Sudbury Master Plan Steering Committee Transportation/Circulation Workshop

February 7th, 2020

The purpose of the Transportation/Circulation Workshop is to determine policy direction related to town services, facilities, and infrastructure in the Master Plan. Specifically:

- Confirm which transportation infrastructure and services the Master Plan will highlight
- Of these, the level of commitment the town will make in the next 5, 10 and 20 years
- Draft goals and/or policy statements related to these commitments
- Identify and prioritize actions to meet to these goals and policies and/or give the consultant direction to draft them

Items in this packet:

- Key findings from the Baseline Report for Town-wide Circulation
- Questions and Talking Points
- Bicycle Facility Selection Guidance
- Bicycling Fact Sheet
- Context Sensitive Traffic Calming Solutions
- Excerpts from *Public Transportation's Impact on Rural and Small Towns* (2017) by the American Public Transportation Association

Key Findings from Baseline Report and Stakeholder Meetings

Traffic Congestion

Traffic congestion is an issue in Sudbury, particularly on the state routes near the Town Center and along Route 20. Congestion is a result of both local and regional traffic trips.

- Build the Town's walking and biking network to encourage residents to do local trips without their car.
- On Route 20, synchronize traffic lights.
- Consider opportunities to consolidate commercial driveways where possible.
- Encourage walking and biking to school to alleviate some traffic congestion associated with school drop offs/pick-ups. Prioritize expansion of walkway network around school facilities.
- Concerns regarding development in neighboring communities

Town-wide Transit

The Senior Shuttle is very popular and overcrowded. Demand is expected to increase.

- Consider adding additional shuttles/drivers.
- Consider adding later times (after 3:30) and additional days during the week.

The Route 20 Commuter Shuttle is a great amenity but not meeting commuter needs.

- Consider adding a fixed stop on Route 20.
- Consider adding later times leaving from Riverside T Station.
- Consider a shuttle between Sudbury and Lincoln

Sudbury's transit network is not well linked regionally.
Lack of transit options presents challenges for seniors, disabled, and lower income residents.

There are transportation needs of low-income students/families accessing schools and their after-school programs.

- Look for opportunities to provide shuttle or van service to Sudbury residents without access to personal vehicles.

Bicycle and Pedestrian Infrastructure

Sudbury has a robust walkway network, and improvements are being made, but gaps exist with missing links between residential areas and important destinations like commercial areas, schools, and parks/open space. The nature of Sudbury's roads, which are winding, narrow, and tree-lined, make it difficult to add some of the missing connections.

- Improve lighting on priority walkways
- Upgrade and add crosswalks to be more accessible at major intersections and key points throughout Town.
- Ensure that locations within proximity to schools are accessible via walkways and crosswalks to ensure students have safe access.

The walking and biking network will be expanded in the future through the Bruce Freeman Rail Trail (BFRT) and proposed Mass Central Rail Trail. These will be major transportation and recreation assets to the town.

- Continue moving forward
- Consider linkages between planned rail trails and Sudbury's open space network to further enhance the walking and biking network.

Questions and Talking Points

- With regard to the circulation network in Sudbury, are there any obvious solutions or low hanging fruit investments the Town could make to improve circulation?
- Balancing improving traffic flow, with enhancing overall safety and livability of Sudbury. What should be prioritized? On Rt 20, Rt 27, Rt 117?
- What Bicycle and Pedestrian Facilities are needed in Sudbury?

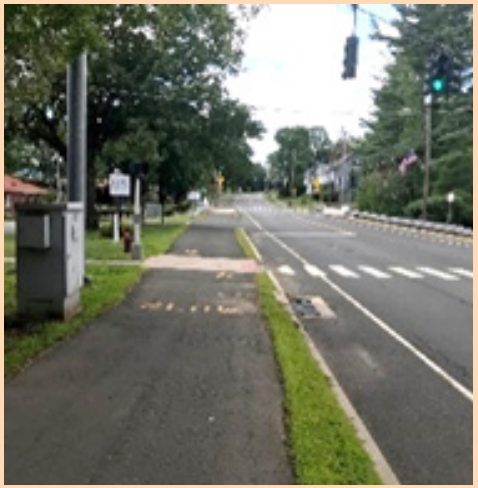
Facility Selection Guide

Several factors should be considered when selecting appropriate bicycle facilities for a street or roadway corridor. The primary factors include traffic speed and volume, but also include anticipated usership, roadway geometry, adjacent land uses, and existing and planned bicycle facilities in proximity to the corridor for which bicycle facilities are considered.

The selection of a bicycle facility for a corridor should seek to maximize the safety and comfort of bicyclists while maintaining the safe and effective operation of other modes of travel along that corridor. As such, the selection of appropriate bicycle facilities is not a "one size fits all" approach; facilities should be selected in response to the unique characteristics of that corridor. In some contexts, the provision of bicycle facilities may not be feasible given operational impacts, physical constraints, or construction cost.

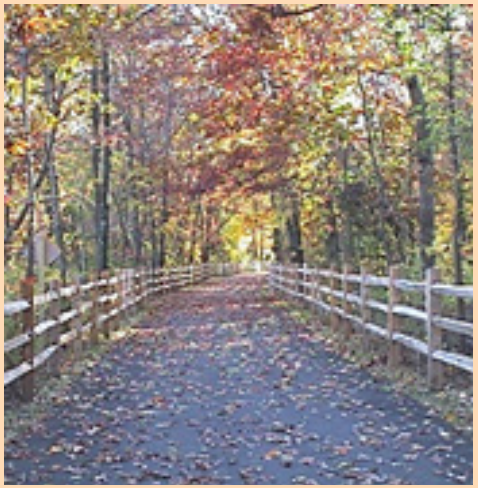
The guidance provided in this manual is based upon the best practices of transportation departments from states and municipalities across the country and from guidance documents from the National Association of City Transportation Officials (NACTO) the American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA). Where specific guidance is lacking, recommendations are based upon published research and professional judgement.

Sidepath



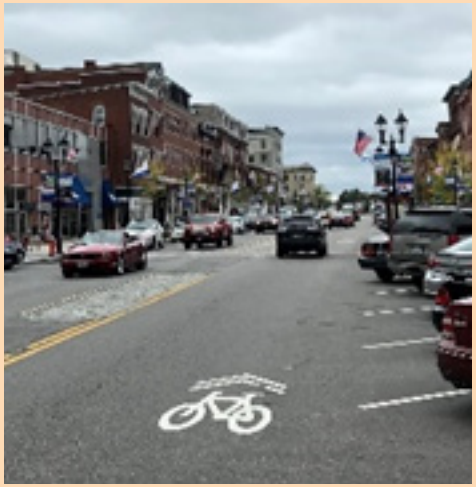
Sidepaths provide a separated facility for the shared use of bicyclists and pedestrians. Like sidewalks, these facilities are physically separated from motor vehicles by a curb, open space, or barrier. These facilities are adjacent to the roadway and are typically located within the right-of-way.

Shared-Use Path



A shared-use pathway is a facility that is shared by bicyclists and pedestrians. These facilities are recreational in nature and often travel through open space areas and along natural features such as riverfronts. While similar in design and function to a sidepath, shared-use pathways, are not typically located adjacent to a roadway.

Shared Roadway



Shared roadways allow bicyclists and motor vehicles to use the same roadway space without any separate lane designations. Shared roadways are typically delineated by “sharrow” pavement markings and accompanying signage.

Buffered Bike Lane

Buffered bicycle lanes are conventional striped bike lanes with a painted or textured pavement buffer space that is used to separate the bike lane from the adjacent motor vehicle lane and/or parking lane.

Bike Lane

Bike lanes designate an exclusive space on the roadway for bicycle travel, which is signified by pavement markings, striping, and signage. Bike lanes are typically located between a motor vehicle travel lane and the curb, road edge, or parking lane.

Separated Bike Lane:

Separated Bike Lanes (also known as cycle tracks or protected bike lanes) are bicycle lanes that are physically separated from motor vehicle traffic. Separated bike lanes can be designed for one-way or two-way travel and can be at street level, at sidewalk level, or at an intermediate level between the two.

Recommended Facilities

A recommended facility is the most appropriate facility type based upon traffic volume and speed. Recommended facility classifications do not account for other factors such anticipated usership, roadway conditions, construction costs, and maintenance requirements.

User preference may differ from the recommended facility type. Bicyclists generally prefer off-street "low stress" facilities which may, or may not, be appropriate to the context or feasible for implementation. The selection of appropriate facilities should balance planning and engineering considerations with user expectations and preferences.

Table 2 below identifies recommended bicycle facility types based upon average daily traffic volume (ADT) and 85th percentile traffic speeds.

Table 1: Recommended Facilities

Bicycle Facility	ADT	85th Percentile Speed
Shared Roadway	5,000 or less	25 mph or less
Bike Lane	10,000 or less	35 mph or less
Buffered Bike Lane	10,000 - 20,000	31 - 40 mph
Separated Bike Lane	20,000 or more	36 mph or higher
Sidepath	15,000 or more	31 mph or higher

Acceptable Facilities

Acceptable facilities are applied where physical conditions, cost of construction, right-of-way constraints, and/or other factors do not allow for implementation of the recommended facility type.

The acceptable traffic volume and speed range is higher for acceptable on-street facilities compared to recommended on-street facilities. The range of acceptable conditions is, however, lower for acceptable off-street facilities when compared to recommended off-street facilities.

Table 3 below identifies acceptable bicycle facility types based upon average daily traffic volume (ADT) and 85th percentile traffic speeds.

Table 2: Acceptable Facilities

Bicycle Facility	ADT	85th Percentile Speed
Shared Roadway	10,000 or less	30 mph or less
Bike Lane	15,000 or less	40 mph or less
Buffered Bike Lane	25,000 or less	45 mph or less
Separated Bike Lane	All conditions	All conditions
Sidepath	All conditions	All conditions

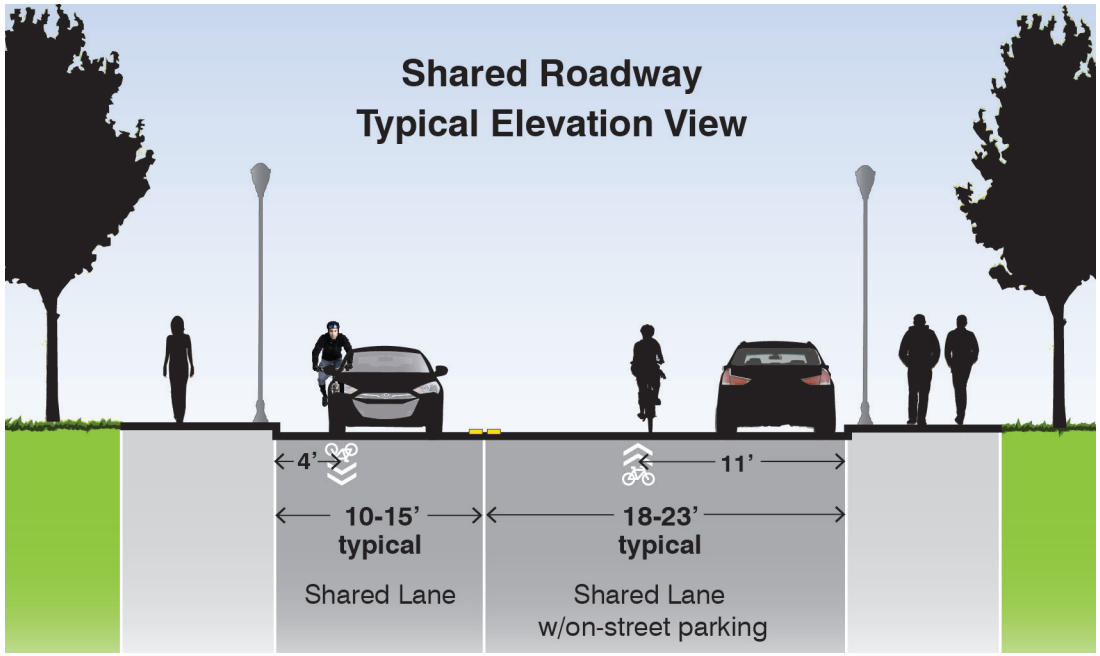
Shared Roadway

Shared roadways allow bicyclists and motor vehicles to use the same roadway space without separate lane designations. Motorists have a greater awareness of, and are more like to yield to, bicyclists on shared roadways when compared to roadways that lack bicycle accommodations. Shared roadways should be used where the provision of dedicated bike lanes or other dedicated bicycle facilities is not feasible due to geometric or right-of-way constraints. Shared roadways are suitable for use on State and local roadways where the conditions conform with the standards provided in this section.

One of the limitations of shared roadways is that they are susceptible to bicycle and vehicular conflicts because of the lack of designated space and/or separation between bicyclists and motorists. As such, the application of shared roadways should be sensitive to conditions such as lane and roadway width, on-street parking, and traffic volume and speed.

On a shared roadway, bicyclists can position themselves where they feel safest and most comfortable. While bicyclists often prefer the right edge of the shared lane, they may also opt to ride in the middle of the shared lane to discourage passing vehicles from attempting to pass within the lane.

Shared roadways can be a valuable tool in developing a bicycle network and providing strategic connections between corridors with dedicated bicycle facilities. Shared roadway pavement markings and accompanying signage provide cyclists with wayfinding assistance and promote awareness of the presence of bicyclists in the roadway environment.

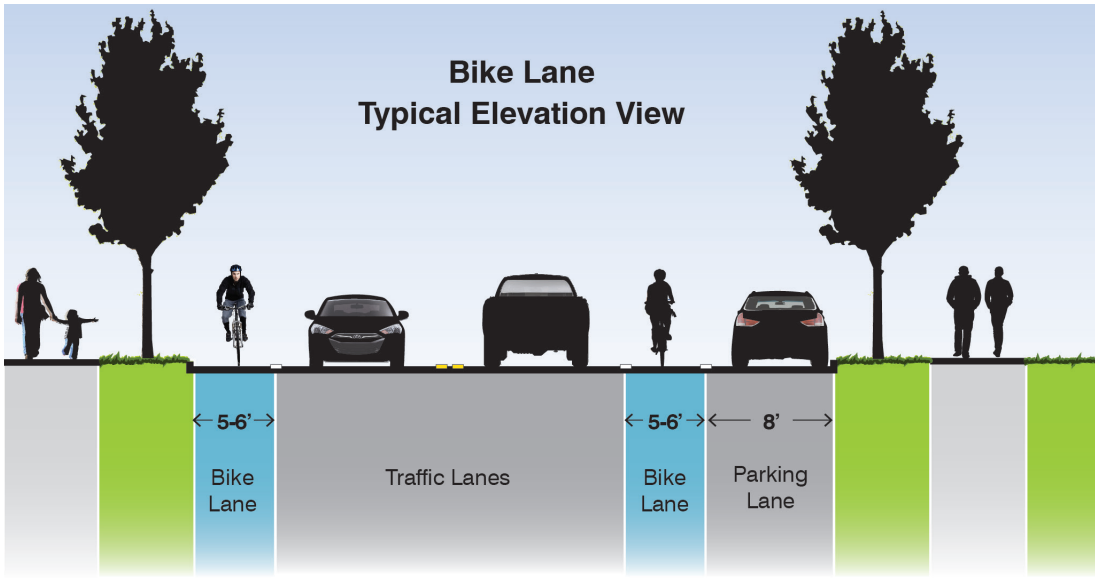


Bike Lane

Bike lanes designate an exclusive space on the roadway for bicycle travel, which is signified by pavement markings and signage. Bike lanes are typically located between a motor vehicle travel lane and the curb, road edge, or parking lane. Bike lanes are used for one-way travel in the same direction as the adjacent traffic lane.

Bike lanes provide separation between bicyclists and traffic and require minimal roadway space which allows for their inclusion via traffic lane width reductions, removal of traffic lanes, and/or removal of on-street parking lanes. Bike lanes may be provided in isolated segments as climbing lanes. Climbing lanes are placed on the uphill direction of a steep roadway grade to provide bicyclists space to ride without slowing down vehicular traffic.

Bike lanes may not be suitable for all users; some bicyclists, especially those with less experience, may not feel comfortable riding without physical separation from traffic.

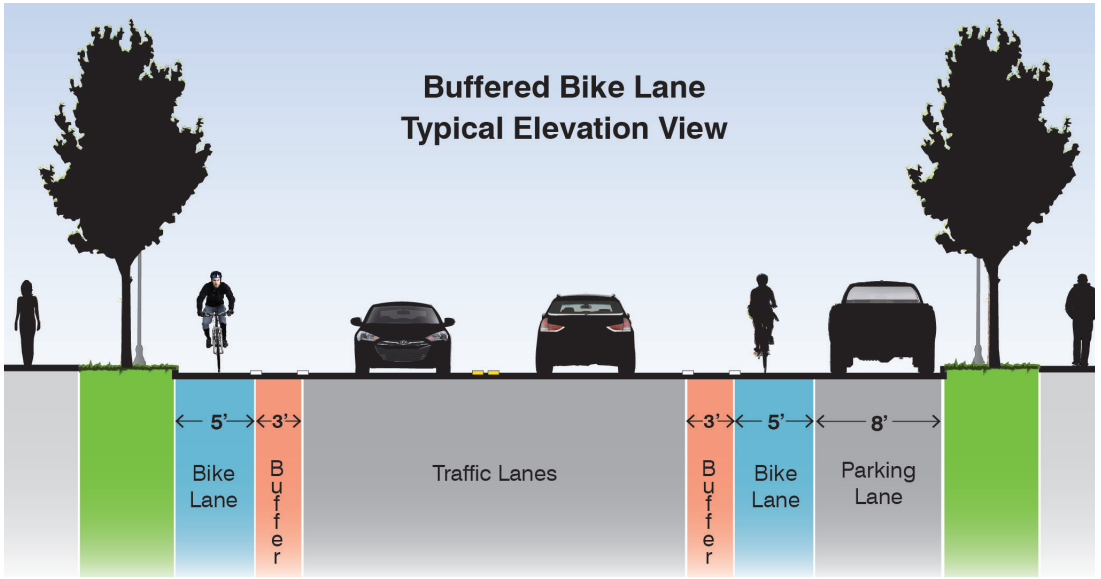


Buffered Bike Lane

Buffered bike lanes are located on the roadway and include a flush painted, colored, or textured buffer space that is used to separate the bike lane from the adjacent traffic or parking lane. Buffered bike lanes provide an improved level of comfort for the bicyclist above that provided by a standard bike lane by providing more space between bicyclists and motorists and more space for bicyclists to pass one another without encroaching into a traffic lane. Buffered bike lanes should be used where traffic volume and/or speed require additional separation between bicyclists and motor vehicles so as to improve bicyclist safety and comfort. Buffered bike lanes are typically paired, one-way facilities but may also take the form of two-way facilities located on one side of the roadway.

One of the challenges of incorporating buffered bike lanes is the additional roadway space needed to accommodate the buffer space. Buffered bike lanes, while providing additional separation between bicyclists and motor vehicles, do not provide the physical protection and separation associated with facilities such as separated bike lanes. Buffered bike lanes may require additional maintenance when compared to a standard bike lane because of the need to maintain the buffer striping or surface treatment.

A benefit of buffered bike lanes compared to separated bike lanes is that they cost less to construct and do not require specialized equipment for sweeping or winter maintenance.



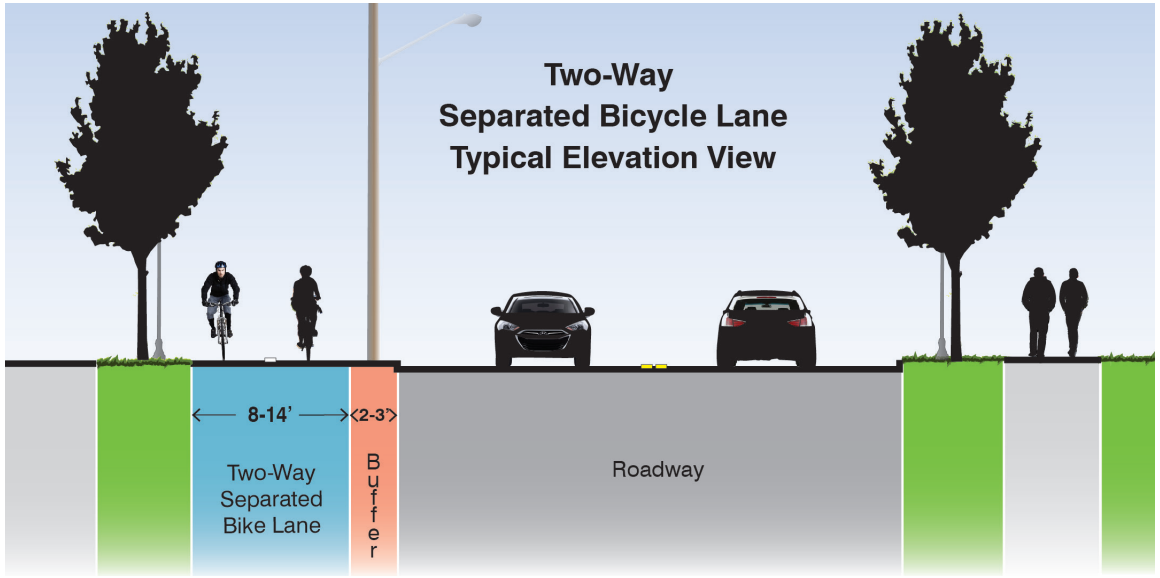
Separated Bike Lane

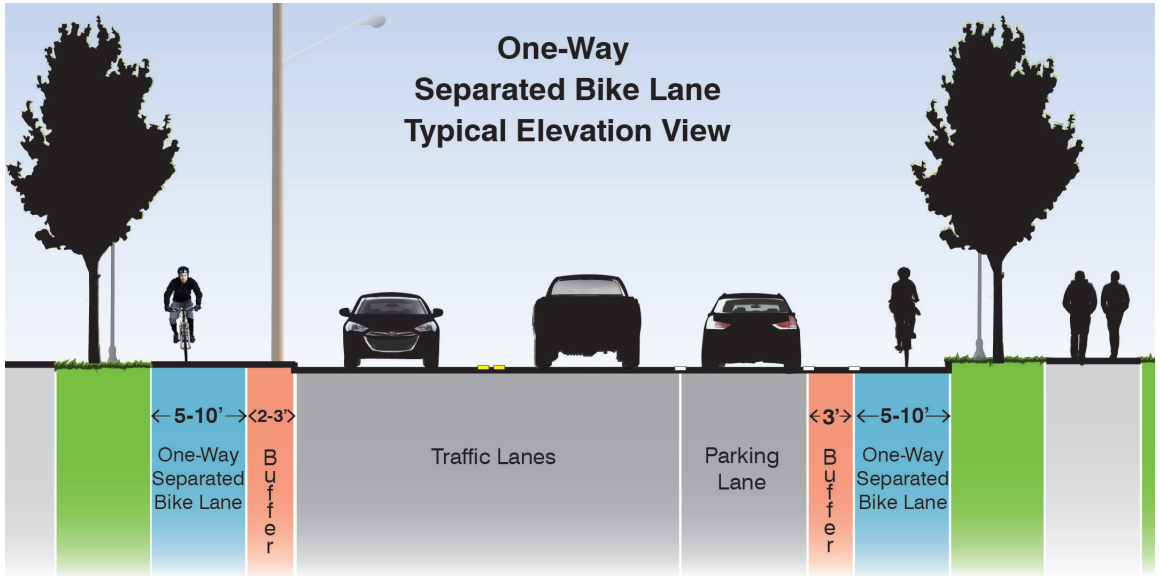
Separated bike lanes are physically separated from motor vehicle traffic. Physical separation can be provided by grade separation or by physical barriers such as curbs, guardrails, bollards, or other traffic barrier systems. Separated bike lanes can be designed for one-way or two-way travel and can be at roadway or sidewalk level.

Separated bike lanes are preferred by less experienced bicyclists and bicyclists of all ages because of the physical separation from traffic. While separated bike lanes improve safety and comfort along a corridor, the physical separation does not resolve conflicts with turning motor vehicles at intersections and driveways. Special treatment is therefore required at intersections to maintain safety. Separated bike lanes usually require bicycle specific traffic signals at signalized intersections or require bicyclists to use a pedestrian crossing signal phase to assist with intersection crossings.

Two-way separated bike lanes located on one side of the roadway may be a desirable facility where the opposite side of the roadway experiences significant turning movements such as at a highway interchange. Two-way separated bike lanes are most appropriately located along the side of a roadway that is not frequently interrupted by driveways or intersections.

Paired (a one-way lane on each side of the road) one-way separated bike lanes are generally preferable to two-way separated bike lanes as they present less conflict at intersections and driveways due to the lack of contraflow traffic. Paired one-way facilities may, however, require more space than a two-way separated bike lane.



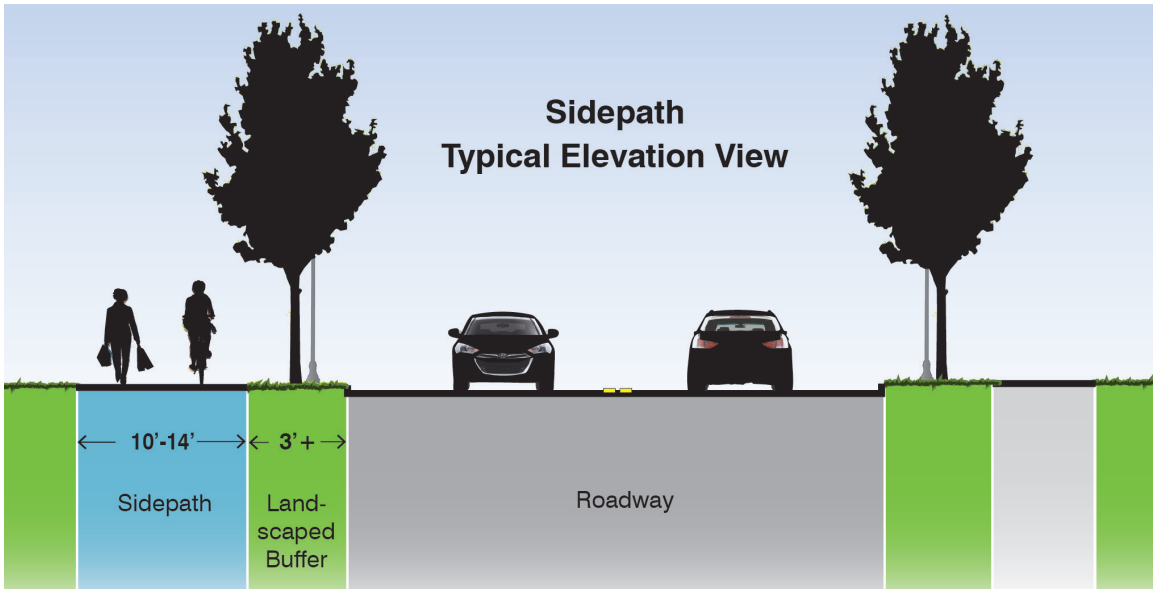


Sidepath

Sidepaths provide a separated facility for the exclusive use of bicycles and pedestrians. Sidepaths are physically separated from motor vehicles by open space, a curb or a barrier and run adjacent to the roadway. They differ from separated bike lanes in that they are used by both bicyclists and pedestrians. Sidepaths often connect recreational pathways and are commonly found along the edge of parks and water features. Sidepaths may also be used to close gaps in a bicycle network created by features such as a highway interchange.

Sidepaths provide significant flexibility in accommodating bicyclists because the facility can be used by both pedestrians and bicyclists in lieu of a sidewalk and on-street bicycle lanes. A sidepath would likely be used along a corridor where a two-way separated bike lane may be desirable, but where physical or right-of-way constraints do not allow for the provision of a sidewalk and separated bike lane.

Sidepaths can create conflicts when they are located alongside a roadway with multiple driveways or frequent intersections. Turning motor vehicles do not expect fast moving traffic and two-way traffic alongside the roadway and might turn right or left in front of a cyclist.



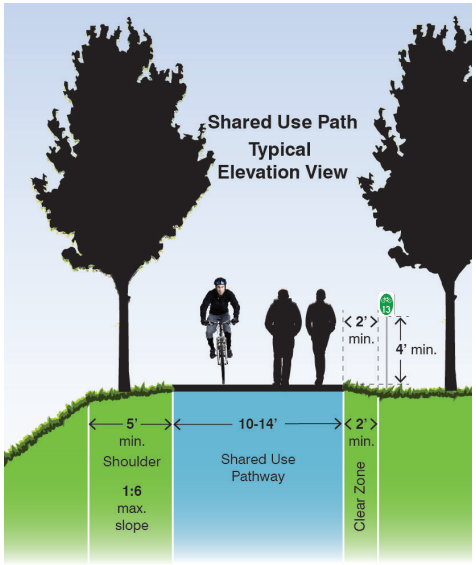
Shared Use Path

Shared use paths, similar to sidepaths, provide a separated facility for the exclusive use of bicycles and pedestrians. Shared use pathways differ from separated bike lanes in that they are used by a range of users including bicyclists, pedestrians and skaters. Shared use paths are typically recreational in nature but can also be effective facilities for transportation.

Shared use paths are typically physically separated from the roadway by a significant distance and have few roadway crossings. Shared use paths often travel through open space areas and along natural features such as rivers and waterbodies. Shared use pathways are also often developed along former rail corridors and may travel along the rear of residential, commercial, and industrial properties.

Path Surface

- Asphalt or concrete path surfaces are preferred.
- Crushed stone surfaces may be appropriate on rural paths where the intended use of the path is primarily recreational.
- A crushed stone shoulder may be provided along the edge of the path to accommodate users that prefer an unpaved surface. When provided for this purpose, the minimum recommended width is 3 feet. This area does not contribute to the required minimum width of the pathway.



Bicycling | A LIVABILITY FACT SHEET

Half of all trips taken in the United States are three miles or less, yet most Americans drive — even to the closest destinations. Only 3 percent of commuting trips in the U.S. are by bicycle, compared to up to 60 percent in The Netherlands.

Still, it's not unreasonable to believe we can improve our numbers. The popularity of bicycling has been on the rise. The number of bike trips doubled between 1990 and 2009, and many communities and the federal government are embracing the bicycle as a transportation solution for a healthy and viable future.[1]

Surveys show that 60 percent of Americans would ride a bicycle if they felt safe doing so, and eight out of 10 agree that bicycling is a healthy, positive activity.

Although issues related to bicycling continue to be debated, experience shows that bicycle-friendly features increase safety for all road users, including motor vehicles.[2]

In 2010, New York City removed a traffic lane and painted a two-way bicycle path with a three-foot parking lane buffer alongside Brooklyn's Prospect Park. Weekday bicycling traffic tripled, speeding by all vehicles dropped from 74 to 20 percent, crashes for all road users dropped 16 percent and injuries went down 21 percent, all without a change in corridor travel time.[3] Throughout New York City, deaths and serious crashes are down 40 percent where there are bike lanes.[4]

Bicycling also provides economic benefits: Two-thirds of merchants surveyed on San Francisco's Valencia Street say that bike lanes have improved business. In North Carolina's Outer Banks, bicycle tourism has already generated $60 million in annual economic activity on its $6.7 million bicycle infrastructure investment. In 2009, people using bicycles spent $261 million on goods and services in Minnesota, supporting more than 5,000 jobs and generating $35 million in taxes.[5]

Building bike infrastructure creates an average of 11.4 jobs for every $1 million spent. Road-only projects create 7.8 jobs per $1 million.[6] The average American household spends more than $8,000 a year on its cars; the cost to maintain a bicycle is about $300 a year.[7]

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This path in New Smyrna Beach, Fla., is part of a Volusia County plan to link schools, parks and businesses through interconnected paths. Fifteen miles were completed by 2012 with overwhelming public support. (Image: bikeflorida.net.)

AARP® Real Possibilities

Walkable and Livable Communities Institute

Myth-Busting!

"Bicyclists don't follow rules."

While there are bicyclists who do break the law, a large Federal Highway Administration study found that motorists failed to yield the right of way in 43 percent of crashes; bicyclists were at fault 36 percent of the time.[8] Since the 1982 passage of Idaho's "stop as yield" law, which allows cyclists to treat stop signs as yield signs, there has been "no discernible increase in injuries or fatalities," according to the Idaho Department of Transportation.[9]

"Bicyclists don't pay their fair share."

All road users — cars, trucks, bicycles, pedestrians, buses, light rail — are subsidized to some extent by society at large. Funding for U.S. roadways comes partly from vehicle taxes, fuel taxes and tolls, which together account for up to 60 percent of direct costs. General taxes and fees pay the remaining 40 percent. The federal gas tax of 18.4 cents per gallon has not been raised since 1992.

Cars, buses and trucks impose much higher maintenance and capital costs on roads than bicycles do, and they benefit from subsidies that are not directly paid by motorists.[10] In 2009, the Seattle Department of Transportation paid only 4 percent of its road expenses with the gas tax while non-motor vehicle funds paid for the rest.[11]

Motor vehicle crash injuries cost society $99 billion in 2010 due to medical expenses and lost productivity.[12] Pedestrians and bicyclists bear a larger share of costs than they impose.[13]

"Bicycling is for fit middle-class white guys."

Six in 10 young bicycle owners are women, eight out of 10 American women have a positive view of bicycling and two out of three believe their community would be a better place to live if biking were safer and more comfortable. Between 2001 and 2009, the fastest growth in bicycle use in the U.S., from 16 to 23 percent, occurred among self-identified Hispanics, African-Americans and Asian-Americans, 86 percent of whom have a positive view of bicyclists.[14]

"Bicycling is too dangerous."

Bicycling does tend to have higher fatality rates per mile than motorized travel, but a typical motorist drives five to 10 times more miles than a typical cyclist.

Bicycling risk can be significantly reduced through improved infrastructure and a greater number of bicycles on the road.[15] Bicycling also imposes a minimal risk to other road users and provides significant health benefits that can offset crash risks.[16]

There were no bicycling fatalities in bicycle-friendly Portland, Ore., in 2013 even though bicycling accounts for at least six percent of all trips. By comparison, 21 people were killed inside motor vehicles that year.[17]

"Bicyclists slow down cars and create congestion."

Average traffic speeds in Manhattan increased nearly seven percent since the installation of bicycle lanes south of 60th Street in 2008.[18] Bicycles take up way less road space than motor vehicles and cyclists tend to avoid congested roads that don't have bike lanes.[19]

"Bicycle lanes hurt business."

After the installation of protected bike lanes on Manhattan's 8th and 9th avenues in 2007, retail sales increased 49 percent in those areas compared to 3 percent in the rest of the borough.[19]

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3. Newmann, A., Steely-White, P. (February 2011), "Battle of the Bike Lanes." *Bicycle Times*. Issue 009; and New York City Department of Transportation. Retrieved February 25, 2014, from http://www.nyc.gov/html/dot/html/bicyclists/prospectparkwest.shtml
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How To Get It Right

Bicycle parking promotes bicycle riding. Bike racks can be placed on or off the street. Fun Fact: One vehicle parking space can accommodate 12 bicycles.

Grade-separated, protected bike lanes (like this raised cycle track in Missoula, Montana) provide separate, defined spaces for riders and drivers.

To encourage bicycling and bicycle-friendly streets and communities, try the following:

■ Embrace a public process and build support

Develop an education and awareness campaign prior to implementation, and reach out broadly to community members, elected officials and municipal leaders. Government officials may need to see public support before acting. Toward that end, advocates can share this fact sheet, talk to neighbors, build community support and then meet with decision makers, the media, experts and others to discuss the benefits of bicycling. Agency staff can engage residents by hosting workshops to build acceptance and understanding.

■ Start with a pilot project

Do a simple, low-cost project, such as striping a bike lane in an area with high bicycling potential and an existing right of way. This can help residents become comfortable with bicycling and enable municipal staff to document what works and what doesn't. Promote the pilot as a road improvement project rather than only as a bicycle project.

■ Provide adequate bicycle parking

Bicycle racks encourage bicycling. Well-placed racks provide a secure place for parking bikes while shopping, working or playing. Racks can be located inside buildings or bolted into sidewalks or even the street. A single parking space can hold up to 12 bicycles on staple racks (they look like an inverted "U" shape) mounted in a row.

■ Create routes and wayfaring signs

Develop a system of routes cyclists can follow to get around town safely. Install highly-visible wayfaring signs that indicate distances, destinations and street names and install signs at all important crossings.

■ Establish a bike share

More than 500 communities worldwide, including at least 50 in the U.S., have a short-term bicycle rental or bike share program.[20] (New York City and Washington, D.C., feature popular bike share networks.) People can join a share program for the day or a full year by paying a nominal fee. To participate, a rider checks out a bicycle from a computerized kiosk and then returns the bike at a share program rack near his or her destination.

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Success Stories

Palo Alto, California: Bicycle Boulevards

Bicycle boulevards are low-volume, low-speed streets that have been optomized for bicycle travel. Palo Alto has an extensive network of paths, bike lanes and boulevards, including connections to schools throughout town.

Data from the 2010 Census showed 7.1 percent of residents commuted to work by bicycle, an increase from 5.6 percent in 2000. The city continues to provide facilities, services and programs to promote travel by bicycle.

Indianapolis, Indiana: Cultural Trail

The eight-mile, $63 million walk-bike trail was completed in May 2013, having been financed by both public and private dollars.

The trail winds through the downtown of this auto-oriented city (home of the Indy 500), connecting a half-dozen emerging cultural districts, a 1.5 mile section of the historic Indianapolis Canal and to White River State Park, a former industrial wasteland that's now filled with museums, lawns and attractions. By April 2014 the trail had added more than $864 million to the local economy.

Memphis, Tennessee: Broad Avenue

The Broad Avenue Arts District initiative revitalized a struggling commercial and residential area. The project's popularity exploded when the focus was expanded to include bicycles.

"The lanes slowed down traffic and people started noticing the businesses more," says Pat Brown, co-owner of T Clifton Art Gallery. "Our revenues have grown on average 30 percent per year. Yes, that's for an art-related business in a tough economy." The district has seen more than 15 new businesses and nearly 30 property renovations. Restaurants report a growth in business due to bicyclists.

WHY IT WORKS

Protected Bike Lanes provide a barrier between motor vehicles and cyclists. (This barrier can be installed and permanent, or as simple as a row of parked cars, planters or plastic posts.) They're good for …

Business: A Portland study found that bike riders will go out of their way to use a street that has good bicycling infrastructure. That's more business exposure.

Safety: Drivers don't have to worry about unexpected maneuvers by cyclists and pedestrians don't need to dodge bike riders on sidewalks.

Lawfulness: Protected bike lanes in Chicago resulted in a more than 150 percent increase in the number of bike riders obeying traffic lights.

Everyone: Bicycles don't pollute, they cause less wear and tear on roadways than cars do, they help people stay healthy!

Source: Adapted from the Tranitized.com infographic "Why Build Protected Bike Lanes?"

RESOURCES

1. **Whose Roads? Defining Bicyclists' and Pedestrians' Right to Use Public Roadways.** Litman, T. Victoria Transport Policy Institute (November 2004), http://www.vtpi.org/whoserd.pdf
2. **Bicycling Means Business: The Economic Benefits of Bicycle Infrastructure.** Flusche, D. League of American Bicyclists, Advocacy Advance (2009, 2012), http://www.advocacyadvance.org/site_images/content/Final_Econ_Update(small).pdf
3. **Urban Bikeway Design Guide.** National Association of City Transportation Officials (NACTO Sept. 2012), http://nacto.org/cities-for-cycling/design-guide/
4. **Pedestrian and Bicycle Information Center.** www.pedbikeinfo.org/
5. **Alliance for Biking & Walking.** Resource Library, http://www.bikewalkalliance.org/resources/resource-library/
6. **Safe Routes to School National Partnership.** http://www.saferoutespartnership.org/resourcecenter/National-Learning-Network Library-of-Resources
7. **Association of Pedestrian and Bicycle Professionals.** http://www.apbp.org/?page=Library
8. **Fundamentals of Bicycle Boulevard Planning & Design.** Portland State University, Initiative for Bicycle and Pedestrian Innovation (2009)
9. **Bicycling and Walking in the United States: 2014 Benchmarking Report.** http://www.bikewalkalliance.org/resources/benchmarking
10. **Protected Bike Lanes Mean Business.** http://www.bikewalkalliance.org/resources/reports/protected-bike-lanes-mean-business
11. **National Complete Streets Coalition.** http://www.smartgrowthamerica.org/complete-streets

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CONTEXT SENSITIVE SOLUTIONS OVERVIEW AND TRAFFIC CALMING STRATEGIES

Context sensitive solutions (CSS) refer to the planning, design, construction, and operation of **transportation facilities to enhance community livability**. CSS considers not only the goals of safety and mobility for a facility, but also the goals of the surrounding community in which the facility exists. This can include factors such as land use, aesthetics, historical considerations, and environmental quality.

CSS emphasizes a **holistic process to transportation development**, beginning with a **multi-stakeholder community input process**, and continuing throughout the lifecycle of the transportation facility to accommodate and enhance the desires of the community. CSS are an element of the larger Complete Streets movement involving multimodal access and safety. Not all CSS require accommodation of every mode of travel. It could be that in certain contexts, it makes sense to provide separate but parallel routes to different modes of travel, such as a multi-use path.

The following treatments are examples of traffic calming measures that operate at different scales depending on right-of-way dimensions, traffic volumes, and community goals relative to pedestrian accommodations. These improvements are discussed here to encourage the committee to consider where specific strategies might be appropriate.

Corner Extension/Bulb-Out

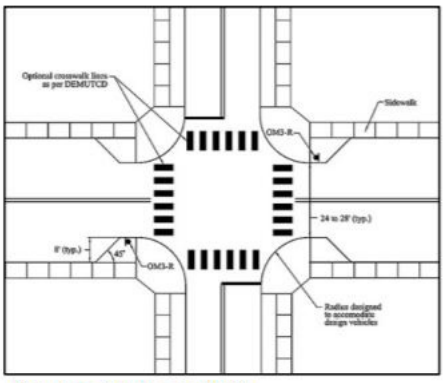
Description:

- Horizontal extension of the sidewalk into the street, resulting in a narrower roadway section
- If located at a mid-block location, it is typically called a choker

Application:

- When combined with on-street parking, a corner extension can create protected parking bays
- Effective method for narrowing pedestrian crossing distances and increase pedestrian visibility
- Appropriate for arterials, collectors, or local streets
- Can be used on one-way and two-way streets
- Installed only on closed-section roads (i.e. curb and gutter)
- Appropriate for any speed, provided an adequate separation is provided between the extension- and the travel lane
- Adequate turning radii must be provided to use on bus routes

(Source: James Barrera, Horrocks, New Mexico)



(Source: Delaware DOT)

Typical Costs:

- Cost between $1,500 and $20,000, depending on length and width of barriers

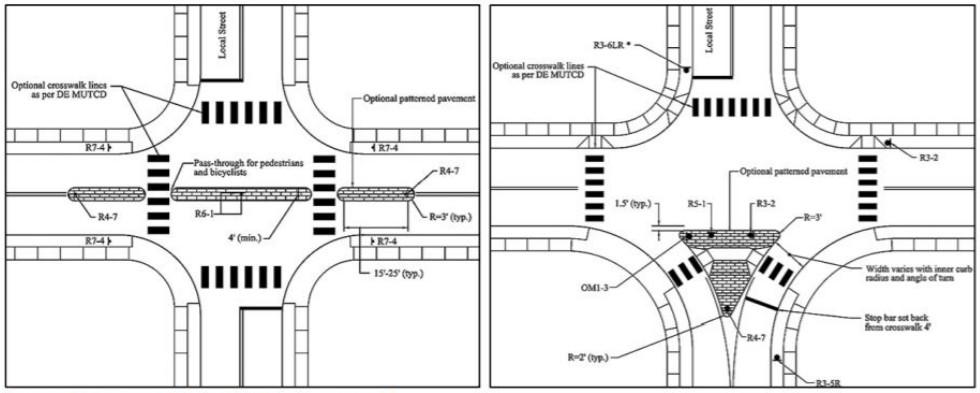
Median Barrier/Turn Island

Description:

- Raised islands along the centerline of a street and continuing through an intersection that block the left-turn movement from all intersection approaches and the through movement from the cross street; also called median diverter, intersection barrier, intersection diverter, and island diverter
- Raised island that forces a right turn is called a forced turn island

Application:

- For use on arterial or collector roadways to restrict access to minor roads or local streets and/or to narrow lane widths
- Typically applied only after other measures have failed or been deemed inappropriate/ineffective
- Barriers are made passable for pedestrians and bicyclists
- Often used in sets to make travel to/through neighborhoods more circuitous



(Source: Delaware Department of Transportation)

Typical Costs:

- Cost between $1,500 and $20,000, depending on length and width of barriers

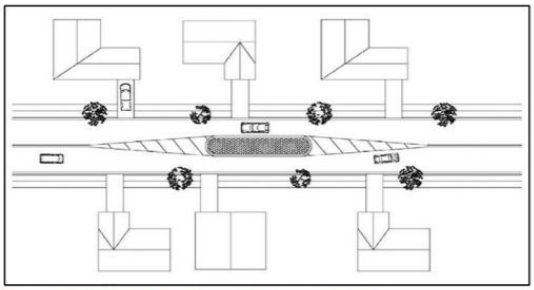
Median Island

Description:

- Raised island located along the street centerline that narrows the travel lanes at that location
- Also called median diverter, intersection barrier, intersection diverter, and island diverter

Application:

- For use on arterial, collector, or local roads
- Can often double as a pedestrian/bicycle refuge islands if a cut in the island is provided along a marked crosswalk, bike facility, or shared-use trail crossing
- If placed through an intersection, considered a median barrier



(Source: Delaware Department of Transportation)

(Source: James Barrera, Horrocks, New Mexico)

Typical Costs:

- Cost between $1,500 and $10,000, depending on length and width of island

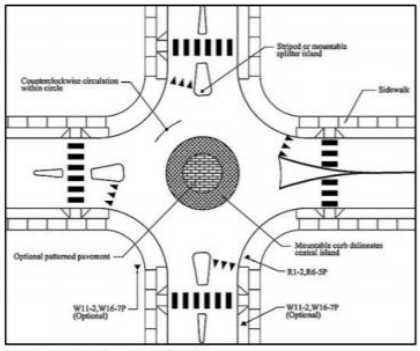
Mini Roundabout

Description:

- Raised islands, placed in unsignalized intersections, around which traffic circulates
- Motorists yield to motorists already in the intersection
- Require drivers to slow to a speed that allows them to comfortably maneuver around them
- Center island of mini roundabout is fully traversable, splitter islands may be fully traversab

Application:

- Intersections of local and/or collector streets
- One lane each direction entering intersection
- Not typically used at intersections with high volume of large trucks or buses turning left
- Appropriate for low-speed settings



(Source: Delaware DOT)


(Source: Gary Schatz)

Typical Costs:

- Cost is similar to bulb-outs because pedestrian ramps and outside curb lines usually have to be relocated

On-Street Parking

Description:

- Allocation of paved space to parking
- Narrows road travel lanes and increases side friction to traffic flow
- Can apply on one or both sides of roadway
- Can be either parallel or angled, but parallel is generally preferred for maximized speed reduction

Application:

- High likelihood of acceptability for nearly all roadway functional classifications and street functions
- More appropriate in urban or suburban settings
- Can be combined with other traffic calming measures
- Can apply alternating sides of street for chicane effect
- Can combine with curb extensions for protected parking, including landscaping for beautification


(Source: PennDOT Local Technical Assistance Program)


(Source: Google Earth, Fort Collins, CO)

Typical Costs:

- Approximately $6000 or less (factor of design specifics and length of application); can be much higher

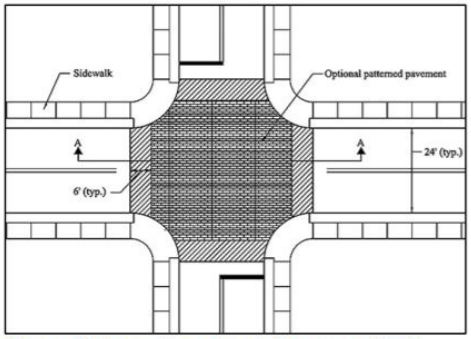
Raised Intersection

Description:

- Flat raised areas covering entire intersections, with ramps on all approaches and often with brick- or other textured materials on the flat section and ramps
- Sometimes referred to as raised junctions, intersection humps, or plateaus

Application:

- Intersections of collector, local, and residential streets
- Typically installed at signalized or all-way stop controlled intersections with high pedestrian crossing demand
- Works well with curb extensions and textured crosswalks
- Often part of an area-wide traffic calming scheme involving both intersecting streets in densely developed urban areas



(Source: Delaware Department of Transportation)


(Source: Chuck Huffine, Phoenix AZ)

Typical Costs:

- Costs range between $15,000 and $60,000

Road Diet

Description:

- Revision of lane use or widths to result in one travel lane per direction with minimum practical width, with goal of reducing cross-section; common application involves conversion of four-lane
- Two-way road to three-lane road – two through lanes and center two-way left-turn lane (TWLTL)
- Can also involve narrowing of existing travel lanes
- Alternate cross-section uses can include dedicated bicycle facilities, left-turn lanes, on-street parking, raised medians, pedestrian refuge islands, sidewalks, etc.

Application:

- High likelihood of acceptability for nearly all roadway functional classifications
- Can be applied in urban, suburban, or rural settings
- Appropriate for most common urban speed limits
- Can be applied at/near intersections or along road segments
- Appropriate along bus routes

Typical Costs:

- $6000 or less, depending on physical geometric changes and length of application
- The biggest impact to cost involves signal modifications, other costs include pavement marking and signing revisions
- Costs can be much higher if outside portion of pavement is converted to other non-motorized uses (dedicated bicycle facilities, sidewalks, grass buffers)

Roundabout

Description:

- Raised islands placed in unsignalized intersections around which traffic circulates
- Approaching motorists yield to motorists already in the intersection
- Requires drivers to slow to a speed that allows them to comfortably maneuver around them
- Different from traffic circles or mini-roundabouts; possible substitute for traffic signal control

Application:

- Intersections of arterial and/or collector streets
- One or more entering lanes
- Can be used at intersections with high volumes of large trucks and buses, depending on design

(Source: Grant Kaye)

(Source: PennDOT Local Technical Assistance Program)

Typical Costs:

- Cost varies widely by site, but is usually comparable to a traffic signal

Speed Hump

Description:

- Rounded (vertically along travel path) raised areas of pavement typically 12 to 14 feet in length
- Often placed in a series (typically spaced 260 to 500 feet apart)
- Sometimes called road humps or undulations

Application:

- Appropriate for residential local streets and residential/neighborhood collectors
- Not typically used on major roads, bus routes, or primary emergency response routes
- Not appropriate for roads with 85th-percentile speeds of 45 mph or more
- Appropriate for mid-block placement, not at intersections
- Not recommended on grades greater than 8 percent
- Work well in combination with curb extensions
- Can be used on a one-lane one-way or two-lane two-way street

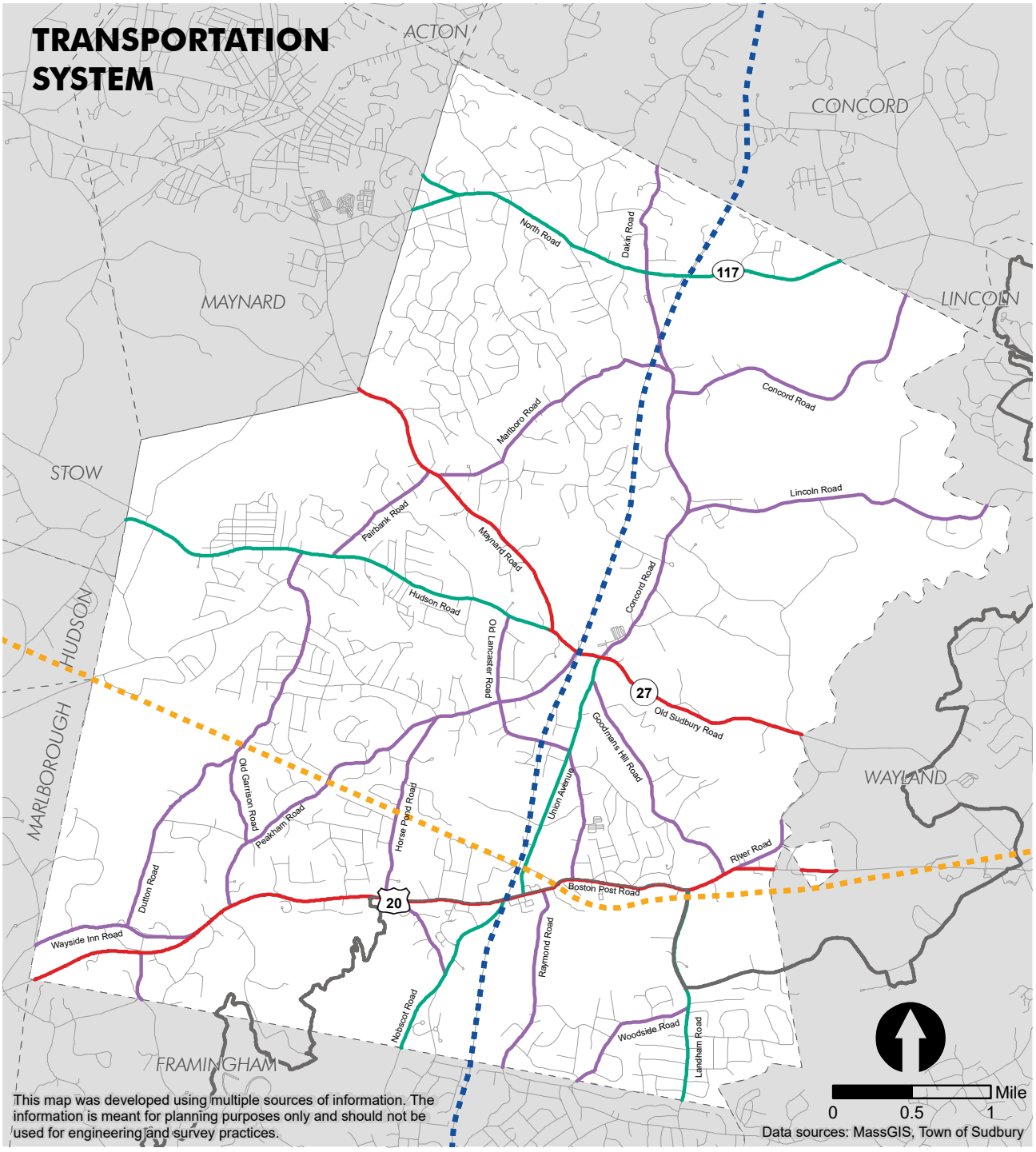
(Source: City of Boulder, Colorado)

(Source: PennDOT Local Technical Assistance Program)

Typical Costs:

- Cost ranges between $2,000 and $4,000

TOWNWIDE CIRCULATION IN SUDBURY



ROADWAY FUNCTIONAL CLASSIFICATION and TRAIL NETWORK

- Principal Arterial
- Minor Arterial
- Major Collector
- Proposed Bruce Freeman Rail Trail
- Proposed Mass Central Rail Trail
- Bay Circuit Trail

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Summary Points

- *The number of rural and small town public transit agencies has increased over the past two decades to approximately 1,400 agencies (2014).*
- *America's rural population is declining, but ridership has increased from 2007 to 2015. This equates to an 8.6 percent increase in per-capita rural ridership over the past 8 years, and a 7.8 percent increase in total rural ridership. For comparison, urban public transit ridership increased by 2.3 percent in the same time period.*
- *Rural demographics make public transit increasingly desired. Older Americans make up a larger portion of rural populations (17 percent) than in urban populations (13 percent).*
- *Rural residents with disabilities rely on public transit- they take about 50 percent more public transit trips than unimpaired people do.*
- *There are 2.9 million rural veterans, making up 33 percent of the veteran population enrolled in the VA health care system. Rural public transit can help them access needed services.*
- *Public transit can reduce the risk of road accidents. Rural residents travel about 33 percent more than urban residents, and although rural areas only make up 19 percent of the population, they account for around 49 percent of traffic fatalities.*
- *Rural poverty rates exceed urban poverty rates in all regions. Rural public transit can help reduce personal travel expenditures due to gas and other vehicle maintenance expenditures (rural households spend about 7 percentage points more of their budgets on transportation than urban households do).*
- *Public transit can help promote active lifestyles in rural communities struggling with health problems such as obesity, and can link people with healthcare services.*
- *Rural public transportation can be an important force in supporting local economies by connecting residents (especially non-drivers) with local businesses and job opportunities.*
- *Rural public transit spending per capita is lower than in urban areas. Increased local and federal investment can help address this.*

Myths and Realities of Rural Public Transit

This section addresses common criticisms of rural public transit.

Myth #1: Public Transit Is Only Justified in Large Cities

Public transit serves various roles in an efficient and equitable transportation system. In large cities, it provides space-efficient mobility on major travel corridors, which reduces traffic and parking congestion. In both large and small communities, it provides basic mobility for non-drivers, affordable transportation for lower-income households, transportation for tourists, and support for local economic development. Although it serves a limited portion of total travel in most rural communities, those trips tend to be particularly important, including travel for healthcare, basic shopping, school, work and tourism. Public transit can help reduce many of the problems facing rural communities and small towns, including population and economic declines, poverty and high traffic fatality rates.

Myth #2: Public Transit Is Costly

Public transit services are sometimes criticized for being costly, particularly in rural areas where low ridership and dispersed development results in high costs per passenger-mile and low cost recovery (portion of total costs financed by fares). However, public transit can actually be very cost effective compared with alternatives. For example, a typical 5-mile rural public transit trip costs about $7, which is less expensive than many alternatives:

- A taxi fare for the same trip (typically $10-15 for a 5-mile trip).
- Total costs to own and operate an automobile for infrequent use ($3,000 annual costs divided by 150 annual trips equals $20 per trip).
- Total vehicle operation and time costs for driver to chauffeur a passenger 5 miles to a destination and return alone (10 miles at 50¢ per mile equals $5 in vehicle operating costs, plus 20 minutes charged at $15 per hour equals $5 in time costs).
- The accident costs of a higher-risk (youth, older, or impaired) driver forced to drive due to inadequate alternatives.

As stated previously, per capita public transit expenses are small in rural areas compared with larger cities, with motor vehicle costs, and even compared with automobile association memberships which offer roadside assistance for drivers who have car problems. Public transit serves a similar function; it provides a mobility option for those who need it most. Even residents who do not frequently use public transit value having it available.

Myth #3: Public transit is subsidized, unlike roads which motorists finance through user fees

Many people assume that roads are fully financed by user fees such as fuel taxes and road tolls. Although user fees finance most highway costs, city and county roads are financed primarily through general taxes (Henchman 2013). Of the $235 billion spent on U.S. roadways (about $732 per capita), only $113 billion (about $360 per capita) was financed by user fees (FHWA 2015, HF-10); the rest was financed by general taxes which residents pay regardless of how much they drive.

Therefore, people who drive less than average subsidize the costs of people who drive more than average. Public transit subsidies offset these cross subsidies and they ensure that residents who do not drive receive a share of government transportation spending.

Myth #4: Buses Run Empty

Some complain that public transit vehicles (buses and vans) occasionally appear empty. These vehicles often operate with extra capacity due to fluctuating demand, just as private vehicles generally operate with empty seats. Most public transit systems have times when vehicles are nearly or completely full.

Myth #5: Small towns and rural communities rely on informal transport services

Informal travel arrangements can be unreliable or uncomfortable. Formal public transit services offer a reliable, professional service, with fixed schedules and amenities such as wheelchair lifts and bike racks. Non-drivers often prefer paying for public transit rather than being entirely dependent on family or friends for transportation. The need for more formal public transit is increasing, with rural community organizations finding that they cannot serve the growing demand with only volunteers.

Myth #6: Self-driving cars will soon eliminate the need for public transit

Some people argue that autonomous (self-driving) cars will soon eliminate the need for communities to subsidize public transit services. Such claims are unrealistic. Although vehicle manufacturers are making progress developing self-driving technologies, it will be several years before such vehicles can operate reliably under all travel conditions – for example, no current technologies can navigate safely in heavy rain and snow – and even longer before they are affordable enough for most households to purchase. Even when these vehicles operate reliably, many children and people with disabilities will still need assistance or supervision. It is unlikely that self-driving cars will replace public transit services before the 2030s, and subsidies will still be needed to provide basic mobility for people with disabilities and those with low incomes.

Conclusions

Public transportation helps rural communities become more efficient and equitable. It helps ensure that all residents, including non-drivers, enjoy independent mobility and receive a fair share of public spending on transportation facilities and services. Serving these demands can provide multiple benefits. However, many of these benefits can be overlooked or undervalued in formal transportation planning, such as during project economic evaluations, as summarized in Table 8. As a result, the importance of rural public transit improvements is often under estimated.

Table 8 **Major Categories of Rural Public Transit Benefits**

Benefit Category	Degree Considered In Conventional Planning
Users	
More independent mobility	Seldom included in formal economic evaluation
Financial savings compared with automobile or taxi travel	Generally overlooked
Reduced accident and assault risk	Generally overlooked
Less risk of impaired driving citation or accident	Generally overlooked
Motorists	
Reduced chauffeuring burdens	Sometimes recognized by individuals but seldom included in formal economic evaluation
Reduced traffic risks (less higher-risk driving)	Generally overlooked
Reduced traffic and parking congestion	Generally overlooked
Local Economy	
Retains and attracts more residents	Seldom included in formal economic evaluation
Increased tourism by non-drivers	Seldom included in formal economic evaluation
Helps attract major employers such as colleges and hospitals	Seldom included in formal economic evaluation

Rural public transit can provide various benefits to users and communities. Many of these benefits can be overlooked, so public transit improvements are often worth far more than recognized.

Although public transit serves only a minor portion of total rural inhabitants, many of those trips are crucial. For example, allowing older residents and people with disabilities to access healthcare and basic shopping, young people to reach school and jobs, and tourists to visit without a motor vehicle. Failing to serve these needs can be costly. If public transit is unavailable, residents may miss medical appointments and lose jobs, or must be chauffeured. Communities that lack public transit will be at a stark disadvantage when it comes to attracting people with disabilities, younger residents, and tourists compared to other communities with better mobility services. This contributes to the spiral of declining population and economic activity that threatens many rural areas. Public transportation can make important contributions in addressing these problems.

Current demographic and economic trends are increasing rural public transit demand and the benefits of serving that demand. Aging population, more residents with disabilities, industrial shifts and rising poverty, further restrictions on higher-risk driving, and changing consumer preferences are increasing the number of residents who cannot, should not, or prefer not to drive. Communities that serve the growing demand for alternative modes and "car free" lifestyles have the potential to attract and retain more residents and visitors, along with the economic activity they generate. Motorists also benefit from reduced chauffeuring burdens and chances of being injured by a high-risk driver.

Analysis in this report indicates that public transit demand can be expected to further increase in rural communities within the next decade. In doing comprehensive transportation planning, agencies should plan for increasing the amount of revenue miles operated, depending on the demographic shifts of each individual community. Rural communities will require increased funding to plan for this operational expansion.

Current rural public transit spending is low, particularly compared with:

1. Per capita spending on public transit in urban areas.
2. What many motorists pay for automobile association memberships.
3. What motorists spend on automobiles.
4. What governments and businesses spend on roads and parking facilities.
5. The potential benefits of such investments.

Many federal and state programs support rural public transit, although local communities must usually provide matching funds. Examples described in this report indicate that many rural communities are using innovative partnerships and diverse funding sources to finance improvements in public transit. Overall, such programs are often very cost effective, considering all benefits and costs; each dollar invested often provides far more than a dollar in total savings and benefits.

Of course, rural communities are diverse, and so are their mobility needs. There are many ways rural communities can provide mobility services -- ranging from volunteer programs operated by local charities, subsidized taxi services, community transport, demand response and fixed-route bus services. Many rural communities have demonstrated that with creativity and good management it is possible to significantly improve public transit services with modest investments.

Improving public transit service requires broad community support. To build this support, proponents must create a vision of a more diverse transportation system and demonstrate the resulting benefits to stakeholders. It is important to have credible technical analyses about these benefits; it is also important to support such analyses with anecdotal material that vividly illustrates how public transit can benefit local individuals, businesses and communities. To meet growing public transit demand, leaders will need to overcome various obstacles including misunderstandings about the role that public transit plays in small towns and rural communities, biases against planning and funding practices, and local underinvestment in public transit.

Draft Formative Issue Statements

The Town wishes to remain rural and quiet in character, yet the Town is faced with managing an urban scale traffic problem. Mitigation measures for traffic along major roads could include engineered improvements that might seem out of character with Sudbury.

The Town recognizes the importance of rural roadways and dark skies to the overall aesthetic appeal of Sudbury. There is mounting pressure to increase the extent of roadside pathways and potentially add lighting to some of the more heavily traveled roads and trails in town.

Below are the draft formative issues and possible actions or policy direction presented to the MPSC in November.

Transportation

1. Traffic congestion is an issue in Sudbury, particularly on the state routes near the Town Center and along Route 20. Congestion is a result of both local and regional traffic trips.
    a. Build the Town's walking and biking network to encourage residents to take local trips without a car.
    b. On Route 20, synchronize traffic lights, look for ways to consolidate driveways with internal circulation.

2. The Senior Shuttle is very popular and overcrowded. Demand is expected to increase.
    a. Consider adding shuttles/drivers.
    b. Consider expanding service to later times (after 3:30) and additional days during the week.

3. The Route 20 Commuter Shuttle is a great amenity but is not currently meeting commuter needs.
    a. Consider adding a fixed stop(s) on Route 20.
    b. Consider adding later times leaving from Riverside T Station.

4. Sudbury has a robust walkway network, and improvements continue, but gaps exist with missing links between residential areas and important destinations like commercial areas, schools, and parks/open space. The nature of Sudbury's roads, which are winding, narrow, and tree-lined, make it difficult to add some of the missing connections.
    a. Streamline the process for acquiring easements. Educate residents.
    b. Improve lighting at key destinations.
    c. Upgrade and add crosswalks to be more accessible at major intersections and key points throughout Town.

5. The walking and biking network will be expanded in the future through the Bruce Freeman Rail Trail (BFRT) and proposed Mass Central Rail Trail. These will be major transportation and recreation assets to the town.
    a. Continue moving forward with the BFRT.
    b. Identify connections along the BFRT to residential and commercial areas and ensure they are accessible and safe.
    c. Identify a regular, sustainable funding source for all trail maintenance.

6. Schools require residents within two miles to pay for bus service. It is difficult to walk or bike to schools. Because of the fees and lack of walking and biking access, many parents will drive their children to school, adding to already congested roads.
    a. Prioritize walking and biking amenities at schools that connect to nearby residential areas.
    b. Consider involvement in a Safe Routes to School study.
    c. There are transportation needs of low-income students/families accessing schools and their after-school programs.