward the benefit of investing in key roads that are currently at LTS 3 or 4 in order to improve overall connectivity.[1]

1 The LTS analysis did include an examination of intersections. Intersections on key routes should be carefully analyzed in future planning projects as intersections are often cited as the most dangerous and stressful points in a bicycle network. The LTS methodology includes criteria for intersections that could be used in future work.


Bicyclists' Level of Traffic Stress
1 (Suitable for most bicyclists, including children)
2 (Suitable for "Interested but Concerned" bicyclists)
3 (Suitable for "Enthused & Confident" bicyclists)
4 (Suitable for "Strong & Fearless" bicyclists, or not suitable for bicyclists)
Bike Lane Underlay
Colleges
Libraries
Parks
Bicyclist Level of Traffic Stress (LTS) Analysis
Bike Network Plan
HOLYOKE, MA
0
0.5
1
2
Miles

Slope Analysis

What is it?

This map shows street segments characterized by slope. Steep slopes will be a barrier to many cyclists, though the degree of slope that is acceptable varies by bicyclist and context within a ride. Some bicyclists avoid all slopes, others seek them out, and there is a wide range of variation in between. Other critical factors include whether a slope is ascending or descending, the length of a slope, how much momentum a bicyclist has entering the slope, and how much operating space a bicyclist has. The table below provides some guidance on acceptable grades for bicyclists:

Maximum Grade Lengths for Bicycles (Shared Paths)

Grade (%)	Maximum Length (ft)
5 to 6	800
7	400
8	300
9	200
10	100
11+	50

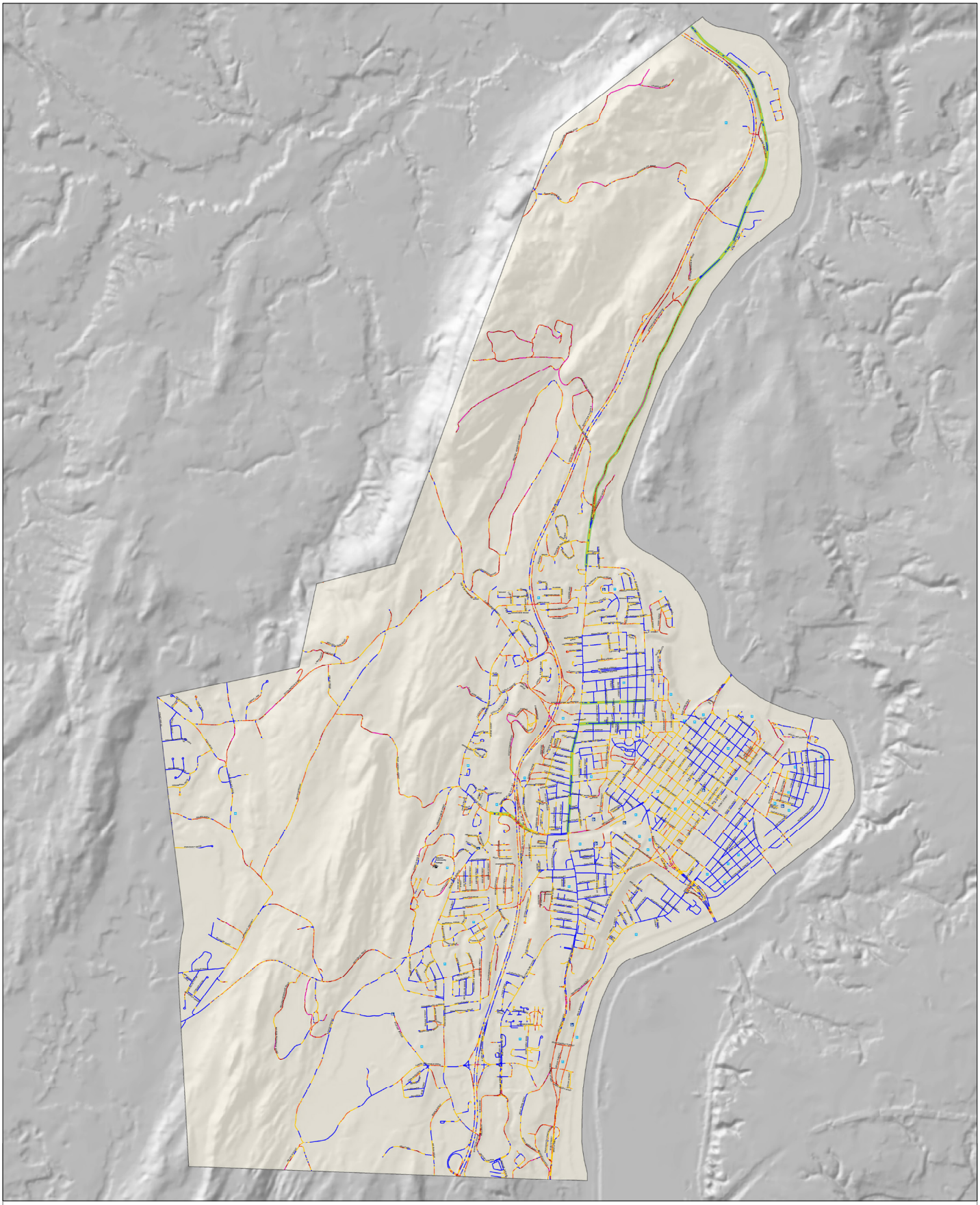
Source: Guide for the Development of Bicycle Facilities, AASHTO, 1999. (Note the more recent version of the AASHTO guide does not include this table).

Generally, guidance for bicycle planning says that 0-3% slopes will be comfortable for most bicyclists. Sustained climbs at 3-5% will challenge some cyclists and acceptable distances drop significantly above 5%. To put the numbers above in perspective, the acceptable length of a 5% slope (800') is about 2 short-blocks in downtown Holyoke or a little more than 1-long block downtown. The acceptable length of a 10% climb (100') is about ¼ of a short downtown block or 1/7th of a long-block.

What does it show?

Holyoke has formidable hills that make it difficult to move from one neighborhood to another. There are steep climbs between downtown and the Highlands. In addition, many low volume streets, that could provide low stress alternatives to major roads often are more hilly than the major roads they could provide alternatives too.

Key bicycle routes with steep slopes may require additional operating room for bicyclists (separation from motor vehicle traffic).


Roadway Slope Key
0 - 3%
3 - 8%
8 -15%
15 - 25%
Above 25%
Bike Lane Underlay
Colleges
Libraries
Parks
Slope Analysis
Bike Network Plan
HOLYOKE, MA
0
0.5
1
2
Miles

Bicycle and Pedestrian Crash Analysis

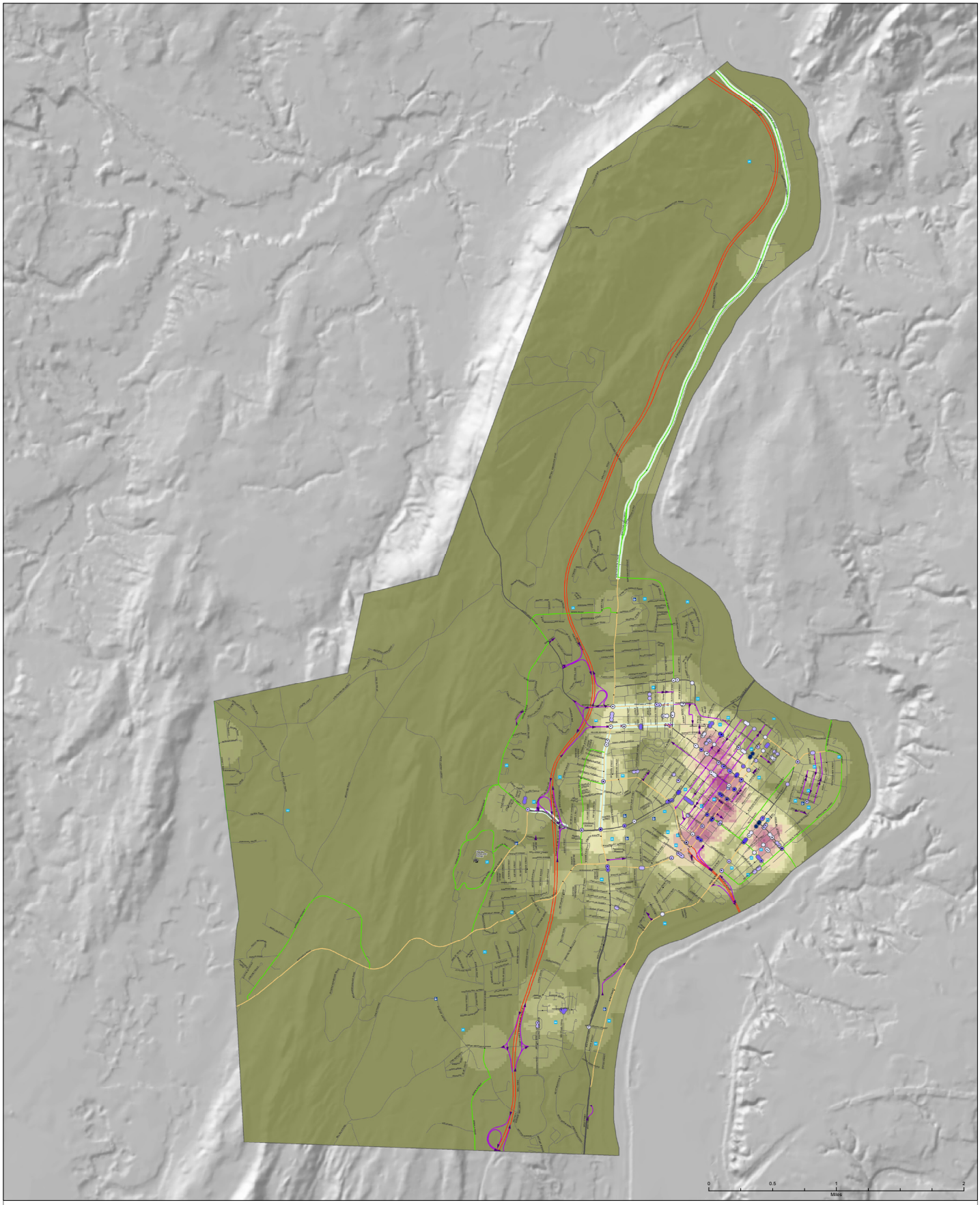
What is it?

This map shows the results of two methods of analyzing ped/bike crash data in Holyoke.

- The large colored blobs (green to purple color ramp) show bicycle crash clusters categorized by the number of crashes within an area. Purple indicates a higher number of crashes in a cluster. Green indicates fewer crashes in a cluster. The numbers in the key show the number of bicycle crashes that occurred within a 1000' radius of a point (1-3 blocks in downtown Holyoke). That color is assigned to a 100 square foot grid cell to make it visible. The map does not show the most dangerous point (for example intersection) in Holyoke. Instead it shows which areas have the most bicycle crashes. Safety from crashes is a major factor driving whether people bicycle and where they ride. Assuming that bicyclists are reasonably able to judge safety, this layer gives an indication of locations that bicyclists may try to avoid—either by detouring around them or choosing not to ride a bicycle.
- The purple dots show pedestrian and bicycle crash clusters categorized by a combination of incidence and severity. The darker the purple the more severe the crashes in that cluster. We used a MassDOT method for this analysis called EPDO index (Equivalent Property Damage Only). Crashes that are within 25 meters (about 80') of each other are combined into a cluster. The severity of the crashes in the cluster are summed using the Equivalent Property Damage Only (EPDO) index where Property Damage Only crashes = 1 Point; Injury crashes = 5 Points; Fatal crashes = 10 points). For this analysis we chose to use data for both bicyclists and pedestrians because bicycle crash data is very limited due to the low numbers of bicyclists combined with significant under-reporting of bicycle crashes. Combining crash data for both pedestrians and bicyclists gives us window into general road risk for active transportation.
- This map also shows "Bicyclists' Preferred Routes" which is the result of a previous PVPC project that solicited input from bicyclists on which roads they preferred to use. This data may be biased toward more confident and active riders. Preferred Routes are routes that bicyclists choose to ride on. Alternate Routes should be interpreted as routes that bicyclists will ride on if they have to. Comparing crash clusters to Bicyclist Preferred Routes appears to reveal that bicyclists generally prefer routes that have low number and severity of crash clusters. In other words, bicyclists appear to be reasonably good at judging safety risk. Meanwhile some Alternate Routes pass through significant crash clusters, including along Maple and High St and at key intersections throughout the city.

What does it show?

This map reveals that bicyclist crashes are most concentrated in downtown Holyoke—particularly in the area around Maple and High Streets. There are also isolated bicycle crash hot spots in the vicinity of Hampden/Pleasant Street and where Northampton Street intersects with other major roads. The *severity* of pedestrian/bicycle crash clusters shows a similar pattern. The most severe crash clusters occur on Main Street near Cabot Street, Maple Street near Dwight Street, and High Street, Maple Street, Sargaent Street, Appleton Street, and Dwight Street. These streets are all key connectors in Holyoke's street network. This points to a need for bicycle and pedestrian safety improvements on these streets.



Roads
- Limited Access Highway
- Multi-Lane Highway - Not Limmited
- Numbered Route
- Local Road
- One-Way Streets
- Bike Lane Underlay

- Colleges
- Libraries
- Parks

Bicyclists' Preferred Routes
- Preferred Route
- Alternate Route

Bicycle & Pedestrian Crash Analysis
Bike Network Plan

HOLYOKE, MA

- Bike Collision Locations

Bike Crash Density 2003 - 2013

0.0	3.0 - 3.5
0.0 - 1.0	3.5 - 4.5
1.0 - 1.5	4.5 - 5.0
1.5 - 2.25	5.0 - 5.75
2.25 - 3.0	5.75 - 6.75

Bike/Ped Crash Clusters-EPDO
- 2 - 8
- 9 - 13
- 14 - 22
- 23 - 34
- 35 - 56

Demographics and Predicted Bicycle Trip Rates

What is it?

Factors that influence rates of bicycling are not as well studied as pedestrian generation factors. Concerns about safety from motor vehicle traffic are likely the most significant factor influencing bicycling rates. The Level of Traffic Stress (LTS) map delves into that topic. But that map treats all parts of Holyoke equally. The Demographics and Predicted Bicycle Trip Rates map adds people to the picture. It attempts to show where bicycle trips are most likely to occur. Combined with the LTS Map it could help Holyoke prioritize key streets that are both key links and likely to serve a relatively large number of potential bicyclists.

When planners think about pedestrian trip generation they usually start from destinations (retail, parks, libraries, major employers, etc). Recent research, however, indicates that unlike pedestrian trip generation, proximity to destinations is not a major predictor of bicycle activity. That is likely because bicyclists will travel much longer distances than pedestrians (close to two miles instead of a ¼ mile). This spreads out the impact of destination proximity.

Demographic factors, on the other hand are correlated with bicycling trip rates. Young males make the vast majority of bicycle trips. In addition, income, vehicle ownership, and to a lesser extent ethnicity are associated with varying rates of bicycling. Based on this, we developed The Demographic Cycling Factors maps to show how demographics of Holyoke may impact bicycle use in Holyoke. It gives a rough picture of home-based bicycle trip generation rates for different parts of Holyoke.

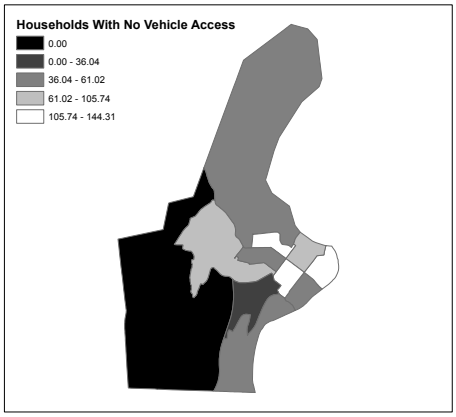
The map shows key demographic factors in the first six panels. The remaining five panels show the "demographic cycling factors." In these panels higher numbers (green colors) indicate expected higher bicycle trip rates. The average American makes 1 trip per 100 by bicycle (1%). In the key to the map, numbers greater than 1 indicate that higher than average bicycle trip rates (greater than 1%) would be expected from that census block or tract. Numbers lower than one (shades of red) have the opposite meaning (lower than expected bicycle trip rates).

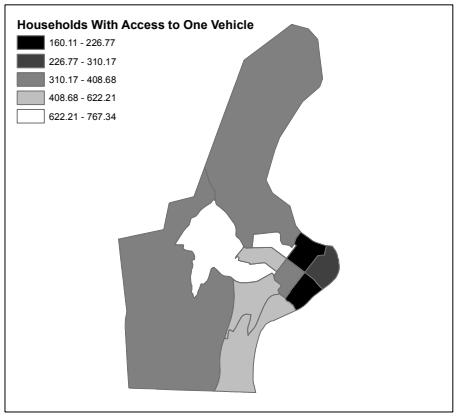
What does it show?

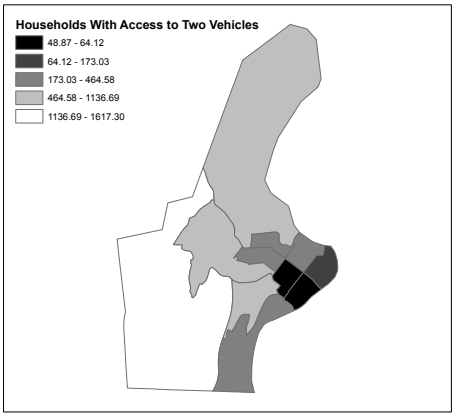
The cycling factor maps are intended to help Holyoke prioritize bicycle infrastructure investments. They can be interpreted in two ways. On the one hand, Holyoke can invest in those places that are likely to have the greatest bike trip share currently based on demographics. On the other hand, Holyoke could choose to prioritize the areas where bike trip share is low but where populations could respond to more safe, or convenient infrastructure. For example, females are generally more concerned about traffic safety when bicycling than males. This likely explains their current low trip share—since so few places nationwide provide adequate safety for cycling. Improving perception of traffic cycling in female dominated neighborhoods could result in dramatic increase in bicycling share.

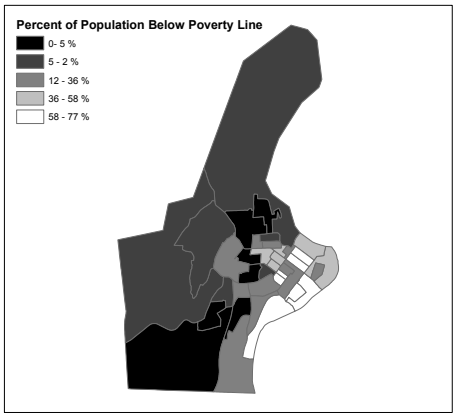
Taken together, the maps indicate that Downtown, Churchill, The Flats and South Holyoke are likely to have the highest residential-based bicycle trip generation rates per population. While bicycling is often perceived to be an upper class white lifestyle choice, "invisible riders" who bicycle for day-to-day transportation may provide a more significant opportunity to increase bicycling in Holyoke and these populations may have a more significant and pressing need for improved infrastructure.

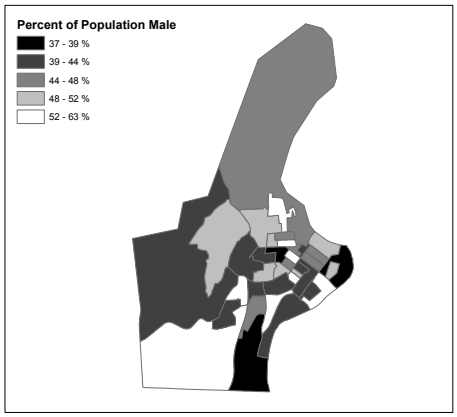
At the same time, it is important to recognize that bicyclists want to go somewhere. While it can be difficult to determine where each bicyclists wants to go, it might make sense for Holyoke to survey potential riders about desirable destinations and to establish a policy about which kinds of destinations Holyoke wants to prioritize bicycle access to, for examples schools, grocery stores, or employment centers like Holyoke Hospital, the Holyoke Mall or Memorial Drive in Chicopee. A recent web tool developed by Metropolitan Area Planning Council provides insight into possible bicycle destinations. Visit it at: http://localaccess.mapc.org/.

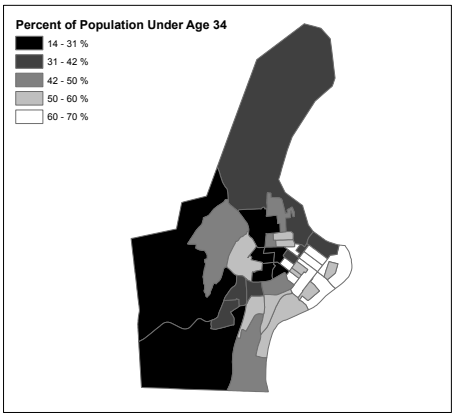


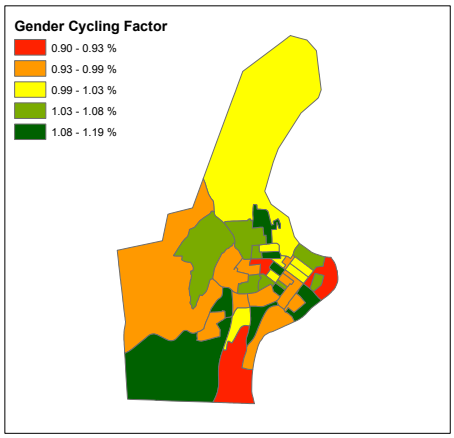


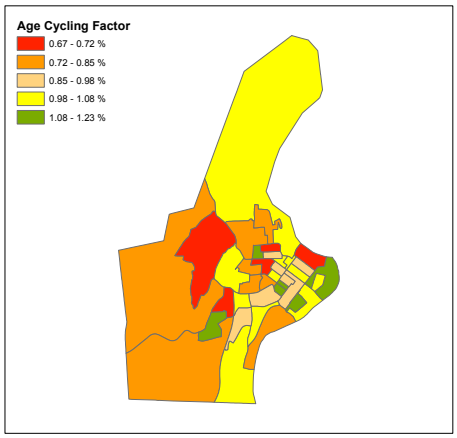


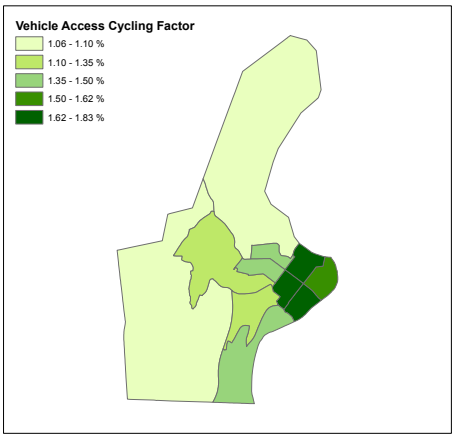










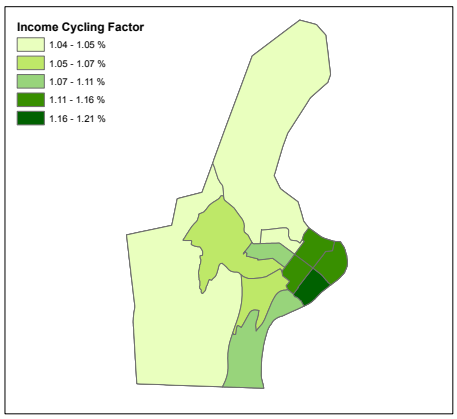


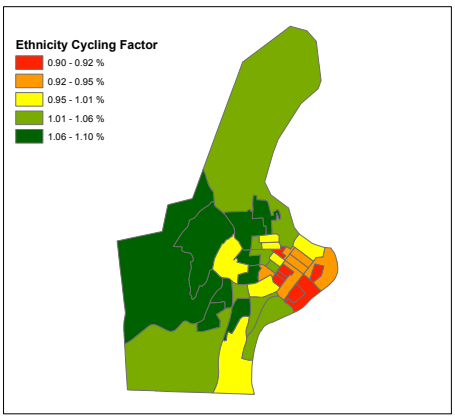
Overall, Americans make 1% of all of their trips by bicycle. Some populations, however, have higher or lower bicycle trip rates than average. This map shows key demographic factors, and how they may impact bicycle trip rates in Holyoke.

The top six panels of the map show key demographic factors by census geography. Populations who make the highest percent of their trips by bicycle include 5-15 year old (3.1% of trips by bicycle), households that do not own a car (2.5%), males (1.6%), and households in the lowest income quartile (1.3%). Populations who make the lowest percent of trips by bicycle include females (0.5% of trips by bicycle), people who are 65 years old or older (0.6%), and 25-39 year olds (0.7%). Bicycling rates vary by ethnicity but the range is relatively small (from 1.1% for whites to .9% for Asians and Hispanics).

The bottom five panels show demographic-based "cycling factors." Higher numbers (shades of green) indicate that we would expect a higher than average bicycle trip rate from that area based on demographic factors (more than 1%). Lower numbers (shades of orange and red) have the opposite meaning—we expect lower than average bicycle trip rates from that area. The "cycling factors" show the combined impact of both variation in population characteristics across Holyoke, and variation in bicycling rates by population.

This map is intended to help Holyoke prioritize bicycle infrastructure investments. Holyoke could choose to prioritize bicycle improvements in areas that currently have high bike trip rates. And/or Holyoke could choose to prioritize areas where bike trip share may be low, but where the populations might respond favorably to more safe, or convenient infrastructure. For example, when cities improve the safety of bicycle infrastructure, it generally has more impact on how often females bicycle than males.





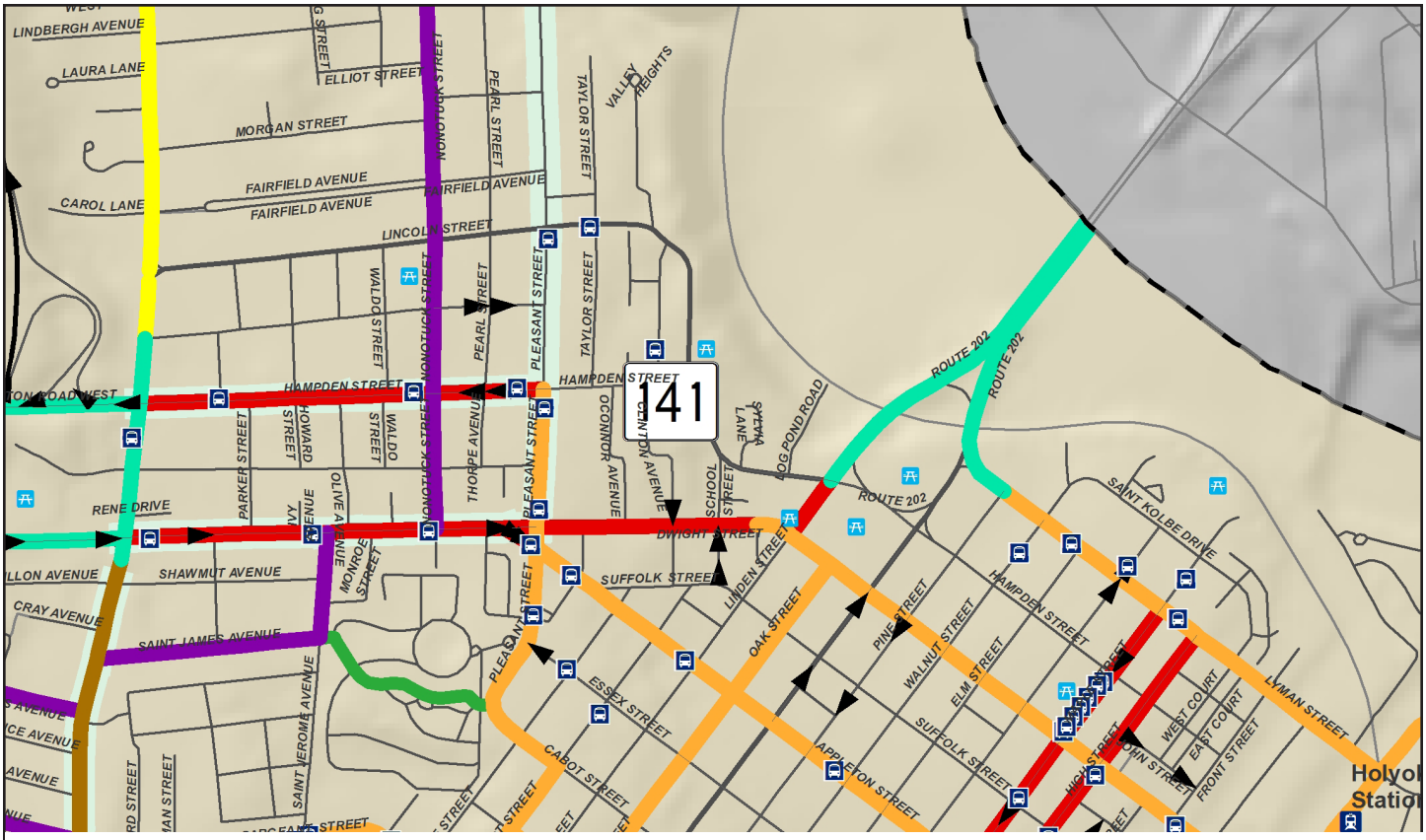
2015 Bicycle Plan Demographics & Predicted Bicycle Trip Rates

HOLYOKE, MA

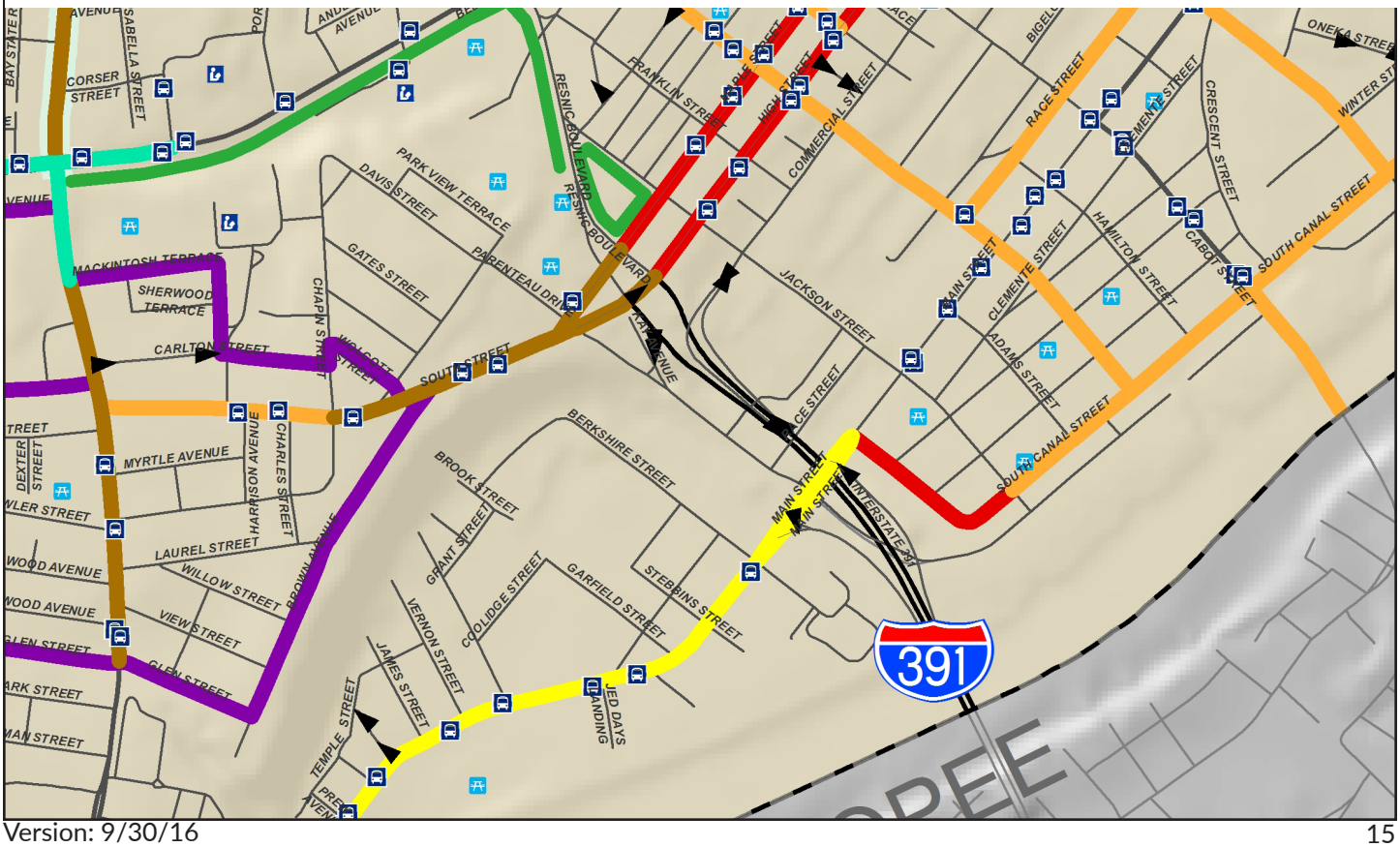
Existing Conditions, Conclusion

The analysis of existing conditions analysis shows that:

- Holyoke has a very strong network for bicycling with the need for a limited number of significant improvements to complete a low stress network.
- Bicycle network improvements should be prioritized in downtown Holyoke with a focus on key streets that have a high degree of connectivity. Many of these key connecting streets also have high crash rates. These include, but are not limited to Maple, High, Appleton, and Dwight streets.
- Connectivity into, and out of Holyoke, particularly on bridges downtown, needs to be improved for bicyclists. Improving the Route 116 Bridge to South Hadley is a key opportunity.
- Low volume residential streets throughout the city already provide many relatively low stress opportunities for bicycling outside of downtown. These streets should be publicized, improved where necessary, and linked to provide low stress bicycling opportunities. This will likely require improving key intersections with major roads and/or improving selected segments of major road where there is no existing low volume alternative route.
- Slopes should be carefully considered when planning Holyoke's bicycle network. Where possible, steep slopes should be avoided. When they must be used to provide connectivity, bicyclists should be provided with ample operating room and separation from motor vehicle traffic.



Proposed Bicycle Network



Proposed Bicycle Network

The Proposed Bicycle Network sketches out a comprehensive, interconnected network for bicycling in Holyoke using the city's existing street network.[1] It has two parts: a map showing key streets that make up the bicycle network; a set of drawings showing potential cross-sections for street types within the network.

The preceding analysis of existing conditions considered throughout the development of the Bicycle Network, including history of crashes, slopes, likely bicycle trip demand, bus routes, existing surface and right of way widths, and presence of on-street parking. Where possible, the proposed bicycle network uses street segments that currently have an LTS score of 1 or 2 and that also provide a high degree of connectivity. Street segments with LTS scores of 3 or 4 were used when necessary.

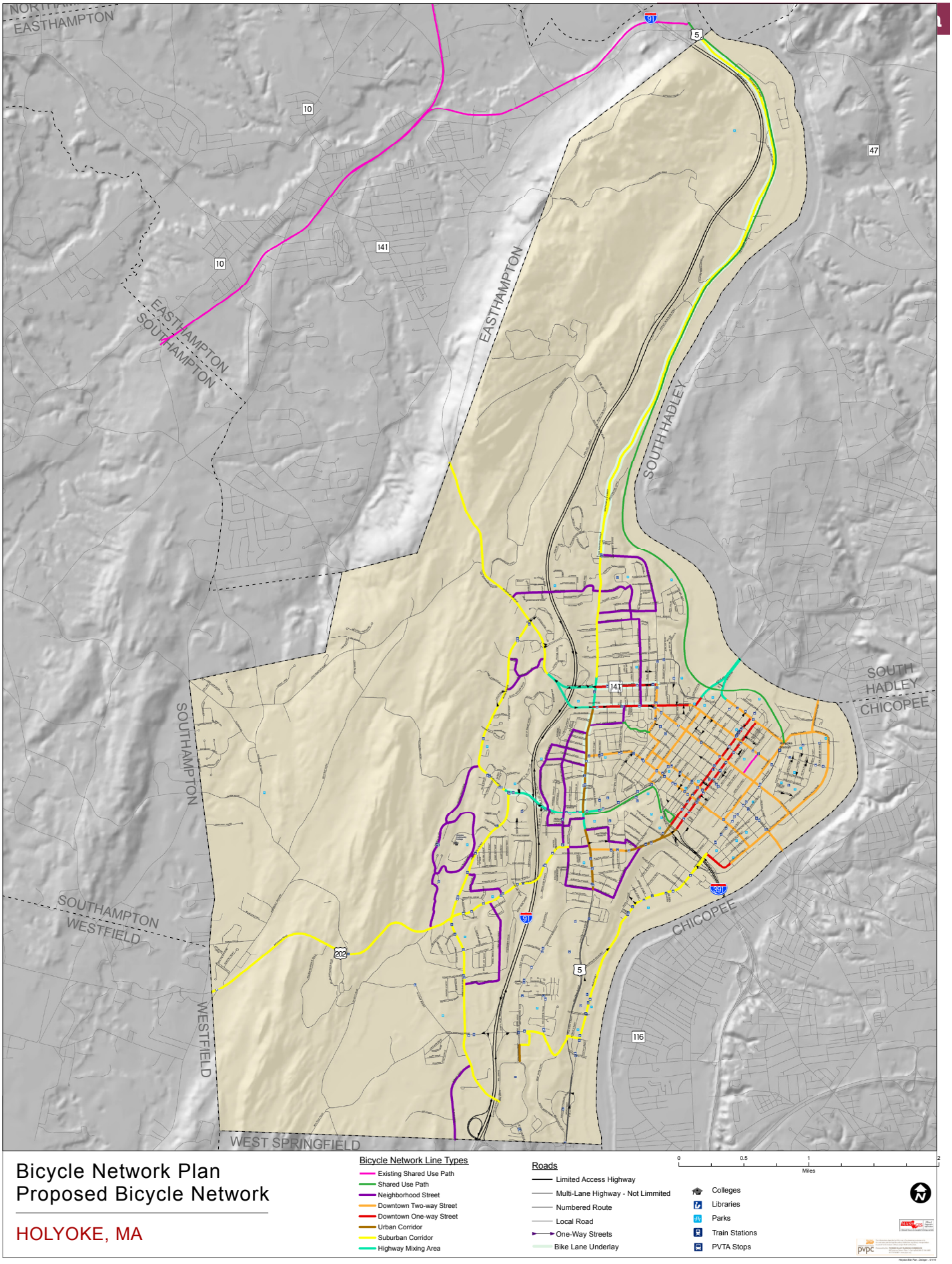
The network is divided into seven street types.

- Multi-use Path (also called shared-use path)
- Neighborhood Street
- Downtown Two-Way Street
- Downtown One-Way Street
- Urban Corridor
- Suburban Corridor
- Highway Mixing Area

The street types reflect the diversity of existing streets in Holyoke based on their physical characteristics (width, number and type of lanes, right of way width, traffic volumes) and their land use context (downtown mixed use, residential, suburban or rural). Possible cross-sections for incorporating bicycle facilities into each street type are presented after the Proposed Bicycle Network map.

While all streets shown in the network are important, the preceding analysis points toward the value of prioritizing improvements to streets in downtown Holyoke, especially those that have a low LTS score, provide key connections and have a history of bicycle and/or pedestrian crashes.

1 Evaluating off-street routes, such as the often recommended Rail Trail paralleling the Connecticut River, was beyond the scope of this project.


NORTHAMPTON
EASTHAMPTON
10
10
141
EASTHAMPTON
SOUTHAMPTON
EASTHAMPTON
91
5
47
SOUTH HADLEY
SOUTH HADLEY
CHICOPEE
141
SOUTHAMPTON
SOUTHAMPTON
WESTFIELD
391
91
CHICOPEE
202
5
116
WESTFIELD
WEST SPRINGFIELD
Bicycle Network Plan
Proposed Bicycle Network
HOLYOKE, MA
Bicycle Network Line Types
Existing Shared Use Path
Shared Use Path
Neighborhood Street
Downtown Two-way Street
Downtown One-way Street
Urban Corridor
Suburban Corridor
Highway Mixing Area
Roads
Limited Access Highway
Multi-Lane Highway - Not Limmited
Numbered Route
Local Road
One-Way Streets
Bike Lane Underlay
Colleges
Libraries
Parks
Train Stations
PVTA Stops
0
0.5
1
2
Miles
pvpc

Bicycle Network Street Types

Introduction

The drawings that follow show a variety of potential bicycle facility treatments appropriate to each of the seven bicycle network street types. In addition, drawings are presented for several key streets including, Maple Street, High Street, Dwight Street and North & South Canal Street.

A number of options is provided for each street type to reflect the diversity of existing conditions and the diverse needs of bicyclists of varying abilities and comfort levels. For each street type, cross-section drawings are ordered from those that will provide the greatest level of comfort (lowest stress) to bicyclists to those that will provide the least (highest stress). In general, separated bicycle lanes provide the greatest level of comfort and safety for bicyclists. Buffered bicycle lanes, and standard bicycle lanes follow. Some people question whether adding shared bicycle lane markings results in a significant improvement in bicyclist comfort or safety. On the other hand streets that have low speeds, and low traffic volumes may be comfortable for most bicyclists without further improvements. Bicycle infrastructure improvements should be combined with other traffic calming measures. The concept of bicycle boulevards is particularly worth considering for Holyoke. For more information on various kinds of bicycle infrastructure including bicycle boulevards see: http://nacto.org/publication/urban-bikeway-design-guide/. In addition, infrastructure improvements should be complemented by other efforts including encouragement, education, and enforcement.

When evaluating which of the proposed cross-sections is most appropriate for a specific street improvement project, the city should consider the preceding analysis maps, and consider additional site-specific factors including on-street parking utilization, frequency of bus and truck traffic, need for on-street loading (typically for retail uses), existing traffic volumes and speeds, existing surface width and ROW width, etc.

Intent of Drawings

The drawings contained in this report are for planning purposes only. Determining appropriate lane configurations and dimensions for specific locations would require field verification of existing conditions, projection of future traffic demands, and design by a qualified professional. All dimensions shown should be viewed as approximate. Dimensions shown often indicate typical minimum requirements. Depending on context, the dimensions shown here may be less than recommended ideal widths cited in standard design guides. In other contexts, lane widths may be larger than necessary.

Notes on Abbreviations in Drawings

(46') when shown in drawing title=total surface width of travel lanes; does not include sidewalks. This width is a general guideline and can be reduced or expanded by modifying lane widths.

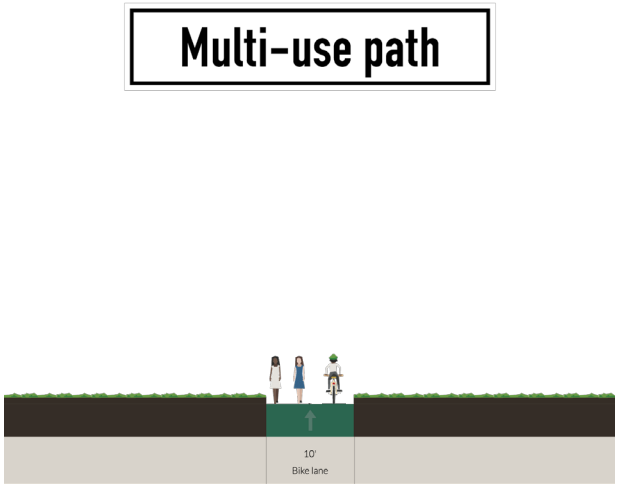
Bus lane=The designation of a 'bus lane' or 'drive lane' in the graphics is a default that comes from the application used to create the graphics (streetmix.net). It should not be interpreted as a recommendation for exclusive bus lanes. Rather, we used the "bus lane" symbol when a street type often has bus routes. We used the "drive lane" symbol elsewhere. While, 12' is the default width we used for bus lanes, 12' should not be considered a rigid minimum. There are numerous examples in the Pioneer Valley of bus routes with less than 12' lanes, including the heavily traveled Coolidge Bridge between Hadley and Northampton. Lane widths should be set based on context and operational requirements.

Contra-flow SBL=a separated bike lane in which the bicycle traffic flows in the opposite direction from motor vehicle traffic.

Drive lane=see the explanation for bus lane above

SBL=Separated Bicycle Lane

Multi-use Path



NOTES

Typical width 10' or greater.

Shared by bicyclists and pedestrians. Separated from motor vehicle traffic.

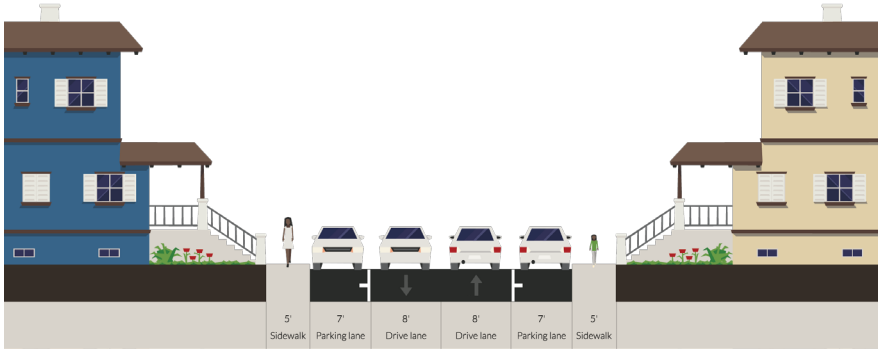
Very high level of comfort for all bicyclists.

Typically requires significant investment in new construction.

Recommended for perimeter of Sheard Park, adjacent to Beech Street, and within Forestdale Cemetery. Also consider for along rail corridor paralleling Connecticut River between downtown Holyoke and Northampton.

Neighborhood Street

Neighborhood St., Typ. Current Conditions (30')



NOTES

Typical current conditions. Surface width varies from 24-43'.

Lane markings are often not striped.

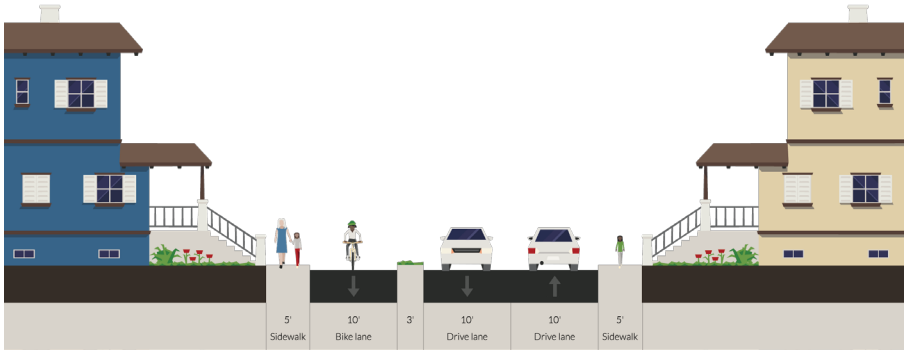
On-street parking utilized on one or both sides of the street according to neighborhood custom

Vehicles operate in yield-street fashion.

No bicycle accommodations provided.

Travel speeds & volumes are typically low.

Street w/Two-way SBL (33')

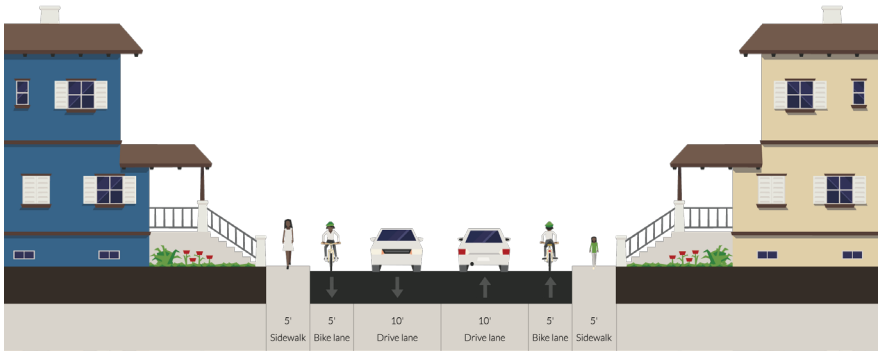


NOTES

Two-way separated bicycle lane provides high level of bicyclist comfort. Requires close attention to design at intersections for contra-flow portion of two-way separated bike lane.

On-street parking provided when space allows.

Neighborhood Street w/Bike Lanes (30')



NOTES

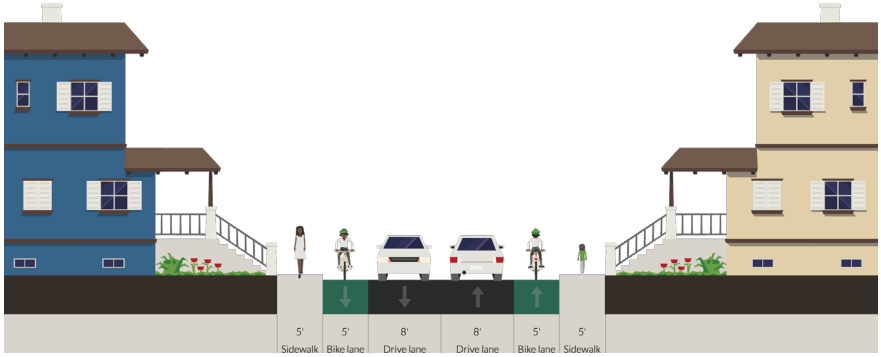
Standard bike lanes provide moderate level of comfort for bicyclists.

On-street parking is provided only when sufficient width is available.

May encourage faster vehicle speeds than a similar width yield street with on-street parking.

Neighborhood Street

Advisory Bike Lane (26' surface width)



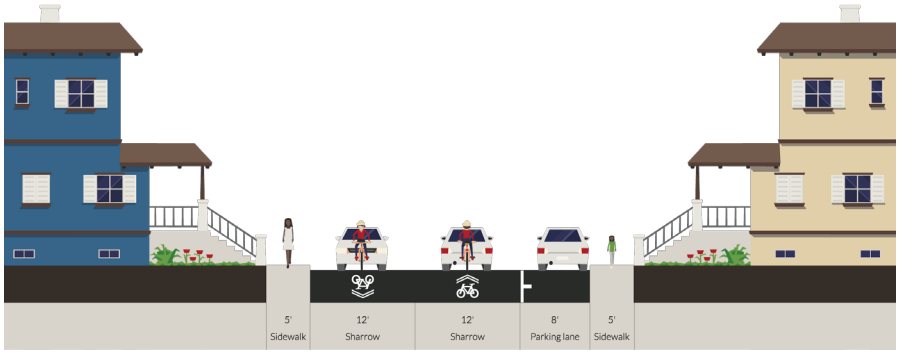
NOTES

Advisory bike lanes can be used when width is not available for standard bike lanes. Bike lane stripes are dashed. A yellow line is not painted in the center of the street. Motor vehicles travel in the center of the street and can yield to on-coming motor vehicles by moving into bike lanes as needed.

On-street parking can be provided on one or both sides of the street

Travel speeds & volumes are typically low.

Street w/Shared Lanes + Parking (32')

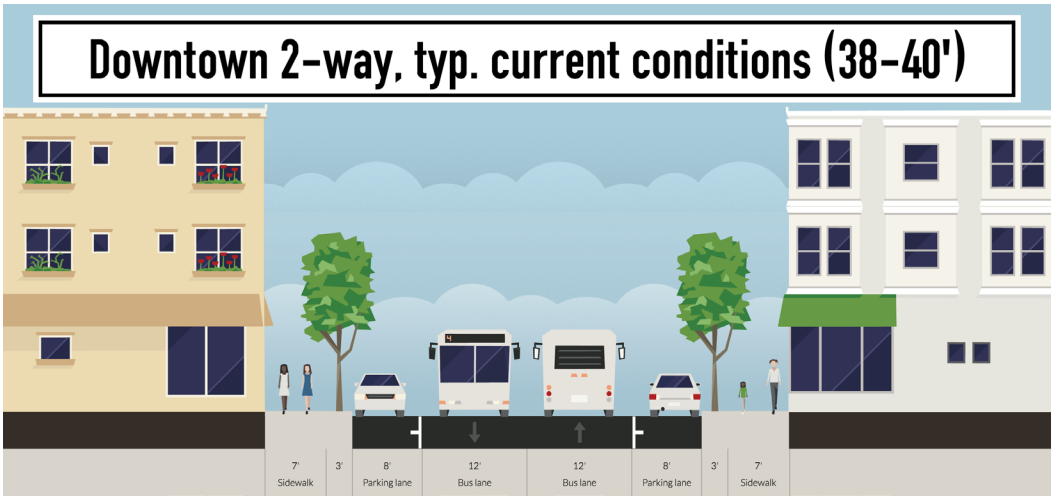


NOTES

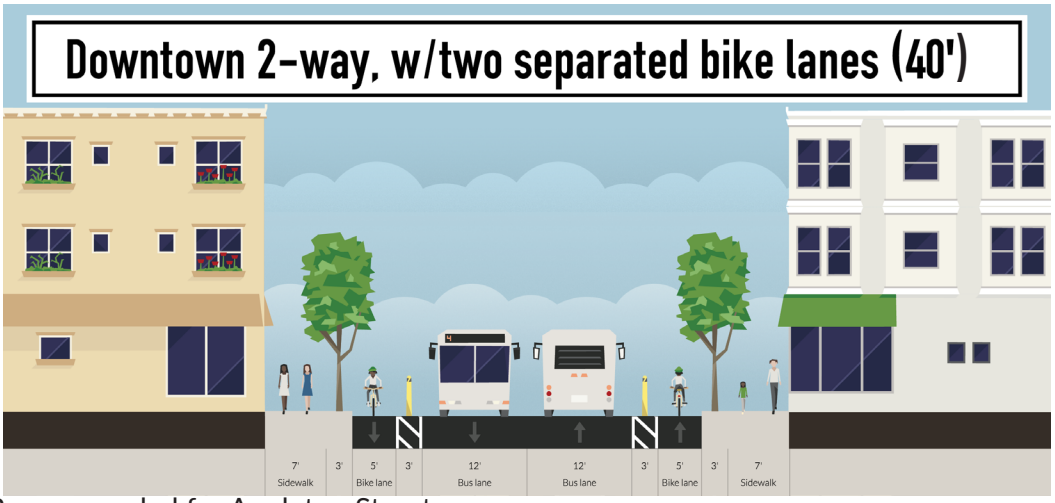
Shared lane markings designate that travel lanes are shared by bicycles and motor vehicles. This configuration has minimal impact on bicyclists' level of comfort or safety.

Parallel parking is provided on one or both sides of the street as surface width and ROW allow.

Downtown Two-way Street

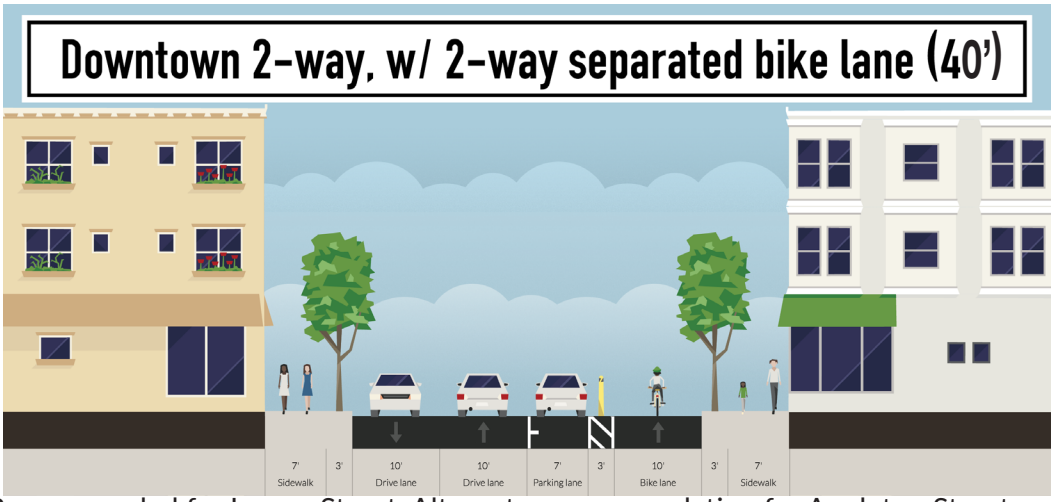


NOTES
Typical current conditions
Existing surface width varies (approximately 34-40').
Typically, parallel parking is provided on both sides of the street.
Typically, bike accommodations are not provided.
Some streets have bus service. Others do not.



NOTES
Maximizes bike level of comfort by providing separated bicycle lanes in both directions.
Eliminates on-street parking.

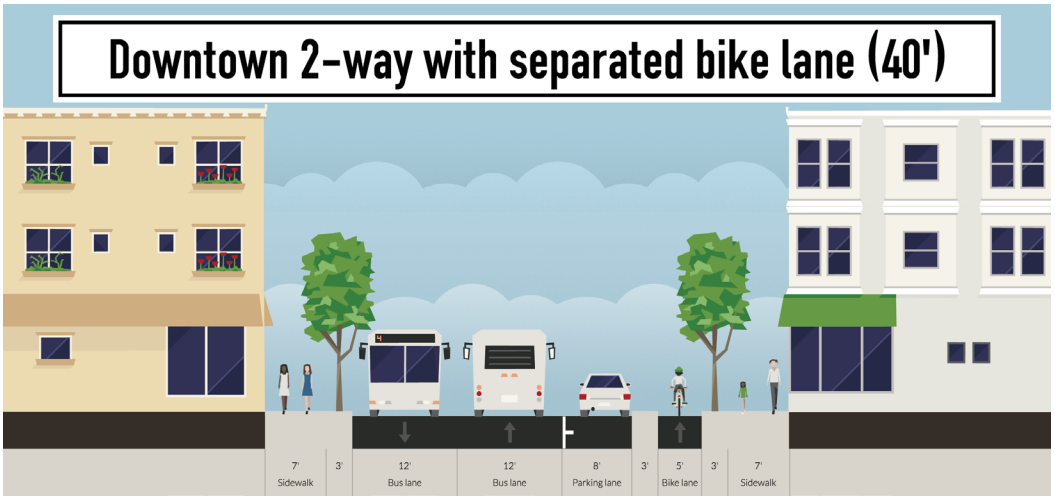
Recommended for Appleton Street



NOTES
Two-way separated bicycle lane provides high level of bicyclist comfort. Requires close attention to design at intersections for contra-flow portion of two-way separated bike lane.
Vehicle lane widths reduced to 10'.
On-street parking provided on one side of street only.

Recommended for Lyman Street. Alternate recommendation for Appleton Street. Reduce motor vehicle travel lane widths as needed.

Downtown Two-way Street



Recommended for Sargeant Street and Hampshire Street

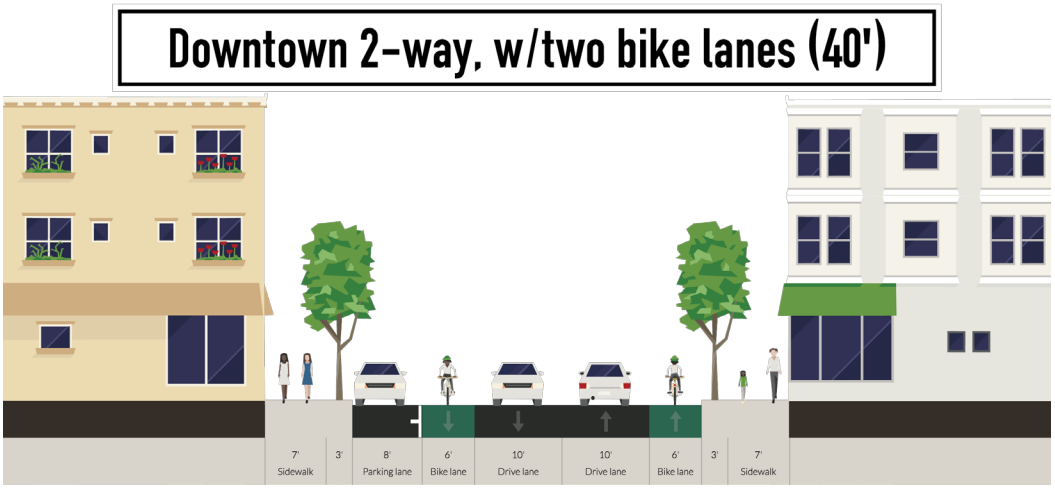
NOTES

Provides a separated bicycle lane in one-direction only.

Full-width (12') vehicle lanes provided in both directions.

On-street parking provided on one-side of the street.

Should be paired with a nearby parallel street that accommodates bicycle traffic in the opposite direction.



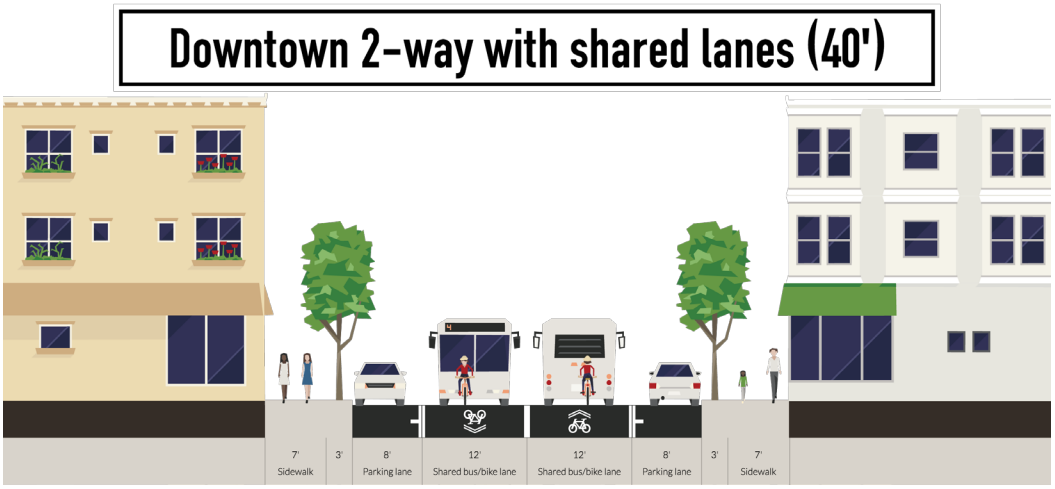
Recommended for Race Street.

NOTES

Standard bike lanes provide moderate level of comfort for bicyclists.

Parallel parking is provided on one side of the street.

Narrow vehicle travel lanes may not be appropriate in some circumstances.



Recommended for Oak Street, Locust Street, Cabot Street, Pleasant Street. Support with traffic calming.

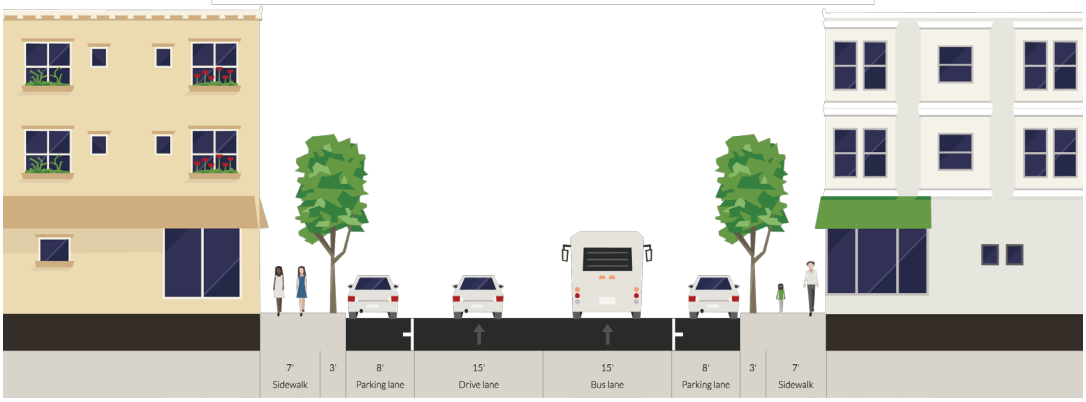
NOTES

Shared lane markings designate that travel lanes are shared by bicycles and motor vehicles. This configuration has minimal impact on bicyclists' level of comfort or safety.

Parallel parking is provided on both sides of the street.

High Street with one-way motor vehicle travel

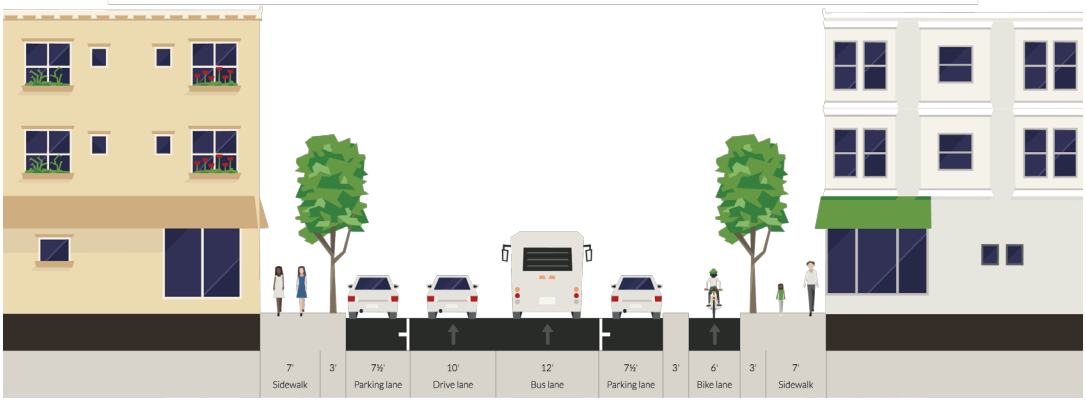
High St, existing conditions (46')



NOTES

Typical current conditions
Street has one-way travel
Typical existing surface width is approximately 46'.
Parallel parking is provided on both sides of the street.
Bike accommodations are not provided.
Travel lanes are very wide.
Travel lanes are occasionally used for double-parking or loading.

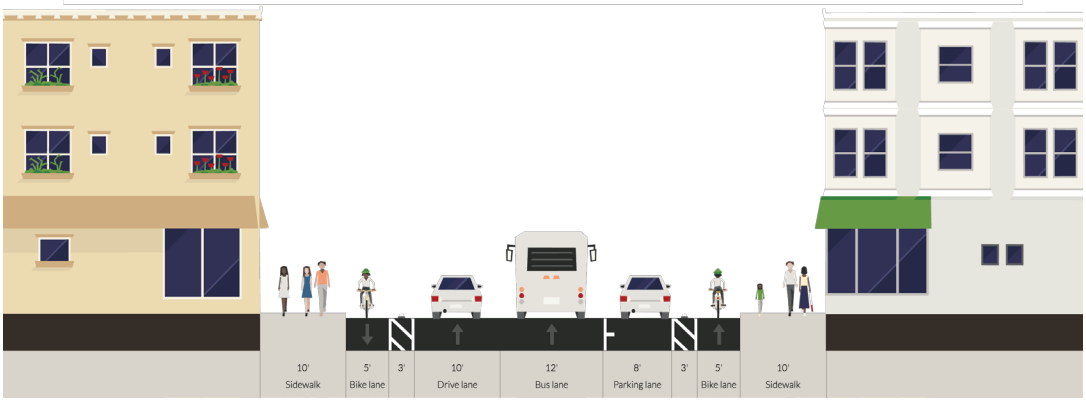
High St, 1-way, with SBL (46' surface width)



NOTES

A separated bike lane provides maximum comfort for bicyclists. Ideally the separated bike lane would be at sidewalk elevation level.
Parking and travel lane widths are reduced to accommodate bicycle facilities.

High St, 1-way, with Contra-flow SBL + SBL (46')

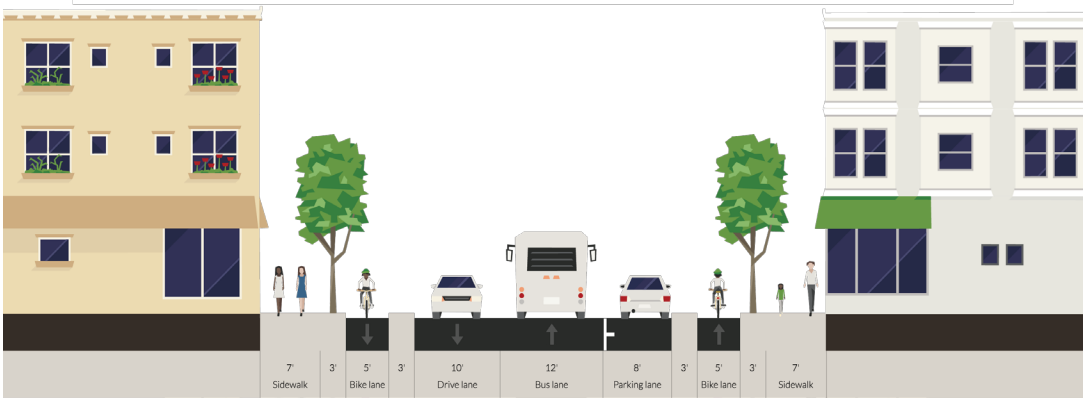


NOTES

Two separated bike lanes provide two-way travel and maximum comfort for bicyclists. Ideally, the separated bike lanes would be at sidewalk elevation level. A curb-stop buffer is shown.
Vehicle lane widths are reduced. On-street parking is provided on one side of the street.
Contra-flow bike lane requires dedicated bike signals heads.

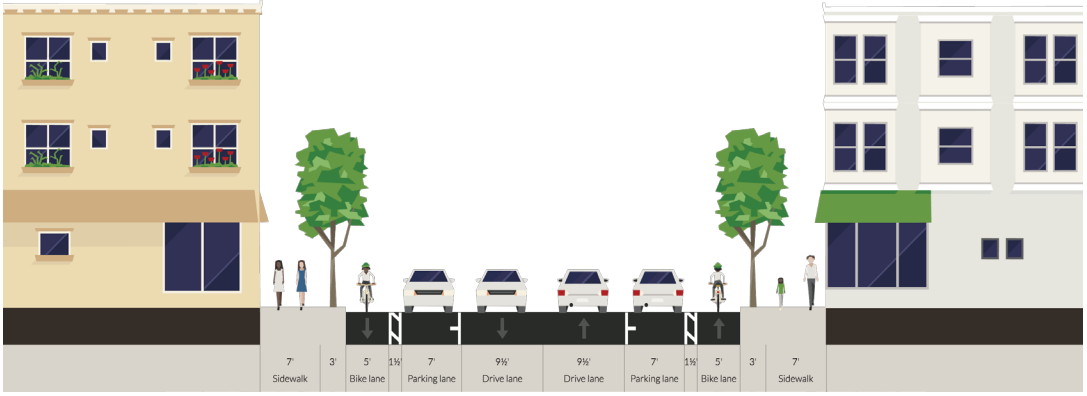
High Street with two-way motor vehicle travel

High St, 2-way, w/2 SBLs & 1 Parking Lane (46')



NOTES
- High St. is converted to two-way travel.
- Separated bike lanes in each travel direction provide maximum comfort for bicyclists.
- On-street parking is provided on one side of the street only.

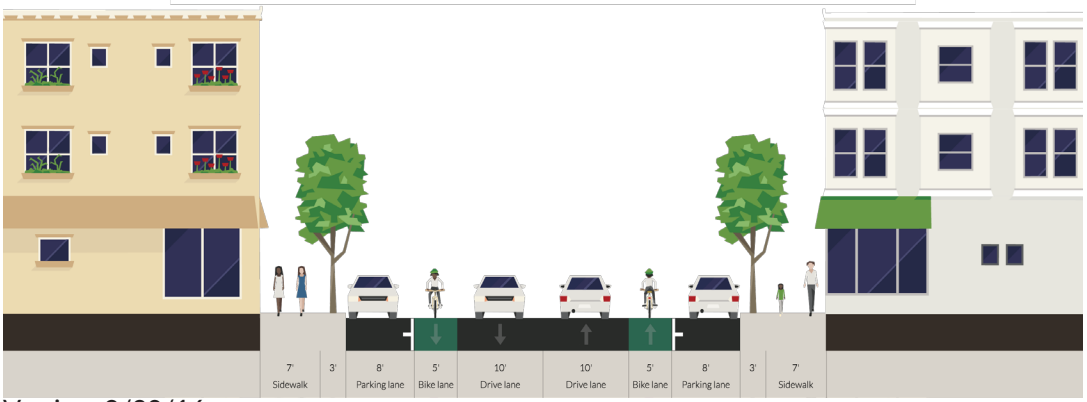
High St, 2-way, with SBLs (46')



NOTES
- High St. is converted to two-way travel.
- Buffered or separated bike lanes in both directions provide a high level of comfort for bicyclists.
- 1 parking lane & 1 vehicle lane is provided in each direction. Widths are reduced to accommodate bicycle facilities.

Note: If vehicle lanes are too small for buses, this concept could be paired with converting Maple Street to two-way traffic and consolidating all bus traffic to Maple Street.

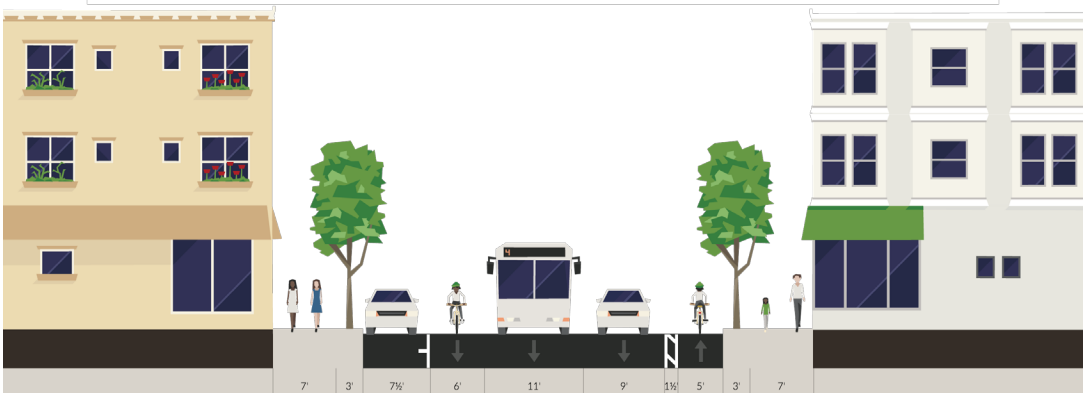
High St, 2-way, with Bike Lanes (46')



NOTES
- High St. is converted to two-way travel.
- Standard bike lanes in both directions provide a moderate level of comfort for bicyclists.
- One parking lane and one vehicle travel lane is provided in each direction.

Maple Street with one-way motor vehicle travel

Maple St, 1-way, with contra-flow SBL (40')



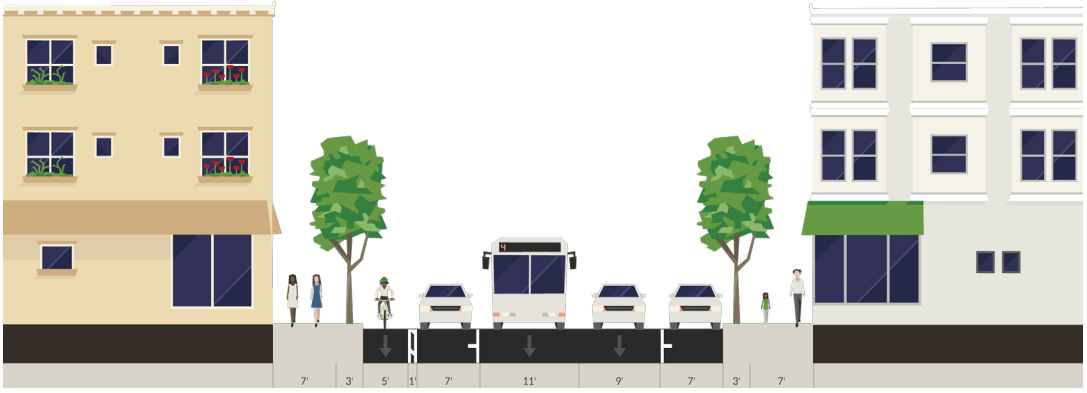
NOTES

A standard bike lane runs with the direction of motor vehicle travel.

A contra-flow separated bike lane runs in the opposite direction. Ideally the separated bike lane would be at sidewalk elevation level. Requires new bicycle signal heads.

One parking lane and two motor vehicle lanes are retained. Their widths are reduced, as needed.

Maple St, 1-way, with SBL (40')

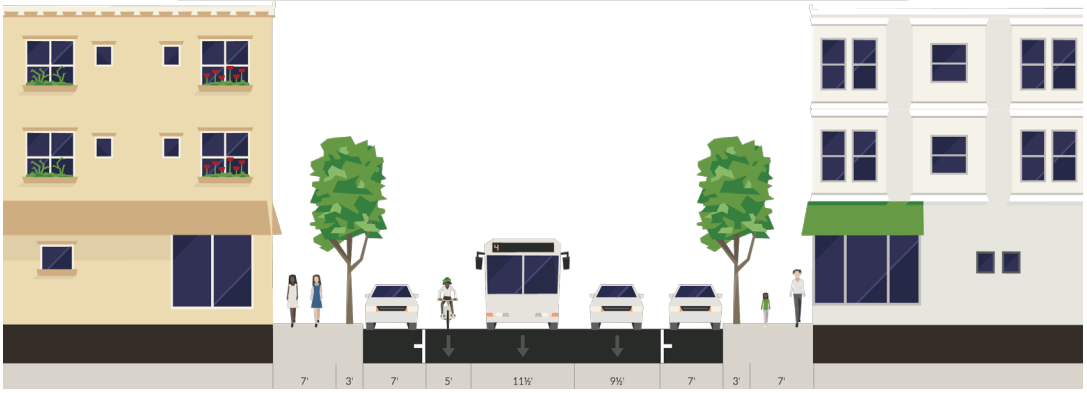


NOTES

One separated bike lane is added. Ideally, the separated bike lane would be at sidewalk elevation level

Two parking lanes and two motor vehicle travel lanes are retained. Their widths are reduced, as needed.

Maple, 1-way, with bike lane (40')



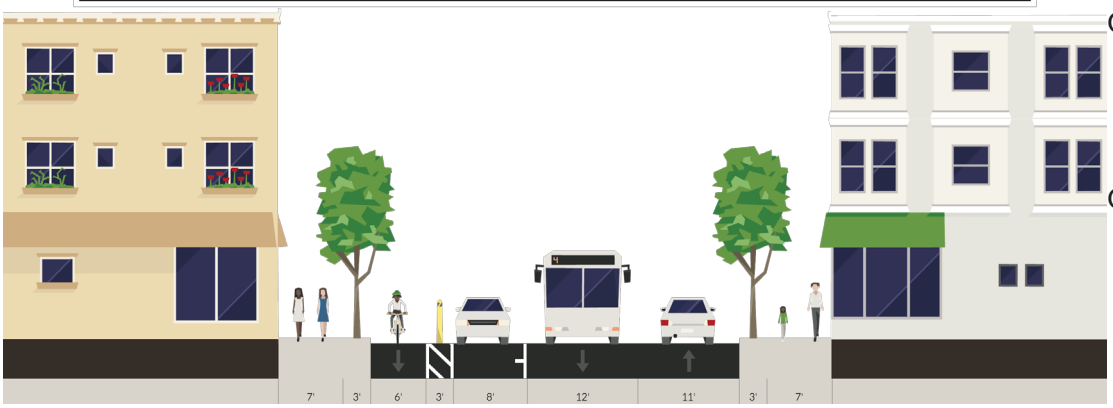
NOTES

One standard bike lane is added. It will provide a moderate level of comfort to bicyclists.

Two parking lanes and two motor vehicle travel lanes are retained. Their widths are reduced, as needed.

Maple Street with two-way motor vehicle travel

Maple St, 2-way, with SBL (40' surface width)



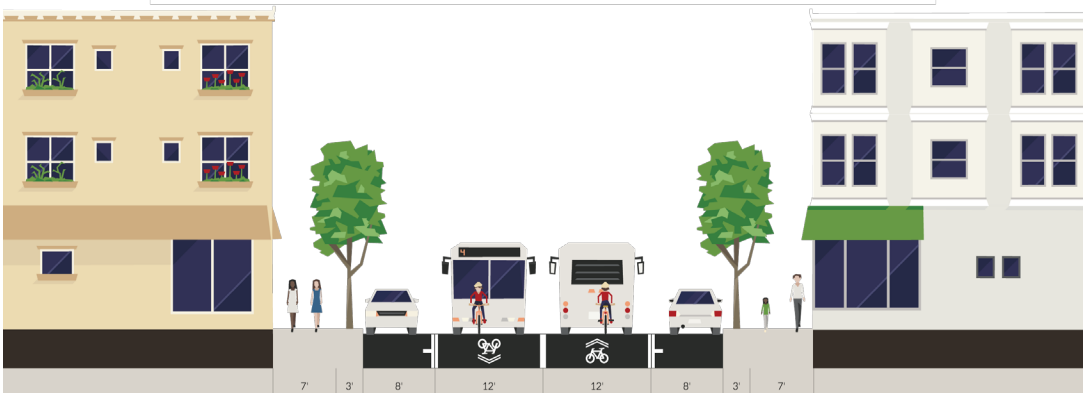
NOTES

Maple St. is converted to two-way travel.

One separated bike lane is added. Ideally, the separated bike lane would be at sidewalk elevation level.

One parking lanes and two motor vehicle travel lanes are retained. Their widths are reduced, as needed.

Maple, 2-way with shared lanes (40')



NOTES

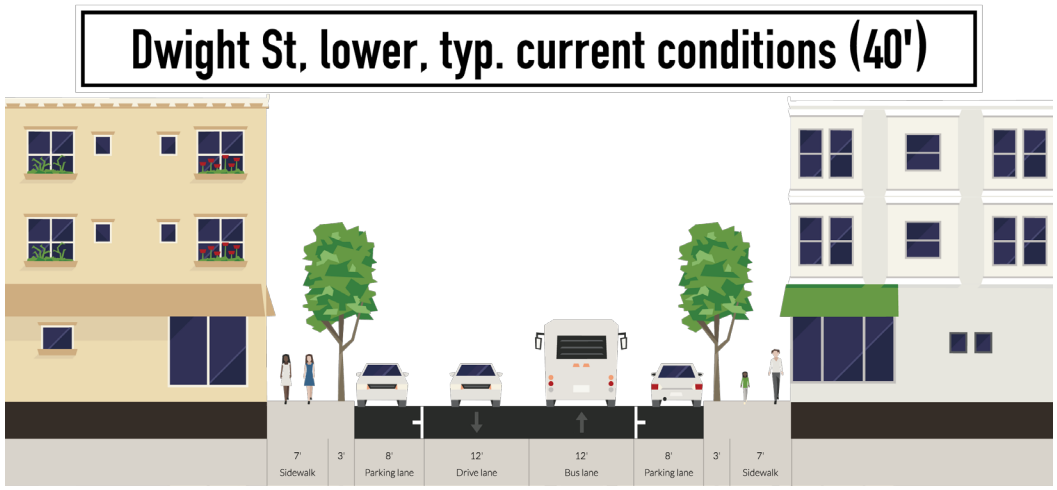
Maple St. is converted to two-way travel.

Shared-lane markings are added. They provide a low level of comfort to bicyclists.

Two parking lanes and two motor vehicle travel lanes are retained at current dimensions.

NOTE: Currently, Maple St is one-way street and has bus service in one direction only. If Maple Street was converted to two-way travel, it might make sense to consolidate bus service from High Street onto Maple Street. This would enable smaller motor vehicle lanes on High St, which would open options for bike facilities on High St.

Dwight Street, lower (two-way)

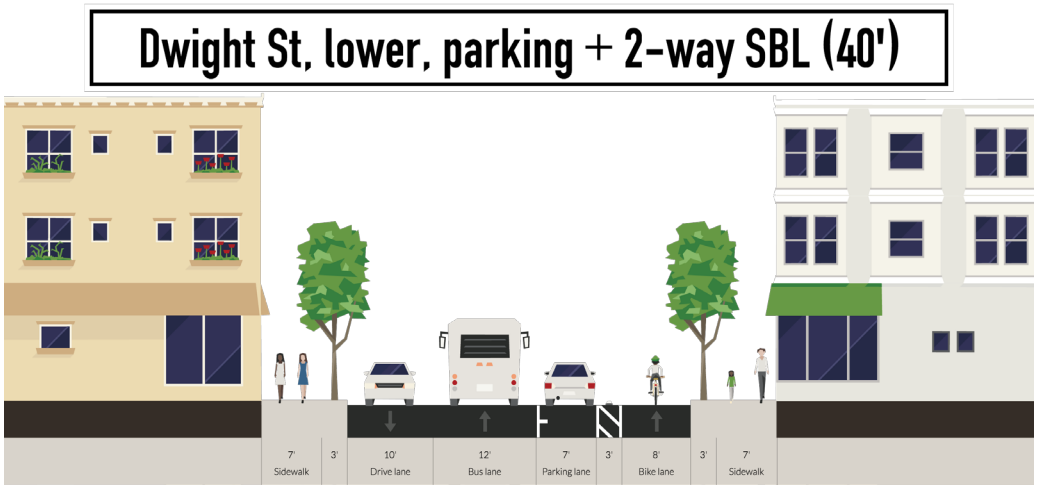


NOTES

Typical current conditions for lower Dwight Street between Main Street and Linden Street.

Street has two-way travel with one motor vehicle lane and one parking lane in each direction.

Bicycle facilities are not provided.



NOTES

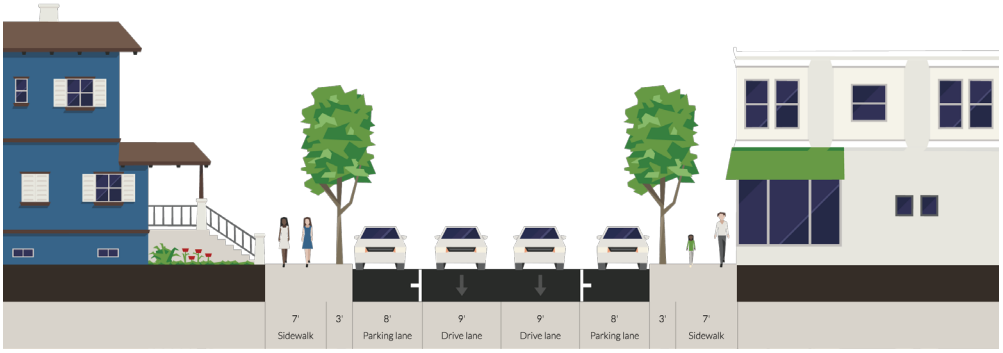
Proposed for lower Dwight Street.

On-street parking is provided on one-side of the street only. Parking and travel lane widths are narrowed.

A two-way separated bike lane provides for two-way travel. Design would require close attention at intersections and driveways due to contra-flow bike travel. Two-bicycle lane may be narrower than required. A curb stop is shown separating the bicycle lane from the parking lane. Elevating the bicycle lane to sidewalk level would be preferable.

Dwight Street, middle (one-way or two-way)

Dwight St, middle, typ. current conditions (34')



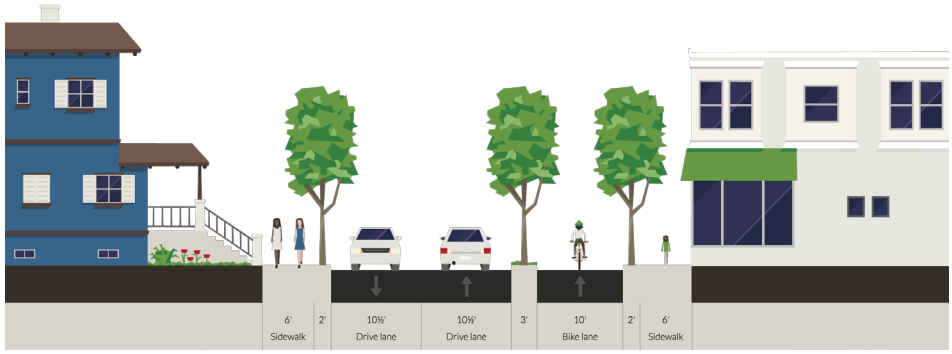
NOTES

Typical current conditions for middle Dwight Street between Linden Street and Pleasant St.

Street has one-way travel with two motor vehicle lanes and two parking lanes.

Bicycle facilities are not provided.

Dwight, middle, with 2-way SBL (34')



NOTES

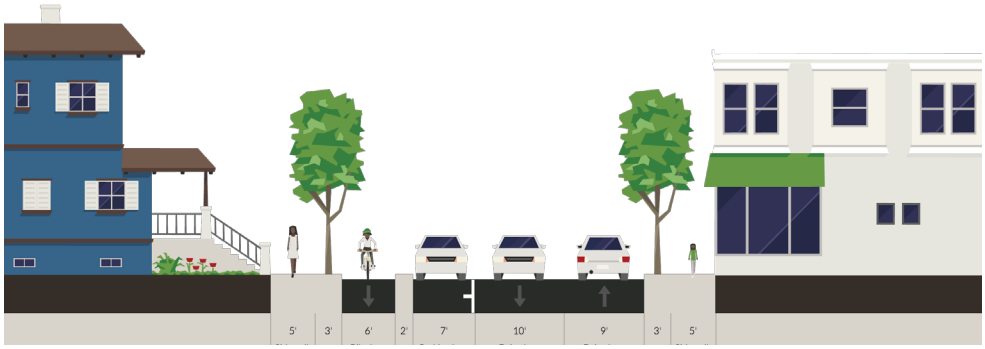
Proposed for middle Dwight Street.

Street is converted to two-way travel with one travel lane in each direction.

A two-way separated bike lane provides for two-way travel with maximum bicyclist comfort.

On-street parking is not provided.

Dwight St, middle, two-way w/SBL (34')



NOTES

Proposed for middle Dwight Street.

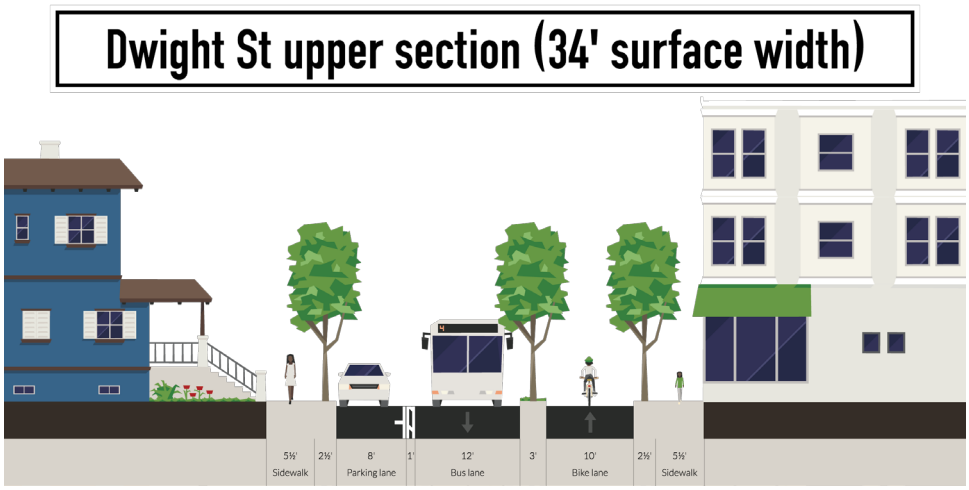
Street is converted to two-way travel with one travel lane in each direction.

On-street parking is provided on one-side of the street only.

A one-way separated bike lane provides maximum bicyclist comfort.

Note: The direction of the motor vehicle lane at right could be switched and this configuration would provide for one-way motor vehicle travel.

Dwight Street, upper (one-way)



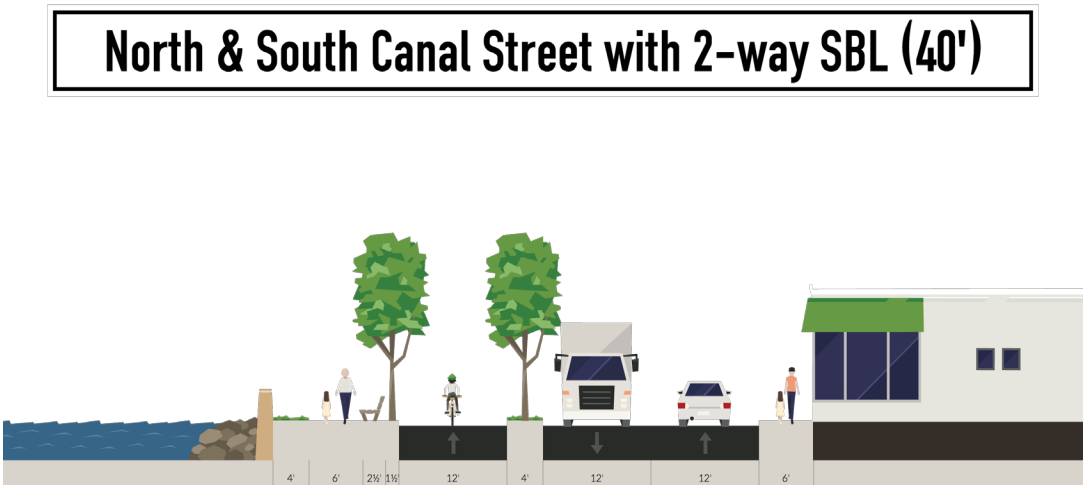
NOTES

Applies to upper Dwight Street between Pleasant St and Northampton St.

A two-way separated bike lane provides maximum comfort for bicyclists.

This area currently has a standard bike lane. motor vehicle and parking lane configurations currently vary.

North and South Canal Street



NOTES

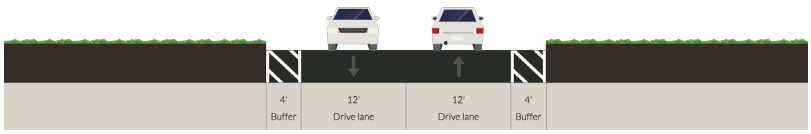
A two-way separated bicycle lane next to the canal provides maximum comfort for bicyclists while still accommodating heavy truck traffic. Where space allows a pedestrian walkway can be added between the separated bicycle lane and the canal. Or pedestrians and bicyclists can share the separated bike lane--it would then be considered a multi-use path.

The southern end of South Canal Street is currently one-way. Continuing the two-way separated bike lane through this portion provides an important bicycle-friendly connection to Main Street and the southern portion of Holyoke.

On-street parking can be provided when necessary and where space allows.

Suburban Corridor

Suburban Corridor, Typ. Current Conditions



NOTES

Typical current conditions. Surface width varies from about 24-44'.

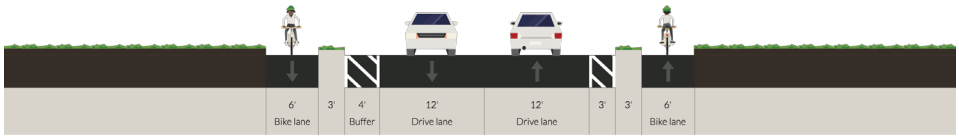
Lanes are typically striped. Shoulder width varies depending on available surface and right of way width.

On-street parking typically absent.

Bicycle accommodations typically not provided.

Travel speeds & volumes are typically high.

Suburban Corridor, w/SBLs

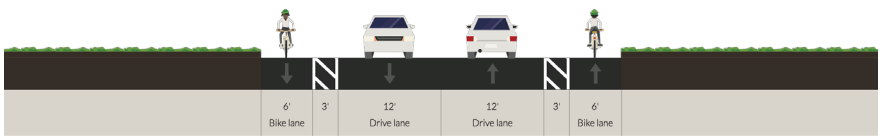


NOTES

Separated bike lanes provide maximum bicycle comfort. This level of bicycle accommodation may be required to encourage less confident riders on these fast and high volume roads.

Requires significant road reconstruction and widening. May require ROW expansion.

Suburban Corridor w/Buffered Bike Lanes



NOTES

Buffered bike lanes provide low-moderate level of comfort for bicyclists.

Fast travel speeds and high vehicle volumes make this street type uncomfortable for all but the most confident riders unless separated bike lanes are provided.

Buffered bike lanes will typically require road widening.

Urban Corridor

NOTES

Current conditions vary widely and are characterized by high vehicle volumes and speeds with numerous turning movements.

High level of separation and attention to design detail required to accommodate bicycles.

Requires customized design. May feature accommodations including separated bike lanes, dedicated bicycle signals, two-stage turn boxes, protected intersections, etc.

Typically bicycle accommodation will require road widening and/or right-of-way expansion.

Highway Mixing Area

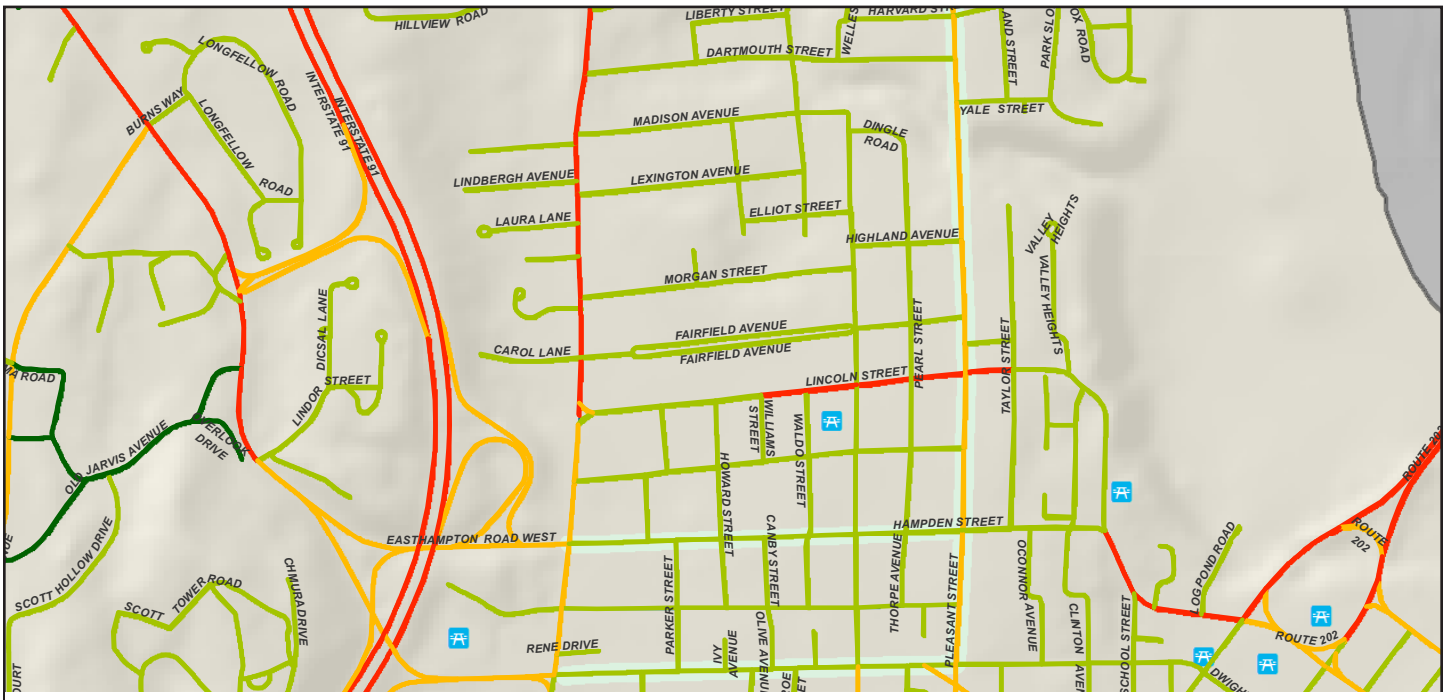
NOTES

Current conditions vary widely and are characterized by high vehicle volumes and speeds with numerous turning movements--often with slip lanes.

A high level of separation and attention to design detail required to accommodate bicycles.

Requires customized design. May feature accommodations including separated bike lanes, dedicated bicycle signals, protected intersections, etc.

Typically, bicycle accommodation will require road widening and/or right-of-way expansion.


HILLVIEW ROAD
LIBERTY STREET
DARTMOUTH STREET
YALE STREET
LONGFELLOW ROAD
BURNS WAY
INTERSTATE 91
MADISON AVENUE
DINGLE ROAD
LINDBERGH AVENUE
LEXINGTON AVENUE
LAURA LANE
ELLIOT STREET
HIGHLAND AVENUE
MORGAN STREET
VALLEY HEIGHTS
DICSAL LANE
FAIRFIELD AVENUE
CAROL LANE
LINDOR STREET
LINCOLN STREET
PEARL STREET
TAYLOR STREET
WILLIAMS STREET
WALDO STREET
OLD JARVIS AVENUE
ERLO DRIVE
HOWARD STREET
CAMBY STREET
HAMPDEN STREET
EASTHAMPTON ROAD WEST
THORPE AVENUE
O'CONNOR AVENUE
CLINTON AVENUE
LOG POND ROAD
ROUTE 202
SCOTT HOLLOW DRIVE
CHMURA DRIVE
SCOTT TOWER ROAD
RENE DRIVE
PARKER STREET
IVY AVENUE
OLIVE AVENUE
PLEASANT STREET
SCHOOL STREET

Appendix


COLUMBUS AVENUE
RIDGEWOOD AVENUE
CONCORD AVENUE
THOMAS AVENUE
CLAREMONT AVENUE
PINEHURST ROAD
HICKS AVENUE
HILLSIDE AVENUE
FORER AVENUE
ISABELLA STREET
PORTLAND STREET
MACKENZIE AVENUE
LADD STREET
ANDERSON AVENUE
SARGEANT STREET
HAMPSHIRE STREET
MAGNOLIA AVENUE
SYCAMORE STREET
ELM STREET
CHESTNUT STREET
MAPLE STREET
NEWTON STREET
WORCESTER PLACE
CABOT STREET
NICK COSMOS WAY
RAMP-RT 91 SB TO RT 202
RAMP-RT 202 TO RT 91 NB
COMMUNITY FIELD ROAD
NORWOOD TERRACE
CHERRY HILL
CALUMET ROAD
BAY STATE ROAD
CORSER STREET
BEECH STREET
CHERRY STREET
LARNODALE AVENUE
FRANKLIN STREET
RESNIC BOULEVARD
COMMERCIAL STREET
PARK VIEW TERRACE
DAVIS STREET
AVON PLACE
MERKEL TERRACE
ARGYLE AVENUE
COIT STREET
MACKINTOSH TERRACE
GATES STREET
PARENTEAU DRIVE
JACKSON STREET
MONRY AVENUE
QUEEN STREET
SHERWOOD TERRACE
CHAPIN STREET
WOLCOTT STREET
SOUTH ELM STREET
WEST KING STREET
MERRICK AVENUE
CARLTON STREET
SOUTH STREET
DOWNING AVENUE
ROOSEVELT AVENUE
HITCHCOCK STREET
BERKSHIRE STREET
MICHIGAN AVENUE
ONTARIO AVENUE
HURON AVENUE
DEXTER STREET
MYRTLE AVENUE
HARRISON AVENUE
CHARLES STREET
BROOK STREET
LAWLER STREET
HILLCREST AVENUE
MARTIN STREET
LONGWOOD AVENUE
LAUREL STREET
GRANT STREET
MAIN STREET
INTERSTATE 91
RAMP-MAIN ST

GIS Methodology for Selected Maps

Level of Traffic Stress (LTS) Analysis

This analysis categorizes streets in Holyoke by "level of traffic stress," a method for bike network planning that is becoming increasingly accepted. The methodology we used is described in this paper: http://transweb.sjsu.edu/PDFs/research/1005-low-stress-bicycling-network-connectivity.pdf

The LTS analysis categorizes road segments into four levels: LTS 1, LTS 2, LTS 3, LTS 4. LTS 1 is the least stressful for bicyclists. LTS 4 is quite stressful for most bicyclists. The four LTS levels correspond to the four kinds of bicyclists as currently described in bike planning, "No Way, No How," "Interested, but Concerned," "Enthused and Confident," "Strong and Fearless." LTS 1 suits children and "Interested but Concerned" riders. LTS 2 suits "Interested but Concerned" riders. LTS 3 suits "Enthused and Confident" riders. LTS 4 suits "Strong and Fearless" riders or is not suitable for bicyclists. The idea behind the analysis is that riders will often not use a street segment or intersection that exceeds the level of traffic stress that they are comfortable with. High stress segments and intersection are a barrier for a bicyclist moving through the city. The bike network becomes fragmented when the LTS level exceeds a rider's comfort. The LTS levels are described in the research paper on this method as:

- LTS 1: Presenting little traffic stress and demanding little attention from cyclists, and attractive enough for a relaxing bike ride. Suitable for almost all cyclists, including children trained to safely cross intersections. On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a slow traffic stream with no more than one lane per direction, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where cyclists ride alongside a parking lane, they have ample operating space outside the zone into which car doors are opened. Intersections are easy to approach and cross.
- LTS 2: Presenting little traffic stress and therefore suitable to most adult cyclists but demanding more attention than might be expected from children. On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a well-confined traffic stream with adequate clearance from a parking lane, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where a bike lane lies between a through lane and a right-turn lane, it is configured to give cyclists unambiguous priority where cars cross the bike lane and to keep car speed in the right-turn lane comparable to bicycling speeds. Crossings are not difficult for most adults.
- LTS 3: More traffic stress than LTS 2, yet markedly less than the stress of integrating with multilane traffic, and therefore welcome to many people currently riding bikes in American cities. Offering cyclists either an exclusive riding zone (lane) next to moderate-speed traffic or shared lanes on streets that are not multilane and have moderately low speed. Crossings may be longer or across higher-speed roads than allowed by LTS 2, but are still considered acceptably safe to most adult pedestrians.
- LTS 4: A level of stress beyond LTS3.

Methodology

The LTS methodology is fairly straightforward and based on commonly available data. It is based on factors including presence of a bike lane, on street parking, number of travel lanes, operating space for a bicyclist, speed limit and traffic volume. The criteria vary depending on context: a separated bike lane; a bike lane alongside a parking lane; a bike lane not along a parking lane; or mixed traffic (no bike lane). Separated bike lanes are always assigned LTS1. There are no separated bike lanes in Holyoke. Here are tables describing the method for the remaining contexts:

Table 2. Criteria for Bike Lanes Alongside a Parking Lane

	LTS ≥ 1	LTS ≥ 2	LTS ≥ 3	LTS ≥ 4
Street width (through lanes per direction)	1	(no effect)	2 or more	(no effect)
Sum of bike lane and parking lane width (includes marked buffer and paved gutter)	15 ft. or more	14 or 14.5 ft.[a]	13.5 ft. or less	(no effect)
Speed limit or prevailing speed	25 mph or less	30 mph	35 mph	40 mph or more
Bike lane blockage (typically applies in commercial areas)	rare	(no effect)	frequent	(no effect)

Note: (no effect) = factor does not trigger an increase to this level of traffic stress.

[a] *If speed limit < 25 mph or Class = residential, then any width is acceptable for LTS 2.*

Table 3. Criteria for Bike Lanes Not Alongside a Parking Lane

	LTS ≥ 1	LTS ≥ 2	LTS ≥ 3	LTS ≥ 4
Street width (through lanes per direction)	1	2, if directions are separated by a raised median	more than 2, or 2 without a separating median	(no effect)
Bike lane width (includes marked buffer and paved gutter)	6 ft. or more	5.5 ft. or less	(no effect)	(no effect)
Speed limit or prevailing speed	30 mph or less	(no effect)	35 mph	40 mph or more
Bike lane blockage (may apply in commercial areas)	rare	(no effect)	frequent	(no effect)

Note: (no effect) = factor does not trigger an increase to this level of traffic stress.

Note: on Table 3: we had no information on bike lane blockage and so did not include it in our analysis.

Table 4. Criteria for Level of Traffic Stress in Mixed Traffic

	Street Width		
Speed Limit	2-3 lanes	4-5 lanes	6+ lanes
Up to 25 mph	LTS 1[a] or 2[a]	LTS 3	LTS 4
30 mph	LTS 2[a] or 3[a]	LTS 4	LTS 4
35+ mph	LTS 4	LTS 4	LTS 4

Note: [a] Use lower value for streets without marked centerlines or classified as residential and with fewer than 3 lanes; use higher value otherwise.

We added a criteria to table 4. In the first two rows of the first column, any road with a volume greater than 3000 cars a day was assigned the higher LTS value.

In each of the tables above, a street segment is assigned the highest LTS score from any row. For example, in table 3, if a street had 1 lane in each direction (LTS1), and a bike lane of 6ft or more (LTS1), and a speed limit of 40mph (LTS4), the segment would be designated the highest value which is LTS4.

The full LTS methodology includes criteria about intersections and turn lanes. We did not use these criteria because we do not have the necessary baseline data.

Demographics and Predicted Bicycle Trip Rates

Overview of Map

Factors that influence rates of bicycling are not as well studied as pedestrian generation factors. Concerns about safety from motor vehicle traffic are likely the most significant factor influencing bicycling rates. The Level of Traffic Stress (LTS) map delves into that topic. But that map treats all parts of Holyoke equally. The Demographics and Predicted Bicycle Trip Rates map adds people to the picture. It attempts to show where bicycle trips are most likely to occur. Combined with the LTS Map it could help Holyoke prioritize key streets that are both key links and likely to serve a relatively large number of potential bicyclists.

When planners think about pedestrian trip generation they usually start from destinations (retail, parks, libraries, major employers, etc). Recent research, however, indicates that unlike pedestrian trip generation, proximity to destinations is not a major predictor of bicycle activity. That is likely because bicyclists will travel much longer distances than pedestrians (close to two miles instead of a ¼ mile). This spreads out the impact of destination proximity.

Demographic factors, on the other hand are correlated with bicycling trip rates. Young males make the vast majority of bicycle trips. In addition, income, vehicle ownership, and to a lesser extent ethnicity are associated with varying rates of bicycling. Based on this, we developed The Demographic Cycling Factors maps to show how demographics of Holyoke may impact bicycle use in Holyoke. It gives a rough picture of home-based bicycle trip generation rates for different parts of Holyoke.

The map shows key demographic factors in the first six panels. The remaining five panels show the "demographic cycling factors." In these panels higher numbers (green colors) indicate expected higher bicycle trip rates. The average American makes 1 trip per 100 by bicycle (1%). In the key to the map, numbers greater than 1 indicate that higher than average bicycle trip rates (greater than 1%) would be expected from that census block or tract. Numbers lower than one (shades of red) have the opposite meaning (lower than expected bicycle trip rates).

Methodology

The maps present key demographic characteristics that are associated with higher or lower rates of bicycling. The underlying associations are based on bike share of all trips data gathered in the 2009 National Household Travel survey. The associations of cycling rates with demographic characteristics comes from an article by J. Pucher et al. See the table below:

Table 4
Trends in cycling by socioeconomic and demographic characteristics in the USA, 2001–2009. *Sources:* USDOT (2005, 2010a).

	Bike share of all trips		Share of all bike trips (%)	
	2001	2009	2001	2009
Gender				
Male	1.2	1.6	67	76
Female	0.5	0.5	33	24
Age group				
5–15 years	3.3	3.1	56	39
16– 24 years	0.6	0.9	8	11
25–39 years	0.5	0.7	21	23
40–64 years	0.4	0.7	10	21
65 and older	0.4	0.6	4	6
Automobiles owned in household				
No car	1.6	2.5	7	10
One car	0.7	1.2	17	25
Two cars	0.9	1.0	47	41
Three and more cars	0.7	0.8	29	24
Household income				
Lowest quartile	0.8	1.3	25	29
Second quartile	0.8	0.8	25	22
Third quartile	0.9	1.0	22	26
Highest quartile	0.8	1.1	28	24
Ethnicity				
White	0.9	1.1	83	77
African American	0.5	1.0	8	10
Hispanic	0.6	0.9	6	9
Asian	0.5	0.9	2	4

Overall, Americans make 1% of their trips by bicycle (not shown in graph). The table above shows the varied percent of all trips made by bicycle for different populations. Key factors include gender, age, car ownership, income and ethnicity. Males bicycle significantly more than females. Young people more than older. People with fewer cars more than those with more cars. Lower income populations bicycle more than middle income populations, and higher income populations also bicycle more than middle income populations, but less than the lowest income quartile. The variance within ethnicities is relative small. White people bicycle .1 more than the national average, African Americans are average, Hispanics and Asians bicycle .1% less than the national average.

The panel map shows a “Cycling Factor” for each key demographic characteristic. The Cycling Factors are created by:

- For each given geography (census tract or block group depending on data availability), multiply the percent of each demographic segment by the bike share of all trips from Pucher’s table.
- Then add those numbers together to get an overall score for the geographic area.

A higher score for a given census tract or block represents more likely bike trips generated from that geographic area. A lower score represents fewer bike trips generated from that geographic area. The numbers are comparable across the cycling factor maps. Maps whose keys show a greater spread of numbers are more significant. For example, the vehicle access cycling factor map has the largest spread--ranging from 1.06-1.83. Because some factors are likely confounding (vehicle ownership and income), the maps cannot be summed together.